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Digital Economy and Society Index (DESI) 2021

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Austria

About the DESI

The European Commission has monitored Member States' progress on digital and published annual Digital Economy and Society Index (DESI) reports since 2014. Each year, the reports include country profiles, which help Member States identify areas for priority action, and thematic chapters providing an EU-level analysis in the key digital policy areas.

In 2021, the Commission adjusted DESI to reflect the two major policy initiatives that will have an impact on digital transformation in the EU over the coming years: the Recovery and Resilience Facility and the Digital Decade Compass.

To align DESI with the four cardinal points and the targets under the Digital Compass, to improve the methodology and take account of the latest technological and policy developments, the Commission made a number of changes to the 2021 edition of the DESI. The indicators are now structured around the four main areas in the Digital Compass, replacing the previous five-dimension structure. 11 of the DESI 2021 indicators measure targets set in the Digital Compass. In future, the DESI will be aligned even more closely with the Digital Compass to ensure that all targets are discussed in the reports.

In addition, DESI now includes an indicator measuring the level of support that adopted ICT technologies provided companies in taking more environmentally-friendly measures (ICT for environmental sustainability) and the take up of gigabit services, plus the percentage of companies offering ICT training and using e-invoicing.

The DESI scores and rankings of previous years were re-calculated for all countries to reflect the changes in the choice of indicators and corrections made to the underlying data.

For further information, see the DESI website: <u>https://digital-strategy.ec.europa.eu/en/policies/desi</u>.

	Au	stria	EU
	rank	score	score
DESI 2021	10	56.9	50.7



Austria ranks 10th among 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI).

On Human capital, Austria performs above the EU average in all the indicators except 'Enterprises providing ICT training', in which, at 18%, Austria is slightly below the EU average of 20%. In connectivity, Austria performs well on mobile coverage, with 50% of populated areas covered by 5G services. The country scores significantly below the EU average for fixed very high capacity network (VHCN) coverage, with 39% in 2020 compared to the EU average of 59%, despite significantly improving since 2019 (14%). Regarding the integration of digital technology, 63% of small and medium-sized enterprises (SMEs) have at least a basic level of digital intensity, slightly above the EU average (60%), but only 9% of all enterprises are using big data, far below the EU average of 14%. The same is observed for cloud computing services with only 20% of all enterprises in Austria using them, compared to the EU average of 26%. In the digitalisation of public services, Austria is among the frontrunners. For example, the country scores high in the number of internet users connecting to e-government services (81% compared to an EU average of 64%) and in open data readiness, with a score of 90% compared to the EU average of 78%.

The 'Digital Action Plan Austria'¹ sets a strategic framework for digitalisation in the country, aiming at a long-term target scenario to become a 'digitally responsible society'. The Federal Ministry for Digital and Economic Affairs (BMDW) coordinates the action plan and develops, chapter-by-chapter, projects with the relevant department and ministry to make progress on digitalisation in the relevant policy field. Over 2020-2021, the chapters in the action plan – 'Data', 'Resilience', 'Digital Economic Transformation', 'Digital Sustainable Economy', 'Digital Universities', 'Digital Talent for the Austrian Economy', 'Digitalisation and Security', 'Digitalisation and Tourism', and 'Digital Competences in the Civil Service' – were drawn up and kicked off for implementation. In Connectivity, Austria's plan to

¹ <u>https://www.digitalaustria.gv.at/aktionsplan.html</u>

use funds from the Recovery and Resilience Facility (RRF) could play an important role in helping the country reach the digital targets set out in its broadband strategy for 2030. In Austria, the public sector is digitally advanced, but the COVID-19 crisis has stressed the need for reliable and interoperable public IT services. A strategic focus has been put on allowing fast and secure exchange of data and quick reuse of already available services (national 'once only' strategy). In January 2020, an important amendment to the e-government-Act² entered into force, recognising digital government and interaction with the public administration as a right of the people in Austria. Regarding Human capital, the number of ICT specialists and graduates increased, but the lack of ICT specialists to address the high demand in the labour market persists and could slow down the digitalisation of businesses (especially SMEs).



Digital in Austria's Recovery and Resilience Plan (RRP)

Austria's RRP has a total value of EUR 4.5 billion. The EU total non-repayable financial support under the RRP is EUR 3.5 billion of which EUR 1.8 billion is dedicated to digital transition. This amounts to a digital share of 52.8%, well above the minimum target of 20%.

The RRP will contribute to Austria's digital transition in several areas.

- Digital skills are addressed by investments under the components 'Digital recovery' and 'Knowledge-based recovery'. The focus is on digitalising education and on reskilling and upskilling.
- Connectivity is addressed by supporting widespread deployment of gigabit-capable access networks.
- Integration of digital technologies (including digital R&D; digitalisation of businesses; digital capacities and deployment of advanced technologies) is supported by a wide range of measures including digitising SMEs and promoting quantum sciences.
- The digitalisation of the public administration is supported by the Digitalisation Fund, which aims to accelerate digitalisation in the federal administration by financing projects with a cross-departmental impact.

The plan also includes an Important Project of Common European Interest (IPCEI) in the field of microelectronics.

² <u>https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=20003230</u>



Digital Economy and Society Index 2021

1 Human capital



2016	2017	2018	2019	2020	2021

		Austria		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	67%	66%	66%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	36%	39%	39%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	71%	69%	69%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	4.5%	4.3%	4.5%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	18%	20%	20%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	27%	18%	18%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	3.9%	4.4%	4.5%	3.9%
% graduates	2017	2018	2019	2019

On Human capital, Austria ranks 9th among EU countries and is above the EU average in all the indicators apart from the percentage of enterprises providing ICT training (18%), which is slightly below the EU average (20%). Austria scores well above the EU average in at least basic digital skills (66% compared to the EU average of 56%) and 69% of people have at least basic software skills, where the EU average is 58%. In 2020, the percentage of ICT specialists slightly increased (4.5%), remaining above the EU average (4.3%) with the proportion of female ICT specialists remaining stable at 20% (EU average 19%). The percentage of ICT graduates (4.5%) is also above the EU average (3.9%). Nevertheless in 2020, 74.3% of enterprises in Austria that recruited or tried to recruit personnel reported that vacancies for jobs requiring ICT specialist skills were hard to fill.

Since 2020, Austria has taken numerous measures to increase the level of digital skills of its population. The Federal Ministry for Digital and Economic Affairs (BMDW) is responsible for providing digital training activities to people, which are not embedded in any formal educational process. The objective is for all people to be equipped with the necessary digital skills for their personal and professional development. In close cooperation with the BMDW, the association fit4internet³ (f4i), which also hosts the National Coalition for digital skills and jobs, launched initiatives targeting digital skills for all and advanced digital skills for ICT specialists. These actions were in line with the priorities set in the government's digital programme 2020-2025, such as 'fit4futureJobs', an initiative for employees and returnees to work, aimed at people born between 1960 and 2005 or 'fit4internet' for people aged 60 and over. The f4i platform also offers a self-assessment tool based on the Digital Competence Framework for Austria - DigComp 2.2 AT. The

³ <u>https://www.fit4internet.at/</u>

National Coalition also continued carrying out major awareness-raising activities to boost the digital skills of all groups in the country.

The BMDW also launched initiatives with a strong focus on upskilling SME employees. In 2020, the programme 'digital pro boot camps' launched a call for implementing boot camps focused on e-commerce, cybersecurity and smart factories to train highly motivated employees from the participating companies to become 'digital professionals' within 4 weeks. It should then be possible to fully entrust these future IT specialists with IT projects in the company and further advance the company's digitalisation agenda. In March 2021, the Ministry also launched a qualification programme, 'Qualifizierungsoffensive', to develop the digital competences of enterprises and their employees to make them fit for the digital transformation of the economy.

In addition, during the pandemic the Federal Ministry of Labour launched the 'Corona Job Offensive', an initiative targeting vulnerable people (e.g. unemployed people with or without qualifications; women re-entering the labour market; people with disabilities) to give them the opportunity for professional reorientation or upskilling in promising fields of qualification such as digitalisation as well as science, technology, engineering, and mathematics (STEM).

In the education system, in 2020-21, Austria developed a new improved digital education strategy, the 'Digital School/8 Point Plan'⁴ aiming to systematically and sustainably implement digitalisation in education. It includes eight key fields of action, among them, further training of teachers; collection of digital teaching and learning materials accessible on a single platform; a seal of approval certifying educational apps for mobile learning; and equipping all pupils at 9th grade with a digital end device.

Organisations from Austria actively participated in EU Code Week 2020, making the country one of the most active in the EU with 3 280 activities involving more than 64 700 participants, 53.8% of whom were women and girls.

In March 2021, the Federal Ministry for Women, Family, Youth and Integration launched a call for proposals with a budget of EUR 1.3 million for projects to raise the interest of women and girls for STEM fields, and support them with technical training and in their career to further increase their participation in STEM education and professions.

Austria successfully deploys policies and initiatives to boost the digital skills of its population. In view of the rapid digital transformation, efforts to upskill and reskill the labour force as well as training young people and women in digital technologies are particularly welcome, to address the high demand in the labour market for digital talent and ICT specialists.

Highlight 2021: the Digital Pioneers⁵

This initiative offers women between 17 and 27 years the opportunity to learn about the professions of the future and gain valuable skills and experience that are required in many jobs. The objective is to encourage young women to discover and learn skills for professions that are in demand in the labour market. At the end of the training, participants will receive a national diploma. The Digital Pioneers addresses in particular computer programming and digital skills, innovative skills and entrepreneurship skills. It is coordinated by the 'Plattform Industrie 4.0'.

⁴ <u>www.digitaleschule.gv.at</u>

⁵ <u>https://digitalpioneers.at/</u>

Human capital in Austria's Recovery and Resilience Plan

The plan includes reforms and investments to develop digital skills for a total budget of about EUR 373 million. The measures address challenges linked to education and training:

- IT equipment for students: the measure finances the provision of digital terminal equipment for at least 80,000 school students per year, with a budget of EUR 172 million;
- reskilling and upskilling: the measure aims to improve the skills of unemployed people, and also aim to provide specific ICT training (e.g. coding, software development (and network engineering), with a digital budget of EUR 202 million.

2 Connectivity

2 Connectivity	Au	stria	EU
	rank	score	score
DESI 2021	11	53.0	50.2



		Austria		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	69%	72%	73%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	7%	8%	12%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	<0.01%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	73%	79%	87%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	13%	14%	39%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	99.5%	99.6%	>99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	33%	33%	66%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	50%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	72%	80%	80%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	75	78	69
Score (0-100)		2019	2020	2020

Austria ranks 11th among the 27 EU Member States in Connectivity. The country has made good progress towards the EU Gigabit objectives. It performs very well on mobile coverage, having almost full 4G coverage and 50% coverage of populated areas with 5G. 80% of individuals have taken up mobile broadband. Despite good availability of fixed broadband, the overall take-up is below the EU average, standing at 73%. There is more mobile take-up than overall fixed take-up, indicating that some households may use mobile connection as a complement to or substitute for their fixed connection. NGA coverage in Austria is at EU average level, standing at 87% and having increased by 8 percentage points compared to 2019. However, rural NGA coverage remains far below the EU average, covering only 38% of households. Austria's weak point is the low coverage and take-up of Very High Capacity Networks (VHCN). Although the country has improved significantly in VHCN coverage (both FTTP at 20% and the upgrade of cables to DOCSIS 3.1 accounting for 27%), increasing from 14% in 2019 to 39% in 2020, it still performs below EU average (59%). Rural VHCN coverage remains low, with only 12% of households covered compared to 28% at EU level. Rural coverage of fibre to the premises stands at 11%. With only 12%⁶ of its households subscribing to offers of at least

⁶ data for 2a2 At least 100 Mbps fixed broadband take-up has been revised by Austrian authorities since the publication of DESI 2020.

100 Mbps, Austria is far below the EU average. While 37% of households are covered with 1 Gbps speeds, there is close to no take-up. Broadband prices overall are slightly below the EU average, with a price index of 78.

With the support of the State aid programmes under the Austrian Broadband Strategy 2020 (BBA2020), which uses funds from the proceeds of past 4G spectrum auctions, many regional private operators and communities have invested in fibre to the home. In the long term, Austria's Broadband Strategy 2030, adopted in August 2019, is aligned with the 2025 EU Gigabit goals and seeks to ensure nationwide access to gigabit-capable broadband services (fixed and mobile) by the end of 2030. Further roll-out of VHCN, coupled with 5G coverage, can help achieve these goals. In April 2021, the government announced that EUR 1.4 billion will be invested in deploying fibre in underserved regions. As part of the national broadband plan, the programme 'BBA2020_Connect' has ensured fibre connections for main socio-economic drivers, including over 300 schools and almost 100 SMEs.

Austria is at the forefront when it comes to 5G, and scores 66% on the 5G readiness indicator. The multiband auction of the 700 MHz, 1500 MHz and 2100 MHz bands was concluded in September 2020, raising EUR 202 million (the 3.6 GHz band had already been awarded in 2019). Each of the existing mobile network operators acquired spectrum. A1 (incumbent) did not bid for spectrum in the 700 MHz band but already had spectrum in both the 3.6 GHz band across all regions and the 800 MHz band. T-Mobile (Magenta) and Hutchison (Drei) acquired 20 MHz and 10 MHz, respectively, in the 700 MHz band. A1 and Hutchison acquired 30 MHz each and T-Mobile 20 MHz in the 1500 MHz band. A1 acquired 25 MHz, Hutchison 20 MHz and T-Mobile 15 MHz in the 2100 MHz band. A novel auction design was used, which offered discounts for accepting extended coverage obligations in underserved areas. The obligations include more than 80% (1 702 areas) of the underserved areas (cadastral communities⁷), which are economically challenging to cover. These areas are expected to be covered with download speeds of 30 Mbps and 3 Mbps for upload by 2027. Furthermore, the auction included a general 5G coverage obligation for main roads and railways by the end of 2023, in line with the Austrian Broadband Strategy 2030.

The 26 GHz band assignment has been postponed beyond 2020 because of lack of clear market demand. The plans for the 26 GHz band are included in the upcoming Spectrum Release Plan (2021 – 2026).

Main market & regulatory developments

The incumbent A1 continues to hold a high market share in the fixed broadband market, including mobile broadband in the home, but it is decreasing. The largest competitors are Magenta and Drei. In the mobile market, A1, with its sub-brands Bob and Yesss, continues to hold the highest market share. Mobile virtual network operators and resellers increased their combined market share to more than 12% in 2020.

At national level, there has been an increase in flat rate mobile broadband tariffs (cube-tariffs) for residential and business use, making up around one third of all residential broadband connections. One reason is the simplicity of buying a mobile modem which can be used instantly compared to fixed broadband installation requiring pre-installation. The price is comparable to that of fixed connections. There is a trend towards fixed-to-mobile broadband substitution in the residential segment. As a result of the COVID-19 pandemic, there has been

⁷ An Austrian community is typically composed of several cadastral municipalities. In many cases, a cadastral municipality is equivalent to a village (settlement).

an increase in mobile data volumes since Q4 2019. All three mobile network operators, A1, Magenta and Drei, offer commercial 5G subscriptions.

Both active and passive fibre network access is offered in Austria, where all publicly funded networks have to offer wholesale access. A new active open access network model for fibre connections has emerged, where a three-layer model is applied: network owner, network access operator and the retail service provider. There have not been any market regulation decisions in recent years; however, since March 2020, a new market analysis covering market definition, analyses and specific obligations has been ongoing.

On 4 February 2021, the Commission addressed a Letter of formal notice to Austria for failure to notify the country's transposition measures for the European Electronic Communications Code. Subsequently, the Commission was notified by Austria that the complete transposition of the European Electronic Communications Code is expected by November 2021.

A task force, the 'Internet Infrastructure Austria 2030 Platform' (PIA 2030), has been established to accelerate VHCN deployment. The objective is to coordinate the interaction between the federal government, states, municipalities, cities, the public, authorities and the private sector and help further develop legal, regulatory and technical measures in the context of broadband deployment. One of its first initiatives is to update the federal government's '5G strategy'.

In its roadmap to implement the Connectivity Toolbox⁸, Austria announced plans to address the decentralised permit granting procedure – responsibilities are distributed between the federal, state and local authorities. Some of the measures considered are (i) the introduction of permit exemptions, (ii) fast track procedures, and (iii) promoting the application of existing lighter procedures for granting permits with all responsible stakeholders as well as a digital administrative platform.

The Austrian Regulatory Authority for Broadcasting and Communications (RTR) has noted an increase in complaints on the quality of internet access services with the increase in home schooling and teleworking during the COVID-19 pandemic. In 2020, complaints about fixed internet connections increased by 50% while complaints on mobile connections increased by almost 20%, compared to the year before.

In recent years, the Telekom-Control-Commission (TKK) decided on a number of cases regarding the blocking of websites due to copyright violations. One decision concerning the provision of IPv4 addresses has been appealed by the incumbent A1 to the Administrative High Court (VwGH).

RTR has noted an increasing number of fraud cases through caller identification spoofing cases, which includes falsely displaying a different number on the receiving parties' caller identification screen.

Austria is a pioneer in the roll-out of 5G and consumers already have access to commercial 5G offers. The country boasts a very high level of mobile coverage and up-take, but scores below the EU average for fixed VHCN coverage and take-up. Reliable fixed connections are a prerequisite for the digital transition and a long-lasting recovery, and therefore further efforts may be needed in this regard. Public policy initiatives and the use of RRF funds can play an important role.

⁸ <u>https://digital-strategy.ec.europa.eu/en/policies/connectivity-toolbox</u>

Connectivity in Austria's Recovery and Resilience Plan

Connectivity accounts for the largest share of the digital-related expenditure of the plan, recognising the need to increase coverage with fixed VHCN in rural areas. The investment is underpinned by a reform to facilitate broadband deployment (ensuring coordination between all stakeholders and reducing red tape) and aims to ensure equal opportunities between urban and rural areas. It is expected to contribute to Austria achieving the digital targets set out in its Broadband strategy for 2030 (Breitbandstrategie 2030) and in Austria's digital action plan (Digitaler Aktionsplan Austria) complementing existing support programmes:

 broadband deployment: roll-out of gigabit enabled access networks to 150 000 to 200 000 households (reaching a total coverage of 50% of households), with a budget of EUR 891 million.

3 Integration of digital technology

3 Integration of	Au	stria	EU
digital technology	rank	score	score
DESI 2021	11	41.3	37.6



		Austria		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	63% 2020	60% 2020
3b1 Electronic information sharing	40%	43%	43%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	21%	30%	30%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	6%	6%	9%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	11%	11%	20%	26%
% enterprises	2018	2018	2020	2020
3b5 AI % enterprises	NA	NA	37% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	70% 2021	66% 2021
3b7 e-Invoices	20%	20%	22%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	13%	19%	22%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	7%	9%	10%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	14%	15%	15%	8%
% SMEs	2017	2019	2019	2019

On the 'integration of digital technology', Austria ranks 11th among EU countries. In Austria, 63% of the SMEs have at least a basic level of digital intensity, above the EU average of 60%. Also, Austria has more enterprises than the EU average using artificial intelligence (AI) (37% compared to the EU average of 25%). However, only 9% of enterprises report using big data (EU average 14%) and cloud (20%) is also below the EU average (26%). 22% of enterprises are using e-invoicing which remains below EU average (32%). Regarding e-commerce, 22% of SMEs are selling online, well above the EU average of 17%, and 15% are selling online across borders (EU average 8%). However, the e-commerce turnover of SMEs (10%) is below the EU average of 12%.

In 2020, the BMDW launched a new initiative 'KMU.E-Commerce'⁹ to drive the digitalisation push in SMEs towards online trade. So far in 2021, the programme has provided EUR 10 million to help implement specific e-commerce projects.

⁹ https://www.bmdw.gv.at/Themen/Wirtschaftsstandort-Oesterreich/KMU/KMU.E-Commerce.html

The use and development of advanced digital technologies (e.g. AI, cloud and edge computing, blockchain) are supported through the Austrian high-tech funding programmes: 'ICT of the Future' and 'Production of the Future' funded by the Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology.

Austria has two centres in Vienna (VSC) and Linz (MACH-2) offering highly-scaled computing power and services for research activities. Since 2020, Austria has been participating in two calls under the EuroHPC Joint Undertaking: (a) advanced pilots towards European supercomputers and (b) the pilot on quantum simulator with a national co-funding budget of EUR1.5 million. The objective of Austria is to successfully use quantum sciences for innovative products and services.

In cloud and edge computing, the bilateral lighthouse project 'EuProGigant' has been launched in collaboration with the German Federal Ministry for Economic Affairs and Energy (BMWi) to foster research in big data applications in industrial settings. In June 2020, the Austrian Cloud (Ö-Cloud)¹⁰ initiative was launched to increase Austria's resilience and data sovereignty. Together with the Austrian industry, the country will play an active part in the GAIA-X project¹¹.

Austria also supports the development of data-driven and sustainable technologies and solutions. In particular, the Data Intelligence Offensive¹² acts as a voice for Austria's stakeholders in the field of data economy and data-driven technologies. Austria strongly aims to advance the intelligent use of data and initiate an economic ecosystem based on the use of data.

Austria does not have a separate national strategy for cybersecurity. However, cybersecurity is included in other strategic frameworks and research support programmes. A new IT security hub, 'Cybersecurity Campus Graz'¹³, was established in Styria. Its centrepiece is a new joint research centre and a cybersecurity testing and certification laboratory. Once it is fully operating, 400 people will work and conduct research there.

The BMDW is helping to establish Digital Innovation Hubs (DIH). Currently there are 6 DIH located throughout Austria, acting as one-stop shops to support enterprises, in particular SMEs, in their digital transformation. Special attention is paid to advanced technologies such as AI, security of digital systems, blockchain and big data.

The Austrian Platform Industry 4.0¹⁴ is facilitating networking activities between national and regional platforms, exchange of good practices on the structure of the platforms, and interaction with stakeholders. In recent years, the focus has shifted towards AI.

The National AI Strategy developed in 2019-2020 is currently under revision.

Integration of digit	I technology in <i>I</i>	Austria's Recovery	and Resilience Plan
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The RRP will support several measures aimed at the digitalisation of businesses; the development of advanced technologies and digital-related investment in R&D using a total budget of EUR 393.2 million:

 digitising SMEs: this project will provide advisory services on business models and processes; e-commerce and online marketing; IT and cybersecurity, and digital

¹⁰ <u>https://www.digitalaustria.gv.at/initiativen/verwaltung/verwaltungs-projekte/OECloud.html</u>

¹¹ <u>https://www.data-infrastructure.eu/</u>

¹² <u>https://www.dataintelligence.at/en/</u>

¹³ <u>https://cybersecurity-campus.tugraz.at/</u>

¹⁴ <u>https://plattformindustrie40.at/</u>

administration as well as support for follow-up implementation (budget EUR 32 million);

- digital investments in enterprises: this scheme will offer investment premiums for companies investing in fixed assets, notably those related to digital solutions and digital infrastructure (budget EUR 69 million);
- digitisation of cultural heritage: as part of a large-scale digitisation offensive across all artistic and cultural sectors, this measure will support the transformation archives into a digital form, making them accessible to a wider public (budget EUR 16.5 million);

In advanced digital technologies and digital-related R&D:

- promotion of quantum sciences: this measure will fund research infrastructure (hardware and software) and research cooperation to expand the knowledge base of quantum computing, simulation and communication (budget EUR 107 million);
- creation of the Austrian Institute of Precision Medicine: the institute will focus on and develop technologies that play a key role in precision medicine projects (e.g. genome sequencing, biobank, data processing), with EUR 13.7 million for the digital part;
- 'Microelectronic und connectivity': this project, which qualifies as an Important Projects of Common European Interest (IPCEI) and will be implemented as a multicountry project, will support the development of future innovative network and microelectronics technologies (budget EUR 125 million);
- digital research infrastructure: this measure will support selected projects that help digitalise universities (budget EUR 30 million).

4 Digital public services

	_		_	100	Digital public services
4 Digital public	Au	stria	EU	80	
services	rank	score	score	60	
DESI 2021	9	79.8	68.1	40	
				20 -	Austria
				0 -	Austria LO

2016 2017 2018 2019 2020 2021

Distant and the second

		Austria		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	75%	79%	81%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	75	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	88	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	85	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	90%	78%
% maximum score			2020	2020

In Digital public services, Austria ranks 9th among EU countries and is therefore above the EU average. Austria is above the EU average in all indicators. The number of e-government users continues to grow (81%), well above the EU average (64%). In Digital public services for citizens, Austria is among the frontrunners with a score of 88 compared to the EU average of 75. With 85 points in Digital public services for businesses, Austria is close to the EU average (84). In terms of Open data readiness, Austria is also among the frontrunners with 90% (EU average is 78%).

In 2020, Austria adopted three important pieces of legislation to push digital public services: an amendment to the e-government Act, the 'Digital Office', and the Web Accessibility Act. These ensure people and businesses have the right to electronic communication with authorities, with access to a safe and easy-to-use electronic mailbox for governmental documents provided by the BMDW. People have access to their personal mailbox via the e-government portal¹⁵, businesses via the Business Service Portal¹⁶. This makes communication and administrative processes much more efficient. Both portals continue to expand. The Business Service Portal offers 70 public service procedures. A very strong emphasis is put on delivering public services using the once-only principle for domestic but also cross-border transactions to reduce administrative burden for businesses.

With its 'Digitales Amt' mobile app, the Federal government promotes user-oriented access to egovernment services and aims to close the digital divide, improve opportunities for people in more remote areas to take part, and reduce traffic.

¹⁵ www.oesterreich.gv.at

¹⁶ www.usp.gv.at

In January 2021, an eIDAS compatible version of the Austrian Citizen Card – the E-ID known as 'Identity Austria - ID-A' – went online in a pilot phase and is available for the public through certain registration offices around Austria. It is expected to become fully operational towards the end of 2021.

Nearly all large Austrian cities have smart city strategies in place (e.g. Bregenz, Graz and Klagenfurt). In October 2019, Vienna launched its smart city strategy 'Vienna 2019-2050'. There is no national smart city plan, since the power to implement this lies with the cities. Nevertheless, there are supporting measures to promote innovation and digital transformation in all cities.

Regarding e-health, to ensure patients were supplied with medicines during the COVID-19 pandemic while preventing the risk of infections, especially for vulnerable groups through visits to the physician's office, a telemedicine service was implemented for physicians to issue prescriptions to patients without personal contact. This involved storing the prescription in the ELGA e-Medication service. This service, initially implemented for a limited period of time, was prolonged until June 2021.

An increasing number of Austria's public authorities are already using AI technologies to improve efficiency, planning and decision-making processes. In the judiciary, AI is used, e.g. for classifying and naming incoming mail; processing large amounts of data in investigation proceedings; and for references to literature or quotations in documents.

In Austria, digital public services are well-developed, making use of advanced technology. To maintain its leading role in digital public services, Austria's challenge will be to keep up with the fast pace of digital technology.

Digital public services in Austria's Recovery and Resilience Plan

The RRP includes one broad and one specific measure to improve digital public services:

- digitalisation fund public administration: the fund will be used to implement IT consolidation in the Federal government, develop public and business services and to improve the efficiency of procedures (budget EUR 160 million);
- electronic mother-child passport platform: this aims to improve health opportunities for pregnant and breastfeeding women and their children and increase social cohesion (budget EUR 10 million).

	Bel	gium	EU	
	rank	score	score	
DESI 2021	12	53.7	50.7	



Belgium ranks 12th among the 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI).

In terms of digital skills, Belgium scores particularly well in the share of enterprises providing ICT training to their employees (2nd in the EU, with 33% compared to 20% on average in the EU). Moreover, the Belgian authorities have stepped up their efforts to address the need for better digital skills among students and to reskill and upskill the labour force. Flanders launched a new overarching digital school education strategy this year.

In terms of connectivity, Belgium displays uneven performance. The country has achieved good coverage of fixed very high capacity networks (VHCNs), thanks in part to its cable network. Fibre coverage, though still low, is also accelerating. In this regard, the recent announcement by Unifiber – a joint venture between the incumbent Proximus and Eurofiber – that it intends to connect 500 000 households and small and medium-sized enterprises (SMEs) in Wallonia with fibre by 2028 is encouraging. Belgium also displays a good level of at least 100 Mbps broadband take-up, where it ranks 6th in the EU. On the other hand, Belgium still lags behind on 5G readiness and coverage. The 5G multi-band auction scheduled for early 2022 and the revision of regional norms on exposure to electromagnetic fields could unlock the situation.

The integration of digital technology by enterprises remains one of Belgium's strong points. The country is leading in terms of the number of enterprises using internal electronic information sharing (53% against 36% on average in the EU) and scores very well on most indicators. Several initiatives at regional and federal level continue to support the digital transformation of the economy.

Belgium shows a mixed performance in e-government. The country is on a par with the EU average on many indicators, in particular on the use of online public services, but could offer more public services to people and improve its score on open data readiness. The formation of a new federal government in October 2020, with an ambitious agenda for digital public services, should boost egovernment over the next few years.

Belgium's latest digital strategy, 'Digital Agenda Belgium', was designed for the 2015-2020 period and is now under review by the new government. For this it has teamed up with a number of

industry stakeholders ('the Digital Minds') to develop its digital strategy. Wallonia has a digital strategy for 2019-2024, 'Digital Wallonia', that encompasses several fields (ICT sector, digital economy, digital skills, digital administration and digital territory). While Flanders and the Brussels region do not have a similar unique brand for their digital strategies per se, they have a number of sectoral strategies and policies in the field of digitalisation. For Flanders, these include Industry 4.0, AI, e-government, cybersecurity, e-commerce and the media sector; for Brussels, smart city, digital innovation and the ICT sector. Close alignment of the digitalisation measures could also have a positive impact on the private sector.



Digital in Belgium's Recovery and Resilience Plan (RRP)

The plan will be financed by a total of EUR 5.9 billion in grants, out of which around EUR 1.58 billion is devoted to the digital transition, representing 26.6% of the overall budget.

11 components out of 17 contain measures that are expected to contribute to the digital transition with a broad, cross-cutting approach.

Digital public services is the main field adressed. Most measures target the modernisation and digitalisation of public services at federal, regional and local level. Measures to digitalise federal administration services include the digitalisation of the justice system and the health system as well as implementation of the single digital gateway.

Human capital also represents an important part of the digital investments, targeting both education and training. The plan includes an overarching digital strategy for the Flemish school education system and several measures to increase the digital skills of workers, adressing skills mismatches and boosting labour market integration.

A full component of the plan is dedicated to connectivity, including key reforms for enabling 5G rollout, as well as investments in fibre rollout to white areas.

Other investments address the digitalisation of specific sectors such as tourism, transport, energy, media and culture.

The plan will also support the integration of digital technologies by companies and public administrations, in particular via investments in cybersecurity. A specific action related to the Important Project of Common European Interest (IPCEI) on microelectronics is also envisaged.

1 Human capital

Trank score score DESI 2021 10 50.8 47.1	1 Human canital	Bel	EU	
DESI 2021 10 50.8 47.1	I numun capitar	rank	score	score
	DESI 2021	10	50.8	47.1



	Belgium			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	61%	61%	61%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	31%	34%	34%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	63%	62%	62%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	5.2%	5.0%	5.0%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	17%	17%	17%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	36%	36%	33%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	1.9%	2.1% 2018	2.1%	3.9%
% graduates	2017		2019	2019

Belgium ranks 10th among the 27 EU countries on Human capital and is therefore above the EU average. It scores slightly above the EU average on basic and advanced digital skills as well as basic software skills. The percentage of ICT specialists (5%) is above the EU average (4.3%), but has not improved compared to last year. The share of women ICT specialists also remains stable, slightly below the EU average (17% versus 19%). The number of ICT graduates is stagnating well below the EU average with 2.1% versus 3.9%. Last year, 33% of Belgium enterprises provided dedicated ICT training to their employees, which was well above the EU average of 20%.

The federal digital skills strategy is currently under review as part of 'Digital Agenda Belgium'. Regions and communities also have strategies and policies in place to improve digital skills at various levels of education. The government of the Wallonia-Brussels Federation adopted its digital school education strategy in 2018¹⁷, in which the 'digital schools programme'¹⁸ offered digital equipment to schools based on their involvement in educational projects. In total, 679 projects were selected in 2020. In Flanders, the 'Digital leap'¹⁹, a comprehensive strategy to digitalise the school education system, was adopted in December 2020. It will provide measures in the fields of ICT infrastructure and equipment for schools, initial teacher training, digital learning resources and cybersecurity, for a total investment of EUR 375 million. The Brussels-Capital region launched a '2021-2024 digital

¹⁷ <u>http://www.enseignement.be/index.php?page=28101</u>

¹⁸ Accueil – Ecole <u>Numérique – Ecole Numérique (ecolenumerique.be)</u>

¹⁹ Digisprong – Vlaams Ministerie van Onderwijs en Vorming (vlaanderen.be)

appropriation plan²⁰ in 2020, which aims to fight the digital divide and improve the digital skills of people living in Brussels. In addition, the National Coalition for Digital Skills and Jobs 2030 was relaunched in May 2021. It will focus on children, students, the unemployed, women in the digital sector, upskilling people over 50 years old and SMEs. The National Coalition aims to connect to the Digital Skills & Jobs Platform²¹ by October 2021.

In 2020, nearly 16 000 young people took part in Code Week despite the COVID-19 pandemic. Half of the participants were female, and two thirds of the 168 activities were organised outside schools²².

In 2020, a study²³ by Agoria (federation of Belgian enterprises) pointed to the fact that the shortage of ICT specialists, already identified as an issue for Belgium in 2018, could again increase in the coming years. In 2020, already 58.8% of enterprises that recruited or tried to recruit ICT specialists reported difficulties in filling ICT vacancies and demand for a more digitally skilled workforce is expected to be even higher than before the COVID-19 crisis. Several projects have been launched or continued in 2020-2021 to address this challenge. At federal level, the Digital Belgium Skills Fund continued its activities in 2020, supporting 30 projects that aim to help young people in precarious situations on the labour market. This fund supports initiatives with a major impact, such as the digital campus BeCentral. In May 2020, the Walloon digital and labour agencies set up 'UpSkill Wallonia'24, a pilot project to help companies with their digital transformation by identifying the skills needed and offering corresponding training. Based on the outcome of this pilot, the region intends to submit a larger scale project to the 2021-2027 European Social Fund + and the European Regional Development Fund calls. In Flanders, the public employment agency VDAB offers workshops on digitalisation and integrates digital skills into all training courses. Training is also organised on e-marketing, building websites, Industry 4.0 as well as IT developer courses for target groups who are further away from the labour market or vulnerable people (e.g. youth not in education, employment or training youth). In addition, VDAB has boosted its offer of online courses in digitalisation (e.g. on AI). It also offers competence check-ups to workers in vulnerable employment to help them identify their training needs. In terms of advanced digital skills, the Flemish Academy for AI was set up in 2020 to offer and develop courses for researchers and early AI adopters as well as short and medium-term courses for higher level professionals. In the Brussels-Capital Region, Digitalcity.brussels, the new training and employment centre for digital jobs, was set up in October 2020.

After signing the 'Women in Digital' declaration in 2019, in March 2021 the federal government set up a 'Women in Digital National and Intersectorial Strategy'²⁵ for 2020-2025. It defines five strategic goals, which include ensuring that more women graduate in digital fields (ICT/STEM) and promoting the inclusion of women in the digital workforce and/or in the digital sector. Wallonia has taken several measures and supported the Wallonia Wonder Women campaign²⁶, the 'Cool girls' code initiative from Coder dojo Belgium²⁷ and a new gender programme from BeCode²⁸.

A severe labour shortage in digital-related domains limits Belgian companies' capacity to innovate and capitalise on innovation. Increasing the number of ICT specialists, narrowing the gender gap and upgrading the digital skills of the labour force are essential if the country is to tap into the full potential of the digital economy.

²⁰ Le plan d'appropriation du numérique 2021-2024 | Inclusion numérique | Brussels Smart City

²¹ <u>https://digital-skills-jobs.europa.eu/en</u>

²² <u>https://digital-strategy.ec.europa.eu/en/news/eu-code-week-organisers-register-over-72000-activities-</u> second-year-row

²³ Agoria: Be the change

²⁴ UpSkills Wallonia. Répondre à la pénurie de profils qualifiés (digitalwallonia.be)

²⁵ <u>Plan interfédéral et intersectoriel 'Women in Digital' | News.belgium</u>

²⁶ Wallonia Wonder Women | DigitalWallonia.be

²⁷ Cool Girls Code (coderdojo4divas.be)

²⁸ <u>Hackeuses club – BeCode</u>

Human capital in Belgium's Recovery and Resilience Plan

The plan includes several measures to develop the digital skills of people, including:

- Digitalisation of schools and higher education institutions in Wallonia and Brussels (EUR 37.2 million); in the German-speaking community (EUR 5.5 million) and a new digital education strategy in Flanders (including EUR 32.3 million for human capital and EUR 282.6 million in ICT equipments, tagged as investments in digital capacities).
- E-inclusion projects (EUR 92.4 million) targeted at vulnerable populations, in particular people lacking basic digital skills or inmates.
- Upskilling and reskilling of the labour force (EUR 98 million): this includes measures to digitalise and improve services and training offered by public employment agencies, as well as to help develop workers' digital skills.

2 Connectivity

2 Connectivity	Bel	EU	
	rank	score	score
DESI 2021	16	48.4	50.2



		EU		
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	NA	79%	85%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	40%	45%	54%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	<0.01%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	99%	99%	99%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	1%	66%	68%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	>99.9%	>99.9%	>99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	3%	3%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	4%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	69%	77%	77%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	52	51	69
Score (0-100)		2019	2020	2020

Belgium ranks 16th in connectivity. At 68%, the country has very good VHCN coverage , largely due to a significant part of the cable networks having been upgraded to DOCSIS 3.1 (Data Over Cable Service Interface Specification) in 2019. The 2 percentage point increase in VHCN coverage since 2019 is mainly due to FTTP (Fibre to the Premises) deployment, with coverage in 2020 reaching 6.5% of households (up from 3.6% in 2019); DOCSIS 3.1 coverage remained stable. VHCN coverage is expected to increase significantly in the next few years as all cable networks are expected to be upgraded and very high-speed digital subscriber line (VDSL) networks (currently covering 96.8% of households) will be partially replaced by FTTP²⁹. Thanks to good VHCN coverage, take-up of 100 Mbps speeds is 20 % higher than the EU average and has increased almost 10 pps in a year. The low FTTP coverage is reflected in the very small 1 Gbps take-up. Overall, fixed broadband take-up increased by 6 pps in 2020. While Belgium has nearly ubiquitous 4G coverage, it lags behind in 5G on both readiness (3% compared to an EU average of 51%) and coverage (4% against 14% at EU level). Broadband prices remain higher than the EU average.

Private investment in fixed VHCNs is increasing as Proximus, benefiting from a EUR 400 million loan from the European Investment Bank, announced the acceleration of its fibre rollout plan. It now

²⁹ The incumbent Proximus plans to cover 70% of households by 2028; other initiatives are also ongoing.

aims to cover 50% of households and businesses by 2025 and 70% by 2028, thanks to partnerships with two fibre companies – Eurofibre in Wallonia and EQT Infrastructure in Flanders. Telenet continued talks with the utility grid operator Fluvius on a potential partnership to roll out a point-to-point fibre network in Flanders. The Federal Council of Ministers approved the launch of a fixed and mobile broadband plan in April 2021, which aims to tackle the areas expected to remain underserved. The plan is expected to include measures to identify white areas, stimulate investment in these areas, provide better information to the public on fibre and 5G and create a national broadband competence office. The Atlas project run by Belgium's communications regulator BIPT should help identify white areas.

Belgium is experiencing delays in the deployment of 5G networks, mainly due to the delay in assigning 5G pioneer bands. The multiband auction for the 700 MHz, 900 MHz, 1400 MHz, 1800 MHz, 2100 MHz, 2600MHz and 3.6 GHz bands initially scheduled for 2021 has now been moved to early 2022. While there is still no agreement between the federal government and the regions on the distribution of the auction's proceeds, an agreement has been reached on its design. In the meantime, the 700 MHz band has been freed from broadcasting and the 3.6 GHz band has been repurposed to ensure 390 MHz of contiguous spectrum. Belgium is not yet planning to assign rights of use in the 26 GHz band.

Other obstacles to 5G deployment, as reported in previous years, persist. Radiation limits are different in each of the three regions and, in particular in Brussels, do not allow economically viable 5G deployment. Changes to the radiation limits in Flanders and the Brussels region are currently planned in order to ease the introduction of 5G. The deadlines for granting environmental permits to deploy antennas (a regional responsibility) and the fees charged by municipalities for pylons, particularly in Brussels, which can go to up to EUR 10,000 per year per antenna, are also impediments to efficient deployment.

Nevertheless, Proximus launched commercial 5G mobile services in April 2020 using existing spectrum holdings and infrastructure in order to provide coverage in more than 30 municipalities across the country. In July 2020, BIPT granted temporary user rights in the 3.6-3.8 GHz band to the three mobile network operators and 2 other operators (Cegeka and Entropia), and in October 2020 distributed Entropia's spectrum to the other operators.

Moreover, BIPT granted rights of use of radio spectrum in the 2.6 GHz band (FDD) to Citymesh.

Main market & regulatory developments

While the fixed market is still dominated by the territorial duopolies of Proximus/Telenet on the one hand and Proximus/VOO on the other, Orange Belgium managed to increase its market share. The sale of VOO (scheduled for 2022) is still pending, with both Telenet and Orange among the potential buyers. Two of the mobile network operators, Proximus (No. 1) and Orange (No. 3), reached an agreement to share investments in towers and base stations and the costs of transmission, maintenance and repair covering all technologies, including the future roll-out of 5G (multi-operator radio access network (MORAN) sharing agreement). The agreement is pending approval by the competition authority.

The market is characterised by the high take-up of bundles (up 2.6% in a year), which are mainly triple-play and quadruple-play. Established operators increasingly include OTT TV apps in these bundles. In parallel, VOO and Orange started commercialising more affordable unlimited standalone broadband products. The COVID-19 pandemic has had a significant

impact on fixed data volume use, which went up 40% on a typical pre-crisis working day. Major internet service providers took the initiative to increase the volume of data in tariff plans with a data cap or to suspend data limits. Fixed voice consumption also increased. Netflix and YouTube temporarily lowered their picture quality, which helped reduce the strain on the fixed networks. At the same time, mobile broadband consumption also continued to grow significantly.

Belgian providers are also trying to compete in the content market. A streaming platform was launched in Flanders in September 2020, as a result of the cooperation between network operators and content providers.

On 4 February 2021, the Commission addressed a letter of formal notice to Belgium for failure to notify it of transposition measures for the European Electronic Communications Code. Subsequently, Belgium notified the Commission of partial transposition of several Articles.

In April 2020, the Conference of Regulators of the electronic communications sector (CRC) notified the Commission of a bottom-up long run incremental cost plus (LRIC+) cost model based on current replacement costs, economic depreciation and monthly rental prices for wholesale access to the cable networks. This draft decision followed up on the previous 2018 decision, which had set common interim prices as an interim solution until a cost model was developed. The new prices differ between the three networks. In its comments, the Commission pointed to a potential risk of overcompensation, which could disproportionally increase wholesale access prices, in particular for high-speed products. The CRC adopted the final decision on 26 May 2020.

In June 2020, BIPT revised the 'one-time fees' for access to the local loop and bitstream access on Proximus' xDSL network.

In March 2021, BIPT adopted new fibre to the home (FTTH) rental fees.

In its roadmap to implement the Connectivity Toolbox³⁰, Belgium announced plans to assess the need for permit exemptions, identify opportunities to digitalise permit application procedures, provide guidance to local entities that do not apply cost-based fees for pylons and antennas, improve the digital availability of information and strengthen synergies between different sources, and encourage access to the physical infrastructure of public bodies.

In 2020, there was a 10% decrease in the number of complaints involving mediation. In around 95% of the mediation complaints, an amicable settlement was reached. The complaints were mainly about invoicing, contractual matters, and failures and malfunctions. There has been a significant increase in the number of complaints about malicious calls via over-the-top (OTT) services.

Since the beginning of 2020, end users can check their data usage directly and automatically with their provider, while providers must send bill shock warnings when mobile users reach their monthly plan limits on voice, data or text usage or the monthly plan limits plus EUR 50.

On open internet access, there has been significant take-up of zero-rated products. During the reporting year, BIPT intervened in several cases where commercial agreements or practices of mobile network operators were found to have a negative impact on end user choice.

Belgium has still not implemented the centralised public safety answering point (PSAP)

³⁰ <u>https://digital-strategy.ec.europa.eu/en/policies/connectivity-toolbox</u>

architecture which was scheduled to be implemented by the end of 2020.

While Belgium made only marginal progress in the deployment of fixed VHCN networks in 2020, the situation is expected to improve significantly in the future thanks to the acceleration of private investments both in fibre and co-axial networks. 5G deployment remains a thorny issue, with solutions on spectrum assignment and deployment expected only in 2022. This will inevitably lead to significant delays in Belgium compared to most EU countries.

Connectivity in Belgium's Recovery and Resilience Plan

The plan includes some investments and key reforms related to connectivity. At federal level, Belgium is preparing a national plan for fixed and mobile broadband. It will include a mapping of connectivity, allowing the country to identify potential white areas and to boost investments in these areas. It will create a national broadband competence office and will provide more information to citizens on fibre and 5G, including by holding public meetings. At regional level, all regions will consider modifying their electromagnetic fields (EMF) emission norms, which are currently an obstacle to 5G rollout, especially in Wallonia and in the Brussels region. Consultations are already ongoing on this.

When it comes to investments, EUR 19.5 million will be dedicated to supporting the deployment of FTTH in the German-speaking community. Wallonia will also invest in connecting business parks and schools (EUR 70.3 million).

3 Integration of digital technology

3 Integration of	Bel	EU	
digital technology	rank	score	score
DESI 2021	6	49.8	37.6



		EU		
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	75%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	54%	53%	53%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	24%	34%	34%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	20%	20%	23%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	31%	31%	43%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	24%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	56%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	21%	21%	25%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	28%	29%	24%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	13%	14%	NA	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	12%	15%	15%	8%
% SMEs	2017	2019	2019	2019

Belgium ranks 6th among the 27 EU countries on the integration of digital technology, and is therefore well below the EU average. In 2020, 75% of Belgian SMEs had at least a basic level of digital intensity, which places Belgium 5th among the EU countries (the average being 60%). SMEs have also taken advantage of the opportunities presented by e-commerce, with 24% of them selling online, which is above the EU average (17%). On the integration of digital technologies, 43% of all Belgian enterprises use cloud services, placing Belgium 6th in the EU (EU average 26%), representing a significant increase over 2019 (31%), and 23% of them use Big Data solutions in their operations, which is also well above the EU average of 14%. 34% of enterprises use social media (against 23% on average in the EU). Belgium performs slightly below the EU average on the use of AI solutions by enterprises (24% versus 25%) and in the use of e-invoices (25% versus 32%)⁽³¹⁾. Furthermore, on the amount of green measures taken by enterprises using ICT, Belgium scores 56% below the EU average (66%).

³¹ Use of e-invoices has further increased since the Eurostat data collection in 2020, see <u>https://efacture.belgium.be/fr/news/la-vague-de-numerisation-la-suite-du-coronavirus-touche-aussi-la-facturation-electronique</u>

Belgium is strongly committed to advancing new digital technologies and investing strategically in digital technologies through EU-coordinated initiatives and programmes. It is a signatory of joint declarations on 'Building the next generation cloud for business and public sector in Europe'³² (15 October 2020) and on microelectronics³³ (7 December 2020), and has expressed interest in participating in the next IPCEI on microelectronics. Belgium also actively participates in the joint undertaking on Electronic Components and Systems for European Leadership (ECSEL) and its upcoming successor, the Key Digital Technologies (KDT) joint undertaking.

Belgian regions have launched several action plans with a link to digital transformation in recent years. Flanders' master plan Industry 4.0³⁴ aims to digitalise production in key industries, while Wallonia strengthened its 2019-2024 digital strategy in 2020 with an additional EUR 3.65 million. This extra funding will be focused in particular on measures for the industry of the future³⁵. In June 2020, the Walloon government also decided to invest EUR 10 million in a new Tier-1 supercomputer to be hosted by Cenaero, a research centre in aeronautics.

Belgian regions continued to deploy their AI strategies and related activities in 2020. Flanders is committed to investing EUR 32 million each year in this field³⁶, of which EUR 15 million is dedicated to AI technology transfer and industrial applications. The Brussels region has created FARI, an 'AI institute for the common good' to provide advice and training on the development and deployment of AI products and services for the well-being of society. Wallonia has launched its second call for 'Start AI', aimed at helping 19 Walloon companies adopt AI through personalised coaching, and has launched 'Tremplin IA' to help five individual projects and five collective projects set up AI demonstrators.

Flanders is currently drafting a new strategy on digital entrepreneurship and innovation and continues to implement its cybersecurity action plan, with a budget of EUR 20 million per year. Wallonia has continued to support SMEs with vouchers for digital transformation and cybersecurity: between March 2017 and November 2020, EUR 6.3 million was co-funded by Wallonia and EUR 2.5 million by more than 500 participating companies. Wallonia has also launched a second phase of its digital innovation programme for 2021-2022 in order to map, structure and animate digital ecosystems as well as support them in their internationalisation. Furthermore, in 2020, Belgium shortlisted 12 candidates for the European Digital Innovation Hubs, with topics including for example Industry 4.0, Al or the construction sector.

Despite performing well and making considerable efforts, one major issue that companies still face in their digital transformation is the skills mismatches that currently prevent them from fully benefiting from the adoption of digital technologies.

Highlight 2020-2021: TRAIL (Wallonia)

TRAIL³⁷ (Trusted AI Labs) was officially launched in September 2020 in Wallonia. It aims to make available to enterprises and public administrations the expertise and tools developed in the field of AI by the five French-speaking universities and the four approved research centres active in AI, in partnership with the Digital National Agency and Al4Belgium. TRAIL focuses on three pillars: supporting the training and work of researchers in AI (TRAIL Institute), making available the results of this research (TRAIL Factory), and providing services to companies

³² <u>https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=70089</u>

³³ https://ec.europa.eu/newsroom/dae/redirection/document/73940

³⁴ Industry 4.0 in Flanders | Vlaanderen Industrie 4.0 (industrie40vlaanderen.be)

³⁵ <u>Renfort de la stratégie numérique wallonne (wallonie.be)</u>

³⁶ www.ewi-vlaanderen.be/ai

³⁷ Trusted AI Labs (trail.ac)

(TRAIL4Ventures).

Integration of digital technology in Belgium's Recovery and Resilience Plan

Investments in the integration of digital technologies amount for EUR 427 million in Belgium's recovery and resilience plan.

A crucial measure is addressed at strengthening the country's cyber resilience (EUR 52.3 million). The measure is expected to lead to increased cyber risk awareness and management capabilities for SMEs and the self-employed, higher resilience against phishing, and greater trust among citizens and businesses in online services thanks to a registry of validated websites. This project will also strengthen the capacity of the Belgian government to handle cyberattacks on IT infrastructure and government service systems, on private businesses and citizens, as well as attribution capabilities of such cyberattacks.

The plan also includes a Flemish project to strengthen R&D, which will support companies taking part in the IPCEI on microelectronics (EUR 20 million).

4 Digital public services



n	Belgium				E	U
J -	2016	2017	2018	2019	2020	2021

	Belgium			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	63%	64%	66%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	70	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	71	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	85	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	62%	78%
% maximum score			2020	2020

Belgium ranks 17th among the 27 EU countries on digital public services and is therefore below the EU average. It performs slightly above the EU average on e-government users (66% versus 64%) and on digital public services for businesses (scoring 85 points out of 100, against the EU average of 84). Belgium also performs well on pre-filled forms (70 points out of 100, versus 63 for the EU). Nevertheless, in the area of digital public services for citizens, Belgium scores lower compared with the EU average (71 against 75). On open data readiness, Belgium ranks 23rd in the Open data indicator with a score of 62% (EU average 78%).

After the new government was formed in October 2020, the State Secretary for Digitalisation outlined his main policies, which will be reflected in the updated federal digital strategy. The main objectives for the digital public services revolve around full implementation of the Single Digital Gateway, the creation of a single app to enable users to access all online public services and available data, greater use of the official digital mailbox already available to citizens and companies, and greater increase of e-ID, which is already available to all residents in Belgium.

Concerning specific regions, the Walloon government has set up a 'CIO team' (Chief Information Officer) to define an overall strategy for the digitalisation of the Walloon administration and produce an action plan, including the recruitment of a CIO, expected in 2021. In March 2020, it launched the project 'Digital Wallonia 4 Good' to give more visibility to initiatives that use digital technology to address health or society issues and that offer services that are complementary to the traditional channels or are alternatives. In addition, following the 2019 open data decree by Wallonia and the Wallonia-Brussels Federation, Wallonia launched the 'GeoChallenge' call in February 2020. It supports projects that aim to exploit public data in order to provide new services to citizens, companies and civil servants. The successful projects are still ongoing and after the success of this new call, a second edition might be launched in 2021.

The 'Flanders Radically Digital' investment programme, which focused on digitalising the Flemish government, was succeeded by a new investment programme 'Flanders Radically Digital 2', with a budget of EUR 30 million for 2021-2023. The Flemish digital platform for entrepreneurs (eloketondernemers.be) was used to provide digital access to temporary financial support measures launched to help companies survive the COVID-19 crisis. New services are being added to the platform to comply with the obligations of the Single Digital Gateway Regulation. Furthermore, the Brussels-Capital region has developed a new 2022 strategy for the Brussels Regional Informatics Centre, the ICT operator of public administrations.

The regions continued measures to support smart cities in 2020. The city of Bruges and the IMEC research centre signed a partnership in September 2020 to start developing an urban digital twin by the end of 2021. This digital 3D replica of the city will allow the city council to simulate the impact of policy measures, for example in the field of air quality and traffic flows. In Brussels, a call for projects in the field of smart cities was launched in early 2021 to support a sustainable recovery.

The Open Data federal taskforce has approved efforts to better centralise open data sets and to promote the use of the federal data portal³⁸, which will be revamped in 2021-2022. New data sets on social sciences³⁹ and transport⁴⁰ have been included, with others in the pipeline (for instance on land registries or on election results).

Some efforts have been made to ensure synergies between the different levels of government. For instance, a coordination and governance structure has been set up between the federal, regional and local governments to successfully deal with the organisational and technical challenges of obligations on information and transactions introduced by the Single Digital Gateway Regulation. In addition to this, the Inter-Community Committee for e-government ensures top-level coordination between the federal level and federated entities in the domain of e-government. However, the Belgian authorities need to continue their efforts— both at federal and regional level — in order to provide even more digital public services to citizens and to make more use of open data.

Digital public services in Belgium's Recovery and Resilience Plan

Investments in digital public services represent a total of EUR 796 million in Belgium's recovery and resilience plan. They include:

- Measures to digitalise services offered by the social security institutions, as well as interactions between users and the administration.
- A package of 12 investment measures to digitalise several federal public administrations (EUR 217.7 million), among which the justice system, but also the Federal Employment Agency, the Ministry of Foreign Affairs, the Federal Agency for the Safety of the Food Chain, asylum and immigration processes, as well as crisis management. There will also be a crosscutting project to improve the use of public data and one project to implement the Single Digital Gateway.
- Measures on e-health (EUR 40 million) that will give healthcare providers new digital tools(for instance in the fields of video consultations and home hospitalisation) and will support the effective adoption of these tools. They also aim to increase the secure use of health data for public policies and for research and innovation.
- Several measures to digitalise regional and local public services in Wallonia, Brussels or Flanders. Some of these investments are targeted at specific institutions or procedures, for instance the digitalisation of services offered by the Office of Birth and Childhood of the Wallonia-Brussels Federation, or of urban and environmental permit procedures in the Brussels region and in Wallonia.
- Four investment projects in the field of energy (EUR 100 million of digital budget), in particular an offshore energy island to improve the integration of renewable energies in the grid.

³⁸ Data.gov.be | The Belgian Open Data Initiative

³⁹ https://www.sodha.be/

⁴⁰ https://transportdata.be/



Digital Economy and Society Index 2021

	Bul	EU	
	rank	score	score
DESI 2021	26	36.8	50.7



Bulgaria ranks 26th (equal to Greece) out of the 27 EU countries in the European Commission digital economy and society index (DESI) for 2021.

On Human capital, Bulgaria's level is still among the lowest in the EU. People with at least basic digital skills account for 29% of the total Bulgarian population aged 16 to 74, against an EU average of 56%. Enterprises still have difficulties in finding skilled staff to innovate and grow.

As regards Connectivity, Bulgaria scores only 59% in overall broadband take-up of households subscribing (EU average: 77%) and is also lagging behind in the take-up of high-speed fixed broadband of at least 100 Mbps (15%, against an EU average of 34%). On mobile broadband, 4G coverage is high but 5G coverage is at 0% for 2020, compared to the EU average of 14%. Take-up of mobile broadband is still low at 63% (EU average: 71%). The recently completed 5G auction is an important step toward achieving timely 5G deployment, although there is still lack of sufficient spectrum in certain bands. As a result of the auction, there has been considerable catch-up compared to 2020; 5G readiness now stands at 20.55%, compared to the EU average of 39%.

Bulgaria shows a mixed picture on enterprises' Integration of digital technology. The country is investing in research and digital infrastructure, but their impact would increase if more enterprises were encouraged to make use of them. In addition, intensive outreach about how the new infrastructure can help SMEs digitalise and raise their skills level could have a positive impact. Use of artificial intelligence is more widespread than the EU average. On the other hand, most SMEs do not yet engage in e-commerce: 8% of Bulgarian SMEs sell online, 3% of SMEs are selling across borders, and 8% of turnover comes from the online segment (these figures are about half the respective EU averages).

On Digital public administration, the outdated legal framework remains a major obstacle. Users of egovernment represent only 36% of internet users (EU average: 64%), and digital public services for citizens score 57 out of 100 (EU average: 75). However, digital public services for enterprises and the use of open data by public administrations are just above the EU average. A national strategy in this domain and the activity of the national state e-government agency have delivered promising improvements. Several actions have been taken to engage with people to encourage take-up of egovernment services (supported by EU funds). Electronic identification and electronic signatures are still facing delays, although there are other means of identification in place. Systems to support e-health solutions were prioritised to support health administration processes and the COVID-19 vaccination campaign.



1 Human capital

1 Human capital	Bulgaria E		EU	50
	rank	score	score	30
DESI 2021	27	32.7	47.1	20
				10



	Bulgaria			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	29%	29%	29%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	11%	11%	11%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	31%	31%	31%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	3.3%	3.1%	3.3%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	30%	28%	28%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	9%	10%	7%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	3.7%	3.8%	4.0%	3.9%
% graduates	2017	2018	2019	2019

On Human capital, Bulgaria ranks last in the 27 EU countries and is thus well below the EU average. The overall level of basic digital skills in Bulgaria is the lowest in the EU; people with at least basic digital skills account for 29% of the total Bulgarian population aged 16 to 74, against an EU average of 56%. Only 11% of people have above basic skills, slightly less than a third of the EU average. ICT specialists account for 3.3% of total employment. This marks an increase compared to 2019, bringing it back to the levels of 2018, albeit a small one in proportion to the workforce given the labour market shortages and the faster increase of the EU average (which now stands at 4.3%). In contrast, women account for 28% of all ICT specialists, making Bulgaria a leader for this indicator within the EU.

The strategic measures for digital education are part of the 2021-2030 Strategic framework for the development of education, training and learning. To support the continuity of education during the pandemic, around EUR 7.2 million were earmarked in the 2020 state budget⁴¹ to fund giving laptops to schools for temporary use by any student or teacher who does not possess their own computer to also be used during normal attendance learning, thus helping modernise school equipment. In addition, around EUR 55 million from EU Structural Funds are directed towards the 'Equal Access to School Education in Crisis' initiative to purchase equipment for pedagogical specialists and students to support education during the crisis and conduct training on acquiring practical skills for remote work with electronic access. For preschool and school education in 2021, the National ICT plan intends to purchase innovative hardware and to give priority to schools that have not received equipment for the last 3 years and to schools with ICT profiles. In 2020, the Ministry of Education

⁴¹ According to Council of Ministers' Decree No 283/15.10.2020.
and Science implemented SIAMU, a system that manages users' identities to provide secure access to all educational platforms and services. The ministry also published electronic textbooks on the main general education subjects on its website for students' use.

Following the entry into force of the Pre-School and School Education Act in September 2016, computer programming in primary school has become part of the curricula for 3rd and 4th grades, covering basic algorithms using a language for block programming. In the 5th grade, students learn programming languages such as Scratch or Code. In grades 6 and 7, students move to script text languages such as Python or JavaScript.

Since February 2021, the European Social Fund and national co-funding have been operating an initiative called 'Digital Skills Development'. This started with identifying the digital skills needed by employees, broken down by economic sector. It will then develop, test and validate unified digital skills profiles for key professions, as well as sectoral qualifications frameworks for digital skills development.

Bulgaria sometimes faces difficulties in retaining ICT specialists, despite a growing ICT sector. Enterprises in all sectors face challenges in filling ICT vacancies, for instance, in cloud architecture or data management, a trend also observed at EU level. Provisionally, based on data provided by the Bulgarian Software Industry Association, the Bulgarian software industry (which represents 3.8% of Bulgarian GDP) and the ICT sector have grown by about 10% in 2020 in terms of revenue, against the backdrop of around a 4.2% drop in the country's GDP (as per the preliminary data from the National Statistical Office).

The Ministry of Labour and Social Policy organises regular free training courses, including at regional level, for unemployed young people under the age of 29 in digital competences, helping them start their own enterprise or become employed. Digital inclusion is also a part of an ongoing e-government action. In addition, a 2021-2027 human resources development programme will train people in Bulgaria in digital competences, targeting all age groups including the elderly and disadvantaged people.

The Digital National Alliance is the Bulgarian national coalition for digital skills and jobs. It adapted its activity to the COVID-19 conditions and organised virtual meetings and online training materials. Its objectives are to break ICT stereotypes, to increase the number of people with digital skills, to involve more women in the technological world and to empower future generations with technological intelligence and curiosity.

In October 2020, during EU Code Week, 663 events took place in Bulgaria. Schools organised events to mark the importance of studying programming and the development of related creative thinking. In addition to developing mobile applications, students took part in workshops on the basics of programming, visual/block programming and activities related to digital competences.

In summary, basic digital skills remain a significant challenge among the Bulgarian population, one that has to be addressed. Enterprises still have difficulties in matching the skills they need to the available competences and skills of the workforce. Increasing the number of Bulgarian ICT specialists and reskilling the labour force are of great importance for Bulgaria to take advantage of the digital transition. Some strategic actions include improving digital skills in the workforce and in the general public as a priority among Bulgaria's digital transformation policies. The European Social Fund+ continues to provide additional support. Targeted and specific policies are needed in the short term to alleviate skills shortages.

2 Connectivity

2 Connectivity	Bul	EU	
,	rank	score	score
DESI 2021	26	38.1	50.2



		Bulgaria		
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	58%	58%	59%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	10%	11%	15%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	0.26%	0.27%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	75%	77%	79%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	38%	42%	43%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	98.7%	99.5%	>99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	0%	25%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	56%	63%	63%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	72	78	69
Score (0-100)		2019	2020	2020

With an overall connectivity score of 38, Bulgaria ranks 26th among EU countries.

In 2020, Bulgaria saw a small increase in fixed broadband network deployment, with fast broadband coverage (NGA) improving from 77% in 2019 to 79% and very high capacity network (VHCN) coverage rising from 42% in 2019 to 43%. The country has still a significant gap to overcome to reach the EU average. VHCN coverage shows limited growth over time, and has increased at an average of 2.5 pp., from 38% in 2018 and 42% in 2019. In rural areas, fixed VHCN coverage is only at 1% (EU average: 28%). Moreover, Bulgaria ranks very low in overall broadband take-up, with only 59% (up 1 pp. since 2019) of households subscribing (EU average: 77%). It is also lagging behind in take-up of high-speed fixed broadband of at least 100 Mbps (15%; EU average: 34%), with very limited, but increasing, progress year on year: 11% in 2019 and 15% in 2020 (EU average: 34%). Take-up of ultrafast broadband (1Gbps) is still insignificant.

The mobile broadband indicators lag behind the EU average. 4G coverage is high, at more than 99.9%. 5G readiness is at [25]% compared to the EU average of [51]% after authorisations were granted in May 2021. However, coverage is at 0% for 2020, compared to the EU average of 14%. Take-up of mobile broadband is still low at 63% (EU average: 71%). Low fixed and mobile take-up

seems not correlated to high prices, as Bulgaria actually ranks relatively high (5th) in the Broadband Price index, with prices significantly lower than the EU average.

In August 2020, Bulgaria updated its broadband plan⁴², aligning it with the targets set by the EU. Among the prioritised areas are: (i) improving access to high-speed internet in less populated regions by establishing favourable conditions for the roll-out of fibre connections; (ii) securing connectivity to all public institutions, i.e. national and local administrative organisations, schools, hospitals and universities; and (iii) bridging the digital divide.

In December 2020, the country's authorities approved measures encouraging co-investment and cousage between private operators and public bodies. The investment needed to reach the Gigabit Connectivity targets is estimated at approximately EUR 500 million. In 2019, 196 investments totalling EUR 31 million were made, accounting for 14.3% of total investments. In 2020, 175 investments were planned, totalling EUR 31.8 million.

Bulgaria plans to use financing under the Recovery and Resilience Facility for major connectivity works. The main objective is to build symmetric gigabit backbone/backhaul networks throughout the country, with a focus on underserved parts of the country, and creating conditions for connecting with networks at European level. The main road networks (TEN-T) are planned to be covered by secure 5G connectivity to ensure high-speed broadband coverage providing speeds of up to 1 Gbps for the main roads. For the time being, no public or private organisations have applied for or received financing from the European Investment Bank or the European Fund for Strategic Investments.

The Bulgarian broadband plan aims among other things to develop high-speed mobile internet everywhere in the country, specifically referring to 5G as an enabling technology to reach the targets. 5G mobile broadband coverage is now available in major cities, and continues to expand. Overall, Bulgaria has assigned [25]% of the EU harmonised 5G pioneer spectrum, compared to the EU average of [52.7]%.

The successful deployment of 5G in Bulgaria depends on the timely availability and assignment of the 5G pioneer bands. The recently launched and completed⁴³ (April 6 2021) 5G spectrum auction that assigned 75% (EU27 71%) of the 3.4–3.8 GHz band is an important step for 5G roll-out in Bulgaria. The auction raised approx. EUR 6.7 million (BGN 13.4 million) and awarded three bidders with rights of use in the auctioned frequency band (3.6 GHz) at 100 MHz each. The 700 MHz and 26 GHz bands have not yet been assigned. Non-civil use seems to still be a limiting factor for the successful assignment of 700 MHz frequency band, while in the 26 GHz band undertakings declare only their principal interest in obtaining spectrum; a new public consultation is being considered for Q4 2021. Operators have signalled a preference for the full release of the 700 MHz band before expressing commercial interest, after a testing period in 2020, during which three operators were conducting 5G trials. The 3.6 GHz band is already commercially available.

Main market & regulatory developments

No significant developments (entries, consolidations, altered market shares) have taken place

⁴³ <u>https://crc.bg/en/news/1379/the-communications-regulation-commission-has-completed-an-auction-procedure-for-granting-authorizations-for-use-of-individually-assigned-scarce-resource-radio-frequency-spectrum-in-the-3-6-g-hz-band.</u>

⁴² <u>https://www.mtitc.government.bg/sites/default/files/updatedngaplanconnectedbulgaria.pdf.</u>

in 2020 in the fixed telephony, fixed internet and mobile markets.

The number of bundled services and their composition have been stable over the last few years. Consumers continue showing a preference for fixed broadband and TV bundles, which amount to 51.9% of bundle subscriptions, followed by fixed voice and mobile services bundles at 38.6%.

Telework and stay-at-home regimes increased the use of services (in particular internet and voice services), but no substantial deterioration of quality of service has been reported, suggesting that operators have sufficient capacity to deal with the COVID-19 induced increase in demand.

The transposition of the European Electronic Communications Code into national law was delayed, and on 4 February 2021 the Commission sent Bulgaria a letter of formal notice. Bulgaria replied notifying complete transposition on 29 March 2021. The Commission is assessing whether the notification is complete.

On 19 June 2020, the Commission registered notifications from the Bulgarian national regulatory authority (NRA) concerning the review of the markets for: (i) wholesale call termination on individual public telephone networks provided at a fixed location; and (ii) wholesale call termination on individual mobile networks in Bulgaria.

In its roadmap to implement the Connectivity toolbox, Bulgaria informed the Commission that it has already implemented a number of best practices such as: (i) permit exemptions and fast track procedures; (ii) availability of georeferenced information about the occupation level of infrastructure and existence of dark fibre; and (iii) easy access to physical infrastructure controlled by public bodies. It also indicated that it is currently working notably on: (i) ensuring that permit applications are submitted through electronic means; (ii) establishing broadband coordinators; (iii) entrusting a body with a coordination role regarding rights of access to existing physical infrastructure; and (iv) reducing networks' environmental footprint.

The Bulgarian NRA received 1,388 complaints from end users during the first 9 months of 2020, a decrease from the reference period in 2019 (1,721 complaints). The complaints relate to charges for services, how bills are structured, charging penalties regarding contract terminations and border roaming. Complaints for roaming and payments made to third parties through direct billing seem have decreased significantly compared to 2019.

Although the COVID-19 pandemic and the teleworking regime led to increased use of internet services, Bulgaria still faces challenges in coverage and take-up of both fixed and mobile broadband. On fixed broadband there is a continued commercial interest in investing. As for mobile broadband, the recently completed 5G auction is an important step toward achieving timely 5G deployment, although there is still a lack of sufficient spectrum. This is even more of an issue since commercial interest has been signalled for frequency bands that have not yet been auctioned.

3 Integration of digital technology

3 Integration of	Bulgaria		EU
digital technology	rank score		score
DESI 2021	27	20.5	37.6



		Bulgaria		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	33% 2020	60% 2020
3b1 Electronic information sharing	23%	23%	23%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	9%	10%	10%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	7%	7%	6%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	6%	6%	8%	26%
% enterprises	2018	2018	2020	2020
3b5 AI % enterprises	NA	NA	31% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	68% 2021	66% 2021
3b7 e-Invoices	13%	13%	10%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	6%	7%	8%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	2%	2%	3%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	3%	3%	3%	8%
% SMEs	2017	2019	2019	2019

As regards the integration of digital technology in enterprises, Bulgaria ranks last among EU countries. Compared to last year, Bulgaria has moved X. Only 33% of SMEs have at least a basic level of digital intensity (while 60% do so in the EU on average). Only 8% of Bulgarian SMEs sell online (below the EU average of 17%), only 3% of SMEs are selling across borders (versus 8% in the EU) and only 3% of turnover comes from the online segment (against 12% in the EU). 6% of enterprises use big data. The relatively high uptake of AI, used by 31% of enterprises, is well above the EU average. Bulgaria scores well on the use of ICT for environmental sustainability.

The strategic document 'Digital Transformation of Bulgaria for the period 2020-2030'⁴⁴ outlines a vision for the digital transition of the Bulgarian economy. In parallel, the 2027 national strategy for SMEs focuses on supporting SMEs in the challenges they face when they innovate. According to a study by the European Investment Bank, as of the beginning of 2020, only 22% of the SMEs in Bulgaria made investments in innovation. Bulgaria's Council of Ministers adopted rules in January

⁴⁴ https://www.mtitc.government.bg/sites/default/files/digital_transformation_of_bulgaria_for_the_period_2020-2030_f.pdf.

2021 to initiate the national procedure to select potential European Digital Innovation Hubs under the Digital Europe Programme. After completion of the national selection procedure, the Council of Ministers approved a list of 17 candidates for EDIHs⁴⁵, geographically located in the six regions of the country, in accordance with the regional specialisation part of Bulgaria's innovation strategy for intelligent specialisation⁴⁶.

Bulgaria is also a founding member of the EuroHPC Joint Undertaking for high-performance computing. In 2020, the procurement contract for a new EuroHPC petascale supercomputer was signed by the EuroHPC Joint Undertaking and the Petascale Supercomputer Bulgaria consortium. Bulgaria also signed the EuroQCI declaration⁴⁷ in 2020.

The 2014-2020 science and education for smart growth operational programme is co-funded by the EU through the ERDF and supports the creation of centres of excellence and centres of competence in highly innovative technologies. A project called QUASAR is being implemented in the field of informatics and ICT and is expected to lead to the creation of patents for inovative products; importantly, it includes quantum communication research and development.

Bulgaria also updated its cybersecurity national strategy in April 2021. Several measures using the structural funds aim to strengthen the capacity of the National Computer Emergency Response Team (CERT) to monitor the national cyber space, detect vulnerabilities, prevent and respond to cyber incidents and crises and increase Bulgaria's cooperation with other EU countries and actors like ENISA.

In 2020, the Council of Ministers adopted a Concept for the development of Artificial Intelligence in Bulgaria until 2030. The document offers a policy vision for the development and use of AI in Bulgaria and identifies priority fields of application such as infrastructure and data availability, research and innovation capacity, knowledge and skills, and building trust in society.

The 'Competitiveness and innovation in enterprises' 2021-2027 (PCIE) programme, funded by the European Regional Development Fund (ERDF), will support the digital transformation of enterprises, including the development and introduction of Industry 4.0 technologies.

In summary, Bulgaria launched several succesful initiatives in several pioneering technologies. However, integration of digital technologies is uneven across regions, and small enterprises show a significant delay in the integration of digital technologies. Policies for the digitalisation of enterprises that support regional balance and on all SMEs are crucial and should be further pursued.

Highlight 2020-2021: Petascale computing in Bulgaria

Bulgaria is a founding member of the EuroHPC Joint Undertaking for high-performance computing. In 2020, the EuroHPC Joint Undertaking signed the procurement contract for a new EuroHPC petascale supercomputer for the Sofia Tech Park. It is the most powerful petascale supercomputer in eastern Europe and will be hosted in Bulgaria. This is an achievement for the Bulgarian economy and society, and more broadly, a regional contribution to the EU's global leadership in high-tech.

The supercomputer will support analysis of the quality of the environment and natural disaster management. It will be used in areas such as pharmacy, biochemistry, mechanics, quantum

⁴⁵ Decision No 424 dated 26 May 2021.

⁴⁶ https://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool.

⁴⁷ https://digital-strategy.ec.europa.eu/en/news/austria-bulgaria-denmark-and-romania-join-initiative-explore-quantum-communication-europe.

chemistry and monitoring of climate change.

4 Digital public services

4 Digital public	Bulgaria		EU
services	rank	score	score
DESI 2021	21	56.0	68.1



	Bulgaria			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	33%	36%	36%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	53	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	57	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	87	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	78%	78%
% maximum score			2020	2020

Bulgaria ranks 22nd in the EU in Digital public services. E-government users represent only 36% of internet users, well below the EU average of 64%. This is consistent with the score of 57 on the provision of digital public services for citizens, for which the EU average is 75. In contrast, digital public services for businesses have a score of 87, slightly above the EU average of 84. Bulgaria performs at the EU average level on open data.

In March 2021, the e-government development strategy was updated to set out a vision until 2025 for the digital transformation of the public sector. This strategy is implemented by the State e-Government Agency (SEGA), which delivers e-government solutions and resources that are also used by, or specifically developed for, regional and local authorities.

Bulgaria has introduced a national interoperability framework and targets to make public registers available and interoperable. Already completed are the registers for budget, and project control. These will be followed by e-government specific registers, such as a register of registers and a register of standards. Since 2018, all administrative institutions have been required to exchange documents using the Electronic Document Exchange platform; currently 1,028 institutions are connected. The SEGA also put in place a portal for access to resources for development of software for e-government. It will be complemented by procedures for personal data access, secure technologies for data exchange and shared cloud infrastructure for public authorities.

A unified model for requesting, and delivering electronic administrative services was developed by the SEGA with the support of EU Structural Funds: it is in operation and provides access to 430 electronic services, among which 148 are provided by municipal administrations. It will be followed by the cross-border provision of e-services.

The SEGA is also implementing the 'Upgrading and Development of State Hybrid Private Cloud for e-Government Needs' project. The main objective of the project is building a highly resilient and redundant cloud infrastructure for public administration. The project funding is EUR 16 million from the EU Structural Funds and EUR 2.5 million from national co-funding.

More generally, the SEGA established a help contact centre to provide assistance to people including from abroad, and developed a quality feedback tool. It also took measures to increase the security and reliability of information and protection of personal data.

The building of a Sofia Digital Twin has started: this is a large interdisciplinary pilot project of the GATE Centre for Excellence in Big Data and Artificial Intelligence. The project aims to develop a digital twin platform to design, test, apply and service the entire lifecycle of the urban environment in a 3D simulation of the city.

In 2020, a consortium of five Bulgarian enterprises successfully applied under the CEF-TC-2020-1 call and received an EU grant for 24 months to set up, deploy and maintain the first Bulgarian EBSI (European Blockchain Infrastructure for Services) node and to develop three use cases – ESSI (European Self Sovereign Identity), notarisation, and diplomas. The consortium will work towards the completion of ready-to-use decentralised digital services and reusable design for the future development of the infrastructure. These actions aim to deliver to the public and the public administration a solid cross-border foundation for interoperable trans-European digital communication.

In 2021, as a response to the pandemic, the health sector was prioritised as a domain for digitalisation. A project for a national health information system was launched to store health records, prescriptions and referrals. It will also contain information about procedures and treatment of patients in hospitals. Other relevant projects include a project to digitise the certification of medical expertise and a project to support the vaccination campaign using a register. Bulgaria was among the first EU countries to launch the EU digital green certificate for COVID vaccination, launching its system on 1 June 2021 (i.e. one month early); as of 1 July 2021, around 1 million certificates had been downloaded.

Several actions have been taken to engage with the public to encourage take-up of e-government services. Electronic identification and electronic signatures would bring substantial advances in this area, but so far their introduction has been delayed and little progress has been made. Until their launch, various means of identification remain in use. These include: (i) qualified electronic signatures; (ii) various personal codes (personal identification codes used by the national regulatory authority (the Communications Regulation Commission), and the National Social Security Institute unique access code used by the National Health Insurance Fund); and (iii) usernames and passwords. Significant improvements in digital public administration could be achieved if delays in the reform process associated with the implementation of the e-government development strategy are overcome.





Cyprus ranks 21st among 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI).

Cyprus has improved its performance in almost all DESI dimensions, although in most cases it still scores below the EU average. Most of its progress has been made in Connectivity.

Cyprus ranks above the EU average on mobile broadband take-up, has improved its coverage of Very High Capacity Networks (VHCN) and scores high (67%) in the 5G readiness indicator, which means that the biggest part of the 5G pioneer spectrum harmonised at EU level has been assigned. However, the country is well below the EU average in the take-up of fast broadband, while almost one in two Cypriots lack basic digital skills. Despite growing demand on the labour market, the supply of ICT specialists is still below the EU average.

The newly established Deputy Ministry of Research, Innovation and Digital Policy (DMRID)⁴⁸ is responsible for implementing the 'Digital Strategy for Cyprus (2020-2030)' which will accelerate its digital transformation. The strategy, adopted in June 2020, is in line with the objectives proposed in the Commission Communication '2030 Digital Compass: the European way for the Digital Decade'⁴⁹ strategy, and is set to contribute substantially to economic growth and productivity. The Cypriot strategy aims to (i) achieve the digital transformation of the public sector (e-government); (ii) promote the digital transformation of the private sector; (iii) facilitate high-speed network connectivity; (iv) promote an accessible and inclusive society that has the skills to embrace the national digital transformation; and (v) promote innovation in line with the country's level of digital maturity.

48 www.dmrid.gov.cy

⁴⁹ COM(2021) 118 final

Cyprus is in the preparation of an 'e-skills Action Plan' to develop and strengthen digital skills across all population groups. This action plan aims to (i) deliver an open and accessible digital society, fully reaping the benefits of digital transformation, (ii) boost basic digital and basic software skills, the levels of which have decreased recently, and (iii) act as a driver of an accelerated digital transition. The action plan will be implemented under the Cypriot National Coalition for Digital Skills and Jobs⁵⁰. The mechanism for implementing these actions includes input from the public sector, academia and private sector.

In May 2019, Cyprus adopted its new 'Cyprus Industrial Strategy Policy'⁵¹. In January 2020, the government approved the national strategy on Artificial Intelligence (AI)⁵², while a cybersecurity strategy has been in place since 2012. The Digital Security Authority has proposed a new, revised cybersecurity strategy, which will be approved by the Ministry of Communication and the Council of Ministers (CoM) by the end of 2021. The implementation of these strategies together with the successful implementation of the digital transition actions set out in the Recovery and Resilience Plan (RRP) would provide a good basis to accelerate the digitalisation of businesses.



Digital in Cyprus's Recovery and Resilience Plan (RRP)

With a total budget of about EUR 1.2 billion, Cyprus's RRP (hereinafter 'the plan') will support the economic recovery by mitigating the economic and social impacts of the COVID-19 crisis, while strengthening the resilience and transformation of the economy through its digital transformation. To this end, the plan includes significant investments in digitalisation exceeding the digital target of 20% by reaching 23%, i.e. about EUR 282 million.

The plan was developed around five policy axes: (i) health and civil protection; (ii) transition to a green economy; (iii) resilience and competitiveness of the economy; (iv) digital transformation; and (v) labour market, social protection, education and human capital. It contains 13 components. The most important contributions to the digital transition come from components 4.1 (upgrade infrastructure for connectivity) and 4.2 (promote e-government). Component 3.4 (modernising public and local authorities, making justice more efficient and fighting corruption) addresses, among other things, e-justice and smart cities and component

⁵⁰ http://www.digitaljobs.cyprus-digitalchampion.gov.cy/el/page/home

⁵¹ https://cutt.ly/xmnUIwj

⁵² https://knowledge4policy.ec.europa.eu/sites/default/files/cyprus_ai_strategy.pdf

3.5 (safeguarding fiscal and financial stability) focuses on fiscal and financial stability.

Measures related to digitalisation are included in almost all of the other components: (i) digital transformation of the education system and digital skills in 5.1 (educational system modernisation, upskilling and retraining); (ii) digitisation of businesses in 3.3 (business support for competitiveness); (iii) e-health in 1.1 (resilient and effective health system, enhanced civil protection); (iv) intelligent transport systems (ITS) in 2.2 (sustainable transport); (v) smart metres, smart grids and water management in both 2.1 (climate neutrality, energy efficiency and renewable energy penetration) and 2.3 (smart and sustainable water management); as well as (vi) certain measures in 5.2 (labour market, social protection, social welfare and inclusion).

The plan includes one major multi-country project to further improve connectivity: a submarine link between Cyprus and Greece.

1 Human capital

1 Human canital	Cyprus		EU
I Human Capital	rank	score	score
DESI 2021	23	39.7	47.1



	Cyprus			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	50%	45%	45%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	19%	25%	25%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	54%	46%	46%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	3.2%	2.7%	3.1%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	19%	19%	18%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	26%	31%	25%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	2.7%	2.6%	2.9%	3.9%
% graduates	2017	2018	2019	2019

Cyprus ranks 23rd in the EU on Human capital, below the EU average. The basic digital skills of Cypriots remain below the EU average of 56%, with only 45% of people between 16 and 74 years having at least basic digital skills. 25% of the population have more than basic digital skills and 46% have basic software skills against EU averages of 31% and 58%, respectively. Although there has been some progress compared to 2019, the share of ICT specialists in the workforce is lower than the EU average (3.1% compared to 4.3%). Cyprus almost reaches the EU average of 19% with 18% of total ICT specialists. However the share of female ICT specialists in Cyprus has decreased since 2019. Furthermore, ICT graduates account for 2.9% of total graduates compared to the EU average of 3.9%.

Cyprus's 'e-skills Action Plan' prepared by the DMRID includes actions for integrating digital skills into the educational system and aligning educational curricula with industry needs. It also includes promoting STEM education and professional pathways to effectively address the market shortage in ICT professionals, as well upskilling and reskilling the workforce of both public and private sectors. This plan also promotes a lifelong learning culture and innovation by using and developing advanced digital tools.

The 'e-skills Action Plan' will be implemented by the DMRID in cooperation with various stakeholders from the public and private sector, academia and enterprises in a complementary way, laying the foundation for creating a digital academy.

The Cyprus Pedagogical Institute (CPI) of the Ministry of Education, Culture, Sport and Youth is implementing the 'Digital Competence Development for Educators programme'⁵³ aiming to strengthen and further develop teachers' digital competence. It promotes the effective use and integration of digital technologies in the teaching and learning process. The CPI plans to implement the programme during the next 4 school years, aiming to increase the number of teachers trained, with an estimated annual budget of EUR 100,000.

All secondary schools in Cyprus participated in the 2020 EU Code week, carrying out relevant activities. This initiative attracted some 3.5 million people who participated in over 70 000 activities in over 80 countries around the world. In 2020, Cyprus organised 51 activities, less than in 2019 due to the COVID-19 restrictions, and attracted 2 100 participants. These events saw a balanced share of male and female participants (51% female), with most held in schools (88%).

Cyprus launched several initiatives in vocational education and training (VET). Over recent years, Cyprus has aimed to improve the relevance of VET to labour market needs and boost its attractiveness. However, participation in upper secondary VET remains low. Cyprus has built new premises, upgraded equipment, modernised curricula and established new courses of studies to better meet the labour market's needs. The post-secondary institutes of technical education have received a new impetus and their graduates have high percentages of employability. Cyprus is also modernising its apprenticeship system, offering learning pathways with prospects for their students.

Cyprus is developing and promoting initiatives to boost digital skills. However, additional effort would be beneficial to further improve the capacity and relevance of VET and to promote VET as an attractive choice for both women and men. An additional boost for stepping up cooperation between academia and industry along with market needs would be beneficial, and research should feed into the process of creating new courses of studies. It is very important that school infrastructure is modernised and its digital capacity improved, while further support is provided to the National Skills Coalition in implementing actions to improve digital skills.

Highlight 2020: Single and Multi-Company Training Programmes

The Human Resource Development Authority of Cyprus (HRDA)⁽⁵⁴⁾ promotes the build-up of digital skills via a number of training programmes, outlined below, to improve and boost the ICT knowledge and skills of companies' employees.

- Single-Company Training Programmes aim to provide incentives to employers to design and organise in-company training programmes in order to meet the specific needs of the enterprise so as to effectively use its staff. In 2020, there were 463 participants in 52 programmes, with total expenditure amounting to EUR 116,000.
- Single-Company Training Programmes Abroad aim to provide incentives to employers to participate with their staff in training programmes abroad. During 2020, there were three participants in three training programmes in ICT and digital skills, with total expenditure amounting to EUR 8,000.
- Standard Multi-Company Training Programmes aim to provide continuing training through training programmes provided by certified public or private vocational training centres. Each vocational training centre may also accept unemployed people who are registered with the Public Employment Service. During 2020, there were 185

⁵³ <u>https://www.pi.ac.cy/pi/index.php?option=com_content&view=article&id=3149%3A2021-02-15-07-33-16&catid=34%3A2010-06-02-08-27-34&Itemid=65&lang=el</u>

⁵⁴ http://www.cea.org.cy/en/we_qualify/anad

participants (183 employees and 2 unemployed) in 20 training programmes in ICT and digital skills, with total expenditure amounting to EUR 98,000.

 High Priority Multi-Company Training Programmes aim to provide continuing training to meet the training needs of employees through training programmes in specific highpriority issues implemented by public or private vocational training centres. During 2020, there were 61 participants in three training programmes in ICT and digital skills, with total expenditure amounting to EUR 97,000.

Human Capital in Cyprus's Recovery and Resilience Plan

The development of digital skills is among the main objectives of measures in component 5.1 of the plan, which dedicates EUR 24 million to digital skills development. The measures planned include modernising primary and secondary education curricula, developing new educational material, training teachers, and making investments in digital equipment for schools. In parallel, Cyprus is in the preparation of a national e-skills action plan to boost digital skills across all population groups, including in public administration, enterprises and society at large.

2 Connectivity

2 Connectivity	Су	EU	
,	rank	score	score
DESI 2021	24	41.8	50.2



	Cyprus			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	85%	87%	92%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	2%	2%	3%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	<0.01%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	90%	100%	100%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	1%	10%	26%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	97.2%	99.6%	99.6%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	0%	67%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	74%	79%	79%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	37	42	69
Score (0-100)		2019	2020	2020

In Connectivity, Cyprus ranks 24th among 27 EU countries and is therefore below the EU average. It performs well in fast broadband (NGA) coverage (100%, ranked first, exceeding the EU average of 87%). Cyprus ranks also above the EU average in the overall fixed broadband take-up (92% against 77%). On the other hand, it still lags behind in at least 100 Mbps fixed broadband take-up, in VHCN coverage and in the broadband price index, where it ranks among the lowest in the EU. Concerning VHCN coverage, Cyprus showed a remarkable increase in 2020, from 10% to 26%. However, its VHCN coverage remains close to the bottom and well below the EU average (59%), and the take-up of at least 100 Mbps continues to stall at a very low level (3%)⁵⁵. Furthermore, Cyprus remains close to the bottom of the price ranking, being among the three most expensive countries in almost all baskets above 100 Mbps⁵⁶. In 2020, Cyprus scored 42 in the broadband price index compared to the EU average of 69. Cyprus's 4G performance is better, with coverage of 99.6%, more or less reaching

⁵⁵ A significant increase occurred in the fourth quarter with the percentage reaching almost 22%.

⁵⁶ The only exceptions are the 100-200 Mbps 2-play and 3-play baskets, where Cyprus is the fifth most expensive country.

the EU average (99.7%). Commercial use of 5G started in January 2021 (not yet reflected in the DESI figures)⁵⁷.

Cyprus is making progress in deploying VHCN and there is an increasing interest from the main operators to deploy fibre. According to Cyprus's national regulatory authority (OCECPR), it is estimated that in total 190 000 premises will be connected to the fibre to the home (FTTH) network of the incumbent operator (CYTA) until 2023, and it will cover approximately 300 000 premises (premises passed). Epic has already deployed a FTTH network covering a very small area in Nicosia and it plans to further expand its FTTH network within the urban boundaries of all the cities. Cablenet is also undertaking new deployments of fibre networks, while Primetel announced its intention to deploy fibre infrastructure too.

The Cypriot authorities are currently updating the national broadband plan for 2021-2025 and aim to have it ready by the end of 2021. Cyprus has already included in the Recovery and Resilience Facility (RRF) a series of investments and reforms and is also planning to submit proposals for CEF2 digital infrastructure funding in the next programme period. An important part of the new broadband plan is to expand the VHCN by using EU funding and focusing on digitally excluded, rural and suburban areas. At the same time, the socio-economic drivers such as schools, hospitals, research and business centres, universities, ports, airports, stadiums and other underserved areas with limited speed internet access, located throughout the country, will be connected to symmetric gigabit speeds.

Another major project is the deployment of submarine fibre cables connecting Cyprus to Greece as well as other non-EU countries. This project is expected to boost the capacity and resilience of the backhaul infrastructure in Cyprus and lead to reduced prices for high-speed broadband services, which will benefit end users, both through fixed and mobile networks. Meanwhile, Cypriot authorities implemented demand-stimulating measures as part of the 2019-2020 national broadband plan⁵⁸. Specifically, to increase the very low take-up of very high capacity connections, the Department of Electronic Communications launched in 2019 a 'Pilot' voucher scheme, using national funds, aimed at all people in Cyprus, which subsidised broadband connections of at least 100Mbps.

On 29 April 2021, Cyprus notified the Commission of its national roadmap for implementing the Connectivity Toolbox⁵⁹, in which it plans to review the existing national framework in order to implement fast track procedures for granting permits and higher transparency of information. This will include assessing the necessity of all the best practices included in the Toolbox.

All major operators are keen to invest in 5G, keeping in mind that national authorities have set concrete targets for awarding 5G spectrum. Currently, Cyprus scores 67% on the 5G readiness indicator as it has assigned the two pioneer bands (700 MHz and 3.6 GHz). The auction included the 3.4-3.8 GHz band and the 700 MHz band, but did not include the 26 GHz band because the market has not shown interest according to the Cypriot authorities. The main issue with the effective use of this band is interference from areas that are not under the effective control of the Republic of Cyprus. Cypriot authorities expect such interference to cease soon, in view of parallel migration from TV to mobile telephony use. This is, of course, a prerequisite for the effective use of the band. The

⁵⁷ The cut-off date for the data of this report was July 2020 and the cut-off date for the regulatory developments was 31 May 2021. During 2020, there were no 5G coverage in Cyprus. By the end of May 2021, CYTA managed to establish around 400 sites (adding 5G panels to existing sites) within the urban areas of Cyprus, in this way, with conservative calculations, covering over 60% of the population with 5G coverage.
⁵⁸ <u>https://dec.dmrid.gov.cy/dmrid/DEC/dec.nsf/All/D0C6BE2B00CDE23DC22584F5004B471A?OpenDocument</u>

⁵⁹ <u>https://digital-strategy.ec.europa.eu/en/policies/connectivity-toolbox</u>

reluctance of some local authorities to grant permits for antenna masts and delays in permitgranting procedures are other major challenges in developing 5G networks and services.

The main challenges to improving take-up of high-speed broadband persist, stemming from a number of factors including the lack of demand and the retail pricing structure adopted by the operators, according to the Cypriot authorities⁶⁰.

Main market & regulatory developments

Operators focus on bundling to gain a competitive advantage. They seek to offer packages that combine fixed telephony, mobile communications, broadband internet and pay TV with prime content, especially football. As a result, around 73% of fixed broadband subscriptions are part of a bundle, with the remaining 27% being single play connections. The most popular bundle remains fixed telephony and broadband access accounting for around 44% of the bundled services followed by fixed telephony, broadband access and IP/Cable TV that make up 30% of the bundled connections. Given the importance of prime content, three operators agreed to share football rights both for local and international games for 2020-2021.

In 2020, prices for fibre-based services charged by the incumbent fell considerably, providing a strong incentive for the transition from copper to fibre. In 2020, the cable provider upgraded all its available services to speeds over 100 Mbps without increasing its prices, which combined with the new FTTH offers had a positive impact on the take-up for high-speed broadband connections. The impact on the take-up for high speeds (\geq 100 mbps) was already visible by the end of the year with their market share being almost 22% compared to 3% in the middle of the year.

Concerning the transposition of the European Electronic Communications Code (EECC), the Department of Electronic Communications of the Deputy Ministry prepared a first draft of the amended national legislation concerning spectrum issues, which was submitted to a public consultation from 18 October 2019 to 27 November 2019. A new amended draft was prepared incorporating the comments received from the public consultation and was submitted to the state legal service for legal vetting. Following this, the final draft was approved by the Council of Ministers. It has been submitted to the Parliament for adoption. In parallel, OCECPR also prepared a final draft covering the areas of its responsibilities, which was forwarded to the Deputy Ministry of Research, Innovation and Digital Policy for approval. However, the national elections, which took place in May 2021, delayed the adoption of the new legislation.

