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COMMISSION STAFF WORKING DOCUMENT

Preliminary analysis of the long-term renovation strategies of 13 Member States

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Introduction

The European Green Deal aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy, with no net emissions of greenhouse gases in 2050 and to decouple economic growth from resource use. In addition, in its Climate Target Plan 2030¹, the Commission has proposed to cut net greenhouse gas emissions (GHG) in the EU by at least 55% by 2030 compared to 1990.

Buildings are indispensable for reaching the EU's carbon neutrality, energy efficiency and renewable energy objectives. The building stock is the largest single energy consumer in Europe, accounting for 40% of the EU's energy consumption and 36% of its GHG emissions. To achieve the net 55% emission reduction target by 2030 the EU should reduce buildings' greenhouse gas emissions by 60%, their final energy consumption by 14% and energy consumption for heating and cooling by 18%².

For 75% of the EU's existing building stock, energy performance is poor and the buildings were constructed before current energy requirements were in place. It is estimated that about 85-95% of today's buildings will be in use by 2050. Today, only 11% of the EU's existing building stock undergoes some level of renovation each year, and a focus on reducing energy consumption, modernising technical building systems and installing renewables is lacking in most cases. However, very rarely, renovation works address buildings' energy performance. The weighted annual energy renovation rate is low at some 1%³. At this pace, cutting carbon emissions from buildings to net-zero would require centuries.

This is why the Commission adopted the 'Renovation Wave for Europe' initiative with the objective **to at least double the annual energy renovation rate of residential and non-residential buildings by 2030 and to foster deep energy renovations.**

According to the impact assessment for the Climate Target Plan 2030, the residential sector would have to undergo the highest reduction in energy demand in heating and cooling, ranging between -19% to -23%, compared to 2015. The annual rate of replacement of heating equipment would have to reach around 4% in both the residential and services sector. During the same time period, the share of renewables and waste heat would have to increase to 38-42% to reach the objective.

The Communication on the Renovation Wave stressed that the COVID-19 crisis has brought EU buildings into a sharper focus, going beyond carbon neutrality, energy efficiency and renewable energy objectives. It underlines that as Europe seeks to overcome the COVID-19 crisis, renovation offers a unique opportunity to rethink, redesign and modernise our buildings, and to integrate renewables into their technical heating, cooling and electrical

¹ Stepping up Europe's 2030 climate ambition, COM (2 020) 562 final.

² Compared to 2015 levels, see *SWD (2020) 176 final*.

³ Annual energy savings achieved from all renovations (light, medium and deep) compared to the energy consumption of the total building stock. See the 'Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU (2019)': https://ec.europa.eu/energy/studies/comprehensive-study-building-energy-renovation-activities-and-uptake-nearly-zero-energy_en?redir=1

systems to make them fit for a greener and digital society, better prepare them for future climate impacts and sustain the economic recovery.

Furthermore, the strategy is set to contribute to Europe's just transition as it enables the retrofitting of residential buildings, with a clear focus on social and affordable housing, and addresses the urgency of tackling energy poverty and worst performing buildings.

Buildings are also a major source of other air pollution, with 50% of primary fine particulate matter emissions related to heating. The Communication highlighted the importance to ensure high air quality, good water management, disaster prevention and protection against climate-related hazards, removal of and protection against harmful substances such as asbestos and radon, fire and seismic safety. The Communication also highlighted the opportunity when renovating for energy efficiency to ensure accessibility of persons with disabilities and older persons. Paying specific attention to the most vulnerable segments of the population is a priority also as a reaction to the COVID-19 crisis, to foster a stable recovery and resilience⁴.

Investing in buildings can inject a much-needed stimulus in the construction ecosystem and the broader economy. Renovation works: (i) are labour-intensive, (ii) create jobs and make investments often rooted in local supply chains, and (iii) generate demand for highly energy-efficient and renewable equipment and professional works and services, which improves the long-term market and quality value of properties. This can be very valuable for a sector where more than 90% of operators are SMEs, hard hit by the economic impact of the COVID-19 crisis. Construction activity fell by 15.7% in 2020 compared with 2019, and energy efficiency investment dropped by 12%. Demand for renewable equipment, technology installation work and professional support services was 30-40% lower in year-on-year comparison⁵. Even if a recovery is expected, there will likely be a lasting impact on the construction sectors and the related equipment and technology supply chain.

In addition to macroeconomic impacts on GDP and employment, building renovations bring other wider benefits, both at societal and individual/micro level such as health, productivity, innovation, energy security, and inclusiveness which are mutually reinforcing in a virtuous process⁶.

The Recovery and Resilience Facility, which is currently under negotiation and which the European Council agreed to endow **with EUR 672.5 billion**, 37% of which would be targeted to climate-related expenditure, can support renovation investment and energy efficiency related reforms across Member States. In the Annual Sustainable Growth Strategy for 2021, the Commission proposed the **European Flagships 'Renovate' and 'Power Up'** to support a coordinated intervention by all Member States, based on projects included in their national Recovery and Resilience Plans⁷.

⁴https://www.energypoverty.eu/sites/default/files/downloads/observatory-documents/20-06/epov_third_report_final_v2_compressed.pdf

⁵ For example, heat pump marketing fell by 40% according to EHPA (European Heat Pump Association) .

⁶https://publications.jrc.ec.europa.eu/repository/bitstream/JRC120683/untapping_multiple_benefits_-_hidden_values_in_environmental_and_building_policies.pdf

⁷ Support from other EU programmes such as InvestEU, the Connecting Europe Facility, LIFE and Horizon Europe as well as national funds can also be combined with the Recovery and Resilience Facility.

To sustain the implementation of these flagship initiatives, the Commission has complemented its guidance⁸ to Member States on the preparation of recovery and resiliency plans⁹ with tailor-made guidance to each Member State, in the context of the individual assessments of national energy and climate plans and long-term renovation strategies. The Commission also **adopted an assessment module on building renovation and energy efficiency** to give Member States practical guidance on how to prepare reforms and investment projects for renovation under the Recovery and Resilience Facility¹⁰.

Some Member States have already submitted their **draft recovery and resilience plans**, and the Commission is discussing these draft plans with them to make sure that the 'renovate' component is correctly addressed and that it corresponds to the submitted national long-term renovation strategies. Information provided in the national long-term renovation strategies, the national energy and climate plans (NECPs¹¹) and the draft plans should be consistent and complement each other so that the Commission has a complete picture of national policies towards achieving a decarbonised building stock.

It also has to be noted that the long-term renovation strategies are part of the required enabling conditions to access Cohesion Funds from 2021 onwards and Member States must respect the energy efficiency enabling condition for the ERDF Operational Programmes.

The **European Green Deal Communication** underlined that the Commission will rigorously enforce the legislation related to the energy performance of buildings, starting with an assessment in 2020 of Member States' national long-term renovation strategies¹². The Renovation Wave Communication confirmed the key importance of strict implementation of the Energy Performance of Buildings Directive and of national long-term renovation strategies as a key planning tool for selecting priority projects to be funded. Under Article 2a of the Directive, Member States had to notify the Commission of their national strategies by 10 March 2020.

The Renovation Wave Communication also underlined that **programming documents** should set out **renovation priorities** drawn from the **national energy and climate plans and long-term renovation strategies**. It invited Member States who had not yet presented their long-term renovation strategies to do so as these strategies are one of the pre-requisites for accessing Cohesion Fund financing from 2021 onwards. The Communication also underlined heating and cooling as a specific focus area for building renovation.

Moreover, the Renovation Wave Communication stated that the Commission will track renovation progress as part of the European Semester as well as through the monitoring and reporting mechanisms set up under the governance system for the energy union and climate action. It will do so in particular through the Technical Working Group on the implementation

⁸ SWD(2020) 205 PART 2/2 and SWD(2021) 12 final

⁹ COM(2020) 575 final Annual Sustainable Growth Strategy 2021

¹⁰ https://ec.europa.eu/info/sites/info/files/component_renovation.pdf

¹¹ https://publications.jrc.ec.europa.eu/repository/bitstream/JRC122862/jrc122862_national_energy_and_climate_plans_under_the_eu_energy_union_governance_final.pdf

¹² COM (2029) 640 final: The European Green Deal.

of the Governance Regulation, with a particular focus on the implementation of **national energy and climate plans** and **long-term renovation strategies**.

Finally, under the Renovation Wave the **New European Bauhaus** was announced as a flagship initiative to engage people in reimagining the places where we live and the way we live in them, a movement integrating three fundamental dimensions: sustainability (including circularity), quality of experience (including aesthetics) and inclusion (including affordability and accessibility).

The present staff working document focuses on analysing the 13 long-term renovation strategies submitted by 15 November 2020 to feed into the implementation of the Renovation Wave strategy and the analysis of the recovery plans. It contains:

- a general part that provides an overall assessment of the long-term renovation strategies;
- a second part that lists existing and planned measures proposed by Member States and highlights best practices;
- a third part with an analysis of each Member State's long-term renovation strategy based on a standardised template.

The Commission will publish an updated version of this staff working document once all strategies - or most of them in case of significant delays - are submitted by Member States.

1 Overall assessment of the long-term renovation strategies

1.1 Submission of Member States' long-term renovation strategies

Under Article 2a of the Energy Performance of Buildings Directive (EPBD), Member States had to notify the Commission of their national long-term renovation strategies by 10 March 2020.

As of 15 November 2020, partly due to the COVID-19 crisis, most Member States did not respect this deadline.

The latest state of play is as follows:

- As of 4 February 2021, 19 Member States had submitted their long-term renovation strategies (Austria, Belgium, Bulgaria, Cyprus, Croatia, Czechia, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Luxembourg, the Netherlands, Romania, Slovakia, Spain and Sweden).
- It is expected that the remaining Member States will deliver their long-term renovation strategies by spring 2021. The Commission will update this staff working document once all strategies have been submitted.
- The Commission is in contact with all Member States to provide guidance on drafting the long-term renovation strategies and accelerate the submission process.

1.2 Overall assessment of Member States' long-term renovation strategies (to be finalised once all have been submitted)

The Energy Performance of Buildings Directive precisely defines the content and structure of the long-term renovation strategies that Member States should submit to the Commission, in its Article 2a. To support Member States in the preparation of their strategies, in 2019 the Commission adopted a Recommendation on building renovation, with guidance on the requirements set out in Article 2a¹³.

In general, there is broad support for easier access to financing, technical support, promotion of advisory tools such as one-stop-shops, tackling energy poverty and better information.

However, the long-term renovation strategies submitted so far vary in terms of:

- the completeness of the elements required by the Energy Performance of Buildings Directive,

¹³ The Commission issued the Recommendation on building renovation (EU) 2019/786 on 8 May 2019.

- the ambition level of renovation targets and goals in terms of objectives and budget allocation.

As regards the **completeness** aspect, and from a formal point of view, the submitted long-term renovation strategies have in general respected the requirements of the Energy Performance of Buildings Directive, providing information in the different categories requested by Article 2a. However, the level of detail provided varies from one long-term renovation strategy to another. The JRC is currently working on an in-depth completeness check; this will be published complementary to this staff working document once all strategies have been submitted. Similar reports, based on an established methodology have been published by the for the previous long-term renovation strategies submitted by Member States in 2014 and 2017¹⁴.

As regards the strategies' **ambition level**, Member States have committed to different types of indicative milestones for 2030, 2040 and 2050, and to different sets of policy measures and budget allocations. Moreover, the data provided by Member States vary in nature and make it difficult to precisely compare the effect of the different national measures. In particular, not all long-term renovation strategies are providing GHG reduction data, which makes it difficult to assess the ambition of the strategies in terms of climate mitigation.

The timing of the submission of the long-term renovation strategies by Member States, spread over the entire year 2020 and not yet concluded has reduced significantly comparability among the plans elaborated in different Member States. Late submissions had indeed the possibility to include in their strategy also the COVID-19 crisis and the latest EU policy initiatives, such as the Renovation Wave. Whenever possible the assessment took into account the different contexts and timing when each strategy was drafted and submitted.

To assess each strategy, the Commission has put together the following table of numeric pledges and the corresponding budget allocation described in the strategies submitted by Member States. This table also includes information from the national energy and climate plans, where appropriate.

¹⁴ See 'Assessment of second long-term renovation strategies under the Energy Efficiency Directive' (2019) <https://op.europa.eu/en/publication-detail/-/publication/e04473ed-2daf-11e9-8d04-01aa75ed71a1/language-en/format-PDF/source-86607487>.

Country	Milestones and numeric pledges for renovations towards a decarbonised buildings stock by 2050	Investments needs	Main characteristics of proposed measures	Potential areas of further improvement
Austria	<ul style="list-style-type: none"> 80% decarbonisation of the building stock by 2050. Renovation rate (across all building types) to be increased to 3% from current 1.5% p.a. (for the 2020-2050 period) 	<ul style="list-style-type: none"> In order to maintain the current level of renovation, approximately EUR 5.3 billion is needed per year. If the renovation rate increases to 3%, more than EUR 10 billion is needed by 2050. 	<ul style="list-style-type: none"> Comprehensive set of regulatory requirements, fiscal and economic incentives and information measures. Highly decentralised approach, structured around federal, regional and municipal obligations and measures. 	<ul style="list-style-type: none"> A clearer overview of the measures and budget at regional or federal level could further increase clarity on the strategy and the existing measures. Wider benefits of building renovation could be analysed in more detail.
Cyprus	<ul style="list-style-type: none"> Around 33 000 residential buildings and 10 000 non-residential buildings are expected to be renovated by 2030. 	<ul style="list-style-type: none"> EUR 70 million is needed from the structural funds by until 2027. A study has identified investment needs of EUR 800 million for the 2020-2030 period. 	<ul style="list-style-type: none"> Comprehensive set of measures: regulatory, financial, awareness raising, user behaviour, training, supporting schemes. 	<ul style="list-style-type: none"> A more detailed plan for decarbonisation by 2050 in view of increasing the renovation rate. Wider benefits of building renovation could be analysed in more detail.
Czechia	<ul style="list-style-type: none"> Final energy consumption in 2050: 289 PJ. Renovation rate for: <ul style="list-style-type: none"> single-family houses: 1.4% multi-apartment buildings: 0.79% public and commercial buildings: 2% About 40% GHG reduction by 2050. 	<ul style="list-style-type: none"> CZK 325 billion is needed by 2050. Investment needs were estimated for different scenarios. 	<ul style="list-style-type: none"> Combination of economic measures, a communication campaign, support to technical assistance for energy efficiency projects with a special focus on Energy Performance Certificates, and education measures. The long-term renovation strategy strongly emphasizes the role of technical assistance and energy management in the take-up of energy efficiency projects, 	<ul style="list-style-type: none"> More detail on the implementation of financial instruments could be helpful. Trigger points could be more precisely identified. Wider benefits of building renovation could be analysed in more detail.

			<p>especially in the non-residential sector.</p> <ul style="list-style-type: none"> • A detailed communication campaign to promote energy efficiency is envisaged. 	
Denmark	<ul style="list-style-type: none"> • Reduction of heating needs by 35% by 2050. • A fossil-free energy supply by 2050. • Energy consumption of existing building stock reduced by 50%. 	<ul style="list-style-type: none"> • Investment needs are estimated at DKK 40.6-76.2 billion until 2050. • Saving an additional 1.4 TWh requires almost double the investment (DKK 76.2 billion vs 40.6 DKK) or 0.28 DKK/kWh vs 0.43 DKK/kWh saved. 	<ul style="list-style-type: none"> • Comprehensive and well balanced set of measures (regulation and standards, financial incentives, information, training and advice). 	<ul style="list-style-type: none"> • Indicative milestones for the efficiency of the building stock should be specified for 2030, 2040 and 2050. • Wider benefits of building renovation could be analysed in more detail.
Estonia	<ul style="list-style-type: none"> • The target is to renovate 22% of the total building stock by 2030, 64% of the total building stock by 2040 and the entire existing building stock (built prior to 2000) cost-effectively into nearly zero-energy buildings by 2050. • A total of 141 000 existing buildings representing 54 million m² are waiting to be renovated in the next 30 years. 	<ul style="list-style-type: none"> • The full renovation of all buildings will cost around EUR 22 billion. • The annual renovation financing needs are expected to increase almost fivefold: from the current cost of under EUR 200 million up to EUR 900 million. 	<ul style="list-style-type: none"> • The strategy proposes to use state-funded financial mechanisms in the form of loans, guarantees and support, as well as to introduce new technologies, develop information and awareness measures, increase data availability for buildings and improve the monitoring process. • Specific planned cost-effective measures focus on replacing/improving heating systems to reduce heat loss. 	<ul style="list-style-type: none"> • A more precise overview of the funding allocated to specific measures could further increase clarity on existing and envisaged measures. • Wider benefits of building renovation could be analysed in more detail.
Finland	<ul style="list-style-type: none"> • The goal is for all buildings (residential and non-residential) to have an energy class of C or above by 2050. • Removing all vacant 	<ul style="list-style-type: none"> • Implementing the strategy will cost EUR 24 billion over the course of 30 years, or EUR 800 million per year. 	<ul style="list-style-type: none"> • Comprehensive set of measures (regulatory requirements, fiscal and economic incentives and information measures). • Almost all the proposed measures have already been 	<ul style="list-style-type: none"> • The investment needs could be further detailed. • Wider benefits of building renovation could be analysed in more detail.

	<p>buildings from the building stock (by 2050, only 70% of the Finnish building stock will remain).</p> <ul style="list-style-type: none"> • CO2 emissions reduced by 90% by 2050. 		adopted and implemented.	
France	<ul style="list-style-type: none"> • Carbon neutrality by 2050. • From 1 January 2023, dwellings whose final energy consumption will exceed a certain threshold may no longer be rented out. • From 1 January 2028, all dwellings with excessive energy consumption will have to be renovated. • 49% decrease in building sector GHG emissions by 2030 compared to 2015. • Residential: 22% reduction in energy consumption in the building sector by 2030, 29 % by 2040, and 41% by 2050, compared to base year 2015. • Tertiary sector: a target of reducing energy consumption by 40% in 2030, 50% in 2040 and 60% in 2050. 	<ul style="list-style-type: none"> • The estimated annual amount of (public/private and public) investment for the 2019-2032 period includes EUR 15-25 billion for buildings. (from the NECP) 	<ul style="list-style-type: none"> • Comprehensive set of measures (regulatory requirements, fiscal and economic incentives and information measures). The measures are in place across all government levels, which guarantees that they are tailored to local needs. • The regulatory measures that address the worst part of the building stock and renovation obligations for large service-sector buildings are clear frontrunners in the EU and a strong stance on refurbishment requirements. • The set of measures to address energy poverty is very comprehensive. 	<ul style="list-style-type: none"> • Wider benefits of building renovation could be analysed in more detail. • Investment needs and budget allocation could be defined in more detail.
Germany	<ul style="list-style-type: none"> • Reduction of greenhouse gas emissions to 70 MtCO₂eq by 2030. • Reduction of non-renewable primary energy 	<ul style="list-style-type: none"> • Only 2018 investment figures have been reported: EUR 182.2 million was given out as grants, triggering investments of 	<ul style="list-style-type: none"> • Comprehensive set of measures that address building renovation with a balanced mix of regulatory requirements, fiscal and economic incentives and information measures. 	<ul style="list-style-type: none"> • A more precise quantification of the milestones for 2040 and 2050 could be provided. • Wider benefits of building

	<p>consumption to 2000 PJ (556 TWh) by 2030.</p> <ul style="list-style-type: none"> From 2030 onwards, the renovation rate is expected to increase from around 1.3% to over 2% for single and two-family houses and from around 1.5% to over 2% for apartment blocks. 	EUR 734 million.	<ul style="list-style-type: none"> The measures are in place across all government levels, which guarantees that they are tailored to local needs. 	renovation could be analysed in more detail.
Ireland	<ul style="list-style-type: none"> Retrofit 500 000 homes to an EPC B2 or cost-optimal equivalent or carbon equivalent by 2030 (average of 50 000 homes each year). Retrofit 1 million houses by 2040 and 1.5 million by 2050. Install 600 000 heat pumps by 2030. In the commercial and public sectors, upgrade at least one-third of total commercial premises to EPC B by 2030. Retrofit 1 million houses by 2040 and 1.5 million by 2050. 	<ul style="list-style-type: none"> The Irish government has approved a national development plan that allocates funding of EUR 4.5 billion to support energy efficiency improvements across the residential and public sectors. Increase the price of carbon to EUR 100 per ton by 2030. 	<ul style="list-style-type: none"> Comprehensive set of measures in a balanced mix of regulatory requirements, economic incentives and information measures. 	<ul style="list-style-type: none"> Milestones to reach by 2040 and wider benefits could be further detailed. Budgetary resources to support the strategy's implementation could be further detailed. Wider benefits of building renovation could be analysed in more detail.
Luxembourg	<ul style="list-style-type: none"> 58% reduction of final energy demand by 2050 vs 2020. Renovation rate of the building stock at 3% per year, corresponding to approximately 4 500 housing units per year. 	Not detailed	<ul style="list-style-type: none"> Comprehensive set of measures of regulatory requirements, fiscal and economic incentives and information measures, tailored to specific needs such as addressing barriers to deep renovation, energy poverty, etc. The set of measures to address energy poverty is very 	<ul style="list-style-type: none"> Milestones should be extended beyond residential buildings. Wider benefits of building renovation should be analysed in more detail. Investments needs and budgetary resources could be defined in more details.

	<ul style="list-style-type: none"> Boiler exchange rate: approx. 5% p.a. 		comprehensive.	<ul style="list-style-type: none"> A clear definition of deep renovation could be presented.
Netherlands	<ul style="list-style-type: none"> All buildings sustainable by 2050. CO2 emissions = 1.5 million tCO2eq. Gradually insulate 1.5 million residential and other buildings and make them gas free, or at least ready to switch over to another, sustainable source of heat ('gas-free-ready') by 2030. Gas-free-ready by 2030 using more renewables and more sustainable sources. No more fossil fuel used in the building environment by 2030. 	<ul style="list-style-type: none"> According to the NECP, the estimated overall amount of private and public investment for the 2019-2030 period is EUR 56-75 billion (roughly 10% of current GDP) for energy. A large share of projected investment amounts is linked to renewable electricity generation and improvement of energy efficiency in key sectors (notably of buildings). 	<ul style="list-style-type: none"> Comprehensive and innovative mix of regulatory requirements, wide range of available fiscal and economic incentives and information measures. Strong focus on a district-oriented approach in view of making all districts gas-free. 	<ul style="list-style-type: none"> The investment needs could be further detailed Wider benefits of the renovations of buildings could be analysed in more details Trigger points could be more precisely identified.
Spain	<ul style="list-style-type: none"> 1.2 million homes (out of 18.7 million primary residence homes) to be renovated by 2030 Energy savings of 64 154 GWh (cumulative for 2020-2050) For residential buildings, a 37% reduction in energy use and 99% reduction in CO2 emissions by 2050 compared to 2020. For residential buildings, consumption from heating to be less than 55% by 2050 against 2020 levels. 	<ul style="list-style-type: none"> The total volume of investment required for 2020-2030 would be EUR 41 471 million, of which EUR 15 520 million would be private investment for the renovation of ACS/heating equipment. Public investment (EUR 6 946 million) would be used to encourage improvements in the 	<ul style="list-style-type: none"> Comprehensive set of measures and relevant number of ongoing initiatives with a coherent and articulated implementation plan. The strategy interact in a synergetic way with other plans, strategies and frameworks (e.g. urban renewal plans, the just transition strategy, national strategy against energy poverty) The strategy contains comprehensive measures on fighting energy poverty and developing communities. 	<ul style="list-style-type: none"> Further defining milestones and intermediate targets could help improve monitoring of progress.

	<ul style="list-style-type: none"> 7.1 million houses are expected to undergo deep renovation by 2050, lowering their individual consumption by 12 kWh/m². The stock of new buildings between 2020 and 2050 is projected to stand at 3.9 million houses, all of them being nearly zero-energy buildings. 	<p>building stock (EUR 4 389 million), covering 1/3 of the total investment required, and a further EUR 2 557 million for the replacement of ACS or heating equipment.</p> <ul style="list-style-type: none"> Public investment rates for private investment would be 25% for installations and 50% for building stock renovation. 		
Sweden	<ul style="list-style-type: none"> 2030:fossil share of building stock end-use energy is 1% 2040: 0% fossil share of end-energy use amongst the building stock Every 10 years, the proportion of buildings in the A-C EPC class should be higher than in the previous reference year, and the proportion of buildings in the E-F EPC class should be lower than in the previous reference year. Buildings built in the 1950s will be renovated in the next 20 years, buildings built from 1961-1975 will be renovated in the next 10 years. Other buildings have 	Not detailed	<ul style="list-style-type: none"> Comprehensive mix of regulatory requirements, wide range of available fiscal and economic incentives and information measures. Some policies presented in the strategy are a continuation of well-established measures, including the energy and carbon tax. 	<ul style="list-style-type: none"> Investment needs and budget allocation could be defined in more detail.

	<p>a renovation cycle of 40 years, meaning that buildings built after 1981 will start being renovated after 2020.</p> <ul style="list-style-type: none"> Expected energy savings by 2050 are around 10-15% (e.g. from 162 kWh/m².y in 2016 to 137 kWh/m².y in 2050). 			
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From the table above it appears that for some Member States the efforts are not sufficient to decarbonize the building stock by 2050 and further actions and higher ambition will be needed over time, as well as encouraging the deployment of sustainable solutions to prepare for the changing climate.

2 Member States' good practice in key categories of existing and planned measures

Article 2a 4) of the Energy Performance of Buildings Directive stipulates that the Commission shall collect and disseminate, best practices on successful public and private financing schemes for energy efficiency renovation as well as information on schemes for the aggregation of small-scale energy efficiency renovation projects.

This section presents a selection of good practices from among existing and planned policies and measures (national, regional and local) described in the submitted long-term renovation strategies. It is therefore not an exhaustive list of the measures proposed in all submitted strategies¹⁵.

The section's structure mirrors the main categories of action specified in the Renovation Wave Communication adopted on 14 October 2020:

- 1) strengthening information, legal certainty and incentives for public and private owners and tenants to undertake renovations;
- 2) ensuring adequate and well-targeted funding;
- 3) increasing the capacity to prepare and implement projects; scaling up technical assistance and making it closer to regional and local actors;
- 4) creating green jobs, upskilling workers and attracting new talent;
- 5) creating a sustainable built environment;
- 6) placing an integrated, participatory and neighbourhood based approach for smart buildings, integrating renewable energy;

In addition, the Renovation Wave Communication singles out **three focus areas** for building renovation:

- 7) tackling energy poverty and worst performing buildings (a Recommendation on energy poverty and an accompanying staff working document to guide Member States in defining and implementing such strategies to reduce energy poverty was adopted as part of the package to reinforce support in this area¹⁶);
- 8) public buildings and social infrastructure showing the way;
- 9) decarbonising heating and cooling.

¹⁵ The selection of good practices will be revised and enriched in the updated version of this staff working document once all strategies - or most of them in case of significant delays - are submitted by Member States.

¹⁶ Commission Recommendation COM(2020)9600 on energy poverty.

2.1 Strengthening information, legal certainty and incentives for public and private owners and tenants to undertake renovations

The Renovation Wave Communication underlines that the starting point of sustainable renovation is always an individual decision that balances expected benefits and costs. Yet, today, insufficient information on the current energy and resource profile of buildings and the potential benefits of renovation, lack of trust in actual energy savings and split incentives between owners and tenants are among the strongest barriers to such decision being taken. The following good practices can be found in the submitted Long-Term Renovation Strategies.

2.1.1 Introducing mandatory minimum performance levels

Some Member States have decided to introduce minimum performance levels by a specified compliance deadline or at certain moments in the lifetime of a building:

- **Netherlands:** as of 1 January 2023, all office buildings (including many buildings with rental units) will be required to have an energy label of ‘C’ or better. This applies to buildings with an electricity consumption of 50 000 kWh/year or more or an annual gas consumption of 25 000 m³. It is estimated that this will impact approximately 38% of all registered office buildings; these must be upgraded by 2023 to meet the new requirement.
- **Belgium, Brussels:** draft legislation applicable to the residential sector requires work to be carried out at five time intervals staged renovations to achieve a minimum level of performance by 2050 (to be defined by typology, taking into account property constraints, where appropriate). The overall objective is an average of 100 kWh/m²/ year by 2050.
- **Belgium, Flemish Region:** Mandatory minimum energy performance for non-residential buildings from 2030 onwards. From 2030, these buildings will have to reach a minimum energy performance label to be defined. The public buildings in Flanders provide a good example by meeting the minimum energy performance label by at least 2 years earlier. Compulsory renovation after transfer of ownership for non-residential buildings (from 2021 at the latest five years after a notary transfer in full ownership).
- **Denmark:** all ministries and state institutions must reduce energy consumption by 14% in 2020 compared to 2006. On 17 January 2020, a revised requirement came into force introducing additional requirements for institutions within the state administration.
- **Greece:** public authorities’ building leases or acquisitions require at least a ‘C’ energy performance certificate class. The obligation should be applied to all existing lease contracts by 2020 and is expected to affect approximately 60% of the public sector's building stock (20 000 buildings).
- **France:** the French strategy includes a gradual set of measures, starting with a ban on rent increase in the case of poorly performing buildings (‘passoire énergétique’, no performance specified) as from 2021, a ban on renting these as from 2023 and an obligation to renovate all worst performing buildings as from 2028.

2.1.2 Reinforcing the quality and use of Energy Performance Certificates (EPCs)

The Renovation Wave Communication underlines that energy performance certificates (EPCs) and their availability in accessible databases improve transparency of the performance

of the building stock. At the building level, EPCs inform about energy performance, the share of renewables and energy costs. At district, regional, national and EU level, they are crucial for identifying the worst performing buildings in urgent need of renovation. They can be used to evaluate improvements relative to the investment before and after the works and to help match available financing with individual renovation projects.

However, the quality and usability of EPCs should be further improved in order to exploit their full potential as an indicator that affects the value of properties and, ultimately, fosters energy upgrades in existing buildings.

The quality of EPCs could be improved by updating the independent control systems and EPC databases and by continuously monitoring and training energy auditors. More elements should be incorporated (cost, benchmarks with reference buildings, wider benefits), while a user satisfaction campaign could help authorities meet market needs. Many Member States also suggest EPC databases should be made more directly interoperable with building register and digitalise the process of developing and collecting EPCs.

The following best practices from submitted long-term renovation strategies can be highlighted:

- **In Denmark**, an initiative launched in 2018 aimed to improve the precision of the energy label, as well as to better involve and support data and digitalisation, to make it easier to implement cost-effective energy renovations. This initiative also focused other areas, such as indoor climate and comfort, level of thermal comfort, daylight and acoustic conditions. In the context of an action plan for better energy labelling, a user satisfaction survey was carried out, a new training for energy consultants was organised, an information campaign on energy labelling was run and improvements to the database website (SparEnergi.dk), where data on energy labelling in buildings are published, were made.
- **In Austria**, quality reviews of EPCs are organised through the country's independent control systems, in parallel with continuous improvement of EPC databases. Support for renovation and other incentives are usually linked with the submission of an EPC, which ensures that cost-optimal remediation steps can be taken.
- **In Greece and Cyprus**, to raise people's awareness of EPCs, financial incentives have been linked to the issuing of EPCs; examples include the Greek 'saving at home' and the Cypriot 'save & upgrade' programme. In order to further improve the role of EPCs in selling and renting properties, Greece and Cyprus plan to increase inspections of commercial advertising, revise the existing legislative framework for the sale and rental of buildings, and make a further link with financial and fiscal incentives.
- **In Estonia**, the development of virtual tools for EPCs and energy audits could be the next step in digitalising the sector. The use of virtual tools would help reduce the time and therefore the cost of producing EPCs and running energy audits. For example, a direct link with the building register, simpler calculations (normal annual heating consumption, energy consumption per square metre, etc.) would make it possible to standardise energy audits in addition to energy labels. The added value would be the possibility of analysing the resulting labels and audit data; the current EPCs are generally documents in pdf format, and therefore not machine readable for analysis. Stakeholders also mentioned that the energy label classes should be stable. A system where the energy label class changes every five years is too unstable for investment decisions to be taken. There is a need for a

more stable and easily understandable system for assessing the energy performance of buildings.

2.1.3 Combining Energy Performance Certificates (EPCs) with Building Renovation Passports (BRP) or roadmaps

Deep renovation is not always achievable in one go. Therefore, the Renovation Wave Communication highlights the importance of creating better conditions for staged renovations and points out instruments such as digital building logbooks, which can integrate all building-related data, including those provided by building renovation passports.

The following best practices from the submitted long-term renovation strategies can be highlighted:

- **Brussels Capital** regional authorities want to put in place a roadmap for residential buildings in order to clarify and explain the steps needed to meet the mandatory minimum performance threshold required by 2050. The roadmap will consist of an individual renovation plan, complementary to the EPC. The authorities also plan to develop a ‘housing passport’: a unique digital platform that gathers a building’s administrative and technical data (e.g. energy, soil pollution, etc.) in one place; this information can be consulted by the owner (or people with power of attorney, such as, for example, building professionals) and by the competent administration, as detailed in the relevant documents. This ‘housing passport’ should accompany a building throughout its life. Its purpose is to simplify access to information relating to housing for both the owner and public authorities. The platform will contain information specific to each dwelling, accessible by means of an identifier or the owner’s identity card. The passport would be created ‘de facto’ for each dwelling (as is the land register); it will be particularly useful in real estate transactions (sale/purchase/estate/rent) or during works (renovation, permit requests, etc.) as each main actor (e.g. notaries, building professionals) will be able to access the housing information based on a licence issued by the owner. Building passports will also be created for collective housing, though in a second phase. The possibility of extending them to the tertiary sector will be assessed.
- **In Finland**, considerable resources have been mobilised to support initiatives in this area. The real estate service manual, mandatory since 2000, is a document that describes a building’s basic features (ownership, volumes, structures, materials, etc.), specifies maintenance tasks, sets target values and goals for technical service and includes a list of operating costs. It also includes an FAQ section on building life-cycle aspects. In general, the initiative is well-known and appreciated by users. The real estate passport created by the Finnish Green Building Council has a more technical nature, which takes full advantage of building information modelling. This fits into the Finnish administration’s plan for mass digitalisation of the construction sector and stimulates real estate productivity.
- **France**: The energy efficiency passport is an online platform offering advice to owners, auditors and professionals. The passport provides a set of solutions combining the best measures for achieving low energy levels, based on a building’s specific features.
- **Germany**: the individual renovation roadmap (iSFP) was initially developed and tested in Baden-Wuerttemberg and has now been adapted so that it can be applied across the entire country. It was officially adopted by the Federal Ministry for Economic Affairs and Energy (BMWi) in 2017. It can already be used voluntarily by energy consultants and for

documentation purposes within the Federal Office for Economic Affairs and Export Control (BAFA) ‘Energieberatung vor Ort’ support programme.

