4

THE GREEN TRANSITION

- The effects of climate change in the EU are exacerbating regional disparities, particularly in coastal, Mediterranean, and south-eastern regions. These regions are at risk of losing over 1 % of GDP annually as a result and their ageing populations are more exposed to the harmful effects of climate change.
- The EU has reduced its total greenhouse gas (GHG) emissions by 27 % since 1990 while GDP has increased by 65 %. There is, however, significant regional variation. Capital city regions with high population density have the lowest emissions per head while regions with heavy industry have the highest. Meeting the 2030 target requires a comprehensive effort to decarbonise all sectors.
- The green energy transition offers opportunities for rural, less developed regions rich in untapped wind and solar energy potential. These regions, however, require a higher level of competitiveness and innovation as well as a skilled workforce to develop and produce the necessary clean technologies.
- The conservation status of most protected habitats and species, which are in danger of disappearing, remains unfavourable. A regional assessment of the health of forests shows that they are productive and well connected but have levels of organic carbon in their soils that are too low, and too few threatened bird species.
- Concerns persist over air, water and soil quality. Air pollution, especially in eastern Europe and urban areas, creates health inequalities. Wastewater treatment gaps exist in south and south-eastern Europe. In rural regions built-up areas per person are increasing faster than in urban ones, weakening the capacity of soil to retain water.
- Rail has the potential to outperform flights for journeys up to 500 kilometres, provided speeds reach 175 kilometres an hour. Electric vehicle recharging points doubled in the EU between 2020 and 2022, but availability is concentrated in certain regions, creating disparities.
- 6 million people work in carbon-intensive industries in the EU. Shifts to green employment favour more developed regions, so widening regional disparities.
- Extending the EU's emissions trading system to fuels for heating buildings and transport will reduce GHG emissions but create problems for low-income, rural households and micro-enterprises that spend proportionately more on fuel.

Chapter 4
The green transition

1. Introduction

Europe has experienced unprecedented droughts, floods, forest fires and heatwaves in recent years, in line with the expected increase in frequency of these extreme weather events as a consequence of climate change. Together with biodiversity loss and environmental pollution, they underscore the urgent need for sustainable practices to protect our planet's delicate ecosystems and ensure the existence of a healthy environment for future generations. The European Green Deal addresses these challenges in a co-ordinated way by providing a comprehensive framework to integrate environmental, economic and social dimensions to tackle ecological degradation and foster a sustainable and resilient EU. It serves as the guiding policy for the EU's efforts to transition to a greener and more sustainable future. Its central objective is to transform Europe into the world's first climate-neutral continent by 2050.

Cohesion Policy, which has been supporting the pursuit of environmental objectives, will continue to play a key role in implementing the Green Deal, notably by providing financial support and guiding regional development in a sustainable direction. The policy, with its long-standing focus on reducing socio-economic disparities between EU regions, is in line with the Green Deal's goals of achieving a sustainable, fair and inclusive transition. In the 2021–2027 period, over EUR 100 billion is programmed to go to supporting the green transition through projects on renewable energy infrastructure, energy-efficiency, sustainable transport, climate adaptation, and initiatives on disaster risk management, circular economy, water management, and nature conservation. Additionally, Cohesion Policy promotes research and innovation, helping regions to develop and implement green technologies and practices[1].

This chapter examines the main regional trends with respect to climate change and the environment. The focus is on assessing the extent to which the impacts of climate change, biodiversity loss and environmental pollution are unevenly distributed across the EU and therefore have the potential to widen inequalities between regions and the people living there. Moreover, this chapter examines the regional contribution to achieving climate targets and describes the challenges and opportunities of the green transition.

2. The climate and energy transition

In 2015, countries agreed in Paris on a global framework to limit global warming to below 2°C and to continue efforts to limit it to 1.5°C above pre-industrial levels. Parties also agreed to increase the ability to adapt to the impacts of climate change and increase climate resilience. The European Climate Law establishes the legal framework for achieving these goals, of the EU becoming climate-neutral by 2050, with an interim target of reducing net greenhouse gas (GHG) emissions by at least 55 % from 1990 levels by 2030.

The 'Fit for 55' package of measures is aimed at achieving this goal by revising and updating the EU's climate legislation and policies. The main elements are a revised emissions trading system (ETS), including fuel use in buildings and road transport, a social climate fund, binding emission reductions for each Member State, new emission rules for cars and vans, a new carbon border adjustment mechanism, and a target for carbon storage in natural ecosystems and agricultural soils. In addition, in response to the global geopolitical situation, the EU has decided to reduce its dependence on Russian fossil fuels, save energy, and accelerate the use of renewable energy while also

1 At least 30 % of the European Regional Development Fund (ERDF), 37 % of the Cohesion Fund (CF), and 35 % of 'horizon Europe' needs to go to support climate action (mitigation and adaptation). The 2021–2027 inter-institutional agreement sets the goal of allocating at least 7.5 % of annual spending to biodiversity objectives in 2024 and 2025 and 10 % in both 2026 and 2027.

scaling up the production of clean technologies, such as batteries, wind turbines, heat pumps, photovoltaics, electrolysers, and carbon capture and storage.

This section assesses current and future territorial climate effects and estimates the costs of inaction to regions. It examines the current emissions pathways by sector and region and identifies challenges to achieving the 2030 emissions reduction target. It also sets out trends in energy-efficiency and highlights the potential for regions to contribute to the transition from fossil fuels to renewable energy generation. It addresses, in addition, the issues of sustainable mobility and a fair transition from the perspective of employment in carbon-intensive sectors and household energy costs.

2.1 Regions in the frontline of climate change

The 2021 floods in the regions along the Belgian-German border caused direct damage of EUR 34.5 billion, while the costs resulting from the 2023 floods in Emilia-Romagna (Italy) amounted to EUR 8.5 billion. These costs show the vulnerability of both national and regional economies to extreme weather events[2]. 2022 was the second-worst year in the EU as regards area burned by wildfires[3]. Nearly 900 000 hectares of natural land were affected by the fires. About 43 % of the total burnt area burned within 'Natura 2000' sites. The frequency of these events is expected to increase with climate change. These examples underscore the importance of preparing regions against the impacts of climate change.

This section reports the effects of climate change on people, ecosystems and economies at NUTS 3 level using a data-driven framework[4]. Historical climate data, socio-economic factors, and reported effects were combined to establish impact relationships. High-resolution climate projections were used to estimate climate hazards in the EU for various global warming scenarios. The corresponding effects were determined at the regional level in 2050. These were calculated under three different scenarios for global warming levels by 2050 (of 1.5, 2 and 3°C), assuming no climate adaptation. The present-day baseline represents the average global climate observed between 1991 and 2020, which was already 0.9°C warmer than the pre-industrial temperature. The economic costs of climate change are based on the estimated damage from river and coastal flooding, droughts and storms to buildings, infrastructure, agriculture, and water and energy supply. Costs resulting from energy demand for climate regulation of buildings, losses in labour productivity because of high summer temperatures and heatwaves, and increased maintenance of roads and railways are also included. Human exposure to climate extremes is quantified as the number or proportion of people exposed to river or coastal flooding, storms, water stress and wildfires. Finally, human mortality is calculated as the number of excess deaths caused by less-than-optimal temperatures, both low and high. Not all possible impacts are included, so the total damage is therefore probably underestimated. Table 4.1 describes the climate effects of the different impact categories used in the regional assessment.