Cyprus deployed a smartphone application and an SMS service allowing end users with disabilities to access the European Emergency number 112. However, it does not ensure yet non-voice 2-way communication and instant caller location. Cypriot authorities have committed to implementing these features and the Commission is monitoring the implementation of equivalent access for disabled end users in Cyprus.

Cyprus is making progress on rolling out VHCNs, as all main operators are seeking to deploy fibre networks. The expected updated National Broadband Plan, which includes targeted investments and reforms in connectivity, combined with the investments and reforms that will be funded under the RRF, will help the country meet the gigabit society targets, including connectivity targets. The multi-country project involving the deployment of submarine cables, including the connection with

⁽⁶⁰⁾ According to Statistical Service, the main reason for households not upgrading their internet connection to higher data transfer speeds is lack of need (83.6%), followed by high cost (52.6%).

Greece, would help Cyprus improve its international connectivity and positively affect broadband prices. Cyprus needs to transpose the EECC and adopt a pro-investment regulatory framework, which would further facilitate and speed-up the deployment of 5G and VHCNs.

Connectivity in Cyprus's Recovery and Resilience Plan

Component 4.1 of the plan (EUR 53 million) includes reforms and investments that aim to foster and facilitate the widespread deployment of VHCN, including 5G (wireless) and fibre. The reforms are expected to identify and remove the administrative bottlenecks, facilitating the rapid deployment of VHCN and investments by private operators. Investments support the build-up of VHCN in areas where there has been no private interest thereby addressing territorial disparities of broadband availability. The plan also includes a voucher scheme for individuals, to encourage the construction of their building internal cabling, for connection to VHCN. Furthermore, the installation of a high-capacity internet submarine link between Cyprus and Greece should further improve connectivity.

3 Integration of digital technology

3 Integration of	Cyprus		EU
digital technology	rank	score	score
DESI 2021	20	30.5	37.6



		Cyprus		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	49%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	35%	33%	33%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	37%	38%	38%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	5%	5%	6%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	14%	14%	22%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	NA	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	NA	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	11%	11%	13%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	12%	12%	15%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	6%	8%	5%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	9%	9%	9%	8%
% SMEs	2017	2019	2019	2019

On Integration of digital technology in business activities, Cyprus ranks 20th in the EU, but is making progress. Cypriot enterprises take advantage of technology capabilities using social media (38% compared to the EU average of 23%), while 15% of SMEs sell online (below the EU average of 17%). The adoption of new technologies is improving but still relatively low: 22% of businesses use cloud services (compared to the EU average of 26%) and 6% big data analytics (below the EU average of 14%). 41.2% of enterprises that recruited or tried to recruit ICT specialists had difficulties in doing so⁶¹. 49% of Cypriot SMEs have at least a basic level of digital intensity, scoring below the EU average of 60%. On electronic information sharing, Cyprus scores close to the EU average (of 36%) with 33%, while for e-invoices, with 13% Cyprus is far below the EU average of 32%.

In December 2019, Cyprus launched a programme to encourage SMEs to adopt digital technologies⁶². It aims to boost the digital identity of business, increase the number of SMEs that use information and communication technologies, including the e-commerce sector, and promote digital

⁶¹ https://digital-agenda-data.eu/datasets/digital_agenda_scoreboard_key_indicators/visualizations

⁶² https://meci.gov.cy/gr/sxediaxorigion

entrepreneurship. A total of 509 proposals were submitted, which would require a total of EUR 18.5 million in investments, corresponding to EUR 8 million in grants. The Ministry of Energy, Commerce and Industry is preparing the SME digital upgrade scheme⁶³, which aims to strengthen the degree of integration of digital technology in enterprises located or to be established in areas of Cyprus controlled by the Republic of Cyprus. The financial consists of providing public support of up to EUR 40,000 for the digital upgrade of existing or new SMEs.

In May 2019, the Council of Ministers adopted the 'Cyprus Industrial Strategy Policy⁴' for 2019-2030. This strategy highlights the digital transformation, focusing on the use of renewable energy and 'green products'. It addresses all sectors of the economy, including traditional industries and manufacturing, and is in line with the 'EU Industrial Policy Strategy: A Vision for 2030'⁶⁴. The strategy suggests taking action in six priority areas, three of which concern smart manufacturing, digitalisation and digital skills.

In January 2020, the government approved the national strategy on Al⁵, which the DMRID will implement. This strategy is built around four key pillars: (i) maximising investment through partnerships, (ii) creating national databases, (iii) nurturing talent and lifelong learning, and (iv) developing ethical and trustworthy AI. These pillars are in line with the key pillars set by the European Commission. In this context, Cyprus has developed an action plan to be implemented until 2026. Its main objectives include: (i) strengthening existing technologies through implementing various AI systems and solutions, (ii) enriching available data and data infrastructure, (iii) developing a legal framework for the widespread implementation of AI, and (iv) establishing international partnerships.

The DMRID has committed to providing funding to a proposal submitted by a Cypriot consortium under the 'Digital Europe Programme 2021-2027'⁶⁵ for developing a Digital Innovation Hub (DIH) in Cyprus. The DIH will serve as a one-stop shop to assist in the digital transformation of the private and the public sector through providing: (i) technological expertise and access to experimentation platforms, (ii) training and development of skills, (iii) networking opportunities, and (iv) support to find investments.

The National Blockchain Legislation has been prepared since early 2020 and is due to be completed by the end of 2021. The evaluation process for the National Blockchain request for interest (RFI) showed market interest and identified the most promising fields for Cyprus to reap the greatest benefits by incorporating this technology. A proposal was submitted in 2020 under the CEF Blockchain Call for establishing European Blockchain services infrastructure node(s) in Cyprus.

Apart from blockchain, Cyprus is committed to developing new advanced technologies and investing in them through EU-coordinated programmes and plans. This concerns, among other things, HPC⁶⁶, AI and quantum communication infrastructure. In 2019, Cyprus signed a declaration agreeing to explore, together with 24 Member States, how to develop and deploy a quantum communication infrastructure across the EU over the next 10 years.

To boost the digital transformation of the Cypriot economy, it is important to raise awareness among SMEs of the relevance of digitisation and how it relates to their needs, and to support the full

⁶³ https://meci.gov.cy/gr/sxediaxorigion

 ⁶⁴ https://op.europa.eu/en/publication-detail/-/publication/339d0a1b-bcab-11e9-9d01-01aa75ed71a1
 ⁶⁵ https://digital-strategy.ec.europa.eu/en/activities/digital-programme

⁶⁶ HPC: High Performance Computing. Cyprus hosts the 'Cy-Tera' institute which has the necessary know-how to upgrade and successfully operate a more powerful HPC capacity, and has extensive experience in HPC-powered applications. Cyprus has recently established its own National HPC Competence Centre.

implementation of the 'Cyprus Industrial Strategy Policy'. This will enable SMEs and entrepreneurs to reap the full range of benefits from adopting digital technologies.

Integration of digital technology in Cyprus's Recovery and Resilience Plan

The plan is expected to contribute to enterprises' digital transition, in particular SMEs (components 2.3 and 3.3 with EUR 10 million in digital). The measures aims to step up the adoption of digital technologies such as cloud, big data, blockchain and digital infrastructure. The plan also includes investments in the deployment of advanced technologies that will support the integration of digital technologies (components 1.1, 2.3, 3.3 and 3.4 with EUR 63 million in digital). This includes investments in smart cities to improve their infrastructure and eservices, and to boost community-driven economic growth, by implementing digital platforms and information systems. The plan envisages investments in civil protection (public warning system for supporting emergency operations through SMS), as well as in smart and sustainable

Finally, the plan under investment 2 (Innovation funding programmes & funding schemes for the enhancement of growth & competitiveness of start-ups, innovative companies and SMEs) of component 3.2 is expected to contribute to the growth and competitiveness of start-ups, innovative companies and high-tech SMEs. These programmes aim to support businesses, in many cases collaborating with research organisations, to develop innovative products and services with international orientation from concept to ready-for-market. Funding could be used for investments supporting the digital transition of enterprises.

water management.

4 Digital public services

4 Digital public	Cyprus		EU
services	rank	score	score
DESI 2021	19	61.8	68.1



	Cyprus			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	49%	58%	59%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	38	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	66	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	86	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	87%	78%
% maximum score			2020	2020

Cyprus ranks 19th in Digital public services. It performs well in digital public services for businesses, scoring above the EU average (86 against 84 of the EU). It also performs above the EU average on open data with 87%. However, the level of online interaction between public authorities and the general public is below the EU average, with 59% of Cypriot internet users actively engaged in using e-government services. Regarding pre-filled forms, Cyprus underperforms with a score of 38, well below the EU average of 63. Furthermore, in digital public services for citizens, Cyprus is improving, but it remains below the EU average of 75 with a score of 66.

The government is developing the national electronic identification (eID) scheme following the eIDAS Regulation⁶⁷. However, Cyprus has yet to notify an eID scheme to the Commission, which is a pre-condition for the cross-border recognition of national eIDs. With the establishment of a national scheme on eID following the eIDAS regulation, and of an electronic signature (e-signature), the public will be able to access and interact digitally with the government through the Government Gateway⁶⁸ simply through using their eID. The related legislation was adopted by the Parliament in April 2021.

The DMRID is working on the Digital Services Factory, a new delivery model for developing end-toend quality digital services where an 'Agile/Scrum' methodology⁶⁹ used for developing microservices will be applied, through redesigning and reengineering procedures, and following an approach that provides adaptability, response to change and is based on user experience.

Cyprus will follow a 'cloud native/cloud-first' policy approach. In this context, a cloud policy is under preparation, which will set the criteria for the data classification, data residency and the decision to

⁶⁷ The eIDAS Regulation on eID and Trust Services unlocks the digital single market. Its importance was in particular highlighted by the COVID-19 pandemic: https://ec.europa.eu/digital-single-market/en/discover-eidas

⁶⁸ https://eservices.cyprus.gov.cy/EL/Pages/Home.aspx

⁶⁹ A project management system that relies on incremental development

host and run government IT systems in a public cloud or a government private cloud (G-Cloud) environment.

Cyprus recognises that in order to boost interoperability and systems' interaction, a solid, secured, integrated and modern government digital architecture is key to achieving the transformation to a digital government and society. Consequently, the database of the Civil Registry Department and the Company Registrar Department are planned to be the single source of data for people and companies respectively.

On e-health, Cyprus is moving towards cross-border integration⁷⁰. Supported by EU4Health⁷¹ funds, Cyprus will become part of a secure peer-to-peer network that allows for the exchange of patient summaries and e-prescriptions via MyHealth@EU using the 'eHealth digital service infrastructure' (eHDSI). The objectives are to (i) align the Cypriot health infrastructure with the standards set by the European Commission for exchanging health data, across national borders within the EU, and (ii) provide interoperable e-health services. Cyprus is one of the signatories of the 'Declaration towards access to at least 1 million sequenced genomes in the EU by 2022' and part of the '1+Million Genomes' initiative⁷².

Improving digital public services is very important for Cyprus's digital transition. This will help digitally transform the economy in line with EU objectives and will step up the public administration's resilience, sustainability and efficiency. Therefore, it is very important for Cyprus to implement the policy in line with the national digital strategy together with the Reforms and Investments envisaged in its Recovery and Resilience Plan.

Digital public services in Cyprus's Recovery and Resilience Plan

Component 4.2 is dedicated to promoting e-government, a goal also envisaged by various other complementary measures of the plan (EUR 35 million). Component 4.2 includes reforms and investments for creating secure and quality digital services for the public, developing a government cloud, creating a modernised registry for companies (beneficial owners), and digitising central government services, including certain police services and the processes carried out in the Cyprus Ports Authority. Component 3.5 provides additional measures for digitalising public administration, e.g. the digitalisation of the tax and customs departments and the investment in a cloud-based IT system for the Cypriot Securities and Exchange (EUR 28 million). Components 3.1, 3.3 and 3.4 dedicate EUR 28 million to the digitalisation of public services and include measures for (i) strengthening e-justice, (ii) setting up a blockchain platform for local traditional foods and drinks, (iii) creating an information system for the Registrar of Companies, (iv) improving public procurement using an e-procurement tool, (v) digitally transforming the Law Office and courts and (vi) strengthening the e-system for issuing building permits. Component 5.2 includes the digitalisation of the social insurance system and the labour department and public employment services (EUR 10 million), while components 2.1 and 2.2 include investments in smart metering infrastructure, smart grids and Intelligent Transport System (EUR 21 million). Finally, component 1.1 supports the digitalisation of healthcare infrastructure and equipment, stepping-up e-health services, developing dedicated digital platforms for the healthcare staff and deploying cross-border interoperable ehealth services based on EU standards (EUR 10 million).

⁷⁰ Law on e-health (59(I)/2019).

⁷¹ https://ec.europa.eu/health/funding/eu4health_en

⁷² https://ec.europa.eu/digital-single-market/en/european-1-million-genomes-initiative







The Czechia ranks 18th of 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI), one place blow the ranking in 2020. Czechia keeps performing best on Integration of digital technology, where it ranks 15th in the EU.

The share of Czechs with at least basic digital skills is above the EU average and a quarter of Czech enterprises offers ICT training to their staff. The new updated school curriculum that increases the focus on digital skills could be of further help for people to acquire basic digital skills and improve the country's score on Human capital in the future.

Czechia remains a leader in e-commerce with a growing proportion of SMEs selling online. The government supports the necessary infrastructure, such as the Digital Innovation Hubs, and directly stimulates digitalisation of enterprises. The country also significantly improved its 5G readiness and the overall broadband take-up rose above the EU average.

The main strategies that steer the digital transformation of the Czech economy and society are *Digitální Česko*⁷³ (Digital Czechia) and the innovation strategy – *The Country for the Future*⁷⁴. Since the 2020 DESI report, the main milestones achieved were the launch of the bank identity, which should increase the use of digital public services, the reform of the school curriculum and an active participation of Czech representatives in major European technological initiatives such as EuroHPC or the European Digital Media Observatory.

A significant share of Czech enterprises still face major difficulties in finding digitally skilled workers. Though the share of digital experts among graduates is rising, it still does not match demand and many enterprises lack sufficient know-how or support to train their own employees or candidates. This hampers the competitiveness of the whole economy and slows down the digitalisation of

⁷³ https://www.digitalnicesko.cz/

⁷⁴ https://www.countryforfuture.com/projekt/inovacni-strategie-ceske-republiky/

enterprises. Additional action to re-skill the labour force and increase the offer of university programmes in advanced technologies could strengthen the impact of existing strategies and help the country tackle the lack of digital experts on the job market.

Digital public services are becoming more sophisticated but take-up remains low. Giving individuals and enterprises a clear purpose for using digital public services would help attract more users. This can be achieved by further improving service quality, enabling data sharing between institutions and by making the services interoperable, building up on the "once only" principle. The roll-out of very high-capacity networks remains slow. Not enough households and enterprises are able to access reliable super-fast internet. Broadband prices remain among the highest in the EU. Better targeted investments and a modernised regulatory framework (including the entry into force of the measures transposing the European Electronic Communications Code) could help address some of these issues.

The pandemic triggered a new dynamic in the digital transformation. Enterprises including SMEs started to consider a wider use of digital technologies, the education system moved completely online for several months and greater requirements were made on the digital infrastructure. The crisis also tested the resilience and reliability of digital public services. The government rolled out several new portals and IT systems to manage and coordinate vaccination, communication and data sharing (Tecka mobile app, open health data, central covid.gov.cz portal, etc.). Often, these services faced technical issues at the launch but over time they became more robust and became important tools to manage the pandemic.



Digital in the Czech Recovery and Resilience Plan (RRP)

Czechia's Recovery and Resilience Plan (RRP), with a total allocation of EUR 7.036 billion, puts a strong focus on digital transformation with a set of targeted reforms and investments. The plan allocates 22.1% of the total investment to digital policies (exceeding the 20% target) with relevant reforms and investments outlined in Components 1.1 to 1.6, 2.1, 3.1, 3.3, 4.5 and 5.2. The total measures in digital is EUR 1.56 billion.

Three main pillars of the plan are: digitalisation of enterprises (with a particular focus on SMEs), digital public services and human capital. In total, the plan contains 55 investments and reforms that will support Czechia's digital transformation.

On human capital, the plan is expected to boost digitalisation in the education system through curriculum reform, training for teachers and ICT equipment in schools. The plan will stimulate the creation of new university programmes and will roll out new re-skilling and up-skilling opportunities for job seekers and employees. These measures should contribute to the European Digital Decade strategy and will help the Czech population acquire relevant digital skills.

The plan is also expected to improve connectivity by updating the regulatory environment to roll out electronic communication networks and by investing in very high-capacity networks (VHCN). The plan puts a particular focus on remote regions. Czechia aims to stimulate the development of 5G infrastructure including along key transport corridors and to promote the use of 5G applications in cities or for industry.

The RRP is expected to help enterprises, in particular SMEs, start or continue their digital transformation. It includes a reform of the governance of digital transformation and contains measures to foster digital innovation and boost research in advanced digital technologies such as Artificial Intelligence (AI) or blockchain. The plan also aims to support entrepreneurship and the Czech start-up scene.

Czechia plans to increase the take-up of digital public services and to build a robust back-end infrastructure to enable data sharing between public institutions. The plan is also expected to provide a broader and more integrated set of e-health services and to strengthen cybersecurity of the critical information systems.

Czechia aims to use RRP to participate in a multi-country projects (MCP) in digital policy, including the important project of common European interest (IPCEI) on microelectronics and communication technologies as well as other multi-country projects: 5G corridors; Digital Innovation Hubs; European Blockchain Services Infrastructure and EuroQCI (quantum computing and quantum information).

1 Human capital



	2016	2017	2018	2019	2020	2021	
100 A							

	Czechia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	60%	62%	62%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	24%	26%	26%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	62%	64%	64%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	4.0%	4.0%	4.2%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	10%	10%	10%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	25%	25%	25%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	4.5%	4.9%	5.0%	3.9%
% graduates	2017	2018	2019	2019

Czechia ranks 15th on Human capital in the EU, one position lower than in 2020. 62% of Czechs have at least basic digital skills and 26% have advanced digital skills. The share of individuals employed as ICT specialists has risen to 4.2% but remains under the EU average (4.3%). The gender gap in technology remains the largest in the EU with only 10% of ICT specialists being women (EU average: 19%). 25% of enterprises provide ICT training to their employees, which is above the EU average of 20% and makes the Czechia a regional leader in this domain.

In October 2020, the Czechia adopted a new education strategy⁷⁵ that contains measures to foster digital skills for students and teachers and to bring more digital technologies to schools. The main milestone is the updated curriculum for primary schools (completed in 2021). Other measures include the implementation of the *Framework of Digital Competences of Teachers* and innovation in the VET system. To mitigate the impact of the pandemic and to foster primary education in advanced technological disciplines such as cybersecurity or robotics, the National Pedagogical Institute helped teachers, schools and parents with guidance and support materials via a new portal: koronavirus.edu.cz.

More than 200 000 people work as ICT specialists, nearly a third of whom live in Prague. This geographic concentration of digital expertise is a barrier to digital transformation outside the capital, notably in remote areas. The Czech labour market still does not provide enough ICT specialists to meet the demand from organisations and enterprises despite rising wages for this profile⁷⁶. 76% of

⁷⁵ The Strategy for the Education Policy 2030+: <u>https://www.msmt.cz/vzdelavani/skolstvi-v-cr/strategie-2030</u>

⁷⁶ <u>https://www.czso.cz/csu/czso/byt-ict-odbornikem-se-vyplaci</u>

enterprises that recruited or tried to recruit digital experts reported difficulties in filling these vacancies in 2020,⁷⁷ which is the highest proportion in the EU.

Czechia lacks a stand-alone strategy and concrete action to address this trend and help enterprises acquire the expertise they need. People in smaller cities especially lack sufficient opportunities to refocus their careers and retrain as digital experts. After the national Digital literacy strategy expired in 2020, the main documents that guide digital re- and up-skilling are the Strategic Framework of Employment Policy⁷⁸ until 2030, the National Artificial Intelligence Strategy⁷⁹ and the Digital Czechia strategy that remains too general in this domain. These documents provide general objectives, but lack specific action and a targeted effort to encourage a significant number of people (in particular employees) to re-skill and adapt to the transforming nature of work. Czechia uses EU and national funds to support projects to help people re-skill and upskill in preparation for the digital transformation. For example, DigiKatalog⁸⁰ aims to create a tool to offer self-evaluation, competence mapping and to recommend relevant training programmes to users. However, the impact of these programmes remains limited.

The government continues to support a higher participation of women in technology. The non-profit organisation *Czechitas*, which helps equip girls and women with digital skills and encourage them to go for ICT careers, is expanding to regions and in 2020 put on over 370 workshops and educational events. Despite these initiatives, about 90% of ICT specialists are men (the highest share in the EU).

The Czech National Coalition for Digital Skills and Jobs (DigiKoalice⁸¹) coordinated by the National Pedagogical Institute stepped up its activities in 2021 and increased support for teachers and schools to provide targeted solutions for remote education. It also helped parents with distance learning, mainly via tips and guidance on its Facebook page⁸². In May 2021, DigiKoalice had 245 members including several ministries, leading ICT enterprises, start-ups, NGOs, universities, foundations and other private and public-sector actors. Thanks to its close links with the public administration, DigiKoalice plays an important role in promoting and implementing digital skills policies.

Czechia remained an active contributor to EU Code Week, but the number of registered activities dropped by 40% to 141. This was due to schools being closed during the autumn wave of the pandemic. The Ministry of Education, Youth and Sport continues to support the initiative. Many of the workshops and coding sessions took place in Prague and in regional capitals.

The insufficient number of digital experts on the job market continues to slow the pace of digitalisation in Czechia. Although supply is improving, enterprises still struggle to find specialists in advanced disciplines. The government addresses these needs by supporting new university programmes and by issuing the updated school curriculum. These steps are appropriate but it will take several years to yield tangible results. More action to support the re-skilling of the labour force and encourage people to go for careers in technology would help enterprises find qualified workers or provide training to their employees.

Human Capital in the Czech Recovery and Resilience Plan

⁷⁷ <u>https://ec.europa.eu/eurostat/statistics-explained/index.php?title=ICT_specialists_statistics_on_hard-to-fill_vacancies_in_enterprises</u>

⁷⁸ <u>https://www.msmt.cz/vzdelavani/skolstvi-v-cr/strategie-2030?lang=1</u>

⁷⁹ https://www.vlada.cz/assets/evropske-zalezitosti/umela-inteligence/NAIS kveten 2019.pdf

⁸⁰ <u>https://digikatalog.cz/</u>

⁸¹ <u>https://digikoalice.cz/</u>

⁸² <u>https://www.facebook.com/DigiKoaliceSkolam</u>

Czechia's plan allocates EUR 369 million to improving digital skills, digital expertise and to offering upskilling and reskilling opportunities in the digital domain. The measures focus on reforming education, providing schools with digital equipment and providing new training opportunities for job seekers and employees.

On education, the plan is in line with the national education strategy and is expected to bring more IT, computer science and digital literacy classes into primary and secondary schools. It will also help teachers acquire digital skills to be able to explain digital technologies to pupils and use them as a tool across subjects. Most of the funds will be used to acquire ICT equipment for schools and pupils and to improve connectivity in schools, taking into account socioeconomic disparities and thus supporting implementation of the European Pillar of Social Rights. On tertiary education, the plan is expected to create better conditions for adaptation to digital learning and development of new university programmes (including in advanced digital technologies and industry 4.0) which could increase the share of ICT graduates and make more digital experts available to meet the needs of job market.

The RRP is expected to address other labour market needs by creating up-skilling and re-skilling opportunities for both employees and job seekers. By the end of 2025, 130 000 people are expected to benefit from training, upskilling and reskilling in digital and to acquire other skills needed in digital economy and industry 4.0. The plan aims to foster cooperation between the government and social partners to better react to the labour market's changing needs for digital skills.

2 Connectivity

2 Connectivity	Cze	EU	
	rank	score	score
DESI 2021	22	44.6	50.2



	Czechia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	74%	74%	83%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	18%	20%	24%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	0.37%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	90%	92%	97%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	28%	29%	33%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	99.4%	99.8%	99.8%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	17%	17%	67%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	64%	71%	71%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	56	59	69
Score (0-100)		2019	2020	2020

In 2020, Czechia saw only a modest increase in the percentage of households covered by fixed veryhigh-capacity networks (provided through FTTP) – up 33.3% from 29.3% in 2019. This puts the country below the EU average (59.3%). However, in the second half of 2020, the country carried out a significant upgrade of cable networks to DOCSIS 3.1, which is not yet reflected in the DESI figures. FTTP coverage in rural areas remains at a much lower level – only 6.4% of rural households were covered by the technology in 2020. This is well below the EU average of 24.9%. In terms of take-up of at least 100 Mbps fixed broadband, 24% of households subscribed to this type of broadband connection in 2020, an insignificant increase from 20% of households in 2019. This indicator also places Czechia below the EU average (34%). Take-up of at least 1 Gbps broadband is practically nonexistent, with fewer than 0.01% of households subscribing to such speeds. The overall fixed broadband take-up, however, is above the EU average (83% of households compared to 77% in the EU). This is despite the fact that its broadband price index is 59, below the EU average of 69. No Czech households had 5G coverage in 2020.

The Czech government approved the National Plan for the Development of Very High Capacity Networks on 1 March 2021. The plan focuses on building the infrastructure for socioeconomic drivers as well as on covering white spots. It aims to provide access to download speeds of at least 100 Mbps, with the option to upgrade to 1 Gbps for all households and access to minimum gigabit speeds (symmetrical) for enterprises, state administration, local self-governments and

socioeconomic entities. Its ambition is also to ensure an optimal development of 5G networks in all urban and rural areas and along the main transport corridors. As such, the National Broadband Plan is in line with the 2025 Gigabit Society targets.

The Czech authorities estimate that the investment gap to roll out fibre connectivity to all municipalities and address points in Czechia totals CZK 13.7 billion (about EUR 532 million). The investment needs are expected to be covered by support under multiple EU funds, including the Integrated Regional Operational Programme, Connecting Europe Facility, Digital Europe and Invest EU.

In its Roadmap for the Implementation of the Connectivity Toolbox⁸³, the country identifies as desirable a number of reforms, for example to bring in permit exemptions and fast-track procedures for network deployment, to promote the use of electronic permit application processes and of the parallel conciliation mechanism in the event of disputes over access to infrastructure.

Czechia has assigned 66.7% of the harmonised radio spectrum for the purposes of 5G deployment, which is above the EU average (52.7 %).

The Czech national regulatory authority, the Czech Telecommunication Office (CTU), announced the completion of the auction of the 700 MHz and 3.4-3.6 GHz frequency bands on 13 November 2020. Five operators won spectrum, paying a total of CZK 5.6 billion (EUR 211 million). The incumbent operators O2, T-Mobile and Vodafone obtained most of the available frequencies. In terms of the main obligations resulting from the auction, the operators that gained frequencies in the 700 MHz band will be required to satisfy a range of 5G coverage criteria phased over 10 years (such as coverage of 100% of TEN-T core and the comprehensive network within six years, coverage of 70% of the Czech population within five years and coverage of 99% of the population of each district and 90% of the area of each district within 10 years. The operators that obtained frequencies in the 3.6 GHz band will need to build 230 5G base stations in at least 30 districts as of five years following the auction. O2 will be obliged to provide national roaming access to its networks to the eligible entities by 30 June 2029. The Czech authorities decided not to use the peer review process under Article 35 of the European Electronic Communications Code before organising the auction.

For the 26 GHz band, a public consultation organised in 2019 demonstrated the lack of demand.

Main market & regulatory developments

In October 2020, PPF Group (the majority owner of Czech fixed infrastructure incumbent CETIN and the retail service provider O2 Czech Republic,) announced that it had completed the acquisition of Central European Media Enterprises Ltd (CME). CME owns TV content providers in the Czechia, Romania, Slovakia, Slovenia and Bulgaria. It is also one of the leading media and entertainment organisations in central and eastern Europe. As a result, the Czech market could be affected by the combination of telco services (CETIN, O2) and content services (CME).

Czechia did not transpose the provisions of the European Electronic Communications Code (EECC) by the deadline of 21 December 2020 – it is one of 24 Member States that are currently subject to an infringement procedure for failure to transpose the Directive. The legislative works on measures to transpose the EECC were close to being finalised at the time of drafting

⁸³ Pursuant to Commission Recommendation (EU) 2020/1307 of 18 September 2020 on a common Union toolbox for reducing the cost of deploying very high-capacity networks and ensuring timely and investment-friendly access to 5G radio spectrum, to foster connectivity in support of economic recovery from the COVID-19 crisis in the Union, OJ L 305, 21.09.2020, p.33.

this report. However, the entry into force of the measures is not expected until 1 January 2022.

On 27 February 2020, the Commission registered a notification from the CTU concerning the Czech fixed and mobile termination markets⁸⁴. The draft measures concern the wholesale call termination on individual public telephone networks provided at a fixed location (market 1, case CZ/2020/2239), and wholesale voice call termination on individual mobile networks (market 2, case CZ/2020/2240). Based on its market analysis, the CTU found that all fixed and mobile operators have significant market power (SMP) on the termination markets. It therefore imposed price and non-price obligations on all operators. Regarding price regulation, in November 2020 the CTU imposed a maximum fixed termination rate (FTR) of CZK 0.033 /minute and a maximum mobile termination rate (MTR) of CZK 0.248 /minute for calls originated within the European Economic Area (EEA) and terminated in Czechia.

The European Commission communicated its comments to the CTU in March 2020. It noted that the regulated FTR and MTR had not been updated since the previous notification in October 2016. The Commission noted that, given the technological and economic changes on the European electronic communication markets, it was unlikely that the proposed rates correctly reflect the efficient cost of termination services. It also noted that the proposed FTR is the sixth highest and the proposed MTR is the third highest in the EU. The Commission encouraged the CTU to explore all options to update the termination rates with reasonable effort.

The market situation (including coverage data) may also be affected by the activities of entities other than telecommunication undertakings, such as non-profit organisations.

Regarding emergency communications, the Czech authorities still do not provide access to emergency communications via SMS for roaming end users, which is particularly important in light of the equivalency requirements for end users with a disability under EU law. The government was seeking a technical solution to provide this access at the time of drafting.

Though Czechia's performance on fixed and wireless connectivity remains below the EU average, the strategic direction of the government is focused on making ambitious connectivity investments. It is important that the government ensures that the regulatory landscape is favourable to the projected advances in connectivity. Swift entry into force of the measures transposing the European Electronic Communications Code is particularly urgent.

Connectivity in the Czech Recovery and Resilience Plan

Component 1.3 of the plan outlines reforms and investments in connectivity, with a total budget of around EUR 227 million. Investments in VHCNs target remote areas where marketbased solutions are not profitable. 23,000 new units should gain access to Gigabit connectivity by 2026. The measures planned are expected improve digital technical maps, connectivity quality monitoring and bring in legislation to facilitate broadband deployment. The reforms and investments are in line with the EU Gigabit objectives and with the Common EU Toolbox for Connectivity.

Component 1.3 aims to develop the 5G ecosystem for 5G technology on transport corridors,

⁸⁴ Corresponding to market 1 and market 2 in Commission Recommendation 2014/710/EU of 9 October 2014 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with the Framework Directive (2014 Recommendation on Relevant Markets) (OJ L 295, 11.10.2014, p. 79).

including cross-border sections. The RRP foresees equipping 350 railway wagons with repeaters or passive walls for 5G signals. The plan is expected to stimulate research in 5G applications, in particular for the automotive sector. 5G should also be rolled out to remote regions.

3 Integration of digital technology

3 Integration of	Czechia		EU
digital technology	rank	score	score
DESI 2021	15	39.1	37.6



	Czechia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	59%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	NA	38%	38%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	13%	20%	20%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	8%	8%	9%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	16%	16%	20%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	40%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	56%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	14%	14%	12%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	23%	28%	29%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	18%	21%	18%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	12%	15%	15%	8%
% SMEs	2017	2019	2019	2019

The Czechia ranks 15th in the EU on integration of digital technology in enterprises' activities. Digital transformation of enterprises is slowly progressing. 59% of Czech SMEs have achieved a level of at least basic digital intensity, slightly below the EU average (60%). The country remains among the European leaders on e-commerce. 29% of SMEs sell online and 15% sell across borders. The share of e-commerce in the turnover of SMEs has fallen to 18% but remains well above the EU average (12%). The use of big data analysis (9% of enterprises) and cloud services (20%) remains below the EU average (14%, 26%). The use of e-invoicing (12% of enterprises) is the second lowest in the EU. By contrast Czechia has the highest share of enterprises in the EU that use AI (40%, EU average: 25%). According to the World Robot Federation, Czechia is the world's 15th largest market for industrial robots⁸⁵.

Czechia follows several strategies that steer digital transformation of the economy and society. The main ones are Digital Czechia⁸⁶ (adopted in 2018), the innovation strategy Czech Republic: The

⁸⁵ <u>https://ifr.org/ifr-press-releases/news/record-2.7-million-robots-work-in-factories-around-the-globe</u>

⁸⁶ <u>https://www.digitalnicesko.cz/</u>
Country for the Future⁸⁷ (adopted in 2019) and the National AI strategy⁸⁸ (2019). Digital Innovation Hubs (DIH) play an important role in the digital transformation of enterprises. They offer resources and capacities to SMEs to develop and test products before large-scale production and introduction to the market, they provide services and advice related to the use of available digital infrastructure and support regional innovation ecosystems. Czechia has eight fully operational DIHs and an additional four are in preparation. Six of the existing hubs have been appointed to join the European DIH network.

Czechia is an active member of most of the key European digital initiatives. The country contributes to the EuroHPC through the National Centre IT4Innovations in Ostrava, which has upgraded its laboratories, offers new programmes for SMEs and will invest nearly EUR 15 million in a new supercomputer with the performance of 15,2 petaFLOPS. Czechia is also involved in the European Blockchain Service Infrastructure, Quantum Communication infrastructure and Czech authorities support the development of an AI excellence centre in Prague focused on security for society.

According to a study⁸⁹ by CERGE-EI⁹⁰ and the Confederation of Industry, the share of Czech enterprises with a digital strategy has risen from 36.9% in 2019 to 41.9% in 2020. The Czech enterprises that invest in automation, robotics and AI are gaining a tangible competitive advantage in productivity and are offering services and products with a higher added value. The study also warns of the slow pace of adoption of digital technologies by small and medium enterprises compared to large enterprises.

The Industry Barometer⁹¹ confirms that the pandemic significantly boosted interest in digital technologies among enterprises and organisations – 27% of enterprises plan to increase investments compared to 2020. A survey by the Ministry of Industry and Trade⁹² shows that the priority investment fields for SMEs are data and cybersecurity in the next year and automation in the longer term. According to this survey, the lack of information on funding, insufficient expertise and reluctance of managers are the main barriers preventing more enterprises, in particular SMEs, to undergo digital transformation. The government is preparing additional support to overcome these obstacles.

The *Start-up Report 2019-2020*⁹³ shows that 54% of Czech start-ups focus on B2B (business-tobusiness) solutions. The most popular fields are e-commerce (22% of start-ups), web services (19%) and big data and analytics (15%). 30% offer products and services also in another country. The government supports start-ups through a network of 15 innovation centres and incubators endorsed by CzechInvest. However, considerable bureaucracy remains the main issue for young innovative enterprises. In 2021, Czechia joined other 23 EU Member States and signed the declaration for the Start-up Nation Standard⁹⁴ to implement good practices to support the start-up scene. The Czech

⁸⁷ <u>https://www.countryforfuture.com/</u>

⁸⁸ <u>https://www.vlada.cz/assets/evropske-zalezitosti/umela-inteligence/NAIS_kveten_2019.pdf</u>

⁸⁹ <u>https://www.spcr.cz/pro-media/tiskove-zpravy/14125-firmy-ktere-zavedly-technologie-prumysl-4-0-jsou-produktivnejsi</u>

⁹⁰ Center for Economic Research and Graduate Education – Economics Institute based in Prague.

⁹¹ <u>https://www.ncp40.cz/files/barometr-ceskeho-prumyslu.pdf</u>

⁹² <u>https://www.mpo.cz/assets/cz/podnikani/male-a-stredni-podnikani/studie-a-strategicke-</u>

dokumenty/2021/3/Strategie-podpory-MSP-v-CR-pro-obdobi-2021-2027.pdf – Page 56, Chart 11 ⁹³ <u>https://www.startupreport.cz/</u>

⁹⁴ <u>https://digital-strategy.ec.europa.eu/en/news/24-eu-member-states-commit-digital-day-take-action-</u> <u>support-growth-eu-startups</u>

video gaming industry continues to grow with 118 active studios and overall sales of 5.32 billion CZK (nearly EUR 210 million) in 2020, which is 17% more than in 2019⁹⁵.

Czech enterprises responded to the pandemic by taking it an opportunity to accelerate their digital transformation. The government provided the necessary infrastructure, such as DIHs or offered direct support, also thanks to EU funds, e.g. the Operational Programme Entrepreneurship and Innovation⁹⁶. But the main problems persist: enterprises do not have access to sufficiently skilled workers and digital experts, they need advice on how to digitally transform and the legal framework has not yet been adapted to reduce the administrative burden and foster innovation. Removing these barriers would stimulate the digital transformation of the Czech economy and society.

Integration of digital technologies Czechia's Recovery and Resilience Plan

Components 1.4 and 1.5 contain the majority of measures to support the digitalisation of enterprises and further integrate digital technologies in the economy and society. The measures are mutually re-enforcing and are likely to trigger long-term structural change. The allocation to digital arises to nearly EUR 53 million for Digital-Related investments in R&D, EUR 403 million for Digitalisation of businesses and EUR 170 for Investment in digital capacities and deployment of advanced technologies.

- 1. Digital infrastructure and management. The plan anticipates investment in quantum communication infrastructure, a new AI excellence centre and the European Blockchain Service Infrastructure. SME owners and managers are expected to get access to training on digital transformation, a new digital media observatory hub aims to help tackle disinformation and Czechia plans to create an institute to analyse and monitor the digitalisation of the economy. The plan also includes measures to improve the certification of new digital technologies and strengthen cybersecurity (Component 1.2), in particular of critical infrastructure such as healthcare.
- 2. Support for innovative enterprises and the start-up scene. The RRP is expected to foster entrepreneurship and stimulate digital innovation. It aims to pilot co-investment funds to support university spin-offs and pre-seed investments. The plan is expected to create regulatory sandboxes and to help Czech start-ups expand across borders. The Rise-up Programme aims to support technological enterprises to develop medical and non-medical solutions for the post-COVID era. The plan is also expected to support research and innovation in the aviation industry with potential spill-over effects in other sectors. The plan also aims to support the creative economy through digitalisation of cultural institutions and creative voucher scheme.
- 3. Digital innovation hubs and SMEs. Czechia plan to use the RRP to complement funding for the DIHs from the DIGITAL Europe programme. These centres are expected to provide support and infrastructure to enterprises allowing them to test new technologies and better manage the digital transformation. Czechia also aims to set up

⁹⁵ <u>https://www.lupa.cz/aktuality/ceske-hry-loni-utrzily-5-3-miliardy-pomohl-covid-cesi-vydali-58-titulu-182-se-jich-chysta</u>

⁹⁶ <u>https://dotaceeu.cz/cs/fondy-eu/kohezni-politika-eu/operacni-programy/op-podnikani-a-inovace-pro-konkurenceschopnost</u>

the European Reference Testing and Experimentation facility. Under the plan, the country is expected support digital transformation of 377 enterprises, mostly SMEs.

4 Digital public services



		Czechia		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	61%	61%	64%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	45	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	71	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	76	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	72%	78%
% maximum score			2020	2020

Czechia ranks 20th in the EU on Digital public services. The country climbed 2 places to the 20th position in the EU ranking compared to 2020. The share of e-government users amongst internet users reached 64% and is now in line with the EU average. However, other indicators remain below the EU average. In particular the score on pre-filled forms is 18 points below the EU average.

Following the national digitalisation strategy *Digital Czechia*⁹⁷, the government is adopting new legislation to offer higher quality and more secure digital public services. The new National Cybersecurity strategy (2020)⁹⁸ builds additional, more advanced state capabilities and mechanisms to provide cybersecurity services, especially for public administration and for critical infrastructure. The new law on the digitalisation of healthcare⁹⁹ should create three core data registers and secure applications that will enable access and work with the health data.

An important milestone to achieve user-friendlier access to digital public services was the launch of the bank identity as an authentication mechanism. Over five million Czechs who use internet or mobile banking will be able to access e-government services using their bank log-in.

As of 2020, approximately half of all 7 000 public information systems were linked with an interconnected data pool that allows public authorities to exchange data and enable the 'once-only' principle. To comply with the law introducing the right for digital services¹⁰⁰, the government developed the Catalogue of e-government services. Existing e-government portals, such as the central public administration portal¹⁰¹ with its transactional Citizen's portal¹⁰², the tax portal¹⁰³, the

¹⁰⁰ <u>https://www.zakonyprolidi.cz/cs/2020-12</u>

⁹⁷ https://www.digitalnicesko.cz/

 ⁹⁸ <u>https://nukib.cz/download/publikace/strategie_akcni_plany/narodni_strategie_kb_2020-2025_%20cr.pdf</u>
⁹⁹ In June 2021, the law was adopted by the government and discussed in the Parliament.

¹⁰¹ https://portal.gov.cz/

¹⁰² https://obcan.portal.gov.cz/

social security services portal¹⁰⁴, and portals for the regions and municipalities¹⁰⁵ are constantly being improved. In March 2021, the number of registered users on the Citizen's portal rose to 114 900 (up from 45 500 in January 2020) with 542 000 accesses to digital services using electronic identification.

However, the non-governmental initiative *Reconstruction of the State* (Rekonstrukce státu) ¹⁰⁶ points out that measures such as the catalogue of services or the Citizen's portal remain incomplete. The organisation also stresses that public procurement of IT has not yet been reformed, the Office of the Chief Architect of e-government ¹⁰⁷does not yet have clearly defined competences and public institutions do not have the necessary expertise to manage major IT tenders. As a result, state IT systems often end up in a state of 'vendor lock-in', tend to be expensive and do not always achieve the highest level of quality.

The e-gGovernment Benchmark 2020¹⁰⁸ places Czechia in the category of 'unexploited egovernment', signalling that the administration offers a range of digital public services, but only few individuals and enterprises use them. The report also underlines a significant gap in the quality of digital public services provided at national and regional level. The consistency of information about digital public services provided by the authorities is an issue. In 2019, when the government claimed to offer 100 services on the Citizen's portal, monitoring by the Supreme Audit Office¹⁰⁹ found that only 29 public services that could be used by any citizen were actually available and interest in using them was limited.

During the pandemic, the government in cooperation with several members of Parliament launched a central user-friendly portal¹¹⁰ that explained the restrictions and measures in an understandable way, based on real-life situations. The open data portal¹¹¹ launched by the Ministry of Health to inform the public about the pandemic, vaccination, hospital capacity and testing helped healthcare professionals and journalists track the spread of the disease and progress with vaccination. The e-Rouška mobile application contributed to tracking infections and 1.6 million people registered on it. After few technical problems around the launch, the vaccination registrations portal¹¹² also proved useful. However, experts and organisations criticised the government's slow roll-out of these online tools.

Digital public services in Czechia are improving and people and enterprises have new channels to access and use them. In 2020-2021, the government rolled out several useful online tools to help manage the pandemic. However, people and enterprises are only slowly starting to use these digital public services and their quality often varies. The government is aware of the low take-up and the main issues. By focusing on improving the current portals, simplifying user environment, maintaining common structure, increasing data sharing and interoperability, making IT procurement more efficient and implementing modern architectural designs to enable the once-only principle, Czechia will improve the use and popularity of its e-government solutions.

¹⁰³ <u>https://adisspr.mfcr.cz/pmd/home</u>

¹⁰⁴ <u>https://eportal.cssz.cz/</u>

¹⁰⁵ <u>https://mesta.obce.cz/</u>

¹⁰⁶ <u>https://www.rekonstrukcestatu.cz/download/3nQolg/nedigitalni_cesko.pdf</u>

¹⁰⁷ <u>https://archi.gov.cz/</u>

¹⁰⁸ <u>https://digital-strategy.ec.europa.eu/en/library/egovernment-benchmark-2020-egovernment-works-people</u>

¹⁰⁹ https://nku.cz/assets/kon-zavery/k19014.pdf

¹¹⁰ <u>http://covid.gov.cz</u>

¹¹¹ <u>https://koronavirus.mzcr.cz/</u>

¹¹² <u>https://registrace.mzcr.cz/</u>

Highlight: Bank ID – simpler access to digital public services

For many years, Czechia has faced the issue of low digital public service take-up. At the same time, the share of population using online or mobile banking has been among the highest in the EU. The banks and their client-centric approach have earnt a high level of public trust. The government has worked together with the Czech Bank Association to enable people to log in by using their Bank ID¹¹³ when accessing e-government systems and portals. The objective was to increase trust in digital public services and bring them closer to people. Nordic countries such as Sweden and Estonia were the inspiration for this approach.

Czechia adopted legislation allowing the use of Bank ID in early 2020 and most of the main banks joined in Q1 2021. In June 2021, already 3.5 million users (third of population) had registered in the system. Bank ID provides a simple way to access e-government services such as the Citizen's portal or tax declaration. It also enables users to e-sign documents or send prefilled forms. Enterprises can use the system to communicate with public administration. In the future, Bank ID could also be used to access utility (electricity, gas and telecommunication) systems and other service providers such as e-shops. The use of Bank ID is free of charge, secure and user-friendly. The Czech legal community awarded the legislation introducing Bank ID as the best and most inspirational law from 2020.

Digital public services in Czechia's Recovery and Resilience Plan

Czechia plans to invest EUR 334 million from the RRF in digital public services. The main measures are described in Components 1.1, 1.2 and 1.6 of the plan.

The plan envisages building a robust back-end infrastructure to link multiple public administration IT systems. The upgraded core registers are expected to facilitate data exchange between institutions and strengthen the 'once-only' principle. Czechia will focus on e-health solutions with improved data sharing between healthcare providers and stronger cybersecurity. The RRP also plans to support digitalisation of and new technologies for railway infrastructure.

The plan also outlines action to upgrade or create new front-end portals (for individuals, for justice matters, healthcare and for entrepreneurs) that are expected to make digital public services more user-friendly and interoperable. Single log-in interfaces and more pre-filled forms are expected to increase the number of e-government users. The number of digital public services for individuals and enterprises should also increase. Czechia plans to set up specialised competency centres to guide and advise in the process of public sector digitalisation. The plan also contains measures to aid publication and a wider use of open data. It is expected to lead to a significant increase (from 23 to 100 by 2024) in the volume of publically available datasets.

Czechia aims to use the RRF to digitise the construction permitting procedure and thus contribute to the general reform that should shorten the whole process, which has been an obstacle both for individuals and for organisations.

¹¹³ https://bankovni-identita.cz/

	Ger	many	EU
	rank	score	score
DESI 2021	11	54.1	50.7



Germany ranks 11th out of 27 EU Member States in the Digital Economy and Society Index (DESI) 2021. Germany performs relatively well in broadband connectivity, although deployment is affected by a shortage of planning and building capacities, and an urban-rural digital divide persists. It is a leader in 5G readiness and is second in the EU in overall fixed broadband take-up. However, although its performance in fixed very high-capacity network coverage improved (from 33% to 55.9%), it remains below the EU average (59.3%). On Human capital, Germany scores above average on almost all indicators (except the share of female ICT specialists). At least basic digital skills and at least basic software skills are widespread in the country, but a lack of ICT specialists still persists. This shortage also affects the Integration of digital technology by businesses. Less than a third of enterprises (29%) share information electronically and only 18% of SMEs issue e-Invoices. In both indicators, the country has not improved much over recent years. As for Digital public services, there is an overall improvement in performance. However, continuous efforts, e.g. to ensure the interoperability of the services provided, are necessary. In November 2018, the Federal Government published its implementation strategy 'Shaping Digitalisation'. As Germany is shifting its focus to implementation of the strategy, the progress achieved is monitored in the digital dashboard 'digitalmade-in.de.' A closely coordinated, targeted approach focused on implementation efficiency could further increase the impact of the numerous digitalisation measures. In addition to that, in January 2021, the Federal Government adopted its first Data Strategy. With over 240 measures, the Data Strategy aims to improve the innovative use of data and data sharing and covers, for example, data infrastructure, use of data and data competency.

With the Corona Recovery Plan 'Fighting Corona Consequences, Securing Prosperity, Strengthening Future Capability', which was adopted in June 2020, the German Federal Government is investing EUR 130 billion in a wide variety of measures to deal with the economic effects of the COVID

pandemic. Several measures were dedicated to digitalisation in the following areas: public administration, culture, forestry, learning, mobility (such as shipping), artificial intelligence, quantum technologies, 5G, fibre roll-out, smart cities, digital sovereignty, and modernisation of hospitals. Some of these measures were taken up in the Recovery and Resilience Plan that Germany submitted to the European Commission on 28 April 2021.



Digital in Germany's Recovery and Resilience Plan

With a total budget of up to EUR 26.5 billion¹¹⁴ (Germany receives EUR 25.6 billion under the Recovery and Resilience Facility, with the difference financed by national funds), Germany's Recovery and Resilience Plan is going to further support the economic recovery, including through significant investments in digitalisation (the 20% digital target¹¹⁵ is largely exceeded, as the contribution to digital objectives accounts for more than 50% of the planned allocation), decarbonisation of industry and climate-friendly mobility.

The plan includes two important multi-country projects on digitalisation: the Important Project of Common European Interest (IPCEI) Microelectronics and Communication Technologies, and the IPCEI Next Generation Cloud Infrastructure and Services (IPCEI-CIS).

Germany aims to address its main digital-related challenges with the Plan.

- Digital skills are addressed in the Component *Digitalisation of education* by investments in teacher terminal equipment, an education platform, education competence centres, and modernisation of the educational institutions of the Federal Armed Forces.
- Digitalisation of businesses and the development and integration of advanced digital technologies are addressed in part by the Component *Digitalisation of the economy*, with a significant focus on the automotive industry: the vehicle manufacturer/supplier investment programme, and measures on Building continuing education and training networks and the Centre for Digitalisation and Technology Research for defence. Additionally, the Component *Data as a raw material of the future* includes a measure on innovative data policy and the two IPCEIs.
- Digitalisation of public administration, which makes up more than half of the investments on digital in the Plan, is supported by measures in the Component *Modern*

¹¹⁴ This is the net amount excluding value-added tax.

¹¹⁵ At least 20% of the total spending under the national RRPs should be digital.

public administration, with projects on European identity ecosystem, implementation of the Online Access Act and modernisation of registers. Moreover, the Component *Strengthening social participation* includes a measure improving the access to information about pension rights for citizens through a digital platform. The Component *Digitalisation of the economy* includes a measure supporting the digitalisation of the rail. The Component *Strengthening a pandemic-resilient health system* includes two relevant measures: the digital and technical strengthening of the public health service and the Future Hospital Programme. In addition, the Component *Reducing barriers to investment* contains reforms aimed at facilitating and speeding up public investments.

1 Human capital

				Human capital
1 Human canital	Ger	many	EU	60
I Human Capitai	rank	score	score	40
DESI 2021	7	55.2	47.1	20
				Germany EU

2016	2017	2018	2019	2020	2021

		Germany		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	68%	70%	70%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	37%	39%	39%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	70%	72%	72%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	3.9%	4.0%	4.7%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	17%	17%	18%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	30%	32%	24%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	4.7%	4.9%	4.5%	3.9%
% graduates	2017	2018	2019	2019

For Human capital, Germany ranks 7th out of 27 EU countries and is thus above the EU average. Levels for both at least basic digital skills and at least basic software skills are well above the EU average, and Germany ranks fourth on these two indicators. Almost a quarter (24%) of enterprises provide ICT training to their employees. Female ICT specialists account for 18% of ICT specialists, slightly below the EU average. In Germany, 4.5% of all graduates are ICT graduates, much higher than the EU average of 3.9%. The proportion of ICT specialists in the workforce is above the EU average (4.7% versus 4.3%). Nevertheless, in some fields of ICT, Germany has a clear shortage of skilled workers. 66.1% of enterprises report hard-to-fill vacancies for jobs requiring ICT specialist skills (EU average 55.4%). Currently, the mismatch is particularly high regarding experts for informatics, software development and implementation, and IT specialists¹¹⁶.

In 2019, Germany adopted a National Skills Strategy¹¹⁷ under the leadership of the Federal Ministry of Labour and Social Affairs (BMAS) and the Federal Ministry of Education and Research (BMBF), and with the participation of 15 other partners, including social partners. The main aim of the National Skills Strategy is to improve continuing education and training and skills development. The recently published National Skills Strategy implementation report (June 2021)¹¹⁸ notes that a large number of the measures have been implemented. The creation of networks for continuing education and

¹¹⁶ https://statistik.arbeitsagentur.de/SiteGlobals/Forms/Suche/Einzelheftsuche Formular.html?nn=27096&to pic f=fachkraefte-engpassanalyse

¹¹⁷ https://www.bmbf.de/de/nationale-weiterbildungsstrategie-8853.html

¹¹⁸ https://www.bmas.de/DE/Service/Publikationen/a805-umsetzungsbericht-nationaleweiterbildungsstrategie.html

training is one example of the strategy's concrete measures. The networks support companies, especially SMEs, with training needs. Digital skills and competence in artificial intelligence (AI) are part of the programme. Another example is the innovation competition INVITE (digital platform for professional development) that the BMBF launched in April 2020. The selected projects support continuing education via digital platforms and content.

Digital skills development also plays an important role in other digital strategies, such as: the Shaping Digitalisation⁽¹¹⁹⁾ strategy, the Artificial Intelligence Strategy⁽¹²⁰⁾, the BMBF's digital strategy 'Digital future: Learning. Researchers. Knowledge.'⁽¹²¹⁾ and the MINT action plan⁽¹²²⁾. Additionally, in specialists, order to address the lack of ICT the Skilled Immigration Act (Fachkräfteeinwandungsgesetz (FEG), March 2021) introduces a work visa for IT specialists with significant work experience.

In 2020, as part of the AI strategy, the BMAS started the programme 'AI Hubs of Tomorrow'. One objective of the programme is to help employees to gain application-oriented competence in AI. For example, centres can provide consulting and analytical services on training needs or deploy learning concepts for the workforce of companies that want to use artificial intelligence.

In 2016, the BMBF launched the Special Programme on Digitalisation to help inter-company training centres modernise their training programmes. The programme, which was extended until the end of 2023, has a budget of EUR 224 million to provide state-of-the-art training.

In order to improve the digital infrastructure in schools, the funding programme DigitalPact School entered into force in 2019. In 2020, to address the challenges schools faced due to the COVID pandemic, the Federal Government increased its initial budget of EUR 5 billion by EUR 1.5 billion. With the additional budget, the scope of the initiative was expanded to also finance staff supporting technical services in schools and terminal equipment for pupils and teachers. In 2020, projects amounting to EUR 735 million were approved under DigitalPact School, and a tripling is expected in 2021.

Germany does not have a national digital skills and jobs coalition. The country participated actively in the 2020 EU Code Week, organising 966 events involving nearly 20 000 participants, of which female participation reached 45%⁽¹²³⁾.

Germany is focusing on digital skills in several strategies and has made significant investments in digitalisation of the education system. An increase in the share of ICT specialists shows that the efforts are showing some first results. However, it is important that Germany continues to focus on the lack of digital experts as there is a high unmet demand from industry.

^{(119) &}lt;u>https://www.bundesregierung.de/resource/blob/975292/1605342/284988700922725d63a0fb95db82402</u> <u>4/digitalsierung-gestalten-englisch-download-bpa-data.pdf?download=1</u>

⁽¹²⁰⁾ https://www.ki-strategie-deutschland.de/home.html

⁽¹²¹⁾ <u>https://www.bildung-forschung.digital/de/die-digitalstrategie-des-bmbf-2479.html</u>

⁽¹²²⁾ https://www.bildung-forschung.digital/de/mint-aktionsplan-3416.html

⁽¹²³⁾ <u>https://digital-strategy.ec.europa.eu/en/news/eu-code-week-organisers-register-over-72000-activities-</u> second-year-row

Human capital in Germany's Recovery and Resilience Plan

The German Recovery and Resilience Plan includes six measures that are entirely or partially linked to digital skills. They have a total digital budget of about EUR 1.8 billion. The measures mainly address challenges linked to education and some cover (further) training. Some of these measures are listed below:

- Teacher devices: the measure finances terminal equipment for teachers (net budget EUR 420.2 million) (part of the DigitalPact School mentioned above).
- Education platform: the measure establishes an education platform of online trainings and courses giving access to people in education and training (e.g. pupils, students, teachers, apprentices) (net budget EUR 529.4 million).
- Education competence centres: the measure establishes competence centres for teachers to improve their knowledge and skills on digital technologies and digital learning concepts e.g. for remote teaching (net budget EUR 172.3 million).
- Modernisation of the educational institutions of the Federal Armed Forces: the measure focuses on modernisation of the technical infrastructure of the educational institutions of the Federal Armed Forces, e.g. to enable remote teaching and working (net budget EUR 84 million).
- Building continuing education and training networks: the measure finances the establishment of training networks that support companies – especially SMEs – to develop trainings in relevant areas (e.g. digital competence) for their staff (net digital budget EUR 12.8 million).
- Support for apprentices: the measure aims at stabilising and increasing the number of apprenticeships, which decreased due to COVID-19. The measure also includes apprenticeships related to digital areas and apprenticeships that take place remotely and use digital technologies (digital budget EUR 290 million).

2 Connectivity

2 Connectivity	Ger	many	EU
,	rank	score	score
DESI 2021	6	58.0	50.2



		Germany		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	87%	88%	92%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	15%	21%	27%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	0.15%	1.12%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	88%	92%	95%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	9%	33%	56%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	97.5%	98.6%	99.7%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	33%	67%	100%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	18%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	79%	75%	75%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	75	75	69
Score (0-100)		2019	2020	2020

In 2020, Germany made progress on most connectivity indicators, ranking 6th in the composite overall indicator for connectivity. The speed of available broadband connections is increasing. From the perspective of a citizen coping with confinement under the COVID-related health crisis since March 2020, this is the most important trend. Germany has 95% coverage of fast broadband, providing a solid base for social and economic participation in society by digital means. Although rural coverage has significantly improved since 2019, from 75% to 81%, and is well above the EU average of 60%, Germany still has a clear *digital divide* between urban and rural areas. Compared with other Member States, Germany performs particularly well on 5G readiness, overall fixed broadband take-up and broadband prices. As to future trends towards, and preparedness for, the gigabit society, fixed VHCN coverage is at 56%, slightly below the EU average of 59%; it nevertheless increased substantially last year, mainly due to the one-off effect of upgrading legacy cable networks. In parallel, take-up of at least 100 Mbps fixed broadband had also increased significantly, without however fully matching the acceleration in VHCN roll-out. At the end of 2020, Germany had approximately 1.9 million fibre to the building/home (FttB/H) subscriptions up and running (up from

1.5 million at the end of 2019)¹²⁴ and 1.1% of German households subscribe to fixed broadband with a minimum capacity of 1Gbps. In the broadband pricing index (based on representative baskets of fixed, mobile and converged offers, adjusted for national household income levels), Germany ranks 8th in the EU.

Germany has almost reached the EU 2020 targets on Next Generation Networks: in June 2020, 94.8% of households had access to 30 Mbps or more. Cable operators are investing in DOCSIS 3.1, while the incumbent, Telekom Deutschland GmbH (TDG) has switched its focus to fibre roll-out. Germany is at the forefront in 5G, scoring 100% in the 5G readiness indicator, and has a 5G coverage of 18% of populated areas, above the EU average of 14%. 4G coverage¹²⁵ stands at 99.7%, which is the EU average.

The Federal Government aims at achieving nationwide gigabit connectivity by 2025. In April 2021, a funding programme started for the roll-out of 2.8 million fibre connections in ('grey') areas with connections of less than 100 Mbps (download). This is targeted at households and socio-economic drivers, more precisely schools, hospitals, SMEs, commercial districts, local administration and traffic hubs. Swedish investment company EQT and Canadian investment fund Omers took over 'Deutsche Glasfaser' and merged it with Inexio, which is expected to invest heavily in rural FttH roll-out. Private investors perceive the construction process in Germany as being slower and more expensive than in other Member States. There are efforts at the administration levels involved to accelerate the permit granting process and conditions. However, there is a persistent lack of available sites where massive infrastructure and towers can be built, and scarcity in civil works planning and building capacities limit further expansion of private and public investment.

Operators implemented dynamic spectrum sharing, a combination of LTE and 5G in selected spectrum bands, allowing fast roll-out and wide population coverage. Standalone 5G network introduction started in 2021, allowing for gigabit speeds and low latency. BNetzA, the national regulatory authority, identified the 6 GHz and 40 GHz bands that might be made available in the coming years for electronic communications services. By May 2021, BNetzA had granted rights of spectrum use in the 3.7-3.8 GHz band for 5G campus and industrial networks to about 120 entities and in the 24.25-27.5 GHz band to five entities. A EUR 1.1 billion federal funding programme has been established aiming at ('white') spots with no or only 2G coverage, addressing the profitability gap of new mobile sites in sparsely populated areas. In addition, some federal states provide funding.

Main market & regulatory developments

In 2020, the revenue of the telecommunications market stood at EUR 57 billion and decreased by slightly less than 1% compared with 2019; at the same time, there was a 7% increase in investment in telecommunications infrastructure, which stood at EUR 10.5 billion in 2020¹²⁶. In addition, there might be a long-term tendency towards consolidation of the fixed retail market, even if there are still many smaller players on the retail market. Since November 2020,

124

https://www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/DE/2021/20210519 Jahresbericht.htm ¹²⁵ BNetzA publishes an interactive map with actual 2G/3G/4G coverage per mobile network operator.

https://www.bundesnetzagentur.de/SharedDocs/Pressemitteilungen/DE/2021/20210519_Jahresbericht.htm

Telefónica has wholesale access to Vodafone's cable network and provides fixed broadband subscriptions to end users also via this network. This was part of Vodafone's commitments in the clearance procedure by the European Commission of its 2019 merger with Unitymedia.

In 2020, 5G services were launched commercially. All three established operators provide 5G services, at least in the biggest cities. The new mobile network operator (MNO) 1&1 AG finalised a national roaming agreement with Telefónica in May 2021. Tower companies play an increasingly important role. MNOs have mainly shifted their mobile site business to affiliated companies. In addition, independent companies are entering the market, most of them operating nationwide. Further newcomers (some from the energy sector) are expected. All MNOs have announced a 3G switch-off for summer/end 2021. With the 3G switch-off, the subscriptions of all remaining 3G customers will be transferred to 4G without additional costs. Only a few customers without a 4G compatible phone will have to change their hardware if they intend to continue using their phones for common data purposes. 2G is still available, so there are no problems expected for calls or SMS.

On 4 February 2021, the Commission opened infringement procedures against 24 Member States for failing to enact new EU telecom rules, more specifically the European Electronic Communications Code (EECC). The Commission sent a letter of formal notice to Germany. The 'Telecommunications Modernization Act' (*Telekommunikationsmodernisierungsgesetz (TKMoG)*) will implement the EECC. It was formally adopted in June 2021 and will enter into force on 1 December 2021. Among other things, the new law will strengthen end user rights for universal service¹²⁷ and increase the standards to be achieved by coverage obligations for MNOs. The possibility for landlords to charge for TV and broadband subscriptions as part of the rental contract will be gradually phased out.

In July 2020, BNetzA decided on the contractual conditions and obligations for access to TDG's local loops and fixed the one-off charges in September 2020. In December 2020, BNetzA mandated a standard offer for (layer 3) bitstream access to TDG's network. In June 2020, BNetzA approved TDG's prices for native Ethernet leased lines. In August 2020, BNetzA found that established MNOs had not fully complied with their coverage obligations of at least 50 Mbps per antenna sector for 98% of households. BNetzA set a deadline of end 2020 to achieve full compliance. By the end of 2022, at least 100 Mbps per antenna sector will have to be achieved. Coverage will have to include 98% of households, motorways, major highways and railway lines. A range of other traffic lines will have to be covered by end 2024. A new market analysis established the (continued) existence of significant market power of mobile operators on their respective network-wide wholesale markets for call termination and the existing obligations (interconnection, non-discrimination, transparency and licensing obligations) had been retained. Price regulation will be revoked upon applicability of the Commission delegated act.

In its roadmap¹²⁸ to implement the Connectivity Toolbox¹²⁹, Germany referred, among other things, to activities assessing mobile network technologies and roll-out strategies as to their

¹²⁷ In 2020, there were 1 100 cases of end users submitting enquiries to BNetzA relating to different legal and practical aspects of basic telecommunications services.

¹²⁸ <u>https://digital-strategy.ec.europa.eu/en/library/connectivity-toolbox-member-states-develop-and-share-roadmaps-toolbox-implementation</u>

environmental impact, to a nationwide electromagnetic fields (EMF) measuring campaign, and to the new public company MIG¹³⁰ that supports access to physical infrastructure.

There has been a decrease in the number of consumer complaints compared with the previous year. Issues became increasingly complex, partly as a result of technological developments. Around a quarter of all end user concerns relate to switching, followed by contract issues, service provision, disruptions and moves, transparency information, internet performance of telecoms providers, and invoices. In January 2020, BNetzA lowered wholesale prices for mobile number portability and fixed maximum end user charges for switching. Under the TKMoG, BNetzA will have to ensure that end users are no longer directly charged.

There remains an urban-rural digital divide regarding fixed NGA coverage and a shortage of planning and building capacities. Challenges on the markets are addressed by increasing private investment and public funding of network roll-out, both fixed and mobile. The share of fibre connections is increasing but starting from a low level of coverage.

¹²⁹ <u>https://digital-strategy.ec.europa.eu/en/news/connectivity-toolbox-member-states-agree-best-practices-boost-timely-deployment-5g-and-fibre-0</u>
¹³⁰ https://netzda-mig.de/

3 Integration of digital technology

3 Integration of	Ger	many	EU
digital technology	rank	score	score
DESI 2021	18	35.5	37.6



		Germany		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	62% 2020	60% 2020
3b1 Electronic information sharing	NA	29%	29%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	16%	23%	23%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	15%	15%	18%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	12%	12%	20%	26%
% enterprises	2018	2018	2020	2020
3b5 AI % enterprises	NA	NA	28% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	57% 2021	66% 2021
3b7 e-Invoices	17%	17%	18%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	19%	17%	17%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	9%	10%	11%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	11%	10%	10%	8%
% SMEs	2017	2019	2019	2019

Germany ranks 18th in the EU on Integration of digital technology in business activities. 62% of SMEs have at least a basic level of digital intensity, slightly above the EU average of 60%. Under a third of enterprises (29%) share information electronically and 18% of SMEs issue e-Invoices. Both indicators are much below the EU average (36% and 32%, respectively). 23% of enterprises use social media (same as the EU average) and 20% use cloud services (below the EU average of 26%). 18% of German enterprises use big data analysis, above the EU average of 14%. As regards AI technologies, 28% of German enterprises make use of them, exceeding the EU average of 25%, and 57% have a medium/high intensity of green actions through ICT (compared with 66% in the EU as a whole).

As part of the national SME strategy (*Mittelstandsstrategie*¹³¹), the national regulatory authority (*Bundesnetzagentur*) set up the new unit 'Digitisation & networking in SMEs' to actively accompany the digitisation process in SMEs. Activities focus on monitoring developments in the SME digitalisation process and on collecting and disseminating relevant information to SMEs and other

¹³¹ <u>https://www.bmwi.de/Redaktion/DE/Publikationen/Mittelstand/mittelstandsstrategie.html</u>

relevant stakeholders. Other activities include the provision of support to the ministry for the implementation of relevant digital funding programmes and acting as a central contact point for SMEs and foreign delegations.

Under the initiative SMEs Digital, a network of 26 Mittelstand 4.0 Centres of Excellence¹³² has been rolled out across Germany. These Centres of Excellence have been established to support SMEs in all matters related to digitalisation, spanning the entire value chain. In 2020, more than 65 000 SMEs benefited from the offers made by the Mittelstand 4.0 Centres of Excellence. Additionally, the Digital Now (*Digital Jetzt*) support programme stimulates SME investments in digitisation and IT security, including the skills of their employees.

The Digital Hub Initiative¹³³ of the Federal Ministry for Economic Affairs and Energy supports the establishment of 12 digital hubs in Germany. The underlying idea is that cooperation between companies and business start-ups within a small area will boost innovation. The hubs support SMEs on any issues relating to digitisation. Some of these institutions or consortia are keen to contribute to the European Digital Innovation Hubs network and have been selected for the national shortlist.

In December 2020, the Federal Government updated its national Artificial Intelligence Strategy (adopted in November 2018) focusing on five key areas: research; minds and expertise; transfer and application; regulatory framework; and society. As part of the German economic stimulus programme, the planned investments in artificial intelligence for the period up to 2025 have been increased from EUR 3 billion to EUR 5 billion. Strengthening information and consulting services on artificial intelligence for enterprises, especially for SMEs, is part of the strategy.

Since the adoption of the Blockchain Strategy in September 2019, almost 90% of the designated measures have been started and even partly completed. There are several important projects in the Federal Ministry for Economic Affairs and Energy (*BMWi*), such as the programme 'Showcase for Secure Digital Identities' (some EUR 85 million, until summer 2024) and the future-energy-lab that supports blockchain applications for energy. As part of its mFUND¹³⁴ research and innovation initiative, the Federal Ministry of Transport and Digital Infrastructure (*BMVI*) is funding several research and development projects on blockchain applications related to data-based innovation for Mobility 4.0.

The project GAIA-X entered its implementation phase and launched a funding programme on applications and data spaces in the GAIA-X ecosystem. The funded consortia will work on the development of data-driven business models and AI-based services by using the GAIA-X infrastructure.

In January 2020, the Federal Ministry of Education and Research (*BMBF*) launched 'Strategic Initiative Quantum Computing'. Under this initiative, R&D in quantum computing will be funded with up to EUR 300 million by 2025. The call 'Quantum processors and technologies for quantum computers' was published in April 2020. It addresses projects on next-generation quantum chips (some EUR 100 million). Additional calls focus on, for example, technology development, the exploration of potential use cases and the creation of research groups.

¹³² <u>https://www.bmwi.de/Redaktion/EN/Publikationen/Mittelstand/smes-digital-flyer.pdf?__blob=publicationFile&v=7</u>

¹³³ <u>https://www.de-hub.de/</u>

¹³⁴ www.mfund.de

Regarding cybersecurity, the German security research programme 'Self-determined and secure in the digital world 2015-2020' brings together national security research activities. The follow-up security research programme 'Digital.Sicher.Souverän.' (*Digital. Secure. Sovereign.*) was published on 2 June 2021 and has a budget of about EUR 350 million up until 2026. Regarding implementation of the Cybersecurity Competence Centre and Network Regulation, Germany is preparing to set up a National Coordination Centre.

The main barrier for digitalisation of enterprises in Germany is the need for investment. The lack of qualified personnel also contributes to this, because the training of employees has its costs. Although companies themselves are primarily responsible in this respect, the state can support this process by offering information and further training, especially for small and medium-sized enterprises, and by providing suitable framework conditions.

Integration of digital technology in Germany's Recovery and Resilience Plan

Germany's Recovery and Resilience Plan includes measures linked to the deployment of advanced technologies and R&D (EUR 3.36 billion) and to the digitalisation of businesses (EUR 1.17 billion) with a total budget of EUR 4.53 billion.

The relevant measures of the Plan are the following.

- The measure 'Vehicle Manufacturers/Supply Industry Investment programme' under the Component *Digitalisation of the Economy* will contribute to the digitalisation of production and the development of new innovative products in vehicle manufacturing (digital budget about EUR 1.6 billion).
- The Centre for Digitalisation and Technology Research will carry out several research and development projects related to digital technologies (e.g. robotics, artificial intelligence and cybersecurity). The Centre supports and promotes research, innovation and technology to strive for digital sovereignty as a possibility for independent selfdetermination for the state and organisations, thus reducing dependence on non-European technologies and knowledge (budget EUR 588.2 million).Cutting-edge technologies will be enabled by the Component *Data as raw material of the future*. The two multi-country projects — the IPCEI on Microelectronics (EUR 1.5 billion) and the IPCEI on Cloud (EUR 750 million) — will especially contribute to the digital sovereignty of the EU. The measure on Innovative data policy for Germany contributes to this pillar with relevant strategies (relevant net budget EUR 129 million).

4 Digital public services

				I	Digital public se	ervices	
4 Digital public	Ger	many	EU	80			
services	rank	score	score	60			
DESI 2021	16	67.5	68.1	40			
				20	Germany	EU	
				0 +	2017 2018 2	010 2020 2	0.21
				2010	2017 2018 2	.019 2020 2	.021
					Germany		EU
				DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government use	rs			61%	63%	69%	64%
% internet users				2018	2019	2020	2020
4a2 Pre-filled forms				NA	NA	42	63
Score (0 to 100)						2020	2020
4a3 Digital public servio	ces for cit	izens		NA	NA	72	75
Score (0 to 100)						2020	2020
4a4 Digital public servio	ces for bu	isinesses		NA	NA	88	84
Score (0 to 100)						2020	2020
4a5 Open data				NA	NA	88%	78%
% maximum score						2020	2020

Germany ranks 16th in the EU on Digital public services. For this, Germany's performance is quite mixed. It performs well and above the EU average in digital public services for businesses (with a score of 88) and open data (88%), but considerably below average for pre-filled forms (with a score of 42) and slightly below average for digital public services for citizens (by scoring 72).

In August 2017, Germany's 'Online Access Act' (*Onlinezugangsgesetz (OZG)*) was adopted. This obliges all German federal and state governments to provide online, by the end of 2022, all services for citizens and companies via public administration portals. This encompasses 575 public services at the federal and state/municipal level, of which 315 were already available online, to varying degrees, in May 2021.

A user-friendly digital administrative service requires reliable, interlinked register data. In March 2021, therefore, an important step was taken for the harmonisation of registers in Germany with the adoption of the 'Register Modernisation Act' (*Registermodernisierungsgesetz*). The act stipulates that administrative data can be assigned to the right person in a secure and data-protection-compliant manner with the help of a classification feature, the tax ID number. The first stages to develop this digital architecture are underway in order to use the tax ID number for important administrative services under the Online Access Act (OZG).

Germany has established and uses the Federal Cloud (*Bundescloud*), which provides automated IT services for federal authorities. Germany is currently working on the 'German Strategy for Federated Cloud Solutions in Public Administration', which was approved in October 2020. The aim is to enable secure cross-cloud usage of (open-source) applications in line with the principle 'build once, run everywhere'. It also targets the development of common standards and open interfaces for different federal cloud solutions.

Digitalisation of the German health system is based on the telematics infrastructure, allowing a secure exchange of medical data. A key application is the electronic patient file provided by health

insurance funds in several stages from 1 January 2021 onwards. People who are insured have access to their stored medical data not only in a medical practice, but also via a suitable mobile device (e.g. smartphone). Another important application is the e-prescription, which will be mandatory by 2022. For cross-border patient safety, the national e-health contact point will be established by mid-2023 so that insured people can also provide doctors in other EU countries with their health data in a secure and translated manner. Citizens in both metropolitan and rural areas have full access to telemedicine. The Digital Healthcare Act (2019) creates an obligation for statutory healthcare funds to promote digital health literacy.

In Germany, the Federal Academy of Public Administration (*BAköV*) is the central training institution for the federal administration. It organises training for all federal authorities. To improve digital skills training for federal staff, they will in future gather together all related training courses in a separate digital academy at BAköV.

The initiative Urban.Rural.Digital (*Stadt.Land.Digital*) of the Federal Ministry for Economic Affairs and Energy (*BMWi*) supports cities and regions in digitalising their services to make better use of new economic and social opportunities.

The Federal Government has taken several measures to advance the digitisation of public services and to make progress in implementing the OZG. These actions seem to translate into a first progress of the relevant indicators to the benefit of citizens and businesses. However, continuous efforts, e.g. to ensure the interoperability of the services provided, are necessary.

Digital public services in Germany's Recovery and Resilience Plan

The German Recovery and Resilience Plan includes measures that support the digitalisation of public services with a total budget of about EUR 7.1 billion.

Seven measures in the Plan are entirely linked to digital public administration and services:

- The measure 'European Identity Ecosystem' under the Component Modern public administration (net budget EUR 168.1 million) is designed to enable citizens to securely issue, transmit and deposit — and to transfer and use — proof of identity in a userfriendly and self-determined manner.
- Implementation of the Online Access Act, with a considerable net budget of EUR 2521 million, aims to digitalise the German administrative landscape. This is to enable a fully digital and user-oriented offer of public administrative services by the Federal Government, the Länder and municipalities.
- The measure 'Implementation of the modernisation of the register' (*Registermodernisierungsgesetz (RegMoG)*) (net budget EUR 231.1 million) aims at preventing citizens from having to resubmit their data and to submit evidence to different authorities by introducing a unique identification number.
- The digital pension overview under the Component *Social participation* (net budget EUR 28.8 million), aims to make it possible for all connected pension institutions to easily retrieve information about their own retirement provision, presenting the information in an understandable, reliable and comparable way.
- The measure 'Support for the digitalisation of rail' in the Component *Digitalisation of the Economy* aims at replacing conventional signposting and will boost the use of digital components in the railway sector (fast-track programme (*Schnelläuferprogramm (SLP*)) to speed up roll-out of 'Digital Rail Germany' (budget EUR 500 million).

• Two measures in the Component Strengthening a pandemic-resilient health system support the digitalisation of the health system: Strengthening the digital and technical resources of the public health service (net budget EUR 684 million) and Programme to future-proof hospitals (budget EUR 3 billion).

In addition, the Component *Reducing barriers to investment* contains reforms to accelerate public investments.

Highlight 2020-2021: Acceleration of the digitisation of health- and crisis-related services

Germany is currently implementing the Online Access Act (OZG), a programme responsible for digitising all administrative services. The Federal Ministry of the Interior manages the implementation. The aim is to make public administration digital, more efficient, user-friendly and safe to use. Due to COVID-19, from the beginning of April 2020, the digitisation of health-and crisis-related services was prioritised and their digitisation has been accelerated through a number of initiatives.

- Remote Express-Laboratory: online application for the reimbursement of loss of earnings due to quarantine or closing of schools/kindergarten because of COVID-19 (German Infection Protection Act), development and implementation in only 36 days: <u>https://www.ifsg-online.de</u>.
- Development of an online application for a 'COVID-19 bridging aid' for small and medium-sized businesses in only three weeks: <u>https://www.ueberbrueckungshilfe-unternehmen.de/</u>.
- Rapid digitisation of 'Unemployment Benefit II' for municipal job centres (the application is implemented in the portal of the respective municipalities).

	Den	mark	EU
	rank	score	score
DESI 2021	1	70.1	50.7



Denmark ranks 1st out of the 27 EU Member States in the European Commission's 2021 edition of the Digital Economy and Society Index (DESI). Denmark leads in Connectivity, ranks 2nd in Integration of digital technology and Digital public services and 4th in Human capital. Denmark has slightly improved its scores in all DESI dimensions, except for Connectivity which has improve significantly.

Danes have strong digital skills compared to other Europeans, but 30% of adults and 25% of the labour force still lack basic digital skills. The country's share of information and communications technology (ICT) specialists in the workforce and its share of ICT graduates are higher than the EU average. Nevertheless, 58% of Danish businesses trying to recruit ICT experts report hard-to-fill vacancies for jobs requiring ICT specialist skills (EU average 55%). Particular attention should be paid to the lack of ICT specialists (especially women) as it holds back the digitalisation of business.

Denmark ranks 1st in Connectivity. 94% of households are connected to very-high-capacity networks (VHCNs) and 70.1% to fibre. However, only 43% of households are subscribed to a broadband connection with at least 100 Mbps. 5G mobile-broadband coverage is one of the highest in the EU at 80% of populated areas. The country is committed to ensuring fast connectivity for all companies and the public and continues to make needed investment.

Most Danish enterprises are adopting digital technologies. 11.3% of Danish enterprises have very low levels of digital intensity, but there is a discrepancy between large enterprises (where only 2.7% have low levels of digital intensity) and SMEs (where 11.6% have low levels of digital intensity). More than half of Danish enterprises use e-invoices and cloud services, and a third use big data and social media. However, they lag behind in the use of artificial intelligence and ICT to make their business processes 'greener' and more environmentally friendly.

Denmark is also among the leaders in digital public services, with high levels of digital interaction by businesses and the public with all levels of government. The country has the highest rates of e-

government use (92% of internet users) and the highest score of all Member States on open data. It is also making progress on green public procurement.

In the spring of 2021, the Danish government launched a Digitalisation partnership. This partnership consists of experts from the Danish business and research community, civil society, trade unions, municipalities, and regions. The partnership will make recommendations to the government on how Denmark should: (i) use the opportunities of digitalisation; and (ii) consider the connections between the digital transition, welfare, equality, growth, and employment. By the end of 2021, the Danish government will adopt a new Digital strategy based on the group's recommendations. It is important that the new strategy is ambitious to move Denmark up to the next level of digital development and for the country to continue to be a digital front-runner.



Digital in Denmark's Recovery and Resilience Plan (RRP)

The Danish RRP budget is EUR 1.6 billion. The RRP's main aim is to support investment in the green transition to reach the target of lowering greenhouse gas emissions in Denmark by 70% by 2030. The RRP therefore channels 59% of its funds to green initiatives. Nonetheless, Denmark will still invest 25% (EUR 382 million) of the RRP in digital measures.

The largest share of the digital investments focuses on digitalising enterprises. Measures include tax deductions (EUR 232 million) for enterprises that purchase ICT equipment (e.g. robotics, 3D-printers and artificial intelligence) as well as grants to partly pay for advice, such as on how to develop enterprises' exports of electronic goods and services (EUR 9 million). A tax deduction is also planned for companies that invest in R&D in fields such as software, hardware, robotics and drone technology (EUR 59 million).

EUR 13 million is earmarked for improving broadband connectivity, and EUR 2 million is dedicated to new technologies and digital solutions in the health sector.

The main reform will be implementation of the forthcoming digital strategy (EUR 67 million), which will be adopted at the beginning of 2022. The expected level of ambition in the strategy is high. Denmark is determined to remain a digital leader in Europe. Four of the planned sub-reforms in the strategy will focus on further digitalising the public administration and preparing it for future challenges, including, inter alia, targets to increase public-private innovation partnerships, uptake of AI technologies in public sector and adopting a new cybersecurity strategy. The new strategy will also address the digitalisation of companies and the development of digital skills.



1 Human capital

	Der	nmark	EU
1 Human capital	rank	ccoro	ccoro
	rank	score	score
DESI 2021	4	61.2	47.1



	Denmark			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	71%	70%	70%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	47%	49%	49%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	72%	70%	70%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	5.1%	5.2%	5.5%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	20%	21%	22%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	28%	31%	30%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	4.8%	4.8%	4.9%	3.9%
% graduates	2017	2018	2019	2019

On human capital, Denmark ranks 4th out of 27 EU countries and is thus well above the EU average. 70% of the adult population has basic digital skills and 49% has above-basic digital skills – among the highest in the EU. Nevertheless, 25% of the workforce still lacks basic digital skills (EU average 36%). The proportion of ICT specialists in the workforce stands at 5.5% and only 22% of ICT specialists are female. The share of ICT graduates is stable compared to last years - one percentage point over the EU average. However, 58% of enterprises trying to recruit ICT experts report that it is hard to fill vacancies for jobs requiring ICT specialist skills (EU average 55%). Around a third of enterprises provide ICT training to their staff.

During the COVID-19 pandemic, all educational establishments were closed for 8 months to keep the spread of the virus under control. Schools could use established learning platforms. This meant a 200% increase in the use of online tools in education and an unprecedented load on the educational-network infrastructures supporting schools and higher education. To strengthen digital skills among teachers in higher education, the Ministry of Higher Education and Research allocated EUR 6 million in 2020 through nine projects¹³⁵.

The Danish technology pact, one of the initiatives included in the national growth plan, provides initiatives to improve skills in science, technology, engineering and mathematics (STEM). The Technology pact is a collaboration between the government, private companies, educational institutions, industry/trade organisations and trade unions. The pact funds a number of projects

¹³⁵ <u>https://ufm.dk/aktuelt/pressemeddelelser/2020/fremtidens-undervisere-skal-mestre-de-digitale-muligheder</u>

aimed at getting more women and girls interested in the STEM area, including IT. The pact also funded a number of projects aimed at getting more students to enrol in IT education and mentoring support to help students to complete an IT education in 2020.

In the national recovery programme, the government allocated EUR 16.1 million to create more places on courses of study of which a significant portion will be allocated to STEM programmes including IT programmes¹³⁶. This comes on top of the extra EUR 13.7 million allocated to increasing study places on STEM courses in December 2019¹³⁷. As a result, the intake in STEM education programmes increased by 9% (1 380 study places) at the 2020 summer intake compared to the previous year¹³⁸.

In June 2020, the national parliament agreed on a reform of the employment system with a budget of EUR 45.3 million in 2020-2023. As part of this agreement, everyone in the labour force will be given access to digital training and education. This had previously been reserved for people working in companies in 2020 and 2021, but is now also open for people who are working independently or who are not part of a company.

In 2021, a new set of initiatives to strengthen the Digital strategy was agreed upon by the Danish central government, the regions, and the municipalities. The purpose of this new set of initiatives is to continue working on achieving the main goals of the Digital strategy throughout 2021¹³⁹.

The Danish Digital Skills and Jobs Coalition is a multi-stakeholder partnership focused on tackling the digital-skills gap and promoting lifelong learning. Dansk IT is the organisation responsible for coordinating the Coalition's activities, initiatives, and projects on digital skills and careers in emerging technologies¹⁴⁰.

Only 5 out of the more than 72 000 EU Code Week activities were organised in Denmark in 2020¹⁴¹.

The level of digital skills in Denmark is high compared to the EU. However, the workforce is in need of upskilling and reskilling and there is a lack of digital specialists. Moreover, 3 out of 10 adults still do not have basic digital skills. Denmark is expected to tackle the digital-skills gap and address the shortage of technology specialists, especially women, with actions in the forthcoming new Digitalisation strategy (scheduled for release in autumn 2021).

Human capital in Denmark's Recovery and Resilience Plan

The Danish RRP recognises the digital skills gaps and aims to tackle them as part of a new Digital strategy, due to be released in autumn 2021. An expert group that includes representatives from the private and public sectors is developing recommendations for the strategy.

Two potential sub-reforms in the strategy touch on digital skills. The Strategy for the digital professions and jobs of the future may include actions to get more people with IT skills into the workforce. The 'Framework for a Denmark fit for a digital future' may include measures on

 ¹³⁶ <u>https://ufm.dk/aktuelt/pressemeddelelser/2020/rekordmange-er-optaget-pa-en-videregaende-uddannelse</u>
¹³⁷ <u>https://ufm.dk/aktuelt/pressemeddelelser/2019/udsigt-til-oget-optag-pa-stem-uddannelser</u>

¹³⁸ https://ufm.dk/aktuelt/pressemeddelelser/2020/rekordmange-er-optaget-pa-en-videregaende-uddannelse

¹³⁹ Kommunernes Landsforening.

¹⁴⁰ <u>https://digital-skills-jobs.europa.eu/en/about/national-coalitions/denmark-national-digital-skills-and-jobs-coalition</u>

¹⁴¹ <u>https://digital-strategy.ec.europa.eu/en/news/eu-code-week-organisers-register-over-72000-activities-</u> second-year-row

promoting both the teaching of digital skills in schools and digital skills for the public, businesses and public employees.

2 Connectivity

2 Connectivity	Den	EU	
,	rank	score	score
DESI 2021	1	74.0	50.2



	Denmark			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	82%	85%	85%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	28%	34%	43%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	1.26%	4.38%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	95%	96%	96%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	64%	93%	94%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	>99.9%	>99.9%	>99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	33%	33%	99%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	80%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	84%	87%	87%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	61	60	69
Score (0-100)		2019	2020	2020

In Connectivity Denmark ranks 1st out of all EU countries. There is excellent, fixed VHCN coverage of 94% of households, the third highest in the EU. Fibre coverage had reached 70.1 % overall and 70.9% of rural households by mid-2020. However, only 43% of households had taken up a broadband connection of at least 100 Mbps even though this is still above the EU average of 34%. On fixed-broadband take-up, 85% of all households subscribe to fixed internet access of some kind, slightly above the EU average of 77%. 4G coverage had already reached 100% of households in 2016, and Denmark has a joint-high coverage of 5G mobile and broadband at 80%.

In 2021, Denmark's digital focus will mainly be on how to ensure coverage with fast broadband to the remaining 4% of households and businesses that currently do not have it, and preparing Denmark for the internet services of the future, including by preparing for the roll-out of 5G.

Since 2016, the National Broadband Fund has provided State aid for the roll-out of VHCN in local communities, where there was no prospect of roll-out by the private providers in the market. Overall, the Fund's contribution has been modest compared to the massive roll-out by private-sector market players. However, the Fund has both offered grants to concrete community projects and generated new interest by broadband providers in offering local roll-out on market terms. This

synergy between the Fund and private-sector market operators has helped a number of underserved communities to get access to VHCN in recent years.

Local or regional (consumer-owned) utility companies have been rolling out fibre networks across the country, including in rural areas. From 2018 to 2019, total investments in the telecommunications sector increased by approximately 23%. Investments in fixed broadband rose by approximately 20%. As a result of an expected ambitious commercial roll-out of fixed broadband, a recent forecast estimates that 99% of all households and businesses will be covered with fixed VHCN broadband by 2025.

Fibre roll-out is progressing rapidly. The incumbent operator TDC is investing significantly in fibre roll-out. At the same time, the utility companies deploying fibre are also rushing to complete fibre roll-out in their regional areas.

In 2020, a number of these utility companies signed agreements with service providers opening their fibre networks to alternative operators. Three of the fibre networks – Norlys, Nord Energi and EWII – signed agreements that opened the networks up to between 4 and 6 service providers. A further three utility companies have concluded agreements that will give alternative operators access to their fibre networks from 2021.

Among others, the utility companies SEAS-NVE and NRGi have pledged to invest an additional EUR 619 million in 2019-2023 in fibre through their mutually owned broadband provider, Fibia. Norlys has pledged to cover all addresses in its supply area with high-speed fixed broadband before the end of 2023. Most of the addresses will be covered with fibre. In addition, a number of small (and in most cases local) providers of fixed wireless broadband are expanding their activities. These activities are typically in rural areas, where addresses are far apart. Some of the providers offer access to high-speed broadband with speeds of 100 Mbps or more.

Denmark now scores 99% in the 5G readiness indicator and ranks first on 5G mobile-broadband coverage (with 80% of households covered). The Danish Energy Agency is taking the necessary actions to ensure that enough spectrum is available in due time. The 700 MHz, 900 MHz and 2 300 MHz bands were auctioned in March 2019. All Danish operators (TDC, Hi3G and the Telia-Telenor joint venture TT-Netværket) were awarded spectrum in this auction, raising a total of EUR 296 million. The 700 MHz and 900 MHz licences entered into force in June 2020, while the 2 300 MHz band licences entered into force in April 2019. Thus, the new licence holders of 700 MHz were able to use the spectrum, complying with the deadline.

The final 5G auction was held at the beginning of 2021. The result of the auction, which raised EUR 279 million, was as follows:

- Hi3G won 40 MHz in the 2 100 MHz band, 120 MHz in the 3.5 GHz band and 1 000 MHz in the 26 GHz band;
- TDC Net won 45 MHz in the 1 500 MHz band, 40 MHz in the 2 100 MHz band, 40 MHz in the 2 300 MHz band, 130 MHz in the 3.5 GHz band and 1 250 MHz in the 26 GHz band;
- TT-Netværket won 45 MHz in the 1 500 MHz band, 40 MHz in the 2 100 MHz band, 140 MHz in the 3.5 GHz band (including 60 MHz with a leasing obligation), and 600 MHz in the 26 GHz band.

The winners must ensure a population coverage of 60% by the end of 2023 and 75% by the end of 2025 using the 3.5 GHz frequency band. Additionally, the winners must ensure mobile-talk and

mobile-broadband coverage of at least 30 Mbit/s download speed and 3 Mbit/s upload speed in a third of 122 local areas where mobile coverage is lagging behind.

Mobile operators such as TDC and Telia have carried out 5G tests and demonstrations using 3.5 GHz. Denmark made it easier to get access to spectrum for trials by acquiring a 5G trial spectrum licence, which could be obtained for EUR 81 as long as the associated frequencies were not used for commercial purposes. It was also possible to get time-limited licences for 3.5 GHz, which could be used for the commercial roll-out of 5G until the permanent licences were issued in May 2021 as a result of the completed auction.

From the industry's perspective, the leading operator TDC has revealed that a national 5G network has already been rolled out using both 700 MHz and 3.5 GHz. Telenor, Telia and Hi3G have already activated several 5G sites using 3.5 GHz. One mobile operator has already made its 5G network available for commercial access in major urban centres.

Network deployment is expected to continue in order to reach uninterrupted 5G wireless broadband coverage in all urban areas as well as major roads and railways by 2025 (and thus meet the goals mentioned earlier of 60% population coverage with the 3.5 GHz band by the end of 2023 and 75% coverage with the 3.5 GHz band by the end of 2025). National 5G coverage is expected by at least one operator in 2021. Another operator has indicated that it will ensure national 5G coverage by 2022.

Main market & regulatory developments

Market shares in the fixed-broadband market have overall been stable, showing only minor changes in the last year. TDC continues to have the highest share, but its share decreased from 49.5% at the end of 2019 to 44.8% at the end of 2020.

Legislative amendments to the existing laws to transpose the European Electronic Communications Code were passed by the Danish Parliament in early December, with entry into force on 21 December 2020. The Danish government issued the necessary executive orders, which entered into force by 21 December 2020. An administrative error in the reporting of the completion of the transposition was corrected to the European Commission on 11 February 2021, but the Commission had already initiated infringement proceedings. The infringement was closed the 15 July 2021.

In 2020, the Danish Business Authority (DBA) completed decisions on the wholesale markets for terminating voice calls in the mobile networks of Telia, Telenor, TDC, Hi3G and Lycamobile (Market 2). At present, the DBA is now working on new reviews of markets and has concluded that the wholesale broadband market should be divided into two sub-markets: Market 3HC – wholesale broadband market for access to high-capacity infrastructure (fibre and coax); and Market 3LC – wholesale broadband market for access to low-capacity infrastructure (copper). Also, the market definition implies that there are 21 geographical segmented sub-markets on the high-capacity market. The DBA is also working on market decisions on the market for wholesale call termination on individual, public telephone networks provided at a fixed location (Market 1 from the 2014 recommendation).

Denmark has already implemented most of the recommendations from the European connectivity toolbox, and is currently considering further implementation measures in civil works, mast sharing, and duct sharing.

In 2020, Denmark's Telecommunications Complaints Board saw a 15% decrease in the overall

number of complaints. The decline in complaints was especially visible in March-June and again in October. Although it is unclear why this was the case, there might be a connection to COVID-19 and uncertainty due to lockdowns, etc. Most of the complaints to the Complaints Board are over terms and conditions (about 30% of all complaints) and most of these complaints concern more than one service (bundled services).