The iBRoad H2020 project should also be mentioned. It aims to develop an individual building renovation roadmap for single-family houses. With a target focus on residential buildings, the iBRoad project analyses and builds upon relevant examples from Germany, France and Belgium (Flanders), to identify the essential elements, develop an integrated concept, and produce modular tools suitable for differing national conditions. This tool looks at the building as a whole, and provides a customised renovation plan (iBRoad-Plan) over a long-term horizon (15-20 years). The iBRoad-Plan is combined with a repository of information, i.e. a building logbook or passport (iBRoad-Log), for aspects like energy consumption and production, executed maintenance and building plans.

2.1.4 Supporting nearly zero-energy buildings (NZEBs)

As of 1 January 2021, new buildings must comply with national requirements for nearly zero-energy buildings (NZEBs). Renovation to NZEB level is not always technically feasible or cost-effective and so, in some Member States, financial instruments linked to energy savings or a specific EPC class provide larger subsidies for this.

The following best practice from a submitted long-term renovation strategies can be highlighted:

- In Cyprus, the **‘save & upgrade’ programme** finances renovations in homes and buildings owned or operated by SMEs. A larger subsidy is awarded to buildings that are being refurbished into NZEBs. Moreover, new buildings and buildings to be renovated are allowed to increase the building ratio by 5% if they are energy class A and if at least 25% of their total energy needs are covered by renewable sources, i.e. if they comply with at least two NZEB requirements.

2.2 Ensuring adequate and well-targeted funding

The Renovation Wave Communication underlines that building renovation is one of the sectors facing the largest investment gap in the EU. The Commission estimates that, in order to achieve the proposed 55% climate target by 2030, around EUR 275 billion of additional investment is needed per year.

In the residential building sector, the lack of simple, attractive and easily accessible public incentives for renovation and the lack of mainstream financing products, including one-stop-shops for making it easier to select, finance and install and operate efficient and renewable heating systems, are often mentioned as a barrier.

All submitted long-term renovation strategies have a chapter related to access to finance. These highlight that a large part of building renovation concerns the change or modernisation of heating and cooling systems and the installation of renewables on-site, in-building or nearby, to cover the overall energy needs for electricity, heating and cooling and - increasingly - for transport always in combination with energy efficiency measures, e.g. envelope energy efficiency, building automation and control systems and smart solutions.

In this context, Member States usually recognise that adequate financing and its easy deployment for integrated building renovation is one of the most important elements of reaching the milestones they set.

2.2.1 Stimulating joint procurement

The EPBD (2010/31/EU), as amended by Directive (EU) 2018/844, Article 2a, paragraph 3(a), envisages the possibility to develop projects, including through the implementation of investment platforms, groups and consortia of small and medium-sized enterprises to enable investors to provide package solutions to potential customers. In some cases, joint procurement across borders could also be usefully considered, for instance in twin cities, in line with Article 39 of Directive 2014/24/EU on public procurement. One way to do this is via the set-up of a joint entity by contracting authorities from different Member States, such as a European grouping of territorial cooperation (EGTC) under Regulation (EC) No 1082/2006.

In this area, the following best practices from the submitted long-term renovation strategies can be highlighted:

- **In the Netherlands, the ‘renovation accelerator’** supports companies by bringing together part of the demand and providing multiannual predictability to the market. Through the renovation accelerator, the demand from housing companies for heat pumps and insulation products is pooled. The Ministry of the Interior runs the renovation accelerator in collaboration with various parties to develop more affordable (joint) offers. This promotes innovation, increases quality, reduces costs and thus lowers prices. The purpose is to match supply and demand. The renovation accelerator also takes part in the procurement process and related work. It is, of course, up to the individual company itself to decide on its own assignments. Between now and 2024, EUR 130 million will be available for the renovation accelerator.
- **Finland has developed a ‘pool for energy savings in industries’.** Group construction has been tested and promoted by Finland’s Ministry of the Environment

and the local government. The legal status and financial arrangements of project participants are safeguarded by the Group Construction Act (199/2015). The Act applies to both new and repair construction. In addition to traditional repair projects, there have also been joint purchases of solar panels.

2.2.2 Reducing the perceived risks of energy efficiency and renewable energy in buildings for investors and the private sector

The EPBD (2010/31/EU), as amended by Directive (EU) 2018/844, Article 2a paragraph 3(b), states that Member States shall facilitate access to appropriate mechanisms to reduce the perceived risk of energy efficiency operations for investors and the private sector more broadly.

In this area, the following good practices from the submitted long-term renovation strategies can be highlighted:

- In **the Netherlands**, the Heating Fund and the National Energy Savings Fund pool public and private money to make attractive financing possible for building owners. The combination of public and private resources makes for a structure in which large amounts of financing can be made available (though the participation of private parties) and risks shared (through government participation).
- In **Sweden**, the Swedish National Board of Housing, Building and Planning currently offers credit guarantees, which can be used to finance both the construction and conversion of residential properties. Credit guarantees can be provided both during construction and/or for end financing. Irrespective of when a credit guarantee is provided, it cannot amount to more than 90% of the Swedish National Board of Housing, Building and Planning's estimated market value. In the case of housing that is let under a cooperative tenancy right, up to 95% of the market value may be guaranteed. As credit guarantees can also be issued for loans for conversions, this instrument is considered to have some impact on the scope of energy efficiency improvement renovations, particularly as regards private and publicly-owned apartment buildings.
- In **Luxemburg**, with a view to overcoming barriers on the investment market, a financial instrument (a 'de-risking' investment platform) is to be designed and implemented to mobilise energy efficiency investments by industry, SMEs and the buildings (renovation) sector, with the primary aim of making progress towards climate emissions, renewable energy and energy efficiency targets, and a secondary aim of reducing energy dependency and increasing energy productivity. The aim of the 'de-risking' instrument is to eliminate the obstacles associated with energy improvements and renovations and the associated project funding.

2.2.3 Using public funding to leverage additional private-sector investment

The EPBD (2010/31/EU), as amended by Directive (EU) 2018/844, Article 2a paragraph 3(c), draws on public funding to attract additional private sector investment and address specific market failures.

The following good practices from the submitted long-term renovation strategies can be highlighted:

- **Czechia:** The ‘PANEL’ programme (financed by the state budget), focuses on investment support to reduce the energy demand of multi-family buildings in the form of soft loans. Specifically, it supports the improvement of a building’s energy performance (building envelope, technical equipment), the integration of on-site renewables and the renovation of electricity, gas and heat distribution systems.
- **Cyprus:** The Mutual Funds Fund runs a loan scheme for energy efficiency and renewable energy. Its initial capital of EUR 40 million comes from the Cohesion Fund, the European Regional Development Fund and a national contribution. The government has added another EUR 40 million from a loan guaranteed by the European Investment Bank. The Mutual Funds Fund is designed to provide loans to households, SMEs and local authorities to enable them to invest in energy efficiency and renewable energy projects. These loans will be made available through commercial banks. The Fund is expected to be operational in 2020.
- **In Denmark,** KommuneKredit provides financial services to municipalities and regions, including loans and leases. A political agreement was reached in 2018 to establish a loan pool of DKK 100 million per year for the energy renovation of buildings in cities and regions in 2021-2024.

2.2.4 Using tax incentives, such as tax credits and adapted VAT rates to foster building renovation

The Renovation Wave Communication indicates that Member States should also explore taxation tools to generate economic incentives to finance building renovation.

The submitted long-term renovation strategies include a wide range of examples of such instruments:

Tax credit/ deduction

- **Germany** has adopted a key measure in the buildings sector: tax support for energy renovation measures in owner-occupied homes. It was introduced on 1 January 2020 as an attractive support instrument for existing support schemes. Support will be given to individual measures on owner-occupied housing, which are also considered eligible under the existing building support programmes. This includes, in particular, the replacement of heating systems, but also the installation of new windows or the insulation of roofs and external walls. Support will also be given for comprehensive renovation, if necessary on a step-by-step basis, through several individual measures. The eligible costs are 20% of the investment costs and of the costs of issuing the certificate to be submitted to the tax office in order to grant the tax reduction, and 50% of the costs of an energy consultant charged with the energy planning and supervision of the eligible measures. Support will be provided through a deduction from tax liability spread over 3 years. Because it is possible to deduct the aid from a tax liability, many owners of residential buildings can benefit from the measure.
- **In Denmark, all energy sources for heating buildings, other than biomass, are subject to relatively high taxes.** The fees for petroleum and natural gas are indexed and maintained at constant prices. The tax on electricity for heating has been substantially reduced in recent years so that it amounts to approximately DKK 43/GJ and is therefore lower than fossil taxes in 2021. This provides a significant

incentive to reduce heating energy consumption and has contributed to a reduction in heat consumption over the last 20-25 years. In addition, Denmark has developed a tax credit of up to DKK 12.200 per person per year (in 2019) for work pay. It is possible to benefit from this deduction for example in the event of installing insulation, replacing windows, improving the heating system, replacing the heating system, etc.

- In **Brussel Capital**, a reform of property taxation is going to be adopted to promote building renovation investment: modulation of registration and /or inheritance tax in relation to the competition of energy savings works; temporary exemption or reduction of property tax, in case of an ambitious energy renovation (e.g. when several recommendations of the mandatory energy performance certificate are carried out at the same time).

Adapted VAT rates

- **The Netherlands** has introduced a specific VAT refund. For insulation of dwellings, labour costs for the application of insulation materials to floors, walls and roofs in dwellings that were built more than 2 years ago is 9 % instead of 21 %.
- **France** applies a reduced VAT rate (5.5% instead of 20%) to energy renovation (supply and installation) carried out in accommodation spaces that were built more than 2 years ago.
- In **Cyprus**, since 2015, a reduced VAT rate (5 % instead of 19 %) has been applied to the renovation of dwellings for which at least three years have passed since the first date of residence. The reduced rate applies to all saving measures related to buildings and the installation of photovoltaic systems. Combined with sponsorship schemes such as the “save & upgrade” and RES and EXE projects, this measure helps reduce renovation costs.

2.2.5 Developing dedicated financial products and business models for building renovation

In this area, the following best practices from the submitted long-term renovation strategies can be highlighted:

Green mortgages, loans, credits, leases

- **In the Netherlands, the credit enhancement for sustainability** helps people who take energy-saving measures in their own home to borrow a higher amount for that investment. Moreover, the Climate Agreement aims to explore the development of a methodology based on housing neutrality and can guide credit enhancement for sustainability. The extent to which individual energy savings can be taken into account in the consumer credit loan standards will be examined in spring 2020.
- In the **Brussels Capital** region of Belgium, the Brussels green loan is available in two ways: a consumer credit issued by Crédal and a mortgage credit from the Housing Fund (extension of the eligible amounts and maintenance of a reduced rate of interest). The authorities are considering to simplify the green loan in the near future, and to open it up to all Brussels citizens with a fixed rate of 1%. They are also considering the possibility of maintaining a revenue ceiling for access to the scheme as well as, under certain conditions, maintaining a 0% rate for vulnerable people.

- In **Sweden**, the ‘Kommuninvest’ is a credit institution owned by Swedish municipalities and regions which offers financing solutions to municipalities and regions in the form of loans and advice. Kommuninvest finances, for example, municipal housing companies, schools and hospitals. The credit institution is non-profit-making. Kommuninvest has special green loans including for improving energy efficiency in the building stock. Loans may be granted to projects in multi-apartment buildings with a result of at least 15% less energy in terms of energy per square metre than determined by the National Board of Housing.

Energy savings certificates / green bonds

A green bond is a bond where the capital is earmarked for projects and activities that contribute to improving the environment and environmental sustainability. For example, banks and other credit institutions issue green bonds to finance the green loans offered to customers. However, it has also become more common for municipalities and real estate companies, for example, to issue their own green bonds, which may be an alternative to traditional bank loans. The difference between green bonds and conventional bonds is that the capital of green bonds can only be used for green projects that meet the requirements of a specific framework, with criteria set out by the company issuing them.

A number of long-term renovation strategies specify the development of such green bonds:

- **France** set up an **energy certificate scheme (EEC)** in 2005: (1 EEC = 1 kWh cumac¹⁷ of final energy) is allocated to legal persons such as local authorities, social landlords etc. who have achieved energy saving operations in accordance with certain criteria. These certificates can be freely exchanged.
- In **Finland**, some private parties have issued green bonds to be used especially to improve the energy efficiency of their own properties.
- **Belgium, Flemish region** placed a sustainable bond issue for the first time on 12 November 2018. An amount of EUR 500 million was raised through a public issue from 61 institutional investors from 11 different countries. The bonds mature on 21 November 2033. ‘Sustainable bonds’ are bonds intended to finance sustainable green or social investments. Flanders uses the amount raised to improve the energy efficiency of its buildings, to build affordable homes and to finance ‘passive schools’ in the context of ‘Schools of Tomorrow’. Moreover, the Flemish energy loan is an interest-free energy loan for the priority target group: EUR 15,000 and duration of 10 years. Since 2015, 21.000 energy loans have been granted for a total of EUR 175 million. It also included the 2 % loans allocated from 2015 to 2018 to the non-priority group. Since 2019, only interest-free loans to people from the priority target group have been granted.

¹⁷ Cumac : abbreviation of the French ‘*cumulé*’ and ‘*actualisé*’, used after the kWh energy unit

2.3 Increasing the capacity to prepare and implement projects and scaling up technical assistance to bring it closer to regional and local actors

2.3.1 Developing energy advisory services for citizens and businesses, including creating one-stop-shops

Article 2a (3) of the EPBD states that Member States shall facilitate access to appropriate mechanisms to provide accessible and transparent advisory tools, such as one-stop-shops for consumers and energy advisory services, related to energy efficiency renovations and financial instruments. Article 20(2) also requires Member States to provide information to owners and tenants through accessible and transparent advisory tools such as one-stop-shops.

“One-stop-shops can be defined as advisory tools that facilitate access to financial mechanisms, assist consumers in relation to technical and financial issues and guide them through a number of key stages in the renovation process (...)”¹⁸.

All submitted long-term renovation strategies include the development of advisory services and policies to inform citizens about energy-efficient renovation opportunities and tools.

The following best practices can be highlighted:

- **In the Netherlands**, the ‘renovation accelerator’ promotes the aggregation of projects into bigger investments that are easier to finance, allowing large-scale renovation of rental homes. As part of this initiative, a regional support programme has been set up and offers a stimulating learning environment which brings together housing associations’ demand for (hybrid) heat pumps, insulation and other reduction measures. Up to 2024, EUR 130 million will be available for the renovation accelerator.
- **In Denmark**, BedreBolig (Better House) is a nationwide market-based scheme developed by the Danish Energy Agency. It aims to make it easier for building owners to renovate in a way that is energy efficient. Advice is available for any stage of a renovation project, and may include drawing up a ‘better housing’ plan that gives a complete overview of the anticipated investment and savings. The BedreBolig plan can help the building owners from the beginning to the end of a renovation project (one-stop-shop) and can be used as a basis for dialogue with banks or mortgage credit institutions.
- **In Czechia**, energy consultation and information centres (‘EKIS’) provide a free public service supporting the introduction of energy saving and renewable energy. This service will be extended to building owners.

¹⁸ JRC Science for Policy Report, Accelerating energy renovation investments in buildings - Financial and fiscal instruments across the EU, Economidou, Marina Todeschi, Valeria Bertoldi, Paolo, 2019

- The **Austrian** long-term renovation strategy provides information on many regional assistance services. One example is the energy consultancy in Burgenland, which is a one-stop-shop giving people free and independent advice for construction and renovation projects in private residential areas. Free advice includes comprehensive information on energy issues relating to the construction and renovation of buildings, heating and air conditioning of buildings, and electricity applications. Coordinated information is available in the areas of thermal insulation, windows, heating systems, financial support, energy saving tips, photovoltaics, storage systems, etc. A wide range of brochures and guides is available free-of-charge for all topics. The energy consultations can take place on-site, in the offices of the district authorities, in the office of the Burgenland Provincial Government or in the municipal centre. Questions that need to be answered quickly are often answered by telephone (service hotline) or email. People can sign up for advice online or by phone. A cost-optimal and environmentally-sound renovation and new construction plan is then drawn up together. At the end of the service, customers receive a record of the advice given.
- In France the FAIRE (« Faciliter, Accompagner et Informer pour la Rénovation Energétique ») network run by ADEME, ANAH et ANIL comprises 1000 experts/450 contact points that act as one stop shop.

2.4 Creating green jobs, upskilling workers and attracting new talent

The Renovation Wave Communication underlines that the design, installation and operation of circular and low-carbon solutions often require a high level of technical knowledge.

Already before the COVID-19 crisis, there was a shortage of qualified workers to carry out sustainable building renovation and modernisation. The potential for job retention and creation in this sector has been and remains high. Energy efficiency in buildings is the largest generator of jobs per million euro invested.

In the submitted long-term renovation strategies, many Member States indicated a shortage of well qualified technical personnel. The strategies mention a number of programmes that can address this challenge, however these remain largely targeted to specific training areas and are not mainstreamed along the entire construction sector value chain. To bring about system innovations in the construction industry, there must ultimately be more structural arrangements among knowledge institutions, education and training, government, contracting authorities and contractors. Regular training on, and retention of, professional skills for energy auditors, designers and architects, installers of heating, cooling and other technical building systems, energy service companies, building firms, project supervisors and other experts, are essential to ensure the market's continuous development. They will also need to be trained on accessibility for persons with disabilities in order to ensure that it is included when doing deep renovations.

From this perspective, the following best practices from the submitted long-term renovation strategies can be highlighted:

2.4.1 Promote sustainability/climate technology in general education and targeted dissemination activities

- In **Finland**, basic qualifications that are needed in the construction sector are taught at all levels of education. To prepare for a specialisation in building physics, building materials, production techniques, real estate management or house engineering, there is an uninterrupted pathway of mathematical subjects from pre-school to vocational and higher education. Finland also promotes close cooperation between university, polytechnic and initial vocational education.
- In **Romania**, there are many MScs programmes on energy efficiency in universities. Romania also aims to set up a training programme that will: (i) authorise and provide training courses and manuals, (ii) develop training programmes for trainers and qualification criteria for energy auditors, designers, technical leaders and qualified contractors to participate in the renovation programmes, and (iii) establish cooperation with Romanian universities and vocational training institutions. The investment is estimated at EUR 50 million.

2.4.2 Promoting ‘green skills’ for all professions in the construction and building sectors

- In **the Netherlands**, the Declaration of Intent on the Labour Market and Training aims to prepare future construction professionals to carry out deep renovations. Moreover, with the ‘green deal for the development of decentralised sustainable heating and cooling technologies’, significant steps are being taken to educate specialists who can design, build and maintain the sustainable systems of the future.
- In **Austria**, the Energy Academy offers a comprehensive training programme on energy technology, energy management, energy advice, construction, renewable energy and energy efficiency. The target groups include energy managers in companies, municipalities and institutions, building and home technology specialists, planners, energy consultants, energy auditors and interested members of the public. There are currently more than 30 seminars on different topics available. See www.energyacademy.at.
- In **Czechia**, the EFEKT programme contributes to the system of education that supports the construction sector. It covers the organisation of courses and seminars and other training and information actions, such those that upgrade the qualifications of energy specialists and those that support the professional activity of installing renewable energy installations, as well as the communication of legislative changes in the field of energy management and energy efficiency.
- In **France**, the PACTE (2015-2019) programme aims to assist construction professionals in building their skills in the area of energy efficiency. The aim is to improve quality in construction and renovation works so that, ultimately, the construction and renovation of buildings is better, faster and cheaper. The actions supported include the development of digital site plans for site staff (tools that have an educational and pictorial presentation on the rules of the art), and the development of tools for measuring the intrinsic energy performance at the reception of a building or specific projects for a particular type of material. The programme supported around 40 projects in mainland France to improve the skills of building professionals, and about 40 projects designed to adapt techniques to local characteristics and to structure the regional sectors. Moreover, since 2007, the FEE Bat programme (training of professionals in energy saving in buildings) has made it possible for construction professionals to grow their skills. Financed by the EDF within the framework of the energy saving certificate scheme, it has allowed more than 175 000 active professionals to get training so far and continues to train around 1 000 interns each month.
- **Cyprus** participates in the European ‘SME Power Efficiency’ project, which aims to help SMEs improve the skills and competences of their staff, develop specific training programmes for energy managers, undergo energy audits and, above all, to take action and implement the proposed energy saving measures. The actions financed under the project include the development of a free certified education and training programme aimed at training energy managers in SMEs.

2.4.3 Training of energy efficiency professionals and energy consultants

- **France** has set up the RGE label programme. Professionals must satisfy a number of qualification criteria to provide households with a guarantee of the high quality of

their work. Issued for a period of four years with annual monitoring, this certification is based on requirements relating to the training of staff, evidence of technical resources, proof of insurance covering the professional's liability and checks on work carried out. In 2019, almost 58 000 companies were labelled as RGE, of which 85 % have fewer than 10 employees. Companies with quality labels are identifiable on the www.faire.fr website.

- **Denmark** has set up a training programme for energy consultants. Energy labelling companies must be certified and registered in order to produce EPCs, and it is the companies' responsibility to ensure that their energy consultants are properly trained. All energy consultants must undergo a training course and pass the corresponding examination in order to be able to carry out EPCs. A new training for energy consultants is being planned in the context of an action plan for better energy labelling and will include requirements for continuous improvement of competences. In addition, the 'RES approval' scheme covers companies that install small renewable energy installations in private homes, i.e. heat pumps, solar cells, solar thermal and small biomass boilers and stoves. In order to qualify for a renewable energy installation, an entity must be already authorised to carry out an electrical or heating operation and have employees who have completed a specific renewable education training course.
- In **Czechia**, energy specialists shall be authorised by the Ministry to carry out energy audits, issue energy performance certificates and carry out inspections of heating and air-conditioning systems. In order to ensure that authorised energy specialists have the necessary expertise, Czech legislation requires energy specialists to follow continuous training activities and to obtain a certain number of credits within the legally defined period.
- In **Austria**, the **Styrian Energy Advisory Network** (netEB) aims to provide clear guidance and improve the quality of energy advice. Although the selection of energy consultants is very wide, they are often specialised in only one field and therefore not sufficiently trained to provide comprehensive advice. All consultants included in the network are appropriately trained and subject to a pre-defined quality control. Through regular training and information sessions, they are up-to-date with the latest energy-related issues.

2.4.4 Research programmes, websites & online training, and knowledge centres

EU programmes offer many funding opportunities to support projects that decarbonise the building stock, including training.

- In **France**, the massive open online course (MOOC) platform is being used for training courses that are open to all and are accessible continuously. The available training courses are made up of educational resources (videos, documents) and offer individual or collaborative activities to assess knowledge. The aim of the platform, managed by ADEME under the sustainable building plan, is to provide access to the best e-learning courses in the field of sustainable building. A specific MOOC on sustainable building was launched in November 2016 and operates through a system of shared governance (professional organisations, training organisations, associations). At the beginning of January 2018, almost 20 000 people were registered on the

platform (predominantly professionals in the field). See: www.mooc-batiment-durable.fr

- In **the Netherlands**, with the renovation accelerator, landlords, market players and knowledge institutions are working to develop knowledge about and promote the industrial and large-scale sustainability of housing. The renovation accelerator is set up as a national support programme that provides a stimulating learning environment. Large-scale landlords and providers work together to aggregate demand and develop standard packages that make it possible to preserve housing more quickly and cheaply. The support programme has allocated EUR 5 million per year for the period until 2025 (total EUR 30 million). A grant scheme for the most promising innovative projects is also provided in the context of the renovation accelerator.
- In **Sweden**, the National Renovation Centre (NRC) is attached to Lund Technology Institute and supports stakeholders in the construction sector in ensuring an efficient renovation process. It does so through the creation of knowledge and the dissemination of information. In addition, the web-based Energilyftet initiative, launched in 2016, provides free training relating to low-energy buildings. Furthermore, during the period from May 2016 to December 2017, ongoing seminars were run to inform people and generate interest in energy efficiency improvements, low-energy construction and training.
- In **Romania**, the **EU-funded BUILD UP Skills Romania programme** has developed a ‘skills roadmap for construction’, to improve skills related to energy efficiency and renewables. The ‘BUS Qualishell’ programme led to the creation of two qualification schemes for high performance building envelopes: (i) ‘train-to-NZEB’ aims to develop and deliver training for construction workers, specialists (architects, designers, experts, energy auditors) and decision makers working towards NZEB goals; (ii) ‘fit-to-NZEB’ aims to develop and deliver various training programmes related to deep energy efficiency renovation (at NZEB level).
- In **Czechia**, the THETA programme managed by the Technology Agency aims to contribute to the medium- and long-term vision for transforming and modernising the energy sector in line with the approved strategy. The focus is on promoting: (a) projects of public interest; (b) new technologies and system elements with high potential for rapid application in practice, (c) long-term technological potential. This corresponds to the division into individual sub-programmes. Total expenditure for the THETA programme from the state budget for the 2018-2025 period amounts to CZK 4 000 million. In turn, the non-public sources should account for CZK 1 715 million. Total expenditure is therefore CZK 5 715 million.

2.5 Promoting comprehensive and integrated renovation interventions for smart buildings, integration of renewable energy and making it possible to measure actual energy consumption

The Renovation Wave Communication insists on the fact that fully reaping the potential of a renovation in terms of co-benefits requires an integrated approach that has already been successfully piloted. ‘Smart’ homes can promote user comfort and increase the integration of renewable and surplus energy into buildings. This needs an integrated digital renovation that combines energy storage and demand-side flexibility, on-site energy generation from renewable sources, the ‘internet of things’ for the system components, appliances and recharging points for e-mobility. This promotes people’s active participation in the energy system as prosumers. Also citizens at higher risk of exclusion such as persons with disabilities will be involved.

In this area, the following best practices from the submitted long-term renovation strategies can be highlighted:

2.5.1 Collecting, collating and using data for the design and implementation of deep renovation projects and schemes – digital platforms

- In **Denmark**, SparEnergi.dk is a central digital platform for information activities related to energy efficiency solutions. The target audience is both private and public building owners. The site provides good advice on energy savings and knowledge of mainstream energy renovation measures. It includes a tool that allows homeowners to turn their energy label up and see related savings. Overall, the 2018 Energy Agreement allocated DKK 19 million in 2018, DKK 33 million in 2019, DKK 34 million in 2020 and DKK 44 million annually in 2021-2024 for information and data. As a result, a number of analyses and demonstration projects will be carried out, with a focus on promoting the use of data and digitalisation as a driver for energy efficiency and flexible energy use in buildings, including support for a data-based energy management approach.
- In **France**, for the residential sector, statistics are used for five main construction periods. Data include the proportion of main dwellings, the type of tenant (owner or tenant), the most common energy supply systems and the energy performance recorded (energy performance and energy performance labels). Data on the non-residential building stock details the wider categories of buildings (schools, office buildings, etc.), estimated energy performance and renovation needs.
- In the **Netherlands**, the sustainable housing platform will start developing a data system containing available energy consumption data, building data and building use data. This ensures that building information does not have to be collected separately and therefore the risk of error is reduced. Moreover, the Netherlands is working to promote the digitisation of new and existing buildings through a Building Agenda, with a digitisation deal for the built environment already signed in April 2019. In this document, contracting authorities, market actors and administrations agree on digitally unlocking the available information and sharing it in a more standardised way.

- In **Ireland**, the Irish Energy Authority (SEAI) hosts a comprehensive database of EPCs. Under an EU-funded project (EPISCOPE)¹⁹, the Irish Energy Action organisation developed a mapping tool for EPCs in 2015, implemented as a pilot project in the northern part of the city of Dublin. This is an interactive map, where layers of building features may overlap (mainly walls, windows, roofs and planters, but also energy poverty indicators, energy supply, metering, etc.) in different Dublin neighbourhoods. Data are aggregated by small areas and administrative units; for each area, the average of indicators (not on individual buildings) was calculated, allowing for targeted intervention, but at a more comprehensive level. The map provides relevant data for local policy making and strategies to alleviate energy poverty or invest in infrastructure²⁰.
- Based on the past experience of EPISCOPE (Energy Action) and ENERMAP, the **ENERFUND** instrument was developed under the EU's HORIZON 2020 programme and can also be used as an online tool to facilitate financing decisions for deep energy efficiency renovations.
- In **Germany**, actions relevant to digitalisation are spread in several sections such as energy research programme with an emphasis for buildings on digitalisation, energy system integration, and district/decentralised supply structures. In addition a digital one-stop-shop is planned to be set up to combine the existing information in a transparent manner. The subsidy programmes run by BAFA and KfW are available in an online database. This database is to be the core of a future "digital one-stop-shop".
- In **Sweden** the National Renovation Centre (NRC) works with businesses and academic institutions to improve knowledge and provide operators in the building industry with the information necessary to carry out renovations efficiently. The aim is to make existing buildings more environmentally, economically and socially sustainable from a life-cycle point of view, while improving or retaining their function so that they meet the requirements of users and the authorities. The Information Centre for Sustainable Construction ICHB's mission is to 'promote energy-efficient renovation and building, using sustainable materials while minimising the impact on the environment from a life-cycle point of view'. This includes collecting information about sustainable building, adapting it to specific target groups and disseminating it. The Centre's website provides information about research, results and experience. The information is targeted at all relevant groups, including professional builders, owners of small buildings, housing association board members, property owners and others involved in the building process in any capacity.

2.5.2 Fostering smart technologies for energy-efficient renovation

The uptake of and investments into digital and innovative technologies by the construction sector remain low.²¹ The Commission will therefore support digitalisation in the construction

¹⁹ <https://episcope.eu/monitoring/case-studies/ie-ireland/>

²⁰ <http://energyaction-static.s3-website-eu-west-1.amazonaws.com/index.html>

²¹ Currently, 70% of construction firms dedicate less than 1% of their revenues to digital and innovative projects, and the uptake of Building Information Modelling (BIM) remains particularly low. Technologies, such as IoT, AI, robots, digital twins reduce the time needed for physical works.

sector through Horizon Europe, Digital Innovation Hubs and Testing and Experimentation Facilities. Digital tools²² help record the progression of works, the use of materials and increase productivity.

- In **France**, the work of the Technical Science Centre for the Building (CSTB), a public industrial and commercial establishment, aims to help those involved in innovation to secure sustainable construction and renovation projects, supporting the energy, environmental and digital transitions. The CSTB continues to make the evaluation of innovative products more accessible by improving their technical procedures, setting up a national support network, and providing regional technical and financial support. The aim is to facilitate the emergence and market access of innovative construction products and processes within the scope of the energy, environmental and digital transition. The CSTB is also an agent of digital stimulation, for example through the CSTB LAB, an accelerator for construction start-ups.
- In **Finland**, a common project organised jointly by the public sector and private enterprises, KIRA-digi, and its follow-up project KIRAHub, have speeded up the process of commissioning smart building technologies. The programme studies and tests the use of the ‘internet of things’ and artificial intelligence in the management of building energy production and consumption, as well as the classification system for smart building solutions (a smart readiness indicator).
- In **Sweden**, the ‘smart built environment’ is part of a joint initiative on strategic innovation programmes run by Formas (a Swedish research council for sustainable development), Vinnova (Sweden’s innovation agency) and the Swedish Energy Agency. The initiative aims to create the right conditions for international competitiveness and sustainable solutions to global societal challenges. In 2018, a number of steps were taken to bring together and establish Smart City Sweden as the national demonstration platform for smart solutions in sustainable cities. A framework agreement was signed with a supplier who will be responsible for operating and developing the platform. The platform will address issues such as planning and construction, digitalisation, social sustainability, mobility and other issues of relevance to sustainable urban development.
- In **the Netherlands**, the KIRAHub project promotes the digitisation of renovation processes, related expertise and development by increasing open, digital education in the fields of renovation and energy efficiency to support lifelong learning.
- For example, a digital twin of a building, enabled by 3D mapping data, provides information on how the building is performing in real-time and prevents serious accidents by helping predict potential failures in building systems.

2.5.3 Promoting faster deployment of smart meters and smart systems

- **Estonia** is developing simplified digital tools for building owners, for example a technical tool where owners of single dwellings can input existing building parameters (wall type, window type, heating system, ventilation system) and choose different

²² Including, Building Information Modelling (BIM), Geographic Information System (GIS) and Augmented Reality

energy efficiency improvement options (insulation thickness of the exterior wall and roof, new windows with three glass packages, change of heating system, installation of ventilation system, installation of solar panels). For commercial real estate owners, a tool that makes it possible to assess energy efficiency based on energy costs will also be developed. Commercial real estate owners are generally not aware of their buildings' energy consumption in kWh or kWh/ (m²a), so this would help them get the unit cost of energy and estimate the energy cost of the building. It would also be possible to propose general recommendations for reducing energy costs in line with a building's overall technical specifications and the main energy consumption component (electricity or heat) determined on the basis of energy bills.

