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Accelerating the EU's green transition

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ACCELERATING THE EU'S GREEN TRANSITION

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ABSTRACT

Accelerating the EU's green transition

The EU's ambitious Green Deal aims at achieving net zero emissions by 2050. The EU is starting from a relatively good position. It has successfully reduced greenhouse gas emissions over the past decade. But further efforts are needed to reach the net zero target. These include an extension of emission trading to agriculture and the phase-out of generous subsidies for fossil fuels. Such efforts should be complemented by additional measures to shift to clean energy, notably more integrated electricity markets and deeper capital markets that provide the necessary investment in new technologies. Accelerating the green transition will also involve costs for displaced workers. Bolstering workers' mobility and training will help improve labour reallocation and reduce transition costs.

JEL classification codes: H23; Q15; Q18; Q42; Q48; Q58; R48

Keywords: European Union, climate change mitigation, agriculture, energy, transport

This Working Paper relates to the 2023 OECD Economic Survey of European Union and euro area (https://www.oecd.org/economy/euro-area-and-european-union-economic-snapshot/)

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Accélérer la transition écologique de l'Union européenne

Dans son ambitieux Pacte vert, l'UE s'est fixé pour objectif de parvenir à la neutralité carbone en 2050. Sa position de départ est relativement bonne. Elle a su réduire ses émissions de gaz à effet de serre (GES) au cours des dix dernières années. De nouveaux efforts sont néanmoins nécessaires pour parvenir à la neutralité carbone. Il s'agit d'élargir le champ d'application des échanges de quotas d'émission à l'agriculture et d'éliminer progressivement les généreuses subventions aux énergies fossiles. Ces efforts devraient être complétés par d'autres mesures pour évoluer vers les énergies propres, à commencer par le renforcement de l'intégration des marchés de l'électricité et l'approfondissement des marchés de capitaux qui assurent les investissements nécessaires dans les nouvelles technologies. L'accélération de la transition écologique aura aussi un coût pour les personnes dont l'emploi aura été supprimé. Favoriser la mobilité des travailleurs et leur formation contribuera à améliorer le redéploiement de la main-d'œuvre et à réduire les coûts de transition.

Classification JEL: H23; Q15; Q18; Q42; Q48; Q58; R48

Mots Clés: l'Union européenne, atténuation du changement climatique, agriculture, énergie, transport

Ce Document de travail a trait à l'Étude économique de l'OCDE de l' Union européenne et zone euro 2023 (https://www.oecd.org/economy/euro-area-and-european-union-economic-snapshot/)

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Accelerating the EU's green transition

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Introduction

Over the past decade, the European Union (EU) has reduced greenhouse gas (GHG) emissions through improvements in energy efficiency, and a gradual switch to less polluting energy sources, including an expansion of renewables. However, emission reduction happened mostly in energy and industrial sectors covered by the EU's Emission Trading System (ETS). This also reflects lower abatement costs in these carbon-intensive sectors. Sectors not covered by the ETS, notably agriculture, buildings, and transportation, have contributed little to the overall emission reduction. Looking ahead, further efforts are needed across all sectors, but particularly in non-ETS sectors, to reach the ambitious net zero emission target by 2050. This entails using the entire toolbox of mitigation policies, including stronger carbon pricing, subsidies for new technologies, and regulatory measures.

This paper provides recommendations to achieve emission reductions effectively and equitably, based on the *2023 OECD Economic Survey of the European Union and the euro area* (OECD, 2023[1]). The transition to a low-carbon economy will have to overcome challenges at the Member State, EU, and international level. But there are also opportunities, as Russia's war of aggression against Ukraine increased the impetus to speed up investments in clean energy to secure energy supply. This paper focuses on the internal market reforms needed to achieve the EU's climate change mitigation objectives. A discussion of climate change adaptation in EU countries can be found in *OECD Environmental Performance Reviews*.

The remainder of the paper is structured as follows. The first section reviews progress towards the new emission reduction targets. An overview of the main mitigation policies to reach the new emission reduction targets follows. The third section discusses mitigation policies to reach the net zero emission target by 2050 in a more cost-effective way. The fourth section focuses on policies for the three main emitting sectors: agriculture, energy, and transportation. The final section concludes with a discussion of policies to reduce reallocation costs for workers affected by the green transition.

Progress towards net zero

The main objective of the EU's climate policy is to achieve net zero GHG emissions by 2050 (European Commission, 2020[2]). In addition, there is an intermediate target of reducing GHG emissions by 55% in 2030 (compared to 1990). Other targets include increasing the share of renewables to 42.5% of final

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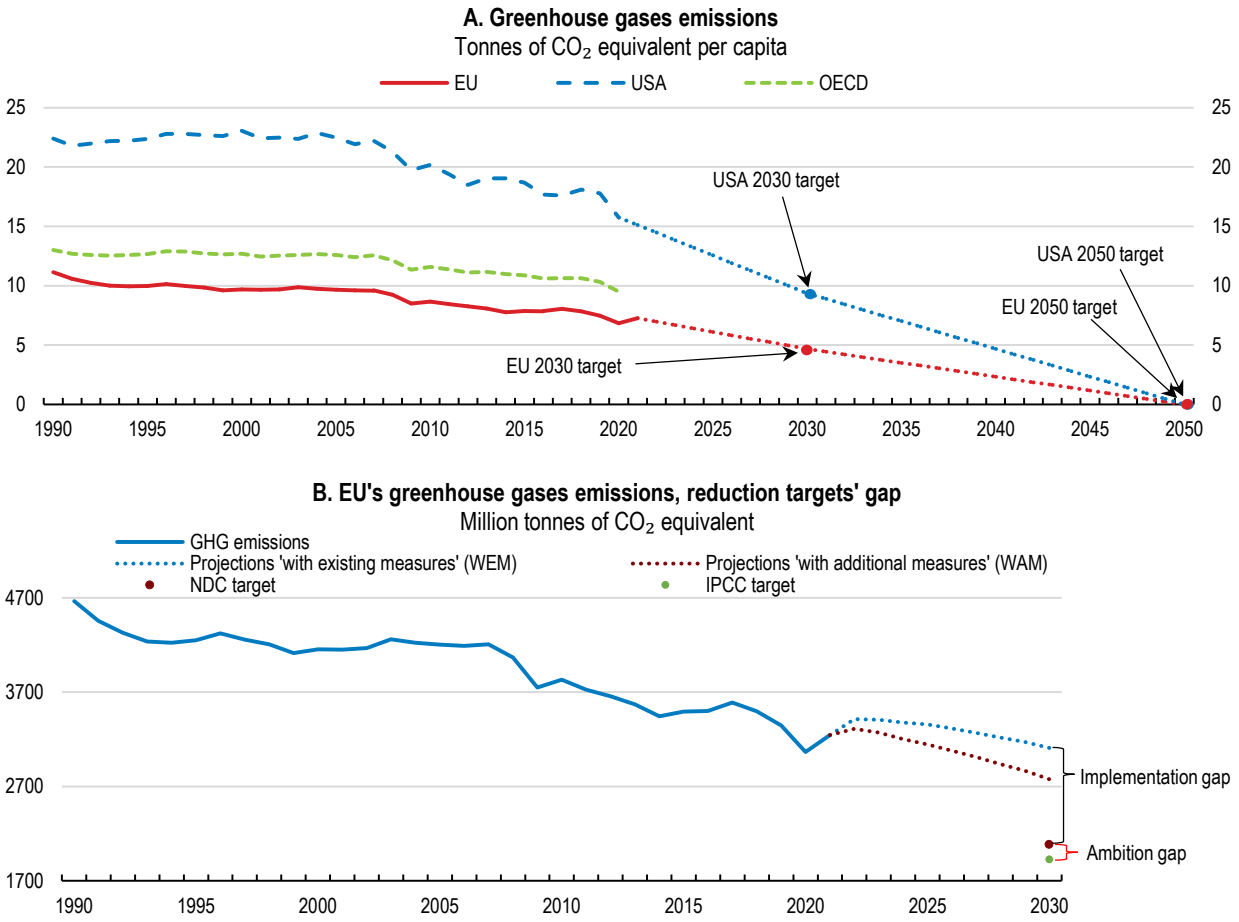
energy consumption by 2030, provided that the agreement on a revised Renewable Energy Directive is adopted, and reducing final energy consumption by at least 11.7% by 2030 (compared with the energy consumption forecasts for 2030 made in 2020).

The EU is starting from a relatively good position to reduce emissions: it has reached its previous climate targets for 2020, including the targets for GHG emissions reductions and the share of renewable energy in final energy consumption. GHG emissions were reduced by 34% between 1990 and 2020, well above the 20% reduction target (EEA, 2021[3]). Similarly, the share of renewables in energy consumption stood at 21.3% in 2020, above the 20% target. Nonetheless, the EU's new and more ambitious target of a 55% reduction in GHG emissions by 2030 (relative to 1990) will require a significant acceleration of emission reduction efforts (Figure 1). To illustrate the challenges ahead, reaching the 2030 target requires a doubling of the rate of emission reductions relative to 1990 and 2020 (European Environment Agency, 2022[4]). Similarly, the rate of deployment of renewables would need to triple compared to the period 1990 to 2020 to reach the new target of 42.5% of renewables in the energy mix by 2030 (IEA, 2022[5]).

Figure 1. Reductions in greenhouse gas emissions need to accelerate

Net greenhouse gases emissions, tonnes of CO_2 equivalent per capita

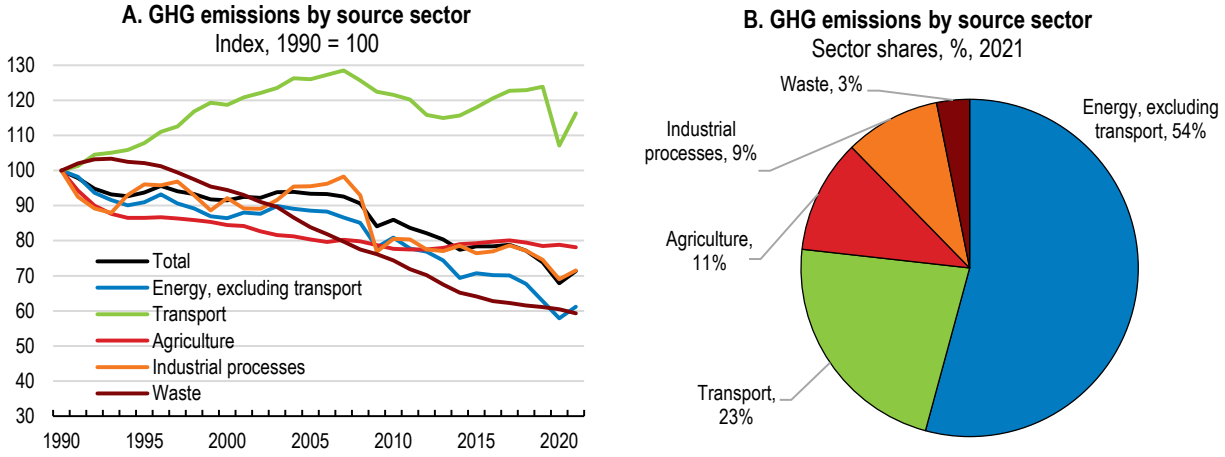


Note: Greenhouse gas (GHG) emissions include those from the land use/land use change and forestry sector (LULUCF). Data on the EU's GHG emissions for 2021 are taken from the European Environment Agency (2022). In Panel B, projections "with existing measures" (WEM) refer to 2019 EU policies and "with additional measures" (WAM) to new policies under the more ambitious FIT for 55 package. GHG emissions as projected by the respective country. NDC stands for Nationally Determined Contributions under the 2015 Paris Agreement. IPCC stands for the Intergovernmental Panel on Climate Change. The IPCC target is equivalent to a 43% reduction compared to 2019 emissions, which is needed to limit global warming to around 1.5°C according to the IPCC (2022).

Source: Eurostat; OECD Environment database; OECD Population database; European Environment Agency; IPCC (2022[6]); United Nations (2022[7]); and OECD calculations.

The sectors that produce the most emissions are energy (power and heat generation, including in industry and buildings), transport and agriculture, accounting for nearly 90% of total EU GHG emissions (Figure 2). Over the past two decades, the most notable emission reductions happened in sectors covered by the ETS, which includes energy-intensive industry and power generation. GHG emissions declined by 41% in these sectors between 2005 and 2020, driven mainly by power generation. This also reflects lower abatement costs of these carbon-intensive sectors. In contrast, emissions in transportation increased (except during the pandemic), while they remained flat in agriculture (EEA, 2021[8]). Achieving emission targets will require all sectors to reduce their emissions and can be reached with a substantial acceleration of emission reductions in agriculture, buildings, and transportation. Such an acceleration of emission reductions could prove much more difficult due to the higher abatement costs in in agriculture, buildings, and transportation.

Figure 2. Energy, transport, and agriculture account for a large share of emissions



Note: Excluding land-use, land-use change and forestry (LULUCF).
Source: OECD Environment Statistics database.

The EU's climate mitigation policies

The EU decided on a set of more ambitious climate mitigation policies in 2023 (Box 1). The EU has been a frontrunner in mitigation policies and introduced in 2005 the world's first and so far, the largest emission trading system. Apart from emission trading, climate objectives are pursued through a toolbox of mitigation policies, including subsidies as well as regulatory measures. The latter include stricter minimum energy efficiency standards for buildings, and more stringent emissions standards for cars. Taxation is mainly the domain of EU countries, although the EU sets minimum tax rates for energy, including transportation and heating fuels.

Box 1. The EU's new climate mitigation policies

The 'Fit for 55' package is a set of proposals to revise the EU's climate-related legislation in order to achieve at least 55% emissions reductions by 2030 (relative to 1990, against a previous target of 40%), and net zero emissions by 2050 (European Council, 2023[9]). The 2050 net zero emission target is set at the EU level, but the Effort Sharing Regulation sets 2030 emission reduction targets for EU countries to help the EU reach net zero CO_2 emissions by 2050. The 'Fit for 55' package includes, among other things, the following policies:

- Extension of the EU's emissions trading system (ETS) to maritime transport. The ETS will apply to intra-European Economic Area (EEA) voyages and to half of the emissions on voyages from and to the EEA from third countries. The ETS already covers power generation, energy-intensive industry, and intra-European aviation.
- A more ambitious emission-reduction target for ETS sectors and emission sources, amounting to a 62% reduction of emissions in 2030 (compared to 2005 levels), against the previous 43% target.
- Creation of a separate new emission trading system for fuel combustion in buildings, road transport and industry (ETS 2). The objective is to reduce emissions in road transportation, buildings and industrial heating processes by 42% in 2030 (compared to 2005 levels). The carbon price is expected to be lower in the new ETS than in the traditional ETS. A potential merger of the new ETS with the traditional ETS will be reviewed in 2031.
- More ambitious emission reduction targets for non-ETS sectors: The Effort Sharing Regulation (ESR) sets legally binding 2030 emissions reduction targets for each Member State for sectors not covered by emission trading. These current non-ETS sectors are responsible for nearly 60% of the EU's total emissions and include road transport, buildings, agriculture, waste management and small industry, although emission trading will be expanded to fossil fuel producers in transport and buildings (see above). The EU-level emission reduction target for 2030 for these sectors was increased from 29% to 40% (compared to 2005 levels), with updates for national targets. However, there is no target for emission reductions in these sectors beyond 2030.
- More ambitious targets for net CO_2 removals from the land use, land-use change and forestry (LULUCF) sector. CO_2 removals by the LULUCF sector are accounted for in the overall 2030 emission reduction target. The target for net CO_2 removals from the LULUCF sector was increased from 225 million tonnes (Mt) of CO_2 equivalent to 310 Mt CO_2 equivalent in 2030. This translates into higher national targets for 2030 for the increase of CO_2 removals.
- Starting in 2026, a carbon border adjustment mechanism (CBAM) will impose a charge on the emissions embodied in specific carbon-intensive EU imports, including aluminium, cement, electricity, fertilisers, hydrogen, iron, and steel, based on their carbon content. The importer will be charged the EU ETS price, deducting any carbon price effectively paid in the country of origin. CBAM will be based on the actual emission content of goods, declared by importers and verified by experts, thus allowing to take into account the effect of non-pricing policies on the emission content.
- Phasing out of the free allocation of emission allowances to aviation by 2026. Free emission allowances will also be phased out for sectors covered by the CBAM over a nine-year period (from 2026 to 2034). In industry and transport, a decision has yet to be taken on the phase-out of free ETS allowances.
- A revised Energy Taxation Directive will broaden the energy tax base. Tax exemptions and reduced rates, including for biomass and gas heating, will be phased out and the tax base will be expanded to include fuels for intra-EU aviation and maritime transport by 2033. It will also set minimum energy tax rates for transportation and heating fuels based on energy content and environmental performance, with fossil fuels being taxed most heavily. So far, energy taxation was based on volume (see below). Discussions are still ongoing in the Council and any change to the Energy Tax Directive will require unanimity.
- More stringent emission standards for new vehicles foresee a complete halt to the sale of combustion engines from 2035, except for internal combustion engine cars running on e-fuels. This means that permitted emissions would be gradually lowered so that after 2035 new vehicles would be only allowed to emit zero CO_2.

The RePowerEU plan is a response to Russia's war of aggression against Ukraine and aims at making the EU independent from Russian fossil fuels before 2030 and strengthen energy security. The plan proposes to revise the Recovery and Resilience Facility to make available EUR 225 bn in unused loans and 20 bn in unused grants. Its main elements include:

- An increase of renewable energy sources in the overall energy mix to at least 42.5% by 2030. This should be accomplished via the tripling of the level of solar photovoltaic and wind capacity from 350 GW in 2021 to 1080 GW by 2030 (600 GW of solar and 480 GW of wind).
- Additional investments of EUR 245 billion in energy security, including 210 billion in gas pipelines, LNG terminals and the power grid by 2030.

Source: European Council (2023[9]).

Meeting the more ambitious emission targets will require higher carbon pricing, together with more stringent regulations. Based on model simulations conducted for this *Survey*, and with the assumed regulatory changes, the ETS carbon price would need to increase roughly five-fold to reduce GHG emissions by 55% in 2030 (relative to 1990 levels), compared to the previous target of 40% emission reductions in 2030. This translates into an ETS price of roughly EUR 210 per CO_2 tonne in 2030 (in 2023 prices), up from around EUR 90 per CO_2 tonne in mid-June 2023 (). The higher ETS carbon price reflects that additional emission reduction efforts in sectors covered by the ETS will need to happen in activities with higher abatement costs, now that cheaper abatement options have already been exhausted. Such an increase in the carbon price will also lead to economic costs in terms of real incomes and competitiveness (Box 1). Still, these costs are necessary to avoid the potentially much higher economic costs from failure to reduce global emissions and limit climate change, which are not considered in the simulations.

Figure 3. The ETS price has risen recently

ETS carbon price, Euro per CO_2 tonne

Source: Investing.

Carbon pricing is the first best and the most efficient measure to reduce emissions. In this regard, it is welcome that the EU is extending carbon pricing to maritime transport, road transport and heating fuels (see below). To address the impacts of higher carbon prices on households most affected by the green transition, ETS revenues are being given back to countries, including via the Social Climate Fund (see below). However, given the need to accelerate the green transition, carbon pricing alone will not be sufficient to reach net-zero emissions by mid-century (D'Arcangelo et al., 2022[10]). Simulations conducted for this *Survey* show that reaching the more ambitious 2030 emission reduction target will also require more stringent emission standards for vehicles, improvements to energy storage, and a more integrated European electricity market (Chateau, Miho and Borowiecki, 2023[11]). Reducing barriers to the deployment

of clean energy, including lengthy permitting processes, may have a strong impact in the short term. In addition, subsidies can help lower the costs of new low-emission technologies and accelerate their adoption, although they can be costly and inefficient. Also, carbon pricing can have potentially important social repercussions and there are concerns that higher carbon pricing will lead to a political backlash. Ways to increase public acceptance of carbon pricing include using carbon pricing revenues for income tax reductions, for example (Dechezleprêtre et al., 2022[12]).

The ETS is the cornerstone of the EU's climate mitigation policy as it determines a market-based carbon price and maintains a level playing field across countries consistent with the Single Market. A carbon price should in principle apply to all polluting activities in line with their environmental impacts to equalise burden sharing and align marginal abatement incentives. Currently, the ETS covers the main emitting sectors power generation, energy-intensive industry, and intra-European aviation. The ETS will be extended to all domestic shipping emissions and half of emissions from international shipping, and a new emission trading system will be established for road transport and heating fuel suppliers as well as fuels for industrial heating processes currently not covered by the ETS, which is welcome (Box 1). The current limitation of emissions trading to industry and energy has historical reasons and no large country in the world currently employs uniform carbon pricing. When the ETS was set up in 2005, only large industrial enterprises and utility companies had emission monitoring and reporting systems in place to verify and price emissions. Since then, the ETS has been successful in reducing emissions (Dechezleprêtre, Nachtigall and Venmans, 2018[13]; Bayer and Aklin, 2020[14]).

The ETS is now well-established and widely accepted, suggesting it can be extended to shipping, transport and heating fuels but also to other sectors such as agriculture. The expansion of emission trading will require setting up systems for monitoring and reporting emissions. Pilots are already in place for agricultural emissions from livestock, peatland-rewetting, and agroforestry (European Commission, 2021[15]). These could serve as a starting point and be subsequently scaled up, although they are technically not easy to implement on a bigger scale. Moreover, expanding carbon pricing will take time. Other approaches to remove bottlenecks for the implementation of the transition, such as reducing barriers to the deployment of clean energy, may have a stronger impact in the short term.

The extension of emission trading will also involve costs. This reflects that sectors such as agriculture, transportation and buildings are difficult to integrate into emission trading. An exception is suppliers of transportation and heating fuels for which ETS 2 will apply from 2027 (see Box 1). There are many smaller producers involved that may have difficulties affording abatement technologies. Households would be affected by higher agricultural and fuel prices, although they will not be directly involved in emission trading. Moreover, monitoring costs are high as these sectors do not have systems in place for emission reporting and verification. Another issue is that emission reductions in current ETS sectors also reflect lower abatements costs of carbon-intensive power generation and energy-intensive industry. Achieving emission reductions in the agriculture and transport sectors could prove much more difficult due to their higher abatement costs. And finally, higher carbon pricing in these sectors will also have an impact on their competitiveness.

Setting legally binding emission targets can strengthen government accountability (D'Arcangelo et al., 2022[10]). In this regard, the overall net zero emission target by mid-century is welcome as it provides a clear long-term objective for governments, households, and businesses. However, the system of complex and overlapping medium-level climate targets may hamper the EU's progress towards emission reductions (see below). For example, achieving the 2030 renewable energy target (achieving 42.5% renewable energy production by 2030) relies on burning biomass, although biomass can be emission-intensive (Figure 4). Burning woody biomass immediately releases CO_2 in the atmosphere, while reforestation takes time. This means that the emission intensity of biomass depends on the time needed for reforestation and the type of feedstock (Brack, Birdsey and Walker, 2021[16]; Schnorf et al., 2021[17]).