Fixed-broadband and mobile-network coverage are significantly above the EU average. As Denmark overwhelmingly relies on private investments, decisions about regulated access to fibre networks resulting from the ongoing market reviews will be significant for investors.

The 5G spectrum auctions were completed at the beginning of 2021 and the roll-out of 5G continues at a good pace with one operator already having announced national 5G coverage.

Connectivity in Denmark's Recovery and Resilience Plan

The Danish RRP estimates that 6% of households and/or companies (corresponding to 100 000 addresses), still do not have high-speed-internet access. The Broadband Pool – a government fund to increase access to broadband – will spend EUR 13 million to cover this gap through investments in very high-speed (minimum of 100 Mbps coverage) internet access for the public, households and companies in rural areas across the country. Further national funding will be added to ensure full coverage and to top up the requested recovery and resilience funding.

3 Integration of digital technology

3 Integration of	Denmark		EU	
digital technology	rank	score	score	
DESI 2021	2	57.9	37.6	



	Denmark			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	88%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	40%	50%	50%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	29%	32%	32%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	14%	14%	27%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	41%	41%	57%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	22%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	54%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	55%	55%	57%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	31%	33%	38%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	17%	18%	20%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	9%	10%	10%	8%
% SMEs	2017	2019	2019	2019

Danish enterprises have embraced digital technologies, with Denmark ranking 2nd among EU countries for the integration of digital technologies. 88% of Danish SMEs and 97% of large enterprises have at least a basic level of digital intensity. On average, 57% of enterprises use cloud services and e-invoices, exceeding the EU averages. 50% of enterprises use advanced software for at least one of their business operations (electronic information sharing), and one third of them use social media and big data – well above the EU average. Danish enterprises lag slightly behind in the adoption of artificial intelligence (22% in Denmark, against an EU average of 25%). Only 54% of Danish enterprises report that ICT has helped them to take environmentally friendly 'green' actions to a medium or high level, which is the lowest in the EU. More than twice as many SMEs sell online in Denmark than the EU average. 20% of all Danish SMEs' turnover is the result of e-commerce. Only 10% of Danish SMEs sell cross-border (although this is still above the EU average of 8%).

The national SME:Digital¹⁴² programme is popular among Danish SMEs. This programme received additional public funds in 2020 to further promote the digital transition and e-commerce capabilities

¹⁴² https://smvdigital.dk/

of SMEs in 2021 and beyond. The programme has also extended its grant scheme to include subsidies to buy new hardware and software. More than 900 enterprises benefited from the programme in 2020.

The Virksomhedsguiden¹⁴³ platform guides enterprises on how to start, operate and develop their enterprises. It has played a key role in informing Danish enterprises about restrictions and opportunities throughout the COVID-19 crisis.

The publicly funded business development centre, and 14 consolidated clusters covering all of Denmark, support the integration and adoption of advanced digital technologies. Three of these clusters are dedicated to digitalisation¹⁴⁴, advanced manufacturing¹⁴⁵ and robotics¹⁴⁶. In addition, Denmark has proposed a consortium for the network of European Digital innovation hubs and is evaluating ways to integrate these hubs into national funding and structures.

In March 2019, the Danish government published a national strategy for artificial intelligence (AI)¹⁴⁷. It aims at putting Denmark at the forefront of responsible development of AI. The strategy includes 24 initiatives for which EUR 9.2 million was reserved by the Danish government for the period 2019-2027. In 2020, local government developed a tool kit for people that wanted to start AI projects. Local government also organised AI workshops focusing on knowledge sharing and joint development of AI-enhanced tools for work collaboration. The EUR 9.2 million budget was reprioritised in 2021 and lowered to EUR 5 million, mainly due to new political priorities and unexpected budget restraints. The government plans to re-evaluate the AI strategy in order to determine future actions in AI.

In 2018, the strategy for national collaboration on digital research infrastructure laid the foundation for Denmark's development of high-performance computing (HPC). In 2020, a group coordinating electronic infrastructure for several Danish universities, DeiC¹⁴⁸, announced its intention to set up four national HPC machines. The same year, DeiC invested EUR 3.8 million to achieve this goal, with financing from the Danish Ministry for Higher Education and Science and eight universities.

The Danish government has also earmarked funds for research into new models and tools to: (i) assess threats and bolster national digital infrastructure against cyber-attacks; and (ii) help improve the ability of authorities and enterprises to identify attackers. Five projects in cybersecurity and new technology have received funds of approximately EUR 2.22 million to conduct this research. The Danish Innovation Fund is also spending EUR 38.3 million on research into new technological opportunities including – among other subjects – IT security.

The Danish authorities continue to focus on: (i) ensuring the uptake and use of advanced digital technologies, and (ii) accelerating the digital transformation, especially in small enterprises to reduce the digitalisation gap between large and small enterprises.

Integration of advanced technology in Denmark's Recovery and Resilience Plan

Around 78% (EUR 300 million) of the digital measures in the Danish RRP are dedicated to the digital transformation of business and digital related R&D in entreprises.

¹⁴³ <u>https://virksomhedsguiden.dk/erhvervsfremme/content/</u>

¹⁴⁴ https://digitallead.dk/english/

¹⁴⁵ https://en.made.dk/

¹⁴⁶ https://www.odenserobotics.dk/

¹⁴⁷ https://knowledge4policy.ec.europa.eu/ai-watch/denmark-ai-strategy-report en

¹⁴⁸ <u>https://www.deic.dk/en</u>

Measures include tax deductions worth EUR 232 million for purchasing ICT equipment, e.g., robotics, 3D printers and AI. The intention is to encourage green investments in advanced and innovative digital technologies, excluding fossil-fuel driven machinery. The RRP also addresses the integration of technology in SMEs by giving national subsidies worth EUR 9 million to: (i) build up SMEs' digital capacities; (ii) support widespread use of advanced ICT; and (iii) promote export activities.

Moreover, tax deductions worth EUR 59 million will be given to companies to boost research and development in interdisciplinary digital fields of software, hardware, robotics, and drone technology.

4 Digital public services

4 Digital public	Denmark		EU
services	rank	score	score
DESI 2021	2	87.1	68.1



	Denmark			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	94%	94%	92%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	84	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	84	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	96	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	96%	78%
% maximum score			2020	2020

Denmark ranks 2nd in the EU in Digital public services. The country has the most e-government users in the EU (92% of internet users use e-government) and Denmark scores well above the EU average in all indicators under this dimension. On digital public services for citizens, the country ranks 10th, indicating there is still potential for improvement. On open data, Denmark has the highest score of all Member States.

Denmark launched several new successful initiatives in 2020 and 2021 to ensure that more public services are digitalised, user-friendly and accessible to all citizens and companies. Denmark is committed to continuing this effort of raising awareness among the public, businesses and authorities of the digital service offering. It is also committed to helping people not yet familiar with digital services to begin using them.

The Danish government has recently created a Digitalisation partnership. The participants in the partnership include CEOs and experts from business, industry, research, civil society, and trade unions. The aim of the partnership is to make recommendations on how Denmark can advance on the digital agenda in four keyways: (i) better service and a more efficient public sector; (ii) strengthening businesses through digital transformation; (iii) digital green initiatives; and (iv) ensuring a fair and equal society that is ever more digital.

The recommendations from this Digitalisation partnership will be included in the preparations for a new Digital strategy that will be published by the end of 2021. The new strategy will set out more ambitious goals for: (i) developing and improving digital welfare solutions for the benefit of businesses and the public; (ii) the effective use of data and new technologies in the fight against climate change; and (iii) the creation of better conditions for a more innovative and interconnected public sector.

From August 2021, Denmark will launch a new electronic identification (eID) tool called MitID ('my-ID'). The new tool has been developed to make the Danish eID infrastructure more future proof, secure and flexible. The system has been developed as a public-private partnership between the
Danish Agency for Digitalisation and Finance Denmark, the Danish bank association. Denmark has also worked to continue to ensure cross-border access to the Danish eID infrastructure. The national eIDAS node¹⁴⁹ for the current national eID system (NemID) has been operational since June 2018. There are currently over 70 services from public authorities connected to the node, and more are expected in the future¹⁵⁰. Work is continuing providing solutions for identity matching to allow cross-border users to use Danish public e-services with the help of the eIDAS node. Work is also progressing on supporting the national implementation of the single digital gateway.

Since November 2020, Danes have been able to download their driving licence in digital form via an app and leave their physical driving licence at home. The new driving licence was quickly adopted: there were more than 500 000 downloads in the 24 hours after release and it has now been downloaded over a million times. Additionally, in June 2021, Denmark launched a digital app-version of the Danish health-insurance card. Within the first month, the app was downloaded more than 1 million times.

During 2020, there was an increased focus on enabling non-digitally literate and semi-digitally literate Danes to access local and national digital infrastructure. Non-digitally literate people have access to help and guidance at their local Citizen Service Centre. In parallel, non-digital services are also available at these centres, to complement the digital services, ensuring accessibility and thus facilitating more inclusive public services.

Since 2018, operators in the Danish healthcare sector have joined forces and coordinated actions to better predict, prevent, detect and respond to cybersecurity and information-security incidents. A decentralised cyber and information security unit was set up in 2018 by the Danish Health Data Authority⁽¹⁵¹⁾ to coordinate the work.

Using ICT to deliver welfare services has for many years been a strategic focus in Denmark. This was reaffirmed in 2021 in the 'Digital health strategy 2018-2022⁽¹⁵²⁾. Denmark's nationwide implementation of tele-health relies on a well-developed national infrastructure based on international standards that facilitates data sharing and integration across the healthcare system.

In March 2021, the Danish Government and Danish regions updated the National strategy for personalised medicine. The focus of the strategy is to ensure coordination and direction to develop better and more targeted healthcare for patients, by using new technologies and knowledge. The overall aim is to establish a common, nationwide and more secure technological infrastructure for performing whole-genome sequencing and using genetic information in healthcare and research. The national budget (EUR 4 million a year) funds the National Genome Centre. The Novo Nordisk Foundation provided EUR 46.6 million for the establishment and operation of the National Genome Centre's infrastructure and to sequence the whole genome of 60 000 patients from 2020 to 2024.

Since April 2021¹⁵³, the new Danish life-science strategy includes an initiative to explore the potential for establishing a common, national analysis platform for so-called secondary use of health data. The aim is to help data users to access health data and other relevant data from different data controllers in a secure analysis environment with extensive storage and computing capacity (supercomputer facilities).

150 Danish Agency for Digitalisation

¹⁴⁹ Each Member State sets up a node i.e. an interface which communicates with other nodes to request or provide cross-border identification and authentication

⁽¹⁵¹⁾ https://sundhedsdatastyrelsen.dk/da/english

⁽¹⁵²⁾ https://sundhedsdatastyrelsen.dk/da/diverse/download

¹⁵³ https://sum.dk/nyheder/2021/april/ny-strategi-skal-loefte-dansk-life-science-op-i-verdensklasse-og-sikre-endnu-bedre-patientbehandling

The current Danish National strategy for cyber and information security (2018-2021) covers: (i) technological resilience to secure better protection of critical government IT systems; (ii) knowledge and skills among the public, universities, enterprises and authorities'; and (iii) national coordination and cooperation on information security. During 2021, the Danish government expects to launch a new national cyber security strategy with a continued focus on strengthening cyber security resilience in the Danish digital infrastructure.

Highlight 2020-2021: Digital-ready legislation

Denmark's public digital infrastructure and focus on developing 'digital-ready' legislation has shown its worth during the COVID-19 pandemic.

Denmark's focus on digital-ready legislation originates from a unanimous parliament decision in 2018. The decision aimed at simplifying legislation to promote automated digital processing of legal cases before the courts. Following the decision, the Danish Agency for Digitisation has worked to simplify unnecessary and complex legislation and ensure that new legislation is more easily understandable and digitally compatible. This will enable quick and seamless implementation of any new legislation.

One example of the benefits of digital-ready legislation was the way the central government of Denmark was able to process COVID-19 stimulus cheques for 2 million benefit recipients fully automatically in less than 8 days in the autumn of 2020.

At this point, more than 270 bills have been analysed by the Danish Agency for Digitisation's secretariat for digital-ready legislation before they were presented in the parliament. A course in digital-ready policymaking will be made available to legislative drafters and policy officers in government departments by the summer of 2021. These efforts will help to ensure that Denmark will continue to reap the benefits of digital public administration.

Digital public services in Denmark's Recovery and Resilience Plan

As part of its RRP, Denmark has sought to make its healthcare system more resilient by focusing on data management and digitalised patient treatments, such as tele-medicine, electronic patient records, and digital management systems (EUR 2 million is earmarked for spending in this area).

Denmark also intends to continue to develop its digital public administration, as part of the digitalisation strategy that will be adopted at the beginning of 2022.

	Est	onia	EU
	rank	score	score
DESI 2021	7	59.4	50.7



Estonia ranks 7th in the DESI 2021, with a score of 59.4 (higher of the EU average 50.7). The country is a front-runner in Digital public services, and performs very well on Human Capital. Estonia remains a medium performer in Connectivity and still lags behind in the deployment of 5G. Not all businesses in Estonia take advantage of digital technologies, although innovative start-ups are flourishing in the country.

The country will release soon its new digital strategy for the period until 2030. This new strategy will be the cornerstone of future digital developments in the country. It will encompass ambitious targets for digital development, with a strong focus on digital public services, connectivity and cybersecurity.

The country performs well on the digital skills of its population. With a relatively high score for basic digital skills, people in Estonia can benefit from increasingly digitalised government services and digital services more generally. In addition, the country is taking measures to: (i) strengthen advanced digital skills among its people; and (ii) upskill and reskill the working population to make sure the skills of the labour force are future-proofed. Estonia is nurturing its pool of Information and Communications Technology (ICT) specialists (who accounted for 6.5% of the active population in 2020) with an increased number of ICT graduates in 2020 compared to 2019. This population of ICT specialists contributes to the active and innovative tech ecosystem in the country.

On Connectivity, both fixed- and mobile-broadband take-up are high. Estonia has high overall coverage of fixed Very High Capacity Network (VHCN) connectivity, except in rural areas where additional investments are needed. The country lags behind in providing 5G commercial service because the spectrum resources necessary to operate 5G networks have not been allocated yet. Nevertheless, Estonia's ambition for 5G connectivity is to cover major cities by 2023 and transport

corridors by 2025. Estonia has not yet met the Gigabit Society¹⁵⁴ targets, and its ability to meet these targets will depend on the timely adoption of its digital strategy 2030 and the allocation of the 5G 'pioneer' bands.

On the Integration of digital technologies by businesses, significant potential remains untapped. Despite a very active start-up scene in the country, including some 'unicorns' (IT companies that are not yet listed on the stock-market, but which are privately valued at more than USD 1 billion), not all Estonian businesses are taking full advantage of digital technology and the online economy. Estonia needs to continue its efforts to better integrate digital technologies, particularly in Small and Medium-sized Enterprises (SMEs) and more traditional businesses.

On Digital public services, Estonia is already well-known for being a top performer in the digitalisation of its administration. It has well-developed e-government systems, with all central government functions and municipalities providing services online. Despite already being a frontrunner in this area, Estonia continues to significantly invest in its e-government services to make sure the country offers the latest technologies to its citizens. Similarly, the COVID-19 pandemic has also demonstrated that Estonia could take a leading role in Europe in implementing innovative solutions for e-health.





Digital in Estonia's Recovery and Resilience Plan¹⁵⁵

In the Estonian Recovery and Resilience Plan (RRP), EUR 208 million is devoted to digital objectives. This represents 21.5% of the total allocation, and thus exceeds the target of 20% set by the Regulation establishing the Recovery and Resilience Facility¹⁵⁶. The contribution to the digital transition comes mainly from two out of the six components of the plan, with a total of 13 measures addressing digital transformation in the country.

The contribution of Estonia's RRP to the digital transition focuses mainly on two priorities: (i) the digitalisation and further modernisation of public services, which will benefit from EUR 97.43 million in spending; and (ii) the digital transformation of enterprises, which will receive funding

¹⁵⁴ <u>https://digital-strategy.ec.europa.eu/en/library/connectivity-european-gigabit-society-brochure</u>

¹⁵⁵ At the time of writing, the plan was approved by the Commission and is pending adoption by the Council. ¹⁵⁶ REGULATION (EU) 2021/241 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 12 February 2021 establishing the Recovery and Resilience Facility.

of EUR 76 million. The plan also includes a smaller investment to improve broadband access in more remote areas of the country (around EUR 24 million) and actions to support the development of digital skills (EUR 10 million). More details on the digital aspects of the country's RRP are discussed in the bullet points below.

- The RRP's Component 3 'Digital State' (with an overall estimated budget of EUR 97 million for the digitalisation of public services) builds on the already successful deployment of digital technologies in delivering public services in Estonia. This component aims at making the delivery of public services more efficient. It also aims at making the underlying digital infrastructures and systems more resilient and sustainable.
- Component 1 'Digital transformation of enterprises' (overall estimated value: EUR 116.2 million) aims at fostering the digital transformation of Estonian companies and strengthening their competitiveness in export markets. This will target SMEs and micro-enterprises from all sectors.
- On digital connectivity, the support for deploying VHCNs in rural areas (part of Component 3 'Digital State' with a EUR 24.3 million budget) is expected to ensure broader access to online services. It is also expected to contribute to the further digital transformation of the country more generally.
- Amongst the measures supporting the digital transformation of companies in Component 1, Estonia plans to target EUR 10 million in spending to ensure the availability of sufficient ICT professionals with up-to-date skills and knowledge to help Estonian companies to seize the opportunities offered by the digital transition.

The Estonian RRP does not include any budget for participation in any Multi-Country Project, but includes a cooperation with Finland on one of the planned measures.

1 Human capital

1 Human canital	Est	onia	EU
i numan capitai	rank	score	score
DESI 2021	5	57.9	47.1



	Estonia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	60%	62%	62%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	35%	37%	37%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	61%	62%	62%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	5.7%	6.0%	6.5%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	22%	23%	22%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	13%	17%	17%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	7.4%	6.7%	8.0%	3.9%
% graduates	2017	2018	2019	2019

On Human capital, Estonia ranks 5th, making it one of Europe's leading countries for digital skills. With 62% of Estonians having at least basic digital skills, the country is comfortably above the EU average on this measure. On advanced digital skills, Estonia also performs well compared to other EU countries. In 2020, ICT specialists accounted for 6.5% of the employed population (EU 4.3%) and ICT graduates represented 8% of total graduates in 2019, significantly above the EU average of 3.9%. However, only 17% of Estonian companies provided ICT training to their employees in 2020 (the same percentage as in 2019), below the EU average of 20%. In Estonia, there is a slightly higher share of female ICT specialists than in the rest of the EU, although the gender gap remains wide: only 22% of ICT specialists are women (although higher than the EU average).

The consequences of the school closure provoked by the COVID-19 pandemic in Estonia was mitigated by good digital infrastructures in both general and vocational schools. People in Estonia were also able to rely on both a good level of digital skills among teachers and readily available educational materials that could be delivered digitally¹⁵⁷. Previous investments in digital educational infrastructure paid off during the crisis by helping the country's schools, students and teachers to adapt swiftly to new circumstances and teaching arrangements.

The education strategy 2035 will be approved by autumn 2021, and will be an 'umbrella' strategy for further modernising the Estonian education system. By 2035, it is expected that: (i) 90% of 16-24-year olds will have above-basic digital skills; and (ii) the share of the population with above-basic

¹⁵⁷ Explained by Heli Aru-Chabilan, Director for Internationalization, Estonian Education and Youth Board (https://futurescot.com/futurescot-live/edutech2021/)

digital skills will increase to 60% from the 37% in 2019. In addition, Estonia expects to train an additional 7 000 ICT specialists between now and 2027.

In 2020, the Ministry of Education and Research supported lifelong learning by focusing on digital skills training courses, based on the recommendation of the OSKA study¹⁵⁸. Moreover, to alleviate the effect of the COVID-19 crisis on the workforce, the Ministry offered online training to more than 11 000 people, of which a third participated in ICT-related training.

To tackle the shortage of ICT experts, the government took a number of measures. One such measure was the IT Academy¹⁵⁹, a cooperation programme between the government, universities and companies in the ICT sector. The IT Academy aims at raising the quality of ICT education and developing research in ICT. New masters programmes to train qualified ICT specialists were created, as were new Massive Open Online Courses (MOOCs) to give young people the right skills for future jobs. As part of the National Artificial Intelligence Strategy 2019-2021, Estonia's first masters degree programme in data science was initiated, and it is expected to educate 50 new highly skilled data-science specialists by 2023.

To reduce the gender imbalance in the ICT sector, the Estonian Ministry of Social Affairs is developing projects, supported by European funds, to increase the share of women among students and employees (including in managing positions) in the sector.

The Estonian National Digital Skills and Jobs Coalition was set up in 2017 and is currently coordinated by the Ministry of Education and Research and is under a major revamping.

Estonia has been an active participant in EU Code Week in recent years. In 2020, around 670 events were organised, reaching more than 20 000 participants in the country. 34% of participants were women. In addition to participation in EU Code Week, education institutions in Estonia can rely on the ProgeTiger programme¹⁶⁰, which helps educational institutions to buy ICT equipment.

Overall, Estonia is performing relatively well on digital skills compared to other EU countries. Ambitious actions are underway to maintain this front-running position, starting in Estonian schools, and continuing in universities and vocational training. The high number of ICT graduates is likely to reduce the shortage of ICT specialists in the country. Attention should be paid to rural and remote areas of the country to make sure all Estonians can benefit from the advantages of digitalisation.

Human capital in Estonia's Recovery and Resilience Plan

The Estonian RRP only includes one measure supporting the acquisition of digital skills for the Estonian population with a budget of EUR 10 million (representing 5% of the digital budget allocation) and consists of the following four parts:

- training managers in companies (SMEs in particular) to increase their ICT skills and knowledge and raise their awareness of the importance of developing and maintaining the skills of their ICT specialists;
- revising the content and organisation of training for ICT experts, taking into account the latest technological developments, the growing importance of cybersecurity, and the needs of companies;
- a pilot programme to redesign the qualification framework for ICT specialists;
- the upskilling and retraining of ICT specialists, including in cybersecurity.

¹⁵⁸ <u>https://oska.kutsekoda.ee/en/future-labour-market-trends/oska-covid-19-study/</u>

¹⁵⁹ <u>https://www.cs.ut.ee/en/studying/it-academy</u>

¹⁶⁰ <u>https://www.educationestonia.org/progetiger/</u>

2 Connectivity

2 Connectivity	Est	EU	
2 00111001111	rank	score	score
DESI 2021	18	46.6	50.2



			EU	
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	81%	83%	83%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	11%	14%	19%	34%
% nousenoias	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	<0.01%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	83%	84%	89%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	54%	57%	71%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	99.3%	99.4%	>99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	0%	0%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	68%	75%	75%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	70	75	69
Score (0-100)		2019	2020	2020

With a connectivity score of 46.2, Estonia ranks 18th in the EU. Estonia's coverage in fixed very high capacity network (VHCN) and Next Generation Access (NGA) networks recorded substantial increases in 2020: VHCN coverage was 71% in 2020 (against 59% for the EU), a 14 percentage point increase year on year. The increase in VHCN coverage can be explained by the successful rollout of high-speed internet connections by Enefit Connect OÜ (formerly Elektrilevi), an Estonian electricity provider. All VHCNs are fibre-to-the- premises networks. As to cable networks, they cover 76.7% of all households but only 23.6% of rural households. The future upgrade of cable networks to DOCSIS 3.1 will certainly improve Estonia's performance in fixed connectivity. Indeed, only 20.5% of households in rural areas are currently covered by VHCN.

Both fixed and mobile broadband take-up are high: the former stood at 83% (against 77% in the EU) and the latter stood at 75% (against 71% in the EU). However, take-up of high-speed services is still very low, with only 0.01% of the households subscribing to 1 Gbps services (against 1.3% for the EU). Take-up may be linked to attractive broadband prices: Estonia's broadband price index stood at 75 (against 69 in the EU).

The Estonian market features ubiquitous 4G coverage reaching 99.9 % of the country. Nevertheless, the country lags behind in providing 5G commercial service. This is because all the spectrum resources necessary for 5G operation have not yet been allocated.

Estonia's new Digital Agenda 2030 is currently being drafted and will most likely be adopted in 2021. This strategy will align the country's connectivity targets to those of the Gigabit Society (including the target of making available speeds of 100 Mbps – upgradeable to 1 Gbps – to all residents).

In the meantime, progress has been made under the Estonian project for a broadband-infrastructure network (EstWin)¹⁶¹. By January 2020, this project had successfully rolled out approximately 7,000 km of fibre backhaul networks in rural areas and settlements with less than 10,000 inhabitants, where optical networks did not previously exist and where operators had no previous plans to install them. These networks were rolled out by non-profit organisations, which were required to provide wholesale access on equal terms to all operators and public authorities. Furthermore, Enefit Connect OÜ continued to provide high-speed internet connections throughout the country, with an additional 3,000 addresses connected by Q4 2020. In 2018, Elektrilevi, which is part of the Estonian State-owned energy group Eesti Energia, won a dedicated public competition and committed to connect 40,016 addresses in 'white areas' (areas without coverage), thanks to State support worth EUR 20 million. Under the terms of the competition award, Eletrilevi's broadband network should: (i) have a technical capability of 1 Gbps download; (ii) be built over a maximum period of 5 years; and (iii) have a household/business contribution of no more than EUR 200 per connection.

On 5G, a consortia was commissioned in November 2020 to draft a report setting out 5G service needs in the following fields: digital culture; connected automated mobility; energy; smart community; environment; internal security; industry; and agriculture. The report is due by Q4 2021. In September 2020, Estonia signed a memorandum of understanding for the Via Baltica – North initiative, which will develop an experimental 5G cross-border corridor with Poland, Latvia and Lithuania. With the underlying objective of further developing 5G connectivity, the experimental cross-border corridor will notably enable Connected and automated mobility services to be tested.

On spectrum allocation, the Estonian authorities have faced restrictions stemming from cross-border coordination issues with a non-EU country, leading to difficulties in allowing the use of both the 700 MHz band and the 3.6 GHZ band. In addition to those restrictions, the authorities' design of the 3.6 GHZ band auction had been challenged in the Administrative Court and in the Circuit Court by a telecommunications operator in 2019. The Decision of the Administrative Court and the Circuit Court were in favour of the State but were appealed by an operator. The dispute ended in March 2020 when the Supreme Court decided not to take any actions concerning this appeal. The operator had claimed that the auction should have provided for the allocation of four frequency blocks instead of three.

Estonia has assigned 0% of the total harmonised 5G spectrum band in the EU. The 3.6 GHz auction is currently still pending and awaits the implementation of 5G security measures. On the 26 GHz band, a public consultation organised at the end of 2019 showed that there was little market demand for this band. There are currently plans to auction this band in the first half of 2022. However, in

¹⁶¹ Approximately 85% of the project costs were financed by the European Regional Development Fund (ERDF), while the remaining 15% of the network construction costs were co-financed by backhaul network operators.

November 2020, one operator already started providing 5G commercial service in three major cities, namely Tallinn, Pärnu and Tartu using dynamic spectrum sharing in the 2.1 GHz band.

Main market & regulatory developments

On consumption patterns, the Estonian market recorded increases in both mobile- and fixedbroadband users of 4% and 2% respectively between Q2 2019 and Q2 2020¹⁶². The consumption of mobile data also increased by 17% between Q2 2019 and Q3 2020¹⁶³.

On 3 February 2021, Estonia received a letter of formal notice for failure to adopt the necessary measures for transposing the European Electronic Communications Code into Estonian law. The European Electronic Communications Code is planned to be transposed into Estonian law with the electronic communications Act, the Building Code and the State fees amendment bill. The draft amendment bill was adopted by the government on 10 December 2020. On 15 December 2020, the Parliament started its scrutiny of the State fees amendment bill as part of the legislative procedure. The first reading of the draft State fees bill was held during a parliamentary session on 24 March 2021.

In 2020, the Estonian national regulatory authority ECTRA reviewed the market for wholesale voice-call termination on individual mobile networks (market 2 of the 2014 Commission recommendation). Following the review, ECTRA set a new mobile termination rate at 0.70 eurocent/minute for the three operators considered as having significant market power in this market (Telia Eesti AS, Elisa Eesti AS and Tele2 Eesti AS).

ECTRA also notified its review of the market for wholesale local access provided at a fixed location (3 a/2014) and wholesale broadband access (3b/2014). On 19 April 2021, the Commission informed ECTRA and the Body of European Regulators for Electronic Communications of its serious doubts pertaining to: (i) a lack of sufficient evidence supporting the definition of the relevant product market; and (ii) a lack of sufficient evidence that the market for wholesale central access, as notified, justified the imposition of a regulatory obligation. ECTRA withdrew its notification of the above-mentioned markets.

On consumer complaints about electronic communications, the main source of complaints recorded in 2020 pertained to the following topics: (i) comprehensibility of contractual terms; (ii) contractual penalties or other fees regarding early contract termination; and (iii) delay of fulfilment of obligations by service provider.

Overall, Estonia has high levels of fixed VHCN coverage, except in rural areas where this type of technology has not yet been made available to many households. The country's ability to meet the Gigabit society targets will depend on the timely adoption of its digital strategy 2030 and the allocation of the 5G pioneer bands.

Connectivity in Estonia's Recovery and Resilience Plan

The Estonian RRP includes one specific measure to improve the connectivity of the most remote areas of its territory. The objective of the measure is to improve access to VHCN for households and socioeconomically significant institutions such as hospitals, schools, public services and

¹⁶² Source: Consumer Protection and Technical Regulatory Authority.

¹⁶³ Source: Consumer Protection and Technical Regulatory Authority, mobile data volume/user/month, from 18GB to 21GB.

businesses in remote areas.

A budget of EUR 24.29 million has been earmarked for this measure, and 8,000 sites shall be equipped with VHCN thanks to this investment. The measure consists in providing financial support for the deployment of VHCN in areas of 'market failure' (i.e. areas to which privatesector providers would otherwise not provide service as it would not be profitable). The eligibility and selection criteria used to allocate the funding will ensure an appropriate regional balance and compliance with State aid rules.

3 Integration of digital technology

3 Integration of	Est	EU	
digital technology	rank	score	score
DESI 2021	9	41.5	37.6



		EU		
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	74%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	28%	26%	26%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	13%	16%	16%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	11%	11%	10%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	26%	26%	48%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	15%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	62%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	23%	23%	62%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	16%	17%	16%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	12%	12%	12%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	8%	9%	9%	8%
% SMEs	2017	2019	2019	2019

On the Integration of digital technology in businesses' activities, Estonia ranks 9th among EU countries. On the new indicator of SMEs with at least a basic level of digital intensity, Estonia scored 74%, 14 percentage points higher than the average EU score, and approaching the 90% target of the Digital Decade Communication¹⁶⁴. 16% of Estonian SMEs sell online (EU average of 17%), while e-commerce represents 12% of SMEs' turnover, and 9% of SMEs sell across borders. On the use of advanced technologies, in 2020: (i) 15% of Estonian companies used Artificial Intelligence (AI) against an average of 25% in the EU, (ii) 16% of Estonian companies used social media (up from 13% in 2019 and compared to 23% at EU level); (iii) 48% of Estonian companies used cloud services (up from 26% in 2019 and compared to 26% at EU level); and (iv) 10% of Estonian companies accessed big-data services (EU average 14%). Estonia is close to the EU average (4 percentage points below) on the use of ICT for environmental sustainability.

¹⁶⁴ <u>https://eur-lex.europa.eu/resource.html?uri=cellar:12e835e2-81af-11eb-9ac9-1aa75ed71a1.0001.02/DOC 1&format=PDF.</u>

On policy developments, the recently appointed government has highlighted two of its priorities as the digital transformation of enterprises and supporting of the uptake of digital technologies by businesses. Supporting the uptake of digital technology by businesses is an essential feature of the Research, Development, Innovation and Entrepreneurship (RDIE) Development Plan 2021-2035¹⁶⁵ presented in October 2020.

Estonia continues the implementation of its National Artificial Intelligence Strategy 2019-2021¹⁶⁶, which it plans to renew this year to cover 2021-2023. The current strategy sets out the actions the government will take to: (i) promote the take-up of AI in both the private and public sector; (ii) increase the relevant skills and research-and-development base; and (iii) develop the legal environment necessary to promote the use of AI in the country. More than EUR 12 million of public investment has been targeted on AI in the past 2 years, most of which came from European structural funds. A research and development centre, the AI and Robotics Estonia Hub, will soon be set up. It has been selected by Estonia to join the network of European Digital Innovation Hubs (EDIHs)¹⁶⁷. The AI and Robotics. This innovation hub is supported by the Ministry of Economic Affairs and Communications, and its activities will be implemented by Estonian universities and science parks.

In addition, Estonia supports the start-up ecosystem through a State-funded organisation called Startup Estonia¹⁶⁸ (see more in the highlight box below). Entrepreneurs can already contact the administration for advice and support online. But to further improve communication between the government and entrepreneurs, the government drew up a roadmap in 2020 for a single online point of contact for entrepreneurs to speak with the administration. The roadmap contains concrete actions for the period 2021-2025. In addition to reducing administrative burden for companies through customer-centric online services, the Estonian administration also expects these measures to attract foreign entrepreneurs to start businesses in Estonia.

On advanced digital technologies, the Estonian Scientific Computing Infrastructure Consortium (ETAIS)¹⁶⁹ is participating in the EuroHPC Joint Undertaking project EUROCC, with a total budget of EUR 2 million for 2020-2021. The objective is to increase the competitiveness of Estonian computing and data-intensive research disciplines by providing a single entry point for resources in High-Performance Computing (HPC) and High Performance Data Analytics (HPDA). The Estonian Scientific Computing Infrastructure Consortium also joined the EuroHPC joint undertaking pre-exascale supercomputer consortium LUMI to provide Estonian researchers with access to world-class computational resources that are created jointly with partners in Finland. Estonia is contributing EUR 2 million to the project for a six-year period starting in 2021. In September 2020, Estonia joined the EU's cooperation framework on Quantum Communication Infrastructure (QCI)¹⁷⁰. As part of this framework, Estonia will explore with other EU Member States over the next 12 months how to develop and deploy a QCI across the EU within the next 10 years. The Estonian Ministry of Economy

¹⁶⁵ (In Estonian) <u>https://www.hm.ee/sites/default/files/taie_arengukava_2035_eelnou</u>

riigikogusse_29.10.2020.pdf

¹⁶⁶ <u>https://en.kratid.ee/</u>

¹⁶⁷ <u>https://teaduspark.ee/en/in-autumn-estonian-companies-will-get-advice-on-the-application-of-ai-and-robotics-in-manufacturing/</u>

¹⁶⁸ <u>https://startupestonia.ee/en</u>

¹⁶⁹ <u>https://etais.ee/</u>

¹⁷⁰ <u>https://www.mkm.ee/en/news/estonia-joined-eus-cooperation-framework-quantum-communication-infrastructure</u>

and Communication has set up a working party in charge of developing a long-term strategy in QCI with the participation of private-sector companies and academic institutions.

With these different initiatives, Estonia is strengthening the competitiveness of its business ecosystem to help position Estonia as an innovative country able to compete globally with major companies. It is important that this support also benefits more traditional businesses and economic sectors to ensure that the digitalisation of the Estonian economy is cross-sectoral.

Highlight 2020-2021: A vibrant start-up ecosystem in Estonia

The Estonian start-up ecosystem is very vibrant. There are 1 126 start-ups currently operating in Estonia, according to the most recent data from the Estonian Start-up Database. In 2020, these start-ups generated EUR 782 million in turnover in the country, 43% more than the year before. They also made the labour market more dynamic, employing 6 072 people locally at the end of 2020.

These start-ups benefit from strong and efficient support from State services through the government's Start-up Estonia platform, which aims 'to supercharge the Estonian start-up ecosystem in order to be the birthplace of many more start-up success stories to come'. Start-up Estonia published a white paper in 2020, laying down a strategy for promoting start-ups in the 2021-2027¹⁷¹ period.

This support and ecosystem has proven to be successful. Estonia is now the country in Europe with the highest number of unicorns per capita. In total there are 7 unicorns founded by Estonians and/or based in Estonia¹⁷². In the last 2 years, Pipedrive.com (founded in 2010, became a unicorn in 2020.), Zego.com (founded in 2016, became a unicorn in 2021.) and ID.me (founded in 2010, became a unicorn in 2021) joined the 4 already existing Estonian unicorns: Skype.com (founded in 2003, became a unicorn in 2005), Playtech.com (founded in 1999, became a unicorn in 2007), Wise.com (founded in 2010, became a unicorn in 2018).

Integration of digital technology in Estonia's Recovery and Resilience Plan

The principal objective of Component 1 'Digital transformation of enterprises' of the Estonian RRP is to foster the digital transformation of Estonian companies and their competitiveness in export markets. Component 1 will provide financial support to SMEs and micro-enterprises in all economic sectors, at different stages of their digital transformation. It will also make specific contributions to the adoption and deployment of digital solutions in the construction and road-freight-transport sectors in particular.

In total, the RRP will dedicate EUR 76 million (37% of the digital allocation) to support the digitalisation of businesses.

The most important measures for the digitalisation of businesses in Estonia's RRP are set out in the bullet points below.

¹⁷¹ <u>https://media.voog.com/0000/0037/5345/files/SE_Whitepaper_Web%20(1)-1.pdf</u>

¹⁷² <u>https://startupestonia.ee/blog/estonia-1-in-europe-in-number-of-unicorns-per-capita</u>

- One measure consists in providing financial support to SMEs and microentreprises from all sectors to make investments that will enhance their digital transformation. This financial support must be complemented with the companies' own resources, and must cover one or more of the following aspects: the adoption of digital technologies; the development of industrial data 'clouds'; industrial research; development; testing and piloting activities; feasibility studies; advisory and support services; or training for staff. This measure will support 230 companies (EUR 58 million).
- Another targeted measure supports the digital transformation of the construction sector to increase its productivity, reduce its environmental footprint, and improve the quality of buildings. A total of 120 projects will be supported by this targeted measure (EUR 9 million).
- The RRP contains plans to digitalise the exchange of information in road-freight transport by introducing digital waybills (EUR 6 million).
- Finally, the Estonian RRP includes some specific reforms to support the competitiveness
 of enterprises including ICT enterprises in foreign markets (about EUR 3 million
 directly relevant to the digital transformation).

4 Digital public services

				Digital public services
4 Digital public	Est	onia	EU	80
services	rank	score	score	60
DESI 2021	1	91.8	68.1	40
				Estonia EU
				0

0 -		Es	stonia		EU		_
0	2016	2017	2018	2019	2020	2021]

	Estonia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	88%	88%	89%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	97	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	91	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	98	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	91%	78%
% maximum score			2020	2020

Estonia ranks 1st place in the EU on Digital public services, and continues to be a strong front-runner in this area. The share of e-government users has slowly increased in recent years, accounting today for 89% of total internet users in the country. Estonia performed better than in 2020 in the number of users using pre-filled forms, scoring 97 (out of 100), and well above the EU average (63). The country is a strong performer in digital public services for citizens (with a score of 91 out of 100, comfortably above the EU average of 75) and for businesses (with a score of 98 against an EU average of 84).

In 2021, Estonia also made progress on open data, increasing its score by 24 percentage points compared to 2019. This significant improvement is because public data are increasingly made available to a wider audience. In early 2021, the Estonian Open Data Portal hosted almost 800 datasets from more than 100 publishers, covering areas such as agriculture, education, energy, health, governance, and transport. These datasets can then be freely used by academic researchers, start-ups and companies to build new services or extend existing ones. In addition, the Estonian authorities also significantly improved the cross-border availability of information. For example, the three Baltic states already allow cross-border exchange of information from their population register¹⁷³, and in 2020 Estonia also started sharing information via the X-Tee (X-Road) initiative¹⁷⁴ with the Finnish authorities¹⁷⁵. The data are only collected once by one specific institution from one country (the 'once-only' principle) and in a secure and confidential manner.

¹⁷³ www.rahvastikuregister.ee

¹⁷⁴ https://www.ria.ee/en/state-information-system/x-tee.html

¹⁷⁵ <u>https://dvv.fi/en/-/population-registers-of-finland-and-estonia-use-suomi.fi-data-exchange-layer-to-exchange-information</u>

In 2020, Estonia developed a vision for the 'real-time' economy (when all the transactions between business entities are in digital format, increasingly automatically generated, and completed in real-time - as they occur) and drew up a roadmap for the development of the real-time economy for 2020-2027¹⁷⁶. The roadmap and vision aim to implement a structural change in the administration and management of companies by: (i) improving data quality through standardisation; and (ii) applying digital technologies, including AI and blockchain technologies, to automate operations.

Estonia's National AI Strategy 2019-2021¹⁷⁷ devotes significant attention to the uptake of AI solutions in the public sector. Estonia has continued to implement this strategy, and the country has identified more than 80 different use-cases for AI in the public sector, such as: forecasting the probability of unemployed people getting a job; identifying the factors that influence whether unemployed people find work; and machine translation of government portals.

In its digital agenda 2020¹⁷⁸, as updated in 2018, the country stresses that vital functions must be resilient to cyber threats. This requires a country-wide strategic overview, interoperability, and effective planning. The Cybersecurity strategy (2019-2022)¹⁷⁹ sets out the long-term vision, objectives, priority action areas, roles, and tasks to ensure Estonia's cybersecurity. The strategy is used as a basis for activity planning and resource allocation. The Council on National Cybersecurity Policy was recently set up, and its recommendations will feed into the new digital strategy 2030, which will aim at keeping Estonia's cyber space secure and trustworthy.

Estonia has experimented with cloud technologies and completed a pilot project called 'Estonian government cloud'¹⁸⁰. This pilot project proved that cloud technology works for public-sector IT applications, and that it is worth considering more widespread use of cloud technology. In parallel, the government is further investigating public-sector use of cloud computing to better understand what kind of data can be kept on the cloud and what cloud services are required. Estonia is working to build its own government cloud to meet these needs.

Estonia was the EU first country to use vaccination certificates (having set up a certificate system in April 2021) and has been a strong advocate of the EU's digital COVID certificate (for vaccination, recovery and testing). In October 2020, the World Health Organization (WHO) and the Estonian government signed a memorandum of understanding to develop distributed digital infrastructure providing health solutions to the COVID-19 pandemic and other public-health needs. In February 2021, the country began working with the WHO on a pilot project to investigate the use of globally recognised, electronic vaccine certificates.

Estonia continues to work on ambitious projects to further improve its leading position in digitalising public services. The recent pandemic has allowed the country to position itself as a world leader in this area, and the new cybersecurity strategy is expected to further bolster Estonia's position as a European and global leader in the digitalisation of its public services.

Digital public services in Estonia's Recovery and Resilience Plan

¹⁷⁶ Real-Time Economy vision and roadmap 2020-2027 <u>https://www.mkm.ee/sites/default/files/real-</u> <u>time_economy_vision_2020-2027.pdf</u>

¹⁷⁷ <u>https://e-estonia.com/nationa-ai-strategy/</u>

¹⁷⁸ <u>https://www.mkm.ee/sites/default/files/digitalagenda2020_final_final.pdf</u>

¹⁷⁹ https://www.mkm.ee/sites/default/files/kyberturvalisuse_strateegia_2022_eng.pdf

¹⁸⁰ <u>https://e-estonia.com/government-cloud-infrastructure-service/</u>

Almost half (47%) of the measures supporting the digital transformation in the Estonian plan will aim at further digitalising the administration and public services. The total budget for these investments will be EUR 97.43 million.

The most important measures within the plan are as follows.

- The reconfiguration of basic digital public services and the safe transition of these services to cloud infrastructure to increase their resilience, security and reliability. The IT systems and services of the Estonian public authorities will be migrated to a private cloud and will require large-scale security testing.
- The development of business-event services and a digital gateway to improve efficiency in the delivery of public services and reduce administrative burden for businesses.
- The redesign of several public services (and the underlying IT systems) to enable their automatic delivery on the basis of life events or business events experienced by citizens (such as a marriage, the birth of a child, or the creation of an enterprise.
- Setting-up a national, virtual-assistant platform in the #Bürokrat programme to improve the user-friendliness of access to online public services in Estonia.
- The creation and development of a centre of excellence for data management and open data to foster better management of the data collected and held by the Estonian public authorities. This will aim at improving the quality of the data, increasing its use for decision-making, and making the data available as open data so that it may also be reused by other stakeholders.

	Gr	eece	EU	
	rank	score	score	
DESI 2021	25	37.3	50.7	



Greece ranks 25th of 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI).

Greece continues to improve its performance in almost all DESI dimensions, although in most cases it still scores below the EU average. Overall, the country made slight progress in digital skills. The proportion of employed female ICT specialists as a share of all ICT specialists employed in Greece has been rising rapidly. Greece improved its scores on connectivity and has started to deploy very high capacity networks, though it still remains far below the EU average in very high capacity networks coverage and in fixed broadband take up of speeds of at least 100Mbps. However, the deployment of future-proof networks is likely to be accelerated with the expected investments in fibre (such as the Ultra-fast Broadband Project) and the 5G network deployment. Greece scores 99% in the 5G readiness indicator, which means that almost the total 5G pioneer spectrum harmonised at EU level has been assigned. On the integration of digital technologies into business activities, Greece is well below the EU average. On the digitalisation of public services, in 2020 Greece scores above the EU average in the number of e-government users, while it far exceeds the EU average in open data readiness, having already implemented relevant legislation and policies.

On 23 June 2021, Greece adopted the 2020-2025 'Digital Transformation Bible'¹⁸¹, a new holistic digital strategy led by the Greek Ministry of Digital Governance, which describes 455 specific projects (of which 145 are ongoing) for implementing the strategy for a 'Digital Greece'. It includes the following strategic axes for the digital transformation of the Greek society and economy: (i) connectivity; (ii) digital skills; (iii) digital state; (iv) digital business; (v) digital innovation; and (vi) integration of digital technology in every sector of the economy. Greece also accelerated legislative reforms to create the right supporting framework conditions for implementing the new digital strategy. One example is the adoption of the Code of Digital Governance on 22 September 2020¹⁸²,

¹⁸¹ <u>https://digitalstrategy.gov.gr/</u>

¹⁸² Greek Law 4727/2020.

which includes, among other provisions, the transposition of Directive (EU) 2018/1972 on the establishment of a European Electronic Communications Code (EECC) and which unifies the legislative framework on key elements. Greece was the first Member State to transpose the EECC in September 2020.

Furthermore, the digitalisation of public services is high on the country's political agenda. In 2020, Greece acted swiftly and decisively in the midst of the COVID-19 crisis to make public services available online in times of lockdown and quarantine so that the general public and enterprises could continue to benefit from public services remotely. The e-government portal 'Gov.gr' is now widely used by the general public. On the other hand, digitalisation of enterprises remains slow. Structural measures to create an environment conducive to digital innovation in the long-run (e.g. Digital Innovation Hubs) are needed with a focus on small and medium-sized enterprises (SME).

Generally, there is a considerable effort to accelerate the country's digital transformation, including several legislative reforms and projects.



Digital in Greece's Recovery and Resilience Plan (RRP)

The total amount of the Greek plan is EUR 30.5 billion, consisting of EUR 17.8 billion in grants and EUR 12.7 billion in loans. The plan dedicates EUR 7 billion to the digital transition, which represents 23.3% of the plan's total allocation (in non-repayable support and loans). It includes a comprehensive set of reforms and investments in digital fields, addressing the country-specific recommendations and reflecting Greece's effort to support the country's digital transition.

The plan encompasses in particular measures aimed at: (i) enhancing connectivity, by accelerating and facilitating the deployment of very high capacity networks; (ii) improving the digitalisation of public administration and key sectors of the economy, notably through a wider adoption of digital capacities and advanced digital technologies; (iii) fostering the digitalisation of Greek businesses; (iv) developing the digital skills of the whole population to reduce the digital divide; and (v) implementing several multi-country projects, to achieve scale and interoperability.

1 Human capital

1 Human canital	Gr	EU	
I numan capital	rank	score	score
DESI 2021	21	41.0	47.1



	Greece			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	46%	51%	51%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	22%	23%	23%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	52%	56%	56%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	2.3%	2.1%	2.0%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	16%	20%	27%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	14%	15%	12%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	2.9%	3.1%	3.4% 2019	3.9%
% graduates	2017	2018		2019

On Human capital, Greece ranks 21st of 27 EU countries, remaining below the EU average. The percentage of people with at least basic digital skills is low (51%). The share of employed ICT specialists (2.1% in 2019) remains low in 2020 (2%) compared to the EU average (4.3%). However, among the country's ICT specialists, the proportion of female ICT specialists is growing extremely fast (from 20% in 2019 to 27% in 2020) and is well above the EU average (19%), making Greece a front-runner in this area. Only 12% of enterprises are providing ICT training to their employees in 2020, compared to the EU average of 20%.

Greece placed the development of digital skills for all at the core of its new digital transformation strategy to facilitate the use of public services and ensure the reskilling and upskilling of the workforce.

Several initiatives are in place to support the development of the population's digital skills, such as the Greek National Coalition for Digital Skills and Jobs¹⁸³, under the responsibility of the Ministry of Digital Governance. In 2020, the Coalition set up four working groups on: (i) education; (ii) training; (iii) ICT professionals; and (iv) general public. The aim is for public and private entities members of the Coalition to work together to develop initiatives for basic and advanced digital skills.

In 2020, the Ministry of Digital Governance created the Digital Skills Academy¹⁸⁴, a dynamic platform that assembles all available training courses of national and international educational organisations to improve the digital skills of learners of all levels. It includes around 251 courses on 33 topics given

¹⁸³ <u>https://www.nationalcoalition.gov.gr/en/national-coalition_en/</u>

¹⁸⁴ <u>https://nationaldigitalacademy.gov.gr/</u>

by 35 different institutions and will be regularly updated with new courses. The Ministry is also planning to create a national digital skills framework and certification system, to set up a national register of digital skills education providers, and to develop a plan to improve the digital skills of all civil servants and local government employees.

On the education system, the COVID-19 pandemic accelerated the process of digitalisation. The Ministry of Education & Religious Affairs introduced in 2020 a remote education strategy for all education levels based on three pillars: (1) synchronous education such as live lessons on online platforms for all levels of education; (2) providing asynchronous education, such as educational material on websites and platforms for teachers and students of all educational levels; and (3) educational television programmes for elementary school pupils.

A digital education action plan was also adopted, which includes the revision of curricula, the provision of a basic certificate for IT skills for 15 year-old students and the provision of digital education resources for primary and secondary education. A major development was the use of specialised technology support for digital accessibility for children with special needs (e.g. the transcription of all the primary and secondary school textbooks into braille code). In parallel, through the 'Digital Access' (Psifiaki Merimna) programme every pupil and student whose family meets specific financial criteria is provided with a voucher of EUR 200 to purchase technological equipment (tablet, laptop, PC).

The eTwinning platform¹⁸⁵ is very popular in Greece. So far, 9 848 schools, 31 199 teachers and 18 512 projects have been registered and 30 educators from 24 Greek schools won the eTwinning European Prize for 2021¹⁸⁶.

In 2020, Greece was once again very active in EU Code Week, with 68 000 people participating in 1 179 activities - ranking Greece among the six most active countries. Furthermore, almost 6 000 students and over 1 600 school teams from all over Greece participated In the Panhellenic Robotics Training Competition.

To address the lack of digital skills in the labour force, a number of initiatives have been launched. The Central Association of the Chamber of Greece under the guidance of the Education Research Centre of Greece launched an action to upgrade the digital skills of employees in the private sector, including certification, for 15 000 beneficiaries. Other actions for training in the ICT sector were launched by the Manpower Employment Organization (OAED) under the guidance of the Ministry of Labour and Social Affairs for the unemployed graduates of universities and technical institutes.

Despite the actions already initiated to foster digital skills for all, supplementary efforts especially for advanced digital skills will be needed in light of the ambitious target set in the Digital Decade¹⁸⁷. Greece needs to massively stimulate the upskilling and reskilling of the labour force and train future generations of workers. The lack of capacity in specialised education and training programmes in areas such as Artificial Intelligence (AI), quantum and cybersecurity is a major challenge. Additional action, in collaboration with universities and enterprises would be welcome to provide education and training and to increase the number of digital experts needed in all sectors of the economy.

Human capital in Greece's Recovery and Resilience Plan

¹⁸⁵ <u>https://www.etwinning.net/el/pub/community/countries/country.cfm?c=300</u>

¹⁸⁶ <u>http://www.etwinning.gr/2016-02-29-10-54-36/2016-02-29-10-56-25/1047-etwinning-2021-4-24-30-etwprizes21</u>

¹⁸⁷ <u>https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en</u>

Reforms and investments are planned across all education levels to digitalise processes and infrastructures and integrate digital skills into school curricula. A reform to modernise Vocational Education Training is also planned to upgrade and align the VET curricula with labour market needs, in particular digital skills for the digital and green transition (EUR 690 million), as well as a programme for digital skills upgrade for conscripts/military (EUR 32 million) and for digital skills for judges and judicial employees (EUR 32 million). Additionally, reforms and investments in upskilling and reskilling programmes for the labour force, focusing on the digital and green transition, are also envisaged to increase long-term employment and productivity.

2 Connectivity

2 Connectivity	Gr	EU	
,	rank	score	score
DESI 2021	27	37.7	50.2



	Greece			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	74%	76%	77%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	0%	1%	3%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	<0.01%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	66%	81%	87%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	0%	7%	10%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	98.2%	99.1%	99.2%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	0%	99%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	52%	60%	60%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	49	53	69
Score (0-100)		2019	2020	2020

On Connectivity, with an overall score of 37.7 (compared to EU average of 50.2), Greece ranks 27th in EU. Greece continues to progress very quickly in fast broadband (NGA) coverage. It increased by 6 percentage points in 2020, reaching 87% which coincides with the EU average. This increase could be attributed to the progressing network deployment through the vectoring scheme. The country has also finally started to deploy very high capacity networks (VHCN). Its fixed VHCN coverage reached 10%, up from 7% one year earlier, although this is still well below the EU average of 59%. However, the take-up of at least 100 Mbps fixed broadband remains very low (reaching 3%, up from 1% in 2019) compared to the EU average (34%). Overall fixed broadband take-up is still progressing at a slow pace, reaching 77 % in 2020, up from 76% in 2019 (in line with the EU average). Greece has progressed on broadband price index with a score of 53 in 2020 compared to 49 in 2019. The mobile broadband take-up (60% in 2019) remains below the EU average (71% in 2019). Greece's 4G performance is better, with a coverage of 99.2%.

The General Secretariat of Telecommunications and Post of the Ministry of Digital Governance is updating the National Broadband Plan (expected in Q4 2021), which will include the country's roadmap for achieving its Gigabit Society targets for 2025 and will integrate the roadmap for the development of 5G networks. The updated National Broadband Plan's main objectives are to

provide by 2023 access to connections with speeds higher than 100 Mbps for more than 70% of consumers and businesses, and to upgrade the connectivity for islands. The upgrade of the existing infrastructure of electronic communications networks in Greece is planned to be addressed through providers' investment programmes, some of which are already under way, in conjunction with supplementary targeted public investments such as the Ultra-fast Broadband (UFBB)¹⁸⁸.

As regards EU funds (ESIF), in the current programming period (2014-2020), a total of EUR 300 million (EUR 265 million by ERDF and EUR 35 million by EAFRD) is being allocated to the major infrastructure project UFBB, for which a final call for tenders was issued on 22 June 2021 with a closing date 17 September 2021. The above-mentioned funding is available until 2023 with the possibility to extend it to the next programming period (2021-2027).

Regarding the deployment of next generation access (NGA) networks in the context of the vectoring procedure, which involves the operators OTE, WIND and Vodafone, 88.4% (19 557) of the 22 121 allocated cabinets offering FTTC/VDSL vectoring or FTTH/GPON technology had already been activated by September 2020, while the rest (2 564 cabinets) are scheduled to be activated by March 2022. Although most of the NGA deployment under the vectoring deployment plan concerns implementation of FTTC/VDSL vectoring access networks, operators also deploy FTTH networks, though to a lesser degree (1 425 FTTH allocated cabinets out of 22 121).

While Greece has recently made progress in tackling long standing obstacles to investment in networks, more efforts are needed, in particular on upgrading the infrastructure registry and creating one-stop-shop functionalities for permit granting, in order to maximise the impact of investments¹⁸⁹.

Greece scores 99% in the 5G readiness indicator, which means that almost the total 5G pioneer spectrum harmonised at EU level has been assigned. The country's deployment and launch of commercial 5G services commenced at the end of December 2020¹⁹⁰, as 5G spectrum rights of use had already been granted following the auction of 16 December 2020. The 5G auction included all the 5G pioneer bands (700 MHz, 3400-3800 MHz and 26 GHz) as well as the 2 GHz band. The Ministry of Digital Governance developed an action plan for the development of 5G networks, which introduces a clear regulatory and legislative framework and takes initiatives to ensure financial incentives and encourage the development of 5G infrastructure, such as tackling the significant delays in the process for antenna permit granting (Law 4635/2019). The establishment (with the Law 4727/2020) of an innovative national funding scheme for 5G in Greece (Phaistos Fund), is expected to play an invigorating role in the aftermath of the COVID-19 crisis. It should support SMEs active in industry 4.0 and in the creation of a market of 5G products in Greece in different sectors.

Main market & regulatory developments

¹⁸⁸ <u>https://ec.europa.eu/regional_policy/en/projects/Greece/ultrafast-broadband-for-internet-users-throughout-greece</u>

¹⁸⁹ Greece recognised these reforms as necessary based on the assessment of the best practices in the Roadmap implementing the Common Union Toolbox for Connectivity notified to the Commission on 24 June 2021 and they proposed an implementation plan (<u>https://digital-</u>

strategy.ec.europa.eu/en/library/connectivity-toolbox-member-states-develop-and-share-roadmaps-toolboximplementation).

¹⁹⁰ The 5G coverage indicator in Greece is zero, because the data are from July 2020 before the commercial launch of 5G in the country.

The Hellenic Telecommunications and Post Commission (EETT) approved in November 2020 the separation of the passive infrastructure, i.e. the old 'towers' of Vodafone and Wind from the two companies and their merger into a new company, named Vantage Towers Greece. The new entity's commercial scope would be the independent lease of those passive infrastructures to the two operators (under non-discriminatory conditions) and also to third parties. The 5G Ventures S.A, an independent fund management company established by the Hellenic Corporation of Assets and Participations S.A (HCAP) and Vantage Towers Greece announced the signing of a memorandum of cooperation to support companies, which are funded by the Phaistos Fund, to develop products and services that take advantage of the capabilities of 5G networks by giving them access to the passive infrastructure owned by Vantage Towers in Greece.

In 2020, United Group, which has telecoms and TV operations in southeast Europe, completed its acquisition of the Greek telecommunications and pay-TV provider, Forthnet. There is still no mobile virtual network operator (MVNO) in the Greek telecommunications market. While Forthnet has not yet activated the June 2019 agreement with Vodafone to enter the market as MVNO, an energy company, Volton, expressed its interest to get MVNO access in the competitive telecommunications sector by submitting a formal request to EETT and the other three operators with the aim of concluding a network access agreement.

Greece was the first Member State to notify the complete transposition of the European Electronic Communications Code (EECC), Directive (EU) 2018/1972¹⁹¹, before the transposition deadline (21 December 2021), which shows the country's effort to improve its connectivity ranking in preparation for the adoption of a pro-investment regulatory framework facilitating the deployment of networks and 5G.

As part of the analysis of the leased lines markets (cases EL/2019 2227, 2228, 2229) and the Commission's comments, EETT notified on 19 November 2020 its decision¹⁹² (ref. 968/02/16.11.2020) on the final measure regarding the pricing methodology and the actual wholesale prices until the development of the bottom-up LRIC+(long-term incremental cost) model. On 18 September 2020, the Commission registered a notification from EETT concerning the fourth round review of the markets for: (i) call termination on individual public telephone networks provided at a fixed location in Greece; and (ii) call origination on individual public telephone networks provided at a fixed location in Greece¹⁹³. Concerning market (i), EETT considered it appropriate to maintain the applicable symmetric fixed termination rate at the level of 0.0545 eurocents/minute, until the entry into force of the relevant Delegated Act. Concerning market (ii) EETT proposed a nine-month transition period before the deregulation of the market.

EETT published in May 2021 a public consultation to determine the content of the provision of broadband access based on the new Universal Service provisions introduced by the Directive (EU) 2018/1972. In addition, on 17 May 2021, EETT issued the new Regulation on General Authorisation, which sets new terms and obligations for electronic communications providers, in line with the transposed provisions of Directive (EU) 2018/1972. On open internet access

¹⁹¹ The Directive (EU) 2018/1972 was transposed in the Greek legislation with the Greek Law 4727/2020).

¹⁹² See CIRCABC : <u>EL 2020 2290</u>

¹⁹³ See CIRCABC: <u>Case EL/2020/2271</u> and Case <u>EL/2020/2272</u>

rules in Greece, a major development is the entry into force of the provisions of the EETT Decision¹⁹⁴ on the inclusion of information about realistic internet access speeds in consumer contracts, elaborating on the general provisions of Regulation (EU) 2015/2120. This Decision's provisions on speeds entered into force on 25 November 2020 for fixed networks and on 1 March 2021 for mobile networks.

With reforms and targeted investments, Greece needs to create the right conditions for achieving the 2025 Gigabit targets, and bridge the digital divide with investments such the cross-border 5G corridors and the interconnection of the islands with submarine fibre cables. The adoption of a proinvestment regulatory framework and the current reforms, combined with the funding from the Recovery and Resilience Facility (RRF) would help Greece to improve its connectivity, by extending coverage of fibre and 5G. This will enable people and enterprises across Greece to use next generation infrastructure and lay the ground for high-technology applications and the take-up of emerging technologies.

Connectivity in Greece's Recovery and Resilience Plan

The plan includes connectivity investments of EUR 321.6 million financed by the grant component of the RRP and additional EUR 912 million for investments in Very High Capacity Networks financed on the basis of the EUR 12.7 billion Loan Facility included in the Plan. Together, it represents a total of EUR 1.2 billion (18% of the plan's total digital budget).

Grants are foreseen to cover: (1) the installation of fibre optic infrastructure in buildings (EUR 131.3 million); (2) the development of 5G corridors covering all major Greek highways (EUR 160 million); (3) the deployment of submarine fibre cables to connect mainland with the Greek islands and Cyprus (EUR 30 million). In additon to the investments in connectivy presented above, the plan includes an investment in the utilisation of space technologies and applications by developing a constellation of small satellites (EUR 200 million). Although this is considered part of the investments in advanced technologies, this investment is also expected to highly contribute to connectivity¹⁹⁵.

Of those investments, three have a cross-border/multi-country (MCP) dimension: the '5G corridors' will also support the cross-border corridor Thessaloniki-Sofia-Belgrade; the 'Submarine fibre cables' will allow interconnecting mainland Greece with Cyprus; and the 'Small satellites' will ensure interoperability with European Quantum communication infrastructure (EuroQCI). The plan also includes reforms which will put in place a framework to facilitate the switch to fast broadband connections and the transition to 5G technology.

¹⁹⁴https://www.eett.gr/opencms/export/sites/default/admin/downloads/telec/apofaseis_eett/kanonistikes_a pofaseis_eett/AP876-007B.pdf

¹⁹⁵ On the basis of the methodology to calculate the support to the digital objectives (Annex VII of the Regulation (EU) 2021/241), the "Small satellites" initiative is part of the intervention field "Investment in digital capacities and deployment of advanced technologies". However, for readability reasons, this initiative is mentioned together with the measures under the intervention field "Connectivity".

3 Integration of digital technology

3 Integration of	Greece		EU
digital technology	rank	score	score
DESI 2021	22	28.5	37.6



	Greece			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	NA 2020	60% 2020
3b1 Electronic information sharing	37%	38%	38%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	21%	19%	19%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	13%	13%	13%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	7%	7%	NA	26%
% enterprises	2018	2018	2020	2020
3b5 AI % enterprises	NA	NA	34% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	65% 2021	66% 2021
3b7 e-Invoices	9%	9%	NA	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	11%	9%	NA	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	4%	4%	NA	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	7%	4%	4%	8%
% SMEs	2017	2019	2019	2019

On integrating digital technology into business activities, Greece ranks 22nd in the EU. Digital technologies are slowly being adopted by Greek enterprises, with only 19% using social media compared to an EU average of 23%. 38% of enterprises use electronic information sharing (above the EU average of 36%). On the adoption of advanced digital technologies, Greece's enterprises are among the frontrunners for the use of AI (34%), well above the EU average (25%). On ICT for environmental sustainability, at 65%, Greece is close to the EU average of 66%. The same applies to big data analytics, where at 13% Greece is close to the EU average of 14%.

The Digital Transformation Bible includes strategic measures to make enterprises in Greece more digital. Having identified the obstacles to the digitalisation of enterprises, the strategy focuses on: (i) adapting information systems and digital services for the export orientation of enterprises; (ii) disseminating best practices for strengthening the digital presence of Greek enterprises; (iii) creating new ecosystems; (iv) making better use of data for developing new products, business models and markets; and (v) training employees and entrepreneurs in digital skills. To give an example, an action named e-retail (e-lianiko), launched by EPAnEK, will provide grants to SMEs in the retail sector for the development/upgrade and management of an e-shop.

Al is one of the main strategic action areas of the Digital Transformation Bible. The Ministry of Digital Governance is preparing a Greek national AI strategy with the involvement of major stakeholders and experts in Greece, as well as EU experts. Its main objective will be to determine the conditions for the development of AI, including skills, a trust framework, data policy, and ethical principles for its safe development and use. It will also define national priorities and areas for maximising the benefits of AI to meet societal challenges and foster economic growth. Greece has also begun to set up an Artificial Intelligence Centre of Excellence in Athens. The Centre is intended to become a global point of reference for document intelligence, connecting researchers, scientists and AI specialists with business experts from a wide range of industrial sectors, and using emerging technologies to accelerate innovation. This private-public initiative aims to help turn the country's 'brain drain' into a 'brain gain'.

Greece is committed to making progress on new digital technologies and investing in them through EU-coordinated programmes and plans. The country signed the European declaration on highperformance computing (HPC), joining the European effort to build the next generation of computing and data infrastructures. The National Infrastructures for Research and Technology (GRNET) coordinates a consortium of partners to create an HPC Competence Centre in Greece. It will enable the uptake of HPC technologies to advance competitiveness in research, improve effectiveness of government services and promote innovation in the industry. In 2021, the country announced plans to expand its hyper-computing system, ARIS (Advanced Research Information System).

In 2019, Greece signed the Quantum Declaration¹⁹⁶ of cooperation to develop and deploy a European Quantum communication infrastructure (EuroQCI). The country intends to develop its national and cross-border EuroQCI network both on the ground and in space. An important development in 2020 was the selection of the Helmos observatory¹⁹⁷ by the European Space Agency (ESA) as the first Optical Ground Station (OGS) for the 'Fibre in the Sky' project that will be part of the EuroQCI Greek national programme.

In December 2020, the Ministry of Digital Governance issued the 2020-2025 Cybersecurity Strategy¹⁹⁸, which sets out strategic objectives, priorities, and policy and regulatory measures to ensure a high level of security for national telecommunications and IT systems, and formed the National Cybersecurity Authority (NCSS). The NCSS fosters R&D investment and promotes local/regional start-up ecosystems and networking channels to support the implementation of the legal framework. The NCSS is actively pursuing collaborations with academic institutions and is already implementing framework agreements with academic departments of major Greek universities.

In Greece, nine Digital Innovation Hubs (DIHs) have been set up and are in operation, focusing mainly on research institutes. In September 2020, an open call for expression of interest for European Digital Innovation Hubs (EDIHs) was issued. To address the lack of an overarching

¹⁹⁷ <u>http://helmos.astro.noa.gr/index.html</u>

¹⁹⁶ <u>https://digital-strategy.ec.europa.eu/en/news/nine-more-countries-join-initiative-explore-quantum-communication-europe</u>

¹⁹⁸ <u>https://mindigital.gr/wp-content/uploads/2020/12/%CE%95%CE%98%CE%9D%CE%99%CE%9A%CE%97-</u> %CE%A3%CE%A4%CE%A1%CE%91%CE%A4%CE%97%CE%93%CE%99%CE%9A%CE%97-

<u>%CE%9A%CE%A5%CE%92%CE%95%CE%A1%CE%9D%CE%9F%CE%91%CE%A3%CE%A6%CE%91%CE%9B%CE%9</u> <u>5%CE%99%CE%91%CE%A3-2020-2025.pdf</u>

framework for organising, systematically monitoring, supporting and coordinating these hubs, concrete steps to develop a strong ecosystem in the country are being planned from Q2 2021. This includes setting up a network of Centres of Excellence (CoE) and EDIHs.

Creating a reliable, sustainable and coordinated network of DIHs to support the digital transformation of Greek enterprises by strengthening and utilising poles of digital innovation at national level would boost the digital transformation of the economy, covering a significant part of enterprises' digitalisation needs. Structural measures to create an environment conducive to digital innovation in the long-run (e.g. business R&D and public-private collaboration in research, networking, clusters and support for activities that allow innovations to reach the market) are needed, with a focus on SMEs.

Greece has also recognised the need for a national digital industrial strategy and for additional measures to create a favourable regulatory and investment framework to speed up the digitalisation of larger and smaller enterprises.

Integration of digital technology in Greece's Recovery and Resilience Plan

The plan includes significant measures to increase the digitalisation of Greek's enterprises, notably investments in the form of grants for the digital transformation of SMEs (budget EUR 375 million). The reforms and investments included in the plan are expected to help SMEs: take up digital technologies; adopt and develop innovative digital solutions tailored to the specific needs of their industries; expand their digital presence, for instance through participation in e-commerce platforms; and reduce their operating costs, through more efficient data processing. The plan also envisages a budget of EUR 330 million in Loan Facility funding for the digitalisation of SMEs and a budget of €770 million for the digitalisation of large enterprises. Finally, the plan also includes a measure called 'Accelerating Smart Manufacturing', which aims to provide financial support for small and medium manufacturing enterprises to enhance their technological infrastructure, upgrade their manufacturing equipment using state-of-the-art smart technologies with low environmental impact and ultimately accelerate the industry's transition to Industry 4.0.

4 Digital public services

4 Digital public	Greece		EU
services	rank	score	score
DESI 2021	26	41.9	68.1



	Greece			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	68%	68%	67%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	36	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	54	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	54	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	85%	78%
% maximum score			2020	2020

Greece ranks 26th in the EU on Digital public services. The open data maturity indicator shows that Greece, with 85% in 2020, performs well, exceeding the EU average of 78%. On active users of e-government services, at 67% Greece is above the EU average of 64%. However, with 36/100 pre-filled forms, Greece is well below the EU average (63/100). The availability of digital public services for both citizens and businesses remains low (54) compared to the EU average of 75 for citizens and 84 for businesses in 2020.

The modernisation of the public administration and the access to e-government services for all is high on the government's agenda. The focus is on increasing the interoperability and robustness of public IT systems, and on e-governance. The main goal is to make digital public services more accessible and usable for citizens and businesses, and to simplify and digitalise State governance and public services, to ensure that Greece is 'digital by default' by 2023.

In March 2020, the e-government portal 'Gov.gr' was launched as a central platform for government information and services with the aim of unifying all governmental services online. Since the beginning of 2020, a large number of procedures related to key life events, such as birth certificates, were simplified and digitalised. During the pandemic, Greece introduced an SMS lockdown permit service, recognised as OECD best practice. It also made registries interoperable in order to: create a unified social security fund (e-EFKA); digitise tax clearance for public procurement; and introduce a unified national e-pass for tolls on highways. It also managed to digitalise other key government certificates and services, making more digital public services available to citizens. There are currently more than 1 119 end-to-end digital government services hosted in gov.gr (starting from 501 services in March 2020). These and other public administration digitalisation measures have resulted in a significant uptake by users. Notably, in 2018 all digital transactions (logins and interactions) with the Greek government stood at 8.8 million, whereas in 2020 this increased 11-fold to 94 million.

In addition, to reduce physical presence in public centres and agencies because of the COVID-19 pandemic, the Ministry launched video call services to enable citizens and businesses to meet and

interact with civil service officials, such as the tax authority, 'KEP' (the Citizen Service Kiosk), consular offices around the world, and the national unemployment agency.

The 'Digital Cabinet' service has allowed the government to share various laws, bills, decrees, and other official documents digitally between Ministries and Parliament, and enabled Ministers to sign them even from their mobile phones.

Greece has yet to notify an electronic identification (eID) scheme under the eIDAS Regulation to the Commission, which is a pre-condition for the cross-border recognition of national eIDs. The procurement process for the Greek national eIDs is still ongoing. The expected actions on eID and trust services (such as electronic signature) are key steps for creating a trusted online environment for the public sector.

Greece shows a strong commitment to digitalising public services as well as State governance. Simplifying processes and reducing the administrative burden on people, enterprises and the public administration remains the biggest challenge. However, the swift implementation of digital services is expected to help increase competitiveness, productivity, investment as well as citizen engagement.

Highlight 2020-2021: The Greek digital vaccination platform

In 2021, Greece developed a digital-first vaccination platform which underpins its overall vaccination strategy. The architecture of this multi-channel platform comprises a central data warehouse that stores all data on vaccination shipments, the supply chain, appointments, and vaccination centres. It also features a public-facing vaccination website, including an open data section with information on the number of total jabs, daily jabs, and first and second doses, both at national and regional level. It also includes an online booking platform where people can book, amend, or cancel their appointments, an SMS notification service, and a booking platform for pharmacists. The vaccination platform accelerated the vaccination process, ensured accuracy, saved time and demonstrated how digitalisation can improve people's quality of life.

Digital public services in Greece's Recovery and Resilience Plan

E-government and the digitalisation of public services account for a large share of the digital budget, worth in total more than € 2.7 billion. Key investments and reforms include among others:

- The digitisation of archives in key services (justice, urban planning agencies, cadastre, immigration & asylum) and their integration in the relevant IT systems, coupled with system interoperability initiatives that allow the application of the 'once only' principle. This is the foundation for the digital transformation of public sector bodies and will help reduce the administrative burden on people and enterprises.
- Reforms and investments related to digital capacities and advanced technologies, such as measures on cloud infrastructures and cybersecurity.
- Investments in cloud computing and big data, in particular to link back-office and frontoffice processes and ensure the interoperability of systems, processes, applications and services.
- The development and implementation of a cybersecurity strategy to increase the reliability and security of public sector systems and data and improve the public's trust in interactions with the public sector. The strategy will include the creation of a National

Cybersecurity Operations Centre (SOC), and advanced security services in G-Cloud critical infrastructure to improve the security of the public sector's central infrastructures and information systems.

142

Spain

	Sp	EU	
	rank	score	score
DESI 2021	9	57.4	50.7



Spain ranks 9th among the 27 EU Member States in the European Commission's 2021 edition of the Digital Economy and Society Index (DESI). Spain is a strong performer in Digital public services thanks to the digital-by-default strategy throughout its central public administration. Spain also performs very well in Connectivity, although gaps between urban and rural areas remain. On Human capital, Spain ranks 12th and has been improving over the last few years, but there is still room for progress, especially on the Information and Communication Technologies (ICT) specialist indicator. Spain ranks 16th on the integration of digital technologies; its score is in line with the EU average and the increase in Small and Medium-size Enterprises (SMEs) selling online is significant. However, enterprises are not yet taking sufficient advantage of new technologies such as Artificial Intelligence (AI), big data and cloud, which could help further develop productivity and e-commerce. In 2020, Spain adopted a new and ambitious digital agenda, Digital Spain 2025¹⁹⁹, to promote Spain's digital transformation through a set of reforms up to 2025, as well as significant public and private investment. Additional specific plans have been launched under the agenda in areas such as human capital, connectivity, and digitalisation of business.

A National Digital Competences Plan²⁰⁰ was presented in early 2021, which includes an exhaustive set of measures to strengthen digital skills among the workforce and citizens in general. Spain is currently a medium performer on the human capital dimension and this strategy will help its population to make better use of the opportunities provided by the digital economy and society.

Spain performs very well in Connectivity and has improved considerably in fibre deployment, but the wide digital gap between urban and rural areas remains. Improved coverage would also support the digital transition of the Spanish farming sector and allow it to better monitor and optimise

 ¹⁹⁹<u>https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210204_Digital_Spain_2025.pdf</u>
 ²⁰⁰ <u>https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210902-digital-skills-plan.pdf</u>

agricultural production. In 2020, Spain launched the Strategy for the promotion of 5G²⁰¹ to improve spectrum assignment and management across pioneer bands and incentivise 5G deployment and use. Spain's Connectivity Toolbox roadmap includes several measures to reduce the cost of deploying broadband.

On the Integration of digital technologies by business, Spanish businesses are still not taking full advantage of the online economy and SMEs are lagging behind on digitalisation. Digital transformation and the uptake or deployment of emerging technologies can boost the innovative capacity of the Spanish economy, driven by SMEs; in 2021, Spain launched the SME Digitalisation Plan 2021-2025²⁰² to boost disruptive innovations and entrepreneurship in digital. The country also launched a National Strategy for Al²⁰³, and participates in significant large-scale European projects. In addition, Spain has adopted an ambitious digitalisation plan for SMEs, has boosted digital skills in education and employment, and has usefully prioritised RRF funding for that purpose with a strong set of coherent support actions.

Spain performs very well in e-government and continues to make progress with new developments, e.g. defining a reference framework to manage identification²⁰⁴ and cooperating with Germany on building an ecosystem of digital identities, including a cross-border pilot and an information exchange in the area of self-sovereign identity²⁰⁵. In 2020, Spain adopted a specific plan for the digitalisation of its public administration²⁰⁶ and a law on electronic trust services, and created the Data Office Division. In 2021, it also approved the Regulation of action and operation of the public sector by online communication.



²⁰¹<u>https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210204_Strategy_for_the_prom_otion_of_5G.pdf</u>

²⁰²<u>https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210902-digitalisation-smes-plan.pdf</u>

²⁰³ <u>https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/201202 ENIA V1 0.pdf</u>

²⁰⁴ <u>https://www.boe.es/boe/dias/2021/01/11/pdfs/BOE-A-2021-413.pdf</u>

²⁰⁵ <u>https://portal.mineco.gob.es/es-es/comunicacion/Paginas/210729_np_ecosistema.aspx</u>

²⁰⁶ <u>https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210902-digitalisation-of-public-admin-plan.pdf</u>
Digital in Spain's Recovery and Resilience Plan (RRP)

Spain's RRP, with a total budget of up to EUR 69.5 billion, contains an ambitious set of reforms and investments in digital. The RRP devotes 28.2% of the total investment to digital (exceeding the 20% target) with a total amount of EUR 19.6 billion.

There is a particular focus on promoting the digitalisation of businesses, including SMEs (25% of the total digital budget), strengthening the digital skills of the Spanish population (22%), improving digital connectivity in the whole of the country (15%), continuing the digitalisation of the public administration (28%), and supporting digital-related R&D and the deployment of digital technologies (10%).

The plan includes actions to further digitalise industries and business, with a specific focus on Spanish SMEs and micro-enterprises, to help them in the transition towards the digitalisation of productive processes and distribution channels.

To improve the population's digital skills, the RRP foresees specific measures to support the digitalisation of the education system, ambitious programmes to upskill and reskill the workforce, and specific initiatives to develop advanced digital skills in key technologies such as AI.

Despite being among the top performers in the EU in terms of Very High Capacity Networks (VHCN), Spain's RRP includes significant investments to close the existing digital divide between urban and rural areas in fixed and mobile broadband networks. Several measures specifically support 5G connectivity and the plan includes reforms to reduce costs and facilitate deployment.

There are also substantial investments to promote the digitalisation of the public administration and of the National Health Service and simplify public interactions with businesses and people in Spain.

The plan includes participation into Multi-Country Projects (MCP), including the Important Project of Common European Interest (IPCEI) on Microelectronics and Communication Technologies, the IPCEI Next Generation Cloud Infrastructure and Services, 5G corridors, and the Genome of Europe. In addition, Spain's RRP includes investments that are aligned to other European projects such as: High Performance Computing (HPC), EuroQCI (quantum computing and quantum information), digital innovation hubs, and cybersecurity operation centres.

1 Human capital

1 Human canital	Spain		EU
I numan capitai	rank	score	score
DESI 2021	12	48.3	47.1



	Spain			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	55%	57%	57%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	32%	36%	36%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	58%	59%	59%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	3.5%	3.6%	3.8%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	18%	20%	20%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	21%	22%	20%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	4.0% 2017	3.9%	4.2%	3.9%
% graduates		2018	2019	2019

On Human capital, Spain ranks 12th among the 27 EU countries. 57% of the people in Spain have at least basic digital skills, just above the EU average but still far from the target of 80% of the European population with at least basic digital skills by 2030²⁰⁷. In addition, 36% of the Spanish labour force still do not have basic digital skills²⁰⁸, hampering further digitalisation of businesses and uptake of advanced digital technologies. The proportion of ICT specialists increased to 3.8% of total employment in 2020; in 2018, the share of ICT graduates accounted for 3.5% of all graduates. Despite some progress, the shortage of ICT specialists is still a productivity constraining factor, especially for SMEs. The gender imbalance remains significant and female specialists only account for 20% of all ICT specialists (just above the EU average of 19%).

Supporting the digital skills of its population is among the 10 priorities of Spain's digital strategy, Digital Spain 2025²⁰⁹. This strategy acknowledges that the lack of digital skills, both basic and advanced, hampers the country's digital transformation. In early 2021, a specific National Digital Competences Plan²¹⁰ was adopted. To reach ambitious targets, in line with those set in the Digital Decade Communication for basic digital skills and ICT specialists, the strategy for digital skills contains seven action lines: 1) digital skills training, with special emphasis on population groups at risk of digital exclusion; 2) bridging the digital gender divide; 3) digitalising the education system and developing digital skills for learning; 4) digital skills training throughout working life (focusing on the working population in the private sector and the unemployed); 5) digital skills training for public

²⁰⁸ Data from Digital Agenda Key Indicators: <u>https://bit.ly/3qJ6pkZ</u>

²⁰⁷ Target defined in the European Pillar of Social Rights action plan.

 ²⁰⁹https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210204 Digital Spain 2025.pdf
²¹⁰ https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210902-digital-skills-plan.pdf

sector workers; 6) digital skills training for SMEs; 7) increasing the supply of ICT specialists (via vocational training and university education).

This plan is an essential instrument in promoting digital skills development in Spain. It will be critical for the acquisition of digital skills by people in Spain in general, and by workers and ICT professionals in particular. The strategy as a whole will benefit from a total investment of EUR 3.75 billion.

The Educa en Digital programme²¹¹, presented in June 2020, includes actions to foster further digitalisation of the Spanish education system, therefore promoting greater social inclusion. It has supported: the completion of a high-speed connectivity programme in public schools; provision of equipment for the most vulnerable people; and the modification of basic legislation on education, assigning a more relevant role to digitalisation in educational centres, both in the learning process and in the curriculum. In addition, amid the COVID-19 pandemic, the government launched a package of emergency actions in response to difficulties in distance teaching, making online training tools and open educational resources available to the educational community. It included actions to foster further digitalisation of the Spanish education system, thereby further supporting social inclusion.

Actions to upskill and reskill the Spanish workforce and tackle the existing shortage of ICT specialists in Spain are also ongoing. Multiple initiatives have been developed, including ones to promote the needs of SMEs, such as Digital Talent, or Digital Professionals, an initiative providing training and facilitating job placements in those areas where advanced digital skills are required.

In addition to these massive investments, public-private collaboration that aims to achieve the European targets for digital skills are of fundamental importance. AMETIC, the business association of the digital industry, is running the Spanish Digital Skills & Jobs Coalition²¹², encompassing more than 150 organisations (companies, public administrations, training centres and universities) active in promoting digital skills in Spain. In May 2021, the coalition launched the Spanish Digital Skills & Jobs Platform, which is connected to the European platform²¹³, as the one-stop-shop for information on digital skills and training materials in the Spanish context. AMETIC will also actively participate in the recently created Hub for Digital Skills, a public-private institutional associative body which will guide the implementation of the Spanish RRP and its actions for digital skills.

During the 2020 edition of Code Week, 1,126 events were organised in Spain; it attracted 90,469 participants, 43% of whom were women, and 57% of the activities were organised in schools.

The Talento Hacker initiative was launched in April 2021. This free cybersecurity training initiative, which aims to promote cybersecurity learning among different types of audiences, attracted a total of 1,258 teams and 437 individual registrations (5,341 participants) in its first edition.

Overall, sound implementation of the new plan and investments will most likely bring a lasting impact for the people in Spain and the country's economy. In a more digitalised society, focusing on the groups among the population that are the least likely to use digital technologies and boosting the participation of women in the digital economy will enable everybody to make the most of Spain's digital transformation. The special attention given to the upskilling and reskilling of the labour force, in both the public and private sectors, will allow Spain to tap into the potential of the digital economy, and therefore contribute to a robust recovery.

²¹¹ <u>https://www.educacionyfp.gob.es/en/prensa/actualidad/2020/06/20200616-educaendigital.html</u>

²¹² <u>https://ametic.es/en/prensa/ametic-lanza-la-web-digital-skills-and-jobs-coalition-spain-para-mejorar-las-competencias</u>

²¹³ <u>https://digital-skills-jobs.europa.eu/en/about/national-coalitions/spain-digital-skills-and-jobs-coalition</u>

Human Capital in Spain's Recovery and Resilience Plan

In Spain's RRP, the entirety of Component 19 - Digital Skills (EUR 3.59 billion) and parts of five other components support the acquisition of digital skills. This wide set of measures includes actions for specific groups and areas such as education, Vocational Education and Training (VET), the public sector and SMEs.

The main actions envisaged in the RRP are:

- The National Digital Competences Plan, which will act as a road map to identify and enact the necessary measures to ensure access and development of digital skills for all people in Spain.
- Transversal digital skills programmes, including: 1) development of a network of digital training support centres; 2) specific e-inclusion actions; 3) awareness-raising campaigns; 4) activities to increase digital skills of people in Spain in general; and 5) digital resources to disseminating and teaching Spainsh (EUR 735 million).
- Digital transformation of education, including 1) access to digital learning through the provison of electronic divises to students from vulnerable groups and an interactive digital system (IDS); and 2) a digital VET plan (EUR 1,412 million).
- Digital skills for employment by: 1) strengthening existing active labour market policies for skills and requalification, targeting employed and unemployed persons; 2) a digital training programme for public administrations; and 3) a programme for digital transformation and training in digital skills for SMEs (EUR 1,256 million).
- Investments for digital professionals, adapting the existing vocational training offer on advanced digital skills, and attracting and retaining talent in those fields (EUR 190 million).

2 Connectivity

2 Connectivity	Sp	pain	EU
2 00111001111	rank	score	score
DESI 2021	3	62.0	50.2



	Spain			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	77%	78%	82%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	30%	53%	65%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	<0.01%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	88%	90%	92%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	77%	89%	92%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	99.5%	99.8%	99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	30%	30%	65%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	13%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	80%	86%	86%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	52	73	69
Score (0-100)		2019	2020	2020

Spain's already high connectivity score has improved further, moving the country up to 3rd place in the EU. Spain performs particularly well in Very High Capacity Network (VHCN) coverage, as persistent gaps between urban and rural areas are starting to close.

Thanks to extensive fibre to the premises (FTTP) deployment, fixed VHCN covered 92% of households in 2020 (3 p.p. above the previous year) and well above the EU average (59%). The increase is sharpest in rural areas, where 64% of households are covered by fixed VHCN (12 p.p. above the previous year). NGA networks covered 92% of households, also above the EU average (87%). Overall fixed broadband take-up increased by 4 p.p., from 78% in 2019 to 82% in 2020. At least 100 Mbps broadband take-up increased from 53% to 65%, to almost double the EU average (34%) in 2020.

While Spain's 5G readiness stagnated at 30% of harmonised spectrum assigned, 5G networks covered 13% of households by June 2020, 1 p.p. below the EU average (14%). Spain published a new connectivity plan and 5G strategy²¹⁴ in December 2020 that aims to cover 100% of the population with more than 100 Mbps by 2025, in line with EU targets, and focusing on rural areas. The roadmap

²¹⁴ <u>https://portal.mineco.gob.es/es-es/comunicacion/Paginas/201201 np conectividad.aspx</u>

to implement the Connectivity Toolbox²¹⁵ includes several measures with the potential to reduce costs. The main measures include streamlining permit granting procedures, improving the single information point and increasing the transparency of physical infrastructure.

The national programme for the extension of next generation broadband networks (PEBA-NGA)²¹⁶, co-financed by the European Regional Development Funds (ERDF), has continued to finance the rollout of NGA networks in rural and less populated areas. In 2020, there was an adjustment of the ERDF, releasing all the amounts not committed or in the process of being committed, to cover urgent needs derived from the COVID-19 pandemic (EUR 94 million for the PEBA-NGA programme). The 2021 PEBA-NGA call aims to distribute EUR 38.76 million to broadband extension projects in 12 provinces.

In 2020, Spain released a Strategy for the promotion of $5G^{217}$ to improve spectrum assignment and management across pioneer bands, and to incentivise the deployment and use of 5G.

As of May 2021, the 3.4-3.8 GHz band was the only assigned 5G pioneer band in Spain (95% of the band). Spain is in the process of migrating the radars in the 3.4-3.8 GHz band and began the refarming process to allow for larger contiguous amounts of spectrum by 2021 or the beginning of 2022²¹⁸.

After delays due to the COVID-19 pandemic, the government published the auction for the 700 MHz band²¹⁹ on 31 May 2021, which was completed on 21 July 2021. Operators are experimenting with using the 26 GHz band, but the band assignment is expected for the second half of 2022.

By Royal Decree 7/2021²²⁰ of 27 April 2021, Spain makes it possible to extend the duration of individual rights of use for radio spectrum from 20 to 40 years for new assignments. The four largest mobile operators have launched commercial 5G services and have announced plans to continue deploying 5G in the main cities. Moreover, operators are involved in several trials, some subsidised by the government, to test support for connectivity-intensive applications.

Market and Regulatory Developments

Telefónica, Orange and Vodafone continue to dominate the Spanish broadband market, despite the decrease in their joint share of fixed broadband lines (from 85% to 82%) between Q4 2019 and Q4 2020. This is due to gains made by MasMovil and Euskatel, which held over 12% and 4% of the market in Q4 2020, respectively. Euskatel reached several wholesale access agreements to provide services beyond northern Spain under its new nationwide brand, Virgin Telco. On 28 March 2021, MasMovil²²¹ announced a takeover bid²²² for Euskatel. In January 2021, Telefónica announced the sale of its tower division, Telxius²²³, to American Towers Corporation (ATC).

In 2020, 97.1% of broadband residential lines and 95.8% of broadband business lines were retailed as part of a bundle. Fixed mobile convergent bundles (6.5 million of 4P and 6.2 million

economicos/Paginas/2021/310521-despliegue 5g.aspx

²²² CNMC unconditionally cleared this bid in June 2021.

²¹⁵ <u>https://digital-strategy.ec.europa.eu/en/library/connectivity-toolbox-member-states-develop-and-share-roadmaps-toolbox-implementation</u>

²¹⁶ <u>http://www.mincotur.gob.es/PortalAyudas/banda-ancha/Paginas/Index.aspx</u>

²¹⁷ https://portal.mineco.gob.es/RecursosNoticia/mineco/prensa/noticias/2020/201201_np_impulso5G.pdf

²¹⁸ <u>https://www.boe.es/buscar/doc.php?id=BOE-A-2020-8286</u>

²¹⁹ <u>https://www.lamoncloa.gob.es/serviciosdeprensa/notasprensa/asuntos-</u>

²²⁰ <u>https://www.boe.es/diario_boe/txt.php?id=BOE-A-2021-6872</u>

²²¹ https://www.grupomasmovil.com/wp-content/uploads/2021/03/Ndp_MASMOVIL_Euskaltel.pdf

²²³ The sale was confirmed on 1 June 2021.

of 5P) account for more than 80% of the fixed broadband market.

On May 5 2021, MasMovil announced it was selling its majority stake in the FTTH network to Onivia²²⁴ (owned by the investment funds Macquarie, Aberdeen and Daiwa). The market share of wholesale-only operators is increasing, though it is not very representative.

The transposition of the European Electronic Communications Code has been delayed and the Commission has sent Spain a letter of formal notice. To address the delay, Spain intends to fast-track the General Telecommunications Law that is currently in progress, the final approval of which is expected only by Q2 2022.

In 2020, Spain's national regulatory authority, Comisión Nacional de los Mercados y la Competencia (CNMC), adopted two decisions to update the economic replicability test for Telefónica's broadband products in the residential segment²²⁵. The second decision led to a 5% decrease in the price of Telefónica's fibre services (NEBA local and NEBA fibre). On 13 May 2021, CNMC approved the Resolution reducing monthly capacity-based prices for Telefónica's wholesale indirect access broadband services (NEBA) by 21.2% until the end of 2021 and by another 11.7% starting in 2022²²⁶. On 23 April 2021, CNMC notified reduced prices for access to Telefónica's civil infrastructure wholesale offer regarding manholes and conduits (MARCo)²²⁷.

In the fourth review of the wholesale local access market (market 1/2020, formerly 3a/2014) and wholesale central access market (market 3b/2014), CNMC proposed to increase from 66 to 624 the number of municipalities (corresponding to approximately 70% of the Spanish population) where Telefónica is not obliged to provide access to its fibre network.

On 22 December 2020, CNMC opened a public consultation on the fourth review of market 4/2014²²⁸ (currently market 2/2020). As Telefónica continues to have significant market power, the regulator proposes to maintain most of the current obligations.

Due to the COVID-19 pandemic, CNMC had to delay by several months the dates for the planned copper phase-out in 569 main distribution frame (MDF) sites with a switch-off date in 2020²²⁹.

Spain reported a 13% decrease in consumer complaints in 2020. The main sources of complaints were pricing and billing (36.1%), followed by contract termination (22%).

The Ministry asked operators to modify their zero rating offers to comply with the European Union Court of Justice judgment from 15 September 2020²³⁰.

The legislation on access to 112 services is currently under review and Advance Mobile Location (AML) deployment is in progress. In January 2020, the Spanish Ministry of the Interior deployed an emergency app (Alertcops App) with location and chat functions promoting equivalent access for end users with disabilities²³¹.

²²⁴ <u>https://www.reuters.com/article/spain-masmovil-onivia-idUSL8N2MS6H3</u>

²²⁵ https://www.cnmc.es/node/385225

²²⁶ https://www.cnmc.es/expedientes/ofedtsa00520

²²⁷ <u>https://www.cnmc.es/consultas-publicas/telecomunicaciones/consulta-publica-precios-oferta-marco</u>

²²⁸ <u>https://www.cnmc.es/prensa/consulta-publica-mercado-4-empresarial-cnmc-20201222</u>

²²⁹ By June 2021, more than 700 sites had already been decommissioned and the current switch-off schedule includes more than 3 000 sites.