- **In Finland**, in September 2016, the Ministry of Employment and the Economy set up a working group to explore specific actions to enable the smart electricity system to serve customers to participate actively in the electricity market and to contribute to maintaining security of supply. According to the recommendations of this working group, technical building systems should be designed for consumption elasticity (flexible customer-centred electricity system, smart grids working group, 2018).
- The **Swedish** government has developed a broadband strategy for a fully connected Sweden by 2025. Since 2009, the pace of development has been progressing at a very rapid pace, both in broadband roll-out and broadband use. In 2018, 81% of all households and businesses had access to broadband at a speed of at least 100 Mbps. In the same year, some 77% of households had access to fibre, an increase of almost five percentage points compared to the previous year.
- In **Cyprus**, the distribution system operator plans to install 400 000 smart electricity meters by January 2027. These will provide real-time information on electricity consumption and generation, helping final consumers to optimise their energy use. This information may be particularly useful for building owners and investors looking to implement energy and energy-saving measures.

2.5.4 Roll-out of infrastructure for e-vehicles in buildings and their car parks

- The **Austrian** long-term renovation strategy reports many regional initiatives in this field, notably, the smart grids model municipality of Köstendorf, Salzburger Flachgau. In this local area, every second household is equipped with a photovoltaic system and electric cars. The smart grid components, such as adjustable recharging points, inverters and a local network transformer, should help to balance supply and demand in such a way as to ensure smooth operation. Residents become prosumers and can consume electricity from their own photovoltaic system or feed it into the electricity grid.
- **Sweden** developed the strategic innovation agenda for smart and sustainable cities, 'viable cities', which is the biggest project in research and innovation on smart and sustainable cities ever implemented in Sweden. The project is led by the University of Technology (KTH) and brings together around 50 players from a wide range of research fields, industry, public services and civil society. The programme spans 12 years from 2018-2029 and has a total programme budget of SEK 1 billion. In 2017, the Swedish government instructed Formas to develop a 10-year national research programme for sustainable community-building in conjunction with other research funders. The programme covers approximately SEK 100 million per year for the period 2019-2026. In 2018, several steps were taken to bring together and establish

Smart City Sweden as the national demonstration platform for smart solutions in sustainable cities. A framework contract was concluded with a supplier to ensure the operation and development of the platform.

- In **Romania**, there have been various local initiatives to promote the smart city concept, including e-mobility, and these were merged into the ‘smart cities project’ (which was launched in 2019). Cities such as Cluj-Napoca, Iasi, Beclean, Zalău, Brăila, Targoviste and Tulcea are promoting ‘smart city’ components, especially in the transport/mobility sector. The key success factor for these projects was cooperation between stakeholders, the Ministry of Communications and the Information Society, local administrations, research institutes, universities, companies, associations and the public. Further pilot projects will be based on well-designed local strategies and plans, with the intention to expand based on the results. Key energy and energy efficiency projects notably include smart electricity grids and renewables integration plus storage.

2.6 Making the construction ecosystem fit to deliver sustainable renovation

Construction technologies and building materials play a crucial role in achieving energy-efficient renovations. In the submitted long-term renovation strategies, this issue is often linked to broader skills and research policies. Some strategies, however, put a special focus on circularity, adaptability and durability aspects of building materials and technologies to facilitate future renovations, reduce waste, extraction of natural resources, and the associated emissions including GHG by ease of selective dismantling that facilitates the re-use/high-quality recycling of materials.

The policies associated with this approach cover research and innovation on energy-efficient and low embodied energy/carbon construction products. A few strategies, notably the one of the Brussels Capital region, cover the traceability of substances/materials used in buildings from a wider sustainability perspective, also encompassing health and safety elements (e.g. tracking of components, including harmful substances).

The following best practices²³ can be highlighted:

2.6.1 Maximising the re-use, recycling, and recuperation of materials in deep renovation following waste management and circularity principles

- In the **Brussels Capital** region, the construction sector generates 628 000 tonnes per year of waste, 91% of which is already selectively collected (inert waste, soil & stones, concrete, asphalt, brick, etc.). There are currently few re-use operations for these streams. Even though the Brussels Capital region will still be heavily dependent on imports of energy and materials in the future, lower consumption of new construction products and a greater uptake of secondary raw materials will reduce this dependence and the associated environmental impacts. A study will be launched to define a strategy for reusing building materials. Furthermore, Brussels Environment will develop a methodology to compare the environmental costs of a demolition/reconstruction operation and a renovation. The strategy agreed will be turned into a regulatory obligation. The Brussels authorities also plan to draft and implement a regulation which will require selective dismantling (via environmental permits). The dismantling operations will need to be organised in such a way that the reusable elements are effectively dismantled and recovered for introduction into a re-use chain. This vision therefore precludes a classic demolition where the components of the building are often destroyed together, thus preventing the re-use of materials and also limiting the possibilities for recycling. The implementation and monitoring of this measure will be achieved by means of minimum rates of materials caught in the recycling and re-use sectors.

²³ In addition, the European Commission published in 2020 a guidance document “Circular economy principles in buildings’ design”: <https://ec.europa.eu/docsroom/documents/39984>

2.6.2 Developing life-cycle sustainability of materials used for the construction and renovation of buildings

- **France** developed a system of labelling construction products that provides information in the form of a performance class, ranging from A+ (very low embodied emissions) to C (high embodied emissions). In addition, environmental and health statement sheets, drawn up by certain industrial or trade unions (standard NF P 01-010), present the pollutant emissions of products, i.e. volatile organic compounds and formaldehyde, the risk of fibre emissions, resistance to micro-organisms, thermal comfort, etc.

2.6.3 Enhancing the climate resilience of buildings

- In **Flanders**, the climate-induced costs avoided were monetised among the wider benefits of building renovation.
- **Finland, Latvia and Spain** assessed the likely impact of future climate on heating and cooling demand.
- **Spain** envisage to encourage the deployment of passive architecture, such as heat-shading and heat-dissipation devices, as well as “bioclimatic” vegetation, to combat increasingly hot summers.

2.7 Focus area 1: Tackling energy poverty and worst performing buildings

Energy poverty results from a combination of low income, high expenditure of disposable income on energy, and poor energy efficiency, especially as regards the performance of buildings.

The Energy Efficiency Directive 2012/27/EU, as amended by Directive 2018/2002/EU, requires Member States to take account of the need to reduce energy poverty in the context of their energy efficiency obligations. Article 7(11) requires that Member States put in place, to the extent appropriate, energy efficiency measures that address vulnerable households as a priority, including those affected by energy poverty. The Governance Regulation contains similar obligations.

Under the revised Energy Performance of Buildings Directive 2018/844/EU, Member States must outline relevant national measures that help alleviate energy poverty in their long-term renovation strategies to support the renovation of the national stock of residential and non-residential buildings²⁴.

The Renovation Wave Communication stresses that, with nearly 34 million Europeans unable to afford keeping their home adequately warm, tackling energy poverty is an urgent task for the EU and its Member States. Each year, 800 000 social homes need renovation, requiring an estimated EUR 57 billion of additional annual funding.

Inefficient buildings are often synonymous with energy poverty and social problems. This often means that people with low incomes have little control over their energy expenditure, causing a vicious circle of high energy bills, arrears and problems with wellbeing and health.. Section 2.2.2 of the EU Guidance on Energy Poverty looks into these issues and provides a reading of relevant energy performance of building stock indicators across Member States, as well as discussing how they can shed light on the issue of energy poverty²⁵.

Poorly performing buildings have high potential for improvement, but their renovation faces persistent barriers ranging from regulatory obstacles to structural factors. Addressing these barriers call for an integrated approach that also accounts for the social setting and affordability of housing.

²⁴ This builds on existing obligations under Article 4 of the Energy Efficiency Directive 2012/27/EU that have been moved to the Energy Performance of Buildings Directive and strengthened as regards the need to address energy poverty. Recital 11 of Directive 2018/844/EU clarifies that the need to alleviate energy poverty should be taken into account, in accordance with criteria defined by the Member States. The Recital further clarifies that while outlining national actions that contribute to the alleviation of energy poverty in their renovation strategies, the Member States have the right to decide what they consider to be relevant actions.

²⁵ SWD (2020) 960 final, page 17.

It is important to recall that Commission Recommendation (EU) 2019/786²⁶ on building renovation provided a first overview of examples of good practices, notably as regards social housing and delivering advisory services to energy-poor households.

In this area, the following, latest best practices from the submitted long-term renovation strategies can be underlined:

2.7.1 Using Energy Performance standards as a key tool to identify the worst performing segments of the building stock

Minimum energy performance standards coupled with financing that limits the monthly net expenditure of inhabitants can significantly accelerate renovation. Accompanying services and technical assistance are essential for the worst performing buildings.

Some Member States are considering setting a specific threshold for gradual phase-out from the market, such as for buildings with an energy performance standard below a certain level:

- **France** plans to introduce a renovation work obligation for the most energy-intensive units by 1 January 2028. It also envisages an annual report on the achievement of the energy renovation targets for housing, and in particular the eradication of ‘passoires thermiques’, to be submitted to Parliament on 1 July each year.
- **The Netherlands** is addressing the worst performing segments of dwellings by improving the average energy label of the whole stock. In the 2012 Covenant on Energy Saving Industry, the housing corporations, the Woonbond and the public authorities agreed that the total rental housing stock for 2021 must reach an average energy efficiency index of 1.25 (average energy label B).
- In the **Flemish region**, vulnerable groups qualify for a free energy scan of their homes; over 20 000 such scans are being carried out every year.
- In **Denmark**, the 2018 Energy Agreement allocates DKK 200 million per year from 2021-2024 to energy savings in buildings. As the savings potential is highest in homes for all-year-round use, efforts are targeting this segment. The pool will support energy actions included in a positive list. In order to ensure the most efficient use of the pool, each action on the positive list will be required. The subordination requirements will ensure that support is provided only for deep renovations where the overall cost-effective potential is achieved to the maximum extent possible. The building’s energy label is included as part of the documentation base. The grant will be awarded to building owners who can demonstrate the highest energy saving potential (maximum savings in kWh/m²). This will make sure that the measure targets the least energy-efficient segments of the national building stock.

2.7.2 Energy Service Companies (ESCOs)

In recent years, there has been an increased interest in the provision of energy services to achieve energy and environmental goals. In particular, some new companies providing energy

²⁶ <https://eur-lex.europa.eu/legal-content/GA/TXT/?uri=CELEX:32019H0786>

services to final energy users, including the supply and installation of energy-efficient equipment, and/or building refurbishment, have started to operate on the European market. What differentiates these companies, defined as energy service companies (ESCOs), from traditional energy consultants or equipment suppliers is the fact that they can also finance or arrange financing for the operation and their remuneration is directly tied to the energy savings achieved²⁷.

The Renovation Wave Communication proposes to expand the use of ESCOs and energy performance contracts, which proved to work well in some Member States to make renovation affordable for all households, including those with a limited ability to cover costs upfront²⁸. Some countries have put in place measures to overcome regulatory barriers by creating intermediaries (for example, public ESCOs, public funds, utilities ESCOs) who work with government agencies to organise auctions for local ESCO companies with the aim of carrying out energy efficiency projects. As independent entities, these intermediaries can take over procurement functions, because they are not subject to public procurement regulations and can use alternative procurement methods, for example based on the highest net present value, instead of contracts based on the lowest price and on deliverables, saved energy. They can also use public funding for projects (as a solution to the low value of local ESCOs), can be a ‘neutral intermediary’ between the public agency and the local ESCOs, can resolve potential disputes on energy savings achieved, etc.

In this area, the following best practices from the submitted long-term renovation strategies can be highlighted:

- The **Brussels Capital** region authorities plan to set up a market facilitator that will support the establishment of ESCOs and energy performance contracting (EPC), with a view to creating the conditions for the emergence of ESCOs. This facilitating body will also play the role of aggregator of applications in order to limit the expenditure of ESCOs in research and project planning. This measure will be accompanied by the removal of administrative and legal disincentives and the provision of standard procurements and contracts. Furthermore, a specific public legal vehicle will be created to support the managers of public building applicants in the preparation of the financing solution, and to offer tax and accounting advice for the renovation programme.
- In **Cyprus**, a study carried out by the JRC suggests the preparation of standard tender documents for the selection of energy service providers, with a view to concluding energy efficiency contracts by the public and wider public sector. The aim is to create standard documents and a short, step-by-step procedure to guide authorities, both central government and the wider public sector, and help them implement such projects. It is expected that the documents will help increase the use of energy service providers when implementing energy efficiency projects in the public sector.

²⁷ <https://e3p.jrc.ec.europa.eu/node/190>

²⁸ For more information : Commission staff working document - SWD(2020) 550 final - Support from the EU budget to unlock investment into building renovation under the Renovation Wave: https://ec.europa.eu/energy/sites/ener/files/eu_renovation_wave_strategy.pdf

- **Austria** will set up an **energy-saving contracting platform for** small- and medium-sized enterprises (SMEs). Its goal will be to record the energy-saving measures that were identified in the context of the supported energy and environmental consultations, but not implemented for various reasons, in a central database, with the consent of the undertakings involved. Contractors and external energy service providers should have access to this database to access information on unimplemented projects and actively contribute to the implementation of upcoming projects. In addition, the platform itself can identify projects from these data according to certain criteria.
- In **Finland**, the Finnish Real Estate Federation invested in the implementation of new contract forms in 2017 and 2018. The investments resulted in new document templates that are compliant with the shared contractual practices of the real estate and construction industries. They are available in digital format at www.sopimuslomake.net.
- In **Belgium Flanders**, the Flemish Energy Company (VEB) facilitates energy performance contracts between ESCOs and public institutions. This is to remove the burden on public institutions as far as possible: the VEB provides knowledge and experience at technical, legal and project levels so that the ESCO process can be successfully completed.
- **The German** LTRS lists a number of mechanisms to promote ESCO and energy performance contracting. The website of the Federal Energy Efficiency Agency provides information on contracting model contracts and guidelines on energy-saving contracting available free of charge. This includes offers specifically aimed at public properties or local authorities.

As part of the advisory programme ‘Energy advice for non-residential buildings of local authorities/non-profit organisations’, a ‘contracting cheque’ (up to 80% of the net consultancy fee, with a maximum of EUR 2 000) is provided for local authorities and non-profit organisations. A qualified energy consultant examines whether and how the measures proposed in a previous energy audit (also supported) or consultation (refurbishment roadmap) can be implemented using an appropriate contracting model. The aim is to draw the attention of local authorities to the often unfamiliar possibilities of different contracting models, encouraging greater use of energy-saving contracting in particular.

The Federal Government/federal state dialogue on energy-saving contracting will provide a platform for intensive exchanges on energy-saving contracting between representatives of the Federal Government and the federal states. The project aims to remove barriers to the implementation of energy-saving contracting and to build up regional expertise in this area. This will be done through annual plenary meetings and workshops, as well as a mentoring programme, the exchange of examples of best practice and the practical implementation of around 10-15 energy-saving contracting model projects in representative properties in local authorities and at federal state level, with the aim of providing a model for the potential of contracting and thus prompting the establishment of a functioning ESC market in Germany.

2.7.3 Grants

According to the Renovation Wave Communication, financing solutions aiming at cost neutrality for low-income households must address rents, energy and operating costs and local taxes through the use of grants, subsidised renovation measures or the use of energy savings for repayment (limiting upfront investment to available grants).

Grant schemes can be useful in stimulating the market by subsidising energy efficiency investments for households and businesses, which otherwise cannot be fully supported by the market alone due to high upfront costs. They directly fill an immediate financial gap and thus enable a temporary shift in the market.

All submitted long-term renovation strategies list targeted grants to foster energy-efficient renovation in specific aspects of the building stock, for example:

- **Denmark** developed an oil boiler scrapping programme: an aid scheme of DKK 20 million for the period 2021-2024, for scrapping oil boilers outside the public utilities. Aid is given on the condition that, following the scrapping of the oil boiler, the home owner will have a heat pump on subscription, and is granted to the company which supplies and runs the heat pump. Denmark also set up a 'heat pump on subscription' programme. In this scheme, selected companies install, own and operate a heat pump for a building owner. The building owner typically only pays a connecting contribution, a continuous subscription and the cost of heat used. The companies selected to benefit from this scheme will receive a grant per heat pump installation.
- **Czechia** developed a green savings programme which focuses on investment support to reduce the energy demand of family- and multi-family buildings. Partial and comprehensive renovation of residential buildings is supported. The budget uses proceeds from the trading in emission allowances (state budget). As of 2021, it amounts to CZK 4 000 million.

2.7.4 Focus on multi-apartment housing

The renovation of social and multi-apartment housing faces additional barriers due to the complex decision-making process involved.

The following best practices from the submitted long-term renovation strategies can be highlighted:

- **Estonia** developed a renovation programme for multi-apartment housing: since April 2010, around 1100 apartment blocks were reconstructed using pre-constructed elements developed close to multi-dwelling buildings. This renovation process has an impact on the neighbourhood and can also motivate other apartment cooperatives to undertake similar processes.
- **Croatia developed an energy renovation programme for multi-residential buildings for 2021-2030**, as a follow-up to the programme that ran from 2014 to 2020. The objective is an annual renovation rate of 1 % at the beginning of the period (2021) to be gradually increased to 3 % by 2030. Annual savings are expected to amount to 0.148 PJ. The expected cost of energy renovation is HRK 1.500/m², which corresponds to the 2020 cost.
- In **the Netherlands**, the concept of 'Energiesprong' is helping to achieve mass deep renovations with pre-fabricated, standardised modules that lead to major cost and time savings. The Energiesprong brokered a deal to bring 110 000 buildings to a NZEB standard. Thanks to a three-year EU Horizon 2020 grant, the initiative is planned to be rolled out in other EU countries, too.
- In **Germany**, the Federal Government wants to promote the industrial pre-production of façade and roof elements and standardised installation of plant technology,

including the supply of self-generated electricity, in conjunction with new investment and contract models. The approaches developed as part of the pilot projects carried out will be put into practice by means of a newly adopted support programme from the end of 2020. The programme's aim is the serial refurbishment of apartment blocks with funding from the BMWi and with the involvement of the Dutch 'Energiesprong' initiative.

2.7.5 Tackling split incentives to establish new 'right to renovate' for citizens living in residential multi-apartment buildings as owners or tenants

Split incentives refer to an information market failure that is based on asymmetric information between the parties and that could lead to energy efficiency investments being foregone, as a result of one party being responsible for investment costs while the other party benefits from energy savings.

The following best practices from the submitted long-term renovation strategies can be highlighted:

- **The Netherlands** are putting in place tenant/owner obligations and rights related to energy renovation. A first step was already taken in the 2018 agreement between housing corporations and the tenants' association. This agreement includes a 'sustainability investment fee table', which is based on the real average savings on energy costs incurred by tenants following the improvement of their home. The scheme does not aim to change legislation, but rather to ensure that tenants agree to sustainability investments when the fee to be paid is based on the agreed table. To promote the transition in the rental sector, the authorities are considering possible **legal changes** requiring that at least 70% of tenants agree to a renovation.
- **In Denmark**, the landlord can choose whether energy improvements should be financed through an increase in the rent according to the general rules set out in the Rent Act or in accordance with the specific rules on the overall economic and cost-effective energy improvements. A scheme has been set up for energy renovations in privately rented buildings. It allows for a rent increase by agreement between the parties, calculated based on the total agreed and documented costs of the energy improvement works.
- **In Finland**, the heating costs of rented apartments and rented premises are, as a general rule, included in the rent. It is therefore worthwhile for the owner to keep the building and systems in good condition in order to minimise energy consumption. Hot water consumption is influenced both by the efficiency of water heating, distribution and equipment, and by water usage patterns. Residents' water use patterns vary significantly, so billing based on measured use allows for savings in housing costs. The costs of lighting electricity are very typically borne by tenants themselves. This is accompanied by the possibility of a split incentive as old buildings are equipped with outdated lighting technologies. Modern technologies and controls have the potential to produce more high-quality and cheaper lighting. Examples of models of leases developed by RAKLI include the green lease and light green lease, both of which support the sharing of investment costs and benefits between the landlord and the lessee.

2.7.6 Reinforcing the role of communities

The Renovation Wave Communication underlines the fact that energy communities generate, consume, store and sell energy, and are an important vehicle for increasing the share of renewables used in buildings for electricity, heating and cooling consumption²⁹. A community approach may also help lift society's most vulnerable people out of energy poverty and support them in using their untapped potential as active players in the energy system.³⁰

In this area, the following best practices can be highlighted:

- In **Spain**, a series of developments aims to define and recognise energy communities as key actors in the energy transition. They include: (i) the IDAE's 'Guide to the development of instruments for the promotion of energy communities'; (ii) the recent publication of standard UNE 216701 by the Spanish standardisation body, UNE; and (iii) the classification of providers of energy services, where collective actors are defined. The IDAE finances energy-relevant projects that help accelerate the process of energy transition and make it possible to demonstrate the viability of new technologies, solutions or strategies. Local energy communities receive particular attention as the IDAE supports local pilot projects that meet technical and economic solvency requirements at early stage. As a result, the promoters of these local energy communities are able to pass on their project proposals to the IDAE, in accordance with the terms and conditions set out on the IDAE's website. Spain has also developed new rules on the regulation of self-consumption: Royal Decree-Law 15/2018 and Royal Decree 244/2019 regulate the administrative, technical and economic conditions of electric energy self-consumption, with the aim of making it easier for consumers to obtain cleaner energy at a lower cost. Spain also introduced a simplified compensation scheme in order to compensate for their surplus production with consumption or selling surplus energy to the market, and regulates the connections of self-consumption through the public distribution network, which allows consumption and generation to be located in neighbouring buildings. In addition, Royal Decree 244/2019 allows collective self-consumption by which consumers of the same building or nearby buildings can share the generation of a single installation for self-consumption, with energy sharing based on an agreed criterion.
- In **Ireland**, the establishment of over 250 sustainable energy communities has been a significant success in encouraging local actors to work together. This is underpinned by mentors and grants. Ireland aims to reach 1 500 sustainable energy communities and to make a concerted effort to ensure that local communities are more conscious of poor carbon technologies and how they can be improved.

²⁹ Many EU H2020 projects focus on energy communities / collective action initiatives: see, for example, the COMETS Project (<http://www.comets-project.eu/>)

³⁰ See "Energy communities: an overview of energy and social innovation" at https://publications.jrc.ec.europa.eu/repository/bitstream/JRC119433/energy_communities_report_final.pdf

2.7.7 Fostering Member State measures to promote renewable heating and cooling in buildings, notably for the benefit of low-income and vulnerable consumers

A number of Member States host projects designed to moderate energy demand by focusing on introducing renewable heating and cooling in buildings and/or retrofitting social housing to reduce energy costs for low-income and vulnerable consumers³¹.

- **Croatia** developed an energy poverty programme for 2021-2030 to: (i) address energy poverty through local info-centres, (ii) provide adequate information and advice to energy-poor people and those at risk of energy poverty, and (iii) provide adequate information and advice on energy efficiency measures contributing to the fight against energy poverty, as well as on the possibilities for co-financing activities in this field. Indicators for the monitoring of energy poverty will be identified and a monitoring system will be set up through the already existing system for collecting data on household consumption and habits (Croatian Bureau of Statistics). Energy efficiency measures for energy-poor households will be co-financed, such as the replacement of household appliances with new systems and the improvement or replacement of heating systems (improving the efficiency of heating systems and the replacement of energy products, in particular electricity and fuel oil, with environmentally, economically and energy-efficient ones, in particular for systems using renewable energy sources).
- In **south-east Europe**, the REACH project has been successful in identifying ways to tackle energy poverty and improve energy efficiency in households. The project encompassed several zones in four countries (Bulgaria, Northern Macedonia, Croatia and Slovenia). The objectives were to make it possible for energy-poor households to act to save energy, to change their behaviour and to establish energy poverty as a problem requiring tailored policies and measures at local, national and EU level. As part of the project, the partners collected data and analysed specific aspects of energy poverty, involved local actors in fighting energy poverty and allowed households experiencing energy poverty to reduce their energy and water consumption. The project trained about 200 energy consultants who contacted households and provided them with advice on energy savings, provided free energy-saving devices and reported good practices from other EU countries. See more at: <http://reach-energy.eu>.

2.7.8 Energy poverty and related social policy measures

The Renovation Wave Communication also underlines that the EU Building Stock Observatory, the EU Energy Poverty Observatory, the Horizon Europe Mission on Cities and the EU Covenant of Mayors Office can further assist Member States in taking stock and identifying segments in need, and in linking renovation strategies to social indicators and policies to address energy poverty.

³¹ <https://aster.vlaanderen.nl/english-summary> and <https://energiesprong.org/>. H2020 Transition Zero (<http://transition-zero.eu/>) built on the success of Energiesprong in the Netherlands, advancing its implementation and kick-starting the project in France and the UK (EU Energy Poverty Guidance).

The examples below show some of the social policy measures reported by Member States in their long-term renovation strategies:

- **France** has developed a wide range of social policies to address energy poverty, including the creation of a guarantee fund of more than EUR 50 million to help 35 000 households with modest income each year. The energy tax base has also been extended to 20% of households with the lowest incomes in order to make it possible to extend the distribution of the energy voucher to 2.2 million additional households, i.e. 5.8 million households in total.
- **Luxembourg** has a wide range of social measures that contribute to alleviating energy poverty. This includes the Act of 1 August 2007 on the organisation of the electricity market and the organisation of the natural gas market. The amended Acts state that a household customer who is unable to pay their electricity or gas bills may receive social assistance from the competent social security office. In addition, the '*allocation de vie chère*' is a subsidy scheme that helps combat energy poverty. Also, the state rent subsidy can help those in need face a possible increase in the cost of housing. It should also be stressed that Luxembourg's current legislation prohibits the disconnection from the grid of a household customer who is unable to pay their electricity or gas bills.
- **Denmark** has developed a heat supplement for pensioners and early retirees. This is an aid provided by municipalities on an individual basis to pay particularly high heating bills for people who have been affected by changes in their circumstances (e.g. unemployment or sickness).
- In **Spain**, a whole National Strategy to alleviate Energy Poverty is developed and reported in the LTRS; the 'social bonus' is a mechanism that the government launched on 1 July 2009 to protect vulnerable consumers. Royal Decree No 897/2017 introduced new requirements for the application of this social bonus. It differentiates between an electricity and a thermal bonus. In early 2020, as a result of the COVID-19 pandemic, more beneficiaries were added (self-employed people who were forced to cease their activity because of COVID-19 or who have seen their turnover fall by 75% as compared with the previous half-year). Several other social policies to address energy poverty are in place, e.g. agile and low-cost refurbishments available to vulnerable households, increase in the number of social housing renovations through public intervention, specific provisions for vulnerable households in grant allocation for building renovations.
- **Romania** is planning several measures, including ones to: (i) streamline existing heating aid to ensure equity among beneficiaries and a level playing field as regards heating sources, (ii) extend social support to energy poverty other than heating, and (iii) introduce a heating strategy coupled with the phasing out of heat price subsidies.
- **Brussel Capital** has developed a wide range of social policies to address energy poverty. The revision of the "Brussels green loan" foresees a 0 % loan rate for a vulnerable target audience. Moreover, free information/coaching support is available to vulnerable households (for example through 'pro deo' architects).
- **Belgium Flanders**, in the framework of the Flemish Region financial support scheme to all those who invest in energy saving, increased energy premiums (i.e. 50 % increase) for protected customers (beneficiaries of the social price caps).
- In **Cyprus**, the measures to protect vulnerable electricity consumers include, the right to apply for special household electricity tariff (which is about 20 % lower than the

normal tariff), inclusion of a legal provision which foresees continuation or reconnection of electricity supply in critical periods for vulnerable consumers who face serious health problems, financial incentives for the installation of a residential photovoltaic system using the 'net-metering' method and higher grant rates for residential energy upgrades offered by the 'Save & Upgrade' financial incentives (75 % instead of 50 % for other consumers) and support for installation of individual energy saving measures.

2.8 Focus area 2: Public buildings and social infrastructure

The Renovation Wave Communication stresses that public and privately-owned social infrastructure, public administrative buildings, social housing, cultural institutions, schools, hospitals and healthcare facilities can spearhead the Renovation Wave, serving as a role model and reference point for the industrialisation of construction and the co-benefits that become immediately visible to the public.

Moreover, according to Article 2a (1) (e) of the revised EPBD, each long-term renovation strategy must comprise policies and actions for all public buildings. This should include ongoing and planned measures, as provided for in the revised EPBD and the EED, to renovate at least 3 % of central government buildings every year.

All submitted long-term renovation strategies contain a specific chapter on public buildings, underlining that the public sector should play an exemplary role and take the lead by improving energy efficiency in its buildings. Renovation will be used as an opportunity to ensure that public buildings are accessible for persons with disabilities. There are, however, differences between the submitted strategies regarding the scope of the public buildings covered depending on the national administrative structure, as well as concerning the breakdown of these public buildings by sub-sector, e.g. schools or hospitals. Nevertheless, most strategies report dedicated policies for central government buildings and schemes to encourage energy-efficient renovations by local authorities such as municipalities.

The following best practices from the submitted long-term renovation strategies can be highlighted:

2.8.1 Setting targets for public buildings

- **In the Netherlands**, a national real estate company roadmap was developed to ensure that planned investments are made in order to accelerate progress on sustainability goals for national buildings. This concerns buildings with a public function such as education, sport, culture, welfare, social care and/or healthcare. These sectors have committed to agreeing their own roadmap describing their contribution to a net-zero-energy built environment by 2050. The central government should serve as a catalyst for others. All office buildings will have to be energy performance certificate class C by 2023 and energy performance certificate class A by 2030.
- **Romania** is planning to develop a project pipeline to ensure the refurbishment of public buildings by at least 26 % by 2030, 52% by 2040 and 100 % by 2050. This should include: (i) technical and procedural support to local authorities for project documentation and access to finance, (ii) increased support for schools and other public buildings with evaluation of technical projects to ensure quality and compliance with best practices, (iii) the aggregation of public building renovations into large procurement packages to get better prices, reduce the number of offers and centralise monitoring, and (iv) the development of standard tender documentation with performance indicators and specific requirements and procedures for technical and economic evaluation, as well as centralised purchasing and procurement frameworks for services and refurbishment works targeting energy efficiency in buildings owned by central government and in municipal buildings. Romania is planning to allocate a budget of EUR 300 million from public/EU funds for

central government buildings and of EUR 1.3 billion (of which ~ EUR 700 million from the public budget/EU funds and ~ EUR 600 million from the private sector) for municipal public buildings.

- **In Croatia**, the public sector is obliged to manage energy systematically, as required by the Energy Efficiency Act and through the energy management information system. The aim is to capture and regularly monitor all public sector buildings and street lighting systems by the end of 2030. Savings based on systematic energy management and the introduction of remote sensing during the previous period are set at around 335 TJ per year. Moreover, Croatia will prolong its energy renovation programme for public sector buildings over the period 2021-2030. From 2016 to 2020, the available ERDF funds amounted to EUR 211 million for the energy renovation of public sector buildings, and up to now approximately HRK 1 494 billion has already been allocated to the energy renovation of 871 buildings. The implementation of projects under this programme is planned to be completed by the end of 2023. Croatia wants to use EU funds for the next programming period 2021-2027, in such a way as to ensure both the mobilisation of private capital and ESCO markets (including hospitals, penitentiaries, etc.).

2.8.2 Promoting green public procurement

- **Brussels Capital** authorities have stated that a 100% green electricity supply for public buildings will be imposed in the very short term for the region's administrations (it should be noted that local authorities are already almost all supplied with 100% green electricity). To this end, an obligation will be imposed on the various regional administrative departments (including ministerial offices) and public interest bodies renewing a contract for the supply of electricity to obtain 100 % green electricity (covered by guarantees of origin).
- **Sweden** has developed legislation on the purchase by public authorities of energy-efficient goods, services and buildings and requires public authorities to procure energy-efficient goods, services and buildings above certain thresholds, subject to certain conditions. Reporting on work in this area is being carried out by the Swedish Agency for Natural Resources, which reports to the Government Offices.
- **Croatia** adopted a national green public procurement action plan for 2015-2017, which set a target of 50 % of public procurement procedures being green by 2020. A National Commission for Green Public Procurement has been set up and monitors the action plan's implementation through a survey and an electronic public procurement notice. The aim is to have 75 % of public procurement procedures implemented using green public procurement criteria by 2030.

2.8.3 Stimulating public-private partnerships to promote public building renovation

- **In Finland**, the obligations set out in the Energy Efficiency Directive have been fulfilled through voluntary energy performance contracts. Around 70 % of Finnish municipalities (in terms of number of inhabitants) are covered by such municipal energy performance contracts.
- **In Denmark** it is compulsory for local authorities to consider the use of Public Private Partnership (PPP) whenever they decide to carry out new construction or renovation of buildings. PPP projects are supported by standard contracts and manuals, which have been developed by the Government for local authorities.

