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COMMISSION STAFF WORKING DOCUMENT

**For a resilient, innovative, sustainable and digital mobility ecosystem
Scenarios for a transition pathway**

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Scenarios for a transition pathway

This document is a European Commission staff working document. It does not constitute the official position of the Commission, nor does it prejudge any such position

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1. INTRODUCTION

On 10 March 2020, the Commission adopted a new Industrial Strategy[1] to help Europe's industry lead the green and digital transformations, to enhance Europe's global competitiveness and to support achieving open strategic autonomy. Following the experience of the COVID-19 pandemic, the update of the EU Industrial Strategy[2], highlights the need to accelerate the green and digital transitions and to increase resilience of EU industrial ecosystems.

The mobility ecosystem defined in the Industrial Strategy covers the entire industrial value chain for automotive, rail and waterborne industries as well as associated retail and water and land transport services[3]. Built together with Member States, industry and stakeholders, the transition pathway will aim to make the transition to a resilient, innovative, sustainable and digital ecosystem a strong business case.

Policy objectives and targets for the fair twin green and digital transition have been established through the European Green Deal[4], the European Climate Law[5], the European Pillar of Social Rights and, concerning digitalisation, the Communication on Shaping Europe's digital future[6] and the European Strategy for Data[7]. The Sustainable and Smart Mobility Strategy[8] outlines how the EU transport system as a whole can achieve green and digital transformation, become more resilient to future crises and improve the well-being and health of citizens. The Strategy contains an action plan aiming at delivering the necessary 90% reduction of greenhouse gas emissions by 2050 and boosting innovation and digitalisation for both freight and passenger transport.

It is now important to accompany the mobility ecosystem transformation with a reflection on its industrial dimension.

The co-creation of transition pathways with Member States and stakeholders (including industry, social partners and non-governmental organisations) as an essential collaborative tool, will factor in the scale of the challenges and is aimed at identifying further actions, such as technology investments, a joint development of projects pipeline, infrastructure support or bridging skills gaps in the horizon towards 2030 and beyond.

The document outlines the main priorities, actions and potential outcomes to support the green and digital transition of the mobility ecosystem, identified in the industrial strategy as the *"Mobility –Transport –Automotive ecosystem"*[9].

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[1] COM(2020) 102 final

[2] COM(2021) 350 final

[3] Aeronautics is included in the "Aerospace and Defence ecosystem".

[4] COM/2019/640 final

[5] Regulation (EU) 2021/1119

[6] COM(2020) 67 final

[7] COM(2020) 66 final

[8] COM(2020) 789 final

[9] A more detailed description of the mobility ecosystem and the other 13 industrial ecosystems is contained in the Annual Single Market Report 2021, SWD(2021) 351

This Staff Working Document (SWD) is the basis for consultation and co-creation with Member States and stakeholders of a joint vision for the transition of the mobility ecosystem. It does not constitute an official position of the Commission, nor does it prejudge any such position.

The consultation process initiated by this SWD invites Member States and all concerned stakeholders to contribute to a bottom-up assessment of the scale, cost, long-term benefits and conditions of the required actions to accompany and support the twin transition of the mobility ecosystem and increase its resilience. The questions contained in this SWD will also be subject of an open public consultation which will be launched in parallel to the document's publication.

1.1. The mobility ecosystem in the EU

The mobility ecosystem covers the entire value chain of the automotive, rail and waterborne sectors[10]. It employs 14.6 million people and represents 7.5% of EU value added (EUR 906 billion). It includes 1.8 million firms, 99.7% of which are SMEs.[11]

The different sectors of the ecosystem are already engaged in their green and digital transition albeit progressing at different pace and facing specific challenges: business environment, availability and feasibility of technical solutions, consumers' needs. But all have to embrace decarbonisation, digitalisation and face global competition[12]. The twin transition is also expected to affect the labour market in all the industries of the mobility ecosystem, though with varying intensity depending on the sector and geographical location. As a result, some parts of the ecosystem will have to face significant labour reallocation and the urgent need of re-skilling and up-skilling of the workforce.

For the automotive sector, including both big companies and SMEs, the transition to zero-emission cars and vans by 2035 will entail challenges for different parts of the value chain. While vehicle manufacturers can more easily adapt their product portfolios and are increasingly doing so, component suppliers may likely face more hurdles in repurposing or reconverting their existing activities towards new growth markets. The challenge can become particularly sensitive in certain regions of the EU with impacts on jobs.

At the same time, the transition to zero emission and connected mobility offers significant opportunities, with the mobility value chain expanding to new areas including batteries, hydrogen, deployment of smart grids, automation, electronics or software.

Last, but not least, all industries of the ecosystem are facing strong competition from third countries and may suffer from distortive market or trade practices while the EU market is based on fair and rules-based competition and trade.

The ecosystem approach taken for this exercise aims at bringing together *all* actors of the value chain, including the SMEs, and social partners, to better understand the specific

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[10] While the ecosystem as such focuses on manufacturing, the ecosystem *approach* implies that engagement with all actors from the value chain, including users (providing transport services).

[11] Data presented in the 2021 Annual Single Market Report, SWD(2021) 351 final

[12] For instance, these sectors continue to rely today largely on the internal combustion engine and the use of fossil fuels. Even though electrification is more advanced in the rail sector, 44.4% of the EU27 network is still not electrified in 2018 (EU Transport in figures – Statistical Pocketbook 2020).

concerns and challenges in relation to the twin transition as well as identifying possible areas of cooperation and common solutions. The added-value of the mobility ecosystem approach lies not only in sharing experience and best practices in embracing industrial transition but also in looking for synergy in solutions among the three sectors and defining approaches which can benefit as much as possible the entire ecosystem.

In this context, the key questions for the stakeholders are:

> - What synergies can be found between the various sectors of the ecosystem in terms of solutions to the twin transition challenge (e.g. technology development, both digital and clean, investments and skills)?
>
> - What should be considered as priority to facilitate the transition of *all* actors of the ecosystem, including the SMEs and how to ensure their involvement in developing a credible and coordinated project pipeline to support the twin transition?

1.2. Main challenges and impacts of the COVID-19 pandemic

As shown in the 2021 Annual Single Market Report[13], the COVID-19 crisis had a strong impact on the mobility ecosystem. The automotive industry, which is the largest component of the ecosystem, was hard-hit and suffered an unprecedented 23.7% decrease of passenger car sales in 2020. However, the massive use of furlough schemes did not prevent the announcement of plant closures[14] by vehicle manufacturers and suppliers. The COVID-19 pandemic triggered a drop in rail transport volumes (-6% for freight in tonne-kilometres and a - 46% for passengers in passenger-kilometres)[15]), which consequently led to postponements and cancellations of orders, as well as a lower services volume. The pandemic has hit European shipyards[16] extremely hard in 2020, with new orders in Europe declining around 90% in terms of Compensated Gross Tonnes (CGT), due mainly to the sharp drop in cruise ship orders[17]. Yet, the economic impact of the COVID-19 pandemic was less pronounced in Asia (-16% ordering in China and -18% in South Korea), where shipbuilding is less concentrated on specific market segments. In addition, governments have put in place enormous stimulus packages, complementing and reinforcing the effect of existing local content policies and financing tools targeted to their domestic shipbuilders. This has reinforced an already existing trend in reduction of EU shipbuilding activity, which has resulted in decreasing EU market share, currently less than 5%.

The pandemic has also shown EU's dependence on global trade to both secure and sustain demand for our industrial output (e.g. raw materials including magnesium,

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[13] SWD(2021) 351 final

[14] Nissan, Renault, Bridgestone, Continental, etc.

[15] Rail transport severely impacted by COVID-19 in 2020 - Products Eurostat News - Eurostat (europa.eu)

[16] Shipbuilding includes the construction of ships and vessels both for commercial and naval use (i.e. for defence purposes), so there may be overlaps with the Aerospace and Defence ecosystem, although COVID19 has impacted the two market segments differently

[17] From "Impact of COVID-19 on the Maritime Sector in the EU", EMSA: http://www.emsa.europa.eu/publications/item/4436-impact.html

electronic components such as semi-conductors or specialised engines) as well as impacts from reducing demand on export markets. This needs to be considered to ensure the overall resilience and open strategic autonomy of the ecosystem, for example by diversifying supply chains and keeping export markets open.

In addition, many EU companies in the ecosystem have been facing increasing competition, notably from Asia, in sectors where the EU traditionally has held a strong position. Competitive advantages of third country companies created inter alia by distortive, non-market oriented government interventions in some jurisdictions (e.g. distortive foreign subsidies) have to be tackled in order to create a level playing field[18].

The transformation of the industry in response to the green and digital transition will facilitate the rebound of the ecosystem by structuring investments not only in the new technologies and services but also in the associated mobility, energy and digital infrastructures as well as reskilling the workforce.

