2 Transitioning to a green economy

A changing climate is threatening livelihoods and economic activity in Greece and the world. Transitioning to a green economy – mitigating the causes of climate change and adapting to its effects, while sustaining activity and improving well-being – is among the greatest policy challenges of the coming decades. In Greece, legacies of high emission intensity, limited fiscal space and scarce private financing amplify the challenge. Greening Greece's energy system is at the core of this transition. This entails swiftly developing its large potential for renewable energies and adapting energy consuming sectors. A well-chosen mix of policies – including carbon pricing, public infrastructure investments, and gradually tightening regulations on minimum energy efficiency standards, while providing financial support and protecting vulnerable households – would minimise the costs of this transition. Developing insurance coverage can better protect households and firms from damages resulting from a warming climate, while limiting fiscal exposure. Engaging all stakeholders and supporting those affected by the transition will help build the consensus for implementing these policies into the long term.

Climate change is making the transition to a green economy imperative

The climate in Greece is changing. Higher average temperatures and more extreme weather events are harming well-being, challenging the economy and threatening livelihoods. Disruptions are likely to grow as climate change accelerates, even if adaptive measures can reduce some of the damages. Over recent years Greece has cut its greenhouse gas emissions (GHG) faster than most OECD countries. By 2050, it has committed to reach net-zero GHG emissions in line with the Paris Agreement, and it has adopted ambitious intermediate targets to get there in time. Greece recognises the need for immediate policy action to help people and businesses to become more resilient to a changing climate, as the priorities of its Recovery and Resilience Plan and the creation of the Ministry for Climate Crisis and Civil Protection demonstrate.

Transforming the economy to mitigate and adapt to climate change will ultimately improve people's lives and firms' productivity. With 70% of emissions generated by fossil fuels, shifting to a green energy system is at the core of this transition, and promises wider benefits. Energy prices increased substantially since the recovery from COVID-19 and the war in Ukraine (discussed in Chapter 1). High energy bills weigh on production costs for firms' and households' purchasing power. Replacing fossil fuels with renewable sources will reduce dependency on oil and gas imports. Many buildings in Greece are not energy efficient and energy poverty is widespread. Renovations will improve housing quality and lower energy bills. Reliance on cars is high, as are air pollution, accidents and road congestion. Shifting to net zero emissions from transport will entail greener and less polluted cities and improved access to transport modes other than cars.

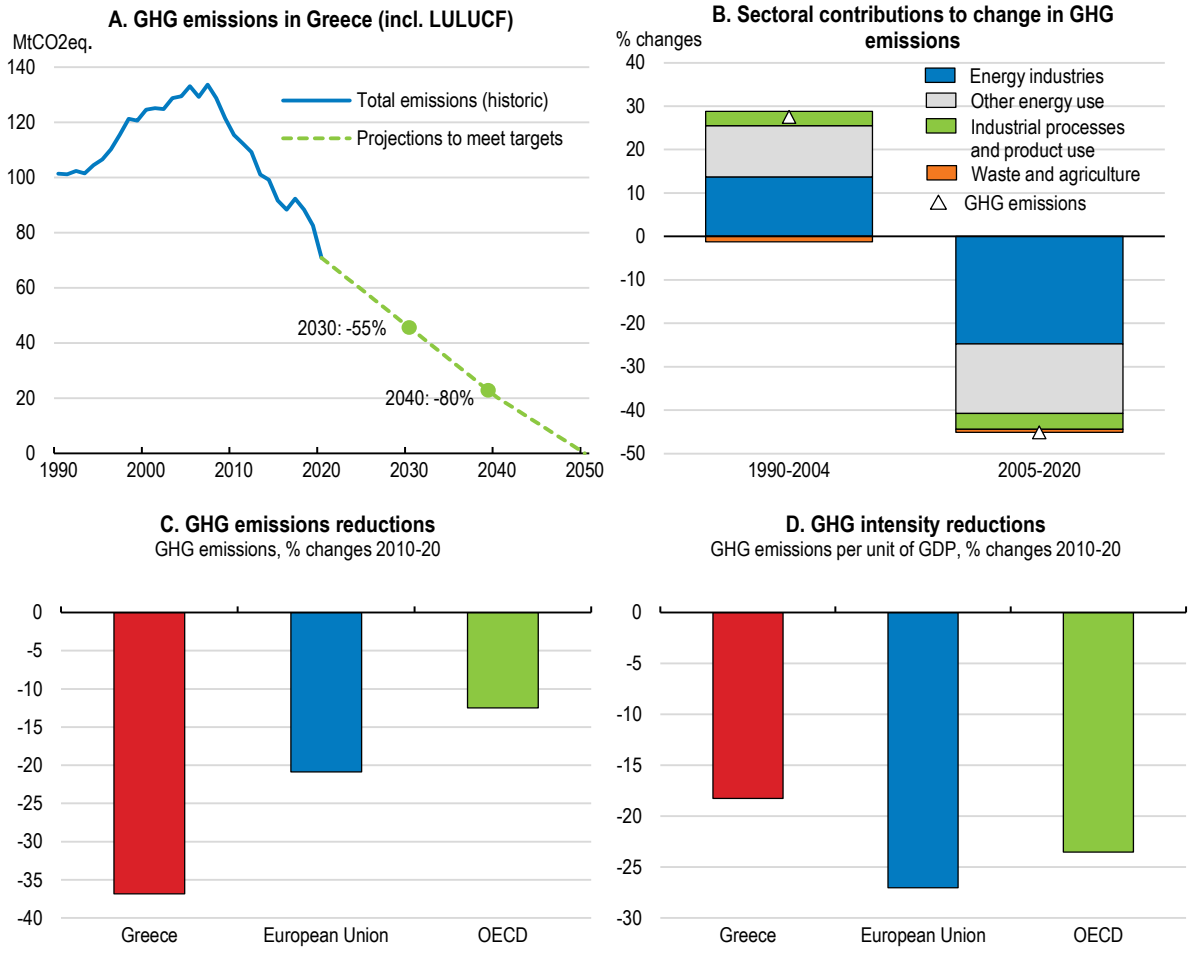
Notwithstanding the long-term benefits, transforming the economy brings inherent costs, especially in the short run. Businesses in sectors ranging from transport to tourism are likely to experience higher costs and will need to invest and restructure their operations. Capital bound up with fossil fuels needs to be replaced and new infrastructure needs to be built. Some products, especially those intensive in carbon, will become more expensive because of carbon pricing policies. Financing capacity has been curbed by the decade-long economic crisis, and the transition will absorb scarce fiscal space and private finance, especially once the exceptional NextGenerationEU facility concludes in 2026. Mobilising capital while cutting emissions and adapting to a changing climate, all at the lowest cost to households, firms and the public sector, are key challenges for Greece for the coming decades. Sustaining a broad consensus for the comprehensive and long-ranging changes involved in transitioning to a green economy will be essential to achieve this. Legacies of low levels of public trust and inconsistent government implementation capacity challenge these goals.

This chapter identifies a mix of policies to help Greece transition cost-effectively to a green economy, by mitigating its contribution to climate change and adapting to a changing climate in a socially and politically acceptable way. The analysis and recommendations are informed by new research conducted by the OECD and the International Transport Forum, assessing different policy options for Greece to cut emissions, and their macroeconomic and distributional consequences. The chapter first focuses on the central role of the green energy transition to meet Greece's GHG emission goals and discusses key cross-sectoral policies as well as macroeconomic and fiscal implications. It then discusses how policies specific to key sectors can support this transition, then on policies to support households and businesses to reduce vulnerabilities by adapting to a hotter and more volatile climate. The final section discusses how these long-term policy programmes for mitigating and adapting to climate change can be implemented by building a consensus and supporting firms and workers through the green transition.

Towards net-zero via the green energy transition

Greece has achieved large reductions in greenhouse gas (GHG) emissions since their peak in 2005 (Figure 2.1, Panel A). This reduction was largely associated with the nearly thirty percent contraction in Greece's GDP during the economic crises of the 2010s, which compressed energy demand, while a shift in energy sources away from coal and oil towards natural gas and renewable energy reduced emission intensity (Figure 2.1, Panel B). This is reflected in the fact that total emissions declined faster than the OECD and the EU (Figure 2.1, Panel C), while the decline in emissions per unit of GDP was slower (Figure 2.1, Panel D). In 2020, Greece's economy remained more emission-intensive than the OECD average (Figure 2.2, Panel A), reflecting a combination of low energy use per unit of GDP (Figure 2.2, Panel B) but high emissions per unit of energy produced (Figure 2.2, Panel D), also because power and heat generation uses more fossil fuels than in most other OECD countries (Figure 2.2, Panel C).

Figure 2.1. Greece needs to sustain its recent pace of GHG emission reductions to reach net zero



Note: Panel A: GHG emissions include land use, land-use change and forestry (LULUCF). Preliminary data for 2019. The reduction for 2030 and 2040 are relative to the 1990 GHG emission level. Panel B: GHG emissions exclude LULUCF.
Source: OECD (2022), Environment: Air and climate (database); and European Environment Agency (2021), EU Emissions Trading System (ETS) data viewer.

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Greece has adopted ambitious plans to reduce GHG emissions over recent years (Box 2.1). In 2022 it raised the targets in its National Energy and Climate Plan and in its Climate Law is now committed to cutting GHG emissions by 55% by 2030 and 80% by 2040 compared to 1990 levels, in line with recent

EU-level targets. Achieving these targets while sustaining growth in economic activity will require Greece decoupling GHG emissions from economic activity faster than achieved thus far.

Box 2.1. Greece's main policy plans and goals for the green economy transition

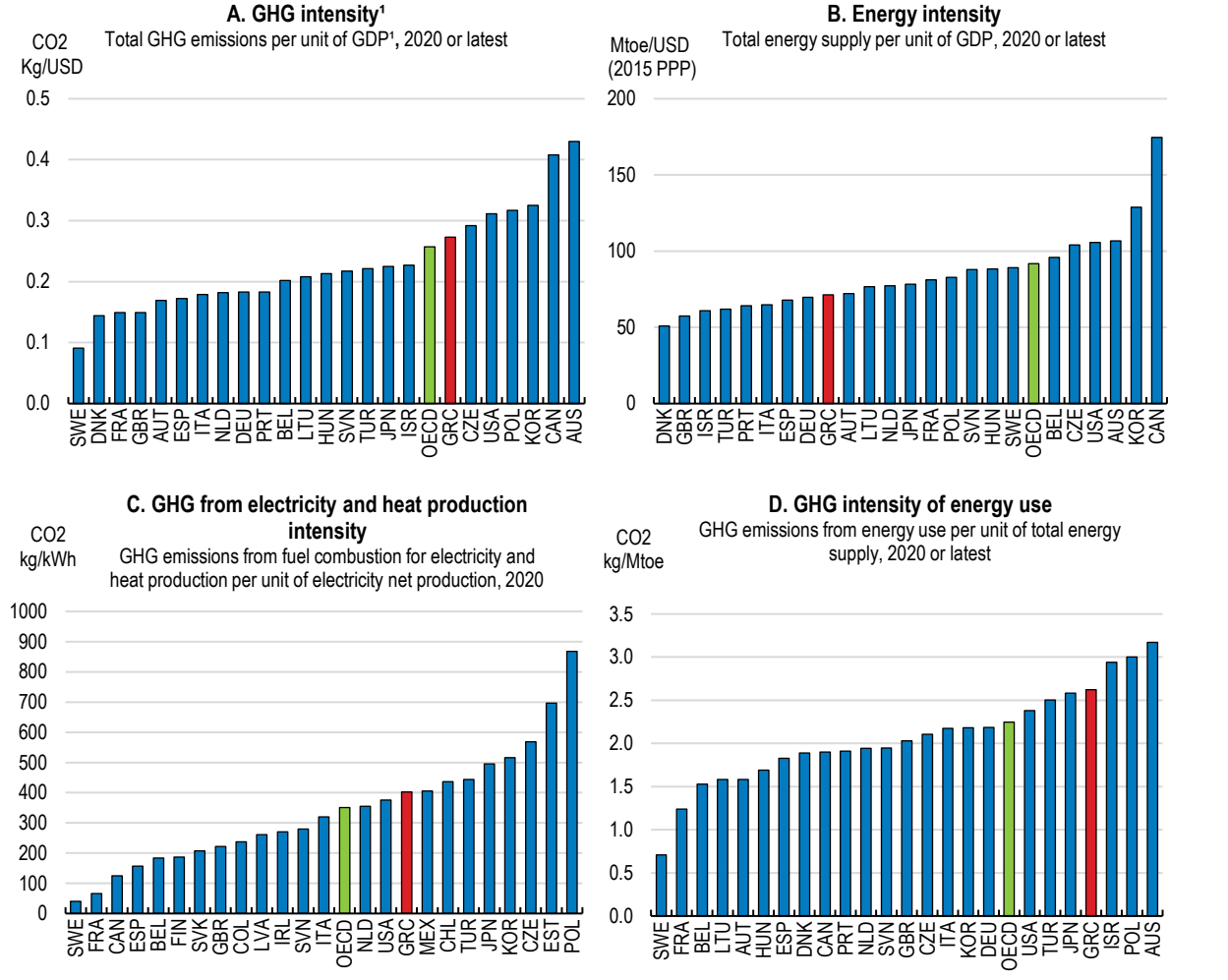
The main policy goals and measures relating to the green economy transition are set out in the National Energy and Climate Plan, the National Climate Law, and the Recovery and Resilience Plan "Greece 2.0", which dedicates 37.5 % of grants and loans to green objectives. Overall, EUR 6.2 billion (3% of 2021 GDP) are budgeted for the green transition, which are expected to mobilise a total of EUR 11.6 billion (6% of 2021 GDP) (Table 2.1). Focusing on adaptation, the National Strategy for Adaptation to Climate Change provides guidelines and indicative actions, which will support identifying policy priorities and devising action plans at the regional and local level through Regional Plans for Adaptation to Climate Change, which are currently being finalised.

Table 2.1. Policy targets and measures for achieving the green economy transition

	National Energy and Climate Plan (2019)	National Climate Law (2022)	Greece 2.0 (2021)
Total greenhouse gas emissions	By 2030 reduction of 43% compared to 1990 level	By 2026, introduction of 5-year sectoral carbon budgets By 2030 reduction of 55% compared to 1990 level By 2040 reduction of 80% compared to 1990 level By 2050 reach net-zero	
Energy industry	After 2028, ban of lignite for power generation; close lignite plants currently in operation by 2023 By 2030, at least 35% of final energy consumption from renewable sources By 2030, connecting to mainland or upgrading power grid for remaining 29 unconnected islands	After 2028, ban of solid fossil fuels for electricity generation, which can be brought forward until 2025 From 2023, requirement for most new and large buildings generate electricity on-site from renewable sources	Investments for electricity storage (EUR 0.5 bn), interconnection of islands (EUR 0.2 bn), and upgrading electricity network (EUR 0.1 bn) Reform account for Renewable Energy Sources (EUR 0.2 bn), licensing procedures and spatial planning for renewable energy sources
Buildings	In 2030, limit final energy consumption to 16.5 Mtoe Upgrade energy efficiency of 60 000 dwellings on average annually Renovate 3% of floor area of central public administration buildings annually	From 2025, sale and installation of heating oil burners is prohibited From 2030, sale of heating oil is allowed only when it is mixed at least 30% with renewable fuels	Investment subsidies for energy saving actions, including renovations, for households (EUR 1.25 bn), businesses (EUR 0.5 bn) and public sector (EUR 0.2 bn) Create framework for tackling energy poverty
Transport	By 2030, 30% of registrations for new vehicle are zero-emissions	From 2030, only new passenger and light commercial vehicles with zero emissions can be sold From 2024, one fourth of business cars have to be electric or plug in hybrid emission below 50 CO_2/km From 2026, in Athens and Thessaloniki, new taxis and one third of new rental cars have to be electric	Subsidies for charging stations and electrification of public transport (EUR 0.2 bn); framework for charging stations R&D investment to cut emissions on carbon capture and passenger shipping (EUR 0.3 bn)
Adaptation			Investment to upgrade water management infrastructure (EUR 0.2 bn), flood protection (EUR 0.1 bn), and civil protection (EUR 0.4 bn)

Note: The table shows selected policy targets and measures.
Source: National Energy and Climate Plan; law 4936/2022 "National Climate Law - Transition to Climate Neutrality and Adaptation to Climate Change"; Recovery and Resilience Plan Greece 2.0.

Figure 2.2. Greening energy use is crucial for decoupling emissions from economic activity



1. Greenhouse gas (GHG) excl. LULUCF emissions intensity per unit of GDP, kg/USD, 2015 PPP
Source: OECD (2022), OECD Environment Statistics (database); and OECD (2022), OECD Economic Outlook (database).

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This Section provides an overview of the policy mix likely to be required to meet Greece's emission reduction goals, focusing on the green energy transition – the shift from fossil fuels to renewable sources. It first presents how reducing the 70% of total emissions that arise from energy use (Figure 2.3, Panel A) can contribute to Greece's mitigation targets. It then discusses key policies to cut emissions from energy use across sectors to achieve the transition at lowest costs, with sector-specific policies then discussed. It concludes by discussing macroeconomic implications for growth, investment needs and the fiscal impact of transforming the energy system.

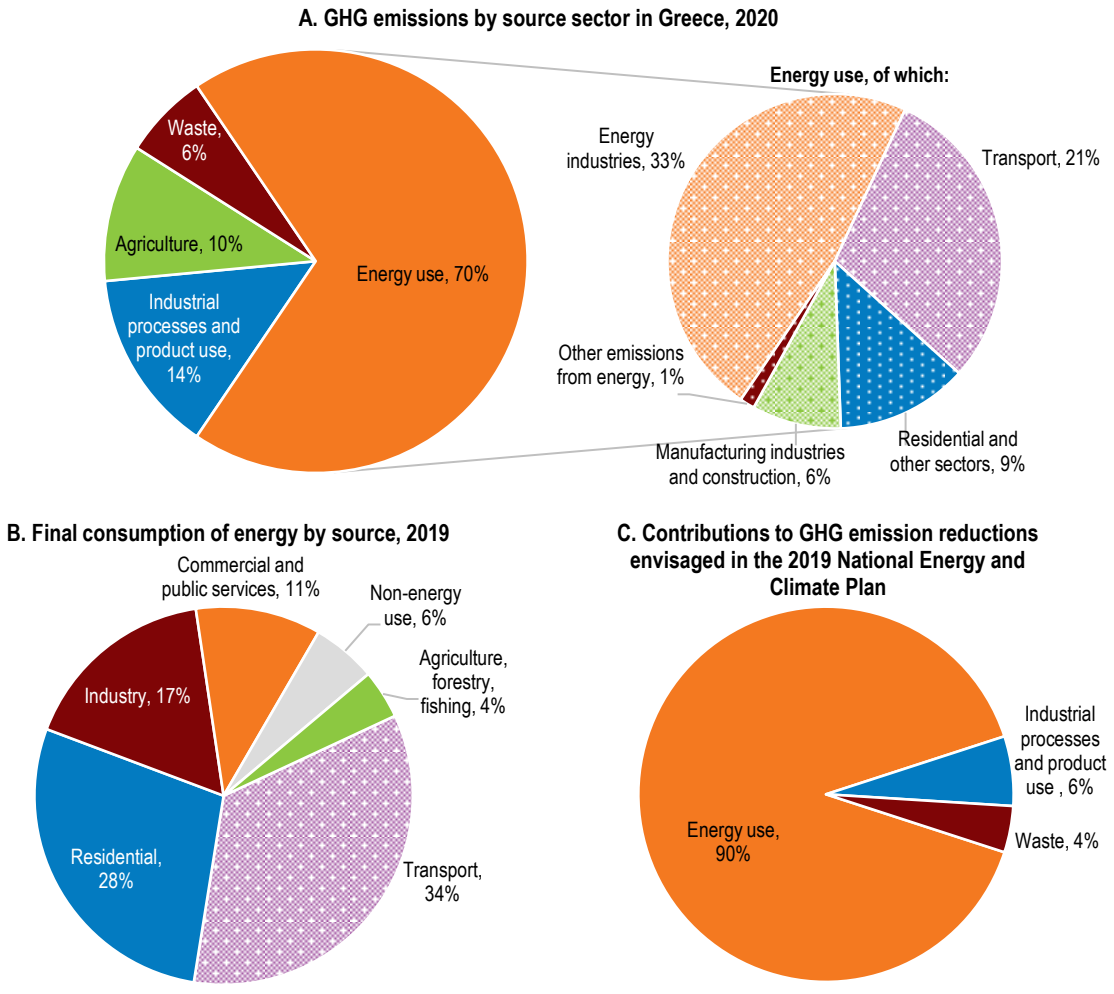
Achieving the green energy transition is key for reaching emission targets

Greece aims to transition to a green energy system to meet its GHG emission targets for 2030. Greece's National Energy and Climate Plan Energy envisages about 90% of emission reductions until 2030 coming from energy use (Figure 2.3, Panel C). The plan is currently under revision to account for its new intermediate emission targets. Sizeable increases in energy use from renewable sources will likely be required to meet these targets, given the large share of GHG emissions from energy use (Figure 2.3, Panel A). OECD modelling (OECD, 2022[1]) suggests that reaching a share for renewable sources of 70% of

primary energy consumption would allow Greece to meet its 2030 GHG emissions target, while reaching a lower share from renewable sources would require achieving more sizeable reductions from emissions not related to energy use.

Upscaling power generation from renewable sources will be key to achieving the green energy transition. In addition, to expand the role of renewable sources, energy use in energy consuming sectors needs to adapt. Most energy is consumed for housing and transport, discussed below, which together account for almost two thirds of final energy use (Figure 2.3, Panel B). Adapting energy use in these sectors to achieve Greece's policy goals for 2030 will be challenging. For transport, given Greece's high car dependency, this entails either replacing its large fossil-fuelled car fleet with more expensive low- or zero-emission vehicles, or shifting transport off the road. For buildings, the latest available data indicate that 70% of final energy consumption come from the direct use of fossil fuels, mostly for heating (MoEE, 2018[2]). Swiftly upgrading Greece's building stock through renovations, improving energy efficiency and replacing machinery will be crucial to reduce reliance on fossil fuels.

Figure 2.3. Transforming the energy system will achieve the largest emission cuts



Note: Panel B: Agriculture includes other non-specified energy use.
Source: OECD (2022), Air and Climate, Environment Statistics (database); IEA (2022), IEA World Energy Statistics and Balances (database).
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In the longer-term, shifting to low-emission energy sources will not be enough to be reach net zero. Just under one-third of GHG emissions are unrelated to energy use and arise from chemical reactions in industrial processes and product use, agriculture, and waste (Figure 2.3, Panel A). Half of these emissions arise from industrial processes, for example when producing cement or steel, and are mostly covered by the EU Emission Trading Scheme (ETS) (MoEE, 2020[3]). International cooperation and gradually rising prices under the EU-ETS can encourage reductions in these sectors, for example by accelerating the diffusion of technologies to produce cement and steel with less energy, improve recycling of materials, and boost research into new technologies, such as carbon capture and hydrogen (OECD, 2019[4]).

Emissions from agriculture, for example from livestock, contribute 10% of Greece's total GHG emissions. Substantial emission reductions can be achieved by providing financial incentives to adopt already available measures to either absorb more emissions in agricultural soils or reduce emissions from agricultural production (Wreford, Ignaciuk and Gruère, 2017[5]; OECD, 2019[6]). Measures include, for example, adopting improved cropland and grazing land management to capture more CO2, changing the feed composition for cattle so less methane is emitted during digestion, or using less fertilisers by better predicting crops' fertiliser needs to reduce nitrous oxide emissions (Henderson et al., 2021[7]).

Emissions from waste management, with most waste going to landfills in Greece, account for 6% of emissions. Physical waste management and low rates of recycling are long-standing issues in Greece. The European Court of Justice fined Greece EUR 127 million in 2021 for the slow improvement in plastics management, and further fines are likely without raising the share of plastics that are collected and recycled. Measures to encourage recycling and reduce landfill include enforcing landfill fees, which were enabled by a 2021 law, or promoting pay-as-you-throw pricing of waste collection (OECD, 2020[8]). Requiring plastic products contain minimum amounts of recycled material would raise demand for plastics to recycle and improve the sectors' economics (Valaskas, Demian and Stavrak, 2022[9]; OECD, 2022[10]).