2.8.4 Focusing on key target groups, in particular schools and hospitals

- **In France**, schools represent 30% of the consumption of municipal buildings. In 2019, a task force on the energy renovation of schools was launched. A Convention was signed on 30 May 2018 between the state, *Ademe* and the *Caisse des depots* to provide comprehensive support for the renovation of buildings owned by local authorities.
- The **Austrian** strategy contains a number of regional/municipal best practices on the energy-efficient renovation of schools. For instance, in Vienna, the school renovation package provides for the reduction of heat consumption in public compulsory schools through thermal improvements made to the building stock. Between 2008 and 2014, as part of the school renovation package, improvements were made to the building technology used in 189 schools: radiator valves were replaced by thermostatic valves, all radiators, controls and pumps were replaced, pipes were insulated and hot water systems were upgraded. The total savings for the years 2006 to 2014 stood at 32.4 GWh. Another good example is the Upper Austria regional support programme for photovoltaic installations in schools and kindergartens, which enabled the construction of photovoltaic facilities in more than 360 schools. About 40 % of all primary and new secondary schools in Upper Austria were reached through this programme and a total of more than 1 kWp (peak power output) of PV installations were installed in public buildings. Due to its great success, the programme was subsequently continued in kindergartens and installed around 700 kWp photovoltaics in over 180 kindergartens. In total, the measure reached 550 schools and kindergartens.
- **Croatia** developed a dedicated programme for the renovation of buildings owned and operated by its Armed Forces. The long-term development plan for the Armed Forces of the Republic of Croatia for 2015-2024 includes the removal of troops from non-adequate sites over two phases — the first phase by the end of 2019 and the second phase over the 2020-2024 period. As a first priority, seven locations were to be targeted, with reconstruction and improvement of energy efficiency. In the second phase, 15 sites will be renovated, which will also include the deployment of renewable energy sources.

2.9 Focus area 3: Phasing out inefficient technologies and fossil fuels in heating and cooling

According to the impact assessment of the climate target plan for 2030, the residential sector would have to undergo the highest reduction in energy demand in heating and cooling, ranging between -19% to -23% compared with 2015. **The annual rate of replacement of heating equipment would have to reach around 4% in both the residential and services sectors.** During the same time period, the share of renewables used in heating and cooling would have to increase to 40% of final energy consumption to reach the objective.

In this area, the following best practices from the submitted long-term renovation strategies can be highlighted:

2.9.1 Fossil fuel phase-out in private dwellings

- **The Netherlands'** strategy describes a progressive fossil fuel ban: the country's direct CO₂ emissions from buildings are almost exclusively derived from natural gas heating. There are also indirect emissions from electricity generation. To reach a CO₂-free built environment, the Netherlands is looking to switch to clean electricity and to phase out the use of natural gas, both inside and outside the built environment. Legal adaptations are making dwellings and neighbourhoods progressively no longer connected to natural gas. A Climate Agreement contains specific agreements with landlords on making rented accommodation gas-free. It has been agreed that landlords will make 100 000 rented homes gas-free or 'gas-free-ready' in the next four years. The central government supports landlords by contributing to the costs of making rented dwellings gas-free. This requires EUR 200 million of the money for the energy investment deduction (EIA). It will be called the 'incentive scheme for gas free rented accommodation' (SAH). The scheme will support the connection of rented dwellings to a district heating grid. Additionally, money is available to landlords through the ISDE sustainable energy investment subsidy and, starting in 2022, the 'reduction of landlord levy' (RVV) scheme for sustainability investments, which is comparable with the current STEP ('incentive scheme for energy performance in the rental sector').
- **In Finland**, the national energy and climate policy aims to be carbon neutral by 2035. Some cities and municipalities are already aiming for carbon neutrality in 2030. In order to achieve this objective, the use of fossil fuels for heat production is restricted. Coal will cease to be used for energy production by 2029. Part of the fossil fuel oil being used must be replaced by bio-oil. Oil heating of state and municipal real estate will be phased out by 2024 (2019 government programme). Finland is encouraging oil-fired buildings to switch to other forms of heating during the 2020s through a separate programme of measures (2019 government programme). In residential buildings, oil heating in individual buildings will be phased out by 2050 (energy and climate strategy).
- **Austria** developed an 'exit from the oil and remediation cheque for private individuals 2019': in order to further facilitate the transition to climate-friendly heating systems, this '*Raus-aus-dem-Öl*' bonus 2019 supported the replacement of heating systems, irrespective of any simultaneous building renovation. To benefit from this, it was necessary to present a valid energy performance certificate of the residential building or an energy advisory protocol of the respective länd. When a thermal renovation

measure was submitted, support of up to EUR 6 000 was possible, as well as a supplement for the use of renewable solutions of up to EUR 3 000. Online registration made it much easier for people to apply.

2.9.2 Fossil fuel phase-out in public buildings

- **The French** long-term renovation strategy includes an obligation to ban oil heating in public sector buildings by 2030.
- **In Finland**, the 2019 government programme includes a phase-out of fossil fuel oil by the early 2030s. Government buildings are already trying to phase out fossil oil by 2024, by switching from oil heating to district heating, and installing heat pumps (geo-heat pump; air-to-water heat pump and additional source of heat such as biofuel).
- **The Brussels Capital authorities** set out requirements for public buildings which are stricter than those applicable to other buildings, and may also take into account the possibility of producing energy from renewable sources. For existing buildings **undergoing major renovation, 30% of the energy consumed in public buildings must be produced from renewable energy or high-efficiency cogeneration.** In the longer term (2030), public buildings will be subject to requirements based on an analysis of the environmental impact of materials used on sustainability. The authorities will develop and implement a regulation on building sustainability, complementary to the energy performance regulation. It will first be imposed on public authorities by being included in the technical specifications of public tender specifications, and will then be imposed on the private sector, depending on building type and size.

3 Country

fiches

Austria

Summary of the long-term renovation strategy

Austria's long-term renovation strategy (LTRS) contains milestones, stocktaking and policies. It sets out a clear list of milestones until 2050, expressed in greenhouse gas emission reductions. The strategy is in line with an overall CO₂ reduction approach. According to the LTSR modelling, the set of measures is adequate to achieve an 80% decarbonisation of the buildings stock. Austria is applying a comprehensive set of measures to address building renovation which includes regulatory requirements, fiscal and economic incentives and informatory measures. The strategy focuses on phasing out the use of coal and oil for heating.

Austria's LTSR is highly decentralised. It is structured around federal and regional obligations and measures. This requires strong coordination between the Länder and the Federal government, especially on financing.

Information on the building stock

2011	Single-family buildings	Multi-family buildings	Apartments	Overall
Buildings	1 727 129	175 910	70 940	1 973 979
Residences	2 012 192	961 237	1 326 620	4 300 049
Principal residences	1 730 263	826 558	1 140 747	3 697 567

- Final residential energy consumption per m²: 8.66 Mtoe, Average annual change [%] 2005-2017: -0.38 (Energy Union indicators)
- Despite a population increase of around 14.5% over the last three decades, energy consumption for heating, cooling, hot water, ventilation and lighting in the buildings sector has remained stable.
- House prices have risen strongly in the past decade, but recent data show the opposite trend. Excess demand for housing appears to have peaked in 2016, as building permits and construction picked up. Most indicators suggest that house prices are overvalued by 10% or more.
- New buildings have increased their energy performance (by about 40%) and energy consumption has fallen by approximately 28.6% since 1990.

- The share of renewable energy sources in buildings has significantly increased (due to the technical regulations on construction that require since 2007 to assess alternatives before embarking on any new construction or major renovation) from 38.3% in 1990 to 54.4% in 2017.
- Greenhouse gas emissions in the buildings sector have been reduced by about 35.1% (1990:12 862 ktCO₂eq to 2017:8 347 ktCO₂eq).

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Overall CO₂ emissions modelling average ktCO₂eq		CO₂ milestones in the buildings sector ktCO₂eq		
	Households	Buildings	MIN	MEDIUM	MAX
2020	6 214	8 149			
2030	4 687	5 550	6 000	5 600	5 200
2040	3 465	3 949	4 700	3 900	3 500
2050	2 465	2 639	3 700	2 600	1 900
INTENDED	2 146	2 572		2 600 (target)	

The LTRS sets out a list of milestones until 2050, expressed in greenhouse gas emission reductions.

- The strategy focuses on phasing out the use of coal and oil for heating.
- According to the LTRS modelling, the set of measures is adequate to achieve an 80% decarbonisation of the buildings stock.
- Underlying rate of renovation (across all building types): 1.5% p.a. (for the period 2020-2050).
- By 2050, green gas will reach approximately 20 TWh, with a total volume of 5 TWh already made available by 2030.
- With maximum effort and in the best-case scenario (in particular the presence of a quantity of approximately 2.5 TWh of green gas), the greenhouse gas savings of 3 million tonnes (calculated from the 2017 data basis) envisaged in the NECP can be achieved in 2030.

Investment needs

- To maintain the current level of refurbishment/renovation work, approximately EUR 5.3 billion in economic output must continue to be spent per year (corresponding to approximately EUR 600 per head or slightly over EUR 1 200 per household), especially since the motivation to make thermal energy improvements often goes hand in hand with a multitude of other home improvement options, which of course can also be seen as refurbishment/renovation work.
- Increasing the (effective) refurbishment rate to 3%, which is one of the stated goals of this legislative programme, would require a range of incentives worth over EUR 10 billion. The funds that will need to be earmarked for these incentives are much higher than the EUR 100 million made available via the Federal Refurbishment Check in recent years.

Good practices

Legislative

- Introduction of mandatory energy accounting accompanied by the free use of an internet-based energy accounting tool. This will make buildings comparable and allow for the establishment of benchmarks.
- **Mandatory phase-out of inefficient lighting systems for municipalities.**
- At least 40% of all efficiency measures under the energy efficiency obligation scheme will be effective for households.
- At regional level: i.e. in Carinthian Länder: mandatory measures to avoid summer overheating.

Finance

- **Climate and energy model regions programme.** Part of the Climate and Energy Fund, this programme provides regions with support for their energy planning and policy making. This includes the design of tailored investment support (partly financed from the Climate and Energy Fund). It also fosters cooperation between municipalities.
- AT Federal government's renovation plan launched in 2009 grants support in the form of one-off, non-reimbursable grants. It was extended from 2012 onwards to include a category of listed buildings. Results for 2018: 5 782 private and 180 business renovation projects supported, triggering sustainable investments of around EUR 283 million. Annual energy savings of around 111 000 MWh and an annual CO₂ savings of over 35 300 tonnes.
- **A 2019 bonus to support the exchange of heating systems** irrespective of a complete building renovation. To be eligible, it was necessary to present a valid energy performance certificate of the residential building or an energy advisory protocol of the respective Länd. The funding amounted to up to EUR 5 000 for a single or two-family house and up to EUR 1 000.

Public buildings

- An energy saving potential of 84.7 GWh has been estimated for 2021-2030. This can be achieved through contracting and refurbishment planning measures, a refurbishment offensive (mission 2030) for the public sector and public procurement of energy-efficient building components. The Federal government and the regions have agreed to adhere to a voluntary agreement to reduce CO2 in the public sector, which will largely be achieved through building renovation.
- **Federal property contracting programme** for renovating Federal buildings.
- The programme for municipalities helps municipalities adhere to energy efficiency requirements, e.g. through training for community staff (energy consultant training) and assessing energy consumption of public buildings against target and limit values (benchmarks for electricity/heat/water).
- The **PV for schools programme** of the province of Upper Austria enabled the installation of photovoltaic facilities in more than 360 schools (more than 1 kWp of PV installed) and in over 180 kindergartens (700 kWp photovoltaics).

Energy poverty – worst performing buildings

- Over a million people are at risk of poverty. According to national statistics, around 2.7% of the population cannot adequately heat their homes in winter. This corresponds to approximately 230 000 people or 120 000 households.
- Energy poverty is addressed by a leverage factor included in the **energy efficiency obligation scheme** under the federal energy efficiency law. Savings achieved in low-income households are leveraged with a factor of 1.5, which makes this segment more interesting for the responsible energy suppliers. Household measures represent 37.3% of the total savings, with annual savings of 25.4 PJ. In low-income households, measures led to annual savings of 0.62 PJ set.

Multi-apartment residential buildings

- Renovation of the Lehen district in the City of Salzburg: the city owns 26 multi-apartment residential buildings in that district built between 1950 and 1965. The buildings were in need of refurbishment and the city decided to renovate 14 buildings and to demolish 12 buildings and replace them with new buildings. The apartments were insulated in 2013 (façade, cellar ceiling and roof) and received new windows and balconies. The other apartments were demolished in stages and replaced by modern dwellings.

Advisory tools

- **Online energy information campaign** (Klimaschutzinitiative klimaaktiv). Information and awareness-raising activities as well as consultations (product-independent, promoted and public) are planned. The energy certificate is to be upgraded qualitatively, and data on the building stock and the technologies for conditioning buildings are to be collected in a structured way (e.g. building and housing

registers). A broad-based communication campaign is planned to enable a targeted transfer of knowledge, e.g. through model buildings that make different building concepts and technologies researchable and tangible.

- **Free advice on energy-related issues** relating to the construction and renovation of buildings, heating and air conditioning of buildings and electricity applications for low-income households. Coordinated information in the areas of thermal insulation, windows and installation, heating systems, support, energy saving tips, photovoltaics, storage systems and cost savings.

Skills

- **Specific training programme for energy consultants:** The Federal Act lays down qualification requirements for energy auditors and energy consultants and requirements for carrying out energy audits, including individuals qualified to carry out energy audits. External energy auditors must also be registered in a publicly accessible register managed by the National Energy Efficiency Monitoring Unit.

Other useful information from the LTRS, the NECP and other sources:

- EPCs are regularly updated with additional information including on regional support programmes.
- Central energy certificate database (ZEUS): regional energy certificates must be submitted by the issuer to the ZEUS energy certificate database of the Länd. These are checked automatically for compliance with the energy-related building and subsidy law provisions.

Areas for potential improvement compared to best practices

It could be useful to consider:

- providing a clearer overview of the measures as well as the regional or federal budget to increase clarity on the strategy and the existing measures; and
- analysing in more details the wider benefits of renovating buildings.

Summary of the long-term renovation strategy

Cyprus' long-term renovation strategy (LTRS) contains milestones for 2030 and sets out a comprehensive set of measures, including regulatory requirements, financial measures, awareness-raising, user behaviour, training and support schemes. According to the LTRS modelling, a mixture of minor, moderate and major renovations in residential and non-residential buildings will lead to a reduction in final energy consumption of 8%, 15% and 20% by 2030, 2040 and 2050 respectively, compared to the baseline projections. However, the plan for decarbonisation in 2050 is not detailed and the renovation rate is still low. The overall ambition could be further increased by adopting more ambitious milestones and measures.

Information on the building stock

Cyprus has 431 059 residential buildings and more than 30 000 non-residential buildings. It has around another 78 000 homes that are used as country or tourist dwellings, meaning that they are typically used seasonally, as well as 54 000 empty homes.

40% of homes in Cyprus were constructed before 1981 and 54% between 1981 and 2006, i.e. the vast majority of homes were constructed when there were no minimum energy performance requirements in force. Based on the available statistics, no energy-saving measures have been taken in 49% of the homes, and only 12% of the homes include some form of thermal insulation.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

Cyprus' energy sector targets for 2021-2030 include:

- final energy consumption of 2 Mtoe in 2030, representing a 13% reduction in final energy consumption compared to the European Commission's 2007 forecast for Cyprus;
- primary energy consumption of 2.5 Mtoe in 2030, representing a 17% reduction in final energy consumption compared to the European Commission's 2007 forecast for Cyprus;
- cumulative energy saving of 243.04 ktoe for 2021-2030;
- 23% RES in final energy consumption;
- 26% RES in final electricity consumption;
- 39% RES in heating and cooling; and

- 14% RES in transportation.

The table below presents the results of a relevant study assessing different scenarios (below the projections for the realistic scenario)

Year	Final energy demand (ktoe)			Total savings (ktoe)	% reduction final energy demand	% reduction GHG emissions	Other
	Residential	Non-residential	Total				
2030	373	266	640	56	8%	24% 40 000 tCOeq	33 000 residential buildings and 10 000 non-residential buildings
2040	373	277	650	112	15%		
2050	361	279	640	163	20%		half the energy intensity in buildings, i.e. energy consumption per unit of gross national product (GDP)

Investment needs

- Based on proposals for the 2021-2027 programming period of the European Structural Funds, support is envisaged for energy upgrades of existing dwellings to nearly zero-energy buildings (NZEB) (EUR 40 million budget), energy efficiency measures in SMEs (EUR 15 million budget) and municipalities (EUR 15 million budget).
- An estimated EUR 800 million (approximately) will be required for 2020-2030.
- The investments in energy upgrades for 2020-2030 are estimated to increase GDP by 0.25%.

Good practices

Legislative

- Setting up of an **energy efficiency obligation scheme**: this is expected to contribute to the 2030 Article 7 requirement by 41.1 % or about 100 ktoe through improvements in energy efficiency in residential, commercial and industrial installations as well as in vehicles. The scheme includes both awareness-raising and technical measures and should trigger an estimated EUR 150 million in investments in the target sectors (including buildings) for 2020-2030.
- Combination of **structural (seismic)** and energy upgrades during renovation opportunities.
- **Green tax reform** which will include carbon pricing in sectors outside Cyprus' emissions trading system. Such a reform is hoped to stimulate investment in energy efficiency and RES in the building sector (to be implemented in 2021) among other sectors.

- Increase of **building floor area ratio** by 5% if energy class A is met and if at least 25% of total energy needs are covered by renewable sources.
- **Reduced VAT** rate (5% instead of 19%) for housing renovations.

Financial incentives

- The **‘Save & Upgrade’** scheme finances renovation of homes and buildings owned or used by SMEs, which had requested a building permit before 21 December 2007. It is co-financed by the EU's Cohesion Fund (CF) for households and the European Regional Development Fund (ERDF) for SMEs.
- The **Fund for RES and EE** was created in 2003 to finance investments in energy performance improvement measures and renewable energy sources' systems. The Fund derives its income from imposing an energy fee per kWh of electricity consumed on all final consumers.
- **‘Mutual Funds Fund’**: In 2018, the Council of Ministers decided to set up a fund to implement a loan scheme for energy efficiency and RES. The Fund has an initial capital of EUR 40 million, which consists of Cohesion Fund and European Regional Development Fund funding as well as a national contribution. A further EUR 40 million has been added to the Fund by the government from a loan guaranteed by the European Investment Bank. The ‘Mutual Funds Fund’ is designed to provide loans to households, SMEs and local authorities for energy efficiency and RES projects. These loans will be made available through commercial banks. It is expected to be operational in 2020.

Public buildings

- To **renovate central government buildings** EUR 20 million of the EU Structural Funds was secured for 2014-2020 and new funds for 2021-2027 are planned to be used for deep renovations and other measures.
- As part of a long-term strategy to upgrade public schools to NZEB, **photovoltaic systems** with a total capacity of 4 MW and roof insulation will be installed, and EU funds have been secured for technical assistance.
- The H2020-funded **‘PEDIA’ project** aims to upgrade 25 schools to NZEB level and gain on average 65% in primary energy savings. Overall, it aims to trigger EUR 7.5m in sustainable energy investment, develop an innovative financing solution for schools’ energy efficiency upgrading and introduce an energy management system (ISO50001) into renovated school buildings to monitor and continuously increase energy savings.

Energy poverty - worst performing buildings

In 2018, 21.9% of the population reported that they were unable to heat their house in winter, while 12.2% were unable to pay their energy bills on time due to financial difficulties (among the highest in the EU). Measures to address energy poverty include:

- **lower electricity tariffs** for vulnerable consumers (20% lower than the normal tariff);
- continuation or reconnection of electricity supply during critical periods for vulnerable consumers who face serious health problems;
- financial incentives to install a residential photovoltaic system using the ‘net-metering’ method;
- higher financial support for residential energy upgrades under the ‘**Save & Upgrade**’ scheme (75% instead of 50% for other consumers) and support for installing individual energy saving measures.

Energy communities

- In 2019, the Commissioner of Mountain Areas prepared the ‘national strategy for development of the way of roads’, which includes a mapping of the region’s energy situation and measures to improve it. These measures include an energy upgrade for private and public buildings, visits to households to provide information and raise awareness on energy efficiency, and the collection of sectoral and green waste with a view to their energy recovery. The total estimated cost of the proposed measures for 2019-2030 is estimated at EUR 4 940 000.

Smartness

- Installation of **smart meters** for electricity: the distribution system operator plans to install 400 000 ‘smart’ electricity meters by January 2027.
- Various research and development programmes (VIOLET, SupERB, European Hotels4Climate Project, SMEPower Efficiency).

Advisory tools

- An **online energy-saving tool** has been set up to help the public easily identify the costs and benefits of different energy saving and renewable energy measures in homes. (<http://energysavingstool.cea.org.cy/>).

Skills

- The Energy Office and the Frederick University - who have both been approved by the Energy Agency as evaluating agencies for the Heating Systems Body - organised a total of seven training courses.
- In 2016, the **legal framework for energy managers** was created by Decree of the Minister for Energy, Trade and Industry. In line with the legislation, any organisation/company may be designated as an ‘energy manager’ provided that it follows a training programme approved by the Energy Service.

Other useful information:

- The new minimum energy performance requirements will be put in place on 1 July 2020. These will require all residential buildings undergoing major renovation to be of energy class A, and all other buildings to be of energy category B+.
- Of the 59 432 energy performance certificates (EPCs) issued so far, only 10.6 % relate to existing buildings, leading to the conclusion that the issuance of EPCs during sale and rental transactions remains low.

Areas for potential improvement compared to best practices

It could be useful to consider:

- further developing the plan for decarbonisation in 2050 so as to increase the renovation rate;
- providing more detail on the wider benefits;
- further developing the ESCOs market;
- exploring district/neighbourhood approaches;
- specifying the development of advisory tools such as one-stop-shops.

Summary of the long-term renovation strategy

Czechia's long-term renovation strategy (LTRS) includes economic measures (investment grants for residential and non-residential buildings financed through structural funds and sales of emission allowances), a communication campaign, technical assistance for energy efficiency projects with a special focus on energy performance certificates (EPC) and education measures. The planned economic measures are mostly a follow-up of the existing programme rather than an update. Most of the LTSR measures are reliant on the final setting of the programmes under the next multiannual financial framework.

The optimal scenario is expected to lead to energy savings of 9% in 2030 and 23.5% in 2050, which is not enough, especially given that Czechia has a higher than average unitary heat consumption in the building sector.

The LTSR lacks details on the implementation of the measures, especially an analysis and quantification of the expected impacts.

Information on the building stock

- Total number of single-family buildings: 1 554 794
- Total number of apartments: 1 896 931
- Total number of non-residential buildings: 613 134
- Public buildings: 117 753
- 25% of single-family houses and 40% of multi-apartment buildings were renovated in 2019. In 2014-2018, 31% of the renovations in multi-family buildings were low renovations, 50% were moderate renovations, and 19% were deep renovations. In 2014-2018, 35% of the renovations in single-family houses were low renovations, 45% were moderate renovations, and 20% were deep renovations. The shares seem to apply to 2020 as well.
- Around 55% of non-residential buildings were renovated in 2019-2020. More specifically, approximately 27% were low renovations, 44% were middle renovations, and 30% were deep renovations (based on estimates from EPC).

Indicative milestones and other information for the vision to decarbonise the building stock by 2050
(based on the optimal scenario of a relevant study)

Milestones of the optimal scenario				
	2020	2030	2040	2050
Specific heat consumption per m ² [MJ/y.m ²]	493	426	368	325
Residential sector	558	488	425	369
Non-residential sector	399	338	287	260
Final energy consumption in the given year [PJ]	373	345	316	289
single-family houses	161	149	136	123
multi-apartment buildings	88	83	78	73
public and commercial buildings	124	113	102	93
Energy savings (compared to baseline 378 PJ) [PJ]	-5	-33	-62	-89
renovation rate	Modelling inputs in the optimal scenario			
single-family houses	1.40%			
multi-apartment buildings	0.79%			
public and commercial buildings	2.00%			
depth of renovation	low	medium	deep	
single-family houses	20%	40%	40%	
multi-apartment buildings	20%	40%	40%	
public and commercial buildings	20%	40%	40%	

- The calculations show that buildings are responsible for 44,35% of Czechia's total emissions. The models show that it is possible to reduce emissions from the current 44.6 Mt to 26 Mt per year by 2050 under the optimal scenario, i.e. by about 40%.

Investment needs

Based on the modelling	2020	2030	2040	2050
Investment costs [CZK billion]	493	426	368	325

- Operational Programme 'technology and applications for competitiveness': CZK 8 000 million.
- Operational Programme 'environment': For the public sector, funding will be provided by the ERDF and the Cohesion Fund (CF). An allocation of CZK 14 000 million is expected.
- New 'green savings' programme and its successor: Revenues from emission trading until now (State budget). From 2021, a budget guaranteed by Act No 383/2012, on the conditions of trading-in greenhouse gas emission allowances, as amended, of CZK 4 000 million per year. For 2020, an allocation of CZK 1,350 million is expected.
- The Modernisation Fund managed by the EIB is expected to support the renovation of State buildings. It is expected that CZK 15 000 million will be used from this fund for the renovation of these buildings for the entire 2021-2030 period.
- PANEL programme: CZK 15 000 million for 2020-2030.

The total funds allocated to this area for 2014-2020 stands at CZK 78.3 billion.

Good practices

Legislative

- Update of the Decree 78/2013 to introduce from 2022 stricter requirements for nearly zero-energy buildings. The amendment also responds to a certain shift in the construction and development of HVAC and updates the parameters of the 'reference buildings'.

Finance - Fiscal

A number of financial instruments are in place (e.g. the 'green savings' programme, the Integrated Regional Operational programme for the residential sector and the 'environment for the public sector' and 'enterprise and innovation for competitiveness for the commercial sector' Operational Programmes). The programmes are mostly in the form of investment grants, and will continue in the next

programming period (2021-2027). However, the LTRS aims to put a much greater focus on financial instruments, which would lead to higher leverage of public finances.

- **New ‘green savings’ programme:** investment subsidy for energy efficiency improvements in residential buildings.
- **Panel programme:** subsidy for energy efficiency improvements in residential multi-apartment buildings through soft loans.
- **ENERG programme:** energy efficiency measures in commercial buildings.

ESCOS

- EPC projects are a rather well-established practice (with the exception of government facilities, which are still bound by budgetary and accounting restrictions).

Public buildings

- Czechia’s strategy for renovating public buildings, especially at municipal and regional level, seems strong. The measures include investment grants, technical assistance, support to EPC, and support to energy management. State-owned buildings still face barriers in developing EPC.
- The LTRS emphasises the role of **energy performance contracting**. It supports technical assistance for developing energy efficiency and specifically EPC projects, and assistance to public tender for EPC projects. Investment grants are the main form of support (the environment Operational Programme and its successor in 2021-2027). The LTRS strives to move from investment grants to a wider range of financial instruments.
- Schools and healthcare facilities are explicitly listed as the recipients of technical assistance to develop EPC projects.
- The environment Operational Programme provides investment grants to public sector buildings, supporting thermal renovation and HVAC, new buildings in passive house standards, monitoring and automation in buildings, and further adaptive measures.
- **EFEKT programme:** Support to energy management in public buildings, support to good quality energy efficiency projects, support for preparing EPC projects for public and commercial buildings.

Multi-apartment residential buildings

- The split-incentives dilemma is perceived as one the main barriers to building renovation, especially for multi-apartment buildings owned by cooperatives. The key initiative to address this issue seems to be the communication campaign on the benefits of energy efficiency measures.

Smartness

- Smart technologies are mainly supported through the ‘enterprise and innovation for competitiveness’ Operational Programme and its successor in 2021-2027. The programme is aimed at companies and supports monitoring, automation and demand management in buildings.
- Additional support stems mainly from research projects (e.g. the national research and innovation strategy for smart specialisation (the ‘RIS3 strategy’) and the Theta programme). The national strategy aims to effectively target European, national, regional and private funding to priority innovative areas of specialisation in order to fully exploit Czechia’s knowledge potential.
- The **Theta programme** aims to use the outputs, results and impacts of supported projects to transform and modernise the energy sector in line with the approved strategic materials in the medium- and long-term. It will support energy research, development and innovation, focusing on: support for projects in the public interest; new technologies and system elements with a high potential for rapid application in practice and support for long-term technological perspectives.
- Other projects include creating a multidisciplinary and interdisciplinary system of cooperation between companies and research organisations to develop energy-efficient and environmentally-friendly technologies, systems, equipment, components, methodologies and strategies for smart buildings in the regions.

Advisory tools

- **Promotion and communication campaign** to raise awareness on energy savings, with a specific target to achieve deeper and good quality renovations
- **EKIS energy consultation** is a free public service to support energy savings and the introduction of renewables.

Skills

- Certified experts (e.g. energy auditors) are obliged to continue their professional education and keep up with the latest information in order to carry out their jobs properly. The Ministry of Industry and Trade runs a programme to support education, which includes workshops, seminars and publications.
- Legal provisions for the following job titles: Energy performance of buildings - energy specialist; installation of renewable energy sources - person authorised to install equipment to produce energy from renewable sources; building design.

Areas for potential improvement compared to best practices

It could be useful to consider:

- providing more specific estimates of impacts (including wider benefits) of the individual measures or groups of measures and information on how the financial instruments (other than investment grants) are going to be implemented and promoted;
- further specifying the trigger points;
- further exploring measures to address energy poverty / vulnerable households;
- exploring district/neighbourhood approaches further;
- specifying the development of advisory tools such as one-stop-shops.

Denmark

Summary of the long-term renovation strategy

Denmark's long-term renovation strategy (LTRS) does not provide indicative milestones for the efficiency of the building stock but it presents a comprehensive and well balanced set of measures (regulation & standards, financial incentives, information, training and advices). Several initiatives for mobilising investment for deep renovations have been put in place.

Information on the building stock

- Total number of buildings: 1 717 580
- Final energy consumption for heating has been reduced by almost 45% compared with 1975 and net heat consumption has been reduced by almost 30%.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

2020	<ul style="list-style-type: none"> • reduce energy consumption in new buildings by 75% compare with 2006 • all ministries must reduce their energy consumption by 14% compared with 2006
2050	<ul style="list-style-type: none"> • reduce heating needs by 35% • reduce average consumption from 113 kWh/m².y to 76 kWh/m².y • have a fossil-free energy supply; (from the NECP: reduce net energy consumption for heating and hot water by 35% compared with 2014) • reduce the energy consumption of the existing building stock by 50% on average to reach the target of a fossil-free society in 2050

Evolution of net consumption of dwellings

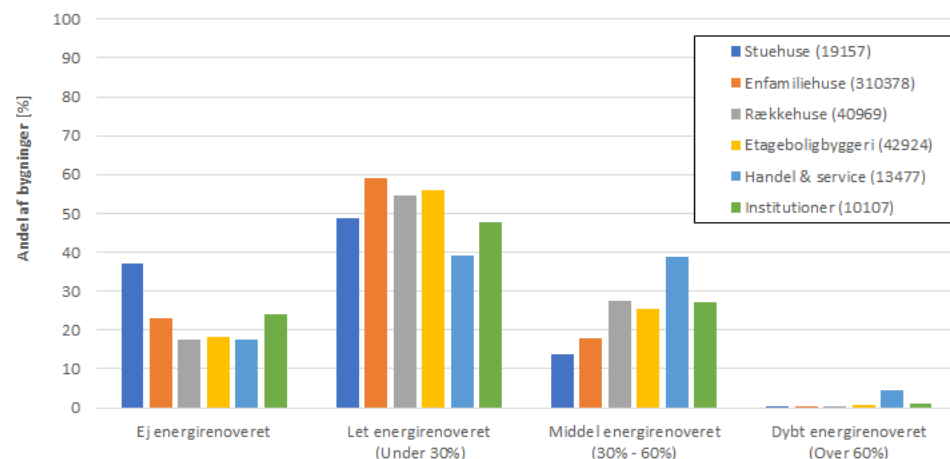
		2017	2020	2025	2030
Heated area	m ²	324.5	321.6	316.7	311.8
Net heat	PJ	139.8	137.4	132.2	127.3

Unit consumption	PJ/million ²	0.431	0.427	0.417	0.408
	kWh/m ²	119.7	118.7	116.0	113.4

The Danish government has set an ambitious overall (all sectors) greenhouse gas reduction target for 2030 of 70% compared to 1990 levels.

- From 2020 to 2030 the net heat consumption per m² is expected to be reduced by 4.4% (reduction of 5.9 PJ compared to 2020).
- Energy saving potential: approximately 30% of the building stock to be renovated by 2050 in compliance with the Building Regulations (80-85% of this potential is in buildings built before 1980).

Anticipated renovation depth in 2020 of buildings built before 1980



Investment needs

- Investment needs are estimated at 40.6-76.2 DKK billion (note that the most ambitious scenario is less cost efficient). Saving an additional 1.4 TWh requires almost double the investment (76.2 DKK billion vs 40.6 DKK) or 0.28 DKK/kWh saved vs 0.43 DKK/kWh.
- The subsidy scheme for residential buildings allocates DKK 200 million each year for the 2021-2024 period.
- The subsidy scheme for non-residential buildings allocates DKK 300 million each year for the 2021-2024 period.
- The subsidy scheme for public buildings allocates DKK 100 million each year for the 2021-2024 period.

Good practices

Legislative

- New building codes (BR18) with tightened minimum energy requirements for new buildings and the introduction of even more restrictive voluntary requirements ('Building 2020' class).
- The **energy label** has been strengthened since 2019, by raising the quality of the label and promoting dissemination. The label is therefore expected to become an even more important tool to support energy efficiency renovations. More attention is also given to the fact that energy efficiency improves indoor climate and comfort, for example.
- The **energy efficiency obligation scheme**, that played a very important role in the previous LTRS, with 45% of the annual target realised within households, will cease at the end of 2020 and will be substituted with a new energy saving subsidies scheme based on a competitive bidding procedure.