NextGenerationEU and the 2021-2027 EU budget have unleashed unprecedented levels of investments in the green and digital transitions across Member States, and over 40% of the recovery spending is in the field of mobility[19]. These measures come on top of COVID-19 mitigating short-term stimulus. This being said, additional measures beyond access to finance will be needed to accompany the huge efforts and investments necessary to accelerate decarbonisation and digitalisation.

2. OPENING THE GATE TO THE TRANSITION OF THE EU MOBILITY ECOSYSTEM

Cross-cutting Commission policies

The discussion on the transformation of the mobility ecosystem will build upon the actions identified in the relevant strategic documents adopted by the Commission.

Apart from the updated Industrial Strategy, these include the European Green Deal[20], the EU Climate Target Plan for 2030[21], the July 2021 legislative package on delivering the increased climate ambition of at least -55% by 2030 and climate neutrality by 2050[22] and in particular a proposal to strengthen the CO_2 emission standards for light duty vehicles. In addition, the Commission proposal for a Council Recommendation on ensuring a fair transition towards climate neutrality[23], which provides a common framework of comprehensive policies and investments needed for ensuring a fair transition.

The Sustainable and Smart Mobility Strategy[24] adopted on 9 December 2020 sets out a roadmap for putting European transport firmly on the right track for a safe, healthy,

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[18] European suppliers, especially in the rail and maritime sectors are concerned by the distorting effect of foreign subsidies in public procurement in the EU.

[19] https://ec.europa.eu/info/strategy/eu-budget/long-term-eu-budget/2021-2027_en

[20] COM(2019) 640 final

[21] COM(2020) 562 final

[22] COM(2021) 550 final

[23] COM(2021) 801 final

[24] COM(2020) 789 final

sustainable and smart future. This strategy lays down the foundation for how the EU transport system can achieve its green and digital transformation and become more resilient to future crises, while not leaving anybody behind. It identifies 10 flagship areas with an Action Plan that will guide EU policy in the years to come to move towards zero emission mobility.

Concerning the challenges for the digital economy, the Digital Decade and the European Strategy for Data[25], aim[26] at establishing a single market for data, ensuring Europe's global competitiveness. It announced the creation of sector- and domain-specific common European data spaces, including a common European mobility data space. It also aims at strengthening data-sharing mechanisms across the EU and supporting the large-scale deployment of next-generation cloud infrastructures and services across the EU.

Sectorial recommendations

In addition to the horizontal strategic orientations, a number of sectorial recommendations and priorities have also been issued and will help identify ways to support the transition in the mobility ecosystem.

In the automotive sector, the High-Level Group GEAR 2030[27] report on the competitiveness and sustainable growth of the automotive industry in the EU issued recommendations on how the industry can anticipate and adapt to current trends - thereby turning short- to medium-term threats into long-term opportunities. Similarly, the European Commission Expert Group on the Rail Supply Industry made a series of recommendations on measures needed to sustain and develop the RSI in the medium term[28].

The NAIADES III action plan[29] adopted on 24 June 2021 tables a 35-point action plan to boost the role of inland waterway transport in our mobility and logistics systems. The core objectives are to shift more cargo over Europe's rivers and canals, and facilitate the transition to zero-emission vessels by 2050.

Resources and enablers

Based on the policy and regulatory framework and on the stakeholders' recommendations, the following key enablers have been identified to kick-start the co-creation process:

- the development and deployment of technologies and the associated infrastructure;
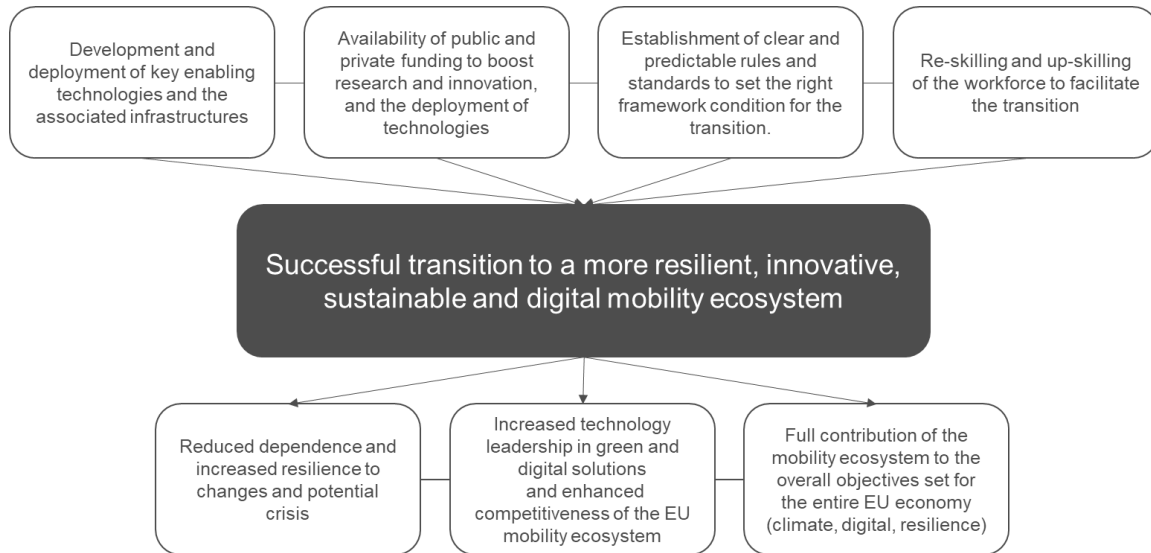
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[25] COM(2020) 66 final

[26] https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en

[27] https://ec.europa.eu/growth/content/high-level-group-gear-2030-report-on-automotive-competitiveness-and-sustainability_en

[28] https://ec.europa.eu/growth/sectors/mechanical-engineering/rail-supply-industry_en

[29] COM(2021) 324 final

- the availability of private and public funding to boost research and innovation, and the deployment of transformative technologies (clean and digital);
- the establishment of clear and predictable rules and standards to set the right framework condition for the transition;
- the re-skilling and up-skilling of the workforce to facilitate the transition, with a focus on the sectors most impacted (for instance due to the shift to zero-emission vehicles);

Consumer perspective: accessibility, availability, affordability,

New products, solutions and services which are developed as a result of twin transition have to be accessible, available and affordable for all consumers and users.

In order to do so, accompanying actions will be needed to ensure the wide affordability and availability of new mobility solutions, including by rolling-out charging and refuelling infrastructure, actions to develop a thriving market for second-hand zero emissions vehicles or boosting retrofitting of the existing fleet.

To make the transition more affordable, it is crucial to reflect on ways to maximise the use of existing assets (including, where necessary, through upgrading or retrofitting) in addition to deploying new means of transportation and infrastructures. In order to safeguard the internal market, this also implies the cross-border deployment of solutions and a specific attention given to the interoperability of systems.

In addition, the user's acceptability of new products and solutions is key to ensure active support from all actors of the value chain, and ultimately meet the citizens' and consumers' needs and expectations.

- What additional considerations, if any, should be taken into account by all ecosystem's actors to plan and implement an inclusive and fair transition of the mobility ecosystem, in particular for SMEs and consumers?

3. A RESILIENT AND COMPETITIVE EU MOBILITY ECOSYSTEM

The COVID-19 pandemic has strongly affected the mobility ecosystem and has tested the resilience of economies worldwide. The economic recovery now unfolding is also revealing bottlenecks in the supply chain of, for instance semi-conductors or magnesium. The shortage of chips for the automotive industry has led to the delay in production of close to 2 million vehicles[30] in Europe since the beginning of 2021. Regarding magnesium, the temporary closure of energy intensive production sites in China led to a 50% decrease in magnesium production. In view of its importance for alloys production (e.g. aluminium), the shortage of magnesium supply risks leading to plant closures in the EU and negative impacts on the mobility ecosystem as a whole.

Increasing the ecosystem's resilience would require, inter alia, reducing strategic dependencies that can lead to vulnerabilities, ensuring a level-playing field in international competition and keeping export markets open and diversified. The EU heavily benefits from world markets being open and from being integrated in global value chains, from both a supply and demand perspective. This is especially true for e.g. the automotive and rail supply sectors where EU companies maintain a very strong position on global markets. But disruptions or frictions in the ecosystem's global value chains can affect specific essential products and inputs that are particularly critical for the EU economy.

In this context, in the Staff Working Document on strategic dependencies, accompanying the update of the Industrial Strategy, the European Commission services carried out a detailed quantitative and qualitative analysis of strategic dependencies and pointed towards possible measures and tools to address them[31].