Policies for reducing emissions from energy use across sectors at lowest cost

A policy mix, combining both sector-specific and cross-cutting measures, can achieve a successful and cost-effective transition to net-zero greenhouse gas (GHG) emissions. Table 2.2 outlines selected policy instruments and how they can contribute to lowering abatement costs.

Pricing emissions from energy use while protecting vulnerable groups is central to identify and exploit the lowest-cost opportunities to cut emissions across sectors (D'Arcangelo et al., 2022[11]; Pisany-Ferry, 2021[12]). How costly it is to cut emissions differs between emission sources, abatement measures, and is likely to change over time as new technologies become available. Putting an equal price on GHG emissions for all sectors, businesses and households in Greece will help to make the most of opportunities to reduce emissions. By contrast, uncertainty and decentralised information about the costs of reducing emissions imply that relying mostly on more directive approaches, such as regulations, may raise total abatement costs by missing already available opportunities for low-cost emission reductions. For example, lower effective emission prices for housing than for transport may encourage fewer low-cost energy saving renovations, for which Greece has large potential (discussed below), and may in turn require larger reductions from other sectors to meet intermediate mitigation targets – for example from transport, where emission costs are already high but where cuts are difficult to achieve due to Greece's high reliance on cars (discussed below). Meanwhile, raising carbon prices can be politically challenging. Box 2.2 discusses how assessing public opinion allows support to be tracked and measures to be adapted.

Table 2.2. Comparing mitigation policy instruments along several cost dimensions

Policy instrument	Cost-effectiveness	Administrative and fiscal costs	Distributional and social concerns	Political acceptability
(a) Emission pricing and incentive-based instruments				
Emission pricing, e.g. GHG tax or fuel excise taxes	High cost-effectiveness. Encourages innovation to reduce future abatement costs, but does not address all market failures.	Low to moderate administrative costs. Increased revenue.	Moderate concerns. Regressive effects can be flanked with compensational policies. May lead to leakage.	Low acceptability. Can be improved through recycling revenues.
Subsidies, e.g. feed-in-tariffs	Medium to high cost-effectiveness. Risk of 'picking winners'.	High administrative costs. Increased expenditure.	Low concerns.	High acceptability.
(b) Standards and regulations				
Performance standards, e.g. zero-emission vehicles	Low cost-effectiveness in short-term. Can reduce future abatement costs by spurring innovation.	Low administrative costs. Fiscal impact neutral.	Low concerns.	Moderate-high (effects on prices are hidden). Associated investments to meet standards can reduce acceptability.
Information requirements, e.g. energy efficiency of electrical equipment	Low to moderate cost-effectiveness. Can help to guide or `nudge' consumption behaviour towards low emission alternatives.	Low administrative costs. Fiscal impact neutral.	Minimal concerns.	High acceptability.
(c) Complementary policies				
Public infrastructure investments, e.g. in railway or electricity network	Reduces overall abatement costs by addressing public good and coordination problem market failures.	Moderate administrative costs. Increased expenditures.	Low concerns.	Mixed acceptability.
Financial support policies, e.g. subsidised loans for renovations or vehicle purchase subsidies	Reduces overall abatement costs by addressing financial frictions and coordination failures.	Moderate administrative costs. Increased expenditures, more for grants than for loans.	Regressive, as favouring those who can afford activities.	High acceptability.

Source: Adapted from D'Arcangelo et al. (2022[11]).

Pricing emissions alone is likely to be insufficient to achieve net zero emissions (D'Arcangelo et al., 2022[13]; D'Arcangelo et al., 2022[11]; High-level Commission on Carbon Prices, 2017[14]). Combining carbon pricing with a mix of complementary, sector-specific instruments – including a mix of regulation, financial support, public investment, and institutional reforms measures – is crucial to make it cheaper to shift away from fossil fuels for several reasons. Reducing emissions is challenged by multiple market failures requiring different instruments, for example credit constraints preventing households from financing cost-saving renovations or coordination failures limiting the adoption of green technologies, such as the lack of charging points for electric vehicles in Greece. In addition, policy instruments can be more effective if combined with one another, while incoherence between instruments can weaken their effectiveness. For example, encouraging renovations by imposing energy efficiency standards that buildings must meet in the future, while providing financial support to address credit constraints, is more effective if carbon pricing strengthens price signals for energy savings. Complementary measures would also shore up competitiveness by lowering energy bills and improving the transport system (European Investment Bank, 2021[15]), counteracting some of the adverse effects from raising costs of emission-intensive inputs.

Harmonising carbon prices to better encourage low-cost emission cuts across sectors

Aligning the price of GHG emissions across fuels and uses by adjusting tax rates and subsidies would provide more consistent price signals. Most energy-related CO_2 emissions in Greece are already priced

either explicitly, through the EU Emissions Trading Scheme (ETS), or through fuel excise taxes, and average CO_2 prices are high in international comparison (Figure 2.4, Panel A). However, there are large differences in the cost of CO_2 emissions across users. For example, CO_2 emitted by road transport is four- to twenty-fold as expensive as CO_2 emitted from other uses. Among road transport fuels, CO_2 emissions from gasoline are twice as expensive as from diesel (OECD, forthcoming[16]). These price differences across emissions reflect the fact that high carbon prices are largely driven by fuel excise taxes, especially from transport (Figure 2.4, Panel C), whereby fuel taxes are typically imposed for objectives other than cutting CO_2 emissions, such as raising revenues and addressing non-climate related negative external effects. Greece's high tax exemptions and subsidies for fuels, for example for remote areas and islands not yet connected to the mainland electricity grid to even energy costs with the mainland, additionally weaken price signals (Figure 2.4, Panel B). Gradually aligning effective carbon prices in the medium-term – to assure that at least a common, minimum price applies – to all sources of GHG emissions would encourage more low-cost emission cuts. The expansion of electricity connections to islands and remote areas provides an opportunity to cut subsidies for these areas. Developing a detailed list of subsidies and taxes, including expenditures for tax exemptions, on fossil fuels as a part of 'green budgeting' expenditure tagging would make it easier to identify policy distortions (OECD, 2020[8]; European Commission, 2020[17]).

Projected pathways to reach net zero by the International Energy Agency suggest increasing carbon prices in the future. Greece's current effective carbon prices are below the level expected to be necessary from 2030 onwards to be on track for net-zero (IEA, 2021[18]; OECD, 2021[19]) (Table 2.3). About 57% of energy-related emissions in Greece are covered by the EU-ETS. Introducing a price floor across fuels and users for the remaining emissions in the medium-term, after the current surge in energy prices, by aligning and gradually raising fuel excise taxes on emissions that are priced below the minimum, would provide more consistent price signals and raise overall effective carbon prices. Empirical work carried out for this Survey, leveraging cross-country experiences of emission reductions associated with carbon pricing, suggests that introducing a carbon price floor at 120 EUR/tCO_2 by itself could decrease CO_2 emissions by 16% relative to 2021 emissions, and bring up to EUR 1.8 billion (1% of 2021 GDP) additional annual revenues (Table 2.3). While the effectiveness of higher emission prices can be impaired by emission-intensive firms shifting production to countries with lower or no carbon prices, past experience points to only small emission leakage effects resulting from pricing emissions (Pizer and Aldy, 2015[20]; Borghesi, Franco and Marin, 2020[21]; Sato and Dechezleprêtre, 2015[22]; Naegele and Zaklan, 2019[23]). Providing rebates, which are gradually phased out, to emission-intensive and exporting firms affected by higher carbon prices could be considered to address concerns about competitiveness and leakage.

Box 2.2. Understanding public acceptability of mitigation policies across countries

Public attitudes towards measures to reduce greenhouse gas (GHG) emissions can be a challenge for implementing policies. Understanding peoples' attitudes about policy tools can help to strengthen support by addressing concerns and potential misconceptions. Ongoing OECD work conducts comparable and nationally representative surveys covering 40 000 respondents across 20 countries to assess how people think about climate policies and which factors shape policy support (Dechezleprêtre et al., Forthcoming[24]).

Beliefs about effectiveness, equity and own costs of climate policies shape policy support

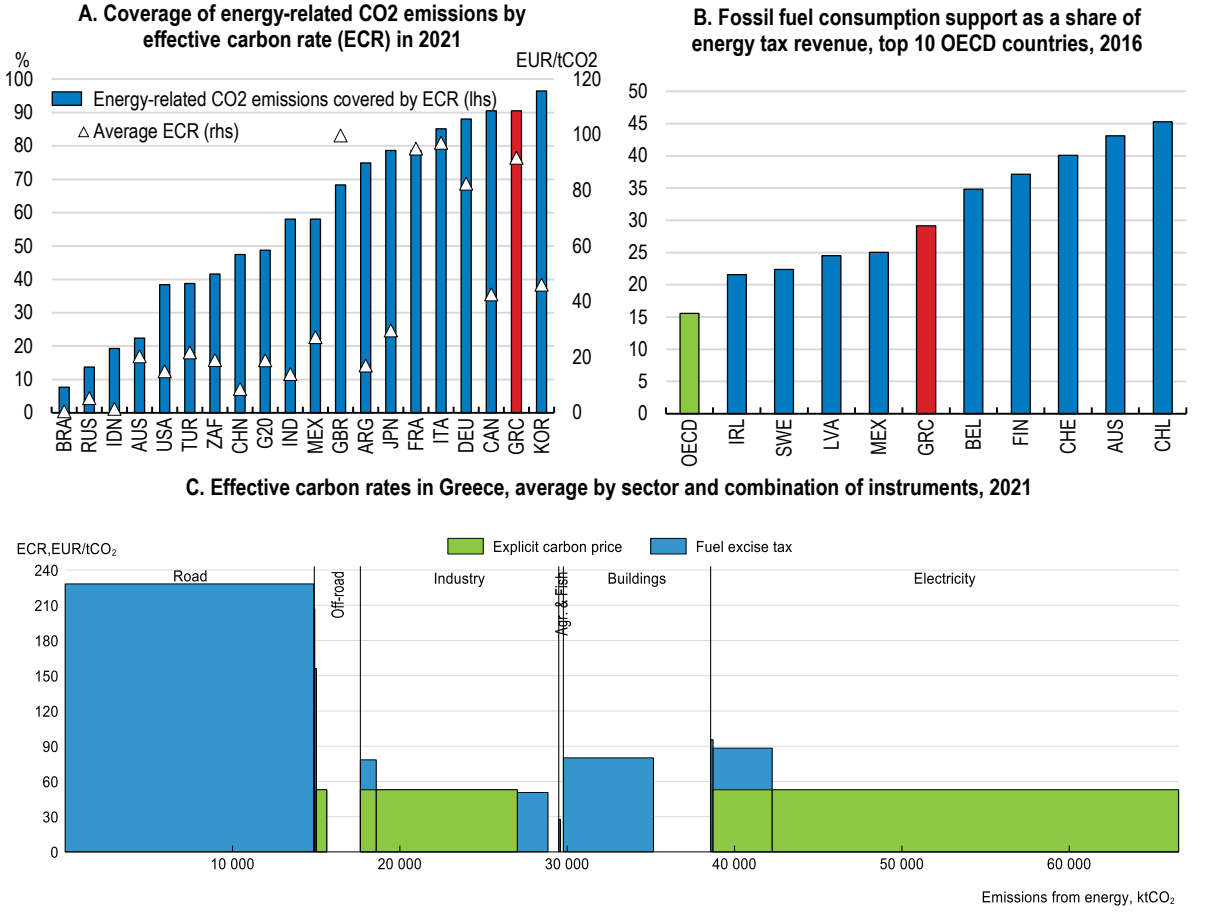
The survey finds broad awareness about climate change: in each country at least three quarters of respondents agree that tackling climate change is important. However, this awareness not always translates into support for climate policies. Whether a policy enjoys strong support is found to hinge on three beliefs: a policy enjoys stronger support if (a) it is perceived to be effective at cutting GHG emissions, and lower support if it is perceived to (b) increase inequality or (c) impose personal costs. These beliefs are much stronger predictors than socioeconomic and lifestyle factors, which are linked more weakly and with more mixed patterns to how a person thinks about climate policies. For example,

while more educated and left-leaning respondents show generally stronger support for climate policies, higher income is related to stronger policy support only in 9 out of 20 countries, and young people are not generally found to show stronger support for climate policies than older people.

Addressing concerns and informing about policies can raise policy support

Designing policies to address peoples' concerns about fairness and their personal costs and informing people about how policy measures work can raise support. A sub-sample of respondents were shown videos on impacts of climate change in their country as well as on particular climate policies; in particular a carbon tax with cash transfers, a ban on combustion-engine cars, and a green infrastructure programme. Seeing videos on policies significantly increased support for these policies, while videos on the impact of climate change had no significant impact. Survey results also indicate that reducing personal costs can raise support. For example, support for a ban of combustion-engine cars in city centres was higher if people had better access to public transport. Support for carbon taxes was higher when revenues are earmarked to support low-income groups or fund green infrastructure projects, reflecting how policies perceived to be fair and contribute to cutting emissions enjoy stronger support.

Figure 2.4. Revising fossil fuel taxes and subsidies to introduce a minimum carbon price floor would make emission pricing more effective



Note: Panel C: Figures shows coverage and height of effective carbon pricing of CO_2 emissions from energy use in Greece in 2021. The width of the bars shows how much of emissions in the respective sector are priced. The height of the bars indicates the effective carbon price. Effective carbon prices do not account for subsidies for fossil fuels, such as heating allowances.
Source: OECD Centre for Tax Policy and Administration; OECD Environmental Performance Reviews: Greece 2020.

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Table 2.3. A higher minimum carbon price floor can reduce emissions while raising revenues

Simulation results for Greece from introducing a minimum price floor for CO_2 emissions from energy use

Effective carbon price floor (EUR/tCO_2)	Year carbon price will be consistent with net-zero	Reduction in CO_2 emission from energy use in 2021	Additional revenues in EUR billions
60	n.a.	-2%	0.40
120	2030	-16%	1.84
220	2050	-37%	3.09

Note: Results refer to annual long-run effects of introducing a minimum price floor for effective carbon prices and removing free allowances and fossil fuel subsidies. Effective carbon prices already above the price floor at left unaffected.
Source: (IEA, 2021[18]; OECD, 2021[19]).

Protecting vulnerable households while encouraging energy savings

Unwinding Greece's energy subsidies and tax expenditures, and instead providing direct support to vulnerable households, would encourage emission reductions and improve equity. Greece supports energy consumption of low-income households mainly by subsidising electricity tariffs and by providing an allowance conditional on heating with fossil fuels. To address the recent surge in energy prices, Greece expanded existing measures and provided several additional subsidies, mostly horizontal subsidies making energy based on fossil fuels cheaper (Table 1.1). Replacing price subsidies with direct income transfers not linked to how much or which type of fuel is being used would better encourage energy savings and switching to cleaner fuel types. For example, converting the subsidy households receive through social tariffs into a direct income transfer means that they could afford their existing energy consumption, while energy savings would bring larger gains in disposable income. Only about one-third of guaranteed minimum income recipients in 2018 received social electricity tariffs (Marini et al., 2019[25]). Targeted income transfers can ensure support reaches the most vulnerable households.

Redistributing revenues from higher carbon pricing would protect lower-income households from rising living costs. OECD work (Blake, Bulman and Joumard, forthcoming[26]) suggests that harmonising and raising prices for energy-related CO_2 emissions to at least EUR 120 per tonne would raise monthly household expenses by EUR 68 on average (Box 2.3). Vulnerable households would be disproportionately affected as they spend a larger share of their budget on energy. For example, while costs for the 20% households with the highest incomes would increase by about 3%, poor households would have to pay about 11% more to maintain consumption. Additional revenues from implementing a minimum carbon price would initially be more than enough to offset higher living costs of lower-income households through income transfers. Over time, both adverse income effects and additional revenues would diminish as consumption becomes less emission-intensive.

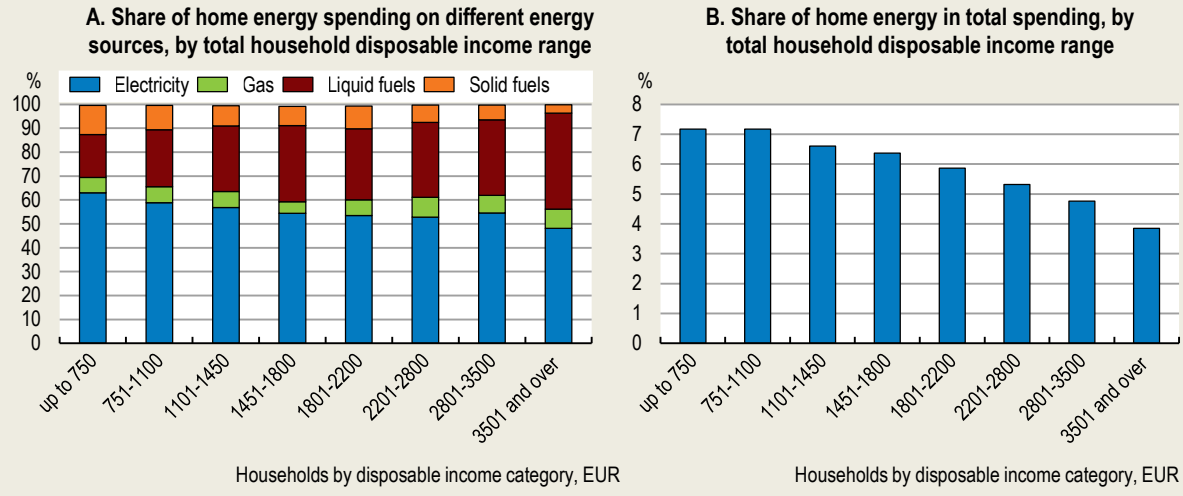
Box 2.3. Income transfers can offset regressive effects from carbon pricing

Introducing a minimum carbon price floor can raise the price of fossil fuels and reduce households' real incomes. Impacts are likely to differ across income groups with share of income spent on emission-intensive goods and services. New empirical research carried out for this survey assessing how households are impacted across income groups can help design appropriate compensatory policies.

Relative to other EU countries, Greek households are particularly vulnerable to an increase in energy prices due to the still high share of coal used for electricity generation (24% in 2019, against a 15% average in European OECD countries). Lack of proper insulation in many buildings additionally raises costs for heating and cooling and contributes to relatively high levels of energy poverty.

Carbon pricing will reduce households' purchasing power through a direct and an indirect effect. The direct effect raises prices of fuels they directly consume whose emission price is below the price floor. Low-income households are more exposed as they spend a higher share of their income spent on home energy: households earning less than EUR 1 100 per month (30% of households) spend on average 7% of their expenditures home energy while this share amounts to less than 4% for households earning more than EUR 3 501 (Figure 2.5).

Figure 2.5. Lower income households spend a larger share of their income on home energy, especially electricity



Source: ELSTAT, Household Budget Survey 2018.

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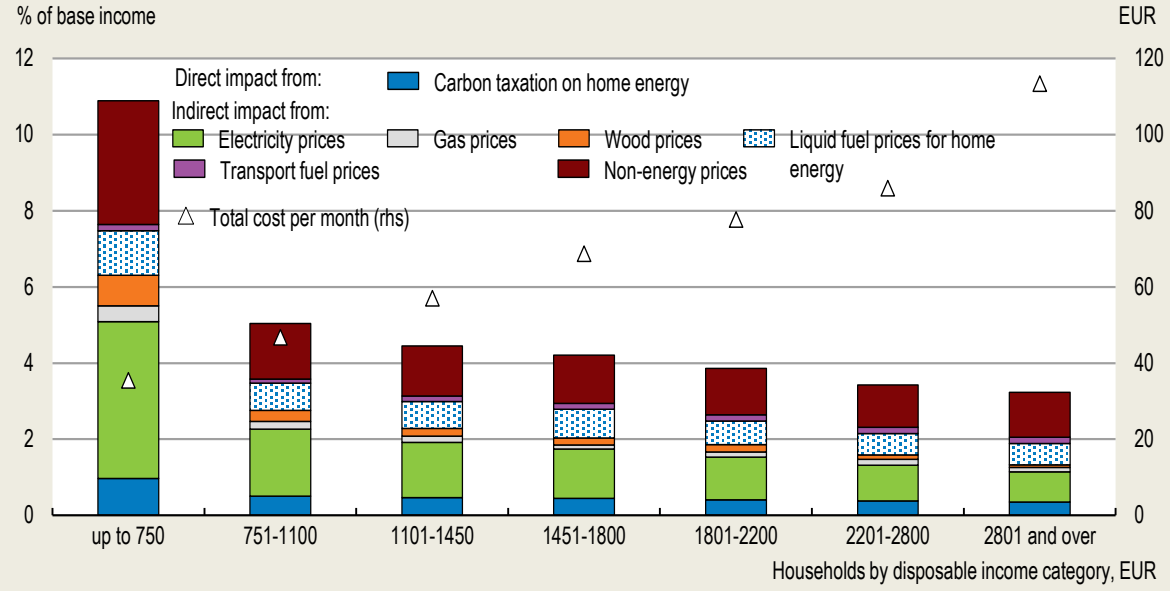
The indirect effect of carbon pricing stems from raising the costs for fuels used as inputs, most notably for electricity production. Using information on the carbon embodied in final demand, calculated from input-output tables, allows assessing how carbon pricing can affect final prices, which is crucial to assess the regressive impact of carbon pricing (Blake, Bulman and Joumard, forthcoming[26]). This is because electricity generally accounts for a larger share in lower-income households' energy mix, who rely less on central heating – only 27% of households with incomes below than EUR 1101 per month compared to 40% for the whole population – and more on electric heating (Figure 2.5).

On average, a minimum carbon price floor of at least EUR 120 per tonne CO_2 in Greece, leaving higher prices unaffected, would imply that households need to pay EUR 68 more per month to maintain

consumption. By far the largest effect, 68% of the total impact on purchasing power, would be indirect, from using fossil fuels as inputs (Figure 2.6).

Figure 2.6. Higher carbon prices would reduce lower income households' real incomes the most



Note: Graph show the estimated direct and indirect impact of a EUR 120 carbon tax price floor on household income. Estimates are based on 2018 spending patterns. Changes in consumption patterns resulting from price changes are not taken into account but are likely to occur. Complementary policies that decrease the carbon content of consumption and are likely to dampen regressive effects.
Source: Calculation based on data from the Greece Household Budget Survey 2018; IEA (2021), Energy prices (database); and OECD data on carbon embodied in trade from Environment Statistics (database).

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Poorer households would have to increase their spending by a larger percentage (Figure 2.6). This regressive impact largely stems from electricity consumption. Besides differential effects across income groups, rural households would be more affected compared to urban households, although the difference would be much smaller than between income groups. The cost of rural households' current consumption baskets would rise by only 2% more than the cost of an urban household. Their living costs would increase by 4.8% of their income, compared with a 3.9% increase for urban households, reflecting rural households' slightly higher share of income spent on energy.

To cushion the loss in purchasing power related to a minimum carbon price floor for the low-income households and offset the regressive impact, the government could provide a means-tested subsidy. The overall cost would amount to EUR 1.4 billion (0.7% of GDP in 2021), which would be less than the additional revenues gained from a minimum carbon price floor.

Growth, investment and fiscal implications of the green energy transition

Gradually abandoning the use of fossil fuels for other energy sources constitutes an economic challenge (Pisany-Ferry, 2021[12]; OECD, 2021[27]). Production costs continue to depend on energy prices from fossil fuels, which are likely to rise with higher emission prices. Shifting away from fossil fuels entails faster depreciation of capital and of workers investing in the skills required to shift to new activities. These costs could be reduced through productivity gains generated by the energy transition, for example from reduced energy needs or a more effective transport system. Importantly, considering the potentially catastrophic

damage of climate change, contributing to the global shift to net-zero emissions remains the best way to limit the overall cost, sustain livelihoods and support activity into the long-term of a changed climate.