The various effects of climate change impose additional costs on the EU economy. Global warming of 2°C by 2050 – the most plausible scenario given current global commitments to reduce GHG emissions[5] – would imply an estimated additional cost of EUR 203 billion by 2050 (0.44 % of total GDP) compared with the present-day baseline. The largest economic effect comes from the energy required for air conditioning in buildings and the losses in labour productivity from excessively high temperatures (Figure 4.1). These additional costs are on top of the already large effects of climate extremes on the economy at present. For instance, under the baseline scenario, the costs of damage from storms, coastal and inland flooding,

2 Source: DG REGIO, data from the EU Solidarity Fund, which supports Member States with post-disaster relief – https://cohesiondata.ec.europa.eu/stories/s/An-overview-of-the-EU-Solidarity-Fund-2002-2020/qpif-qzyn/.

3 San-Miguel-Ayanz et al. (2023).

4 Based on preliminary results of an ongoing study by the Joint Research Centre (JRC), building on the 'PESETA IV' project: https://joint-research-centre.ec.europa.eu/peseta-projects/jrc-peseta-iv_en.

5 Intergovernmental Panel of Climate Change (2021).

Table 4.1 Socio-economic characteristics of development-trapped regions and other regions

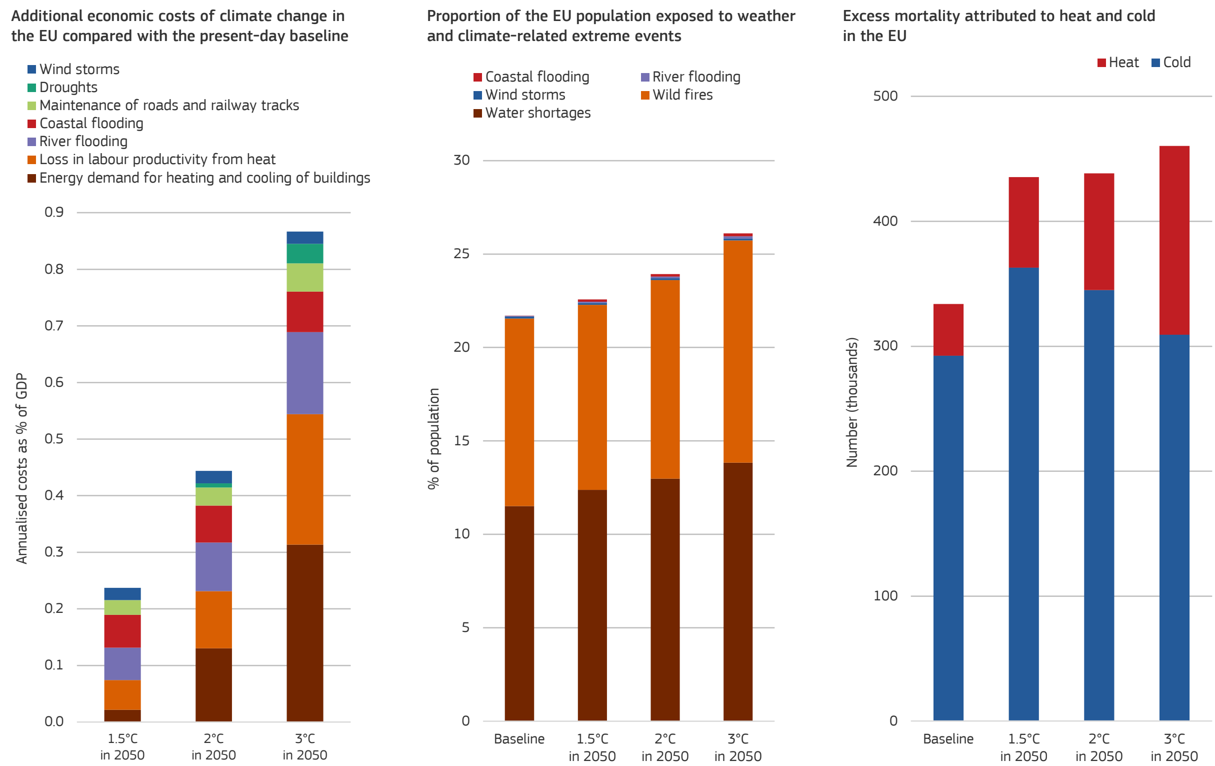
Sector	Description of the climate effects
Coastal flooding	Coastal Europe faces rising sea levels and more intense storms, increasing economic losses and population exposure. Inadequate flood protection may amplify the damage, varying with coastal features and wealth distribution. Urbanisation exacerbates these threats.
River flooding	In most river basins, floods become more frequent and intense as global warming continues, leading to increased economic losses and population exposure. Urbanisation of river floodplains exacerbates these effects.
Droughts	The effects of drought increase most in southern and western parts of the EU, while in central and eastern European regions they remain relatively unchanged with 2°C warming. The effects in most northern and north-eastern regions will decline because of northern Europe generally becoming wetter with climate change.
Fires	Regions in the southern EU already face a high risk of fire for prolonged periods. 2°C global warming increases and lengthens fire risk in most regions, with the most significant expansion of the population exposed to the risk of wildfires being in western and south-eastern parts of the EU where scrubland and woods are close to urban areas.
Wind and storms	Projections for storms associated with global warming are highly uncertain, with the effects tending to be limited and variable in different regions of the EU. Damage from storms increases as the density of infrastructure and asset values increase.
Water availability	Global warming leads to northern Europe becoming wetter and the south drier, causing the availability of water to increase in the former and diminish in the latter. The duration and intensity of water scarcity increases in existing water-scarce areas in southern Europe, along with the number of people exposed.
Labour productivity	Labour productivity declines everywhere in Europe with global warming, but the effect is greater in southern regions, which are already more exposed to heat stress.
Transport	In all regions of the EU, higher temperatures increase the risk of roads rutting and rails buckling, raising operating and maintenance costs. The largest effects are projected for eastern regions, where routine maintenance is less frequent, and replacement costs higher than in other parts.
Energy	Warmer climates reduce the need for heating per unit of floor area but this is countered by increasing house sizes with higher income levels, while the need for cooling increases. This results in higher energy costs across most of the EU, most notably in the south and east.
Temperature-related mortality	Global warming reduces cold-related deaths because of milder temperatures. However, this is offset by the increased mortality with an ageing population. Heat-related deaths rise in all regions, amplified by population ageing. This leads to higher overall mortality from non-optimal temperatures, with the largest increases in the eastern and southern EU.

and droughts amount to EUR 28 billion a year. This is projected to rise to EUR 73 billion with a rise of 2°C by 2050, a figure well above the estimated costs of such damage in 2021 and 2022 (EUR 50– 60 billion)[6].

Crucially, the effect is very different across regions (Map 4.1). In the vast majority of NUTS 3 regions (76 %), the additional economic costs in 2050 are estimated to remain below 1 % of regional GDP. In regions of north-eastern Germany, Lithuania and Finland, costs would be slightly lower than today, mainly because of less risk from drought and lower energy demand for buildings. By contrast, 42 of the 1 152 regions are estimated to face additional costs of over 2 % of regional GDP, 28 regions costs of over 3 %, 17 regions costs of over 4 %, 11 regions costs of over 5 %, and six regions costs of over 6 %. In several of these regions, the high costs mainly come from a large increase in coastal damage.

6 European Environment Agency – EEA.

Figure 4.1 Overall estimated effects of climate change in the EU in 2050 under the present-day baseline and different global warming scenarios



Source: JRC.

In addition to economic effects, climate change will increase people's exposure to coastal and inland flooding, storms, water shortages and wildfires. Already, 97 million people, 21 % of the EU population, are exposed to these hazards. This number is estimated to increase to 24 % by 2050 under a 2°C global warming scenario and to over 25 % if global warming reaches 3°C. Water scarcity and wildfires have the potential to expose people to risks over a wider geographical area, while coastal and inland flooding and storms have much more localised effects and so result in less exposure. Exposure also varies markedly between the north and south (Map 4.1), with southern regions and the people living there most exposed, especially to forest fires and water shortages.