Box 2. A Computable General Equilibrium analysis of the economic effects of the EU's 'Fit for 55' policies

The OECD ENV-Linkages model, a dynamic global Computable General Equilibrium (CGE) model, is used to analyse the economic effects of implementing the EU's 'Fit for 55' climate mitigation policies (Chateau, Dellink and Lanzi, 2014[18]). A 'Fit for 55' scenario, where GHG emissions are reduced by at least 55% in 2030 (compared to 1990 levels), is compared to an "EU reference scenario 2020" based on 2019 policies, i.e., a reduction of GHGs emission by 40% in 2030 (compared to 1990 levels). Another comparison is made to a scenario without any climate policy action. The model projects macroeconomic, sectoral, energy and emission trends for the EU as a whole, and for five larger EU economies separately (France, Germany, Italy, Poland and Spain), up to 2035. The policies implemented are based on the EU's 'Fit for 55' policies and national level policies, as described in National Energy and Climate Plans. The model also includes the effects of Russia's war of aggression against Ukraine on fossil fuel demand and prices in the EU. Other model assumptions include rising energy efficiency, although the model does not assume major technological innovations that reduce the costs of clean energy. Labour is uniform in the model, with workers having one type of skill, and labour reallocation from declining sectors (e.g., fossil fuel power generation) to growing sectors (e.g., renewable power generation) is assumed to be frictionless. The results are presented in more detail in the technical background paper for this *Survey* (Chateau, Miho and Borowiecki, 2023[11]).

- The **reference scenario** is calibrated to achieve the same emission reductions and carbon price as the EU Reference Scenario 2020 (European Commission, 2021[19]). It implies an EU-wide GHG emission reduction of 42.5% in 2030 (relative to 1990 values) in net terms, i.e., including emissions from the land use and forestry (LULUCF) sector. This translates into a 40% gross emission reduction (relative to 1990), i.e., excluding emissions from the LULUCF sector.
- The '**Fit for 55' scenario** assumes a more ambitious 2030 GHG emission reduction target for sectors covered by the ETS, rising to 62% from 43% in the reference scenario (relative to 2005). It also includes an increase in the emissions reduction target in 2030 for non-ETS sectors, up to 40% from 29% in the reference scenario. Final energy consumption decreases by 11% relative to 2023 and the share of renewables in the energy mix goes from 32.5% in 2023 to 42.5% in 2030. To achieve these targets, multiple policy instruments are implemented in the model to reflect new EU policies: i) the extension of the EU ETS system to maritime transport, ii) the creation of a carbon border adjustment mechanism (CBAM) for EU ETS sectors from 2026, iii) a new ETS 2 for fuel combustion in buildings, road transport and industry, as well as iv) national policies such as the Effort Sharing Regulation for non-ETS sectors (see above) and coal phase-outs in Germany, France, Italy, and Spain. The scenario also assumes that one third of ETS carbon price revenues are used to finance investment in the electricity grid, with the remaining two thirds given back to households as lump sum payments and subsidies for the take-up of electric vehicles and building renovations to make them more energy efficient.

Under the 'Fit for 55' scenario, the EU is projected to reach its target and reduce GHG emissions by 55% in 2030 (relative to 1990) (Table 1). This reflects, among other things, stronger abatement in the power sector, driven by a faster rollout of renewables, together with stronger energy saving efforts across all sectors. A key assumption is that the need for conventional backup capacity for renewable generation, notably gas, will fall significantly from about 40%-50% to 7% of total electricity generation on the back of improved energy storage and electricity transmission and distribution across the EU. Emission reductions are achieved in large part due to a stronger shift to renewables in Germany and Spain. In contrast, the electricity mix remains more carbon intensive in Poland, where emission reductions are driven by improvements in energy efficiency (Table 2).

Table 1. Economic effects of EU 'Fit for 55' policies in 2030

	Reference scenario	Fit for 55 scenario	Percentage change compared to reference scenario (in %)
Emissions and energy mix			
Total GHG emissions percent reduction vs 1990 (excluding LULUCF)	-42.4	-53.6	-11.2*
Total GHG emissions percent reduction vs 1990 (including LULUCF)	-45.4	-57.2	-11.8*
GHG emissions percent reduction in the ETS sectors vs 2005	-44.3	-59.1	-14.8*
GHG emissions percent reduction in the ETS 2 sectors vs 2005	-33.0	-42.2	-9.2*
GHG emissions percent reduction in the ESR sectors vs 2005	-29.7	-37.5	-7.8*
GHG per capita	5.6	4.4	-21.5
Total final energy consumption (million tons of oil equivalent)	1011.6	955.5	-5.5
Electricity generation (terawatt hour)	3063.7	3650.7	19.2
Share of renewables in electricity generation	57.1	70.3	13.2*
Share of fossil fuels in electricity generation	24.3	10.2	-14.1*
Macroeconomic effects			
Carbon price (EUR at 2020 prices) for EU-ETS	30.4	177.8	485.6
Real GDP per capita (EUR at 2014 prices)	32493.2	32157.3	-1.0
Real gross fixed investment (billion EUR at 2014 prices)	2.3	2.3	-0.5
Real private consumption (billion EUR at 2014 prices)	9.2	9.2	-0.5
Employment (million)	212.2	211.7	-0.2

Note: * denotes percentage point. Simulations are conducted using the OECD ENV-Linkages model. The table shows results from a scenario introducing the EU 'Fit for 55' targets, which means that the EU reduces net GHG emissions by 55% in 2030 (relative to 1990). Results are shown relative to the reference scenario, which is based on 2019 policies, meaning that the EU reduces its net GHG emissions by at least 42.5% in 2030 (relative to 1990). Non-EU countries are assumed to reduce emissions as in the reference scenario.
Source: Chateau et al. (2023[11]).

Comparison of economic costs under 'Fit for 55' vs. the scenario without climate action. Overall, the economic costs of climate policies are higher when compared to a scenario of no policy action taken. In such a scenario, there is no emission trading in the power sector and energy-intensive industries and no regulatory measures to reduce emissions in transport and buildings sectors. Compared to such a scenario of no policy action, 'Fit for 55' policies are projected to lead to a loss in GDP per capita of 1.2% in 2030. As 'Fit for 55' policies are being implemented gradually until 2030, higher economic effects are projected to materialise only after 2030, leading to a loss in GDP per capita of 2.3% in 2035 (compared to the scenario of no policy action).

Comparison of economic costs between the two scenarios with climate action. The 'Fit for 55' policies are projected to lead to a moderate loss in GDP per capita of 1% in 2030 compared to the reference scenario, reflecting increasing production costs on the back of higher carbon pricing. Countries with a current larger emission intensity of production are projected to see higher income losses, notably Poland. Overall, employment will slightly decrease but this hides differences across countries.

The economic effects already consider benefits from using carbon pricing revenues to raise investment in the energy transition, notably in electricity grids. Without such growth-enhancing measures, the negative effect of climate policies on GDP would be higher. Other downside risks to the projections include higher-than-expected inflation, continued supply chain problems and skill shortages, as well as a slower-than-expected energy transition. Similarly, labour market rigidities are likely to raise the costs of labour reallocation across countries and sectors, adding to the costs of the green transition.

Under 'Fit for 55' policies, higher carbon pricing will lead to a loss of competitiveness of energy-intensive industries, as measured by losses in market share of energy-intensive industries on world markets, and losses to their gross output (compared to the reference scenario). Additional projections show that CBAM may mitigate only partly the loss of competitiveness of energy-intensive industries in the EU (Chateau, Miho and Borowiecki, 2023[11]).

Table 2. Economic effects of EU 'Fit for 55' policies in 2030, by country

Percentage changes compared to the reference scenario (in %)

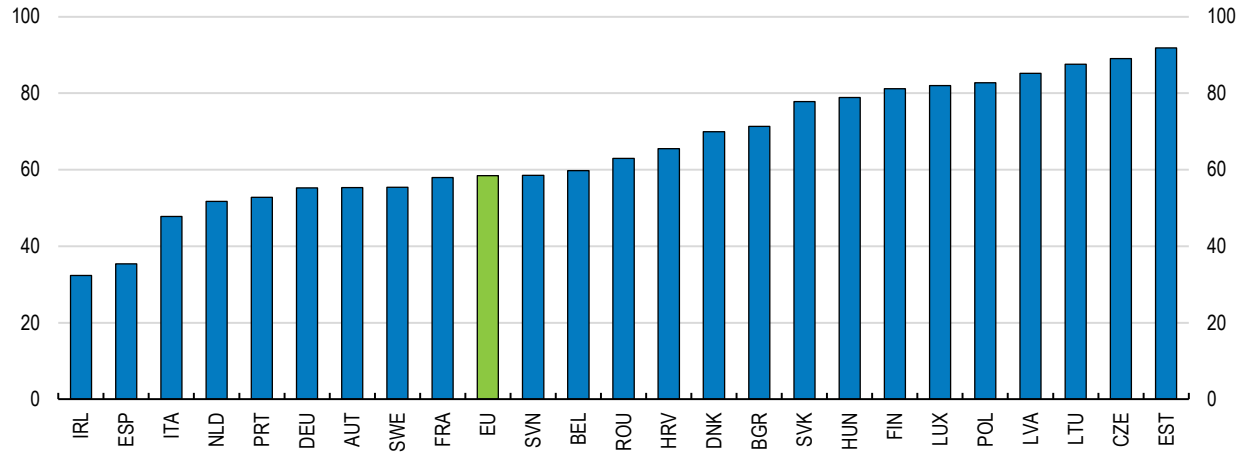
	EU	DEU	ESP	FRA	ITA	POL
Total GHG emissions reduction	-11.2*	-10.5*	-14.2*	-4.9*	-10.0*	-21.5*
GHG per capita	-21.5	-26.6	-19.9	-9.4	-18.4	-33.3
Total final energy consumption	-5.5	-5.6	-8.0	-2.0	-5.0	-11.0
Electricity generation	19.2	29.9	7.9	17.4	16.1	31.8
Share of renewables in electricity generation	70.3	87.2	87.4	44.2	73.9	73.0
Share of fossil fuels in electricity generation	10.2	12.8	3.5	2.3	26.1	27.0
Share of renewables in electricity generation, percentage point change compared to the reference scenario	13.2*	24.9*	4.9*	1.1*	19.9*	43.2*
Share of fossil fuels in electricity generation, percentage point change compared to the reference scenario	-14.1*	-24.9*	-5.3*	-2.5*	-19.9*	-43.2*
Real GDP per capita	-1.0	-1.1	-1.1	-0.6	-1.0	-3.0
Real gross fixed investment	-0.5	-0.5	-0.5	-0.3	-0.6	-0.8
Real private consumption	-0.5	-0.6	-0.3	-0.3	-0.6	-1.8
Employment	-0.2	-0.2	-0.2	-0.1	-0.2	-0.8
Market share of energy-intensive industries**	-1.0*	-0.2*	-0.1*	0.1*	0.0*	-0.1*
Real gross output of energy-intensive industries**	-3.9	-2.6	-4.9	-2.3	-2.6	-8.7

Note: * denotes percentage point. ** Energy-intensive industries are iron and steel, chemicals, pulp and paper, non-metallic minerals and non-ferrous metals. Simulations are conducted using the OECD ENV-Linkages model. The table shows results from a scenario introducing the EU 'Fit for 55' targets, which means that the EU reduces emissions by 55% in 2030 (relative to 1990). Results are shown relative to a reference scenario, which is based on 2019 policies, meaning that the EU reduces its emissions by 42.5% in 2030 (relative to 1990). Non-EU countries are assumed to reduce emissions as in the reference scenario.
Source: Chateau et al. (2023[11]).

The analysis also studies the effect of Russia's war against Ukraine on reaching emission reduction targets. Without the war, the EU would have had access to cheaper Russian fossil fuels, resulting in 0.6% higher GDP per capita in 2030. But lower fossil fuel prices also lead to higher demand for fossil fuels. Such initially higher fossil fuel demand implies higher mitigation costs under the 'Fit for 55' scenario, leading to a loss in GDP per capita of 1.2% (relative to the no-war reference scenario), compared to a loss in GDP per capita of 1% under the 'Fit for 55' scenario with war in Ukraine (relative to its respective reference scenario). This reveals important costs from postponing climate change mitigation.

Figure 4. Biomass accounts for a large share of renewable energy supply

Biomass as a share of renewables total energy supply, %, 2021



Source: OECD Energy Statistics database; and OECD calculations.

The structure of medium-level targets with multiple objectives makes it difficult to find market-based solutions that minimise abatement costs. For instance, if countries are not on track to meet the renewable energy target for 2030, additional investment in renewables will be needed. Such investment will not be driven by abatement cost considerations, but by the impetus to expand renewables to reach the target. Such an investment boost may lead to shortages of labour and key component and raw materials, including lithium, nickel and cobalt needed for renewables. In principle, a more cost-efficient approach would entail pricing all emissions and letting market forces determine the appropriate technology mix with lowest abatement costs to reduce emissions. Carbon pricing leaves the decision on when and where to cut emissions to those who know best about their abatement costs (OECD, 2005[20]).

But carbon pricing alone will not be sufficient to reach emission targets. Multiple market failures call for comprehensive mitigation strategies relying on a policy mix involving pricing and non-pricing policies. For instance, new technologies that are not yet cost competitive may require subsidies, including carbon capture and green hydrogen. The EU's flagship research and development programme Horizon Europe provides funding of EUR 95.5 billion (or 4.7% of the 2021-27 EU budget) for such technologies. Moreover, revenues from the ETS are used to support innovation, including EUR 40 billion (or 2% of the EU budget) for low-carbon technologies under the Innovation Fund (assuming an ETS price of EUR 75 per tonne of CO_2). Despite these efforts, the pace of climate-related innovation as measured by patent filings and venture capital funding going to climate-related start-ups has decreased over the past half decade (Cervantes et al., 2023[21]). This also reflects that EU countries' support for renewables mainly benefits mature technologies such as biomass, solar and wind energy (see below). This is despite the EU's state-aid framework, which encourages EU countries to steer subsidies towards new technologies that are not yet competitive.

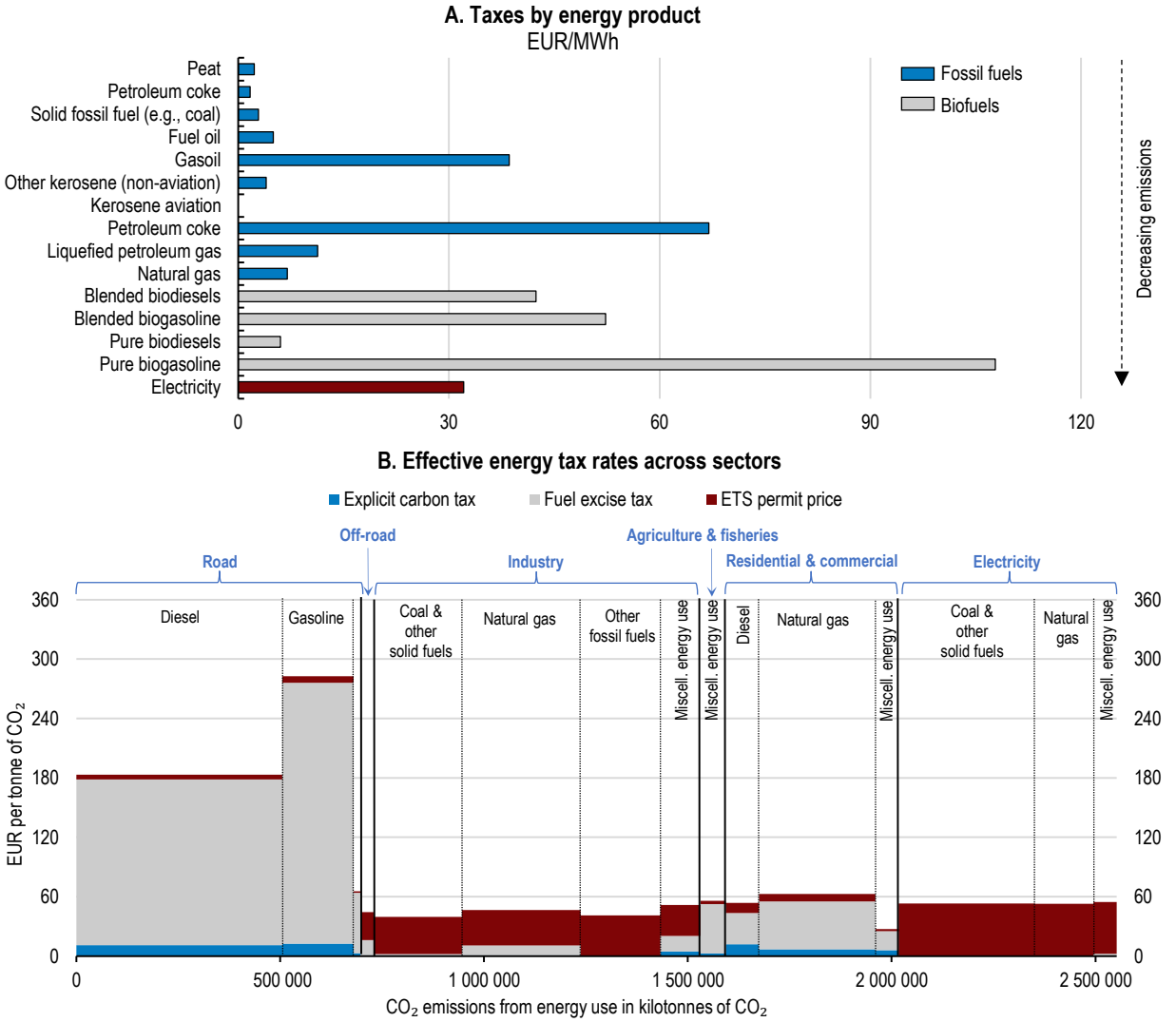
Frequent policy changes may increase the costs of achieving environmental objectives. The EU has recently set more ambitious emission reduction targets for 2050, which is welcome as it provides a clear path for emission reductions going forward. However, the overall 2050 target is complemented by more stringent intermediate 2030 targets for emissions, renewables, and energy efficiency (European Council, 2023[9]). All these changes to intermediate targets have been further compounded by the global energy crisis, which prompted the European Commission to call for a diversification of fossil fuel supplies and additional investments in gas pipelines and LNG terminals under the RePowerEU plan. These measures were taken by the EU Member States with a due regard to securing energy supplies and preventing a deterioration of their competitiveness. The EU is trying to accelerate the pace of the transition, which is welcome. Nonetheless, frequent policy changes may lead to adverse social consequences, undermining

social acceptance of climate policy. They may also lock in sub-optimal technology, making the transition more costly. Such contradictions and frequent alterations may come at the expense of the stability and predictability of climate policy. Policy stability is crucial to attract the private investment necessary to make the green transition.

Policy consistency is missing as national support for fossil fuels contradicts EU-wide decarbonisation efforts. Fossil fuels continue to benefit from tax reductions and exemptions, such as exemptions on aviation and maritime fuel as well as reduced rates for heating gas (Figure 5, Panel A). The EU Commission proposed to reform EU-wide minimum energy tax rates for energy products, including for fossil fuels, to encourage energy efficiency and the use of sustainable fuels. According to the proposal, exemptions, and reduced rates for fossil fuel should be phased out, and taxation of fuel would no longer be based on volume but on energy content and environmental performance, with fossil fuels being taxed most heavily. This would also include extending the energy tax base to fuels for aviation and maritime navigation, as well as to biomass. However, the proposal foresees only a gradual phase-out of reduced rates and exemptions for natural gas, maritime and aviation fuels until 2033, which is too late to help meet ambitious emission reduction and energy efficiency targets for 2030. Meanwhile, tax exemptions and reduced rates for fossil fuels reduce their effective carbon price (European Court of Auditors, 2022[22]) (Figure 5, Panel B). This is particularly a concern in cases when such exemptions and reduced rates lead to a lower effective carbon price than the ETS price. First, the EU should broaden the energy tax base by phasing out reduced rates and exemptions to make taxation of fossil fuels uniform across sectors and different uses of energy. Second, minimum tax rates for fossil fuels should be introduced that are based on energy content and environmental performance, as proposed by the Commission. Such minimum tax rates should be the same for all non-ETS sectors to ensure equal burden sharing and efficiency. Thereafter, these minimum tax rates can be gradually increased to the ETS price level where this is not the case yet. Such changes will be difficult to adopt as changes to energy taxation require unanimity among EU countries.

Apart from carbon pricing and subsidies, the EU also sets regulations and standards for agriculture, transportation, and buildings, among other things. In agriculture, the Nitrate Directive and the Water Framework Directive set stringent standards for water quality and nitrous oxide emissions from fertiliser use. In transportation, the EU announced a complete halt to the sale of combustion engines from 2035, with potential exceptions for vehicles powered exclusively by e-fuels. Another area is the insulation of buildings, where the EU Commission proposed minimum energy performance standards to increase energy savings, which will be key to reduce emissions from buildings (European Council, 2023[9]).

Figure 5. Fossil fuels benefit from a favourable tax treatment



Note for Panel B: Data refers to EU member countries that are also members of the OECD (22 countries). Effective carbon rates (ECRs) have been averaged by sector and energy category. Year of coverage is 2021, taxes as of 1st April 2021. ETS coverage estimates are based on OECD (2021[23]), with adjustments to account for recent coverage changes. Instrument coverage: specific fuel excise taxes, explicit carbon taxes, ETS (Emission Trading System) permit price includes German National ETS besides EU-ETS. No fossil fuel subsidies or other GHG are accounted for. The ETS permit price is the price of tradable emission permits in mandatory emissions trading and cap-and-trade systems representing the opportunity cost of emitting an extra unit of CO_2 equivalent, regardless of the permit allocation method. "Off-road" and the third portion of "Road" refer to "Miscellaneous energy use".

Source: European Court of Auditors (2022[22]), and OECD (2022), Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action, OECD Series on Carbon Pricing and Energy Taxation, OECD Publishing, Paris, https://doi.org/10.1787/e9778969-en.

Towards more efficient mitigation policies

Phasing out free allowances could improve the effectiveness of the ETS carbon pricing. Likewise, aligning effective carbon rates across non-ETS sectors and countries would improve cost-efficiency of policy and lead to a more equal burden sharing between sectors and countries. Moreover, the EU could use an internal carbon price (or shadow carbon price or value) for budgeting and planning purposes to improve cost-efficiency of budgetary measures with environmental impact. But mitigation policy is not alone about carbon pricing. Equally, the mitigation policy toolbox includes regulations and standards. In the financial

sector, for instance, reducing overly restrictive regulations could help steer private finance towards sustainable investment.