²³⁰ <u>https://curia.europa.eu/jcms/upload/docs/application/pdf/2020-09/cp200106en.pdf</u>

²³¹ <u>https://alertcops.ses.mir.es/mialertcops/en/index.html</u>

Spain continues to be among the top performers in the roll-out of fixed VHC networks and take-up of ultra-fast broadband connections (>100 Mbps). An ambitious national connectivity plan promises to tackle persistent gaps between urban and rural areas and a complementary 5G strategy has been put forward to accelerate 5G deployment. Delayed spectrum assignment has been the biggest barrier to 5G deployment in Spain, but a reorganisation of the 3.4-3.8 GHz band and the recently completed auction of the 700 MHz band are likely to increase the country's 5G readiness within the year.

Connectivity in Spain's Recovery and Resilience Plan

Component 15 of Spain's RRP is dedicated to supporting the digital connectivity of the country and related uptake. This component contains an ambitious set of reforms and investments in connectivity in general, and 5G in particular, aligned with the digital connectivity and infrastructure plan and with EU targets.

Some of the main reforms and investments set out within the plan on connectivity and 5G are:

- Reforms to the telecommunications regulatory framework and implementation of the 5G roadmap, assigned to digital public services in Spain's plan, including measures on managing and assigning spectrum, reducing burdens on deployment and support for local authorities.
- Promoting territorial cohesion through ultra-fast broadband connectivity (above 100 Mbps) to those areas, mainly rural areas and areas of historical value, which currently do not have such connectivity (EUR 812 million).
- Strengthening connectivity in centres of reference, socio-economic drivers and sectoral digitalisation projects (EUR 480 million), through specific actions including: 1) measures to enhance connectivity in focal points and public services; and 2) measures providing gigabit connectivity and support for some key sectors.
- Infrastructure renewal and sustainability, by improving equipment that enables optimal deployment of VHCN in existing buildings and optimising the deployment of NGA networks in a sustainable way (EUR 80 million).
- 5G networks deployment, technological change and innovation (EUR 1,405 million), including actions in the following areas: 1) main transport corridors; 2) some areas not covered by obligations included in spectrum assignment procedures; 3) key economic activities and essential services; and 4) support to 5G and 6G related R&D, for innovation ecosystems and 5G cyber security ecosystems.
- The plan includes a multi-country project (MCP) to deploy the 5G network along the cross-border corridors with Portugal and France.

3 Integration of digital technology

3 Integration of	Spain		EU
digital technology	rank	score	score
DESI 2021	16	38.8	37.6



		EU		
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	62% 2020	60% 2020
3b1 Electronic information sharing	46%	43%	43%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	28%	29%	29%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	11%	11%	9%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	16%	16%	22%	26%
% enterprises	2018	2018	2020	2020
3b5 AI % enterprises	NA	NA	22% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	76% 2021	66% 2021
3b7 e-Invoices	33%	33%	33%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	18%	19%	24%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	10%	9%	10%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	7%	7%	7%	8%
% SMEs	2017	2019	2019	2019

Spain ranks 16th among EU countries for the Integration of digital technology in business. 62% of Spanish SMEs have at least a basic level of digital intensity, in line with the EU average (60%), 24% sell online (an increase of 5 p.p. compared with the previous year and 7 p.p. above the EU average), but only 7% sell across borders within the EU. 10% of SMEs' turnover is generated by online sales.

43% of Spanish enterprises have an electronic information sharing system in place (the EU average is 36%) and 29% use social media to promote their products and services (against an EU average of 23%). 22% of enterprises use cloud services (against an EU average of 26%), 22% use AI, but only 9% rely on big data analysis. 76% of enterprises have a medium or high intensity of green actions through ICT (above the EU average of 66%).

In July 2020, Spain presented its new digital strategy, Digital Spain 2025, promoting the country's digital transformation through public-private collaboration and with the participation of all economic and social agents in the country. Under this strategy, in January 2021 Spain published the SME

Digitalisation Plan 2021-2025²³² to boost disruptive innovations and entrepreneurship in digital fields. It included five main action lines: 1) basic digitalisation for SMEs; 2) supporting the management of digital change; 3) advancing disruptive innovation and entrepreneurship; 4) supporting sectoral digitalisation, with a special focus on industry, tourism and trade; and 5) ensuring coordination and efficiency. In addition, the strategy Spain Entrepreneurial Nation²³³ aims to boost Spain's business ecosystem in all sectors.

In December 2020, Spain presented a national AI strategy²³⁴ that aims to: 1) foster scientific research, technological development and innovation in AI; 2) promote digital skills, boost national talent and attract global talent; 3) develop data platforms and technological infrastructure supporting AI; 4) integrate AI into value chains to transform the economic fabric; 5) promote the use of AI in the public administration and national strategic missions; and 6) establish an ethical and regulatory framework that ensures the protection of individual and collective rights, so as to guarantee inclusion and social welfare.

In 2021, Spain has published a call for projects that use AI to solve strategic challenges in areas such as healthcare, employment, energy, environment and agri-food²³⁵, and has also been very active with the EuroHPC Joint Undertaking, promoting the participation of the main Spanish research institutions in its R&D calls²³⁶. Spain has also approved the multi-annual agreement for the HPC National Centre (BSC - CNS) for 2020-2029, reflecting a budgetary commitment to the EuroHPC Joint Undertaking of EUR 63 million, as well as the new Strategic Plan for the Spanish supercomputing network (RES) for 2021-2024.

On cybersecurity, Spain has developed a significant number of coordination measures. In 2020, it launched the National Guide to Notification and Management of Cyber Incidents, designated the National Cybersecurity Institute (INCIBE) as the National Coordination Centre, and launched the National Cybersecurity Forum and the 017 cybersecurity helpline.

Regarding data economy, cloud and edge computing, in 2020 Spain joined the GAIA-X²³⁷ Governmental Advisory Board and is now working with the industry to create the Spanish hub of GAIA-X. This will boost the development of a data sharing ecosystem that enables entities and individuals to control access and re-use of their data²³⁸.

Spanish businesses still have plenty of scope to take advantage of the benefits of digitalisation and new technologies, especially SMEs and micro-enterprises. The significant increase in SMEs selling online reflects the fact that consumer behaviour is changing and is more demanding as regards new online products and services. Al and other emerging technologies can act as a catalyst for SMEs to improve productivity and scalability.

Highlight: The role of Artificial Intelligence in Spain's digital transition

²³² <u>https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210902-digitalisation-smes-plan.pdf</u>

²³³<u>https://www.lamoncloa.gob.es/temas/espana-nacion-</u>

emprendedora/Documents/ENE Resumen%20ejecutivo.pdf

²³⁴https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/201202_ENIA_V1_0.pdf

²³⁵ <u>https://portalayudas.mineco.gob.es/misiones-ia-2021/Paginas/Index.aspx</u>

²³⁶ The Agencia Estatal de Investigación is awarding grants to 17 Spanish groups participating in 10 projects approved under the EuroHPC 2019 calls, with a budget of about EUR 6 million.

²³⁷ <u>https://gaia-x.eu/</u>

²³⁸ <u>https://portal.mineco.gob.es/es-es/ministerio/participacionpublica/consultapublica/Paginas/mdi-gaiax.aspx</u>

In 2020, Spain adopted a national AI strategy as part of its new digital agenda, Digital Spain 2025. This strategy aims to integrate AI into value chains and create an environment of trust around inclusive and sustainable AI.

The strategy seeks to boost research and the use of reliable AI to serve economic and social development through a set of initiatives including, among others: promoting new national multidisciplinary technological development centres; and creating support programmes for companies to develop AI solutions and data.

Spain is introducing consistent, coherent measures to take advantage of AI and advanced data analysis, which are key enablers for competitiveness and successful digital transformation.

Integration of digital technology in Spain's Recovery and Resilience Plan

Spain's RRP devotes substantial investment to the digitalisation of SMEs within Component 13, but also includes several measures to foster digitalisation and the integration of digital technology in Spanish industry in general (Component 12) and the tourism sector in particular (Component 14); the RRP also promotes key technologies such as AI (Component 16). Other sectoral components often include specific measures to support the digitalisation of the sector.

Some of the most important reforms and investments relating to digitalisation of businesses are:

- Promoting digitalisation and innovation among SMEs through a set of measures to provide them with digital tools, boosting digitalisation and technological innovation. More specifically, these measures include 1) a digital toolkit, and 2) concrete programmes, namely: "Actors of Change"; "SMEs 2.0 Accelerators"; "Innovative Business Clusters Support"; and "Digital Innovation Hubs" (total budget of EUR 3.5 billion).
- Concrete investments in tourism, to promote digitalisation of tourist destinations and businesses and introduce an intelligence system based on data economy and interoperability (EUR 337 million).
- A programme to promote, modernise and digitalise the audio-visual sector (EUR 155 million).

The plan also includes measures aimed at supporting the deployment of advanced technologies that would contribute to the integration of digital technology:

- Investments to foster disruptive innovation and data spaces in strategic industrial sectors (except tourism), including agri-food, sustainable mobility, health and retail, among others (EUR 400 million).
- Investments aimed at developing the cybersecurity capacities of people in Spain, SMEs and professionals, boosting Spain's cybersecurity ecosystem as part of the European digital sovereign strategy (EUR 524 million).

As regards digital-related investment in R&D, the plan includes Spain's national AI strategy (EUR 500 million), which contains: 1) a regulatory and ethical framework; 2) R&D&I activities; 3) measures to attract talent; 4) promotion of data and technology infrastructure; and 5) integration of AI into SMEs' value chains.

Spain's RRP is very ambitious as regards participation in MCPs such as the IPCEI on Microelectronics and Communication Technologies, IPCEI Next Generation Cloud Infrastructure

and Services, and the Genome of Europe. The plan includes investments that are aligned to other European projects like HPC, EuroQCI, digital innovation hubs, and cybersecurity operation centres.

4 Digital public services

4 Digital public	Spain		EU
services	rank	score	score
DESI 2021	7	80.7	68.1



	Spain			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	65%	63%	67%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	78	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	82	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	94	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	94%	78%
% maximum score			2020	2020

Spain ranks 7th in the EU for digital public services, well above the EU average. Indicators show a high level of online interaction between public authorities, citizens and business. 67% of Spanish online users engage actively with e-government services, compared with a 64% EU average. On the indicator for pre-filled forms (measuring the re-use of information across administrations to make life easier for individuals), Spain scored 78 points, well above the EU average of 63, even though the system in Spain works differently as it does not ask the individual for information that can be obtained through back-end structures. On digital public services for citizens, Spain scores 82 for citizens (against the EU average of 75) and 94 for business (against 84). Spain performs very well on the open data indicator, with a score of 94% (16 p.p. above the EU average).

In the Digital Spain 2025 strategy, the fifth priority is to promote the digitalisation of public administrations, which was made concrete in 2020 in a specific Plan for the Digitalisation of Spain's Public Administration²³⁹. This plan aims to have, at the least, 50% of all digital public services available through mobile handsets by 2025, leading towards greater personalisation and better user experience, and to increase the effectiveness, efficiency and transparency of the public sector. The plan envisages modernising the central state administration, with a specific focus on key areas such as health, justice and employment, and strengthening the digitalisation of regional and local administrations. In doing so, it aims to make the public sector a catalyst for technological innovation.

In 2020, Spain adopted a law on electronic trust services²⁴⁰, repealing the previous law on electronic signature and complementing existing regulations in the field. The law recognises that some remote identification methods could offer an equivalent level of trust to physical presence and establishes a series of obligations that trust service providers must meet.

²³⁹ <u>https://portal.mineco.gob.es/RecursosArticulo/mineco/ministerio/ficheros/210902-digitalisation-of-public-admin-plan.pdf</u>

²⁴⁰ https://www.boe.es/eli/es/l/2020/11/11/6

In 2020, Spain also launched the first global standard on decentralised digital identity management, based on blockchain and distributed ledger technologies (DLT), and is cooperating with Germany on building an ecosystem of digital identities, including a cross-border pilot and an information exchange for self-sovereign identity. Findings from the pilot project could be incorporated into the upcoming toolbox to implement the European digital identity framework.

In 2021, Spain approved the regulation of the public sector's actions and operations by electronic means²⁴¹, with the aimed of improving administrative efficiency, increasing transparency and participation, guaranteeing easily usable digital services, and improving legal certainty.

Spain also created, in 2020, the Data Office Division²⁴² to facilitate the sharing and re-use of public data by people in Spain and enterprises, and launched the initiative 'Setting up European Blockchain Service Infrastructure (EBSI) compliant nodes and case uses in Spain' (as part of the European blockchain strategy to connect legacy/national systems to the EBSI network). Spain is at the forefront in e-government and digital public services within the EU and continues to update its services and infrastructure to respond to the rapid evolution of technology and citizens' needs. Interoperability at national, regional and local levels is now key to ensuring a smooth digital transition between administrations to achieve synergies and avoid overlaps.

Digital public services in Spain's Recovery and Resilience Plan

Digital public administration and services will be supported and driven forward through reforms and investments included in Component 11 and, partly, through many other components dealing with digitalisation of the health system; transport infrastructures and services; energy; natural resources; tourism; culture; sport; and other public and social services in general. Some of the main measures included in the plan for digital public administration are:

- Reforms to modernise and digitalise the administration in general, including specific reforms in areas such as justice and national public procurement.
- Investments to modernise the general State administration through: 1) citizen-oriented administration and improvement of interopeability and digital public services provided to citizens and businesses; 2) smart operations and data government (i.e. procurement management); and 3) digital infrastructure and cybersecurity (EUR 960 million).
- Specific measures to digitalise the central government in: 1) the health system; 2) the justice system; 3) public employment services; 4) inclusion, social security and migration; 5) consular services; and 6) pilot initiatives for security and agriculture (EUR 1,205 million).
- Investment in digital transformation and modernisation of the Ministry of Territorial Policy and the Civil Service and of the administration of the Autonomous Communities and local authorities (EUR 1,000 million).

²⁴¹ https://www.boe.es/eli/es/rd/2021/03/30/203

²⁴² https://www.boe.es/eli/es/o/2020/07/31/etd803

	Fin	EU	
	rank	score	score
DESI 2021	2	67.1	50.7



Finland ranks 2nd out of the 27 EU Member States in the European Commission's 2021 edition of the Digital Economy and Society Index (DESI). Finland continues to lead in human capital, integration of digital technology and digital public services, improving its scores in several DESI dimensions.

Finland excels in the availability and use of e-government services with high take-up by the public.

Finland strongly supports digital skills: the proportion of ICT graduates in the total number of graduates is almost double the EU average (7.4% vs. 3.9%), and almost twice as many enterprises provide ICT training (38% vs. 20% in EU). This is insufficient, however, as 59% of companies trying to recruit ICT specialists report hard-to-fill vacancies (EU 55%). These shortages could negatively affect the digitalisation of Finnish businesses.

Finland ranks 13th in connectivity with 57% overall fixed broadband take-up. This is partly due to the high usage of mobile internet in Finland, with 4G networks close to saturation in certain areas and a lead in 5G readiness with commercial deployments under way. A significant urban-rural divide exists, as does a gap characterised by low population density and vast areas with comparatively low economic incentive to roll out connectivity networks. The overall fixed very high-capacity network (VHCN) coverage is 67% (against 59% for the EU average), but this is very low (9.36%) in rural areas (27.8% EU average). Finnish SMEs perform well on a basic level of digital intensity and uptake of advanced technologies. Finland is well above the EU average in the integration of digital technology by businesses: 88% of Finnish SMEs have at least basic level of digital intensity (compared to the EU average of 60%), and 62% of all enterprises use cloud solutions, significantly more than the EU average (26%). Digital innovation hubs could expand business opportunities by linking up to European innovation hubs.

Several strategic programmes adopted in 2020 provided new impetus to digital policies. In February 2021, the government published the digital progress programme²⁴³ as a framework for increasing the digital capabilities of the public sector and developing cooperation between the public and

²⁴³ <u>https://vm.fi/digitalisaation-edistamisen-ohjelma</u>.

private sector. In October, Digivisio 2030²⁴⁴ set out an implementation model and principles for deepening the digitisation of higher education institutions in Finland. In November, Finland updated its AI strategy with the artificial intelligence 4.0 programme²⁴⁵ to encourage the development and use of AI in companies.



Digital in Finland's Recovery and Resilience Plan-(RRP)²⁴⁶

In Finland's RRP, the contribution to digital objectives accounts for EUR 574.3 million, which represents 27.5% of the total allocation RRP. The focus of the plan is on public digital services, digital skills and digital transition of economy.

In the area of digital public services, measures include digitalisation in health and employment services, digitalisation of rail systems and the implementation of smart energy grids (in total over EUR 332 million).

Finland will also invest in data-driven innovation (EUR 37 million), cybersecurity (EUR 20 million), connectivity in the areas where the market mechanism cannot deliver (EUR 50 million), digital skills at various stages of education and life, and related digital public services (over EUR 50 million), deployment of advanced technologies and digital R&D&I (EUR 43 million), and the digitalisation of businesses, including SMEs, innovation infrastructures, and grants for businesses development (EUR 40 million). The Finnish RRP includes funds for the enterprises to participate in a multi-country project: the Important Project of Common European Interest (IPCEI) for microelectronics.

https://digivisio2030.fi/.

²⁴⁵ <u>https://tem.fi/en/-/artificial-intelligence-4.0-programme-to-speed-up-digitalisation-of-business.</u>

At the time of writing, the plan was approved by the Commission and is pending adoption by the Council: <u>https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility/recovery-and-resilience-plan-finland_en.</u>

1 Human capital

				Tunia
1 Human canital	Fin	land	EU	80
I numan capitai	rank	score	score	60
DESI 2021	1	71.1	47.1	40
				20



	Finland			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	76%	76%	76%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	45%	50%	50%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	76%	77%	77%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	6.7%	6.8%	7.6%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	20%	21%	23%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	36%	37%	38%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	6.3%	7.0%	7.4%	3.9%
% graduates	2017	2018	2019	2019

Finland ranks 1st out of the 27 EU countries when looking at human capital. Its digital skills level is well above the EU average: 76% have basic skills and 50% have above-basic skills (against EU average levels of 56% and 31%, respectively). The proportion of employed people working as ICT specialists has increased to 7.6%, continuing to top EU rankings in this indicator. Finland's proportion of female ICT specialists is slightly above the EU average, at 23% (EU 19%). ICT graduates in Finland account for 7% of the total number of graduates, close to twice the EU average (3.6%). Almost twice the share of enterprises provides ICT training to their employees in Finland compared to the EU average. However, 59% of companies trying to recruit ICT specialists report hard-to-fill vacancies (EU 55%).

In 2020, Finland was managing the challenges of the COVID-19 crisis in education²⁴⁷. Schools and universities were closed from March 2020, prompting the replacement of in-person schooling by distance learning. The platforms and applications²⁴⁸ that schools were already using before the pandemic proved useful. To level up opportunities for all pupils, private companies were urged to donate laptops to students as part of the Device for All campaign²⁴⁹. Several companies provided e-learning materials at koulu.me with certified, free-of-charge, high quality pedagogical content crafted for distance learning.

²⁴⁷ <u>https://op.europa.eu/webpub/eac/education-and-training-monitor-2020/countries/finland.html.</u>

²⁴⁸ Examples: Helmi, Wilma, Studentaplus and Sopimuspro.

²⁴⁹ <u>https://www.oph.fi/fi/uutiset/2020/kaikille-kone-kampanja-haastaa-yritykset-lahjoittamaan-tarpeettomia-tietokoneitaan.</u>

Finland participated in the 2020 edition of EU Code Week, with 38 activities bringing together 3 000 of the overall 3.4 million participants²⁵⁰.

In higher education, the LUMA centre (an organisation boosting cooperation between schools, universities, and business) continued to motivate children to study STEM through the most up-todate pedagogical methods. The implementation of the LUMA2020 programme²⁵¹ supports lifelong learning for teachers and strengthens research-based teaching. In addition, the finna.fi search service that has previously brought together Finnish cultural and scientific material now offers new learning opportunities with open source, free educational resources. Digivisio 2030 is another long-term project prepared in 2020 to ensure flexible learning in Finnish higher education.

Digital skills feature in the continuous learning reform²⁵² that the Finnish Parliament adopted in December 2020. This promotes opportunities for working age people to develop their competences and supports the availability of skilled labour. A digital service will be introduced that combines education and training, guidance and information on the labour market. The package includes mapping and identifying competence and career planning services as well as looking ahead to potential future opportunities. A set of intelligent e-services will operate as a platform for a continuous learning system.

Finland announced the simplification of administrative procedures, with an online service platform that brings together public and private services for foreign workers arriving in Finland. This is expected to include information on labour market opportunities, matching potential workers and employers, reliable sharing of data between the parties on the platform, and assistance in managing the administrative process. The project aims to help companies recruit ICT specialists for hard-to-fill vacancies.

Highlight: Digivisio 2030

The Digivisio 2030²⁵³ project is one of the decade's most significant digitalisation projects for higher education institutions in Finland. It aims to ensure flexible learning opportunities and improve the competitiveness of the higher education institutions globally. All higher education institutions pledged their contribution to the project in February 2020, agreeing on the project's implementation model and principles. The Ministry of Education and Culture has granted EUR 20 million as initial funding for the project, allocating a further EUR 17.8 million in strategic funding for 2021-2024.

Human Capital in Finland's Recovery and Resilience Plan

Several measures foster digital skills in the Finnish RRP. The plan includes a reform of continuous learning with a focus on vocational training (EUR 4,5 million). This is complemented by a targeted measure for Åland islands expected to introduce student-centred digital education in all higher education studies and to introduce new study programmes in particular

²⁵⁰ <u>https://digital-strategy.ec.europa.eu/en/news/eu-code-week-organisers-register-over-72000-activities-second-year-row</u>.

²⁵¹ <u>https://www.luma.fi/en/news/2020/12/17/national-development-program-luma2020-brought-new-openings-materials-and-inspired-collaboration-between-schools-universities-and-industry/</u>.

²⁵² <u>https://minedu.fi/en/-/common-policies-adopted-for-reforming-continuous-learning-securing-the-future-</u> with-competence.

²⁵³ <u>https://digivisio2030.fi/</u>

in the field of digitalisation and automation (EUR 2,4 million).

The plan, under the umbrella of digital public services, foresees a comprehensive digitalisation programme of the education, training and skills development system (EUR 46 million), which is expected to harness digital tools to raise Finland's level of digital competences and increase the effectiveness of the higher education system.

In the field of advanced technologies, an investment of 5 million has the objective to increasing basic cybersecurity skills of the general population through the creation of a common digital platform for teaching and developing cybersecurity skills. Another measure, also worth EUR 5 million, will fund cybersecurity exercises for at least 2,000 public officials.

2 Connectivity

2 Connectivity	Fin	land	EU
,	rank	score	score
DESI 2021	13	51.3	50.2



	Finland			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	58%	57%	57%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	21%	23%	26%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	0.90%	0.95%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	74%	75%	75%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	31%	62%	67%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	>99.9%	>99.9%	>99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	67%	67%	99%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	12%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	74%	NA	NA	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	75	75	69
Score (0-100)		2019	2020	2020

With an overall score of 51.3, Finland ranks 13th in the EU for Connectivity. Finland has a significant divide regarding fixed network coverage, which may be explained by the lack of economic incentives to roll out network in its sparsely populated areas. While Finland has very good total fixed very high-capacity network (VHCN) coverage (67% compared with an EU average of 59%), it scores low (9.3%) in rural areas (27.8% EU average). 'Fibre to the premises' coverage stood at 37.7%, below the EU average (of 42.5%) and almost on a par with cable networks upgraded to DOCSIS 3.1 (37.8%). The figures suggest that the two kinds of VHCN are complementary rather than in competition with each other.

Despite the good availability of VHCN, fixed broadband take-up is low at all speeds: 57% of households used fixed broadband (compared with an EU average of 77% of households), 26% of households had fixed broadband at 100 Mbps (compared to an EU average of 34%) and only 0.95% of households had fixed broadband at 1 Gbps (compared to an EU average of 1.3%). The low take-up does not appear to be correlated with price. Finland's broadband prices are good compared to those in other EU countries: its broadband price index stood at 75, above the EU average of 69. The low

take-up of fixed broadband may be explained by the choice of a considerable number of end users to switch to mobile broadband instead (fixed-to-mobile substitution)²⁵⁴.

5G commercial service provision is available in several parts of the country. In 2019, operators began deploying networks in the 3.4-3.8 GHz spectrum band in mainland Finland. Commercial service provision expanded in Finland since 2019. The available 5G networks covered 12% of the country as of mid-2020²⁵⁵.

Finland's national broadband plan, the digital infrastructure strategy, is being implemented. Finland is currently focusing on delivering at least the gigabit connectivity objectives. By 2025, all Finnish households should have access to a connection of at least 100 Mbps and it should be possible to increase connection speed to 1 Gbps.

The government has reserved EUR 5 million for 2021 to implement its national broadband plan. In addition, for very high-capacity connections in rural areas, resources from the European Agricultural Fund for rural development will also be available for 2021-2027. Decisions regarding the total amount of funds have not been made yet.

Finland has assigned 99% of the spectrum harmonised at EU level for wireless broadband. The 26 GHz spectrum was auctioned in June 2020. The winning bidders got 800 MHz of spectrum for EUR 7 million each: Elisa Corporation won the 25.1 - 25.9 GHz block, Telia Finland Oyj won the 25.9 - 26.7 GHz block and DNA Plc won the 26.7 - 27.5 GHz block. The 24.25 - 25.1 GHz frequency band was set aside from the auction, expected to be licenced for private local 5G networks in early 2021.

The 700 MHz band was auctioned in 2016 and is widely used for long-term evolution (LTE). The 3.4-3.8 GHz band was auctioned in 2018 and is currently used to offer 5G commercial services in several parts of the country as indicated above. Some spectrum coordination issues with a non-EU country have nevertheless been reported in the eastern part of the country. However, a new coordination Agreement regarding the 3.6-3.8 GHz band was signed in spring 2021, which reportedly improved the situation.

Main market & regulatory developments

In 2020, two new market players entered the Finnish telecommunications market: Valokuitunen Oy and Global Connect Finland. The former is a joint venture owned by CapMan Infra (60%) and Telia (40%). It has acquired Telia's open fibre networks and announced its intention to build open fibre networks for 200,000 households in the coming years, mainly in suburban areas with single dwelling houses.

Global Connect Finland is a Swedish fibre-based data communication and data centre services provider. Focusing on wholesale business customers, they intend to build fibre networks and provide high-performance connectivity and data storage services.

²⁵⁴Mobile broadband take-up stands above the EU average (it was already at 74% in 2018, before the EU average reached 71% in 2019)

²⁵⁵ According to Traficom, at the end of 2020, 100 Mbps 5G connections were available to 67% of Finnish households, covering slightly more than 2% of the country's land area. Meanwhile, mobile networks offering speeds of 300 Mbps were available to 60% of households in about 1% of Finland's land area.

In terms of consumption patterns, the COVID-19 crisis increased the use of electronic communications services: the use of mobile data increased by 15% and mobile phone call minutes by 17%.

The Finnish voice call market features fixed-to-mobile substitution, with only 249,000 fixed telephone lines left in Finland, while the number of mobile subscriptions stands at 9.23 million.

The operators Elisa, Telia and DNA are the main market players in the fixed business market. Their national market shares for fixed broadband connections are Elisa 33%, DNA 31%, Telia 25%, Finnet Group 8% and others 3%.

Competition dynamics vary depending on the geographic area. While the three main operators still have high retail market shares in many regions, there is more competition in the Helsinki area, featuring increasing Fibre To The Building (FTTB) deployment by alternative operators.

On 18 January 2021, Finland notified the Commission of its complete transposition of the European Electronic Communications Code into national law. The Commission is assessing the completeness of the national implementing measures.

As for market regulation, Traficom reported that it is planning a new market analysis for markets 3 and 4 for wholesale high-quality access provided at a fixed location in the 2014 Recommendation on relevant markets.

On 12 November 2020, the highest administrative court decided to partly annul FICORA's decision from 2018 on significant market power in market 3a (market for wholesale local access provided at a fixed location) in relation to Elisa. The Court found that Ficora's decision was insufficiently reasoned. It held that the decision should have considered more precisely the fixed network competition in the capital and Tampere regions when delineating the geographical markets.

Furthermore, the Court annulled the decision on the pricing of the local loop market in all SMP areas. The Court's decision implies that the maximum wholesale monthly prices set by Ficora on Elisa Corporation's fibre local loops are lifted. It was ruled that the validity of the NRA's LRIC+ model's geotype segmentation and digging costs should have been investigated further.

The matter has been resubmitted to Traficom for reconsideration.

Finland chose to grant subscribers with fixed-term contracts for mobile services a higher level of consumer protection than the protection set out in Article 105(1) of the code. While the code provides that contracts should not mandate commitment periods exceeding 24 months, the national implementing measure for Article 105(1) of the code stipulates that fixed-term contracts for mobile services should not mandate commitment periods longer than 12 months.

Regarding universal service, Finland is planning to increase the minimum data speed of the right to internet connection from 2 Mbit/s to 5 Mbit/s.

Finland is a leader in 5G readiness and has begun commercial deployment.

Further spectrum resources have been made available through auctioning the 26 GHz band. The country's fixed broadband coverage is good. Nevertheless, fixed coverage in rural areas could be improved. The main problem has been a lack of incentives for market players to invest in the country's sparsely populated areas. Finland relies on the allocation of public funding to continue implementing its national broadband plan and achieve ubiquitous VHCN coverage throughout the country.

Connectivity in Finland's Recovery and Resilience Plan

The Finnish plan includes an investment support scheme to increase the quality and availability of high speed connectivity network in areas where such connections are not provided by the market mechanisms. Financial support amounting to EUR 50 million will be disbursed to broadband providers. The broadband connections supported under this scheme will offer at least a capacity of 100 Mbit per second. Additionally, Finland is expected to establish a coordinator position in the National Broadband Office with the aim of promoting broadband and planning the coordination of national and EU broadband.

3 Integration of digital technology

3 Integration of	Finland		EU
digital technology	rank	score	score
DESI 2021	1	59.5	37.6



	Finland			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	88% 2020	60% 2020
3b1 Electronic information sharing	39%	43%	43%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media % enterprises	29% 2017	44% 2019	44% 2019	23% 2019
3b3 Big data	19%	19%	22%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	50%	50%	62%	26%
% enterprises	2018	2018	2020	2020
3b5 AI % enterprises	NA	NA	20% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	77% 2021	66% 2021
3b7 e-Invoices	79%	79%	83%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	20%	22%	18%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	NA	NA	NA	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	6%	9%	9%	8%
% SMEs	2017	2019	2019	2019

Finland ranks 1st among EU countries, well above the EU average on the integration of digital technology by businesses.

Some 88% of Finnish SMEs have a at least basic level of digital intensity, which is higher than the 60% EU average. On ICT for environmental sustainability, Finland records 77% of enterprises having medium/high intensity of green action through ICT, a value above the EU average of 66%. Advanced technologies continued to gain popularity among Finnish enterprises, with 62% using cloud solutions, a notable jump from 50% 2 years before (and significantly more than the EU average). 20% of enterprises integrate AI technology in their operations and 43% use electronic information sharing. The use of social media by enterprises is nearly twice as high as the EU average (44% v 23%), while e-invoice use by enterprises is very common (83%), which is not the case for the EU on average (32%).

Building on previous years' experience and policy preparations, the government launched the digital progress programme²⁵⁶ in February 2020. It aims to increase technology and digitalisation capabilities in the public sector and to develop cooperation between the public and private sectors, integrating digital tools in the economy and in society. In particular, the YritysDigi²⁵⁷@Paims to decrease the need for face-to-face contacts and paper documents.

In line with Finland's public policy tradition of continuity of organisation and funding instead of ad hoc initiatives, several well-structured projects continued to be implemented. The principal policy implementing body remains the Business Finland²⁵⁸ governmental agency. It manages programmes like the Kasvumoottorit (growth engines) that supports the use of data and the development of digital platforms, the Venturi, funding RDI for leading companies in digital ecosystems and Smart Mobility (EUR 50 million). The VTT Technical Research Centre of Finland provides funding for the digitalisation of industry, and the multi-annual 2018-2022 digital Finland framework²⁵⁹ is being implemented for the digital transformation of local governments, with EUR 400 million over the whole period.

Finland developed its AI strategy in 2017. On that basis, the artificial intelligence programme was implemented through funding for the AI business programme (EUR 100 million) and the Finnish Centre for Artificial Intelligence (FCAI, EUR 8.3 million — both figures apply to 2019-2022). In November 2020, Finland revised and updated its AI strategy with the artificial intelligence 4.0 programme²⁶⁰. It encourages the development and introduction of AI in companies with particular emphasis on SMEs. AI is to be embedded in a wide array of other technologies, such as the internet of things, 3D printing, robotics, quantum computing, virtual and augmented reality.

Finland is a member of the EuroHPC Joint Undertaking and will host one of the three pre-exascale supercomputers²⁶¹. It is a signatory of the Declarations on European Blockchain Partnership and Artificial Intelligence.

Finland performs well in the integration of digital technologies by businesses. The challenges seem to be in improving the international reach of its companies and in reskilling and upskilling the labour force with advanced digital skills. The country is at the cutting edge of technology and keeping this position will require consistent work.

Integration of digital technology in in Finland's Recovery and Resilience Plan

Finland's RRP foresees several measures to support the integration of digital technologies into the public and private domains. The support for renewal in the cultural and creative sectors aims at the digital transformation of those companies, growth acceleration programme for small enterprises, and special focus on digital growth in the tourism sector.

In the field of advanced technologies, the RRP provides for actions to strengthen the applied research deployment of advanced technologies, particularly 6G, artificial intelligence and quantum computing (EUR 10 million). Support will also be provided to accelerate and increase Finnish companies' investments in the development of the production value chain of

²⁵⁶ <u>https://vm.fi/digitalisaation-edistamisen-ohjelma</u>.

²⁵⁷ <u>https://vm.fi/yritysdigi</u>.

²⁵⁸ <u>https://www.businessfinland.fi/</u>.

²⁵⁹ <u>https://www.businessfinland.fi/496a6f/globalassets/julkaisut/digital-finland-framework.pdf</u>.

²⁶⁰ <u>https://tem.fi/en/-/artificial-intelligence-4.0-programme-to-speed-up-digitalisation-of-business.</u>

²⁶¹ <u>https://www.lumi-supercomputer.eu/</u>.

microelectronics, increase the ability to design and manufacture semiconductor components in Finland and the EU thanks their expected participation in the Important Project of Common European Interest (IPCEI) for microelectronics (EUR 15 million). Finally, the plan includes a number of RDI funding packages to support innovative growth companies and to promote digital innovation.

4 Digital public services

4 Digital public	Finland		EU
services	rank	score	score
DESI 2021	3	86.7	68.1



	Finland			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	87%	91%	91%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	97	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	87	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	93	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	85%	78%
% maximum score			2020	2020

In digital public services, Finland ranks 3rd among EU countries, well above the EU average. Online interaction between government authorities and the public approach the maximum, with 91% of Finnish internet users using e-government services, the same as last year. The country also performs very well in relation to the availability of pre-filled forms (97%), and online services for both the public and enterprises (scores of 87 and 93, compared to EU averages of 75 and 84, respectively).

In 2020, the major change in the architecture of e-government services consisted in the launch of the Digital and Population Data Services Agency²⁶² on 1 January 2020. The merger of the Population Register Centre, the Local Register Offices and the Steering and Development Unit for the Local Register Offices was prepared in legislation before the outbreak of the pandemic and the integration was carried out during that year. The Agency provides data from the registers for government bodies, companies and citizens.

The Valtori e-government centre²⁶³ that provides various ICT services for central government and facilitates inter-governmental cooperation played a crucial role during the COVID-19 crisis. A major switch to remote working by central government was made possible by increasing the capacity of systems and organisational measures. The situation also required management changes, as the Board of Directors was dissolved, and the Ministry of Finance took over its direct supervision. As a precautionary measure, a review of the organisation of security network operations was conducted to identify and analyse options for the future.

The national open data portal²⁶⁴ continues to provide data in open formats for companies and members of the public. Examples of the applications using this data range from collecting and

²⁶⁴ <u>https://www.opendata.fi/</u>.

²⁶² <u>https://dvv.fi/en/digital-and-population-data-services-agency.</u>

²⁶³ <u>https://valtori.fi/en/-/year-2020-valtori-s-customer-and-personnel-satisfaction-increased-in-the-midst-of-the-pandemic.</u>

analysing invoices from municipalities to inform citizens about the activities of these institutions (*Handata*²⁶⁵), to making predictions on when blueberries would be ripe for harvesting, based on locally gathered information and the meteorological institute forecasts (*Mustikkaan*²⁶⁶). However, the open data indicators²⁶⁷ show that, unlike other metrics, Finland is not among the countries that make most use of this data. Given the experience of public institutions rarely making funds available for opening their data, central government has carried out a programme to encourage wider and more efficient use of public data for societal and economic purposes, to be implemented in 2020-2022.

In June 2020, to support the implementation of the cyber security strategy (2019), the government published a resolution on digital security in the public sector²⁶⁸ that sets out the development principles and key services to be considered to increase resilience in cybersecurity. Within the framework of comprehensive security, the goal is to protect members of the public communities, and society from threats to information, services and the functioning of society online. The 2020-2023 action plan for digital security in the public administration (*Haukka*²⁶⁹) describes how the resolution will be put in practice. Cybersecurity has also received funds in relation to broader e-government, for instance the EUR 100 million project on a digitalisation, experimentation and deregulation strategy for public sector ICT.

Compared to the EU average, Finland is a stellar performer on most e-government indicators. The main challenge remains to keep abreast of the fast pace of technology. State-of-the-art solutions are in place and people are reportedly pleased with most services provided. However, government analyses show increasing threats to cybersecurity and new challenges brought about by AI applications. These require constant adjustments in the digital aspects of Finland's public administration.

Digital Public Services in in Finland's Recovery and Resilience Plan

The Finnish RRP includes significant investments in the digitalisation of public administration and improvement of digital public services for the public and businesses.

Following the pandemic, the plan envisages important investments to complement the ongoing reform of the social and health care sector, introducing a wide range of digital innovations and eHealth projects (with a total value of EUR 145 million), including contacts with patients handled remotely by electronic means. This also includes digital solutions enabling remote diagnoses, monitoring and treatment of diseases; supporting early identification of problems and increasing the use of preventive services; enabling a wider range of multidisciplinary services and expertise to be shared between different regions and service providers, with a strengthen role of their customers.

The reform of the public employment services process also encompasses important digital innovations (EUR 40 million) to support the development of personalised and integrated services for job-seekers, thereby increasing active labour market integration. A digital information system will be developed to support inter alia customer relations management,

²⁶⁸<u>http://urn.fi/URN:ISBN:978-952-367-337-3</u>

https://handata.fi/.

²⁶⁶ <u>https://mustikkaan.fi/</u>.

²⁶⁷ <u>https://data.europa.eu/sites/default/files/country-factsheet_finland_2020.pdf</u>.

²⁶⁹ <u>https://julkaisut.valtioneuvosto.fi/handle/10024/162290</u>.

appointment booking, self-reporting by job seekers and online guidance.

The plan also includes several measures promoting the digitalisation of public administration, with a focus on data-driven innovation, the exchange of digital information and use of public sector data. This includes a measure to streamline the administrative procedures for processing residence permit applications attracting international talent (EUR 20 million). A virtual platform, 'Virtual Finland', will offer a single gateway to electronic services of different ministries and agencies for persons arriving in Finland (EUR 9 million). In addition, electronic solutions for the prevention of money laundering (EUR 10 million), focussing on the automation of data processing and analysis. The roll-out of a system of real-time structured exchange of digital financial data such as e-invoices or procurement documents will benefit the competitiveness of both the public and private sector (EUR 14 million). The creation of residential and commercial property information system (EUR 14 million) will help strengthen the monitoring of household debt.

Furthermore, the plan contains investments in the digitalisation of rail transport (EUR 85 million) encompassing the preparation and carrying-out of testing and piloting activities that will lead to the introduction of the European Rail Traffic Management System (ERTMS), along with the 4G and 5G-based Future Railway Mobile Communication System (FRMCS).





France ranks 15th of the 27 Member States in the 2021 edition of the Digital Economy and Society Index (DESI).

France is in line with the EU average in terms of digital skills, both basic skills (57% of individuals) and advanced skills (31% of individuals), but it is still far from the EU front runner. In 2020, the number of ICT specialists in employment increased to 4.5% of total employment, slightly above the EU average of 4.3%.

France has improved its performance in terms of connectivity: fixed very high capacity network (VHCN) coverage registered a significant increase of 9 percentage points to reach 53% in 2021, and fast broadband networks (NGA) coverage, now at 69%, is up 8 percentage points compared with 2020. Both values are still below the EU average, which is respectively 59% and 87%, and rural coverage remains low.

French enterprises have started to make use of digital technologies in their business operations, in particular big data (22% of enterprises using them compared with an EU average of 14%).

France is investing significant resources to improve the resilience of the education system, equipping schools and universities with the necessary digital tools, improving connectivity and supporting innovative ways of teaching with the use of digital technologies. Measures to improve digital skills among the general public are being implemented, such as the additional allocation for individual learning accounts and measures supporting the development of basic digital skills for the most vulnerable. Implementation of the French national broadband plan *Très Haut Débit* continued in 2020²⁷⁰, with a noteworthy change: the French government decided to set a new target for universal roll-out of new fibre-to-the-home (FTTH) networks throughout the country by 2025.

²⁷⁰ The overall objective of the national broadband plan is to guarantee that all French households have access to internet connections of at least 100 Mbps by 2025. There was significant progress in Q4/2020 both in FTTH

France is also investing in the development of capacities in key digital technologies, for example through participation in European projects, and it continues to support digitalisation of French companies and the uptake of digital solutions. These investments are expected to have a significant impact, if implemented efficiently and where taking into account the specific needs of SMEs, as they still face some challenges in adopting digital solutions.

A comprehensive strategy is being implemented for the digitalisation of services and to support public administrations in their digital transformation, also making use of technologies such as cloud, Artificial Intelligence (AI) and cybersecurity. Digital health services are also being supported, with significant investments in shared medical records and development of the national health data space.



Digital in France's Recovery and Resilience Plan (RRP)

The French RRP will contribute to supporting the country's digital transition with an overall contribution of EUR 8.4 billion (21.32%), exceeding the 20% target. These resources will also be complemented by national resources as part of the *France Relance* plan.

Digitalisation of health will be supported with an investment of EUR 2 billion, with the aim of improving the sharing of medical records, to set up the digital health platform and to ensure interoperability among software of players in the public and private sectors.

France will also invest EUR 1.8 billion in developing and deploying key digital technologies, such as cybersecurity, quantum and cloud to support innovation in these areas and encourage their widespread use, in line with EU values. France will also participate in two Important Projects of Common European Interest (IPCEIs) in the areas of cloud and edge computing and on microelectronics and communication technologies.

The French RRP will also contribute to improving the digitalisation of public administration, to provide efficient online services and deploy the e-identity scheme. Connectivity will also be

deployment and take-up: there were 10.4 million FTTH subscriptions as of 31 December 2020 and the total number of broadband and superfast broadband subscriptions stood at 30.6 million at the end of 2020. This is 285 000 more than in the previous quarter and 800 000 more than the year before (+2.7% year on year). Source: Arcep.

improved in rural areas, contributing to the larger aim of providing access to very high speed networks for all households (100% fibre-to-home) by 2025.

Education and training systems are expected to be further digitalised. In order to improve the use of digital technologies in education, 45 000 classrooms should be equipped with new digital solutions and 1.4 million students in higher education should have access to hybrid learning by the end of 2022. As part of the investment in skills, digital skills development for students and workers will be supported. Finally, 200 000 companies, in particular SMEs, will be supported in their digital transformation under the umbrella of the *France Num* initiative.

1 Human capital

1 Human canital	Fra	EU	
I Human capitai	rank	score	score
DESI 2021	14	47.4	47.1



	France			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	57%	57%	57%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	29%	31%	31%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	60%	60%	60%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	3.9%	4.2%	4.5%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	19%	20%	20%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	19%	21%	15%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	3.0% 2017	3.5%	3.6%	3.9%
% graduates		2018	2019	2019

In the Human capital dimension, France ranks 14th of the 27 EU countries and is thus in line with the EU average. Basic digital skills levels are slightly above the EU average (57% against the EU average of 56%), whereas 'above basic digital skills' are in line with the EU average, with 31% of individuals possessing them. The proportion of ICT specialists grew in 2020 compared with the previous year and is now slightly above the EU average at 4.5% of total employment (against an EU average of 4.3%). Female ICT specialists represent 20% of total ICT specialists, 1 percentage point higher than the EU average in 2020. The number of enterprises providing ICT training has registered a significant decrease compared with the previous year, falling to 15%, which is below the EU average of 20%.

Implementation of the national education strategy is ongoing. Significant investment has been mobilised to improve digital infrastructure and connectivity for schools (EUR 2.3 billion over 2013-2017). As a result, the number of highly digitally equipped and connected schools has increased, mostly at higher secondary level (81% in France against an EU average of 71% in 2018), while it remains below the EU average for primary schools²⁷¹. Following the introduction in 2019 of a new computer science course in all upper secondary schools, at present all pupils can benefit from courses in computational thinking, coding, programming and digital science teaching throughout their schooling, from primary school to the end of secondary school. Digital skills of students are assessed and certified at the end of studies in lower and upper secondary school via the Pix tool²⁷², which is developed on the basis of EU Framework for the Digital Competence of Educators (DigCompEdu).

²⁷¹ https://op.europa.eu/webpub/eac/education-and-training-monitor-2020/countries/france.html

²⁷² https://pix.fr/

During the COVID crisis, to continue teaching activities at a distance, the National Centre for Distance Education (*Centre national d'enseignement à distance* - CNED) provided online learning modules during the lockdown. It also developed online platforms²⁷³ to provide assistance in French and maths. According to a report of the French government, distance learning during the COVID-19 crisis has likely increased gaps in educational outcomes. It is estimated that 6% of pupils in primary education and 10% in secondary education became disengaged from study²⁷⁴.

Between 2018 and 2019, adult participation in learning increased from 18.6% to 19.5%, placing France well above the EU average of 10.8%. The individual learning account (*Compte Personnel de Formation* – CPF), which makes individuals responsible for their learning pathway, is the main vehicle to provide training opportunities for (re)entry to the labour market or occupational mobility. CPF was digitalised in recent years, providing common online access for companies and beneficiaries to training opportunities, including apprenticeships and distance learning²⁷⁵.

In 2019, a new digital certification was launched, in addition to the existing *Certification Socle de compétences et de connaissances professionnelles (CléA),* which gives employees and jobseekers the opportunity to test their competence level in relation to labour market needs.

In order to tackle shortages of digital specialists in key digital technologies, all national technology strategies (Quantum, Cybersecurity, AI, Cloud, EdTech, etc.) systematically include education and training activities. For example, the cybersecurity strategy aims to double the number of employees in this domain, with a target of 75 000 people employed. As regards quantum, the strategy provides for the training of 6 600 people, also via PhDs.

The *Femmes@Numérique*²⁷⁶collective has been created under the patronage of the French Secretary of State for the Digital Economy. It mobilises companies, training institutions and all their partners and associated ministries to make women aware of the opportunities that the digital economy presents for them.

The French Digital Skills and Jobs Coalition runs a number of activities to promote digital skills. At the moment, a project is being implemented in cooperation with the Ministry of Labour, focusing on the use of AI for enterprises, in particular SMEs. This has led to the development of a dedicated website <u>Perspectives-ia.fr</u>, offering a number of services, such as a self-assessment tool, showcasing AI use-cases by enterprises and providing information on the possibilities offered by AI solutions.

During 2020, more than 130 events linked to EU Code Week were organised in France, involving more than 30 000 people.

Despite improvements, the digital skills of French citizens and workers remain far from the levels achieved by the EU's top performers. An increase in basic digital skills is an imperative to ensure that everyone can access essential online services and avoid social exclusion. At the same time, a higher number of people with advanced digital skills and ICT specialists would contribute to reducing current shortages and help the deployment of digital solutions across all economic sectors.

Human capital in France's Recovery and Resilience Plan

²⁷³ The Homework Done (*Devoir Faits*) and Jules platforms: <u>https://www.tice-education.fr/tous-les-articles-</u> <u>er-ressources/ent/1353-jules-une-plateforme-numerique-pour-l-aide-aux-devoirs</u>.

²⁷⁴ DEPP (2020a), Information note n° 20.26 – Crise sanitaire de 2020 et continuité pédagogique : les élèves ont appris de manière satisfaisante.

²⁷⁵ Education and Training Monitor, European Commission, 2020.

²⁷⁶ <u>https://femmes-numerique.fr/</u>

The recovery and resilience plan includes significant investment to support education and employment, including specific initiatives for digital skills development, with a total budget of EUR 1.6 billion. Digitalisation of education will be supported, in particular for primary and secondary schooling, including an enhanced use of platforms and digital technologies for pedagogical purposes. A total budget of around EUR 350 million will be devoted to the "digital teaching" strategy, supporting the development of Education Technologies. In addition, EUR 304 million will be devoted to the digitalisation of training platforms for lifelong learning.

Specific investment is also dedicated to digital inclusion, with a budget of EUR 250 million, aiming to provide citizens with basic digital skills, necessary to have access to online public services, thereby contributing to preventing social exclusion. In addition, the recovery and resilience plan includes a complementary allocation to individual learning accounts to training 25 000 people in digital skills or digital professions.

Finally, a dedicated action aims at supporting the development of digital education ecosystems at all levels of education, from primary school to universities, encouraging the development of structural partnerships between educational and research institutions and businesses (EUR 750 million). These partnerships can be particularly relevant if implemented in the digital area because they offer students the possibility to use state-of-the-art technologies in their training and ensure that school curricula are in line with the rapidly changing demands of the labour market.

2 Connectivity

2 Connectivity	Fra	EU	
·····,	rank	score	score
DESI 2021	17	47.4	50.2



	France			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	73%	71%	NA	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	14%	17%	NA	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	NA	NA	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	58%	62%	69%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	38%	44%	53%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	99.3%	99.5%	99.8%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	33%	33%	59%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	68%	76%	76%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	80	78	69
Score (0-100)		2019	2020	2020

With an overall score of 47.4, France ranks 17th in connectivity for the EU.

France has ubiquitous 4G coverage with 99.8% of households covered. This is linked to the implementation of 4G deployment commitments undertaken by all four market players in 2018. In white rural areas²⁷⁷, 4G roll-out has also made significant progress: whereas one third of the relevant sites were equipped with 4G as of 30 June 2020, the main operators reported that a little over 60% of them were equipped as of 30 September 2020²⁷⁸. France's fast broadband (NGA) coverage stood at 69% (against the EU average of 87%). As of mid-2020, its coverage with fixed very high capacity networks (VHCN) stood at 53% (against the EU average of 59%), consisting exclusively of Fiber to the Premises (FTTP) (against an EU average of 42.5%), as cable networks that cover 27% of households

²⁷⁷ The coverage programme known as *Zones blanches centres-bourgs* aims to provide mobile coverage in village centres identified as having no such coverage.

 ²⁷⁸<u>However, around 80%</u> of them were equipped in 4G as of 30 September<u>31 December</u> 2020.
Source: Arcep.
have not yet been upgraded to the DOCSIS 3.1 standard. FTTP covers 18.4% of rural households (against 25% for the EU average).²⁷⁹

Thanks to the completion of the auction of the 3.4-3.8 GHz band in Q4 2020, France improved its 5G readiness indicator, which stood at 59% as of mid-2020 (against an average of 51% for the EU). Coverage started to increase at the end of 2020 as all four mobile network operators offered 5G services²⁸⁰. France's mobile broadband take-up stood at 76% (against an average of 71% for the EU) and its broadband price index stood at 78 against the EU average of 69. This suggests that the relevant prices are good compared with other prices applied within the EU for similar services.

Implementation of the French national broadband plan (*plan France Très Haut Débit*) continued in 2020²⁸¹, with a noteworthy change: the French government decided to set a new target for ubiquitous roll-out of new FTTH networks throughout the country by 2025. This objective is to be carried out through the allocation, by the State, of an additional EUR 240 million as part of the national recovery plan. These funds will be added to the EUR 3.3 billion already assigned to the plan *Très Haut Débit* and the EUR 30 million that were allocated at state level in 2020. Fibre roll-out still increased in 2020 in spite of the COVID-19 pandemic crisis.

On 31 December 2019, the awarding procedure for the 3.4-3.8 GHz band was launched by the national Regulatory Authority Arcep. The operators Bouygues Telecom, Free Mobile, Orange and SFR were declared eligible to take part in the dedicated auction procedure and each to receive a block of 50 MHz for EUR 350 million. In addition, they were allowed to participate in the auction for the remaining 11 blocks of 10 MHz still available. The overall result of the 3.4-3.8 GHz band is as follows: Bouygues Telecom (70 MHz), Free Mobile (70 MHz), Orange (90 MHz), and SFR (80 MHz). Each licence holder is rolling out 5G across an increasing number of sites (3,000 sites should be covered by 2022, 8,000 by 2024 and 10,500 by 2025) and has the obligation to provide increased throughput. All four operators started providing 5G services at the end of 2020. Following the reluctance of some municipalities as regards the roll-out of 5G services, in April 2021, the French Agency for Food, Environmental and Occupational Health & Safety (*Agence nationale de sécurité sanitaire, de l'alimentation, de l'environnement et du travail - ANSES*) published a report finding that 5G roll-out for mobile services does not entail new health hazards.

Main market & regulatory developments

The French mobile telecommunications market features a massive use of 4G networks.

²⁷⁹ FTTP coverage stood at 60% including <u>18.431</u>% of the rural households in December 2020. Source: Arcep

²⁸⁰ As of 31 December 2020, 7,175 base stations were equipped with 5G (using 700 MHz, 2100 MHz and 3.4-3.8 GHz bands). Among these, 1,198 were using the 3.4-3.8 GHz band. Source: https://www.arcep.fr/cartes-et-donnees/nos-cartes/deploiement-5g/observatoire-du-deploiement-5g-janvier-2021.html

²⁸¹ The overall objective of the national broadband plan is to guarantee that all French households have access to internet connections of at least 100 Mbps by 2025. Q4 2020 recorded significant progress both in FTTH deployment and take-up: there were 10.4 million FTTH subscriptions as of 31 December 2020 and the total number of broadband and superfast broadband subscriptions stood at 30.6 million at the end of 2020. This is 285 000 more than in the previous quarter and 800 000 more than the year before (+2.7% year on year). Source: Arcep.

55.5 million customers used them in 2020 and, as of Q3 2020, the average monthly consumption of active 4G customers exceeded 10 GB per month (an increase of 37% in one year). The use of mobile services also increased by 30% in 2020 due to the COVID-19 sanitary crisis. According to Arcep, a major share of FTTH subscriptions (95%) among new subscriptions is for very high speed internet services (>30 Mbps).

On 3 February 2021, a letter of formal notice was served on France for failure to notify complete transposition into French law of national measures implementing the Directive establishing the European Electronic Communications Code. France has notified additional implementing measures since that date. The notified measures are being examined by the Commission.

As to market regulation, after receiving the Commission's observations, the national regulatory authority Arcep adopted several new market analysis decisions for fixed broadband and superfast broadband markets²⁸² for the period 2021-2023. These aim at three main objectives: facilitating the transition from the legacy copper network to fibre; maintaining pro-investment regulation to make fibre the fixed infrastructure of reference; and creating a truly competitive business market.

Several decisions²⁸³ set up asymmetric regulation that only applies to the significant market power operator *Orange*. They will apply from 2021 to 2023 for the following markets: a separate civil engineering market; market 3 a (passive solutions); market 3b (generalist active solutions); and market 4 (dedicated active solutions for businesses). Secondly, Arcep adopted a decision²⁸⁴ to complete 'symmetric' optical fibre regulation, which applies equally to all FTTH network operators, and a recommendation that provides additional details on this framework's application. Lastly, Arcep adopted a decision²⁸⁵ setting the maximum tariffs that *Orange* can charge for accessing its copper local loop. This decision complements those on markets 3 a and 3b.

In December 2020, Arcep launched a new version of its *Wehe* application²⁸⁶ by expanding the list of services that it can test to include several videoconferencing services and various French video streaming platforms. The new version of *Wehe* also includes a new functionality to detect port blocking.

In addition, in November 2020, Arcep launched a new version of its online platform 'J'alerte l'Arcep' dedicated to reporting issues notably in the telecommunications field to the authority. The platform is now open to new user groups such as application developers, telecommunication operators or consumer associations who can use a dedicated space to alert

²⁸² Market 3a (wholesale local access provided at a fixed location), 3b (wholesale central access at a fixed location for mass-market products) and 4 (wholesale high-quality access provided at a fixed location) under the Commission's 2014 Recommendation.

²⁸³ Decision n° 2020-1446 of 15 December 2020 (market 3a), Decision n°2020-1447 of 15 December 2020 (market 3b), Decision n°2020-1448 of 15 December 2020 (market 4).

²⁸⁴ Decision n°2020-1432 of 8 December 2020.

²⁸⁵ Decision n°2020-1493 of 16 December 2020.

²⁸⁶The Wehe application aims at helping consumers to detect potential traffic throttling on the internet. Since it was first launched, about 145 000 tests have been run in France using the tool and, up to Q4 2020, no differentiation in internet traffic management had reportedly been detected through the application.

the authority. The platform's management tools have also been improved by introducing a specific algorithm for alert classifying purposes.

The French national broadband plan is ongoing and has been enhanced with the new target of ubiquitous roll-out of new FTTH networks throughout the country by 2025. It has already produced noticeable results in terms of overall FTTH coverage across the country, except in rural areas where coverage is still low but the pace is increasing steadily thanks to this national broadband plan.

Connectivity in France's Recovery and Resilience Plan

The plan includes an investment to boost connectivity in rural areas with an allocation of EUR 240 million (component 9), part of a total budget for connectivity of EUR 540 million. This sum contributes to a larger effort to improve connectivity under France's *Très Haut Débit* plan, supported by national funds to the tune of EUR 3.3 billion. The objective set in the recovery and resilience plan is to reach 100% ultrafast) coverage by 2025.

Investments in connectivity are also planned for the implementation of 5G and new networks under the communication strategy adopted in February 2021 (component 6). This strategy aims to develop French solutions around telecommunications networks, for technological sovereignty and to achieve end-to-end control of these solutions (sovereignty over exploitation) through support for supply, R&D and training.

3 Integration of digital technology

3 Integration of	Fra	EU	
digital technology	rank	score	score
DESI 2021	19	34.8	37.6



	France			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	55%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	38%	48%	48%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	16%	22%	22%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	16%	16%	22%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	15%	15%	21%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	19%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	55%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	25%	25%	23%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	15%	15%	13%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	11%	11%	12%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	7%	6%	6%	8%
% SMEs	2017	2019	2019	2019

As regards the integration of digital technology in business activities, France ranks 19th among EU countries. More French enterprises are now using digital solutions. In particular, 22% of French enterprises are using big data analysis, well above the EU average of 14%, an increase of 6 percentage points compared with 2018. Almost every second enterprise in France uses electronic information sharing, compared with an EU average of 36%. The use by enterprises of cloud, AI and e-invoices is below the EU average (respectively 21%, 19% and 23%). The percentage of SMEs selling online seems to have decreased by 2 percentage points compared with 2019, thus remaining below the EU average. In addition, the digital intensity of French SMEs remains lower than the EU average: while 55% of SMEs in France attain basic levels of digital intensity, this stands at 60% in the EU as a whole. Also, the intensity of green actions through ICT is 11 percentage points lower than the EU average (respectively 55% and 66%).

France has invested significantly in the digitalisation of its economy over recent years, also focusing on the development and deployment of key digital technologies. A number of strategies were published in 2020 and 2021 to strengthen France's competitiveness in areas such as artificial intelligence, cybersecurity and quantum. France was one of the first EU countries to adopt an AI strategy, in 2018. As part of the activities launched under the strategy, France has established a bottom-up research network, including both the private and public sector. Four *Instituts Interdisciplinaires d'Intelligence Artificielle* (3IA Côte d'Azur, ANITI, MIAI@Grenoble-Alpes, PRAIRIE) were set up in 2020²⁸⁷. They gather 137 academic chairs, 8% of whom are international. In the long term, the recruitment target is set at 600 staff. A new AI strategy is currently under preparation. This will focus on the uptake of AI solutions for enterprises and local authorities, to respond to challenges in mobility, energy, smart cities and urban planning, with a particular emphasis on the greening of the economy. It will also focus on the development of frugal AI (i.e. less data and energy intensive) in edge computing.

In February 2021, France published a roadmap on 'Digital and the Environment' to support the greening of the ICT sector and to encourage the use of digital solutions for a greener economy²⁸⁸. One axis of this roadmap is dedicated to the pooling of data in order to design efficient AI systems for economic sectors linked to the environment.

France is an active member of the EuroHPC joint undertaking for high-performance computing. French organisations, both private and public, are directly involved in its ongoing projects.

In order to increase cybersecurity capacities, the French government is setting up the *Campus Cyber*, a national hub that will foster cooperation within the French cybersecurity community. It is expected to be operational as of autumn 2021. It will focus on four main areas of activities: operations (incident detection, incident response, threat intelligence sharing); education and training; innovation; and community animation. About 60 stakeholders covering various areas of expertise are involved in the project, including several public authorities.

In addition, France has a number of Digital Innovation Hubs of varied nature: competitive clusters, technical centres for industry, and local offices of the *Alliance pour l'industrie du Futur and La French Tech*, which all aim at encouraging the uptake of digital technologies and solutions across the economy. These structures work in close cooperation with the regions and cities, and with the digitalisation programmes set up at national and regional levels. In 2020, France also launched its European Digital Innovation Hubs (EDIH) preselection process for the forthcoming Digital Europe Programme (DIGITAL). Results are published online: 17 EDIH candidates were selected, with at least one candidate per region, indicating a strong commitment from regional authorities.

The above measures are expected to have a significant impact on the digitalisation of the French economy and on the strengthening of capacities related to key digital technologies. An efficient implementation, combined with a sustained effort to ensure that also SMEs benefit from the innovative digital solutions, will be important to unlock the potential for growth stemming from the adoption of digital technologies.

Integration of advanced technology in France's Recovery and Resilience Plan

As part of the investments in the *Programme d'Investissement d'Avenir*, France is expected to invest EUR 1.8 billion in the development and deployment of key digital technologies, such as cybersecurity, quantum and cloud, to support innovation in these areas and encourage their widespread use, in line with EU values.

• Cybersecurity: EUR 200 million will be devoted to implementing the cybersecurity

²⁸⁷ Highlight DESI 2020.

²⁸⁸ <u>https://www.economie.gouv.fr/environnement-numerique-feuille-de-route-gouvernement</u>

strategy, launched by the French government on 18 February 2021. This strategy aims at strengthening the state's digital security and safety, and to help businesses and citizens increase their cyber awareness and ensure that they can benefit from a secure digital environment. Investments planned in the RRP aim at more than trebling the turnover of the cybersecurity value chain, doubling the number of employees in the sector, and supporting the emergence of three unicorns by 2025.

- Quantum: Investment in the area of quantum computing (EUR 350M) will focus on development of the first prototype quantum computer, training 6 600 PhDs, master's graduates, engineers and technicians, and ensuring France's self-sufficiency in its supply of resources to the development of quantum technologies.
- Cloud: EUR 300 M will be devoted to implementing the cloud strategy, which will focus most of the investment on the development of a French offer for cloud and advanced services. Projects anticipating future uses of the Cloud, including edge computing, are being studied and could enable the emergence of solutions that could be global market leaders. These major projects could be carried out on a European scale through an IPCEI. They will lead to offers that can be part of the GAIA-X project.

France will also participate in the IPCEI on microelectronics and communication technologies, co-funded under the *Programme d'investissements d'avenir*.

The RRP envisages support to R&D investment in digital areas, increasing the budget for R&D projects under the National Research Agency and supporting the preservation of employment in private research. It is estimated that this action will contribute to the digital objective. From past records, more than 40% of projects selected through competitive calls concerned digital areas, from fundamental research on algorithms to the use of digital technologies (e.g. sensors and modelling) to fight climate change.

The RRP includes investment to use digital technologies in support of the transition to the green economy in key markets. Resources will be dedicated, among others, to the digitalisation of the mobility sector, the roll-out of sustainable farming systems and the decarbonisation of industry. In addition, the roadmap published in February 2021 includes a number of existing and new measures, such as the establishment of an environmental barometer for digital platers and support for artificial intelligence projects for ecology.

As for the digitalisation of businesses, the recovery and resilience plan builds on existing initiatives such as *France Num*, with the objective of increasing the digitalisation of 200 000 enterprises by 2024, while providing employees with the necessary support to manage the transition to digital technologies (component 7).

4 Digital public services



	France			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	79%	82%	NA	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	42	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	73	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	91	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	94%	78%
% maximum score			2020	2020

France ranks 13th in the EU for Digital public services. France performs particularly well in the field of open data, scoring 94% of the maximum score, and in digital public services for businesses with a score of 91 out of 100. Its performance for services for citizens is in line with the EU average, two points lower than the EU average (respectively 73 and 75). France is not performing well in the number of pre-filled forms, as the score is significantly lower than the EU average (42 and 63 respectively).

To accelerate the digital transformation of public administration, France is currently implementing the *TECH.GOUV* programme, launched in 2019²⁸⁹. This includes various actions to encourage the uptake of digital solutions in the delivery of public services, develop an interoperable e-identity framework, including implementation of the 'only once' principle, improve data infrastructure, and better manage collected data.

In particular, the eIDAS Regulation²⁹⁰, establishing one single framework for electronic identification (eID) and trust services in the EU, is implemented in France via the *FranceConnect* service. In 2020, *FranceConnect* registered a significant increase in the number of users, reaching more than 22 million French citizens. On the basis of current trends, the French government estimates that 30 million French citizens will be connected to it, which is more or less 60% of the eligible population. *FranceConnect* is deployed in several hundred digital services, mostly in the public sector but also in the private sector (health industry, banks and insurance). It also plays the role of an eIDAS node: in 2021, it will allow recognition of cross-border e-identifications in French digital public services requiring a substantial or high-level identification.

²⁸⁹ <u>https://www.numerique.gouv.fr/publications/tech-gouv-strategie-et-feuille-de-route-2019-2021/</u>

²⁹⁰ https://digital-strategy.ec.europa.eu/en/policies/discover-eidas

Implementation of the 'only once' principle (OOP) progressed significantly in 2020 and 2021. To support administrations to implement the necessary provisions for data exchanges, a dedicated structure has been created — in the directorate in charge of digital transformation of the French government — to overcome technical, legal, and operational obstacles. The infrastructures supporting OOP data exchanges are also being strengthened, with the development of an application programming interface (API)²⁹¹ data hub for OOP exchange of citizen and business data²⁹² and the DataPass, a digital counter to manage the various requests to connect to existing APIs.

A number of initiatives are in place to ensure the user-centricity of digital public services, such as a review of the 250 most popular services by users, which helps to gather feedback on the user experience. In addition, the project *Commando UX*²⁹³ allows public administrations to hire user-experience experts for a limited period to improve their existing and future services and the *Start-Ups d'État* programme helps to build digital services starting from the needs expressed (or problems identified) by citizens or businesses.

Actions to ensure that all citizens can benefit from digital public services are being implemented through the *Inclusion numérique* project, which aims at reaching the most vulnerable and facilitating the use of digital public services.

France is implementing ambitious measures to be at the forefront of a digitally enabled public service modernisation. Full implementation of the country's strategy in this area, including through additional measures to increase user-centricity and inclusiveness, are important to ensure that all citizens can benefit from digital services.

Highlight 2020-2021: Artificial Intelligence for public services – AI Lab

The AI Lab supports administrations to use their data through data science and artificial intelligence²⁹⁴. Since its launch in 2019, the AI Lab has supported the development of 6 projects in 2019 and 15 projects in 2020-2021. Both calls for expression raised a lot of interest, resulting in a high number of applications by central and local administrations.

The winning projects are selected by a panel of experts in AI and digital public services. The selected projects are noteworthy both for their impact in the transformation of public services and the technical solutions.

A number of solutions are already being deployed in various areas: for example, the tax administration is putting in place a system for the detection of fraud, the ministry of health is using AI to detect high-priority alerts about health equipment using data from the portal for reporting adverse health events²⁹⁵, and *Pôle emploi* (the French unemployment agency) has a major programme on using AI to make the public service provision more efficient (*Intelligence Emploi*).

²⁹¹ Application programming interface is a software intermediary that allows two applications to talk to each other.

 ²⁹² API Particulier (<u>https://api.gouv.fr/les-api/api-particulier</u>) and API Entreprise (<u>https://entreprise.api.gouv.fr/</u> - an API data hub for OOP exchange of business data).

²⁹³ <u>https://design.numerique.gouv.fr/commando-ux/</u>

²⁹⁴ Lab IA : Datasciences et intelligence artificielle – Le blog d'Etalab

²⁹⁵ https://www.etalab.gouv.fr/intelligence-artificielle-decouvrez-les-15-nouveaux-projets-selectionnes

Digital public services in France's Recovery and Resilience Plan

The RRP allocates a total of EUR 3.2 billion to improve digital public services, including digitalisation of the state and territories (component 7). E-identity (eID) will be deployed with the objective of delivering, in 2023, up to 12.5 million national digital identity cards and an application for online authentication will be developed. A budget of EUR 136 million is devoted to cybersecurity specifically for strengthening public services whose disruption would have a strong detrimental impact on citizens. It also supports innovation competitions to develop an efficient and competitive cybersecurity offer and make local centres able to respond to cybersecurity challenges.

EUR 2 billion will be devoted to digitalisation of health (component 9), supporting national digital health service infrastructure and project management. The plan will also finance software updates to interoperability standards, upgrades or new software, and the integration, transformation and sharing of data. These measures underpin the introduction and establishment of two digital health flagship projects in France: *health records* and the electronic health data space.





Croatia ranks 19th of 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI). Croatia's score increased thanks to an improved performance in some of the DESI dimensions measured.

While Croatia has good fast broadband coverage (86% national and 39% rural), its overall fixed broadband take-up is slightly below the EU average. One of the positive developments in connectivity is the assignment of harmonised spectrum for 5G in August 2021. This is a stepping stone for further acceleration of digital transformation and is bringing benefits to both businesses and individuals.

Levels of at least basic digital skills remain slightly low compared to the EU average. In contrast, for above basic digital skills, Croatia comes in above the EU average. Croatia is progressing its successful implementation of the e-Schools programme, with all Croatian schools (1,320) included in the second phase of the programme. Education, science and research are reflected in the national Recovery and Resilience Plan (RRP), which is expected to give further a boost to the digital transformation of higher education, the digitalisation of research and innovation activities, and finally for further development of digital skills.

Croatian enterprises continued to take advantage of the opportunities offered by digital technologies. They actively participate in online commerce, with 30% of SMEs selling online and 10% selling across borders to other EU countries. The sharp rise in popularity in Croatia of e-invoices, with enterprises' usage up from 12% in 2018 to 43% in 2020, is linked to the amendment of the Law on public procurement which made e-invoices mandatory for enterprises. Croatia is also very committed to promoting and investing in digital technologies through various EU coordinated programmes. By mid-2022, the Ministry of Economy and Sustainable Development expects to finalise the 2021-2027 National Plan for the Digital Transformation of the Economy (2021-2027). The 2021-2029 Smart Specialisation Strategy and the National Plan for the Development of Artificial Intelligence are also under development.

Croatia's 2021-2030 Development Strategy recognises the green and digital transitions as key directions for development and sees the digital transition of society and the economy as a strategic objective. Croatia has taken several steps to provide more digital access to the public administration, for example through the eID notification platform for electronic payment of fees. Nevertheless, it is still underperforming on Digital public services, with only 52% of internet users interacting with public authorities in 2020 (EU average: 64%).

The national Recovery and Resilience Plan lays out an ambitious roadmap, with reforms and investments touching on all dimensions of the Digital Economy and Society Index. Closing the current gaps requires sustained efforts and an integrated approach to policies for human capital and public administration. Robust implementation of the measures under the Recovery and Resilience Plan can provide an important change of pace and opportunity to drive digitalisation across Croatia.



Digital in Croatia's Recovery and Resilience Plan (RRP)

The Croatian plan, which involves a total investment of approx. EUR 6.3 billion, includes digital investments of a total of EUR 1,285 billion (20.4% of the plan's budget). It is structured around five priorities: (i) the economy; (ii) public administration, the judiciary and the State; (iii) education, science and research; (iv) labour market and social security; and (v) healthcare. It also contains a specific initiative on renovating buildings.

- Economy component: this includes several investments supporting the digital transition for a total of EUR 576 million, with the largest investments in the digitalisation of transport (EUR 281 million) and energy (EUR 155 million), and the digitalisation of culture and creative industries (EUR 40 million). Other investments in digitalisation are planned in tourism, agriculture, smart working, government services and public infrastructure, and there are plans for grants/vouchers for digitalisation.
- Public administration, judiciary and state assets component: total investment for this component is EUR 437 million, with EUR 158 million dedicated to connectivity.
- Education, science and research component: this includes digital investments of EUR 158 million, including substantial measures for the digital transformation of higher education (EUR 84 million) and the digitalisation of research and innovation activities in universities and research centres.
- Labour market and social protection component: a total digital investment of about EUR 57 million is planned, mostly for the development of digital skills to facilitate the

digital transition of the labour market (EUR 44 million).

- Healthcare component: this includes a substantial investment (about EUR 44 million) in telemedicine, with the largest investment earmarked for the digitalisation of the National Oncology Network and a national oncology database, plus EUR 8 million on digitalisation of operating theatres. Other smaller measures focus on e-care, teletransfusion, robotic surgery and digitalisation of diagnostic units.
- Buildings renovation initiative: this features a digital investment of EUR 13 million to strengthen capacity to monitor seismic phenomena, plus other smaller measures for the digitalisation of buildings restoration, the planning of future constructions and the setting up of an energy management system.

1 Human capital

1 Human canital	Cro	oatia	EU
1 Human capital	rank	score	score
DESI 2021	16	46.7	47.1



	Croatia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	NA	53%	53%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	NA	35%	35%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	NA	56%	56%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists % individuals in employment aged 15-74	3.5% 2018	3.2% 2019	3.7% 2020	4.3% 2020
1b2 Female ICT specialists	18%	21%	18%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	24%	23%	23%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	5.5%	4.0% 2018	4.4%	3.9%
% graduates	2017		2019	2019

On Human capital, Croatia ranks 16th of 27 EU countries. Levels of at least basic digital skills remain low compared to the EU average, with only 53% of people between 16 and 74 years having at least basic digital skills. In the 16-24 age group, however, basic and above-basic digital skills are the highest in Europe. In addition, for above-basic digital skills, Croatia comes in above the EU average (35%, against an EU average of 31%). As regards basic software skills, Croatia scores only 2 percentage points less (56%) than the EU average (58%). ICT specialists account for a lower percentage of the workforce in Croatia than the EU average (3.7%, EU average: 4.3%). The percentage of female ICT specialists is slightly below the EU average. Conversely, Croatian enterprises are investing in ICT training for employees, with 23% of enterprises offering specialised ICT training.

CARNET²⁹⁶, the main body responsible for the digitalisation of education, has fully supported a transition to online teaching and learning as a response to COVID-19. All Croatian schools (1,320) were included in the second phase of the e-Schools programme²⁹⁷. In 2020-2021, all teachers received personal devices and most schools were equipped with wireless local area networks.

The Croatian National Digital Skills and Jobs Coalition²⁹⁸ was involved in establishing regional centres of excellence in vocational education, supporting quality assurance, job market information,

²⁹⁶ CARNET - Croatian Academic and Research Network -: <u>https://www.carnet.hr/en/.</u>

²⁹⁷ The programme aims to digitally transform the teaching and educational processes in all schools in Croatia by 2022. It strengthens the digital competences of teachers, and then indirectly of students, to prepare them for the 21st century labour market, further education and lifelong learning: <u>https://pilot.e-skole.hr/en/.</u>
²⁹⁸ <u>https://digitalnakoalicija.hup.hr/novosti/</u>.

employers' involvement in counselling schools, and curriculum enhancement. It also supported the new Foreigners Act (adopted in 2021) regulating the terms for entry, movement, stay and work of non-EU nationals in Croatia. The act opens up the job market to ICT specialists, tech talents and digital nomads by facilitating visa processes and employment opportunities.

Croatia is investing actively to introduce Artificial Intelligence (AI) into education. The AI School Challenge competition, organised by the CroAl²⁹⁹ association in cooperation with CARNET, encourages primary and secondary school students to learn the basics of AI through the course entitled 'Elements of AI'. Croatia was the first country in the region to translate the course and make it available. Since its launch in November 2020, the course has attracted 21,000 participants.

Raising the digital skills of the population from a young age is one of Croatia's priorities, for example by promoting coding and digital literacy during EU Code Week³⁰⁰. In 2020, it was among the top 10 countries in the number of activities organised (1,033), reaching almost 36,000 participants, 46% of whom were women. Croatia continues to award talented students with scholarships in Science, Technology, Engineering and Mathematics (STEM) studies (3,400 scholarships per school year). The Office for Gender Equality, in cooperation with the Central State Office for development of the Digital Society, is creating an Action Plan for Gender Equality and inclusion. The act aims to improve women's digital skills, advance their employability and encourage girls and young women to consider an ICT career and STEM studies.

Despite an increase in the supply of ICT specialists, 68% of enterprises recruiting or trying to recruit ICT professionals still report problems in finding suitable candidates. ICT specialists' shortcomings can directly limit enterprises' capacity of to innovate, provide new digital services and products. It is therefore vital to tackle the existing skills mismatches in the labour force by increasing the number of digitally skilled experts, by reskilling and upskilling workers and employees, and by promoting ICT careers and STEM studies among women.

Human Capital in Croatia's Recovery and Resilience Plan

The Recovery and Resilience Plan includes investments to support the development of digital skills. The plan includes the continuation of the reform of the education system to improve the basic skills of pupils through increased instruction time and strengthen the link between vocational and adult education and the labour market. The development of new curricula, which will include a focus on the digital transition, is also planned. Alongside, Croatia launches dedicated measures to boost employment, develop skills for the labour market and strengthen pension and welfare systems, with further efforts to combat poverty and social exclusion. The measures are expected to increase the employment rate, improve quality of life and strengthen social cohesion, especially for young people and the self-employed. Fostering lifelong learning and upskilling of workers through investments to adapt to labour market needs will contribute to the employability of all generations. A system or model for reskilling/upskilling will also be developed in line with the needs of the economy and through the proactive role of the Croatian Employment Service (CES).

Skills acquisition is also partially addressed in other areas of the plan for example by implementing a voucher system for re- and up-skilling aimed at vulnerable groups, measures to educate students and unemployed persons to strengthen knowledge and skills in tourism, and by funding a voucher system that will cover training for improving digital skills.

²⁹⁹ <u>https://www.croai.org/</u>.

³⁰⁰ https://codeweek.eu/.



2 Connectivity

2 Connectivity	Cro	oatia	EU
,	rank	score	score
DESI 2021	20	45.4	50.2



	Croatia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	72%	70%	73%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	5%	6%	9%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	<0.01%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	83%	86%	86%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	23%	43%	47%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	97.6%	99.3%	99.5%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	0%	100%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	62%	71%	71%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	61	60	69
Score (0-100)		2019	2020	2020

Croatia ranks only 20th in Connectivity. It features good fast broadband coverage (86% national and 39% rural). In contrast, the overall fixed broadband take-up is slightly below the EU average, standing at 73% in 2020. The prevailing technology remains xDSL. Fixed very high-capacity networks (VHCN) coverage (47% national and 11% rural) is below the EU average (59%) but steadily increasing. This is partly due to increasing coverage of fibre to the premises, standing at 36% in 2020 (7% rural) and the recent partial upgrade of cable networks to DOCSIS 3.1 (34%). Despite access to very high broadband speeds, the uptake of at least 100 Mbps broadband is low (9%), although it has increased by 3 pp. compared to 2019. There has not been any uptake of 1 Gbps services so far. Broadband prices are higher (price index of 60) than the EU average. On mobile, its strong point is the near-complete 4G coverage and the take-up of mobile broadband, which stands at the EU level (71%). Croatia has assigned all 5G spectrum in the pioneer bands (5G readiness reached 100%), but still lacks 5G coverage completely.

In March 2021, the Croatian Government adopted the National Plan for Broadband Development. The plan takes into account the EU 2030 objectives but mainly covers the components of the previous 2016-2020 strategy. Croatia took the necessary administrative steps to implement the previous strategy but did not achieve results in terms of infrastructure deployment. The National Framework Programme for the Development of Broadband Access Infrastructure, co-financed by the

EU, is expected to enable fibre coverage to 240,000 households by the end of 2023. The public funding is expected to complement private investment in fibre coverage for 210,000 additional households and businesses. Despite these public and private investments, the national regulatory authority, HAKOM, has identified a EUR 778 million investment gap for 740,000 households to achieve complete VHCN coverage. Most of these investments are needed in rural areas.

Croatia awarded spectrum for 5G use in a multiband auction concluded on 12 August 2021. The three largest operators all acquired frequencies in the 700 MHz, 3.6 GHz band and in the 26 GHz band. EOLO, a new entrant, also acquired a licence in the 26 GHz band³⁰¹. Rights of use will be issued for 15 years, with a possible 5-year extension. One serious obstacle to national 5G developments is cross-border interference from Italy in the 700 MHz band affecting the Croatian coastline. Another impediment to the timely allocation of 5G spectrum is that, in two counties in the northern part of Croatia, 70 MHz in the 3.4–3.6 GHz band are unavailable due to existing use and are expected to be freed only by November 2023. The remaining part of the band is available countrywide. Despite the lack of allocation of harmonised 5G spectrum, Hrvatski Telekom (in November 2020) and A1 (in December 2020) launched commercial 5G offers using DSS technology in the 800 MHz, 900 MHz, 1,800 MHz, 2,100 MHz and 2,600 MHz frequency bands, which facilitates the use of 5G technology in the existing 4G networks. A positive development much welcomed by the mobile network operators is the 50% reduction in fees for rights of use of frequencies for all spectrum used for mobile communication.

The authorities have been active in addressing concerns over electromagnetic fields, in particular through information campaigns and an up-to-date platform providing relevant 5G-related information such as recent developments and test locations.

Main market & regulatory developments

The Croatian fixed and mobile markets remain stable, with the incumbent, Hrvatski Telekom holding almost 73% of the fixed broadband market and almost 46% of the mobile market. Its main competitor is A1, with market shares of almost 29% and 35% respectively. Tele2 changed its brand name to Telemach in November 2020, and holds 19.4% of the mobile market. It has also announced its entry into the fixed market.

Since 2014, in the context of an insolvency procedure, the incumbent has had a time-limited right of control over Optima Telekom and had to initiate the sale of its shares in the company and the transfer of its control in January 2020. This was an opportunity for new entry in the Croatian market, which could contribute to increased competition and additional benefits for end users in terms of more options, better service and lower prices. However, even after extending the deadline for bids during 2020 there were not any valid offers. Optima therefore still remains with Hrvatski Telekom.

While dual play bundles dominated the market in previous years, these have considerably decreased in 2020. In contrast, triple play remained stable and quadruple play offers are increasing. On the mobile market, post-paid subscriptions are more popular and are slowly increasing (56.7% in 2020), while pre-paid subscriptions are decreasing (43.3% in 2020). TV service is one of the main drivers for subscribing to bundled offers and is included in 71% of all subscriptions. Consumption of over-the-top services is expected to increase, to the detriment of SMS traffic, in particular, decreased by 17% in 2020. On the other hand, traditional mobile

³⁰¹ Telemach, HT and A1 acquired 20 MHz each in the 700 MHz frequency band. Telemach and A1 acquired 100 MHz each in the 3.6 GHz band while HT acquired 120 MHz at national level, while several operators, including a new entrant, EOLO, acquired regional spectrum licences in the 3.6 GHz band.

voice traffic has increased by 17%, most likely as an effect of the COVID-19 pandemic and the increase in remote and home working.

The main developments in market regulation are the decisions on: (i) market analysis of the market for wholesale high-quality access provided at a fixed location (market 4 of the 2014 Recommendation³⁰²; and (ii) on the market for wholesale trunk segments of high-quality access provided at fixed location (previous market 14 of the 2003 Recommendation³⁰³), both notified in July 2020.

On 4 February 2021, the Commission sent a letter of formal notice to Croatia for failure to notify transposition measures for the European Electronic Communications Code. Subsequently, Croatia provided notification that the transposition is planned for Q3 2021.

In a country with over 550 local authorities, excessive right-of-way fees paid to the local municipalities remain a problem for private infrastructure owners. Furthermore, stringent local planning regimes remain another obstacle to efficient roll-out of both fixed and mobile infrastructure. In its roadmap to implement the Connectivity Toolbox³⁰⁴, Croatia announced plans to address the main obstacles to efficient VHCN deployment, such as planning restrictions, faster procedures to rights of way, and the need to establish a coordination body for permit handling and draw up guidelines for application of fees.

In 2020, consumer complaints remained stable (872 complaints) compared to the year before (879), with the bulk of complaints concerning bills, contractual terms and quality of service. Although there was a general increase in both fixed and mobile traffic, which were consistently monitored, no significant congestion issues occurred.

While Croatia is making modest progress to reach the Gigabit Society objectives, significant improvements are still needed. High right-of way fees are an impediment to VHCN deployment. Efficient VHCN deployment could be further facilitated by absorption of EU funds, implementation of the connectivity toolbox and addressing the lack of coordination in permit granting between central and local government, in particular on permit granting and fees. The recent assignment of harmonised spectrum suitable for 5G usage is an important step towards digital transformation, enabling Croatia to take full advantage of a digitalised economy and society, both for households and businesses.

Connectivity in Croatia's Recovery and Resilience Plan

The Croatian plan includes two main connectivity measures to strengthen connectivity as a cornerstone of the digital transition of society and the economy.

The first measure, worth around EUR 106 million, aims to provide VHCN connectivity services in line with the EU gigabit ambition objective by 2025:

- 100 Mbps services to 100,000 Croatian households (700,000 inhabitants) in 20 projects in as many local government units, to overcome in particular the connectivity barrier to teleworking and distance learning, especially in rural areas and among vulnerable groups such as students from disadvantaged families or those with disabilities;
- 1 Gbit services to all major socio-economic drivers such as schools, universities,

³⁰² <u>https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014H0710.</u>

³⁰³ <u>https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32003H0311</u>.

³⁰⁴ <u>https://digital-strategy.ec.europa.eu/en/policies/connectivity-toolbox</u>.

research centres, transport hubs, hospitals, public administrative authorities and businesses.

Other investments of about EUR 20 million will target: (i) building passive electronic communications infrastructure to provide access to VHCN and 5G services in rural and sparsely populated areas where there are no the market conditions to attract private investment'; and (ii) 5G coverage in urban areas and the main terrestrial transport routes (5G corridors). About 55% of the households covered by these measures are in rural areas, 26% are in suburban areas, and only 19% in urban areas.

About EUR 400,000 will be invested in four reform activities on:

- analysis and identification of administrative burdens on spatial planning and construction and permit granting
- developing guidelines for removing administrative burdens drawing on examples of good practice in EU countries
- developing guidelines for the development of spatial plans, focusing on the conditions and method of planning of electronic communications
- developing guidelines for the harmonisation of procedures for obtaining building documents based on good practice in EU countries.

3 Integration of digital technology

3 Integration of	gration of Croatia		EU
digital technology	rank	score	score
DESI 2021	13	40.0	37.6



		Croatia		
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	62%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	26%	26%	26%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	16%	22%	22%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	10%	10%	14%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	22%	22%	29%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	21%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	75%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	12%	12%	43%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	18%	21%	30%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	11%	9%	14%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	8%	10%	10%	8%
% SMEs	2017	2019	2019	2019

On the Integration of digital technology, Croatia ranks 13th among EU countries. 62% of Croatian SMEs have at least a basic level of digital intensity, slightly above the EU average of 60%. As for the use of ICT for environmental sustainability, 75% of Croatian enterprises record medium/high intensity of green action through ICT, significantly higher than the EU average of 66%. Croatian enterprises are taking advantage of the opportunities offered by digital technologies. They actively participate in online commerce, with 30% of SMEs selling online and 10% selling across borders to other EU countries. Advanced technologies are becoming more popular among Croatian enterprises, with 29% using cloud solutions and 21% using AI solutions. Every fifth (22%) enterprise actively uses social media, while one in four (26%) share information electronically. Croatia has experienced a boom in e-invoices, with a record increase of enterprises using them, up from 12% in 2018 to 43% in 2020. The uptake of big data analysis is also increasing, reaching the EU average of 14% of enterprises.

By mid-2022, the Ministry of Economy and Sustainable Development expects to finalise the 2021-2027 National Plan for the Digital Transformation of the Economy. The plan will be a strategic planning act supporting the overall implementation of the digital measures under Croatia's 20212030 National Development Strategy³⁰⁵. The 2021-2029 Smart Specialisation Strategy and the National Plan for the Development of Artificial Intelligence are also under development. Both programmes aim to support the repositioning of Croatian enterprises in global value chains via the development of digital business models and digital skills to adapt their organisational structures to the new global challenges. The Cybersecurity Act is expected to be in force by the end of 2021, and it is a response to European initiative establishing the Network of National Coordination Centres (NCCs) guided by the European Cybersecurity Competence Centre (ECCC). Croatia's 2020 National Reform Programme³⁰⁶ includes support from the European Regional Development Fund (ERDF) to set up a European Centre for Innovation, Advanced Technologies and Skills Development (ECINTV). ECINTV will be a one-stop shop providing support for the digital and entrepreneurial skills and access to the latest knowledge and resources for testing and experimenting with advanced technologies. It will also facilitate access to digital solutions and provide networking to strengthen the national innovation ecosystem.

The Croatian Association for Artificial Intelligence (CroAI)³⁰⁷, founded in 2019, gathers more than 170 members consisting of Croatian AI enterprises, start-ups, scale-ups, universities and AI enthusiasts with a view to connecting leading enterprises and start-ups in the field of artificial intelligence in Croatia.

The Centre for Artificial Intelligence and Cybersecurity (AIRI) at the University of Rijeka³⁰⁸ connects scientists from various fields working on interdisciplinary research projects. The Regional Centre of Excellence for Robotics (CRTA)³⁰⁹ works as a reference centre for research, development and educational activities on robotics and Al³¹⁰. CRTA focuses on the research and development of advanced robot applications, especially in industry and medicine, and where traditional automation and human work can be replaced with adaptive and intelligent systems.

To continue boosting the digital transformation of the Croatian economy, it is important to support SMEs in raising the uptake of advanced technologies, paying particular attention to start-up ecosystems, businesses in disadvantaged regions and female digital entrepreneurs. This will require a coordinated and comprehensive approach combining incentives, investments, and simultaneously building strong links with the relevant investments in human capital. Ensuring that employees are well equipped with relevant advanced digital skills will enhance the innovation capacity of SMEs. The development of a comprehensive digital strategy for the collection, analysis and exploitation of data across several public and private domains would help to address weaknesses and reinforce strengths in the fields of security, privacy, products and services innovation, both in the private and public domains, and contribute to relevant EU initiatives (for example the 1 Million Genomes Declaration³¹¹).

³⁰⁵ <u>https://narodne-novine.nn.hr/clanci/sluzbeni/2021_02_13_230.html.</u>

³⁰⁶https://vlada.gov.hr/UserDocsImages/Europski%20semestar%202020/National%20reform%20programme% 202020.pdf.

³⁰⁷ <u>https://www.croai.org/.</u>

³⁰⁸ https://airi.uniri.hr/.

³⁰⁹ <u>https://www.tehnozavod.hr/regional-center-of-excellence-for-robotic-technologies-at-the-fsb/.</u>

³¹⁰ <u>https://100.fsb.hr/en/118/Regional+Center+of+Excellence+for+Robotic+Technology/.</u>

³¹¹ Croatia became the 17th EU Member State to sign the Declaration *Towards access to at least 1 million sequenced genomes in the European Union by 2022.*

Integration of digital technology in Croatia's Recovery and Resilience Plan

Croatia's plan features a number of measures to support the integration of advanced technologies into the public and private domains. These measures include support to strengthen capacities for digital transformation through the European Centre for Innovation, Advanced Technologies and Skills Development (ECINTV) as a one-stop shop for the coordination and implementation of the relevant activities. Such activities include: (i) the digital transformation of the economy; (ii) lifelong learning and development of digital and entrepreneurial skills; (iii) access to the latest knowledge and resources for testing and experimenting with digital solutions needed to develop new products, processes and business models for users; and (iv) networking and strengthening national ecosystems for digitally focused stakeholder innovation and entrepreneurship at national and European levels.

The objective of this investment is to put in place the framework to establish and monitor Digital Innovation Hubs (DIHs) in Croatia. The investment has a budget of about EUR 7.5 million.

The measure also includes co-financing of up to four DIHs under the Digital Europe 2021-2027 programme. The plan will support the EDIHs so that they can provide four types of services to SMEs:

- testing before investing,
- skills development and training,
- access to finance; and
- support for networking and development of innovation ecosystems.

4 Digital public services

4 Digital public	Croatia		Croatia EU		EU
services	rank	score	score		
DESI 2021	24	52.0	68.1		



	Croatia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	48%	41%	52%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	43	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	60	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	73	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	82%	78%
% maximum score			2020	2020

On Digital public services, Croatia ranks 24th among EU countries and is still underperforming in this dimension of the Digital Economy and Society Index. It has a below-average level of online interaction between public authorities and members of the public, with 52% of internet users using e-government services (EU average: 64%). For the indicator measuring the amount of data pre-filled in public service online forms, Croatia scores far below the EU average (score of 43; EU average: 63). Croatia is also below the EU average on the availability of digital online services, both on digital services for citizens (score of 60; EU average: 75) and for businesses (score of 73; EU average: 84). In contrast, on open data Croatia performs well.

Croatia is progressing with the START platform³¹² that enables members of the public to start a business remotely and without intermediaries, via one single electronic procedure at a single digital location. In parallel, the Financial Agency (Fina) is preparing to introduce 20 physical locations in its branches to assist users who are not electronically literate in using the platform. By April 2021, 1,283 companies had started operations using the platform.

During 2020, 24 new e-services were integrated in the e-Citizens system, which is currently used by over 1.2 million users. It was redesigned in April 2021 and offers a total of 89 e-services³¹³. In addition to the visual and interface changes, the system was adapted for use by mobile devices. It is following a recently published 'Standard for the Development of Public e-Services' (April 2021), which includes guidelines for developing intuitive user interface in e-services.

New services launched in 2020-2021 include the 'e-children' card, e-wedding registration, industrial property registration, and e-renovation. 2020-2021 also saw the establishment of the platform for

³¹² <u>https://start.gov.hr/st/broj-osnivanja.html.</u>

³¹³ As of end of May 2021.

electronic payment of fees and/or charges. The system also enables card payment of administrative fees or charges. It lays the ground for further development of more complex electronic services in both the 'e-citizens' and 'e-business' systems.