Resilience and secure supplies with regards to raw materials, batteries and semiconductors are especially important, since they are key enabling technologies and inputs crucial for the decarbonisation and digitalisation of the mobility industry (further described in sections 4 and 5). In addition, as new technologies develop, or new frictions or disruptions in supply chains unfold, new strategic dependencies may appear and would need to be addressed as rapidly as possible through tailor-made and balanced measures. This could for instance occur with regard to the availability of renewable and clean energy for the production and supply of new alternative fuels such as hydrogen.

The update of the Industrial Strategy also highlights the importance of the international competitiveness of the ecosystems and the need to ensure undistorted trade and investment, including through open and fair access to export markets. The Commission has outlined in its Trade Policy Review that it intends to work towards diversifying international supply chains and pursue international partnerships applying the principle of "open strategic autonomy", having an open, sustainable and assertive trade policy[32]. As part of this new trade policy, the Commission will aim at supporting the green transition and promoting responsible and sustainable value chains[33]. The trade strategy

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[30] Weekly data gathering by IHS Markit compared to 2019 yearly production.

[31] SWD(2021) 352 final

[32] COM(2021) 66 final

[33] It will do so, by launching climate and sustainability WTO initiatives; cooperating with partners by using FTAs as platforms to engage on climate, biodiversity, circular economy and sustainable food systems; seeking commitment from G20 countries on climate-neutrality; making Paris agreement an essential

also recognises the strategic importance of the digital, services and regulatory spheres for our long-term competitiveness. The EU actively participates in the WTO e-commerce negotiations which aims to set ambitious global rules for digital trade. The Commission will also work to reinforce EU's regulatory impact and make the best use of the attractiveness of the EU's single market for this purpose. Implementation and enforcement of trade agreements are equally important and the Commission will present proposals for further instruments to complement its toolbox and new online tools to support our companies, particularly SMEs, to make best use of our trade agreements.

Table 1 Issues, actions and scenarios for a more resilient and competitive EU mobility ecosystem

Issues	Actions and possible division of roles	Possible output scenarios
Reduce EU's strategic dependencies on key technologies	**Commission / Member States / Stakeholders:** • Implement strategies and action plans already set in motion to reduce EU's strategic dependencies, increase circularity in the mobility ecosystem, notably on batteries and raw material, hydrogen; diversify sourcing of inputs. • Devise strategies in the upcoming European Chips Act to jointly create a state-of-the-art European chip ecosystem. • Identify technologies (and related inputs) and infrastructures at risk of supply chain tensions or that could create possible strategic dependencies. **Member States/Regions:** Step-up investments, notably through the National Recovery Plans and the new cohesion programmes, in technologies and infrastructures that could reduce current and possible future dependencies.	• A globally integrated, sustainable and competitive industrial base for battery (cells) production by 2025 • Sustainable and reliable EU production of advanced battery materials/chemicals (cathodes, anodes, electrolytes, etc.) • In line with EU Hydrogen Strategy[34], 40 GW of renewable hydrogen electrolysers and producing 10 million tonnes renewable hydrogen by 2030. • Following the Digital Decade ambitions[35], production of cutting-edge and sustainable semiconductors in Europe including processors that are at least 20% of world production in value by

element and WTO-compliant Carbon Border Adjustment Mechanism (CBAM); introducing mandatory due diligence including effective action against forced labour; conducting early and comprehensive review of implementation and enforcement of TSD chapters.

[34]   COM(2020) 301 final

[35]   COM(2021) 118 final

	Stakeholders:	2030.
	• Take stock and build on the success of industrial alliances (e.g. batteries, hydrogen), identify barriers to the deployment of technologies and address these with a view to accelerate technological developments.	• Increased diversification of sourcing countries / suppliers for critical technologies and goods
	• Map strategic risks in the supply chain	• Higher investments in all segments of the value chain
	• Step up investments in all segments of the value chain to reduce the risks of strategic dependency and support the rapid deployment of alternative sources of energy for mobility (incl. batteries, hydrogen and renewable and low-carbon fuels).	
	• Reinforce collaboration on Research & Innovation and deployment to facilitate the uptake of innovative technologies.	
Reinforce cooperation with key trade partners	**Commission / Member States:** • Continue and strengthen technical and regulatory dialogue and cooperation at the international level. • Establish international rules and standards based on EU experience and existing rules (cooperation with UN bodies such as UNECE, IMO, OTIF). • Strengthen technical dialogue and trade relations at bilateral level with like-minded nations, and at multilateral level in international fora such OECD and the WTO.	• Increased cooperation among private and public actors to promote European standards internationally. • EU standards are recognised internationally as "seal of excellence".
Secure and improve **access to third country markets**	**Commission**: • Strengthen efforts to open markets and remove tariff and non-tariff barriers to trade, to get access to key inputs and markets for EU products. • Implementation and enforcement of trade agreements to ensure	• Improved market access for EU companies and strengthened enforcement of applicable trade rules. • Stronger approach to

	maximum benefits from international trade. • Continue to tackle market access barriers under the recently created Single Entry Point. **Member States/Regions:** Raise awareness on third countries market opportunities; cooperate closely with the Commission to resolve existing trade irritants; **Stakeholders:** Take advantage of export supporting mechanisms (e.g. support to SMEs internationalisation[36], Access2Markets data base[37])	distortive practices by some of our trading partners
Improving **level playing field**	**Commission:** Addresses the potentially distortive effects of foreign subsidies: - Applying WTO rules and the relevant provisions in trade agreements - Promoting WTO modernisation, including by working towards reform of subsidies rules. - Facilitating the adoption of the regulation on foreign subsidies[38] and subsequently ensure its proper implementation - Implementing of the labour and environmental provisions in the trade and sustainable development chapters of the free trade agreements	• Delivery on the main actions set out in the Trade For All Communication. • Delivery on the main actions set out in the 15-point trade and sustainable development action plan and its successor • Enforcement of the Regulation on distortive foreign subsidies.
Protection of **security and**	**Commission/Member States:** screening of foreign direct investments	Implementation of the Regulation on FDI

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[36] https://ec.europa.eu/growth/smes/sme-strategy/access-to-markets/internationalisation/support-tools_en

[37] https://trade.ec.europa.eu/access-to-markets/en/home

[38] https://ec.europa.eu/commission/presscorner/detail/en/ip_21_1982

public order	on the basis of security or public order (Regulation on FDI Screening Regulation (EU) 2019/452) **Member States/Regions:** Identify and analyse the impact on security and public order potentially resulting from foreign direct investment with regards to e.g. critical infrastructure, critical technologies or critical inputs.	screening.

The key questions for the stakeholders are:

> • Do the actions listed above comprehensively address the resilience challenges? If not, what are the gaps and what measures should be considered as a matter of priority (providing relevant data / evidence)?
>
> • What additional or different outcome scenarios could be envisaged?
>
> • Can you identify already existing projects or good practices to ensure resilience of the sector you represent that could benefit other sectors of the mobility ecosystem?
>
> • What should be the role and responsibilities of public authorities (EU, National, Regional and local levels) to successfully address the upcoming challenges?
>
> • Are there specific challenges faced by individual actors of the ecosystem, in particular SMEs, that should be addressed?

4. GREENING OF THE MOBILITY ECOSYSTEM

Delivering on the European Green Deal ambition means that the transport sector should reduce its greenhouse gas emissions by 90% by 2050, as set out in the Sustainable and Smart Mobility Strategy. Moreover, transport should become drastically less polluting, especially in cities.

By 2030, for example, a market share of more than 40% zero-emission vehicles (compared to 6% in 2020) is projected in the new cars fleet to meet the proposed revised CO_2 emission standards for cars, proposed in July 2021[39] as part of a comprehensive regulatory package by the Commission. Other complementary measures are foreseen, for example, on the commensurate roll-out of alternative fuels infrastructure to meet the growing fleet of zero emission vehicles and vessels, the decarbonisation of fuels used by the existing transport fleets (for example, the revision of the Renewable Energy Directive and the Energy Taxation Directive and the proposed introduction of emissions trading for

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[39] COM(2021) 556 final

road transport and buildings) and measures to kick-start markets for alternative fuels in maritime and aviation.

The additional investments needed for 2021-2030 to reach at least the –55% target in vehicles, rolling stock, vessels, aircraft and renewable and low carbon fuels infrastructure deployment are estimated at EUR 130 billion per year, compared to the previous decade[40]. The 'green and digital transformation investment gap' for infrastructure would add an additional EUR 100 billion per year[41]. This transition will also lead to labour reallocation in certain sectors and will require reskilling and upskilling of workers, in close dialogue with social partners.

At the same time, this transformation also offers great opportunities for the European industry across the value chains to modernise, create high-quality jobs, develop new products and services, strengthen competitiveness and pursue global leadership as other markets are moving fast towards zero-emission mobility.