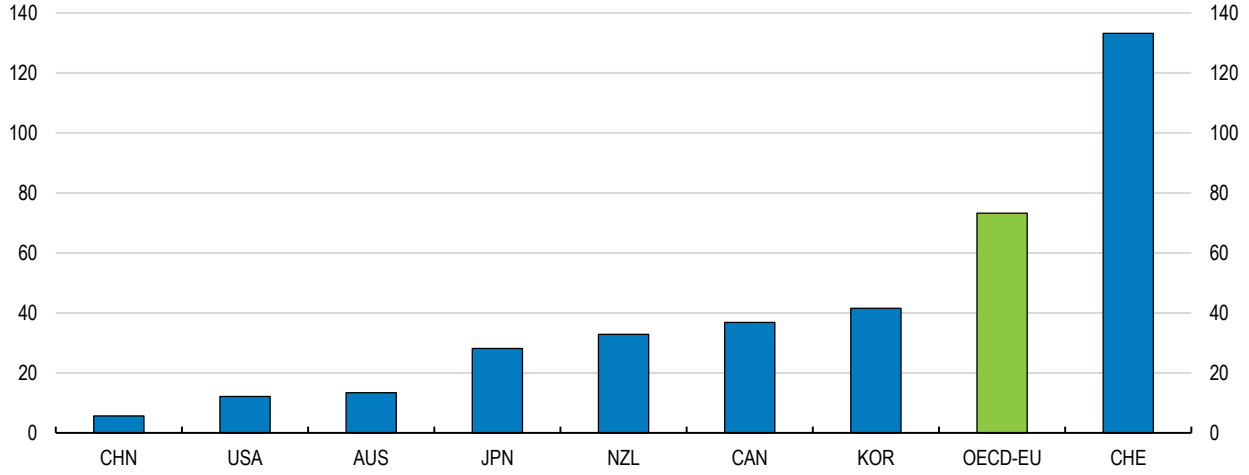
Free allowances reduce the effectiveness of carbon pricing

In principle, there is a unified carbon price in ETS sectors. Under the ETS, producers need to purchase emission allowances covering their carbon emissions via auctions or on the carbon market, where an ETS carbon price is set. However, the free allocation of allowances to industry reduces the effective carbon price compared to the energy sector where no free allocation takes place, muting the price signal. Specifically, industry receives free emission permits, covering 94% of the sectoral emissions in 2021. Such a system of free allowances reduces incentives to innovate and invest in cleaner production processes (Dechezleprêtre, Nachtigall and Venmans, 2018[13]; European Commission, 2019[24]; Pellerin-Carlin et al., 2022[25]). In contrast, the energy sector must buy all its emissions permits via auctions. The EU already announced a gradual phase-out of free ETS allowances over a nine-year period to 2034 for sectors covered by its Carbon Border Adjustment Mechanism, including aluminium, cement, hydrogen, electricity, fertilisers, iron, and steel. Installations that will still benefit from free ETS allowances will need to comply with conditionality requirements, including in the form of energy audits and climate neutrality plans for certain installations. Phasing out free allowances to industry would align effective carbon prices in the ETS system.

The rationale for free allowances has been that industry faces higher international competition than energy generation and could easily relocate production outside the EU, where carbon pricing is lower (Figure 6). Such a situation could result in an increase in global greenhouse gas emissions (so-called carbon leakage). Free allowances imply that most efficient EU firms do not face higher carbon costs compared to international competitors, while at the same time having marginal incentives to reduce emissions from the sale of the credits. The coverage of free allowances in the EU ETS is narrower compared to some other emission trading systems, with free allowances accounting for 43% of annual ETS emission allowances in 2019 (European Commission, 2023[26]; European Court of Auditors, 2020[27]). For example, the emission trading systems of South Korea and the metropolitan region of Tokyo allocate almost all emissions allowances for free (International Carbon Action Partnership, 2023[28]; Korean Ministry of Environment, 2018[29]). The lower share of free allowances reflects that the allocation of free allowances in the EU ETS is based on the risk of carbon leakage. However, the EU ETS treats equally all sectors that are deemed to be at risk of carbon leakage. This means that all sectors included in the carbon leakage list benefit from free allocation, irrespective of their emission intensity or trade exposure. In contrast, the US state of California and the Canadian province of Québec base free allowances on a more nuanced approach to the risk of carbon leakage, resulting in fewer free allowances (California Air Resources Board, 2023[30]; Quebecois Ministry for Environment, 2023[31]). Sectors are divided into low, medium, and high leakage risk based on their levels of emissions intensity and trade exposure. As a result, free allowances covered roughly 25% of total annual emission allowances in California in 2019, while they accounted for 30% of total annual emission allowances in Québec (Galdi et al., 2020[32]). The lower share of free allowances also reflects that both the ETS in California and Québec have a higher coverage of overall GHG emissions, with 75% and 80% of state GHG emissions covered, respectively. This compares to 40% of EU GHG emissions covered by the EU ETS.

Figure 6. The effective carbon price is relatively high

Average net effective carbon rates, EUR per tonne of CO_2 equivalent, 2021



Note: Effective carbon prices are averaged across all GHG emissions, excl. LULUCF, including those emissions that are not covered by any carbon pricing instrument. 2021 Fossil fuel subsidy estimates (component of net ECR).
Source: OECD (2022), Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action, OECD Series on Carbon Pricing and Energy Taxation, OECD Publishing, Paris, https://doi.org/10.1787/e9778969-en.

To avoid carbon leakage, the EU Commission proposed to gradually replace the system of free ETS allowances with a carbon border adjustment mechanism (CBAM) (Box 3). Such a mechanism aims at equalising the carbon price of imports with those of domestic production, by charging the importer the EU ETS price deducting any carbon price paid in the country of origin. This system would apply to imports of aluminium, cement, hydrogen, electricity, fertilisers, iron, and steel. An alternative to CBAM would be better targeting of free allowances based on the risk of carbon leakage, for example by classifying sectors as highly exposed, moderately exposed, or lightly exposed, as done in the United States and Canada (see above).

Box 3. The EU's Carbon Border Adjustment Mechanism

From 2026, the carbon border adjustment mechanism (CBAM) will impose a charge on the emissions embodied in specific carbon-intensive goods imported by the EU and most at risk of carbon leakage. These include aluminium, cement, electricity, fertilisers, hydrogen, iron, and steel. The importer will be charged the EU ETS price, deducting any carbon price effectively paid in the country of origin. In practice, EU importers of goods covered by CBAM will have to purchase CBAM certificates, the price of which will be based on the weekly average auction price of EU ETS allowances. CBAM will be based on the actual emission content of certain goods, declared by importers and verified by experts, thus also allowing to take into account the effect of non-pricing policies in the country of origin on the emission content.

The EU indicates that measures were designed to make CBAM compatible with World Trade Organisation rules (European Commission, 2023[33]). It will be introduced gradually starting in 2026 to allow third countries to adjust to the new EU trade framework. So that EU importers are not at a disadvantage compared to EU producers, free emission allowances will be phased out for sectors covered by the CBAM over a nine-year period from 2026 to 2034. This means that until free allowances are completely phased out in 2035, the CBAM will apply only to the share of emissions not covered by free allowances under the EU ETS.

Source: European Commission (2023[33])

Strengthen carbon markets for sectors not covered by the ETS

There is no EU-level emission trading yet in non-ETS sectors such as transportation and buildings, although these sectors accounted for about 60% of EU emissions in 2021 (European Environment Agency, 2022[34]). According to the EU's Climate Law, in years when Member States are not on target to meet their annual emission limit in non-ETS sectors, they can borrow a limited amount of emission permits (annual emission allocations) from the following year, use a surplus of ETS emission allowances or the surplus of CO_2 removals generated in their land and forest sector. Countries that still miss their national emission reduction target for non-ETS sectors are obliged to purchase annual emission allocations bilaterally from countries that overfulfill their targets. However, there is no EU-wide mechanism in place for trading of annual emission allocations. So far only Malta and Germany had to buy allocations to fulfil their obligations and did so in bilateral deals with Bulgaria, the Czech Republic and Hungary. In contrast, Sweden cancelled its surplus emission allocations in 2015, meaning these could not be transferred to underachieving countries (Appunn, 2019[35]). The very limited amount of trade and the surplus of annual emission allocations during the period up to 2020 has kept prices of annual emission allowances low. During the period up to 2030, costs per ton of CO_2 could be significantly higher than those in the ETS with annual emissions allocations in short supply as more countries may fall short of their more ambitious 2030 targets (Gores and Graichen, 2021[36]). Without emission trading, these countries might need to drastically reduce emissions in a very short time span, potentially leading to economic and social disruptions. Looking ahead, the expansion of emission trading into road transportation and buildings in 2027 will reduce the need for such bilateral agreements. Until then, the EU should encourage countries to trade their annual emission allocations in non-ETS sectors, by setting up a market for annual emission allocations covering non-ETS sectors. Another option to encourage emissions reductions in non-ETS sectors is trade of international emission credits, but the EU has opted for a different approach with its Climate Law.

The EU also has penalties and sanctions at its disposal to encourage Member States to fulfil their emission reduction obligations in non-ETS sectors. If, in a given year, despite the above-mentioned flexibilities, a Member State does not meet its GHG emission reduction target in non-ETS sectors, the amount of GHG emissions in excess will be computed in that Member States' account of GHG emissions of the subsequent year, multiplied by a factor of 1.08. Hence, Member States have a strong incentive to avoid the application of the multiplication factor, as it will render the annual emission limit in non-ETS sectors of the subsequent year more difficult to achieve. In addition, the Commission may ask a Member State that is not on track to present a correction action plan setting out additional polices and measures to avoid excessive emissions in the future. Ultimately, if non-compliance remains, the European Commission may take an infringement legal action against the Member State before the Court of Justice of the European Union, which could result in financial sanctions.

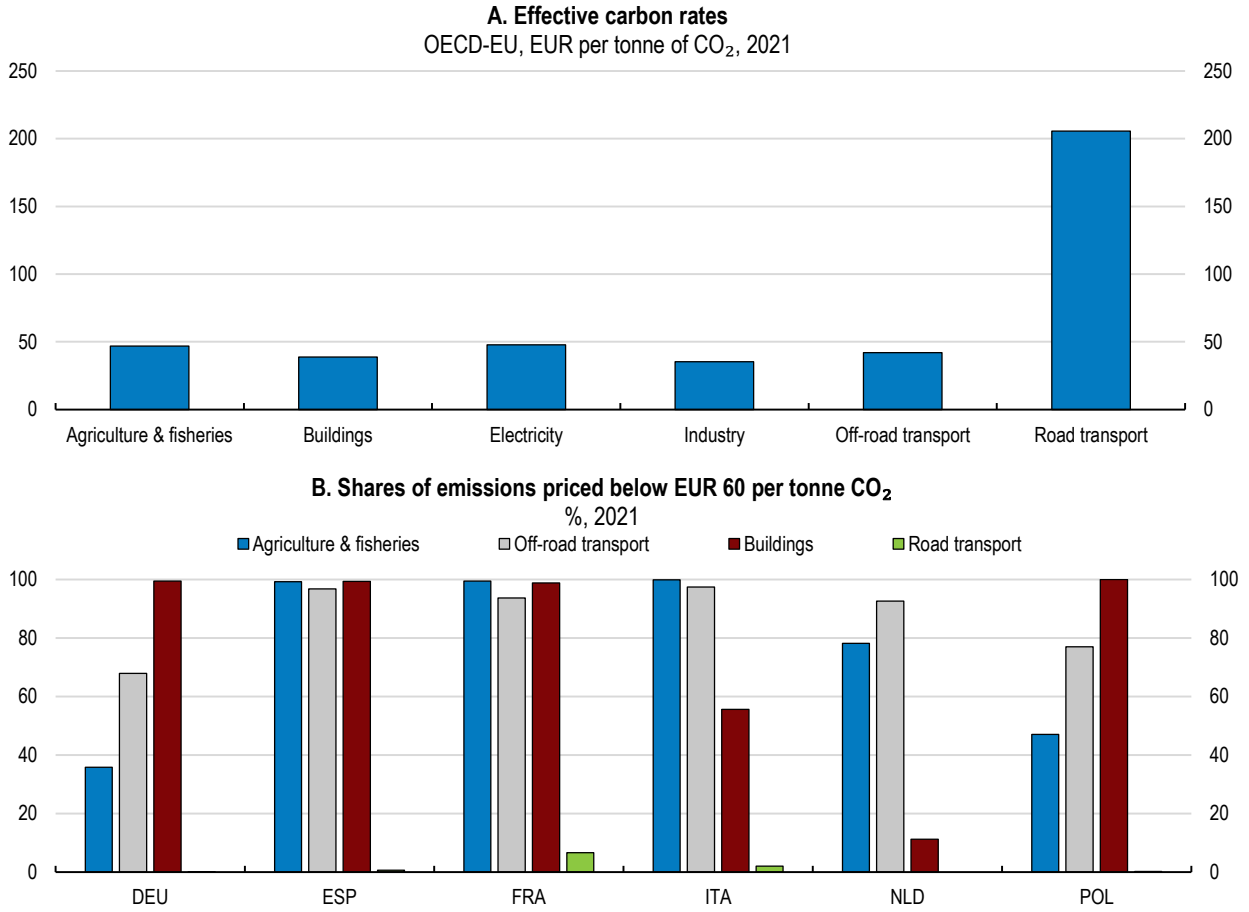
Effective carbon rates vary across countries and sectors

The EU already announced the establishment of a new emission trading system (ETS 2) for transportation and heating fuels as of 2027. However, the system is estimated to have a different ETS carbon price than the traditional ETS system (see below). A unified ETS carbon price for all sectors covered by emission trading would align marginal abatement incentives. Such a uniform ETS carbon price should then be extended to large producers in non-ETS sectors such as agriculture.

Non-ETS carbon prices vary across countries and sectors, leading to varying abatement incentives and reducing the effectiveness of the EU's climate policy. Taxation of carbon, such as fossil fuels, affects the effective carbon price (Figure 7). But in general, fossil fuel taxation imperfectly mirrors carbon-content. This reflects that exemptions and reduced rates lead to a lower effective energy tax rates for aviation and maritime fuels as well as heating gas, among others. There is scope to increase the effectiveness of the climate policy mix by aligning carbon prices and taxing polluting activities in line with their environmental impacts. The establishment of the ETS 2 for transport and heating fuels means that a uniform carbon price will be established in these sectors, although it will be lower than in the traditional ETS sectors (see above).

In addition, the EU Commission has proposed to broaden the energy tax base by phasing out tax exemptions and reduced rates and to introduce EU-wide minimum energy tax rates based on energy content and environmental performance, with fossil fuels being taxed most heavily. Currently, minimum tax rates are based on volume and do not consider environmental performance. As discussed above, the broadening of the energy tax base and minimum tax rates for fossil fuels based on environmental performance should be adopted, preferably the same for all sectors to ensure an equal burden sharing. Thereafter, minimum tax rates can be gradually increased. Ideally, the EU should announce clear time paths for the evolution of minimum tax rates to allow households and producers to adjust to the new energy tax framework. However, a concern is the interaction with the new emission trading system for transportation fuels, which will add to transport fuel prices (see below).

Figure 7. Carbon pricing differs considerably across sectors and countries



Note: Data includes CO_2 emissions from the combustion of biofuels. In Panel A, the effective carbon rate is a weighted average of the 22 OECD EU countries (plus Cyprus).
Source: OECD Effective Carbon Rates database.

An internal carbon price can improve efficiency of public spending

The EU budget for the current period 2021-27 has a 30% spending target for climate objectives. In practice, the EU follows a scaled approach to determine whether budgetary items are helpful or harmful to reach climate objectives (OECD, 2016[37]; European Commission, 2011[38]). However, this approach has been criticised for overstating the budget's true contribution to emission reductions, particularly in the case of the Common Agricultural Policy (European Court of Auditors, 2022[39]). Notably, there is no accounting for spending with negative climate impacts. For example, direct payments to farmers support the agricultural use of drained peatlands, which is associated with 20% of all agricultural emissions (see below). Moreover,

the EU's approach does not allow to identify abatement costs across EU funded programmes and their cost-efficiency. To improve cost-efficiency, the EU could apply an internal carbon price (or shadow carbon price or value) to all public budgeting, planning, procurement and cost benefit analysis of EU-funded projects with a carbon impact, as done in the United Kingdom (Department for Business, 2021[40]). Ideally, such an internal carbon price should apply to all emissions resulting from EU spending and regulations, including agricultural funds and the pandemic recovery funds.

To promote green budgeting practices among Member States, the European Commission has developed an EU Green Budgeting Reference Framework (GBRF). The GBRF is currently used by 12 Member States. In addition, the Commission provides technical support on green budgeting to 23 Member States. However, countries that implement green budgeting differ in the way they identify the environmental impacts of their budgets. This reflects different budgetary frameworks with different underlying concepts and methodologies regarding environmental costs and benefits (Box 4). National budgetary frameworks are difficult to change, which has led the Commission to propose common guidelines instead. Nonetheless, to promote green budgeting practices, the EU should introduce a common methodology for countries assessing environmental impacts of public spending, including an EU-wide internal carbon price.

Making financial markets work for the green transition

The EU adopted a taxonomy of environmentally sustainable activities in 2020, which pursues multiple environmental objectives, including climate change mitigation. It includes low-carbon technologies such as solar and wind power, but also carbon-intensive forms of biomass. This reflects that the criteria for inclusion in the taxonomy do not follow a single approach based on carbon-intensity of economic activities. It results in activities equally included in the taxonomy despite significant differences in their contribution to decarbonisation. More recently, the Complementary Climate Delegated Act extended the taxonomy in 2022 to include nuclear energy and gas as interim solutions (European Commission, 2023[41]). Since 2023, large EU companies must report whether their business activities are aligned with the taxonomy of sustainable activities. This requirement will be extended to financial companies from 1 January 2024. However, the existing Non-Financial Reporting Directive, despite being mandatory, has proven inadequate to provide comparable and reliable information on the environmental impact of companies. This means that in most cases investors do not have the necessary information on the environmental impact of companies, potentially obscuring future costs and leading to unintended consequences of investment decisions. To tackle this problem of information asymmetry, the EU is currently working on extending sustainability disclosure requirements from 2024 to all large EU companies, as well as listed small and medium-sized enterprises. This will be done gradually and, in several stages, mandating larger companies to comply with the reporting standards first, followed by listed small and medium-sized enterprises.

Another issue is the lack of uniform reporting standards, which leaves scope for greenwashing in finance. For instance, roughly 40% of funds classified as sustainable invested at least 5% in fossil fuels in 2022 (EUROSIF, 2022[42]). This reflects that the sustainable finance framework is still under development. The EU has already adopted sustainability disclosure and reporting requirements for companies and investors active in financial markets, as well as for manufacturers of financial products and financial advisers. In 2020, the Platform on Sustainable Finance was established, which advises the European Commission on issues related to the implementation of the sustainable finance framework. Furthermore, the EU Commission requested in 2022 the European Supervisory Authorities to advise on issues relating to greenwashing in financial markets. In 2022, the EFRAG (formerly European Financial Reporting Advisory Group) developed common reporting standards for companies' GHG emissions and climate-related risks, as well as environmental and social standards (EFRAG, 2022[43]). Such reporting standards for corporates should be gradually introduced to allow them to adjust to the new compliance framework. To reduce compliance costs, the EU should ensure the consistency and close interoperability of EU standards with international standards. This will require cooperation with stakeholders (e.g., international accounting bodies and credit rating agencies) within and outside the EU, including the International Sustainability Standards Board (ISSB).

Box 4. Green budgeting across the OECD

Green budgeting refers to the use of budgetary tools to help achieve climate and other environmental objectives. Across the OECD, 24 of 36 countries had implemented green budgeting measures in 2022 according to the 2022 OECD Green Budgeting Survey (OECD, 2023[44]). Effective green budgeting depends on strategic and fiscal frameworks and clear institutional arrangements:

- Green budgeting is used by twelve countries, and it is part of the fiscal framework by law in eleven countries (i.e., Austria, Chile, France, Italy, Korea, Luxembourg, Mexico, the Netherlands, the Slovak Republic, Spain, and Sweden). Italy, a country with a longstanding tradition in this field, included specific environmental reporting requirements on budget spending in 2009.
- National strategies for decarbonisation are important for an effective green budgeting framework. Twenty OECD countries have developed strategies in the past years to inform green budgeting.
- A clear institutional arrangement is key. In several countries, the central budget authority has a leading role (e.g., in Denmark, Ireland and Mexico), while in other countries this responsibility is shared with other actors, such as the Ministry of Environment, or other government agencies (e.g., in Canada, which has a strong culture of cross-government collaboration). Eighteen countries established specialised entities (e.g., funds or green investment banks) to inform governments with an environmental perspective.

The most common methods for the execution of green budgeting are:

- ***Environmental cost-benefit analyses*** inform budget decision-making. In the United Kingdom, the Treasury provides the government with an overall assessment of climate-related impacts of all government programmes (the so-called Green Book).
- ***Ex-ante/ex-post environmental assessments*** are useful for in-year adjustments and to improve scrutiny of budget execution. In Italy, budget decisions are supported by reporting on environmental programmes in relation to both budget execution and final accounts.
- ***Carbon budgets*** set carbon emission ceilings for a specific period. France has adopted three carbon budgets since 2015. Similarly, Ireland adopted a five-year carbon budget in 2021.
- ***Carbon assessments*** provide estimates of GHG emissions associated with budget measures. Several OECD countries provide such carbon assessments (Austria, Canada, Denmark, Finland, Ireland, Korea, Lithuania, New Zealand, Norway, Sweden, and the United Kingdom).
- ***Green budgeting tagging*** assesses whether budget items are helpful or harmful to green objectives. For example, Ireland follows a binary approach, where the entire cost of a measure is tagged as green or not, while the EU, France and Italy use a scaled approach to determine the green content of budgetary items.
- ***Internal carbon price:*** Few countries use carbon pricing to assess cost-efficiency of budgetary measures. For instance, the United Kingdom uses an internal carbon price (or carbon value) to assess impacts on GHG emissions resulting from all public spending, taxation, or regulations.

Other instruments are green budget statements, as in France and Italy, and reporting on emission impacts of budget measures as in Denmark. Training organised by the central budget authority (e.g., in Austria, Canada, Colombia, Denmark, Mexico, and Portugal), detailed instructions in the annual budget circular (e.g., in France, Italy, Luxembourg, Mexico, Norway, Portugal and Sweden), and inter-agency groups to ensure coordination across the government and stakeholders (e.g., in Canada, Colombia, Denmark, France and Mexico) can support green budgeting activities.

While much progress has been made in green budgeting, challenges remain. Countries often lack adequate resources and methodologies to implement green budgeting. The EU's Green Deal and the related technical support on green budgeting offered to 23 Member States will likely encourage the use of green budgeting among EU countries. Moreover, the OECD Paris Collaborative on Green Budgeting is a helpful forum for countries to share best practices and foster their harmonisation in this area.

Source: European Commission (2022[45]); OECD (2021[46]); OECD and European Commission (2020[47]); EC-OECD-IMF (2021[48]); OECD (2021[49]); Braendle (2021[50]); and Blazey, A. and M. Lelong (2022[51]).