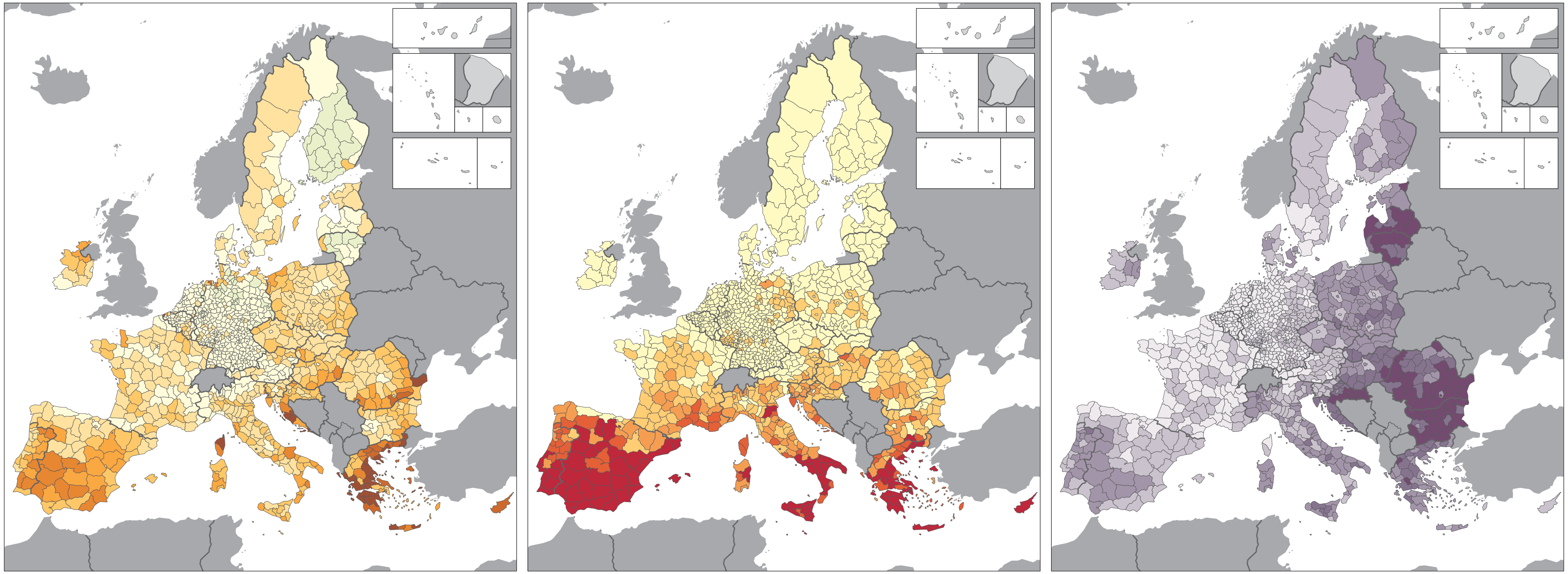
Heat and cold are recognised environmental risk factors for human health. The current excess mortality from cold and heat in the EU amounts to 334 000 people, with the majority dying from the cold. Overall mortality is projected to increase to 438 000, with a larger proportion dying from heat than at present. Mortality is higher in eastern Europe than elsewhere, mainly because of population ageing more than in the rest of the EU (Map 4.1). (Perhaps unexpectedly, excess mortality from the cold is higher than from the heat, even under global warming scenarios.)

The impact of climate change on tourism, which is responsible for 5 % of total GDP, is also likely to be significant. Global warming will lead to a redirection of tourism. According to forecasts, a temperature increase of 3°C will reduce the number of summer tourists in southern coastal regions by almost 10 % and increase those in northern coastal regions by 5 %[7].

In summary, the regions that will be most affected by climate change are mainly in the Mediterranean region and in the eastern EU, especially in Bulgaria

7 Matei et al. (2023).

Map 4.1 The impact of climate change under a 2°C global warming scenario in NUTS 3 regions, 2050



Additional economic costs

Human exposure to harmful climate impacts

Mortality from less-than-optimal temperatures

% of GDP
- <= 0.0
- 0.0 – 0.5
- 0.5 – 1.0
- 1.0 – 1.5
- 1.5 – 2.0
- 2.0 – 2.5
- 2.5 – 3.0
- > 3.0
- no data

Additional economic costs of a 2°C global warming scenario by 2050 compared with the present-day baseline.
Source: JRC.

% of population
- <= 10
- 10 – 25
- 25 – 50
- 50 – 75
- > 75
- no data

Share of the population exposed to wind storms, coastal flooding, river flooding, water shortage and wildfire danger.
Source: JRC.

0 1 000 km

Deaths per million inhabitants
- <= 1 000
- 1 000 – 1 500
- 1 500 – 2 000
- 2 000 – 2 500
- > 2 500
- no data

Mortality from heat and cold under a 2°C global warming scenario by 2050.
Source: JRC.

and Romania. Many of these regions are already poorer than the EU average. Their economies are expected to be disproportionately affected, their populations to be much more exposed to climate risks and, in the case of eastern Europe, their ageing populations to experience higher mortality.

Climate risk management and adaptation are crucial in the EU to prepare for the climate impacts and to mitigate the escalating costs of the effects of extreme weather events, floods, forest fires and water scarcity. By pro-actively preparing for these challenges, EU regions can reduce the impacts on human life as well as the economic costs associated with disaster response, infrastructure repair, and healthcare needs, so safeguarding their financial stability. In addition, effective adaptation strategies enhance resilience, ensuring the well-being of both ecosystems and communities in the face of climate change. For every euro invested in risk prevention, the return on investment in terms of lives saved and damage avoided can range from EUR 2 to EUR 10, and sometimes even more[8]. Importantly, these investments can also yield additional economic and social benefits. For example, nature-based solutions help reduce climate-related disaster risks such as floods or wildfires, but they also attract tourism, increase property values, and improve air quality and public health conditions.

2.2 Reducing GHG emissions must be accelerated to meet the 2030 target

In 1990, total GHG emissions in the EU were 4.9 gigatonnes of CO_2 equivalent ($GtCO_2eq$)[9]. This had fallen to 3.6 $GtCO_2eq$ by 2022, a reduction of 27 %. The total amount of GHG emissions corresponds to 11.7 tCO_2eq per person in 1990 and 8.0 tCO_2eq per person in 2022[10]. This is unevenly distributed across regions (Map 4.2). Capital city regions have the lowest emissions per person, often less than 5 tCO_2eq, while regions with heavy industry or gas- and coal-fired power plants emit over 10 tCO_2eq per person. It should be noted, however, that these emissions are production-based and are calculated by dividing the GHG emissions produced in a region by its population. This means that the emissions generated by the electricity consumed by a region are accounted for in the region where it is produced rather than where the demand for it arises. Moreover, GHG emissions from imports to the EU have not been factored in.

The downward trend in GHG emissions has not prevented the EU economy from expanding by 65 % between 1990 and 2022, signifying a decoupling of growth from emissions. This is demonstrated by the carbon intensity of GDP (the tonnes of GHGs emitted to produce EUR 1 000 of GDP), which in 2022 averaged 259 kilogrammes of CO_2eq, less than half that in 1990 (600 kilogrammes of CO_2eq). In several eastern countries, many regions had both low GDP and high emissions in 1990, but have succeeded in achieving high growth while reducing emissions since then. As a result, regional disparities in carbon intensity have narrowed across the EU[11].