Finance

- Several initiatives to mobilise investment for deep renovations have been put in place and, according to the strategy, the financing of energy efficiency initiatives is not a major barrier for most projects in Denmark.
- The '**Pool for energy savings in buildings**' is a subsidy scheme, that, starting from 2021 **will substitute the current energy efficiency obligation scheme**, will allocate DKK 200 million/y in 2021-2024 with a competitive bidding procedure. The incentive is granted based on the ratio of subsidy per saved kWh in the individual projects. Subsidies are first granted to the project with the lowest costs per saved kWh, then to the one representing the second-lowest costs, and so on. Similar schemes are planned for public buildings (DKK 100 million/y in 2021-2024), and for non-residential buildings (DKK 300 million/y in 2021-2024). Preliminary calculations show that the building pool of DKK 200 million per year in 2021-2024 will have an impact in 2030 of about 1.2 PJ.
- The Danish pension funds and other parties are able to participate in energy projects by pooling projects in cooperation with other actors as well as through ESCO and EPC schemes.
- The **National Building Fund**, a self-governing institution, whose funds originate from the tenants of the general housing sector. The Fund supports, among other things, the renovation of social housing, and therefore also provides indirect support for energy improvements.
- **National Green Climate Fund**, to support initiatives across all sectors that promote the green transition in an appropriate manner (e.g. establishment grants for electric heat pumps on non- ETS cogeneration plants, promotion of green building, and mapping and advice for decentralised CHP plants).

- **Loans for finance renovations** - mortgage credit system: a much used system of well-established mortgage institutions lending money to building owners with certainty on the value of the building. The financing is obtained through the sale of obligations. The rules for mortgage credit institutions ensure that the obligations are highly secure, which means the interest on loans to buildings owners is low.
- **Municipal mortgage credit** (Kommunekredit): a special credit institution providing financial services, including loans, to municipalities and regions. The funding is provided through the issuance of bonds, including green bonds, to finance, for example, energy-efficient building renovations.
- The **BoligJobordning scheme** grants a **tax credit** of up to DKK 12 200 per person per year (in 2019) for renovation works (e.g. insulation, replacement of windows, improvement or replacement of heating systems).
- **Heat pumps on subscription**: a scheme to help selected companies install, own and operate a heat pump in private buildings. The building owner typically pays only a connection contribution and a bill for the used heat. The selected companies receive a grant per heat pump installed. The scheme will expire in 2020, but will continue under a new scheme focusing on the scrapping of oil boilers.
- **Grants for scrapping oil boilers**: covering the years 2021-2024, these grants (for a total of DKK 20 million/y) will support the replacement of oil-fired boilers with individual heat pumps. There are currently approximately 80 000 oil-fired boilers heating Danish homes.
- **Tax and duties**: In Denmark, all energy sources for heating buildings, other than biomass, are subject to high taxes. Fees for petroleum and natural gas are indexed and maintained at constant prices. Energy efficiency incentives include:
 - Tax credit for work pay, including VAT when paying for labour costs, notably for energy efficiency works.
 - Tax on natural and town gas (carbon tax).
 - A tax (under the Coal Tax Act) on hard coal/lignite (DDK/t). Since 1999 includes also waste heat tax and since 2010, waste incineration tax also covered by that Act.
 - Tax on electricity (DKK/kWh). Increasing reductions on electricity on heat introduced in 2013 to reflect the increasing share of RES in electricity production.

Public buildings

- **All ministries are obliged to reduce energy consumption** by 14% in 2020 compared to 2006 (the State already reduced its energy consumption by 10.9% in 2006-2018). On 17 January 2020, a revised obligation entered into force introducing additional requirements for the central government institutions.
- Construction or renovation and maintenance of public buildings is carried out by private partners, while the public pays an agreed rent for the use of the buildings based on a long-term contract. **ESCO projects can be considered best practice.**

- Local authorities are obliged to consider using the public-private partnership (PPP) model whenever they decide to build or renovate buildings. PPP projects are supported by standard contracts and manuals, which the government has developed for local authorities.
- **Loan pool for municipalities and regions:** The 2018 Energy Agreement introduces subsidies for energy efficiency improvements in buildings owned or operated by municipalities carried out between 2021 and 2024. During this period, the scheme will allocate DKK 100 per year in loans to finance energy renovations in buildings owned or operated by municipalities and regions.
- **Kommune Kredit** is another fund providing financial services to municipalities and regions, including loans and leases.

ESCOs – Energy performance contracts

- Since 2016, energy companies install, finance, run and maintain heat pumps installed in smaller residential and commercial buildings. Customers have no upfront investment cost but pay for the supplied heat much as they would for district heating. This has increased the number of heat pump installations, and heat pumps in the scheme tend to operate more efficiently, because they are run by professionals rather than building owners. The initiative mainly targets areas without a supply of natural gas or district heating.

Split incentives

- This scheme for privately rented buildings allows for rent increases agreed between the parties to be calculated on the basis of the total agreed and documented costs of the energy improvement works. This option only covers leases in properties which at the time of the lease have achieved an energy label rating of A-D, among other energy improvements.
- The ‘**Agreed green urban renewal**’ scheme for energy renovations in private rental buildings allows for rent increases agreed between the parties to be calculated based on the total agreed and documented costs for the energy improvement works.

Energy poverty - worst performing building

- **Heat supplement:** allowances/subsidies are given to the economically weakest group of pensioners.
- Aid by municipalities to help individuals who have been affected by a change in circumstances (e.g. unemployment or sickness) pay for particularly high heating bills.
- The Traffic, Construction and Housing Authority has launched an analysis of the renovation needs of the whole social housing sector, which will serve as a basis for the political negotiations on the size of the renovation framework in a future housing agreement.
- People who fulfil specific conditions and have high housing costs or a high dependency ratio may receive special support if their need for assistance cannot be met through other benefits. The special support is not paid as a lump sum, but is rather calculated as the difference between what the applicant assumes to be able to pay in housing costs (limit value) and the net balance of their network costs, including water, heating, gas, electricity.

- A pilot scheme for public housing enables public housing organisations to carry out tests on ‘dynamic heat accounts’, where the heat cost is billed on the basis of indoor air quality (indoor temperature, humidity and CO2 content) as an alternative to a traditional heat consumption measurement.

Smartness

- Denmark focuses on better using the potential of data and increasing digitisation, so that energy efficiency improvements provide the most value and the transaction costs of energy renovations are reduced.
- The 2018 Energy Agreement allocated DKK 19 million in 2018, DKK 33 million in 2019, DKK 34 million in 2020 and DKK 44 million annually in 2021-2024 for the overall information and data effort.
- Energy development and demonstration: support to R&D activities include energy savings, more efficient energy conversion, renewable energy technologies and advances in system integration and smart energy (updated in the Energy Agreement).

Skills and education

- Setting up of a **knowledge centre** for energy savings in buildings - among other tools and training materials - for the vocational education and training system.
- **Specific training programme** for energy consultants who must pass the corresponding exam to be able to carry out energy label assessments.

Advisory tools

- **Better Home** is a voluntary, market-driven scheme from the Danish Energy Agency focusing on energy renovation of buildings. It aims to make it easier for building owners (mostly homeowners) to renovate their energy systems by creating a **one-stop-shop** for energy renovation, where the owner only has to contact one certified building contractor to get advice on energy renovation for the entire building.
- The **Better Boost Mechanism** meets the EU’s description of a building renovation passport.
- The **information campaign** on energy efficiency at end-user level (**SparEnergi.dk**) focuses on home owners, the public sector and businesses (i.e. both private and public building owners). The SparEnergi.dk website provides advice on energy savings and information on mainstream energy renovation measures. It includes a tool for homeowners to boost their energy label and make related savings.

De-risking and aggregation

- From 2019, the **energy label** has been strengthened by raising its quality and promoting dissemination. The label is therefore expected to become an even more important tool to support energy efficiency renovations.
- **Default value catalogue:** The Danish Energy Agency has set default values for energy savings in order to simplify the calculation of realised energy savings. This is done by a simple multiplication of the value by number of initiatives carried out. The basis for the default values is a professionally qualified tender for the energy savings resulting from an activity.
- The **SBI guidelines** give instructions on the method and process for carrying out energy renovation projects in large buildings at all stages of the project - from conception to the operational phase. They therefore help the parties involved realise the energy gains from their major renovation projects.

Other information

- Denmark already significantly reduced energy consumption in its building stock in the last 30 years.
- In 2020, about 20% of the building stock built before 1980 has never been energy renovated; 55-60% has had a light renovation (-30% energy consumption); 20-25% has had an average renovation (-30/-60% energy consumption); and only 5% has had a deep renovation (-60% energy consumption reduction).
- In 2008 it was decided that energy requirements should be established for new buildings built in 2010, 2015 and 2020. The aim is to reduce the energy consumption of new buildings by 25% every 5 years. Two voluntary low energy classes anticipated the requirements that would have entered into force in 2015 and 2020.
- A national EPC database is managed by the Danish Energy Agency (including 600 000 EPC out of a total of 1,7 million buildings).

Areas for further improvements compared to best practices

It could be useful to consider:

- specifying indicative milestones for the efficiency of the building stock in 2040 and a roadmap for achieving the targets;
- analysing in more detail the wider benefits of renovating buildings, including the effect on climate resilience.

Summary of the long-term renovation strategy

Estonia's long-term renovation strategy (LTRS) includes both intermediate milestones and a roadmap to 2050 with a list of existing and planned measures to be implemented in the next decade. The planned cost efficiency measures focus on replacing/improving the heating system to reduce heat loss. The strategy proposes to use state-funded loans, guarantees and other financial support, to introduce new technologies, to develop information and awareness measures, and to increase data availability in order to improve the monitoring process.

Estonia plans to renovate its entire building stock (for all buildings built up to 2000) by turning them into nearly zero-energy buildings by 2050. This target seems very ambitious and the measures to achieve it are unclear. It is also not clear whether the allocated funding is adequate. It will be necessary to increase public funding and private investment to implement the strategy successfully and achieve the goal of decarbonising the building stock.

The Estonian LTRS does not include an energy savings contribution for the policy measures, but it forecasts a potential reduction in final energy consumption and CO₂ emissions.

Information on the building stock

- The total number of buildings in use cover 76 million m². Buildings that are not completely renovated cover 70 million m². The surface to be renovated p/year in 2020 is 500 000 m².
- There are 155 150 single-family houses covering a total floor area of 19 998,000 m².
- There are 22 600 apartment buildings covering a total floor area of 28 378 000 m².
- There are 375 000 non-residential buildings covering a total floor area of 62 million m².
- There are 27 000 non-residential buildings covering a total floor area of 22 m².
- Up to 25% of private houses (around 40 000) and up to 23% apartment buildings (around 5 300) might fall out of use. It is projected that by 2050 up to 10 million square meters of apartment buildings and non-residential buildings will fall out of use.
- In 2018, the central government sector used a total of 2.3 million m², 1.4 million m² of which is owned by the central government and 860 000 m² is rented.
- The State Real Estate Registry has energy performance certificate information on 49% of the floor area of central government owned buildings with climate control. Based on floor area, 25% of government-owned property, i.e. 200 000 m², with an energy performance certificate has been awarded class A, B or C.

- The buildings owned by local authorities cover 5.3 million m².
- If current trends continue, 80% of private houses, 68% of apartment buildings and 60% of non-residential buildings will remain unrenovated in 2050.
- The annual average net area of new private houses with use permits is 200 000 m², which accounts for 1% of the area of private houses taken into use before 2000.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

- The main goal is the full renovation, by 2050, of buildings erected before 2000.
- The target is to renovate 22% of the total building stock by 2030, 64% of the total building stock by 2040 and the entire existing building stock (built prior to 2000) cost-effectively into nearly zero-energy buildings by 2050.
- The potential CO₂ savings from the renovation of existing buildings is 3.9 million tCO₂ in 2050, representing an 89% reduction compared to 4.4 million tCO₂ emission in 2020.
- A total of 141 000 existing buildings covering 54 million m² are waiting to be renovated within the next 30 years. These include around 100 000 single dwellings with a total surface area of 14 million m², around 14 000 apartment dwellings with a total surface area of 18 million m² and around 27 000 non-residential buildings with a total surface area of 22 million m².
- The strategy focuses on non-residential buildings with climate control. Estonia has around 32 000 such buildings covering a total floor area of 28 million m².
- Energy savings, a healthy indoor climate in buildings and a high-quality spatial environment, is estimated to improve the living and working conditions of 80% of the Estonian population.
- The effort so far is inadequate to renovate the existing building stock by 2050, and if the current trend continues only the central government owned buildings (representing 1.5% of the building stock) will be renovated according to plan. Considering the total annual renovation volumes of various building categories, Estonia will need to fully renovate 2.3 million square meters a year, which is almost five times more than the current figure.
- A final energy consumption reduction of around 7 TWh/y would be possible if the buildings were fully renovated. It would be possible to lower the heating consumption by up to 70% (approximately 6.4 TWh/y) and electricity consumption by up to 20% (approximately 0.5 TWh/y).
- Energy savings of 60% by 2050 compared to today could be achieved if the target level of renovation activity were delivered.
- Reconstruction of the building stock by 2050 would reduce greenhouse gas emissions by 90% compared to today (reduction of 4 MtCO₂eq).

- Around 500 to 700 private houses and around 400 apartment buildings are renovated a year. The average annual area that needs to be renovated to achieve the target is approximately twice as big as the current estimate. There is therefore no need to increase the number of apartment buildings that are renovated; instead, the percentage of a full renovation should be increased (at least up to energy class C).
- The average area of non-residential buildings that needs to be renovated each year to achieve the target specified in this strategy is approximately 730 000 m², i.e. around four times bigger than the current estimate.

Residential building renovation volume up to 2050

	Existing		Renovated		Falling into disuse		In need of renovation	
	Quantity	Area, m ²	Quantity	Area, m ²	Quantity	Area, m ²	Quantity	Area, m ²
Private houses	155,000	19,998,000	10,000	1,500,000	40,000	4,800,000	105,000	14,000,000
Apartment buildings	22,600	28,378,000	3,000	5,000,000	5,300	5,000,000	14,000	18,000,000

Renovation need of non-residential buildings until 2050

	Central government	Local government	Private sector	Total
	Area, m ²	Area, m ²	Area, m ²	Area, m ²
OFFICE	271,000	279,000	2,760,000	3,310,000
ACCOMMODATION	74,000	207,000	520,000	801,000
COMMERCE AND SERVICES	69,000	712,000	2,440,000	3,221,000
EDUCATION, RESEARCH	243,000	2,212,000	690,000	3,145,000
HEALTHCARE	12,000	205,000	590,000	807,000
WAREHOUSES	19,000		3,060,000	3,079,000
INDUSTRY	7,000		6,880,000	6,887,000
SPECIAL-PURPOSE BUILDINGS	164,000		150,000	314,000
OTHER		427,000	0	427,000
	860,000	4,000,000	17,100,000	22,000,000

Final consumption	Final consumption 2020 TWh/y			Final consumption 2050 TWh/y			Reduction, %		
	Heating	Electricity	TOTAL	Heating	Electricity	TOTAL	Heating	Electricity	TOTAL
Private house*	2.9	0.4	3.2	0.5	0.6	1.1	82%	-49%	67%
Apartment building	3.1	0.6	3.8	1.0	0.5	1.6	68%	15%	59%
Office	0.4	0.2	0.7	0.2	0.1	0.3	58%	49%	55%
Commerce	0.3	0.4	0.7	0.1	0.2	0.4	45%	51%	49%
Education	0.4	0.1	0.5	0.1	0.1	0.2	66%	-15%	52%
Other buildings	1.9	0.9	2.8	0.7	0.6	1.3	64%	34%	55%
	9.0	2.7	11.7	2.7	2.1	4.8	70%	20%	59%

*in the case of private houses it is considered that 50% of private houses will install a heat pump and 50% a boiler as a heat source

	Area to be renovated, m ²						TOTAL
	2021-2025	2026-2030	2031-2035	2036-2040	2041-2045	2046-2050	
Private houses	400,000	950,000	1,900,000	3,100,000	3,900,000	3,800,000	14,000,000
Apartment buildings	2,280,000	3,200,000	4,000,000	3,900,000	3,000,000	1,800,000	18,000,000
Private-sector non-residential buildings	840,000	1,800,000	3,200,000	4,200,000	4,100,000	2,900,000	17,000,000
Local government buildings	680,000	1,400,000	1,300,000	480,000	70,000	0	4,000,000
Central-government buildings	200,000	240,000	230,000	150,000	70,000	20,000	900,000
	4,400,000	7,600,000	10,600,000	11,800,000	11,100,000	8,500,000	53,900,000

CO ₂ emissions	CO ₂ emissions in 2020, t/y			CO ₂ emissions in 2050, t/y			Reduction, %		
	Heating	Electricity	TOTAL	Heating	Electricity	TOTAL	Heating	Electricity	TOTAL
Private house*	429,000	432,000	860,000	25,000	90,000	120,000	94%	79%	86%
Apartment building	467,000	737,000	1,200,000	50,000	88,000	140,000	89%	88%	88%
Office	66,000	270,000	340,000	9,000	19,000	30,000	86%	93%	91%
Commerce	38,000	515,000	550,000	7,000	35,000	40,000	82%	93%	93%
Education	62,000	102,000	160,000	7,000	16,000	20,000	89%	84%	88%
Other buildings	288,000	1,030,000	1,320,000	34,000	94,000	130,000	88%	91%	90%
	1,350,000	3,086,000	4,430,000	132,000	342,000	480,000	90%	89%	89%

*in the case of private houses it is considered that 50% of private houses will install a heat pump and 50% a boiler as a heat source

Investment needs

- The full renovation of all buildings costs around EUR 22 billion.
- The annual renovation financing needs also increase nearly five fold: from the current cost of under EUR 200 million to EUR 900 million.
- The financial support needed to launch investments in full renovation will grow from the current almost EUR 90 million a year to the maximum of EUR 370 million in 2035. However, almost EUR 300 million will be returned to the state budget as taxes each year.
- According to one possible scenario, the annual financing needs will be around EUR 220 million in the first few years, while the state contribution would presumably be 10%, i.e. the state should cover one-tenth of the amount. The total financing need by 2050 will be EUR 8.4 billion, and the state will get back around 30% of the construction costs as taxes, i.e. the related tax revenue would be EUR 70-170 million a year.
- The annual financing needs of the R&D&I activities are up to EUR 4 million.
- To implement the measures under its LTRS, Estonia will use national tax revenues, EU funds (ERDF, Cohesion Fund and to a lesser extent H2020) and auctioning revenues from the EU greenhouse gas emission allowance trading scheme and the national budgetary strategy.

		Renovation cost, €M						TOTAL
	Cost, €/m ₂	2021-25	2026-30	2031-35	2036-40	2041-45	2046-50	
Private houses	400	161	381	776	1,236	1,541	1,504	5,600
Apartment buildings	300	683	953	1,189	1,160	886	530	5,400
Private-sector non-residential buildings	450	379	811	1,437	1,884	1,828	1,312	7,650
Local government buildings	600	409	869	792	287	41	2	2,400
Central-government buildings	600	119	142	136	90	41	13	540
		1,749	3,156	4,330	4,657	4,337	3,361	21,590

Costs of the renovations proposed by the strategy until 2050

Renovation support, €M			
	Support, %	2020-2025	2026-2030
Private houses	30	48	114
Apartment buildings	40	273	381
Private-sector non-residential buildings	40	152	324
Local government buildings	50	204	435
Central-government buildings	100*	119	142
		796	1,396

* This is not the usual financial support as the central government is the owner of the buildings.

Support needs until 2030

Good practices

Legislative

- The minimum energy performance requirement is mandatory for major renovation for both residential and non-residential and central government buildings. In the Estonian energy performance regulation for buildings, the cost-optimal level of energy efficiency for major renovations corresponds to energy performance certificate class C.

Finance

- A comprehensive renovation of all unreconstructed buildings would require an investment of up to EUR 17 billion per year.
- To promote building renovation, Estonia offers **financial support of 30%, 40% or 50%** depending on the decrease in CO2 emissions, the energy label class to be achieved, and the location and size of the building.
- Financing measures such as **loans, guarantees and grants are available** and are based on an energy audit by the KredEx building SA (the State credit foundation). They include a **mortgage loan guarantee** for buying a new home or for renovating an existing one.
- The strategy sets out a group of measures to improve energy efficiency. They include staged deep renovation for residential and non-residential buildings. If implemented, this will lead to at least an energy class C (triggering financial support for the insulation of external walls, roof or beech insulation, replacement of old windows with triple glazed windows, renewal of the heating system, installation of thermostatic valves, installation of heat recovery ventilation system, insulation of the wall or a heat pump for exhaust air, building automation system upgrade/correction, changing the lighting into LED lights, upgrade of the heating system, cooling system equilibration or installing a complete new system).
- **Public-private partnerships** to address specific market failures, explore subsidies and gather the revenue needed to finance the measures. Given the limited public funding available, there is a need to increase the use of EU funds, revenue from ETS and other public funds to leverage additional private sector investment.
- **Replacement of a multi-apartment space heater** using biomass or fossil fuel or a heater using direct electric heating by a renewable fuel heater or the connection of a multi-apartment building to a district heating network.
- Construction of local heating to replace the district heating system of an existing building and the demolition of parts of the district heating system falling out of use as a result.
- Mortgage loan guarantee for the purchase of a new home or the renovation of an existing one.
- Aid for the reconstruction of small residential buildings in order to improve their energy efficiency.
- Support for families with many children to acquire, expand or renovate their homes.
- Guarantee for multi-dwelling loans to finance reconstruction works.

- Aid for the comprehensive renovation of multi-apartment buildings.
- Support for the renovation of electrical installations for the transition of the old voltage system buildings in Tallinn to a new voltage system.
- Investment aid for the installation of solar panels for apartment associations, businesses and local authorities.
- Demolition aid to local authorities for the demolition of abandoned residential and non-residential buildings.

Public buildings

- Central government should only purchase or lease buildings that meet at least the minimum energy performance requirements.
- Support measures for improving the energy efficiency of central government buildings, and support for energy-efficient local authority buildings.
- The main types of buildings owned by the central government are schools and offices, and 25% of the real estate area owned by the central government has at least a class C energy label.
- Healthcare buildings and educational (including tertiary) buildings are in the best condition. Information on the energy label for real estate owned by the central government is provided for 49% of the total area of real estate. 25% (or 200 000 m²) of the total surface area owned by the central government has an A, B or C energy label. Of the central government's rented buildings, 30% (or 230 000 m²) of the indoor air-conditioning has an A, B or C energy label.
- Support for improving the energy efficiency of central government buildings - both when renovating an existing building and when building a new one.
- Demolition aid to local authorities.
- Support for local authorities buildings in implementing energy efficiency measures.

Energy poverty - worst performing buildings

- Energy poverty is not seen as a real issue in Estonia. According to the Energy Poverty Observatory, 2.9% of households struggle with heating costs, while 6.3% are in arrears on energy bills.
- Policy measures on the worst performing segment of the building stock concern buildings built before 2000.
- To address energy poverty, a Taskforce on accessibility has been set up in the State Chancellery to ensure that the renovation of buildings is accessible to all social groups.
- It is estimated that **by 2050 up to 5 000 apartment blocks and up to 10 000 non-residential buildings will fall out of use**. To tackle the worst performing buildings Estonia offers a demolition aid to local authorities for the **demolition** of abandoned residential and non-residential buildings.

Advisory tools

- According to the **National Buildings Register** 3 200 energy performance certificates (based on consumption data) have been issued for residential buildings built before 2000.
- The **State Shared Service Centre** provides support for improving the energy performance of central government buildings – both when renovating existing buildings and when building new ones. It also provides local government with support to make their buildings energy efficient.
- There is currently no central database listing all public buildings. There is a lack of data for monitoring renovation activities. There is no data available to allow building owners and tenants to compare the energy performance of their building with that of other buildings.

Skills

- The building sector currently employs approximately 60 000 workers.

Other useful information

- The number of energy performance certificates issued on the basis of consumption data for residential buildings taken into use before 2000 (included) stands at 3 200. Class A, B or C has been awarded to only 22% of small residential buildings and 9% of apartment buildings with an energy performance certificate.

Areas for potential improvement compared to best practices

It could be useful to consider:

- specifying further funding resources (EU budget, ERDF, Cohesion Funds, further funds for National budgetary strategy) that would need to be allocated to the different measures;
- providing more specific estimates of the wider benefits of individual measures or groups of measures (including the effect on climate resilience) and how the financial instruments (other than investment grants) are going to be implemented and promoted;
- promoting energy services and ESCOs further;
- exploring further district / neighbourhood approaches;
- specifying the setting up of advisory tools such as one-stop-shops;
- developing further the explanation on smart technologies promotion.

Finland

Summary of the long-term renovation strategy

Finland's long-term renovation strategy (LTRS) is detailed and well balanced, with a strong focus on the decarbonisation of the building stock and measures to reduce the carbon footprint. It contains a clear roadmap with intermediate targets for heating energy consumption. Almost all the policies and measures have been adopted and implemented already (new binding legislation and requirements in energy efficiency renovations, voluntary agreements, incentive schemes, information, awareness raising, training and educational measures). The LTRS also includes a list of energy efficiency improvement measures for each building component/system that aim to decarbonise heating for each different type of building. The strategy has a strong focus on reaching carbon neutrality (aiming to reduce by 2050, 90% of CO₂ emissions of the building stock completed by 2020) and cutting the energy consumption of residential and non-residential buildings in half by 2050.

Information on the building stock

- Single-family and semi-detached houses include a total of 1.2 million housing units in a total of 1.1 million buildings, of which 91% are permanently occupied.
- Floor area of single-family and semi-detached houses: 166 million m².
- Floor area of terraced houses: 35 million m².
- Terraced houses include a total of 0.4 million housing units in a total of 82 000 buildings, of which 89% are permanently occupied. Less than 5% of Finns live in housing units that are in poor condition. According to energy performance certificates, 4% of all terraced houses have low energy efficiency.
- Blocks of flats include a total of 1.4 million housing units in a total of 62 000 buildings, of which 88% are permanently occupied.
- Less than 5% of the population live in housing units that are in poor condition. According to energy performance certificates, 10% of all blocks of flats have low energy efficiency. Blocks of flats are responsible for 30% of the heating emissions of the entire housing stock.
- Finland has 144 700 non-residential buildings with a combined floor area of 110 million m². They are divided into commercial buildings and transport and communications buildings (40%), office buildings (20%), buildings for institutional care and educational buildings (30%) and assembly buildings (10%).

- According to energy performance certificates, 12% of the non-residential buildings have low energy efficiency. Non-residential buildings are responsible for almost 40% of the heating emissions of the entire housing stock.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

Finland's LTRS includes specific milestones and indicators for the overall building stock energy consumption, heater, emissions, emission intensity for heating, the share of nearly zero emission building, the share of old and degraded buildings.

Year	Consumption of heating energy (gross) TWh	Consumption of heating energy (delivered) TWh	CO2 emissions (total building stock) 1 000 tCO2	Heating emissions intensity 1 000 tCO2/GWh
2020	70,9	65,1	7.809	110
2030	55,5 (-78% vs 2020)	45,7 (-70% vs 2020)	2.874 (-37% vs 2020)	52
2040	45,1 (-64% vs 2020)	33,3 (-51% vs 2020)	1.476 (-13% vs 2020)	33
2050	36,4 (-51% vs 2020)	24,5 (-38% vs 2020)	654 (-8% vs 2020)	18

- Renovation projects are expected to cut the energy consumption of residential and non-residential buildings by half by 2050 compared to heating energy consumption in 2005.
- By the currently valid binding legislation, CO2 emissions of the building stock will be reduced by 90% by 2050.
- Objective of having all buildings (residential and not residential) with an energy class C or above by 2050.
- Good maintenance to ensure the correct functioning of the building and promote the energy efficiency and indoor conditions of the property.
- Part of the main cost-effective approach highlighted is related to removing all the vacant buildings from the building stock. According to the projections, unused building stock will become more common in Finland and by 2050 only 70% of Finnish building stock will remain.

- The document also indicates that the implementation of the LTRS will lead to 12 000 person-years in the construction products industry and service industries, as well as at construction sites.
- Making the Finnish building stock highly energy efficient and carbon neutral by 2035. Coal use in energy production abandoned as of 2029 and must be replaced with bio-oil. Central government and municipalities will cease using oil heating by 2024. In residential buildings, property-specific oil heating will be abandoned by 2050. Construction companies will prepare a roadmap for the decarbonisation of the industry.

Investment needs

- Implementing the strategy will cost EUR 24 billion over the course of 30 years, or EUR 800 million per year.

Good practices

Legislative

- Municipalities and companies must improve their energy efficiency through **voluntary energy efficiency agreements**. Around 70% of Finnish municipalities (in terms of number of inhabitants) are covered by the municipal energy performance contract.
- Invoicing based on actual measured consumption is an opportunity to make savings in housing costs.

Finance / Fiscal

- In general, funding for renovation projects is available through public and private banks and international financial institutions, e.g. the Nordic Investment Bank (NIB), the European Investment Bank (EIB), and the European Energy Efficiency Fund.
- To promote building renovation and investment in new technologies, Finland offers higher **tax incentives** when the energy efficiency improvement is significantly higher than the level required.
- Banks offer loans for energy efficiency building renovation of up to a maximum of 50% of the building's market value. Leasing-based funding solutions for projects where a renovation to improve energy efficiency is paid monthly are available. Banks also support customers with **green bonds** so that companies and financial institutions can collect funding for projects that support their responsibility agenda and with **green loans**.
- EUR 100 million in energy subsidies for residential renovation projects that will result in an energy efficiency improvement significantly higher than the required level. The amount can cover 50% of the planning costs.

Public buildings

- **Central government and municipalities will stop using oil heating by 2024.**
- ESCO projects in the public sector with an **ESCO subsidy** (which will lead to higher incentives). The subsidy is 25% for companies and corporations included in the scope of the energy agreement scheme. If the ESCO project uses new technology, an additional subsidy of up to 40% is available.
- The Competence Centre for Sustainable and Innovative Public Procurement (KEINO) was established in 2018 to help contracting authorities develop sustainable, innovative public procurement.

Split incentive

- In Finland, the heating costs of rented housing units and other facilities are, as a general rule, included in the rent. The owner should keep the building and its systems in good condition to ensure that as little energy as possible needs to be used to heat the building.
- Invoicing based on actual measured consumption is an opportunity to make savings in housing costs.
- Green Lease and Light Green Lease templates to divide the investment costs and benefits between the landlord and the tenant.
- The Finnish Real Estate Federation has developed for its members ecologically **efficient agreement practices** where the property owner and tenant agree on mutually beneficial means of improving the site's ecological efficiency.

Energy poverty - worst performing buildings

- According to EU studies on energy poverty, 1.7% of Finns have had problems with keeping their homes warm enough and 1% are in danger of being affected by energy poverty.
- Buildings falling under energy classes F and G according to the 2018 legislation are considered as the worst performing building stock in terms of energy efficiency (6% of single-family and semi-detached houses, 4%, of terraced houses and 14% of non-residential buildings).
- **Energy subsidy for renovating buildings in energy classes F and G.** A renovation subsidy can also be applied for if the housing unit/residential building has humidity/microbial damage or indoor air problems.
- **Demolition subsidy** covering 90% of the demolition costs.
- Subsidies in the form of housing allowance and social assistance to cover the housing costs (water, heating bills, rent and maintenance).

7. Share of worst performing building	Indicator	Unit	2020	2030	2040	2050
Single-family and semi-detached houses	Share of F and G energy class buildings total	%	6	0	0	0
Terraced houses	Share of F and G energy class buildings total	%	4	0	0	0
Blocks of flats	Share of F and G energy class buildings total	%	10	1	0	0
Office buildings	Share of F and G energy class buildings total	%	7	2	0	0
Commercial buildings	Share of F and G energy class buildings total	%	9	3	0	0
Educational buildings and day-care centres	Share of F and G energy class buildings total	%	20	9	0	0

Smartness / Databases

- A register for energy performance certificates (EPC) is already available. The Housing Finance and Development Centre of Finland ARA maintains an EPC website which provides relevant information for a variety of stakeholders.
- Determining functional properties of smart electricity meters and **installing second generation electricity meters**.
- **Online permit services for municipalities**.
- Numerous projects to speed up the deployment of smart technologies in buildings, including the joint public-business project Kira-Digi and its successor KIRAHub.
- Centralised data exchange system for retail electricity markets to be introduced in 2022.
- Between 2020 and 2022 Finland will set up a cooperation group coordinated by the Ministry of the Environment to collect information on the built environment and identify legislation and development needs through interaction with stakeholders.

ESCOs

- Projects realised by ESCO are promoted with an **ESCO subsidy**. The ESCO subsidy can be granted to any company or corporation for an investment in regular or new technology implemented in building renovations. A higher investment subsidy (25% of investment value) is provided for municipalities that implement energy efficiency measures if the project in question is an ESCO service.

Advisory tools / Information / Education / Skills

- Finland has well-established consulting services for energy efficiency improvements. There are many initiatives to provide advice and information to owners, tenants, housing associations and public authorities on energy efficiency renovations. For example: a specific platform to communicate information about successful energy efficiency improvements; a public database on cost-effective measures for experts preparing energy performance certificates; a virtual model for implementing a renovation project that requires planning permission; and information on the impact of energy efficiency investments.
- The state-owned company Motiva Oy is responsible for information, consulting, audit templates, calculators, energy efficiency campaigns and supporting projects.
- A programme on humidity and mildew (2009-2016) that provided information and instructions on how to resolve problems in residential buildings will continue as part of a national indoor air and health programme (2018-2028).
- **General education scheme:** Basic qualifications in the construction sector taught at all levels of education, including: building physics, building materials, production techniques, real estate management and house engineering. Preparation includes an uninterrupted pathway of mathematical subjects from pre-school, primary and secondary school through to vocational and higher education. Improved cooperation between universities, polytechnics and initial vocational education.
- In preparation: production of freely accessible educational materials for use in teaching, including from the perspective of renovation and low carbon (cf. BUILD UP Skills Finland). Further development of digital education and continuous learning in order to increase renovation and energy efficiency in the building sector.

De-risking and aggregation

- Banks can offer loans to cover renovation costs up to a maximum of 50% of the building's market value.
- Leasing-based funding solutions for projects where a renovation to improve energy efficiency is paid monthly according to the leasing model.
- Issuing green bonds so that businesses and financial institutions can collect funding for projects that support customers' responsibility agenda.