The loss of output from the green energy transition for Greece is likely to be modest overall, and can be offset by the continued policy reforms and investments to raise Greece's productivity and employment rates discussed in Chapter 1. Scenarios illustrate the potential investment needs and change in output engendered by the shift to net zero emission energy system. These scenarios extend the OECD global long-term model by incorporating abatement cost estimates from the Network for Greening the Financial System and the OECD's ENV-Linkages Computable General Equilibrium model (OECD, 2022[1]) (described in Box 2.4). They suggest that average annual output would be 0.3% slower between 2023 and 2050 under the scenario of a front-loaded energy transition, and 0.2% slower in the case of a slower transition, both compared to a scenario that abstracts from the shift to low- and zero-emission energy sources. Regarding the path of the transition to net zero emissions, achieving a fast transition in line with Greece's ambitious targets – as compared to a more gradual transition – would entail a larger slowing in economic growth in the current decade and a smaller slowing in growth in the following decades (Figure 2.8, Panel A). Importantly, a more gradual transition to net zero emission energy would require larger cuts in emissions generated by other sectors for Greece to meet its intermediate emission reduction targets. Figure 2.8, Panel B illustrates this by showing that, from 2030, the level of energy emissions under the 'slow' transition scenario would be near the level of total projected GHG emissions consistent with overall emission reduction targets, while under the 'fast' scenario energy emissions are well below total projected emissions. Further, a slower transition implies that Greece would accumulate higher total emissions before reaching net zero emissions, equivalent to about three times current annual emissions (Figure 2.8, Panel C). If replicated globally, higher cumulative emissions entail larger increases in average temperatures, and a higher risk of reaching climatic tipping points with more disastrous consequences.

Achieving the green energy transition goals requires significant, but feasible, front-loaded investments. Chapter 1 discusses how to mobilise private and public investment which can support the green energy transition in a fiscally sustainable way. For a fast transition, estimates suggest the needed additional investments to develop renewable generation capacity correspond to about 0.8% of GDP per year over the current decade (Figure 2.8, Panel D). Investment needs in subsequent decades would be substantially smaller. Additional investments will be needed to upgrade the electricity network, provide storage, and adapt energy use to renewable sources, for example to replace internal combustion engine cars and renovate houses. Research conducted for this survey by the International Transport Forum and the OECD suggests adopting ambitious scenarios for greening transport would require additional infrastructure investments of 0.2% of GDP per year on average until 2050. The 'Greece 2.0' Recovery and Resilience Plan allocates EUR 1.0 billion (0.5% of 2021 GDP) to direct investments in the electricity network and capacity from renewable sources until 2026, in addition to the EUR 2.27 billion (1.2% of 2021 GDP) scheme to encourage investments in capacity from renewable sources. In addition, some of the revenues from 25 million EU-ETS allowances, worth EUR 2.0 billion at 80 EUR/tonne CO_2 (1% of 2021 GDP), will be used for investments to connect islands to the mainland electricity grid, and for storage and capacity from renewable energy sources.

Box 2.4. Modelling the macroeconomic implications of transitioning to a green energy system

The OECD regularly prepares long-term scenarios about economies' long-term prospects for activity, investment and employment in light of their structural policies and demographic developments. New empirical research extends the OECD global long-term model to account for the macroeconomic implications of measures to reduce greenhouse gas emissions from energy use (OECD, 2022[1]). The model abstracts from direct effects of climate change, such as damages from extreme weather events, the scale of which remains highly uncertain.

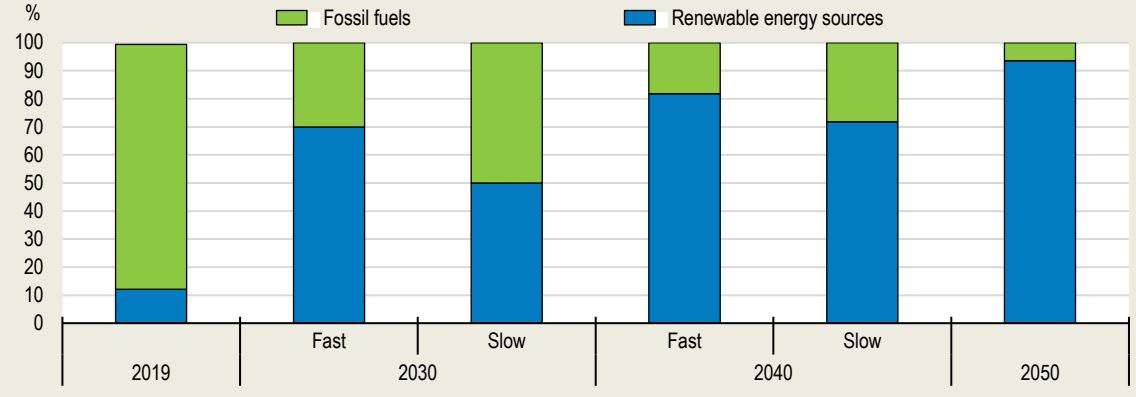
The green energy transition entails shifting energy use away from fossil fuels towards low- or zero-emission energy sources, notably renewable energies. The focus on energy use reflects their contribution of 73% of global greenhouse gas emissions (Lenaerts, Tagliapietra and Wolff, 2021[28]). For a particular country, the model produces trajectories for a host of macroeconomic variables for a given evolution of the primary energy mix. The link between the green energy transition and potential output is mediated by an abatement cost curve. This cost curve expresses how much annual GDP growth is reduced as a function of emissions reduction in that year relative to a business-as-usual path. It is based on reduced-form estimates of average carbon mitigation costs in two Integrated Assessment Models (MESSAGEix-GLOBIOM 1.1 and REMIND-MAgPIE 2.1-4.2, using the Network for Greening the Financial System scenarios) and one Computable General Equilibrium model (ENV-Linkages). It captures the trade-off between rising costs from cutting more emissions in a given year – as the lowest-cost means of reducing emissions are exhausted and additional reductions are more costly – and falling costs in the future – as technological advances make low-emission alternatives less costly. Among others, the model produces results on potential output, investment needed to build capacity for energy generation, and CO_2 emissions. The development of these long-term scenarios is ongoing. Future work will enrich how different policy choices affect abatement costs.

Two scenarios, shown in Figure 2.7, Panel A, are considered to assess the macroeconomic implications of the green energy transition for Greece:

- "Fast": the energy mix evolves to meet intermediate targets by cutting emissions from energy use. Renewable sources generate 70% of energy needs by 2030 and reach a share compatible with net-zero greenhouse gas emissions in 2050.
- "Slow": the energy mix evolves slowly at first, with 50% of energy generated by renewable sources by 2030, but speeds up thereafter and reaches a share compatible with net-zero greenhouse gas emissions in 2050.

Figure 2.7. Scenarios for greening the energy mix

The assumed evolution of primary energy sources under different transition scenarios



Source: OECD calculations; and OECD Energy database.

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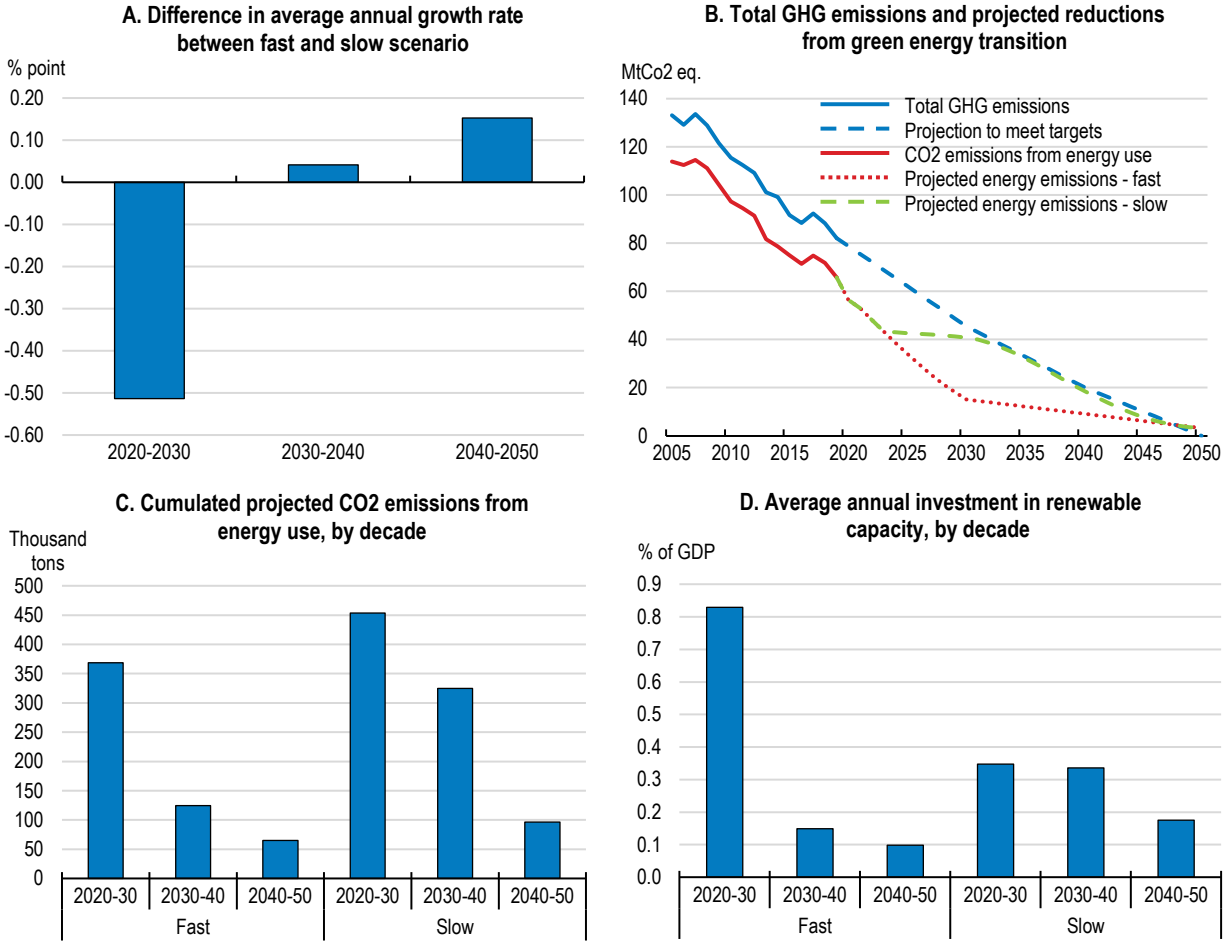
Figure 2.8. A faster green energy transition would shift growth to future decades and contribute to reducing the damages from climate change



Source: Simulations based on the OECD's Global Long-Term Model and Eurostat population projection scenarios (OECD, 2022[1]) and OECD (2022), Environment: Air and climate (database).

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Containing the fiscal impact of the green transition

Transitioning to a green economy entails fiscal costs. Most importantly, the transition requires additional investments, including for renewable energy production, building renovations, and in low-emission transport modes. These investments will, at least partly, be financed by the public sector directly or through grants and loans. In addition, the green transition will affect government revenues. While rising carbon prices under the EU-ETS or raising fuel excise taxes to at least a minimum carbon price floor will bring additional revenues in the short- to medium-term, these revenues will ultimately shrink as the economy becomes less emission intensive.

Revenues from taxing road transport, mostly from fuel excise taxes, are substantial in Greece, at about 4% of GDP (Figure 2.9). Analysis based on the ITF transport model suggests that tax revenues related to road transport over 2020 to 2050 would be up to 20% lower in a scenario for transformative change of the transport system (Box 2.6). Disruptions to the labour market as jobs shift from carbon-intensive work to new opportunities in the green economy can temporarily reduce employment, decrease revenues from income tax and social security contributions, and raise spending on unemployment benefits. Tax

expenditures to support green investments can help achieve emission reduction goals but reduce public income.

This Survey proposes measures to help contain fiscal costs. Measures would contribute in several ways, as detailed in Table 2.4. First, they would bring additional revenues, for example from introducing a minimum carbon price floor or, in the long-term, shifting towards distance-based charges in road transport discussed in Box 2.5. Second, they would reduce public expenditures, for example by boosting energy-efficiency improving renovations to halve energy consumption from buildings (MoEE, 2018[2]), or cost-effective training and hiring subsidies (Brown and Koettl, 2015[29]). Third, they would help to make public spending more effective by combining subsidised loans with gradually tightening regulations to leverage more private financing.

Table 2.4. Selected measures to help limit fiscal costs of the green economy transition

Section	Policy area	Description of proposed measures	Contribution to limiting fiscal costs
2.2.2	Carbon pricing	Harmonised and rising fuel excise taxes to at least a minimum price floor for carbon emissions.	Additional revenues, which will decline as fossil fuels are used less intensively.
2.2.2	Energy support measures	Replacement of energy price subsidies with targeted income transfers.	No fiscal impact.
2.3.2	Transport	Increased investments in public transport; replacement of purchase grants for low emission vehicles with subsidised loans; adjustment of vehicle taxes and restrictions of use in cities for fossil fuel cars. Increased reliance on road usage pricing.	Reduced need for financial support for fleet renewal to meet intermediate emission targets; leveraging more private financing through loans and regulations. Additional revenues from vehicle taxes and increased road usage pricing.
2.3.3	Building renovations	Tightening regulations on minimum energy efficiency standards for more existing buildings; expansion of financial support measures prioritising subsidised loans over grants.	Lower spending needs on energy support measures in longer-term; leveraging more private financing through loans and regulations.
2.4.2	Adaption	Regulations broadening insurance coverage against damages from extreme weather events.	Reduced contingent liabilities of public sector by leveraging more private financing.
2.5.2	Labour market	Expansion of active labour market policies, including training and hiring subsidies.	Higher revenues and lower expenditures through shorter unemployment spells and higher employment level.

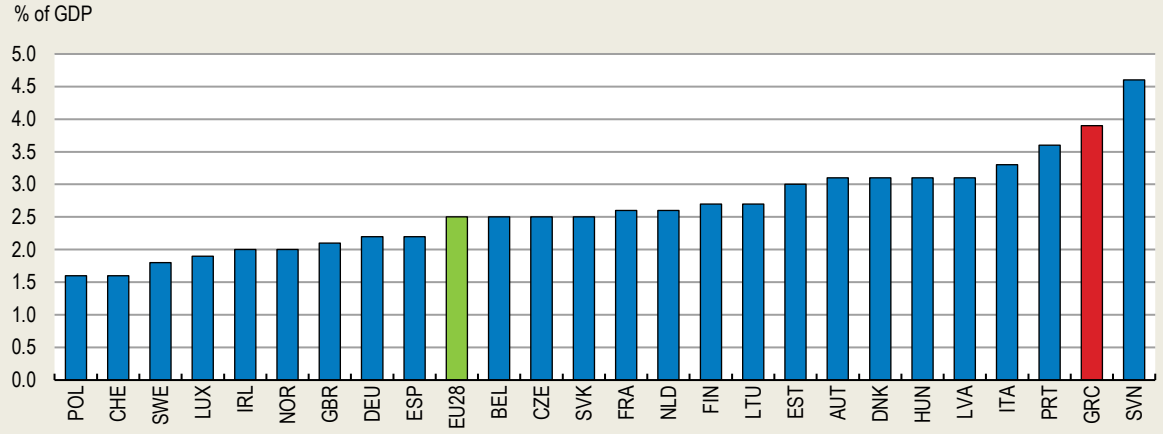
Box 2.5. Raising revenues from road transport in a green transport system

Taxes from road transport, for example from fuel excise taxes, are an important revenue source for governments, especially in Greece (Figure 2.9). Road transport taxes also support efficiency objectives, as a means to charge for road use, and to apply a cost to congestion, pollution and noise.

Changing the transport system to achieve net-zero emissions from transport implies that, under current tax and charging schemes, revenues from road transport would decline substantially as internal combustion engine vehicles give way to low- and zero-emission vehicles and fossil fuels are used less. New empirical analysis from the OECD and the International Transport Forum (ITF), described in Box 2.6, suggests revenues from road transport – in particular fuel excise duties, registration and circulation taxes, and tolls – would be one-fifth lower until 2050 in a scenario of transformative change.

Figure 2.9. Taxes from road transport are a significant source of governmental income

Total tax and charge revenues for road, rail and inland navigation transport, 2016



Source: European Commission (2019), Directorate-General for Mobility and Transport, Transport taxes and charges in Europe: an overview study of economic internalisation measures applied in Europe, https://data.europa.eu/doi/10.2832/416737.

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A stable tax base for a transport system less reliant on conventional cars could be achieved by shifting from fuel-based to distance-based charges reflecting the costs related to the distance driven. The ITF model suggests that Greece could sustain tax revenues while transforming the transport system by charging about EUR 0.003 per kilometre in 2025, rising gradually to EUR 0.021 in 2050. The revenue so gained would correspond to EUR 86 per adult and year on average, and would equal the decrease in revenue from road-related taxes compared to the baseline scenario.

Source: (OECD/ITF, 2019[30]).

Policy mixes to achieve the green energy transition in key sectors

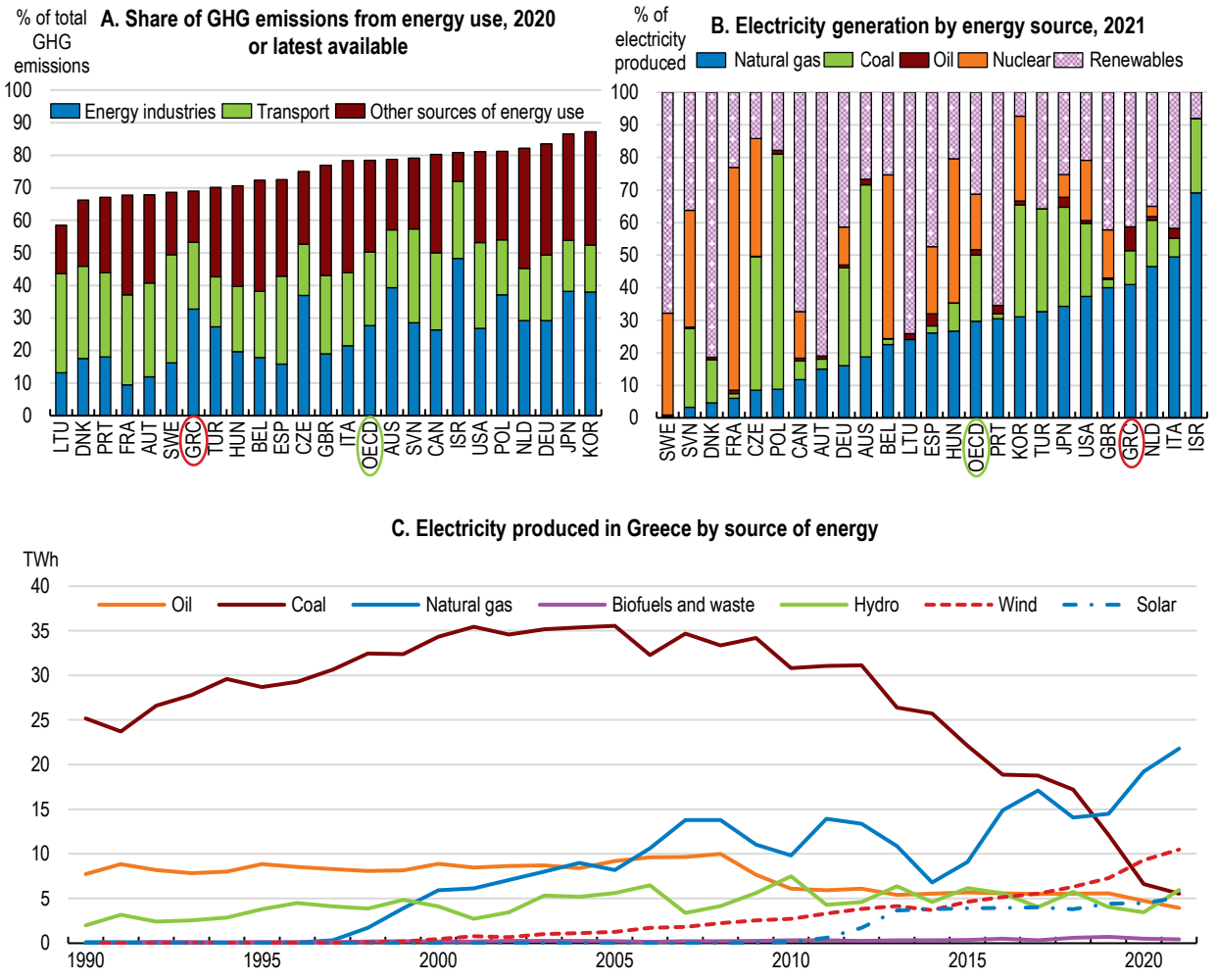
This Section discusses sector-specific policy mixes aiming at reducing the costs of shifting to low-emission alternatives for energy use in key sectors, complementing cross-cutting policies discussed above. It focuses in turn on electricity generation, buildings, and transport, which contribute the bulk of emissions from energy use.

Shifting electricity production to renewable sources

Upscaling electricity production from renewable sources will be essential to enable low-cost and low-emission energy as alternative to fossil fuels. Energy use produces 70% of Greece's GHG emissions. Using more renewable sources in the energy industry, for example to replace lignite for power generation, would allow cuts of up to half of those emissions; the other half of emissions can be cut by adapting other sectors to use electricity produced from renewable sources (Figure 2.10, Panel A). This will require expanding electricity generation from renewable sources, and producing more electricity overall (DESFA, 2022[31]).

Greece's reliance on fossil fuels for electricity production remains high (Figure 2.10, Panel B). Recent years have seen coal being replaced mostly with natural gas (Figure 2.10, Panel C), as carbon pricing made coal less competitive to natural gas. Replacing coal with gas has slowed however as a result of rising natural gas prices and uncertain supply following Russia's invasion of Ukraine, with closures of several coal plants postponed (Greece's reliance on Russian energy imports is discussed in Chapter 1). Replacing coal with gas can deliver more limited emission reductions while generation from renewable sources is being expanded, as natural gas produces about one-third less CO_2 emissions than coal to generate an equivalent amount of electricity (OECD, 2022[1]). In the long run, retrofitting gas generation plants with carbon capture or to run on hydrogen can further reduce emissions from natural gas, although costs can be high (IEA, 2021[18]). Greece does not envisage developing nuclear power generation. It will ban solid fossil fuels, such as lignite, for electricity production by 2028.

Figure 2.10. Greening electricity generation can make significant inroads into Greece's emissions



Note: Panel A: Other sources of energy use covers manufacturing industries and construction, residential and other sectors, and fugitive emissions from fuels. Panel B: Renewables include biofuels and waste, hydro, wind, solar, geothermal and other energies.
Source: OECD (2022), Environment Statistics (database); and IEA (2021), Electricity Information (database).

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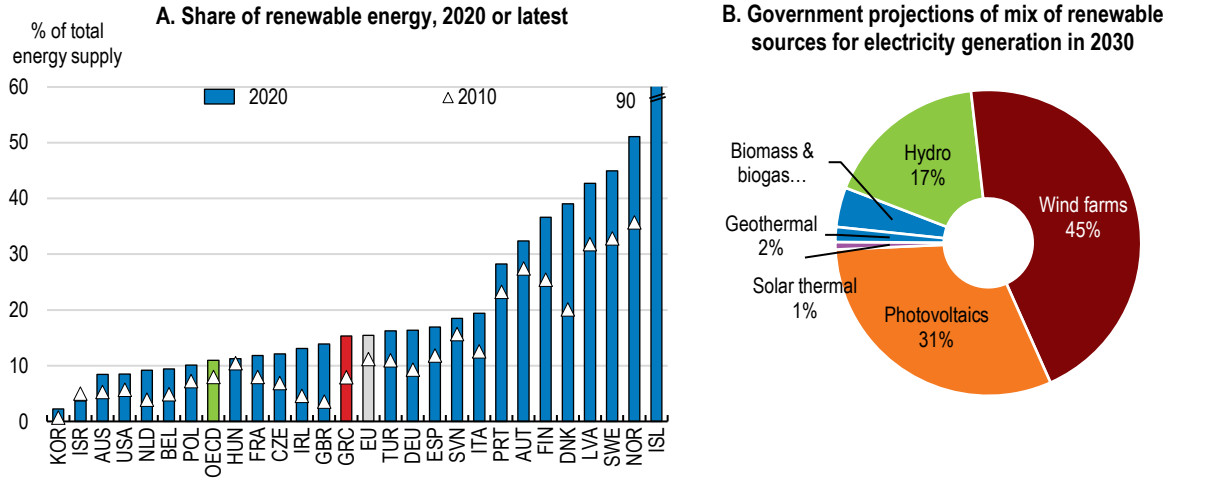
Boosting the role of renewable sources in the electricity system

Greece has ambitious aims to exploit its large potential for renewable energy, including from solar and wind (OECD, 2020[8]). Its share of electricity generated from renewable sources grew faster than the EU average in recent years, driven by generous feed-in-premiums, but still lags most other OECD countries (Figure 2.11, Panel A). Greece plans to substantially raise the share of renewable sources for final energy consumption, relying mostly on solar and wind (Figure 2.11, Panel B). Reaching a 70% share of renewable sources of primary energy consumption would allow meeting its GHG emission target in 2030 by focusing on cutting emissions from energy use. This would require the share to expand about four times faster than during the previous decade. For example, providing the increased share through wind power alone to meet projected demand for 2030 would correspond to installing more than 310 large wind turbines (based on 10MW capacity and operating at their full capacity on average 35% of the time) each year (DESFA, 2022[31]).