Greening the mobility ecosystem would require significantly reducing transport's current dependence on fossil fuels (through the steep increase in the uptake of zero-emission vehicles, in the modernisation of the fleet, improving energy efficiency, and boosting the deployment of renewable and low-carbon fuels), while encouraging the increased use of more sustainable transport modes and internalising external costs.

A number of initiatives to support new clean technologies have already been put in place and are being implemented. These aim in particular at ensuring that the key enabling technologies, like space data and services are available for the sector to undertake the transition and to allow the EU to keep technological leadership on the most innovative solutions.

For instance, recognising the need and urgency for the EU to develop a battery value chain, the Commission launched the European Battery Alliance (EBA) in 2017[42] and adopted the Strategic Action Plan on Batteries (2018)[43]. Both have acted as a catalyst for major investments all along the battery value chain and already delivered significant results. They have been followed in September 2020 by the Action Plan on Critical Raw Materials to secure the European Union's sustainable supply of critical raw materials as well as the European Raw Materials Alliance[44]. Both initiatives will be high priorities in the coming years, with significant importance for the EU battery sector and mobility ecosystem.

In order to boost the uptake of renewable and low-carbon fuels the Commission has adopted in July 2020, the EU Hydrogen Strategy[45] and set up the European Clean

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[40] COM (2020) 562 final

[41] SWD (2020) 98 final, based on TEN-T related estimates and EIB calculations. This estimate does not include the costs of equity repairs, or that of the regular renewal of the fleet, which however may be delayed due to the impact of the COVID-19 pandemic on transport companies.

[42] https://ec.europa.eu/growth/industry/policy/european-battery-alliance_en

[43] COM(2018) 293 final, Annex II

[44] https://ec.europa.eu/growth/industry/policy/european-raw-materials-alliance_en

[45] COM(2020) 301 final

Hydrogen Alliance[46]. In the Smart and Sustainable Mobility Strategy, the Commission has also announced its intention to establish a Renewable and Low-Carbon Fuels Value Chain Alliance, to complement these activities and support the uptake of alternative sources of energy for mobility. In addition, Horizon Europe, the new EU Framework Programme for Research and Innovation (2021-2027) will continue supporting the competitiveness of the European Industry and fostering EU's technological leadership, in particular through its dedicated Cluster on "Climate, Energy and Mobility".

Table 2 Issues, actions and scenarios for a greener, more sustainable EU mobility ecosystem

Issues	Actions and possible division of roles	Possible output scenarios
Make key enabling **technologies available for clean mobility** and deploy the required infrastructure (batteries, hydrogen, renewable fuels)	**Commission:** • Assess the need for boosting the availability of recharging points in the proposal for the Energy Performance of Buildings[47] • Launch the Renewable and Low-Carbon Fuels Industrial Alliance to support the deployment of alternative energies in maritime transport and aviation. • Explore the potential of new disruptive technologies and transport modes (e.g. hyperloop). **Member States/Regions**: • Fund, notably through the National Recovery Plans and the new cohesion programmes, public recharging and refuelling infrastructure including in rural and remote areas, as well as projects supporting the rapid deployment of alternative sources of energy for mobility (incl. batteries, hydrogen and renewable and low-carbon fuels). **Commission / Member States:** • Adopt Alternative Fuels Infrastructure Regulation to provide the appropriate regulatory	• Significant penetration of zero emission vehicles in the new cars sales by 2030 • By 2025, at least 1 kW installed public charging capacity per zero emission vehicle on the road in each Member State, and wide-spread availability of infrastructure across the TEN-T network (charging capacity at each 60 km, hydrogen refuelling at each 150 km) • Mandatory shore side electricity supply in all TEN-T maritime and inland waterway ports according to the provisions of AFIR • Increased cooperation among private and public actors, and social partners to support the rapid deployment of technologies.

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[46]   https://ec.europa.eu/growth/industry/policy/european-clean-hydrogen-alliance_en

[47]   COM(2021) 802 final

	framework supporting the deployment of the required infrastructure. • Implement the EU Hydrogen Strategy, achieve the Clean Hydrogen Alliance objectives and support the development of Hydrogen IPCEIs proposed by Member States. **Stakeholders**: • Building on the success of industrial alliances (e.g. batteries, hydrogen), identify the barriers to the deployment of technologies and address them to accelerate technological developments. • Step up investments in all segments of the value chain to support the rapid deployment of alternative sources of energy for mobility (incl. batteries, hydrogen and renewable and low-carbon fuels), covering for instance fuel production, where necessary adapting vehicles and vessels, deploying the distribution infrastructure, etc.	• New Renewable and Low-Carbon Fuels Industrial Alliance boosting supply of sustainable fuels, in particular for maritime (and aviation) modes.

Use research and innovation to foster EU's **technological leadership**	**Commission / Stakeholders**:
	
	support R&I to accelerate the development of the necessary technologies for mobility, including through the following partnerships under Horizon Europe: 'Batteries', 'Clean Hydrogen', 'Towards Zero-Emission Road Transport (2Zero)', 'Zero-Emission Waterborne Transport', 'Europe's Rail'.
	
	Member States/Regions:
	
	co-finance R&I projects, support the identification of research priorities, support industry (financing) in deploying research results
	
	Stakeholders:
	
	• Increase cooperation to better
		• Enhanced cooperation and increased investment by private and public actors to support the rapid development of technologies.
		
		• Key objectives of R&I partnerships are achieved, notably on:
		
		  o The development of high-performance solid-state batteries and associated manufacturing technology
		
		  o The development of environmentally

	identify relevant research priorities and improve the delivery of R&I projects	sustainable processing technologies, and sustainable, safe and efficient recycling processes
	• Participate in the public private partnerships by co-financing R&I projects and engaging in R&I consortia.	o The demonstration, within the 'Zero-Emission Waterborne Transport' partnership, of zero-emission solutions for all main ship types and services before 2030, which will enable zero-emission waterborne transport before 2050.
	• Step-up investments to ensure the rapid market deployment of research results (limiting or avoiding the "valley of death")	o The development, as a result of Europe's Rail JU activities, of solutions widely supported across the EU, resulting in a rail market uptake of up to 75% by 2030.
Framework conditions: **standards and regulatory approach**, including pricing and polluter pays principle	**European Parliament and Council/Member States:** Adopt ambitious legislation based on Commission proposals regarding: • CO_2 performance targets for new cars and vans: -55% and -50% reduction respectively by 2030 and -100% by 2035 compared to 2021[48] • The new regulation on the deployment of alternative fuels	• The legal framework providing clear signals to facilitate and accelerate the transition in the ecosystem, while taking account of social implications • Rules are simplified and modernised, making the limits, testing procedures and

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[48] COM(2021) 556 final

	infrastructure, repealing Directive EU/2014/94[49]	conditions more robust
	• The revision of the Renewable Energy Directive[50]	
	• The new Regulation on renewable and low carbon fuels in maritime transport (FuelEU Maritime)[51]	
	• The EU Emission Trading System (scope extended to maritime) and a new emission trading for road transport and buildings[52]	
	• The revised Energy Taxation Directive[53]	
	• National measures facilitating the pricing of environmental externalities, while addressing social and redistribution aspects	
	Commission:	
	• Adopt revision of the CO_2 standards for heavy-duty vehicles (planned in 2022)	
	• Adopt initiative on the EU framework for harmonised measurement of transport and logistics emissions	
	Member States / Regions:	
	• Map and phase-out of environmentally harmful subsidies and incentivize clean mobility solutions	

The key questions for the stakeholders are:

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[49]   COM(2021) 559 final

[50]   COM(2021) 557 final

[51]   COM(2021) 562 final

[52]   COM(2021) 551 final

[53]   COM(2021) 563 final

- Do the actions listed above comprehensively address the green transition needs? If not, what are the gaps and what measures should be addressed as a matter of priority (providing relevant data/evidence)?

- Based on data available to you, what additional or different expected output scenarios could be set until 2030? In order to achieve these, should additional actions be prioritised?

- What should be the role and responsibilities of the public authorities (EU, National, Regional and local levels) to successfully address the upcoming challenges?

- Technology development will be essential to achieve a greener, more sustainable EU mobility ecosystem. What type of technologies should be prioritised to deliver these objectives? What technologies could be commonly used by the three sectors constituting the mobility ecosystem? Which barriers exist to the adoption of new green and digital technologies in the ecosystem, specifically for SMEs?

- Can you identify already existing projects or good practices to drive the green transition of the sector that could benefit other parts of the mobility ecosystems?

- How to best address the issue of affordability and acceptability to meet consumers' needs and expectations while ensuring a fair and inclusive transition?

- Are there specific challenges faced by individual actors of the ecosystem, in particular SMEs and social partners, which should be addressed? Apart from the envisaged measures, how else should social implications of the transition be tackled?