In the EU as a whole, GHG emissions have steadily decreased since 1990 at a rate of 0.1 tCO_2eq per person a year. There are pronounced national and regional differences in the pattern of reduction, but three main 'pathways' can be distinguished (Figure 4.2). In Belgium, Czechia, Germany, France, the Netherlands, Denmark and Sweden, average emissions peaked well before 2000 and then gradually declined. In most of the countries that joined the EU in 2004 and in subsequent years (Estonia, Latvia, Lithuania, Poland, Hungary, Slovakia, Bulgaria and Romania), average emissions declined rapidly in the early 1990s after the collapse of the Soviet Union when GDP fell markedly, but then remained broadly unchanged, though with fluctuations up and down, reflecting (in some degree) developments in GDP. In the southern Member States (Spain, Portugal, Italy, Slovenia, Greece and Malta), as well as in Ireland, Austria and Finland, emissions peaked around 2005 and then declined sharply up until 2021. All three pathways show a

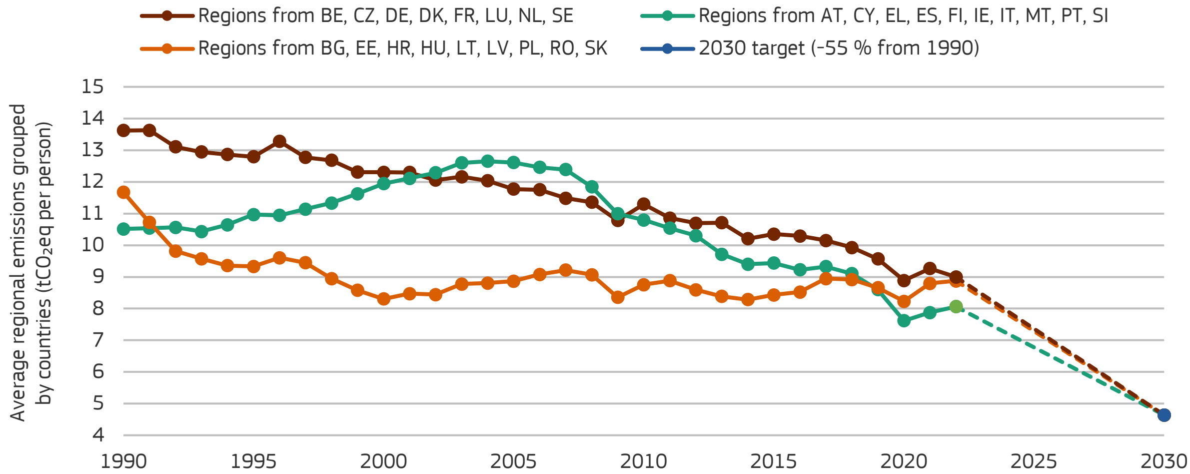
8 International Bank for Reconstruction and Development / World Bank (2021).

9 Crippa et al. (2023); GHG emissions based on the emissions database for global atmospheric research (EDGAR) excluding emissions from shipping, aviation, offshore installations and land use, land-use change, and forestry.

10 Population and GDP from the annual regional database of DG REGIO; GDP at constant prices (2015 as reference year).

11 European Commission (2023b).

Figure 4.2 Trends in regional greenhouse gas emissions, 1990–2022



Note: Countries are grouped based on their emission profiles. The 2030 target is at the EU level and represents a reduction in emissions of 55 % compared with 1990.
Source: JRC-EDGAR.

rebound of emissions in 2021 and 2022 as GDP recovered from the effects of the COVID-19-related restrictions on economic activity in 2020.

Achieving the 2030 target (a 55 % reduction in GHG emissions compared with 1990) means that the average GHG emissions in the EU in 2030 need to fall to 4.7 tCO_2eq per person[12]. To achieve this, emissions will need to fall at a faster rate between 2023 and 2030 than between 1990 and 2022. Power generation and industry together accounted for nearly half of GHG emissions in 2022. For both, emissions were reduced by 37 % over the 1990–2022 period and by 29 % over the 2005–2022 period. The two are since 2005 covered by the EU ETS, a mechanism that limits the total number of emission allowances each year. Emissions also declined from buildings (by 30 %) and agriculture (by 24 %) over the period, whereas emissions from transport increased by 20 %.

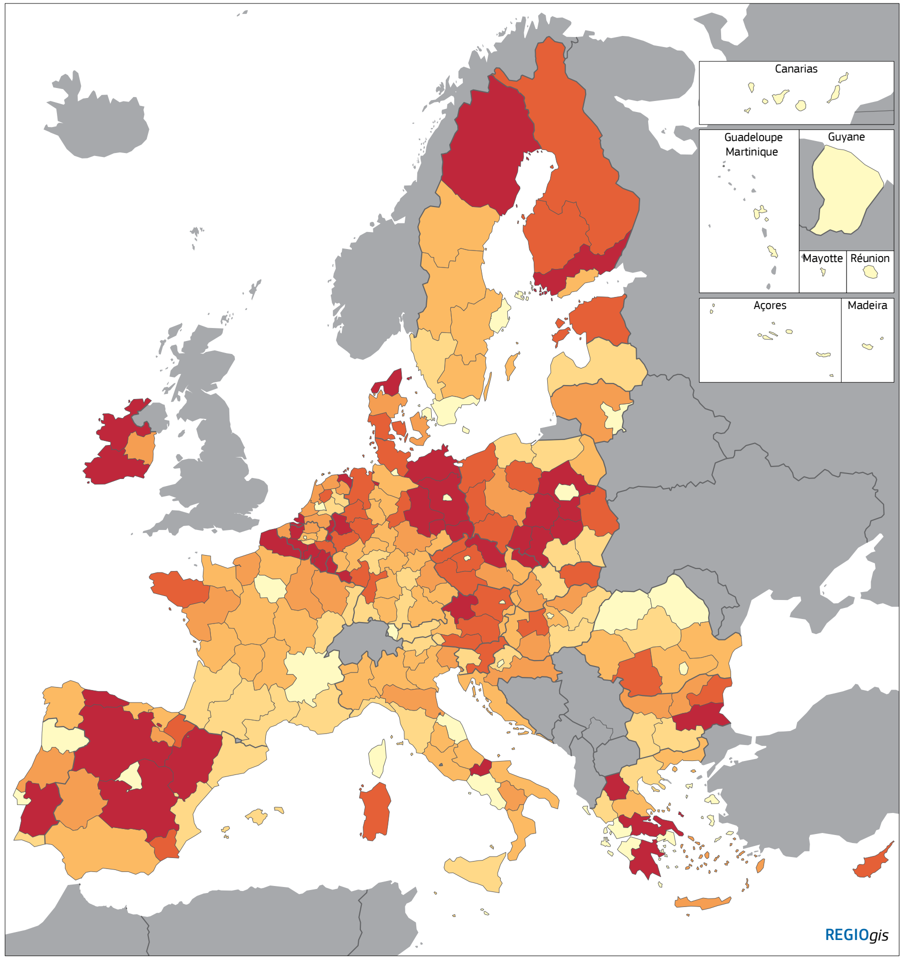
The challenges that regions face to reduce emissions differ (Map 4.3, which uses a different colour for the sector contributing most to total GHG emissions in 2022, indicates some of these). Agriculture contributed most to GHG emissions in the Irish and Danish regions. Transport was the most important source in rural regions in Spain, France, Italy, Austria and Germany (see also Box 3.5 in Chapter 3). Up to now, it has proved difficult to fully decarbonise transport, with oil and petroleum remaining the main source of power, still accounting for nearly 30 % of final energy demand in the EU. To reverse this trend, the Commission has proposed a separate emissions trading scheme for fuel combustion in buildings and for road transport, the Social Climate Fund providing financial support to vulnerable households, transport users and micro-enterprises in the transition to sustainable energy use.

2.3 Rural, less developed regions can drive the energy transition

Achieving the EU's climate and energy goals requires saving energy, increasing the share of renewable energy, using energy more efficiently, and enhancing carbon sinks. Beyond reducing GHG emissions, these measures also help lower energy bills, protect the environment, and reduce fossil fuel purchases (and hence the EU's dependence on oil and gas imports).