Greece is encouraging and simplifying investments to scale up renewable capacity. A EUR 2.27 billion (1.2% of 2021 GDP) scheme provides financial incentives to develop capacity via a contract-for-difference premium, guaranteeing a stable price – established through competitive auctions – to electricity suppliers from renewable sources (European Commission, 2021[32]). New legislation, requiring most buildings larger than 500m^2 to install solar panels covering at least 30% of the building covered area will further add capacity from renewable sources. Planned reforms of licensing procedures and special spatial plans for renewable sources are intended to speed up procedures to implement investments.

Figure 2.11. Greece plans to rapidly expand electricity generated from renewable sources



Source: OECD (2022), Green Growth Indicators, Environment Statistics (database); and Ministry of the Environment and Energy (2019), National Energy and Climate Plan.

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Greece is expanding its electricity network to allow it to better exploit its renewable energies. Limited network capacity is emerging as a major constraint for scaling up electricity production from renewable sources. Investments in the transmission and distribution network will allow connecting more capacity from renewable sources to its electricity grid (IPTO, 2021[33]). In addition, the Greece 2.0 Resilience and Recovery Plan provides for ongoing investments to connect islands to the mainland electricity grid. This will allow exploiting more fully the large potential for renewable energy sources on islands (OECD, 2020[8]). Meanwhile, prices for electricity network costs are lower compared to other EU countries (ACER, 2021[34]). Assuring that prices for network usage provide sufficient funds for maintaining and expanding the network may further support upscaling electricity production from renewable sources.

Assuring reliable energy from renewable sources

Further investments in Greece's electricity system will be needed to ensure supply is reliable as more energy will come from renewable sources. Uncertainty about when the wind blows or the sun shines makes it difficult to predict electricity production from renewable sources, while periods of peak electricity demand do not generally align with peak supply. More balancing capacity from sources that can be switched on and off at short notice, and better limiting non-essential electricity consumption when production is low, can help to align energy supply and demand (OECD/NEA, 2012[35]; NEA, 2019[36]). Making buildings more energy efficient, as discussed below, will complement these efforts.

Greece is planning to boost capacity for energy supply when production from renewable sources is low. Greece 2.0 includes grants for installing storage capacity of up to 1400 MW. A previously planned Strategic Reserve Mechanism for 2023 has been abolished, as the postponed closure of several coal-fuelled generators means they can provide balancing capacity for longer. For the future, when currently high electricity prices may have decreased, Greece is considering proposing a capacity remuneration scheme to encourage private investors to provide balancing capacity (European Commission, 2021[37]).

Better integrating Greece's electricity network with neighbouring countries will add additional capacity by enlarging the pool of potential energy supply. Greece made important progress in connecting its wholesale electricity market with neighbouring countries by implementing the EU target model in November 2020 (Ioannidis et al., 2021[38]), and is taking several steps to improve capacity for cross-border trade (IPTO, 2021[33]; European Commission, 2021[37]).

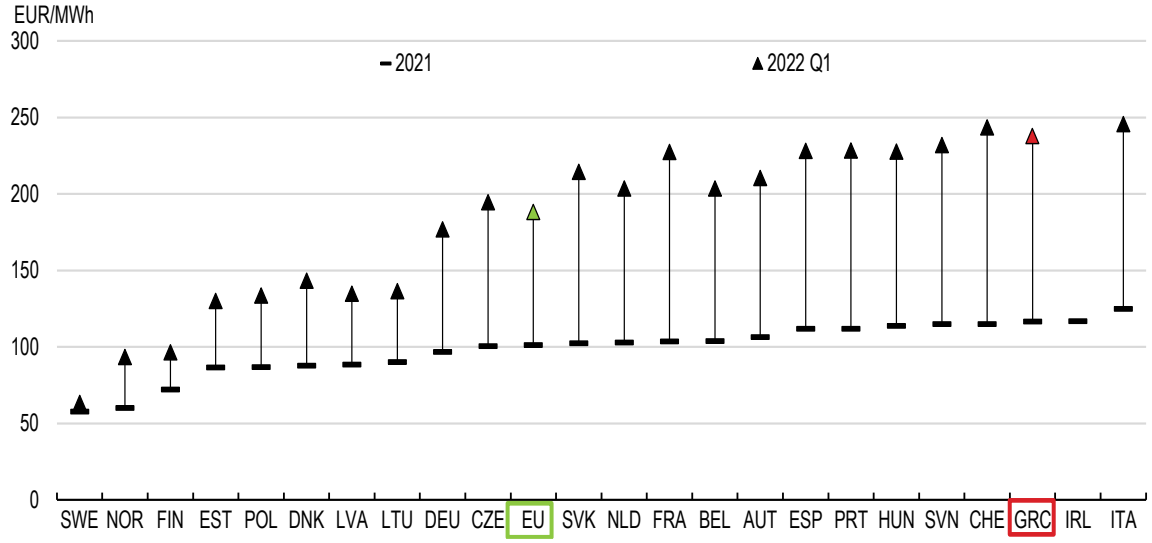
Making electricity consumption more responsive to supply conditions, for example by programming energy-intensive tasks for times when supply is plentiful relative to demand, would reduce system stress and the need for balancing capacity (IEA, 2021[18]). This can be achieved through disseminating smart meters, which inform consumers about their electricity consumption in real-time, combined with dynamic pricing, which provides financial incentives to shift electricity demand to periods when supply is more plentiful. Measures in Greece 2.0 will promote the roll-out of smart meters, while the share of consumers with dynamic pricing contracts, which reflect current production costs more closely, is low (European Commission, 2022[39]). Promoting time-differentiated tariffs while informing customers about the risks and benefits, replacing price subsidies with income transfers (ACER/CEER, 2021[40]), and simplifying electricity bills by removing items not related to energy costs (IEA, 2017[41]), could encourage uptake of dynamic contracts.

Providing affordable electricity through a more competitive market

Wholesale electricity prices have generally been higher in Greece than in other OECD countries (Figure 2.12), and were among the highest in Europe during the 2021-2022 price surge (ACER, 2021[34]), mainly due to the high dependence of electricity production on natural gas. While a successful transition likely would ultimately reduce energy costs (IEA, 2021[18]), several factors may temporarily contribute to rising electricity prices as renewable sources become more important for Greece's energy mix. Fossil fuels will become more expensive as their prices incorporate the environmental costs of carbon emissions, while investments in exploration and production reduce. Replacing retiring fossil fuel plants with renewables requires substantial investments, whose costs will likely be passed on to customers (IEA, 2021[18]). While new installations of renewables are increasingly competitive with fossil fuels, they entail growing systemic costs, for example for providing storage, as their share of overall electricity supply increases (IEA/NEA, 2020[42]). In addition, wholesale prices are largely based on variable production costs. As more energy comes from renewable sources, prices could vary substantially depending on whether there is enough supply from renewable sources to satisfy demand, or whether dispatchable sources need to be switched on. Lowering electricity prices, also by improving competition in electricity markets and reducing systemic costs through flexible demand and providing balancing capacity as discussed above, will be key to limit costs and support businesses' competitiveness.

Figure 2.12. Wholesale electricity prices in Greece are among the highest in Europe

Wholesale prices for electricity, annual average of day-ahead electricity prices (EUR/MWh)



Note: 2022 Q1 covers the period from 1st January 2022 to 13th March 2022.
Source: Union of the Electricity Industry – Eurelectric (2021), Power Barometer (powerbarometer.eurelectric.org).

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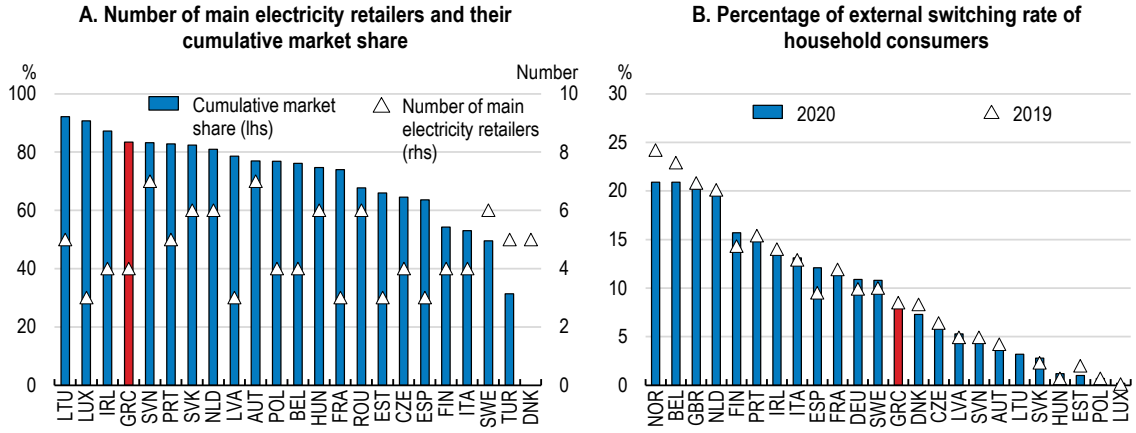
More competitive wholesale and retail markets could make electricity more affordable. Retail prices are generally lower in countries with less concentrated electricity markets (European Commission, 2022[39]). While Greece considerably improved competition in both wholesale and retail markets in recent years (IEA, 2017[41]; European Commission, 2021[37]), market concentration in the retail market remains high (Figure 2.13, Panel A), and customers change suppliers – which raises competitive pressure by enabling customers to shift to more competitive suppliers – less often than in other countries (Figure 2.13, Panel B). Promoting price comparison tools, for example with data-driven information campaigns aimed at winning new users (ACER/CEER, 2021[43]), would promote competition and contribute to reducing electricity bills. The introduction of a framework to encourage demand responses in wholesale electricity markets in 2022, allowing all domestic and non-domestic consumers to provide balancing capacity for example by trading reductions in their electricity consumption to third parties, is welcome. When considering a future capacity remuneration scheme, assuring that no restrictive requirements, for example minimum bid sizes, prevent capacity providers – those reducing consumption or generating electricity – from participating would further support competition in wholesale electricity markets (ACER/CEER, 2021[40]; Vitale and Terrero, 2022[44]).

Figure 2.13. Greece could further improve competition in its electricity retail market



Note: Panel A: retailers considered as "main" if they sell at least 5% of the total national electricity consumption.
Source: Eurostat; ACER/CEER (2021), Annual Report On The Results Of Monitoring The Internal Retail Markets And Consumer Protection In 2020.

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Research shows that, across OECD countries, more independent and well-governed regulators are associated with more pro-competitive decision-making, better firm performance and higher investments in network industries (Sutherland et al., 2011[45]; Koop and Hanretty, 2018[46]; Demmou and Franco, 2020[47]). Best practice principles (OECD, 2014[48]), complementing the OECD Council Recommendation on Regulatory Policy and Governance, suggest that further safeguards for the independence of Greece's Regulatory Authority for Energy could involve selecting heads and board members by an independent panel, instead of by the government, and restricting government guidance on its work programme (Vitale and Terrero, 2022[44]).

Shifting transport to net zero emission fuels

Greater reductions in the transport sector's greenhouse gas (GHG) emissions would put Greece more firmly on a path towards net zero. Transport is the second largest source of total GHG emissions in Greece; one fifth of energy-related GHG emissions emanate directly from transport, for example when burning fuel to run an internal combustion engine car (Figure 2.3, Panel A). Transport is the single sector with the largest energy needs and accounts for 38% of final energy consumption (Figure 2.3, Panel B).

Large emission reductions by 2030 could be achieved from land transport. For some forms of transport – notably aviation, shipping, and heavy trucks – commercial low-emission technologies are still to be developed (IEA, 2021[18]). For land transport, low-emission solutions such as electric vehicles, rail, and metro, are more readily available. Most emissions from transport in Greece, 85%, arise from road transport (Figure 2.14, Panel A), as Greece relies intensively on road transport for both passengers and freight (Figure 2.14, Panel B and C). Simulations conducted for this Survey, described in Box 2.6, suggest that adopting a high-ambition policy path focusing on reducing emissions from road transport and shifting transport off the road, for example onto rail, could achieve large emission cuts by 2030, and up to 74% by 2050 if including comprehensive measures such as land use and urban planning (Table 2.5). These policies also hold the potential to raise firms' productivity, for example by improving linkages between ports and rail to lower freight costs. Technological advances will reduce future abatement costs for still hard-to-decarbonise transport modes, including for ferries which account for 12% of emissions from passenger transport. Box 2.7 discusses challenges for Greece's large shipping services sector to reduce emissions from ocean freight shipping.

Box 2.6. Simulating policy pathways with the International Transport Forum model

Scenarios for the global development of transport until 2050 have been developed by the International Transport Forum (ITF) in the ITF Transport Outlook 2021 (ITF, 2021[49]). The global model covers detailed transport modes for passenger and freight transport within cities, between cities and between countries. Characteristics such as speed and costs of available transport modes, demand for trips and which modes are being used to optimally satisfy mobility needs, are estimated sequentially at the detailed geographical level. A set of assumptions about regional policy pathways and technological developments, indicating different levels of ambition to reduce greenhouse gas (GHG) emissions from transport, are reflected in several scenarios: 'Recover' reflects mostly existing policy commitments, limited support for technological developments and a return to travel norms before the Covid-19 pandemic, whereas 'Reshape+' reflects more ambitious policies to transform the transport system and seize opportunities from the pandemic to change travel behaviours, such as expanding teleconferencing. While 'Reshape+' is consistent with transport's contribution to limit global warming to 1.5 degrees, ambitions under 'Recover' are insufficient to bring transport's contribution to net zero.

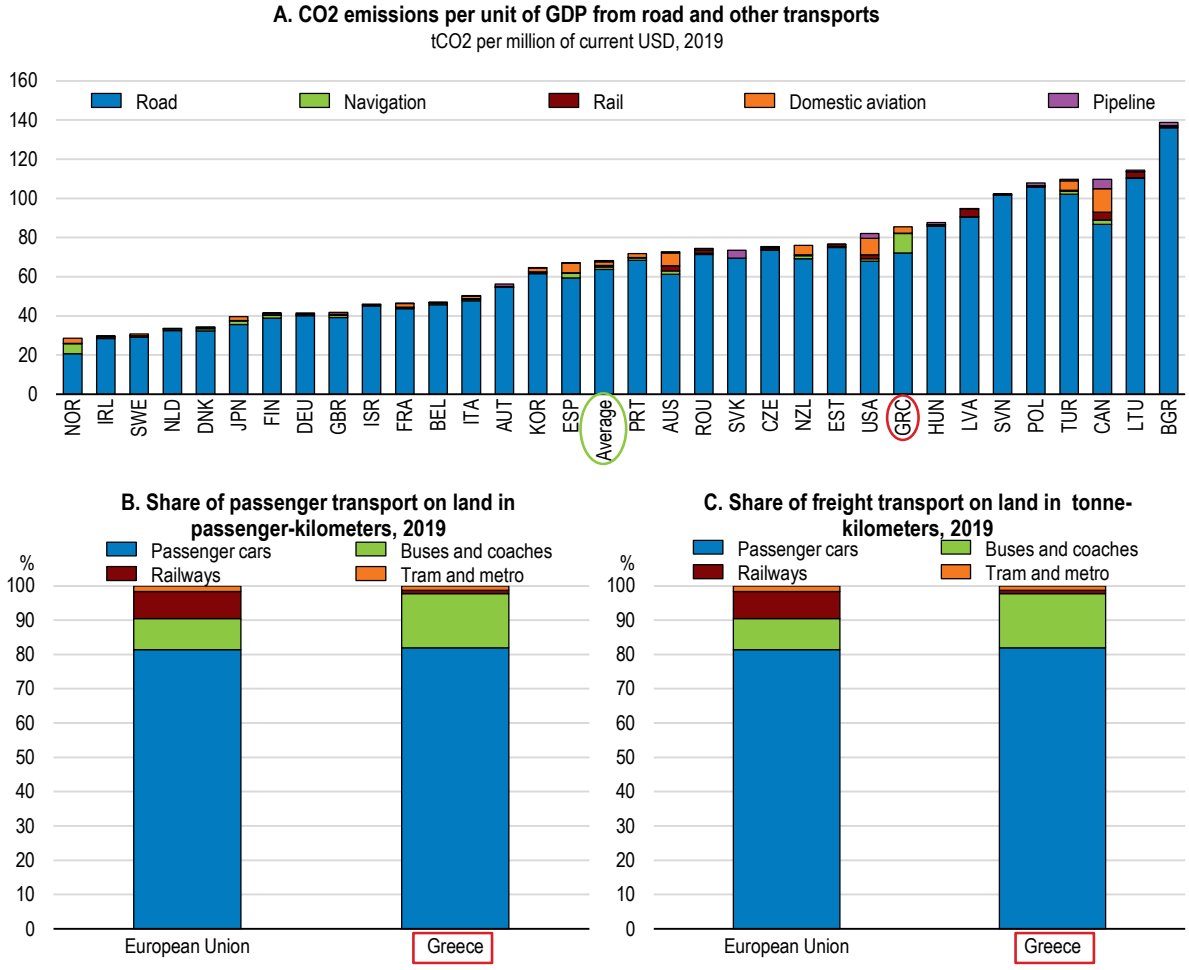
New empirical analysis developed by the OECD and the ITF for this survey explored by how much different policy pathways could reduce emissions for Greece in 2030 and 2050 and associated costs. The scenarios considered high ambition policies for particular policy areas for land transport, based on Greece's regional specification of `Reshape+', while remaining policies and technological developments followed the `Recover' scenario. Scenarios and results are described in Table 2.5 below.

Table 2.5. More ambitious policies focusing on land transport could achieve large emission cuts

			Reduction in annual GHG emissions from transport, relative to 2019, %		Additional average network infrastructure costs until 2050, % of GDP	Average annual foregone tax revenues until 2050, % of GDP
	Policy scenario	High ambition policy areas	2030	2050		
1	Private transport	Diffusion of zero-emission vehicles and low-emission fuels; longer range and lower costs of electric cars	13%	57%	0.0%	0.2%
2	Public transport	Increase in rail use to close gap in intensity of use of existing railway network to EU average with improvement in service quality, frequency and speed; improved linkages between railway and ports; improvement in network density and frequency of metro and bus; improved integration between different public transport modes and ticketing; prioritisation of public transport in traffic	13%	47%	0.2%	0.2%
3	Public transport and transport efficiency	Scenario 2 plus increase in mixed use neighbourhoods around public transport hubs and limiting urban sprawl with land use and urban planning; improved shared transport; increased teleconferencing; deprioritisation of private car transport	19%	51%	0.2%	0.1%
4	Transformative change	Scenarios 1 plus 3	29%	74%	0.2%	0.4%

Note: Simulations for Greece based on ITF Transport Outlook 2021 (ITF, 2021[49]). GHG emissions from domestic and international passenger and freight transport. Emissions from international transport not emitted in Greece and from sea transport not landing in Greek harbours have been excluded. Infrastructure costs include additional construction and maintenance costs for urban and non-urban road, metro, bus and rail networks compared to the baseline scenario; costs for purchasing vehicles are not included. Costs and foregone revenues from taxes on fuels, car registration and circulation, and tolls under current tax system, are calculated relative to baseline scenario Recover and expressed as percentage of cumulated simulated GDP over 2020 to 2050.
Source: OECD and ITF calculations for Greece based on (ITF, 2021[49]).

Figure 2.14. Road transport can make a large contribution to reducing Greece's GHG emissions



Note: Panel A: Emissions from international transport and navigation excluded. Pipeline refers to long-distance transport of liquids or gas through a system of pipes. Average shown for countries included in the figure.
Source: OECD transport database; EC (2021), Statistical Pocketbook for Transport 2021.

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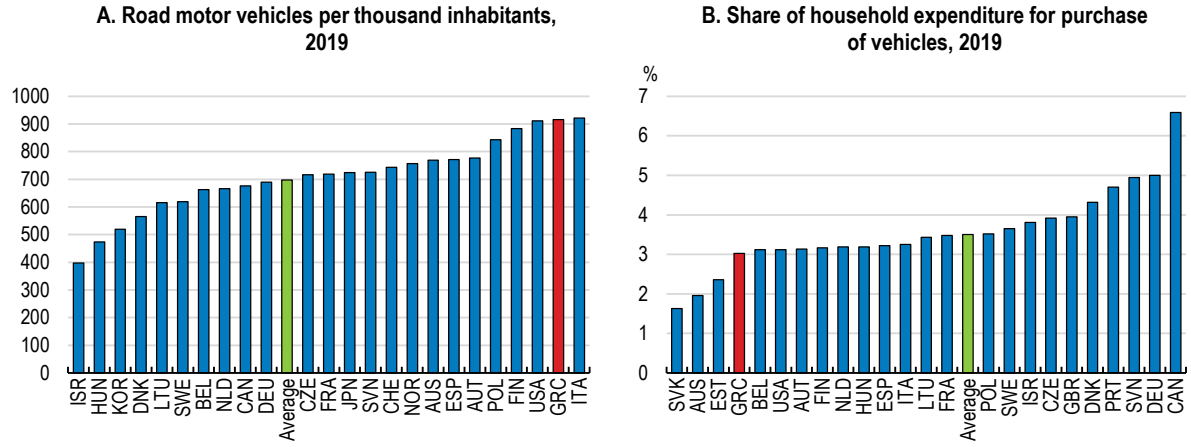
Cutting emissions in road transport

Greece faces financial headwinds to green its vehicle fleet. The fleet renews only slowly, likely reflecting limited financial resources of households and businesses to purchase cars. Greeks use motor vehicles for transport more than most other OECD countries (Figure 2.15, Panel A) but spend among the lowest share of their income on buying cars (Figure 2.15, Panel B). Buying used cars is common, with second-hand cars making up almost half of all passenger car and more than half of all van registrations in 2020-22 (ELSTAT, 2022[50]). As a result, Greece has one of the oldest car fleets among OECD countries (Figure 2.16, Panel A). Financial constraints and high costs for electric vehicles may delay the switching of many households and businesses to zero-emissions cars. Although price gaps between electric and combustion engine cars may disappear within the next few years (Lutsey and Nicholas, 2019[51]), used combustion engine cars are likely to remain substantially cheaper beyond 2030.

Figure 2.15. Greece is especially reliant on motor vehicles but spends few resources on purchasing them



Note: Average shown for countries included in the figure.
Source: OECD Transport database.