5. DIGITALISATION OF THE MOBILITY ECOSYSTEM

Digitalisation has a major impact on the mobility ecosystem and is driving its competitiveness. Digitalisation will not only allow the industry to meet the market demand for new products and services (e.g. automation and connectivity), but it will also accelerate the transition (e.g. through new mobility service, better energy efficiency, smart charging and routing etc.). With smooth data flows among transport modes, digitalisation can accelerate shift towards a multimodal transport system. This will enable seamlessly interoperability, also using space data and services such as those provided by the Union's flagships Galileo and Copernicus. Digitalisation can also be a tool to improve the functioning of the single market and of cross-border trade. Digital certificates for drivers and vehicles, freight transport information, including in the form of electronic consignment notes, improved inter-modal and cross-border passenger information, contactless payments would all contribute to a smoother transport and mobility experience. Availability of electronic certificates and freight transport information would also facilitate digital enforcement, while real time tracking and tracing of goods would be a significant step towards the completion of the Digital Single Market, the real time economy and green transition.

However, a number of important challenges hampering the speed and the scope of the digital transition still exist. They concern in particular the level of investments required by the industry; in the automotive sector alone, each carmakers will have to spend more

than €60 billion to address automation, connectivity and electrification challenges[54]. Important investments will also have to be made to ensure the existence of the necessary IT infrastructure to support new technologies and systems (e.g. 5G corridors and ERTMS for rail) everywhere in Europe. In addition, goods produced as well as mobility services offered will rely on digital technologies, which could create new dependencies.

In the face of shortage of semiconductors, Member States agreed on the need to act collectively to reinforce the EU processor and semiconductor value chain and to expand industrial presence across the supply chain[55]. The Commission launched an industrial alliance on processors and semiconductor technologies, which is mobilising industrial partners, and Member States are working towards an Important Project of Common European Interest.

Securing essential patents on connectivity technologies is an issue with regard to the transition to higher degree of automation and connected mobility. To this end the Commission adopted an IP Action Plan[56] announcing follow-up initiatives to solve such issues. In addition, digitalisation will require securing trustworthy data sharing across the whole mobility sector. This will be a pre-condition for unlocking the economic and societal potential of the digitalisation of the mobility sector. The common European mobility data space will contribute to this objective. Artificial Intelligence (AI), data and robotics technologies, as well as space data and services, will have a strong impact on the mobility sector as a whole. However, as new data is being generated by users (and used for commercial purposes to improve services), the question of valuation of data, data protection, ownership and access and the changes in business models emerge as important points for further reflection.

Digital transformation in mobility can be further supported by an appropriate legal framework. One of the pillars of the implementation of the European Data Strategy is the 2020 Commission proposal for a Data Governance Act. A forthcoming proposal for a Data Act will address issues that affect relations between actors in the data-agile economy to provide incentives for horizontal data sharing across sectors. A horizontal Regulation for laying down harmonised rules on Artificial Intelligence, the AI Act (AIA) and the review of the Coordinated Plan on Artificial Intelligence (AI) are currently undergoing the legislative process following proposal from the Commission. It specifically includes a chapter on transport and mobility as one of the high impact sectors where EU can build strategic leadership. The AIA aims at addressing specific risks related to certain artificial intelligence system use cases including in the transport sector.

Continued support will also be given to research and innovation through Horizon Europe, where several partnerships between the Commission and the industry have been set up to support the digitalisation of the mobility ecosystem and foster EU's technological leadership.

Table 3 Issues, actions and scenarios for a smarter and digital EU mobility ecosystem

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54   Mobility's future: An investment reality check | McKinsey

55   https://digital-strategy.ec.europa.eu/en/library/joint-declaration-processors-and-semiconductor-technologies

56   COM/2020/760 final

Issues	Actions and possible division of roles	Possible output scenarios
Make key enabling **technologies available for smart mobility** and deploy the required infrastructure (semi-conductors, 5G, artificial intelligence, data , robotics, cloud and edge)	**Commission / Member States:** • Support seven 5G cross-border corridor trial projects (Horizon Europe EUR90 million) to test and validate connectivity use cases for automated driving, digital rail operations and inland waterways based on 5G (covering 12 intra-EU borders). • Support the deployment of 5G corridors and related edge computing facilities throughout Europe over 2021-2027, with a budget of around EUR 1bn. • Through the Digital Europe Programme, set up reference Testing and Experimentation Facilities to support sectoral activity in Smart City and Communities, which could include mobility. • Implement actions which are agreed in the Coordinated Plan on AI in the section "Make mobility smarter, safer and more sustainable through AI". • Establish the European Alliance for Industrial Data, Edge & Cloud**.** **Member States / stakeholders** • Prepareof the 2nd IPCEI on microelectronics (projects along the whole value chain from design to manufacturing, including advanced packaging) **Member States/Regions**: • Provide regulatory, administrative and financial support, including through the National Recovery Plans and the new cohesion programmes, for	• Technological leadership of EU industry • Availability of critical technologies. • The production of cutting-edge and sustainable semiconductors in Europe including processors at least of 20% of world production in value. • At least the full TEN-T network covered by 5G corridors, with EU funding leveraging private investments. • Business continuity in the cross-border provision of 5G connectivity for safety and non-safety services • First products validated in the Testing and Experimentation Facilities under the Digital Europe Programme • The first wave of DIGITAL and Recovery and Resilience Facility (RRF) projects will have been completed and Manufacturing Data Spaces will be in operation to support maintenance and supply chain

	the deployment of the key enabling technologies for smart mobility and the required infrastructure including in rural and remote areas.	agility.
	Stakeholders:	
	• Take stock and build on the success of the industrial alliances, identify barriers to the deployment of technologies and address these with a view to accelerate technological developments with practical applications for the mobility ecosystem.	
	• Step up investments in all segments of the value chain to support the rapid deployment of the key enabling technologies for smart mobility.	
Use research and innovation to foster EU's **technological leadership**	**Commission / Member States / Stakeholders:** support R&I to accelerate the development of the necessary technologies and solutions for a smart mobility ecosystem (cloud, edge, AI, IoT, data and automation, robotics) under Horizon Europe, including through the following partnerships and R&I initiatives: • Key Digital Technologies Joint Undertaking. • the Public-Private Partnership on AI, Data and Robotics • 'Connected, Cooperative and Automated Mobility' (CCAM). • 'Cloud-Edge-IoT for European data' on Next Generation Operating Platforms for the smart IoT (Cluster 4) tentatively included in 2023. • The collaborative development of a common open framework	• Establish European scientific leadership in trustworthy digital technologies with high socio-economic and environmental benefits • By 2030, the CCAM will have demonstrated inclusive, user-oriented and well-integrated mobility concepts with increased safety and a reduced carbon footprint. • Close collaboration across industry and across sectors like energy and mobility, along trusted and open platforms reinforcing European leadership on global

	for the next generation of car operating systems. **Member States/Regions:** • co-finance R&I projects, support the identification of research priorities, support industry (financing) in deploying research results • Set up regional and national research excellence centres around the main technology solutions (such as AI) and strengthen investment in research at national level. **Stakeholders:** • Increase cooperation along the value chain to better identify relevant research priorities and improve the delivery of R&I projects • Participate in the public private partnerships by co-financing R&I projects and engaging in R&I consortia. • Step-up investments to ensure the rapid market deployment of research results, hence limiting or avoiding the "valley of death"	open standards. • European businesses in the mobility ecosystem are at the forefront of digital innovation and achieve greater diversification along the automotive value chain including with respect to all digital components, e.g. car operating systems.
Deploy **connected and automated vehicles and vessels**	**Commission**: • Prepares legislation on the approval of driverless vehicles in particular shuttles. • Continues the work initiated by the EU Operational Guidelines on safe, secure and sustainable trials of Maritime Autonomous Surface Ships to facilitate the safe deployment of automated and autonomous maritime operations. • Supports the migration from manual to digital automatic	• The wide-scale connectivity infrastructure pulls the demand for automated vehicles, with the aim to have growing number of cars in the market equipped with an advanced automation level (SAE levels 3-4) • Major uptake of fully automated / unmanned inland and