Other useful information

Indicator energy classes	–1959	1960–69	1970–79	1980–89	1990–99	2000–09	2010–19	All buildings
A	0%	0%	0%	0%	0%	1%	14%	1%
B	3%	4%	5%	6%	4%	16%	80%	12%
C	8%	10%	16%	15%	15%	27%	4%	13%
D	32%	25%	27%	45%	53%	48%	1%	35%
E	45%	41%	43%	33%	28%	8%	0%	31%
F	8%	13%	6%	1%	0%	0%	0%	4%
G	4%	6%	3%	0%	0%	0%	0%	2%
Total	100%	100%	100%	100%	100%	100%	100%	100%
Floor area shares	26%	8%	13%	18%	12%	14%	9%	100%

Energy class distribution of single-family and semi-detached houses based on the number of energy performance certificates, by decade.

Indicator energy classes	–1959	1960–69	1970–79	1980–89	1990–99	2000–09	2010–19	All buildings
A	0%	0%	0%	0%	0%	0%	7%	0%
B	3%	2%	2%	1%	1%	2%	82%	1%
C	9%	22%	24%	14%	16%	42%	7%	21%
D	39%	48%	41%	38%	43%	30%	2%	39%
E	40%	25%	27%	44%	38%	27%	0%	35%
F	6%	3%	5%	3%	3%	0%	0%	3%
G	4%	0%	2%	0%	0%	0%	0%	1%
Total	100%	100%	100%	100%	100%	100%	100%	100%
Floor area shares	3%	6%	23%	31%	17%	11%	9%	100%

Energy class distribution of terraced houses completed during different decades as shares of the total numbers.

5. Share of nearly zero energy buildings	Indicator	Unit	2020	2030	2040	2050
Single-family and semi-detached houses E-value	Share of nearly zero energy buildings total	%	10	25	57	99
Terraced houses E-value < 105	Share of nearly zero energy buildings total	%	7	34	65	100
Blocks of flats E-value < 90	Share of nearly zero energy buildings total	%	10	17	47	82
Office buildings E-value < 100	Share of nearly zero energy buildings total	%	12	28	75	100
Commercial buildings E-value < 135	Share of nearly zero energy buildings total	%	12	19	83	100
Educational buildings and day-care centres E-value	Share of nearly zero energy buildings total	%	12	18	56	96

6. Share of buildings completed in the 2010s and old renovated buildings	Indicator	Unit	2020	2030	2040	2050
Single-family and semi-detached houses	Share of A, B and C energy class buildings total	%	26	50	98	100
Terraced houses	Share of A, B and C energy class buildings total	%	22	54	99	100
Blocks of flats	Share of A, B and C energy class buildings total	%	23	67	98	100
Office buildings	Share of A, B and C energy class buildings total	%	48	77	100	100
Commercial buildings	Share of A, B and C energy class buildings total	%	69	89	100	100
Educational buildings and day-care centres	Share of A, B and C energy class buildings total	%	40	57	90	100

Areas for potential improvement compared to best practices

It could be useful to consider:

- specifying further the investment needs for specific measures;
- providing more specific estimates of the wider benefits and the energy savings contribution of the measures;
- further developing the data on electro-mobility and the impact of the air quality measures.

Summary of the long-term renovation strategy

France's long-term renovation strategy (LTRS) sets out comprehensive measures to address building renovation (including regulatory requirements, fiscal and economic incentives and information). The measures are in place across all government levels, which guarantees that they are tailored to local needs. The LTRS clearly explains the overall milestones and measures to reach them. The set of measures seems promising in terms of decarbonising France's building stock, especially the legal obligation to refurbish the worst part of the building stock and the tertiary sector.

The LTRS is highly ambitious in terms of planning, objectives (-49% GHG emission of the building sector by 2030 compared with 2015; carbon neutrality by 2050) and policy measures.

Information on the building stock

- In 2013, the French housing stock included around 33.5 million homes, 27.8 million of which were main residences.
- 36% of single-family houses were built before 1948, 18% between 1949 and 1974, 30% between 1975 and 1999 and only 16% after 2000.
- 82% of the stock of single-family houses is occupied by owners, 13% by tenants (private sector) and 3% by tenants in social housing.
- 29% of multi-family houses were constructed before 1948, 32% between 1949 and 1974, 25% between 1975 and 1999 and only 14% after 2000.
- 24% of the stock of multi-family houses is occupied by owners, 42% by tenants (private sector) and 30% by tenants in social housing
- The 1948-1974 construction period saw a large concentration of low-rent social housing units; social housing accounts for almost 40% of the housing units built between 1948 and 1974.
- Single-family buildings represent 59% of the national housing stock and multi-family buildings 41%.
- The table below present the non-residential building stock, where offices, commercial premises and education establishments cover 65% of the total surface area.
- The stock of office buildings covers a total surface area of some 225 million m² in buildings of all sizes.
- The number of commercial buildings amounted to 476 546 in 2011.
- The total surface area of education buildings amounts to 168 250 965 m². This area is mainly occupied by primary schools (écoles) and lower secondary schools (collèges), which cover a total of 110 641 994 m², or 66% of the total floor surface of the stock of education buildings.

- 190 000 dwellings have been renovated to low-energy building standard over 10 years (98% of which are apartments). Such renovations have steadily increased since 2013. In 2018, more than 30 000 dwellings were renovated to low-energy building standards.
- In the tertiary sector, a total surface area of 3.7 million m², have been renovated to low-energy building standard.

Sector	Millions of m ²	% of building stock
Offices	225	23%
Hotels and restaurants	65	7%
Commercial premises	212	22%
Education	188	19%
Communal residences	70	7%
Health care	115	12%
Sport, leisure and culture	72	7%
Transport	25	3%
Total	973	100%

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

Year	Final energy consumption compared to 2010 (ktoe)	
	Residential	Tertiary
2030	-22%	-40%
2040	-23%	-50%
2050	-41%	-60%

- For the residential and tertiary sector, France's national carbon strategy aims for:
 - carbon neutrality by 2050; and

- a 49% decrease in building sector greenhouse gas emissions by 2030 compared to 2015.
- These targets are based on a 22% reduction in energy consumption in the building sector by 2030, 29 % by 2040, and 41% by 2050, compared to base year 2015.
- Tertiary sector: a target of reducing energy consumption by 40% in 2030, 50% in 2040 and 60% in 2050.
 - 190 000 dwellings and 3.7 million m² of tertiary buildings have been renovated to the low-energy ‘BBC’ standard over 10 years.

Good practices

Legislative

- A **standardised technical sheet for energy performance contracting services** (CPE services) was created at the end of 2018 to encourage the use of energy performance contracts for new installations.
- From 1 January 2022, energy performance certificates and tenancy agreements will have to include information on the **actual energy** consumption of dwellings expressed in primary and final energy, and an estimate of the theoretical amount of energy expenditure.
- **Carbon pricing**, including proposing a minimum price for carbon that is harmonised at European level.
- **New environmental rules for buildings** (including a minimum level of heat from renewable sources; a greenhouse gas emissions criteria that applies to a building’s entire life-cycle; and a higher energy performance requirement, which also considers ‘summer comfort’).
- The factor for the conversion of final energy into primary energy from electricity will be set at 2.3, corresponding to the average calculation over 50 years.
- The emission factor for electricity will be determined by the monthly method by use, which leads to a value of 79 gCO₂/kWh for electric heating.
- A **reduced rate of VAT**: 5.5% applied to energy renovation works (supply and installation) in properties over 2 years-old;

Finance

- Staged renovations are addressed by the ‘bâtiment basse consommation [BBC] compatible’ concept, which certifies that each renovation lot is compatible with an overall renovation roadmap leading to a NZEB.
- Several national and regional programmes and initiatives entail staged renovations that are monitored under the **Effinergie initiative** (see <https://www.effinergie.org/web/bbc-par-etapes>).
- **Energiesprong.fr** which aims to roll-out major renovations works.

- Simplify aid for people in France by making the **tax credit on a flat-rate basis** and adapting the existing zero-rate eco-loan.
- Co-financing through **MaPrimeRenov** and the **SARE** programme (accompanying service for energy renovation), diagnosis (F or G performance diagnostics) for households with low income owners in particular, and support for overall renovations.
- Maintain incentives for individuals to **move away from oil heating by 2028** towards renewable heating installations, such as heat pumps, boilers biomass, combined solar systems or a connection to a renewable heating network.

Public buildings

- Encourage a massive renovation of public buildings by mobilising EUR 4.8 billion.
- A comprehensive set of policies for the public sector, comprising city renovation plans, an open data list of public buildings' energy performance and technical features, regulatory measures (banning of oil boilers) and financial support.
- The 2018 renovation plan has a specific energy consumption reduction objective for the public sector: the State should aim to reduce its stock energy consumption by 15% by 2022 compared with 2010.
- Obligation to **ban oil heating in public sector buildings by 2030**.
- A dedicated **taskforce for school renovation** is to be put in place. Educational premises represent around 50% of the public building stock and account for 30% of total consumption.
- Financing tool for building renovation by regional authorities: as part of the Grand Plan d'investissement 2018-2022, EUR 3 billion is available to local and regional authorities in order to renovate the energy systems in their own buildings.

Energy poverty - worst performing buildings

- 11.6% of people in France are living in energy poverty.
- 15% of the French population stated that they suffered from the cold for at least 24 hours in the winter of 2017; for 4 out of 10 households, this was due to poor insulation.
- 572,440 households were subject to action on the part of an energy supplier (power reduction, disconnection or termination of contract) in 2018 for unpaid energy bills.
- The proportion of households living in energy poverty in metropolitan France as measured by the expenditure indicator fell between 2013 and 2017 from 14.5% to 11.6%, i.e. by 3.3 million households comprising 6.7 million individuals.
- The percentage of households stating that their gas and electricity bills account for a large share of their household expenses rose from 55% to 65% between 2016 and 2018.
- A very comprehensive set of measures to address energy poverty has been put in place, including an energy efficiency obligation scheme, advice and financial support.

- Creation of a **guarantee fund** of more than EUR 50 million to help 35 000 low-income households per year.
- For the stock of private housing and for the lowest income households, the **Habiter mieux ('Better living')** programme of the National Housing Agency (ANAH) has been operating since 1 January 2018. Its ambitious target to renovate 75 000 dwellings by 2022 was actually achieved in 2019.
- Policies to address the worst performing segment of the building stock are in place, most notably a renovation obligation which will come into force in 2023. The obligation is part of the revised energy and climate law. It includes the following measures:
 - Rent calculations and property estimates will be done upon completion of renovation measures which remove the building from the 'thermal sieve/passoire thermique' category (term used to designate worst performing buildings, i.e. classes F and G) by 1 January 2021. This will ban worst-segment property owners from increasing the rent between two lettings without undertaking energy renovations.
 - Energy performance diagnostics and rental contracts for housing must include information on the actual primary and final energy consumption of housing, and an estimate of the theoretical amount of energy expenditure by 1 January 2022 at the latest.
 - An obligation to display the theoretical amount of estimated energy expenditure in property advertisements by 1 January 2022 at the latest.
 - Finally, an **obligation to renovate these dwellings**. From 1 January 2023, energy performance will become a criterion for assessing the decency of housing. From this date, dwellings whose final energy consumption exceeds a certain threshold, defined by decree, may no longer be rented out.
 - **From 1 January 2028, all dwellings with excessive energy consumption will have to be renovated.**
- The **energy tax** base has been extended to 20% of households with the lowest incomes. This will make it possible to extend the distribution of the energy voucher to 2.2 million additional households, i.e. 5.8 million households in total. The tax credit for the energy transition (CITE), and the successor premium, will also be made more effective thanks to the introduction of a new flat rate in 2020.
- Dedicated **energy saving certificates** to benefit low-income households by offering basic measures for EUR 1.
- New **grants** for low/very low income households and subsidised energy audits.
- **Interest-free eco-loans** including for people living in social housing. The aim is to provide individual eco-loans for 35 000 low-income households a year by 2021 and 6 500 loans to building management bodies by 2021 (for multi-family buildings).
- The **National Observatory of Energy Poverty (ONPE)** monitors energy poverty using an annual scorecard and also acts as a think tank on policy solutions.

Advisory tools

- A **national renovation observatory** has been put in place and will monitor the following indicators: ‘renovation equivalents’ per year; annual energy consumption of existing building stock; share of building stock per energy performance class (annual monitoring); and share of building stock per heating system.
- The **FAIRE** (‘Faciliter, Accompanyer et Informer pour la Rénovation Energétique’) network run by ADEME, ANAH and ANIL is a one-stop-shop comprising 1000 experts/450 contact points. The network includes building and real estate professionals, NGOs, local and regional authorities and energy companies who work together to identify relevant solutions for household renovation and to help households put them in practice by increasing their confidence and knowledge, including on how to access funding.
- Regional and local advisory one-stop-shops.

Skills

- The government has put in place a comprehensive set of **skills and education programmes** in the construction sector. For example, ‘Massive open online courses (MOOC)’ for renovation experts which lead to certified qualifications (see <https://www.mooc-batiment-durable.fr>).
- Better training of professionals and better control of the quality of work by reforming the RGE label (recognised as the guarantor of the environment), investing EUR 30 million in the training of professionals and EUR 40 million in innovation.

Digitalisation

- New digital tools designed to collect and process data on housing stock can now be used as a basis for energy renovations.
- The French government is **planning to install a digital logbook** for building renovations and to exploit the data on housing. This logbook will be a secure online service to improve knowledge on accommodation. It aims to provide information to and gather information from successive users in order to: encourage work to improve energy performance and provide targeted information to owners on what to do in the event of equipment failures and on the support available and on how to better manage their building to improve energy consumption. It will also be a useful source of information for professionals in need of renovation or energy improvements. It therefore aims to reduce energy poverty.

Multi-family buildings

- The stock of multi-owner buildings in France comprises 6.9 million primary residences, that is to say 28% of all dwellings in France, located in some 617 000 buildings.
- **3 Energy-saving certificate programmes** have recently been launched to multiply awareness-raising efforts, and provide training and coaching for multi-owner building stakeholders in energy renovation:

- CEC, at a cost of EUR 3 million, which is developing a coaching scheme for homeowners and management bodies of multi-owner buildings to promote energy renovation;
- RECIF, at a cost of EUR 2.8 million, which is conducting a major campaign to stimulate demand, managed regionally and implemented locally;
- ETHEC, at a cost of EUR 1.4 million, which targets multi-owner buildings in town and city centres undergoing revitalisation.
- 2 Energy-saving certificate programmes focus on awareness-raising and training for professional building management bodies:
 - ACTIMMO, at a cost of EUR 5.75 million, which is developing a standardised awareness-raising tool for professional building management bodies;
 - Expertise rénovation copropriété ('Expertise in the renovation of multi-owner buildings'), at a cost of EUR 5 million, which implements awareness-raising and training measures for professional building management bodies and offers an online training module in energy renovation for co-owners (at www.coprosvertes.fr).
- These programmes will mobilise almost EUR 18 million in energy-saving certificates between now and mid-2021.

Areas for potential improvement compared to best practices

It could be useful to consider:

- Investments needs and budgetary resources could be defined in more details;
- providing more specific estimates on the wider benefits and energy savings contribution of the measures.

Germany

Summary of the long-term renovation strategy

Germany's long-term renovation strategy (LTRS) sets out comprehensive measures to address building renovation. It comprises a balanced mix of regulatory requirements, fiscal and economic incentives and information. Fiscal support and energy advice measures have been especially stepped up and refined to address different target groups. The measures are in place across all government levels, which guarantees that measures are tailored to local needs. A quantitative milestone is set for 2030, whereas the milestones set for 2040 and 2050 are qualitative. The LTRS has no concrete budget allocation.

Information on the building stock

- The housing stock in Germany comprises around 19 million buildings with almost 40 million dwellings. This total includes around 14 million single and two-family houses with around 9 million dwellings, and around 5 million apartment blocks with almost 21 million dwellings.
- There are more than 1 million dwellings in non-residential buildings. In 2018, nearly 287 000 new homes were completed in Germany.
- New construction accounts for just over 0.5% of the housing stock.
- 26% of residential buildings were built before 1948, of which almost half (13%) were built before 1919.
- Between 1949 and the first regulation from 1977, which set minimum energy efficiency requirements (First Thermal Protection Regulation (WSVo)), around 7 million buildings were erected. This means that around 64% of the current housing stock was built before energy efficiency standards became mandatory. A further 3.6 million buildings (20%) were erected before the Third Thermal Protection Regulation in 1995. By 2002, a further almost 2 million residential buildings (10%) were erected. The First Energy Conservation Ordinance (EnEV, 2002) has been in place since 2002. Since then, more than 1 million new residential buildings have been erected (6%).
- Germany has at least 3.5 million non-residential buildings, with an estimated net floor area of 2.35 billion m².
- Germany's cities and municipalities have around 175 000 non-residential buildings.
- The energy performance of buildings improved by more than 25% between 2008 and 2018. Greenhouse gas emissions in the buildings sector were reduced by around 42% between 1990 and 2019. The share of renewable energy in final energy consumption for heating and cooling was over 14% in 2018.

- In 2018, construction permits were granted for the refurbishment or construction of around 340 000 housing units, and around 282 000 housing projects were completed. New construction accounted for around 302 000 of the permits, i.e. around 89% of the 340 000 housing units. In 2018, new construction projects with around 90 000 housing units were funded under the ‘energy-efficient construction’ programme of the Kreditanstalt für Wiederaufbau (KfW) as part of the CO2 building refurbishment programme.
- In 2018, KfW’s ‘Energy-Efficient Refurbishment’ support programme improved the energy efficiency of around 270 000 housing units. Energy-efficient construction unlocks potential for economic solutions. In the field of renewable energy for heating, the installation of approximately 50 000 renewable heating installations, mainly in residential buildings, was supported in 2018 under the ‘Renewable Energy in the Heating Market Incentive Programme’ (MAP).

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

- Germany aims to reduce the greenhouse gas emissions from its building stock to 70 MtCO₂eq in 2030 (according to its Climate Protection Act), which represents a 67% reduction compared to 1990 (210 MtCO₂eq).
- It also aims to reduce non-renewable primary energy consumption (PEVn.E.) by 2030 to 2 000 PJ (556 TWh). The indicative milestone corresponds to a reduction in PEVn.E. of around 55% as compared with the base year 2008 (4 400 PJ). In 2018, when PEVn.E. was around 3 300 PJ, a reduction in PEVn.E. of around 25% was already achieved as compared with 2008.
- Germany has increased its intended contribution to the European 2030 energy efficiency targets in the heating and cooling sector by 30% as compared with 2008 and by 27% for the share of renewables.
- Germany can at this stage only provide a qualitative description of its indicative milestones for the building sector after 2030. Germany will continue to push for a steady and substantial increase in energy performance beyond 2030. A continued dynamic impact, in particular the measures and instruments adopted last year under the 2030 Climate Change Programme, will increase the potential for significant gains in energy performance. This can be expected to be reinforced by the upcoming investment and renovation cycles in the building stock in the coming years, which will be used to implement energy efficiency, renewable energy, sector coupling and decarbonisation of energy supply and to exploit cross-sectoral synergies such as electro-mobility. Innovation and digitalisation, as well as important achievements from energy research that will be brought into the market, also have the potential to generate further positive effects on energy performance. In addition, the right incentives will further increase the potential for cost reduction in energy performance.
- From 2030 onwards, the refurbishment rate (full refurbishment equivalent) is around 1.3% to over 2% for single and two-family houses and around 1.5% to over 2% for apartment blocks.

Investment needs

- Only 2018 investment figures are reported: EUR182.2 million was given as grants, triggering investment of EUR 734 million.
- The CO2 building renovation programme has generated a total of around EUR 385 billion of private investment since 2006 and the MAP has generated more than EUR 20 billion since 2000. In order to refinance the loans granted to the beneficiaries under the CO2 building renovation programme, KfW issued 'green bonds' for the first time in 2019 for sectors of the programme ('energy-efficient construction').

Good practices

Legislative

- Trigger points are clearly identified (i.e. change of ownership, technical/economic point in time of replacement of a building component, complete refurbishment etc.) together with renovation obligations that come into force once a trigger point is reached.

Finance

- Public funding to leverage additional private investment is largely in use via several dedicated support schemes run by **BAFA and KfW**. The funding schemes will be transformed into an umbrella instrument to have a clearer trademark and simplified access to finance.
- **Tax support for energy renovation measures in owner-occupied homes:** A key measure in the buildings sector is the tax support for energy renovation of buildings, which was introduced on 1 January 2020 to complement existing support schemes. The tax incentive can be used as an alternative to the existing loan and grant schemes in the buildings sector. Support will be given for individual measures in owner-occupied housing that are also considered eligible under the existing building support programmes. This includes the replacement of heating in particular, but also the installation of new windows or the insulation of roofs and external walls. Support may also be provided for comprehensive remediation, if necessary on a step-by-step basis, through several individual measures. Eligible costs include 20% of the investment costs and the costs of issuing the certificate (that needs to be submitted to the tax office in order to grant the tax reduction), and 50% of the costs of an energy consultant to carry out the energy planning and supervise the eligible measures. Support will be provided through a deduction from tax liability spread over 3 years, e.g. when replacing old windows with modern thermal windows. By offsetting the support against the fixed tax liability without any progression, as many owners of residential buildings as possible can benefit from the measure.
- **CO2 - Federal government reconstruction programme:** The programme will support the long-term renovation strategy for buildings by supporting energy-efficient construction and renovation programmes administered by the **KfW**. The programme is the same size as the volume support instrument (2016-2017 budget: EUR 2 billion for each year). Energy efficiency measures in the building sector carried out using subsidised loans will be supported in part with repayment grants or, alternatively, investment grants.

- The **market incentives programme** (MAP) supports installations for the use of renewable energy for the production of heat and cooling, as well as certain heat storage facilities and local heating networks, both in residential and non-residential buildings. This means that almost exclusively installations in the building stock are eligible for support, and only in exceptional cases of installations in new buildings. The programme consists of two support parts. For smaller plants, the Federal Office of Economics and Export Control (Bundesamt für Wirtschaft und Ausfuhrkontrolle, BAFA) provides investment grants. Solar collectors, biomass plants and efficient heat pumps are eligible for support here. For larger plants, the Federal government grants aid under the KfW renewable energy programme 'Premium' in the form of pro rata loans for soft loans. This part includes large solar thermal, biomass (kraft) works, large efficient heat pumps, biogas lines, deep geothermal plants, local heat networks for renewable heat, and large heat reservoirs for renewable heat. The MAP currently has an annual budget of around EUR 320 million.
- **Incentive Programme for Energy Efficiency (APEE):** The MAP support has been strengthened through the introduction of the Energy Efficiency Incentive Programme (APEE). This includes three investment areas: (1) installation of ventilation systems (ventilation package) combined with a renovation on the building envelope in order to avoid construction damage (among others), (2) the replacement of inefficient heating through efficient heating (heating package), (3) the placing on the market of nuclear fuel cell heating in new buildings and existing buildings. The aid will be granted through a grant for stationary fuel cell heating with an electrical capacity of 0,25 to 5.0 kW through the KfW.
- **Carbon pricing:** The Fuel Emissions Trading Act (BEHG) entered into force in December 2019. From 2021, the Federal government introduced carbon pricing for the transport and heat (non-ETS) sectors. The national emissions trading system (ETS) covers emissions from the combustion of fossil fuels (in particular fuel oil, liquefied petroleum gas, natural gas, coal). In the heating sector, the system covers the emissions of heat produced by the building sector and energy and industrial installations outside the EU ETS. The CO2 price would be EUR 25 per tonne as of January 2021 and then gradually increase to EUR 55 in 2025. For 2026, a price corridor of a minimum of EUR 55 and a maximum of EUR 65 shall apply.
- The Federal government will promote the **industrial pre-production of façade and roof elements and a standardised installation of plant technology**, including the supply of self-generated electricity, in conjunction with new investment and contract models. The serial approaches developed as part of the pilot projects carried out will be put into practice by means of a newly adopted support programme from the end of 2020. Serial refurbishment of apartment blocks' with funding from the BMWi and with the involvement of the Dutch initiative '**Energiesprong**'. For the next three years, however, the focus will be on the stock of housing companies (mostly apartment blocks).
- **Support programme for heating optimisation (HZO):** The support is up to 30% of the net investment costs for services related both to the replacement of heating and hot water circulation pumps with high-efficiency pumps and to hydraulic balancing, however with a maximum of EUR 25 000. The measure must be carried out in an existing building or on an existing heating system (measures in new

buildings are not eligible). Each eligible measure may be applied for once only per heating system. It is appropriate to combine measures, implement them together and apply for them once.

- The **‘Energy-efficient urban redevelopment’** support programme invests in comprehensive energy efficiency measures in buildings (indirectly) and supply infrastructure (heat/cooling/water/sewage) in residential areas. It aims to stimulate energy efficiency in the municipal sector. In addition to the planned continuation of the ‘Energy Urban Renovation’ programme, new funding measures will be developed in 2020 or existing ones will be improved. The grant scheme will, in particular, take greater account of environmentally-friendly mobility concepts, inter-municipal concepts, heat network planning measures in remediation management concepts and concepts relating to mixed neighbourhoods (combination of new buildings and existing buildings).

Public buildings

- The Federal government has adopted a comprehensive **‘Energy efficiency strategy 2050’** (EffSTRA), which also addresses the buildings sector. This strategy integrates a wide range of energy efficiency measures for 2021-2030 into the new national energy efficiency action plan (NAPE 2.0). It also takes into account the measures in the 2030 climate action programme.
- **New central government buildings need to meet the lowest KfW efficiency standard** (EH 40) from 2022 and renovations need to meet the second-lowest KfW standard (EH 55). A KfW programme grants subsidies to municipalities and a national climate protection initiative promotes municipal climate protection concepts.
- The **Federal government/länder dialogue contracting** project will provide a platform for intensive energy saving contracts to be set up between the Federal government and the länder. The project aims to remove barriers to energy-saving contracting and to develop regional competences in this area. Its activities will include annual plenary sessions and workshops, a mentoring scheme and the exchange of best practice. Support will also be given to develop regional centres of excellence.
- Municipalities can form a network to improve their energy and/or resource efficiency. Together they can identify and implement savings by supporting a network of teams. Municipalities and municipal companies can also get a qualification to carry out energy renovation in their own building stock.
- **Energy-efficient procurement by public institutions** is compulsory under the Public Procurement Regulation (Vergabeverordnung) and all public contributors to pan-European tenders are bound by it. The regulation stipulates that the highest performance level for energy efficiency and - where available - the highest energy efficiency class, will be required when energy-related products are procured or are essential for providing a service. Energy efficiency must also be an evaluation criterion when determining the most economical bid.

Energy poverty – worst performing buildings

- The worst performing segment of the national building stock (which includes 30% of the total dwelling space) is clearly identified (i.e. buildings in G energy class, consuming more than 200 kWh/m²). 54% of heated non-residential buildings have a final energy demand of 200 kWh/m² or more and 18% of buildings even have an energy demand of more than 700 kWh/m² of energy.
- Measures to address inefficient buildings and energy poverty include:
 - KfW subsidies for heritage-protected buildings;
 - a requirement under the Energy Conservation Act to ensure a minimum level of energy efficiency if renovation is carried out and to exchange the combustion unit after 30 years;
 - a requirement under the German Federal Emission Control Act for chimney sweeps to monitor heating system emissions;
 - a requirement for heating systems to display a label with their efficiency class;
 - Federal support for energy advice from consumer centres;
 - an energy savings check;
 - a housing allowance (as part of the overall social welfare payments).

Smartness

- An energy research programme that emphasises digitalisation, energy system integration, and district/decentralised supply structures in buildings.
- Federal funding for the **Smart Meters** pilot programme.
- The ‘EnEff.thof.2050’ initiative promotes lighthouse projects that demonstrate innovative technologies and approaches to achieve low-carbon buildings and neighbourhoods. They should help make the entire building stock almost climate-neutral by 2050. Eligible projects may involve developing key technologies (including small parts developed by the sponsor) and procedures for new buildings or the renovation of existing buildings (‘innovation projects’). Projects involving ambitious ‘model’ buildings and neighbourhoods (‘transformation projects’) can also be supported.

Split incentives

- Germany already has a number of **rental law** instruments targeting ‘split incentives’
- Since 1 January 2019, annual rent can only be increased by 8% and this increase should be purely due to modernisation costs. The rent increase after modernisation can apply for an unlimited period of time. In other words, the property owner is not bound by the standard rent increase limit that otherwise applies.
- Current rental law allows the property owner to pass the cost of energy-efficient refurbishment on to the tenant. Ideally, the increase in ‘cold rent’ and reduced operating costs are in balance, making it possible to achieve ‘warm rent’ neutrality.

ESCOs

- The LTRS lists a number of mechanisms (contracting support programme for municipal level ‘EBK’), blueprint ESCO/EPC contracts, federal government-level dialogues on use of ESCO/contracting, model projects for enhanced EPC contracts. The Federal Agency for Energy Efficiency is responsible for promoting the energy service markets and overcoming barriers to ESCO/EPC deployment. The website of the Federal Energy Efficiency Agency provides information on contracting model contracts and guidelines on energy-saving contracting available free of charge. This includes offers specifically aimed at public properties or local authorities.
- As part of the federal/regional dialogue on contracting, around 10-15 forms of contracting for ‘model’ projects in representative sites at local and land-level will be demonstrated to show the potential of contracting and thus help establish a functioning ESCO market in Germany. The pilot projects will also be an opportunity to train key actors and to develop standards and guidelines for similar projects.

Advisory tools

- A comprehensive set of advisory services that are broadly tailored to different needs (energy poverty, residential, SMEs, industry, etc.). They also give advice on access to financing.
- A **digital one-stop-shop is planned** to consolidate the existing information in a transparent manner.
- The individual **building renovation passport (iSFP)** takes into account the added value of energy renovation of residential buildings in the energy advice for residential buildings. iSFP assists the energy consultant in drafting the advisory report. At the end of the consultation, the client will receive a iSFP tailored to them and their building. iSFP is financially supported through the energy advice for residential buildings (on-site advice, building renovation passport) with up to 80% of the consultancy costs incurred through a grant.
- The subsidy programmes run by BAFA and KfW are available in an online database, which will be central to a future ‘digital one-stop-shop’.
- Since 2017, Germany has also introduced an optional, building renovation passport together with an 80% subsidy for issuing it. Subsidised, optional individual building roadmaps for non-residential buildings were introduced in 2016.
- Energy advisory services for residential buildings are available to owners (private property owners, housing associations and communal housing associations). A qualified energy advisor examines the property and prepares a comprehensive energy advisory report which includes the funding per programme and the consultants’ individual possibilities.
- With the ‘**Refurbishment configurator**’ service launched in 2012 (<https://www.sanierungskonfigurator.de/start.php>), building owners and tenants can learn about possible refurbishment measures for their building, their cost and savings potential and state support programmes on a dedicated website of the Federal Ministry of Economic Affairs and Energy.

- Concise initial advice for private households is provided by the Federation of German Consumer Organisations (Bundesverband der Verbraucherzentrale Bundesverband e. V. (vzbv)) and financially supported by the Federal Ministry of Economic Affairs.
- A statistically-verified pool of data will be created in Germany over the next few years using a consolidated data collection concept and will be updated regularly.
- Many information campaigns are also under way, such as the ‘**Germany Does It Efficiently**’ campaign.

Training - Skills

- Current practices are reported for training and providing qualifications for experts, energy consultants, craftsmen, etc.

Areas for potential improvement compared to best practices

It could be useful to consider:

- providing a quantitative description of milestones for 2040 and 2050;
- specifying further the set of indicators to track progress;
- further detailing budgetary resources to support the implementation of proposed measures;
- providing more specific estimates on the wider benefits.

Summary of the long-term renovation strategy

Ireland's long-term renovation strategy (LTRS) sets out a comprehensive set of measures to address building renovation. Its indicative milestones are based on those set out in the Climate Action Plan and National Energy and Climate Plan that focus on reducing CO2 emissions in the built environment by retrofitting existing residential, public and commercial buildings. More specifically, the LTRS aims to reduce CO2 emissions from the built environment by 40-45% relative to 2030 projections by retrofitting 1 500 000 buildings by 2050 with an indicative 2030 target to retrofit 500 000 homes to EPC level B2.

The LTRS clearly describes the building stock and the existing and planned policy measures to retrofit and improve the energy efficiency of the building stock, but it does not provide full details on the budget allocation.

Information on the building stock

- There are approximately 1.7 million occupied residences in Ireland. The vast majority of residential buildings in Ireland are single-family houses. Only one in eight dwellings in Ireland is an apartment or part of a multi-residential unit.
- There are 124 000 buildings in the commercial and public sector with the largest numbers being offices and retail outlets.
- The building stock includes approximately 15 000 public sector buildings.
- There are currently over 45 000 protected structures. 18% of dwellings fall into the traditionally built category.
- Irish homes use 7% more energy than the EU average, and are 70% reliant on fossil fuels, including oil-fired boilers.
- Over 80% of homes and other buildings have an EPC of C or worse.
- The majority of existing housing stock is energy inefficient, with only 0.4 to 1.2% of the stock being renovated each year.
- More than one-third of Irish dwellings are in rural areas and 93% of these dwellings are either detached or semi-detached.
- Ireland has high levels of privately-owned single-family dwellings which makes the retrofitting aggregation more challenging. Approximately two-thirds of residential buildings in Ireland are owner occupied.
- Ireland has the youngest dwelling stock in the EU. Approximately 16% of the residential building stock was built before 1940. A further 15% of the current housing stock was completed before 1970, and has little or no insulation.
- There is a gradual increase in the share of electricity and gas and a gradual, decline in coal, peat and oil use.