In 2021, the EU's primary energy consumption was 1 309 million metric tonnes of oil equivalent (Mtoe), down 12.6 % from 2005. The current 2030 target is 992.5 Mtoe. At the country level,

12 European Commission (2023a).



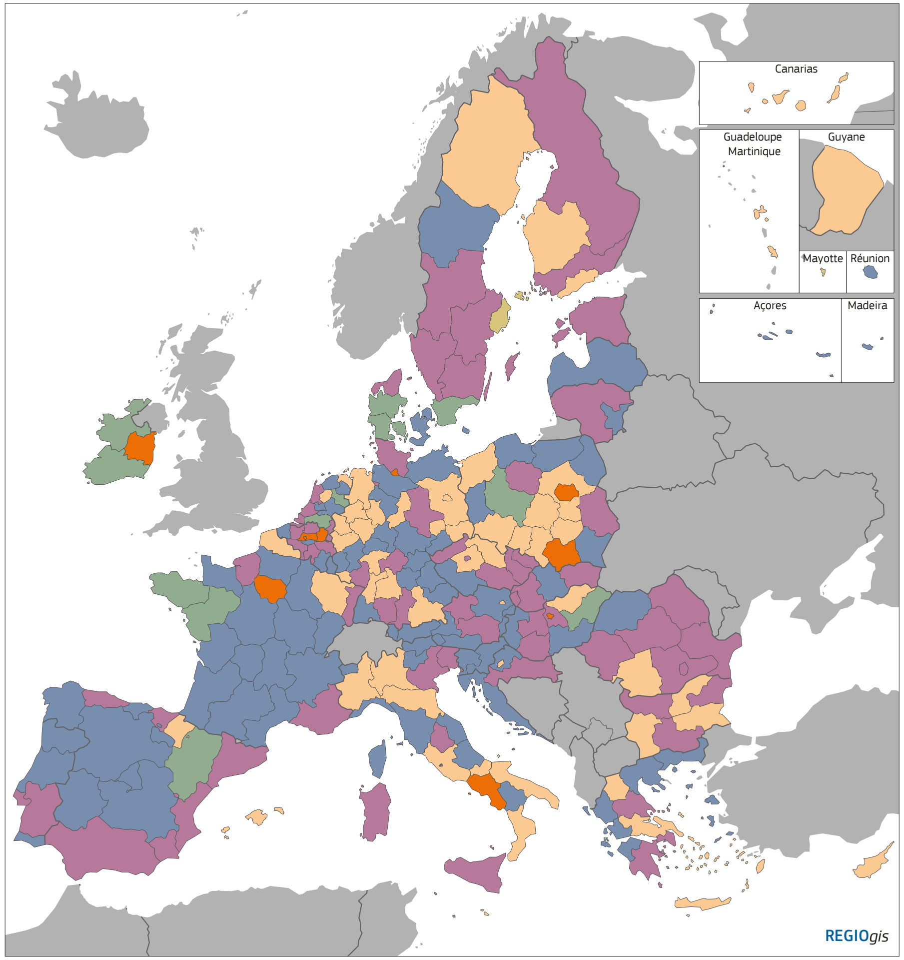
Map 4.2 Greenhouse gas emissions per person by NUTS 2 region, 2022

tCO_2 equivalent per capita

- <= 5.0
- 5.0 – 6.5
- 6.5 – 8.0
- 8.0 – 9.5
- 9.5 – 12.0
- > 12.0

EU-27 = 7.96
Source: JRC-EDGAR.

0 500 km



Map 4.3 Sector with the highest contribution to total greenhouse gas emissions, 2022

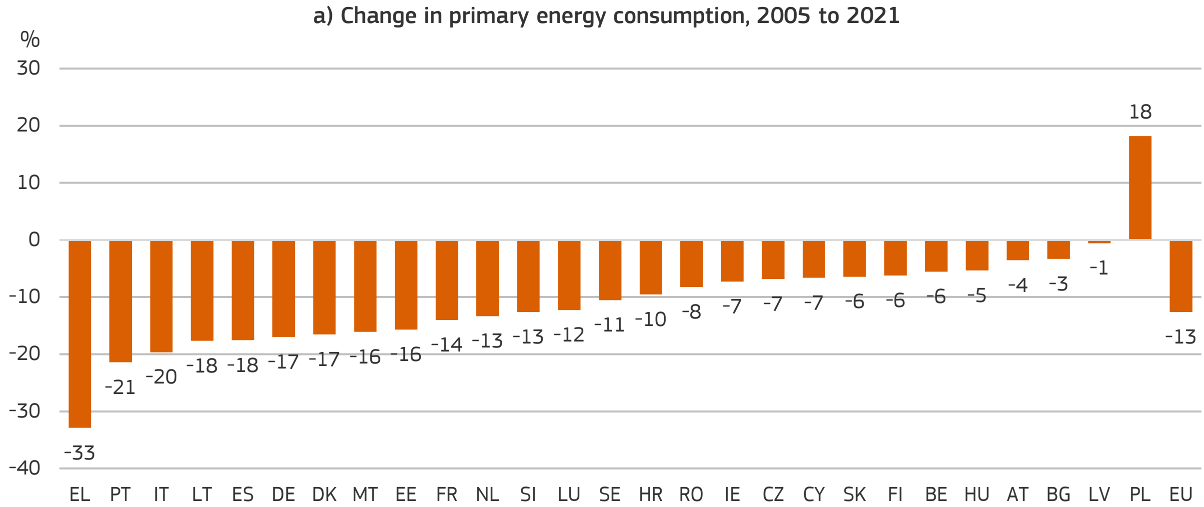
Sector

- agriculture
- buildings
- energy
- industry
- transport
- waste

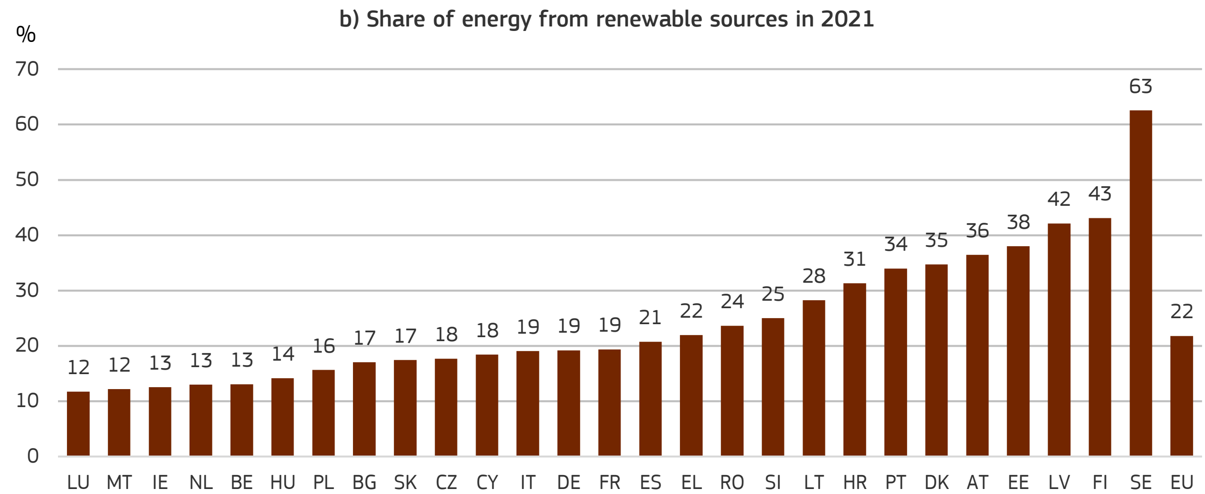
This map uses a different colour to show the sector that contributes most to greenhouse gas emissions in each region in 2022.
Source: JRC-EDGAR.