	coupling (DAC) for rail freight.	short-sea vessels
	• Prepares a favourable legal framework (including adaptation of existing legal framework) for the harmonised operation of automated vessels in inland navigation, including remote controlled operation and track pilot systems.	• In line with the ambition outlined in the proposed revision of the TEN-T Regulation, ERTMS to be deployed by 2040 on the entire TEN-T network and national systems being removed.
	Member States/Regions:	• The close cooperation among industrial and public actors allows the EU to gain leadership on automated mobility.
	• Support the more rapid roll out of ERTMS (European Rail Traffic Management System) as the backbone for rail digitalisation	
	• Provide regulatory and administrative supports for the testing of the connected and automated vehicles and vessels and their rapid deployment (e.g. traffic rules, certification, etc.)	
	• Support connectivity investments along the EU network to facilitate the deployment of connected and automated vehicles and vessels.	
	Stakeholders:	
	Engage in all segments of the value chain to deploy connected and automated vehicles and vessels, including through the identification of technical or regulatory barriers to the broad testing and deployment of technologies and acceleration of investments in projects.	
Framework conditions: Put in place the **legislative and standardisation framework, governance and infrastructure to foster trusted data sharing and**	**Commission:** • EU data legislation to facilitate wider B2B and B2G data sharing as well as between consumers and companies. • Supports the development of a common and interoperable European mobility data space	• Thriving and competitive market for data-driven mobility services enabled by data marketplaces, enabling more sustainable and efficient

innovation	facilitating easy, cross-border access to key data resources.	transportation for passengers and freight.
	• Proposes rules on a trusted environment for corridor data exchange to support collaborative logistics, taking account of the work of the Digital Transport and Logistics Forum (DTLF)	• Improved monitoring of transport activities and their impact, supporting sustainable mobility planning and management at local, regional, national and European level.
	• Deploys a European federation of cloud/edge computing infrastructures to support trusted mobility services as well as trusted data exchange.	• Consumers benefit from seamless and cross border multimodal transport services (including ticketing).
	Member States / European Parliament: Adopt the EU Regulation on Artificial Intelligence (AIA), providing a horizontal definition of artificial intelligence and requirements that high-risk AI systems will have to comply with.	• Data sharing infrastructure at EU level facilitating cross-border access to passenger and freight mobility data such as traffic and travel information as well as mobility indicators.
	Commission and Member States: Implement the e-FTI Regulation to enable digital exchange of multimodal freight information and the Maritime Single Window environment to enable data exchange in ports.	• Freight transport becomes more digital • Harmonised rules for interoperable data sharing in freight and logistics used commonly by private and public actors.
	Member States: Implement the harmonised rules in their specific policies and programmes offer more mobility data through National Access Points, launch and scale up national mobility data sharing initiatives, such as the Mobility Data Space[57] in Germany.	• Increased collaboration across industry and across sectors (including energy, mobility, manufacturing etc.) through greater interoperability
	Stakeholders: Agree on common governance and	

[57] https://mobility-dataspace.eu/

	open standards for data sharing across industry, Original Equipment Manufacturers, suppliers, service providers.	across data spaces.

The key questions for the stakeholders are:

- Do the actions listed above comprehensively address the issues identified with regard to the ecosystem's digital transition? If not, what are the gaps, and what measures should be addressed as a matter of priority (providing data/evidence)?

- Based on data available to you, what additional or different outcome scenarios could be set until 2030? In order to achieve these, should additional actions be prioritised?

- What should be the role and responsibilities of public authorities (EU, National, Regional and local levels) to successfully address the upcoming challenges

- Technology development will be essential to achieve a smarter, digital EU mobility ecosystem. What type of technologies should be prioritised to deliver these objectives? Are there any commonalities that could be found among the three sectors constituting the mobility ecosystem? Are there barriers to the technology transfer from research institutions to industry? Which barriers exist to the adoption of new green and digital technologies in the ecosystem?

- Can you identify already existing projects or good practices to drive the digital transition of the sector that could benefit other parts of the mobility ecosystems?

- How to best address the issue of affordability and acceptability to meet consumers' needs and expectations while ensuring a fair and inclusive transition?

- Are there specific challenges faced by individual actors of the ecosystem, in particular SMEs, that should be addressed? What are the social implications (including for workers, consumers and passengers) inside the EU of the digital transition in this ecosystem? How do you think these implications should be tackled?

6. HORIZONTAL AND CROSS-CUTTING CHALLENGES

Transformation of the mobility ecosystem will require addressing horizontal and cross-cutting challenges such as skills, financing and public procurement. These are necessary enablers for the ecosystem transition. In assessing these elements and their potential, particular attention should also be given to the situation of SMEs.

6.1. Skills

The twin green and digital transition needs to be fair and ensure no one is left behind. The EU's move to a resource-efficient, circular, digitised and climate-neutral economy and the wide deployment of artificial intelligence and robotics are expected to create new jobs. At the same time, jobs in the sectors which relevance decreases will disappear or

will need to be transformed. As Europe is also facing demographic changes, with an ageing workforce, there is an even greater need for the EU to provide its workers with skills needed to take advantage of the new job opportunities that are being created in the course of transition[58].

As Europe sets off on its path to recovery, the need to improve and adapt skills became even more an imperative. Skills and lifelong learning are crucial for long-term and sustainable growth, productivity and innovation and therefore a key factor for the competitiveness of businesses of all sizes, in particular SMEs.

As the mobility ecosystem is right at the forefront of the green and digital transition, it is particularly important to ensure that it benefits from the wide availability of talented, well-educated and inventive workers and entrepreneurs.

Challenges and opportunities

- Transition of the automotive sector towards zero-emission and digital mobility is already significantly impacting around 15 million Europeans employed, directly and indirectly, in the automotive value chain. At the same time, automotive is struggling to attract and recruit qualified people, notably young people and women, for new and emerging jobs.

- In the new battery value chain, the main challenge has been created by its rapid growth, almost from nothing just a few years ago. There are currently around 70 major battery projects in the EU. There is hence a huge demand for skilled and experienced workers but there is a shortage of suitably qualified staff in a number of areas such as high-quality, high-volume, highly-digital and technically complex production process, chemical engineering or experts in mass production, to name but a few.

- A significant challenge will be faced by SMEs specialised in manufacturing of products that transition will gradually render less relevant (e.g. parts of internal combustion engines). The workers of these SMEs will likely need to participate in re-skilling and up-skilling programmes to be empowered for new opportunities in other sectors of economic growth. These programmes would need to be appropriately designed to take into account the current skill profiles of these workers and the skills needed in the new sub-sectors, as well as addressing the challenge that the geographic and regional distribution of impacted jobs and the creation of new jobs may not overlap.

- In the rail supply industry, there is a workforce of around 400.000 across the EU. The main challenge is the shift to digitalisation, including the increasing replacement of mechanical with electronic components. This is leading to skill shortages (current and expected) in areas such as systems engineering, cloud-based signalling, cybersecurity, virtual reality simulators and big data analysis.

- The waterborne sector has around 300 shipyards and 22.000 equipment suppliers and service companies providing around 1 million, direct and indirect, jobs. It is also facing the challenge of the green and digital transition especially with the focus on

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[58] For instance, InnoEnergy expects that the EU battery sector will create around 3-4 million jobs in the EU with around 800.000 needing re- and up-skilling.

developing zero-emission short sea ships and inland vessels. This kind of technological change is leading to shortages of skills in certain areas and especially electrical engineering. In addition, the sector has an ageing workforce with 40% of the current workforce retiring in the next 10 years.

Tackling these challenges will require major, and sustained, investments in re- and up-skilling, as well as in an attractive working environment and fair working conditions, in order to retain, as far as possible, existing workers and to train, educate and attract new ones, including women. The nature and scale of the challenge varies among the different parts of the ecosystem. It is envisaged to use the existing EU tools and available financing to ensure that:

- There is a solid mapping of the skills challenges in the various sectors and regions of the mobility ecosystem;

- Concrete pilot projects are carried out to show-case best practices in the field of re-skilling and up-skilling and repurposing and reconversion of business activities;

- Local and regional training schemes are developed to meet local needs;

- All stakeholders including industry, social partners, local authorities and training establishments are involved in designing and delivering these trainings;

- There are systems in place to ensure that lessons learnt and exchange of best practice is managed efficiently so that all of the EU and different parts of the ecosystem can benefit;

- There is a long-term assessment of the skills needs for different parts of the ecosystem together with proposed training solutions and tools to deliver them which could include: databases of training courses, agreed recognition of job roles and competences, mutual recognition of skill certification etc.; and

- Dedicated information centre is established to provide up to date information on potential sources of EU funding and eligibility criteria.

In 2021, the Commission presented the European Pillar of Social Rights Action Plan, which introduced a headline target establishing that 60% of adults should be participating in training every year by 2030. In addition, under the EU "Skills Agenda", adopted in July 2020, the flagship "Pact for Skills" initiative was launched to provide concrete commitments for the re-/upskilling of the workforce. The automotive sector is amongst the first industrial sectors to have concluded a sectoral Partnership under the Pact for Skills ("Automotive Skills Alliance ASA[59]") and a further Partnership on shipbuilding has been accepted.

The "Blueprint Alliances for Sectoral Cooperation on Skills", established under the Erasmus+ programme, aim at creating new strategic approaches and novel forms of cooperation between key stakeholders (e.g. industry, social partners, research, education and training institutions and public authorities) for concrete skills development solutions.