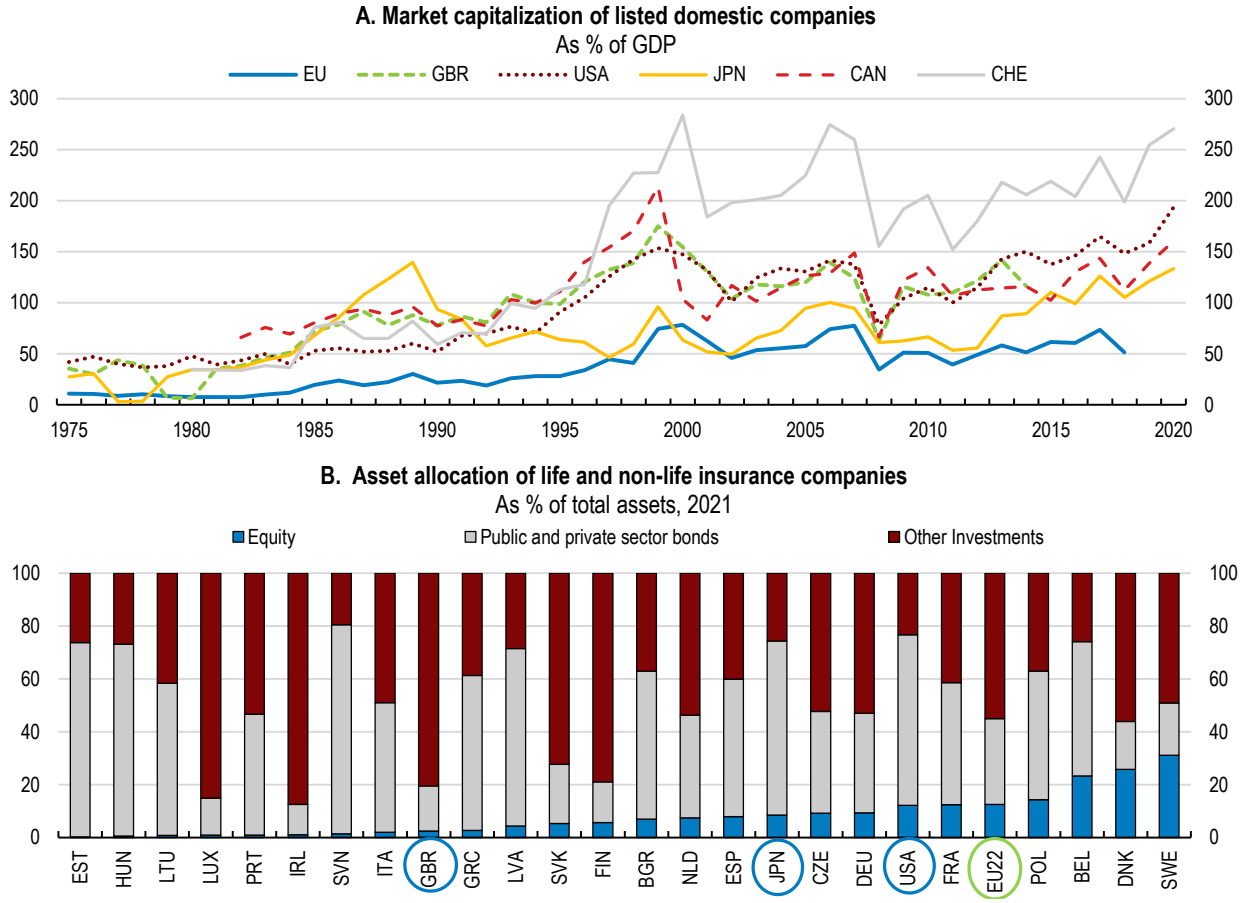
EU companies rely heavily on debt-based funding, highlighting the importance of banking for raising investment in the green transition (Carradori et al., 2023[52]). This is especially important for small and medium-sized companies as well as the housing sector, where bank lending constitutes an important source of financing of investment in abatement. The EU already adopted reporting and disclosure requirements for banks. The Capital Requirements Regulation and the Capital Requirements Directive require lenders to disclose their exposure to transition risk from 2023. This includes the amount of loans to, as well as bonds and equity holdings in, carbon-intensive industries and the fossil fuel sector, and the extent to which lenders finance their direct and indirect emissions. For mortgages, banks must report the energy performance of their real estate portfolios. The new regulatory disclosure requirements for banks aim at creating a wedge in financing costs between fossil fuel projects and sustainable investment, making the latter more attractive.

Investment needs in the insulation and renovation of buildings to reach energy efficiency targets are massive (see below). So far, such investments rely heavily on bank lending, often supported by government support schemes. To increase the role of financial markets, the European Commission proposed to introduce EU-wide mortgage portfolio standards to support the securitisation of mortgage portfolios. Such standards would reflect the energy efficiency performance of buildings and get more stringent over time, mirroring more stringent EU-wide minimum efficiency standards for buildings for 2033. Importantly, common standards would also ease securitisation, or the issuance of financial and debt instruments based on mortgage portfolios. However, a lack of common guidelines on how these standards are defined could result in a fragmented landscape of mortgage portfolio standards across the EU. Such a fragmentation would hamper securitisation and cross-border investments into the renovation and insulation of buildings (European Central Bank, 2023[53]). To make securitisation work to its full potential, the EU should harmonise minimum requirements for mortgage portfolio standards. Such harmonisation could facilitate cross-border investments by institutional investors in buildings' renovation in the context of the Capital Markets Union. Raising the contribution of financial markets to energy efficiency improvements of buildings would also reduce the reliance on bank lending and government support schemes.

A deeper Capital Markets Union can boost private investment needed for the green transition. Stock market capitalisation in the EU is lower than in peer economies (World Bank, 2022[54]) (Figure 8, Panel A). A factor behind shallower capital markets is the limited role of institutional investors, notably insurance companies. This is despite the well-developed insurance market in the EU. Insurers invest mostly in low-risk government and corporate bonds. Investment in equity by insurance companies, especially non-life insurers, is lower than in the United States (Figure 8, Panel B). This notably reflects more restrictive EU rules for insurers that encourage them to move into risk-free government bonds and other high-rated bonds. For instance, equity capital charges ranging between 22% and 49% add to the solvency requirement for insurers. There is a lower capital charge of 22% for long-term equity, although overly restrictive criteria mean that only an estimated 2% of all insurers' equity investment meets the criteria (High Level Forum on the Capital Markets Union, 2020[55]). The European Commission is reviewing the solvency rules, including the treatment of equity capital charges to ensure they better reflect the long-term nature of investment by institutional investors. There are prudential risks associated with this. In some cases, the risks may be lower if climate change risks are explicitly incorporated. The European Insurance and Pensions Authority is analysing those aspects (European Insurance and Occupational Pensions Authority,

2023[56]). Nonetheless, prudential regulation should ensure that risk in the insurance sector is properly managed.

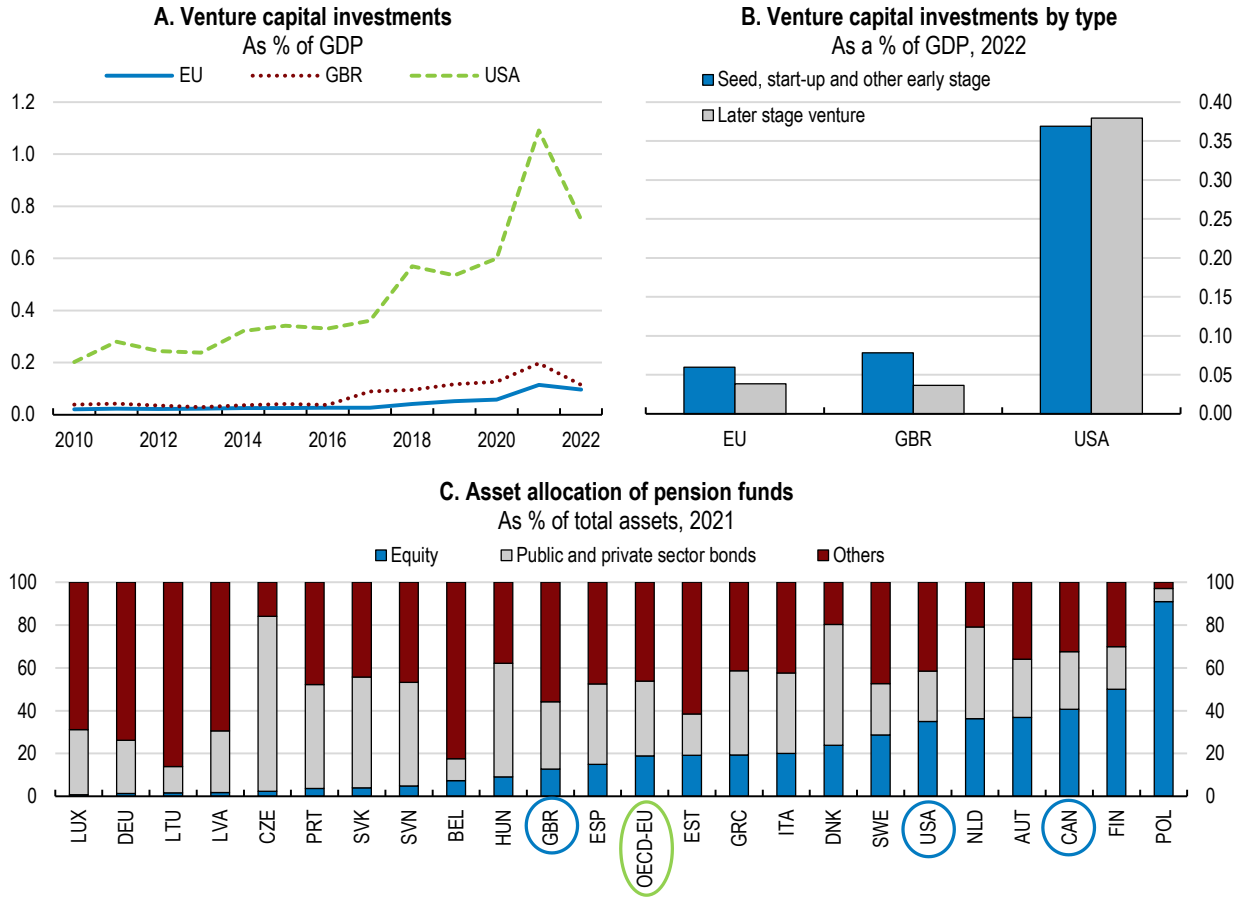
Figure 8. Capital markets are less developed than in peer economies



Note: In Panel B, the "Others" category includes investments in private equity funds, hedge funds, structured products, collective investment schemes, cash and deposits, loans, and land and buildings. The EU22 aggregate includes 22 EU countries (all EU27 member countries except Austria, Cyprus, Croatia, Malta, and Romania for which data is unavailable).
Source: World Bank; and OECD Global Insurance Statistics database.

The mobilization of household savings can support investment. For instance, the pensions system, and particularly capital-based pensions systems, can contribute to providing sufficient long-term-risk capital to support the green transition. Many EU countries have quantitative restrictions on pension funds in place that limit investment in private equity and venture capital (OECD, 2022[57]). Existing restrictions reduce funding options for start-ups. Limited financing contributes to slowing the development and commercialisation of new technologies. A particular concern is low funding for the scale-up of innovative start-ups (Figure 9). Prudent regulations are important to protect pensioners' contributions. However, quantitative restrictions may currently be too restrictive to make greater use of pension funds for raising private finance for the green transition (OECD, 2022[58]). Hence, easing quantitative restrictions on pensions funds could unleash investment in green technologies. There are prudential risks associated with relaxing rules. Safeguards and appropriate investment regulations need to be in place to ensure that pension providers continue acting in the best interest of members (OECD, 2022[58]). In the longer term, bolstering capital markets could be achieved through a stronger take-up of capital-funded pensions. This could entail auto-enrolment in occupational pension schemes, although this is under the responsibility of EU countries (High Level Forum on the Capital Markets Union, 2020[55]).

Figure 9. Venture capital remains relatively low



Note: EU corresponds to the average of EU OECD countries, according to data availability. In Panel B, 2019 data for USA. In Panel C, the "Others" category includes cash and deposits (including those of mutual funds), land and buildings (including those of mutual funds), loans, hedge funds, structured products, unallocated insurance contracts, derivatives, commodities, trade credits and advances and other accounts receivables and payables. OECD-EU is an average of the OECD-EU countries presented in the graph.
Source: OECD Enterprise Statistics database; and OECD calculations.

Targeting mitigation policies to sectors

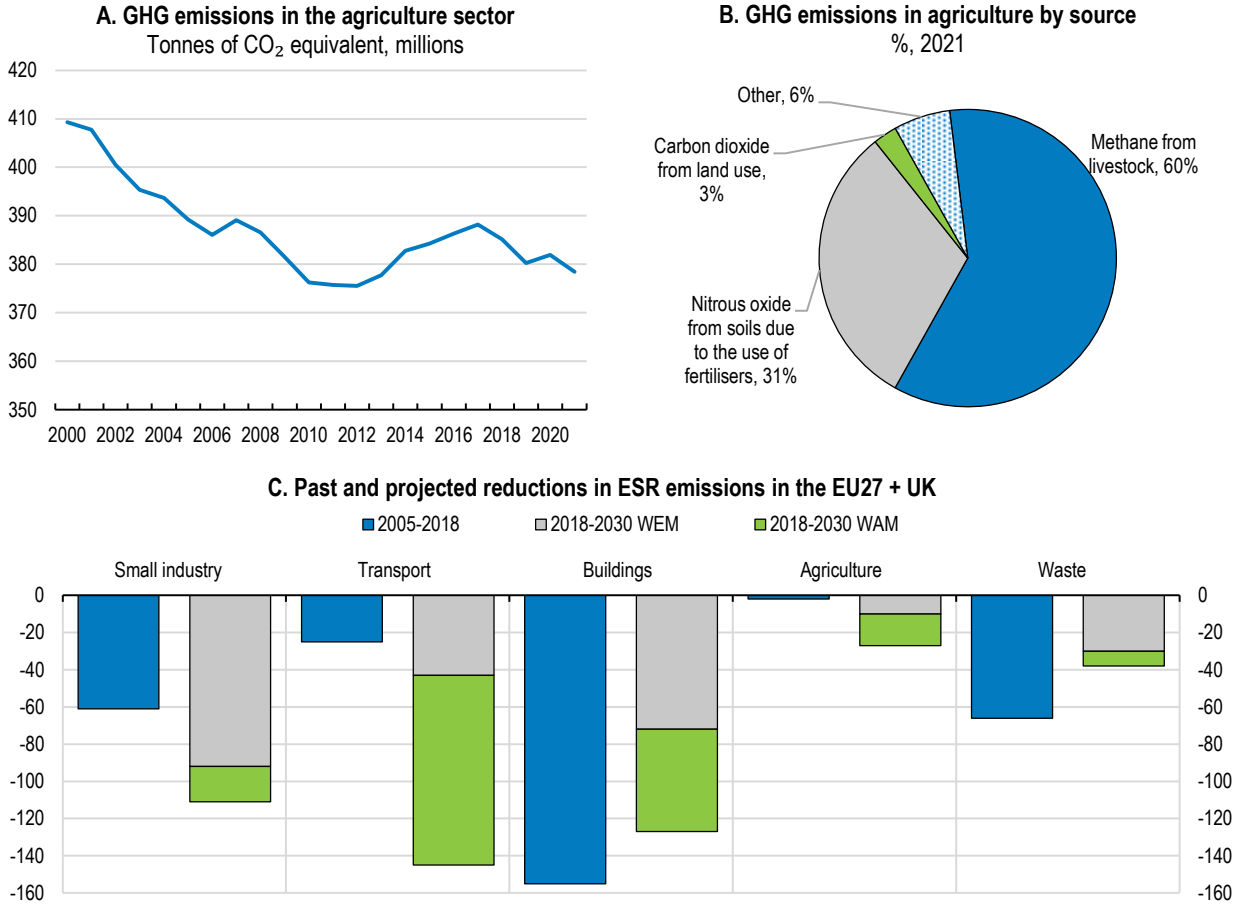
Achieving the ambitious emission targets requires a comprehensive strategy to tackle a broad range of sectors. A key challenge remains the decarbonisation of the energy sector. A significant acceleration of emission reductions is also necessary in agriculture and transportation, which have contributed little to emission reduction targets so far.

Ramping up mitigation in agriculture

The EU has successfully reduced its emission intensity in agriculture since 1990 as agricultural emissions grew slower than agricultural output, reflecting a decoupling of emissions from production. Emission reductions happened in the 1990s and 2000s due to falling cattle livestock numbers, but also better use of fertilisers (OECD, 2023[59]). More recently, however, progress has stalled. Carbon emissions in agriculture have hardly been reduced over the last decade, pointing to inconsistencies between the EU's climate policy and agricultural policy. This is despite climate action being a core objective of the Common Agricultural Policy (CAP) since 2013 (Box 5). In 2014-20, a quarter of CAP spending was deemed to contribute to climate mitigation and adaptation according to the European Commission (2019[60]). However, an

assessment of the European Court of Auditors (2021[61]) found that CAP funds attributed to climate action have contributed little to emission reductions, which have not changed significantly since 2010. Moreover, EU countries are not projecting significant emissions reduction in the agricultural sector by 2030, choosing instead to focus on other sectors (Figure 10). Apart from emission reductions, there are other important environmental challenges in agriculture, including biodiversity, water, air, and soil quality, which are discussed in more detail in the *OECD Economic Surveys of Denmark, France, Germany, Sweden, and the United Kingdom* for example (OECD, 2021[62]; OECD, 2021[63]; OECD, 2022[64]; OECD, 2023[65]; OECD, 2023[66]).

Figure 10. Agricultural emission reductions have stalled



Note: In Panel C, ESR refers to Effort Sharing Regulation, which sets national emission reductions targets for EU countries. The bars represent changes in emissions between 2005-2018 and 2018-2030 based on inventories, approximated estimates for 2018 (proxy) and projections "with existing measures" (WEM) and "with additional measures" (WAM) under more ambitious FIT for 55 targets.
Source: Eurostat; and EEA (2021), Effort Sharing targets 2021-2030 (Effort Sharing Regulation, ESR).

Box 5. The EU's Common Agricultural Policy and climate action

For the 2021-27 financing period, EUR 387 billion in funding has been allocated to the CAP (or 19% of the EU budget including Next Generation EU funding), of which 75% are allocated to Pillar 1, and the remaining 25% to Pillar 2:

- Pillar 1 mainly provides direct income support to agricultural producers. A small share of 5% of Pillar 1 funds is also used to intervene in certain agricultural markets in case of adverse shocks to food prices. The underlying rationale is that the agricultural sector is crucial for the food supply for the EU. Until 2003, direct payments to farmers were based on production volumes. Since then, such payments based on production were reduced and replaced by payments based on eligible hectares.
- Pillar 2 finances rural development activities as well as increasingly environmental and climate objectives. It requires co-financing of 40% by Member States.
- The EU Commission monitors the work of national agencies and is accountable for the use of EU funds, while EU countries are responsible for making payments and carrying out checks on recipients.

Climate action is a core objective of the CAP since 2013, complementing the other objectives of maintaining agricultural incomes and rural development (European Parliament and the Council of the European Union, 2013[67]). For the period 2021-27, about 40% of CAP funding is dedicated to climate action, corresponding to 28% of overall spending on climate action under the EU budget for 2021-27 (European Commission, 2022[68]).

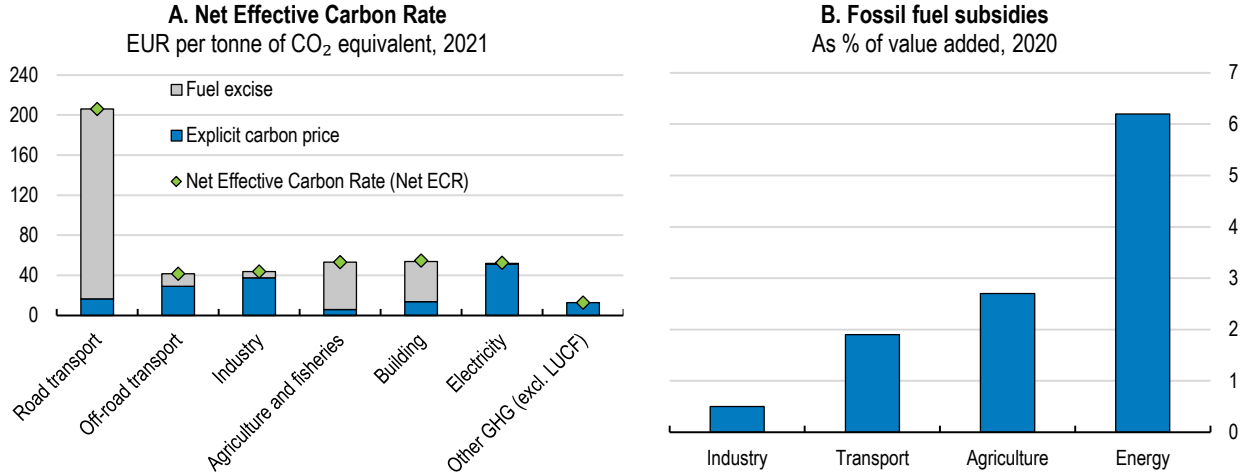
- Since 2015, a third of all direct payments to agricultural producers under Pillar 1 (or 24% of the CAP budget) have been subject to compulsory agricultural practices that are beneficial for the climate and the environment (green direct payments). Such practices include the maintenance of permanent grassland, crop diversification, and practices to safeguard and improve biodiversity of arable land (such as nitrogen-fixing crops, fallow land and catch crops).
- In addition, all direct payments to farmers are subject to meeting certain environmental and public health standards (cross-compliance provisions).
- As of 2023, a quarter of the direct payments will be dedicated to eco-schemes to provide stronger incentives for environment-friendly farming practices, including organic farming.
- About 13% of rural development funds (or 3.3% of the CAP budget) pay farmers for achieving certain environmental objectives that go beyond the compulsory green direct payment and cross-compliance requirements. The more ambitious environmental objectives relate mostly to biodiversity, organic farming, and the conservation of landscape features.
- Spending directly related to GHG emissions reduction and carbon conservation is considerably smaller, with 0.9% of the CAP budget, according to latest available data for 2014-20 (European Network for Rural Development, 2021[69]).

Source: OECD (2023[59]), *Policies for the Future of Farming and Food in the European Union*, OECD Agriculture and Food Policy Reviews, OECD Publishing, Paris, https://doi.org/10.1787/32810cf6-en.

The polluter-pays principle rarely applies to emissions from agricultural activities. Carbon taxation is little used, as reflected in a low explicit carbon price. Fuel excise taxes, indirectly pricing emissions, cover less than 10% of the sector's GHG emissions, mainly stemming from farm vehicles which in large part run on diesel (Figure 11). However, large fossil fuel subsidies in the form of reduced rates and exemptions for diesel in agriculture reduce the effective carbon price (European Commission, 2022[70]; European Court of Auditors, 2022[22]). Moreover, agricultural emissions do not fall under the EU's emission trading system. As a result, carbon pricing does not apply to most of the sector's GHG emissions, which consist of methane mostly from livestock, nitrous oxide from soils due to the use of fertilisers, and carbon dioxide from land

use. Without stronger price incentives to reduce emissions, agriculture is set to become one of the biggest emitting sectors in the EU by 2030 (Chateau, Miho and Borowiecki, 2023[11]). To make polluters pay for their emissions, environmentally harmful fossil fuel subsidies should be phased out (see above).