0 500 km

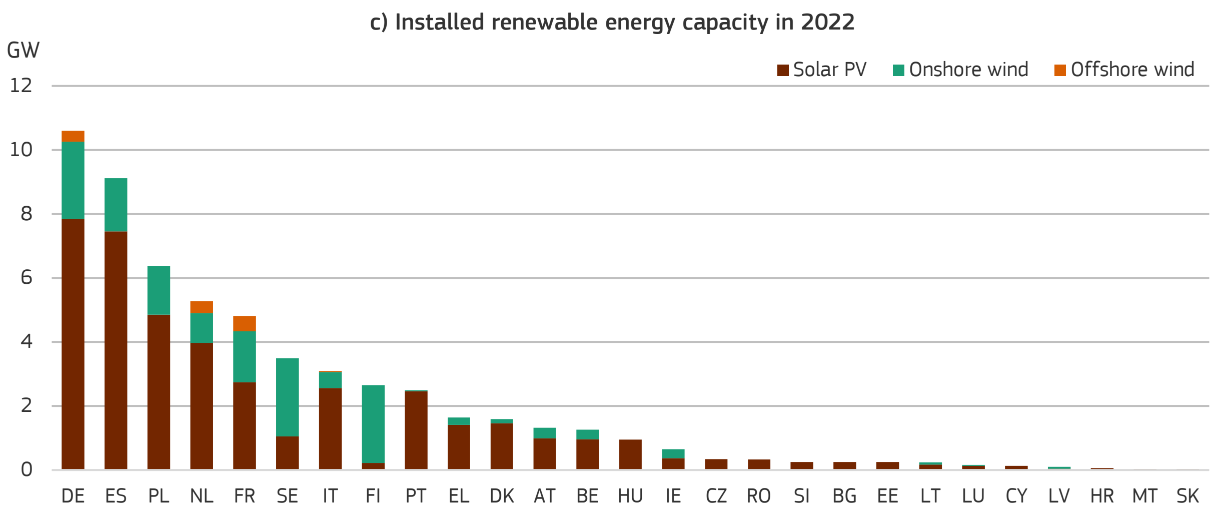
Figure 4.3 Energy statistics by country



Source: Eurostat [NRG_IND_EFF].



Source: Eurostat [NRG_IND_REN].



Source: Wind Europe and Solar Power Europe.

Box 4.1 How well prepared are regions to make the transition to a climate-neutral economy?

Highly competitive and innovative EU regions that are able to develop and produce the necessary green technologies are better equipped for the green transition of their economies. In most cases, these are the economically strongest, urbanised regions with a large share of knowledge-intensive services.

This conclusion is reached by several studies[1] that examined the risk of territorial imbalances that may result from the green transition. Map 4.4, based on results of the CINTRAN project, identifies regions that are at risk. The analysis shows that more economically diversified regions, such as Köln, have lower socio-economic risk than regions heavily dependent on fossil fuel extraction, such as Severozápad. Most of the regions with a high risk are already lagging behind the national average and need to rely on support to overcome the challenges from decarbonisation of energy. Carefully implemented territorial policies can help mitigate the adverse effects and ensure that all regions reap the benefits from the transition to climate neutrality.

1 Maucorps et al. (2022); Rodriguez-Pose and Bartalucci (2023); CINTRAN (2023); Sasse and Trutnevyte (2023).

the largest reductions in energy up to 2021 were achieved in Greece (of 33 %) – where GDP declined substantially after 2002, so depressing energy demand – Portugal (21 %) and Italy (20 %) (Figure 4.3). Poland is the only country that consumed more primary energy than in 2005 (18 % more).

In 2021, renewable energy accounted for 21.8 % of gross energy consumption in the EU, only around half the target for 2030 (42.5 %). Again, there are wide variations between countries. Sweden (62.6 %) had by far the largest share coming from renewables in the EU, ahead of Finland (43.1 %) and Latvia (42.1 %). At the other end of the scale, Luxembourg (11.7 %) had the smallest share. Forest biomass is an important source of renewable energy, especially in northern Europe. It should be emphasised that biomass can only contribute effectively to reducing GHG emissions if it is produced in a sustainable way.

Following Russia's war of aggression against Ukraine and the subsequent rise in energy prices, demand for natural gas in the EU fell by 13 % in 2022, the sharpest decline in history[13]. While milder winter temperatures played a role, policy was also important, particularly record increases in solar and wind capacity. Two industry organisations, SolarPower Europe[14] and WindEurope[15], have estimated that 41 GW of new solar photovoltaic (PV) capacity and 16 GW of additional wind capacity, mostly onshore, were installed in the EU in 2022, signifying an increase of 47 % relative to 2021 for solar and 40 % for wind power. Germany and Spain accounted for nearly 35 % of the overall increase in renewable capacity.

These numbers suggest that EU policies to reduce reliance on Russian fossil fuels and to accelerate the green energy transition are succeeding. However, achieving a carbon-neutral energy sector requires further upscaling of renewables and there is substantial untapped potential in this regard[16].

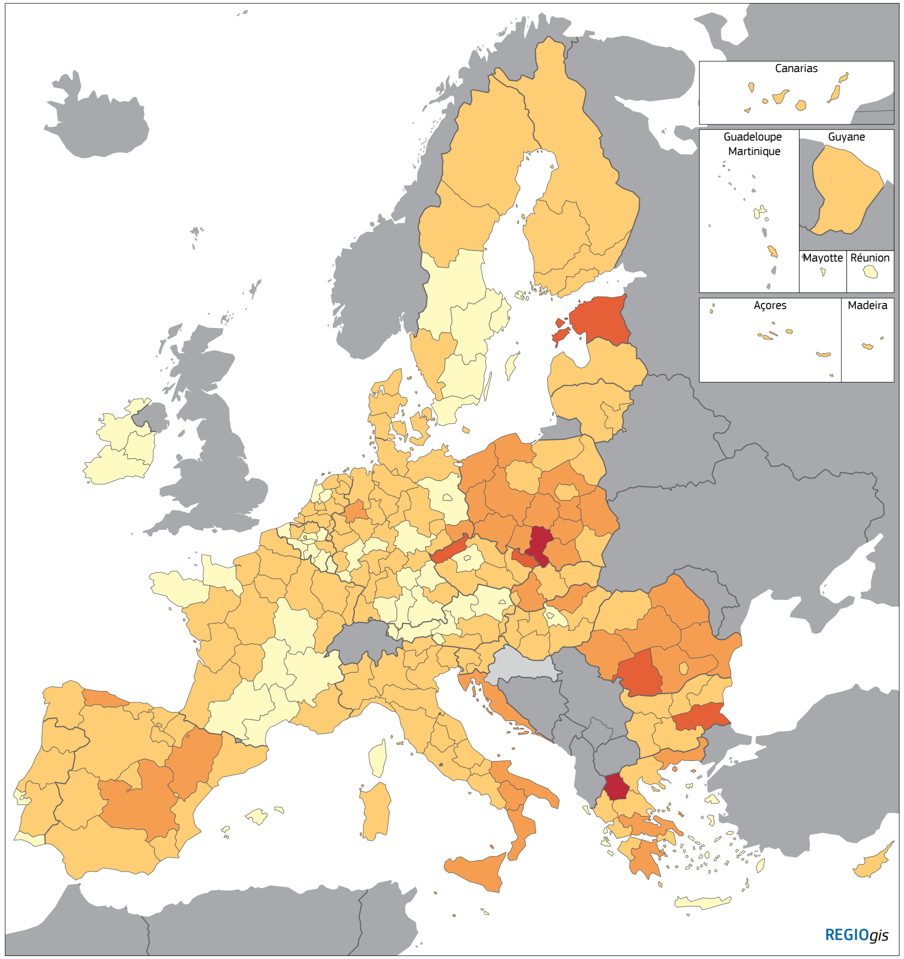
In 2023, solar, wind and hydro power installed in the EU together produced 972 terawatt hours (TWh) of electricity. But this represents only a fraction of the technically available potential, estimated at 12 485 TWh a year, divided between solar PV (88 %), onshore wind (11 %) and hydro power (1 %). The potential amounts to over 5 times the electricity consumed in 2021 and is mainly concentrated in the EU's rural areas (9 784 TWh). It would come predominantly from potential