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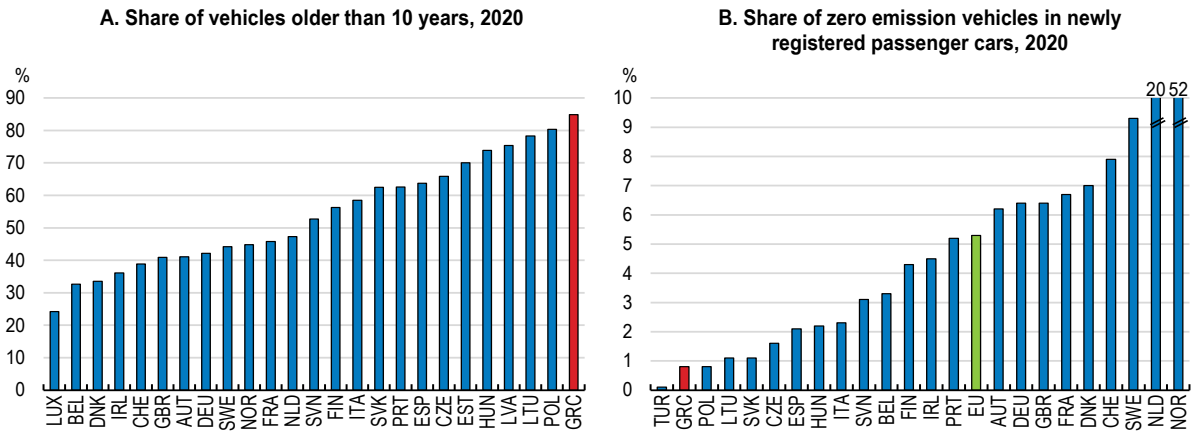
Ambitious policies will be needed to overcome these headwinds. Greece lags other countries in adopting zero-emission vehicles. Both the share of zero-emission vehicles for the existing fleet (Figure 2.16, Panel B) and for new registrations is among the lowest in the OECD and EU (IMF, 2021[52]). Greece plans to raise the share of zero-emission cars among new registrations from 0.8% in 2020 to 30% in 2030. Replacing older and more emission-intensive cars with newer internal combustion engines would bring some modest emission reductions. Starting in 2024 and 2026, restrictions to registering new business vehicles, taxis or rental cars will promote zero- and low emission vehicles (see Table 2.1). From 2030, for new cars, only zero-emission passenger and light commercial vehicles can be sold. Achieving this will depend on sufficient zero-emission cars being produced, which may be challenging given global supply constraints. Slow fleet renewal implies these measures may make limited inroads into overall emissions reductions from vehicles. For example, based on registrations for passenger cars in 2019, these plans imply replacing vehicles with zero-emission cars corresponding to 0.7% to 2.5% of the current vehicle stock each year, thus taking several decades to replace all internal combustion engine cars (European Commission, 2021[53]). Measures to ban the import of used, very high-emission cars are welcome. Making purchasing zero-emission vehicles more attractive compared to internal combustion engine cars, as discussed below, would accelerate the adoption of zero-emission vehicles. OECD and ITF modelling suggests that adopting a high-ambition policy scenario focusing on the fast diffusion of zero-emission vehicles would yield GHG emissions reductions from transport of 13% in 2030 and 57% in 2050 (Table 2.5).

Developing a dense network of charging points would make electric vehicles more attractive. Most charging for electric cars is done at home or at work. However, having easy access to charging points elsewhere is crucial for their practicality. Greece has one of the least dense networks for public charging stations among OECD countries (IMF, 2021[52]). Measures included in Greece 2.0, such as a framework and financial support for installations, plan to add more than 8 000 charging points. This corresponds to achieving one charging point every 13 kilometres along Greece's road network. Leveraging more private capital, and concentrating public support on areas where charging points are not financially viable, could further bolster the network's density. Greece's recent Climate Law requires municipalities to prepare and implement Charging Point Plans together with private investors. Regulation could make the installation of publicly accessible charging points obligatory for petrol stations or other focal points (IEA, 2021[54]). Germany, for example, planned to negotiate voluntary commitments by petrol station owners to equip 75%

of all existing petrol stations by 2026 with charging points, and to mandate this if the goal is missed (Bundesregierung, 2020[55]).

Figure 2.16. Greece's vehicle fleet is old and fleet renewal towards greener vehicles is slow



Source: European Automobile Manufacturers' Association (ACEA, 2022), Vehicles in Use - Europe 2022; European Commission and European Alternative Fuel Observatory (EAFO).

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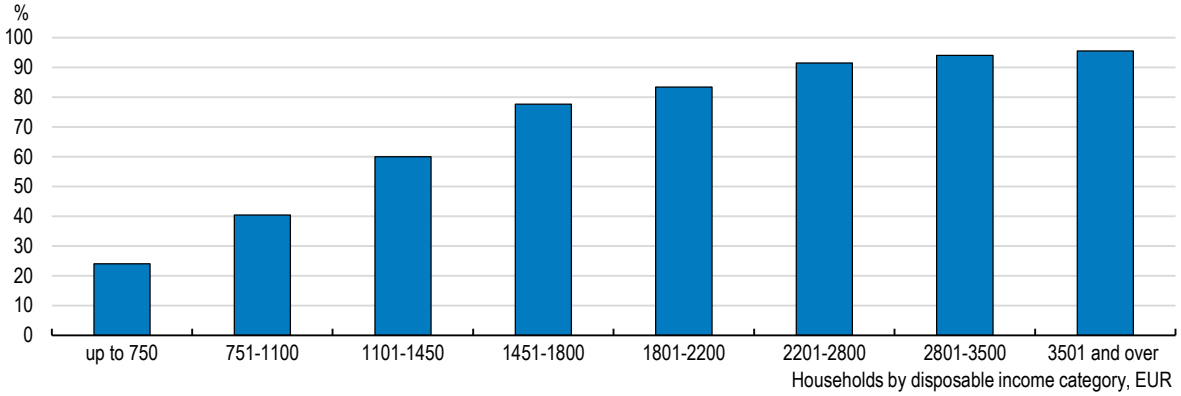
Targeted financial support to buy cleaner vehicles could accelerate take-up. Greece is offering generous purchase grants of up to EUR 8000 in addition to vehicle or business tax reductions or exemptions, including for registration taxes (ACEA, 2021[56]). An additional EUR 1000 is offered for scrapping an old conventional vehicle. Making zero-emission cars cheaper to buy helps to kick-start the market but is a fiscally costly way to promote wider adoption. For example, providing purchase subsidies to replace one-third of the vehicle stock, at the same average cost per vehicle as Greece's programme operating in mid-2020 (Electrive, 2019[57]), would require EUR 12 billion (6.5% of 2021 GDP) of grants. Furthermore, the households that buy electric cars and benefit from these subsidies largely have high incomes. In the United States, for example, 90% of tax credits for electric vehicles went to the 20% highest income households (Borenstein and Davis, 2016[58]). Subsidising stations with zero-emission cars available for renting could provide better access for low-income households, who are less likely to own a car (Figure 2.17) (Nicholas and Bernard, 2021[59]). Subsidising loans rather than grants for purchasing zero emission vehicles, as done in Scotland, addresses financial constraints by overcoming high upfront costs of electric cars and mobilises more private funding (ICCT, 2020[60]).

Figure 2.17. Poorer households are less likely to own a car

Percentage of households with car ownership across household income groups, 2018



Source: ELSTAT, Household Budget Survey 2018.

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Box 2.7. International coordination will be crucial to cutting emissions from shipping

Maritime transport is core to global trade flows, and for producers and consumers of essential goods from food to energy supplies. 90% of global merchandise is moved via ships. Greece plays a key role for maritime transport. Greek ship-owners own about one-fifth of the global shipping capacity. Ships owned by Greeks are of strategic importance for the European Union's oil and natural gas and other essential goods and staples' imports. 32% of oil tankers and 22% of liquefied natural gas carriers globally are Greek-owned. In turn, maritime transport is also important for Greece's economy, to which it contributes about 3% of value added, while shipping services contribute about 20% of total export receipts.

Maritime transport accounted for 2.5% of global emissions from energy in 2020, making it important for the global economy to become greenhouse gas emission neutral by mid-century. Most of maritime transport is by bulk carriers and tankers operating across oceans, which require fuels with high energy density. Batteries are still far less energy dense than conventional fuels, while alternative fuel types, such as hydrogen and ammonia, are not yet commercially available in the needed volumes at ports across the globe (IEA, 2021[18]).

In the short term, including shipping in carbon pricing schemes such as the European Union's Emission Trading Scheme can encourage commercial ship operators to reduce emissions and support innovation. For example, slow steaming (i.e., reducing vessel speed to use less fuel per trip (Degiuli et al., 2021[61])), is already available, but currently high freight rates and shortages of ships pressure commercial ship operators to minimise journey times. Until technologies and fuels allowing for larger emission cuts become commercially viable, pricing emissions from shipping may lead to higher trade costs with little effect on emissions.

In the longer term, including shipping in the green economy transition will require switching to low-emission fuels. Several technologies are being developed but it remains uncertain which ones will dominate. In this context, Greece proposed the establishment of an EU Research Centre for Alternative Marine Fuels and Technologies. The long lifespan of vessels, ranging from 25 to 35 years (IEA, 2021[18]), and of port infrastructure, make the required transition to net zero emissions from shipping less than one vessel lifetime away. Today's investment decisions need to anticipate future technologies. For example, ship builders need to decide how to adapt ships currently being built for future fuels. Ports globally will need to invest in the infrastructure to supply the future low-emission fuels so carriers are able to refuel. Coordination across global ship-owners and shipbuilders, marine fuel producers and suppliers, port operators, commercial ship operators, industry associations and regulators will be central to developing solutions. The key global role of Greece's shipping services firms makes it a potential leader in this process.

Source: Union of Greek Shipowners.

Adjusting vehicle taxes, for example for registration and ownership, could encourage faster fleet renewal. Measures to impose a special environmental tax on imported used, high-emission vehicles are welcome. However, unlike for passenger cars, vehicle taxes for commercial vehicles, coaches and busses are not based on CO2 emissions; vehicle taxes for used passenger cars, including the luxury tax, decrease with vehicle age (ACEA, 2021[62]; OECD, 2020[8]). Making all vehicle taxes dependent on CO2 emissions, and removing the negative link between vehicle taxes and car age, would strengthen financial incentives for switching to new zero-emission vehicles.

Gradually tightening restrictions for using fossil-fuel cars in large cities, with a clear timeline, would also encourage buyers to choose a zero-emission vehicle sooner. Some cities in Greece already impose restrictions on cars, for example to reduce congestion or pollution. Enforcement of restrictions for high-emission cars is weak, however (OECD, 2020[8]). Measures to exempt electric vehicles from these

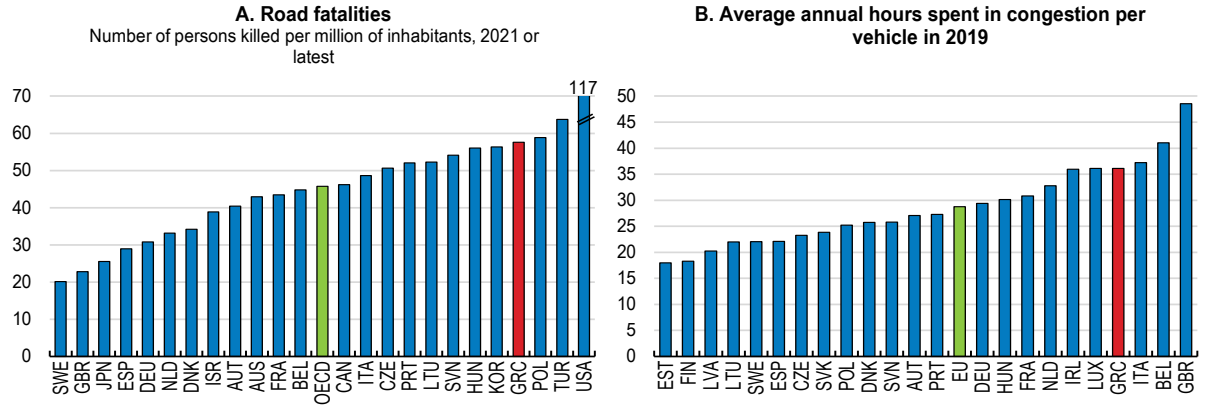
restrictions and being granted free parking are welcome. Enforcing and expanding restrictions based on vehicle emissions, for example through road pricing, congestion charges, priority lanes, emission-free zones in cities where other transport modes are readily available, would add to the benefits of zero-emission cars. For example, Amsterdam, Oslo, Paris, Rome, London and Milan are planning to phase out fossil-fuel cars (ICCT, 2020[60]).

Cutting emissions by moving transport off the road

There is substantial scope to reduce emissions by making public transport more attractive to shift more transport off the road. OECD and ITF modelling suggests that adopting a high ambition policy path focusing on improving public transport services and infrastructure could achieve greenhouse gas (GHG) emission reductions of up to 13% in 2030 and 47% in 2050, and by 19% and 51% if combined with more comprehensive measures (Table 2.5). As well as cutting emissions, reducing road transport would reduce air pollution, traffic congestion and road accidents, which in Greece are higher than in most other countries (Figure 2.18, Panels A and B).

Greece's railway network is one of the least dense railway networks in the OECD and additionally is used less intensively than in most other OECD countries (Figure 2.19, Panel A and B). With slow trains, reports of delays and routes not being served, perceived efficiency of train services is among the lowest in the OECD (Figure 2.19, Panel D). Greece has one of the OECD's most competition-friendly rail industry regulatory frameworks (Figure 2.19, Panel E), which largely reflects the absence of direct government involvement with any rail operator, while the number of competing firms in the sector is very small. Governance of the rail sector could be improved (Figure 2.19, Panel F). Reforming sectoral regulation to use competitive tenders to allocate public service contracts could improve service quality (Vitale and Terrero, 2022[44]). Low service quality also likely reflects lack of public investment in rail, which is among the lowest in the OECD (Figure 2.19, Panel C). Greece is undertaking several measures to improve the infrastructure, organisation, and service quality of its railway system, including investments of EUR 1.3 billion (0.7% of GDP in 2021), partly covered by the Recovery and Resilience Fund and the Connecting Europe Facility (Hellenic Republic, 2022[63]). The recent start of its first fast train between Athens and Thessaloniki signals ongoing improvements. Further increasing investment to rail, to first making better use of its existing network and then expanding it, would support the shift towards travelling or moving goods by train.

Figure 2.18. Using cars less would reduce Greece's high incidence of accidents and congestion



Note: Panel A: OECD is an unweighted average. Panel B: Average number of hours spent in road congestion per year by a representative commuting driver. Data are estimated by the Commission Joint Research Centre, based on data from TomTom.
Source: International Transport Forum (2022), Trends in the Transport Sector (database); and European Commission, Directorate-General for Mobility and Transport.

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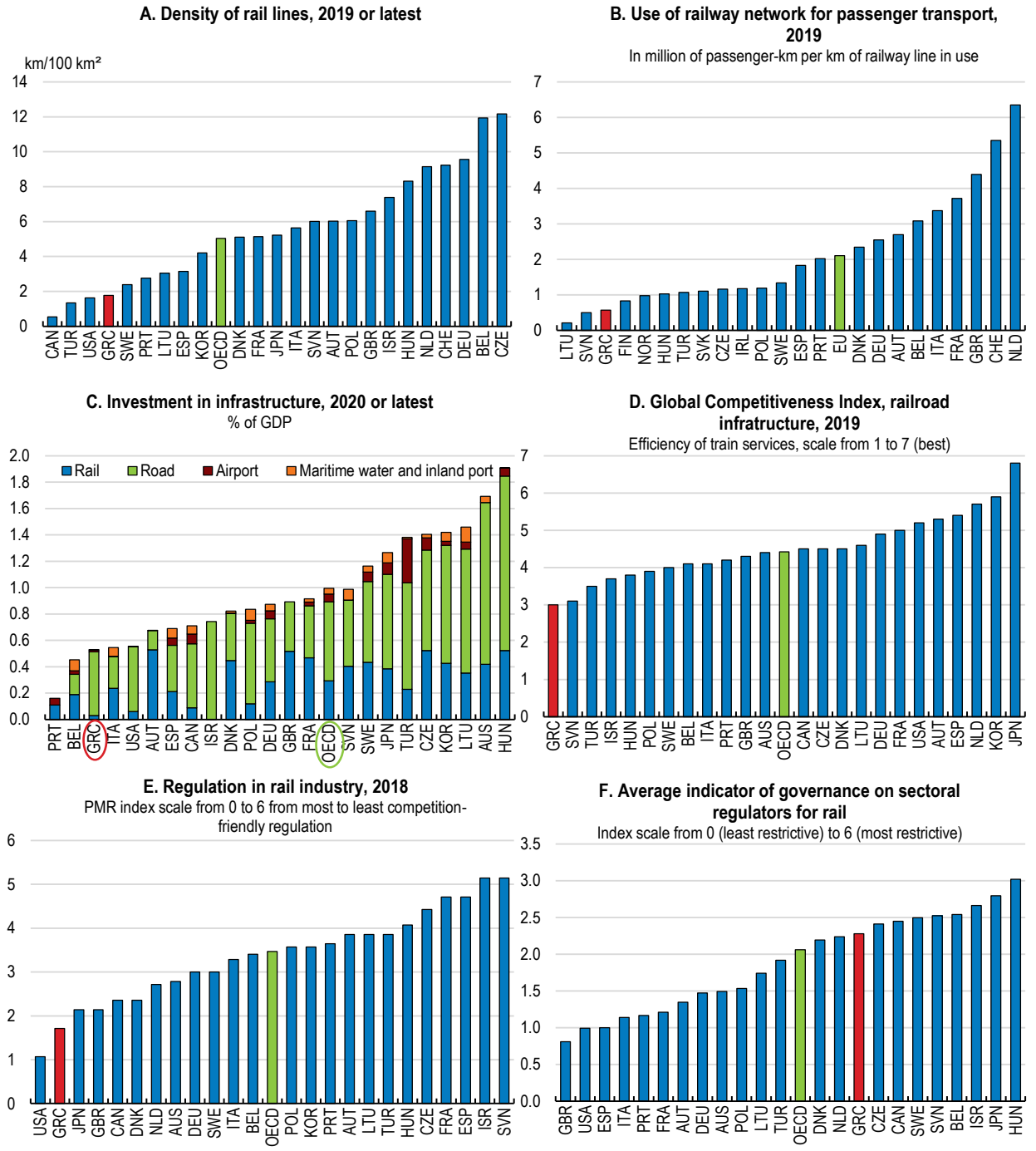
Figure 2.19. Greece's railway network can be expanded and used more intensively



Note: Panel A: OECD unweighted average excludes Australia, Colombia, Costa Rica, Iceland and New Zealand. Panel C: OECD unweighted average excludes Colombia, Costa Rica and the Netherlands. The ITF survey covers all sources of financing, a number of countries do not include private spending. Panel D: OECD unweighted average excludes Costa Rica and Iceland. Panel E: OECD unweighted average excludes Iceland. Panel F: Average indicator of governance on sectoral regulators for rail on independence, accountability and scope of action.

Source: OECD Transport database; and EC (2021), EC Transport Pocketbook 2021; International Transport Forum (ITF, 2021), ITF Investment in Transport Infrastructure Questionnaire; World Economic Forum (2019), The Global Competitiveness Report 2019; OECD (2018), PMR database; OECD Indicators on the Governance of Sector Regulators 2018.

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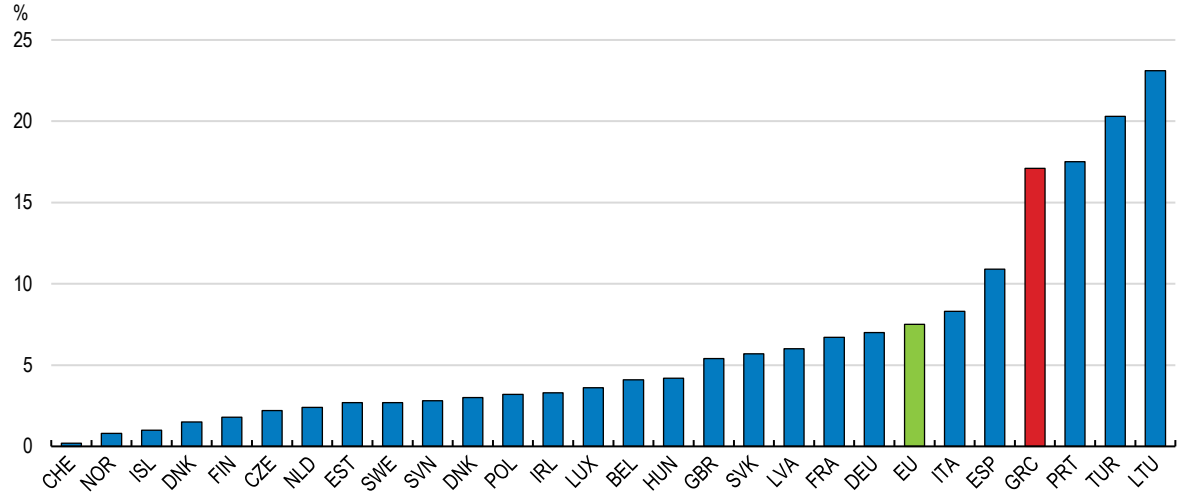
Making travelling by public transport more attractive would help reduce car use. Many people may choose travelling by car because public transport is slower over the total journey, does not cover the entire journey, or requires switching between different modes. Several investment measures, worth EUR 4.3 billion (2% of GDP in 2021), will improve the metro network in Athens and Thessaloniki (Hellenic Republic, 2022[63]). There is further scope to make different public transport modes work together more seamlessly with digital technologies (European Commission, 2021[64]), for example by promoting Mobility-as-a-Service or offering integrated ticketing, and by promoting shared transport modes such as on-demand taxi-buses to cover the last kilometre (ITF, 2017[65]). Better incorporating transit in urban development would make using public transport more convenient by bringing terminals closer to where people live, work and shop (ITF, 2021[49]).

Making buildings part of the green energy transition

Making buildings more energy efficient is crucial for containing energy consumption and reducing greenhouse gas (GHG) emissions from energy use. Residential and tertiary buildings are responsible for 40% of Greece's energy consumption, mostly for heating (MoEE, 2018[2]). Better insulating buildings is also crucial to adapt to a hotter and more extreme climate (discussed above). Renovating residential buildings would additionally help to reduce households' energy bills and the high incidence of energy poverty (Figure 2.20).

Figure 2.20. A large share of the population faces high energy bills and limits heating

Percentage of inhabitants unable to keep their home adequately warm, 2020 or latest available



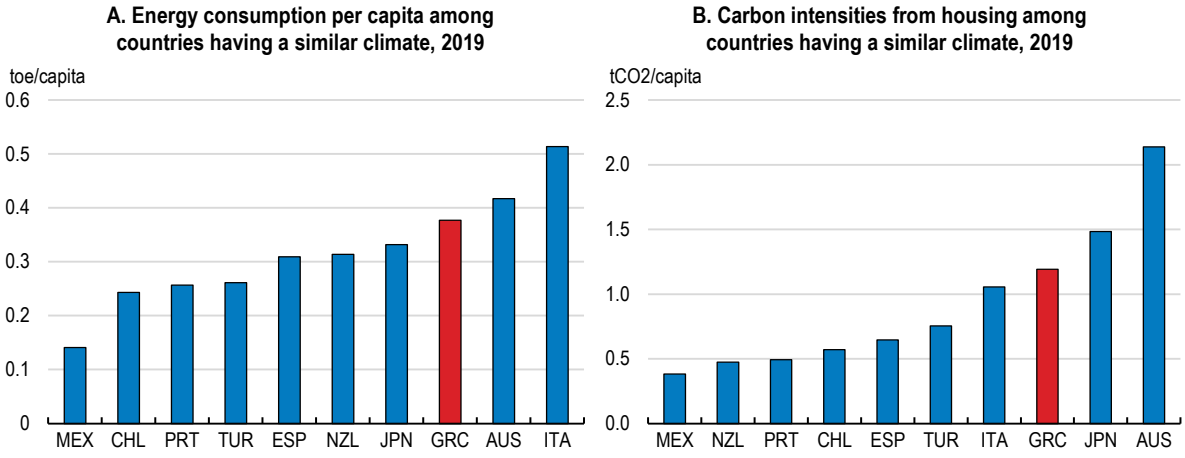
Source: Eurostat.

StatLink https://stat.link/10eidl

Improving the energy efficiency of existing buildings can generate large energy savings. Since June 2021, new buildings must meet near-zero-energy standards (BPIE, 2021[66]). Many existing buildings, however, lack sufficient insulation, with more than 80% of the building stock in 2014 having been constructed before 2000, when thermal regulations were either absent or lax (European Commission, 2021[67]; BPIE, 2018[68]). The use of emission-intensive heating oil is still widespread (MoEE, 2018[2]). As a result, both energy consumption (Figure 2.21, Panel A) and GHG emissions from housing (Figure 2.21, Panel B) are high compared to countries with similar heating needs. New legislation banning the sale and installation of oil-fuelled heating burners by 2025 is welcome. Promoting renovations of existing buildings – for example by installing shading systems, improving thermal insulation, upgrading heating systems and installing automatic control devices – would substantially reduce greenhouse gas (GHG) emissions and energy costs (EC/EIB, 2019[69]) and could contribute to climate change adaptation (discussed below) by making

buildings more heat resistant. State aid systems for such interventions are already under implementation funded by the EU and national sources.