Croatia launched several activities in the area of e-accessibility. Among the most prominent was a dedicated course for public service officials in charge of public service websites. In 2020, the programme was completed by 646 participants with more training planned for 2021.

Croatia has been working on the next comprehensive and medium-term strategic framework for public services e-health development (the Croatian e-Health Strategic Development Plan) and its corresponding Action Plan. The plan incorporates the most recent developments in e-health and actions planned for 2021-2027. Croatia continue to invest in e-health and telemedicine services, which have proven especially important during the global pandemic (for more on advancements in e-health solutions, see the highlight 2020-2021 box below).

Croatia could see even more improvements in digital public administration if it were to make e-services for the public and businesses more user-friendly and easier to access. Additional measures to promote the use of e-government services could boost take-up of these e-services. Concentrating on reskilling and upskilling of healthcare professionals and bridging the shortfall in qualified ICT experts in heath will be even more important if Croatia is to tap the full potential offered by the digital economy. Important complementary actions to promote and strengthen digitalisation of public administration and public services include further simplification efforts, as well as measures to ensure interoperability between governmental services and data.

Highlight 2020-2021: e-Health in Croatia

Croatia was an early adopter of e-prescriptions; currently less than 2% of all prescriptions are issued on paper. It also pioneered cross-border e-prescriptions. All four services with 12 cross-border exchange routes are currently available between Croatia, Estonia, Portugal and Finland. Croatia and Portugal are the only EU countries participating in the eHealth Digital Service Infrastructure (eHDSI) with all four services and Croatian doctors can receive patient summaries from other EU countries. By 2022, it is expected that the interoperability of Patient Summary exchange will be established with 15 EU countries.

As a part of joint EU digital response to the COVID-19 pandemic, Croatia has implemented the 'Stop COVID-19' app for exposure notification. It was launched nationwide in July 2020, and successfully connected to European Federation Gateway Service (EFGS) on 16 November 2020. Additionally, as part of public-private cooperation, a chatbot application for Messenger (Facebook) was created and linked to the Facebook page of the Croatian Institute of Public Health³¹⁴ to further assist the general public and provide crucial health information and guidance.

Croatia is also presenting very ambitious investments in the national Recovery and Resilience Plan, notably in telemedicine, with the largest investment in digitalisation of the National Oncology Network and a national oncology database, alongside measures in e-care, teletransfusion and robotic surgery.

³¹⁴ <u>https://www.hzjz.hr/priopcenja-mediji/omogucena-chatbot-komunikacija-korisnika-i-hrvatskog-zavoda-za-javno-zdravstvo/.</u>

Digital Public Services in Croatia's Recovery and Resilience Plan

The Plan includes significant investments for the digitalisation of public administration, supporting the modernization of the digital infrastructure and the improvement of digital public services for citizens and businesses.

The plan includes a number of consistent measures to improve the interoperability of information systems used by the Croatia's government, which will materialize with the establishment of a central register for public authorities and support data driven decision-making at all levels of the administration. It is reinforced by significant investment to expand the capacity of the State cloud and integrating it into the Common European Data Spaces. The plan includes an investment to create a one-stop-shop harmonising and centralising the helpdesk system of all public administrations' online services to strengthen the interactions between citizens, business and public services. The plan also includes an investment to enable citizens to easily use online public services, by creating a mobile e-service platform, promoting the use of electronic signatures in citizens' interaction with the public administration and investments for development of digital identity card.





Hungary ranks 23th out of 27 EU Member States in the Digital Economy and Society Index (DESI) 2021. Over the last few years, its score has improved broadly in line with the EU average.

Hungary scores above average on broadband Connectivity. It is the leader in the take-up of at least 1Gbps broadband (13.2% of lines compared with the EU average of 1.3%) and performs well in 5G readiness, overall fixed broadband take-up and at least 100 Mbps take-up. On Human Capital, it ranks 22nd, scoring below average on most of the indicators. Only 49% of Hungarians have at least basic digital skills, which is significantly below the EU average of 56%; other indicators also reveal a relatively low level of digital skills. To address shortcomings in digital skills, Hungary has developed an ambitious policy framework.

The most challenging DESI dimensions for Hungary remain Integration of digital technology and Digital public services. Only 46% of SMEs have at least a basic level of digital intensity, compared with a 60% average for the EU, and the adoption of key digital technologies (big data, AI and cloud) is low. To foster the digital transformation of SMEs, more, and more effective, support is necessary. For Digital public services, the key indictors measuring the online provision of services show a need for improvement. A stronger focus on users would improve the acceptance and quality of the services.

Hungary has largely completed the implementation of the National Infocommunication Strategy 2014-2020 and the Digital Success Programme 2.0 (*'Digitális Jólét Program – DJP 2.0'*) launched in 2017.

In autumn 2021, Hungary adopted a new strategic framework for the next 10 years, the National Digitalisation Strategy (NDS) 2021-2030³¹⁵. The strategy is structured around four main pillars

³¹⁵ https://2015-2019.kormany.hu/download/f/58/d1000/NDS.pdf

corresponding to the DESI dimensions: digital infrastructure, digital skills, digital economy and digital state. The overarching objective of the NDS is to identify and exploit the potential of digitalisation in the economy, education, research, development and innovation (RDI) as well as the public administration, thereby improving the country's competitiveness and the well-being of its citizens. Hungary aims to exceed the EU average in digital development by the middle of the decade and be among the 10 leading EU economies in terms of digitalisation by 2030.



1 Human capital

1 Human canital	Hui	ngary	EU	50
1 Human capital	rank	score	score	30
DESI 2021	22	40.5	47.1	20
				10



	Hungary			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	50%	49%	49%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	26%	25%	25%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	52%	51%	51%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	3.7%	3.4%	3.8%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	9%	11%	12%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	17%	16%	16%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates % graduates	4.3% 2017	4.6% 2018	4.9% 2019	3.9% 2019

Hungary ranks 22nd among EU countries on Human capital. Only about half of the population possess at least basic digital skills (49% compared to the EU average of 56%), while the percentage of Hungarians with at least basic software skills is also modest. Only a quarter of the population aged between 16 and 74 has above basic digital skills, below the EU average of 31%. The proportion of ICT specialists in the workforce has increased slightly (3.8%) but remains below the EU average (4.3%). However, the share of ICT graduates among all graduates (4.9%) is above the EU average (3.9%). The proportion of female ICT specialists is still very low (12%). In 2020, 16% of enterprises provided ICT training to their employees, compared with 20% in the EU overall.

Hungary has recently introduced several measures to improve digital education. Under the Digital Competence Development priority project³¹⁶ supported by the European Social Fund (EUR 130 million), 45,630 notebooks and 24,000 tablets were provided to schools; broadband network connectivity was upgraded in 429 primary schools, 265 secondary schools and 39 vocational schools. WiFi networks are under construction in more than 400 vocational schools (more than 3,500 primary and secondary schools already have a WiFi connection). The Educational Authority offers students and teachers free-of-charge access to digital educational content, such as specific digital textbooks (smartbooks) and digital copies of traditional textbooks. To improve teachers' digital and digital pedagogical competences, online training was offered to 40,000 teachers. On 1 September 2020, the new national core curriculum was launched for grades 1, 5 and 9 (pupils aged 6, 10 and 14). It modernises ICT education by emphasising computational thinking and information

³¹⁶ <u>https://kk.gov.hu/efop-3-2-4-16-2016-00001</u>

and media literacy. The curriculum also promotes the use of ICT tools in all subjects for tasks such as information search, data use and manipulation, and for digital assignments.

To upskill the workforce, the government has launched several training programmes, including an eight-week long online IT training programme under the economic protection action plan.

Regarding basic digital competences, so far 238,500 people have participated in digital competency development training (93% of the target)³¹⁷.

Following the outbreak of the pandemic, several IT companies offered help, via the National Coalition for Digital Skills and Jobs, to teachers, parents and students to develop their digital competences and support the transition to digital education. The Coalition also carried out a number of research projects to support policymaking, including a labour market survey which revealed a growing shortage of IT professionals in Hungary (employers could hire 44 000 additional digital professionals in the next 2 years).

Hungary's new digital strategy lists three priority areas for digital skills: (1) developing digital competence (based on the DigKomp³¹⁸ framework); (2) increasing the number and qualifications of IT professionals and engineers; and (3) supporting the structural change needed to develop digital skills in education and vocational training. Under digital competence development, the government plans large-scale programmes for citizens, with an emphasis on social inclusion and e-health (improving the competence of both citizens and healthcare workers). Three sub-priorities have been set for the education and training system: (1) developing digital pedagogical methodologies and preparing a digital education strategy 2.0; (2) developing digital tools and competences required for the 21st century education system; and (3) labour market adjustment programmes across the education system.

The policy framework to upgrade digital skills is ambitious. It covers both the development of basic skills of citizens and the supply of IT professionals with support from ESF+.

³¹⁷ EDIOP 6.1.2 – Decreasing the digital skills gap programme

³¹⁸ <u>https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework</u>

2 Connectivity

2 Connectivity	Hur	EU	
- connectivity	rank	score	score
DESI 2021	12	52.0	50.2



	Hungary			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	77%	82%	81%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	40%	51%	56%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	9.26%	13.21%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage % households	87%	90%	89%	87%
	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	36%	43%	49%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	99.2%	99.2%	99.3%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	8%	60%	60%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	7%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	58%	69%	69%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	64	64	69
Score (0-100)		2019	2020	2020

On Connectivity, Hungary ranks 12th. Fast broadband coverage has stagnated at around 89% of households, slightly above the EU average of 87%. Fixed broadband take-up has stagnated as well, at 81%, but above the EU average of 77%. Connection speeds have seen a significant improvement, 56% of homes, against the EU average of 34%, subscribe to at least 100 Mbps fixed broadband, mainly owing to the country's widespread cable network. Hungary stands out for at least 1 Gbps take-up, with 13.2% compared to the 1.3% EU average. VHCN coverage stands at 49%, below the EU average of 59%. However, rural VHCN coverage grew by 7 percentage points last year and is, at 36%, above the EU average of 28%. The 4G coverage of 99.3% is just below the EU average of 99.7%, while the 7% 5G coverage is also below the EU average of 14%. Mobile broadband take-up stands at 69% compared with the EU average of 71%.

The development of digital infrastructure is one of the pillars of Hungary's 2014-2020 National Infocommunication Strategy³¹⁹. This strategy was updated at the end of 2015 with the adoption of the Digital Success Programme and the launch of the Superfast Internet Programme (SIP). In

³¹⁹ <u>https://joinup.ec.europa.eu/sites/default/files/document/2016-11/nis_en_clear.pdf</u>

addition, one of the objectives of the new NDS 2021-2030 is to cover 95% of households by gigabit networks.

The vast majority of projects under the SIP deployed FTTH (fibre to the home) technology, enabling speeds envisaged in the Gigabit Society targets. SIP intended to cover all Hungarian households – broadband coverage for almost 410,000 households is financed from EU Structural Funds, with networks supplying at least 30 Mbps broadband internet service by 2023. For areas that are not commercially viable, a EUR 250 million State aid scheme has been set up to ensure broadband roll-out. By the end of 2020, 245 325 households were covered by at least 30 Mbps broadband through the SIP.

The SIP gives preference to future-proof FTTH solutions and most of the participating undertakings are deploying this technology (86% of the coverage area).

60% of the total harmonised 5G spectrum has been assigned in Hungary, mainly through the two spectrum auctions organised in the past 2 years. Three mobile network operators have launched commercial 5G services in Hungary.

The multi-band award process for the 700 MHz and 3.4-3.8 GHz bands and remaining spectrum in the 2.1 GHz and 2.6 GHz bands took place on 26 March 2020. Magyar Telekom, Telenor and Vodafone obtained licences for a total amount of HUF 128.5 billion (approximately EUR 360 million).

In January 2021, the National Media and Infocommunications Authority (NMHH) held an auction for the 900 MHz and 1800 MHz frequency bands. The incumbent operators, Magyar Telekom, Telenor and Vodafone, paid a total of HUF 150.2 billion (approximately EUR 420 million) for a 15-year licence with the possibility of an extension for 5 years.

The application of the fourth mobile operator, DIGI, to participate in the auction held in March 2020 was rejected, inter alia, because it had previously been found in breach of merger rules. DIGI did not participate in the second auction as it included similar exclusion criteria and, in its view, the conditions did not allow for the successful participation of a new entrant in these bands.

Main market & regulatory developments

At the end of 2020 there were 364 fixed internet service providers, down from 373 in December 2019; this high number is due to the high number of small cable operators. Over the same period, the number of fixed telephony operators remained stable at 157. In October 2020, there were 17 mobile voice service providers and 21 mobile broadband providers, including mobile virtual network operators.

Based on the number of access points, the market shares for fixed broadband services in Q3 2020 were: 38.3% for Magyar Telekom, 23% for the DIGI group and 21.4% for Vodafone (former UPC) and 17.3% for small operators. In the market for mobile broadband services, market shares based on the number of SIM cards with mobile broadband traffic were: 43.2% for Magyar Telekom, 27.8% for Telenor, 27.1% for Vodafone and 2% for other operators.

On 1 April 2020, Vodafone completed the acquisition of Liberty Global's (UPC) cable business in Czechia, Germany, Hungary and Romania. The Commission approved the acquisition, on the condition that Vodafone complied fully with the commitments it had offered on 18 July 2019, and did not raise any concerns over competition in the Hungarian market. UPC's fixed network footprint ensures that Vodafone Hungary is a strong challenger, offering bundled fixed and mobile services.

Two wholesale-only companies entered the market as a spin-off from two mobile operators,

Vantage Towers Hungary from Vodafone and CETIN Hungary from Telenor. In both cases the mobile network infrastructure was transferred to the newly formed companies.

Operators complain about the conditions set by electricity companies for accessing their infrastructure to construct telecommunication networks. The time and cost implications are a significant obstacle to developing both fixed and mobile networks.

Hungary has adopted the measures transposing the European Electronic Communications Code, which entered into force on 21 December 2020; it has since notified full transposition. In April 2021, it submitted its roadmap towards the implementation of the connectivity Toolbox.

On 18 February 2020, NMHH notified to the Commission and BEREC the analysis of market 18 of the 2003 Commission Recommendation³²⁰ on broadcasting transmission services. In March 2020, the NRA adopted its decision to further regulate the market, designating Antenna Hungária as an operator having significant market power.

On 19 November 2020, NMHH notified to the Commission and BEREC the analysis of market 2 of the 2014 Commission Recommendation³²¹ on wholesale voice call termination on individual mobile networks. The Commission issued no comments.

During the pandemic, due to teleworking arrangements, there was higher demand for bandwidth and higher expectations regarding availability of services. However, no significant problems were detected in connection with availability and network capacity.

To ensure affordability and seamless use of digital services, government decision 501/2020 entitled teachers and pupils/students to benefit from free subscriptions to fixed broadband services during the COVID emergency.

In September 2020, the European Court of Justice issued a preliminary ruling in joint cases C-807/18 and C-39/19 in relation to proceedings between Telenor and NMHH. The Court ruled that discriminatory traffic management practices in the form of zero-rating policies were incompatible with Articles 3(2) and 3(3) of the Net Neutrality Regulation; such zero-rating practices were likely to negatively affect the exercise of end users' rights, in breach of Article 3(2). They were also deemed to be in breach of Article 3(3) due to discriminatory internet traffic management measures undertaken solely for commercial reasons, rather than being based on technical or other purposes that might otherwise have been acceptable under the Net Neutrality Regulation.

To make emergency communications more efficient and ensure compliance with the new requirements of the European Electronic Communications Code, Hungary participated in the Commission-financed HELP 112 II project to deploy advanced mobile location (AML), a handset-derived location solution, by July 2020.

Fixed broadband coverage and take-up increased in 2020. In mobile broadband take-up, Hungary managed to reach the EU average. Thanks to the completion of the auction for two of the 5G pioneer bands, Hungary scores well in terms of 5G readiness. However, the fourth mobile operator contested the 5G multi-band auction in March 2020 and the 900 MHz and 1800 MHz auction in January 2021 as it could not participate in them.

³²⁰ Recommendation 2003/311/EC.

³²¹ Recommendation 2014/710/EU.

3 Integration of digital technology

3 Integration of	Hungary		EU	
digital technology	rank	score	score	
DESI 2021	26	23.3	37.6	



	Hungary			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	46%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	14%	14%	14%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	15%	12%	12%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	6%	6%	7%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	11%	11%	17%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	17%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	65%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	10%	10%	13%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	12%	12%	13%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	9%	11%	9%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	5%	5%	5%	8%
% SMEs	2017	2019	2019	2019

On the Integration of digital technology in enterprises' activities, Hungary ranks 26th among EU countries. Hungarian enterprises perform poorly on most technology indicators: only 14% of enterprises have an integrated system for electronic information sharing (ERP), which is less than half the EU average (36%); the use of e-invoices has slightly increased in recent years but remains low (13%); social media engagement (12%), use of big data (7%), cloud (17%) and AI (17%) are all at a relatively low level; and SMEs' online sales performance is also below the EU average. On the other hand, 65% of enterprises reported that their use of ICT triggered environmentally-friendly actions to a significant extent, which is close to the EU average (66%).

Hungary joined the EuroHPC Joint Undertaking in 2018, in which it has been an active participant, and also joined the Leonardo consortium developing a top-of-the-range supercomputer located in Bologna. The existing High Performance Computing (HPC) infrastructure in Hungary is insufficient to meet the growing demand, although new capacity (5 PetaFlops) will become available in the first half of 2022. The European Structural and Investment Funds supported the development of HPC infrastructure with EUR 16.5 million and national financing covers the operational costs of EUR 2 million/year. To support the use of HPC and foster a national ecosystem, Hungary set up a national

HPC Competence Centre (in operation since 1 August 2020), which is part of the EuroHPC Competence Centres network.

Hungary adopted a national AI strategy in September 2020. One of its goals is faster uptake of AIenabled solutions in both the private and public sectors to further develop the quality and efficiency of services.

In 2020, Hungary launched a national quantum technology programme involving research institutions, universities and private companies.

The new NDS 2021-2030 recognises that more support is needed to digitalise the economy. It focuses on: (1) increasing SMEs' use of digital technology; (2) developing digital start-ups; (3) targeted development of the ICT industry through support programmes; (4) using State data assets for economic purposes.

Among other measures, Hungary plans to extend the Modern Enterprises Programme and launch a new financing scheme for business digitalisation.

To close the digital gap between Hungarian SMEs and the EU average, it is necessary not only to increase the size of the support but also its effectiveness.

Highlight 2020/2021 – National Laboratories

In 2020, Hungary launched the National Laboratories Programme³²². The main objective of the programme is to bring together research institutions, universities and industry in a given research field, and to make available future-oriented technologies that could be used by domestic research organisations to implement world-class research and innovation programmes. The programme also seeks to develop the competences that are essential for this purpose and to make the most of research results.

The programme covers 17 laboratories in the areas of 'Industry and digitalisation', 'Culture and family', 'Health' and 'Secure society and environment'.

Several of the laboratories cover advanced digital technologies, notably:

- The Autonomous Systems National Laboratory, which carries out research and development in relation to road vehicles, aircrafts and mobile robots.
- The Security Technologies National Laboratory, which integrates research in technology-based security, namely institutional security, settlement security and cyber security.
- The Digital Heritage National Laboratory, which focuses on developing a methodology for the AI-based processing, research and education of national cultural heritage, and ensuring the widest possible accessibility thereof.
- The ICT and IT National Laboratory, which focuses on 5G-related cyber defence, applications of AI in cyber defence, development of cyber skills and vulnerability of protocols and encryption algorithms.
- The Quantum Information National Laboratory, which aims to set up a regional quantum communication network, develop hardware components for quantum informatics and build a domestic base of experts with state-of-the-art knowledge.
- The Artificial Intelligence National Laboratory, which has flagship projects in medical

³²² <u>https://nkfih.gov.hu/for-the-applicants/innovation-ecosystem/national-laboratories-programme</u>

image processing, transport, manufacturing and logistics.

4 Digital public services



	Hungary			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	67%	64%	70%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	60	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	54	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	76	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	34%	78%
% maximum score			2020	2020

The digitalisation of public services has proven to be challenging in Hungary. The country ranks 25th on this dimension and performs below the EU average on all indicators except e-government users (70% of internet users interacted online with the administration last year). According to the indicators on Digital public services for citizens and Digital public services for business, the quality of e-government is relatively low, mainly because of the lack of cross-border services. In addition, Hungary has the weakest performance in the EU on Open data.

Under the e-Administration Act, since January 2018 the use of online administration has been obligatory for businesses and a right for citizens. Practically all relevant public services are available online and the most important ones have their own structured online forms, online applications or applets. All other services are available via the e-paper online form service, which allows users to submit authenticated electronic documents to the public administration. The development of dedicated and structured online forms continues, as does the migration from the old electronic forms to more user-friendly ones.

As of 31 March 2021, 57% of the population (approximately 5.5 million) had an e-ID card. The Hungarian e-ID scheme is not yet part of the eIDAS Network but is expected to join by 2022; the node is ready, connectivity tests have been successful and bilateral interoperability tests are under way.

Launched in 2017, the National e-Health Infrastructure (EESZT) provides a single communication space for health service providers and patients³²³. Every healthcare provider is obliged to connect to EESZT. During the pandemic, more than 20 new functionalities were implemented, including collecting and reporting pandemic-related data, ordering protective materials and devices, and registering for COVID vaccinations.

³²³ The development of this single communication space was supported by the European Social Fund with EUR 46 million.
One of the four main pillars of the new NDS focuses on further digitalisation of the public administration, with the following main priorities: (1) coordinated, user-centric digital development of central and regional administrations and professional systems on all platforms; this will be done by creating barrier-free, customer-centric services, with a greater emphasis on proactivity and automation, and by introducing emerging technologies, such as AI, where their use is appropriate and offers real added value; (2) establishing a data-driven administration by further enhancing interoperable data links between public registries and relevant back-end systems, as well as egovernment services; (3) developing smart settlements and smart areas; (4) increasing the information security of government electronic services; and (5) digital development of public services (e.g. in healthcare, transport, energy, education and culture).

To improve the quality and acceptance of digital public services, it is important to make them more user-friendly. This is a key challenge for the NDS and more generally for the digital transformation of the country.





Ireland ranks 5th of the 27 EU countries in the 2021 edition of the Digital Economy and Society Index (DESI). Ireland performs very well on the integration of digital technology, and maintains its high scores in the use of e-commerce by SMEs (for example, indicators for SMEs selling online and across borders are well above the EU averages). Ireland's performance for connectivity improved substantially in 2020: for example, fixed very high capacity network (VHCN) coverage rocketed from 35% to 83%. Ireland also scores well for digital public services, particularly in open data and providing digital public services for citizens and businesses. With regard to the latter, Ireland scores a perfect 100. Although Ireland performs above the EU average in advanced digital skills (for example, for the indicators on ICT specialists, female ICT specialists and ICT graduates), the basic digital skills of the population are a little lower (53% against the EU average of 56%).

Ireland is committed to continuing its fast-paced digital transformation. The Department of the Taoiseach is currently developing a new National Digital Strategy, which will comprehensively address the entire digital ecosystem. Building on the increased levels of connectivity that are being delivered by the National Broadband Plan, the strategy is expected to further develop Ireland's leadership in new digital technologies, including cloud computing, data analytics, blockchain, Internet of Things and Artificial Intelligence (AI). It will also further drive digital transformation in the public service, with greater integration of digital services.

Further efforts to support the improvement of digital skills are important, as a relatively low percentage of the population, compared with the country's overall digital performance, has at least basic digital and software skills. A number of ongoing initiatives are aimed at upskilling and reskilling in higher education (for example, *Springboard+* and *Human Capital Initiative Pillar 1*). Others are aimed at both employees and the unemployed in the further education and training sector (for example, *Skills to Advance* and *EXPLORE*). Moreover, a new 10-year Adult Literacy,

Numeracy and Digital Literacy Strategy was launched in September 2021. For connectivity, despite the rapid growth in 2020 of fixed VHCN coverage, at least 100 Mbps fixed broadband take-up is only in 31% of households, which is below the EU average of 34%. Transposition of the European Electronic Communications Code is still ongoing in Ireland. Ireland performs well for 5G mobile broadband coverage and it is important that the remaining 5G spectrum is awarded without delay.

A number of ongoing initiatives to support the adoption of digital technologies by SMEs are now complemented by a strategic *National SME and Entrepreneurship Growth Plan* (published in January 2021). Ireland is continuing to enhance its high-performance computing (HPC) capacities (for example, in 2020, Ireland's EuroHPC Competence Centre was launched and Ireland acquired a Quantum Learning Platform). To advance Ireland's performance in AI, Ireland's first National Artificial Intelligence Strategy was launched in July 2021. Ireland is also advancing in the blockchain and cyber security technology. To further boost cyber security capacity, ensuring appropriate financial resources and technical and educational skill sets is important.

Ireland maintains its focus on accelerating the digitalisation of public services, for example, by further enhancing the government platform (gov.ie) and national open data portal (data.gov.ie). Ireland is continuing to advance on a number of digital projects. For example, in 2021, Digital Postboxes were introduced and the government is continuing its GovTech engagement. Work is continuing to replace the 2015 Public Service ICT Strategy and the eGovernment Strategy 2017-2020. Further progress can still be made particularly on cross-border electronic identification (eID).



Digital in Ireland's Recovery and Resilience Plan (RRP)

- In spite of a relatively modest financial allocation (EUR 989 million), Ireland's Recovery and Resilience Plan includes ambitious and comprehensive digital measures pertaining to all dimensions of the DESI.
- The measures supporting digital objectives in the plan account for EUR 312 million, which represents 32% of the plan's total allocation of EUR 989 million, well above the 20% target set out in the Recovery and Resilience Facility (RRF) Regulation. The measures are expected to accelerate and expand Ireland's digital transformation while also being catalysts for the wider economic recovery, growth and increased competitiveness.

- Regarding the digital transition, Ireland's plan is expected to support digitalisation of enterprises, contribute to addressing the digital divide, including in the education sector, enhance digital skills, as well as support investment in digital infrastructure, the delivery of digital public services and digital-related R&D activities.
- In particular, the plan covers the following digital policy areas identified in Annex VII to the RRF Regulation:
 - o to support connectivity the plan envisages building a low-latency edge platform;
 - o digital-related investment in R&D is expected to be covered by the plan as part of the national grand challenge programme;
 - human capital is expected to be enhanced by a programme to provide digital infrastructure and funding to schools and also by four reform measures aimed at addressing the digital divide and enhancing digital skills;
 - o digital public services are covered by installing an online response option for the population census and a suite of eHealth projects;
 - o digitalisation of businesses is expected to be supported through a programme to drive the digital transformation of enterprise in Ireland;
 - o digital capabilities and the deployment of advanced technologies are covered by the development of a shared government data centre, which also constitutes a green digital investment.
- Finally, the plan envisages the establishment of four Irish European Digital Innovation Hubs as part of a multi-country project.

1 Human capital

				Human capital
1 Human canital	Ire	land	EU	60
I numan capitai	rank	score	score	40
DESI 2021	8	54.1	47.1	20
				0 Ireland EU

2016

2017

2018

2019

2020

2021

	Ireland			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	48%	53%	53%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	28%	34%	34%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	49%	55%	55%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	4.8%	4.9%	5.7%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	19%	21%	21%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	30%	31%	27%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	7.3%	7.9%	7.8%	3.9%
% graduates	2017	2018	2019	2019

For human capital, Ireland ranks 8th of the EU's 27 countries and is thus above the EU average. In 2020, the proportion of ICT specialists increased sharply and is above the EU average. Ireland also performs above the EU average for the indicator on female ICT specialists. 27% of enterprises provide ICT training to their employees, which is above the EU average (20%). The proportion of ICT graduates is 7.8% of all graduates, and is significantly higher than the EU average (3.9%). Nevertheless, in 2020, 53% of enterprises reported hard-to-fill vacancies for jobs requiring ICT specialist skills³²⁴. Although more than half of the population has at least basic digital skills (53%) and at least basic software skills (55%), Ireland performs below the EU average, 56% and 58% respectively, for indicators that measure those skills. On the other hand, 34% of people have above basic digital skills, which is slightly above the EU average (31%).

In Ireland, significant targeted upskilling and reskilling provision in higher education is available through *Springboard+*³²⁵ (for employed, unemployed and those looking to return to the workforce), *Human Capital Initiative (HCI) Pillar* 1³²⁶ (for graduates) and *July Jobs Stimulus* initiatives³²⁷. While ICT courses under *Springboard+* and *HCI Pillar* 1 are principally geared to address shortages in high-level

³²⁴ <u>Analyse one indicator and compare countries</u> — Digital Scoreboard - Data & Indicators (digital-agenda-<u>data.eu</u>).

³²⁵ <u>HEA - Springboard+ (springboardcourses.ie).</u>

³²⁶ Human Capital Initiative | Skills and Engagement | Higher Education Authority (hea.ie).

³²⁷ gov.ie - July Jobs Stimulus (www.gov.ie). As a next stage in Ireland's response to the COVID-19 crisis, the July Jobs Stimulus aims at getting Ireland's businesses back on their feet and as many people as possible back to work quickly.

ICT skills, there is a considerable focus on basic digital skills in all courses provided. *Springboard+* 2020 and *HCI Pillar 1* were launched in June 2020, and over 15,000 places (including 4,000 in ICT) were added under the *July Jobs Stimulus*. In 2021, *Springboard+* focuses on providing relevant skills for those affected by the COVID-19 public health emergency and an additional EUR 7 million has been provided for *Springboard+* under the 2021 budget. In addition, Ireland continues to support the improvement of workforce digital skills, specifically targeting people who have lost their jobs due to the COVID-19 crisis (*Skills to Compete*), vulnerable employees who require upskilling or reskilling (*Skills to Advance*), and people who are over 35 years old in the manufacturing sector (*EXPLORE*).

In July 2020, the National Further Education and Training (FET) Strategy was launched for the period 2020-2024. The priorities are set out across three core pillars: (1) building skills; (2) creating pathways; and (3) fostering inclusion. A key component of the latter is increased literacy and numeracy support. To help individuals build capacity in terms of literacy, numeracy and digital literacy, and participate fully in society, in September 2021, SOLAS³²⁸ launched a new 10-year Adult Literacy, Numeracy and Digital Literacy Strategy³²⁹.

The Mitigating Against Educational Disadvantage Fund, worth EUR 8 million, was targeted at the FET sector in 2020. This fund aims to support educationally disadvantaged learners in accessing and participating in FET and enable investment in building the FET digital infrastructure.

Work is underway on developing the next Digital Strategy for Schools 2021-2027. It builds on the Digital Strategy for Schools 2015-2020 while taking into account the progress made, the learning from the impact of the COVID-19 crisis, feedback from the consultation process, and best international practice. The new strategy will be financed with EUR 200 million under the National Development Plan and Project Ireland 2040.

In 2020, over 3,000 people received informal basic digital skills training under the government's *Digital Skills for Citizens Grant Scheme*, which focuses on providing people who are not online with the opportunity to gain the basic skills. The scheme is due to end in 2021 once training obligations for pre-funded grants have been delivered.

In 2020, SOLAS also significantly increased the capacity of its online service *eCollege*, which provides online courses, including computer programming, data science, office productivity and web and graphic design. Science Foundation Ireland's³³⁰ (SFI) Education and Public Engagement programme seeks to promote the awareness and engagement of the Irish public with science, technology, engineering and maths. In March 2021, SFI announced a national investment of EUR 5.2 million through the SFI Discover Programme to support 49 public engagement and education initiatives. These include *AI in My Life*, led by Dublin City University, to engage 500 Dublin teenagers from disadvantaged backgrounds in workshop series to reflect on AI, personal data processing and digital transformation, and the *Cyber Academy*, led by Munster Technological University, a series of activities for 11-18 year-olds to help them explore their passion for tech by introducing them to the world of cyber security.

³²⁸ Further Education and Training Authority in Ireland.

³²⁹ Adult Literacy, Numeracy and Digital Literacy Strategy for Ireland (solas.ie)

³³⁰ National foundation for research.

Currently, the Irish National Digital Skills and Jobs Coalition³³¹ is developing the interface to connect to the new EU Digital Skills and Jobs Platform³³². Ireland was involved in the 2020 EU Code Week with 123 activities and 6,138 participants (of whom 44% were women), and is set to participate in the 2021 edition.

It is important that Ireland continues to focus its efforts on improving the basic digital and software skills of its population.

Human capital in Ireland's Recovery and Resilience Plan

- The plan dedicates EUR 64 million to support human capital through an investment measure and envisages a reform.
- The investment consists of two sub-measures to ensure that learners in primary and post-primary schools are equipped with appropriate digital skills. The first sub-measure shall provide high-speed broadband connectivity for primary schools, and the second shall support schools to provide digital devices and software to disadvantaged students.
- The objective of the reform is to support digital transformation of Irish education and training at all levels, enhance digital skills and address the risk of a digital divide. The reform consists of four measures: (i) a Digital Strategy for Schools 2021-2027 that shall aim to realise the potential of digital technologies in teaching, learning and assessment; (ii) a 10-year Adult Literacy, Numeracy and Digital Literacy Strategy to help individuals build their digital literacy; (iii) a measure to increase the number of graduates with high-level ICT skills; and (iv) a measure enabling further and higher education institutions to provide laptops to disadvantaged students.

³³¹ https://www.digitalcoalition.ie/

³³² <u>https://digital-skills-jobs.europa.eu/en</u>

2 Connectivity

2 Connectivity	lre	EU	
,	rank	score	score
DESI 2021	7	56.4	50.2



	Ireland			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	73%	76%	78%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	20%	25%	31%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	0.26%	3.52%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	96%	96%	96%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	13%	35%	83%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	95.8%	99.0%	99.0%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	30%	30%	30%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	30%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	69%	81%	81%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	45	63	69
Score (0-100)		2019	2020	2020

With an overall connectivity score of 56.4, Ireland ranks 7th among EU countries. There was a rapid growth in 2020 of the fixed very high capacity network (VHCN) coverage, increasing from 35% to 83%, mainly due to the roll-out of DOCSIS 3.1. Looking at fast broadband (NGA) access, rural areas are covered almost to the same extent as non-rural areas with 91.2 % and 96.2% respectively. In terms of fixed broadband take-up, 78% of all households subscribe to some kind of fixed internet access, slightly above the EU average of 77%. Ireland's rate for at least 100 Mbps fixed broadband take-up is only 31% of households, which is below the EU average of 34%. 4G coverage is at 99%.

There are some notable developments on fixed and mobile VHCN broadband networks. Ireland has over 200,000 (248,000 in Q4 2020) fibre to the premises (FTTP) broadband subscriptions, representing an increase of 59% from Q2 2019 to Q2 2020, albeit starting from a low base. This increased take-up of VHCN comes on the back of investments made in the networks by the following operators: Eir continues to roll out its fibre to the home (FTTH) network (in April 2021, its Gigabit fibre network was available to customers in 79 towns and villages across Ireland); SIRO is also continuing to roll out its network; Virgin Media completed a significant deployment in August 2020 when it announced that it had deployed DOCSIS 3.1 technology across 97.5% of its network in

Ireland; and the National Broadband Plan, operated by NBI, is continuing to roll out the network, which eventually aims to provide VHCN to 537,596 premises and 1.1 million people.

Ireland scores 30% for the 5G readiness indicator and has good 5G mobile broadband coverage, with 30.5% of households covered. The three mobile network operators currently publish the following figures for their 5G roll-out: Vodafone is running commercial 5G services in 5 cities; Eir's 5G network currently offers coverage in 268 towns and cities in the 26 counties of the Republic; and in September 2020, Three Ireland switched on its 5G network, rolling out 315 sites across the country.

As for future spectrum awards, the Commission for Communications Regulation (ComReg, the statutory body responsible for the regulation of the electronic communications and postal sectors in Ireland) published its *Multi Band Spectrum Award – Information Memorandum and Draft Regulations for the 700 MHz Duplex, 2.1 GHz, 2.3 GHz and 2.6 GHz Bands* on its ComReg website on 16 April 2021. This sets out the timeline, but currently does not indicate an end date for the process.

Main market & regulatory developments

Eir's fixed broadband market share fell slightly during the year from 32.1% in Q2 2019 to 30.7% in Q2 2020 (29.9% in Q4 2020). Vodafone's and Three's retail mobile market share has decreased slightly, while Eir's market share increased to 21.8% in Q2 2020 (21.7% in Q4 2020). This is likely to be due, in part, to the launch of its GoMo sub-brand in Q4 2019. While there were no new entrants in the mobile market during the reporting year, competition intensified. Eir Mobile's GoMo offers customers a plan that includes all calls, texts and data for EUR 12.99 per month for life. In response, Three Ireland promoted its sub-brand labelled '48', which offers new customers a EUR 7.99/month plan with 100 GB of data, all calls and all texts.

At the end of Q2 2020, there were 1,375,126 (1,327,000 in Q4 2020) fixed voice subscriptions (a decrease of 4.1% on Q2 2019). As of Q2 2020, Eir had 39.7% (40.3% in Q4 2020) of all fixed voice subscriptions, followed by Virgin Media with 23.3% (22.6% in Q4 2020), Vodafone with 13.7% (13.6% in Q4 2020), Sky with 13.6% (13.6% in Q4 2020) and Pure Telecom with 3.9% (3.9% in Q4 2020).

The transposition of the European Electronic Communications Code is still ongoing and infringement proceedings have been initiated³³³ for non-communication.

ComReg adopted measures to address the high cost of calling non-geographic numbers (NGN) and to tackle confusion about the different NGN ranges. Firstly, since 1 December 2019, the retail cost of a call to a 1850, 1890, 0818 or 076 NGN costs no more than the retail cost of calling a landline number. Secondly, from 1 January 2022, the five NGN ranges will be reduced to two, with a 3-year transition period. In January 2020, ComReg introduced wholesale price controls for 0818 and 1800 NGNs that came into effect on 1 May 2020.

ComReg reviewed the market for broadcasting transmission services in Ireland. It found that 2rn, the wholly owned subsidiary of RTÉ, has significant market power (SMP) on the market for wholesale access to national terrestrial broadcast transmission services; and that RTÉ has SMP on the market for wholesale access to digital terrestrial television multiplexing services. Both SMP operators will have to comply with obligations of access, non-discrimination, transparency,

³³³ INFR(2021)0054

accounting separation, price control and cost accounting.

As regards access regulation, during 2020, ComReg adopted a new methodology for setting the weighted average cost of capital (WACC) for future pricing decisions and calculated the corresponding WACC values. These values will be recalculated on an annual basis and updated values will be used for any subsequent ComReg decision on price controls.

In January 2020, ComReg also completed its market review of the wholesale high-quality access (WHQA) markets.

ComReg also reviewed the market for wholesale call termination on individual public telephone networks provided at a fixed location (fixed termination markets). It amended the market definition by including 0818 numbers (non-geographic numbers), and designated additional fixed service providers as SMP.

To mitigate identified potential competition problems that could arise from the exercise of market power by additional SMP fixed service providers (FSP), ComReg has imposed a range of *ex ante* regulatory remedies to ensure effective and efficient access to Fixed Voice Call Termination for the benefit of competition and, ultimately, consumers. In this regard, ComReg imposed similar regulatory obligations on each of the additional SMP FSPs, in line with those that were imposed on the 2019 SMP FSPs under the 2019 Termination Markets Decision.

In its roadmap to implement the connectivity toolbox, Ireland announced plans for action on all the best practices not yet implemented, with a target of end Q1 2022.

During the period 1 January 2020 to 31 October 2020, ComReg's Consumer Line received 7,547 complaints from residential and business customers. This is an overall increase of 43.4% compared with the number of complaints that were raised in the same period in 2019 (5,263). This increase in complaints being reported to ComReg is mainly due to: (a) customer service issues associated with one large service provider; and (b) the critical nature of electronic communications services in enabling consumers to continue to work effectively in a remote environment³³⁴.

ComReg took compliance actions including in relation to open internet transparency measures. In May 2020, ComReg issued six opinions of non-compliance regarding transparency obligations under the Open Internet Regulation³³⁵. This was the culminating phase of enforcement undertaken in December 2019. These actions concerned issues set out in Article 4 of Regulation (EU) 2015/2120 of the European Parliament and of the Council of 25 November 2015, and were taken against Digiweb Limited, Pure Telecom Limited, Three Ireland (Hutchison) Limited, Three Ireland Services (Hutchison) Limited, Virgin Media Ireland Limited and Vodafone Ireland Limited³³⁶. An Opinion of Non-Compliance was issued to Imagine Communications Ireland

³³⁴ <u>https://www.comreg.ie/consumer-information/consumer-care/consumer-statistics/</u>

³³⁵ <u>ComReg issues opinions of Non-Compliance | Commission for Communications Regulation</u> ³³⁶

https://www.comreg.ie/enforcement?date_from=&date_to=&orderby=date__desc&query=open+internet&da te_from=01&start-year=1995&end-month=06&end-year=2021

Limited on 19 February 2021³³⁷.

Regarding caller location information for emergency calls, the Advanced Mobile Location functionality was introduced for 112 SMS on Android phones while the iOS implementation is still ongoing.

Ireland is doing well on 5G mobile broadband coverage, but it is important that the remaining 5G spectrum is awarded without delay. Ireland has already awarded 5G spectrum in the 3.6 GHz band and is now moving forward with the award of the 700 MHz band in line with the published timetable. The Multi Band Spectrum Award – Information Memorandum and Draft Regulations for the 700 MHz Duplex, 2.1 GHz, 2.3 GHz and 2.6 GHz Bands was published on the ComReg website on 16 April 2021.

Connectivity in Ireland's Recovery and Resilience Plan

- The plan's allocation for connectivity is EUR 19 million.
- The connectivity measure aims at ensuring that public administrations maximise the benefit from 5G technologies. The investment consists in building a low-latency platform with a high-speed backbone using edge compute nodes to enable a faster response. A variety of public services shall subsequently be developed, tested and deployed using the platform, notably for public protection and disaster relief. SMEs and start-ups shall also be able to use the platform to test new services.

³³⁷ <u>https://www.comreg.ie/publication/information-notice-imagine-opinion-of-non-compliance-open-internet-access-case-reference-1429</u>

3 Integration of digital technology



	Ireland			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	66%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	28%	28%	28%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	36%	44%	44%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	20%	20%	23%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	33%	33%	41%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	14%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	67%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	20%	20%	19%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	30%	35%	32%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	26%	29%	27%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	17%	18%	18%	8%
% SMEs	2017	2019	2019	2019

Ireland ranks 7th of the 27 EU countries in the integration of digital technology and is thus above the EU average. 66% of SMEs demonstrate at least a basic level of digital intensity. SMEs also maintain a strong e-commerce performance: 32% of SMEs sell online and 18% sell across borders, well above the EU averages of 17% and 8% respectively. 27% of SME total turnover originates from online sales, more than double the EU average of 12%. Irish companies rank high in the use of social media (44%), cloud services (41%) and big data (23%). For the ICT for environmental sustainability indicator, Irish companies are slightly above the EU average of 66%. However, neither the use of AI nor e-invoices is widespread among Irish companies (14% and 19% respectively) in comparison with the EU average (25% and 32% respectively).

To support SMEs in the adoption of digital technologies, Local Enterprise Offices provide a range of assistance, including the Trading Online Voucher Scheme, Business Expansion Grants, training programmes, workshops and digital skills webinars. Enterprise Ireland³³⁸ also offers a range of

³³⁸ Agency responsible for the development and growth of Irish enterprises in world markets.

support grants to help reduce the development cost of new or improved products, services or technical processes. Furthermore, a *National SME and Entrepreneurship Growth Plan*³³⁹ (published in January 2021) sets out strategic recommendations, including in the areas of digitalisation, clustering, regulation and education. These recommendations are currently being taken forward by a ministry-led implementation group, in conjunction with relevant government departments and agencies. This work is continuing during the second half of 2021. It also lists the following deliverables on digitalisation: in the short term, online business productivity diagnostic tool and existing digitalisation support extended to traditional non-exporting sectors, and in the medium term implementation and uptake of a competitive digital transformation scheme.

Ireland continues to drive collaboration between research bodies and industry. Science Foundation Ireland (SFI) currently funds six SFI Centres for Research Training, all in the broad area of data and ICT skills for the future. The aim is to train academically outstanding postgraduates, including in the skills and knowledge required to address the future challenges of an ever-changing work environment. In addition, 16 SFI Research Centres provide infrastructure to support researchers to commercialise their research, including in digitalisation (for example, AI, cloud computing, virtual/augmented reality, Internet of Things, and cyber security). Furthermore, Enterprise Ireland helps companies find partners for collaborative research, including in the delivery of digital solutions, through 8 Technology Centres, 16 Technology Gateways, and Knowledge Transfer Ireland. Each year, Enterprise Ireland supports 125 new start-ups with nearly two thirds in ICT (including digital technologies). Starting in 2021, the third call of the Disruptive Technologies Innovation Fund will see 29 projects receive EUR 95 million in funding over the next three years, to develop novel technologies capable of transforming business.

The year 2020 marked the launch of Ireland's EuroHPC Competence Centre. Hosted by the Irish Centre for High-End Computing, this initiative will initially include two programmes: (i) an SME Accelerator offering advanced training in HPC and new technologies for eligible Irish SMEs; and (ii) an Academic Flagship, which aims to increase Irish competitiveness in the European supercomputing landscape. Ireland has dedicated EUR 64,000 (2020) and EUR 510,000 (2021) in funding to EuroHPC activities. In 2020, Ireland acquired a Quantum Learning Platform, which will be used to conduct R&D and national-level skills development activities in quantum technologies. Finally, an HPC Advisory Group was launched in 2021 to exchange views and advise on how best to position Ireland and exploit opportunities in HPC-relevant areas (including EuroHPC, PRACE³⁴⁰, quantum technologies and AI).

Blockchain technology continues to transform the financial services industry. FINTECHNEXT³⁴¹ is a multi-million euro, 4-year collaborative research programme between University College Cork and Fexco, supported by SFI. It started in 2019 with the aim to deliver applied and funded research dedicated to disrupting three key fintech verticals: treasury services, digital taxation, and corporate asset administration.

³³⁹ gov.ie - Report of the SME Taskforce: National SME and Entrepreneurship Growth Plan (www.gov.ie).

³⁴⁰ PRACE – Partnership for Advanced Computing in Europe (prace-ri.eu)

³⁴¹ About Project (fintechnext.ie).

In 2020, a European Commission enterprise survey indicated that 35% of Irish enterprises had adopted at least one AI technology, which is lower than the EU average of 42%³⁴². Ireland's first National Artificial Intelligence Strategy, 'AI – Here for Good'³⁴³, was launched on 8 July 2021. It will serve as a roadmap for how Ireland can leverage the potential of AI for unlocking productivity, for addressing societal challenges, and for delivering public services. It envisions a future for Ireland as an international leader in using AI to the benefit of business, public services, and for people, through a people-centred, ethical approach to AI development, adoption and use.

Cyber security in Ireland is implemented under the National Cyber Security Strategy 2019-2024, which covers cyber security research and investment in operation and infrastructure, and references the Cyber Security Skills Initiative. The work of the National Cyber Security Centre (NCSC) received a higher profile due to its advisory role on measures to take in response to remote working as a result of the COVID-19 public health emergency. In July 2021, the government agreed a significant expansion of the NCSC, in terms of the number of staff and associated budget, and other measures to further strengthen its capacity. As regards the Cybersecurity Competence Centre and Network Regulation, the work in relation to identifying an entity to take on the functions of the National Coordination Centre is currently ongoing and it is anticipated that the NCSC will have a role in this area. The main issues to be addressed for boosting cyber security technology in Ireland are the financial resources and technical and educational skillsets that are required both to maintain existing levels of capacity and resilience and to build capacity for the future.

Highlight 2020-2021: European Digital Innovation Hubs (EDIHs)

Ireland has designated four candidate EDIHs to participate in the European Commission's 2021 restricted call for the EDIH network. This represents one hub in each region of the country, as well as a dedicated AI hub. The EDIH network will help companies (notably SMEs) and the public service become more competitive in their business/production processes, and in products or services, by providing access to technical expertise and experimentation in AI, HPC and cyber security and advanced digital skills.

As the Irish economy is dominated by SMEs, which account for 99% of enterprises, it is critical that they receive the digitalisation support they need to compete in global markets. Ireland intends to maximise its contribution to the EDIH programme to fully benefit from the advantages this initiative presents to drive transformational change in Irish enterprise and to build on pan-European expertise in digital technologies through sharing knowledge, equipment and personnel. Subject to the timeframe of the European Commission call, it is intended that the EDIHs will be operational in 2022.

Integration of digital technology in Ireland's Recovery and Resilience Plan

• The plan allocates EUR 85 million to digitalisation of businesses, EUR 39 million to

³⁴² European Commission, European enterprise survey on the use of technologies based on artificial intelligence, a study prepared for DG Communications Networks, Content & Technology by Ipsos and iCite, 2020.

³⁴³ gov.ie - Taoiseach and Minister Troy launch Government Roadmap for AI in Ireland (www.gov.ie).

investment in digital capacities and deployment of advanced technologies and EUR 21 million to digital-related investment in R&D and covers three investment measures.

- First, the programme to drive the digital transformation of enterprise in Ireland (EUR 85 million) aims to tackle an unbalanced digitalisation among companies, particularly SMEs, and more generally to enhance the digitalisation of businesses. This measure also aims to support Irish European Digital Innovation Hubs as part of the multi-country project. The hubs shall further help companies become more competitive by undergoing a digital transformation.
- In addition, the plan provides for the construction of a high-quality, energy-efficient and fit-for-purpose shared government data centre (EUR 39 million) enabling the migration of servers and services to it. The data centre shall function in a more environmentally friendly manner, including by using the data centre's waste heat for other buildings.
- Finally, the digital dimension of the national grand challenge programme (EUR 21 million) aims to incentivise research teams to develop viable, practical and innovative solutions in the areas of e-government, e-health and e-inclusion.

4 Digital public services

4 Digital public	Ire	EU	
services	rank	score	score
DESI 2021	6	82.6	68.1



	Ireland			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	64%	67%	67%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	63	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	86	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	100	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	92%	78%
% maximum score			2020	2020

For digital public services, Ireland ranks 6th of the 27 EU countries and is thus above the EU average. While Ireland's score for digital public services for businesses is perfect (100), it scores lower in digital public services for citizens (86), although still above the EU average of 75. Ireland also scores very high in open data (92%), while for the indicators measuring e-government users and pre-filled forms, its performance is more or less average.

In 2020, the government continued its efforts to consolidate and simplify access to government services, in particular through enhancing the quality and basic functionality of the Digital Service Gateway (gov.ie), which is a one-stop central platform that provides citizens online access to government services and information. The platform aims to provide user-orientated interaction and to present information in a clear, understandable and accessible manner. Citizens can access the platform using a verified MyGovID account, of which there are now over 600,000. There has been a notable increase in the figures for digital public services transactions: the evidence indicates that more people are visiting the portal site and are staying longer. The objective is that by the end of 2023 towards 90% of the available digital public services will actually be used.

The government platform is a major component of the 'Build to Share' pillar of the 2015 Public Service ICT Strategy and also a key action of the eGovernment Strategy 2017-2020. Work is currently underway on the replacement of the 2015 Public Service ICT Strategy. The new strategy will also replace the eGovernment Strategy 2017-2020.

The Public Service Data Strategy 2019-2023 sets out a detailed vision with a set of goals and actions to deliver a more joined-up whole-of-government approach to how data are used and managed within the public service. A key output of the Department of Public Expenditure and Reform, which is responsible for Ireland's open data policy, has been the development of a national open data portal (data.gov.ie) that provides access to official non-personal government data, in open format.

The portal currently links to over 12,953 datasets from some 148 publishers³⁴⁴. This data must be published under an open licence so it can be freely used, reused and redistributed.

Over the course of 2020 and 2021, the departments worked through a list of priority digital projects. At the beginning of 2021, Ireland introduced Digital Postboxes to its citizens through e-Boks, a digital solutions company. This solution provides people with an opportunity to receive their government-related post in a secure digital mailbox via a single shared platform. Building on its GovTech³⁴⁵ engagement in 2019, the government is further exploring innovative digital opportunities by partnering with industry, in particular the start-up and SME sector.

To embed innovation across the public service, in November 2020, the Public Service Innovation Strategy was published. Its purpose is to deliver improved services, including supporting and promoting digital transformation, for example by using digital solutions that are informed by the right data.

In the 2020 eGovernment Benchmark report³⁴⁶, Ireland scored 0% on cross-border eID for both citizens and businesses (EU average 9% and 36% respectively). Ireland has not notified an eID scheme under the eIDAS Regulation³⁴⁷. This impedes cross-border use of eID.

Although Ireland is committed to drive digital transformation in the public service through continuous development of the integration of digital public services, further efforts, in particular for cross-border eID, are crucial.

Digital public services in Ireland's Recovery and Resilience Plan

- The budget allocated to digital public services amounts to EUR 85 million and covers two investment measures.
- The objective of developing an online response option for the population census (EUR 10 million) is to improve the efficiency of data collection and analysis by digitalising the census.
- The suite of eHealth projects (EUR 75 million) comprises two sub-measures. The first sub-measure shall support the deployment of ePharmacy systems across hospitals in Ireland to better monitor the use and costs of medication. The second sub-measure aims to support the deployment of an integrated financial management system to provide financial and procurement efficiencies within the health system.

³⁴⁴ Data as available on 15 October 2021.

³⁴⁵ GovTech is the application of emerging technologies to deliver enhanced public services through increased efficiency and reduced cost.

³⁴⁶ <u>https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=69461.</u>

³⁴⁷ Regulation (EU) No 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC (OJ L 257, 28.8.2014, p. 73).

	lt	aly	EU
	rank	score	score
DESI 2021	20	45.5	50.7



Italy ranks 20th out of 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI). This position represents a significant progress compared to the 2020 edition of the DESI, where the country ranked 25th.

During 2020, Italy made some progress in both coverage and uptake of connectivity networks, with a particularly notable increase in the take-up of connectivity services offering speeds of at least 1 Gbps. However, the pace of fibre deployment slowed between 2019 and 2020, and efforts are still needed to increase the coverage of Very High Capacity Networks and 5G and to stimulate take-up.

Italy lags significantly behind other EU countries on Human capital. Compared with the EU average, it records very low levels of basic and advanced digital skills.

The share of Italian online users who use e-government services increased from 30% in 2019 to 36% in 2020, but it is still substantially below the EU average. The use of the electronic health record by people and healthcare professionals also remains uneven between regions.

Most Italian small and medium enterprises (69%) have at least a basic level of digital intensity, a share that is well above the EU average (60%). Italian enterprises perform very well in the use of e-invoices, although gaps remain in the use of technologies such as big data and Artificial Intelligence, and in the uptake of e-commerce.

Legislation adopted in 2020 provides for reforms to speed up broadband rollout – including 5G – and to simplify and accelerate the digitalisation of public services.

During 2020 and 2021, there was a sharp acceleration in the adoption of major enabling platforms for digital public services by public administrations. New reforms under the national Recovery and Resilience Plan are expected to give a further boost to the digitalisation of services and modernisation of public administration across the country.

In recent years, the pressing need to act to reduce the major gaps in digital skills gained increasing attention. In 2020 Italy launched its first National Strategy for Digital Skills and a related operational plan that lists more than 100 specific actions and sets ambitious targets for 2025.

The government also extended the fiscal benefits under Transition 4.0, which will be supported under the Recovery and Resilience Plan, and pre-selected the hubs that will participate in the network of European Digital Innovation Hubs (EDIHs).

The national Recovery and Resilience Plan lays out an ambitious roadmap, with reforms and investments touching upon all aspects of the DESI.

Overcoming the delays and closing the gaps between Italy and other EU countries requires sustained efforts and an integrated approach to policies on human capital, innovation and business competitiveness. Robust implementation of the initiatives undertaken in recent years and the measures under the Recovery and Resilience Plan can represent an important change of pace and opportunity to drive digitalisation across the country.



Digital in Italy's Recovery and Resilience Plan (RRP)

The Italian Recovery and Resilience Plan is the largest in the EU, accounting for a total of about EUR 191.5 billion. 25.1% of it (i.e. approximately EUR 48 billion) is devoted to the digital transition.

The reforms and investments contributing to the digital transition cover the digital transformation of the public administration and justice system and the strengthening of the healthcare system through digital technologies, the modernisation of businesses through the uptake of advanced technologies (Transition 4.0), and the deployment of gigabit connectivity across the country.

The plan also addresses digital-skills development, with measures aimed at improving the basic digital skills of the general population, increasing the offer of training on advanced digital skills, and upskilling and reskilling the workforce.

Moreover, investments are expected to support the development and deployment of advanced technologies, such as microelectronics, cloud and High Performance Computing (HPC).

The plan supports the participation in a number of multi-country projects in advanced technologies and beyond, notably in the Important Projects of Common European Interest (IPCEIs) on microelectronics and Next Generation Cloud Infrastructure and Services, 5G corridors, the EuroHPC Joint Undertaking, the network of European Digital Innovation Hubs (EDIHs) and international consortia for specialised education and training in digital domains.

1 Human capital

1 Human canital	lt	EU	
I numan capitai	rank	score	score
DESI 2021	25	35.1	47.1



	Italy			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	NA	42%	42%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	NA	22%	22%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	NA	45%	45%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	3.6%	3.5%	3.6%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	15%	15%	16%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	17%	19%	15%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	1.0%	1.3%	1.3%	3.9%
% graduates	2017	2018	2019	2019

In Human capital, Italy ranks 25th of 27 EU countries. Only 42% of people aged 16-74 years have at least basic digital skills (56% in the EU) and only 22% have above basic digital skills (31% in the EU). The percentage of ICT specialists in Italy is 3.6% of total employment, remaining below the EU average (4.3%). Only 1.3% of Italian graduates study ICT, well below the EU average. Italy's performance is closer to the EU average on female ICT specialists: they represent 16% of ICT specialists (the EU average is 19%). Only 15% of Italian enterprises provide ICT training to their employees, five percentage points below the EU average.

In 2020 Italy launched its first National Strategy for Digital Skills, which sets out a comprehensive approach to digital skills development to narrow the gaps with other EU countries³⁴⁸. Comprising four strands, it covers a broad range of areas and target groups:

- students in education and training, to integrate e-skills within primary and secondary schools, university and higher-education curricula;
- active workforce, covering e-leadership, and basic as well as advanced and specialised digital skills;
- ICT specialists, to enhance the country's ability to develop skills for new markets and new jobs;
- general public, to develop the digital skills needed to exercise citizenship rights.

³⁴⁸ Strategia Nazionale per le Compentenze Digitali, July 2020 (<u>Strategia nazionale per le competenze digitali |</u> <u>Strategia Nazionale per le Competenze Digitali (italia.it)</u>).

The related operational plan, published in December 2020, translates the strategy into specific actions and ambitious targets for 2025 (see the box below)³⁴⁹. It catalyses efforts on digital skills in Italy by introducing new initiatives and reinforcing ongoing ones.

Looking at some of the initiatives already under way, between 2020 and 2021 two important projects supported digital literacy among the population. In 2020, the nodes of the digital facilitation services network trained more than 100 000 people and helped them access the most common online services, including digital public services³⁵⁰. The government also promoted training on digital skills for individuals at risk of digital exclusion through the 'digital civil service'.

Measures to support the reskilling and upskilling of the workforce and advanced digital skills include the Transition 4.0 national plan, which further extended the tax credit for 'Training 4.0'. In 2020 and 2021, projects for capacity building in the area of digital also involved the network of technology transfer centres. For example, the Chamber of Commerce (which runs the *Punti Impresa Digitale*) developed digital maturity-assessment tools, including a platform dedicated to the assessment of digital skills ('digital skills voyagers').

A key role in the implementation of the National Strategy for Digital Skills is played by the Italian Coalition for Digital Skills and Jobs. The coalition builds on 'Repubblica Digitale', a multi-stakeholder initiative that promotes digital skills at all levels. Since its launch in 2019, more than 180 organisations have joined the Italian coalition and contributed with more than 220 projects. In 2020, the coalition's initiatives trained more than 2.7 million students, about 70 000 teachers, over 900 000 other people, and more than 250 000 workers in the private and public sector³⁵¹. A number of projects specifically addressed the gender gap.

Finally, between 2020 and 2021, more than 10 000 EU Code Week events were organised across Italy, targeting primary and secondary-school pupils in particular³⁵².

In conclusion, Italy is faced with significant shortcomings in both basic and advanced digital skills, which risk translating into the digital exclusion of a significant part of the population and limit the capacity of enterprises to innovate. The National Digital Skills Strategy represents an important milestone and opportunity to narrow this gap. It is crucial to heighten the focus on human capital and continue efforts on education, reskilling and upskilling and training on the job in technology-intensive sectors.

Highlight 2020-2021: The National Strategy for Digital Skills and its operational plan

The operational plan of the National Strategy for Digital Skills is structured along the four strands (or lines of action) identified in the strategy and provides for 111 specific actions.

The plan includes ambitious targets for 2025, in line with the objectives defined at EU level and in large part based on DESI and Eurostat indicators. These targets will be used to monitor the implementation of the strategy. The aims are to:

• reach the target of 70% of the population equipped with at least basic digital skills and

³⁴⁹ Piano Operativo della Strategia Nazionale per le Compentenze Digitali, December 2020 (<u>https://repubblicadigitale.innovazione.gov.it/assets/docs/Piano-Operativo-Strategia-Nazionale-per-le-</u> <u>competenze-digitali.pdf</u>).

³⁵⁰ Around 650 centres across different Italian regions were active in 2020. Data provided by the Italian authorities.

³⁵¹ <u>Repubblica Digitale | Il Programma (innovazione.gov.it)</u>.

³⁵² Europe Code Week.

close the gender gap;

- double the population with advanced digital skills (achieving: 78% of young people with higher education, 40% of workers in the private sector and 50% of civil servants);
- triple the number of graduates in ICT and quadruple the number of female ones;
- increase by 50% the share of small and medium enterprises (SMEs) using ICT specialists.

The plan is accompanied by a dashboard of over 60 indicators to monitor milestones, results and impacts of the actions under each strand. The dashboard builds on the indicators of the DESI and the Digital Maturity Index (DMI) established by the Digital Agenda Observatory. Monitoring will be carried out on a six-month basis; this will enable continuous analysis of progress and a prompt recalibration of actions if needed.

Human capital in Italy's Recovery and Resilience Plan

As part of the budget dedicated to the digital transition, a total of around EUR 7 billion is allocated to the human capital field. Digital skills are addressed in the plan through a comprehensive set of measures targeting the general population (with particular regard for people with disabilities and at risk of digital exclusion), the public administration, the education system and the needs of a labour market in transition.

The plan includes measures to tackle the digital divide by strengthening people digital skills. Investments aim to reinforce the 'digital civil service', a programme which deploys a network of young volunteers across Italy to train people in digital skills (EUR 60 million), and are expected to strengthen the existing network of digital facilitation centres (EUR 135 million). The latter centres are physical access points, usually located in libraries, schools and social centres, which provide individuals with both in-person and online training to effectively support their digital inclusion.

Regarding advanced and specialised digital skills, the plan is expected to finance PhD courses in new technologies (EUR 240 million) and expand the academic offer in the field of digital technologies, also envisaging possible cross-border cooperation (EUR 500 million). The plan includes a number of reforms and investments to modernise the education system, facilitate the transition to the labour market and boost upskilling and reskilling, for example by strengthening the tertiary vocational-training system (ITS), updating university curricula, and strengthening public employment services. Italy is expected to also launch a new 'National Programme for the Guaranteed Employability of Workers' (for a total of EUR 4.4 billion³⁵³) which aims to support the unemployed and workers in transition, including through digital skills training.

Finally, investments for digital skills development also target the public sector, such as public sector employees, through Massive Open Online Courses on key competences including digital skills; teachers, under the National Digital School Plan; and doctors, in connection with measures to strengthen the electronic health record.

³⁵³ Of which, approximately EUR 1.8 billion contributing to the digital transition.

2 Connectivity

2 Connectivity	lt	EU	
,	rank	score	score
DESI 2021	23	42.4	50.2



		Italy		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	60%	61%	61%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	9%	22%	28%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	3.56%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	88%	89%	93%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN)	24%	20%	2.4%	E0%
coverage	24/0	50%	3470	39%
% households	2018	2019	2020	2020
2c1 4G coverage	98.9%	98.9%	99.3%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	60%	60%	60%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	8%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	39%	49%	49%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	74	74	69
Score (0-100)		2019	2020	2020

With an overall score of 42.4 Italy ranks 23rd among EU countries in connectivity. 61% of households subscribe to fixed broadband, somewhat lower than the EU average (77%). The percentage of households with a take-up of at least 100 Mbps continued to grow, rising from 22% in 2019 to 28% in 2020, which, however, still places the country below the EU average of 34%. 3.6% of households had a take-up of at least 1 Gbps in 2020, a remarkable increase compared with 2019 and a percentage that places Italy above the EU average for this indicator. Concerning fast broadband next generation access (NGA) coverage, the number of households included is 93%, above the EU average of 87%. On fixed Very High Capacity Network coverage, the percentage of households covered was 34% in 2020 – an increase of four percentage points compared to 2019, but still considerably below the EU average of 59%. FTTP coverage stood at 33.7% of households (up from 30% in 2019), increasing almost at the same pace as the EU average (42.5% in 2020, up from 37.5% the previous year). Only 8% of populated areas are covered by 5G, lower than the EU average of 14%, in spite of the relatively high score of 60% in 5G readiness. On the broadband price index, Italy's score of 74 did not change between 2019 and 2020 and remains higher than the EU average.

In recent years Italy has pursued the EU connectivity targets through a combination of regulation and public policy, and measures to boost supply and demand.

During 2020 in particular, with the aim also of a rapid response to the COVID-19 outbreak, the Italian authorities devoted particular attention to the demand side, setting up phase I of the 'voucher plan', approved by the Commission with Decision C(2020)5269. The voucher plan, dedicated to households with a gross income per year of less than EUR 20,000, provides for a contribution of up to EUR 500 to upgrade fixed lines or to activate a new line with a speed of at least 30 Mbps. A new measure is expected to be launched in 2021 which will mobilise around EUR 900 million and will be dedicated to both residential users and businesses (SMEs).

The 'School Plan', which received funding of over EUR 400 million, provides connectivity of up to 1 Gbps for state schools and educational institutions, connecting all first and second-level secondary school complexes throughout the national territory as well as all primary and kindergarten complexes located in the areas already concerned by infrastructural interventions (called 'white areas'). About 35,000 buildings are involved in total³⁵⁴.

The revised national ultra-broadband plan aims to reach and exceed the objectives set by the European Commission for 2030 by introducing a target of at least 1 Gbps for all by 2026. The plan provides that where fixed and wireless private networks cannot guarantee achievement of this target, the State can intervene by creating the necessary infrastructures to reach it. In terms of investments, it has been estimated that public resources are needed to fill the fixed infrastructural gap in areas not covered by private operators, i.e. approximately 8.5 million households.

In Italy, the rights of spectrum use in 5G pioneer bands, namely the 700 MHz, 3.6 GHz, and 26 GHz bands, were awarded in 2018 and before. However, not all bands are available; 700MHz will not be available until 1 July 2022. The Law decrees 'Cura Italia' and 'Semplificazioni 2021' include measures to boost 5G coverage. The decrees, in particular, set limitations on the veto power of local authorities in the instalment of antennas. The limits of electromagnetic emissions are 6 V/m and 0.1 Watt/m², lower than the caps recommended in the Council Recommendation.

Main market & regulatory developments

In September 2020, Telecom Italia (TIM) notified its new separation project according to which – following an agreement with KKR Infrastructure and Fastweb – a new company will be created called 'FiberCop' that will own TIM's secondary network (from cabinets to customer premises) along with the fibre network developed by FlashFiber. FiberCop will include all of TIM's passive secondary network infrastructure (both copper and fibre) from the cabinet (excluding legacy copper cabinets but including optical cabinets) to the customers' premises. According to the project, FiberCop: (i) will be active only in the wholesale market, providing access to the secondary segment of the network both to TIM and to OAOs (also through a co-investment scheme notified under Article 76 EECC (European Electronic Communications Code), currently under assessment by AGCOM); and (ii) will develop an FTTB/FTTH network at national level in more than 2 500 municipalities by 2026.

AGCOM started a coordinated analysis of access markets in order to evaluate the impact of the separation project on existing regulations.

On 15 December 2020, the Italian competition authority launched an investigation against

³⁵⁴ https://bandaultralarga.italia.it/en/.

Telecom Italia, FastwebS.p.A., TeemoBidcoS.r.l., FiberCopS.p.A., Tiscali, and KKR as regards the contracts governing the establishment and operation of FiberCop and the supply agreements with Fastweb and Tiscali. The purpose of the proceedings is to make sure that these agreements do not hinder competition between operators in the medium and long term. The proceedings are expected to end by 31 December 2021.

In 2020, COVID-19 and related restrictive measures heavily impacted data traffic on both fixed and mobile networks, with peaks in March-April 2020 and March 2021 (up to +89% data traffic volume on fixed networks and up to +67% on mobile networks). There were no structural traffic management measures; however, telcos implemented temporary and reasonable traffic-management measures to avoid traffic congestion in peak time. Despite the sudden increase in data-traffic volumes, no particular congestion was recorded, thanks in part to the infrastructural adjustments implemented by operators on the basis of the rules issued by the government and the regulator.

Nevertheless, the 'Cura Italia' Decree³⁵⁵ included a request to telcos to increase the average fixed bandwidth by 30% where technically feasible; and to TIM to provide transport equipment and the virtual LAN necessary to increase bandwidth, and to reduce the timeframe for opening new next-generation access (NGA) cabinets. Telecom operators were also required to prioritise requests for electronic communications services coming from the crisis units located throughout the territory during the pandemic's peak.

Italy was one of the 23 EU Member States that failed to incorporate Directive (EU) 2018/1972 – the European Electronic Communications Code – into national law by the deadline of 21 December 2020. The European Commission sent Italy a letter of formal notice on 4 February 2021. The European delegation law was approved on 31 March 2021 by one of the two parliamentary branches and was sent to the second one for final approval. Within 3 months from the approval of the European delegation law, the law that will transpose the EECC will be adopted as a preliminary draft by the government's Council of Ministers; once Parliament's opinion on the draft has been received and taken into account, the law will be adopted.

Italy presented a national roadmap for the implementation of the 5G connectivity toolbox recommendations. The roadmap includes several reforms, in particular on streamlining permitgranting procedures for civil works; improving transparency and reinforcing the capabilities of the single information point; and expanding the right of access to existing physical infrastructure.

In 2018 the Italian telecom regulator AGCOM created an online platform called Conciliaweb for receiving and processing users' complaints. The overall number of complaints decreased in 2020 (-9%), in spite of the COVID-19 outbreak, and there was an increase in disputes resolved (+10%) compared to the previous year. The main sources of consumer complaints in 2020 were billing (22%), contract termination costs (15%), malfunction (10%), and unsolicited services (9%).

Currently, broadband internet access is not included in the scope of the universal service. After the incorporation of the EECC into national law, an analysis will be conducted that will determine the appropriate broadband internet access service to be included within the scope of the universal service.

³⁵⁵ <u>https://www.agcom.it/documents/10179/17989494/Documento+generico+20-03-2020/91c37308-e175-</u> 44af-b038-9db0d7b3ae75?version=1.2.

In broadband deployment, the COVID-19 outbreak prompted the implementation of certain measures that have resulted in an acceleration of the ultra-broadband coverage in white areas also. However, more structural long-term solutions are needed to address the delays that still occur in rolling out the Italian ultra-broadband plan. It will also be important to translate the high 5G readiness score into 5G coverage in populated areas and, to this end, to continue the structural reforms started in 2020 and implement the measures included in the national roadmap on the 5G connectivity toolbox.

Connectivity in Italy's Recovery and Resilience Plan

Ambitious investments support the deployment of ultra-fast broadband and 5G networks to reduce the digital divide, also targeting socio-economic drivers such as schools, hospitals and transport corridors. To this end, the plan provides for the following five projects for a total amount of EUR 6.7 billion:

- 'Italia a 1 Giga', with the objective of providing at least 1 Gbit/s in download and 200 Mbit/s in upload connectivity in grey and black next-generation access (NGA) market failure areas. These areas will be determined after the completion of a mapping exercise.
- 'Italia 5G', focusing on: investments to incentivise the deployment of 5G mobile infrastructure in the 'market failure areas'; 5G corridors, to support EU efforts towards the diffusion of optical fibre and 5G-based technologies along European transport corridors, facilitating the introduction of autonomous driving and new value-added 5G services; and 5G-ready extra-urban roads, to deploy optical-fibre backhauling on provincial and extra-urban roads and ensure their 5G readiness.
- 'Connected schools', to connect with state-of-the-art connectivity (at least 1 Gbps) the approximately 9 000 school buildings currently not covered by the existing National School Plan.
- 'Connected health care facilities', which intends to cover approximately 12 000 hospitals and healthcare facilities (at least 1 Gbps and up to 10 Gbps connectivity).
- 'Connected smaller islands', to deliver adequate connectivity to 18 smaller islands through submarine fibre cables.

In addition to the investments in connectivity presented above, the plan also includes measures for satellite constellations and services. In particular, the SatCom initiative aims to develop a secure (with quantum key distribution) system of telecommunication satellites in emergency conditions (EUR 385 million)³⁵⁶.

³⁵⁶ On the basis of the methodology to calculate the support to the digital objectives (Annex VII of the Regulation (EU) 2021/241), the SatCom initiative is part of the intervention field "Investment in digital capacities and deployment of advanced technologies". However, for readability reasons, this initiative is mentioned together with the measures under the intervention field "Connectivity".

3 Integration of digital technology

3 Integration of	Italy		EU	
digital technology	rank	score	score	
DESI 2021	10	41.4	37.6	



	Italy			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	69%	60%
3b1 Electronic information sharing	37%	35%	35%	36%
3b2 Social media % enterprises	17% 2017	2019 22% 2019	2019 22% 2019	23% 2019
3b3 Big data % enterprises	7% 2018	7% 2018	9% 2020	14% 2020
3b4 Cloud % enterprises	15% 2018	15% 2018	38% 2020	26% 2020
3b5 AI % enterprises	NA	NA	18% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	60% 2021	66% 2021
3b7 e-Invoices % enterprises	42% 2018	42% 2018	95% 2020	32% 2020
3c1 SMEs selling online % SMEs	10% 2018	10% 2019	11% 2020	17% 2020
3c2 e-Commerce turnover % SME turnover	8% 2018	8% 2019	9% 2020	12% 2020
3c3 Selling online cross-border % SMEs	6% 2017	6% 2019	6% 2019	8% 2019

Italy ranks 10th in the EU in Integration of digital technology. Most Italian SMEs have at least a basic level of digital intensity (69%, well above the EU average of 60%). Italian enterprises perform very well in the use of e-invoices: 95% of them use electronic invoices, a figure that is almost three times the EU average and is the result of legislative interventions between 2014 and 2019. From 2018 to 2020, the share of enterprises using cloud services rose sharply, reaching 38% (from 15% in 2018). Italy's performance remains weak in other areas. The use of big data is low (used by 9% of Italian enterprises compared with an EU average of 14%), as is the use of technologies based on Artificial Intelligence (18% of Italian enterprises; the EU average is 25%). The uptake of e-commerce and the use of ICT for environmental sustainability are also below the EU average.

In terms of policy developments, the government revised and further extended the fiscal benefit under Transition 4.0, moving from hyper-depreciation to tax credits. The results of the first years of implementation of the hyper-depreciation measure show that it was used widely by SMEs and that it stimulated investments in Industry 4.0 assets, although the uptake of the benefits was relatively higher among medium and large enterprises and largely concentrated in the North of Italy³⁵⁷.

Support services and technology transfer centres play a key role for SMEs digitalisation. In 2020, Italy selected 45 national hubs which will participate in the restricted call for the establishment of the network of European Digital Innovation Hubs (EDIHs) under the Digital Europe Programme. The hubs selected by Italy cover technologies such as Artificial Intelligence, High Performance Computing (HPC) and cybersecurity, and will supplement the existing network of technology-transfer centres in the country.

In advanced digital technologies, Italy is involved in a number of European initiatives. In March 2021, it launched the call for expression of interest for the 'Important Projects of Common European Interest' (IPCEI) on Next Generation Cloud Infrastructure and Services. It will support innovative projects for the development of cloud and edge infrastructure and services, with potential applications in areas such as data protection, cybersecurity, industrial automation or healthcare. Italy is also part of the first IPCEI on microelectronics (started in 2018) and at the end of 2020 published a call for expression of interest to select enterprises for the second IPCEI on microelectronics. This second IPCEI has the overall objective of equipping the EU with key strategic capacities in the sector of processors and semiconductor technologies, which are essential to power the EU's critical digital infrastructures, artificial intelligence-enabled systems and communication networks.

Italy is one of the most active EU players in the field of supercomputing/HPC. The country hosts supercomputers ranked in the world's Top 500 systems (two of them in the Top 20). With the support of EuroHPC, Italy is leading a consortium for the development of a supercomputer that will be among the top five in the world (LEONARDO). It will be installed at the end of 2021 in the new data centre located in Bologna.

Boosting the digital economy requires a coordinated and comprehensive approach which combines investment incentives, support services and awareness raising, and builds strong links with investments in human capital. It is important to continue efforts to build capacity among Italian enterprises for a long-lasting transformation, equipping people with relevant advanced digital skills and in parallel creating opportunities for young people and for high-quality jobs. It is also important that Italy continues its efforts in advanced digital technologies and develops strategic capacities.

Integration of digital technology in Italy's Recovery and Resilience Plan

The plan allocates resources to support digitalisation of businesses (EUR 12.8 billion), the development and deployment of advanced technologies (EUR 5.1 billion) and ICT-related Research and Development (EUR 1 billion).

The plan addresses the digitalisation of businesses by focusing on stimulating the uptake of

³⁵⁷ The findings of a study on the first year of implementation of the hyper-depreciation measure show that medium and large enterprises were over-represented among those that invested in Industry 4.0 capital goods in 2017 compared to their share in the entire population (18.4% of those that used the benefits, against 2.7% in the entire population). At the geographical level, 66.3% of the investments benefiting from the hyper-depreciation were found in three regions in northern Italy (Bratta, Romano, Acciari, Mazzolari, 2020, <u>The</u> Impact of Digitalisation Policies. Evidence from Italy's Hyper-depreciation of Industry 4.0 Investments).

Industry 4.0 technologies. Significant investments support tax credits under Transition 4.0 (referred to above). The plan allocates a total of EUR 13.4 billion to this measure, of which EUR 11 billion contribute to the 20% digital target. It will enable Italian enterprises to access tax credits for the acquisition of: (i) 4.0 tangible assets, i.e. technologically advanced machines (EUR 8.9 billion); (ii) 4.0 intangible assets, such as 3D modelling, artificial intelligence and machine-learning software, systems, platforms and applications (EUR 1.9 billion); (iii) 4.0 training activities, covering subjects such as big data, human machine interface, internet of things or cybersecurity (EUR 300 million); (iv) traditional intangible capital goods (EUR 300 million); and (v) R&D&I on technological innovation, green and digital innovation, and design activities (EUR 2 billion).

In addition to Transition 4.0, digital aspects are also included in measures to promote the development of innovative production chains and the international competitiveness of Italian companies, and in measures with a sectoral scope (e.g. in agriculture and the audiovisual sector).

The plan also includes investments to strengthen support services and collaboration between businesses, universities and research centres by reinforcing technology-transfer centres such as existing competence centres and the network of European Digital Innovation Hubs.

The plan provides for some investments in digital capabilities and the deployment of advanced technologies. It includes an important measure to support the development of the strategic value chain of microelectronics (EUR 340 million), and interventions aimed at promoting R&D in the field of advanced digital technologies such as: the establishment of national leaders on key emerging technologies, which might cover AI, HPC and Quantum; and support for R&I partnerships, including those on Key Digital Technologies and HPC.

Finally, the plan allocates EUR 900 million to approved and potential IPCEIs in the digital field, with part of the funding expected to support the IPCEIs on microelectronics and on next-generation cloud infrastructure and services.

4 Digital public services

4 Digital public	lt	Italy	
services	rank	score	score
DESI 2021	18	63.2	68.1



	Italy			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	32%	30%	36%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	51	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	69	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	89	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	87%	78%
% maximum score			2020	2020

Italy ranks 18th in the EU in Digital public services. Despite the improvement recorded, the use of digital public services remains relatively low. The share of Italian online users who engage actively with e-government services increased from 30% in 2019 to 36% in 2020. While this is a notable increase, it remains well below the EU average of 64%. Italy outperforms the EU on digital public services for businesses and open data, but is below the EU average in digital public services for citizens and the availability of pre-filled forms.

During 2020 and 2021, there was a sharp acceleration in the adoption of major enabling platforms for digital public services. The number of digital identities issued (SPID, the eIDAS-compliant digital identity system) reached 20 million in April 2021, an increase of 400% compared to April 2019; the public administrations using SPID grew to 7 420, an increase of 80% compared with 2020. The IO app was launched in April 2020 as a one-stop-shop for access to user-centric digital public services, also through smartphone; a year later, in April 2021, it had reached 11 million downloads. The government made use of the IO app mandatory to access some financial incentives³⁵⁸, with the objective of encouraging the use of digital tools by people. This initiative played a key role in the successful roll-out of the app.

Good progress was also recorded in the implementation of the national digital population registry (ANPR), which aims to increase efficiency by consolidating personal information spread across administrations into a single register. It is expected to be adopted by all municipalities by 2021. Furthermore, in June 2020, the government launched a new Ultra-broadband Plan platform increasing the amount of open data made available to the general public and other users.

³⁵⁸ Holidays Voucher (Bonus Vacanze) and Cashback.

Legislative initiatives undertaken between 2020 and 2021 introduced a mix of obligations and incentives³⁵⁹ to boost the adoption of the main e-government platforms and are expected to give further impetus to the modernisation of the public administration across the country.

Regarding e-health, the electronic health record (EHR) is operational in all regions and has been activated by the large majority of citizens. However, the level of uptake by both people and healthcare professionals varies widely at regional level³⁶⁰.

Finally, regarding digital skills in the public sector, the operational plan of the National Digital Skills Strategy includes 17 projects to strengthen such skills, combining the revision of recruitment policies with targeted training, including in collaboration with universities, and with the promotion of communities of practice involving researchers, business managers and civil servants.

Overall, Italy continued to improve digital public services for citizens and enterprises. The legislative initiatives taken are expected to boost the adoption of enabling platforms by all public administrations, including local ones. The full deployment of the IO app, combined with the reinforcement of digital skills among the population, might also contribute to a gradual increase in the uptake of digital public services by the general public and by enterprises. Simplification efforts, measures to ensure interoperability, and capacity building in the public administration are all important complementary measures to promote and reinforce the digitalisation of public administration and public services.

Digital public services in Italy's Recovery and Resilience Plan

The plan includes significant investments for the digitalisation of public administration, supporting the modernisation of the digital infrastructure, the reinforcement of cybersecurity, the interoperability of databases and the improvement of digital public services for the general public and businesses.

Investments of EUR 1.9 billion are expected to help build a secure and energy-efficient national cloud-based hybrid infrastructure (called 'Polo Strategico Nazionale') and migrate local and central public administrations' IT system to a cloud-based system for a more efficient and secure delivery of public services. Moreover, a reform ('cloud first and interoperability') is planned to remove obstacles to cloud adoption, streamline data-exchange processes between public administrations, and boost the broad adoption of digital services, by introducing a set of incentives and obligations.

Measures also aim to increase the accessibility and interoperability of online public services and complete key digital platforms like SPID and ANPR. Leveraging on the above-mentioned 'middleware' platforms (ANPR, SPID, IO), the plan earmarks an investment of EUR 556 million for the creation of a National Digital Data Platform ("Piattaforma Digitale Nazionale Dati"). Through a catalogue of application programming interfaces (APIs), the platform aims to guarantee the interoperability of datasets and empower the *once-only* principle, including with forms pre-filled with information already available to the government across the different institutions. In parallel, three investments amounting to EUR 783 million are expected to

³⁵⁹ The 'Rilancio' Decree established a fund for innovation and digitalisation to support municipalities and local authorities in delivering digital services (Legislative Decree No 34 of 19 May 2020). The simplification and innovation decree of July 2020 (Legislative Decree No 76 of 16 July 2020) mandated the adoption of the main e-government platforms by all public administrations.

³⁶⁰ Indicatori di Utilizzo Cittadini | Fascicolo Sanitario Elettronico.

improve quality, accessibility and compliance with Single Digital Gateway procedures of citizenfacing digital services, including municipalities, schools and cultural institution websites.

The plan aims to reinforce cybersecurity capabilities by investing in both technology tools and operating structures (EUR 623 million). Among other things, the plan will support a 'national hyper Security Operations Centre (SOC)', expected to be integrated within the European network of SOCs to foster the sharing of information and best practices to prevent and mitigate cyber threats. In addition, the plan included the setting up of the new national cyber security agency, which will also be in charge of supporting the development of cybersecurity firms in Italy.

Finally, measures are expected to reinforce the digital back-office and front-office of main central public administrations, such as the Ministry of Justice, Defence and Home Affairs (EUR 611 million).

In the health sector, investments aim to support the completion and interoperability across regional systems of the electronic health record (EHR) and data usage for health risk monitoring (EUR 1.7 billion). These investments will be complemented with measures to boost the use of telemedicine solutions (around EUR 1.3 billion) and the digital upgrade of hospitals and diagnostic equipment (around EUR 1.5 billion).

Additional sectoral investments are planned to support the digitalisation of the justice system.





Lithuania ranks 14th of the 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI).

Lithuania still has room to improve the digital skills of its population and invest in the reskilling and upskilling of its labour force (it is currently ranked 17th in the human capital dimension of the DESI). Low basic digital skills and a lack of ICT specialists are major obstacles to Lithuania's digital transition, hampering its capability to fully exploit its innovation potential. Despite several national strategies and measures to develop the digital economy and society, relatively few companies offer digital upskilling for employees, and businesses report significant difficulties in filling ICT specialist vacancies.

In terms of Connectivity, 65% of all Lithuanian households subscribe to fixed internet access and 31% have at least 100 Mbps fixed broadband, both below the EU average. Lithuania is deploying fibre faster than the EU average. The fast broadband (NGA) coverage rate for all households is 71%, although a digital divide is still notable in rural areas, where NGA coverage drops to 29.6%. 4G coverage is almost 100%, but the take-up of mobile broadband is 67%, lower than the EU average. Lithuania has no commercial 5G coverage, but 5G piloting is already under way.

On the Integration of digital technology, Lithuania performs slightly above the EU average. Its strengths are the take-up of artificial intelligence, ICT for environmental sustainability, SMEs selling online and electronic information sharing. On the other hand, the share of SMEs with at least a basic level of digital intensity, cloud services and big data usage are below the EU average. Despite e-commerce turnover being higher than the EU average, the adoption of e-invoices is decreasing and is lower than the EU average.

Lithuania is addressing the slow modernisation of its public sector over the last decade through its digital policy priorities. These are: (i) consolidating state information resources, IT infrastructure and services; (ii) ensuring reliable public-sector data and the possibility to share them across sectors; and

(iii) digitalising government processes and expanding digital public services, making them accessible also to people with disabilities.

Lithuania excels in some of Digital public services, with two indicators in the EU's top 4: digital public services for businesses and pre-filled forms. Its performance is above the EU average in open data and the number of people using digital public services. Digital services for the people are slightly below the EU average.

The Lithuania 2030³⁶¹ national strategy is the principal document setting out the roadmap and guidelines for achieving the country's vision for a smart economy, society and governance. Lithuania aims to become one of the EU's top 10 performers, measured by indicators such as the Sustainable society index, the e-Government index and Business R&D. Specific plans are translating the strategy into concrete actions. These include The National progress plan 2021-2030³⁶², the Guidelines for the development of Fifth Generation Mobile Communications (5G) of Lithuania (2020-2025)³⁶³, the National Health Strategy 2014–2025³⁶⁴, the State Education Strategy for 2013–2022³⁶⁵ and the Lithuanian Industry Digitisation Roadmap 2020–2030³⁶⁶.



Digital in Lithuania's Recovery and Resilience Plan (RRP)

The total budget of Lithunia's Recovery and Resilience Plan of EUR 2.2 billion dedicates EUR 700.6 million (31.5%) to measures supporting the digital transition. Over half of these funds are dedicated to digital public services and infrastructure.

The RRP's Component 3 – *Digital transformation for growth* – covers most digital measures including:

- implementing and monitoring 15 digitisation projects (EUR 115 million)
- developing the public cloud infrastructure (EUR 95 million)

seimas.lrs.lt/portal/legalAct/lt/TAD/90085d5127f911ec99bbc1b08701c7f8?jfwid=32wf90sn

³⁶³ <u>https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/669a3b64aa5411ea8aadde924aa85003.</u>

³⁶¹<u>http://www.unesco.org/education/edurights/media/docs/2953897c103c13043bfabea84b716ae2f8c82f47.p</u> df

https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.425517.

³⁶²https://e-

³⁶⁴ <u>https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/35834810004f11e4b0ef967b19d90c08/NRPRyqDDim?jfwid=-</u><u>fxdp770g.</u>

³⁶⁵<u>https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.463390.</u>

³⁶⁶<u>https://eimin.lrv.lt/uploads/eimin/documents/files/Lithuanian%20Industry%20Digitisation%20Roadmap%20</u> 2020-2030%20UPDATED%20EN%20(1).pdf.

- a data management model and data transfer to the national data lake (EUR 30 million)
- step towards 5G (EUR 73.5 million)
- technological resources for the Lithuanian language (EUR 35 million).

Other components of Lithuania's RRP include substantial digital measures such as:

Component 1 – Health: digitalising the health sector (EUR 85.7 million)

Component 7 - Social: digital skills (EUR 46.3 million)

Component 4 – Education: digital education (EUR 9.8 million).

Lithuania indicated participation in the following multi-country projects: 5G, Genome of Europe and European Digital Innovation Hubs.

1 Human capital	Lith	EU	
	rank	score	score
DESI 2021	17	46.1	47.1



	Lithuania			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	55%	56%	56%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	32%	32%	32%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	57%	58%	58%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	2.7%	3.1%	3.3%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	26%	24%	24%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	9%	11%	14%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	2.7%	3.1%	3.7%	3.9%
% graduates	2017	2018	2019	2019

Lithuania ranks 17th of the 27 EU countries on Human capital, positioning itself slightly below the EU average. Both basic and above-basic digital skills, and software skills, are at the EU average. On the other hand, fewer Lithuanian enterprises provide ICT training to their employees than EU companies. Numbers of ICT specialists and graduates are also below the EU average, but the proportion of female ICT specialists is higher than in the EU.

To strengthen digital skills, Lithuania adopted the 2020–2030 Industry Digitisation Roadmap³⁶⁷ and 2013–2022 State Education Strategy³⁶⁸. It has developed the National skills strategy³⁶⁹ in cooperation with the OECD and reviewing primary and secondary schools' curricula as well as adult learning.

The National Education Agency provides online training and upskills ICT teachers in line with the DigCompOrg framework³⁷⁰. The Employment Service actively promotes digital skills. The Agency collaborates with Coursera, Microsoft and universities in the Baltic countries. Public libraries organise digital skills capacity building in collaboration with local communities, which helped train over 245,000 citizens in 2020. Software companies contribute to digital capacity building through initiatives such as Sourcery academy, Grow with Google and Skaitmenizuokis.lt. The reskilling and upskilling of ICT specialists takes place at dedicated bodies such as the Vilnius, Kaunas and Klaipėda coding schools, the Code academy, Akademija.IT and the Turing Society.

³⁶⁷<u>https://eimin.lrv.lt/uploads/eimin/documents/files/Lithuanian%20Industry%20Digitisation%20Roadmap%2</u> 02020-2030%20UPDATED%20EN%20(1).pdf.

³⁶⁸ <u>https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/TAIS.463390.</u>

³⁶⁹ <u>https://strata.gov.lt/lt/igudziu-strategija.</u>

³⁷⁰ <u>https://ec.europa.eu/jrc/en/digcomporg/framework.</u>
School children learn to code at academies such as Turing College, Sourcery for Kids and an interactive online course entitled Angis.net. The 2020 edition of EU Code Week attracted over 17,000 participants (44% females), who participated in 417 educational activities.

To train the public to safely use digital technologies and e-services, the Lithuanian public sector is implementing the Connected Lithuania³⁷¹ project in collaboration with the National Digital Skills and Jobs Coalition Langas j ateitj. In 2020, it created a volunteer network of 524 digital leaders, 1,600 e-scouts and 1,260 digital advisers, trained almost 80,000 people (of whom 45 980 jobseekers) at beginner and basic levels, updated and developed over 30 educational resources, and organised three campaigns: Safer Internet Week, Seniors Online Week, All Digital Week, involving over 60,000 participants in total.

Lithuania participates in the annual international Girls in ICT event to motivate females to choose careers in ICT. Another initiative is Women Go Tech, a mentorship programme supporting women's careers in IT and engineering.

Lithuania promotes digital skills at all levels as part of its national strategies. On most human capital indicators, Lithuania is approaching the EU average or is at a comparable level. It is imperative that Lithuania further increases digital skills, particularly the number of ICT graduates, specialists and enterprises providing ICT training, to tap into the full potential of the digital society and economy.

Human capital in Lithuania's Recovery and Resilience Plan

The main activities for the development of human capital in Lithuanian Recovery and Resilience Plan are digital skills and education (EUR 56.1 million, with additional financing included into partly digital measures), digitalising educational content and resources (EUR 20 million) and creating technological Lithuanian languagage resources for AI solutions to help Lithuanian citizens communicating with advanced AI technologies and to contribute towards the preservation and viability of the Lithuanian language (EUR 35 million).

Lithuania should significantly increase its human digital capacities through the following initiatives:

- 10,000 adults should acquire digital skills and competences.
- 500 educators should achieve a master's degree in IT.
- 2,200 teachers and 800 higher education staff should develop digital competences.
- More than 21,000 students and more than 21,000 adults should improve their skills (of which at least 40% digital). 4,000 public-sector staff should be trained in digital skills.
- 900 digital self-employed jobs should be created.
- Laboratory equipment should be upgraded at least at 10 STEM centres.
- 2 new digital solutions for people with disabilities should to be launched.
- Other measures should be taking place such as aprenticeships, vocational education and trainings, etc.

³⁷¹ <u>https://www.prisijungusi.lt/.</u>

2 Connectivity

2 Connectivity	Lith	EU	
,	rank	score	score
DESI 2021	25	41.7	50.2



		Lithuania		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	64%	68%	65%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up % households	29% 2018	32% 2019	31% 2020	34% 2020
2a3 At least 1 Gbps take-up % households	NA	<0.01% 2019	0.23% 2020	1.3% 2020
2b1 Fast broadband (NGA) coverage % households	63% 2018	69% 2019	71% 2020	87% 2020
2b2 Fixed Very High Capacity Network (VHCN)	61%	61%	67%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	99.2%	>99.9%	>99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	0%	5%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	60%	67%	67%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	79	75	69
Score (0-100)		2019	2020	2020

With an overall connectivity score of 41.7, Lithuania ranks 25th among EU countries. Many households are covered by fast broadband (NGA) 71%, but in rural areas only 29.6% have fast broadband (NGA) access. Take-up of at least 100 Mbps fixed broadband stands at 31% of households, which is below the EU average of 34%. On fixed broadband take-up, 65% of all households subscribe to some kind of fixed internet access, below the EU average of 77%. Lithuania is among the EU countries without 5G mobile broadband coverage but with 100% coverage of 4G. Lithuania ranks 18th in the broadband price index.