Figure 11. The effective carbon price in agriculture is relatively low



Note: In Panel A, the net effective carbon rate and its components are averaged across all GHG emissions of the 22 OECD EU countries (plus Cyprus), including those emissions that are not covered by any carbon pricing instrument. LULUCF refers to land use change and forestry. Data excludes CO_2 emissions from the combustion of biofuels. In Panel B, fossil-fuel subsidies (in the form of fuel consumption support, such as reduction or exemption of fuel taxes) refers to the EU27 aggregate and are based on estimates from the EC's 2022 Report on Energy Subsidies in the EU and on value added data by sector sourced from Eurostat's database.
Source: OECD Net Effective Carbon Rates database; European Commission (2022[70]); Eurostat National Accounts database; and OECD calculations.

Bringing agricultural emissions on a downward track will require, first, phasing out environmentally harmful fossil fuel subsidies, and second, higher carbon pricing. Higher carbon pricing could entail expanding emission trading to include agriculture, as announced for transportation and housing. Extending emission trading is a gradual process that should eventually lead to the extension of emission trading to agriculture. An alternative to emission trading is a carbon tax on agricultural emissions, as planned in Denmark and New Zealand (OECD, 2022[71]). However, carbon pricing in agriculture comes with challenges as it is technically not easy to implement. Farm-level emissions for inclusion in emission trading are challenging to calculate. Nonetheless, there are already pilot monitoring systems in place for emissions from livestock, peatland-rewetting, and agroforestry. Before emission trading is extended to agriculture, such monitoring systems could be scaled up and introduced more broadly in agriculture, although emission reductions from improved agricultural practices for soil management are more challenging to measure (European Commission, 2021[15]). The extension of emission trading will require stronger support for farmers to set up systems to monitor and report emissions, by diverting agricultural funds to support low-income farmers most vulnerable to higher mitigation costs as these often cannot pass on higher costs to consumers (see below). Lessons could be learned from New Zealand, where the government and the agricultural sector are working towards a system for farm-level carbon pricing for emissions from livestock and fertiliser use (Box 6). Several safeguards aim to ensure that farmers are not overburdened with the new carbon pricing framework, including a gradual phase-in and free allowances. However, policies are still experimental, and it is not yet clear what works. In addition, it will be more difficult to replicate emission monitoring and reporting for small agricultural producers and part-time farmers, which are often family-run and lacking the expertise to implement such approaches. Another challenge to carbon pricing is strong resistance from companies in the sector that needs to be overcome (D'Arcangelo et al., 2022[10]).

The extension of emission trading to agriculture will also involve costs. Achieving emission reductions in agriculture could prove much more difficult than in power and industrial sectors due to higher abatement costs. For instance, many smaller agricultural producers may not be able to afford abatement technologies

and practices. The EU supports carbon mitigation activities of farmers, but funding is limited, with 0.9% of the CAP budget for 2014-2020 (see above). At the same time, there will be social costs as households will be affected by higher agricultural prices.

Box 6. New Zealand's approach to carbon pricing in agriculture

New Zealand plans to introduce carbon pricing in agriculture from 2025. The government and the agricultural sector are working towards a system for farm-level carbon pricing covering emissions from livestock. This includes ongoing consultations on farm-level pricing of synthetic nitrogen fertiliser emissions, recognition for some types of carbon removals from 2025, and a processor-level carbon levy as a transitional step if farm-level carbon pricing cannot be implemented by 2025. If such a system is not implemented by 2025, the Climate Change Response Act states that agricultural emissions will be priced under the emission trading system.

Agricultural producers will have to report livestock emissions as of 2024. The agricultural sector already has experience with emission reporting. Companies in the agricultural supply chain (e.g., meat processors, dairy processors, nitrogen fertiliser manufacturers and importers) are required to monitor and report their agricultural emissions within the framework of the ETS. A simplified accounting approach is expected to increase incentives for participation in the ETS.

Source : Pareliussen et al. (2022[72])

A relatively straightforward way to reduce emissions in agriculture is the restoration of drained peatlands. Drained peatlands account for 20% of EU agriculture emissions (or 3% of EU emissions), although they represent only 2% of the total cropland and grassland area in the EU. The EU has proposed a new law on nature restoration that aims to restore degraded ecosystems, including drained peatlands. However, direct payments under the CAP continue to promote agricultural use of drained peatlands, despite their negative impact on the climate. Only six EU countries used CAP funding to restore drained peatlands, and the uptake was too low to have a meaningful impact on emission reductions (European Court of Auditors, 2021[61]). In 2023, the EU introduced new stringent rules regarding the protection of wetland and peatland, making direct payments to farmers conditional on complying with these rules (so-called cross-compliance provisions). However, compliance with cross-compliance provisions has been low, reflecting low penalties (see below). Hence, direct payments for the agricultural use of drained peatlands should be linked to the rewetting of peatlands.

Mitigation policies involve mainly voluntary measures with a low potential to reduce emissions (European Commission, 2017[73]). Green direct payments for farmers to adopt potentially climate-friendly practices have had a limited impact, with an uptake of environmentally beneficial agricultural practices observed on only 5% of EU farmland (European Court of Auditors, 2017[74]). The low impact is due to low ambitions as green requirements mostly reflect established farming practice. This means that farmers are not required to introduce new mitigation practices. Similarly, the agri-environmental payment schemes underperform in achieving environmental objectives (OECD, 2023[59]). The underperformance reflects that those payments are not linked to achieving specific environmental outcomes. For instance, the schemes support an expansion of organic farming, although the impact of such practices on greenhouse gas emissions is unclear (European Court of Auditors, 2021[61]). To better link payments to environmental outcomes, reforms to the CAP will see stronger conditionality of direct payments based on agricultural practices beneficial to the environment from 2023 (see below). To further improve cost-efficiency, payments should be made conditional on achieving emission reductions (OECD, 2022[75]). Results-based payments come with difficulties since emission monitoring and reporting is not in place in agriculture. Initially, such outcome-based payments could be introduced in areas where emission monitoring systems can be more easily introduced, such as peatland-rewetting, agroforestry, and livestock farming (see above).

Agricultural producers receive direct payments conditional on compliance with agricultural practices beneficial to the environment. This includes maintaining a minimum soil cover or limiting the use of nitrogen fertilisers. Non-compliance with these so-called cross-compliance provisions can lead to a reduction in direct payments, which is an effective mechanism to protect the environment. Compliance is enforced through on-the-spot controls of agricultural producers. Every year, about 2% of farms that apply for CAP support are selected for on-site checks on whether they follow cross-compliance provisions. However, enforcement of environmental legislation remains insufficient. Penalties are low at around 3% of the amount granted as direct payment (European Commission, 2022[76]). Low penalties reduce the deterrent effect, as reflected in high rates of infringements (European Court of Auditors, 2016[77]). In fact, one in four inspected farmers had their aid reduced for non-compliance with regulations. To encourage stronger compliance with environmentally beneficial practices, enforcement of cross-compliance provisions should be strengthened. This entails higher penalties reflecting the environmental damage resulting from the violation (OECD, 2014[78]).

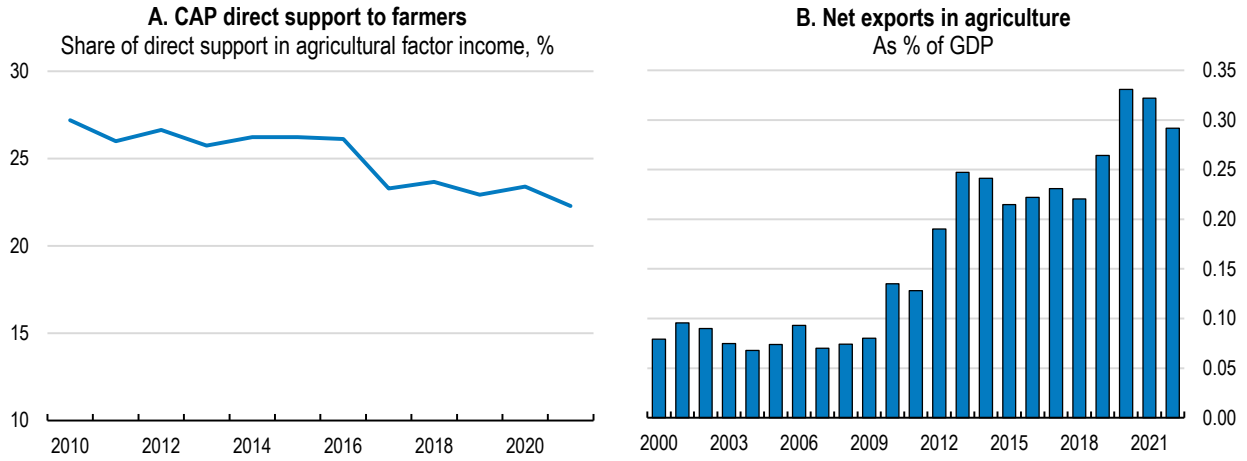
There are contradictions between emission reduction incentives and incentives for emission-intensive meat production. One channel that actively prevents the reduction of emissions are direct payments based on livestock numbers (or coupled payments). Overall, a positive development has been that direct payments based on production volume have been reduced since 2003. However, about 8% of direct payments to agricultural producers continue to support livestock farming, which accounts for half of all agricultural emissions, although the EU cattle herd has decreased by 2% between 2010 and 2020 (European Commission, 2018[79]; European Commission, 2023[80]). Agricultural producers can receive coupled payments irrespective of their profitability. This means that unprofitable farms also receive support. For the period 2021-27, the ceiling for coupled payments was raised from 11% to 13% of direct payments, and the effective share of coupled payments reached 11.2% of direct payments in 2022 (European Commission, 2022[81]). Such support encourages the maintenance of high livestock numbers because agricultural producers would receive less payments if they reduced livestock numbers. The European Commission estimates that coupled payments have increased beef production by 2.4% and lowered beef prices by 3.9% between 2007 and 2015 (European Commission, 2018[82]). Such a practice also keeps fertiliser use high, as more nitrogen is required for animal products than for plant-based foods. Withdrawing support for high livestock numbers could help reduce agricultural GHG emissions (Jansson et al., 2020[83]). However, without coupled payments, farming in poor regions would be difficult to maintain and additional mitigation costs would make it even more difficult. In addition, withdrawing coupled payments may lead to lower meat production and higher meat prices. Lower meat production would not endanger food security as the EU is self-sufficient in this area, but higher meat prices may have an impact on food affordability for low-income households (European Commission, 2022[84]). Hence, the EU should withdraw direct payments based on livestock numbers. This should be done gradually to dampen the impact on food prices. If such a phase-out of coupled payments is politically not feasible, the EU should ensure that coupled payments at least do not lead to higher livestock numbers and are more targeted.

Another measure to reduce livestock emissions is the Industrial Emission Directive, which also regulates pollution from industrial-scale intensive livestock farms, such as nitrogen oxide, methane, and carbon dioxide. The Directive is currently under revision to strengthen the rules and cover more farms, including emission limits for key pollutants, which is welcome. Nonetheless, a policy push towards lower animal production, if not accompanied by a shift in EU consumer behaviour towards lower meat content diets, may have little effect on global emissions due to carbon leakage.

Since payments are based on hectares, the system of direct payments subsidises land use and keeps more agricultural land in use than would otherwise be the case. Currently, about 38% of the total land area of the EU is used for agriculture. Especially grassland used for emission-intensive livestock is dependent on direct payments as it is less productive than arable land. However, a growing trade surplus in agriculture over the past two decades, which reached 0.3% of EU GDP in 2021, questions the rationale for the continued high support for agricultural producers (Figure 12). Moreover, support is not targeted as larger

and more productive producers benefit disproportionally, with 80% of direct payments going to the largest 20% of agricultural producers (European Commission, 2022[85]). A reduction of direct payments could reduce agricultural emissions from land use (Brady et al., 2017[86]). The freed-up land could be made available for the large land needs of the renewable energy sector. At the same time, direct payments should be directed to mitigation activities of affected farmers (see below).

Figure 12. Agricultural income support remains high despite a growing trade surplus



Note: In Panel B, data refer to trade of the category "Food and live animals" of the SITC classification, including sub-category "Cereals and cereal preparations" but excluding sub-category "Fish (not marine mammals), crustaceans, molluscs and aquatic invertebrates, and preparations thereof".

Source: EC Farming Income Support database; Eurostat Trade Statistics database.

Some measures to reduce emissions in agriculture may have adverse social consequences for the income of farmers. For example, reducing direct income payments based on the number of livestock could affect low-income farmers disproportionally. Analysing such social effects requires detailed data on direct income support by type of farmer and income group, as provided by the EU's Farm Accountancy Data Network (see below). Using such data will be important to better target direct payments to those who need it and those who produce with less emissions. Similarly, the extension of emission trading to agriculture, as proposed in this *Survey*, will involve costs for farmers. This entails setting up monitoring systems for emissions at the farm-level. More importantly, this will also include pricing agricultural emissions. Some of these costs will be passed on to consumers in the form of higher prices. But there is room to raise financial support for farmers' carbon mitigation activities, which remains limited with 0.9% of the CAP budget for 2014-2020 (European Network for Rural Development, 2021[69]). Hence, the EU should redistribute CAP funds to farmers' climate mitigation activities, so that the total burden to farmers can be limited.

The European Commission estimates that 40% of CAP spending between 2021 and 2027 will contribute to climate mitigation and adaptation. Reforms to the CAP will see an increase of funding for voluntary measures to encourage climate mitigation and adaptation, as well as more stringent mandatory rules to protect wetland and peatland. Climate mitigation efforts are stepped up due to restricted tillage as well as a ban on conversion, drainage, burning or extraction of peat. As part of the reformed CAP, the EU Commission will also assess EU countries' progress towards reaching climate objectives (Box 7). National CAP Strategic Plans aim at reducing greenhouse gas emissions and increasing carbon sequestration, by protecting and increasing carbon sinks, and addressing emissions from mineral fertilisers and livestock. Also, carbon removal is gaining more prominence. A voluntary certification scheme for carbon removals is being established, with carbon removal practices being funded by Horizon Europe and the Innovation Fund (see above). The enhanced requirement to maintain non-productive areas on at least 3% of arable farmland is also expected to increase carbon removal. In addition, the new CAP will incentivise farmers to store carbon in soil and biomass and reduce emissions on 35% of the EU's agricultural area through

appropriate management practices, such as extensive grassland management, organic fertilisation, and agroforestry.

Box 7. The new Common Agricultural Policy 2023-27

The CAP 2023-27 has a new governance model (new delivery model) with increased devolution to Member States, allowing for a more flexible implementation that considers local conditions and needs. At the same time, the new CAP has higher ambitions in terms of sustainability. It is built around ten specific objectives, including income support for farmers, climate change, landscape conservation, and biodiversity, among others. These objectives are also the basis upon which EU Member States have designed their national CAP strategic plans (CSPs). Each CSP combines a wide range of targeted interventions, addressing the specific needs of that Member State, with the view of delivering tangible results in relation to EU-level objectives, including "contributing to climate change mitigation and adaptation".

The new CAP includes a new 'green architecture'. Greening requirements were replaced by higher mandatory environmental requirements in cross-compliance (enhanced conditionality) and eco-schemes were introduced to encourage environmental and climate action funded under Pillar 1. Eco-schemes are voluntary measures that reward farmers for the management of land in a nature- and climate-friendly way. Supported action includes, among other, climate mitigation and adaptation, the prevention of soil degradation, soil restoration, the protection of biodiversity, restoration of habitats or species, reduced or sustainable use of pesticides, as well as improved animal welfare and anti-microbial resistance. Ring-fencing rules on spending have also been introduced: 40% of the CAP budget should be climate-relevant, with at least 25% of the budget in the first pillar allocated to eco-schemes, and at least 35% of funds in the second pillar allocated to measures supporting climate, biodiversity, environment, and animal welfare.

Enhanced conditionality increases the mandatory layer of the CAP, strengthening standards for good agricultural and environmental conditions (GAECs) in cross-compliance and greening commitments. Member States have a degree of flexibility to further increase mandatory measures under conditionality. Previous GAECs on the maintenance of permanent grassland and the ban on burning arable stubble have been modified, while new conditionality rules regarding climate have been introduced. The latter include the requirement to protect wetland and peatland.

An important innovation is that national CSPs include interventions under both pillars of the CAP and not only rural development interventions as previously. As for climate objectives, the 2023-27 CSPs cover a range of targeted interventions addressing country-specific climate-needs. Specifically, EU countries must demonstrate how their interventions contribute to the ambitions of the European Green Deal. The aim is stronger performance orientation based on result indicators. While these result indicators often still focus on practices, the use of indicators does reflect a step in the direction of a result-based policy. In this regard, a new set of indicators was established, allowing the European Commission to monitor national progress through annual performance reports and biannual performance reviews of the CSPs. Climate-related indicators include contributions to climate change mitigation; the share of livestock units under support to reduce GHG emissions; and the share of land under supported commitments to reduce GHG emissions or to maintain or enhance carbon storage. When submitting their CSPs, EU countries had to demonstrate increased ambition in their climate-related measures over the previous funding period ("no backsliding" clause).

CSPs are also intended to support the uptake of carbon removal methods (so-called carbon farming), either through Pillar 1 eco-schemes or Pillar 2 rural development schemes.

Source: OECD (2023[59]), *Policies for the Future of Farming and Food in the European Union*, OECD Agriculture and Food Policy Reviews, OECD Publishing, Paris, https://doi.org/10.1787/32810cf6-en.

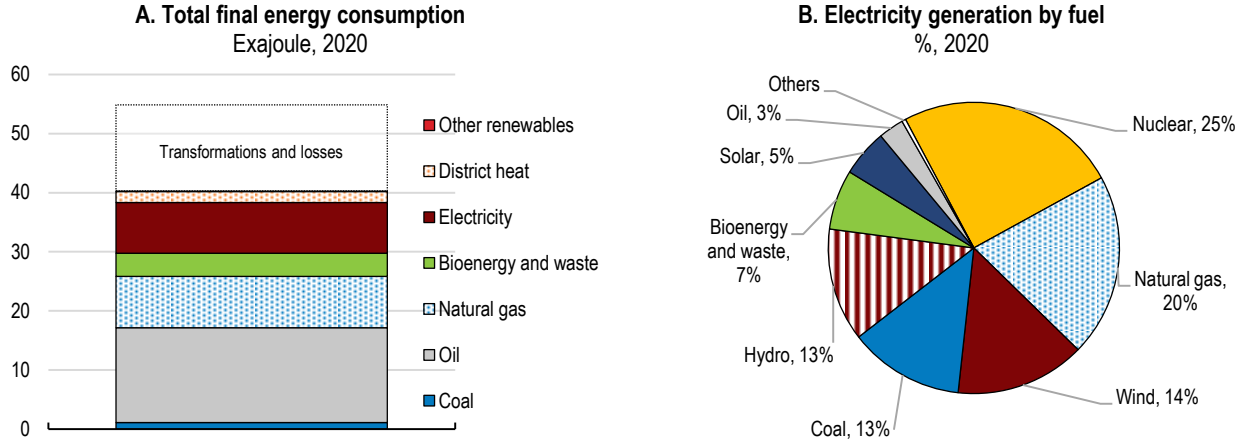
However, the Commission does not collect farm-level data on emissions that would allow a proper monitoring of greenhouse gas emissions in agriculture (OECD, 2023[59]). Such data could improve accountability of CAP spending and its impact on net greenhouse gas emissions. Hence, emission accounting should be extended to agricultural producers, as currently envisaged in Denmark (OECD, 2021[62]) (see above). As part of the Farm to Fork Strategy, the Commission has proposed in 2022 to improve farm level monitoring of environmental indicators through the transformation of the Farm Accountancy Data Network into the Farm Sustainability Data Network, which is welcome. In fact, a way forward would be to collect emission data as part of the questionnaire of the Farm Accountancy Data Network, which collects accountancy data from over 80 000 EU farms on a yearly basis (European Commission, 2021[87]). Initially, part-time farmers could be excluded.

Accelerating the energy transition

The energy transition will be key for reducing overall emissions and achieving energy security. To reduce emissions in the energy sector, the EU plans to decarbonise electricity production (European Commission, 2018[88]). In addition, consumers will have to move to higher electricity use. Momentum is strong as Russia's war against Ukraine increased the impetus to speed up investments in clean energy to secure energy supply.

Electricity accounts only for around 15% of energy consumption, reflecting that direct combustion of fossil fuels are still the dominant source of energy use (Figure 13). Thus, further decarbonisation of the sector will require a massive electrification of the economy and huge investments in additional supply and network infrastructure, as well as replacing existing fossil-fuel capacity (particularly coal) with cleaner technologies. This entails more integrated electricity markets to ensure electricity trade better balances supply and demand. Likewise, stronger price signals are needed to encourage investment in renewables and stronger demand response, while ensuring investment also flows into backup and storage capacities at times when solar and wind are not generating sufficient supply.

Figure 13. Energy consumption remains heavily reliant on fossil fuels



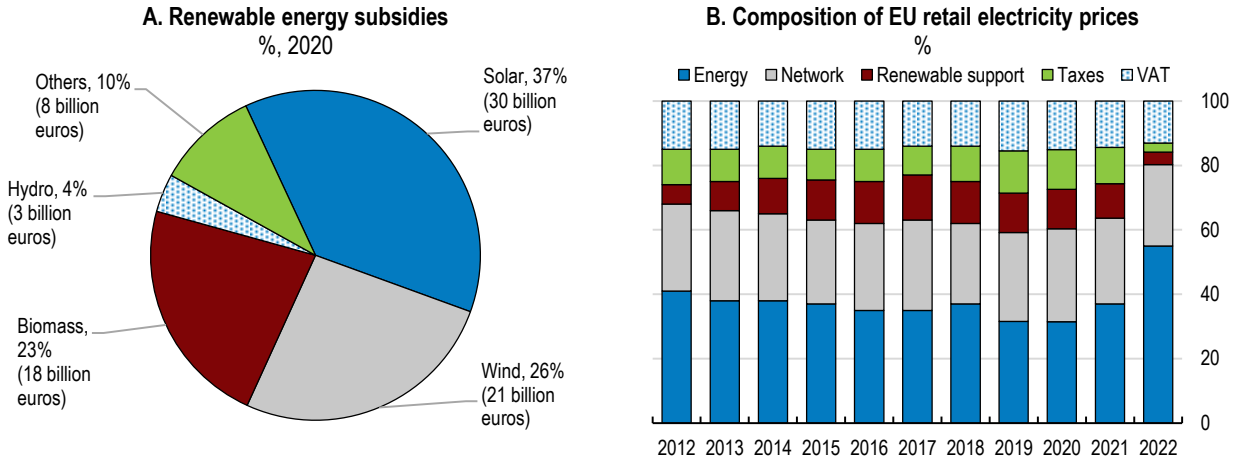
Note: Data refers to the European Union (27 countries). In Panel A, other renewables include hydro, solar and wind energy.
Source: IEA World Energy Balances database; and OECD calculations.