- Oil remains the dominant fuel in the residential sector (39% in 2005, 38% in 2018). Electricity is the second largest source of energy (25% in 2018) with natural gas having the next largest share (22% in 2018). The renewables share of final energy used directly in households was 2.5% in 2018 which does not take into account the renewable share of electricity used.
- Over 2007-2014, residential energy use declined by 18%, returning to growth in 2015- 2016, falling again in 2017, and growing again in 2018. The emissions of energy-related carbon per dwelling fell by 39% over 2005-2018.
- Dwellings built in 2015-2019 were considerably more energy efficient than in earlier periods, with 97% of them receiving an EPC A compared with 36% in 2010-2014 and 1% in 2005-2009.
- The installation of oil boilers has fallen from 36% to 4% in new dwellings, and electrical systems (primarily heat pumps) make up 44% of heating systems in new dwellings with this percentage growing steadily each year.
- New buildings require 90% less energy than an equivalent dwelling built in 1978.
- Since its introduction, more than 400 000 households have received government grant support under the better energy programme. The focus since 2017 has been on more in-depth renovation.
- A limited number (around 3% of non-residential and public sector buildings) have been upgraded using support schemes.
- District heating and cooling in Ireland is at a very low level and is estimated to be less than 1% of heat consumption.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

- Ireland's climate action plan sets out a detailed roadmap for 2021-2030 to reduce CO₂eq from the built environment by 40-45%.
- In the residential sector:
 - Retrofitting 500 000 homes to an EPC B2 or cost-optimal equivalent or carbon equivalent by 2030 (average 50 000 homes each year). It is expected that it will be necessary to retrofit 1 million houses by 2040 and 1.5 million by 2050.
 - Local authorities upgrading their housing stock under Phase 2 of the social housing retrofit programme to bring dwellings up to an EPC B2 or cost-optimal equivalent;
 - Installing 600 000 heat pumps (400 000 in existing buildings).
- In the commercial and public sectors at least one-third of total commercial premises upgraded to EPC B.
- It is projected that approximately 355 000 new dwellings will be constructed to an EPC level A by 2030.

Number of Residential Buildings Expected to be Retrofitted to BER B2 per Annum (or carbon equivalent)	
Year	Heat Pumps in Residential Buildings
2021	13,000
2022	33,500
2023	55,000
2024 - 2030	56,215 each year

NECP Projected Energy Efficiency Savings		
Primary Energy Savings (GWh)	2020	2030
Industry	3,564	6,032
Residential	8,436	23,662
Business	8,918	21,166
Transport	1,839	6,859
Cross sectoral	2,347	4,451
Total Savings	25,103	62,171

Investment needs

- The Irish government has approved a national development plan that has allocated funding of EUR 4.5 billion to support energy efficiency improvements across the residential and public sector.
- Increase the price of carbon to EUR 100 per tonne by 2030.

Good practices

Legislative

- **Advanced performance requirements** in the current regulations combined with a mandatory renewables requirement, creating a rapid transition to low-carbon heating systems in new dwellings.
- A **Retrofit taskforce** with cross departmental and agency membership has been established to oversee the design and development of a new retrofit delivery model for the residential sector (supported by stakeholder engagement).
- Further regulation from 2022 will effectively **phase out further installation of oil boilers from 2022 and the installation of gas boilers from 2025 in all new dwellings**.
- An enhanced **EPC advisory report** will be introduced in 2020 and will be provided when a new EPC is obtained.
- Exploring the potential use of **tax incentives** to stimulate the demand for residential energy efficiency improvements.
- A **Code of practice** for the energy-efficient retrofit of dwellings was published in 2014 by the National Standards Authority of Ireland.
- **Retrofit guidance** for traditionally built buildings (in development).
- A guidance document for traditional buildings is being prepared for building professionals, particularly specifiers and installers.

Finance

- A range of government support and grant schemes is in place and is continuously reviewed and redesigned to ensure alignment with government objectives and value for money.
- The **Better Energy Homes** scheme provides grant aid to private homeowners who wish to improve the energy performance of their home.
- The **Deep Retrofit pilot programme** was carried out to establish how best to support deeper levels of renovation in the residential sector, and to gain practical experience on how to develop residential energy efficiency offerings at scale post-2020.
- The **Climate Action Fund** supports initiatives that help Ireland achieve its climate and energy targets in a cost-effective way.
- Accelerated Capital Allowances allow businesses to reduce their taxable profits in line with the amount they spend on energy efficiency.
- The **Support Scheme for Renewable Heat** supports the replacement of fossil fuel heating systems for commercial, industrial, agricultural, district heating and other non-domestic heat users in the non-ETS sector.
- The EXEED programme, launched in 2017, incentivises and facilitates energy efficiency in businesses.

Public buildings

- The building stock includes approximately 15 000 public sector buildings.

- The energy efficiency improvement of each public sector body is monitored annually through the monitoring & reporting system operated by SEAI to which each public sector body is legally required to report. Good progress has been made on energy efficiency, with a 27% improvement achieved by the end of 2018 through a combination of behavioural measures, improved energy management and renovation. In the coming years the system will be extended to include a mechanism to monitor compliance with the rule to display energy certificates. Public sector bodies that make savings as a result of their energy efficiency efforts can keep those savings within their organisational budgets.
- A new programme was approved that commits to reduce overall greenhouse gas emissions by an average of 7% per year from 2021 to 2030 (a 51% reduction over the decade) and to achieve net-zero emissions by 2050.
- The **Public sector energy efficiency strategy** includes an associated support programme for public bodies.
- A number of **Pathfinder partnership programmes** that focus on energy efficiency retrofit improvements in schools, central government and higher education buildings, have been put in place.
- Ireland benefits from EU support under the structural reform support service (SRSS) to develop a comprehensive public sector building upgrade programme.
- Under Irish legislation, public sector bodies can only enter into new rental or leasing agreements for private sector buildings if they have an EPC of at least A3 (with exemptions allowed in limited circumstances).

Energy poverty - worst performing buildings - social housing

- Alleviating energy poverty is an important policy goal and a key benefit of retrofitting in the residential sector. The **Better Energy Warmer Homes scheme** has been in place since 2000. The scheme provides free energy efficiency upgrades to homes where the householder receives a social welfare payment. The scheme has upgraded more than 142 000 homes since 2000.
- The **Warmth and Wellbeing pilot scheme** provides energy efficiency improvements to the homes of older people and children living with chronic respiratory conditions.
- The Department of Housing, Planning & Local Government is currently funding an ambitious programme by local authorities to insulate and retrofit the least energy-efficient social homes (launched in 2013 and carried out under Phases 1 and 2).
- The same department is working closely with the Department of Communications Climate Action and Environment, Midlands local authorities and SEAI on a pilot retrofitting programme for social housing upgrades, with an allocation of EUR 20 million (from the increased carbon price).

Smartness

- Mechanical electricity meters will be replaced in every house in Ireland by 2024 under the EUR 1.2 billion National Smart Metering programme.
- For public sector bodies, the Office of Public Works has been running the state-wide staff energy conservation campaign ‘Optimising Power at Work’. Every participating building has been fitted with energy monitoring equipment that automatically records electrical and thermal energy usage every 15 minutes.

Split incentives

- An expert advisory group (comprising representatives from relevant government departments, the SEAI, and the Residential Tenancies Board), established in 2019, compiled a range of possible measures that could help to address the problems. Key measures emerging from the public consultation include the right tax incentives, grants, technical support and appropriate regulation.

Energy Communities - Local dimension

- The establishment of over **250 Sustainable Energy Communities** has led to significant success in encouraging local actors.
- The **Better Energy Communities scheme** supports community-based partnerships to improve the energy efficiency of the building stock in homes, schools, community buildings, business premises and energy-poor homes.

ESCOs

- The ESCO market is in its infancy and a number of measures are recommended to promote (e.g. guidelines, template contracts, grants, fuel tax). EPC in the public sector.
- The SEAI supports the wider deployment and use of EPCs by helping build capacity and providing expertise.

Advisory tools

- The SEAI Behavioural Economics Unit, established in 2017, focuses on encouraging homeowners’ and business’ energy behaviour.
- A **network of one-stop-shops will be promoted** by the Retrofit Taskforce.
- Ireland is piloting a **Building Renovation Passport** scheme.

Training - Skills

- The SEAI Energy Academy has developed **free online training modules** for general use and for SMEs to help them identify and pursue energy efficiency opportunities including renovation (see <http://www.seaienergyacademy.ie/>).

- Training programmes that cover energy efficiency and the installation of energy efficiency products are available from the national training body SOLAS, the Education & Training Boards and from various Universities and Institutes of Technology, along with private sector training providers, accredited by a variety of national and international bodies.
- The SEAI also supports relevant professional bodies.
- The Department of Education & Skills continues to engage with higher education institutions to encourage the adaptation of courses, in consultation with stakeholders, to ensure that graduates have the necessary training and skills.
- Establishment of the High Performance Building Alliance that aims to increase Ireland's stock of high performance buildings through training, research and quality standards.
- The SME support programme, operated by SEAI, provides advice and training for SMEs on energy management, particularly in areas such as lighting, heating and cooling.
- A pilot 10-module course, 'Fundamentals of Energy Renovation for Traditional Buildings', was co-developed with expert input from key stakeholders.

Other useful information

- The NZEB requirements will equate to EPC A2 and represents a 70% improvement in energy efficiency and a 70% reduction in CO2 emissions compared to the 2005 Regulations. It also introduces 20% renewables as a percentage of the total building energy use (applied to all new dwellings commencing construction from 1 November 2019).
- The cost-optimal energy performance level for major renovations is equivalent to EPC B2.

Areas for potential improvements compared to best practices

It could be useful to consider:

- providing a quantitative description of milestones for 2040;
- providing more specific estimates of the wider benefits, including the effect on climate resilience;
- providing mechanisms to reduce the perceived risks and the use of public funding to leverage additional private-sector investment;
- developing the description of measures for boosting the ESCOs market;
- further detailing budgetary resources to support the implementation of proposed measures.

Summary of the long-term renovation strategy

Luxembourg's long-term renovation strategy (LTRS) sets out a comprehensive set of measures to address building renovation. They include a balanced mix of regulatory requirements, fiscal and economic incentives and information, tailored to specific needs such as barriers against deep renovation, energy poverty, etc. The overall milestones are clearly set only for residential buildings. The measures to tackle energy poverty are very comprehensive.

Overall, Luxembourg's LTRS is highly ambitious with clear measures attributed to each segment (residential and non-residential buildings). However, details on the budget allocation could be further specified.

Information on the building stock

- In 2011, Luxembourg's residential building stock included almost 208 000 residential units, of which around 88 000 were multi-family dwellings and almost 114 000 were single-family dwellings, semi-detached houses and terraced houses.
- The number of apartments in multi-family dwellings as a share of the total number of residential units is 42.4%, while the share of single-family dwellings, semi-detached houses and terraced houses is much higher, at 54.7%.
- The share of owner-occupied residential units is very high (around 70%), and the share of rented units is low.
- The share of social housing is low compared to neighbouring countries (around 3.6%).
- The vast majority of Luxembourg's residential building stock is dependent on fossil fuels in terms of the energy carrier mix for heating; almost 90% of all residential units are heated using fossil fuels.
- Building envelope renovation rates have not been systematically recorded to date. The average area-weighted building envelope renovation rate for the years since 2008 can be roughly estimated at 0.4% to 1% per year of the total stock. Since buildings were also being renovated before 2008, the number of residential units renovated by 2020 can be estimated at around 10–14% of the residential building stock. Lock-in effects resulting from mediocre renovation qualities are therefore only present in a small market segment.
- Non-residential buildings account for around 29% of the total area of all buildings constructed, and residential buildings for 71%.
- Non-residential buildings account for a total area of around 6.75 million m². Adding the 'semi-residential' category (380 000 m²) gives a total area of 7.13 million m². Buildings in the trade and services categories account for around 4.6 million m² of this area.
- The useful floor area in non-residential buildings is more likely to be in the region of at least 14 million m².

- Private office buildings represent the largest individual category in terms of area, while the share of public buildings can be estimated at around 21-30% of the total area covered by non-residential buildings.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

The milestones section presents the following indicators for tracking progress:

Year	Final energy demand (GWh/a) Residential		GHG emissions reduction Residential	Final energy demand (GWh/a) Non-Residential
2020	6438			4 046
2030	4611	-28% vs 2020	- 62%	3 205
2040	3551	- 45% vs 2020	- 96%	2 883
2050	2715	-58% vs 2020		2 557

- The share of renovated buildings in 2020 is estimated to be in the range of 10-14%.
- Renovation rate of the building envelope (according to NECP): 3% per year of the number of housing units built before 1991, corresponding to approximately **4500 housing units per year** (full renovation equivalents) and **420 000 m² per year** for non-residential buildings.
- Renovation rate of the building envelope: approximately 1.6% of the number of all housing units whose building envelope has reached the average technical lifetime, corresponding to **4400 to 7800 housing units per year** (full renovation equivalents, number of housing units to be rehabilitated increases because account is also taken of the construction years after 1990, despite taking the demolition into account).
- Renovation quality: Efficiency class A/A to B/B, with mean renovation depth of approximately 72% in line with NECP.
- Boiler exchange rate (residential and non-residential): approximately 5% p.a. (in relation to the total area of the residential buildings concerned).

Investment needs

Building envelope renovation rate (full renovation equivalent)	Number of residential units to undergo deep renovations	Total living space to be renovated	Renovation investments (minimum performance)	Renovation investments (cost-optimal performance)	Workstations for minimum-performance renovation	Workstations for cost-optimal-performance renovation
%	Residential units/year	m ² living space	EUR/a	EUR/a	EUR/a	EUR/a
0.4	1 000	129 000	47 730 000	69 660 000	430	627
0.6	1 500	193 500	71 595 000	104 490 000	644	940
0.7	1 750	225 750	83 527 500	121 905 000	752	1 097
0.8	2 000	258 000	95 460 000	139 320 000	859	1 254
1.0	2 500	322 500	119 325 000	174 150 000	1 074	1 567
1.2	3 000	387 000	143 190 000	208 980 000	1 289	1 881
1.4	3 500	451 500	167 055 000	243 810 000	1 503	2 194
1.6	4 000	516 000	190 920 000	278 640 000	1 718	2 508
1.8	4 500	580 500	214 785 000	313 470 000	1 933	2 821
2.0	5 000	645 000	238 650 000	348 300 000	2 148	3 135

Good practices

Legislative

- Stricter minimum requirements in terms of thermal insulation for individual components in the form of new energy efficiency regulations (for non-residential buildings from 2021 and for residential buildings from 2023).
- Revision of existing monitoring system to ensure that renovation works comply with the requirements.
- Introduction of ‘**renovation passports**’ (renovation roadmap) to ensure that the overall sum of individual measures gradually results in full renovations with a sufficient depth (‘deep renovation’).
- Obligation to build up financial reserves for the renovation of owner-occupied and rented apartments (based on the example of Austria’s ‘Maintenance and Improvement Contribution’). Introduction of an obligation to build up renovation reserves in ownership communities.
- **Pause in the expansion of gas networks in residential areas.**
- Preparatory measures for the installation of photovoltaic systems on the roofs of other non-residential buildings during redevelopments (with the exception of buildings protected as historical monuments and heavily shaded buildings) from 2023.

- Luxembourg introduced nearly zero-energy building (NZEB) standard for residential buildings as of 1 January 2017. The early introduction of this far-reaching standard has allowed Luxembourg to reduce CO2 emissions in the residential sector despite the growth of the population. This policy will be complemented by a new regulation in summer 2020, which will gradually require climate neutrality for both residential and non-residential new buildings by 2023. This will be extended in the short term (A+ energy class) to ensure 100% renewable energy coverage. Following the introduction of the NZEB standard for new residential buildings in 2017, this standard will also apply to non-residential buildings from 2020/2021. Until 2030, this standard will continue to be raised and the ‘near zero’ standard will be redefined by improving the energy efficiency requirements for new non-residential buildings.
- It is planned to extend the mandatory energy audits for large industrial energy consumers to the SME sector, taking into account the specificity and possible simplifications for SMEs. SMEs will also be required to have their energy consumption reviewed on a regular basis in order to better assess the renovation potential of their buildings among other factors.
- New residential and non-residential buildings will also integrate aspects such as health and wellbeing, alongside a stronger anchoring of sustainability. This will be implemented through the integration of elements in the national energy passport, the ‘LENOZ’ sustainability certification or the creation of a new label. Toxic and harmful building materials will be banned and a positive list of building materials containing natural and ecological building materials will be established.
- The concept of the circular economy will be further promoted in the construction sector in order to improve the quality of future buildings. This should be done through support programmes as part of ‘progressive requirements’.
- **Spatial Strategy 2035:** To better plan the country and its cities in a dynamic economic environment, the government is working under the Ministry of Energy and Spatial Development on a new Spatial Strategy 2035 (‘Programme Directeur’). This strategy sets out proposals for increasing the number of dwellings to be built in Luxembourg in the future (e.g. near existing or new stations), which new transport infrastructure is needed and which taboo zones are key to maintaining biodiversity.
- **Phasing-in of CO2 pricing from 2021** (2021: EUR 20/tonne; 2022: EUR 25/tonne; 2023: EUR 30/tonne).
- 2024: entry into force of a Grand-Ducal Regulation on renovations of non-residential buildings, **potentially including a renovation obligation with a deadline of 2040** (all office buildings subject to the renovation obligation must be renovated by 2040).

Finance

- The **PrimeHouse** support scheme is to be upgraded to allow for deep renovations. The scheme provides investment aid for the energy and sustainable renovation of residential buildings and related qualified energy advice, the construction of sustainable residential buildings and the use of renewable energies (PV, solar thermal installations, wood pumps and heat pumps). It has been extended or revised several times since 2001. The current programme runs until the end of 2020. Its upgrade will include: (i) checking and, if necessary, adjusting the amounts of support; (ii) integrating additional sustainability criteria, in particular to promote the circular economy; (iii) including criteria

to mitigate health risks in residential buildings; (iv) developing eligibility criteria for energy efficiency in listed buildings, in coordination with existing Heritage Protection Authority support programmes; and (v) further administrative simplification, for example by increasing the digitalisation of the application procedure or optimising quality assurance (quality improvement – intensity of controls).

- **Climate loan:** low interest or interest-free loans for low-income households for energy and sustainable renovation of residential buildings. The technical requirements are the same as the PrimeHouse programme. A revision and simplification of conditions and application procedures is planned so that more homeowners can benefit from a climate loan in the future.
- **Reduced VAT rate of 3% for renovation measures:** The conditions for benefiting from the reduced rate of VAT of 3% for renovation measures will be adapted and harmonised with the requirements of the PrimeHouse programme. The aim is to examine whether owners of buildings with a construction age of 10 years can benefit from the reduced VAT rate instead of the current 20 years.
- The 2008 **Housing Compact (Pacte Logement)**, which provides municipalities with additional financial resources to create new housing and public infrastructure, among other support, will expire in December 2020. Given the high demand for affordable housing in Luxembourg, the government has decided to continue and relaunch the scheme under the name ‘Pacte logement 2.0’, providing a wide range of measures to help municipalities achieve key housing objectives and improve the quality of housing for their inhabitants. The focus is on increasing the supply of housing, mobilising building land and improving housing quality and energy performance in both new housing projects and existing ones. The new Pacte Logement will run until around 2030 and its structure will be more diverse. Possible elements include improved advice to municipalities by the Ministry of Housing, a housing adviser function and the promotion of various measures that focus on both the quantity and quality of housing. The catalogue of measures to achieve the objectives was drawn up in cooperation with the municipalities.
- **Taxation of fuel oil and natural gas:** the taxation of heating oil will gradually be increased under the above-mentioned tax reform, taking into account the CO₂ minimum price described above. The aim is to encourage the shift towards renewable and more climate-friendly heating. To make this measure socially acceptable, an attractive support programme for oil heating exchange will be introduced. The competent ministries will analyse the impact of increasing the cost of heating oil with the public subsidy from the ‘Allocation de vie chère’ and, if necessary, will respect the effectiveness of this premium, as well as the technical feasibility.
- Support accompanying the transition to renewable energy sources.

Public buildings

- The stock of central government public buildings amounts to a useful floor area of almost 3 million m² across 710 buildings.
- Requirement to install photovoltaic systems on all public buildings by 2030 (with the exception of buildings protected as historical monuments).

- The government has stepped up its efforts in recent years and implemented an ambitious national renovation programme. Luxembourg drew up an inventory of the public buildings concerned in order to calculate the amount of renovations needed.
- The public social housing institutions, the Societe Nationale des Habitations a Bon Marche (SNHBM) and the Fund du Logement are working to gradually renovate and improve the rented housing parks.
- The main city airport is also to be transformed into 'Findel Green Airport'. This notably involves introducing energy saving measures and using renewable energy in order to transform the existing terminal into an 'energy plus' building.
- Another aspect of the state's pioneering role is the **replacement by 2025 of light bulbs in public buildings and street lighting by LEDs** to improve energy efficiency and help fight against light pollution. The government's administrations will convert all lighting sources from roads, public spaces, buildings, stations and monuments from existing energy-absorbing luminaires to energy-efficient LED lighting.
- A State **Top Runner** programme will be introduced to encourage the State and municipalities to purchase energy-efficient equipment.
- **Ultra-efficient public buildings** are part of a government strategy on 'sustainable and energy-efficient public buildings' to improve sustainability, energy efficiency and the use of renewable energy in new and existing public buildings. It integrates circular economy principles and relevant health considerations. It includes introducing an obligation to integrate photovoltaic installations in state-owned buildings, both for new constructions and renovation. It also involves the scaling-up of the Public Buildings Administration's PV programme. The aim is for all suitable public buildings to be equipped with photovoltaic installations by 2025.
- **Climate-friendly schools:** Collection of pupils' ideas for increasing RES and EE in schools in 2019 and integrating RES/EE in school curricula.
- **Land and dwellings and the management of the building stock.** A professional housing adviser (housing adviser) will be made available to the municipalities. In general, synergies with the Climate Pact and the Nature Pact will be identified and made the most of. The capacity of the Ministry of Housing will also be strengthened to help municipalities set up housing estates.

Split incentive

- Luxembourg also plans to introduce the Austrian model (maintenance and improvement contribution). In Austria's non-profit housing construction, the EVB is a third component of the rent, in addition to cold rent and operating costs. Tenants pay a monthly contribution which is used to build up reserves for renovations. The maximum amount of the contribution increases with the age of the building. The payment of the EVB as a special-purpose renovation reserve means that the renovation costs are saved in the long term and are not 'randomly' passed on to the tenants who live in the building at the time of the major renovation.
- Removing obstacles at the level of building managers.

- Adjustment of decision-making sequences (lower quorums) for the implementation of renovation measures (introduction of a simple majority in decisions of ownership communities).

Energy poverty - worst performing buildings

- Luxembourg's worst performing buildings include the following four market segments: (i) conditionally rehabilitable buildings (nominal or ensemble protection); (ii) buildings without monument or ensemble protection with the highest average energy consumption; (iii) underused buildings; and (iv) social housing.
- Energy poverty is clearly defined and a set of indicators have been developed to systematically detect it. The national statistical office is currently developing two indicators to monitor energy poverty.
- The following measures contribute to alleviating energy poverty:
 - Acts of 1 August 2007 on the organisation of the electricity market and the natural gas market. The amended Acts stipulate that a household that is unable to pay its electricity or gas bills may receive social assistance from the competent social security office. The Law of 18. December 2009 on the organisation of social assistance further stipulates that the competent social security office must verify whether the household customer is unable to pay its energy bills and is therefore entitled to social assistance.
 - The ongoing 'allocation de vie chère' scheme aims to combat energy poverty. The state rent subsidy can also help those in need to face a possible increase in the cost of housing. It should also be stressed that the current legislation prohibits the disconnection from the grid of a household customer that is unable to pay its electricity or gas bills.
 - Financial assistance for households for electricity, gas, heating oil, water, food and municipal levies, distributed via 30 social welfare offices.
 - Consultations provided by 'myenergy' to households at risk of energy poverty.
 - Subsidised electrical appliances ('myenergy' scheme 2017-2019).

Smartness

- National initiatives to promote smart technologies are largely integrated into the overall energy market regulation. **Smart meter roll-out** is expected to be completed by the end of 2020.
- Pilot projects for the pre-fabrication of refurbishment elements to counter the labour shortages; cooperation with foreign countries.

ESCOs

- The planned de-risking instrument - the investment bundling platform - seems promising (the platform will help bundle several projects in order to make them attractive for EPCs).

District approaches

- Sustainable neighbourhoods, **eco-quartiers made in Luxembourg** (new buildings): Luxembourg will ensure that future built neighbourhoods will improve urban quality and quality of life and will be free of CO₂. To this end, a definition of sustainable neighbourhoods, with common criteria and a clear methodology, and new funding will be developed under the guidance of the Minister for Spatial Development. In addition, more harmonised inspections of buildings are to be carried by municipalities out in order to guarantee compliance with construction and energy standards. The Luxembourg government is developing major housing projects with state and municipal partners that aim to be ‘zero-CO₂’, ‘zero-waste’, ‘car free’ and ‘socially inclusive’ as well as ‘climate neutral’ even in light of the expected increase in population.

Advisory tools

- The ‘**myrenovation**’ app is to be further developed to close information gaps on funding and financing schemes.
- **Myenergy**, the national structure for promoting a sustainable energy transition, provides information and support for the efficient use of energy. It is Luxembourg’s one-stop-shop for building renovations.
- In autumn 2019, a project to develop tools and methodologies for a future de-risking platform was launched by the Ministry of Energy, in cooperation with the EIB (European Investment Bank) and Myenergy. This project continued in 2020, in close cooperation with the Ministry of Economy and the Ministry of Finance, involving banks and relevant market actors.
- **Building renovation passports are being explored** as a future policy measure. This energy passport would provide owners with a transparent and personalised assessment of the renovation potential and the associated savings. A study found that 56% of tenants do not have information about an energy passport for their building or the energy efficiency class of their building.
- For existing functional buildings, an energy passport ‘plus’ is planned.
- **Heat cadaster and solar cadaster:** Energy investment planning will play a more important role. The Energy and Spatial Planning Departments within the Ministry of Energy and Land Planning are therefore working together to produce two important cadasters; a heat cadaster to identify Luxembourg’s priority housing estates and neighbourhoods that use natural gas or fuel oil with a view to replacing heat grids with renewable energy or waste heat from industrial plants or data centres. A national solar register will also help with the planning of large and smaller solar installations.

Skills

- Improvements in skills and education will be achieved through training and education programmes such as ‘further training on energy and economic optimisation of renovations in non-residential buildings’ and ‘further training to reduce the need for cooling energy in the future climate’ that will complement existing programmes.
- Access to the PrimeHouse support scheme by certified craftsmen in an individual measure. Bonus support for overall renovation only in the case of advice from certified energy consultants. Substantial increase in support for consultancy costs.

Areas for potential improvement compared to best practices

It could be useful to consider:

- enlarging the scope of milestones which currently mostly relate to residential buildings;
- providing more specific estimates of the wider benefits, including the effect on climate resilience;
- further detailing the investment needs for the proposed measures;
- developing a detailed definition of deep renovation.

Summary of the long-term renovation strategy

The Dutch long-term renovation strategy (LTRS) sets out an innovative and comprehensive set of policies as well as milestones and stocktaking. The Climate Agreement is the successor to the Energy Agreement and forms the basis of the LTSR. Indicative building renovation milestones towards 2030-2040-2050 are based on the Climate Agreement and calculated using a linear reduction of greenhouse gas emissions and straight conversion of the 2050 CO₂ emission reduction target of 95% indicated in the Climate Act.

A key Climate Agreement objective is to gradually insulate 1.5 million residential and other buildings by 2030 taking a district-oriented approach and to make them gas free, or at least ready to switch over to another, sustainable source of heat ('gas free-ready').

The LTSR comprises a good mix of regulatory requirements, fiscal and economic incentives and information measures.

It focuses strongly on the district-oriented approach to make districts gas-free. This approach integrates environmental policy into urban planning and is based on roadmaps to be implemented by municipalities who should also identify available sources of energy in their district.

Renovation activities are mostly incentivised through tax reduction and tax exemption measures, reduced VAT rates, VAT refund, investments costs deduction, depreciation of investment, favourable loans and interest rates.

Information on the building stock

- The Netherlands has nearly 8 million homes and 470 000 non-residential buildings.
- Owner-occupied homes accounted for approximately 58% of the housing stock in 2019, rented housing association accommodation for 29% and other rented homes for 13%.
- The rental sector in the Netherlands is dominated by social rentals (through 320 housing associations with approximately 2.2 million residential units) which account for around 67% of the rental market for residential properties.
- Homes built before 1975 account for approximately half of the housing stock. Homes built in 1995 or later account for approximately 22%.
- Nearly 6 in every 10 homes built in 1995 or later have energy label A. Only just over 10% have label C or worse. The proportion of homes with a bad label (F or G) has fallen sharply, from 54% in 2006 to 23% in 2018.
- In 2015, the floor area of non-residential buildings stood at approximately 600 million m² (including vacant buildings) spread over 470 000 buildings.
- Industrial halls account for 44%; offices for 15% and shops, healthcare, education and hospitality and catering each account for between 6% and 9% of the total surface area.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

2020	<ul style="list-style-type: none"> • Gas consumption will fall steadily to 264 PJ • 100 PJ energy saving vs 2012 • New building energy neutral
2030	<ul style="list-style-type: none"> • Gas consumption will fall steadily to 234 PJ • Gradually insulate 1.5 million residential and other buildings and make them gas-free, or at least ready to switch over to another, sustainable source of heat ('gas free-ready') • 3.4 million metric tonnes less CO2 • 1 million metric tonnes less emissions from non-residential buildings • 49% reduction in CO2 emissions
2040	<ul style="list-style-type: none"> • CO2 emissions = 8.4 million tCO2eq
2050	<ul style="list-style-type: none"> • Vision for 2050: all buildings sustainable • CO2 emissions = 1.5 million tCO2eq

Milestones are based on CO2 emission reduction and expressed in CO2 million metrics tonnes compared to 1990 (based on the Climate Agreement forecasts for the built environment - using a linear reduction of greenhouse gas emissions and a straight conversion of the 2050 CO2 emission reduction target of 95% indicated in the Climate Act).

- The Climate Agreement stipulates that 1.5 million homes and non-residential buildings are to be made sustainable and natural gas is to be gradually phased out by 2030. To achieve this objective, the Netherlands needs to scale-up its action and renovate 200 000 homes per year. After 2030 a further acceleration will be necessary in order for all homes and non-residential buildings to have sustainable heating by 2050.
- Gas-free programme – districts to be gas-free or gas-free ready by 2030 using more renewables and more sustainable sources; no more fossil fuel used in the building environment by 2030 (Transition Vision for Heating plan).
- Decrease in electricity since 2013, falling further from 78PJ in 2020 to 71 PJ in 2030.
- Increased use of heat pumps and solar panels.

- Gas consumption in the service sector is expected to decrease from 117 PJ in 2020 to 82PJ in 2030.
- Benefits for health and safety and the environment due to the elimination of fossil fuels (replacement of internal combustion engines (petrol, diesel, LPG and CNG) by electric motors). A 10% reduction in NOx gases and particulates by 2030 vs 2016.

Investment needs

- The heating fund is financed by public and private resources. The government will make a total of EUR 900 million available between now and 2030. To make a flying start with the heating fund in 2020 the government used the structural and financing proceeds of the National Energy Saving Funds (NEF). The volume of financing in the heating fund will grow in the short term to more than EUR 1 billion, with private contributions expected to account for around 75% of the total.
- Housing associations and other landlords obtain from the central government a reduction of the lessor levy of EUR100 million per year.
- The renovation accelerator is an instrument for pooling demand and matching it with supply to enable larger-scale and cheaper renovations. For this, EUR 130 million is available until 2024.

Good practices

Legislative requirements/ standards

- **Mandatory requirement for offices over 100m² to have a minimum ‘C’ energy label by 2023.**
- The Climate Agreement commits to developing standards and target values for the main and characteristic types of residential properties and to provide owner-occupants with guidance on how to make their homes sustainable. The standards and target values will be indicated on the energy label. The standards for existing owner-occupied homes are not mandatory at present, but if owner-occupiers renovate the obligation to comply with the Building Decree already applies.
- **Agreements with landlords:** the starter motor and renovation accelerator aim to make 100 000 rented homes gas-free or ‘gas-free-ready’ in the next 4 years. The central government supports this starter motor by contributing to the costs of making rented dwellings gas-free. For this, it uses EUR 200 million of the Energy Investment Deduction allocation.
- The **Reduction of Landlord Levy (RVV)** scheme aims to help landlords make their properties more sustainable.
- **Lower tax rates.** Labour costs for insulating floors, walls and roofs of homes that are more than 2 years-old are subject to VAT at 9% instead of 21%.
- **Exemption from energy tax for self-generated energy for energy cooperatives** (private individuals). Members of energy cooperatives (groups of private individuals) do not have to pay tax in the first bracket of the energy tax for the portion of the collectively generated renewable electricity allocated to them.