Figure 2.21. Energy consumption and carbon emissions of Greece's buildings can improve



Note: Countries with similar numbers of heating degree days are classed as having similar climates. Heating days are the number of degrees that a day's average temperature falls below the level at which residents typically turn on the heating system.
Source: OECD (2021), Brick by Brick: Building Better Housing Policies, OECD Publishing, Paris, https://doi.org/10.1787/b453b043-en.
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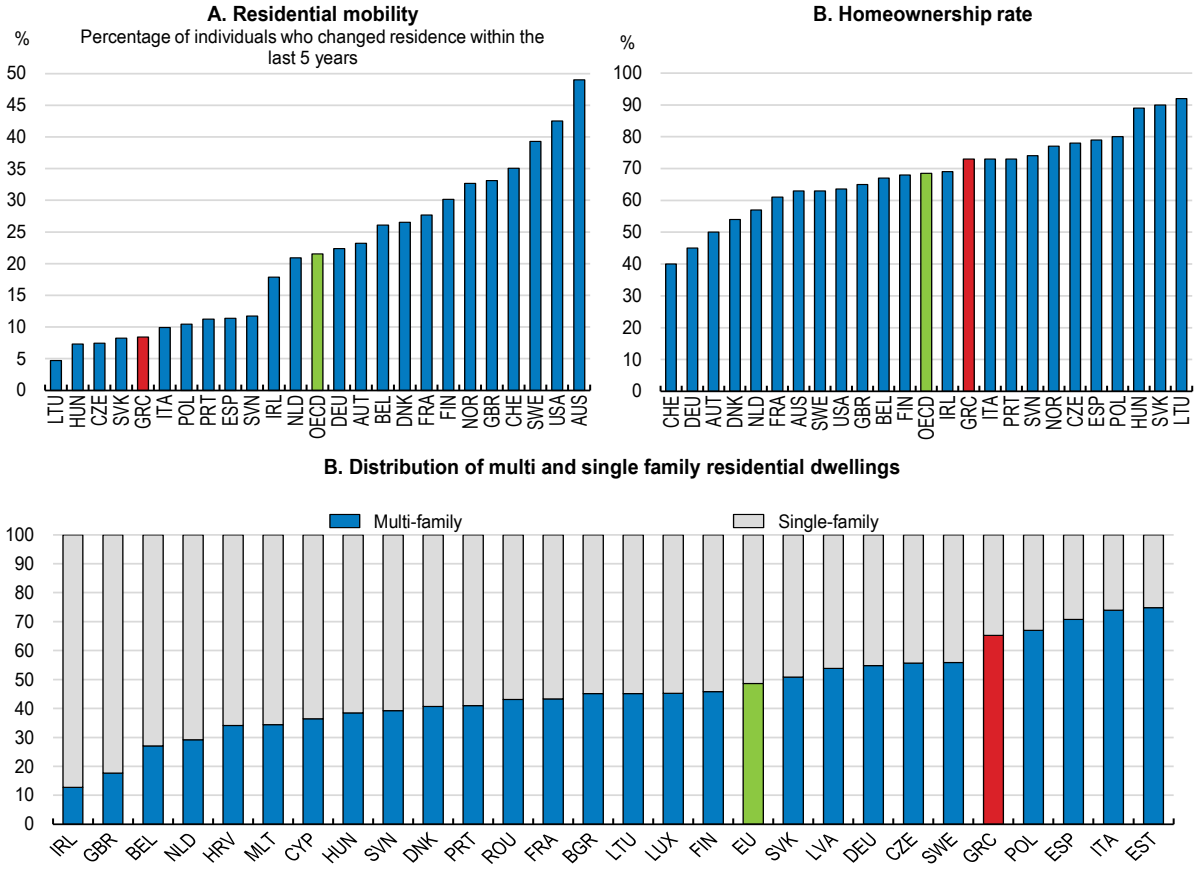
Improving energy efficiency will require an acceleration in building renovations for households and small and medium enterprises (SMEs). Greece's National Energy and Climate Plan proposes renovating 60 000 dwellings per year until 2030 (OECD, 2020[8]). This corresponds to achieving about as many renovations every year as the previous main support programme "Saving at Home" achieved over six years (EC/EIB, 2019[69]). Upgrading the entire building stock by 2050 would require twice as many renovations per year as currently planned (European Commission, 2020[17]). Making inroads to renovating housing will be key for reaping gains from energy efficiency improvements, with housing accounting for 84% of the total floor area in 2014 (European Commission, 2021[67]). Businesses in hospitality and retail, which are dominated by SMEs, and public sector buildings account for a smaller share of about 4% of the total floor area (European Commission, 2021[67]), while commercial buildings consume up to two times as much energy as housing (MoEE, 2018[2]). Financial support measures and investments included in the 'Greece 2.0' Recovery and Resilience Plan promote renovations especially for energy-poor households, both SMEs and larger firms, and the public sector. Greece is making good progress with implementing these measures (European Commission, 2022[70]). Financial support measures included in the plan aim to renovate up to 105 000 households by 2025 (Hellenic Republic, 2022[63]). Expanding financial support measures to more buildings and households and SMEs would realise more of the potential reduction in buildings' emissions.

Expanding the coverage of energy efficiency regulations to all existing buildings would boost demand for renovations. Mandatory energy performance certificates and minimum efficiency standards for existing buildings apply when selling, renting to new tenants, or renovating properties (BPIE, 2018[68]). Such regulations have limited impact given the high share of owner-occupiers and low housing ownership turnover in Greece compared with other OECD countries (Figure 2.22, Panel A and B). In 2016, less than 20% of residential buildings possessed an energy efficiency certificate (BPIE, 2018[68]; Gaglia et al., 2018[71]). Greece could follow other countries in applying increasingly demanding minimum energy efficiency standards that apply to existing buildings, for example as discussed in Box 2.8. Providing a timeline for regulatory requirements would allow owners to adapt and encourage businesses and workers to acquire the skills and build the capacity needed to undertake the renovations.

Figure 2.22. Requirements to upgrade buildings' energy efficiency will need to account for Greece's high home ownership rate, low mobility and high share of multi-owner buildings



Source: OECD (2021), Brick By Brick: Building Better Housing Policies; and European Commission (2022), EU Buildings Factsheets (https://ec.europa.eu/energy/eu-buildings-factsheets_en).

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Overcoming barriers to renovations will require a mix of regulation and financial support measures. Access to finance remains challenging, following the prolonged economic crisis (Chapter 1). Even with access to funds, investors are often deterred by renovations' high upfront costs and long and uncertain returns through energy savings (Economidou, Todeschi and Bertoldi, 2019[72]). Recent surges in energy prices or future carbon price increases may act to strengthen financial incentives. In the short run, however, shrinking real incomes and growing material costs and shortages of materials and workers have made renovations more costly. The previous "Saving at Home" programme combined subsidised loans with grants to promote renovations among households. Upscaling schemes with sizeable grant components is fiscally costly and may end up paying for investments that would have taken place with private financing. Targeting grants to vulnerable groups, and providing subsidised loans that are repaid via utility bills through energy savings, such that customers do not pay more for energy plus the renovation than they would have paid without the renovation, to other households and SMEs can address barriers to renovations while leveraging more private capital (Economidou, Todeschi and Bertoldi, 2019[72]).

Multi-owner buildings are particularly widespread in Greece (Figure 2.22, Panel C). Agreeing on costly and potentially disruptive renovations is more difficult for rented properties or apartment buildings with several owners, as the link between an owner's contribution to renovation costs and their benefit from energy savings is weakened (Castellazzi, Bertoldi and Economidou, 2017[73]). Supporting loans with on-bill repayment can address this challenge, as agreeing on renovations may be easier when upfront costs are

fully financed through future energy savings (Economidou, Todeschi and Bertoldi, 2019[72]). There may be scope to further support renovations in multi-owner buildings by changes to the legal arrangements governing these renovations, for example to promote majority-based decision-making and individual metering (Castellazzi, Bertoldi and Economidou, 2017[73]). Energy service companies, which the 'Greece 2.0' Recovery and Resilience Plan plans to involve in renovating public buildings, can provide finance to larger renovation projects of commercial owners, where savings are high enough to repay the costs of the service companies' involvement (Economidou, Todeschi and Bertoldi, 2019[72]).

Box 2.8. Using energy efficiency standards to boost renovations in existing buildings

To substantially scale up energy efficiency-improving renovations, several countries plan or have adopted plans to gradually tighten regulations on minimum energy efficiency standards, applying to a broadening range of office, residential and rented properties.

In the **Netherlands**, for example, office buildings are required to have an energy label that is revised every four years. From 2023 onwards, all larger office buildings which consume more than certain threshold levels of energy, will need to reach an energy label of at least C (on a scale ranging from A to G). Municipalities or provinces are responsible for enforcement depending on the size of the business.

In **Belgium**, its capital Brussels plans legislation to first make energy labels obligatory for all residential buildings by 2025, and then require renovations improving energy efficiency in five-year intervals to reach particular minimum energy efficiency standards in 2050. Brussels is also planning exemptions from inheritance and property taxes for more ambitious renovations. The Flemish Region plans to mandate minimum energy performance standards, yet to be defined, for all non-residential buildings from 2030 onwards. Minimum efficiency standards are enforced at the municipal level.

France set out a strategy to gradually tighten minimum efficiency standards for rented properties. Rent increases were banned from 2021 for properties which have an energy label below E (on a scale ranging from A to G). From 2023, properties below the minimum efficiency standard will be banned from being rented, and from 2028 onwards the worst performing buildings must renovate.

In the **United Kingdom**, proposed measures to enforce minimum energy efficiency for rental properties include registering and licencing landlords contingent on possessing energy efficiency certificates, and giving tenants legal rights for compensation in case landlords fail to comply with standards.

Source: (European Commission, 2021[74]), (OECD, 2021[75]), (RSM, 2019[76]).

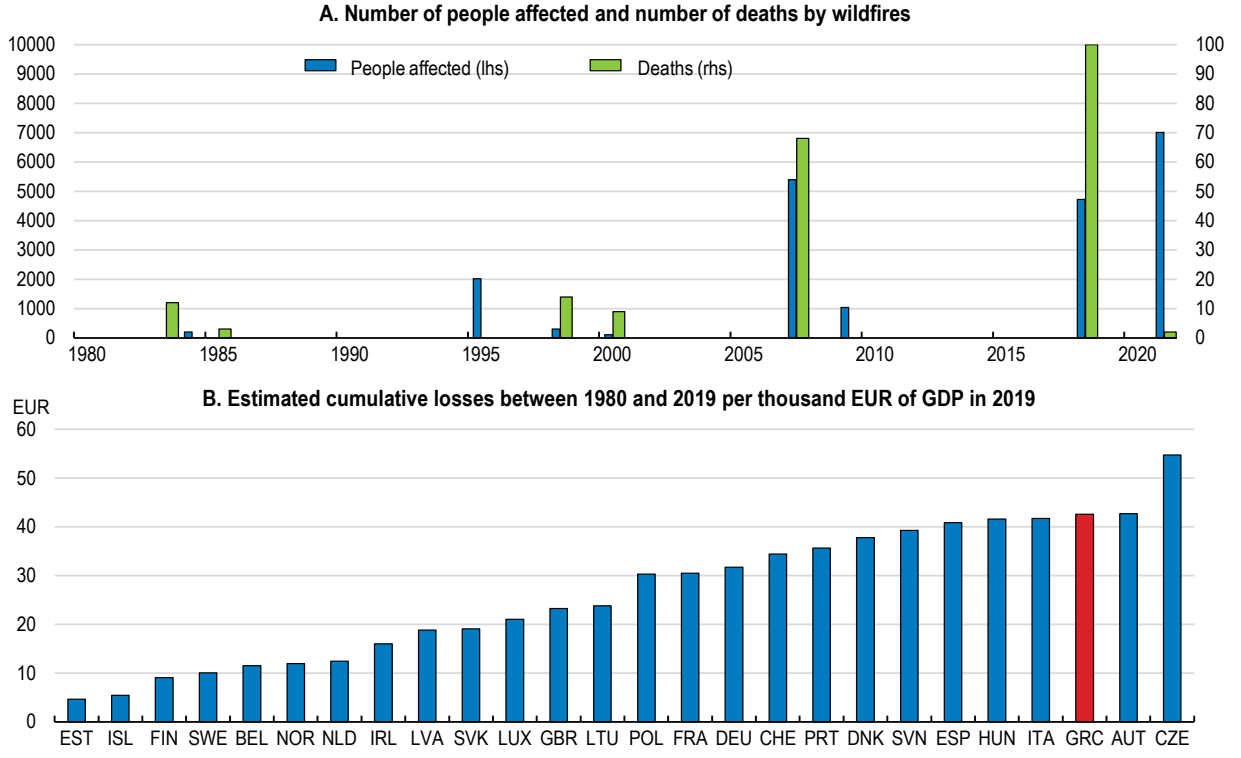
Many owners may not renovate because they are unaware of potential energy savings or find the renovations too difficult to plan. While these obstacles can prevent even large firms from undertaking energy-efficient renovations, they are particularly pronounced among households and SMEs (European Commission, 2021[74]; OECD, 2021[75]). Providing more information alongside energy performance certificates, for example on renovation roadmaps, and making information more widely available, could better guide market and investment decisions. There is no publicly available registry for energy performance certificates, which appear to have limited influence on real estate prices (BPIE, 2018[68]). Easier access to information about renovations would make regulatory and financial support measures more effective. France, for example, provides an online platform for energy efficiency passports, which suggests measures to improve energy efficiency (European Commission, 2021[74]). Greece could build on its progress in digitalising public services to promote one-stop-interfaces on potential energy savings and available financing. Providing targeted technical assistance to SMEs, as Ireland and Sweden do via energy consultants at the local level, would address SMEs' limited planning capacity (OECD, 2021[75]).

Policies to adapt to a changing climate

The impact of climate change on people and businesses in Greece will mount

Greece is already experiencing relatively large human and economic losses from climate change (Figure 2.23, Panels A and B), which are likely to increase with a warming climate. Average daily temperatures in Greece are likely to be one to two degrees higher than in pre-industrial times by 2050 if the global community manages to sharply lower emissions, and may be two to three degrees higher otherwise (ECMWF, 2021[77]). If the international community fails to achieve the globally agreed emission reduction targets, even larger and more frequent losses from climate change become more likely (IPCC, 2022[78]). As a Mediterranean country, Greece is particularly vulnerable to the impact of climate change. Extreme weather events such as forest fires, frequently involving casualties, are on the rise (Figure 2.23, Panel A), and the economic losses are already high (Figure 2.23, Panel B). Deaths from heat waves in southern Europe will likely be ten to forty times higher by 2050 compared to the period before 2010, depending on the level of global warming (Naumann et al., 2020[79]). Precipitation may decrease by 5-10% by 2050 if emissions are low and by 10-20% if emissions remain high (Figure 2.24). Water stress is relatively high (Figure 2.26, Panel A) and will become more severe with higher water demand and lower rainfall during hotter summers (MoEE, 2018[80]). Also, 21% of Greece's coastline is vulnerable to a one metre rise in sea level. Sea levels are projected to rise between 0.2 and 2 meters by 2100, which can lead to flooding and coastline erosion. One-third of the population live within one to two kilometres of the coastline (Bank of Greece, 2011[81]).

Figure 2.23. Wildfires have already become more frequent and severe



Note: Panel A: Number of people affected by wildfires is the sum of people injured, requiring immediate assistance during emergency situation, or being homeless as result of wildfires. Panel B: The figures vary according to the proportion of damage that is insured and do not therefore reflect the real cost of damage.

Source: CRED/UCLouvain (2022), the International Disaster Database (EM-DAT, www.emdat.be); and calculations based on records from the NatCatService provided by Munich Re and Eurostat structural indicators.

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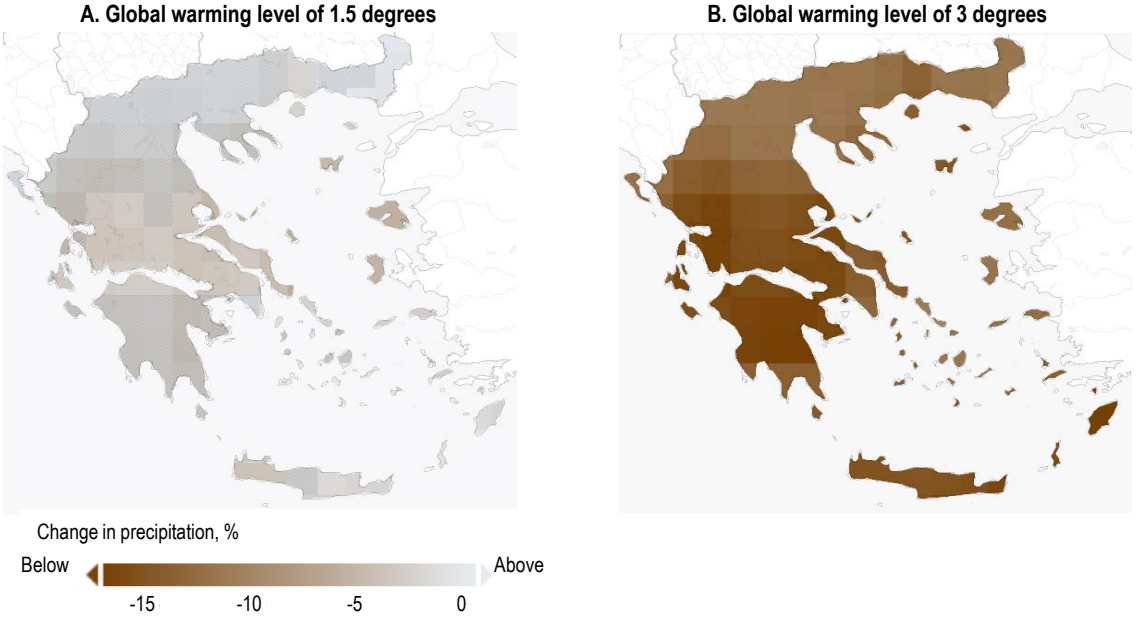
Businesses and employees, especially in tourism and agriculture, will encounter changing seasonal patterns and more frequent natural disasters (MoEE, 2018[80]; Dianeosis, 2021[82]). Risks of physical damages from climate change to businesses, and potential knock-on effects on the banking system, are higher in Greece than many other Euro-zone countries and may contribute to new non-performing loans in the future (Alogoskoufis et al., 2021[83]; Bank of Greece, 2021[84]). The European Commission estimates cumulated costs of extreme weather and climate events for Greece between 1980 and 2020 to be 5.4% of GDP in 2019 (European Environment Agency, 2022[85]). An impact assessment from 2011 by the Bank of Greece, which is currently being updated, found cumulative losses of climate change corresponding to two to three times annual GDP until 2100, depending on the level of global warming (Bank of Greece, 2011[81]); recent analysis estimates GDP in 2050 to be up 3.5% lower if emissions are contained in line with the Paris Agreement, but up to 13% lower if average temperatures rise by more than 3 degrees (Swiss Re Institute, 2021[86]).

Figure 2.24. Climate change is likely to affect the south and west of Greece most

Relative change in precipitation in percent at different levels of global warming for 2050 compared to 1986-2006



Source: Climate Analytics, https://climate-impact-explorer.climateanalytics.org/.

Policies can help people and businesses adapt to mounting climate change risks

There is scope for policies to reduce the costs of climate change by limiting vulnerabilities and reducing exposure. Awareness for the types of risks related to climate change, which take long to materialise fully and involve relatively infrequent extreme events such as floods and forest fires, can be low due to cognitive biases. People and businesses may thus largely abstain from taking protective measures. Policies can help to overcome these biases by providing information and encourage limiting exposure through regulations and price signals (Economides et al., 2018[87]). In addition, adapting public infrastructure to a hotter, drier and more volatile climate implies substantial investment needs.

Encouraging businesses and people to adapt

Households and businesses can adapt more effectively with more, and more easily accessible, information on their vulnerability and exposure to the impacts of climate change. Providing information on risk exposure can encourage protective behaviour, such as limiting exposure during heatwaves or reducing human

hazards that exacerbate the risks of wildfires. Price signals, for example from insurance premiums, are also more effective if people know which adaptation measures work best. Greece created a new Ministry for Climate Crisis and Civil Protection which focuses on coordinating emergency response. It provides a contact point for information on self-protection and risk maps, and Greece is actively involved in disseminating this information effectively (OECD, 2016[88]). The plans for several initiatives – including a Climate Dialogue Website, a National Observatory for Climate Change Adaptation, and a National Adaptation Hub – to collect and disseminate information and engage with stakeholders are welcome.

Expanding private insurance coverage for extreme weather events can reduce the contingent liability for governments and raise the involvement of private finance. Greece, like many other countries, partially compensates private losses after disasters have occurred (OECD/The World Bank, 2019[89]). The lack of clear risk-sharing rules implies uncertainty about how and when people will be compensated and slows down the recovery from disasters. In addition, if the government is known to step in to cover losses from extreme events, private actors have fewer incentives to minimise their risks and to invest in their own protection.

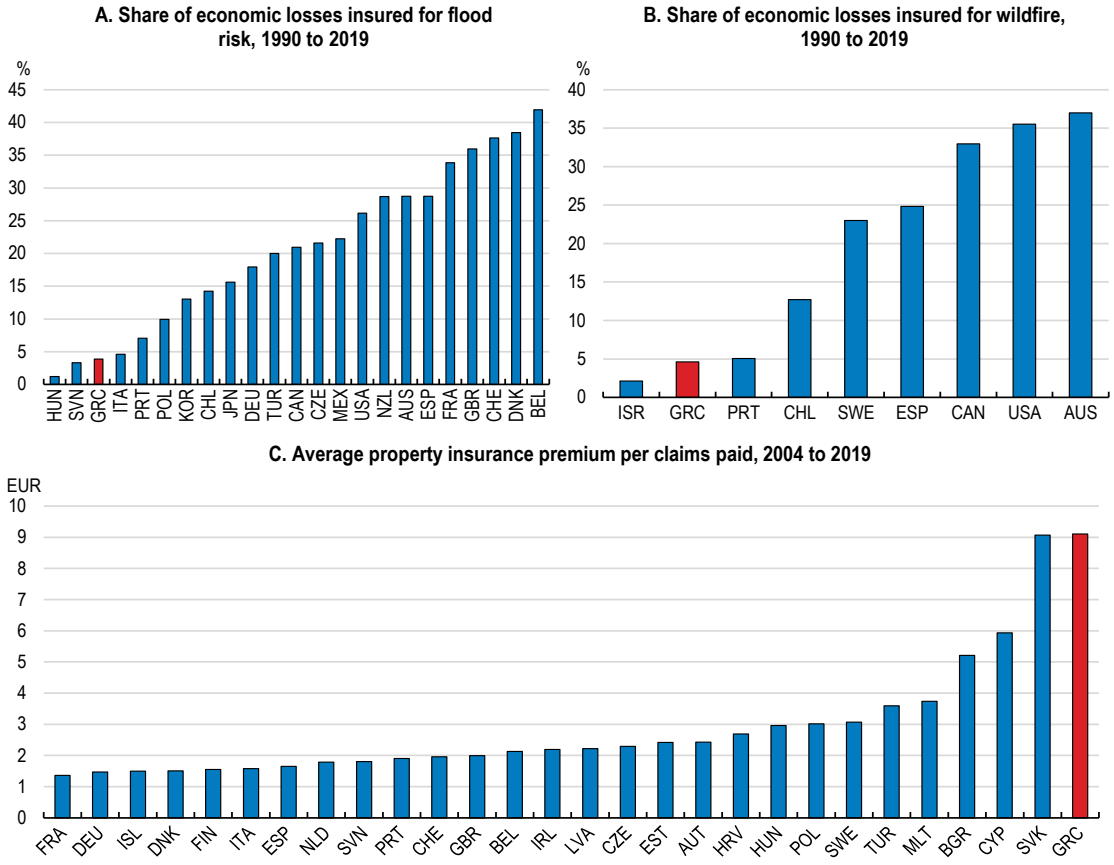
Making insurance against climate-related damages mandatory for all buildings would expand insurance coverage and could reduce prices for insurance (European Commission, 2018[90]) (OECD, 2021[91]). Insurance coverage for damages from extreme weather events is low compared to other countries (Figure 2.25, Panels A and B), while insurance costs for property are high (Figure 2.25, Panel C). Greece's insurance market is characterised by a large number of insurance companies, including many international providers. Monitoring competition and supporting transparent publication of information about policy costs and coverage could help to assure that premiums for mandatory insurance are competitive. The nature and intensity of risks may also evolve with climate change, making it more difficult to run insurance markets (OECD, 2021[91]). Conducting regular risk assessments about likely damages would inform insurers' financial planning, and the need for re-insurance to assure insurability, as risks evolve (G20/OECD, 2012[92]).