13 IAE (2023).

14 SolarPower Europe (2022).

15 WindEurope (2022).

16 Perpiña Castillo et al. (2024).

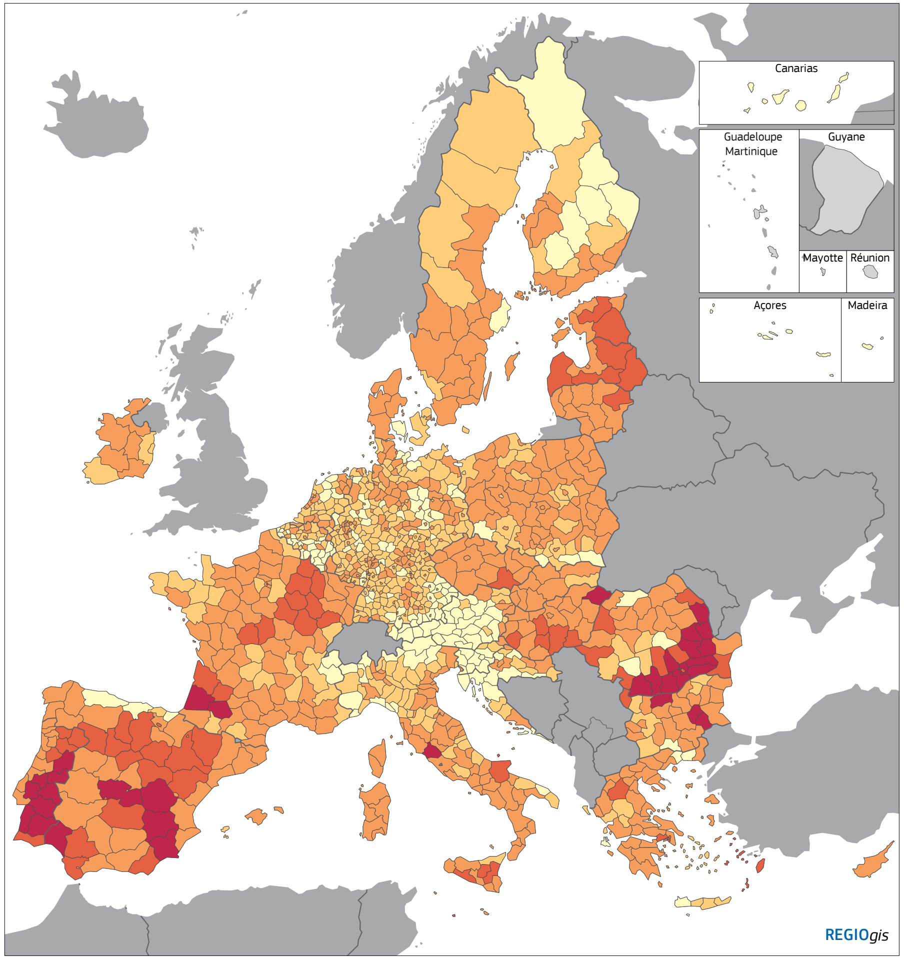


Map 4.4 Socio-economic risks associated with the green transition by NUTS 2 region

Index (0 – 100)
- <= 20
- 20 – 40
- 40 – 60
- 60 – 80
- > 80
- no data

Source: CINTRAN project (carbon-intensive regions in transition).

0 500 km



Map 4.5 Untapped potential from solar, wind and hydro power by NUTS 3 region

MWh/km²/year
- <= 500
- 500 – 1000
- 1000 – 5000
- 5000 – 10000
- > 10000
- no data

Potential annual production per unit area.
Source: JRC.

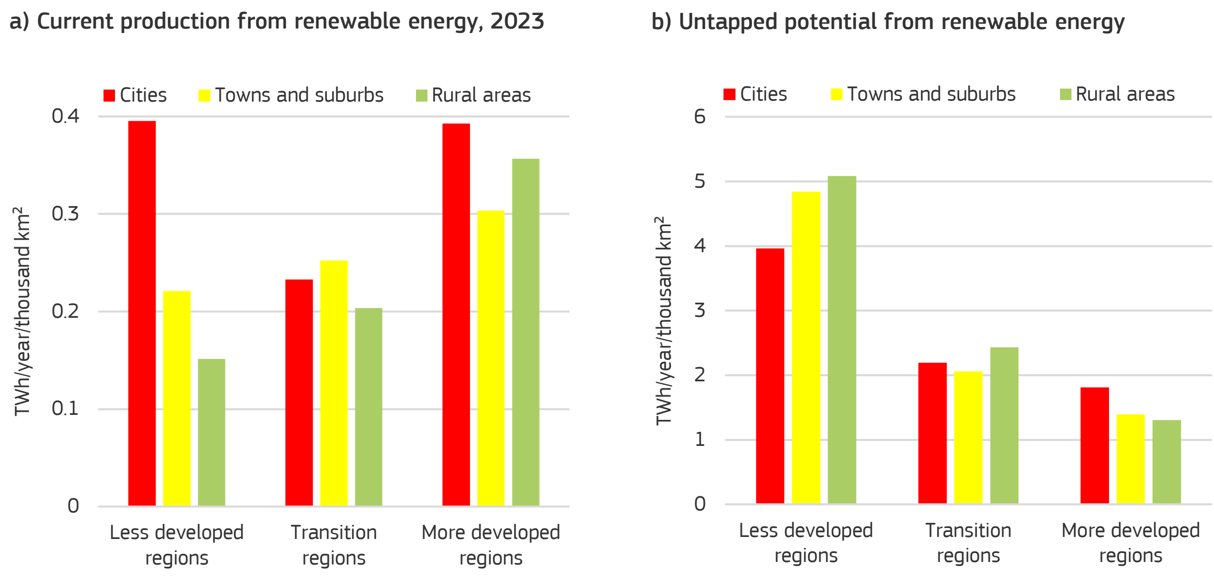
0 500 km

ground-mounted PV systems in Spain, Romania, France, Portugal and Italy (Map 4.5)[17].

The green energy transition and the associated strengthening of the role of renewables offer unique opportunities for rural, less developed regions, as they can benefit from their natural resources and geographic position. Whereas most of the current energy production from renewables is in the more developed regions, especially in their rural areas, most of the potential production is in the rural areas of less developed regions (Figure 4.4). Exploiting this potential could benefit economic cohesion in the EU. A recent study[18] used the data on untapped potential to simulate the impact of exploiting this on job creation and economic growth. Phasing out fossil fuels for energy generation while phasing in wind and solar energy is projected to deliver more value-added (up to EUR 1 570 per head more) and more employment (up to 4.9 % more) in lagging, rural regions. Realising this potential, however, necessitates facilitating knowledge exchange, technical support, and investment in renewable energy generation but also in distribution infrastructure, digitalisation and connectivity potential. It also requires factoring in the impacts on landscapes or biodiversity but also on rural communities. A number of EU-level initiatives were taken to provide needed support and technical assistance to rural areas willing to create, among others things, rural energy communities, so that they also benefit from the green transition[19].

Green hydrogen is produced when renewable energy is used to produce hydrogen gas through electrolysis. In 2022, there were 143 renewable hydrogen projects in Europe, of which 97 in operation and 46 under construction. The projects currently under construction are projected to significantly outperform existing operational plants, with an anticipated average capacity of 26 MW – around 10 times higher than the current operational plant's average

Figure 4.4 Current production and untapped potential from renewable energy by category of region and degree of urbanisation



Source: JRC.