- **Since 1 July 2018, new buildings do not get a gas connection.**

Finance

- **Environmental Investment Deduction (MIA) & Arbitrary Depreciation of Environmental Investments (VAMIL)** (businesses). This allows entrepreneurs to depreciate the investment (up to 75% of the investment cost) with advantages in terms of liquidity and interest. (MIA) offers tax deduction for up to 36% of the investment amount. This deduction is on top of the usual investment deduction for entrepreneurs.
- **Sustainable Energy Investment Subsidy (ISDE)** (businesses and private individuals). This encourages individuals and businesses to invest in (small) appliances for renewable energy generation. It supports sustainable installations such as heat pumps, and will be expanded to cover insulation.
- The **Dutch Municipalities' Stimulus Fund for Housing (SVn)** extends the energy saving loan from the National Energy Savings Fund. Interest and repayments go back into the fund so that new energy saving loans can be granted. A total of EUR 600 million is available.
- The **Heating Fund** offers home owners attractive financing for making their home sustainable, including those that currently have no access to financing. The interest rate will be comparable to that for mortgage loans and will be on the same terms as the national mortgage guarantee. Thanks to the available subsidies for insulation and sustainable heating options, the cost of making homes sustainable will come down. Owners will also increasingly be able to recoup their costs through lower energy bills.
- The combination of public and private resources can mobilise large amounts of financing (though the participation of private parties) and ensure that risks are shared (through government participation).
- The Dutch '**Energiesprong**' concept is generating mass deep renovations with pre-fabricated, standardised modules in order to achieve major cost and time savings. Energiesprong brokered a deal to bring 110 000 buildings to a NZEB status. Thanks to a three-year EU Horizon 2020 grant, this initiative is planned to be rolled out in other EU countries.

Public buildings

- Roadmaps for the public sector aim at a CO2 neutral central government portfolio, but there are no concrete measures in place. Eleven sectors are drawing up roadmaps: Central government (the Central Government Real Estate Agency), municipalities (VNG), provinces (IPO), police, education (primary and secondary, senior secondary vocational, higher professional and university), the healthcare sector and the sports sector.
- The **Central Government Real Estate Agency (RVB)** manages about 12 000 buildings with a total gross floor area of around 12 million m². This includes 11 000 buildings (6 million m² GFA) of the Ministry of Defense, and 1 200 buildings (6 million m²) of other users. The

roadmap aims at a CO2-neutral central government portfolio by 2050, with the vast majority being achieved in 2040 (at least 85% less emissions than in 1990).

Split incentives

- The split incentive dilemma is well addressed in the Netherlands. Several measures are in place to help landlords recover some of their investments from the tenants and will be enforced by amending the Law on renting.
- The **Social Rental Agreement** contains a ‘Table of compensations for investments in sustainability’ based on the real average saving in energy costs that tenants make after home improvement.
- A **performance contract** joined to a Green Lease can establish agreements on performance guarantees, on how to share the benefits of the sustainability measures and on monitoring methods. This allows both the tenant and landlord to benefit from the sustainability measures.
- The **Energy Performance Compensation (EPV)** scheme aims to achieve housing cost neutrality for landlords so that they can recover part of their investment when making social rental homes energy-neutral. Under this scheme, landlords can ask tenants for compensation for energy-neutral or ‘Zero on the Meter’ homes.

Energy poverty - worst performing buildings

- Energy poverty is not a major issue in the Netherlands. However, it is addressed by protecting tenants from high energy costs, and by supporting households with a lower income. In 2014-2015 the Netherlands had a total of 528 000 households at risk of energy poverty.
- The Netherlands assists lower income households through its general social policies. The Netherlands is not in favour of income policies through energy bills. The Netherlands does not have a definition of energy poverty.
- Landlords are obliged to bring residential properties up to the required ‘standard’ in order to protect tenants from high energy costs.
- The government agreed that the total rental housing stock would attain an average Energy Index of 1.25 (average energy label B) by 2021.
- For insulating existing homes subsidy schemes have been in place for a long time.

Smartness

- Promotion of smart technology support measures such as innovation programmes, a Demonstration Energy Innovation scheme, and an obligation for **large non-residential buildings to have an extensive energy and building management system from 2026**.

- The Building and Technology Innovation Centre aims to act as an initiator and broker in order to integrate R&D programmes in the design, construction and technological sectors. This will involve establishing links, as far as possible, with the vocational training sector and addressing labour market and training issues.

Advisory tools, Education

- A digital platform, available to building owners and occupants, serves as a one-stop-shop providing advice on relevant energy efficiency home improvements, financing instruments and possible subsidies.
- The **Regular Explorer home** allows owners to calculate the costs and benefits of energy saving measures for their home. They can also get advice on the measures they can take to attain a higher energy performance class (e.g. from F to D, or B to A). (See <https://energiebesparingsverkenner.rvo.nl/>)
- The **High Ambitions Explorer home** provides owners with advice on how to make their home ‘nearly energy-neutral’. Homeowners can also get information on the costs and benefits of the various measures, and advice on alternatives to gas-fired heating installations. (See <https://energiebesparingsverkenner.rvo.nl/>)
- The **Energy Savings Explorer for Offices** provides office owners with information on how to qualify for energy label class ‘C’. It provides information on the investment costs, the annual savings in energy costs, the payback time and the environmental effect (CO2 reduction per m²). (See <https://energieslag.rvo.nl/news/view/51138486/snel-inzicht-in-besparingsopties-met-de-energiebesparingsverkenner-kantoren>)
- The **Sustainable Housing Platform** has made a start on developing a data template with available data on energy consumption, construction technology and building use.
- The **Knowledge and Innovation Platform for Sustainable Social Real Estate**. Eleven sectors are in the process of drawing up roadmaps: Central government (the Central Government Real Estate Agency), municipalities (VNG), provinces (IPO), police, education (primary and secondary, senior secondary vocational, higher professional and university), the healthcare sector and the sports sector. This platform is not intended to support the preparation of the roadmaps, but to help individual institutions make their buildings sustainable. (See <https://www.rvo.nl/onderwerpen/sustainable-ondernemen/gebouwen/social-vastgoed>)
- The **Gas-free district knowledge and learning programme** aims to not only provide technical solutions and information on costs and financing, but to also help with management and organisation, data-based planning, legal aspects and communication and participation.
- With BUILD UP Skills Netherlands@Work, eight profiles of blue collar professional competences have been created setting out the skills required for building energy-neutral buildings.

De-risking and aggregation

- Specific measure such as the **renovation accelerator** help aggregate projects into bigger investments that are easier to finance, to enable the large-scale renovation of rental homes. The Renovation Accelerator has aggregated housing associations' requests for (hybrid) heat pumps, insulation and other reduction measures, through a regional support programme. Up to 2024, EUR 130 million will be available for the renovation accelerator.
- De-risking is partly addressed by **pooling public and private money** to provide attractive financing for building owners. The Netherlands supports this with the **Heating Fund** and the **National Energy Savings**. By combining public and private resources large amounts of financing can be made available (though the participation of private parties) and risks can be shared (through government participation).

A district-oriented approach to the built environment

- Municipalities have to develop (together with stakeholders and residents) a '**Transition Vision for Heating**', an environmental plan and the implementation plan towards eventually ending the supply of gas and being able to offer residents alternative sustainable heating options.
- The idea is that on an aggregate basis the municipalities' goal under the Transition Vision for Heating should be to make 1.5 million residential and other buildings sustainable by 2030.
- A programme is already under way to make 100 districts gas-free. In 2018 the first lot of 27 test beds began, each of which were given about EUR 4 million from the Municipal Fund to cover the project shortfall.

Areas for potential improvement compared to best practices

It could be useful to consider:

- providing a more precise description of the share of renovated buildings or an absolute value (number or m2 per type of building) in 2020;
- providing more specific estimates of the wider benefits, including the effect on climate resilience;
- further detailing the investment needs and budget allocation for the proposed measures;
- specifying further trigger points.

Spain

Summary of the long-term renovation strategy

Spain's long-term renovation strategy (LTRS) builds on previous strategies, setting out a comprehensive and well-structured set of policies organised in a coherent and articulated implementation plan. The LTRS target of renovating 1.2 million dwellings over 2021-2030 (improving the EE of the building envelope) would mean an expected substantial increase in the annual renovation rate - from 30 000 dwellings today to 300 000 in 2030.

In the residential sector, the strategy aims for a 99% reduction in greenhouse gas emissions by 2050 compared to today. Resources seems appropriate, comprising a combination of public and private investments. The LTRS sets ambitious but still achievable objectives and targets.

The LTRS interacts with other plans, strategies and frameworks at different levels (e.g. urban renewal plans and the national strategy against energy poverty). It pays specific attention to energy poverty and energy communities.

Information on the building stock

- Of the total of 25.7 million houses in Spain (2020 estimate), 74.6% are main dwellings (18 771 653) and 25.4% are secondary and empty dwellings (6 375 471).
- Multi-family housing accounts for 71.8% and single-family for 28.2% of the housing stock.
- In the secondary housing stock, single-family homes account for 46.9% and multi-family housing for 53.1%.
- The table below presents the situation for the non-residential sector:

	Number	Floor area (1000 m ²)
Total non-residential	12 280 309	2 229 342
Tertiary, services and equipment	2 058 779	998 555
Offices	295 224	117 293
Commercial	1 337 585	239 102
Sports	84 513	225 432
Performances	5 567	112 574

Leisure and hospitality	204 105	106 857
Health and wellbeing	37 640	55 966
Cultural	51 349	112 574
Religious	42 796	28 755

- Among the buildings with an Energy Performance Certificate (EPC), less than 5% are classified as either A or B and slightly more than 15% have a C class.
- Renovation has increased from 25 996 buildings in 2017 to 28 364 in 2019 (9.1%).

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

	Final energy consumption (GWh)	Energy savings and other indicators
2020	<ul style="list-style-type: none"> • 172 419 (residential) • 131 858 (tertiary) 	
2030	<ul style="list-style-type: none"> • 146 025 (residential) • 131 858 (tertiary) 	<ul style="list-style-type: none"> • Energy savings (GWh): 26 394 (residential) • Renovate 1.2 million homes
2040	<ul style="list-style-type: none"> • 124 172 (residential) • 91 703 (tertiary) 	<ul style="list-style-type: none"> • Energy savings (GWh): 21 853 (residential)
2050	<ul style="list-style-type: none"> • 108 264 (residential) • 84 463 (tertiary) 	<ul style="list-style-type: none"> • Energy savings (GWh): 64 154 (Cumulative 2020-2050) • Residential: 37% reduction in energy use and 99% reduction in CO2 emissions compared to 2020 • Residential: consumption from heating would be less than 55% of 2020 levels • Non-residential: 36% reduction in energy use compared to 2020

		<ul style="list-style-type: none"> • 7.1 million houses are expected to undergo deep renovation, lowering their individual consumption to 12 kWh/m² • The stock of new buildings between 2020 and 2050 is projected to amount to 3,9 million houses, all of them NZEBs.
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- 1.2 million homes (out of 18.7 million primary residence homes) are on the market for renovation in the coming decade.
- Energy renovation of 1.2 million homes would reduce the number of people being diagnosed with cardiovascular problems by 96 000. The total accumulated energy savings would reach 6,949 ktoe.
- Adequate measures for photovoltaic installation and self-consumption (i.e. generating power for one's own use), together with energy efficiency renovations are likely to lead to the expected decarbonisation of the building stock by 2050.
- Emissions are expected to fall from 14 799 503 tCO₂ equivalent (in 2020) to 185 566 t in 2050 with a cumulative reduction of 14 613 937 tCO₂ equivalent over the 2020-2050 period.
- Socioeconomic benefits, including savings on energy bills, increased GDP of 0.47% in 2030, generation of 33-88 000 jobs in 2030 (+0.44%) and improved indoor air quality and health.

Investment needs

- The total amount of investment required for 2020-2030 is EUR 41 471 million, of which EUR 15,520 million should be private investment for the renovation of expired ACS/heating equipment.
- Public investment (EUR 6 946 million) would be used to encourage the rehabilitation of shells (EUR 4,389 million), covering one third of the total investment required, and a further EUR 2.557 million to replace ACS or heating equipment in view of the fuel changes needed to achieve the energy targets set in 2030 (covering 1/5 of the total investment). In this case the ratio of public investment would be 25% for installations and 50% for renovations.

Good practices

Legislative

- **Update of the Technical Construction Code (CTE):** The basic energy saving document as sub-section of the CTE is updated to include NZEB requirements and introduce new indicators and criteria for both new and existing buildings.
- **Update of the Regulation on Thermal Installations in Buildings (RITE):** Update of requirements for the qualification of professionals and companies.

- **New rules on self-consumption:** a simplified compensation scheme to compensate for households' surplus production with consumption or selling surplus energy to the market and to regulate the connections of self-consumption through the public distribution network, which allows consumption and generation to be located in neighbouring buildings. Royal Decree 244/2019 allows collective self-consumption meaning that consumers living in the same building or in nearby buildings can share the energy generated by a single installation under commonly-agreed conditions.
- New rules on the regulation of **energy communities** that define and recognise energy communities as key actors in energy transition.
- **Building energy assessment report** on the state of conservation, and compliance with the basic accessibility and energy efficiency conditions that are mandatory for residential properties over the age of 50. The idea is to make the report a basic tool for boosting energy renovation. In Spain, the conservation of buildings and the fulfilment of basic accessibility conditions are part of the legal obligations inherent to ownership. Owners must carry out the necessary conservation work and provide reasonable accommodation in line with the Building Evaluation Report.
- Creation of a **centralised register of certificates** at the Ministry with statistics on the energy rating status of the building stock.
- Consideration of trigger points, including when to replace boilers and carry out renovations to improve a building's fire/earthquake safety.

Finance

- The **PAREER II programme for financing the energy retrofit** of existing buildings has proven effective. It was established in December 2017 as a follow-up to PAREER and PAREER-CRECE. It sets out clear and strong requirements (e.g. energy class measured on the EPC scale of CO₂ emissions (kg CO₂/m² year)), extra financing for actions that reach energy class 'A' or 'B' or that increase the initial energy rating of the existing building by more than two letters in the EPC scale). Measures include: (i) improving the energy efficiency of thermal and lighting installations; (ii) conventional solar energy substitution; (iii) replacement of conventional energy by geothermal energy; and (iv) improving the energy efficiency of the thermal envelope. The aid can be in the form of repayable loan or grant.
- EUR 240 000 000 for financing renovations in existing buildings. This allows the combining of grants and loans.
- Work should continue on a possible guarantee system or a '**Limited Guarantee Fund**' to cover possible defaults on loans from private financial institutions.
- The **2018-2021 State housing plan** covers nine housing assistance programmes of which two have an impact on improving the energy efficiency of the building stock, promoting better energy efficiency and housing sustainability, and promoting urban and rural regeneration. The grants (between EUR 8 000 and 12 000 per house) are linked to specific measures and a minimum improvement level.

The plan also includes grants to finance the joint rehabilitation of buildings and dwellings, the ‘reurbanisation’ of public areas and, where appropriate, the renovation of buildings under the regeneration and urban/rural renewal actions.

- **ICO line:** all costs for the renovation of dwellings or buildings, or the reform of their common elements, may be eligible for financing, including labour (including VAT or similar taxes). Funding can be provided in the form of a loan, leasing, letting or credit facility.
- ERDF support for energy efficiency in buildings and public infrastructure, and in housing within low-carbon economy axis.
- ERDF support to improve energy efficiency in urban areas under the integrated sustainable urban development (ISUD) axis.
- A fiscal reform incentivises energy efficiency. It includes changes in **real estate tax**, transmission property tax and income tax.

Public buildings

- The **inventory of buildings** produced by the Central Public Administration provides detailed information about the General State Administration’s buildings stock and its energy consumption.
- The government **proposes to extend the 3% per year renovation requirement set out in EED Article 5 to all public bodies**, including autonomous communities and local entities, and to call on each administrative body to develop an energy saving action plan, alongside a range of other initiatives.
- Law 8/2013 introduced different possibilities for the public sector to complement the financing of renovation and urban renewal (reinvestment of town-planning gains by changes of use or increases of construction, rent of roofs for installation of solar panels, etc.), which are implemented at local level.
- The **Spanish Urban Agenda is a national urban policy** that aims to establish the criteria underpinning public policies for Spain’s towns and cities, in order to achieve socially inclusive, environmentally sustainable and economically competitive development. To this end, the Urban Agenda lists a set of strategic objectives and 30 specific objectives and proposes lines of action which, together with a system of monitoring and monitoring indicators and a procedural guide, will enable the other public administrations and actors involved to draw up their respective action plans. It is also an action plan setting out all regulatory measures, planning, financing, governance improvements and exchange of knowledge that the central government administration needs to carry out in order to achieve its objectives.

Energy poverty - worst performing buildings

- The **2019-2024 national energy poverty strategy** adopted by the government on 5 April 2019, integrates all ongoing and planned actions under the various public policies to combat energy poverty and ensure that everyone in Spain can effectively exercise their right to energy. The strategy’s four point approach includes: (i) improving knowledge; (ii) improving the response to the current situation; (iii) structural changes to reduce energy poverty; and (iv) measures to protect consumers and raise social awareness. The main building-

related actions include: (i) agile and low-cost refurbishments for vulnerable households; (ii) an increase in the number of social housing renovations through public intervention; and (iii) specific provisions for vulnerable households in terms of grant allocation for building renovations.

- **‘Bono social’** is a ‘social bonus’ launched by the government on 1 July 2009 to protect vulnerable consumers. Royal Decree No 897/2017 introduced new requirements that need to be met in order to apply the bono social. It differentiates between electricity and the thermal bonus. In early 2020, a number of beneficiaries particularly affected by the COVID-19 pandemic were added (e.g. self-employed people who have ceased their activities because of COVID-19 or have seen their turnover fall by 75% as compared with the previous half-year).

Smartness

- Reference to H2020 research projects (e.g. EuroPACE and AUNA) or other European projects (e.g. Build Upon and FP7 CityFied Project).

Aggregation

- The LTRS sets out appropriate mechanisms for aggregating projects (e.g. the H2020 project ‘AUNA’ has created a platform/forum to help financial actors develop smart finance solutions, including project aggregation, and risk reduction strategies).

ESCOs

- The implementation of the ESCO scheme and the capitalisation of energy savings in large-scale projects such as the district-level action is part of the European FP7 CityFied Project - coordinated by the Cartiff Foundation) in Valladolid Torrelago, Laguna del Duero. In the latter an entire district has been renovated (building envelopes, district heating, renewables) with a mix of public and private investments directly managed by the building company and the ESCO.

Advisory tools

- Spain has a wide network of local and regional **one-stop shops** (‘ventanillas unicas’) that provide the public with various services (including financial and technical advice).
- The **Building Energy Assessment Report** (already in place) is to be combined with **Building Passport** (not yet implemented). This creates synergies between building projects, making information clearer and more transparent for all stakeholders involved and making it possible to group measures and prepare a roadmap for staged renovations.

- Pilot projects and research for the introduction of a **Building energy passport**: a feasibility study was conducted in 2018 on the objectives and financing tools needed to support staged building renovation. A pilot ‘PAS-E - Building Passport’ has also been developed.
- A number of campaigns to raise the public’s awareness on energy-efficient behaviour and opportunities, and provide information on available financial support (e.g. thematic guides released by the government of Navarra under the SustaNAPlity European project, web portals on building renovation such as. the ‘Observatorio Ciudad 3R’, and the ‘Ni un hogar sin energia’ project, developed by ECODES).
- A number of guides are available for download at: <https://www.idae.es/publicaciones>.
- Updated and new **technical and explanatory guides**, some of which specifically targeted vulnerable households facing energy poverty: e.g. the ‘Express soft rating for vulnerable households - low-cost solutions’ guide.
- Development of user-friendly public tools that enable people to make simulations on the energy performance of buildings, and calculate energy savings and renovations costs (e.g. Galicia’s MOVIGA model of building stock).

Skills

- A number of specific training and information events have been launched, including a series of seminars particularly targeted at technicians, but also at users, housing managers and neighbouring communities. Some of these have been organised by public administrations, others by professional sectors (professional and professional architects’ associations, etc.) and others by the private business community (such as the ANRE rehabilitation forum) or universities.

Areas for potential improvement compared to best practices

It could be useful to consider:

- further developing milestones and intermediate targets in order to better monitor progress.

Summary of the long-term renovation strategy

The measures presented in the Sweden's long-term renovation strategy (LTRS) together with those outlined in the national energy and climate plan (NECP) comprise a comprehensive set of energy efficiency measures in the buildings ecosystem complementing the traditional umbrella energy and carbon tax. The measures set out in the LTRS are often a continuation of previously well-established measures, some of which are being significantly scaled-up or complemented by new policies.

Information on the building stock

- Houses account for 93% of all residential buildings in Sweden. 20% of apartments in houses were built before 1930 and 45% were built between 1961 and 1990.
- In 2016, the heated area in houses amounted to a total of 302 million m² and the energy consumption for heating and hot water stood at 106 kWh/m².
- Approximately 15% of houses fulfil the requirement for near-zero energy buildings, i.e. energy classes A-C. Energy classes D-E account for 53% of energy-declared houses and energy classes F-G account for 32%.
- Apartment buildings account for 5% of all residential buildings in Sweden. According to the apartment register, 61% of apartments in apartment buildings were built between 1941 and 1980.
- Of the apartments in apartment buildings, 27% are owned by the public housing sector, i.e. municipal housing companies, 41% by housing associations and the remaining 32% are under other private ownership.
- Approximately 5% of apartment buildings fulfil the requirement for near-zero energy buildings, i.e. energy classes A-C. The majority (79%) fulfil energy classes E-G. The majority (34%) of apartment buildings in energy classes E-G were built between 1950 and 1979.
- Approximately 3 500 houses and 52 150 apartment buildings contain both residential properties and non-residential premises.
- There are 55 675 non-residential premises. The energy consumption for these buildings is 128 kWh/m².
- Approximately 14% of non-residential buildings currently fulfil the requirement for near-zero energy buildings, i.e. energy classes A-C. The breakdown between energy classes D, E, F and G is relatively evenly split, with 19-24% of non-residential buildings in each class.

Indicative milestones and other information for the vision to decarbonise the building stock by 2050

2020	40% reduction compared to 1990 in emissions from sectors outside the EU emission trading system (ETS) by 2020. A maximum of 13% can be generated from additional measures
2030	50% more efficient energy consumption by 2030 - Lower energy consumption per m2 and building type than in 2020 - Higher proportion of buildings in A-C and lower proportion of buildings in E-G than in 2020 - 1% Fossil share of end-energy use in the building stock 75% reduction in emissions compared to 1990 from sectors outside the EU ETS by 2040. A maximum of 2% can be generated from additional measures
2040	100% renewable electricity production - Lower energy consumption per m2 and building type than in 2030 - Higher proportion of buildings in A-C and lower proportion of buildings in E-G than in 2030 - 0% Fossil share of end-energy use in the building stock 63% reduction compared to 1990 in emissions from sectors outside the EU ETS by 2030. A maximum of 8% can be generated from additional measures
2050	Lower energy consumption per m2 and building type than in 2040 Higher proportion of buildings in A-C and lower proportion of buildings in E-G than in 2040 0% of Fossil share of end-energy use in the building stock

- Sweden must cut its net greenhouse gas emissions to zero by 2045 and then achieve negative emissions.
- The EPCs are used as a metric for the definition of milestones. Every 10 years the proportion of buildings with A-C should be higher than the reference year before (2030 to 2020/2040 to 2050/2030) and E-F should also be lower than the previous reference year.
- Sweden's LTRS mentions a current renovation rate of 2.3%. The data concern apartment buildings, but are assumed to also apply to schools and offices. The renovation rates rise from 2.5% to 5% in 2016-2019 and from 2.5% to 10% after 2019.

- Buildings built in the 1950s will be renovated over the next 20 years, buildings built between 1961 and 1975 will be renovated over the next 10 years. Other buildings have a renovation cycle of 40 years, meaning that buildings built after 1981 will start being renovated after 2020.
- According to the strategy's reference scenario, assuming that the existing or equivalent instruments remain in place, the expected energy savings by 2050 will stand at around 10-15% (e.g. from 162 kWh/m².y in 2016 to 137 kWh/m².y in 2050). However, according to a study, the potential for energy savings in the building sector is much higher than the reference scenario (i.e. 25% for the 'energy-efficient renovation' scenario, and 38% for the 'major renovation' scenario).

Year of construction	Proportion of area already renovated, 2019	Expected proportion of renovated area, 2020
Before 1940	14.9%	15.4%
1941-1960	14.9%	15.7%
1961-1970	22.4%	25.2%
1971-1980	14.6%	16.0%
1981-1990	1.9%	2.0%
1991-2000	1.9%	1.9%
2001-2010	1.9%	1.9%
After 2011	1.9%	1.9%

Expected proportion of renovated buildings (apartment buildings, offices and schools) in 2020.

Good practices

Legislative

- The energy performance certificate (EPC) Act requires that for every transaction, an energy declaration should be released. EPCs are widely used throughout the country and are expected to increase in the coming years. With an increase in renovations due to the age of the buildings, EPCs serve as an indicator of the renovation rate of the Swedish building stock.
- A trigger point is a major renovation opportunity that is said to occur every 40-50 years when energy efficiency improvements could be made in addition to structural and safety renovations. Another trigger point is when there is a change in owner or tenant.
- National Board of Housing, Building and Planning Building Regulations: The building regulations include energy management requirements which specify the energy consumption limits in buildings. The primary energy requirement is expressed as kWh per square metre per year, and currently stands at 90 kWh/m² for small buildings (i.e. one- and two-dwelling buildings), 85 kWh/m² for multi-dwelling buildings and 80 kWh/m² for non-residential buildings.
- **Split incentives** are a relatively minor obstacle to energy efficiency improvements compared with profitability issues and knowledge-related obstacles, but are considered to be a bigger problem in non-residential premises because leases do not include heating. Various state-funded initiatives that promote the use of **green leases** may help overcome this barrier.

Finance

- The use of fiscal measures is the stand-out measure that has always been present in Swedish energy efficiency policies. The use of green bonds and green leases are some of the most interesting ones currently in place.
- The **Energy Efficiency Finance Facility** was established in 2011 and offers facilities for loans, equity and guarantees and technical assistance for project development support through EU financial support.
- The **tax deduction for renovation**, conversion and extension applies to the labour costs for house repairs, maintenance, conversions and extensions. It was introduced in 2008 to increase the supply of labour and reduce undeclared work. Some of the measures covered also help to increase energy efficiency. An obvious effect of the deduction is that it gives property owners an incentive to carry out more renovations. On 1 July 2016 the tax reduction was cut from 50% to 30% of the labour costs. The maximum support will now be SEK 50 000 per person per year. The facility is offered to owners of small buildings, owner-occupied apartments and holiday homes, and to tenants.
- **Energy and carbon taxes** increase the cost of using energy and therefore provide consumers with an incentive to take energy-saving measures, reduce their energy consumption and/or consume energy more efficiently.
- **Green bonds** finance certain expenses relating to sustainable investments and projects.

Public buildings

- The **Offentliga fastigheter Collaboration Fund** (Public Properties) is one of the most noteworthy initiatives identified. It is a collaboration between the Swedish Association of Local Authorities and Regions and state property managers. It currently includes a number of energy-related focus areas, such as lighting in public premises, renovation involving energy efficiency measures, energy-efficient schools, and low-energy construction in the state, municipality and county council sectors.
- The **state aid for the refurbishment of school premises** initiative ran from 2015 to 2018, providing grants for the refurbishment of school premises in order to improve the learning and working environment and reduce the impact on the environment.
- **Environmental management systems in central government** and annual monitoring and reporting of the results.
- Purchases of energy-efficient products, services and buildings by authorities: Ordinance (2014:480) requires public authorities to procure energy-efficient goods, services and buildings above threshold values, subject to certain conditions.
- **The Energy Efficiency Council** acts as an arena to raise strategically important issues to strengthen inter-agency cooperation and increase transparency on energy efficiency, including on procurement by central government authorities and measures to improve energy efficiency.
- **Kommuninvest and Sverige AB Credit** institution owned by Swedish municipalities and regions, offers financing solutions to municipalities and regions in the form of loans and advice. Kommuninvest finances municipal housing companies, schools and hospitals, among other bodies. The credit institution is non-profit-making.

Energy poverty - worst performing buildings

- Sweden makes no differentiation between energy poverty and general poverty. The issue is managed within the context of social policy and there are no instruments in place that are specifically aimed at energy poverty.
- On 1 October 2016, support was introduced to encourage renovation and energy efficiency measures in rented properties in areas facing socioeconomic challenges. The support is divided into two parts: one for renovation and one for energy efficiency. The renovation support, which is 20% of the costs, is given directly to the tenants as a rent rebate over 7 years. The energy efficiency support is calculated on the basis of the energy savings achieved after the renovation. This part of the support is given to the property owner. To be eligible for this part of the support, the renovations must improve energy performance by at least 20%. Support cannot be sought for renovation or energy efficiency alone, as that does not fulfil the purpose of the measure.
- For the worst performing buildings, a new requirement to install individual metering and charging for heating and hot water comes into force on 1 July 2021. This is expected to encourage owners of the worst performing buildings, in particular, to improve their performance.

Smartness

- **Viable Cities** is a 12-year strategic innovation programme for smart and sustainable cities with a budget of SEK 1 billion. It brings together 50 stakeholders from a wide range of research fields, industry, public services and civil society.
- **Smart City Sweden** is the national demonstration platform for smart solutions in sustainable cities. In addition to energy and environmental aspects, the platform will address issues such as planning and construction, digitalisation, social sustainability, mobility and other issues of relevance to sustainable urban development.

Advisory tools

- The **National Renovation Centre (NRC)**: The NRC works with businesses and academic institutions to improve knowledge and provide operators in the building industry with the information necessary to carry out renovations efficiently. The aim is to make existing buildings more environmentally, economically and socially sustainable from a life-cycle point of view, while improving or retaining their function so that they meet the requirements of users and the authorities.
- The **Information Centre for Sustainable Construction (ICHB)**: The ICHB's mission is to 'promote energy-efficient renovation and building, using sustainable materials while minimising the impact on the environment from a life-cycle point of view'. This includes collecting information about sustainable building, adapting it to specific target groups and disseminating it. The Centre's website provides information about research, results and experience. The information is targeted at all relevant groups, including professional builders, owners of small buildings, housing association board members, property owners and others involved in the building process in any capacity.
- **Municipal energy and climate advisory services**: Advisory services provide impartial, free, technologically neutral and commercially independent advice to households, companies, housing associations and organisations. This can be done by telephone, email or face-to-face.
- **Renoveringsinfo.se information website**: An initiative of the NRC and Svensk Byggtjänst AB that aims to improve knowledge and distribute information to help operators in the industry carry out renovations efficiently. The website collects opinion pieces, news, examples of renovation projects, research and comprehensive information on specific renovation measures. The news section is a subscriber service, but the other parts of the website are free.
- The Swedish authorities, particularly the Swedish Energy Agency, have developed **web-based tools** to disseminate information about energy consumption and energy efficiency to specific target groups. The information initiatives are targeted at households, companies and authorities.
- **Energikalkylen** is a web-based calculation programme which provides households with information about energy efficiency.

- **Halvera Mera and the Rekorderlig Renovering method:** This is to identify cost-effective measures with a view to halving the energy consumption of buildings, although the improvement in energy efficiency will vary between the buildings concerned. The aim is to increase energy efficiency when property owners renovate their buildings. It provides owners with a systematic overview of the renovation and energy efficiency improvement needs of individual buildings to help inform their decisions in this area, with a focus on indoor environment, energy consumption and knowledge-building.

Skills

- **Training programmes for low-energy buildings:** Capacity-building programmes for low energy consumption in buildings targeted at various building industry operators such as architects, engineers, customers, technicians, installers, site managers and teachers of secondary school building courses.
- **Energilyftet** is a free web-based training course on low-energy building aimed at customers, architects, engineers, building project managers, administrators and control technicians.

Other useful information

- 63% of apartment blocks (104 000) had an EPC and 5% of them fulfil the requirement for NZEB (i.e. energy classes A-C) by 2019. 55 675 non-residential buildings had an EPC and 14% of them fulfil the requirement for NZEB (i.e. energy classes A-C). Only 22% of houses (486k) have had an EPC made by 2019. 15% of houses with ‘NZEB grade’ (A-C) until 2019.

Areas for potential improvement compared to best practices

It could be useful to consider:

- further specifying investment needs and budget allocation related to specific policies.

Annex I - 2014-2020 ERDF and Cohesion Fund investments in energy efficiency

Member State	Planned EU amount (EUR)	Selected EU amount (EUR)	Declared EU amount (EUR)
AT	31.872.819	25.139.023	11.929.198
BE	81.235.213	47.763.419	11.899.385
BG	380.246.531	353.662.893	298.357.199
CY	57.000.000	52.337.971	20.463.341
CZ	1.220.940.318	1.100.392.089	506.191.024
DE	1.215.131.430	858.320.227	263.451.326
DK	41.451.729	36.980.448	6.986.903
EE	277.183.028	168.077.316	124.322.488
ES	1.705.517.673	606.879.327	275.356.585
FI	51.120.487	11.966.765	6.902.895
FR	806.103.679	676.790.592	276.521.668
GR	591.226.911	798.078.998	254.235.287
HR	291.810.805	537.474.508	179.450.844
HU	1.359.401.885	1.159.139.745	402.588.378
IE	84.500.000	115.491.108	42.734.559
IT	1.285.250.639	822.416.859	230.968.391
LT	515.212.980	405.892.697	234.849.936
LU	3.610.915	3.754.826	1.852.503
LV	348.822.761	290.869.331	87.508.984
MT	20.212.701	2.200.661	4.302.404
NL	54.380.806	60.539.707	26.982.133
PL	2.460.721.406	2.342.438.226	1.060.469.647
PT	624.958.895	372.059.974	44.486.717
RO	1.186.170.213	1.056.086.698	190.979.465
SE	85.801.400	95.639.740	36.350.393
SI	220.213.527	236.841.245	126.720.071
SK	666.975.034	689.832.312	325.796.892
TC	203.469.754	188.146.240	58.528.354
UK	348.694.151	338.385.002	106.206.827
Total	16.219.237.691	13.453.597.946	5.217.393.795

Categories 013, 014, 068 as of end-2019

- 013: Energy efficiency renovation of public infrastructure, demonstration projects and supporting measures
- 014: Energy efficiency renovation of existing housing stock, demonstration projects and supporting measures
- 068: Energy efficiency and demonstration projects in SMEs and supporting measures