Covering more buildings and risk types allows insurance providers to charge lower premia by pooling risks. To achieve broad coverage, Switzerland, for example, mandates building insurance against natural catastrophes in 22 out of 26 of its cantons, which either private or public insurers provide at a rate that varies with risk (OECD, 2017[93]; OECD, 2016[94]). In France, the CATNAT insurance scheme mandates a premium at a flat rate for all property and motor vehicle insurance policies to insure against natural disasters (OECD/The World Bank, 2019[89]). Involving insurance providers also leverages their capacities to collect data, assess risks and damages, and disburse funds (OECD, 2021[95]). For example, Denmark set up an independent Danish Storm Council with technical expertise that assesses damages and provides compensation for floods, windfall and storm surges, financed by a premium surcharge, for those who choose fire insurance for their property (OECD, 2021[91]).

Making insurance against climate-related damages mandatory for all buildings can raise several issues for insurers and low-income households, though experience in OECD countries provides guidance on how to address them. Insurers may choose to offer no or very costly insurance as large and growing potential damages from climate-related extreme events can exceed their financial capacity or require large and costly reserves. Public support may be needed to assure that all building owners can afford insurance. Providing a public backstop for losses borne by insurance providers can limit uncertainty, and thus costs, for private insurances (OECD, 2021[95]). Japan shares losses from earthquakes between the government and private insurers depending on the aggregate loss. Losses up to about EUR 800 million are fully covered by private insurers, additional losses up to about EUR 2 billion are shared equally, and losses above this threshold are largely borne by the state (OECD/The World Bank, 2019[89]). Meanwhile, setting a maximum compensation can limit fiscal exposure. New Zealand offers direct insurance against natural perils but limits compensation to about EUR 90 000 for each property (OECD, 2021[91]). Finally, mandatory insurance implies higher housing costs for households. Subsidising insurance for vulnerable households could address potential concerns about housing affordability (OECD, 2021[96]).

Using water efficiently will become crucial as temperatures increase and precipitation declines. Water is currently used less efficiently than in other countries. For example, water abstraction is high and in agriculture, which accounts for about 80% of water consumption, is mostly used for irrigation, for which more wastewater could be used (Figure 2.26, Panel B). Planned investments in the national irrigation network and the establishment of a new water and wastewater regulatory authority can contribute to using water more efficiently (Hellenic Republic, 2022[63]). Water prices vary substantially across municipalities but are generally too low to recover costs (Farmaki and Tranoulidis, 2018[97]). Better reflecting water scarcity and delivery costs in water prices would improve incentives for businesses and households to use water efficiently, which is especially important on islands. Higher water supply revenues can finance investments to improve the efficiency of the water system, such as developing groundwater recharging. Replacing social water tariffs with income transfers not linked to water consumption would encourage saving water while protecting vulnerable groups (OECD, 2020[8]).

Figure 2.25. Greece can increase coverage and reduce costs for climate-related insurance



Note: Panels A and B: To account for single events with large losses, results are shown as average of two measures: (a) the share of total insurance losses of economic losses and (b) the average of the share of losses included for each event, giving each event equal weight. The data for Japan includes both Japanese private and mutual insurers although data from mutual insurers for individual events is not always available. As a result, some underestimation of insured losses in Japan in possible.
Source: OECD (2021), Enhancing Financial Protection Against Catastrophe: The Role of Catastrophe Risk Insurance Programmes; and Insurance Europe (2021), European insurance industry database, https://www.insuranceeurope.eu/.

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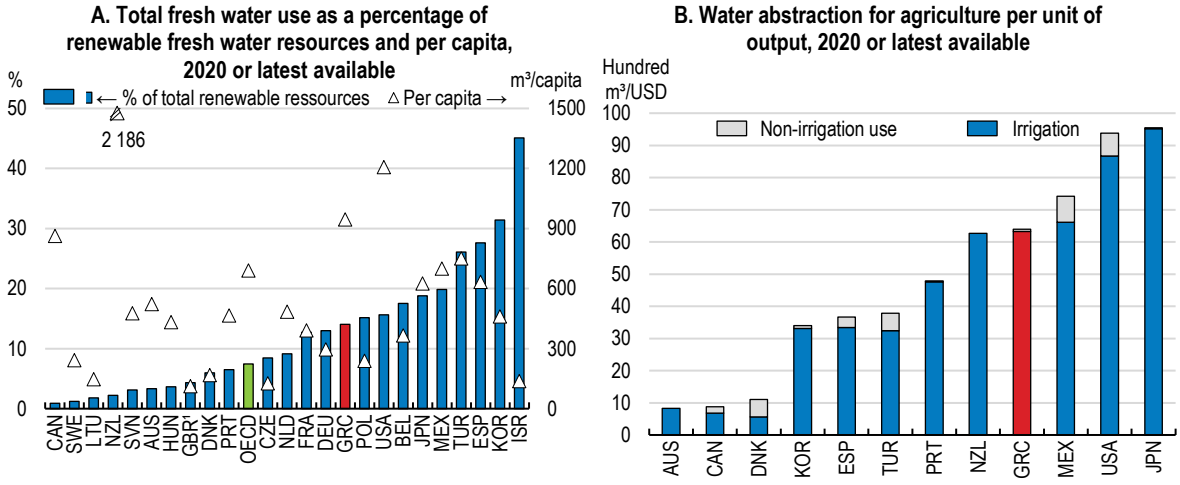
Figure 2.26. Greece can use its water resources more efficiently



1. England and Wales only.

Note: Panel B: Gross freshwater abstraction (surface and ground water) for agriculture, forestry and fishing in cubic meter divided by gross value added in agriculture, forestry and fishing at current prices converted into USD using current PPPs.

Source: OECD Environment Statistics (database); OECD National Accounts (database); and OECD calculations.

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Investing in protective and resilient infrastructure

Making existing public infrastructure more resilient to extreme weather events, and emergency responses will further reduce vulnerabilities to climate change (OECD, 2018[98]; World Bank, 2021[99]). Adjustments include making electricity networks able to withstand extreme weather events and cope with higher peak demand during more intense summers, protecting coastline infrastructure against erosion, and making water systems more efficient to cope with changing rain patterns and more evaporation (MoEE, 2018[80]). Better warning systems and more equipment will help to reduce damages from more frequent and intense forest fires and other natural catastrophes. The uncertain impact of climate change means that investment needs keep evolving (OECD, 2018[98]). Investment measures included in Greece's Recovery and Resilience Plan are welcome and will improve the resilience of its electricity network, adapt the built environment to warmer temperatures, improve the efficiency of the water system, and improve emergency measures. Revising the National Adaptation Strategy currently underway and finalising Regional Adaptation Action Plans may identify additional investment needs.

Incorporating adaptation concerns into plans for how space is being used and how new infrastructure, which will remain for many years, is built would reduce future vulnerabilities. Reforms contained in Greece 2.0 to consider climate change adaptation needs in urban and spatial planning are welcome. Cities are particularly vulnerable to climate change due to their high density and the built environment's heat absorption (OECD, 2010[100]), and Athens has been the first European city to appoint a Chief Heat Officer to identify ways how to improve the city's heat resilience. Legacies of many illegal buildings, partly in forest and coastal areas, pose a challenge, and can raise exposure to damages (OECD, 2020[101]). Strengthening enforcement in high-risk areas, and accounting for the risks illegal buildings are exposed to when retroactively legalising buildings, would contribute to reducing exposure (OECD, 2020[8]). Incorporating adaptation concerns into infrastructure projects often incurs additional costs. Fully reflecting adaptation concerns in procurement processes would assure that bidders who integrate climate resilience into their offers are not put at a disadvantage (OECD, 2018[98]).

Implementing the policies to transition to a green economy

The preceding discussion described what are the key policies for Greece to mitigate and adapt to climate change. This Section presents priorities for how these policies can be implemented. Many of the policies for the green economy transition entail significant near-term costs, in the form of significant investments and higher prices especially for carbon-intensive goods. Many will take many years to fully implement and deliver outcomes. Most of these measures are intended to reduce the scale and costs of climate change.

Sustaining such a policy programme is notoriously challenging, given the inevitable pressures of responding to short-term shocks and of the political cycle. The experience of several OECD countries (Box 2.9) suggests that implementing the policies for the green economy transition will require: building a consensus around policies, by improving understanding of the climate change challenges and ensuring processes lead to sustained and well-designed policies; helping workers and firms during the transition phase; and ensuring adequate and sustained financing for policies (D'Arcangelo et al., 2022[11]).

Developing, implementing and sustaining well-designed green policies

Developing broad awareness of the challenges posed by climate change and the green economy transition

Awareness of the potential costs of climate change is high in Greece (Figure 2.27), and around 80% of the public support the adoption of more stringent environmental laws (WWF, 2018[102]). This awareness provides solid foundations for climate policies. Teachers are trained to cover environmental issues and about 80% of primary and secondary schools partake in sustainability initiatives. To distribute educational materials on environmental matters to teachers, parents and the general public, Greece has developed the Photodentro (Tree Light) digital platform, managed by the Institute of Educational Policy (IEP) under the Ministry of Education (OECD, 2020[8]). It has also integrated into the mandatory national curriculum the "Skill Labs" school module, which promotes education for sustainable development, climate change and environment.

Box 2.9. Lessons from OECD countries on implementing policies for the green economy transition

Several OECD countries' green transition policies have faced at times strident and broad-based criticism for their costs and distributional effects. Anticipating and addressing these, countries have taken steps to develop awareness and consensus around policies, and to remedy some of the distributional and transition costs.

In 2014, **the French government** initiated an ambitious carbon tax scheme (Contribution Climat-Énergie or CCE) to reduce the country's greenhouse gas (GHG) emissions, planning to annually increase the carbon price from EUR 7 per tonne of CO_2 in 2014 to EUR 86.2 per tonne of CO_2 by 2022. In this context, the so-called "Yellow Vests" protests broke out in November 2018, centring around the regressive outcomes that were not coupled with fully parallel compensation for the most vulnerable or rural households – perceived as unfair (Douenne and Fabre, 2020[103]; Guisse and Hoibian, 2017[104]; Vie Publique, 2017[105]; Agence de la transition écologique (ADEME), 2019[106]; Conseil des prélèvements obligatoires (CPO), 2019[107]). In addition, the pre-planned carbon price increase in 2018 coincided with a sharp rise in world oil prices (Magnenou, 2019[108]; Statista, 2019[109]), while general communication efforts were insufficient. The strong public response led the government to freeze the carbon price at EUR 44.6 per tonne of CO_2 (Douenne and Fabre, 2020[103]). Subsequently, the French president led the formation of the Citizens Convention for Climate (Convention Citoyenne pour le

Climat), which assembled in 2019 and 2020 as a deliberative body to propose policies to reduce GHG emissions by 40% from their 1990 level, while accounting for social needs and challenges.

The **British Columbia province of Canada**, which introduced carbon pricing in 2008 (with a schedule for annual increases of CAD 5 per tonne of CO_2 up to a maximum levy of CAD 30 per tonne of CO_2 in 2012) suffered from similar challenges. Rural communities argued they would bear more of the cost of the tax, due to the colder weather they face and greater reliance on private transport (Peet and Harrison, 2012[110]); and the tax was applied in a period of high gas prices – further hampering acceptability. However, public support for the tax significantly rose by 2012, in part thanks to revenue recycling and complementary support measures to firms, income tax cuts, targeted property tax rebates to rural and northern homeowners and targeted financial transfers for low-income households (Beck et al., 2015[111]).

Switzerland's Long-Term Climate Strategy, adopted by the Federal Council in 2018, established climate targets for key sectors and set the carbon price at CHF 96 per tonne of CO_2 (about EUR 88 per tonne of CO_2) (OECD, 2019[112]). To address distributional and competitiveness concerns, the federal government redistributed about two-thirds of the tax revenue to households (through a lump-sum rebate) and firms (through a reimbursement proportional to their wage bill), with the remaining third earmarked for retrofitting works and the development of sustainable heating fuels. It also exempted from carbon taxation large emitters who are not included in the ETS ('grandfathering') if they committed to abate emissions, and committed to freezing any carbon price increases upon early achievement of abatement goals (Office fédéral de l'environnement (OFEV), Confédération Suisse, 2020[113]).

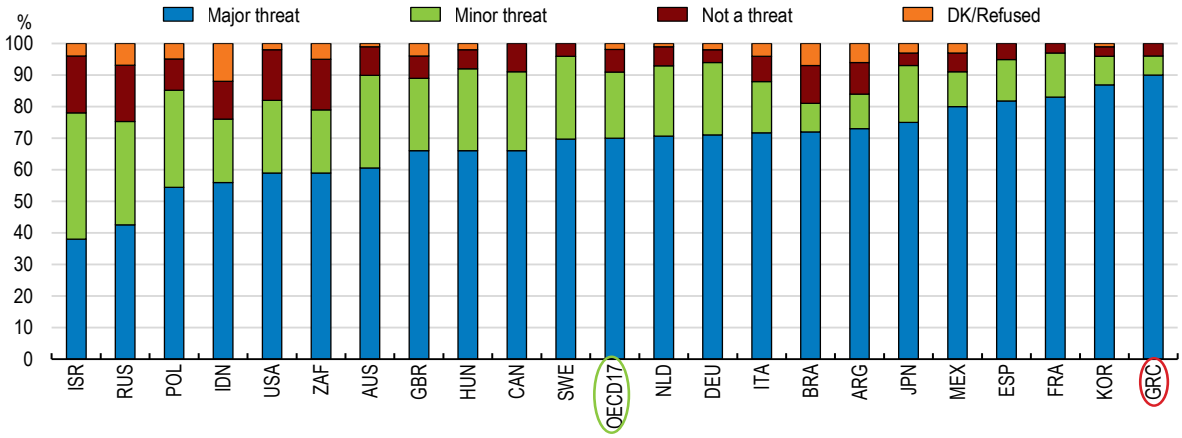
New Zealand has been especially successful in garnering public support when enacting its Climate Change Response (Zero-carbon) Amendment Act in 2019, which develops a framework for reaching zero GHG emissions by 2050. In the years preceding the plan's enactment, the government led successful communication and education campaigns, developing public awareness that was reflected in climate issues playing a central role in most political parties' agendas (Policy Ltd., 2020[114]). New Zealand's geographical exposure to climate change may have helped develop this awareness: similarly to Greece, New Zealand is composed of islands, is exposed to a rise in the sea level, and recent floods have led to the evacuation of thousands of households (Royal Society, 2016[115]). Further aiding acceptability, the policy tools were planned to be phased gradually, therefore allowing for adjustment, and were coupled with grandfathering and support measures (e.g., free allocation of 95% of the carbon credits at the farm level, as part of the local ETS) (de Klein, Rollo and van der Weerden, 2019[116]; OECD, 2021[117]; Climate Action Tracker, 2020[118]; Ministry of Environment, New Zealand Government, 2019[119]).

Source: (D'Arcangelo et al., 2022[11]).

For the broader population, ensuring the availability of independent information that is clearly communicated and combating false information are ongoing challenges. Providing accessible and relevant public information, communicated by diverse experts, promoting the skills to critically assess information, alongside regulating intentionally dishonest speech can contribute to balancing public discussions and encourage private investors to pursue green projects (Matasick, Alfonsi and Bellantoni, 2020[120]; Vona, 2021[121]). Emphasising the longer-term benefits of green economy policies, while acknowledging their short-term costs, can build support (Cohen et al., 2007[122]). Achieving awareness is especially important among more disadvantaged socio-economic groups (Vona, 2021[121]) and in regions that will be most affected by the transition, such as Western Macedonia and Peloponnese, with a high share of low-income households relying on the lignite mining industry (discussed below).

Figure 2.27. Nine out of ten Greeks perceive climate change to be a major threat

Share of survey respondents in a country perceiving climate change as a major, minor or no threat, 2018



Note: "OECD17" is the average of the participating OECD countries.
Source: (Pew Research Center, 2018[123]).

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Although Greece has significantly improved accessibility to environmental data in recent years, there is room for further progress. The Ministry of Environment and Energy (MoEE) oversees the collection and publication of environmental data, in collaboration with the Hellenic Statistical Authority (OECD, 2020[8]). However, there is no coherent framework to collect, classify or maintain data. For example, many websites often offer fragmented or outdated data (IEEP, 2019[124]). There have been reports in the past of government bodies refusing to disclose environmental information to the public, including a case in which Greece's national Ombudsman found the refusal to disclose information to be not properly justified (WWF, 2018[102]; WWF/HOS, 2021[125]). Addressing these issues, the climate law voted by the Parliament in May 2022 creates a National Observatory for Climate Change Adaptation within the new Ministry of Climate Crisis and Civil Protection. It is designed to provide a reliable single national climate database as well as a monitoring and evaluation platform, providing information for business planning and general public awareness. The Observatory can assess and adapt the platform to support its usefulness for public decisions.

Achieving stakeholder consensus around green economy policy measures

Informing and engaging stakeholders and the general public in the design of policies can help improve the policies' quality, build a supporting consensus, and ensure that policies that bring short-term costs continue to be implemented. To this end, Greece engages in extensive consultation for draft laws before they are submitted to parliament, although these consultations happen relatively late in the legislative process (OECD, 2021[126]). The process involves exchanges with selected groups and uses the open government portal to engage with the general public, as occurred during the drafting of the new climate law. In addition, every regional and municipal administration must establish a stakeholder consultation committee, including representatives from local business associations, trade unions, NGOs and the public.

Greece can strengthen its consultation processes. First, ensuring a minimum time for consultations, and the availability of explanatory materials would improve the quality of discussions (IEEP, 2019[124]). Second, broadening the range of participants who are consulted through the open government portal will boost knowledge and trust in the process. It may also reduce the risk of policy capture (see Chapter 1 for a discussion on strengthening Greece's lobbying regulations) or limited perspectives participating in the consultation, which are challenges in Greece like in other OECD countries. This is illustrated by the online review of the new climate law, where most comments were made by actors in potentially affected industries or from environmental NGOs. Some OECD countries, including Denmark and France, established an advisory citizen assembly to discuss citizen involvement in climate action and proposed policy tools to raise the quality of public debate and support. Third, regulations and decisions that are not subject to mandatory consultation could also be brought to public discussion as part of their effectiveness evaluation, hence improving public engagement and the quality of a significant part of Greece's laws (OECD, 2020[8]). Assuring the participation of women and giving particular attention to gender considerations in policy evaluations would allow to mainstream gender into policies for achieving the green transition (OECD, Forthcoming[127]).

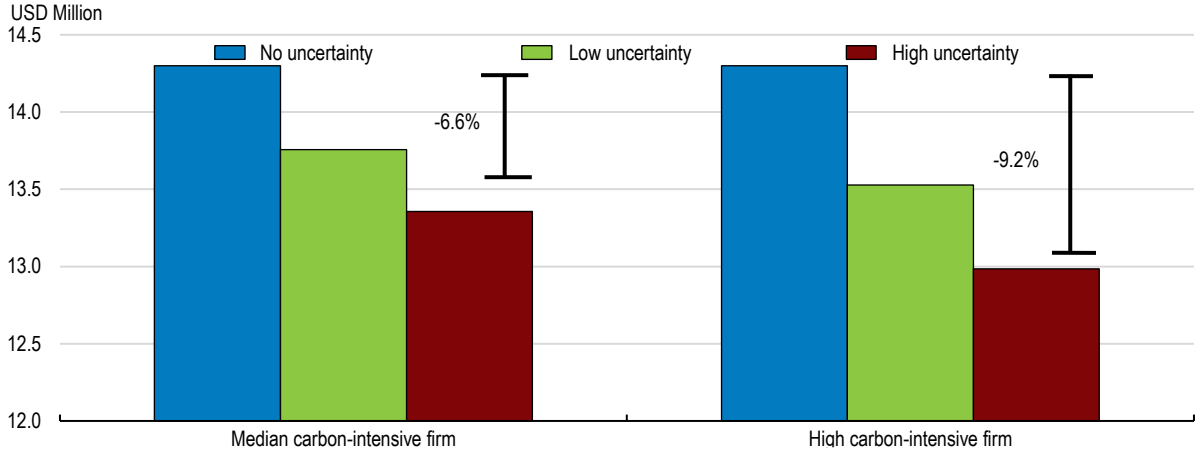
Policy certainty and stability support green investments

Providing a predictable and stable path for policies for the green economy transition helps firms and workers plan and adapt, and improves the acceptability of climate policies (Coady, Parry and Shang, 2018[128]; IMF, 2019[129]). Countries with higher environmental policy uncertainty have suffered from lower investment in support of the green economy transition (Figure 2.28). Stable and predictable policy paths are key to supporting private investors' long-term decisions and reducing transition risks, for example economic losses stemming from stranded assets (Tandon, 2021[130]). Greece's National Energy and Climate Plan and New Climate Law (Box 2.1) contribute to providing this certainty if their goals are implemented. Implementing mechanisms that help to avoid policy reversals can help achieve this. Other OECD countries, discussed in Box 2.10, have found that an independent institutional body that monitors and reports on progress towards long-term targets can help sustain the policy effort. Including climate mitigation and adaptation plans into higher order levels of legislation, so that they are more difficult to overturn; ensuring clear trajectories of carbon pricing or corridors (i.e., price floor and ceiling); introducing policies gradually; and establishing means to reduce speculation in climate-related financial assets (e.g., tools to appraise the conduct of climate-related financial trading (Quemin and Pahle, 2021[131])).

Greece can improve the certainty of firms' green investments, by guaranteeing tax credits or subsidies for green R&D or investments in green technology over long time horizons (Cammeraat, Dechezleprêtre and Lalanne, 2022[132]). The recent law granting super deductions on green and digital expenses and investments for SMEs from 2023 until 2025 is a step in the right direction.

Figure 2.28. Pursuing clear long-term policy programmes bolsters private sector investment

The effect of climate policy uncertainty on firm-level investment by carbon-intensity



Note: Height of bars gives average amount of firm-level investment in the sample. Whiskers indicate the difference in investment for firms under high or no uncertainty for median- and high carbon intensive firms respectively. Uncertainty refers to a cross-country indicator of Climate Policy Uncertainty based on newspaper article counts, covering 12 countries between 1990-2018.
Source: (Dechezleprêtre, Kruse and Berestycki, Forthcoming[133]); OECD Distributional information on household income, consumption and saving database (experimental); and OECD calculations.

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Consolidating capacity to implement green transition policies

Policy certainty and predictability, especially given the long time horizon of climate policies, are strongly linked to the need for effective governance. While Greece is a unitary state with public fiscal and staff resources concentrated in the central government, its system of environmental governance is decentralised, with several governmental bodies involved in the policy design and implementation process. The main responsibility for green policy at the central government lies with the Ministry of Environment and Energy. Several other ministries are involved in devising and implementing climate-related policies, including the newly created Ministry of Climate Crisis and Civil Protection, the Ministry of Development and Investments, the Ministry of Rural Development and Food, the Ministry of Finance, the Ministry of Infrastructure and Transport, the Ministry of Maritime Affairs and Insular Policy, and the Ministry of Tourism. At the subnational level, each regional authority has its own directorate for development planning, environment and infrastructure, and is involved in the implementation of climate-related policies, for example by devising regional adaptation actions plans and setting up land-use plans. Decentralised administrations of the national government supervise local governments and have significant environmental management responsibilities, particularly concerning spatial planning (OECD, 2020[8]).