Currently, however, the rate of deployment of renewables is insufficient to reach the EU target of more than doubling the share of renewables in electricity generation to 69% by 2030 (European Commission, 2022[89]; European Commission, 2022[90]). Based on pre-2022 performance, the EU will need to add more than three times as much renewable capacity per year to achieve its target (IEA, 2022[5]). Moreover, reducing carbon-intensity of electricity has its limits. This reflects that renewable energy currently requires roughly 40-50% of backup capacity, notably gas, which is important at times when solar and wind are not

generating sufficient supply, although backup capacity needs can be reduced by enhanced capacity storage and demand response going forward (EASE, 2022[91]; IEA, 2020[92]).

Investment in renewables is encouraged by generous government support schemes such as feed-in tariffs, accounting for 13% of consumer electricity bills in 2021. In total, EU countries spent EUR 81 billion (or 0.6% of EU GDP) on such renewable subsidies in 2020, mostly benefiting biomass, solar and wind energy (Figure 14). National spending is enhanced by up to a third of EUR 800 billion pandemic funds and EUR 100 billion cohesion funds for the period 2021 to 2027 (or 0.4% of EU 2021 GDP a year). In contrast, competitive auctions are used less frequently (ACER, 2022[93]; IEA, 2020[94]). In 2020, only eight EU countries used competitive auctions for onshore wind and solar (Baringa Partners, 2022[95]). During auctions, firms compete for energy capacity allocations based on lowest price. Hence, competitive auctions encourage competition and may help minimise the fiscal cost of deploying renewables.

Figure 14. Government support for renewables remains high and mostly benefits solar and wind



Source: European Commission (2022[96]); Eurostat database.

A temporary relaxation of state aid rules in response to the pandemic and then the energy crisis allows EU countries to spend more on renewable subsidies. The measure aims at accelerating the energy transition and is also a response to higher renewable spending in the United States (Box 8). State aid can support the development and upscaling of low-emission technologies that are not yet competitive, such as carbon capture and storage (see below). Strong support for wind and solar energy was called for when these technologies were still in their infancy and not cost-competitive. However, electricity generated from solar photovoltaic and onshore wind has become cost-competitive in most EU countries over the last decade, reducing the need for government subsidies such as feed-in tariffs. Moreover, EU subsidies are already generous, and these subsidies are associated with risks. For instance, relaxed state-aid rules risk distorting the Single Market. Another issue is whether subsidies are efficient (OECD, 2005[20]). The EU acknowledges these concerns and encourages EU countries to reduce subsidies for cost-competitive technologies (European Commission, 2022[97]). Generous subsidies for solar and wind should be phased out and rechannelled towards new technologies that are not yet competitive such as carbon capture and hydrogen (IEA, 2022[5]). Hence, the EU state-aid framework should ensure that state aid is only provided for renewable technologies that are not yet competitive (OECD, 2023[1]). At the same time, deeper capital markets could support technological breakthroughs (see above).

Box 8. US Inflation Reduction Act

Under the Inflation Reduction Act (IRA), the United States provides USD 38 billion a year in government support for renewables for the period 2023 to 2033. This adds to USD 25 billion a year in spending on energy-related programmes under the Bipartisan Infrastructure Bill for the period 2021 to 2025. Altogether, spending under the two Acts accounts for 0.3% of GDP in 2023, or half of EU countries' spending on renewable energy subsidies of 0.6% of GDP in 2020. The IRA also imposes domestic content rules. In practice, domestic requirements might be less stringent as sub-components can be imported (JDSupra, 2023[98]).

USD 5 billion a year are allocated to the clean-vehicle credit. US consumers who purchase new electric vehicles are eligible to receive a tax credit of up to USD 7 500. This applies only to cars produced in the US, Canada, and Mexico, and essentially amounts to an import tariff of about 15% for an electric vehicle with a price of USD 50 000. In comparison, the EU imposes a 10% tariff on imported cars.

The bulk of government support under IRA (USD 25 billion a year) consists of tax credits. For instance, wind installations can obtain a tax credit of USD 0.15 per kWh. If 40% of the manufacturing content of wind turbines are produced in the Unites States, the tax credit rises by 10% (White and Case, 2022[99]).

Source: US Department of Energy (2022[100]) and US Internal Revenue Service (2022[101]).

Excessively long permitting procedures slow down the deployment of renewables (Figure 15). As permitting is the responsibility of EU countries, the EU calls on EU countries to simplify procedures for new permits and has proposed to designate renewable projects as of public interest to shorten permitting times. In addition, the EU Commission proposed the Net Zero Industry Act in March 2023. It foresees that Member States are to designate a single national authority to act as a single point of contact in charge of coordination and facilitation of permitting (European Commission, 2023[102]). EU countries should aim to permit onshore wind turbines and solar parks within two years and offshore wind projects within three years. Another factor behind lengthy permitting times is understaffed permitting authorities (European Commission, 2022[103]). To accelerate the deployment of renewables, permitting times for new renewable installations need to be reduced, as done in Germany and Spain in 2023 (IEA, 2022[5]). This requires bolstering the resources of permitting authorities. Furthermore, designating more agricultural land for renewable projects would free up important space (see below). These measures, which are to be implemented by Member States, are discussed in more detail in the *OECD Economic Surveys of Germany and Sweden* for example (OECD, 2023[65]; OECD, 2023[66]).

A question is whether the expansion of renewables to reach the target is technically feasible. Estimates suggest that a decarbonised electricity system will require up to 5% of the EU's land surface to be occupied by solar power plants (van de Ven et al., 2021[104]). Such an area corresponds to the area of Greece and the Czech Republic combined. This is in addition to onshore wind farms and offshore wind farms at sea. Achieving the energy transition will necessitate a significant acceleration of land conversion, especially agricultural land. However local resistance to onshore wind parks may slow down such a conversion.

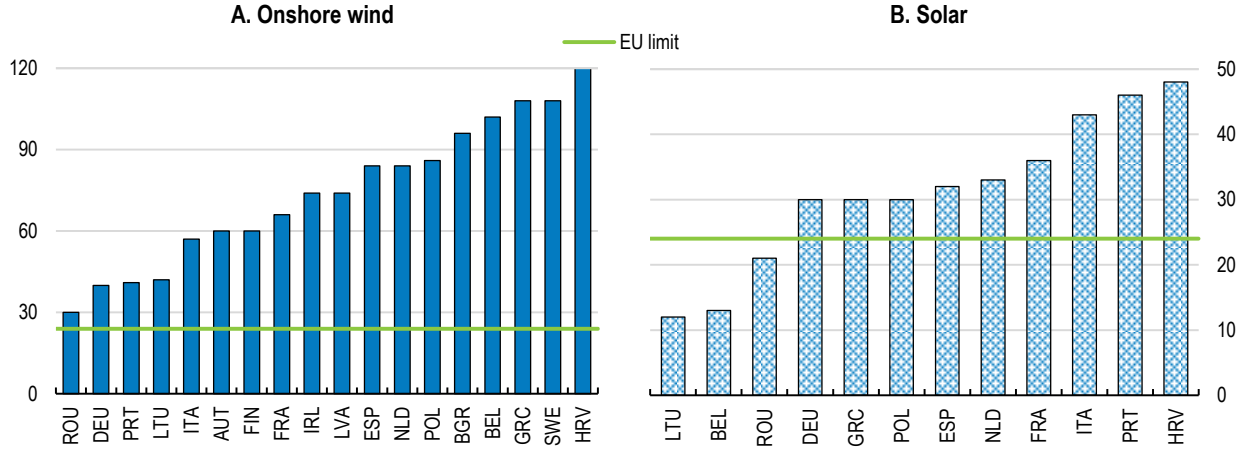
More integrated wholesale electricity markets are key for the transition towards a higher share of renewable electricity. For instance, countries with excess supply of wind and solar can export electricity to meet demand in other countries where supply is short. However, insufficient physical cross-border electricity grid connections hamper market integration. This is reflected in limited cross-border transmission capacity. Cross-border trade in electricity increased from 8% to 12% of final energy consumption between 2010 and 2015 but has remained stagnant since then. One of the central EU funding vehicles for cross-border grid investment, the Connecting Europe Facility, has a budget of less than EUR 6 billion (0.4% of EU GDP) in 2021-27. The REPowerEU plans to invest an additional EUR 29 billion in cross-border grid connections. Specifically, the REPowerEU chapters of national Recovery and Resilience Facility plans call for investments in infrastructure and cross-border projects. But the investments announced or already

underway in new grids for 2030 only cover about three quarters of the needed increase in cross-border interconnections (ENTSO-E, 2022[105]; ENTSO-E, 2022[106]). The case for additional EU funding is strong as many of the benefits of an integrated market accrue at the EU level. More integrated electricity wholesale markets will help to manage increased price variability of renewable electricity generation in a cost-effective way. Such an integrated market approach requires bolstering investment in cross-border connections. Hence, the EU should make more funding available for investment in cross-border grid connections by diverting funds to the Connecting Europe Facility or REPowerEU.

National transmission system operators (TSOs) are responsible for planning and building of electricity grids within and across EU countries. However, national plans for grid investment are not coherent, resulting in limited cross-border transmission capacity (European Court of Auditors, 2023[107]) (see above). The EU recognised limited coordination as a barrier to cross-border infrastructure investment and has started to establish a pan-EU governance structure for grid planning and building in 2018. As a first step, it mandated the European Network of Transmission System Operators for Electricity (ENTSO) to produce Ten-Year Network Development Plans (TYNDPs) on a biennial basis. With the TYNDPs, ENTSO assesses European electricity infrastructure needs and its future development, supply adequacy, and network resiliency, based on identified infrastructure bottlenecks. Efforts to reinforce coordination in grid infrastructure planning and investment should continue, especially through stronger coordination between TSOs. This should be combined with stronger resources and powers for the EU Agency for the Co-operation of Energy Regulators (ACER), the supervisory authority for electricity markets, to enforce EU rules regarding cross-border transmission capacity.

Figure 15. Lengthy permitting processes slow down the deployment of renewables

Permitting times, months



Note: In Panel A, EU limit of 24 months is stated in the Renewable Energy Directive (2018/2001). Countries analysed make up 96% of installed 2021 wind capacity and 91% of installed 2021 solar capacity and were chosen according to available data quality. Data only available for the countries presented in the Figure. Data extracted from an article published on 5 April 2022 (https://www.energymonitor.ai/policy/data-insight-the-permitting-problem-for-eu-wind-farms/).
Source: WindEurope; EMBER; and GlobalData.

Another issue is how to set prices in a competitive electricity market when the marginal costs of renewable energy are zero. Day-ahead electricity wholesale markets are based on marginal pricing, where the price is set by the most expensive energy plant that is needed to meet demand. With falling costs of renewables, gas plants have become price setters. Gas plants have clear marginal costs, including the fossil fuel they burn. In contrast, renewables produce electricity at almost zero marginal cost. This means that an additional kilowatt hour of electricity is generated nearly for free once the solar or wind installations are set up and running. Nonetheless, fixed costs of solar and wind installations are high as these are capital-intensive. Higher interest rates in the medium-term are likely to raise such fixed costs further.

Looking ahead, the move towards renewables will have consequences for pricing in electricity markets. Electricity price volatility is set to increase. Electricity prices can fall to zero and become even negative when renewable energy is abundant. The opposite occurs when renewables are in scarce supply and demand is high, such as at night or during winters in the case of solar energy (IRENA, 2017[108]) Increased price volatility may reduce certainty in terms of long-term revenues, which renewable energy producers need in order to recover their fixed costs. In such a situation, investment in renewables may increasingly depend on markets for long-term electricity contracts (Barroso et al., 2021[109]). For instance, long-term commercial power purchase agreements (PPAs) allow companies to contract with renewable producers to buy the electricity from their plants for up to 20 years, reducing exposure to price volatility for businesses and providing producers with the needed revenue certainty to attract investment. The EU has made a proposal to reform the EU electricity market to strengthen long-term commercial contracts and contracts-for-difference capacity auctions (Box 9). With contracts-for-difference auctions, governments guarantee electricity producers a fixed minimum price for the capacity provided. However, the proposal foresees regulated retail electricity prices for consumers in times of emergency. In addition, contracts-for-difference auctions would set a maximum price for electricity at wholesale markets, effectively constituting a price cap. Such wholesale and retail price caps reduce investment incentives in renewables. Hence, there is a need to remove barriers to long-term electricity contracts, including regulated prices below market price.

Price volatility might also reflect the costs of back-up generation (such as gas power), which is needed at times when the sun and wind do not provide sufficient supply. An issue is how to remunerate providers of back-up capacity when they are only needed at times when there is not sufficient renewable electricity supply. Securing investment in additional energy supply may require long-term markets for back-up capacity, including capacity auctions.

Retail electricity markets are fragmented along national boundaries, as reflected in wide retail price differences across countries and sometimes within countries (European Court of Auditors, 2023[107]). To some extent price differences mirror taxes and levies. But the fragmentation also reflects that national markets are still not competitive and dominated by regulated retail electricity prices (Figure 16) (IEA, 2020[94]). Such a system of regulated retail prices reduces the effectiveness of the price signal as retail prices poorly reflect market demand (ACER/CEER, 2022[110]). As a result, electricity providers have reduced incentives to invest in cost-efficient low-carbon electricity generation. Moreover, retail price regulation reduces energy saving incentives and discourages consumers to reduce peak demand by shifting consumption to periods with lower prices. The EU Directive on Common Rules for the Internal Market for Electricity requires countries to phase out retail price regulation except if it is time-limited and for energy-poor or vulnerable households. The Directive also sets out that the protection of energy-poor and vulnerable households should be primarily through social policy or means other than price regulation. Further integration of wholesale electricity markets requires stronger price signals. This also entails making national retail electricity markets more competitive, reducing price divergence. Hence, the EU should ensure that countries fully implement the EU Directive on Common Rules for the Internal Market for Electricity by phasing out regulated retail prices. A more integrated wholesale electricity market will be also important to tackle the energy crisis and secure energy security.

Faced with higher price volatility and potential adverse social consequences, governments stepped in to subsidise fossil fuel consumption and regulate retail electricity prices in 2022. However, such interventions need to be assessed against the functioning of integrated electricity markets, which are estimated to have delivered price savings of 2.4% of GDP a year for consumers over the past decade due to lower electricity prices (ACER, 2022[93]). Targeted income support for low-income households can address social concerns while preserving energy saving incentives, although such targeted support also comes with implementation difficulties (OECD, 2023[111]).

Another issue holding back more competitive retail electricity markets is the lack of transparent pricing for electricity and gas in most EU countries. Despite EU regulations calling for countries to establish certified online tools for comparing retail electricity and gas prices, only seven EU countries provide such tools

(ACER/CEER, 2022[110]). Transparent pricing can support more competitive retail markets by encouraging consumers to switch to the cheapest supplier.

Box 9. The European Commission's proposal for a reform of the EU electricity market

In March 2023, the European Commission proposed to reform the EU electricity market in reaction to the energy price shock in 2022. The proposal aims to reduce price volatility for consumers, enhance long-term price stability, and encourage investments in renewables.

Protecting and empowering consumers

- Regulated retail prices for households and small and medium enterprises in case of an emergency.
- Consumers should have the right to choose between a fixed price contract and a dynamic price contract, providing options both for risk-averse and risk-taking consumers. A stronger uptake of dynamic pricing aims to encourage demand shifting to times when electricity prices are cheaper, such as at night.

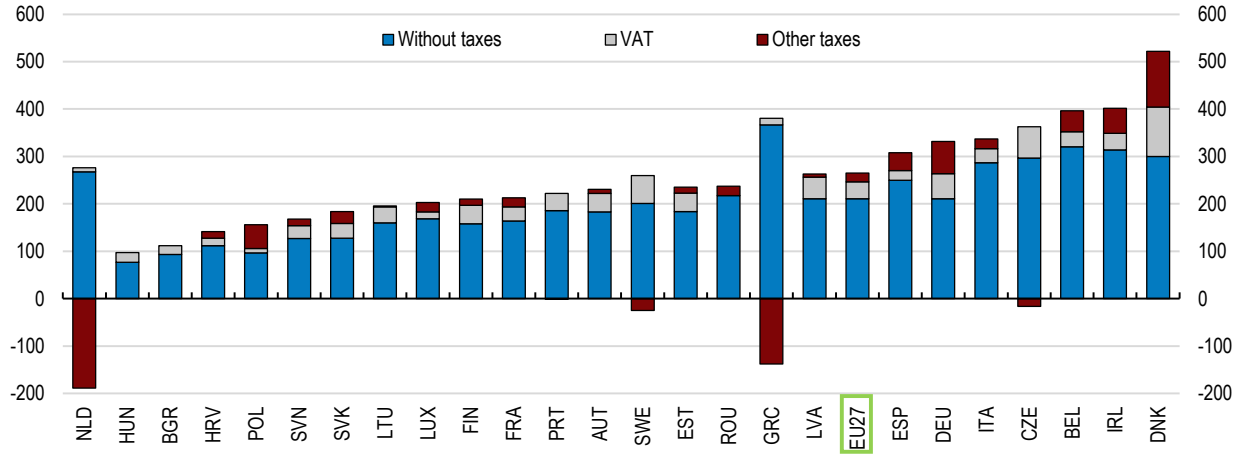
Enhancing energy costs' predictability and stability to boost industrial competitiveness

- Enhanced market access to long-term contracts, notably long-term commercial power purchase agreements (PPAs) and contracts-for-differences (CfDs):
- Member States would provide state guarantees to reduce the financial risks associated with payment default, which is often a major barrier to PPAs. Renewable energy providers participating in a public tender would have to reserve a share of the generation for sale through a PPA. In addition, electricity providers would be subject to more stringent hedging requirements, which is also expected to boost demand for PPAs.
- Through CfDs, governments guarantee electricity providers a minimum price. The proposal foresees 2-way CfDs for electricity providers, with a minimum price as well as a maximum price or price cap, so that any revenues above the price cap would have to be paid back to the government. CfDs would apply to solar, wind, geothermal, hydro, and nuclear energy providers.
- Improving the functioning of the short-term wholesale electricity market, by reducing the minimum bid size for intraday and day-ahead markets to improve liquidity.
- To improve the flexibility of the electricity system, Member States would be required to assess their electricity system needs and would have the possibility to introduce new support schemes especially for demand response and storage.
- The Agency for the Cooperation of Energy Regulators (ACER) would have enhanced ability to monitor energy market functioning. In particular, the updated Regulation on Wholesale Energy Market Integrity and Transparency would ensure better data quality as well as strengthen the agency's role in investigations of potential market abuse cases of cross border nature.

Source: European Commission (2023[112]).

Figure 16. Retail prices for electricity differ across EU countries

Electricity prices for households, EUR per MWh, 2022



Note: Electricity prices for household consumers in the consumption bands 2.5 MWh-5 MWh (band DC). "Other taxes" is negative when the environmental tax allowance's amount is higher than the amount of the environmental tax itself.
Source: Eurostat Electricity prices components for household consumers database.

A related issue is price regulation in wholesale energy markets. High energy prices during the energy crisis in 2022 were a burden on many households, reducing their disposable incomes. In contrast, energy companies benefitted from high windfall profits on the back of rising wholesale energy prices. Such a situation led governments to tax the high profits of energy companies and use the tax receipts to finance energy support for households. In December 2022, EU countries agreed to introduce a temporary revenue cap for energy companies (so-called inframarginal technologies revenues). Specifically, revenues of non-gas electricity producers were capped at EUR 180 per megawatt hour at the wholesale market, including renewables. However, the drawback of such temporary measures is that they create more uncertainty and may discourage investment. The revenue cap corresponds to a 100% tax on revenues above the threshold in the energy sector. In general, such sectoral taxes on revenues distort activity. That is, the sectoral allocation of capital is distorted by differences in tax rates across sectors. In addition, the cap only applies for market revenues above EUR 180 per megawatt hour and thus may increase with the tax base. As a result, the tax burden may be higher for larger renewable producers, reducing their incentives for investment and expansion (IEA, 2022[5]). The revenue cap is explicitly designed as a temporary measure and will be reviewed in June 2023. Fostering investment incentives in the green transition requires a more predictable tax system for renewable producers. This entails ensuring that the cap on revenues remains exceptional by phasing it out.

A higher reliance on renewables will entail securing sufficient backup capacity. About 40-50% of the electricity mix currently consists of conventional energy sources, notably gas, to provide such backup capacity at times when solar and wind are not generating sufficient energy, such as at night or in winter in the case of solar energy (EASE, 2022[91]; IEA, 2020[92]). This means that for every additional megawatt hour of energy supply from renewables, an additional 0.4-0.5-megawatt hour of backup capacity is needed. However, price regulation and windfall taxes discourage investment in backup capacities as higher taxation of the energy sector reduces investment incentives. Most backup capacity continues to be provided by legacy gas, with little investment in new capacities (IEA, 2020[94]). A clear price signal and a stable business environment are essential to attract investment in backup capacities (see above). In addition, more integrated electricity markets will reduce the need for backup capacity as excess supply of wind and solar electricity can be exported to meet demand in other countries where supply is short.

The carbon intensity of electricity production differs significantly across EU countries. While some countries have a low-carbon intensity electricity mix due to high shares of renewables and nuclear, several Central

and Eastern Member States rely heavily on coal for electricity generation (EEA, 2022[113]). Coal remains the largest single contributor to emissions in the power sector, accounting for a third of all ETS emissions (Ember, 2022[114]). Four EU countries have already phased-out coal, with another 14 having announced they would do so by 2030. Several Central and Eastern EU countries remain committed to coal production after 2030, accounting for about 45% of current EU coal use (Ember, 2023[115]; Climate Action Network Europe, 2023[116]). Efforts to phase out coal need to accelerate if the EU is to meet the emission target in 2030 (IEA, 2021[117]).

Biomass has been the main driver behind the renewable rollout in the past decade, accounting for nearly 60% of renewable energy in 2020. This reflects generous government support for biomass, amounting to almost a quarter of total renewable support across EU countries (Figure 14). Biomass such as biofuels can be sustainable when produced with low-emission energy and made from wastes and residues. For instance, nearly 70% of renewable diesel and biojet fuel came from wastes and residues in 2021 (IEA, 2022[118]). However, some types of biomass, such as wood pellets, can be 1.8 times more emission-intensive than coal due to combustion and processing losses, especially when transported over distances of 145 kilometres or more (Schnorf et al., 2021[17]; Sterman, Siegel and Rooney-Varga, 2018[119]). Despite these concerns, the EU imports almost 40% of wood pellets for domestic consumption, mostly from the United States (Brack, Birdsey and Walker, 2021[16]). Another issue is that burning woody biomass immediately releases CO_2 in the atmosphere, while reforestation takes time. This means that depending on the time needed for reforestation and the type of feedstock, emissions may increase for decades before they are reabsorbed (IEEP, 2021[120]). Another negative environmental externality associated with biomass is worsened biodiversity (IEA, 2022[118]).