In order to achieve the EU 2025 targets, Lithuania is implementing the RAIN3 project. It plans to build approximately 30 communication towers, lay 1,210 km of fibre-optic cables and a passive optical network (PON) infrastructure in the white areas where the market cannot provide this infrastructure and fast internet services. The project aims to further develop broadband networks in rural areas between 2018 and 2022. It offers wholesale access to a newly built fibre backhaul network to operators and allow them to connect end users at download speeds above 30 Mbps. The network is provided by Plačiajuostis internetas, a state-owned body. So far, 822 km of fibre-optic cable lines (out of 1,210 km planned in total) have been deployed, and 271 telecommunication facilities have been connected.

Lithuania has assessed the areas that do not have at least 100 Mbps broadband coverage. On that basis, regulatory and financial measures have been identified to cover the country's 100 Mbps broadband-free white areas. These conclusions and measures will be the basis for the renewed National Broadband Plan up for approval in 2021.

The Guidelines for the Development of the Fifth Generation Mobile Communications (5G) of Lithuania in 2020-2025 were approved by Government Resolution No 577 on 3 June 2020. As yet there is no fully fledged commercial 5G service in Lithuania's major cities. Following one operator's request, Lithuania's Communications Regulatory Authority (RRT) is supporting its initiative to test the operation of 5G services by assigning it free radio frequencies from the 3.5 GHz radio frequency band for temporary non-commercial use. The frequencies were assigned for a limited period only, providing free-of-charge 5G services to end users in three cities.

On spectrum assignment, there are issues with neighbour countries using the same frequencies. Use of the 700 MHz band is still pending as broadcasting services in Belarus using this band are still in operation and there is yet no information on the Broadcasting Development Concept from Russia. For the 3.5 GHz band, the cross-border coordination agreement with Russia has not yet been concluded. In August 2020, the Russian administration confirmed that it will continue using the band for fixed and satellite services. This could block the use of mobile 5G in a major part of Lithuania. For the 26 GHz band, the relevant Radio Communications Development Plan for the 24.25–27.5 GHz band was approved on 23 September 2020 and will be granted if there is market demand.

Main market & regulatory developments

The incumbent operator Telia Lietuva AB remained the largest operator, followed by two mobile operators, UAB Tele2 and UAB Bitė Lietuva. Telia Lietuva AB was the sole operator, providing a wide range of services based on fixed and mobile networks.

UAB Bitė Lietuva acquired AB Lietuvos radijo ir televizijos centras internet access services, data transmission services, fixed telephone services and IPTV business grouped under the 'Mezon' brand. This includes the frequencies assigned to AB Lietuvos radijo ir televizijos centras and used to provide these services.

The transposition of the European Electronic Communications Code (EECC) was not complete by the deadline of 21 December 2020 and the Commission sent Lithuania a letter of formal notice.

Regarding market reviews, the analysis of the market for access to the public network at a fixed location for residential and non-residential customers resulted in the withdrawal of obligations. The analysis of the market of voice call termination on Lithuania's individual mobile networks determined that UAB Bite Lietuva, UAB TELE2, Telia Lietuva AB, UAB CSC TELECOM, UAB Mediafon Carrier Services, UAB Nacionalinis telekomunikaciju tinklas and UAB ECOFON all have significant market power. As a result of the analysis, the obligations on UAB Linkotelus, UAB Mediafon and UAB Omnitel were withdrawn.

In its roadmap to implement the Connectivity Toolbox, Lithuania plans to enhance transparency of existing infrastructure and civil works with a new national web-based geographic information system. It intends to develop guidelines to facilitate legal, technical and administrative conditions for mobile operators and apply a flexible authorisation regime, with a focus on local licensing, infrastructure sharing or other market needs for the 26 GHz band.

The second quarter of 2020 saw an increase in complaints by end users: 82 complaints were received in the first quarter, 103 complaints in the second quarter, 92 complaints in the third

quarter and 103 complaints in the fourth quarter. Also in the third quarter, there was an increase in end users' complaints regarding mobile telephone services (37 complaints in the second quarter, 50 in the third quarter and slightly less in the fourth quarter – 46). Several end users' complaints related to internet access services (40 complaints in the second quarter, 23 in the third quarter, and 48 in the fourth quarter) and to television services (33 complaints in the second quarter, 18 in the third quarter, 26 in the fourth quarter).

The main cause for the complaints in 2020 were changes in the terms of the contracts (end users' complaints varied between 4 complaints and 17 complaints over the year) and in the consequences of those terms (an increase from 16/15 complaints to 20). There was an increase in consumer complaints about billing in the second quarter (19 to 24 complaints, dropping to 14 in the fourth quarter). The third quarter saw a further decrease to 9 complaints.

As of 1 July 2020, the national public safety answering point (PSAP) supports an application allowing end users with hearing disabilities to access emergency communications (112 mobile app) on Android and iOS devices.

Lithuania is investing in broadband roll-out but currently lags behind in 5G deployment due to delayed spectrum assignment procedures, caused by frequency coordination problems with neighbouring countries. It is important for the country to finalise transposition of the EECC and swiftly put in place the measures from its roadmap to implement the Connectivity Toolbox.

Connectivity in Lithuania's Recovery and Resilience Plan

For Connectivity, the Lithuanian Recovery and Resilience Plan envisages two measures:

- Infrastructure (EUR 49 million), including building 50 new towers, rolling out 2,000 km of fibre and related active equipment with appropriate maintenance and administration. These investments should provide gigabit speed to 5,000 digitally intensive enterprises/institutions. In addition, internet service providers in white areas should be able to increase the speed of their last-mile services.
- Delivering on Connectivity Innovation (EUR 25 million), at least 7 projects are planned to enhance sectoral digitalisation by making practical use of mobility innovations such as: (i) autonomous transport; (ii) drones; (iii) internet of things; (iv) virtual reality; (v) 5G-based robotisation or automation and advanced technological solutions such as (vi) transport waybills and sustainable mobility data management solutions; and (vii) unified ticketing schemes and solutions for the digitalisation of transport benefits.

Connectivity investments will also contribute to European 5G multi-country projects.

3 Integration of digital technology

3 Integration of	Lithuania		EU
digital technology	rank score		score
DESI 2021	12	41.2	37.6



		Lithuania		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	54%	60%
	47%	10%	1020	2020
3D1 Electronic information sharing	2017	4878	2019	2019
2h2 Social modia	2017	2015	2015	23%
% enterprises	2017	2019	2019	2019
3h3 Big data	14%	14%	11%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	17%	17%	23%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	34%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	74%	66%
2h7 a Invoicas	29%	29%	27%	32%
% enterprises	2018	2018	2020	2020
3c1 SMFs selling online	21%	24%	28%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	14%	12%	15%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	12%	13%	13%	8%
% SMEs	2017	2019	2019	2019

Lithuania ranks 12th in the EU on Integration of digital technology. It performs above the EU average in the take-up of Artificial Intelligence (AI), ICT for environmental sustainability, SMEs selling online and electronic information sharing. Cloud services and big data usage are below the EU average. Despite higher than the EU average e-commerce turnover, the adoption of e-Invoices is decreasing and is lower than the EU average. Lithuanian enterprises use social media slightly more often and sell more across borders than their EU counterparts on average. On the other hand, the share of SMEs with at least a basic level of digital intensity is lower than in the EU.

The 2020-2030 industry digitisation roadmap³⁷² sets out the guidelines for the integration of digital technologies. These are: increasing the private and public sector' take-up of digital technology, strengthening research and innovation, adapting standards, and actively participating in international value chains.

³⁷²https://eimin.lrv.lt/uploads/eimin/documents/files/Lithuanian%20Industry%20Digitisation%20Roadmap%2 02020-2030%20UPDATED%20EN%20(1).pdf.

There are 18 Lithuanian Digital Innovation Hubs of varying levels of maturity supporting the digitalisation of business and registered in the EU S3 catalogue³⁷³, operating in biotechnology, manufacturing, maritime, construction, transport and public administration. In 2020, Lithuania proposed three candidates for the European Digital Innovation Hubs to be partly financed by the Digital Europe Programme.

Startup Lithuania³⁷⁴ is a one-stop shop for young innovative companies aiming to develop the ICT ecosystem. Services for start-ups are offered by the Agency of Science, Technology and Innovation (MITA)³⁷⁵, the Lithuanian Innovation Center (LIC)³⁷⁶, Saulėtekio slėnio mokslo ir technologijų parkas 'Sunrise Valley'³⁷⁷, Enterprise Lithuania³⁷⁸ and other entities. The services offered include: incubation and acceleration, expert advice on reaching foreign markets, intellectual property rights, marketing, access to funding, finding scientific partners, and developing infrastructure. There is a broad ecosystem of pre-accelerators and accelerators, incubators/hubs (GovTech Lab, Evolut 4.0, TechHub, Baltic Tech Park, Sunrise Valley, etc.) and private venture investors such as LitCapital, Verslo angelų fondai, Start-up wise guys, Practica capital, financing the different stages of the start-up life cycle. Regulatory sandboxes are also gaining popularity e.g. the Lithuanian central bank's Fintech Sandbox.

The Lithuanian Innovation Center participates in implementing the Baltic large-scale computing project³⁷⁹ with the goal to enable smaller actors to create innovative products and services. The project also aims to analyse and develop a universal practical solution – the BalticLSC (Supercomputing) Environment: a hardware platform and easy-to-use software.

Lithuania is among the EU's frontrunners on Artificial Intelligence, with a national AI strategy which recommends creating a stable and AI-friendly data environment. The strategy focuses on the public sector to ensure that Lithuania's data meet international standard requirements. The strategy is implemented by the AI Boost³⁸⁰ initiative, running an AI accelerator (helping to train AI models) and information centre, and organising AI-related events and podcasts.

Lithuania has adopted its National Cyber Security Strategy (NCSS)³⁸¹, broadly aligned with the EU NIS Directive, the EU Cybersecurity Strategy, ENISA's recommendations and international good practice. The new generation cyber toolbox for the development of National rapid cyber response teams will be co-financed by the Ministry of National Defence, which is also developing a financial mechanism for the private sector to participate in European defence cooperation programmes, including cyber defence projects. Private-sector initiatives include: two programmes implemented by NRD Cyber Security³⁸²: IntEye³⁸³ and CySystem³⁸⁴; Tesonet's office works with cryptographic protocols; and CUJO AI's development of AI models to detect network security threats.

To continue boosting the digital transformation of its economy, it is important that Lithuania further builds up its start-up ecosystem and supports the integration of digital technologies in SMEs, with particular attention to businesses in disadvantaged regions.

³⁷³ <u>https://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool</u>.

³⁷⁴ <u>https://www.startuplithuania.com/.</u>

³⁷⁵ https://mita.lrv.lt/.

³⁷⁶ https://lic.lt/.

³⁷⁷ <u>https://ssmtp.lt/.</u>

³⁷⁸ <u>https://www.enterpriselithuania.com/en/.</u>

³⁷⁹ https://www.balticlsc.eu/.

³⁸⁰ <u>https://aiboost.lt/.</u>

³⁸¹https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/27107170d04511e8a82fc67610e51066?jfwid=-ub28x8e9q. ³⁸²https://www.nrdcs.lt/en/.

³⁸³ IntEye – Open Source Intelligence gathering and analysis system, which will be using several AI modules to continuously learn from the user and proactively search for the most relevant information online.

³⁸⁴ CySystem – solution, which will help monitor cyber space, promptly identify and alert about abnormalities in networks.

Integration of digital technology in Lithuania's Recovery and Resilience Plan

The Recovery and Resilience Plan includes measures to advance the integration of digital technology such as:

- Developing and deploying digital innovation (EUR 15 million) leading to 184 contracts to support the digital innovation in AI, blockchain technologies and robotics process automation.
- Opening and re-use of cultural and cultural heritage content for added value (EUR 26 million).
- Creation of an ICT Competence Centre.
- Fostering participation in Horizon Europe and other European programmes which could support the digital transition.

Innovation activities in the Lithuanian RRP under the heading of digital innovation will link with the European Digital Innovation Hubs multi-country project.

4 Digital public	Lith	Lithuania EU		Lithuania	
services	rank	score	score		
DESI 2021	12	78.0	68.1		



	Lithuania			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	63%	67%	69%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	89	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	73	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	96	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	86%	78%
% maximum score			2020	2020

Lithuania ranks 12th in the EU on digital public services. On digital service for businesses (DESI score 96 out of 100), Lithuania is 4th in the EU, performing well above the average. However, on digital services for citizens (73 points out of 100) its performance is slightly lower. The gradual growth in e-Government users shows that people are embracing digital public services, currently at 69% and above the EU average. That trend is also visible in pre-filled forms, where Lithuania performs far above the EU average, coming in 4th in the EU. The country's ranking in digital public services for businesses is similar.

The Electronic Government Gateway³⁸⁵ aims to be a single access point to Lithuanian e-government services, in line with the 'once-only' principle (OOP), and operating through the State Information Resources Interoperability Platform and the Public Administration Institutions' Information System. The gateway links with information systems for legislative information, courts, taxation, e-health, education, municipal institutions, etc. In 2020, the gateway integrated over 600 e-services.

The Register of Legal Acts (TAR)³⁸⁶ is used to register and publish legal acts, their consolidated versions, anonymised rulings and international treaties. Residents are involved in decision-making processes through the E.citizen platform³⁸⁷, an electronic service provided by the Lithuanian Government, and through similar digital services provided by municipalities. These systems are publicly available and usually free of charge.

Lithuanian courts make wide usage of the e.teismas.lt e-services portal³⁸⁸. In 2020, around 80% of all civil and administrative cases were managed only electronically, including paying fees, submitting

³⁸⁵ <u>https://www.epaslaugos.lt/portal/.</u>

³⁸⁶ https://www.e-tar.lt/portal/en/index.

³⁸⁷ <u>https://epilietis.lrv.lt/.</u>

³⁸⁸ https://e.teismas.lt/lt/public/home/.

and distributing procedural documents, accessing data on a particular case, and issuing and implementing court orders.

The e-accounting system of the State Tax Inspection³⁸⁹ allows SMEs and the self-employed to use simplified accounting services using pre-filled forms with the tax inspection's data and streamlining tax collection.

Lithuania is a member of the European Blockchain Partnership. It has set up its own node of the European Blockchain Services Infrastructure (EBSI) with the goal of identity management, trusted and verifiable sharing of data as part of the 'DLTnode' project, which is developing a support system for the node, training public institutions, sharing good experiences, communicating with state institutions and discussing possible use cases.

The 2014–2025 National Health Strategy³⁹⁰ plans to complete the country's e-health system and its integration with EU e-health systems. The esveikata.lt³⁹¹ portal, in line with the 'One patient – one health history' principle, links to the central e-health system (ESPBI IS) and allows services such as registering for on-site and online medical consultations or receiving the EU digital COVID certificate.

During the COVID-19 crisis, most medical consultations took place online. The number of electronic prescriptions grew to 99.8%, hospital discharge records to 84%, and outpatient visits and electronic referrals to 100%. Sets of open health data are planned to be provided by ESPBI IS to the National Open Data Portal³⁹², which aims to become an integral part of the EU Open Data Portal³⁹³.

Lithuania is well advanced in public digital services. However, more user-friendly and easily accessible e-services for the public and businesses could lead the way to greater improvements in digital public administration. A better integration and orchestration of e-services would help the public and businesses find the services they need and help government bodies to set up the new services and automate the existing ones.

Highlight 2020-2021: GovTech Lab³⁹⁴

To ensure increased uptake of innovative digital solutions in the public sector, Lithuania has set up the GovTech Lab, an initiative giving start-ups and innovative tech companies access to public-sector bodies so that they can help meet the challenges such bodies fac.

The GovTech Lab focuses on three key activities:

- 1. matching public-sector tech challenges with ideas from the community of innovators
- 2. accelerating GovTech startups from idea to pilot solution to scaling
- 3. building GovTech community locally and internationally.

GovTech Challenge Series is designed to solve public-sector challenges that do not have a clear answer. In 2020 the Govtech lab brought together 13 start-ups, 7 co-creator companies and a university, solving 10 problems raised by 15 public-sector institutions:

1. automating illegal content detection on the internet

³⁸⁹ <u>https://imas.vmi.lt/isaf/.</u>

³⁹⁰ <u>https://e-seimas.lrs.lt/rs/legalact/TAD/608a896236f811e6a222b0cd86c2adfc/.</u>

³⁹¹ https://www.esveikata.lt/.

³⁹² <u>https://data.gov.lt/.</u>

³⁹³ <u>https://data.europa.eu/en.</u>

³⁹⁴ <u>https://govtechlab.lt/.</u>

- 2. supervising trust service providers in an innovative way
- 3. matching green consumers and green products
- 4. creating a real-time satellite image of Lithuania
- 5. detecting unsafe products on the web
- 6. creating the public health monitoring tool for a school
- 7. detecting and monitoring hate speech on the internet
- 8. verifying facial images quickly and reliably
- 9. automatically logging plane movements in airports
- 10. automating supervisory data collection for the Bank of Lithuania.

Digital public services in Lithuania's Recovery and Resilience Plan

The Lithuanian Recovery and Resilience Plan should launch the next generation of digital public services. A high number of measures has been planned, such as:

- Implementing and monitoring 15 public services digitisation projects (EUR 115 million), which should aim at convenience and interactivity for end users, as a result of using advanced technologies such as artificial intelligence and data analytics.
- Developing the public cloud infrastructure (EUR 95 million). This would enable the launch of the Open Data and Digital Transformation Competence Centre and the implementation of a data management model and dedicated data exhange tool to integrate 376 information resources.
- Digitalising the health sector (EUR 85.7 million), which would allow 60% of the population to receive health-related e-services and 70% to use personalised e-health facilities and/or products, as well as to digitally supervise 50% of healthcare professional licences.
- Launching a digital employment platform (EUR 7.1 million).
- Rolling out genome sequencing infrastructure, which should allow for 1,570 sequencing tests for the whole human genome, contributing to the Genome of Europe multi-country project.
- New digital public ICT solutions, which should enable the practical use of e-invoices and e-consignments.
- At least 60% of people with disabilities should be satisfied with digital public services.

Luxembourg





Luxembourg ranks 8th of 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI). It performs very well on Connectivity, ranking 4th in the EU. Luxembourg compares well in Human capital. It is also above the EU average score on Integration of digital technology.

Luxembourg's share of ICT specialists and graduates is higher than the EU average, but there is still a shortage of ICT specialists and a decline in the share of ICT graduates since 2020 and this impedes the digitalisation of businesses. Luxembourg implements a range of strategies and initiatives to boost the digital skills of its population. The competent ministries launched an initiative for children and youth in the school system, and also support advanced digital-skills training for industry, education, research and the public sector. A coalition of private and public-sector bodies organises a range of thematic digital-skills webinars. 65% of 16-74 year-olds in Luxembourg have at least basic digital skills, compared to the EU average of 56%. The country continues to report an increase in the share of ICT specialists as a percentage of total employment, and in this respect is well above the EU average (6.3% and 4.3% respectively). 20% of ICT specialists are female, slightly above the EU average of 19% and a significant increase by five percentage points since 2020.

Luxembourg is improving in the roll-out and uptake of fibre and mobile 5G networks, addressing also the digital divide between urban and rural areas. The new national broadband strategy will focus on ensuring that private investment is sufficient to fulfil the gigabit objectives for 2025 and the situation will be re-assessed around 2022, by which time public-funding mechanisms could be established if necessary. Priority would be to cover the single-digit percentage of the population that does not have access to 100 Mbps today, in order to avoid a digital divide. Luxembourg performs very well in the take-up of fixed broadband services and 53% of households have opted for speeds of 100 Mbps and above. Coverage of 4G mobile networks stands at 99.8% and 5G services were commercially

launched in the second half of 2020. Framing a strategy to streamline permit procedures and facilitate access to public property would further stimulate and accelerate the roll-out of both fixed and mobile infrastructure.

Luxembourg promotes the uptake of strategic digital technologies by businesses. The country invests in a high-performance computer and in 2019 launched a national public-sector blockchain.

In artificial intelligence (AI), the 'Al4Gov' initiative was launched and six teams received funding for projects on AI in public administration. The Government IT Centre is running a GovCloud which hosts the projects of around 90 public administrations and has been upgraded to meet administrations' AI needs. Deploying digital technologies in the broad business sector, including SMEs, would contribute to productivity growth. SMEs can benefit from a public-private partnership leveraging knowledge from accredited digitalisation experts. In June 2021 the Ministry of the Economy published a roadmap called 'Ons Wirtschaft vu muer' to accelerate the green transition and digital technological platform for the exchange, processing and governance of data. Luxembourg performs well on the share of companies that analyse big data (19% versus the EU average of 14%, ranking 9th). A high share of companies (41% versus the EU average of 36%) uses enterprise resource planning software to share information between different functional areas.

The 2021-2025 e-governance strategy for the public sector was adopted by the Government Council in early 2021 to explore new ways of working and to facilitate a paperless administration. Luxembourg ranks 3rd in the EU in the provision of digital public services to businesses and performs above the EU average on the number of administrative steps that can be done online for people's major life events.



Digital in Luxembourg's Recovery and Resilience Plan (RRP)

Luxembourg's RRP is expected to contribute to the green and digital transition, while the components related to skills, health, housing and governance also significantly support cohesion and growth potential in the long term. The plan includes measures totalling EUR 183.1 million, of which EUR 93.4 million will be financed using the Recovery and Resilience Facility (RRF), and the rest from national or other EU funds. 31.6% of the EUR 93.4 million will finance its digital elements, well above the target of 20%. The digital elements include investments in future and digital skills (EUR 5.6 million), telemedicine, and a digital register for health professions (EUR 1.17 million). In addition, the RRF's digital pillar includes a contribution to a multi-country project on ultra-high-security communications based on quantum technologies

(EUR 10 million), and several investments in digital public administration (EUR 12.73 million) which contribute to research and innovation, deployment of new technologies and digitalisation of the public administration.

Some medium to long-term perspectives are given on how the measures of the RRP are expected to favour innovation and digitalisation of the business sector and investment-related economic policy, which are Luxembourg's main digital challenges. The measures aimed at improving the digital inclusion of the population and workers and those expected to favour the digitalisation of SMEs have the potential to increase productivity growth.

Luxembourg's RRP does not include any investments in connectivity, as the policy focus is on ensuring that private investment is sufficient to fulfil the objectives for 2025. It is planned to reassess the situation around 2022.

1 Human capital

1 Human canital	Luxer	EU	
I numan capital	rank	score	score
DESI 2021	6	56.2	47.1



	Luxembourg			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	NA	65%	65%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	NA	36%	36%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	NA	68%	68%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	5.9%	6.1%	6.3%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	14%	15%	20%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	27%	27%	21%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	4.6% 2017	5.8%	5.0%	3.9%
% graduates		2018	2019	2019

In the Human capital dimension, Luxembourg ranks 6th. It ranks above the EU average on the three digital-literacy indicators. 65% of 16-74 year-olds in Luxembourg have at least basic digital skills compared to the EU average of 56%. Luxembourg continues to report an increase in the share of ICT specialists as a percentage of total employment and is well above the EU average (6.3% and 4.3% respectively). 20% of specialists are female, slightly above the EU average of 19%. The share of companies providing ICT training to their employees dropped significantly from 27% in 2019 to 21% in 2020, which is still slightly above the EU average of 20%. The share of ICT graduates in the total pool of graduates increased in 2018 compared to the previous year, and remains above the EU average (5.0% and 3.9% respectively). At the same time, Luxembourg continues to experience a significant shortage of ICT specialists; 67% of companies that recruited or tried to recruit ICT specialists in 2019 reported difficulties in filling vacancies, considerably above the EU average of 55%.

In 2020, the Ministry of Education launched 'Einfach Digital!'³⁹⁵ ('simply digital'), a new initiative that focuses on critical thinking, creativity, communication, collaboration and coding for children in the school system. It represents the next generation of the ministry's digitalisation approach, replacing the former Digital4Education initiative. One of the key projects of the 'Einfach Digital!' initiative is 'Einfach Kodéiren' ('simply coding') which integrates coding into school curricula, providing specialised teachers, courses – some of them with external partners – training material and family

³⁹⁵ https://digital-luxembourg.public.lu/initiatives/einfach-digital

afternoons that parents can attend together with their children³⁹⁶. The Ministry for Education aims to improve digital literacy by strengthening it in the curriculum, combining a general cross-cutting approach ('Medienkompass') with a more specific subject-oriented strand to ensure basic understanding of underlying technological and ethical concepts³⁹⁷.

Luxembourg strongly supports advanced digital skills in areas such as AI. Together with specialised partners, the 'Digital Luxembourg' initiative promotes advanced digital-skills training and upskilling opportunities for industry, education, research and the public sector. Examples include the AI academy, deep-learning training³⁹⁸, learning content on AI³⁹⁹, an online programme for people with nontechnical backgrounds⁴⁰⁰ and an upskilling seminar on 5G for companies with a low digitalisation level.

Launched in September 2019, Luxembourg's Digital Coalition counts over 50 members comprising key participants from the private and public sectors. It is governed by the Digital Luxembourg initiative, together with the Luxembourg Chamber of Commerce and the Chamber of Skilled Trades and Crafts. Throughout the pandemic, thematic digital-skills webinars replaced physical meetings. Key topics of 2020/2021 meetings focused on remote learning and working, AI skills, digitalisation in traditional sectors, 5G, and space technologies. The Digital Skills and Jobs Coalition coordinated a consultation on digital skills and jobs from June to August 2020. Subjects included digital skills and remote working, new models and habits for events and training courses, the state of the market for ICT specialists, and new challenges⁴⁰¹.

Luxembourg participated in the 2020 EU Code Week⁴⁰², a grassroots movement run by volunteers to encourage people of all ages to discover coding and digital creativity. Despite the pandemic, Luxembourg organised significantly more activities with more participants than in 2019 (149 activities with 3 500 participants in 2020).

To continue improving the population's digital-skills level and to tackle the shortage of ICT specialists, it is critical to continue working on the initiatives detailed above and encourage companies to provide targeted ICT training to their employees.

Human capital in Luxembourg's Recovery and Resilience Plan

The component 'skilling, reskilling and upskilling' is part of the government's general policy for digital inclusion, namely the process of narrowing the digital divide by including all people in the digital transformation of society and making digital skills accessible to everyone. The training courses planned under the Future skills and Digital Skills projects include courses at different degrees of difficulty in order to cater for different levels of digital skills and ensure equal access to public administration services for all, including people with low digital skills and older people.

The health crisis caused by the COVID-19 pandemic is significantly disrupting the Luxembourg economy, with a severe impact on businesses but also on the employment market. Continuing

³⁹⁶ <u>https://digital-luxembourg.public.lu/stories/claude-meisch-introduces-einfach-kodeiren-keeping-pace-digital-world</u>

³⁹⁷ <u>https://www.edumedia.lu/</u>

³⁹⁸ https://www.competence.lu

³⁹⁹ <u>https://KI-Campus.org</u>

⁴⁰⁰ https://www.elementsofai.com/lu/

⁴⁰¹ <u>https://www.digitalcoalition.lu/wp-content/uploads/2020/09/Consultation-results-</u>

Digital Skills and Jobs.pdf

⁴⁰² https://codeweek.eu

training is crucial for mobilising the potential of human capital and thus promoting long-term economic growth. In an environment of social distancing as a result of the pandemic, training centres are offering e-learning courses in order to be more flexible, allowing employees to have access to training at any time. Under Future Skills, the courses are expected to attract mainly job seekers aged 45 and above, to help reduce the widespread early retirements and to improve skills. The contents generated by the programme shall be put at the disposal of a larger population of job seekers over a longer time horizon. Under Digital Skills, all employees placed on short-time work schemes between January and March 2021 may have access to e-learning courses of digital skills. Using vouchers worth up to EUR 500, they may choose from among basic and intermediary courses.

2 Connectivity

2 Connectivity	Luxer	EU	
_ connectivity	rank	score	score
DESI 2021	4	61.0	50.2



		Luxembourg		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	88%	91%	88%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	33%	45%	53%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	0.46%	1.80%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	98%	98%	99%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN)	63%	92%	95%	59%
coverage	03/0	52/0	55/0	3370
% households	2018	2019	2020	2020
2c1 4G coverage	98.7%	99.8%	99.8%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	0%	61%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	81%	84%	84%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	71	72	69
Score (0-100)		2019	2020	2020

Luxembourg is almost fully covered by fast fixed broadband networks and also has very good coverage of very high-capacity networks (VHCNs), with 72.1% coverage of fibre to the premises and 88.9% of Docsis 3.1. Thanks to the wide availability of VHCNs, Luxembourg performs very well in the take-up of fixed broadband services and 53% of households have opted for speeds of 100 Mbps and above. The take-up of 1 Gbps services is however very low, albeit higher than the EU average. Broadband services (based on representative baskets of fixed, mobile, and converged broadband offers, adjusted for national household income levels) are slightly more affordable compared to the EU average.

In Luxembourg, 44% of the total 2 090 MHz spectrum harmonised at EU level for wireless broadband has been assigned. Luxembourg scores 61% on the 5G readiness indicator, as by the end of 2020 there were 60 MHz available in the 700 MHz band and 330 MHz in the 3.6 GHz band. 4G coverage stood at 99.8%. 5G services were commercially launched in the second half of 2020, so at mid-2020, 5G coverage still stood at 0%.

The national broadband strategy is currently being updated to align national targets with the EU 2025 gigabit targets. The focus is on ensuring that private investment is sufficient to fulfil the objectives for 2025. Under the new strategy, the situation will be reassessed in around 2022, and by

then public-funding mechanisms could be established if necessary. This might include EU support for projects (under CEF 2). The priority would be to cover the single-digit percentage of the population that does not currently have access to 100 Mbps, preventing a digital divide.

Luxembourg continues to be well on track to meet the EU broadband targets. Despite there being no public funding for broadband roll-out, the 100% state-owned incumbent operator POST is the only significant contributor to fibre roll-out. At the same time, cable operators are investing in the upgrade of their networks to DOCSIS 3.1 technologies. Given the good coverage of fibre to the premises, further roll-out is aimed at households nationwide that do not have fibre connections. POST had a 5.3% increase in the total number of new connections in 2020 compared to 2019, the increase being particularly significant in rural areas (53%).

In July 2020 the national regulatory authority 'Institut Luxembourgeois de Régulation' (ILR) held the spectrum auction for the 700MHz and 3.6 GHz bands. The auction lasted 5 days and demand was higher than anticipated. For the 700 MHz band, there was enough spectrum available for all participating bidders. In the 3.6 GHz band, there were five bidders, four of which successfully obtained spectrum. As a result of the auction there was a new market entrant, Luxembourg Online, which acquired a small (10 MHz) portion in the 3.6 GHz band. Electromagnetic field (EMF) strength requirements are a limiting factor for roll-out and use of 5G radio-access infrastructure. A public consultation on the 26 GHz was launched in October 2020. From the contributions, it was concluded that there was no demand and the ministry decided in March 2021 not to launch assignments at that juncture.

Main market & regulatory developments

In 2020, telecommunications market revenue⁴⁰³ stood at EUR 567.6 million and decreased very slightly by 0.1%. Investment increased by 14.6% compared to 2019, standing at EUR 91.7 million in 2020; it focused on the fixed network (EUR 67.7 million, up by 31.2%) while it decreased in the mobile network (EUR 24 million, down by 15.5%). 64.3% of the overall investment is made by POST.

The market share of POST in the fixed internet access market diminished very slightly by 0.2% compared to its competitors Luxembourg Online and Proximus and stood at 62.1% in 2020. On the mobile market, market shares in SIM cards of the three main operators showed no substantial changes. Alternative operators LUX Mobile and MTX gained slightly at the expense of POST, which had a market share of 44.4% in 2020⁴⁰⁴ for pre- and post-paid mobile subscriptions. The number of M2M SIM cards decreased for the second consecutive year, standing at 74 000, which is below the 2016 figure.

As for the business market, 14.3% of internet subscriptions in Luxembourg are by enterprises, accounting for a revenue of EUR 40.1 million. The revenue in the business market for data transmission increased by 12.6% and stood at EUR 61.5 million in 2020.

At the beginning of the lockdown in mid-March 2020, fixed networks experienced a sudden increase in demand for telephony services (between 40% and 50%; mobile voice minutes

⁴⁰³ https://assets.ilr.lu/telecom/Documents/ILRLU-1461723625-872.pdf

⁴⁰⁴ https://assets.ilr.lu/telecom/Documents/ILRLU-1461723625-872.pdf

increased by only 30-40%). The use of SMS decreased by about 30%. Most notably, the number of mobile subscriptions fell sharply, by more than 60%⁴⁰⁵. During the pandemic, the increase in demand of professional clients was twice that of residential clients.

In the fixed access market, Eltrona, one of the two Luxembourg cable operators, took over – through a merger – the business of the second cable operator SFR-Coditel. At the same time, the POST group, a shareholder in Eltrona since 1998, decided to sell its 34% holding to the Flanders-based company Telenet. The shareholders in Eltrona will hold 50% +1 share and Telenet 50% -1 of the merged entity.

On 4 February 2021, the Commission opened infringement procedures against 24 Member States for failing to enact new EU telecom rules, more specifically the European Electronic Communications Code (EECC), and the Commission sent Luxembourg a letter of formal notice. Luxembourg's law No 7632 will implement the EECC and is based closely on the text of the Directive. It was under discussion in parliament in April 2021 and is not yet adopted.

The wholesale price for unbundled fibre access, which is regulated through an economic replicability test approach, increased from EUR 18 per month to EUR 19 per month.

In July 2020, ILR updated the rules for the economic replicability test.

Regarding the markets for terminating segments of leased lines (market 4 of the 2014 Decision on relevant markets), in October 2020, ILR finalised the market analysis and identified an operator with significant market power along with its obligations. In the same month, ILR notified new prices for this market, based on a bottom-up long-run incremental cost-plus model. The Commission commented on the use by ILR of the weighted average cost of capital value.⁴⁰⁶ It was also working on a new analysis of the markets for fixed and mobile termination (markets 1, 2 and 4 of the 2014 Decision on relevant markets).

The ILR commissioned a study on the national numbering plan.

Luxembourg communicated its roadmap⁴⁰⁷ to implement the Connectivity Toolbox⁴⁰⁸. In March 2020, the government adopted a strategy to adapt to the effects of climate change in Luxembourg. One component is a consultation of datacentre and telecommunications operators to analyse risks and measures taken to adapt to more extreme weather conditions.

The Checkmynet.lu tool measures the performance and quality of internet access services for end users and is free of charge. If a consumer finds the measured bandwidth to be lower than the one contracted, they can contact their provider; if they do not receive a reply or the reply is unsatisfactory, the consumer can use ILR's mediation service free of charge. Between the second quarter of 2018 and the first quarter of 2021, the average download speed increased by more than 110% for fixed subscriptions and by 245% for mobile subscriptions, and upload speeds over local area networks (LAN), including wireless LAN, increased by almost 70 Mbit/s.

⁴⁰⁵ <u>https://assets.ilr.lu/telecom/Documents/ILRLU-1461723625-856.pdf</u>

⁴⁰⁶ ILR updated this value in June 2021.

⁴⁰⁷ <u>https://digital-strategy.ec.europa.eu/en/library/connectivity-toolbox-member-states-develop-and-share-roadmaps-toolbox-implementation</u>

⁴⁰⁸ <u>https://digital-strategy.ec.europa.eu/en/news/connectivity-toolbox-member-states-agree-best-practices-boost-timely-deployment-5g-and-fibre-0</u>

The share of measured fixed download speeds above 100 Mbit/s increased from 14% in 2018 to 28% in 2021⁴⁰⁹.

In 2020 there was a decrease in consumer complaints. Complaints concerned contract terms and contract termination (35%); quality of service, disturbances & installation (30%); billing (26%); premium services (9%) and bundled services (29%).

Luxembourg continues to improve in roll-out and uptake of fibre networks, also addressing the digital divide. Conditions for 5G roll-out have been improved by the significant spectrum assignments in the 700 and 3.6 GHz bands. Framing a strategy to streamline permit procedures and facilitate access to public property to extend and densify mobile networks would further stimulate and accelerate the roll-out of both fixed and mobile infrastructure.

⁴⁰⁹ https://assets.ilr.lu/telecom/Documents/ILRLU-1461723625-871.pdf

3 Integration of digital technology

3 Integration of	Luxer	EU	
digital technology	rank	score	score
DESI 2021	14	39.4	37.6



		Luxembourg		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	64% 2020	60% 2020
3b1 Electronic information sharing	41%	41%	41%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	20%	29%	29%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	16%	16%	19%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	16%	16%	23%	26%
% enterprises	2018	2018	2020	2020
3b5 AI % enterprises	NA	NA	32% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	80% 2021	66% 2021
3b7 e-Invoices	16%	16%	14%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	12%	9%	9%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	NA	NA	NA	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	8%	8%	8%	8%
% SMEs	2017	2019	2019	2019

On the integration of digital technology by businesses, Luxembourg ranks 14th. Consistent with the country's ambition to make the transition to a data-driven economy, Luxembourg has made major progress in the uptake of digital innovation. In particular, it performs well on the share of companies that analyse big data (19% versus the EU average of 14%, ranking 9th). A high share of companies (41% versus the EU average of 36%) uses enterprise resource planning software to share information between different functional areas such as accounting, planning, production and marketing. By contrast, Luxembourg continues to perform well below the EU average on the share of SMEs selling online, with only 9% compared to the EU average of 17%. Furthermore, only 8% of SMEs sell online to other EU countries.

Luxembourg is committed to fully engaging at European level on digital technology. It is a member of the Euro High Performance Computing (Euro HPC) Joint Undertaking⁴¹⁰. The government invested in a High Performance Computer as a key infrastructure necessary for a data-driven economy. In 2019

⁴¹⁰ <u>https://ec.europa.eu/digital-single-market/en/eurohpc-joint-undertaking</u>

it signed the declaration creating a European Blockchain Partnership⁴¹¹ and in 2020 the Ministry for Digitalisation and the Government IT Centre launched a national public-sector blockchain, operated by a series of public-sector bodies at central government and municipality level. This project offers new capabilities to all public-sector bodies. Also in 2019, Luxembourg signed the declaration on cooperation on AI.

The Ministry for Digitalisation identified demand for dedicated AI computing infrastructure which could not be provided through offers in public clouds. In view of the integrity and confidentiality of the data, as well as the type of processing and the type of applications, the existing GovCloud infrastructure was upgraded to service the AI computer needs of the public administration.

The law on electronic invoicing in public procurement and concession contracts⁴¹² was approved on 26 March 2019. It aims to improve companies' productivity and increase private sector competitiveness, and to work towards a more efficient public administration. For all electronic invoices issued under a public or concession contract, the law establishes an obligation for contracting authorities and contracting entities to accept and process them in electronic form, provided they comply with the European standard on electronic invoicing and with one of the syntaxes on the list published by the European Commission.

The Fit4Digital⁴¹³ initiative helps Luxembourg-based SMEs benefit from digital tools by leveraging knowledge from digitalisation experts and receive financial support. Fit4Digital is a public-private partnership operated by the Luxembourg innovation agency 'Luxinnovation'⁴¹⁴ and the Luxembourg Ministry of the Economy, while the digitalisation experts are private firms. These experts – referred to as 'Fit4Digital consultants' – are chosen and accredited by Luxinnovation.

In June 2021, the Ministry of the Economy published a roadmap called 'Ons Wirtschaft vu muer' to support the transformation of the Luxembourg economy by 2025. In response to the COVID-19 pandemic and the vulnerabilities it has revealed, the roadmap proposes a vision and a way forward for the coming years. The roadmap further accelerates the green transition and digital transformation of Luxembourg's economy and society and provides for six short-term pilot measures to provide rapid strategic support for Luxembourg's industrial fabric, including the creation of a national technological platform for the exchange, processing, and governance of data to position Luxembourg among the pioneers of the data economy. The platform makes available an inventory of data to private or public operators, specifying the respective conditions of access and use and protecting privacy and intellectual property. The implementation of data-set interoperability standards and a range of tools and services for this data platform facilitate the users' access to the value chain of the data economy⁴¹⁵.

Luxembourg is implementing large and diverse initiatives and projects on the integration of digital technologies. It is important that these programmes which are first targeted at the government sector will ensure that in the long run they help attract private international investment, companies and skills.

 ⁴¹¹ <u>https://ec.europa.eu/digital-single-market/en/news/european-countries-join-blockchain-partnership</u>
⁴¹² <u>http://legilux.public.lu/eli/etat/leg/loi/2019/05/16/a345/jo</u>

http://legilux.public.iu/eli/etat/leg/i0i/2019/05/16/a345/j0

 ⁴¹³ <u>https://www.luxinnovation.lu/innovate-in-luxembourg/performance-programmes/fit-4-digital/</u>
⁴¹⁴ <u>https://www.luxinnovation.lu/</u>

⁴¹⁵<u>https://meco.gouvernement.lu/fr/actualites.gouvernement%2Bfr%2Bactualites%2Btoutes_actualites%2Bco</u>mmuniques%2B2021%2B06-juin%2B21-fayot-wirtschaft-muer.html

Highlight 2020-2021: Luxembourg's participation in the EuroHPC initiative

Luxembourg is a founding member of the European High Performance Computing Joint Undertaking set up with the aim of developing a world-class pan-European infrastructure of supercomputers. The new Luxembourg supercomputer Meluxina, hosted in the data centre of LuxConnect in Bissen, has been fully operational since June 2021. It will provide leading-edge HPC infrastructures and services to a wide range of users, including SMEs. As part of the EuroHPC network, Meluxina will deliver a peak performance of more than 10 Petaflops/second of computing power. Meluxina will be one of the five petascale supercomputers designed to upgrade Europe's computing power to go operational in 2021.

Integration of digital technology in Luxembourg's Recovery and Resilience Plan

The use of new digital solutions help to fulfil the government's ambition to strengthen institutional resilience. The establishment of an ultra-secure communication infrastructure based on quantum technology will facilitate the exchange of confidential information within the public and private sectors. The project consists of developing and deploying a national testbed which will be fully integrated into an EU multi-country project and will stimulate the creation of a new ecosystem in Luxembourg. The technology protects communications and data against future attacks, complementing and reinforcing existing technologies and making them more productive for security purposes. Within the EU multi-country project, it is envisaged that Luxembourg will coordinate the space segment, considered to be essential for all connections above 100 km in length.

4 Digital public	Luxembourg		EU	
services	rank	score	score	
DESI 2021	11	79.4	68.1	



	Luxembourg			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	65%	62%	64%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	68	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	90	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	97	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	65%	78%
% maximum score			2020	2020

In Digital public services, Luxembourg has made major progress. It now ranks 11th in the EU, significantly improving its score to more than 11 percentage points higher than the EU average. The country performs particularly well and ranks 3rd in the EU in the provision of digital public services to businesses, scoring 97 out of 100, against the EU average of 84. By contrast, there is an average level of online interaction between public authorities and the public: 64% of individuals used the internet in 2020 to interact with public services. Luxembourg performs above the EU average on pre-filled forms and the number of administrative steps that can be performed online for major life events such as the birth of a child or a move to a new residence. It performs below average on open data, ranking 22nd in the EU.

One of the strategic competence strands of the Ministry for Digitalisation is to strengthen egovernment, enabling the transition to a digital government so that it can respond effectively to the needs of society.

The 2021-2025 electronic governance strategy⁴¹⁶ developed by the Ministry for Digitalisation and the Government IT Centre (CTIE) establishes the essential elements of the State's successful digital transition in order to provide high-quality digital services.

The overarching objective is to facilitate the transition to an efficient paperless administration and to ensure an IT environment conducive to new ways of working by relying on a central IT partner that is competent, agile and reliable. To this end, the Government IT Centre aims to strengthen its digitalisation services, develop cutting-edge infrastructures and guarantee very high levels of security and reliability. The six principles guiding and supporting the digitalisation of public services

⁴¹⁶ <u>https://ctie.gouvernement.lu/fr/publications/2021/strategie-gouvernance-electronique-2021-2025.html</u>

are (1) Once Only; (2) Digital by Default; (3) inclusion and accessibility; (4) openness and transparency; (5) reliability and security; (6) interoperability and standardisation.

The Guichet.lu portal⁴¹⁷, aimed at both individuals and companies and acting as a single point of contact (SPOC) for interactions with administrative bodies, has seen major updates. The primary objective is to improve the value and quality of electronic services, integrating various administrative formalities in a single internet portal that gathers all relevant procedures, forms and information made available by the State. The interactive portal MyGuichet.lu allows users to: carry out administrative procedures in a simple and transparent manner reusing their personal data from authentic sources; view their personal data held by official bodies; receive electronic documents issued by official bodies (e-delivery); and book appointments with administrative bodies. Users can log in to their personal space with electronic authentication certificates that guarantee secure information exchanges and confidentiality of personal data. In June 2021, around 1 300 administrative procedures were made available online and almost 400 transactional administrative procedures were available to companies and individuals.

In November 2020, the GovTech Lab⁴¹⁸ was launched, which aims to accelerate the digitalisation of public services through innovation partnerships.

The Ministry for Digitalisation's central coordination role has the potential to lead to major improvements on digital public administration. The public sector is digitally advanced. Continued work to create further digital public services is essential to complete the process of modernising the public administration.

Highlight 2020-2021: Luxembourg's initiative to validate digital health technologies

The Ministry of the Economy, the National Research Fund (FNR) and Luxinnovation have joined forces to offer a new funding opportunity to companies, research and healthcare organisations seeking to work together to evaluate digital health technologies. A joint call was launched in April 2021 with the goal of developing and validating innovative digital health solutions benefiting the national healthcare system (patients and healthcare professionals, among others). The call aims to provide a financial incentive to stakeholders who have an identified technology/product/solution and have to demonstrate its relevance and benefit for human health. Clinical investigations will be carried out in close collaboration with hospitals or care organisations. FNR will fund the costs of the accredited research organisations in Luxembourg, up to EUR 700 000 per project covering all project-specific costs. The Ministry of the Economy will co-finance costs borne by eligible Luxembourg companies up to EUR 700 000 per project, using the R&D aid scheme.

The results of this pilot will be evaluated at the beginning of next year and may lead to a renewal.

Digital public services in Luxembourg's Recovery and Resilience Plan

Measures to digitalise public administration set out in the RRP include: (1) establishing and

⁴¹⁷ https://guichet.public.lu/english.html

⁴¹⁸ <u>https://govtechlab.public.lu/en.html</u>

making operational a platform for the electronic management of documents and document exchanges of public administrations; (2) extending an existing e-government platform to allow for virtual appointments with the public administration; (3) implementing 12 new online services to expand the digital offer to people and business; (4) establishing and making operational a platform for electronic management of public consultations and surveys; and (5) improving an existing electronic system for customer management of public employment and labour-market administration.

	Latvia		EU
	rank	score	score
DESI 2021	17	49.5	50.7



Digital Economy and Society Index (DESI) 2021 ranking

Latvia ranks 17th among the 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI).

Latvia is a front-runner in broadband coverage and take-up and is well prepared for the 5G roll-out. The country's main strengths are the extremely advanced coverage of fast broadband (NGA) (93% against the EU average of 87%) and the fact that 39% of households subscribe to at least 100 Mbps broadband, compared to the EU average of 34%, even though fixed broadband take-up is generally low. Latvia has almost complete 4G coverage (99.9%) and has already allocated a radio spectrum for 5G. The digital divide is still present, despite extensive investment in middle-mile connections in rural regions. There has been no private investment in last-mile connections due to a lack of commercial viability; public funds are therefore needed to ensure fast internet access in rural regions.

Latvia performs well in the provision of Digital public services. The number of e-government users continues to increase and the provision of online public services has further improved. The government adopted its 2020-2023 Public Service Development Plan, which aims for: proactive service provision; a user-centric approach built around key life events; coordinated and integrated service design; cross-border services; digital-by-default and digital-first principles.

Latvia scores below average in Digital skills, with over half of its population still lacking basic digital skills. However, the country's performance is above average when it comes to ICT graduates and female ICT specialists. Latvia is also reducing the gap for ICT specialists, representing 3.7% of total employment versus the EU average of 4.3%. The shortage of digital skills is a key obstacle to more widespread use of digital solutions by the private sector; almost half of Latvian firms that tried to fill vacancies for digital specialists encountered difficulties.

Latvian businesses are capable of taking greater advantage of the opportunities offered by digital technologies. The country ranks 23rd for the integration of technology by business. While Latvian companies are catching up in the use of cloud services with an 18% share, only 9% use big data, only 19% have social media activities, only 11% of SMEs sell online and only 7% of SMEs' turnover comes from e-commerce.

On 6 July 2021, Latvia adopted its 'Digital Transformation Guidelines for 2021-2027'⁴¹⁹. This is an overarching strategy for the country's digital transformation, covering ICT education and skills, internet access, modern and efficient public administration, e-services and digital content for society. Other guidelines have been developed in specific areas, i.e. for education from 2021 to 2027 ('Future skills for the society of the future'), focusing on ICT education and skills.



Digital in Latvia's Recovery and Resilience Plan (RRP)

Latvia's Recovery and Resilience Plan, with a budget of EUR 1,826 million, includes measures addressing all key challenges. It is an adequate response to the economic and social situation, and strengthens Latvia's growth potential. The plan includes almost EUR 384 million (21% of the total budget) to tackle the main digital challenges:

- The plan addresses the lack of digital skills by training public officials, students, teachers, professionals and ICT specialists. It includes investments to improve availability of ICT equipment and provide digital skills for people with special programmes for youth, low educated and unemployed.
- Investments and reforms in the *Digital Infrastructure Transformation* address the insufficient rural connectivity with investments in last-mile connectivity and physical infrastructure in 5G corridors.
- Targeted measures in the *Digital transformation and innovation of businesses* aim to enhance digitalisation capacities through a broad spectrum of actions, such as: establishing a European Digital Innovation Hub (EDIH); a digital one-stop-shop; grants and financial instruments to support the digital transformation of businesses, including research and innovation, training and advanced technologies.
- Measures in the Digital transformation of public administration including municipalities

⁴¹⁹ Latvian Digital Transformation Guidelines 2021-2027, draft: <u>https://www.varam.gov.lv/lv/digitalas-</u> <u>transformacijas-pamatnostadnes-2021-2027gadam</u>

is expected to maintain and improve Latvia's performance.

Latvia's plan comprises five multi-country projects on digital, including the network of EDIHs, the Via Baltica 5G corridor, the IPCEI Microelectronics and Communication Technologies, the IPCEI Next Generation Cloud Infrastructure and Services (IPCEI-CIS) and Genome Europe.

1 Human capital

1 Human canital	La	EU	
i numan capitar	rank	score	score
DESI 2021	20	41.1	47.1



	Latvia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	48%	43%	43%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	27%	24%	24%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills % individuals	49% 2017	44% 2019	44% 2019	58% 2019
1b1 ICT specialists	2.6%	3.1%	3.7%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	19%	24%	23%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	11%	18%	17%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates % graduates	5.0% 2017	4.7% 2018	4.4% 2019	3.9% 2019

Latvia ranks 20th among the 27 EU countries for Human capital, below the EU average. Only 43% of the population aged 16 to 74 have at least basic digital skills, versus the EU average of 56%. Latvia fares better and is above the EU average when it comes to ICT graduates, with 4.7% against 3.8%. Its share of female ICT specialists stands at 23%, against 19% at EU level. The gap with the EU average for ICT specialists is narrowing, as they represent 3.7% of total employment compared to the EU average of 4.3%.

2020-2021 has been a time of policy planning. Latvia has identified the development of digital skills at all levels as a national priority in its Digital Transformation Guidelines 2021-2027⁴²⁰, as highlighted by the OECD review 'Going Digital in Latvia'⁴²¹. The government's mid-term education and skills strategy is part of its Guidelines for the Development of Education 2021-2027: Future skills for the society of the future. Other sectoral policies address the development of digital skills, such as the Implementation Plan on an Adult Education Governance Model, which is in force until 2023 and which has also created the Adult Education Governance Board. Since 2020, the Training Commission of the Ministry of Welfare has outlined broader 'Digital skills' among the priority fields for the courses organised by the State Employment Agency. A change in existing adult education and training for the workforce is necessary to introduce a needs-based approach to the training offer, with an emphasis on digital skills. Improving digital skills will be the key objective for the

⁴²⁰ Latvian Digital Transformation Guidelines 2021-2027, draft: <u>https://www.varam.gov.lv/lv/digitalas-</u> <u>transformacijas-pamatnostadnes-2021-2027gadam</u>

⁴²¹ OECD publication 'Going Digital in Latvia'. Web - iLibrary

unemployed in Massive Open Online Courses (MOOCs) and courses and modules offered by higher and vocational educational institutions. Activities to improve digital skills among unemployed people and jobseekers will be available through traditional classroom courses and new MOOCs and ICT modular learning.

Projects such as Women4IT or Improving the Professional Competence of Employees (2017-2023) are helping strengthen advanced digital skills and increase the number of ICT graduates and female ICT specialists.

In 2020, 6,000 employees of state and municipal institutions participated in training and communication activities organised by the Ministry of Environmental Protection and Regional Development; these launched the Project on Integrated Communication and Learning Activities 'My Latvija.lv. Do it digitally!'. The Latvian Information and Communications Technology Association, together with IT Cluster, kicked off the project 'Training of ICT professionals to promote innovation and the development of the industry'; this aims to train 1,400 digital specialists in the latest ICT technologies. Funded by the European Regional Development Fund (ERDF), the project is expected to increase competitiveness in external markets and support ICT skills development in the ICT industry, non-technological innovations and training to attract investors.

In 2021, Latvia received additional React-EU ERDF funding for the digital transformation of enterprises, including digital skills of employees in SMEs and large enterprises. In 2021, the Latvian Information and Communications Technology Association continued to implement the project 'Support for small and micro ICT skills development and implementation' in the fields of digital technology, digitalisation of internal processes and digital tools for manufacturing and development of services. Through this project, employees of small and micro enterprises and self-employed people can update their skills to handle new technologies.

In December 2020, the Ministry of Education and Science concluded a memorandum of cooperation, 'Young Internet for all Latvian Schools', with the Latvian Association of Local and Regional Governments, major state communication operators, Riga Technical University, LLC 'MicroNets', etc. to implement technological solutions in every school. In 2020, the Minister of Education and Science purchased thousands of laptops, smartphones and tablets to facilitate distance learning, also accepting some donations.

Activities that started in recent years have progressed. The revised general education curriculum (School2023/Skola2023⁴²²) has been implemented since the academic year 2019/2020. It highlights the importance of digital literacy, coding and algorithmic thinking skills; digital literacy is viewed as a transversal skill to be integrated throughout the general education cycle. From pre-school children to secondary education, students learn to use digital technologies in computing, design and technology, advanced coding or specialised courses in digital design or robotics.

The general education curriculum also applies to initial vocational education programmes. Modernising vocational education includes developing modular programmes that are responsive to the current labour market, including digital transformation.

The Latvian National Digital Skills and Jobs Coalition, the 'eSkills Partnership', comprises Latvian public bodies, private companies and non-governmental organisations active in supporting digital skills and the digital transformation.

In 2020 and 2021, the Coalition organised nationwide digital skills development and awareness campaigns, Digital Week 2020 in March 2020 and Digital Week 2021 in March 2021, each involving

⁴²² https://www.skola2030.lv/lv

over 150 partners. The Coalition has also promoted digital transformation skills for SMEs, as well as discussions on their financing and development. In 2021, the Latvian National Coalition will update its priorities for 2021-2030.

During the 2020 CodeWeek, partners organised online programming lessons, hackathons or contests such as 'Meet and Code', which awarded EUR 400 to implement innovative programming activities. 70 out of 90 registered activities (five per 100,000 inhabitants) were developed in primary schools and 42% participants were women. In September 2020, the improved learning content came into force with compulsory computer classes.

The low skills level of the workforce has been holding back Latvia's digital transformation. The new policies for reskilling and upskilling the population and increasing the number of ICT specialists, while continuing to reduce the gender gap, will help Latvia boost its economy.

Highlight 2020-2021: MOOC - Digital skills, key for future developments

Latvia has recently set the development of digital skills as a national priority. The MOOC initiative provided by Latvia's State Employment Agency (SEA) was introduced in 2020/2021.

In 2020, the SEA, in cooperation with local and international learning platforms, began offering free-of-charge open online courses to the unemployed and jobseekers until the end of 2020, giving access to skills certification. Within 6 months, over 1,850 persons had participated in the initiative. In the second half of 2020, digital skills courses were among the most popular ones. In addition, 4,000 SEA clients on average participate every year in ICT formal learning.

ICT-related fields such as computer science, data science and information technology were added in 2021. MOOC will be supported by a vouchers scheme with a post-payment of EUR 150. It will be financed through the State budget and the European Social Fund within the project 'Support for Education of Unemployed Persons'.

Human capital in Latvia's Recovery and Resilience Plan

Latvia's Recovery and Resilience Plan will address the lack of digital skills in most age groups, social and work environments. The measures entirely or partially related to digital skills have a combined budget support of EUR 106 million, comprising 6% of the whole RRP.

The five investments focusing on the digital transformation of society and the labour market will allocate over EUR 71 million, as follows:

- EUR 17 million to help professionals and learners acquire advanced digital skills.
- EUR 20 million for key digital skills in enterprises.
- EUR 7.6 million for self-accompanied training of ICT specialists through non-formal education.
- More than EUR 14 million to develop individual learning accounts for adults.
- 'Digital skills for citizens including young people' will disburse over EUR 12.5 million for technological innovation activities and the acquisition of advanced digital self-service skills.

Two measures that include provisions for the aim to reduce the risks of social exclusion by improving digital skills for students and adults, with EUR 26.5 million, are:

• Participation in the labour market by the unemployed, jobseekers and people at risk of

unemployment.

• The project to close the digital divide for socially vulnerable learners and educational institutions, which will make ICT equipment available to target groups through a 'computer library'.

The plan allocates €8.25 million to a measure aimed at increasing the digital skill levels of over 60,000 public administration employees, to support the digital transformation the public administration.

2 Connectivity

2 Connectivity	La	EU	
2 connectivity	rank	score	score
DESI 2021	14	50.4	50.2



	Latvia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	60%	64%	62%	77%
2a2 At least 100 Mbps fixed broadband take-up % households	32%	38%	39%	34%
2a3 At least 1 Gbps take-up % households	NA	<0.01% 2019	<0.01% 2020	1.3% 2020
2b1 Fast broadband (NGA) coverage % households	93% 2018	93% 2019	93% 2020	87% 2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	88%	88%	88%	59%
% households	2018	2019	2020	2020
2c1 4G coverage % populated areas	98.6% 2018	> 99.9% 2019	> 99.9% 2020	99.7% 2020
2c2 5G readiness Assigned spectrum as a % of total harmonised 5G spectrum	33% 2019	33% 2020	29% 2021	51% 2021
2c3 5G coverage % populated areas	NA	NA	0% 2020	14% 2020
2c4 Mobile broadband take-up	56%	65%	65%	71%
	2018	2019	2019	2019
201 Broadband price index Score (0-100)	INA	2019	2020	2020

With an overall connectivity score of 50.4, Latvia ranks 14th among EU countries. Latvia's strength is its near-complete fast broadband coverage, coupled with near-complete 4G coverage and good very-high capacity network (VHCN) coverage. Coverage of fixed networks capable of providing services of 30 Mbps remains stable at 93% of all households. Latvia performs above the EU average on VHCN, although coverage of FTTP (Fibre to the Premises) remained at 88% in 2020, without any significant progress in the past 5 years. Rural VHCN coverage has also stagnated at 73% (compared to 28% at EU level) of households since 2018. However, the country completely lacks 5G coverage, scoring 29% in terms of 5G readiness, even though the complete 3.4-3.8 GHz band was awarded on technical conditions suitable for 5G in 2018 and limited commercial 5G services are available in the cities of Jelgava and Daugavpils.

Overall fixed broadband take-up stands at 62% of all households, below the EU average of 77%. Uptake of households subscribing to offers of at least 100 Mbps was 39% in 2020, slightly above the EU average (34%) but falling short of the EU target of 50% of households. There is no take-up of at

least 1 Gbps connections. Take-up of mobile broadband is higher at 65% in 2020, but below the EU average (71%).

Overall, broadband prices in Latvia are consistently lower than the EU average, with a price index of 81 compared to 69 at EU level. With 135 mobile subscriptions per 100 people in 2020, Latvian households confirm the trend towards fixed to mobile substitution.

The next broadband strategy for 2021-2027 is still in preparation; meanwhile, Latvia has made good progress on the national broadband strategy goals for 2013-2020, which include the Digital Agenda for Europe targets and the Gigabit Society objectives. Closing the digital divide between urban and rural areas was one of its main objectives, but deploying the last mile (connection to the premises) in white areas (areas that lack connection) remains a challenge. Through the 'middle mile' project, fibre, particularly backhaul infrastructure, has been deployed up to the last mile in white areas. Due to low income and population scarcity in rural areas, network providers have little commercial interest in deploying the last part of the connection up to the premises. At national level, efforts will be made to find an appropriate model to reach territories not covered by the current State aid programme. The objective is to bring the middle mile as close to end-users, schools and public services as possible, making the deployment of the last mile more economically attractive for operators.

Latvia was a front-runner in preparations for 5G deployment but is now lagging behind at EU level as no significant developments were made in the past years. The auction of the 700 MHz band, initially planned for 2020, was delayed for end of 2021 due to unresolved concerns regarding frequency sharing. In the meantime, on 30 March 2021, the national regulatory authority (SPRK) gave the green light to Bite and Tele2 for partial sharing of their frequencies as of 31 March 2021. According to the decision, the two operators could share a total of 44% of their acquired spectrum, so as not to affect competition between them and the third operator that holds licences in that band. It also allowed the two operators to jointly use their infrastructure, such as towers, masts, equipment and base stations⁴²³. SPRK later annulled the decision after requests by both operators. The operators towers, masts, active equipment and other radio network access elements without sharing of frequencies⁴²⁴.

The 26 GHz band has not been allocated due to a lack of demand. However, 1 GHz is available on a first-come, first-served basis.

The Via Baltic 5G corridor project is still in the planning phase⁴²⁵. It aims to promote connected automated driving and support sustainable mobility, including improving road safety through innovation. Moreover, 5G roll-out along the Via Baltica route will improve the interconnection of connected vehicles and connect the Baltic States with other essential European transport corridors.

Main market & regulatory developments

The Latvian market is characterised by a high share of mobile subscriptions and high

 ⁴²³ <u>SPRK atļauj SIA "Tele2" un SIA "Bite Latvija" sadarbību mobilo sakaru frekvenču izmantošanā</u>, 30.03.2021.
⁴²⁴ <u>Tele2 un Bite Latvija attīstīs tīkla koplietošanu bez frekvenču kopīgas izmantošanas</u>, 21.05.2021.

⁴²⁵ In September 2018, transport ministers from the Baltic States signed a memorandum of understanding on the development of connected and automated driving and 5G technologies along the Via Baltica corridor.

competition between the fixed incumbent and the mobile operators. For that reason, the fixed incumbent, Tet, is expanding into other market segments such as electronic devices and TV, but also infrastructure construction and electricity (business-2-business).

On 4 February 2021, the Commission addressed a Letter of formal notice to Latvia for its failure to notify transposition measures for the European Electronic Communications Code. Latvia confirmed the partial transposition of the Code to the extent that secondary regulation and decisions necessary for the adoption of the legal draft have been issued. The second public consultation round on the final draft of the transposed European Electronic Communications Code has been concluded and is ready to go to the Parliament. The complete transposition is expected in November 2021.

The national regulatory authority, SPRK has introduced fees for the allocation of numbers to increase the efficient use of numbering ranges that have been free of charge until now.

In its roadmap to implement the Connectivity Toolbox⁴²⁶, Latvia announced plans to simplify the permit-granting procedure for building electronic communications networks. The aim is to assess the possibility for tacit approval and a fast-track procedure for rights of way, further develop the single information point and simplify deployment of small cells. A working group has been established to evaluate the environmental footprint of electronic communications networks.

SPRK noted that trends in consumer complaints did not differ significantly from the previous year, but that there was a slight increase in complaints relating to quality of service (27%) compared to 2019 (22%). As mobile operators have also noted, these complaints are related to the increased use of mobile services due to the pandemic. Households typically rely on mobile connections and are experiencing more capacity constraints.

SPRK identified several caller identification (CLI) spoof cases that include falsely transmitting a different number on the receiving parties' caller identification screen. For example, personal data has been acquired from individuals by falsely transmitting public telephone numbers used by banking institutions. SPRK is assessing possible measures against this specific fraudulent use of numbers.

While there is wide availability of very high broadband speeds, households do not make use of them; public policy initiatives can incentivise the take-up of the available very high speeds. Latvia was among the front runners on 5G, with early awards of the important 5G spectrum in the 3.4-3.8 GHz band, but deployment of 5G has stagnated in recent years. In the medium to long term, considering the delays in assigning the 700 MHz band, which is crucial for 5G and important for coverage, Latvia risks falling further behind at EU level. The utilisation of RRF is expected to address further network roll-out in the already advanced market and help to create the necessary economic incentives for investment in the identified gaps in white areas.

Connectivity in Latvia's Recovery and Resilience Plan

Latvia's Recovery and Resilience Plan includes two measures on connectivity infrastructures, with a combined budget of EUR 16.5 million, accounting for 4% of the RRP digital budget. They

⁴²⁶ <u>https://digital-strategy.ec.europa.eu/en/policies/connectivity-toolbox</u>
will address last-mile connectivity in rural areas and passive infrastructure on the Via Baltica 5G corridor.

- The broadband or VHCN last-mile infrastructure development measure foresees to provide connectivity to 1,500 households, businesses, schools, hospitals and other public buildings in rural areas. It has a budget of EUR 4 million.
- Construction of passive infrastructure on the Via Baltica corridor for 5G coverage: the investment of EUR 12.5 million, aims to ensure 100% fibre backhaul availability along the Latvian part of the Via Baltica corridor, as well as the necessary physical infrastructure to provide 5G coverage.

The Via Baltica corridor seeks to link Latvia, Estonia, Lithuania, Finland and Poland by providing uninterrupted 5G coverage on the main paths.

3 Integration of digital technology

3 Integration of	La	EU	
digital technology	rank	score	score
DESI 2021	23	26.8	37.6



			EU	
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	42%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	25%	32%	32%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	13%	19%	19%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	8%	8%	9%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	11%	11%	18%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	21%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	65%	66%
% enterprises having medium/high intensity of green action through ICI			2021	2021
3b7 e-Invoices	7%	7%	15%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	10%	11%	11%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	5%	5%	7%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	5%	7%	7%	8%
% SMEs	2017	2019	2019	2019

Latvia ranks 23rd among EU countries in the integration of digital technology in enterprises, which is still well below the EU average in almost all categories. The share of SMEs with at least a basic level of digital intensity is 42%, while the EU average is 60%. Even though Latvian companies have increased their use of cloud services, the use of big data is progressing slowly. The share of companies using cloud services is 18%, a notable increase from 11% last year, but only 9% of enterprises use big data and only 19% have activities on social media, which is below the EU average. Regarding e-commerce, only 11% of SMEs sell online and only 7% of SMEs' turnover is from e-commerce.

Latvia uses different measures to support its growing start-up ecosystem. The law on aid for the activities of start-ups established a support programme to recruit highly skilled workers and provide personal income tax relief for start-up employees. In addition, subsidies and loans are available to business start-ups in rural areas to promote digital innovation or the development of new products and services. The loans programme is targeted at start-ups in the agricultural, rural and fisheries sectors.

Latvia continues to use the Competence Centre and other complementary programmes such as the technology transfer programme to promote innovation in SMEs. Other support measures for the digitalisation of enterprises include training programmes organised by the Latvian Information and Communications Technology Association, and the EU co-funded development project for SME training in digital technologies and innovation.

The Ministry of Environmental Protection and Regional Development and the Ministry of Economics have nominated two Digital Innovation Hubs. The Latvian IT Cluster will focus on the digital transformation of enterprises using available digital solutions; the digital accelerator of Latvia will focus on R&D and innovative digital solutions. Both hubs, which involve public and private stakeholders, plan to be part of the network of European Digital Innovation Hubs and provide the infrastructure for prototyping.

The digital transformation strategy stated in the Latvian Digital Transformation Guidelines 2021-2027⁴²⁷ will cover the integration of digital technology, alongside ICT education and skills. The national AI strategy promotes artificial intelligence in education and science, in the public sector and in the wider economy. It aims to integrate automation and artificial intelligence in all sectoral strategies.

Latvia participates in several EU initiatives. It is a member of the EuroHPC Joint Undertaking, has signed the Declaration on European Blockchain Partnership and the EU Declaration on Cooperation in Artificial Intelligence, and has announced its intention to participate in the EuroQCI project. It is also launching the Latvian National Federated Cloud, focusing on interoperability between the government and academic clouds and integration into the European federated cloud to implement cross-border services and access HPC resources.

Latvia has improved in some categories, but still performs below the EU average in all of them. The integration of digital technologies is mainly hampered by a lack of investment in R&D, a lack of digitally skilled employees and insufficient connectivity in rural areas.

Integration of digital technology in Latvia's Recovery and Resilience Plan

Latvia's Recovery and Resilience Plan includes five investments linked to the digitalisation of businesses, with an added budget support of EUR 125 million aiming to create a competitive environment to boost digitalization and innovation. The plan includes:

- Support for the establishment of European Digital Innovation Hubs (EDIHs) and Regional Contact Points, dedicating EUR 10 million to transform the business ecosystem and support companies on digitalization, including testing, mentoring, training and upskilling.
- A measure targeting the digitalisation of processes in commercial activities, which will provide EUR 40 million of support to companies.
- EUR 24 million in aid for businesses to introduce new digital products and services.
- EUR 45 million in financial instruments to facilitate the digital transformation of economic operators and provide grants to companies attracting private investment.
- EUR 5.7 million to foster the digital transformation of media companies by supporting new platforms and digital solutions.

⁴²⁷ Latvian Digital Transformation Guidelines 2021-2027, draft: <u>https://www.varam.gov.lv/lv/digitalas-</u> <u>transformacijas-pamatnostadnes-2021-2027gadam</u>

Under the plan, there are also investments in the deployment of advanced technologies. Latvia aims to invest additional 12.5 million in its National Federal Cloud.

Latvia would also take part in some multi-country projects and thereby supporting the development of key digital capacities in the EU, such as the network of EDIHs, and the IPCEIs on Cloud and on Microelectronics.

4 Digital public	La	EU	
services	rank	score	score
DESI 2021	10	79.6	68.1



	Latvia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	78%	80%	85%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	82	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	87	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	85	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	80%	78%
% maximum score			2020	2020

Latvia ranks 10th in the EU for digital public services and scores above the EU average in all categories. It ranks 6th (85% of internet users) for its share of e-government users, far exceeding the EU average of 64%. Latvia also ranks 6th for pre-filled forms, with a score of 82, and for digital public services for citizens, scoring 87 (EU average of 75). It is also slightly above the EU average in digital public services for businesses, on 85. The maturity of open data has increased to 80%, but the EU average has approached Latvia's level, scoring 78% for this indicator, and Latvia has dropped from 10th to 18th in the ranking.

In 2020, the government adopted a new methodology for transforming the public service to develop the public administration service system and set its policy strategy. It organised focus group discussions, usability tests and surveys to build a user-centric approach to digital public services.

Digital skills among public employees and availability of ICT tools are essential to deliver quality digital public administration services. The Learning and Development Strategy for Public Administration 2021-2027 covers the future development of civil servants, including their digital skills. Latvia envisages reforms to remove barriers for the efficient exchange of the public administration's ICT resources to improve their efficiency and quality, and to promote the development of specialised centres of competence that provide shared ICT services. Latvia also aims to enable public authorities to procure innovative solutions, including AI-based systems (Interreg Europe project 'iBuy') or running AI testbeds for autonomous vehicles.

Following the Web Content Accessibility Guidelines (WCAG) 2.0, which make recommendations for chatbots, text-to-speech and speech-to-text technologies, Latvia added easier access for people with

disabilities via the automated translation service of the national platform of digital language tools and technologies, HUGO.LV⁴²⁸.

During 2020, largely due to the COVID crisis, over 2,000 residents per day engaged in conversations with digital assistants on e-government websites on various topics. The COVID-19 pandemic also contributed to the introduction of state-funded telemedicine services (doctor-patient consultations) starting from March 2020. Although the Public Health Guidelines 2021-2027 are in place, the Ministry of Health is working on a Healthcare Digitalisation Strategy for 2022-2027.

The Ministry of Environmental Protection and Regional Development has developed a network of 122 State and Municipal Unified Customer Service Centres, where citizens can receive public services. These centres facilitate the development of citizens' digital skills, their staff assist citizens with the provision of e-services, and the centres provide 28 authorised e-services for non-digital groups. The total number of services registered in these centres (applications, support for application of e-services, support for users of the portal Latvija.lv) has increased by 26% compared to last year.

Latvia continues to perform well in digital public services and is in the leading group in e-Government users, pre-filled forms and digital public services for citizens. However, it is only slightly above the EU average in digital public services for businesses, indicating that there is still room for improvement in this area.

Digital public services in Latvia's Recovery and Resilience Plan

Latvia's Recovery and Resilience Plan dedicates more than EUR 123 million to Digital public services. The digital transformation of public administration, including municipalities comprises three measures focused on modernising governance and data strategy:

- Administration modernisation and digital transformation of services, including the business environment, which provides more than EUR 24 million to develop ICT solutions for modernised public administration functions.
- EUR 70 million for supporting centralised governance platforms and systems.
- Data availability, sharing and analysis, allocating close to EUR 22 million to develop data on the national economy and to develop the digital services economy.

Latvia will take part in the IPCEI of Common European data infrastructure and services (including the Cloud Federation).

⁴²⁸ HUGO.LV (https://hugo.lv/en), the e-government language technology platform developed by Tilde, provides automated translation, speech recognition and speech synthesis, as well as various tools for multi-language support for e-services. It will operate in all European languages from 2022.

	м	alta	EU
	rank	score	score
DESI 2021	6	59.6	50.7



Malta ranks 6th out of 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI). It performs well on broadband connectivity. Already since 2019, all Maltese households are reached by Very High Capacity Networks offering speeds of up to 1Gbps. A continued focus is instead needed to increase the take up of these networks and ensure the swift assignment of all 5G pioneer bands.

The country records good scores on Human capital, especially because of the high shares of ICT graduates (6% of graduates in Malta, versus 3.9% in the EU). The country also performs slightly higher than the EU average in terms of ICT specialists (4.4% versus 4.3% in the EU).

However, the presence of women is still relatively low: female ICT specialists account for only 11% of all ICT specialists (against an EU average of 19%). On basic digital skills, Malta's performance is just in line with the EU average. Efforts are still needed to improve the level of basic digital skills among the population, close the gender gap in the digital sector and meet the increasing demand for ICT specialists.

The large majority (71%) of Maltese Small and Medium Enterprises (SMEs) have at least a basic level of digital intensity and perform particularly well in the use of technologies such as big data and cloud solutions, respectively used, by 31% and 38% of enterprises in the country. The country has also placed a strong focus on advanced digital technologies, such as blockchain and Artificial Intelligence, which can be further leveraged to reinforce the country's strategic approach to digitalisation.

Malta's performance in Digital public services remains good, especially when looking at the offer of online services by the public administration. While open data policies remain weak, there has been an improvement in uptake of e-government services, with the share of e-government users reaching 63% in 2020.

The National Strategy "Digital Malta" has driven the digital policies in the country in 2014-20 and set the ambition of Malta as a "digitally enabled nation". Malta is currently in the process of developing

a new overarching digital strategy for 2021-27, next to new sectorial strategies on digital public services, cybersecurity, e-commerce and data.

During 2020 and 2021, the National eSkills Strategy continued to bring together stakeholders and support initiatives to boost digital skills in the country.



Digital in Malta's Recovery and Resilience Plan (RRP)

The Maltese Recovery and Resilience Plan accounts for a total of \leq 316.4 million, as allocation under the Recovery and Resilience Facility⁴²⁹. 25.5% of it (i.e. \leq 80.8 million) is devoted to the digital transition.

The investments focus on the digital transformation of the public administration, health and justice systems, as well as the private sector.

Specifically, the plan includes investments in the improvement of the government digital backbone, the digitalisation of the Merchant Shipping Directorate, and further digitalisation of the public administration and its services.

It also envisages investments to boost the digital transition of Malta's healthcare system, in particular through digitalising outpatient and consumer engagement processes, and to strengthen the functioning of the justice system through implementing secure digital solutions and tools to support users.

Moreover, a dedicated financial support scheme aims to stimulate the uptake of digital technologies among Maltese enterprises, notably SMEs.

In addition, the plan envisages reform measures to facilitate the digital transition, which build on national strategies under development. These strategies aim to address the digital divide, by strengthening and promoting digitals skills, improve digital public services and implement Malta's smart specialisation strategy with a focus on business R&I and public-private cooperation.

⁴²⁹ The total value of the Maltese Recovery and Resilience Plan is €344.9 million, which is above the nonrepayable financial support under the Recovery and Resilience Facility of €316.4 million. Malta did not ask for loans.

1 Human capital

1 Human canital	м	EU	
I Human capital	rank	score	score
DESI 2021	11	49.1	47.1



	Malta			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	57%	56%	56%	56%
1a2 Above basic digital skills	39%	38%	38%	31%
% individuals		2019	2019	2019
1a3 At least basic software skills % individuals	57% 2017	58% 2019	58% 2019	58% 2019
1b1 ICT specialists	4.8%	4.6% 2019	4.4%	4.3%
% individuals in employment aged 15-74	2018		2020	2020
1b2 Female ICT specialists	18%	11%	11%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	26%	26%	28%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	7.9%	7.0%	6.0%	3.9%
% graduates	2017	2018	2019	2019

In the Human capital dimension, Malta ranks 11th out of 27 EU countries. The performance on basic digital skills is in line with the EU average: 56% of people have at least basic digital skills and 58% have at least basic software skills. The share of ICT graduates is above the EU average (6% versus 3.9%). 38% of people in Malta have above basic digital skills, above the EU average of 31%. The percentage of ICT specialists in the workforce is also slightly higher than the EU average (4.4% versus 4.3%). Female ICT specialists, however, account for only 11% of all ICT specialists, considerably below EU average.

Malta has a comprehensive "National eSkills Strategy 2019-2021"⁴³⁰, which is led by the eSkills Malta Foundation, a multi-stakeholder partnership leading the Maltese National Coalition for Digital Skills and Jobs⁴³¹. The strategy covers many areas of action, including: (i) basic digital literacy; (ii) quality of ICT teaching; (iii) advanced skills; and (iv) re-skilling and upskilling of the workforce.

During 2020 and following a review process (Education Excellence 2030), Malta started to update its strategies on education policies, including a focus on digital literacy. The update of the strategic framework for education is expected to be completed during 2021.

Under the current strategy and as a response to the pandemic, the eSkills Malta Foundation supported several initiatives in 2020. For example, it facilitated distance learning in schools and remote work in SMEs, by providing learning resources.

⁴³⁰ National eSkills Strategy 2019 - 2021.

⁴³¹ eSkills Malta Foundation is made up of various representatives of the government, industry and education.

A webinar leading to digital transformation online courses ("Challenges and opportunities for SMEs: a post-COVID-19 perspective") was organised to help enterprises adapt to the post-COVID-19 scenario and thrive by leveraging digital tools.

Moreover, in 2020 a collaboration between the eSkills Malta Foundation and the Malta Communications Authority (MCA) led to the setup of a training programme on e-commerce (the eBiznify⁴³²). The eSkills Malta Foundation also provided online training on cloud technology, addressed to ICT practitioners, business leaders, young aspiring students and the unemployed⁴³³. Tech.mt supported projects to boost social inclusion and address challenges related to ageing and the gender gap in digital skills, through projects such as "ICT 4 the Elderly" and "Women4IT".

Despite the COVID-19 pandemic, the work on the 'Demand and Supply Monitor' continued, with the launch of a survey to map the skills requested by the ICT industry on the one hand, and the local ICT education and training offering on the other hand. The results, regularly collected, are expected to support policy and the design of upskilling and re-skilling paths by the respective stakeholders.

The Maltese Public Employment Service (Jobsplus) also provides training opportunities through a mix of online and on-site courses. Jobsplus initiatives related to skills development aim to reflect the changes brought by the advancements made in technology and digitalisation and reduce the skills mismatch experienced by employers and upskill the workforce.

The eSkills Malta Foundation coordinates the EU Code Week. In 2018 and 2019, Malta ranked first in the number of coding events held per capita. The country continued to be active and, in 2020 around 317 online EU Code Week events were organised across the country, targeting especially pupils in primary and secondary schools⁴³⁴. In addition, together with Tech.mt, the eSkills Malta foundation supported code.sprint⁴³⁵, the Ministry for Education's (MFED) national coding competition, open to Computing secondary students, and computing/IT post-secondary and undergraduate students. It aims to gauge participants' problem solving, computational and programming skills in an environment different to that students are used to in schools and during traditional exams.

Overall, it is important that Malta continues and steps up the efforts to ensure that basic digital skills are widespread among the population, aligning its performance in this area with the good positioning achieved in terms of advanced and specialised digital skills and in other digital-related dimensions. Efforts are also important in order to close the existing gender gap in the digital sector and match the growing demand for skilled labour force, which may increasingly represent an obstacle to further progress in digitalisation of the economy and public administration.

Highlight 2020-2021: Digital skills online courses

To address the challenges faced by schools and students because of the pandemic, in 2020 the eSkills Malta Foundation launched the initiative "COVID-19: Free Online Education"⁴³⁶: a database of resources for online education and distance learning.

The online courses and other resources target primarily children and younger people, from

⁴³² Home - eBiznify.

⁴³³ eSkills Malta Foundation - Amazon Web Services Courses | Melita Foundation Malta.

⁴³⁴ Europe Code Week.

⁴³⁵ code.sprint 2021 - Codesprint (codesprintmalta.edu.mt).

⁴³⁶ <u>COVID-19: Free Online Education (eskills.org.mt)</u>.

kindergartners to secondary schools, including activities on coding, computational thinking, STEM or robotics.

A section of database is dedicated to private citizens and SMEs employees, spanning from basic digital skills to programming and data analytics, to a free cybersecurity testing and training programme designed to raise awareness of cyber threats. The resources listed in the repository also include free remote learning solutions from other European countries.

Moreover, as in previous years, the eSkills Malta Foundation continued to organise the "Digital Skills Bootcamp"⁴³⁷.

The Summer Bootcamp, carried out totally online, was attended by a high number of teachers (1,400), children, SME employees, and members of the general public. Themes covered included online services, Artificial Intelligence, Python, effective distance learning and teaching techniques and tools, game development, essential and emerging technologies, and office tools for employees.

Human capital in Malta's Recovery and Resilience Plan

The Maltese Recovery and Resilience Plan envisages developing and implementing initiatives for digital skills under the umbrella of the country's upcoming Digital Strategy 2021-27⁴³⁸.

In particular, a reform included in the plan pursues the objectives of: (i) reducing the digital divide and (ii) promoting digital skills through initiatives for upskilling and for increasing Malta's pool of ICT professionals.

Regarding the first objective, Malta is expected to design and launch a programme targeting low-income families, to enable them to be connected and have access to computers and benefit from digital technologies. This programme is expected to support at least 1,000 individuals.

Regarding the second objective, the reform aims to increase Malta's pool of ICT professionals especially in niche areas, such as Artificial Intelligence. This approach is expected to favour specialisation, in line with national policies and the ambitions of the upcoming Digital Strategy. One of the concrete measures will be the launch of a scholarship scheme for students to become ICT professionals in specific areas.

However, funding from the Recovery and Resilience Facility will not be used to implement these measures, which will be supported by national and/or other EU funding instruments.

Investments for digital skills development target the public sector, with measures to accompany the digitalisation processes in public administrations (such as the Merchant Shipping Directorate).

⁴³⁷ Digital Skills Bootcamp 2021 (eskills.org.mt).

⁴³⁸ Reform of the Maltese Plan "Deepening the digital transformation through policy reform, with a focus on reducing the digital divide and promoting digital skills".

2 Connectivity

2 Connectivity	М	EU	
,	rank	score	score
DESI 2021	8	54.1	50.2



		Malta		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	83%	84%	86%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	23%	34%	43%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	NA	1.15%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	100%	100%	100%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN)	222/	40000	4.000/	500/
coverage	32%	100%	100%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	99.9%	>99.9%	>99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	0%	17%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	69%	71%	71%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	63	57	69
Score (0-100)		2019	2020	2020

Malta's connectivity score has improved further, moving the country up to rank 8 in the EU. Extensive deployment of DOCSIS 3.1 resulted in nationwide VHCN coverage with speeds of up to 1Gbps in 2019. Malta exceeds the EU average in DOCSIS 3.1 coverage by 72 p.p. This contrasts with FTTP coverage, where Malta fell behind the EU average of 43% by 2 p.p. in 2020. The percentage of households subscribing to internet services of at least 100 Mbps climbed from 34% in 2019 to 43% in 2020, expanding Malta's modest lead over the EU average to 9 p.p. Nevertheless, the take-up of at least 100 Mbps broadband connections is increasing at a lower rate than in previous years. The gap between coverage and take-up is especially wide for networks offering at least 1 Gbps services, which were used by only 1% of Maltese households despite nationwide coverage in 2020. Malta's broadband price index of 57 suggests a possible reason for slow take-up. It shows that prices are higher than the EU average, and that the gap between average prices in the EU and Malta is widening.

Regarding wireless networks, 4G coverage is near-universal and, in May 2021, incumbent Melita launched Malta's first nationwide 5G network using spectrum outside of the pioneer bands. At that time, spectrum assignment in the 5G pioneer bands was ongoing.

The follow-up to the 2014-20 Digital Malta Strategy is expected to include upgrades to the national broadband plan. Public funding for fixed VHCN deployment is not likely, since ongoing investment by the two incumbent network operators, GO and Melita, allowed Malta to achieve total fixed VHCN coverage in 2019. The operators are continuously upgrading their respective FTTH and DOCSIS 3.1 networks, and one of them already provides nationwide coverage with speeds up to 1Gbps. Moreover, Melita allows its subscribers to access around 50,000 high-speed Wi-Fi hotspots in public areas and via home modems that have been re-programmed to provide mobile data coverage. Malta's Wi-Fi network infrastructure is further extended by Tech.mt, which is responsible for 400 free Wi-Fi connections around Malta and Gozo and, in collaboration with its various partners, offers at least four Wi-Fi connections in every town or city.

Following GO's investment in a third new submarine cable system in 2019, work is underway to connect Malta to Marseille and Egypt. Once completed, the new system will expand the island's international connectivity beyond the existing cables terminating in Italy.

In April 2021, the Malta Communications Authority (MCA) paved the way for spectrum assignment in the 5G pioneer bands with its decision⁴³⁹ to make available the entire 700 MHz and 3.6 GHz bands for the provision of wireless broadband electronic communications services. Moreover, the authority decided to make available 1.2 GHz within the 26 GHz band and reserve remaining parts of the spectrum for future use, once relevant business models are developed.

Following a formal call for expression of interest in the 3.6 GHz band, the MCA announced on 19 April 2021 that, since demand did not exceed available spectrum, it would proceed with the assignment directly to the three incumbent operators⁴⁴⁰. Melita has already launched a 5G trial in the 3.4-3.8 GHz band⁴⁴¹. The commercial launch by Melita, Epic Communications and GO is expected within the year. The Ministry for Economy and Industry reports that local players are already acting on plans to migrate to 5G technology.

Main market & regulatory developments

The fixed electronic communications service market continues to be dominated by two players, Melita and GO, who hold 48% and 47% of the market share, respectively.

Operators experienced a significant increase in demand for fixed broadband subscriptions compared to the previous year, driven by take-up of connections supporting fast and ultra-fast download speeds. For products supporting headline download speeds of at least 100 Mbps, the number of subscriptions rose by 31% to a total of 103,003 in 2020. The rise in subscriptions is accompanied by an ongoing increase in the take-up of bundled packages featuring fixed broadband and pay-TV. In 2020, 79% of all pay-TV subscriptions were on a bundle plan, up from 75% a year earlier.

The mobile telephony market was reshaped in April 2020, when Monaco Telecom acquired the entire share capital of Vodafone Malta Ltd. and later rebranded itself as Epic. Epic Communications Ltd. now is the country's largest mobile operator in terms of number of customers. Operators in this market experienced a slight decline of 1.6% in subscriptions between 2019 and 2020. During the same period, mobile voice minute volumes and data

⁴³⁹ MCA/D/21-4177.

⁴⁴⁰ <u>https://www.mca.org.mt/articles/assignment-36-ghz-band-submissions-call-expression-interest.</u>

⁴⁴¹ <u>https://www.melita.com/melita-launches-limited-5g-trial/</u>.

consumption (excluding roaming) increased by 15% and 33%, respectively. Both trends can be explained by reference to the Covid-19 pandemic. Many workers left Malta to return home, but people in Malta had to rely on mobile communications for social interaction to comply with social distancing requirements.

The transposition of the European Electronic Communications Code into national law has been delayed and on 4 February 2021 the Commission sent a Letter of Formal Notice to Malta⁴⁴². Malta has already implemented a number of recommendations from the Commission's Connectivity Toolbox and is currently considering further implementation measures to streamline permit granting procedures and address aspects related to electromagnetic fields and public health connected to 5G deployment.

As regards the Broadband Cost Reduction Directive, Malta has yet to appoint a dispute resolution body and providers report that access to information about existing physical infrastructure through the single information point remains challenging. Malta's Connectivity Toolbox Roadmap does not propose new measures to address these shortcomings.

On spectrum management, on 26 November 2020 MCA published a new edition of the National Frequency Plan⁴⁴³, which implements a series of EU Decisions on terrestrial systems capable of providing wireless broadband electronic communications, ultra-wideband technology, and short range devices.

On market access, the Maltese authority is reviewing fixed broadband wholesale markets 3a and 3b. It completed a market analysis and public consultation in July 2020⁴⁴⁴.

Between January and September 2020, the MCA received an average of 10 complaints a month, with no change compared to 2019. Most complaints concerned the quality of goods or services, specifically in regard to internet accessibility and speed, followed by issues related to billing as well as contract termination and switching.

Following a consultation in August 2020⁴⁴⁵, MCA concluded that, to meet universal service requirements, adequate broadband internet access at a fixed location should have a download speed of at least 30 Mbps, an upload speed of at least 1.5 Mbps, latency that is capable of allowing the end-user to make and receive voice and video calls effectively, and an unlimited data usage cap.

On emergency communications, Malta is in discussions with Apple to expand handset-based Advance Mobile Location from Android to iOS users. The Ministry for Economy and Industry also reports ongoing efforts to implement Galileo-enabling infrastructure leveraging the Global Navigation Satellite System.

Malta has already fulfilled the 2025 Gigabit society objectives. The country boasts nationwide Gigabit connectivity and 5G coverage. The new digital strategy is therefore expected to focus on take-up. Recent developments show that market demand for the 5G spectrum is emerging. It is

 ⁴⁴² On 23 September 2021, the Commission followed up with a Reasoned Opinion to Malta. On 1 October
2021, Malta notified complete transposition of the obligations of Directive (EU) 2018/1972 into national law.
⁴⁴³ <u>https://www.mca.org.mt/articles/national-frequency-plan-0</u>.

⁴⁴⁴ Available at this <u>link</u>.

⁴⁴⁵ Available at this <u>link</u>.

important that Maltese authorities now ensure the swift assignment of spectrum in the pioneer bands.

3 Integration of digital technology

				60	integration of algital teelinolog
3 Integration of	м	alta	EU	00 -	
digital technology	rank	score	score	40 -	
DESI 2021	4	50.8	37.6	20 -	
				0	EU

20 -						
0 -			Malta	-	EU	I
0	2016	2017	2018	2019	2020	2021

Integration of digital technology

			EU	
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	71%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	29%	32%	32%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	26%	43%	43%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	24%	24%	31%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	22%	22%	38%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	NA	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	NA	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	18%	18%	22%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	20%	23%	25%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	NA	NA	8%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	9%	NA	NA	8%
% SMEs	2017	2019	2019	2019

Malta ranks 4th in the EU 27 on the Integration of digital technology. Malta's positive performance recorded in recent years is confirmed by the Digital Intensity Index, according to which 71% of SMEs in Malta have at least a basic level of digital intensity. This figure is well above the EU average of 60%. Maltese businesses are very strong in the use of big data analysis (31%, the highest rate in the EU), social media (43% versus an EU average of 23%) and cloud computing (38% versus 26% in the EU). The percentage of enterprises that use electronic information sharing remains stable (32%) almost reaching the EU average (36%). Looking at e-commerce, 25% of SMEs sell online, and ecommerce represents 8% of SMEs turnover. The performance of the country is rather weak when it comes to the uptake of e-invoices (22% in Malta, against 32% in the EU).

In recent years, the Maltese government has promoted measures to boost the deployment of digital technologies in the country. In addition to the strategic and legislative framework on blockchain adopted in 2018, the government adopted a national strategy on Artificial Intelligence in 2019,

covering three strands: (i) investment; (ii) start-ups and innovation; and (iii) public sector and private sector adoption⁴⁴⁶.

To support the strategy, Malta is in the process of setting up a Digital Innovation Hub (DIH), which will specialise in "AI research and data analytics around HPC use". It will be managed by the Malta Digital Innovation Authority (MDIA).

Malta is developing a new overarching digital strategy for 2021-27, which is expected to emphasise the use and application of innovative technologies and the benefits of digital as a tool for improving the economic well-being of businesses and people's quality of life. In addition, the country is working to update two sectoral strategies: a Cybersecurity Strategy and a National Data Strategy.

The Malta Information Technology Agency (MITA) runs several programmes to help Maltese enterprises adopt digital technologies. They include: the MITA Emerging Technologies Lab⁴⁴⁷, which has been providing learning activities and equipment to experiment with different technologies; and the MITA Innovation Hub⁴⁴⁸, which hosts an accelerator programme (YouStartIT) in the area of advanced technologies such as blockchain, deep tech, Internet of Things and AI.

During 2021, Tech.mt launched the 10th edition of the eBusiness Awards⁴⁴⁹ to promote the most innovative initiatives in eBusiness and spread awareness about the role of web-based technologies in addressing social and economic concerns.

In 2021, Tech.mt will also be launching the 'Excelerate' project which will encourage businesses to go digital and invest in cloud technologies, as an opportunity to increase their efficiency and margins and generally provide a better customer experience.

In 2021, Malta became a participating state within the European High-Performance Computing Joint Undertaking (EuroHPC). Malta's participation in EuroHPC will enable the local research and scientific community, industry (including SMEs) and the public sector to avail themselves of a portfolio of activities addressing usage and skills development in the field of supercomputing.