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[59] AUTOMOTIVE SKILLS ALLIANCE (automotive-skills-alliance.eu)

The mobility eco-system benefits from five blueprints; the "Alliance for Batteries Technology, Training and Skills (ALBATTS[60]) launched in December 2019, the "Development and Research on Innovative Vocational Educational Skills (DRIVES[61]) launched in January 2018, the European Rail Skills Alliance (STAFFER[62]) launched in December 2020, the Maritime Technology Skills Alliance (MATES[63]) launched in January 2018 and the Alliance "Futureproof Skills for the Maritime Transport Sector (Skillsea[64]) launched in January 2019.

Table 4 Issues, actions and scenarios on skills in the EU mobility ecosystem

Issues	Actions and possible division of roles	Possible output scenarios
Establish EU Frameworks to assess skill and training solutions for the eco-system.	**Member States/Regions**: to take advantage of EU funding opportunities to supporting training and re- and up-skilling activities. **Member States/Regions:** to take advantage of the guidance for adequate accompanying policies provided in the Council Recommendation on ensuring a fair transition towards climate neutrality, notably Recommendations 5, 10 and 11. **Stakeholders:** Batteries & automotive manufacturers and suppliers-through Erasmus+ projects ALBATTS and DRIVES, establish long-term strategies to identify skill needs, educational programmes to meet and mutual recognition of qualifications to	Parts of the mobility ecosystem that face particular challenges in the twin transitions are offered appropriate support to facilitate their transition – expected to be around 5% of the workforce each year. European universities/technical colleges are educating sufficiently qualified engineers, technicians and other staff for the manufacturers and value chains of the ecosystem. Sufficient new recruits entering the sector each year. Industry sponsorship of technical and university level qualifications including practical work experience. The Partnerships, under the

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[60] Project ALBATTS (project-albatts.eu)

[61] Project DRIVES (project-drives.eu)

[62] Project STAFFER (https://www.railstaffer.eu/)

[63] Media - Project Mates - Project Mates

[64] Project Skillsea (https://www.skillsea.eu/)

Take advantage of EU funding to support the re- and up-skilling required and to meet the demands of new jobs created by the green and digital transition. **Active participation by stakeholders in EU-funded training schemes to ensure training provision meets specific local and regional needs**	support worker mobility. Maritime - through Erasmus+ project MATES [65] (marine technology), to establish a long-term strategy to identify skill needs, educational programmes to meet and mutual recognition of qualifications to support worker mobility. Batteries & automotive - to actively participate in EU and nationally-funded training initiatives which will contribute to the implementation of concrete skilling commitments of the Partnership under the Pact for Skills initiative. EIT InnoEnergy, EIT Raw Materials and EIT Urban Mobility deliver education and professional programmes in their field of expertise (including batteries, raw materials and mobility). Maritime - Shipbuilding & maritime technology - to actively participate in EU and nationally-funded training initiatives which will contribute to the implementation of concrete skilling commitments of the Partnership under the Pact for Skills initiative. Rail - through Erasmus+ project STAFFER (rail supply industry) to establish a long-term strategy to identify skill needs, educational programmes to meet and mutual recognition of qualifications to support worker mobility.	Skills Pact, develop a strong portfolio of regional training schemes that can be supported and used as best practice throughout the EU. The skills academies operated by some manufacturing companies are integrated into local and regional training schemes. Industry sponsorship of technical and university level qualifications including practical work experience.

The key questions for the stakeholders are:

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[65] [Maritime industry concerns over skills supply and demand - Project Mates - Project Mates](#)

- Do the actions listed above comprehensively address the issues related to skills, including for SMEs? If not, what are the gaps, and what elements should be addressed in priority?

- What additional or different outcome scenarios could be envisaged?

- What unmet skill needs exist in the workforce at all levels of the ecosystem to realise the twin transition?

- Do cultural and mind-set barriers to the twin transition exist in the ecosystem? If you identify additional barriers or needs that have not been addressed in this document, please share them.

- What should be the role and responsibilities of public authorities (EU, National, Regional and local levels) to successfully address the upcoming challenges?

6.2. Investments, financing & public procurement

The transition to a resilient, innovative, sustainable and digital mobility ecosystem will require significant investments by private actors and, to the extent necessary by public investments. Public funding will neither be sufficient to meet the massive investment needed, nor should it crowd out private investment. Helping to channel private funding, including by creating an enabling framework and providing targeted support, will be a key role for the public sector. For the next decade, the additional private and public investment needs are estimated at nearly EUR 230 billion per year. National Recovery and Resilience Plans are expected to provide a boost to green and digital investments, covering areas such as public charging infrastructure, hydrogen for mobility, infrastructure to support modal shift, stimulating fleet and rolling stock renewal, digitalisation of the logistic chain and traffic infrastructure, etc.

Investment in sustainable, safer and smart mobility projects in line with EU priorities are eligible under InvestEU, in particular under the Sustainable Infrastructure window. InvestEU includes the possibility to blend its support with EU grants and/or financial instruments from sectorial programmes. The EIB has provided long-term finance (mainly in the form of loans and guarantees) to support the development of many transport networks in Europe. EIB Group will continue to invest in the transformation of mobility and transport for a low-carbon future in Europe and beyond. This will be critical for the mobility ecosystem to ensure that the most innovative products and solutions supporting the twin transition are rapidly and widely deployed across Europe.

Member States can also directly contribute to accelerating the transition through investments that can be supported with State aid[66]. To this end the Commission has already proposed its revised Climate, Environmental and Energy Guidelines which will include a section for supporting clean mobility. The Commission plans to have them adopted and applied as from January 2022. The State aid rules for R&D&I already allow support in new technologies in zero emission mobility and for digital innovations and solutions.

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[66] https://ec.europa.eu/competition-policy/state-aid/state-aid-overview_en

The Connecting Europe Facility (CEF) transport programme supports the development of interconnected and multimodal networks and infrastructure for sustainable, smart, interoperable and accessible mobility on trans-European transport network (TEN-T). In line with the Green Deal, CEF will dedicate at least 60% of its budget to the Union´s climate objectives, thus supporting investments in greener transport modes, in particular in rail infrastructure. In addition, Alternative Fuels Infrastructure Facility will support the deployment of such infrastructure for all transport modes on TEN-T, for example electric recharging and hydrogen refuelling points on TEN-T roads. CEF also contributes to the seamless connections between transport modes in TEN-T urban nodes by supporting the improvement of multimodal passenger hubs.

Cohesion policy[67] will finance actions related to sustainable, climate resilient, intelligent and intermodal transport. It will also support research and innovation, skills, industrial transition and entrepreneurship, as well as sustainable transport infrastructure.

For the 2021-2027 period, at least 8% of the ERDF resources will be allocated to sustainable urban development projects based on cities' development strategies. These will pay particular attention to tackling environmental and climate challenges, notably the transition towards a climate-neutral economy by 2050, and to harnessing the potential of digital technologies for innovation purposes. Cohesion policy will continue to finance sustainable urban development, offering opportunities for local authorities to address the issues in support of the transition of local mobility ecosystems. Finally, the European Urban Initiative financed by the ERDF will support cities to develop innovative actions, capacity and knowledge building, territorial impact assessments, policy development and communication.

The **Just Transition Mechanism** will support the regions most affected by the socio-economic transition to climate neutrality in line with the Territorial Just Transition Plans. Areas for support include: (a) energy; (b) decarbonisation projects, economic diversification of the regions and social infrastructure; (c) circular economy; and (d) re-skilling, upskilling of workers. In addition, the European Globalisation Adjustment Fund can be mobilised to support measures such as career guidance and individualised job-search support, acquiring new or additional skills or advice on starting an own business for regions and sectors impacted by job losses[68].

Horizon Europe, the new EU Framework Programme for Research and Innovation (2021-2027) will support the competitiveness of the European Industry and foster EU's technological leadership. There is a dedicated Cluster on "Climate, Energy and Mobility" with the overarching driver to accelerate the twin green and digital transitions and associated transformation of our economy, industry and society. The total budget for the whole Cluster 5 is EUR 15 billion. This is implemented in particular by several partnerships related to transport: co-programmed partnerships (Towards Zero-Emission Road Transport (2Zero); Batteries; Zero-Emission Waterborne Transport; Connected, Cooperative and Automated Mobility (CCAM)), co-funded partnership (Driving Urban Transitions to a sustainable future (DUT)) and institutional partnerships (Clean Aviation, Clean Hydrogen and Europe's Rail').