While the responsibilities of the central, regional, and local governments are defined by law, their practical division is frequently unclear, resulting in gaps or overlap in implementation (IEEP, 2019[124]). To overcome this fragmentation, Greece has developed coordination networks, such as the Greek Environmental Network, the Inter-ministerial Committee on Energy and Climate, the National Climate Change Adaptation Council within the Ministry for Climate Crisis and Civil Protection (OECD, 2020[8]) and the Working Group on Sustainable Finance and Green Economic Transition within the Ministry of Finance. The Special Scientific Committee for the response to Climate Change within the Ministry for Climate Crisis and Civil Protection is providing scientific policy advice. These are steps in the right direction. Ensuring that mandates of the different bodies do not overlap, and consolidating responsibilities and resources would concentrate resources, expertise and responsibilities, and so improve implementation. The effectiveness of such consolidation and stronger coordination in implementing policies could be monitored by the independent body tasked with assessing progress against long-term climate targets (discussed above and Box 2.10).

Box 2.10. Independent advisory bodies can help strengthen and coordinate the policy mix

One effective strategy in designing and monitoring climate plans involves the establishment of independent economic advisory bodies on climate change. These bodies provide technical advice and help to coordinate different policy interventions across public and governmental institutions. The United Kingdom, Denmark and the Netherlands offer some examples.

In 2008, the **United Kingdom** established the **Committee on Climate Change (CCC)** as an executive non-departmental public body under the Climate Change Act. It is sponsored by the Department for Business, Energy & Industrial Strategy and works in cooperation with the Department for Environment, Food and Rural Affairs which oversees climate change and sustainable development. The CCC's role is to provide independent analysis and advise the Government on setting legally binding carbon budgets, monitoring the actions of the government and providing policy advice to reach the goals of the Climate Change Act. Each year, the CCC provides an assessment of the progress of the United Kingdom to the parliament. The government must respond to the reports with transparency and produce statements on the policies implemented to meet the carbon budget and emission goals of the country (Climate Change Committee, 2021[134]).

As part of the **Danish Climate Change Act**, The Danish Parliament has established two main independent councils (Danish Economic Councils, 2021[135]):

- **The Environmental Economic Council**, which is part of the Danish Economic Councils, was established by law in 2007. Its main goal is to provide analysis and advice to policymakers on the transition to a low-carbon economy by 2050, in addition to other environmental issues.
- **The Danish Council on Climate Change (*Klimarådet*)**, composed of experts to advise the government on the most cost-effective solutions to lower emissions, was strengthened and expanded with the Climate Change Act. It provides annual recommendations to the Ministry of Climate, Energy and Utilities with the aim of reaching the long-term national climate targets. The Council is tasked with preparing an annual climate status report, which includes a ten-year projection, assesses whether existing policy initiatives are sufficient to meet emission reduction targets, and presents a possible climate policy programme for the Danish Parliament. The government, in turn, has to produce an annual national strategy to ensure progress.

In **the Netherlands**, two independent research institutes are working with the government on climate change:

- **The Netherlands Environmental Assessment Agency** was established in 2008 and it is part of the Ministry of Infrastructure and Water Management. It advises the government on environmental policy, and amongst others releases annually the Climate and Energy Outlook, which reports the expected CO_2 emissions and the progress of the country in reducing them.
- **The National Institute for Public Health and the Environment** helps the Dutch government to coordinate the actions of different ministries and their policies relating to a sustainable, safe, and healthy environment. It is responsible for monitoring the quality of air, water and soil.

Source: (D'Arcangelo et al., 2022[11]).

Ensuring budget decisions support the green economy transition

To help ensure public finance decisions support environmental and climate policy goals, Greece is developing green budgeting tools as part of the Greece 2.0 Recovery and Resilience Plan reforms. Since 2020, Greece has been participating in the OECD Paris Collaborative on Green Budgeting, a platform to advance green budgeting practice, and is drawing on the OECD (2020[136]) Green Budgeting Framework, which applies across the budget cycle from planning to execution and oversight.

Greece's green budget is focusing on developing 'green tagging', one of the most widely used tools for green budgeting. France provides a useful example of the use of green budget tagging (Box 2.11). Green budgeting breaks down proposed expenditures by analysing their assessed impacts on environmental, climate and/or biodiversity objectives. The created database of information can help budget decisions support environmental objectives, by highlighting both spending that supports or weakens green objectives. It also serves to improve the quality of budget monitoring and enhance the transparency of spending, thus promoting accountability (OECD, 2020[137]). A challenge in implementing green tagging is to ensure that it is integrated early enough into the budget cycle and budget structure so that it can inform decisions, rather than being an additional, peripheral reporting obligation. Ongoing efforts by the Ministry of Finance, in collaboration with line ministries, to gradually implement green budgeting tools and build analytical capacities in its General Accounting Office contribute to achieving this.

Box 2.11. France, a pioneer in implementing green budget tagging

France conducted its first green tagging exercise in 2020. It established a system using positive, negative, and neutral classifications of all expenditures according to six environmental objectives. In 2022, a total of EUR 53.4 billion was tagged as having an impact on the environment from a total of EUR 586.6 billion of budget outlays and tax expenditure.

A working group of government officials was established to define the methodology, composed of officials from the Ministry of Economy and Finance (Budget Directorate, Directorate General of the Treasury, Tax Policy Directorate) and from the Sustainable Development Agency, a cross-cutting entity in charge of producing analyses and studies to support the Ministry of Ecological Transition.

The tagging tool is fully integrated into the regular budget procedure – preparation, approval and execution. A Budgetary Circular is produced every year by the Budget Directorate to define the procedures to be followed by the line ministries. The Budget Directorate is in regular contact with line ministries throughout the procedure.

The evolution of green tagging practices in France will enable the Ministry of Economy and Finance to publish a consistent time series to inform budget decisions. The procedure is evolving as France will continue to publish an annual green budget. The 2022 edition incorporates methodological clarifications and a green performance section.

Supporting workers and firms in transitioning to the green economy

Preparing workers for the green economy

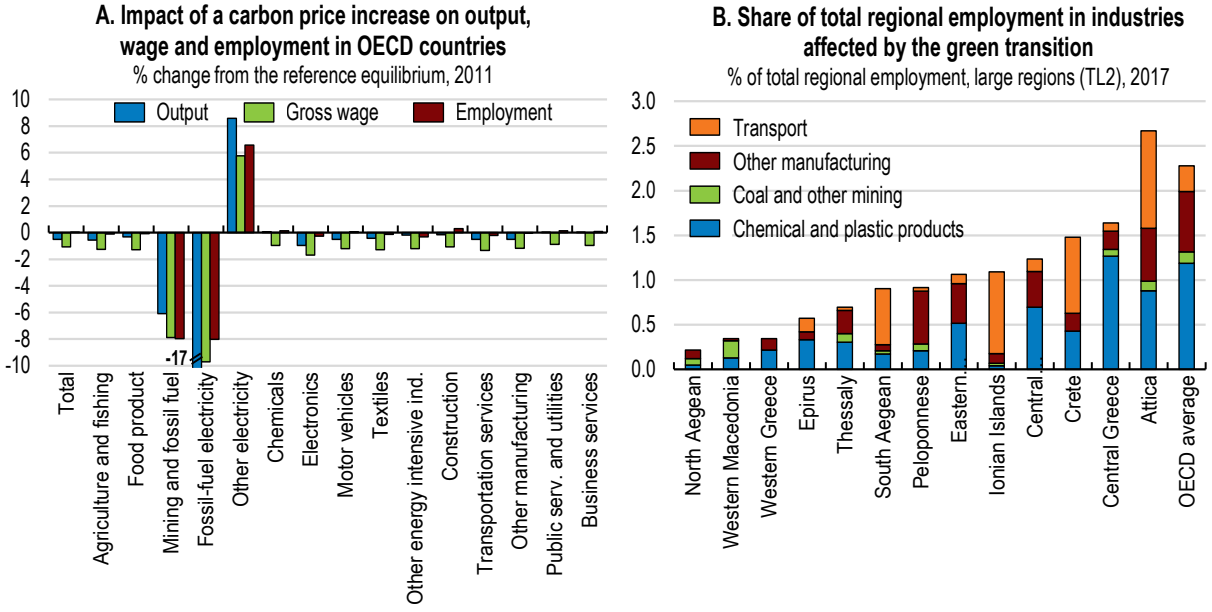
Greece's efforts to reduce greenhouse gas emissions and the likely effects of the changing climate will substantially alter firms' skill needs, implying that many employees will change jobs and professions. Carbon pricing mechanisms and government plans to replace fossil fuels with renewable energy sources, including ending lignite-fuelled electricity generation by 2028 (Government of Greece, 2021[138]), imply that many jobs in emission-intensive activities will disappear. Some sectors that are particularly affected, such

as in lignite mining and the linked value chain, are regionally concentrated in Western Macedonia and Peloponnese (see Box 2.12 for an overview and a comparison to similar challenges in Germany). In these regions, they are the dominant economic activity and employ around 11 000 workers, the skills of many of whom are not easily transferrable to other sectors. However, many affected jobs in energy-intensive industries, such as basic metals, plastics, non-metallic minerals, electrical equipment and motor vehicles (Figure 2.29) (OECD, 2017[139]; Dussaux, 2020[140]), are spread across Greece. In addition, important employing sectors less directly linked to energy will be affected. Hotter summers and reduced air travel may see tourism employment decline and shift to colder seasons and other non-traditional geographical regions, while the shift to zero-emission vehicles is likely to transform and potentially end the work of tens of thousands in the vehicle industry, such as mechanics.

The green economy transition has the potential to ultimately raise the total number of jobs, if supported by effective labour market policies. While some activities cease to be profitable, opportunities for new jobs arise. Modelling exercises and experience in other countries suggest that the total number of jobs is likely to decrease at first, as emission-intensive activities decline. These initial job losses are likely to range from insignificant to moderate, with effects depending on policy choices, industry mix and workers' skills (Chateau, Bibas and Lanzi, 2018[141]; Dechezleprêtre, Nachtigall and Stadler, 2020[142]; Dussaux, 2020[140]; Marin and Vona, 2019[143]; Metcalf and Stock, 2020[144]). In the long term, if managed successfully, the green economy transition is expected to create more jobs than it destroys (Fankhaeser, Sehlleier and Stern, 2008[145]; IEA, 2021[18]).

The green economy transition creates an opportunity for Greece to better match workers' skills with employers' needs, which can raise productivity if workers are well supported in acquiring the skills called for in the green economy. While some skills required in green jobs are transferable from brown jobs (ILO (International Labour Organisation), 2011[146]), the transition will increase the demand for some specific skills (for example, wind turbine technicians or solar consultants), generally in science, technology, engineering and maths (STEM), and for managerial skills to implement and monitor environmentally related organisational practices (Vona et al., 2018[147]; IMF, 2022[148]). Aligning training with firms' skill needs and improving access to high-quality training by implementing Greece's New Strategy for Lifelong Skilling would help workers in affected industries. Greece's large number of self-employed or workers in very small enterprises are likely to benefit from targeted support. In addition, employment subsidies to encourage hiring long-term unemployed can encourage workers to invest in skills (OECD, 2020[149]). For example, measures included in Greece's Recovery and Resilience plan, such as a EUR 50 million Green Jobs Initiative, subsidise the hiring of up to 10 000 unemployed, focusing on women, older workers and long-term unemployed (Government of Greece, 2021[138]). The scale of this programme is modest, and its success will require avoiding the administrative complexities that have limited employers' use of existing employment subsidy programmes. For example, it could provide priority groups of jobseekers with vouchers that reimburse employers some of their employment costs (OECD, 2020[149]).

Figure 2.29. Greece's green economy transition is likely to affect workers across many sectors



Note: Panel A: Estimated impacts on the total of OECD economies if a uniform tax of USD 50/tCO2 is implemented in all countries in the world, excluding emissions from land use, land-use change and forestry. The global nature of the tax in this scenario addresses potential issues of carbon leakage and other trade / reallocation effects stemming from the interactions across OECD and non-OECD countries. The outputs of the policy simulation are compared to the reference equilibrium (reference year of 2011) in which the carbon tax is not included. Panel B: The employment deviation represents the percentage difference between 2017 (base data) and 2040 under assumptions of SDS (Sustainable Development Scenario) of the IEA, as computed by the OECD ENV-Linkages model.
Source: (Chateau, Bibas and Lanzi, 2018[141]); and OECD (2021[150]).

StatLink https://stat.link/9h65of

Box 2.12. Phasing out the lignite industry in Western Macedonia, and a related case study from Germany

Phasing out the lignite industry in Western Macedonia

Located in North-Western Greece, Western Macedonia's economy is dominated by lignite mining, lignite-fired power plants and district heating systems. With Greece's electricity network long dominated by lignite thanks to the abundant domestic deposits, providing cheap and reliable energy, the region has been hosting 80% of the national industry for around 70 years (Ziouzios et al., 2021[151]; WWF Greece, 2016[152]). Around 190 000 people reside in the centres of the lignite industry – with 24-30% of the districts' population employed in the related mining or energy industries (Greek Ministry of Labour, 2020[153]).

Phasing out lignite is expected to lead to a large decline in regional GDP, a loss of 21 000 direct and indirect jobs (as more than 25% of all local jobs are directly or indirectly linked to the lignite industry) and a loss of EUR 9 billion in income between 2018-2028 (Ziouzios et al., 2021[151]; Alves Dias et al., 2018[154]).

Western Macedonia suffers from long-standing challenges. It is among the poorest regions in Greece, with GDP and disposable income about 30% lower than Attica; it suffers from chronically high unemployment (at 25-30% throughout the last decade, of which a large share is youth unemployment),

consistently higher than the national average; and the workforce has received less formal education, ageing faster than elsewhere in Greece (Greek Ministry of Labour, 2020[153]; TRACER, 2019[154]).

To help address these challenges, Western Macedonia is one of several regions targeted by the Just Transition Development Plan (JTDP), which tailors support and restructuring measures depending on local conditions, existing industries and infrastructure and upskilling potential. The country-wide plan includes twelve major investments totaling EUR 3 billion involving private, public and PPP financing, and is supported by an EU-wide facility. These investments support shifting toward natural gas and renewable energy production, establishing a pharmaceutical industry and facilitating a wine tourism ecosystem. In parallel, the plan introduces fifteen incentives to attract new production units, maintain existing businesses and support individuals throughout the transition (Greek Ministry of Labour, 2020[153]). A detailed Master Plan provides for five development pillars for Western Macedonia (SDAM - Greek Government Committee, 2020[155]): 1) Clean energy development; 2) Boosting manufacturing industry activities and trade; 3) Intelligent agricultural production; 4) Sustainable tourism; and 5) Combining education with research innovation and technology. The government expects the Master Plan to create 6000 new jobs in the region by 2028 that will absorb many of the workers laid off from the lignite sectors. Simultaneously, the plan is intended to encourage high-skilled workers to come to the region to work in emerging industries, and to diversify economic activities.

Phasing out the lignite industry in Germany

Coal-fired power generation is a major source of greenhouse gas emissions in Germany, and provides 18% of its energy supply mix (IEA, 2020[156]). In July 2020, the parliament passed legislation to end coal-fired power generation by 2038, potentially bringing the date forward to 2035. The major effect of exiting coal on the German economy will be in several relatively poor regions where larger shares of the population work in lignite (coal) mining, such as Lausitz and Rhineland.

The government is accompanying emission reductions with support for regions and workers. The federal government has pledged EUR 40 billion (1.2% of 2019 GDP) in support to affected coal mining regions up until 2038, focusing on infrastructure, innovation and job markets, and financial support of up to EUR 5 billion (0.1% of 2019 GDP) for early retirement (amounting to about EUR 580 000 per affected employee) (Commission on Growth, Structural Change and Employment, 2019[157]). To power plant owners, the government will pay EUR 4.35 billion (0.1% of 2019 GDP) to address potential future costs from legal remedies. This contrasts with the 'polluter pays' principle and increases the fiscal cost of reducing emissions. As exiting coal generation will raise electricity prices, to limit the loss in real incomes of lower income households the government is reducing renewables-generated electricity prices (Bach et al., 2020[158]).

Sources: Western Macedonia (The World Bank, 2020[159]; Hellenic Republic, 2019[160]; Ziouzios et al., 2021[151]; Karasmanaki et al., 2020[161]; SDAM - Greek Government Committee, 2020[155]); Germany (OECD, 2020[162]).

Helping firms seize the opportunities of the green economy

The green transition entails many firms changing what and how they produce. These shifts can allow firms to develop new markets and to expand, attracting workers from the sectors that will shrink with the shift to net-zero emission technologies. For example, firms specialising in upgrading energy efficiency through renovating buildings are likely to create new job opportunities (OECD, 2017[139]). These shifts are also likely to support sectors that are less developed in Greece than in other European countries, such as those associated with the circular economy (e.g., waste recycling, repair and reuse, and rental and leasing; discussed in Chapter 1) (OECD, 2020[8]). The small size of many of Greece's firms makes these shifts more challenging, given smaller firms generally lack the resources to develop new business processes and products. The government is dedicating some of the regional support for the green transition (discussed previously in Box 2.12) to the development of green economy SMEs. The 2021 Development

Law, which provides a legal framework for investment in such enterprises, may prove effective if they do emerge and grow (Government of Greece, 2019[163]). Further tools to support firms of various sizes are discussed in Box 2.13.

Box 2.13. Policy tools to support firms through the green transition

- **Supporting innovation** by firms to adopt low-carbon technologies, through public support for private R&D and technology investments (via grants, tax credits or prizes for innovations), public procurement (OECD, 2020[164]; OECD, 2011[165]) and accelerated depreciation rates. This may benefit from coupling with **supporting financing** through preferential loans, risk-sharing schemes, or increased climate-related disclosure obligations for firms and investment projects (OECD, 2020[164]).
- **Temporarily reducing business taxes** can support firms facing higher costs from rising emissions charges, as the reduced business taxes would free some cash flow, while the emission charge encourages measures to reduce emissions (Vona, 2021[121]; Klenert and Mattauch, 2019[166]). However, targeting the support may be challenging.
- **Abatement subsidies**: payments for reducing emissions below a pre-defined baseline, hence giving firms the flexibility to decide on how to reduce emissions. These subsidies face less opposition given they do not increase firms' costs, but they weigh on the public budget and may be difficult to phase out without sunset clauses announced up front. In addition, abatement subsidies by nature favour historical polluters while penalising firms that were already limiting emissions (D'Arcangelo et al., 2022[11]).
- **Exemptions, grandfathering and rebates**: reducing the potential negative effects of a mitigation policy by offsetting them with financial aid or excluding certain firms. This practice has sizable drawbacks as it may undermine the goal of emission reduction and create distortions that benefit incumbents to the detriment of innovative new firms (Tompson, 2009[167]; D'Arcangelo et al., 2022[11]).

Mobilising more private finance for the green economy transition

The substantial investment needs of the green economy transition, in combination with strained public finances, will require a boost to private financing for green projects. The Key Policy Insights chapter discusses how to mobilise private investments. In addition, green bonds can raise funds specifically for green projects by signaling higher expected profitability during the green economy transition and so redirecting funds from high-emission projects (OECD, 2021[27]). Greece's plans to issue its first green bonds in the second quarter of 2023 are an important step to develop this market.

The information gap between bond issuers and investors is a key obstacle for the growth of green bonds (Sartzetakis, 2019[168]). Measures included in the New Climate Law to provide information about their environmental impact and plans to reduce emissions for larger facilities and businesses, for example companies listed on the stock exchange or retailers employing more than 500 people, are welcome. However, penalties in case businesses fail to provide this information are small and capped at 0.1 to 0.5% of annual earnings. Stronger penalties would better encourage disclosing information. Aligning finance flows with the green economy transition thereby also requires funds for developing low-emission solutions for hard-to-abate activities. Devising rules for information disclosure such as that firms are not excluded based on narrow criteria such as current emission intensities would promote access to finance (Tandon, 2021[130]).

Policy recommendations for transitioning to a green economy

MAIN FINDINGS	RECOMMENDATIONS (Key Recommendations In Bold)
Policies to reach emission targets cost effectively	
Effective carbon prices differ substantially between fuels and users and are below levels expected to be necessary to reach net-zero. Higher carbon prices would disproportionately affect low-income households under current social support schemes.	**In the medium term, raise the price of emissions to at least the level of the EU Emission Trading Scheme, accompanied by temporary and targeted measures to help households adjust.**
Electricity wholesale market prices have been higher than in other European countries, while retail prices have been lower largely because of lower network costs. There is scope to improve competition in both markets. Financing and regulatory reforms are supporting the government's ambitious shift of electricity generation to renewable sources, while network and storage capacity are growing constraints.	Ensure network pricing provides sufficient financing and incentives to maintain and develop the network's capacity. Improve price comparison tools in the retail electricity market.
Reliance on road transport is high and contributes to pollution, congestion and accidents. Low spending on car purchases delays the shift to low emission vehicles. Cutting emissions from transport, to achieve Greece's 2030 target, will likely require shifting away from individual road transport. Restrictions on high-emission vehicles are weakly enforced. Taxes for vehicles are not always based on CO_2 emissions. Purchase grants and tax exemptions for low-emission vehicles have high fiscal costs and benefit higher-income households more. Tax revenues from fuel sales will decline with a higher share of low emission vehicles.	Enforce existing restrictions on high-emission cars. Set out a timeline for gradually tightening restrictions for using fossil-fuel cars in cities through congestion charges and low-emission zones. Base all vehicle taxes on CO_2 emissions. Replace purchase grants with subsidised loans to leverage more private financing and encourage the shift towards zero-emission cars. Implement distance-based road-usage charge to maintain transport tax revenues.
The railway network is under-used and underdeveloped with low perceived efficiency. Infrastructure investments prioritise road transport.	**Raise investment in public transport informed by cost-and-benefit analyses.** For railways, prioritise quality improvements of existing lines to reach EU average network usage. Use competitive tenders to allocate public service contracts to railway operators.
The government targets renovating the energy efficiency of 60 000 dwellings annually, and this pace will need to approximately double to renovate all insufficiently insulated buildings by 2050.	**Mandate a timeline of tightening minimum energy efficiency standards, to apply to all existing buildings by 2050.** Substantially upscale plans for supporting renovations with interest-subsidised loans that can be repaid via energy savings to leverage more private financing.
Adapting to a hotter and more volatile climate	
Public compensation for damages from extreme weather events imposes fiscal costs and provides little certainty. Insurance coverage is low and the sharing of risk between the public and private sectors is not transparent.	Conduct risk assessment for damages from climate change to anticipate exposure, private capacities to bear costs and to identify governmental re-insurance needs. **Formalise risk-sharing, for example by making property insurance for extreme weather events compulsory for all buildings.**
Water scarcity is projected to increase with climate change. Water could be used more efficiently. Water prices are generally too low to recover costs while social tariffs for water discourage saving.	Ensure water prices reflect water scarcity and supply costs. Replace social water tariffs with income transfers not directly linked to water consumption.
Climate change will impact public infrastructure.	Incorporate planning for the future climate into infrastructure projects, including by considering shadow carbon prices.
Implementing the policies for the green economy transition	
The transition to a green economy will require many workers, firms and regions to adapt their existing activities to new opportunities. Responsibility for implementing green economy transition policies is fragmented across many government bodies. Lack of knowledge about climate change and low levels of public trust can raise opposition to mitigation policies. Uncertainty about long-term returns during the green economy transition leads the public and private sectors to under-invest in green projects relative to carbon-intensive projects. Lack of information on how public expenditures would support green objectives can make public spending less effective in achieving the green economy transition.	**Increase access and quality of active labour market policies and training of workers across all sectors and regions affected by the green economy transition.** Consolidate responsibilities and resources for implementing policies. Improve public access to environmental data. Strengthen consultation of draft policies by setting minimum consultation periods, attract broader participation in the open government portal, and call on independent bodies to review policy programmes and have the government respond to the review. Support financing of green investments by limiting longer-term policy uncertainty and putting into place a regulatory framework for green bond-financed investments. Integrate green budgeting early into the budget cycle.

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