Malta is a signatory of the Joint declaration on Building the next generation cloud for businesses and the public sector in the EU⁴⁵⁰ and is a member of the European Blockchain Partnership (EBP). The EBP supports cooperation among Member States and other countries to establish a European Blockchain Services Infrastructure (EBSI) that will support the delivery of highly secure cross-border digital public services⁴⁵¹.

Regarding advanced technologies, a study conducted by Tech.mt during 2021 investigated perceptions of local firms around the Internet of Things (IoT), covering areas such as sectoral relevance, willingness to invest, barriers and challenges, and effectiveness for business operations. This study is intended to support the formulation of Malta's national objectives for the adoption of emerging technologies such as IoT among the business community, and it will be followed by an awareness and educational programme.

It is important that Malta continues its initiatives to boost the digital transformation of the economy, focusing on the widespread adoption of digital technologies by SMEs. In line with the strategies launched in the recent years, it is also important that Malta develops its positioning on advanced

⁴⁴⁶ 'The Ultimate AI Launchpad - A Strategy and Vision for Artificial Intelligence in Malta 2030', https://malta.ai/wp-content/uploads/2019/11/Malta The Ultimate AI Launchpad vFinal.pdf.

⁴⁴⁷ <u>https://mita.gov.mt/en/DigitalOutReach/Pages/lab.aspx</u>.

⁴⁴⁸ https://mih.mt/.

⁴⁴⁹ Malta eBusiness Awards - Malta's Official Tech Awards.

⁴⁵⁰ <u>https://digital-strategy.ec.europa.eu/en/news/towards-next-generation-cloud-europe.</u>

⁴⁵¹ <u>European countries join Blockchain Partnership | Shaping Europe's digital future (europa.eu)</u>.

digital technologies, such as blockchain and AI, and effectively deploys them across the public administration and economic sectors to help boost the country's innovation capacity.

Integration of digital technology in Malta's Recovery and Resilience Plan

The plan addresses digitalisation of businesses by establishing support schemes (for a total of EUR 15 million) to help enterprises in different economic sectors go digital, including wholesale and retail, tourism and culture, and manufacturing.

In the tourism sector, the scheme is intended to support the digitalisation of logistics but also explore the use of analytical tools and AI to design, adapt and personalise Maltese tourism services and optimise the customer experience.

In manufacturing, investments are expected to support the transformation of operations and the transition to Industry 4.0, by optimising the use of existing technologies and exploiting emerging technologies and trends such as digital twinning or predictive maintenance.

The schemes might also support the uptake of technologies such as Internet of Things (IoT), cybersecurity and data protection, augmented reality and artificial intelligence.

The measure is addressed primarily to SMEs, including micro-enterprises and the selfemployed.

Moreover, a reform included in the plan is related to establishing a new Smart Specialisation Strategy. One of the smart specialisation areas identified is that of "Future Digital Technologies". Developments in this area will also act as an enabler of innovation in all thematic areas. Measures will focus on issues like raising awareness of funding schemes and providing guidance to potential beneficiaries about building closer public-private cooperation and bringing research results to market.

4 Digital public	Malta		EU	
services	rank	score	score	
DESI 2021	4	84.2	68.1	
DESI 2021	rank 4	score 84.2	score 68.1	



	Malta			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	57%	58%	63%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	97	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	100	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	95	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	47%	78%
% maximum score			2020	2020

Malta ranks 4th in the EU on Digital public services. The country continues to be a leader in providing government services to the public. It ranks very high in its offering of public services for citizens and it scores well above average in the re-use of information across administrations to make life easier for people (pre-filled forms).

The country also scores above the EU average on online public services for businesses (with a score of 95 in Malta versus 84 in the EU). The share of e-Government users increased from 58% in 2019 to 63% in 2020, almost reaching the EU average. Regarding open data, however, Malta still lags behind the EU.

Malta has been implementing various initiatives to improve existing digital public services or create new ones and boost uptake among citizens. The 'Mapping Tomorrow'⁴⁵² plan defined the strategic framework for the digital transformation of public administration in 2019-21. The plan focuses especially on delivering improved, simplified and client-centred e-government services. Building on this plan and taking into account the ongoing review of the National Digital Strategy, Malta is developing a new Public Administration Strategy for 2022-27.

Currently, all digital public services are accessible through the portal of the 'Servizz.gov' Agency, which represents the government's one-stop-shop for citizens and businesses⁴⁵³. It provides access to services aggregated under 12 categories (e.g. tax and finance, education, transport, health), as well as the possibility to report excessive bureaucracy through an online form.

Malta has promoted internal sharing and re-use of data and information within ministries, thus providing more efficient processes, benefiting both citizens, organisations and public administration. In addition to facilitating data sharing across ministries, the Maltese Government is addressing open

 ⁴⁵² Mapping Tomorrow, A Strategic Plan for the Digital Transformation of the Public Administration 2019-2021 (<u>https://publicservicecms.gov.mt/en/Documents/MappingTomorrow_StrategicPlan2019.pdf</u>).
⁴⁵³ www.servizz.gov.mt.

data issues by making it easier to access public sector information. The National Data Portal gives access to government data in the fields of education, police and taxation⁴⁵⁴.

Regarding e-health and telemedicine, in 2020, the department of Health launched the introduction of online consultations using video-conferencing tools, to reduce the number of people going to primary healthcare centres and hospitals. The myHealth portal⁴⁵⁵ is the main tool, an interactive website that allows Maltese citizens and their doctors to access their medical records through their Maltese e-ID.

Malta should continue its efforts to boost provision and uptake of digital public services, linking egovernment strategies with the plans to deploy advanced technologies across the public and private sector.

Digital public services in Malta's Recovery and Resilience Plan

The Maltese plan places a strong focus on the digitalisation of the public administration and public services. These investments are framed in the context of the upcoming Public Administration Strategy (2022-2027) and the overarching National Digital Strategy 2021-2027. Investment worth EUR 37.7 million aim to support the following three measures:

- Reinforcing the government's digital backbone, i.e. investments in digital services and infrastructure (including, for example, data centres and cloud services) which are expected to improve service delivery, increase interoperability across public administrations and enable the implementation of the "once-only principle". The investments also cover tools and infrastructure for cybersecurity, which aims to support the work of a Security Operations Centre (SOC).
- Digitising the Merchant Shipping Directorate within Transport Malta, to boost the efficiency of regulatory practices and improve internal operations and customer relations. The measure also covers the upskilling of public officers.
- Improving digital public services, including reengineering services which are manual, paper-based or hosted on non-responsive legacy platforms; setting up registers for data sharing and reuse purposes (targeting, in particular, the processes for the clearance of goods and property transfer); and improving customer care through physical and online hubs. The investment will also provide laptops and virtual desktops for remote work by public officers.

The plan also addresses digitalisation in the healthcare system (EUR 15.5 million) by supporting the digitalisation of outpatient and consumer engagement processes, to improve resource utilisation, quality of patient care and patient experience and reduce waiting times.

Finally, EUR 10 million are devoted to digitising Malta's justice system. The plan envisages implementing digital solutions and tools to foster collaboration and integration across the justice system, increasing accessibility and efficiency. The investment supports the establishment of an integrated e-filing system, or the use of e-ID authentication in public-facing solutions, allowing single-sign-on for various services. The regional hubs operated by the National Agency responsible for Public Services (servizz.gov) are expected to help less digitally literate users access services online.

⁴⁵⁴ https://open.data.gov.mt/.

⁴⁵⁵ https://myhealth-ng.gov.mt/.



The Netherlands

	Neth	EU	
	rank	score	score
DESI 2021	4	65.1	50.7



Digital Economy and Society Index (DESI) 2021 ranking

The Netherlands ranks 4th out of 27 EU Member States in the 2021 edition of the DESI. Therefore, it remains one of the top performers across Europe, with a widespread uptake of digital technologies among enterprises and use of online services, as well as high levels of basic and advanced digital skills.

The Dutch Digitalisation strategy, first adopted in 2018, and updated in 2019, 2020 and 2021⁴⁵⁶, remains a solid political and strategic foundation for the country's digital ambitions: (1) 'Be in the vanguard and grasp opportunities'; (2) 'Everyone joins in and we work together'; and (3) 'Trust in the digital future'.

Over the years, the Netherlands has increasingly prioritised and focused its efforts. Current priorities of the strategy are: (i) artificial intelligence (AI), (ii) better and responsible use of data, (iii) digital government, (iv) digital connectivity, (v) digital security and resilience, and (vi) digital skills and inclusion. The European and international aspects are integral parts of the strategy and new topics such as sustainability are gaining momentum. Finally, to prepare the public for future developments, the Netherlands has launched a foresight report 'Digitalisation 2030', which includes major economic, technological and societal trends that impact the digital transition and vice versa⁴⁵⁷.

The country made significant steps in 2020 to upscale and better coordinate existing projects and initiatives to foster human capital, and to improve basic and advanced digital skills for the whole population. Although the proportion of ICT specialists in the workforce is above EU average, the

⁴⁵⁶ The latest review of the Dutch digitalisation strategy is included in the letter from State Secretary Keijzer to the Dutch Parliament of 26 April 2021 (also available in English).

⁴⁵⁷ <u>https://www.rijksoverheid.nl/documenten/kamerstukken/2021/04/26/toekomstverkenning-digitalisering-</u> 2030

DESI

2021

EU

share of ICT graduates is the fifth lowest in the EU. Increased attention needs to be placed on current and future shortages of digitally skilled professionals (e.g. in AI, data and cybersecurity) and on bridging the gender gap.

The Netherlands is among the top performers in connectivity, ranking 2nd in the EU. There were marked improvements in 5G coverage, but the overall 5G readiness is still below EU average and needs continued attention, as do the broadband prices in the country that are consistently higher than the EU average.

The Netherlands ranks 5th in the EU for Integration of digital technology. 75% of Dutch small and medium-sized enterprises (SMEs) have at least basic levels of digital intensity, the fourth highest score in the EU. The corresponding figure for large enterprises is 95%. Compared with last year, the percentage of enterprises using big data and cloud technologies has slightly increased. The percentage of enterprises using AI technologies is slightly below the EU average. The adoption of the National Growth Fund is a welcome development. It is worth EUR 20 billion and is reserved for infrastructure, innovation, and R&D, including sizeable portions allocated to AI, health data infrastructure, digital education technology and quantum technology.

The Netherlands is one of the EU countries which, overall, performs better in terms of digital public services, ranking 8th in the EU. Care should be taken to ensure that local and regional digital public services are interoperable and well aligned within the country. National strategies towards digital public services should also remain in line with the EU approach.

It is important that the Netherlands remains ambitious in its digital transformation, benchmarking itself with the other leading countries in digitalisation. As a country whose economy and society are strongly dependent on open trade and mutually beneficial cooperation with European partners, the Netherlands would benefit from a clearer strategy on its EU-wide engagement on digital investments and reforms, particularly on possible interfacing with the Next Generation EU fund and the Recovery and Resilience Facility.



1 Human capital

1 Human canital	Neth	erlands	EU
i numan capitai	rank	score	score
DESI 2021	3	61.5	47.1



	Netherlands			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	79%	79%	79%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	48%	50%	50%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	80%	80%	80%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	5.3%	5.6%	5.9%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	16%	17%	18%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	26%	NA	24%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	2.5%	2.8%	3.1%	3.9%
% graduates	2017	2018	2019	2019

In the human capital dimension, the Netherlands ranks 3rd out of 27 EU countries. Basic and above basic digital skills levels remain fairly stable and well above the EU average. The proportion of ICT specialists in the workforce is also above the EU average. However, the proportion of female ICT specialists (out of the total number of ICT specialists) while increasing slowly over recent years, is slightly below the EU average. The share of ICT graduates is the fifth lowest in the EU. 24% of enterprises provide training for their staff to develop their ICT skills.

The importance of equipping everyone with the right skills and competences to take full advantage of the opportunities that digitalisation brings for economic growth and for tackling societal challenges was one of the key principles underlying the Digitalisation strategy, adopted in 2018. This approach was confirmed and strengthened in a review of the strategy, finalised in summer 2019. The main focus is on lifelong learning, although this comes with significant challenges and requires strong cooperation across the public and private sector, and in general between all stakeholders. In 2019, the Human capital agenda – the 2015 action plan to meet the growing demand for ICT professionals – focused on helping educational institutions make adjustments to the curriculum due to the emergence of new technologies⁴⁵⁸.

In 2020 and 2021, partially in response to the effects of the COVID-19 pandemic, several Dutch stakeholders worked on a plan to scale up several existing regional and local initiatives (including

⁴⁵⁸ Source: Dutch Digital Delta, <u>https://dutchdigitaldelta.nl/hca-ict</u>

Make IT Work⁴⁵⁹, a model project identified by the European Commission and the Digital Champions in 2018) to strengthen basic and advanced digital skills across the whole population.

A large number of companies report the shortfall in digitally skilled professionals (e.g. in AI, data and cybersecurity) as a serious threat to their growth. 71.3% of companies recruiting or trying to recruit ICT professionals reported difficulties in doing so in 2020. Therefore, short-term, flexible retraining arrangements that ensure a well-functioning lifelong learning and development environment are needed.

Furthermore, in 2020, Dutch stakeholders recognised that teachers did not yet have the full range of skills to effectively use digital tools and equip students with digital literacy. This challenge can be addressed through (i) public contributions to training costs, by giving teachers time to professionalise without increasing their workload, and (ii) targeted use of new ICT/digital learning tools in everyday teaching practices. These efforts could be integrated with national Code Week activities, which in the Netherlands were only marginally conducted in or with schools in 2020 (about 43% of the 155 recorded activities).

The Platform for the Information Society (ECP) works closely with partners in public authorities across different ministries as well as with industry, teachers, researchers and non-governmental organisations to advance this agenda. It coordinates the Dutch National Coalition for Digital Skills, which has already launched and supported a number of relevant projects⁴⁶⁰.

In 2020, despite the pandemic, 155 Code Week activities were organised in the Netherlands, of which 43% took place in schools. A total of 4 500 participants took part of which nearly half (48%) were female.

To further develop digital education, the National Education Lab is a new initiative to promote educational innovation projects that bridge the gap between fundamental scientific research and the market. With the Education Lab, public and private parties work together on AI-based educational innovation projects. The initiative recently received a grant of EUR 80 million from the National Growth Fund⁴⁶¹.

It is important that the Netherlands continue its efforts to upscale and better coordinate ongoing initiatives, paying particular attention to current and future labour market mismatches for ICT specialists.

 ⁴⁵⁹ <u>https://ec.europa.eu/digital-single-market/en/digital-skills-initiatives/make-it-work</u>
⁴⁶⁰ <u>https://digital-strategy.ec.europa.eu/en/policies/national-coalitions</u>

⁴⁶¹ <u>https://www.nationaalgroeifonds.nl/documenten/rapporten/2021/04/09/adviesrapport-eerste-</u> beoordelingsronde-commissie-nationaal-groeifonds

2 Connectivity

Netherlands		EU
rank	score	score
2	68.4	50.2
	Nethe rank 2	Netherlands rank score 2 68.4



	Netherlands			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	97%	98%	90%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	39%	42%	41%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	<0.01%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	98%	98%	98%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	32%	89%	90%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	99.4%	99.4%	99.5%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	0%	33%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	80%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	84%	88%	88%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	56	61	69
Score (0-100)		2019	2020	2020

The Netherlands is one of the top performers in Connectivity, ranking 2nd among EU Member States. One of its main strengths is that it has a highly developed fixed and mobile broadband market. The country is well on its way to achieving the Gigabit Society goals⁴⁶² and has just achieved the EU 2020 targets, with nearly all households covered by fixed networks capable of providing services of 30 Mbps (98%), even in rural areas (97%) and near-complete 4G coverage of households. It has the second highest 5G coverage of households at EU level (80%), including 30% of rural households. VHCN coverage has increased considerably over the past 2 years, reaching 90% of households in 2020 (59% at EU level). This is mainly thanks to the upgrade of cable networks to DOCSIS 3.1 (79% of nationally, 60% in rural areas) in 2019, while coverage with fibre to the premises is slowly increasing (36% nationally, 27% in rural areas). In terms of fixed broadband take-up, despite decreasing from 98% in 2019 to 90% in 2020 it is still above the EU average (77%). Despite the wide availability of VHCN, there is practically no take-up of gigabit speeds and the take-up of speeds of at least 100 Mbps stands at 41% of households (34% at EU level). 88% of individuals subscribe to mobile

⁴⁶² <u>https://digital-strategy.ec.europa.eu/en/library/connectivity-european-gigabit-society-brochure#:~:text=The%20objective%20is%20to%20ensure,all%20urban%20and%20rural%20areas</u>

broadband. Although the broadband prices in the Netherlands have slightly decreased (price index score 61) compared to 2019 (score 56), they are consistently higher than the EU average.

With the increase in fibre roll-out, the Authority for Consumers and Markets (ACM) expects that around 99.5% of households will have access to at least 100 Mbps in 2023. T-Mobile announced investments of at least EUR 700 million in fibre roll-out, aiming to reach 1 million households within 5 years. KPN announced fibre roll-out to 80% of all households in 2026 as part of its strategy to modernise the networks. These developments, in addition to the upgrade to DOCSIS 3.1, with VodafoneZiggo expecting to reach 2 million households additionally, will ensure access to gigabit speeds throughout almost the entire country. An investment gap has been identified only for the remaining 0.5%, representing the most remote addresses in rural areas. The Ministry of Economic Affairs is looking into making public funding available to reach, at a minimum, the 20,000 households in the most remote locations, with VHCN.

The Netherlands made significant improvements in 2020 regarding its goal to be the European leader in 5G, but it still stands at only 33% 5G readiness. A multiband spectrum auction (700, 1400, 2100 MHz) was concluded on 21 July 2020, with all of the available spectrum being assigned. The 700 MHz band licences are accompanied by coverage obligations. By 28 July 2022, licence holders are obliged to cover 98% of the geographical area of all municipalities in the Netherlands. That coverage should ensure that all users can, at any time, access a service that provides them with at least 8 Mbps with a 90% probability. This speed requirement will increase to 10 Mbps by 28 July 2026. To achieve these obligations, licence holders can use any of their available frequencies in other bands. VodafoneZiggo has yet to roll out its 5G network on the 700 MHz band. However, it was the first operator in the Netherlands to provide 5G services via its existing antennas and Dynamic Spectrum Sharing (DSS) technology which makes it possible to dynamically allocate existing 4G LTE spectrum to 5G. With the upcoming auction of the 5G spectrum, the 3.6 GHz band, operators are likely to increase the deployment of 5G networks. The auction of part of this band is expected to start only in Q2 2022, enabling the use of 300 MHz of the band from September 2022. The auction has been delayed because part of the band has been used by Dutch military intelligence agencies and another part of it is currently used for satellite communications. The Rotterdam District Court recently ruled in favour of the current licence holder, Inmarsat, in a dispute over the use of the band, ordering the government to suspend its plans to use this part of the band for 5G.

The Netherlands auctioned the 700 MHz for use in its part of the North Sea ('Economic Exclusive Zone') separately from the multiband frequency auction mentioned above. Four operators took part in the auction. The winners were T-Mobile (2x10 MHz) and Tampnet (2x20 MHz). They paid a combined total of EUR 975,000⁴⁶³. Tampnet already provides 4G coverage in a large part of the area that the Netherlands controls in the North Sea⁴⁶⁴. The 26 GHz band award has also been delayed despite being prepared for the last year. A market consultation was held in March 2020 but the consultation regarding award procedures has been delayed. In September 2020, the National Health Council advised⁴⁶⁵ against awarding these millimetre wave frequencies due to a lack of knowledge about potential health implications⁴⁶⁶.

⁴⁶³ <u>https://www.agentschaptelecom.nl/onderwerpen/veilingen/verdeling-op-afroep-700-mhz-vergunningen-noordzee</u>

⁴⁶⁴ <u>https://www.tampnet.com/coverage-maps</u>

⁴⁶⁵ <u>https://www.healthcouncil.nl/documents/advisory-reports/2020/09/02/5g-and-health</u>

⁴⁶⁶ In June 2021, a Dutch Court of appeals dismissed a civil law case filed against the government by a 5G opposition movement which claimed that 5G technology poses potential health risks.

Main market & regulatory developments

The market shares of the mobile operators remained stable, with KPN and T-Mobile holding between 25-30% each and VodafoneZiggo 20-25%. ACM approved T-Mobile's acquisition of the mobile virtual network operator Simpel. 2G and 3G networks will be gradually decommissioned – KPN plans to switch off 3G in 2022 and Vodafone has already switched of 3G but maintains 2G for now because of a large user base of connected devices (IoT and M2M) that are only 2G enabled. T-Mobile had planned to switch off the 2G network by June 2021.

The trend on the mobile market is subscriptions with larger data volumes and increased wi-fi offloading. On the fixed market, users mostly buy bundled products, typically with TV-services.

The market share on the fixed market also remained stable, with the two major providers KPN and VodafoneZiggo holding 40-45% and 45-50% respectively. After a stagnation in the past 3 years, the Dutch market has recently seen an increase of new entrants deploying fibre. KPN, responded to the market change and in some cases acquired the early entrants. On a highly saturated broadband market, there are, according to ACM, only a few network operators left that are deploying fibre next to KPN. According to ACM, in urban areas there are signs of potential strategic overbuilding, while there is little commercial interest in exploring the possibilities of voluntary co-investments.

The highest administrative court annulled ACM's decision on markets for wholesale local access provided at a fixed location and wholesale central access provided at a fixed location for massmarket products (markets 3a and 3b of the EU's 2014 Recommendation⁴⁶⁷, respectively). ACM had established joint dominance by KPN and VodafoneZiggo, and imposed access and tariff obligations on both. The Court annulled the market review decision on the ground that ACM did not meet the burden of proof as regards the retail market not being competitive. Following the ruling, KPN has maintained its existing agreements with wholesale operators, while VodafoneZiggo ceased all fixed wholesale offers on its coaxial network.

On 4 February 2021, the Commission addressed a letter of formal notice for failure to notify to it complete transposition measures for the European Electronic Communications Code. The Netherlands plans to completely transpose the Code into its law and enter into force the relevant national legislative act in December 2021.

Various efforts have been made to coordinate between local and national governments regarding permit granting procedures. Next to information and knowledge sharing, the Ministry of Economic Affairs and Climate Policy created a taskforce of national and local authorities, to develop a uniform approach to permit-granting procedures for antennas and access to physical infrastructure for small cells. These efforts are part of the Dutch roadmap under the EU's Connectivity Toolbox⁴⁶⁸. In its roadmap, the Netherlands also announced that, overall, there has been improved coordination between central and local authorities, as well as more efficient digital handling of permits. It also introduced the possibility to establish broadband coordinators and develop guidelines on fees.

Emergency-SMS can be used as a means of access to emergency communications. It enables the advanced mobile location of whoever is sending the emergency SMS to be obtained. This provides end-users with disabilities with an additional means to access the 112 single emergency number. An emergency application, the 112 NL-app, is expected to be tested for launch before the end of 2021.

⁴⁶⁷ <u>https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32014H0710</u>

⁴⁶⁸ <u>https://digital-strategy.ec.europa.eu/en/policies/connectivity-toolbox</u>

In 2020, ACM registered a lower number of consumer complaints (2 110) compared to 2019 (2 400). The number of questions or complaints per category has been stable, except for bundled services, which account for almost half of all complaints (increasing from 924 in 2019 to 1114 in 2020).

ACM noted problems with quality of service in roaming where the roaming provider (home operator) blocks access to 4G roaming, only enabling 3G access or limiting the available data speed on certain visited networks. ACM did not take any formal steps due to lack of legal clarity regarding quality of roaming services.

With the launch of 5G services in July 2020, KPN introduced a specialised service called <u>Application Priority</u> for business customers. This prioritises the delivery of mobile data of certain services in the public interest, such as secure payment transactions and traffic control by emergency services (e.g. turning traffic lights green).

ACM published <u>guidelines</u> to inform consumers about the misuse of forwarding services. Consumers have been charged high rates for unwittingly calling forwarding services acting as an intermediary.

The Netherlands has high-quality infrastructure with several fixed electronic communications networks (copper, cable and fibre) and three mobile network providers. With the transition towards fibre deployment in the Netherlands, there has been uncertainty on the market after the annulment of the decision on markets for wholesale local access provided at a fixed location and wholesale central access provided at a fixed location for mass-market products. Despite broadband prices falling in 2020, the uptake of higher Mbps and gigabit speeds has not increased. Public policy initiatives could boost the efficient use of the advanced broadband technologies by promoting uptake. Significant 5G developments have been made with the award of the 700 MHz band as well as with 5G deployment in the last year. However, the delay in assigning the 3.6 GHz band is an obstacle to 5G deployment.

3 Integration of digital technology

3 Integration of	Neth	EU		
digital technology	rank score		score	
DESI 2021	5	50.7	37.6	



	Netherlands			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	75%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	48%	48%	48%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	39%	37%	37%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	22%	22%	27%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	42%	42%	47%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	24%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	64%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	22%	22%	26%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	17%	21%	19%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	10%	12%	13%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	11%	13%	13%	8%
% SMEs	2017	2019	2019	2019

On integrating digital technology into businesses' activities, the Netherlands ranks 5th among EU countries. 75% of SMEs have at least basic levels of digital intensity, recording the fourth highest score in the EU. The corresponding figure for large enterprises is 95%. Compared with last year, the percentage of enterprises using big data and cloud technologies has slightly increased. Dutch enterprises are the second largest users of big data in the EU. In 2020, the percentage of SMEs selling online fell slightly from the previous year, but the e-commerce turnover increased. This is probably linked to the effects of the pandemic. Cross-border sales remained stable. The percentage of enterprises using AI technologies is below the EU average, despite the past investments and push from Dutch stakeholders underlining the importance of advanced digital technologies for economic and societal growth. Dutch businesses also lag behind in using ICT to trigger green actions.

The adoption of the National Growth Fund, with its EUR 20 billion reserved for infrastructure, innovation, and R&D, including sizeable portions allocated to AI, health data infrastructure, and quantum technology,⁴⁶⁹ is a clear sign that Dutch stakeholders prioritise digitalisation.

The Netherlands is committed to advancing new digital technologies and to investing strategically in digital technologies thanks to joint initiatives with the EU. The country is a member of the European High-Performance Computing Joint Undertaking and has signed the Declaration on Cooperation Framework on High-Performance Computing. It has also signed EU declarations on the European Blockchain Partnership, Cooperation on AI, and Quantum Computing Infrastructure.

Furthermore, the Netherlands is a signatory to the declaration on the European Cloud Alliance. In signing this, it agreed to: (i) focus on combining private, national and EU investment in deploying competitive, green and secure cloud infrastructure and services; (ii) set out a common European approach on joining up cloud capacities, by working towards one set of joint technical solutions and policy norms in order to foster interoperable EU cloud services; and (iii) drive the take-up of more secure, interoperable and energy-efficient data centres and cloud services, in particular, for SMEs, start-ups and the public sector.

The Dutch government also takes part in the public-private partnership 'Smart Industry' to help implement digital technologies. Field laboratories, or 'Fieldlabs', play an important role in this context by helping organisations with digitalisation by providing new digital innovations. The current infrastructure contains 47 fieldlabs that help develop, test and implement new technologies. This is a collaboration involving companies, research centres and other relevant stakeholders.

The Netherlands continues to invest in the use of digital technologies by businesses across sectors, which is a welcome confirmation of the country's strategic approach to digitalisation.

Highlight 2020-2021: the National Growth Fund

The National Growth Fund⁴⁷⁰ (*Nationaal Groeifonds*) is a government initiative, co-managed by the Ministry of Economic Affairs and Climate, and the Ministry of Finance. It aims to invest EUR 20 billion over the coming 5 years, in three areas where most of the opportunities for structural and sustainable economic growth exist: (1) knowledge development; (2) research, development and innovation; (3) infrastructure. An independent committee has been set up to assess project proposals and provide advice, but ultimately it is the government that decides on which projects to fund.

The philosophy underlying the National Growth Fund is as simple as politically ambitious: the recognition that while prosperity might seem obvious (especially in a country such as the Netherlands and in the EU when compared to other parts of the world) it is not. Therefore, public investments, jointly with private investors, in key strategic projects are essential.

Within the Fund, EUR 1.35 billion will be allocated to projects related to AI, health data infrastructure, educational innovation and quantum technology.

⁴⁶⁹ See <u>https://www.government.nl/latest/news/2021/04/21/innovative-projects-given-additional-</u> %E2%82%AC1.35-billion-boost-due-to-funding-from-national-growth-fund

⁴⁷⁰ <u>https://www.nationaalgroeifonds.nl/documenten/rapporten/2021/04/09/adviesrapport-eerste-beoordelingsronde-commissie-nationaal-groeifonds</u>

4 Digital public	Netherlands		EU	
services	rank	score	score	
DESI 2021	8	79.9	68.1	



	Netherlands			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	86%	84%	91%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	81	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	86	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	83	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	85%	78%
% maximum score			2020	2020

As regards Digital public services, the Netherlands ranks 8th among EU countries, above the EU average. It performs well across the board. 91% of internet users use digital public services, up 7 percentage points from last year's DESI, putting the Netherlands just after Denmark and Finland. 86% of administrative steps can be done online for major life events such as registering child births and new residences. However, when it comes to the share of online public services needed for starting and running a business, the Netherlands lags behind and is just under the EU average. For open data, the Netherlands ranks within the middle group of countries, but above the EU average.

Already in 2018, the Dutch Digitalisation strategy had put the goal of a transparent and accessible egovernment squarely at the centre of the country's priorities and ambitions were further developed in the value based digital government agenda NL DIGIbeter. This agenda followed up on an assessment recognising that work was needed to ensure there is sound, future-proof, basic digital infrastructure and to improve the skills of public sector workers. In addition, in December 2018 a new inclusion agenda was introduced, aimed at (i) making services user-friendly and accessible, for everyone, (ii) helping people to go digital and (iii) increasing digital skills and awareness.

In 2020, partially in response to the effects of the COVID-19 pandemic, the digital government agenda was updated to include the aim of ensuring that everyone can participate digitally in society. The "#allemaaldigitaal" campaign, a joint public-private initiative coordinated by the Digital Society, NL Digital and SIVON alliance, gave thousands of people access to a refurbished laptop. A helpline was opened to help people experiencing problems when using their laptop or tablet. With support from the Kids' Council, older people receive help in achieving greater digital contact, as a means of tackling social isolation⁴⁷¹.

⁴⁷¹ Source: <u>https://www.nldigitalgovernment.nl/digital-government-agenda/</u>

Furthermore, in April 2020 the Dutch government adopted the proposal for the revised government data agenda, to review and update the first version that was launched in March 2019. The underlying philosophy, i.e. using a data-driven approach to make policy development more effective and increase transparency for the public, remains unchaged. However, there is now a stronger focus on the legal and ethical frameworks, in particular ensuring algorithms used to take decisions that significantly affect people are transparent and can be easily explained⁴⁷². This is a welcome development.

Although it was already set up in 2017, the importance of the RADIO initiative (the Governmental Academy for Digitalisation and Computerisation of the Government) was particularly apparent in 2020. It aims to give civil servants the proper skills so digitalisation and digital technologies become a normal part of their job. Relevant training can also take the form of webinars, e-learning or blended learning.

In conclusion, the Netherlands is one of the countries that, overall, performs better than others in terms of the widespread use of online services, with a good level of back- and front-office digitalisation⁴⁷³. It is important that local and regional digital public services are interoperable and well aligned within the country, and that the national strategies that advance digital public services remain in line with the EU approach.

⁴⁷² Source: <u>https://www.nldigitalgovernment.nl/overview/new-technologies-data-and-ethics/data-agenda-government/focusing-on-legislation-and-public-values/</u>

⁴⁷³ Source: <u>https://digital-strategy.ec.europa.eu/en/library/egovernment-benchmark-2020-egovernment-</u> works-people





Poland ranks 24th of 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI).

During 2020, Poland made progress in many indicators, but given the equally positive developments in other countries this has not translated into a change in its overall position. There are still persistent significant gaps as regards human capital, where Poland ranks 24th, scoring below average on most of the indicators. Although the country has reached the EU average in the percentage of ICT graduates among total graduates, the shortage of specialists is significantly affecting businesses' integration of digital technology, preventing enterprises, in particular SMEs, from tapping the full potential offered by the digital economy.

The COVID-19 pandemic had a major impact on the education system, with Poland having to make a sudden switch from stationary to remote learning. This increased the demand from pupils and teachers for equipment, software and digital skills dedicated to remote learning and teaching. Also, many digital tools and e-learning platforms had to be modernised fast. Many funding projects were subsequently launched to fulfil the demand and assist all those involved in the transition.

On connectivity, progress continued in 2020 for fixed broadband take-up and there was an increase in the percentage of households covered by Fixed Very High Capacity Networks – 64.6%, compared to 60.3% in 2019. Nevertheless, efforts are still needed on connectivity, notably on legislation favourable to the development of robust connectivity, ensuring full transposition of the EU regulatory framework. Additionally, as Poland has not assigned any harmonised radio spectrum for 5G deployment, swift assignment will be necessary for the provision of 5G connectivity under transparent, open and non-discriminatory conditions.

Digital technologies kept on gaining popularity among Polish enterprises, with 15% using cloud solutions and 18% integrating some kind of AI technology in their operations. It is important to

continue efforts and capacity building among Polish enterprises to digitise further, innovate and create new services and products. Poland will be able to speed up its digital transformation through further incentives to invest, through dedicated support and encouragement (especially for businesses in disadvantaged regions) and by enhancing female digital entrepreneurship.

Finally, Poland's performance is offset by below-average scores in digital public services, where additional measures promoting the use of e-government services among businesses and citizens could further boost take-up and improve the county's overall score. Simplification efforts, measures to ensure interoperability and capacity building in the public administration are all-important complementary actions and emerging opportunities for Poland to drive digitalisation across the country. It is important to highlight that one particular Polish digital solution – the *m-Obywatel* digital wallet for documents and services – is currently one of the most developed case studies among European digital identity wallet solutions. Poland could play an even more proactive role in developing and implementing the European Digital Identity Framework.

Autumn 2020 saw a change in the government's organisational structure. As part of a broader government reorganisation, the Ministry of Digital Affairs was merged into the Chancellery of the Prime Minister, with the relevant departments continuing to provide leadership in the government in the digital domain. The pandemic increased the demand for digital public services. This was visible, for example, in the increased subscriptions to the 'Trusted Profile' (central authentication service). In turn, this demand prompted acceleration in the delivery of digital solutions planned many years before. Among the biggest, the Nationwide Education Network (OSE) supplying fast internet access to 23 500 primary and secondary schools in Poland was nearly concluded.





1 Human capital

1 Human canital	Ро	land	EU
1 Human capital	rank	score	score
DESI 2021	24	37.7	47.1



	Poland			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	46%	44%	44%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	21%	21%	21%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	49%	46%	46%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	3.0%	3.1%	3.4%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	14%	14%	15%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	13%	13%	18%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	3.5%	3.8%	3.8%	3.9%
% graduates	2017	2018	2019	2019

On Human capital, Poland ranks 24th of 27 EU countries and is thus below the EU average. Levels of digital skills remain low compared to the EU average, with only 44% of people between 16 and 74 years having at least basic digital skills (EU 56%) and only one in five (21%) have above-basic digital skills. On at least basic software skills, Poland scores only 46%, significantly below the EU average of 58%. ICT specialists and female ICT specialists account for a lower percentage of the workforce in Poland than the EU average. Conversely, ICT graduates currently account for 3.8% of all graduates in Poland. Nevertheless, Polish enterprises are investing in ICT training and last year 18% of them offered specialised ICT training to their employees.

The COVID-19 pandemic had a very strong impact on the development of digital skills. The switch to remote learning increased the demand for additional equipment and called for development or modernisation of digital platforms, as well as for training in digital skills. From April 2020 onwards, under the Operational Programme Digital Poland for 2014-2020, co-funded by the European Regional Development Fund (ERDF), the Ministry of Education and Science, and the Digital Poland Project Centre government agency offered local government funding, around EUR 81 milion through Remote School projects (*Zdalna Szkoła, Zdalna Szkoła+*), to buy equipment for students and teachers for distance learning (computers, laptops or tablets). Local authorities could also buy software, hardware, mobile internet access or other accessories needed for distance learning. Many other
funding projects were subsequently launched to fullfil these new needs. An example of such a project is the Active Blackboard (*Aktywna Tablica*⁴⁷⁴).

Irrespective of the pandemic, the Operational Programme Digital Poland for 2014-2020, co-funded by the European Regional Development Fund, was in the final stages of implementation, delivering solutions planned many years before. Among the biggest, the Nationwide Education Network providing fast internet access to 23,500 primary and secondary schools in Poland was nearly concluded.

Building on the experience and results of the previous financial planning period, Poland held a consultation on the programmes for the next financial period (2021–2027). As in the previous years, the national Coalition for Digital Skills and Jobs⁴⁷⁵ assisted in coordinating opinions from, and actions undertaken by the public society to support digital skills, upskilling and reskilling. However, the policy that it helped to craft, the Digital Competence Development Programme (*Program Rozwoju Kompetencji Cyfrowych*), has not been adopted by the government as a binding document.

Outside of the formal education system, EU Code Week turned out to be a major event for pupils. Thanks to broad involvement by schools, NGOs and other institutions, the number of participants in Poland (632,000) was the second highest among all countries participating, while the number of activities per citizen was the highest in Europe⁴⁷⁶.

2020 saw the launch of a significant project to foster advanced digital skills, the Academy of Innovative Applications of Digital Technologies (AI Tech)⁴⁷⁷. Its goal is to develop a model to educate high-class specialists in artificial intelligence, machine learning and cybersecurity. The project is being implemented in partnership between the Chancellery of the Prime Minister and a consortium of five universities⁴⁷⁸ that are well advanced in research in these field. The investment will not only open the door to professional careers for students, but will also intensify the competitiveness of the fastest growing sector of the economy.

Poland needs to enhance digital skills within and outside the education system. A participatory approach in the development of important policies involving, local and regional governments and civil society would be of particular value. It is vital to provide further support for local communities to adjust to the digital age challenges in order to tap the full potential offered by digital economy.

⁴⁷⁴ <u>https://www.gov.pl/web/edukacja-i-nauka/kolejne-srodki-na-zakup-sprzetu-do-szkol-w-ramach-</u> <u>rzadowego-programu-aktywna-tablica.</u>

⁴⁷⁵ <u>http://umiejetnoscicyfrowe.pl/.</u>

⁴⁷⁶ <u>https://digital-strategy.ec.europa.eu/en/news/eu-code-week-organisers-register-over-72000-activities-second-year-row.</u>

⁴⁷⁷ <u>https://www.gov.pl/web/govtech/akademia-innowacyjnych-zastosowan-technologii-cyfrowych-ai-tech.</u>

⁴⁷⁸ The consortium consist of Gdańsk University of Technology, Wrocław University of Science and Technology, Poznań University of Technology, University of Warsaw and Adam Mickiewicz University.

2 Connectivity

2 Connectivity	Ро	EU	
,	rank	score	score
DESI 2021	21	45.3	50.2



		Poland		
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	60%	62%	68%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	23%	28%	37%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	0.47%	1.10%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	67%	76%	76%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	29%	60%	65%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	>99.9%	99.9%	>99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	0%	0%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	10%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	47%	58%	58%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	81	88	69
Score (0-100)		2019	2020	2020

Poland ranks 21st in connectivity. In 2020, Poland observed an increase in the percentage of households covered by Fixed Very High Capacity Networks – 64.6% compared to 60.3% in 2019. The figure places the country above the EU average for this indicator (59.3%). Poland's total Fiber-to-the-Premises (FTTP) coverage also saw increase – 44.6% in 2020 compared to 38.3% in 2019. FTTP coverage in rural areas remains at a lower level – only 24.1% of rural households were covered by the technology in 2020 (only slightly below the EU average of 24.9%). However, this is an upward trend in comparison with 2019, when 17.9% of rural households had access to the technology.

On fixed broadband take-up, 68% of households subscribed to some kind of broadband connection in 2020, a small increase on the 2019 figure of 62% of households. Poland performs well on access to a fixed broadband connection of at least 100Mbps – 37% of Polish households used such a connection in 2020, above the EU average of 34% for the same indicator.

As for 5G coverage, 10.3% of households were covered by the technology in 2020, only slightly below the EU average of 13.8% for the same indicator. While 4G coverage stands at 99.9%, mobile broadband take-up (58%) lies significantly below the EU average (71%).

On public funding for infrastructure deployment (both fixed and wireless), the Polish authorities plan to continue the 'Digital Poland' Operational Programme in the period 2021-2027. The programme is funded through the EU cohesion funds and is used to provide support to projects implemented in areas where 'Next Generation Access' (NGA) networks do not exist and are unlikely to be established on a commercial basis in the next 3 years. Still under the previous financial programming period, the facility has so far funded investments in broadband networks expected to reach around 2 million households, mainly using the 'Fibre to the Home' (FTTH) technology.

Another source of public funding used to support investments in the deployment of NGA networks in Poland is the Broadband Fund, which began operation at the end of 2020. The Fund is financed through charges borne by telecommunications firms for numbering resources, rights to use radio spectrum, etc.

In its Roadmap implementing the Common Union Toolbox for Connectivity⁴⁷⁹, Poland identifies as desirable a range of reforms concerning e.g. digitisation of permit-granting procedures, issuing guidelines on access to physical infrastructure, and further strengthening the Single Information Point.

Poland has not assigned any harmonised radio spectrum for 5G deployment as of April 2021. Poland considers to establish a wholesale operator in the 700 MHz band and to create a Strategic Communications Operator, a state-owned entity that would provide telecommunications services to the public administration. At the time of drafting of this report, legislative work on the proposals was still ongoing in the executive branch.

The Polish government cancelled the 5G auction for the 3.6 GHz band in May 2020 due to the COVID pandemic. The move came about 6 weeks after the regulator initiated the procedure, offering four licences in the 3.6 GHz spectrum band with validity until 30 June 2035. A new auction proceeding is about to be finalised and submitted to public consultation.

A public consultation carried out between July and September 2020 showed that there was no demand for the 26 GHz band before 2022-2023 among Polish operators.

Main market & regulatory developments

In June 2020, P4 took control of Virgin Mobile Poland, a virtual mobile network operator and part of the Virgin international investment group. Virgin Mobile Poland will continue its activities within the Play Communications Group.

In the second half of 2020, Orange Poland started establishing a separate company (Światłowód Inwestycje) to build fibre infrastructure in poorly urbanised areas of Poland. Orange Poland intends to transfer in kind to Światłowód Inwestycje around 600,000 fibre lines (of which 150,000 are used for active services, including wholesale). It is understood that Światłowód Inwestycje will be a wholesale operator ensuring open access to its services for other operators.

⁴⁷⁹ Pursuant to Commission Recommendation (EU) 2020/1307 of 18 September 2020 on a common Union toolbox for reducing the cost of deploying very high capacity networks and ensuring timely and investment-friendly access to 5G radio spectrum, to foster connectivity in support of economic recovery from the COVID-19 crisis in the Union.

Poland did not transpose the European Electronic Communications Code (EECC) by the deadline of 21 December 2020 – it is one of the 24 Member States currently facing an infringement procedure for failure to transpose the Directive. The legislative work on the measures transposing the EECC is now expected to be finalised around November 2021.

On 13 November 2020, the Commission registered a notification from the Polish national regulatory authority, UKE, concerning wholesale high-quality access provided at a fixed location in Poland⁴⁸⁰. The content of the notified draft measures covered the analysis of the two separate product markets within the high-quality access market: high-quality access at a fixed location with capacity up to and including 2 Mbps, and a separate market above 2 Mbps. Regarding the former, UKE found that the competitive conditions in the market for leased lines below and including 2 Mbps indicate that the market is effectively competitive. As for the market above 2 Mbps, UKE maintained its conclusion from the previous market review that no operator has significant market power in the market for high-quality access provided at a fixed location above 2 Mbps. The Commission had examined the notification and had no comments.

Poland is currently facing another infringement procedure concerning the termination in May 2020 of the mandate of Marcin Cichy, the then President of UKE. The European Commission considers that the dismissal breached the EU law's safeguards protecting the independence of the national regulatory authorities.

While Poland has at its disposal a range of robust investment instruments, with the potential to advance the deployment of very high capacity networks in the country, it is important that the authorities ensure that legislation is favourable to the development of robust connectivity and that it fully transposes the current EU regulatory framework. A swift assignment of radio spectrum necessary for the provision of 5G connectivity under transparent, open and non-discriminatory conditions is also of crucial importance.

⁴⁸⁰ Corresponding to market 4 in Commission Recommendation 2014/710/EU of 9 October 2014 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services (Recommendation on Relevant Markets), OJ L 295, 11.10.2014, p. 79.

3 Integration of digital technology

3 Integration of	Ро	land	EU	
digital technology	rank score		score	
DESI 2021	24	25.9	37.6	



		Poland		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	52% 2020	60% 2020
3b1 Electronic information sharing	26%	29%	29%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	10%	14%	14%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	8%	8%	8%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	7%	7%	15%	26%
% enterprises	2018	2018	2020	2020
3b5 AI % enterprises	NA	NA	18% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	60% 2021	66% 2021
3b7 e-Invoices	16%	16%	13%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	12%	13%	13%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	NA	NA	NA	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	4%	5%	5%	8%
% SMEs	2017	2019	2019	2019

Poland ranks 24th among EU countries on the Integration of digital technology in businesses' activities. 52% of Polish SMEs have at least a basic level of digital intensity, which is below the EU average of 60%. As for ICT for environmental sustainability, Poland achieved a figure 60% of enterprises with medium/high intensity of green action through ICT, a value below the EU average of 66%. Polish enterprises slowly continued to take advantage of the opportunities offered by digital technologies engaging in online commerce, with 13% of SMEs selling online and 5% selling across borders to other EU countries. Advanced technologies are slowly gaining popularity among Polish enterprises, with 15% of them using cloud solutions and 18% integrating AI technology into their operations. Nevertheless, only 14% of Polish enterprises actively use social media, while 29% engage in electronic information sharing. e-Invoices and Big Data are not yet widely popular.

Poland invests in digital technologies through EU-coordinated programmes and is a member of the EuroHPC Joint Undertaking on high-performance computing. It participates in PRACE (Partnership for Advanced Computing in Europe) and the PIONIER-LAB National Platform for Integration of Research Infrastructures, and is an active member of the European Blockchain Partnership Policy Group.

In December 2020, the Council of Ministers adopted the Polish national AI strategy, entitled *Policy for the development of artificial intelligence in Poland from 2020*⁴⁸¹. It discusses AI developments in six areas: society, education, science, business, public affairs and international relations. The strategy defines the values to be observed and goals to be achieved through government action in various contexts. The overarching goal is to protect human dignity while supporting fair competition in the international relations as the use of AI is essential for the competitiveness of economies.

Cooperation between the public and the private sector on authentication continues, with some banks providing their customers with authentication services through the 'Trusted Profile' (*Profil Zaufany*), which makes it possible to log in to all online public services and securely sign official documents.

To continue boosting the digital transformation of the Polish economy, it is important to further develop governmental cloud services. Another area for further investment might be the introduction of electronic structured invoices to allow for the issuing, receiving and storing of structured invoices and to analyse and control data. Finally, Poland can speed up its digital transformation by giving further support to SMEs in their efforts to raise their uptake of advanced technologies and by encouraging start-up ecosystems, businesses in disadvantaged regions, and female digital entrepreneurs.

³²⁹

⁴⁸¹ https://monitorpolski.gov.pl/M2021000002301.pdf

4 Digital public	Ро	EU	
services	rank	score	score
DESI 2021	22	55.1	68.1



	Poland			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	45%	49%	49%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	65	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	65	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	67	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	90%	78%
% maximum score			2020	2020

Poland ranks 22th in Digital public services. 49% of internet users relied on e-government services, compared to 64% in the EU. On pre-filled forms, Poland scores slightly above the EU average (65 compared to 63). On the availability of digital online services, Poland is still below the EU average, 65 on digital public services for citizens (EU average: 75) and 67 for businesses (EU average: 84). Poland scores well on open data (90% compared to 78% for the EU).

The lockdown of the economy that followed the COVID-19 crisis turned out to be a boom for the use of e-government services. The main authentication service 'Trusted Profile' (*Profil Zaufany*) gained greatly in popularity. In 2020, over 4 millions profiles were set up, doubling the number of active profiles in comparison to 2019. A video-verification function was launched as one of the identity confirmation methods enabling to setup the temporary trusted profile. A user of the e-government services can use the Trusted Profile to perform online administrative tasks like registering a place of residence or sending a request for a maternity allowance. Its propularity is therefore an important proxy of the popularity of all e-government services⁴⁸².

The open data policy pursued by the Polish government is bearing fruit: there are more data available for re-use and an increasing number of companies are harnessing their potential. *Otwarte Dane*⁴⁸³, the national one-stop-shop portal for open data, gained significantly in popularity and received international recognition⁴⁸⁴ in 2020. In the 'Open Data Maturity 2020' ranking, which puts countries into one of four categories depending on their maturity in this field, Poland advanced from

⁴⁸² An example of growing popularity of services is the number of maritial status certificates issued, up from 53,000 in 2019 to 198,000 in 2020. Another popular service was parents' notification of the birth of children; the number of such notifications tripled from 45,000 in 2019 to 147,000 in 2020.

⁴⁸³ https://dane.gov.pl/.

⁴⁸⁴ https://data.europa.eu/sites/default/files/country-factsheet_poland_2020.pdf.

the third category (fast trackers) to the highest fourth category (trend setters). One of the best illustrations of the use of open data by the citizens was the *CzyNaCzas* application, which shows public transport buses and trams on the map in real time. During the health pandemic, another portal, *SwiatPrzychodni*, was widely used to search for public healthcare facilities with the shortest queues to doctors⁴⁸⁵. Building on these successes, the government is continuing to implement its 'Open Data Programme' prompting public bodies to increase the number of datasets available and making the administration use the standards that allow for the opening of data. In 2020, the specifications on national open data standards were updated after an evaluation and public consultation⁴⁸⁶, and the relevant institutions are putting them in use in everyday practice.

In the area of public healthcare, the immediate action in response to the pandemic was the extension of the e-health projects funded from the EU structural policy funds, and introduction of e-registration and basic telemedicine services to allow remote consultation and access to basic healthcare services. In addition, the government's Patient's Portal⁴⁸⁷ successfully introduced drug prescriptions in electronic form into the internet patient account (*Internetowe Konto Pacjenta*) that can be accessed on the *mObywatel* application (see box below). The patient account made it possible to get rid of the paper prescriptions in favour of electronic ones. This is a significant step ahead as for many years this solution met obstacles from doctors and patients alike. On one side, doctors were reluctant to submit to external control of their prescription. During the pandemic, these hindrances were overcome out of sheer necessity. Certain features of the portal (e.g. storing health histories or handling appointments) are not yet popular among users, but several improvements are planned to increase uptake. The Ministry of Digital Affairs has also implemented the sanitary inspection record system (*System Ewidencji Państwowej Inspekcji Sanitarnej*, SEPIS), which aims to automate and centralise the handling of quarantine and infection notifications.

The national Computer Security Incident Response Team recorded an increase in cyber-attacks and incidents – 2020 saw a 60% increase on 2019. In view of this growing threat to digital security, the challenge for Poland is to increase the resilience of public administration information systems and to improve public and private institutions' capacity to prevent and respond to incidents. In response to this challenge, the 2019-2024 Cybersecurity Strategy was actively implemented. The strategy includes both legislative and organisational changes, such as setting up operational cybersecurity centres at various levels – regional, sectoral and industrial.

In summary, e-services for the public and businesses that are more user-friendly and easier to access could lead the way to even more improvements in digital public administration. Additional measures to promote the use of e-government services among businesses and the public could further boost the take-up of these e-services.

Highlight 2020-2021: mDriver's licence in m-Citizen application

In 2017, the Ministry of Digital Affairs launched the *m-Obywatel* (m-Citizen) mobile application. The idea behind the project was to create an application that would act as a digital wallet to

⁴⁸⁵ <u>https://dane.gov.pl/pl/application/application-1250,swiatprzychodnipl</u>.

⁴⁸⁶ <u>https://dane.gov.pl/pl/article/article-1264,standardy-otwartosci-danych-po-konsultacjach-publicznych.</u>

⁴⁸⁷ https://pacjent.gov.pl/.

store documents that citizens used frequently in their everyday life, such as a driver's licence.

Freeing up drivers from the requirement to carry a physical driver's licence with them at all times has been in demanded for a long time. For the issue to be resolved, changes to the law had to be implemented, connecting relevant registers and providing mobile access systems and devices to the police. In 2020, the road traffic law was enacted and an option was introduced to have a digital driving licence in the *m*-*Citizen* application.

This added one more feature to the app, which already contained a few important features for the public. One is *mTożsamość* (m-Identity), which contains ID card data and can be used instead of an identification document when checking transport tickets, collecting a registered mail at the post office or performing other similar activities. Another is *mPojazd* (*m-Vehicle*), which contains all the necessary vehicle information, from the registration certificate and insurance to the vehicle ID. An additional feature is the *e-Recepta* (e-prescription) which allows people to pick up necessary medication at the pharmacy using their smartphone and a specially generated QR code.

The use of the *mObywatel* application is voluntary. The need for non-physical contacts during the COVID-19 pandemic contributed to the increase in its popularity in 2020. In the wake of this widespread use, features were added in 2021 relating to COVID-19 (EU vaccination certificate, negative test, recovery from the disease).





Portugal ranks 16th of the 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI). On human capital, Portugal significantly increased the proportion of ICT specialists, bringing the figure close to the EU average. Portugal performs below the EU average on basic digital skills but has a higher share of individuals with above basic digital skills. The share of female ICT specialists exceeds the EU average. On connectivity, Portugal performs well in VHCN (very high-capacity network) and fast broadband coverage. Additional effort would ensure that VHCN coverage and mobile broadband take-up reach all households, including those in rural areas. Portugal's leap from 56% to 63% in at least 100 Mbps fixed broadband take-up places it far ahead of the EU's 34% average. However, it lags behind on mobile broadband take-up.

The proportion of Portuguese enterprises with at least basic digital intensity stands at 51% versus an EU average of 60%. They exceed the EU average on the use of ICT for environmental sustainability, SMEs selling online, and AI use. Enterprises using cloud services have increased from last year. Portugal is among the EU leaders in digital public services. E-government users have increased to 57%, still trailing the EU's 64% average. Portugal's performance is ahead of the EU average in pre-filled online forms and digital public services for the public and businesses. Improving digital skills remains a national priority as reflected in its recovery and resilience plan (RRP), which includes initiatives for various population groups. In 2020, Portugal approved the national action plan for digital transition prioritising digital inclusion and training of people together with digital transformation of businesses, public administration and digitalisation of education. These objectives are in line with the digital transition strand of the Portuguese RRP which will focus on digital skills and digitisation of business, of public administration and of education.

In May 2021, Portugal revised its national digital skills initiative (INCoDe.2030), aligning its goals and lines of action with the action plan for 2025-2030. The new digital public services strategy embodies relevant EU policies, such as the single digital gateway and the eIDAS regulation, the eGov action plan, the interoperability framework, open data and web accessibility. With this reinforced and

aligned strategic framework Portugal plans to promote among others, digital skills in schools (including connectivity and internet access), upskilling and reskilling programmes for the labour force e.g. *Emprego+Digital or Jovem+Digital*, and gender balance.

In connectivity, Portugal's priority is to replace the Atlantic submarine cable ring linking its mainland with Madeira and Azores, as well as between their islands as it is at the end of its life cycle. Stepping up efforts on very high capacity networks coverage and mobile broadband take-up would ensure outreach to all households, including in rural areas. Delayed spectrum assignment is a barrier to 5G deployment, but the auction of the main pioneer bands is under way and is likely to increase Portugal's 5G readiness within the year.

On integration of digital technology in businesses, Portugal promotes the development of digital innovation hubs and the reskilling of workers in ICT professions in the countryside. Its substantial RRP investments for European digital innovation hubs will boost SMEs' capacity to digitalise their business processes.

Portugal continues to support advanced technologies such as AI, advanced computing and open data. In 2021, Portugal launched a new strategy for the digital transformation of the public administration (2021 – 2026).



Digital in Portugal's Recovery and Resilience Plan (RRP)

Portugal's contribution to the digital objectives amounts to 22.1% of its RRP's allocation, exceeding the digital target of 20%. The digital measures altogether amount to approximately EUR 3.67 billion spread across 14 components. The most prominent digital measures include: education and training in digital skills; digital transformation of businesses; and digitalisation of the State as a lever for: (i) sustainable public finances; (ii) competitive, investment-friendly business environment; and (iii) an efficient public administration, closer to citizens and businesses. The measures target Portugal's digital priorities, touching upon structural aspects of the Portuguese socio-economic system with a long-term horizon.

The overarching goal is to adapt the skills of the Portuguese working force to the needs of the labour market marked by new production processes and novel business models, products and services due to the intensifying digitalisation of economic activity. The measures are also expected to mitigate the socio-economic impact of the COVID-19 crisis by strengthening the resilience of economic and social institutions and reducing their vulnerability to shocks. Specific digital investments in Madeira and the Azores contribute to their territorial and social cohesion.

Improving the quality of public finances, strengthening institutional resilience and cutting contextual costs, with a focus on economic justice, and administrative and legislative simplification, aim at a closer, efficient and transparent public administration. Actions are enhanced through the digitisation of processes and procedures. Digital investments are relevant to people and businesses alike as they include digital school, tax administration, social security, justice, and the digital empowerment of enterprises. They are expected to significantly cut red tape for a more efficient public administration. Digital investments will also include decisive upgrades to the information systems for public financial management and healthcare, modernisation of public administration for better accessibility, and simpler interactions with businesses and the public.

1 Human capital

					fiaman capitar
1 Human canital	Por	tugal	EU	50 -	
i numan capital	rank	score	score	45 -	
DESI 2021	18	45.6	47.1	40 -	
				25 -	Portugal



Human canital

	Portugal			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	50%	52%	52%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	31%	32%	32%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	55%	55%	55%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	3.1%	3.6%	4.0%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	18%	18%	22%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	19%	28%	23%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	1.9%	2.2%	2.3%	3.9%
% graduates	2017	2018	2019	2019

As regards Human capital, Portugal ranks 18th of the 27 EU countries. The level of basic digital skills remains at 52%, falling short of the 56% EU average. Portugal marks a significant increase in the proportion of ICT specialists from 3.6% to approximately 4% approaching the EU average. The share of female ICT specialists has increased considerably from 18% to 22%, above the 19% EU average. ICT graduates remain low compared to the EU average of 3.9%. In Portugal, the number of enterprises providing ICT training is above the EU average (20%), although there is a significant drop compared to last year: from 28% down to 23%.

In 2021, Portugal continued efforts to improve the population's digital skills. It reinforced the INCoDe.2030 national initiative on digital competencies, which also acts as National Coalition for Digital Skills and Jobs. INCoDe.2030 has a new governing structure, broader objectives and greater alignment to relevant programmes and strategies, such as the national action plan for digital transition (2020). Its lines of action include education and professional training; qualification and requalification; inclusion; advanced training; and research. In addition, public-private bodies will promote the development of INCoDe.2030, leveraging the work of private organisations towards its actions. Within the reinforced strategic framework, examples of digital skills initiatives include: a digital skills assessment platform for certification as per Portugal's dynamic digital competency reference framework; digital literacy for the labour market; a non-degree programme for students with disabilities; mentoring for digital inclusion: designing municipal plans for digital competence; digital literacy of schools by increasing the digital literacy of 1 000 students in the third and secondary study cycles; and expanding the inclusion programme for digital literacy to national level.

Regarding digital skills of the labour force, Portugal has interconnected programmes to upskill and reskill employees and entrepreneurs with digital competences, including in SMEs. The *Emprego+Digital* programme, launched in 2020, upskills the labour force in manufacturing, commerce, services, tourism and agriculture, all affected by the digital transformation and the COVID-19 crisis. Employers can apply free of charge and prepare a training programme that fits their employees. The Institute for Employment and Vocational Training, the Confederation of Portuguese Business and Portugal Digital manage the programme. It will be extended to the Confederation of Trade and Services and that of tourism to cover 50 000 employees in 2021. Under the RRP, the programme will encompass 200 000 employees by the third quarter of 2025 with a total investment of EUR 94 million.

Also in 2020, Portugal launched the national programme *Jovem+Digital* for the digital upskilling of young unemployed people aged 18-35. It establishes 10 training paths of vocational training in high employability areas. *Upskill* is a reskilling programme for unemployed adults with secondary or tertiary education. It offers six-month intensive courses in programming at a university or polytechnic and 3 months' work-based learning in a company. It guarantees job placement to at least 80% of its trainees. It is running its first edition in 2021 with over 400 trainees in different regions, aiming to reach 3 000 people by 2023.

Gender balance in ICT in Portugal is also tackled by INCoDe.2030 and the digital transition action plan. For example, the initiative *Engenheiras por 1 dia* has reached over 7 500 female students, promoting engineering as part of the 2018-2030 national strategy for equality and non-discrimination.

Portugal participated in EU Code Week 2020, a grassroots initiative for people to discover coding, with 547 activities (up from 140 in 2019). Over 27 000 participants, 42% of whom were girls, engaged in the activities which mainly took place in schools.

Negative demographic trends and rising skill shortages underscore the urgency of investments in the skilling, upskilling and reskilling of Portugal's workforce. The implementation of current initiatives on a large scale is important in order to attain appropriate levels of digital literacy and ensure technology uptake.

Human capital in Portugal's recovery and resilience plan (RRP)

Portugal's RRP contributes to addressing the challenges in raising the digital skills level of the population using a segmented, systemic approach covering key population groups with a budget contribution to this policy area of EUR 1.36 billion. Reform and investments tackle digital skills through tailored measures for the training of civil servants, students, teachers, and the workforce, adjusting adult learning to the labour market and anticipating its needs. Planned activities include raising the percentage of STEM students, upskilling/reskilling, early school orientation for skills and labour market match. To speed up its transition to the digital economy and society, Portugal prioritises the development of its human capital through the modernisation of vocational education and training institutions, with particular focus on digital literacy and competences reflected in:

- 1. training and digital inclusion of people through education in schools;
- 2. training in digital skills and promotion of digital literacy;
- 3. digitalisation of the business sector;
- 4. digitalisation of public services.

Portugal Digital Academy is a platform for digital competences to be launched in 2021, aiming to train 800 000 employees through funding from RRP. It will evaluate employees in their digital skills level and find a personalised training path to match the skills required by their jobs profile.

2 Connectivity

2 Connectivity	Por	EU	
,	rank	score	score
DESI 2021	15	48.5	50.2



		Portugal		
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	74%	75%	79%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	50%	56%	63%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	1.18%	1.28%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	76%	83%	87%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	70%	83%	87%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	99.2%	99.7%	99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	8%	8%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	59%	62%	62%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	51	50	69
Score (0-100)		2019	2020	2020

Portugal ranks 15th for connectivity. The country progressed by seven percentage points in at least 100 Mbps fixed broadband take-up (63% compared to an EU average of 34%), and by four percentage points in Very High Capacity Network (VHCN) broadband coverage (87% against an EU average of 59%) and fast broadband (NGA) coverage (87%, equal to EU average). Total and rural fibre to the premises (FTTP) coverage continues to increase, from five percentage points in total FTTP coverage to two percentage points in rural FTTP coverage. However, Portugal lags behind the EU average in mobile broadband take-up despite its almost 100% mobile 4G coverage. At least 1 Gbps take-up is equal to the EU average (1.3%). Overall fixed broadband take-up rose from 75% in 2019 to 79% in 2020, slightly surpassing the EU average (77%).

None of the pioneer bands have been assigned yet, causing delays in the deployment of fifthgeneration services (5G coverage 0%). However, the 700 MHz and the 3.4-3.8 GHz bands are in the process of being assigned in a spectrum auction that is still ongoing.

Public investment and private competition are driving Portugal's broadband expansion. In 2020, mobile network operator MEO continued investing in FTTH, enlarging its coverage in several rural areas. Following the 2019 agreement between DSTelecom, NOS and Vodafone, FTTH is expected to cover 900,000 to 1.2 million homes.

Under its action plan for digital transition⁴⁸⁸ with the European Commission as lead investor, Portugal has implemented the Building Europe Link to Latin America (BELLA) under which the consortium EllaLink deployed a submarine cable system connecting Latin America and Europe. Portugal's priority continues to be the replacement of the Atlantic submarine cable ring linking the mainland with Madeira and Azores and the islands to one another (CAM submarine cables), as the cables are reaching the end of their life. The operational sections are planned respectively in 2024 to Azores and 2025 to Madeira. The public telecommunications operator, IP Telecom S.A., was awarded the concession to develop this project as a wholesale operator.

Portugal's roadmap to implement the Connectivity Toolbox⁴⁸⁹ contains measures with costreduction potential. They include revising the legislation to provide model regulations on electronic communications network deployment, launching a digital guide (2021/2022), and new cooperation between the government, the Autoridade Nacional de Comunicações (ANACOM) and the municipalities to harmonise permit-granting procedures. Portugal also plans to set up a permanent group for improving transparency through the single information point and the right of access to existing physical infrastructures. A significant milestone is the final approval of the regulation on the methodology for setting the price of access to physical infrastructures.

The migration of digital terrestrial television releasing the 700 MHz band was completed in December 2020⁴⁹⁰. By its Decision of 30 October 2020, ANACOM launched the auction of the 700 MHz, 900 MHz, 1800 MHz, 2.1 GHz, 2.6 GHz and 3.6 GHz frequency bands⁴⁹¹. The bidding phase for new entrants to the auction for frequency-user rights allocation in the 900 MHz and 1800 MHz⁴⁹² bands ended on 11 January 2021 after 44 rounds. The bidding phase of the main auction is taking longer than expected⁴⁹³. In April 2021 ANACOM announced a modification of the auction regulation⁴⁹⁴ to reduce its duration. In the meantime, MEO, NOS and Vodafone announced that they had conducted 5G trials in several Portuguese cities.

Main market & regulatory developments

At the beginning of 2020, Cellnex Telecom acquired OMTEL and NOS Towering. In April 2020, Altice Europe's 'Altice Portugal FTTH' became 'Fastfiber', the largest FTTH network wholesaler in Portugal.

MEO was the largest player in all market segments, with subscriber shares between 39.8% and 45%. MEO was also the largest multiple play operator (40.5%). NOS group was the second-largest operator of pay-TV (39.7%), fixed voice (33.5%) and fixed broadband (35.5%) and the third-largest mobile operator (26.2%). Vodafone is the second-largest mobile operator (30.1%) and the third-largest fixed operator, with subscriber shares of between 16.7% and 20.2%. NOWO/Oni is the fourth-largest fixed operator with 3%-4% of subscriber shares. It also operates a MVNO service (1.5%).

As ANACOM provided in mid-2020, the number of subscribers to fixed services continued to

⁴⁸⁸ <u>https://www.portugal.gov.pt/pt/gc22/comunicacao/documento?i=apresentacao-do-plano-de-acao-para-a-transicao-digital.</u>

⁴⁸⁹ <u>https://digital-strategy.ec.europa.eu/en/library/connectivity-toolbox-member-states-develop-and-share-roadmaps-toolbox-implementation.</u>

⁴⁹⁰ <u>https://www.anacom.pt/render.jsp?contentId=1599223.</u>

⁴⁹¹ <u>https://www.anacom.pt/render.jsp?contentId=1573881.</u>

⁴⁹² <u>https://www.anacom.pt/render.jsp?contentId=1601735.</u>

⁴⁹³ <u>https://www.anacom.pt/render.jsp?categoryId=416583.</u>

⁴⁹⁴ <u>https://anacom.pt/render.jsp?contentId=1614343.</u>

grow (2.3% for fixed voice, 4.1% for pay-tv and 4.3% for fixed broadband in the last 12 months), driven by the increasing residential penetration of bundles (83.9 per 100 inhabitants). Bundles grew by 4.4%, one of the lowest growth rates recorded to date, but 4P/5P bundles grew by 6.2% due to upgrades of existing clients, reaching 50% of the total number of multiple play subscribers.

The transposition of the European Electronic Communications Code⁴⁹⁵ into Portuguese legislation is delayed and the Commission sent Portugal a letter of formal notice. According to information provided by the Portuguese authorities, the draft legislation incorporating the European Electronic Communications Code is expected to be finally approved by the Parliament in Q3 2021.

On markets 4⁴⁹⁶, ANACOM notified the European Commission of its final draft decision of 4 February 2021 approving a 10% reduction of the maximum prices of Ethernet leased lines connecting the mainland to the Azores and Madeira (CAM circuits). These circuits, supported over submarine cables owned or operated by MEO, are supplied under the Reference Ethernet Leased Lines Offer (RELLO).

On 20 February 2020, ANACOM approved updates of the maximum price for the termination of voice calls on individual mobile networks and for the termination of voice calls on fixed networks to be applied by operators notified as having significant market power (SMP). The maximum price for the termination of voice calls on mobile networks was set at 0.36 eurocents per minute (as from 1 July 2020), and for fixed terminations was set at 0.046 eurocents per minute (as from 1 October 2020).

The incorporation into Portuguese law of the system of penalties for non-compliance with Regulation (EU) 2015/2120 of 25 November 2015 was established by Decree-Law No 49/2020 of 4 August 2020⁴⁹⁷.

Due to the COVID-19 pandemic, the government enacted extraordinary measures through decrees. Consumer complaints about electronic communications services increased by 25% in the first semester of 2020 compared to the same period of 2019, a trend that persisted in the third quarter. In the first semester of 2020, consumers complained mostly about billing issues (27%), technical assistance (21%), the way the service was sold and contract terms and conditions (21%), fixed services failure (21%), the way the complaints were handled (20%), and service failures (20%).

Overall, Portugal performs well on deployment of very high-capacity networks and on the take-up of broadband connections of at least 100 Mbps. An additional effort is required to extend very high-capacity networks coverage and mobile broadband take-up, including in rural areas. Delayed spectrum assignment remains the biggest barrier to 5G deployment, but the ongoing auction of the main pioneer bands is expected to end in Q4 2021. That could help speed up Portugal's 5G deployment in 2022.

Connectivity in Portugal's recovery and resilience plan (RRP)

⁴⁹⁵ Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code (*OJ L 321, 17.12.2018, p. 36–214*).

 ⁴⁹⁶ Prices revision applied to circuits connecting the Mainland, the Azores and Madeira and inter-island circuits.
⁴⁹⁷ <u>https://data.dre.pt/eli/dec-lei/49/2020/08/04/p/dre.</u>

The Portuguese RRP includes minor investments in 5G deployment. These cover local 5G networks in business parks and a local project to deploy about 90 km of the 5G network for the public administration in Madeira. These investments focus on connecting schools to the publicly owned enlarged education network and improving the coverage of local 5G networks, targeting the public administration of Madeira (Component 19) and business parks (Component 7). The investments in schools' connectivity are expected to have a lasting impact on the digital transition of the education system and the development of digital skills.

3 Integration of digital technology

3 Integration of	Por	EU		
digital technology	rank score		score	
DESI 2021	17	36.6	37.6	



		Portugal		
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	51%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	40%	42%	42%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	16%	16%	16%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	13%	13%	11%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	16%	16%	21%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	31%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	86%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	27%	27%	17%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	18%	16%	19%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	15%	15%	16%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	8%	8%	8%	8%
% SMEs	2017	2019	2019	2019

Portugal ranks 17th among EU countries in the integration of digital technology in businesses where 51% of enterprises manifest at least basic digital intensity versus the EU average of 60%. Portuguese enterprises stand out from the EU average with 86% of them using ICT for environmental sustainability. As for online commerce: 19% of SMEs sell online, above the EU average of 17%; 31% of enterprises use AI, considerably higher than the 25% EU average; 21% use cloud services, a marked leap from 16%; and 11% of companies access big data services. Portugal's enterprises are lagging on e-invoicing at 17%, considerably below the EU's 27% average.

Portugal continues to actively promote the digitisation of its businesses, including SMEs. The Portuguese economy is dominated by micro enterprises in traditional sectors with low digital literacy. SMEs are less active in digitalisation than their larger counterparts. Portugal's digital transition action plan (2020)⁴⁹⁸ promotes the digitalisation of enterprises through entrepreneurship and start-up ecosystems, digital transformation of companies and SMEs, and knowledge transfer.

⁴⁹⁸ <u>https://dre.pt/application/file/a/132140881.</u>

Measures targeting the integration of digital technology in enterprises are free zones for technology testing knowledge and intellectual property; digital capacity-building for SMEs inland via the programme +CO3so Emprego to reskill workers in ICT professions in the countryside; digital innovation hubs to provide artificial intelligence, cybersecurity and high-performance computing; and the cloud strategy for the public administration.

Indústria 4.0 was the main programme for the digital transformation of businesses. Its second phase, called *Advantage 4.0* is under way until the end of 2021. Although the digital transition action plan has a wider scope, it directly aligns with *Indústria 4.0* and *Advantage 4.0* as most of its measures link to it along three actions lines: (i) Generalise i4.0 to stimulate companies, tech suppliers and institutions to share knowledge and experience; (ii) Empower i4.0 adapting the skills of human capital to the reality of i4.0 through an academic offer in digital skills and requalification of the existing workforce; and (iii) Assimilate i4.0 focusing on solutions and technologies for easier access to technical skills and funding.

Portugal aims to create a national network of 16 digital innovation hubs (DIH), 5-6 of which would be recognised as European DIH. Their purpose is to support the digital transformation of enterprises especially SMEs, mid-caps and the public sector, guaranteeing regional, sectoral and territorial coverage, digital technologies specialisation and complementarity. The network will work with tech and R&D centres, laboratories, competitiveness clusters and enterprises. Each DIH will found an accelerator to foster the entrepreneurial ecosystem around its sectors. National DIHs are meant to generate added value at European level as potential candidates for the European network under the Digital Europe programme.

Portugal is committed to developing advanced technologies with several strategies under the national initiative on digital competencies INCoDe.2030⁴⁹⁹ such as the 2030 Artificial Intelligence Portugal strategy and the 2030 Advanced Computing Portugal strategy. Also, in the context of INCoDe.2030, Portugal is developing the open data strategy outlining specific initiatives that promote data reuse and sharing. Portugal participates in the European high-performance computing initiative. It has signed a Declaration for quantum communication infrastructure and participates in the European Blockchain Partnership. In alignment with the overall strategy but without neglecting specific local characteristics, the action plan for the digital transition includes a programme for government digitalisation and two sub-programmes: Simplex and TIC 2020 relating to blockchain activities.

Portugal has put strategies in place, consolidating its priorities and actions on the digitalisation of enterprises. It targets sector-specific policies at various levels and territories, aimed at enterprises of all sizes. Clear communication of the benefits of digital transformation and ensuring cooperation between business, industry and academia could add thrust to its efforts.

Highlight 2020-2021: Eu Sou Digital

The Eu Sou Digital (*I'm Digital*) programme launched in July 2021 aims to train over 1 million adults in basic digital skills by 2023, involving a national network of 30.000 young volunteers and 1.500 training centres all over Portugal. Focusing on training older adults who have never used the internet, this program promotes the creation of digital training actions developed by volunteers in the family context or in nearby places in their community such as parish councils, schools or

³⁴³

⁴⁹⁹ https://www.incode2030.gov.pt/.



Integration of advanced technology in Portugal's recovery and resilience plan (RRP)

The measures that support the digitalisation of business amount to EUR 592 million. Component 16 Empresas 4.0 of Portugal's RRP supports the digitalisation of businesses with measures amounting to in six groups of actions: 1) 'Test Beds network' aimed to create the conditions for businesses to develop and test new products and services and accelerating the digital transformation process; 2) 'Digital Commerce' a programme for the digitalisation of SMEs, with a focus on micro-enterprises in the commercial sector, to activate their digital trading channels, to incorporate technology into business models and to dematerialise processes with customers and suppliers using information and communication technologies; 3) 'Coaching 4.0' a programme to support businesses in the adoption of advanced digital technologies; 4) -'Entrepreneurship' that aims to support start-ups in their development and in the adoption of new digital technology. Other investments for EUR; 5) Digital innovation hubs; 6) platforms and actions for dematerialisation of invoices and cybersecurity.

Other measures under Component 5 Investment and Innovation, will strengthen and empower the national scientific and technological system and improve business academia linkages to ensure an efficient technology transfer and the translation of research results into innovation.

4 Digital public	Por	EU	
services	rank	score	score
DESI 2021	14	68.5	68.1



	Portugal			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	55%	54%	57%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	72	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	84	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	86	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	48%	78%
% maximum score			2020	2020

Portugal ranks 14th in the EU on digital public services. E-government users have increased from 54% to 57%, still significantly behind the EU's 64% average. Scoring 72, it is ahead of the EU's average of 63 in pre-filled online forms. Portugal's performance in digital public services for citizens (score of 84) and businesses (score of 86) exceeds the EU's score of 75 and 84 respectively. Conversely, only 48% of the digital public services in Portugal are open data, compared to the EU average of 66%.

Portugal's new 2021-2026 strategy for digital transformation of the public administration⁵⁰⁰ sets goals such as common frameworks for digital public services of the future, web accessibility, the once-only principle, open data sharing to foster interoperability, reference architectures (interoperability, eID, data, ICT skills, infrastructure, services), and security and trust. It also integrates relevant EU policies, such as the single digital gateway and the eIDAS regulation, the eGov action plan, the interoperability framework, open data and web accessibility.

Portugal's new cloud strategy of January 2021⁵⁰¹ addresses outstanding legal, contractual, financial, security and data-location concerns, and structural issues for standardising and simplifying concepts and processes in a two-year timeframe. Portugal is pushing the massive adoption of cloud by the public administration to put pressure on its ICT industry to keep up. This should positively affect the entire industry, accelerating adoption in the private sector. Under the digital transition action plan, Portugal has signed memorandums of understanding with cloud providers for incentives and access to programmes targeting education, entrepreneurship and public administration.

500

<u>Https://tic.gov.pt/documents/37177/280325/Estrat%C3%A9gia+de+Transforma%C3%A7%C3%A3o+</u> Digital+da+AP+2021-2026.pdf/6cdc9450-4600-a630-b2c1-5355b78f7bb6

⁵⁰¹ <u>https://tic.gov.pt/web/tic/-/estrategia-cloud-da-administracao-publica</u>.

The approach to accessibility includes training for public administration, workshops for the general public and the creation of an observatory. The Web Accessibility Observatory identifies the best accessibility and usability practices, presents statistics, and alerts decision-makers to inclusive digital services. The updated version of the web accessibility practices evaluator (WCAG 2.1) was launched in 2021.

The last two e-government benchmark exercises show that 98.9% of public services are available online for national users, and 69.5% for cross-border services. The government is committed to making more services available to other EU citizens in line with the single digital gateway regulation. Portugal has two eID schemes, citizen card and digital mobile key, and nodes set up with 14 countries under the eIDAS Regulation.

Several projects foster citizens' involvement in policymaking using digital channels. SIMPLEX is Portugal's flagship simplification programme. Its participative approach uses co-creation of real-life services to make life easier for people and businesses. The soon-to-be launched portal *participa.gov.pt* will engage citizens in policy planning at all government levels through budget planning, using blockchain to give votes to citizens. The *consultalex portal* involves people in drafting legislation. The *Transparency Portal* launched in April 2021 renders the European funds' execution process more transparent, e.g. RRP, the 2021-2027 multiannual financial framework.

Specific projects seek to make digital public services human-centric. LabX is the experimentation lab where citizens and public officials redesign public services to match user needs. TicAPP is the public administration digital competencies centre for digital transformation through human resources specialised in emerging technologies.

Portugal continues to deepen and adopt relevant measures to digitalise its public services and is one of the EU leaders in this regard. The parallel efforts made to improve basic digital skills will enable an increasing share of the population to benefit from these services. Promoting initiatives that address digital skills and digital public services together can help enhance both aspects.

Digital public services in Portugal's recovery and resilience plan

The recovery and resilience plan dedicates significant investments to e-government and digital public services with total contribution to this policy area of EUR 1.65 billion. Structural reform and measures to increase its service effectiveness for users and its cost-efficiency for the State underpin the investments including in in the sphere of public finances, economic justice and business environment, and the national health service. The investments in digital public administration include measures to (i) modernise consular services via an omnichannel response capacity (single digital gateway, call centre and in-person services), (ii) foster adoption of cloud and 5G services, and (iii) reduce asymmetries in the provision of public services. Actions are also foreseen to reinforce the use of data by public services, strengthening interoperability and data sharing with external entities and cross-border connections e.g. with the European Open data portal. Other investments will target the government's IT network, improve the coverage and capacity of the State Emergency Communications network and the national internal security network, and review the information systems and processes of the country's security forces. These investments will implement the once-only principle in order to reduce the administrative burden on citizens and businesses. Measures also tackle obstacles in obtaining business licences and inefficiencies in the justice system. The ambition to use RRF funds to modernise the public administration using novel technologies is noteworthy e.g. cloud. Specific reforms aim to improve the interoperability of the public administration at

national and international level, to comply with the requirements of the single digital gateway regulation.





Romania ranks 27th of 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI). On Human capital, Romania ranks 26th, scoring below average on most of the indicators. Although the country has a high number of ICT graduates (ranked 4th), the shortage in ICT specialists limits the country's capacity to innovate and to reap the benefits of the digital transformation. By contrast, on female ICT specialists Romania ranks 3rd. Regarding Connectivity, while progress continued in 2020 for fixed broadband coverage, take-up of broadband services progressed at a slower pace. Nonetheless, Romania ranks 7th thanks to the high take-up of at least 100Mbps broadband (52%). Connectivity in Romania could be further improved by focusing on lifting the urban-rural digital divide, streamlining permit-granting procedures, updating the broadband strategy to reflect the 2025 gigabit targets, and transposing the regulatory framework in line with EU legislation.

Romanian enterprises do not take full advantage of digital technologies (electronic information sharing, social media, big data and cloud), with the exception of artificial intelligence. As for Digital public services, Romania ranks last for key indicators such as digital public services for citizens and for businesses, e-government users and pre-filled forms. Projects aiming to meet different digital priorities are included in the National investment and economic recovery plan⁵⁰² launched by the Romanian Government in July 2020, with a budget allocation of EUR 100 million from EU and national funds, covering the years 2021-2030. Digital projects in the programme include:

⁵⁰² <u>Planul Național de Investiții și Relansare Economică.pdf (gov.ro)</u>

https://gov.ro/fisiere/programe_fisiere/Planul_Na%C8%9Bional_de_Investi%C8%9Bii_%C8%99i_Relansare_Ec onomic%C4%83.pdf

⁽in English: Dentons - Romania's National Plan For Investment And Economic Recovery - Note).

- the creation of an interoperability hub, coupled with the identification and connection of the main data registers;
- the use of electronic signatures in public administration;
- the development of a single point of contact;
- the introduction of the electronic identity card;
- the migration of public services to a government cloud;
- the development of open data systems that will allow private-sector access to data assets held by the public administration;
- investments to increase capacity to manage cyber risks and connect electronic fiscal cash registers.

2020 was a challenging year due to the change in government at the end of the year and the COVID-19 pandemic. The pandemic triggered increasing use of, and demand for, digital public services and accelerated the digital transformation of the Ministry of Internal Affairs, which made efforts to develop and deploy various ICT systems in a fast and secure manner. In December 2020, the new government established the Ministry of Research, Innovation and Digitization⁵⁰³, to which the Authority for the Digitalization of Romania (ADR)⁵⁰⁴ is attached. Continuity in the development and implementation of digitalisation measures would contribute to a stable increase in Romania's performance in all DESI dimensions. This will involve addressing the shortage in ICT specialists, boosting business digitalisation and modernising the public administration to offer more and better digital public services that could improve Romania's performance.



Digitalisation in Romania's Recovery and Resilience Plan (RRP)⁵⁰⁵

The Romanian Recovery and Resilience Plan's total allocation is EUR 29.1 billion, with EUR 14.2 billion of non-repayable financial support and EUR 14.9 billion in loans under the Recovery and Resilience Facility. Together, this represents 13.09% of the 2019 Romanian GDP. There are 171 measures in the Plan - 64 reforms and 107 investments, structured around six pillars and fifteen

⁵⁰³ Government Emergency Ordinance No 212/2020 of 28 December 2020, Official Gazette No 1307 of 29 December 2020

Ministerul Cercetării, Inovării și Digitalizării: www.research.gov.ro. ⁵⁰⁴ https://www.adr.gov.ro/.

⁵⁰⁵ At the time of writing, the plan was approved by the Commission and is pending adoption by the Council.

components. Five of the seven digital policy areas identified in the Annex VII of the Recovery and Resilience Facility Regulation are covered by measures in the RRP: connectivity, human capital, e-government, digital public services and local digital ecosystems, digitalisation of businesses, investment in digital capacities and deployment of advanced technologies. They also cover the four digital flagship initiatives presented in the Annual Sustainable Growth Strategy 2021⁴: Connect, Modernise, Scale-up, Reskill and upskill.

The measures contributing to digital objectives account for 20.5% of the financial allocation, which is above the 20% minimum requirement of the RRF Regulation.

While reforms and investments related to the digital transition can be found throughout the Plan, component 7 'Digital transformation' is focused on digitalisation. The digital allocated amount to this component is EUR 1 817 million and it includes measures in several areas: digital public services, digital connectivity, cybersecurity, and digital skills, human capital and internet use. These measures tackle important digital issues and priorities in Romania, such as government cloud infrastructure, improving the interoperability of digital public services, investments in e-health or the large scale deployment of electronic identity cards.

Equally significant contributions are made by component 15 'Education', which tackles reforms and investments for the digitalisation of the education process, amounting to EUR 1 129.5 million.

Investments in the digitalisation of road and rail transport are also expected to contribute to the digital transition through the EUR 864 million allocated in the sustainable transport component.

Component 9 'Business support, research, development and innovation', earmarks EUR 1 064 million. The digitalisation of businesses plays a prominent role in the RO RRP and is expected to increase the competitiveness and innovation potential of both SMEs and large companies.

Romania is expected to contribute to the cross border dimension of digital transformation by supporting companies' participation in a multi-country project on microelectronics, allocating EUR 500 million to support this initiative planned to be implemented as an Important Project of Common European Interest (IPCEI) as well as the overall the development of microelectronics in Romania.

1 Human capital

1 Human capital	Ron	EU	
	rank	score	score
DESI 2021	26	33.1	47.1



	Romania			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	29%	31%	31%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	10%	10%	10%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	32%	35%	35%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	2.2%	2.3%	2.4%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	24%	24%	26%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	5%	6%	6%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	5.6%	5.8%	6.3%	3.9%
% graduates	2017	2018	2019	2019

On Human capital, Romania is well below the EU average. Less than one third of people aged between 16 and 74 have at least basic digital skills (56% in the EU as a whole), while 35% have at least basic software skills (EU average: 58%). Only 10% of individuals have above-basic digital skills. Although there was a slight increase in the percentage of ICT specialists, they represent a much lower proportion of the workforce than in the EU as a whole (2.4% against an EU average of 4.3%). The number of enterprises providing ICT training to their employees is very low, standing at 6% (EU average: 20%). In contrast, Romania performs very well in terms of female ICT specialists, who account for 26% of total ICT specialists, and for ICT graduates, ranking high among EU Member States, with 6.3% of all graduates.

The main institutions in charge of digital skills policies are the Ministry of Education and the Ministry of Labour. In addition, the Authority for the Digitalization of Romania is the national authority coordinating efforts to draft national plans on digital skills, one for citizens and one for the public administration. Under the Human Capital Operational Programme (HCOP) 2014-2020, two dedicated calls for proposal were launched recently to increase employees' digital competences. These are: (i) 'Digital competences for SMEs' employees' (available budget EUR 20 000 000); and (ii) 'Digital competences for big enterprises' employees' (available budget: EUR 10 000 000).

To address the necessary digitalisation of education, in October 2020 the Ministry of Education launched the 2021-2027 SMART.Edu strategy on the digitalisation of education in Romania. The strategy's two main strands are: (i) digital skills relevant to the digital transformation; and (ii) developing a high-performance digital education and training ecosystem.

The draft action plan implementing the 2021-2027 national strategy for inclusion and poverty reduction⁵ refers to the development of digital skills at all levels of education. The aim is to reduce digital gaps and increase socio-economic inclusion, by increasing digital skills and internet use among the general population and disadvantaged groups and by organising training sessions adapted to the needs of each community.

In 2017, the Ministry of Labour, together with the Ministry of Education and the National Authority for Qualification, initiated a series of actions, including several legislative amendments to give poorly qualified adults access to training programmes to acquire key competences. In 2019, the number of unemployed people with a low level of qualification who have received basic or transversal skills training courses was 816, including 95 people under 25 years old and 52 NEETs⁶. Nevertheless, this number is small, considering the size of the Romanian workforce.

The National Agency for Employment is also organising vocational training programmes for registered jobseekers to help them acquire IT skills specific to any fields facing labour shortages. In 2020, the agency delivered 50 training courses on digital skills for 711 jobseekers.

In the context of the COVID-19 pandemic, the 'Safe Education' national programme (approved by Government Decision No 756/2020) provides endowments of electronic devices for schools. By 1 April 2021, 39 149 tablets, 4 698 webcams and 3 109 computers had been purchased through this programme. The 'School from Home' national programme is equipping schools with internet-connected electronic devices for online learning for students from disadvantaged environments. Although Romania has a high number of ICT graduates and a high percentage of female ICT specialists, the country is facing a shortage in ICT specialists in the overall workforce, which in time might limit its capacity to innovate and capitalise from innovation. Ensuring that ICT graduates stay in Romania and find work there will increase the number of ICT specialists. Additionally, Romania will need to ensure that the population has minimum software and digital skills.

Human capital in Romania's Recovery and Resilience Plan

The digital education of all sectors of the population is mentioned extensively in the Romanian RRP, its main objective focusing on increasing the resilience of the education system by modernising education infrastructure and related facilities to ensure participation in a quality, modern and inclusive education process. To achieve this, Romania puts forward a number of reforms and investments, notably reforming the compulsory education system, setting up a professional route, increasing the digital competence for public service and digital education for the citizens, adoption of legislative framework for the digitalisation of education, digitisation of SMEs and universities and cybersecurity skills for society among others. The key challenges for the Romanian education system is quality, equality and infrastructure: these challenges restrict Romania's ability to build a modern knowledge-based economy and its ability to facilitate social mobility.

The Romanian Recovery and Resilience Plan includes measures that are entirely or partially linked to digital skills. The total budget allocated specifically to digital skills development is about EUR 1 267 million. The reforms and investments mainly address challenges linked to education and digital skills training. Among these are the following:

 Advanced Digital Skills Training Programme for Civil Servants as well as grants schemes dedicated to upskilling/reskilling of employees in firms

- Investment to create new cybersecurity skills for society and the economy
- Funding schemes for libraries to become digital skills hubs to enhance basic digital skills
- Digitisation of universities and their preparation for the digital professions of the future
- Transformation of agricultural high schools into professionalisation centres
- Equipping IT laboratories in vocational education and training (VET) schools
- Online School: Assessment platform and content development to provide an integrated approach to teaching activities online or in special situations
- Digitalised classrooms for the schools with the highest percentage of children at risk of dropout.

2 Connectivity

2 Connectivity	Ron	EU	
	rank	score	score
DESI 2021	10	53.2	50.2



	Romania			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	66%	66%	67%	77%
% households 2a2 At least 100 Mbps fixed broadband take-up % households	45%	49%	52%	34%
2a3 At least 1 Gbps take-up % households	NA	<0.01% 2019	<0.01% 2020	1.3% 2020
2b1 Fast broadband (NGA) coverage % households	76% 2018	82% 2019	87% 2020	87% 2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	63%	68%	76%	59%
2c1 4G coverage % populated areas	96.3% 2018	99.1% 2019	99.7% 2020	99.7%
2c2 5G readiness Assigned spectrum as a % of total harmonised 5G spectrum	0% 2019	21% 2020	21% 2021	51% 2021
2c3 5G coverage % populated areas	NA	NA	12% 2020	14% 2020
2c4 Mobile broadband take-up % individuals	56% 2018	68% 2019	68% 2019	71% 2019
2d1 Broadband price index Score (0-100)	NA	92 2019	97 2020	69 2020

Romania ranks 10th on Connectivity. In 2020, it improved in terms of coverage while stagnating in terms of overall take-up. Fast broadband coverage increased to 87%, reaching the EU average. Strong infrastructure-based competition in Romania, mainly in urban areas, is reflected in the fixed very high capacity network (VHCN) coverage indicator of 76%, well above the EU average of 59%. Romania's urban-rural digital gap decreased in terms of VHCN coverage after a 17% rise to 56% of coverage for rural areas (double the EU average of 28%). Overall, fixed broadband take-up stalled around 67% of households for the fourth year in a row, well below the EU average of 77%. This is all the more surprising as teleworking was used widely during the pandemic, creating expectations of an increase on the demand side. However, the demand for at least 100 Mbps fixed broadband is reflected in the growth of take-up to 52%, well above the EU average of 34%. Romania closed the gap in terms of 4G coverage, reaching the EU average of 99.7%. The mobile broadband take-up indicator has still not reached the EU average, despite the very low broadband prices. Romania continues to rank first in the EU in terms of broadband prices when analysing all product baskets (fixed, mobile, converged).

The national broadband plan was adopted in 2015 and an update to reflect the Gigabit Society targets is overdue. As reported in previous years, the lack of streamlined administrative procedures

at local level for granting construction permits is hampering investment in high-speed broadband networks. Improvement in this area is crucial for deploying networks. However, Romania is one of the few EU countries that did not submit a Connectivity Toolbox Roadmap to the Commission. This is all the more noteworthy as the importance of effective implementation of the Broadband Cost Reduction Directive was highlighted in the Commission's comments on the market review for wholesale local and central access provided at a fixed location.

A grant scheme for next-generation network deployment with a total contracted budget of EUR 59 million provides support to private operators to deploy backhaul and last-mile access infrastructure to additional localities in white spots. The project aims to cover 160,000 households in white spots.

Only 21% of the total harmonised 5G spectrum is assigned in Romania due to the delay in the 5G spectrum auction.

The national strategy for the implementation of 5G in Romania was adopted on 20 June 2019. The drafting of the strategy involved a large interinstitutional consultation, which included stakeholders from local authorities, who are expected to play a significant role in deploying the new 5G networks.

The national strategy envisages the organisation of a spectrum multi-band auction in the 700 MHz, 800 MHz, 1.5 GHz, 2.6 GHz and 3.4-3.8 GHz bands. The auction process was repeatedly delayed by the transposition into national legislation of a Memorandum between Romania and the US on the security of 5G infrastructure and, in the past year, by the delayed transposition of the European Electronic Communications Code.

By May 2021, three mobile operators had launched 5G services in more than 30 localities served by 768 base stations.

Main market & regulatory developments

The Romanian telecom market continued to become more consolidated.

Orange Romania and OTE Greece signed an agreement on 9 November 2020 for the acquisition of OTE shares in Telekom Romania Communications. However, the transaction does not cover mobile operations (Telekom Romania Mobile Communications). This move would see Orange, the operator with the biggest share in the Romanian mobile market, improving its position significantly in bundled fixed and mobile services⁷.