EU regulations do not discourage the use of woody biomass for energy. The ETS currently excludes emissions from burning of biomass, in line with international emission accounting rules. According to these rules, emissions from the use of woody biomass are reported in the land-use sector (LULUCF) and not in the energy sector to avoid double counting of emissions. This means that emissions from burning biomass count towards the national LULUCF commitments of the country where the wood is harvested. However, this practice may in effect subsidise energy installations for burning biomass since imported woody biomass emissions at combustion are not accounted for in the EU but in the exporting country, risking overstating the progress made by EU countries towards emission targets (Brack, Birdsey and Walker, 2021[16]). The EU's proposal for a revised Renewable Energy Directive therefore requires bioenergy generators to demonstrate that the country of origin has laws in place to protect against unsustainable harvesting of wood, and to report emissions from forest harvesting. It would also make government support for biomass conditional on more stringent sustainability criteria. Nevertheless, the Renewable Energy Directive and the taxonomy of environmentally sustainable activities continue to include woody biomass. In line with emission reduction targets, the EU should discourage government support for unsustainable biomass, by adopting the revised Renewable Energy Directive and ensuring that unsustainable biomass is clearly excluded for sustainable activities under the taxonomy.

Carbon removal from the atmosphere is essential, along with emissions' reductions, to achieve the net-zero target. However, carbon capture, storage and use efforts remain limited and happen almost entirely in agriculture and forestry. In these sectors the options for further carbon removals are limited and would require large reforestation and the conversion of urban and built-up land into agricultural land. Novel methods for carbon dioxide removal (CDR) outside these sectors accounted only for 0.1% of carbon removals in 2020 (Smith et al., 2023[121]). Examples include carbon storage pilots in the United States or Danish and Norwegian projects in the North Sea. In 2022, the EU proposed a voluntary framework to certify carbon removals but markets for carbon removals remain non-existent. Moreover, the deployment of novel CDR technologies does not seem to feature prominently in the EU's innovation policy, as reflected in low funding (Box 10) (Philp, 2023[122]). In comparison, the Unites States have expanded tax credits under the Inflation Reduction Act of 2022 to incentivise CDR deployment, complementing funding of 0.01% of GDP per year under the Infrastructure Investment and Jobs Act. CDR technologies are still in their infancy

and require stronger incentives. This entails an expansion of tax credits for carbon capture, which should be technology neutral. A more efficient solution would be the establishment of markets for carbon removals, for instance by including carbon removed from the atmosphere in emission trading.

Box 10. Policy support for carbon capture and storage

Carbon capture and storage in agriculture and forestry

Reforestation, rewetting of peatlands and other soil management techniques can capture and permanently store CO_2 in the soil. In the EU, the LULUCF sector (land use, land change, and forestry) was estimated to have absorbed about 230 mega-tonnes of CO_2 from the atmosphere in 2020, or 6% of total EU GHG emissions (European Environment Agency, 2022[123]). The EU has set an EU-wide target of 310 mega-tonne CO_2 for removals from the LULUCF sector by 2030, helped by generous support for conservation practices under the Common Agricultural Policy (European Commission, 2022[124]). Such support includes direct payments to farmers and voluntary agri-environmental payment schemes that provide funding conditional on certain conservation practices. In addition, the European Commission has made a proposal for an EU framework for carbon removal certificates to incentivise carbon removals, as already introduced in the United Kingdom (Scottish Forestry, 2022[125]).

Carbon capture and storage in industry and energy

Novel applications in industry and energy include direct air capture (DAC) and bioenergy with carbon capture and storage (BECCS), among other things. With carbon removal technologies still considered as immature, governments deploy subsidies to support research and development, pilot projects and the first utility-scale projects (IEA, 2022[126]).

European Union: The EU provides EUR 3.4 billion between 2021 and 2030 (or 0.002% of 2021 GDP per year) to support carbon removal technologies, with 3 billion coming from the 38 billion EU's Innovation Fund, and the remaining funding from Horizon Europe, the EU's programme on research, development and innovation (European Commission, 2022[127]; European Commission, 2023[128]). The Soil Mission programme under Horizon Europe finances large projects on carbon removal in agriculture (so-called carbon farming). In addition, national subsidy schemes exist, such as in Denmark and the Netherlands, although funding remains small compared to support for established wind and solar technologies (Figure 14).

United Kingdom: Research and development is supported through GBP 100 million (or 0.003% of 2021 GDP a year) between 2021 and 2024. In 2022, consultations have been launched by the government to expand the existing carbon removal certification system in agriculture and forestry to novel applications like BECCS and DAC with carbon storage (UK Department for Business, 2022[129]; UK Department for Business, 2022[130]). There is also a debate about extending the emissions trading system to carbon removals, with carbon removals incentivised by contracts guaranteeing a fixed price per tonne of CO_2 removed (Department for Business, 2022[131]).

United States: The 2021 Infrastructure Investment and Jobs Act provides approximately USD 12 billion (0.01% of 2021 GDP a year) in R&D support and loans for carbon capture and storage technologies over the period 2021 to 2025. In addition, the Inflation Reduction Act from 2022 increased tax credits to enhance the financial viability of carbon capture projects. It doubled the tax credit for carbon that is captured and permanently stored from power and industrial plants to USD 85 per tonne of CO_2, and more than tripled the tax credit for CO_2 that is captured and stored from direct air capture to USD 180 per tonne. Eligible projects need to demonstrate a capture and storage capacity of 18 750 tonnes per year for power plants and 12 500 tonnes per year for industrial facilities. The capture threshold to claim credit for direct air capture facilities was significantly lowered from 100 000 tonnes to 1 000 tonnes per year, making tax support more attainable (IEA, 2022[132]).

Improved energy efficiency standards can reduce emissions. One such area is improved insulation of buildings. Buildings account for 36 per cent of EU energy-related carbon emissions (Tsemekidi-Tzeiranaki et al., 2019[133]). Roughly three-quarters of that comes from running buildings, including heating, and reflects that three quarters of the EU building stock is energy inefficient. The market already ensures that insulation is better in colder climates. Nonetheless, insufficient insulation means that many EU countries have higher per capita energy consumption than their income levels would suggest (IEA, 2022[134]).

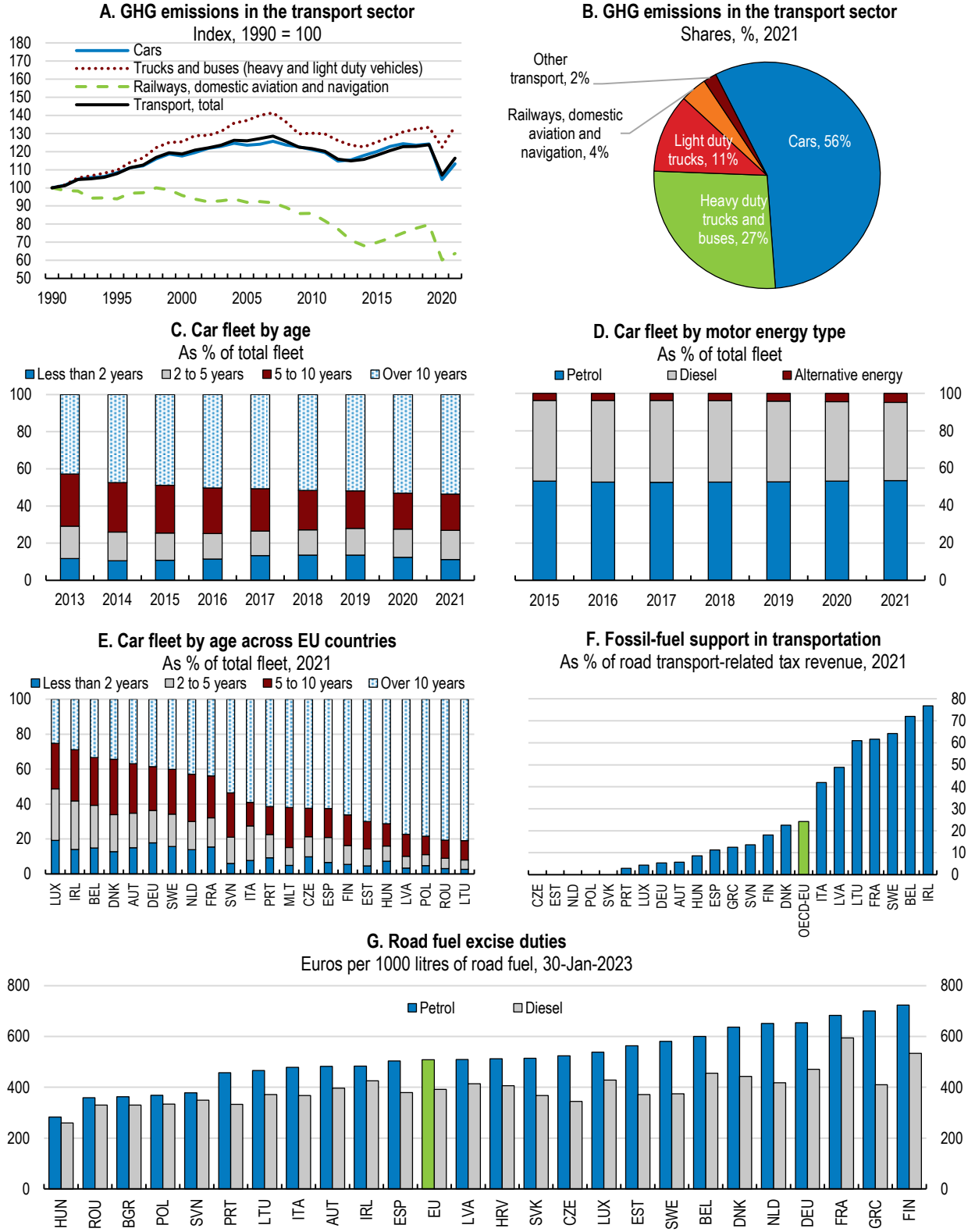
The EU addresses the issue of energy efficiency and provides subsidies to improve the energy and thermal efficiency of the housing stock. Poor insulation can also be addressed by regulation. For instance, the EU Commission proposed more stringent minimum energy performance standards to increase energy savings in buildings. Since EU-wide minimum energy efficiency standards were first introduced in 1993, energy consumption in new buildings has halved in 2020 relative to typical buildings from the 1980s (European Commission, 2020[135]). The proposal for more stringent minimum energy efficiency standards foresees that all new buildings emit zero emissions from 2028. More importantly, the proposal would also require the renovation of the existing housing stock, with the objective that all buildings should have at least energy efficiency label E by 2033, where class G is the lowest and class A the highest energy efficiency label. This means that in a 10-years-time it would be impossible to sell or rent the F or G energy class homes. Achieving this will require massive investment by EU countries in insulation and renovation, as about 15% of buildings in the EU have a G energy label (European Commission, 2020[135]; OECD, 2023[65]). However, the efficiency of such regulations is reduced by regulated retail energy prices for households, which reduce energy saving incentives. Domestic policies such as energy support measures should support common EU objectives.

Bringing down emissions in transportation

Emissions in transport have risen in recent years, reflecting increased economic activity and an ageing vehicle fleet that still relies heavily on fossil fuels (Figure 17, Panel A to E). Emissions fell only during the pandemic. The EU adopted a gradual reduction of CO_2 emissions from road light-duty vehicles leading to net-zero emission standards for new vehicles from 2035 and proposed a gradual phase-out of fossil fuel subsidies by 2033. However, many EU countries still have incentives for passenger road transport in place that contradict EU-wide green efforts, such as various tax reductions for transport fuels and commuting allowances (Figure 17, Panel F). For instance, all EU countries give preferential tax treatment to diesel relative to petrol despite diesel's higher carbon content (Figure 17, Panel G). There are also tax exemptions and reduced tax rates for fuels in aviation and shipping. To make polluters pay, a faster phase-out of environmentally harmful reduced rates and exemptions for fossil fuels should be envisaged. This should be complemented with taxation of fuels based on energy content and environmental performance.

Road transportation already faces high carbon prices in the form of fuel excise duties (see above). In contrast, transport fuels for aviation and shipping remain under-priced, reflecting lower energy tax rates and tax exemptions. To better reflect the carbon content of fossil fuels and align carbon pricing across sectors and different uses of energy, the EU will establish a new emission trading system for transport, industrial and residential heating fuels (Box 11). A similar emission trading system for transport and residential fuels was successfully introduced in Germany in 2021 (OECD, 2023[65]). Extending the ETS carbon price to transport fuel producers will strengthen the price signal for carbon and help direct emission reduction efforts to activities with the lowest abatement costs (OECD, 2022[71]).

Figure 17. Cars are the main source of emissions in the transport sector



Note: In Panel A and B, GHG emissions in the transport sector exclude emissions from international aviation and navigation. In Panel C and D, data refer to 24 EU countries (the 27 EU Members States, except Bulgaria, Greece, and the Slovak Republic).
Source: Eurostat; OECD Environment Statistics database; European Environment Agency; and OECD calculations.

Box 11. EU Emission Trading System for buildings and road transport (ETS 2)

The EU will establish a new emission trading system for emissions from fuels used in road transport, buildings, and certain industrial process that are not covered by the existing ETS. This new ETS 2 will be launched in 2027, although it may be introduced a year later in the event of exceptionally high energy prices. The new ETS 2 will be separate from the existing ETS for emissions from energy, industry, maritime transport, and within-EU aviation.

ETS 2 will regulate fuel suppliers rather than end-consumers. Nonetheless, fuel producers are likely to pass on higher carbon costs to consumers. As in the traditional ETS, the ETS 2 will put an absolute cap on the covered emissions, which will decrease annually to achieve an emission reduction of 42% in 2030 (compared to 2005 levels). Emission allowances will be auctioned and there will not be free allowances. The carbon price is expected to be lower in the new ETS 2 system than in the traditional ETS system. A potential merger of the new ETS with the traditional ETS will be reviewed in 2031.

To mitigate the impact of higher fuel prices on households, a new Social Climate Fund will be established. The Social Climate Fund will mobilise EUR 86.7 billion, including 25% from co-financing from Member States. To complement this, Member States should spend the remaining emissions trading revenues on climate and energy-related projects and address social aspects of the transition.

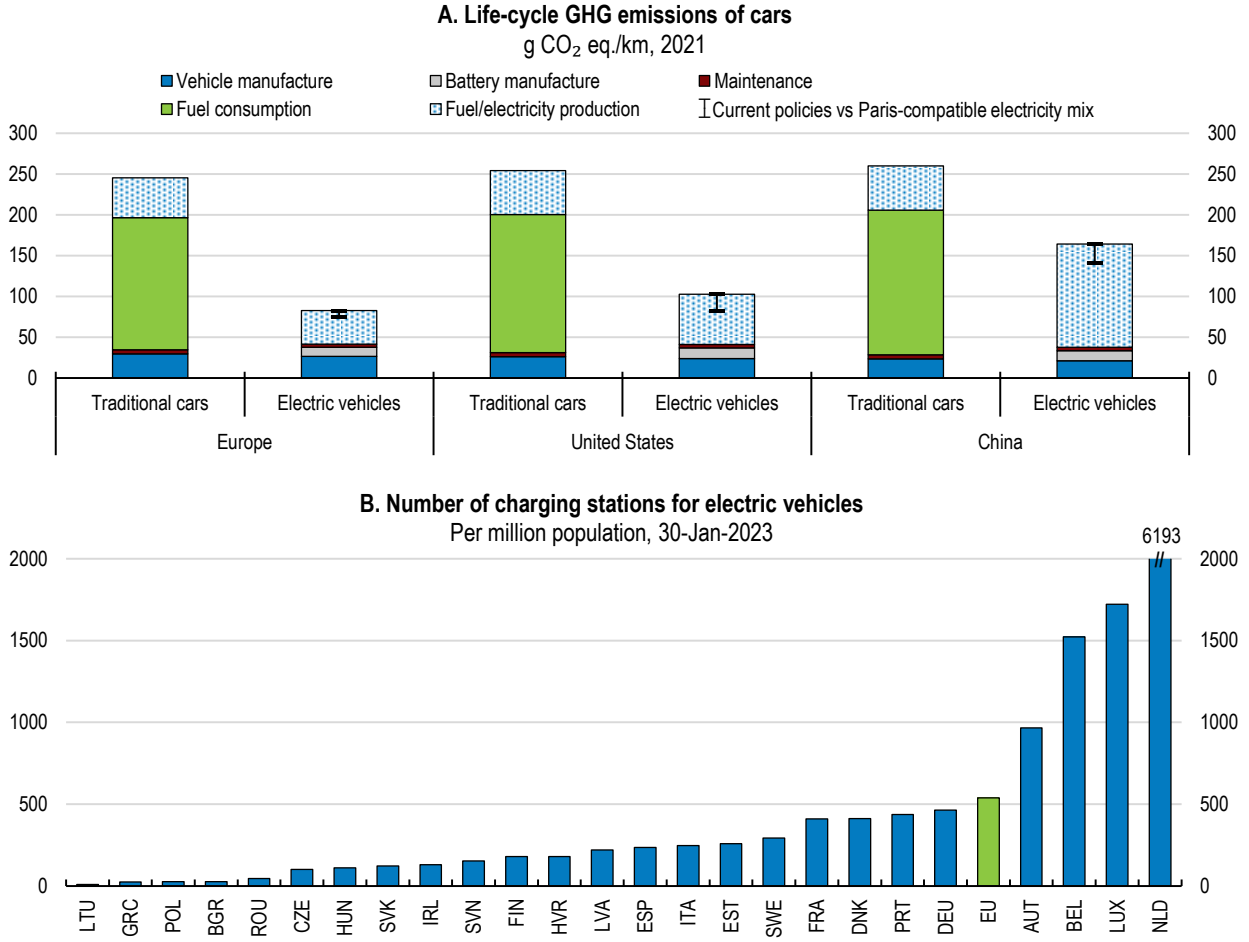
Source: European Commission (2023[136]).

Emission standards for new vehicles are an important regulatory measure to reduce emissions from road transportation. The EU announced more stringent emission standards that foresee zero CO_2 emissions for new cars and vans registered from 2035 onwards. The Commission will make a proposal for registering vehicles after 2035 that run exclusively on CO_2-neutral fuels. In practice, this entails gradually lowering the annual permitted emissions of new cars, so that after 2035 new cars are only allowed to emit zero CO_2. However, this regulatory measure will only affect new cars. It may not be sufficient to lower overall emissions in private transportation as the increasing average age of cars means that the composition of the car fleet only changes slowly. This is particularly the case as the resale value of used cars will fall, increasing incentives to extend the life stock of the existing car fleet. A factor behind the slow renewal of the car fleet are national purchase and registration taxes for cars, which often do not reflect carbon-intensity (ACEA, 2022[137]). Also, the production and use of electric vehicles causes emissions, albeit markedly lower than the production and use of combustion engine cars, once the electricity mix, battery production and decommissioning are taken into account. An issue is that electric cars produced in countries with high carbon-intensive energy mix, for instance based on coal, are also more carbon intensive, although not as much as combustion engine cars (Figure 18, Panel A) (Buberger et al., 2022[138]; Transport and Environment, 2022[139]; IEA, 2022[140]; Bieker, 2021[141]). For road transport to contribute significantly to emission reductions, national vehicle taxation should reflect carbon-intensity of cars in circulation and consider emissions over the life cycle of the car, including battery production and decommissioning.

Another factor is the slow rollout of electric cars, although this has started to pick up significantly since 2020. Almost all EU countries offer direct subsidies and tax incentives for the purchase of electric vehicles (ACEA, 2022[142]). Electric cars accounted for 18% of new sales in 2021, but their share in the stock of vehicles remains low at around 3% (EEA, 2022[143]; IEA, 2022[144]). The high price of electric cars compared to traditional cars remains a barrier to their uptake. Another factor behind the slow rollout of electric cars may be insufficient charging stations. In fact, the density of charging stations is higher in richer Western European countries, but even there it is mostly limited to urban areas, leaving rural areas with the greatest need for private cars underserved (Figure 18, Panel B) (Wappelhorst, 2021[145]; Colle, Micallef and Horstead, 2022[146]). Looking ahead, the uptake of electric cars will depend on sufficient charging infrastructure in rural areas. Regulations can help spur the rollout of home charging stations, especially in rural areas where distances to charging infrastructure are larger. In this respect, the EU's Alternative Fuels Infrastructure Regulation proposes to extend the coverage of recharging stations on main roads. There

should be recharging stations for electric vehicles at least every 60 kilometres on main roads by the end of 2025. In addition, the EU requires charging infrastructure for all new residential buildings with more than ten parking spaces, which is welcome. A higher uptake of electric cars should be supported by higher taxation of fossil fuels (see above).

Figure 18. The carbon-intensity of electric cars depends on the electricity mix of the country of production



Note: In Panel A, life cycle GHG emissions of average medium-size gasoline internal combustion engine and battery electric vehicles registered in Europe, the United States and China in 2021. The error bars indicate the difference between the development of the electricity mix according to stated policies (the higher values) and what is required to align with the Paris Agreement.
Source: International Council on Clean Transportation Europe (2021[147]); Electromaps (2022[148]); Eurostat Population database; and OECD calculations.