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[67] Cohesion Policy 2021-2027 - Regional Policy - European Commission (europa.eu)

[68]   https://ec.europa.eu/commission/presscorner/detail/en/IP_21_5820

The Technical Support Instrument (TSI) provides technical support to design and implement reforms in EU Member States. The support is provided upon request across a wide range of policy areas, including a resilient, innovative, sustainable and digital mobility ecosystem, in line with EU priorities such as the green and digital transitions. Under TSI 2022, Member States were invited to request support, among others, on the European Flagship of Recharge and Refuel which focuses on sustainable mobility.

Also, public procurement can be a powerful lever for the mobility ecosystem. Specific rules have already been adopted to encourage the public procurement of clean vehicles (Clean Vehicle Directive 2019/1161) and ensure a certain proportion of procurement of clean vehicles. Public authorities should use this lever in a more strategic manner, to boost jobs, growth and investment, and to contribute to a more innovative, sustainable, inclusive and competitive economy.

The Smart and Sustainable Mobility Strategy also underlined the potential of exploring the benefits of retrofitting and renewal schemes in various transport modes. This has the advantage of potentially enhancing demand to the industry while allowing the rapid replacement of vehicles and vessels with more advanced technologies (higher energy efficiency, reduced air and noise pollution, modern TSIs in rail, etc.). Any scrapping scheme must however be designed to sustain and encourage a healthy market in second hand vehicles to support new market entrants.

Table 5 Issues, actions and scenarios on financing and public procurement in the EU mobility ecosystem

Issues	Actions and possible division of roles	Possible output scenarios
Private and public funding to boost resilient, green and digital mobility ecosystem	**Commission:** Facilitates and monitors implementation of National Recovery and Resilience Plans, provides debt and equity financial support to green and digital investments via **InvestEU**, informs stakeholders of available financial instruments and research funding. Works with the EIB Group and other financiers to support business investments. Launches annual calls for project proposals and the rolling call of the Alternative Fuels Infrastructure Facility under the Connecting Europe Facility transport programme. Direct investments towards sustainable projects through the	Close the investment gap to achieve the sustainable and digital mobility objectives

	Taxonomy Regulation and the respective Delegated acts. **Member States/Regions:** Implement National Recovery and Resilience Plans taking all territories into account (promotion of future-proof clean technologies to accelerate the use of sustainable, accessible and smart transport, charging and refuelling stations and extension of public transport). Use ERDF to support mobility transition pathways. **Stakeholders:** EIT Urban Mobility, EIT Innoenergy and EIT RawMaterials provides support to business creation and growth, as well as to the maturation of innovative solutions in the field of battery and mobility.	
Promote green/digital mobility products and services through public procurement	**Commission:** Public Procurement + State aid rules without competition distortions; **Member States/Regions – public authorities in charge of transport and mobility**: • promote and encourage the systematic use of sustainable public procurement for the purchase of products, services and works, • create a critical demand for innovative and green goods, services and business models such as low emission vehicles or shared mobility solutions.	Thanks to shared definitions and criteria at EU level[69], using some basic sustainability/life cycle considerations has become easier and mainstream for most public buyers across the EU.

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[69] The EU has adopted rules making sustainable public procurement mandatory at the very least for several products.

The key questions for the stakeholders are:

> - Do the actions listed above comprehensively and coherently address the issues identified in this area? If not, what are the gaps, and what elements should be addressed in priority?
>
> - What additional or different outcome scenarios could be envisaged?
>
> - What additional measures could further assist the phasing out of fossil-fuels financing in transport to the benefits of greener technologies?
>
> - What additional actions, if any, would need to be considered to reflect the specific situation and needs of SMEs within the mobility ecosystem? Are there any systemic barriers in this ecosystem to access to funding for the twin transition - particularly for SMEs?
>
> - What should be the role and responsibilities of public authorities (EU, National, Regional and local levels) to successfully address the upcoming challenges?

7. CONTINUATION OF THE CO-CREATION PROCESS AND NEXT STEPS

This Staff Working Document is the basis for consulting Member States and stakeholders and hence initiate the co-creation process for a joint vision on the transition of the mobility ecosystem. This section provides first elements on the possible next steps and indications on how to track the effective transition of the mobility ecosystem through a set of key performance indicators.

7.1. Key indicators

As indicated in section 2 of this Staff Working Document, the actions presented here largely build upon the objectives identified in the strategic documents adopted by the Commission to frame the scope of the necessary transitions in the mobility ecosystem and list the main instruments to deliver them. These documents may already contained quantified objectives, which should remain the primary benchmarks.

In order to be successful, the transition of the mobility ecosystem will have to be analysed in terms of the development and deployment of the main key enabling technologies, and, when relevant, the associated infrastructures. This transition will also have to be supported by sufficient human and financial resources. In this respect, the re- and up-skilling of the workforce is an important factor to potentially accelerate the transition of the ecosystem and improve its competitiveness. As the industry is still recovering from the aftermath of the COVID crisis, tracking the effect of the necessary transition on the sector's competitiveness, including globally, will be essential.

One of the values of the ecosystem approach is to bring together industries facing similar challenges to learn from good practices and potential share common solutions. In this respect, particular attention should be given to cross-sectorial cooperation, involving for instance suppliers and operators, but also cooperation beyond the traditional mobility industrial ecosystem (reaching out to energy, IT providers, etc.).

Last but not least, it will be important to monitor how the changes to the industrial ecosystem also affect the provision of mobility services in Europe, in particular those that

are essential to facilitate the twin transition (e.g. co-modality and combined transport, uptake of new solutions such as mobility as a service, etc.).

> - Considering all elements presented in the SWD, what specific key indicators should be used to track the successful transition in the mobility ecosystem?
>
> - What indicators / data are currently collected and used by actors in the ecosystem to measure their performance with regards to the twin transition and their resilience?
>
> - Which common indicators could be used to monitor cooperation among all actors or the ecosystem?

7.2. Thematic stakeholders meetings and governance

The Commission services will ensure that the co-creation process for the Mobility Transition Pathway will continue through structural interaction with Member States, and stakeholders at large, including industry, social partners and non-governmental organisations. The Commission services will organise cross-sectoral thematic roundtables, notably under the auspices of the Industrial Forum that will provide oversight over the transition process. These roundtables will allow exchanging best practices and feed into innovations for the green and digital transition.

By bringing together stakeholders from different sub-sectors of the value chain, new partnerships for the transition could also be facilitated, for instance between vehicles manufacturers and component suppliers, or among suppliers and recharging infrastructure operators, energy suppliers or operators in the field of batteries recycling. This should also help to define a clear project pipeline that would boost investments in the years to come.

The process will support the identification of 'Frontrunners/ Transition Ambassadors' in consultation with industry to steer, through concrete examples, how this transition could be successful in particular for the most vulnerable enterprises. It will also look at existing schemes to see what elements could provide a useful template offer assistance and capacity-building in the practical steps to the transition.

The Commission services will also use the existing platforms (Motor vehicle Working Group, Rail Supply Industry Expert Group, possible use of the relevant European sectorial social dialogue committees, etc.) to address sectoral issues and will assess the best option to bring all components of the mobility ecosystem in a joint platform to discuss the transition pathway, and may consider follow-up structures at higher political levels to take stock of the overall twin transitions. The question for the stakeholders is:

> What more, or different, actions would be needed in order to support the transition towards 2030 from the Commission, Member States and the stakeholders at large?

8. CONCLUSIONS AND INVITATION TO STAKEHOLDERS

This paper lists instruments to support the green and digital transitions as well as the resilience of the mobility ecosystem. That can only be reached if the different sectors of the ecosystem and their diverse actors come together. All stakeholders, large and small, public and private, as well as the social partners are invited to work together and propose

concrete commitments, actions, and investment plans that will complement policy actions designed by the Commission and which could be implemented at sectoral, national and regional levels of the mobility ecosystem. Stakeholders and social partners are also invited to provide an assessment of scale, cost, long-term benefits and conditions of the required actions to accompany the twin transition of the mobility ecosystem. Concrete responses, proposals and suggestions from mobility stakeholders and social partners will be welcome by 31 March 2022 through online consultation.

Our shared ambition should be to help the EU Mobility ecosystem embrace the green and digital transformation and become even more resilient than today to foster growth, jobs and competitiveness of the EU. This cannot be achieved by the Commission, Member States, stakeholders and social partners acting on their own.

The key for recovery is collaboration and a forward-looking responsible attitude. All together, we need to think beyond the current difficulties to build back a mobility ecosystem in socially, economically, environmentally and culturally sustainable manner, ensuring we leave no one behind. We have the momentum of the recovery, the need for change driven by businesses and citizens, the awareness of Member States and the availability of EU funds, e.g. through the NextGenerationEU recovery plan, to leverage private investment. This transition pathway offers opportunities to bring the industrial community together to find common solutions to upcoming challenges and to reinforce the business case for the twin transition. The expected outcome should ideally be a clear projects pipeline that would boost investments in the years to come.