On 1 April 2020, Vodafone completed the acquisition of Liberty Global's cable business in Czechia, Germany, Hungary and Romania, cleared by the European Commission on 18 July 2019. The Commission did not identify competition concerns in Romania. UPC's fixed network footprint ensures that Vodafone Romania will become a strong challenger, offering bundled fixed and mobile services.

Further market consolidation resulted from RCS & RDS SA's acquisition of Digital Cable Systems SA, Akta Telecom SA and ATTP Telecommunications SRL as of 1 August 2020. The National Competition Authority in Romania approved the transaction on 24 July 2020, following a series of commitments endorsed by RCS & RDS SA.

On 4 February 2021, the Commission sent a letter of formal notice to Romania for failing to enact new EU telecom rules, specifically the European Electronic Communications Code.

On 2 August 2020, the Romanian national regulatory authority (ANCOM) notified the European

Commission and the Body of European Regulators for Electronic Communications (BEREC) of a measure on market 2 of the 2014 Commission Recommendation⁸ on wholesale call termination on individual public telephone networks provided at a fixed location, specifically concerning the update of the fixed termination rate. In its comments, the European Commission encouraged ANCOM to base its future WACC calculations on the notice⁹ and the parameters report¹⁰.

On 19 October 2020, ANCOM notified the European Commission and BEREC of its analysis of markets 3a and 3b of the 2014 Commission Recommendation concerning the review of the markets for wholesale local and central access provided at a fixed location. The Commission commented on the market definition, on the assessment of significant market power and on the need to effectively apply the Broadband Cost Reduction Directive.

The outbreak of the pandemic determined an abrupt shift from office-based working to teleworking. This was accompanied by an 11% rise in complaints over issues such as service failure and quality of service (especially regarding internet access service) and availability of service/coverage.

As of 1 April 2020, Advanced Mobile Location has been deployed to ensure handset derived caller location for smartphone users who call the '112' European emergency number.

While progress continued in 2020 on fixed broadband coverage, take-up progressed at a much slower pace despite the teleworking arrangements during the pandemic. It is important that Romania updates its broadband strategy in line with the 2025 gigabit targets. Romania should also fully transpose the EECC. In addition, it is of utmost importance that the national Connectivity Toolbox Roadmap is drawn up and that it includes adequate measures to streamline permit-granting procedures. The multiband auction to award spectrum usage rights in the 700 MHz, 800 MHz, 1.5 GHz, 2.6 GHz and 3.4-3.8 GHz bands should be completed without delay to pave the way for large scale 5G deployment.

Connectivity in Romania's Recovery and Resilience Plan

The reforms in component 7 (Digital transformation) are expected to accelerate the national roll-out of 5G networks and to improve broadband coverage. Romania acknowledges that investments in infrastructure in currently poorly connected regions of the country and digital connectivity in rural areas will be key to bringing the country closer together. As regards the use of 5G networks, risk scenarios are related to insufficient security measures, 5G supply chain, modus operandi of key threat actors, interdependencies between 5G networks and other critical systems as well as to the operation of internet of things (IoT), smartphones or devices. The plan also includes reforms implementing the Common Union Toolbox for Connectivity and the entry into force of the 5G security law.

The EUR 94 million earmarked for the implementation of a scheme to support the use of communication services through different types of instruments for beneficiaries, with a focus on white areas is expected to address some of the concerns and risks mentioned above. The objective of this investment is to provide coverage of very high-speed internet access to areas where the market cannot deliver these services on its own (villages, including disadvantaged areas). The minimum speed shall be at least 100 Mbps upgradeable and the networks shall be fibre networks (FTTB/H) and/or 5G.

3 Integration of digital technology

3 Integration of	Romania		EU
digital technology	rank	score	score
DESI 2021	25	23.8	37.6



	Romania			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	33%	60%
3b1 Electronic information sharing	22%	23%	23%	36%
3b2 Social media % enterprises	9% 2017	8% 2019	8% 2019	2019 23% 2019
3b3 Big data % enterprises	11% 2018	11% 2018	5% 2020	14% 2020
3b4 Cloud % enterprises	7% 2018	7% 2018	13% 2020	26% 2020
3b5 Al % enterprises	NA	NA	31% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	68% 2021	66% 2021
3b7 e-Invoices % enterprises	20% 2018	20% 2018	17% 2020	32% 2020
3c1 SMEs selling online % SMEs	8% 2018	11% 2019	17% 2020	17% 2020
3c2 e-Commerce turnover % SME turnover	5% 2018	5% 2019	8% 2020	12% 2020
3c3 Selling online cross-border % SMEs	2% 2017	6% 2019	6% 2019	8% 2019

Romania ranks 25th in the EU on Integration of digital technology in businesses' activities. Most indicators in this dimension are well below the EU average. Only 33% of SMEs have at least a basic level of digital intensity, compared to the EU average of 60%. Although 17% of Romanian SMEs are taking advantage of the opportunities presented by online commerce, more could be selling across borders (6% compared to the 8% EU average). Only 17% of enterprises are issuing e-invoices, significantly below the EU average of 32%. Some 8% of enterprises use social media (low compared to the EU average of 23%), 13% use cloud services (EU average: 26%) and only 5% of them analyse big data. At the same time, 31% of enterprises are using artifical intelligence, much higher than the EU average of 25%. The percentage of enterprises using ICT for sustainablity is 68%, slightly above the EU average of 66%.

The proposed 2021-2027 Government Strategy to Develop the SME Sector and Improve the Romanian Business Environment towards a Digital and Data Economy¹¹ is a cross-cutting strategy that aims to achieve a digital and data economy in the medium term. The strategy's main measures and actions are: (i) supporting the development of the Digital Innovation Hubs (DIHs) network¹² and defining the role they can play in the Digital Europe Programme to support SMEs; (ii) ensuring that SMEs can acquire the relevant skills for new technologies and that they can easily switch digital

service providers and take advantage of data portability; (iii) raising SMEs' awareness and stimulating investments in cyber security.

The main high-performance computing (HPC) initiative in 2020 was the participation in the EuroCC Project (National HPC Competence Centres as part of the EuroHPC Joint Undertaking), a 2-year project started in September 2020 with a budget of EUR 57 million. The National Institute for Research & Development in Informatics (ICI Bucharest) has become the sole partner in the establishment of the National Competence Centre in Romania. Each of the 33 participating countries will open a HPC national competence centre, with the aim of identifying and evaluating available HPC competences and education/training programmes in their respective countries. In parallel, they will identify and analyse the gaps and needs for HPC adoption for target groups/users (public administration, academia, industry & SMEs).

On cyber security, Romania does not yet use a certification system for public procurement or technical regulations at national level. The intention is to regulate this once the primary legislation establishing the Romanian National Cyber Security Directorate (NCSD) is approved, so that the directorate can take over these tasks.

Romanian enterprises do not take full advantage of advanced digital technologies and are generally scoring lower than the EU average. It is therefore very encouraging to see the efforts the country is putting in place to push for the digitalisation of enterprises across a high number of areas, supported by a number of ministries.

Integration of digital technology in Romania's Recovery and Resilience Plan

In the Romanian RRP, the integration of digital technologies is widely addressed in a number of components with the aim to modernise the economy and the response of different entitities to the challenges of today's economy. The Business Support component puts forward targeted actions in order to create a sustainable, predictable and simplified environment for doing business, to increase access to finance by developing tools tailored to business needs, increase the innovation capacity of the RDI system to create research-business synergies, and to develop the necessary prerequisites for sustainable reform of state-owned companies. The digital measures included in the Plan are expected to increase the country's competitiveness. In particular, Romania is expected to be able to improve the efficiency of the economy and to take much better advantage of its digitalisation potential by: (i) accelerating the digitalisation of both SMEs and large companies with significant investments included in component 9 (Business support, research, development and innovation); (ii) adjusting digital skills to labour market needs and (iii) implementing electronic forms in public procurement procedures. As regards the digitalisation of SMEs, several financing schemes shall be established to enhance the innovation potential of businesses by focusing not only on the adoption of existing digital technologies but also on the development of advanced digital technologies such as blockchain, quantum and cloud computing as well as artificial intelligence.

Romania's Recovery and Resilience Plan includes several measures that are entirely or partially linked to the digitalisation of businesses and advanced technologies. They have a total budget of about EUR 1 579 million:

- Private sector aid schemes to support the digitisation of SMEs
- Financial instruments for the private sector to support the digitisation of SMEs

- Digitalisation of the non-governmental organisations sector and increase the level of digital literacy among the employees
- Accelerating the digitalisation of film production and distribution to strengthen the capacity of micro, small and medium-sized enterprises in film production.

The reforms and investments are expected to tackle legislative transparency, debureaucratisation and procedural simplification for business, develop digital platforms for the implementation of reforms on legislative transparency and will set up private sector financial instruments and aid schemes. Romania envisaged in the RRPsupport for innovative investments in microelectronics (IPCEI) with EUR 500 million earmarked for this endeavour.
4 Digital public services

4 Digital public	Romania		Romania		EU
services	rank	score	score		
DESI 2021	27	21.5	68.1		



	Romania			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	12%	15%	16%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	6	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	44	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	49	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	69%	78%
% maximum score			2020	2020

Romania ranks last in this dimension among Member States, as all indicators are well below the EU average. Only 16% of Romanian online users engage actively with e-government services, compared with an EU average of 64%. On the indicator for pre-filled forms, Romania's score of 6 is significantly below the EU average of 63. On digital public services for citizens and businesses respectively, Romania scores 44 (EU average: 75) and 49 (EU average: 84). At 69%, the country performs below the EU average of 78% on open data.

The Authority for the Digitalization of Romania has developed a Public Policy on e-Government¹³, adopted on 3 June 2021. Its main objective is to increase the number and quality of electronic public services in Romania. The objective should be reached by the end of 2030. The policy will involve: (i) developing digital public services for citizens and businesses; (ii) increasing public bodies' capacity to function in an advanced digital environment and provide mature electronic public services; (iii) consolidating the general digital skills of public sector employees; and (iv) increasing the motivation and specialisation levels of public-sector ICT personnel.

Additionally, the ADR launched in December 2020 a large project creating a strategic national framework for the adoption of innovative technologies in the public administration for the period 2021-2027. The areas covered include artificial intelligence, blockchain, open science cloud and high performance computing. One of the most important parts of this project is the development of a national blockchain strategy for the public administration, including a financing programme for the 2021–2027 financial period.

In 2020, both the public and private sector started to develop and implement numerous blockchain initiatives. One example is 'Connecting Romania through Blockchain', a CEF telecom blockchain project, running between 2021 and 2023. The central aim of the project is to create an extendable and sustainable ecosystem to facilitate and accelerate awareness, knowledge and adoption of the European Blockchain Services Infrastructure (EBSI) by Romanian citizens, businesses, institutions and

administrative authorities. In 2021, the National Institute for Research and Development in Informatics (ICI Bucharest) activated the first EBSI¹⁴ node in Romania.

Furthermore, the draft action plan implementing the 2021-2027 National Strategy for Inclusion and Poverty Reduction includes a specific action to make public information accessible to all citizens by publishing information on the websites of town halls and public institutions in an easy-to-read format.

The ADR conducted an analysis of the barriers to digitalising the public and private sector in Romania¹⁵. As regards the public sector, the report shows that the following barriers should be addressed: the lack of an efficient and effective IT architecture; the lack of IT systems for central public institutions; the reduced number of specialists in e-government; and the absence of a coordinated and efficient legislative and procedural framework.

Highlight 2020-2021: establishment of the Romanian Authority for the Digitalisation of Romania (ADR)

One of the main highlights of 2020, with implications for the development of Romania's digital transformation process, was the establishment of the ADR⁽⁵⁰⁶⁾ during the first quarter. Following the dissolution of the former Ministry for Communications and Information Society, the ADR has taken over most responsibilities related to the consistent implementation of policies in the field of digitalisation, acting as a common platform and shared expertise resource mainly for the public administration.

Relevant initiatives launched by the ADR during 2020/2021 include:

- improving the National Electronic System for Online Payments (ghiseul.ro)
- launch of the implementation of the Centralized Digital Identification Software Platform (PSCID) project
- conducting an analysis and finalising the document on Barriers to the digitalisation of the public and private sector in Romania
- finalising the Public Policy on e-Government, which is the action plan for the following 10 years, establishing a programme of efficient and sustainable measures for the digitalisation of public administration

- starting an inventory of existing digital public services offered by central public administrative authorities. Once finalised, the Registry of Digital Public Services will show which areas/sectors are insufficiently digitalised and it will be possible to identify the new courses of action responding to public institutions' real needs

- implementing the IT system for the health registers (RegIntermed) in partnership with the Ministry of Health, to advance the digitalisation of the public health system.

Digital public services in Romania's Recovery and Resilience Plan

⁽⁵⁰⁶⁾ Government Decision No 89/2020 on the organisation and functioning of the Authority for the Digitalisation of Romania, Official Gazette No 113 of 13 February 2020.

- The RO RRP includes a key reform on the development of the government cloud in component 7 (Digital transformation), which aims to modernise the public administration by establishing the necessary framework for achieving interoperability of the various public institutions' IT&C systems, ensuring coherence with the eIDAS Regulation and implementing the "once only" principle embedded in the Single Digital Gateway Regulation.
- The Plan includes a number of measures that are entirely linked to digital public administration and services, with a budget of about EUR 3 037 million. Some of the reforms and investments are:
- Implementation of the National Building Register
- Developing and implementing a unitary framework for defining the architecture of a government cloud system as well as complete cloud development and migration
- Promotion of the 12 touristic/cultural routes and development of a digital system for cultural funding processes
- Technical support for the revision of the taxation framework, improving tax and tax administration processes
- Supporting the process of assessing and recalculating pension files and support the operational efficiency through digitalisation of the pension system
- Implementation of the eForms electronic forms in public procurement
- Digital transformation in civil service management and investments for digitalisation in employment and social protection
- Developing performance human resources management in the public sector.





Sweden ranks 3rd of 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI).

Sweden's human capital is one of its strongest competitive advantages (ranking 2nd in the EU). 72% of the population has at least basic digital skills and 46% has above basic digital skills. However, more action is needed to increase the pool of digital experts. Estimates indicate that the country will have a shortage of 70,000 ICT specialists by 2024.

Sweden is a front-runner on connectivity (ranking 5th in the EU). The recently completed 5G auction is a positive development. However, Sweden could speed up the availability and assignment of the 5G pioneer bands and increase efforts to deploy 1 Gbps connections.

Swedish companies have been successful in integrating digital technologies and the country ranks 3rd in the EU. However, the pace of growth in Sweden is slowing down, while other countries continue advancing.

The general level of digital maturity in the population, the public sector and companies is high. Sweden ranks 5th in Digital public services in the EU, but other countries are progressing faster. One area in which Sweden has improved significantly is in making available open data, which has been identified as a key driver for innovative public services. The uptake of eID is very high among the Swedish population, but the potential to use the eID across borders is not being tapped.

The Swedish Digitisation strategy adopted in 2017 guides the country's work to meet its goals. Sweden aims to become the world leader in unlocking the potential that the digital transformation offers, while creating a digitally advanced public sector that provides legal certainty, availability and which contributes to the development of effective Swedish and EU policies.

The country is gradually putting in place specific policy instruments that target the gaps and areas of improvement it has identified, such as closing the digital skills gap and using advanced technologies

(artificial intelligence, cybersecurity and cloud services), and it is doing so in discussion with all stakeholders.



1 Human capital

1 Human canital	Sw	EU	
I numan capitai	rank	score	score
DESI 2021	2	64.6	47.1



		Sweden		EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	77%	72%	72%	56%
1a2 Above basic digital skills	46%	46%	46%	31%
1a3 At least basic software skills	78%	74%	74%	58%
% individuals	2017	2019	2019	
1b1 ICT specialists	6.8%	7.0%	7.5%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	21%	21%	21%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	24%	32%	32%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	4.3%	4.3%	4.3% 2019	3.9%
% graduates	2017	2018		2019

Under the section on human capital, Sweden ranks 2nd out of the 27 EU countries. It scores significantly above the EU average on the share of the population with both at least basic and above basic digital skills. Moreover, the share of ICT specialists is among the highest in the EU at 7.5%, of which 21% are female. The share of ICT graduates is also over the EU average. However, in 2020, 55.1% of companies seeking to recruit ICT specialists reported hard-to-fill vacancies.

Sweden's goal is to be a world leader in unlocking the potential of the digital transformation. A main factor to achieve this is the digital skills policy, which is a joint responsibility of four ministries: education and research, enterprise and innovation, employment and infrastructure. Since it was launched in 2016, the Skills supply and lifelong learning programme⁵⁰⁷ aims to strengthen and develop demand for skills development. Starting with demand from industry for employees with digital skills, the programme also covers the expansion in opportunities for people to reskill and upskill to become more attractive on the job market and to learn new skills over their entire career.

ICT specialists are, and are expected to remain, in shortage. The industry organisation Swedish IT and Telecom Industries⁵⁰⁸ estimates the shortage of ICT specialists to reach 70,000 by 2024, unless action is taken⁵⁰⁹. The areas in which specialists will be needed span the entire digital value chain: data science and other skills in artificial intelligence, game development, cybersecurity, cloud

 ⁵⁰⁷ <u>https://www.government.se/government-policy/the-governments-innovation-partnership-programmes/innovation-partnership-programme-skills-supply-and-lifelong-learning/</u>
⁵⁰⁸ https://www.itot.se/

⁵⁰⁹ https://www.itot.se/2020/12/it-kompetensbristen/

services, the internet of things, e-commerce, project management and specific business domain expertise.

The Swedish National Agency for Higher Vocational Education⁵¹⁰ reports⁵¹¹ that the number of study places in higher vocational education available in 2020 increased to reach 83,000 places⁵¹². Of these 18% were for specific courses on technology and manufacturing, 18% on economy and administration, 16% on building and construction and 13% on data and ICT. 29% of the 484 courses offered were directly linked to digitalisation. An estimated 40% of courses and study places should contribute to bridging the digital skills gap.

The National Coalition for digital skills and jobs⁵¹³ launched in 2018 comprises over 24 organisations, coordinated by the Swedish IT and Telecom Industries⁵¹⁴. The coalition focuses on highlighting both the need for and best practices in promoting action on digital competence in Sweden, in the areas of digital skills in education, for the labour force, for ICT professionals and for the whole population. For the latter, the Swedish Post and Telecom Authority has been awarded approximately EUR 150,000 to help people over the age of 70 improve their access to and their ability to use digital services.

The Swedish educational system is highly decentralised. Municipalities and independent schools have the responsibility to operate schools, including providing both students and teachers with the digital equipment they need. Many schools sourced this equipment even before the COVID-19 pandemic hit.

To support teachers during the pandemic, the state-owned research institute RISE, the Swedish Association of Local Authorities and Regions (SALAR) and other key stakeholders set up a platform⁵¹⁵, which was used by both teachers, municipalities and independent schools. In the framework of the Digital education strategy and related implementation plan, the Swedish government tasked the National Agency for Education with coordinating the digitisation of the school system.

EU Code Week is an initiative supported by volunteer ambassadors, teachers and SALAR. In terms of the number of activities run during Code Week, Sweden ranked 26th out of over 80 participating countries in 2020. 126 activities involving nearly 11,000 people took place, 86% in schools, with the average female participation rate of 47%⁵¹⁶.

Digital or digitally associated skills continue to be a focus area in Swedish education. It is important that Sweden continues to take action to bridge the lack of digital experts and to increase the share of women working as ICT specialists to meet the demand from industry.

515 skolahemma.se

⁵¹⁰ <u>https://www.myh.se/In-English/Swedish-National-Agency-for-Higher-Vocational-Education-/</u>

⁵¹¹ <u>https://www.myh.se/publikationer/statistisk-arsrapport-2021</u>

⁵¹² Between 2018 and 2020 the agency decided to increase the number of new study places by 31,000-36,100 per year, compared to 19,300-25,700 per year between 2015 and 2017.

⁵¹³ <u>https://www.itot.se/2019/01/digital-skills-jobs-coalition-sweden/</u>

⁵¹⁴ <u>https://digital-skills-jobs.europa.eu/en/organisations/ittelekomforetagen-swedish-it-and-telecom-industries</u>

⁵¹⁶ EU Code Week 2020 in numbers — Code Week

2 Connectivity

2 Connectivity	Sw	EU	
_ connectant,	rank	score	score
DESI 2021	5	59.6	50.2



	Sweden			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	78%	86%	84%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	55%	66%	67%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	2.84%	3.63%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	82%	85%	87%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	72%	77%	81%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	>99.9%	>99.9%	>99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	22%	22%	49%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	14%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	86%	92%	92%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	65	69	69
Score (0-100)		2019	2020	2020

Sweden ranks 5th on Connectivity well above the EU average. In terms of very high capacity network (VHCN) 81% of households are covered compared to 59% in the EU. Both VHCN and fibre-to-thepremises coverage is at 80.5% in total, but rural areas lag at 48.1% on both metrics. Overall, 87% of rural households have access to a broadband connection, but speed can be increased. VHCN coverage has risen steadily to reach 81% in 2020, increasing at an average of 4.5 percentage points from 72% in 2018 and 77% in 2019. Sweden has yet to tap its full potential in the take-up of 1 Gbps connections, currently at 3.6% (EU average 1.3%). Both 4G coverage and 100 Mbps access are in the top tier compared to the EU average; over 99.9% and 67%, respectively (compared to 99.7% and 34%). Next generation access (NGA) coverage has increased at an average of 2.6 percentage points from 2018 onwards, and is at 87% in 2020 (on par with the EU average, 87%). The overall take-up by households of fixed broadband has dropped by 2 percentage points and is now at 84%, above the EU average of 77%. This is the only indicator where there was a decrease in 2020. Pricing for broadband is on par with the EU average and has not changed significantly over the last year.

Sweden addresses the differences in connectivity levels and fast broadband access between sparsely and densely populated areas in its broadband plans. It has an ambitious fixed broadband access

plan⁵¹⁷ that aims for all households and companies to have access to 100 Mbps broadband by 2020 and high-speed broadband available throughout the entire country by 2025, using a mix of fixed and mobile networks.

The most recent addition to the funding to achieve these national broadband targets (approximately EUR 220 million) was announced in 2020⁵¹⁸. To increase coverage, Sweden plans to grant State aid to roll out high-speed broadband infrastructure with a speed of at least 1 Gbps in areas where there is no existing or planned deployment of NGA within three years. There is an annual budget for this scheme and in 2020 it allocated approximately EUR 13.6 million to the roll-out. From 2020-2025, Sweden will make available a total of EUR 285 million. Public and private-sector organisations have neither applied to nor received financing from the European Investment Bank or from European Fund for Strategic Investments.

Many Swedish cities and municipalities and one private-sector operator at national level operate as wholesale only (or dark fibre) operators. Two examples are the city of Stockholm, which owns Stokab, the company that owns and rents out dark fibre to market players and GothNet, owned by the city of Gothenburg.

5G has been identified as a key technology and an important aspect of Sweden's broadband strategy to help Sweden achieve 100% high-speed broadband access, especially for access in rural and sparsely populated areas. The successful deployment of 5G in Sweden depends on the timely availability and assignment of the 5G pioneer bands. The recently launched and completed 5G spectrum auction⁵¹⁹ (both on 19 January 2021), which was resumed after delays and halted in late 2020, is an important step for the 5G roll-out in Sweden. The auction raised approximately EUR 230 million and awarded four bidders rights of use in the two auctioned frequency bands (2.3 GHz and 3.5 GHz). One bidder won rights of use in the 2.3 GHz band and three bidders won rights of use for 320 MHz in the 3.5 GHz band.

Sweden has not yet assigned rights of use of the 26 GHz band. As of May 2021, Sweden has assigned 66.7% (EU 61.1%) of the 700 MHz band, 80% (EU 71%) of the 3.4-3.8 GHz band, and 0% (EU 25.9%) of the 26 GHz band, compared to the EU weighted average for 5G pioneer bands. The 20 MHz spectrum reserved in the 700 MHz band for emergency communications services is still not assigned. Overall, Sweden has assigned 48.9% of EU harmonised 5G pioneer spectrum, against the EU average of 52.7%.

Sweden's score on 5G readiness (49%), slightly below the EU average (51%) does not reflect the country's intention to be a forerunner in 5G in the EU. 5G coverage is on par with the EU average at 14% of the population.

Main market & regulatory developments

The Swedish market focuses on rolling out new fibre technologies and decommissioning older technologies (copper and coaxial cable).

No significant developments (entries, consolidations, altered market shares) took place in 2020.

⁵¹⁷ <u>https://www.regeringen.se/4b00e7/contentassets/a1a50c6a306544e28ebaf4f4aa29a74e/sverige-helt-uppkopplat-2025-slutlig.pdf</u>

⁵¹⁸ <u>https://www.regeringen.se/pressmeddelanden/2020/09/kraftig-satsning-pa-befintliga-stod-till-bredbandsutbyggnad/</u>

⁵¹⁹ <u>https://pts.se/sv/nyheter/pressmeddelanden/2021/auktionerna-i-35-ghz--och-23-ghz-banden-ar-avslutade/</u>

Only the merger between Tele2 and Com Hem (approved by the Commission in 2018 and finalised in 2020) and the incumbent Telia's acquisition of the TV4 TV operator are worth noting.

The number and composition of bundled services have been stable over the last years. Likely as a direct effect of the COVID-19 pandemic, demand for fibre broadband subscriptions and ultra-fast services continues to increase. Use patterns based on increased teleworking and spending more time at home may explain this. There has been no substantial impact on the quality of these services during the COVID-19 pandemic.

The transposition of the European Electronic Communications Code into national law is delayed and on 4 February 2021, the Commission sent Sweden a Letter of Formal Notice. In its reply⁵²⁰ of March 25 2021, Sweden informed that work on transposing the EECC is of high priority, but will be delayed until the first quarter of 2022. The steps leading to transposition are (i) preparation of new legislation to replace the current electronic communications legislation (2003:89), (ii) decision to be taken by government in the summer of 2021, (iii) tabling of proposal to parliament in autumn 2021, (iv) adoption of new legislation in the first quarter of 2022.

Sweden has prepared for using the broadband connectivity toolbox by publishing a roadmap, which the Commission has asked to extend and improve.

The most common consumer complaints (in total 2,400 in 2020) concerned 5G, withdrawal of the copper network, numbering issues (portability, receiving calls from unknown numbers and loss of access to numbers), interruption of service and coverage. There were no reported complaints concerning cases of confirmed or potential non-compliance with the Roam Like at Home rules in 2020. Freely available and free of charge comparison tools exist and are widely used.

The NRA (Post och Telestyrelsen, PTS) reported one case where an EU company sued several internet service providers, motioning that they should block a number of websites for file sharing containing content subject to the company's copyright.

Sweden continues to perform very well in terms of both coverage and take-up of fixed broadband. On mobile broadband, the recently completed 5G auction allows Sweden to pursue becoming a leader in connectivity. Sweden is increasingly overcoming the challenges faced in rolling out broadband to the remaining sparsely populated areas, allowing the country to keep its high ranking compared to the EU average. To ensure Sweden remains a top-ranked EU country, it could accelerate the availability and assignment of the remaining spectrum in the 5G pioneer bands and step up action to successfully deploy 1 Gbps connections.

Highlight 2020-2021: 5G auction puts Sweden on track

Building on its tradition in mobile technologies, the initially delayed and recently successful auction for the 3.4-3.8 GHz band will allow Sweden to continue ranking high in connectivity in the EU. Sweden aims to close the remaining gap between densely and sparsely populated areas in terms of both coverage and the take-up of fast broadband by focusing on this divide, in order to reach the goal of high-speed broadband throughout the entire country by 2025.

⁵²⁰ Svar på formell underrättelse 2021-0094.

3 Integration of digital technology

3 Integration of	Sw	EU	
digital technology	rank score		score
DESI 2021	3	56.3	37.6



	Sweden			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	82%	60%
% SMEs			2020	2020
3b1 Electronic information sharing	31%	37%	37%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	25%	40%	40%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	10%	10%	19%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	43%	43%	59%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	30%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	73%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	36%	36%	45%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	30%	30%	31%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	18%	18%	15%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	10%	10%	10%	8%
% SMEs	2017	2019	2019	2019

On integrating digital technology in business activities, Sweden ranks 3rd in the EU. Sweden ranks relatively high compared to the EU average on most metrics and above the EU average for all indicators. It ranks high for SMEs with at least a basic level of digital intensity (82%), for enterprises using social media (40%) and for the use of cloud (59%). These areas have a clear potential for improvement, especially given the difference between SMEs selling online (31%) and those selling across borders (almost a third of those at 10%). There is also a gap between the digital transformation rate for large enterprises and SMEs. 75% of large enterprises and 25% of SMEs have high levels of digital intensity.

A recently concluded national process led to the selection of 15 Swedish Digital Innovation Hubs that can participate in the upcoming Digital Europe call to be part of the Network of European Digital Innovation Hubs. Sweden actively participates in the high-level working group for AI and Digitising European Industry to exchange information and present its views and perspective in the ongoing activities. Sweden is active also in the European Blockchain Partnership and has invested in the Euro high performance computing joint undertaking (EuroHPC).

AI has been identified as an area that will have a strong impact on Swedish society and an area in which Sweden can demonstrate excellence both in research and business. The Swedish government adopted the national approach to AI in 2018 with the aim of making Sweden a leader in harnessing the opportunities that the use of AI can offer to strengthen Sweden's welfare and competitiveness. In 2021, this approach will be complemented by a strategy focusing on securing access to and use of open data as a strategic resource, in line with the rules on cyber security, data protection and privacy.

In addition, a number of public-private initiatives support the activities in AI, such as 'AI Sweden'⁵²¹, the Swedish National Centre for applied Artificial Intelligence; the Wallenberg AI, Autonomous Systems and Software Program (WASP) and RISE⁵²² (Research Institutes of Sweden), where AI research is combined with cross-disciplinary research.

The RISE Infrastructure and Cloud research and test Environment (ICE) data centre runs a test bed aimed at developing edge solution prototypes. One of the recent projects is 5/6G edge solutions that are linked to calls for funds under the Horizon Europe programme.

The digital transformation affects all sectors in the society and is at the same time heavily dependent on international developments. In a recent report,⁵²³ four agencies (Vinnova, Swedish Post and Telecom Authority, the Agency for Digital Government and the Swedish Research Council) jointly concluded that additional investments are required for Sweden to remain competitive, to boost the digital transformation in the private and public sector and to meet global sustainable development goals.

Increasing the use and level of expertise in both enterprises and research has been identified as a major factor to enable Sweden to achieve competitive advantages. SMEs are not specifically targeted with particular projects but they stand to benefit from general measures to support all businesses. SMEs are digitally advanced, but do not yet reap the full benefits of selling across borders in the EU, even though Sweden still ranks above EU average on this metric.

⁵²³ <u>https://www.vinnova.se/contentassets/b6f628d9450642068ce283db0f16381d/rapport-ru-kraftsamling-for-digital-strukturomvandling.pdf</u>

⁵²¹ https://www.ai.se/en

⁵²² https://www.ri.se/en

4 Digital public services

4 Digital public	Sweden		EU
services	rank	score	score
DESI 2021	5	83.9	68.1



	Sweden			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	90%	88%	88%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	72	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	88	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	94	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	84%	78%
% maximum score			2020	2020

Sweden ranks 5th in the EU on Digital public services. The percentage of Swedish e-Government users is stable at 88% in 2020, above the EU average at 64%. Digital public services for both individuals and businesses rank higher than the EU average. Open data is the area where Sweden has made a significant improvement and is for the first time above the EU average. However, there is still room for improvement since Sweden ranks 16th of the 27 EU Member States.

Sweden's national digitalisation strategy⁵²⁴ outlines the focus of the government's digital policy. Although it does not address the public sector specifically, the aim is to establish an innovative and cooperative public sector that is legally certain, available and contributes to the development of effective Swedish and EU policies. In the strategy, the public sector is invited to work towards the strategy's five goals: digital skills, security, innovation, leadership and infrastructure. Digital skills in the public sector are identified as a particularly important element in the overall framework of being more efficient, innovative and offering better services, which in combination with more data being made available will enable the public sector to develop more advanced and user-friendly services.

In Sweden, most governmental services are digitalised and highly decentralised. The Agency for Digital Government (DIGG) has been tasked with coordinating and supporting digitisation across the public sector in order to make it more efficient and fit for purpose. DIGG also supports the Swedish government by providing decision-making material and analyses.

Being an early supporter of the eIDAS scheme, Sweden has run an eIDAS node⁵²⁵ since 2018, which is connected to all EU Member States that have notified a scheme. The Swedish NRA (Post och Telestyrelsen, PTS) and DIGG are single points of contact and are active in the cooperation network, the technical subgroup and the expert group.

⁵²⁴ <u>https://www.regeringen.se/regeringens-politik/digitaliseringsstrategin/</u>

⁵²⁵ Each Member State sets up a node i.e. an interface which communicates with other nodes to request or provide cross-border identification and authentication.

Over 80% of Sweden's population uses mobile eID solutions, indicating a high degree of penetration. 98% of people between 18 and 67 use the BankID solution. According to a study carried out by the organisation Internetstiftelsen⁵²⁶, 86% of Swedish pensioners that use the internet also use mobile BankID.

Having a long tradition in data exchange within the public administration, Sweden is now seeking to move to a national infrastructure for data exchange, away from previous bilateral exchanges. The Swedish parliament decided to allocate between EUR 4.5 and EUR 8 million yearly to this goal. DIGG has been appointed to lead this development in cooperation with several other public authorities.

As part of the implementation of the Swedish National cybersecurity strategy⁵²⁷, the government commissioned the Civil Contingencies Agency to carry out targeted educational initiatives and to develop a structure to monitor systematic information security work in the public administration⁵²⁸. Sweden has also taken steps to ensure that cybersecurity certification is taken into account in public procurement and national technical regulations.

In addition, Sweden set up a national cybersecurity centre in 2020 with the aim of strengthening the country's overall ability to prevent, detect and manage cyber threats.

Recently, the Swedish data portal⁵²⁹ was launched, which lists open data sources, application programming interfaces (API's) and relevant specifications across multiple public administration bodies. It enables interested parties to search for and use relevant datasets in a coherent manner, promoting the re-use of data for the benefit of the entire society.

In order for Sweden to maintain its leadership on digital public services, it is important to ensure that it strengthens and maximises synergies between skills, use by the public administration of advanced technologies and the use of open data.

⁵²⁶ <u>https://internetstiftelsen.se/</u>

⁵²⁷ <u>https://www.regeringen.se/regeringens-politik/krisberedskap/nationell-strategi-for-samhallets-informations--och-cybersakerhet/ Nationell strategi för samhällets informations- och cybersäkerhet — Regeringen.se</u>

⁵²⁸ <u>https://www.regeringen.se/pressmeddelanden/2019/09/regeringen-genomfor-atgarder-for-starkt-informations--och-cybersakerhet/</u>

⁵²⁹ https://www.dataportal.se/en





Slovenia ranks 13th among the EU Member States in the 2021 Digital Economy and Society Index (DESI). It is 9th in the EU in Connectivity. The number of households covered by fixed very high-capacity networks has increased slightly and is above the EU average. The country performs well in the take-up of at least 100 Mbps broadband. Next generation access broadband covers 88% of households, close to the EU average, but this percentage is significantly lower in rural areas. Slovenia's 5G deployment has not yet begun and 5G spectrum is yet to be assigned. Certain radio frequency bands will be available later in 2021 and in January 2022.

On Human capital – one of Slovenia's biggest strengths – the country remains just below the EU average. The government is revising its digital education strategy, addressing digital skills as part of its 2027 digital education action plan to stimulate the uptake of digital technology by businesses.

Slovenia ranks 8th among EU countries on integration of digital technology in businesses. Highperformance computing (HPC) is a national investment priority. Slovenia now has 'HPC Vega', its first petascale EuroHPC supercomputer. In March 2021, Slovenia adopted the national cyber incident response plan, unifying cyber incident management procedures and providing stakeholder guidelines for a coordinated response.

In digital public services, the country performs well in the open data indicator, advancing to 10th position in the EU. Slovenian internet users actively engage with e-government services (77%) compared to the EU average of 64%. The country's 2030 digital public services strategy will set out the forthcoming goals and actions in this field.



Digital in Slovenia's recovery and resilience plan (RRP)

Slovenia's RRP has a total budget of about EUR 2.5 billion (5.4% of GDP) comprising EUR 1.78 billion in non-repayable financial support and EUR 705 million in loans allocated to four 'clusters': 'Green transition'; 'Digital transformation'; 'Smart, sustainable and inclusive growth'; and 'Health and welfare', including social housing. The plan's measures encompass all seven European flagships. Slovenia has earmarked 21% of the RRP for measures supporting the digital transition. The components with the largest contribution are those for the digital transformation of public services and the public administration (EUR 260 million), healthcare (EUR 83 million), competence development and modernising the education system (EUR 60 million) and the digitalisation of businesses (EUR 49 million). National strategies are under way with reforms and investments included in the RRP to address digital skills, digitalisation of businesses and electronic identification is expected to strengthen public e-services and the digitalisation of companies, boosting cybersecurity across sectors. Investments in connectivity and digital skills are expected to reduce the digital divide.

Slovenia is planning four multi-country projects on advanced technologies: i) Next Generation Cloud Infrastructure and Services, ii) Low-Power Processors and Semiconductor Chips, iii) European Blockchain Service Infrastructure and iv) European Quantum Communications Infrastructure. The country aims to build a new generation of energy-saving infrastructure and services from edge to cloud, implementing industrial and service applications, and strengthening the cybersecurity of cloud infrastructure and services. Slovenia's goals are to (i) improve planning capabilities and the autonomy and resilience of semiconductor value chains, (ii) extend European blockchain service infrastructure by integrating it with national infrastructure and (iii) establish a national quantum communication infrastructure network connected to those of neighbouring countries.

1 Human capital

1 Human canital	Slov	venia	EU
I naman capitai	rank	score	score
DESI 2021	13	47.8	47.1



	Slovenia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	54%	55%	55%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	30%	31%	31%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	57%	59%	59%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	4.0%	3.9%	4.4%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	17%	20%	17%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	29%	28%	26%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	3.7%	3.5%	4.1%	3.9%
% graduates	2017	2018	2019	2019

On Human capital, Slovenia ranks 13th among EU Member States. Slovenia's human capital is one of its strengths, with a high number of STEM graduates and ICT start-ups above the EU average. In all indicators in this dimension, Slovenia is close to the EU average. 55% of people aged 16 - 74 years have at least basic digital skills. The proportion of ICT specialists stands at 4.4% of the workforce, up from 3.9% a year ago and women make up 17% of all ICT professionals. ICT graduates in Slovenia account for 3.5% of the total.

The *Digitalna Slovenija 2020*⁵³⁰ strategy 2016-2020 helped improve connectivity and wi-fi access in schools, digital literacy and inclusion, also that of older people. Guidelines for active employment measures for 2021-2025 were adopted in early 2021, focusing on digital skills, literacy, and lifelong learning, especially for vulnerable groups. Slovenia is revising its digital education strategy to address digital skills in its 2027 digital education action plan finalised by the Ministry of Education, Science and Sport⁵³¹. Its vision is a robust education and training system which prepares people for a quality life in a digital and green society, comparable to the most advanced countries. It will establish a national centre and hubs for digital education, a comprehensive structure coordinating all aspects of digital education: organisational, content-related and financial.

⁵³⁰ See Digitalizacija družbe | GOV.SI.

⁵³¹ Key areas: digital education hubs, pedagogy, updating curricula, study programmes and job profiles, education and training of educators, management and other experts; inclusive digital support environment; education in special circumstances.

In response to the COVID-19 crisis, Slovenia took steps to equip schools, teachers and students with digital devices, educational applications and content to allow for continuity during the school closures. Through the European Regional Development Fund project 'SIO 2020' and other funds, the Slovene government purchased ICT equipment for schools and server infrastructure for applications and e-services. It prioritised e-services, educational applications and the raising of teachers' and parents' digital competences. Slovenia is stepping up the development of emerging technologies that improve teaching and learning to reduce the share of underperforming students in computer and information literacy. The government is developing the 2030 'Digital Slovenia' strategy, outlining its digitalisation goals around five priorities, one being digital inclusion.

Numerous programmes support digital development. The Chamber of Commerce's Digital Academy has been running since 2017. The Ministry of Economic Development and Technology funds vouchers for digital competences, marketing, strategy and cybersecurity for small and medium-sized enterprises (SMEs). In 2020, SMEs received over 2000 vouchers to help them improve their digital performance. The Digital Innovation Hub Slovenia is preparing consultancy services for digital education programmes in companies and digital roadmaps matching their digital maturity. The project collaborates with the Slovenian Chamber of Commerce and Industry and the Ministry of Economic Development and Technology. A public tender in April 2021 aims to strengthen companies' digital competencies supporting 2 500 older (50+ years) employees by June 2022.

Slovenia's human capital is characterised by a relatively high number of ICT start-ups above the EU average and a high proportion of STEM graduates. Slovenia would benefit from encouraging more people, particularly women, to train and reskill to become ICT specialists, with software developers most in demand according to the Digital Innovation Hub Slovenia.

Slovenia witnessed a significant take-up of teleworking, remote schooling, online commerce (click and collect) and online banking over the past year. The COVID-19 crisis provided the push for change, stimulating support programmes and measures that are expected to positively affect the digital divide, and address weaknesses highlighted in the past.

Human capital in Slovenia's recovery and resilience plan (RRP)

Investments in digital skills is a key focus of the digitalisation measures in the Slovenian plan, which dedicates EUR 66.72 million to the digitalisation of education, science and sport. Measures include reforms and investments to increase the digital skill levels of public employees as well as of the population at large. This includes the setting up of a competence centre for upskilling civil servants and strengthening their digital skills, the development of IT solutions for education, trainings of teachers, modernising curricula for digital skills development, and digitally equipping learning places. A significant part of the education investments in the RRP also focuses on increasing digital skills and the number of education professionals and managers who have completed training in digital and sustainable development. Parts of the investment under the 'digitalisation of the public administration' component also contain measures to develop digital skills in the public administration sphere.

2 Connectivity

2 Connectivity	Slov	venia	EU	
,	rank	score	score	
DESI 2021	9	53.2	50.2	



	Slovenia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	85%	83%	80%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	16%	21%	29%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	0.02%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	86%	87%	88%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	61%	64%	66%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	99.5%	99.7%	>99.9%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	0%	98%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	64%	73%	73%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	63	72	69
Score (0-100)		2019	2020	2020

With an overall score of 53.2, Slovenia ranks 9th in the EU for connectivity. It has very good fixed Very High-Capacity Network (VHCN) coverage (66% – rising from 61% in 2018 – against an EU average of 59%). The VHCN networks (65.6%) are all fibre to the premises, while cable networks, which currently cover 58.7% of households, have not yet been updated to DOCSIS 3.1. On the other hand, the take-up of at least 100 Mbps broadband steadily increased (from 21% of households in 2019 to 29% in 2020), but overall, Slovenia scores lower than the EU-27 average for this indicator (34% of households in 2020). Concerning next generation access (NGA) broadband coverage, 88% of total Slovenian households are covered, which is close to the 2019 figure and one percentage point higher than the EU average. However, regarding the percentage of households covered in rural areas, the figure drops to 63%. 5G deployment stood at 0%, as no 5G spectrum was assigned in 2020. The broadband price index observed an increase in 2020, rising from 63 to 72 (on an index score from 1 to 100). This figure is slightly higher than the EU average of 69.

Although the Slovenian 2020 national broadband strategy (next-generation broadband network development plan – NGN), set up in 2016 and updated in 2018, is in line with the gigabit society targets, the EU 2020 goals for gigabit coverage have not yet been achieved. This was mainly due to

the delay of the publicly funded project for the construction of the 2020 NGN, with a budget of approximately EUR 29.5 million (of which EUR 23.5 million came from the European Regional Development Fund). The two calls for tender in 2018 were unsuccessful due to lack of applicants. According to the Slovenian authorities, the causes included insufficient public funds for co-financing and a relatively low population density. Later in 2020, a new tender was launched with an improved co-financing model, with 27% of the existing white spots (areas without network coverage) covered under this call. In March 2021, a new tender was published with a further improved co-financing model.

The new national broadband plan for Slovenia, which was originally scheduled for 2020, but then postponed due to the COVID-19 outbreak, is now under preparation and will be part of the 2030 'Digital Slovenia' strategy, still to be adopted in 2021. The new plan is expected to include measures in line with the EU gigabit objectives for 2025, including (i) 5G coverage for urban areas and main terrestrial transport routes, (ii) gigabit connectivity for schools, transport hubs, public services providers and digitally intensive enterprises, and (iii) at least 100 Mbps upgradable to 1 Gbps coverage for the public.

According to data collected by the Ministry of Public Administration, the interest expressed by operators in 2016-2017 and in 2019 shows that they intend to build infrastructure for around 130,000 fixed Next Generation Access (NGA) networks in the coming years using private funds, where such connections do not yet exist today. This would leave approximately 55,000 households uncovered.

A multiband auction for spectrum assignment took place in April 2021. After several bidding rounds, the frequencies were assigned to A1 Slovenije, T-2, Telekom Slovenije and Telemach. Except for frequencies in the 2100 MHz band, which became available in September 2021 and frequencies in the 2300 MHz band, which become available in 1 January 2022, all other bands were already available.

The Slovenian government is planning to propose projects to finance digital infrastructure in the next funding period (2021-2027) of the Connecting Europe Facilities 2 (CEF 2) programme, with a focus on continuing the construction of broadband infrastructure. The priorities are mainly in 5G technology, i.e. the 5G corridors Ljubljana-Koper and Ljubljana-Trieste. The project proposals are planned to involve both public and private organisations. The Slovene authorities intend to have the projects involving the construction of co-financing broadband infrastructure in white spots co-financed within the RRF and in the next funding period within the European Regional Development Fund.

Main market & regulatory developments

In 2020, the Slovenian market experienced an increase in the take-up of quadruple-play and triple-play bundles. A slow migration of users from stand-alone broadband access and double play to other bundles was also observed in 2020. Telemach has the highest market share of bundles (33.0 %), followed by Telekom Slovenije (29.1 %) and T-2 (19.5 %).

In terms of usage patterns of over-the-top media services (OTTs), communication between people migrated from SMSs to calls and use of social media such as Zoom, Webex, Viber, WhatsApp, and Skype. This phenomenon occurred due to COVID-19 pandemic measures. At the same time, until March 2020, roaming calls (made and received) and SMSs maintained their

seasonal pattern, which showed a growth trend. The pandemic and the measures taken have affected roaming calls (made and received) and SMSs, with revenues significantly decreasing from April 2020 onwards.

Although Telekom Slovenije remained the leader in terms of market share of fixed broadband connections (30.3%) in 2020, Telemach has been advancing rapidly. Concerning VoIP, mergers of small but important operators have greatly increased the market share of Telemach (32%), which is gaining gradually on Telekom Slovenije's market share (34%).

The public consultation on the draft of the new electronic communications act was (the ZEKom-2) completed by the end of October 2020. Slovenia is one of the 23 EU Member States that received, on 4 February 2021, a letter of formal notice that started the infringement procedure for failing to transpose into national law Directive (EU)2018/1972, establishing the European Electronic Communications Code, by the deadline of 21 December 2020. According to the procedure, inter-ministerial coordination must be carried out before the government confirms the wording of the ZEKom-2. It must then be sent to the National Assembly for adoption. The government had been expected to finish the first part of the procedure by July 2021, while the National Assembly is expected to adopt the ZEKom-2 by November 2021. Then the act is expected to be published in the Official Gazette of the Republic of Slovenia in either November 2021 or, at the latest, the beginning of December 2021.

Slovenia presented a National Roadmap for implementing the EU 5G Connectivity Toolbox. It includes measures on simplifying the procedure for operators when applying for permits, the applications for which can be submitted electronically. The ZEKom-2 is expected to (i) retain the limit on fees for rights of way from the existing Law on Electronic Communication (ZEKom-1) and extend it further to all networks, and (ii) retain (from ZEKom-1) free of charge access to real estate owned by the state or a self-governing local community, when using public funds for construction.

In October 2020, the government presented a draft proposal to merge eight regulators, including the Slovenian National Regulatory Authority for Telecommunications, AKOS, into two super-agencies. The proposal did not get enough support in Parliament during the first reading in April 2021, and the bill was therefore rejected.

In 2020, the overall number of complaints fell from 2019 (568 against 720). Also, in 2020, most disputes were connected to billing and poorly operated services (unjustified invoices and unavailability of service). This drop in complaints could be linked to AKOS' launching of a service advising end users about their rights, where to find solutions, and when/how to file a formal dispute.

By completing the spectrum multiband auction, Slovenia has taken a significant step in implementing its strategy for managing the radiofrequency spectrum needed for promptly assigning the 5G pioneer spectrum bands and for deploying 5G. However, it will be important to ensure that (i) the European Electronic Communications Code is promptly transposed into national law, (ii) the recommendation included in the EU Connectivity Toolbox to make the 5G deployment sustainable for the operators is systematically implemented, and (iii) the measures are in line with the 2025 gigabit society targets.

Highlight 2020-2021: multiband auction

The multiband auction took place in April 2021. The frequencies were acquired by the following bidders: A1 Slovenije, T-2, Telekom Slovenije and Telemach. The following radio frequency bands are still available after the licences were issued in mid-2021 – 700 MHz FDD, 700 MHz SDL, 1500 MHz SDL, 3600 MHz and 26 GHz. Frequencies in the 2100 MHz band are available since 22 September 2021 and those in the 2300 MHz band as of 1 January 2022. Before the additional frequency bands were awarded in 2021, Telekom Slovenije established a fifth-generation national network in July 2020 upgrading 150 base stations.

Connectivity in Slovenia's recovery and resilience plan (RRP)

The digital administration component is expected to further address the transition to a gigabit society by improving the regulatory environment and strengthening digital connectivity through investment in broadband infrastructure in hard-to-reach areas.

Investments in connectivity (EUR 30 million) are envisaged to bridge the digital divide. The plan includes the development of the Connectivity toolbox roadmap to foster 5G and broadband roll-out with the introduction of best practices. The strategy for the digital transformation of enterprises will also include a roadmap for implementing the Common Union Toolbox for Connectivity⁵³², which will focus on activities related to a single information point. The reform included in the roadmap will be completed by 30 June 2022.

⁵³² According to Commission Recommendation (EU) 2020/1307 on a common Union toolbox for reducing the cost of deploying very high capacity networks and ensuring timely and investment-friendly access to 5G radio spectrum, to foster connectivity in support of economic recovery from the COVID-19 crisis in the Union.

3 Integration of digital technology

3 Integration of	Slo	EU	
digital technology	rank	score	score
DESI 2021	8	42.3	37.6



	Slovenia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity	NA	NA	68%	60%
3b1 Electronic information sharing	30%	33%	33%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	18%	24%	24%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	10%	10%	7%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	17%	17%	26%	26%
% enterprises	2018	2018	2020	2020
3b5 AI	NA	NA	33%	25%
% enterprises			2020	2020
3b6 ICT for environmental sustainability	NA	NA	74%	66%
% enterprises having medium/high intensity of green action through ICT			2021	2021
3b7 e-Invoices	62%	62%	58%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	17%	17%	17%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	NA	11%	12%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	12%	12%	12%	8%
% SMEs	2017	2019	2019	2019

Slovenia ranks 8th among EU countries on integration of digital technology in businesses. In all the indicators apart from businesses using electronic information sharing, where it is 3 percentage points below the EU average, Slovenia's scores are equal to or higher than the EU average. The country performs in line with the EU average for cloud services, SMEs selling online and e-commerce turnover, but falls short on the use of big data analysis at 7% against the EU average of 14%. SMEs with at least a basic level of digital intensity are at 68% compared to 60% at EU level. 33% of companies use AI, compared to 25% at EU level, and 58% of them use e-invoices (nearly twice the EU average).

The country continues to implement the *Digitalna Slovenia 2020* strategy, the research and innovation strategy, and the smart specialisation strategy. Actions stemming from those strategies are the strategic research and innovation partnerships (SRIPs), digital innovation hubs and FabLabs (digital fabrication laboratories, providing access to skills, materials and technology to create, mentor and invent). SRIPs are long-term partnerships between the business community, research organisations, the state, innovation users and NGOs. Stakeholders coordinate R&D activities, share capacities, knowledge and experience. There are nine SRIPs involving key digital technologies,

including the SRIP Smart Cities and Communities/ICT Horizontal Network and the SRIP Factories of the future (robotics, photonics, process technologies, and plasma).

Slovenia's programme for SMEs' digital transformation 2018-2023 includes: (i) activities of the digital innovation hub; (ii) the Slovene Entrepreneurial Fund's voucher schemes for digitisation worth EUR 1 000 - EUR 9 999 per project for investments related to digital strategy, marketing, competencies and cybersecurity; (iii) SMEs' digitalisation, for which SPIRIT Slovenia (the business development agency) launched a call. Slovenia has successfully finished the national designation process, proposing three candidates for the Network of European Digital Innovation Hubs⁵³³. Slovenia plans to use financing from the European Regional and Development Fund to strengthen its network of hubs.

Slovenia has signed the EU declaration on cloud computing. High-performance computing (HPC) is a national priority according to the 2011-2020 research and innovation strategy, the 2014-2020 research infrastructure development plan and the smart specialisation strategy S4⁵³⁴. HPC Vega, operating since 2020, is the country's first petascale Euro HPC supercomputer and the first EU supercomputer jointly financed with EU funds. It will support European researchers and users from the public and industrial sectors, driving innovation and competitiveness in AI, high-performance data analytics, personal medicine, bioengineering, climate change, and drug and material design.

Slovenia has made a successful bid under a CEF call for a hub setting up blockchain infrastructure to allow reliable cross-border services. It launched the national test blockchain infrastructure 'SI-Chain', which will enable existing and new blockchain applications for the public and private sectors to be tested. Creating a supportive environment may boost the innovation potential of SMEs and start-ups. The European blockchain services infrastructure would be part of the 2022 strategy for eight nodes at national level, funded with EUR 6.5 m. Slovenia has signed the EU Declaration on AI⁵³⁵, and is adopting the national programme for artificial intelligence. In June **2020, Slovenia** co-launched the Global Partnership on Artificial Intelligence (GPAI) initiative, which promotes responsible AI use and development, and encourages investments that consider human rights and diversity⁵³⁶.

In March 2021, Slovenia adopted the national cyber incident response plan (NCIRP), unifying the management of cyber incidents and providing guidelines for a coordinated response to all stakeholders. It offers a uniform taxonomy for classifying hazards and effects of cyber incidents, a methodology for reporting incidents, and a response at national level. The NCIRP also sets out the composition and tasks of the CyberSecurity Coordination Group as per the Information Security Act. Slovenia intends to continue its efforts to (i) digitalise businesses, with a specific focus on SMEs, (ii) tap into the potential of digital technologies for higher productivity and innovation capacity and (iii) further improve the competitiveness of its economy.

⁵³³ Zaključen izbor prijaviteljev v Republiki Sloveniji za kandidaturo za Evropska digitalna inovacijska stičišča (EDIH) | GOV.SI)

⁵³⁴ Slovenia is currently preparing its new 2021-2030 research and innovation strategy, in which open science is a priority area.

⁵³⁵ See EU Declaration on Cooperation on Artificial Intelligence | JRC Science Hub Communities (europa.eu)

⁵³⁶ According to the Ministry of Education, Science and Sport, this international initiative will aim to close the gap between theory and practice by supporting state-of-the-art research, pilot projects and top-priority AI efforts. The initiative will bring together experts from various fields in cooperation with international organisations and partners. The task forces will focus on four subjects: responsible AI, data management, the future of work, and innovations and commercialisation.

Integration of advanced technology in Slovenia's recovery and resilience plan (RRP)

The digital transformation strategy for enterprises included in the RRP is expected to be finalised by the end of 2021. It envisages RRF investments for EUR 49 million. It will ensure that all business operators are registered in one register in accordance with the "once-only" principle embedded in the Single Digital Gateway Regulation EU 2018/1724. It will include a roadmap for the implementation of the Common Union Toolbox for Connectivity, activities relating to a single information point and a timeline for the completion of each action. Flanking those measures are reforms on electronic identification that will increase the use of public eservices and the digitalisation of companies, as boost cybersecurity across sectors.

Slovenia's RRP includes reforms an investments related to the digitalisation of businesses. The reforms are expected to accelerate the implementation of the following two investments: establishing a hybrid cloud and the industrial/business digital transformation programme for 20 consortia of large, medium and small businesses. The purpose is to boost the competitiveness of SMEs and large companies.

The digital cluster comprises four multi-country projects on cloud and edge computing, microelectronics, quantum communication and blockchain. In terms of advanced technologies for businesses, the plan includes €7.5 million in support to the IPCEIs in cloud, edge computing and microelectronics.

4 Digital public services

4 Digital public	Slovenia		EU
services	rank	score	score
DESI 2021	15	68.0	68.1



	Slovenia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	67%	63%	77%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	67	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	74	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	78	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	84%	78%
% maximum score			2020	2020

Slovenia ranks 15th among EU countries in digital public services. 77% of Slovenian internet users engage with e-government services compared to the 64% EU average. Slovenia's digital public services score for businesses is 78 compared to 84 for the EU. The country performs well in the open data indicator, ranking 10th.

According to the latest eGovernment Benchmark Report⁵³⁷, Slovenia is experiencing a medium-low level of penetration, with an average level of digitalisation in public services. Therefore, it is part of the 'expandable eGov scenario', in which the innovation process has been carried out efficiently, but it is desirable to expand the number of users to fulfil its potential. A common national electronic identifier is missing, but an e-ID action is planned for 2021 (including the development of e-identity for businesses or the creation of a single register, together with an innovative solution to create e-identity for businesses – 'digital cards'). This action is planned as access to several open databases and services is not secure or user-friendly. Efforts are needed to accelerate the introduction of secure, unique and user-friendly solutions such as e-identifiers or e-signatures, which will boost the uptake of digital public services. It is also necessary to increase interoperability across public IT systems (for the tax authority, land registry, company register, etc.) which are mostly designed as closed systems, operating with different access codes to those for the general digital public services platform e-VEM.

Investments in common standardised architecture and digital infrastructure with converging 4IR technologies (Internet of things, big data, AI/machine learning, blockchain, and cybersecurity) will

⁵³⁷ https://digital-strategy.ec.europa.eu/en/library/egovernment-benchmark-2020-egovernment-works-people

support the reform of local public services making digital services more accessible to users and decreasing the risk of social exclusion.

The COVID-19 crisis affected key societal indicators related to public use of internet services. Public administration interacted online with the public and businesses, as some identification requirements were lifted or loosened to make digital public services more user-friendly.

The 2030 digital public services strategy will set out the goals and actions in the field through a secure and smart public service ecosystem that will increase its efficiency through advanced technologies and tools. Slovenia is preparing new legislation to introduce a national e-identity card in 2021 and has rolled out the 'SMS PASS' for mobile-based access. It intends to introduce new appbased mobile solutions for authentication and e-signature to offer more secure mobile access. Slovenian citizens and companies have unique ID numbers widely used in paper-based and online procedures, but which are unsuitable for electronic identification. At present, most e-services rely on qualified digital certificates issued by the public or private sector used for authentication and e-signature. Their caveat is that they are relatively complex for the user and can depend heavily on browser policies.

The authentication and e-signature service 'SI-PASS', which offers a central service for authentication and e-signature, is integrated into the portals of over 100 municipalities. This service along with the Slovenian eIDAS node can enable cross-border authentication according to the eIDAS regulation. Projects to implement the CEF building blocks are being prepared and in this instance, Slovenia intends to use EU structural funds. The planned roll-out of the national e-identity card in 2021 and the recent app-based mobile solutions for authentication and e-signature implemented in 2020 are expected to result in secure, unique, user-friendly electronic identifiers. This should boost the take-up of digital public services and online transactions in the business sector. The governance framework will be included in the forthcoming 2022-2027 strategy for digitalisation of healthcare – an outcome of the structural reform support programme.

The lower than expected up-take of digital public services could be linked to a low degree of trust, security concerns and low interoperability, although Slovenia saw considerable take-up of e-government services by businesses and households. The roll-out of e-identity through a certificate or through SMS Pass should boost the use of digital public services and trust in online transactions. It should ensure mobile and cross-border access to public services. The adoption of a national digital public services strategy will lay the foundation for a forward-looking policy framework flanked by a new institutional organisation: the IT Development Council, responsible for steering and coordinating digital solutions in the public sector.

Digital public services in Slovenia's recovery and resilience plan (RRP)

Slovenia's RRP brings a comprehensive approach to digitalisation of the public administration, backing it with an allocation of almost EUR 309 million (12.5% of the budget). A balanced package of reforms and investments in ICT infrastructure aims to strengthen e-government, the data economy and R&D for AI.

The plan introduces a national electronic identifier to speed up the development of e-services nationally and cross-border, opening access to interoperable e-services. Slovenia is expected to adopt the 2021-2030 digital public services strategy and re-establish the Informatics Development Council as the coordinator for all ICT investments. The national cybersecurity strategy will strengthen capacity and diminish risks. Investment in research, development and

innovation as regards the digital transition should ensure state-of-the art digital solutions. The one-stop shop for businesses in their dealings with the public administration will be expanded for the public, aiming to reduce the administrative burden for businesses by providing them with a single digital identity, facilitating market access, increasing security and reducing operational risks. Key measures in these components include a strategy for digital transformation of the public sector including eIDs for the public and companies.

The RRP promotes the digitalisation of the following areas: (i) the public administration for internal security (upgrade the technology available to the police via state-wide TETRA digital radio network infrastructure, involving 11 000 users); (ii) education; (iii) science and sport; (iv) space and environment; (v) agriculture, food and forestry; (vi) culture (EUR 10 million for building an e-culture platform); (vii) spatial planning; (viii) real estate; (ix) nature; (x) water; and (xi) justice (upgrading equipment for courts, and providing a virtual assistant at the Supreme State Prosecutor's Office, making the justice system more accessible and shortening the time needed to handle cases).





Slovakia ranks 22ND of 27 EU Member States in the 2021 edition of the Digital Economy and Society Index (DESI). The country stays at the same position as in 2020.

Slovakia is just below or around the EU average across the human capital dimension indicators. 54% of Slovaks have at least basic digital skills and 27% have above-basic digital skills in comparison to 56% and 31% for the EU average. The number of enterprises providing ICT training was 16% in 2020, which is 4 percentage points lower than the EU average of 20%. The share of ICT specialists in total employment has also grown and almost reached the EU average. Overall fixed broadband take-up in Slovakia increased steadily from 72% in 2019 to 78% in 2020. Slovakia has significantly improved the take-up of super-fast internet and progressed in VHCN coverage, and the completed 5G auction improved the score in 5G readiness. 52% of SMEs have at least a basic level of digital intensity, which is below the EU average of 60%. 15% of enterprises used at least two artificial intelligence (AI) technologies in 2020, in comparison to 25% in the EU. The percentage of enterprises using e-invoices is 16%, significantly below the EU average of 32%. Most indicators for the Digital public services dimension are lower than the EU average, except for the 68% share of e-government users in 2020, compared to 64% for the EU.

Overall, Slovakia's progress in the areas monitored is limited. Public funds spent so far to stimulate digital transformation have not always achieved the desired effect. There has been some progress in the integration of digital technology; for example, the percentage of enterprises using cloud computing services is steadily increasing. However, there continues to be a need for enterprises to utilise the potential of big data, AI and electronic information sharing systems. Average performance in e-commerce is a missed opportunity. Digitalisation of education is below its potential, as schools, teachers and pupils lack skills and tools. Fast broadband and very high-capacity network coverage needs to be improved creates a barrier for a wider use of digital technologies and services by households and enterprises. Administrative barriers often slow down network deployment, and Slovakia has not yet transposed the provisions of the European Electronic Communication Code.

Slovakia is rolling out new digital public services, but more can be done to improve their quality and interoperability. People and businesses would benefit from an increased availability, efficiency and user-friendliness of digital public services. Digital transformation is one of the main pillars of the Slovak Recovery and Resilience Plan (RRP) with the main focus on public services, skills and digitalisation of businesses. Slovakia is well connected to the main European initiatives in the digital domain, and the RRP will further support several multi-country projects.

The COVID-19 pandemic made existing weaknesses in Slovakia's digital economy and Slovak society even more visible, including in connectivity, digital skills attainment and digitalisation of schools, households, enterprises and in public services. IT systems in hospitals, schools and public institutions were not ready for the sudden switch to online and remote functioning.

Slovakia has committed to improving its score and position in DESI. The Ministry of Investments, Regional Development and Informatisation unveiled a detailed strategy and action plan⁵³⁸ with concrete measures to address shortcomings identified by DESI indicators. This document mirrors the main DESI dimensions and aims to deliver significant improvements by 2025. This initiative builds upon the *2030 Strategy for the Digital Transformation of Slovakia*⁵³⁹ and the related action plan⁵⁴⁰.



Digital in Slovakia's Recovery and Resilience Plan (RRP)

⁵³⁸ <u>https://www.mirri.gov.sk/aktuality/digitalna-agenda/ministerka-remisova-predstavila-plan-ako-slovensko-dostat-v-digitalizacii-na-europsku-uroven/index.html</u>

⁵³⁹ <u>https://www.mirri.gov.sk/wp-content/uploads/2019/06/Strategia-digitalnej-transformacie-Slovenska-</u> 2030.pdf

⁵⁴⁰ https://www.mirri.gov.sk/wp-content/uploads/2019/07/Akcny-plan-DTS 2019-2022.pdf

The digital transformation of the economy and the society is at the heart of Slovakia's Recovery and Resilience Plan. Digital reforms and investments included in the plan should help to modernise Slovakia, focusing on areas which show significant investment needs. The Slovak plan's contribution to the digital transition amounts to EUR 1.33 billion or 21% of its total allocation of EUR 6.33 billion.

The plan places a strong emphasis on the digitalisation of the public sector, both as part of sectoral reforms (justice, police, healthcare) and cross-cutting measures aimed at increasing the quality and accessibility of e-government solutions. A reform of the governance model for the digital economy, together with investments in digital technologies and the digital capacity of enterprises, in particular SMEs, should help in developing the digital ecosystem. Developing digital skills is one of the objectives of the proposed educational reforms and of the investment in the skills of teachers, seniors and disadvantaged groups.

The Slovak authorities plan to finance connectivity investments from other sources; however, the recovery and resilience plan will help to achieve national targets in the broadband strategy by strengthening the coordination role of the Broadband Competence Office.

The plan will support participation in several cross-border projects to enable the digital transition. This includes participation in a network of digital innovation hubs and European digital innovation hubs to support Slovak SMEs with digitalisation. It also includes investment in high performance computing (HPC) with the aim to participate in the EuroHPC joint undertaking. The Recovery and Resilience Facility will also support two other multi-country projects to be determined at a later stage. Potential projects include participation in the European blockchain and quantum communication infrastructure.

1 Human capital

rank score score
DESI 2021 19 43.8 47.1



	Slovakia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
1a1 At least basic digital skills	59%	54%	54%	56%
% individuals	2017	2019	2019	2019
1a2 Above basic digital skills	33%	27%	27%	31%
% individuals	2017	2019	2019	2019
1a3 At least basic software skills	63%	56%	56%	58%
% individuals	2017	2019	2019	2019
1b1 ICT specialists	3.2%	3.7%	4.2%	4.3%
% individuals in employment aged 15-74	2018	2019	2020	2020
1b2 Female ICT specialists	13%	14%	16%	19%
% ICT specialists	2018	2019	2020	2020
1b3 Enterprises providing ICT training	18%	18%	16%	20%
% enterprises	2018	2019	2020	2020
1b4 ICT graduates	3.3%	3.9%	3.9%	3.9%
% graduates	2017	2018	2019	2019

In the Human capital dimension, Slovakia ranks 19th out of 27 EU countries and is thus below the EU average. 54% of Slovaks have basic digital skills and 27% have advanced digital skills. Both indicators are below the EU average of 56% and 31% respectively. The share of enterprises that provide ICT training to their employees decreased to 16%. The proportion of ICT specialists in total employment grew to 4.2%, although it is still slightly below the EU average (4.3%). 16% of ICT specialists are women.

Improving digital skills continues to be one of the government's priorities. Slovakia's newly adopted Strategy and action plan to improve its position in the DESI Index by 2025⁽⁵⁴¹⁾ also covers measures in the human capital dimension, such as measures to improve the conditions for keeping graduates in ICT, support the study of technical disciplines at all levels of education or increase the performance of Slovak universities. Furthermore, the *2030 Strategy for the Digital Transformation of Slovakia* ⁽⁵⁴²⁾ and the related action plan for 2019-2022⁽⁵⁴³⁾ are being implemented, but many key measures have been delayed. The aim is to adapt the education system and focus on skills for jobs. The strategy also mentions the need to develop soft skills and competences for taking part in digital society (digital citizenship). The government is working on a programme for education's digital transformation, but Slovakia is far from having all schools connected to very high capacity broadband.

The education sector records the biggest digital skills mismatches and needs for ICT specialisation, with approximately 10,000 ICT experts needed. Due to the lack of digital skills and infrastructure,

542 https://www.mirri.gov.sk/wp-content/uploads/2019/10/SDT-English-Version-FINAL.pdf

⁵⁴¹ <u>https://rokovania.gov.sk/RVL/Material/25949/1</u>

⁵⁴³ https://www.mirri.gov.sk/wp-content/uploads/2019/10/AP-DT-English-Version-FINAL.pdf

some schools, especially at the beginning of the pandemic, struggled to organise and deliver distance learning. The upskilling of teachers and other workers within lower levels of the education system has become a priority. According to the Slovak School Inspectorate, 45% of schools do not have a single qualified IT teacher. In 2020, webinars were held on a regular basis as part of the national 'Teachers' programme ⁽⁵⁴⁴⁾, the aim being to provide online methodological assistance to teachers during the pandemic. In 2020, the Ministry of Education, Science, Research and Sport granted EUR 6 million to schools for the purchase of necessary digital equipment and in January 2021 granted an additional EUR 3 million for this same purpose. Altogether, 2,265 schools received a grant.

Slovakia has several initiatives and projects such as the IT Fitness test⁽⁵⁴⁵⁾ or IT Akademia⁽⁵⁴⁶⁾ to improve students' and teachers' digital skills. The country also follows the national education programme, which highlights the need to increase the use of digital technologies in classrooms and improve the digital skills of both students and teachers. The Ministry of Education, Science, Research and Sport has adopted the outcomes from the IT Akademia project and is preparing to implement the concept of *digital coordinators*, i.e. trained teachers who will advise and manage schools' digital transformation programmes. The goal is to help teachers improve their digital skills so they are better equipped and empowered to use digital educational content and better prepared for online or hybrid teaching.

Since 2017, Slovakia has an active National Digital Coalition⁽⁵⁴⁷⁾ that works closely with the government. Its 83 members have submitted 219 pledges that range from bringing more IT classes to schools and training teachers to helping workers get their skill-sets ready for industry 4.0.

The IT Fitness test run by the National Digital Coalition has helped to signifcantly improve the reach of the testing and has doubled the number of both student and teacher participants. However, the results of the testing were below expectations, particularly when it came to security and the use of office software.

Slovakia regularly participates in EU Code Week. In 2020, the number of activities increased by 8% to 165 and the organisers reported over 9,100 participants.

Slovakia continues to implement reforms to improve its performance in the Human capital dimension. However, the country remains below the EU average. The strategy focuses on reforming education, adapting it to technological developments, and on equipping teachers and students with skills and competences for living and working in a digital economy. Translating the strategies into concrete actions, ensuring proper funding and using current successful initiatives such as the IT Fitness test to reach a larger share of the population could improve Slovakia's score in this dimension.

Highlight 2020: IT Academy (IT Akademia)

Since 2016, the IT Akademia has contributed to increasing digital skills of students and teachers in all levels of education. Its goal is to create a model of education and training for young people that better addresses the needs of the society and the labour market with a focus on digital skills. The project is delivered in partnership with five Slovak universities and is cofinanced by the European Social Fund. Total financing for the project is EUR 19 million for the

⁵⁴⁴<u>https://www.youtube.com/channel/UCGltBBHjdTeaJ4g0HuT-iAA/videos</u>

⁵⁴⁵ https://itfitness.sk/sk/

⁵⁴⁶ <u>https://itakademia.sk</u>

⁵⁴⁷ <u>https://digitalnakoalicia.sk/</u>

period 2016-2021.

The project involves a total of 683 primary and secondary schools, five universities, more than 50 thousand primary and secondary school students, more than 300 primary and secondary school teachers and more than 4,000 university students. During the COVID19 pandemic, IT Akademia has provided professional assistance to help with distance learning.

Some of the main outcomes of the project include:

- 1,132 innovative methodologies for teaching informatics, mathematics, biology, physics, chemistry, geography and other subjects at primary and secondary schools
- 60 new and innovated subjects at 5 universities to address the needs of the labour market and digital transformation —in fields such as Data Science, Internet of Things, Computer Networks and Business Information Systems
- Teacher education and professional development (updates, innovation, webinars, consultations) with a focus on the use of created teaching materials and on supporting the digital transformation of education

In 2018, IT Akademia received a special ITAPA award for its contribution to education.

Human capital in Slovakia's Recovery and Resilience Plan

Slovakia considers digital skills a key condition for the digitalisation of its economy and society, with the total contribution of the recovery and resilience plan to this policy area being EUR 298 million. Developing digital skills is one of the main objectives of the educational reform outlined in the plan and the reform builds on previous and existing initiatives to improve digital skills. Concrete measures include revising the curriculum to focus more on digital skills, providing training opportunities for teachers and ensuring investments in the digital equipment of schools and digitalisation in higher education.

The plan includes developing a national digital skills strategy for adults to ensure that all adults are able to participate in a society transformed by digitalisation. Additionally, investments are planned to improve the digital skills of the elderly and vulnerable persons through the combination of training in digital skills and the provision of digital equipment. The plan also focuses on developing the specialised skills of IT and cybersecurity experts in the public sector. Digital innovation hubs will offer services to businesses, in particular SMEs, for developing the digital skills of their employees.

2 Connectivity

2 Connectivity	Slovakia		EU
··· ··· ·,	rank	score	score
DESI 2021	19	46.3	50.2



	Slovakia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
2a1 Overall fixed broadband take-up	70%	72%	78%	77%
% households	2018	2019	2020	2020
2a2 At least 100 Mbps fixed broadband take-up	13%	15%	25%	34%
% households	2018	2019	2020	2020
2a3 At least 1 Gbps take-up	NA	<0.01%	0.38%	1.3%
% households		2019	2020	2020
2b1 Fast broadband (NGA) coverage	73%	74%	75%	87%
% households	2018	2019	2020	2020
2b2 Fixed Very High Capacity Network (VHCN) coverage	43%	45%	50%	59%
% households	2018	2019	2020	2020
2c1 4G coverage	97.4%	98.4%	98.4%	99.7%
% populated areas	2018	2019	2020	2020
2c2 5G readiness	0%	33%	67%	51%
Assigned spectrum as a % of total harmonised 5G spectrum	2019	2020	2021	2021
2c3 5G coverage	NA	NA	0%	14%
% populated areas			2020	2020
2c4 Mobile broadband take-up	59%	67%	67%	71%
% individuals	2018	2019	2019	2019
2d1 Broadband price index	NA	60	78	69
Score (0-100)		2019	2020	2020

Slovakia ranks only 19th in connectivity. In 2020, it observed a slight increase in the percentage of households covered by fixed very high capacity networks provided on FTTP infrastructures – 50% compared to 45% in 2019. The FTTP coverage in rural areas remains at a much lower level – only 18% of rural households were covered by the technology in 2020. It should be noted, however, that this demonstrates an upward trend in comparison with 2019, when 15.3% of rural households had access to the technology.

In terms of fixed broadband take-up, 78% of households subscribed to some form of broadband connection in 2020, a small increase compared to 72% of households in 2019. 25% of households had a fixed broadband connection of at least 100 Mbps in 2020, which is below the EU average of 34% for the same indicator. Although Slovakia is the 7th cheapest broadband market in the EU, consumers tend to choose lower broadband speeds.

Despite the fact that 67% of the total harmonised 5G spectrum has been assigned in Slovakia, 5G coverage is available only in the capital.

While the main objective of the Slovak 2011 national broadband strategy was to guarantee coverage of the entire country with speeds of at least 30 Mbps by 2020, this objective has not yet been achieved – the NGA broadband networks in Slovakia covered 75% of households in 2020. Providing

high-speed broadband coverage for 'white spots' (i.e. municipalities covered by speeds of less than 30 Mbps) remains one of Slovakia's long-term connectivity issues.

The Slovak government adopted the new national broadband plan in March 2021, setting out Slovakia's connectivity vision and targets until 2030. The plan aims for all households, whether urban or rural, to have access to internet connection of at least 100 Mbps, with the possibility of upgrading to gigabit speeds, as well as for major socio-economic drivers to have access to gigabit connectivity. The national broadband plan continues with the preparatory phase for the feasibility study. Calls co-financed with the European Structural and Investment Funds will be used to support the funding for connecting the 'white addresses'⁵⁴⁸ with a high-speed broadband connection through very high capacity networks.

Regarding public funding for infrastructure deployment (both fixed and wireless), the Slovak government wishes to finance its infrastructure development in the 2021-2027 financial perspective through Connecting Europe Facility 2: this would mainly involve building corridors between Member States (e.g. between Slovakia and Poland as well as between Slovakia and Czechia). Coverage for households and projects focused on 5G for smart communities.

One of the biggest mobile network operators (MNOs) in Slovakia intensified its fixed wireless access deployment in 2020 in line with the memorandum of understanding signed with the government of Slovakia in January 2018. The other three MNOs have also introduced similar programmes.

Slovak operators wishing to deploy networks continue to face administrative obstacles. Permitgranting bodies in Slovakia are legally obliged to insist on an active involvement of sectorial bodies with no direct relevance to the submitted projects, slowing down the process of receiving the necessary approvals. The Slovak government is currently contemplating the possibility of adopting new construction and zoning legislation, which would aim to simplify the construction process. According to the draft, a specialised building authority would be established with branches at the district level. The plans are also reflected in the Slovak roadmap for the implementation of the Connectivity Toolbox⁵⁴⁹.

Connectivity objectives are part of the Recovery and Resilience Plan (component digitisation). However, the authorities intend to finance connectivity investments from other sources.

In June 2020, the Slovak government published its strategy for the support of 5G networks in Slovakia for 2020-2025. The objectives of the strategy include ensuring the efficient use of radio spectrum by refarming the 3.6 GHz frequency band, releasing the 26 GHz frequency band based on market demand and preparing an amendment to the relevant legislation on cybersecurity in order to define security-related measures and requirements for the procurement of 5G technologies and networks.

The auction of radio spectrum frequencies in the 700, 900 and 1800 MHz bands ended on 23 November 2020 - the winning bidders were the four MNOs (02, Orange, Slovak Telekom, SWAN). Slovakia assigned frequencies in the 3.6 GHz band already in 2016, with rights of use extending until 2025: as frequencies were allocated in line with the principle of technological neutrality, MNO holders are already entitled to use them to provide 5G services. The 26 GHz band is currently used for both civilian and military purposes – the existing rights in the band are expected to expire in 2025.

⁵⁴⁸ The national broadband plan is working with more detailed units on the level of particular addresses rather than 'white spots' understood as whole municipalities in the Memorandum from 2018. Moreover, while the Memorandum focused on NGA coverage, the national broadband plan aims at VHCN coverage.

⁵⁴⁹ Pursuant to Commission Recommendation (EU) 2020/1307 of 18 September 2020 on a common Union toolbox for reducing the cost of deploying very high-capacity networks and ensuring timely and investment-friendly access to 5G radio spectrum, to foster connectivity in support of economic recovery from the COVID-19 crisis in the Union, OJ L 305, 21.09.2020, p.33.
O2 Slovakia launched its 5G network in October 2020 in some parts of Bratislava, using its licences in the 1800 MHz and 3.4–3.8 GHz bands. O2 presented it as 'pilot commercial testing' using technologies from four vendors.

Overall, 66.7% of harmonised spectrum has been assigned in Slovakia for the purposes of 5G deployment as of August 2021 – this is a major improvement compared to the 33.3% assigned in 2019.

Main market & regulatory developments

The fixed broadband market in Slovakia is characterised by a strong orientation towards deployment of own access infrastructure - wholesale access is used only in cases where there is no other technical or economic solution available. Slovakia therefore observes a significant fragmentation in this segment of the market: there are 738 operators providing fixed broadband services in the country. The mobile broadband market is dominated by the four MNOs (02, Orange, Slovak Telekom, SWAN).

As a result of a continuous increase in the use of mobile services in general, 2020 saw an increasing use of bundles. The fastest growing and the most popular type of bundles including mobile services is a triple-play bundle ('mobile service + fixed internet + TV'). The number of subscriptions to this type of bundle observed the most significant increase in 2020.

Some Slovak operators have undertaken voluntary measures to ease the impact of the COVID-19 pandemic. The examples of the measures taken were a change of limits for voice and data packages and a free-of-charge internet service for teachers to support the provision of online education.

Slovakia did not transpose the provisions of the European Electronic Communications Code (EECC) by the deadline of 21 December 2020 – it is one of the 24 Member States currently subject to an infringement procedure due to its failure to transpose the Directive. The delay is understood to be a result of a variety of factors, including the parliamentary elections in March 2020, the election of the new Chairman of the Slovak regulatory authority for electronic communications (RÚ) in September 2020, as well as the COVID-19 pandemic. The provisions transposing the EECC are now expected to enter into force at the end of 2021 at the latest.

According to the information provided by RÚ, the number of consumer complaints in 2020 was stable compared to the previous years. The regulator did not identify any specific end-user issues caused by the COVID-19 pandemic.

Regarding open-internet issues, RÚ received a few complaints in 2020 concerning a zero-rated service provided as part of a bundled offer by a Slovak internet service provider. The service in question consisted of access to a zero-rated news website. The concerned provider has since stopped the practice.

Concerning emergency communications, location data for the end-user requesting emergency assistance is provided within 15 seconds of receiving an emergency call and of the request from the public-safety answering point (PSAP) with 99.5% availability of location data. The advance mobile location (AML) system has been implemented as such. However, it is not functional due to data protection constraints under the national law.

While Slovakia observed a steady increase in the 'main coverage' and 'take-up connectivity' indicators, these modest gains could be lost if relevant legislative and strategic reforms are not carried out. Slovakia needs to ensure a swift and full adoption of the measures transposing the EECC.



Digital Economy and Society Index 2021

3 Integration of digital technology

3 Integration of	Slovakia		EU	
digital technology	rank	score	score	
DESI 2021	21	29.1	37.6	



	Slovakia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
3a1 SMEs with at least a basic level of digital intensity % SMEs	NA	NA	52% 2020	60% 2020
3b1 Electronic information sharing	31%	31%	31%	36%
% enterprises	2017	2019	2019	2019
3b2 Social media	17%	18%	18%	23%
% enterprises	2017	2019	2019	2019
3b3 Big data	9%	9%	6%	14%
% enterprises	2018	2018	2020	2020
3b4 Cloud	14%	14%	18%	26%
% enterprises	2018	2018	2020	2020
3b5 Al % enterprises	NA	NA	15% 2020	25% 2020
3b6 ICT for environmental sustainability % enterprises having medium/high intensity of green action through ICT	NA	NA	76% 2021	66% 2021
3b7 e-Invoices	15%	15%	16%	32%
% enterprises	2018	2018	2020	2020
3c1 SMEs selling online	13%	11%	17%	17%
% SMEs	2018	2019	2020	2020
3c2 e-Commerce turnover	11%	11%	11%	12%
% SME turnover	2018	2019	2020	2020
3c3 Selling online cross-border	8%	7%	7%	8%
% SMEs	2017	2019	2019	2019

Slovakia ranks 21st in the EU on integration of digital technology by enterprises. Only 52% of Slovak SMEs reach at least the basic level of digital intensity (EU average: 60%). Slovakia falls short of the EU average in the use of AI by enterprises (15% versus 25%) and in the use of cloud services (18% versus 26%). The share of enterprises that use big data analysis dropped from 9% to 6%. The country's e-commerce scores have partially improved: 17% of SMEs sell online which is at the EU average. However, the share of SME turnover from e-commerce stagnates at 11% (EU average: 12%). 16% of Slovak enterprises used e-invoices in 2020, in comparison to 32% in the EU. 76% of Slovak businesses had a medium to high use of ICT technologies for more environmentally friendly actions in 2021, which is 10 percentage points higher than the EU average of 66%.

Slovakia follows its 2030 Strategy for the Digital Transformation of Slovakia ⁵⁵⁰, which supports the integration of innovative technologies in enterprises, including cloud & edge computing, HPC, Blockchain and AI. Concrete measures are described in Slovakia's action plan for digital

⁵⁵⁰ https://www.mirri.gov.sk/wp-content/uploads/2019/10/SDT-English-Version-FINAL.pdf

transformation for 2019-2022⁵⁵¹. The plan establishes an Independent Expert Group on AI Ethics, introduces a digital impact assessment that evaluates the effects of regulations on innovation and the digital economy and supports new business models and smart mobility.

Slovakia participates in the EuroHPC joint undertaking, mainly through the National Supercomputing Centre⁵⁵² established in 2020 (see details in box below). Slovakia is home to two active digital innovation hubs in Košice and two in preparation in Bratislava. Their focus ranges from robotics and microelectronics to the Internet of things and cybersecurity. They operate in close collaboration with universities and with other European hubs. In 2021, Slovakia pre-selected 7 candidates that are ready to join the European Digital Innovation Hub Network. Slovakia contributes to the European Blockchain Service Infrastructure through Blockchain Slovakia⁵⁵³. This non-profit organisation brings together researchers, entrepreneurs, public authorities, investors and other actors with the aim of increasing the use of blockchain among businesses and addressing societal issues.

According to a survey by Industry4UM, 74% of Slovak enterprises consider Industry 4.0 essential for the future, but its deployment slowed down in 2020⁵⁵⁴. This was in part because of the challenging economic environment, which hampered investments. Also, there is a lack of training and development of employees, as well as a need to strengthen the role of management in the transformation process. The results also show that enterprises with foreign capital are more likely to follow an Industry 4.0 strategy than enterprises fully owned by Slovaks.

Slovak start-ups connect well with neighbouring markets, but the biggest challenge is to expand globally⁵⁵⁵. According to the OECD, starting a business is less costly in Slovakia than in most EU Member States, but the administrative burden is relatively heavy due to the numerous requirements and complexity of the rules⁵⁵⁶. Slovakia has signed the EU Start-up Nations Standard of Excellence⁵⁵⁷ and committed to follow good practices, such as innovation in regulation and procurement that would help young innovative enterprises to grow and expand in Europe. In 2020, the government improved the conditions for start-ups through tax simplification, and it plans to support digital archiving and automation in accounting as of 2022.

Slovakia is improving its efforts to scale up its digital economy, although it continues to perform below the EU average. The main barriers are the fast-changing market environment and the slow reaction of market participants, who are mainly dependent on the import of technologies and knowhow from other markets. A relatively low level of digital intensity among businesses remains an issue. The administrative and financial burden of existing legislation slows down the spread of innovation. Limited access to and awareness of financing and financial instruments for investments into new technologies remains an issue.

Integration of digital technology in Slovakia's Recovery and Resilience Plan

⁵⁵¹ <u>https://www.mirri.gov.sk/wp-content/uploads/2019/10/AP-DT-English-Version-FINAL.pdf</u>

⁵⁵² <u>https://eurocc.nscc.sk/en/</u>

⁵⁵³ https://blockchainslovakia.sk

⁵⁵⁴ <u>https://industry4um.sk/vyhodnotenie-prieskumu-industry-4-0-v-sr-2020/</u>

⁵⁵⁵ <u>https://ceedtech.eu/an-inside-look-at-the-slovakian-startup-ecosystem/</u>

⁵⁵⁶ https://www.oecd.org/cfe/smes/Slovak-Republic-IE-2020.pdf

⁵⁵⁷ <u>https://digital-strategy.ec.europa.eu/en/news/24-eu-member-states-commit-digital-day-take-action-support-growth-eu-startups</u>

The plan puts forward an ambitious package for the Slovak economy's digital transformation. The total contribution of the recovery and resilience plan to this policy area is EUR 100 million for advanced technologies, EUR 151 million in digital research and development, and EUR 92 million for digitalisation of enterprises. The plan includes a reform of the governance model for the digital economy, together with investments in digital technologies and the digital capacity of enterprises, in particular SMEs. The investments will support the development and application of advanced digital technologies, such as technology-oriented competence centres and cooperation platforms.

The digitalisation of Slovak enterprises, in particular SMEs, will be fostered by 'voucher' schemes, for example digital and innovation vouchers. Digital innovation will also be supported through a series of hackathons. Digital innovation hubs connected to the European network will provide infrastructure and guidance to enterprises, in particular SMEs. Slovakia will build a new supercomputer that should be part of the EuroHPC joint undertaking. Investments in the digitalisation of transport and energy infrastructure will make them more resilient and reliable.

Slovakia	
score	score
53.7	68.1
	vakia ^{score} 53.7



	Slovakia			EU
	DESI 2019	DESI 2020	DESI 2021	DESI 2021
4a1 e-Government users	62%	69%	68%	64%
% internet users	2018	2019	2020	2020
4a2 Pre-filled forms	NA	NA	36	63
Score (0 to 100)			2020	2020
4a3 Digital public services for citizens	NA	NA	64	75
Score (0 to 100)			2020	2020
4a4 Digital public services for businesses	NA	NA	79	84
Score (0 to 100)			2020	2020
4a5 Open data	NA	NA	53%	78%
% maximum score			2020	2020

With a score of 53.7 in 2021, Slovakia ranks 23rd in the EU for Digital public services. The share of egovernment users among internet users has slightly decreased to 68% but is still above the EU average (64%). In all other monitored indicators, Slovakia scores below the EU average. In the category of 'amount of data pre-filled in public service online forms', the country scores 36 in 2020, which is significantly below the EU average of 63. Digital public services for citizens is also below the EU average, being 64 in comparison to 75 at EU level. This gap is less pronounced for digital public services for businesses, where Slovakia scores 79 compared to an EU average of 84.

Slovakia's public administration is underperforming, and the compartively low level of digitalisation of the public administration and of public services is a key bottleneck for the business environment and economic growth. Important barriers continue to prevent a wider use of digital public services in Slovakia. The main obstacles include the lack of integration between public registers and re-use of available data.

Nevertheless, according to the EU eGovernment Benchmark⁽⁵⁵⁸⁾, Slovakia's overall eGovernment performance has improved by 7 percentage points. User-centricity, or the extent to which governments deliver and design services with the needs of users in mind, has also improved for Slovakia by 7 percentage points. However, Slovakia's score of 61% in the eGovernment Benchmark's Digitalisation Index is below the EU27+UK average of 72%. This index also provides insights into a country's ability to match high levels of digital service usage with a high availability of digital services. Slovakia can be categorised as not yet fully utilising digital tools and where the benefits of digitalising service delivery have not been realised yet.

⁵⁵⁸ <u>https://digital-strategy.ec.europa.eu/en/library/egovernment-benchmark-2020-egovernment-works-people</u>

Investments are needed to improve the efficiency of the country's public administration, reduce the administrative burden and improve the business environment. The focus should continue to be on user-friendliness to make investments effective. Slovakia has taken several steps to improve the user friendliness of its digital public services. In 2021, new legislation will oblige public bodies who are the business owners of respective digital public services to collect user feedback on satisifaction in a standardised manner. Slovakia also has a design manual for digital services, which includes guidelines on how to apply human-centric design in the development and provision of digital services. New projects, in their preliminary phase, also have to conduct a qualitative and quantitive survey of user needs.

The 'State software house', Slovensko IT, was launched in 2020 to create cheaper, more modern and flexibile state IT systems. One of its tasks is to develop a new one-stop-shop for the digital public services app, eSlovensko, which will enable people to connect with public institutions through their smart phones⁵⁵⁹.

In 2020, the Slovak authorities took further steps to implement the 'once-only' principle. They improved the quality of data in the central address register, making it one of the reference registries allowing other databases to consult it in order to verify the accuracy of data. The 'anti-bureaucracy' initiative simplified the sharing of certificates and documents between public institutions and should save EUR 42 million per year overall⁵⁶⁰. The 'Consolidated analytical layer' project will enable evidence-based decision-making by public sector bodies through more thorough data analysis and modelling.

The Data Office at the Ministry of Investments, Regional Development and Informatisation is managing projects on data integration, interoperability and quality and working with the opendata community and the concept of MyData. Work is also being undertaken to better enable data sharing between public bodies. These actitivites are being supported through legislative initiatives such as the Act against bureaucracy⁽⁵⁶¹⁾ and the national Data Act⁽⁵⁶²⁾, which is in preparation.

Slovakia is currently updating its *National Concept of Informatization of the Public Administration*. The guiding principles are user-centricity, digital by default, data as an asset, re-use, transparency of public administration and security. The new National Concept will follow two national strategic documents: the 2030 Vision and Strategy for the Development of Slovakia and the 2030 Strategy for the Digital Transformation of Slovakia.

Slovakia needs to intensify its efforts to improve and expand digital public services. The country is below the EU average, and the low quality and take up of e-government services makes the society more vulnerable in critical situations such as the pandemic. Focusing on user-friendliness and informing larger groups of the population about the benefits of digital public services would convince more people to consider their use. To reach at least the EU average, it is also necessary to continue the effort in the digitalisation of public administration and the interoperability of systems with increased data sharing between institutions.

 ⁵⁵⁹ <u>https://spectator.sme.sk/c/22545056/new-government-promises-a-new-era-in-state-it.html</u>
<u>https://www.mirri.gov.sk/aktuality/informatizacia/ministerka-remisova-nas-novy-zakon-proti-byrokracii-ludom-usetri-100-kil-nervov-a-42-milionov-eur-rocne/index.html</u>

⁵⁶¹⁾ https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2018/177/20210101.html

⁵⁶² https://www.slov-lex.sk/legislativne-procesy/SK/LP/2021/55

Digital public services in Slovakia's Recovery and Resilience Plan

Investments in digital technologies in the country's public administration are a strong focus of the plan, including the roll-out of information systems to increase the quality and efficiency of the judiciary, police, firefighting, and rescue processes. Digital investments are planned to simplify the payment of taxes and levies. A new digital platform for providing more efficient and better-quality public services will be developed as part of the plan in order to improve the quality and accessibility of e-government solutions. The Slovak authorities will identify 16 priority 'life situations' for citizens and businesses, where simplified and more efficient digital solutions will be proposed. These measures will minimise the required administrative steps for citizens and businesses, reduce the time and costs, and improve the user-friendliness of services. In addition, the plan also envisages measures for a more efficient management of IT resources in the public administration. Slovakia also intends to strengthen and standardise cybersecurity across all sectors of public administration to increase trust in the new e-services, and it intends to invest in the digitalisation of healthcare to make medical and operational processes more efficient. The total contribution of the recovery and resilience plan to this policy area is EUR 686 million.