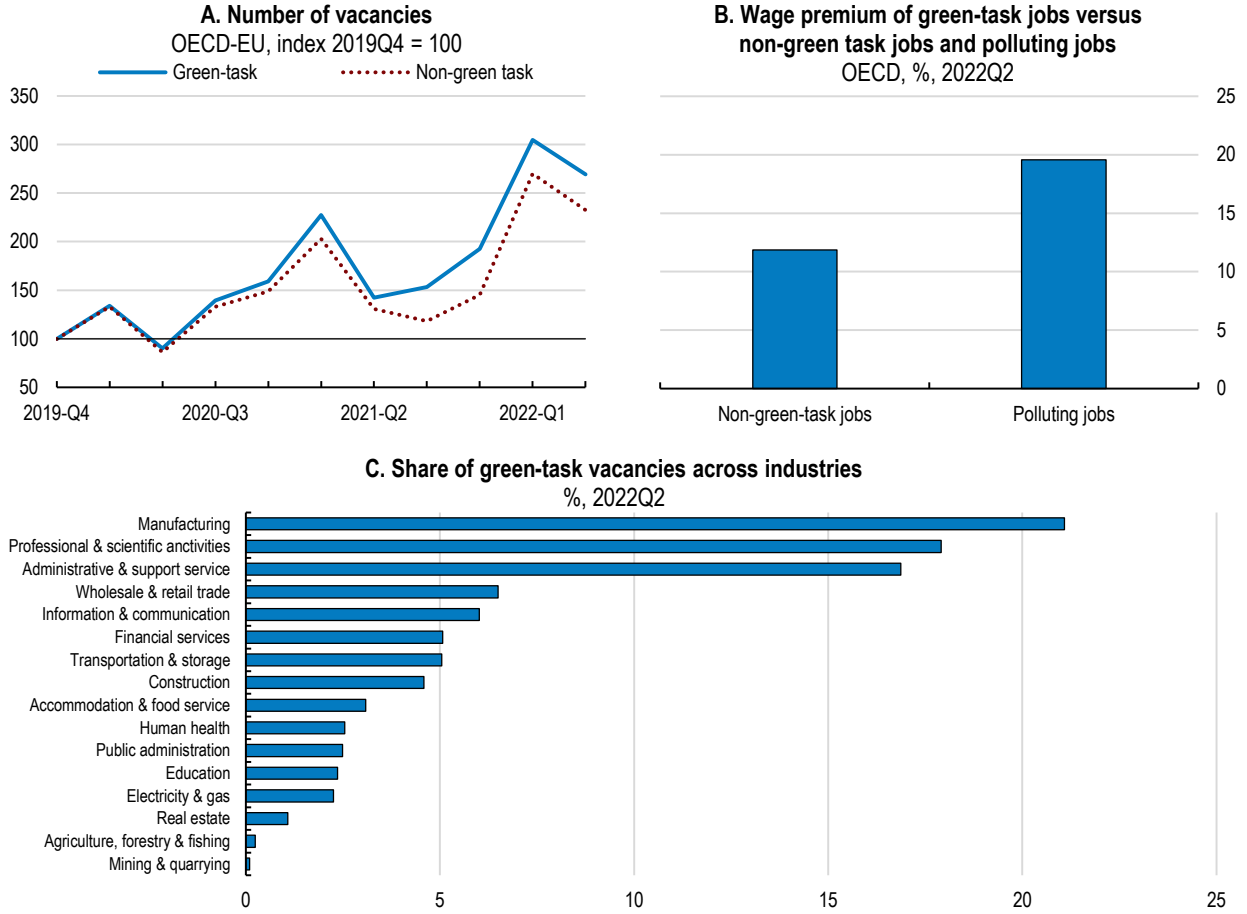
Rail has on average lower carbon emissions per kilometre than other forms of passenger transport (ITF, 2023[149]). Nonetheless, cross-border rail traffic remains underdeveloped across the EU as a whole, accounting for only 6% of passenger services in 2021. This share is somewhat higher for freight traffic (European Union Agency for Railways, 2022[150]). This reflects different security standards, signalling systems, national rules-induced red tape, and other technical and administrative systems that hamper the flow of international rail travellers and raise ticket prices. For instance, different technical systems mean that to start operating across borders, new trains need to be ordered that are specifically modified for the countries they pass through. Another example are different rules for brakes, which can lead to lengthy technical checks at the border of between 50 minutes and 9 hours (European Union Agency for Railways, 2022[151]). Also, national rail network operators charge foreign train operators rent for using locomotives, access to rails, and parking fees. Such charges can be set higher for cross-border services than domestic services, increasing fares, reducing entry, and leaving rail infrastructure underutilised. Other issues are high rail track charges (amounting up to 40% of the ticket price), national regulations that forbid passenger

transport at high-speed routes at night, and the lack of a unified and transparent ticketing system in Europe. All these barriers create the wrong incentives for cross-border trains (European Commission, 2021[152]). To bolster cross border trains and reduce waiting times at border crossings, national technical rules and infrastructure requirements should be harmonised. Moreover, the EU should ensure non-discrimination in locomotive lease prices and rail charges for domestic and foreign trains.

Limiting reallocation costs from the green transition

The green transition will entail social costs, including those arising from the reallocation of workers across sectors or regions. At the same time, population ageing is projected to lead to a smaller workforce. This will give rise to labour shortages, which is likely to help smooth the reallocation of labour from carbon-intensive sectors to non-carbon-intensive sectors. The wage premium associated with green jobs such as engineers and specialized construction workers may encourage workers to move into these activities (Figure 19). Nevertheless, there remains room for policy to support this process. Policy can ensure that barriers to job-to-job mobility are reduced, including flexible labour and housing markets. While this is primarily under the responsibility of EU countries, the EU also provides support to regions most affected by decarbonisation. Another important barrier to the green transition is skills shortages.

Figure 19. Vacancies and wage premia in green jobs are high



Note: In Panel A, data refer to OECD-EU countries. The numbers have been normalised so that demand equals 100 in the last quarter of 2019 and is a ratio of the demand in the following quarters to the demand in the last quarter of 2019. In Panel B, the average is calculated as a weighted sum of wage premiums in OECD countries, where the weights are equal to the share of OECD's labour force of each country. In Panel C, data refer to EU countries, Norway, Switzerland, and the UK.
Source: OECD (2023), Job Creation and Local Economic Development 2023: Bridging the Great Green Divide, OECD Publishing, Paris, https://doi.org/10.1787/21db61c1-en.

The impact of decarbonisation policies will vary across regions. For instance, the coal phase out is estimated to lead to a loss of about 160 thousand direct jobs in coal regions by 2030 (Alves Dias et al., 2018[153]). The most affected regions are located in Member States such as the Czech Republic, Poland, and Romania, where coal regions already experience higher levels of unemployment. More broadly, higher carbon pricing is projected to lead to job losses in energy-intensive manufacturing, reflecting higher production costs (Chateau, Bibas and Lanzi, 2018[154]; Chateau, Miho and Borowiecki, 2023[11]). Job losses are expected to be more than compensated by job gains in less emission-intensive service sectors, mostly in urban regions, but labour market rigidities may slow the reallocation of workers across sectors and regions. Other barriers to labour reallocation include imperfect housing markets and skill mismatches (OECD, 2023[155]; Borgonovi et al., 2023[156]).

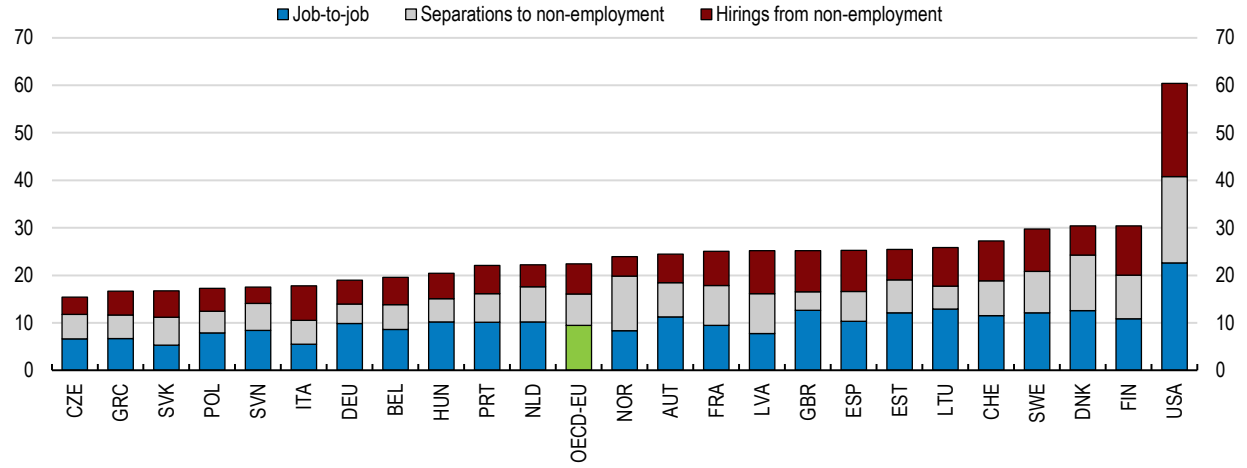
Labour mobility within EU countries is relatively low, which does not support the reallocation of workers (Figure 20). In addition to within-country mobility, there is also the issue of cross-border mobility. One barrier to labour mobility is an abundance of licensing and certification requirements, affecting roughly 40% of the European labour force (Figure 21). Such occupational entry barriers were shown to reduce labour reallocation in EU countries (Bambalaite, Nicoletti and von Rueden, 2020[157]). A concern is that the recognition of qualifications is a much higher barrier for third country professionals. Since 2018, the EU requires countries to assess the proportionality of such occupational entry barriers, although with limited success (European Commission, 2021[158]). Prior checks of qualifications for the provision of cross-border services have been abolished for two fifths of all regulated professions (Single Market Enforcement Taskforce, 2022[159]). The EU has several instruments to support cross-border mobility such as the European Professional Card, recognition of professional qualifications based on professional experience, and the automatic recognition of qualifications. Nonetheless, only seven professions across EU Member States allow for automatic recognition of qualifications, and none in jobs relevant for the green transition (such as engineers and construction workers) (European Commission, 2023[160]). The failure to assess the proportionality of occupational entry regulation has led the European Commission to open infringement proceedings against 18 Member States in 2021. Reducing licensing and certification requirements in sectors particularly relevant for the green transition would support employment transitions. This entails continued efforts to reduce entry barriers through proportionality tests. A more mobile European labour force would also help dampen skill shortages. Other barriers to cross-border mobility include language and housing markets (see below).

The lack of portability of social benefits across countries increases mobility costs. For instance, unemployment benefits are portable only for three months when moving to a different EU country. This may discourage cross-border mobility as jobseekers may not have sufficient time to search for new employment in other countries and employment that matches their skills. At the same time, mobility support for unemployed persons such as subsidies for housing are often not transferable, although the EU provides mobility grants for students and young workers via the Erasmus+ programme (European Commission, 2023[161]). Extending the benefit duration abroad to six months could improve cross-border mobility, especially from poorer regions into growing labour markets. The European Commission proposed to extend the period from three to six months and, optionally up to the end of the entitlements.

Another factor behind low geographical mobility is rigid housing markets. In many EU countries, housing supply is only slowly adjusting to demand, reflecting to some extent the prevalence of many regulated professions in construction (OECD, 2021[162]). Reducing the number of regulated professions in the construction sector may encourage a more flexible housing supply (see above). Geographical mobility is also restricted by high transaction costs when buying and selling property (Rupert and Wasmer, 2012[163]). The impact of such housing market frictions is amplified in EU countries with high rates of home ownership and small rental markets. However, housing policy is under the responsibility of EU countries and hence outside the scope of this paper (OECD, 2021[164]; OECD, 2022[165]; OECD, 2021[166]).

Figure 20. Labour market churn is low on average

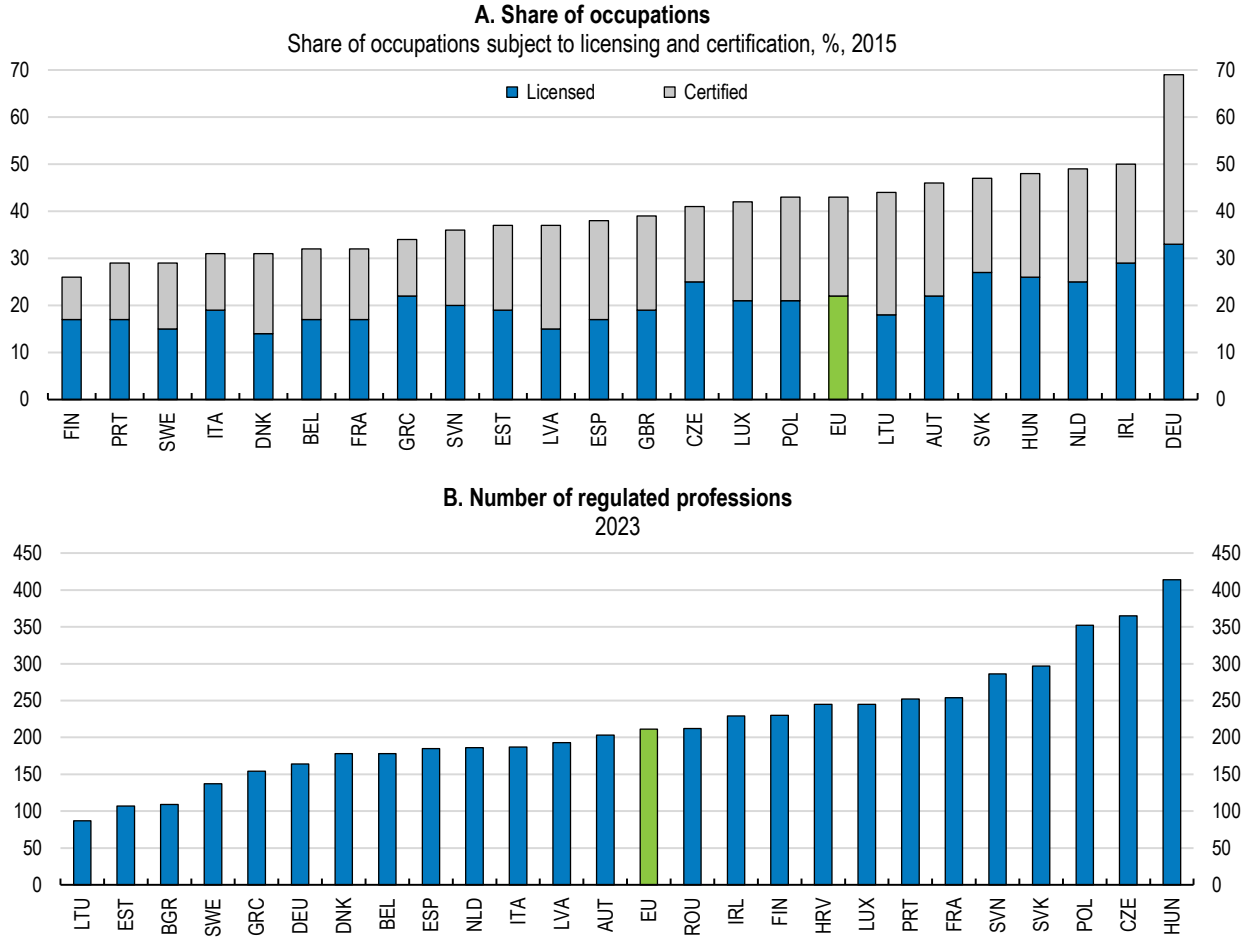
Labour market transitions, % of average employment, 2019



Note: Labour market flows for European countries are computed as the number of working-age individuals moving between two statuses from one year to another as a share of average employment between these two years. Job-to-job flows measure job changes from one job to another. Hirings from non-employment and separations to non-employment include flows from and to both unemployment and inactivity.
Labour market flows for the United States are available on a quarterly basis and defined as a share of the average number of jobs at the beginning and the end of quarter. Job-to-job flows include job changes within a quarter and from the previous to the adjacent quarter. Hirings from non-employment and separations to non-employment flows are from and to "persistent non-employment", defined as non-employment that lasts at least one quarter. Estimated annual transitions are obtained by summing quarterly rates.
Source: Causa, O., N. Luu and M. Abendschein (2021), "Labour market transitions across OECD countries: Stylised facts", OECD Economics Department Working Papers, No. 1692, OECD Publishing, Paris, https://doi.org/10.1787/62c85872-en.

The EU provides support to regions most affected by decarbonisation. The European Social Fund+ is making available EUR 99 billion over 2021-27 (or 4.9% of the EU budget) to support employment and skills, which can be also used to support green skills and green jobs. This is complemented by spending under the Recovery and Resilience Facility as well as cohesion policy funds. In addition, the 2020 Just Transition Mechanism (JTM) aims to help the most affected regions manage the adverse effects of the green transition, including social and employment effects. The JTM focuses on regions dependent on the production of solid fossil fuels (such as coal, peat, and oil shale), as well as regions dependent on carbon-intensive industries (such as steel, cement, or chemicals). Although the JTM is complemented by other funds for cohesion policy, its limited financial resources of 1% of the EU budget do not match the wide-ranging ambitions of the project, which include supporting labour market transitions, economic revitalisation, and land restoration of regions most negatively affected by the transition. A more effective approach would be to concentrate the available resources under the JTM on policies with the highest impact on worker reallocation, including training, job placement and mobility support (OECD, 2021[166]; OECD, 2023[155]; OECD, 2023[65]). Another policy instrument is the Social Climate Fund to mitigate the social impacts of a new emissions trading system for buildings and road transport (Box 12). However, the Social Climate Fund will not come into force until 2026.

Figure 21. Occupational entry barriers remain high



Note: In Panel A, workers in licensed occupations declared that without having a professional certification, licence, or taking an entry exam, it would be illegal to practice their occupations. Workers in certified occupations proclaimed that they have a license, certificate, or that they passed an exam to practice their occupation. However, it would not be illegal to practice their occupations without it.
Source: Koumenta and Pagliero, 2017 and Koumenta and Pagliero, 2016, based on the EU Survey of Occupational Regulation; Bambalaite, I., G. Nicoletti and C. von Rueden (2020), "Occupational entry regulations and their effects on productivity in services: Firm-level evidence", OECD Economics Department Working Papers, No. 1605; and European Commission (2020[167]).

Funding under the Just Transition Fund (JTF) is conditional on Territorial Just Transition Plans that set out local financing needs. However, in a few regions limited involvement of local stakeholders was found to hamper the discoveries of areas with highest need of support (CEE Bankwatch Network, 2022[168]; CEE Bankwatch Network, 2021[169]). This is even though all Member States adopted the 2022 Council Recommendation on ensuring a fair transition towards climate neutrality, which invites Member States to ensure a whole-of-society approach. It is essential to continue involving both the private sector and social partners in the development of transition plans to ensure that funding is tailored to local labour market needs, such as skills and training (Cameron et al., 2020[170]; OECD, 2021[166]). To better ensure this, funding could be made conditional on labour market outcomes such as job-to-job transitions, or transition from unemployment to employment in affected regions that result from active labour market support funded by the JTF. In practice, this means that EU funding would only be disbursed after a set of outcome-based milestones and targets are met. Such changes could be envisaged for the next round of JTF funding under the post-2027 Multiannual Financial Framework.

Box 12. Just Transition Mechanism and Social Climate Fund

Just Transition Mechanism

The JTM aims at making the green transition more inclusive, including by supporting workers in the regions most affected by mitigation policies. The Mechanism provides EUR 20.7 billion (1% of the EU budget) for the period 2021-27, with the aim to mobilise an additional EUR 34 billion in public and private funding:

- The Just Transition Fund (JTF) provides EUR 19.3 billion, complemented by national co-financing. Funding is provided for economic diversification, social and labour market policies, as well as the restoration of land affected by coal mining, among other things. This includes investment in SMEs, renewables, training of workers, and job-search assistance (European Commission, 2023[171]).
- The Public Sector Loan Facility will combine EUR 1.5 billion of grants from the EU budget with EUR 10 billion of loans from the European Investment Bank.
- The InvestEU Just Transition Scheme will provide EUR 15 billion in EU budgetary guarantees to attract private investment of EUR 34 billion in renewable energy deployment, innovation and digitisation, small and medium-sized businesses, and skills.

Social Climate Fund

Starting in 2026, the Social Climate Fund will provide EUR 86.7 billion (or 4.3% of the 2021-27 EU budget) to address the social impact of the expansion of emission trading to heating and road transportation fuels. The Fund will finance investments in energy efficiency, buildings renovation, low-emission heating and cooling systems, the purchase and charging infrastructure for electric vehicles, as well as public transportation. The Fund will also finance temporary direct income support to vulnerable households that are likely to be affected by the increase in road transport and heating fuel prices.

Initially, the Fund will be financed through EUR 50 million in revenues from auctioning ETS allowances in 2026. Once the ETS system for heating and transportation fuels (ETS II) enters into force in 2027, the Fund will be funded from auctioning ETS II allowances to reach EUR 65 billion, complemented by EUR 21.7 billion in national contributions. Looking ahead, the European Commission intends to fund the Social Climate Fund via the post-2027 Multiannual Financial Framework.

To receive funding, EU countries will have to submit Social Climate Plans that will be assessed by the European Commission and demonstrate the achievement of the milestones and targets defined in the Plan. These Plans are to be prepared in consultation with local and regional authorities, social partners as well as civil society.

Source: European Commission (2023[172]) and European Parliament (2022[173]).

Table 3. Recommendations

Main findings	Recommendations (key ones in bold)
Towards more efficient climate change mitigation	
The uneven coverage of the EU Emission Trading System (ETS) across sectors and differences across national tax systems impose heterogeneous abatement incentives across countries and sectors. Energy taxation maintains inequalities in tax treatment across sectors and different uses of energy. Reduced rates and tax exemptions for environmentally harmful fossil fuels, including heating gas, aviation, and maritime fuels, continue to undermine decarbonisation efforts.	**Continue expanding the coverage of ETS, for instance in agriculture, by establishing emission monitoring and reporting systems (e.g., for emissions from livestock and fertiliser use) and including emissions of large emitters.** **Bring forward the phase-out of free emission allowances.** **Revise the Energy Taxation Directive to introduce minimum tax rates for fossil fuels based on energy content and environmental performance, and broaden the energy tax base by phasing-out exemptions and reduced rates for fossil fuels. Announce clear time paths for the evolution of minimum tax rates for fossil fuels.**
Budgetary policies impose heterogeneous abatement costs across EU programmes.	Introduce an internal carbon price for all budget and planning preparations.
There is a lack of risk capital for financing new sustainable technologies. Sustainability reporting requirements will raise compliance costs for business.	**Promote the Capital Markets Union by reviewing the regulatory burden on institutional investors**. Ensure consistency and interoperability of EU sustainability reporting standards with international standards.
Ramp up mitigation in agriculture	
Direct payments continue to promote the environmentally harmful use of drained peatlands. Direct payments to agricultural producers based on livestock numbers have increased.	**Remove support for the agricultural use of drained peatlands.** **Gradually withdraw direct payments for high livestock numbers.**
Mitigation measures are voluntary and have a low potential to reduce emissions.	Make payments under the agri-environmental schemes conditional on achieving emission reductions.
Enforcement and inspection of cross-compliance provisions are low.	Increase the number of on-the-spot checks and adjust penalties to reflect the environmental damage resulting from the violation.
Accelerate emission reductions in energy and transportation	
Government support for renewables remains high and mostly benefits cost-competitive solar and wind. There is room to further increase the use of competitive auctions.	**Ensure that the EU state-aid framework allows government subsidies only for renewable technologies that are not yet competitive.**
Retail electricity markets are fragmented along national boundaries, reflecting price regulation. Insufficient investment in cross-border grid connections slows down the integration of wholesale electricity markets.	**Ensure that EU countries phase out regulated retail electricity prices by fully implementing the EU Directive on Common Rules for the Internal Market for Electricity.** **Increase investment in cross-border grid connections by diverting EU funds to the Connecting Europe Facility.**
The temporary cap on market revenues for non-gas electricity producers in wholesale electricity markets reduces investment incentives. Marginal cost pricing in wholesale electricity markets, along with the planned increase in the share of renewables (with very low marginal costs) in electricity generation poses long-term challenges for profitability and investment in electricity markets.	Do not renew the temporary cap on market revenues of non-gas electricity producers in wholesale electricity markets. In the longer-term, consider reforms to the wholesale electricity market pricing system, including a stronger reliance on long-term contracts, and capacity auctions for conventional backup capacity.
EU regulations encourage the use of emission-intensive biomass for energy.	**Ensure that EU countries do not support the use of unsustainable biomass, by revising the Renewable Energy Directive and ensuring that unsustainable biomass is excluded from the taxonomy of sustainable activities.**
Markets for carbon removal are non-existent.	Establish markets for carbon removals, for instance by including carbon removals in emission trading.
International rail traffic remains underdeveloped.	**Ensure non-discrimination in locomotive lease prices and rail track charges for domestic and foreign trains.**
Limit reallocation costs from the green transition	
Occupational entry barriers reduce labour mobility.	**Continue efforts to reduce occupational entry barriers.**
Spending efficiency is a concern for the inflow of EU funds under the Just Transition Fund.	**Concentrate future funding for alleviating the socio-economic impacts of the green transition on mobility support and training, and make it conditional on labour market outcomes.**
Unemployment benefits are portable only for three months when moving to a different EU country, discouraging cross-border mobility.	Consider extending the unemployment benefit duration to six months when moving to a different EU country.

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