17 Note that, because of the Russian invasion of Ukraine, the planned development of renewable energy installations in regions bordering Russia and Belarus can be postponed or cancelled. This is particularly relevant for onshore wind, since 21 % of the EU's technical potential is located in border regions, and to a lesser extent for solar (9 %) and hydropower (1 %). Overall, Latvia and Lithuania have the largest shares (over 50 %) of technical potential in border regions for solar and wind power, while in Finland it is over 60 % for hydro and wind power and in Estonia over 40 % for all three sources.

18 Többen et al. (2023).

19 Rural Energy Community Advisory Hub (https://rural-energy-community-hub.ec.europa.eu/index_en).

Box 4.2 The condition of European forests

EU forests absorb 10 % of all carbon dioxide emitted each year, meaning that forests are essential to achieving a net-zero economy. Healthy forests also help regions to be resilient to climate change. They regulate surface and groundwater flows and so mitigate floods and droughts, or they help cool down cities and towns during heatwaves. But forests do much more than delivering climate services. They are important habitats for protected plant and animal species, they are a source of economic activity, and they provide people with opportunities for recreation. Keeping forests healthy, restoring them where they are degraded or planting new biodiverse forests in areas where they have been cut down, therefore serves the twin goal of mitigating climate change and adapting to it, while also helping to restore biodiversity.

An assessment of their health[1] shows that forests in the EU are productive and well connected to each other and to other natural areas. But forests have too low levels of organic carbon in their soil and too few threatened bird species in their trees. Forests in Mediterranean regions and in the Atlantic plain stretching from France to Denmark are worse off than others in the EU and need to be restored to a good condition. Forests in mountain regions, on the other hand, are often in the best condition (Map 4.6).

The development of regional accounts describing the condition of forests is useful for supporting Cohesion Policy objectives, particularly the goal of a greener, low-carbon Europe. Protecting and restoring forests is still overlooked as a means of mitigating climate change and adapting to it. Under Cohesion Policy programmes for 2021–2027, investments of over EUR 22 billion are planned on action on biodiversity, around EUR 16.8 billion of which is funded by the EU. The forest accounts can help Member States decide where to invest to restore degraded forest ecosystems.

1 Maes et al. (2023).

capacity. The RePowerEU ambition is to produce 10 Mtoe of renewable hydrogen in the EU and to import another 10 Mtoe from outside the EU.

The production of biomethane in EU-27 also increased significantly. According to the European Biogas Association it multiplied by 2 in the period 2018–2022 (3.4 bcm were produced in EU-27 in 2022). However, the estimated potential is much higher. The EU has set itself the objective of producing 35 bcm of biomethane by 2030 as part of its efforts to phase out its dependence from Russian fossil fuels.

2.4 Healthy ecosystems as nature-based solutions to address climate change and biodiversity loss

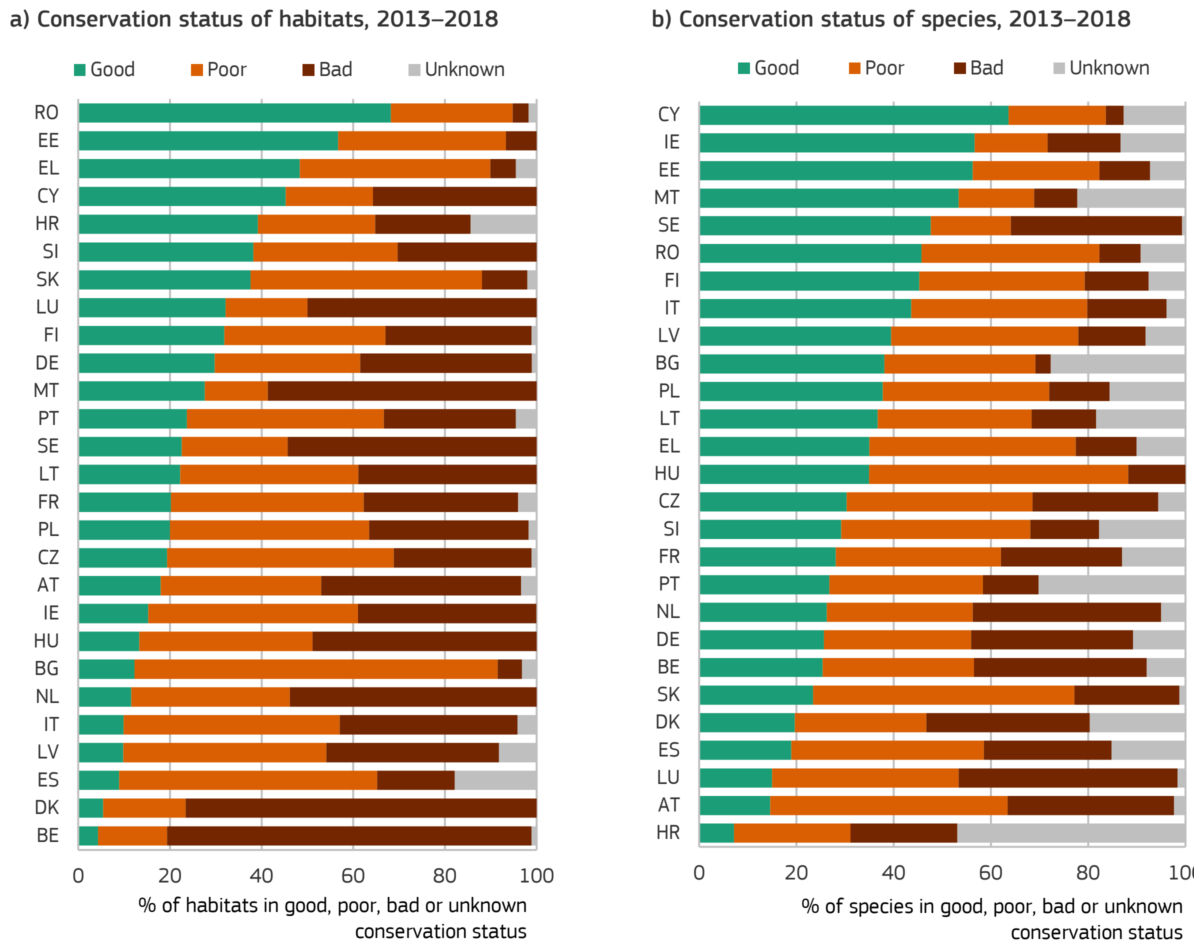
Natural ecosystems are essential in the fight against climate change. Reaching climate neutrality requires first and foremost reducing GHG emissions, but also depends on enhancing carbon removal, particularly for those sectors with hard-to-abate emissions. Healthy ecosystems, particularly natural forests and wetlands, are carbon sinks. They sequester and store more carbon dioxide from the atmosphere than they emit. Moreover, through ecosystem services such as water retention or the cooling effect of trees and forests, ecosystems mitigate the effects of climate change and extreme weather events. These ecosystem services are so important that over half of the world's total GDP is moderately or highly dependent on nature[20]. In the same way, 75 % of the bank loans in the eurozone is exposed to risks from nature loss[21]. Key sectors of the economy are particularly concerned, in particular construction, agriculture, food and beverages. In 2019, the economic value provided by a wider set of ecosystem services in the EU amounted to EUR 234 billion. This value is comparable to the gross value-added of agriculture and forestry combined[22]. Yet the biodiversity

20 World Economic Forum (2020).

21 European Central Bank (2023).

22 Vysna et al. (2021).

Figure 4.5 Conservation status of habitats and species protected under the EU Habitats Directive for the period 2013-2018



Source: European Environment Agency (EEA).

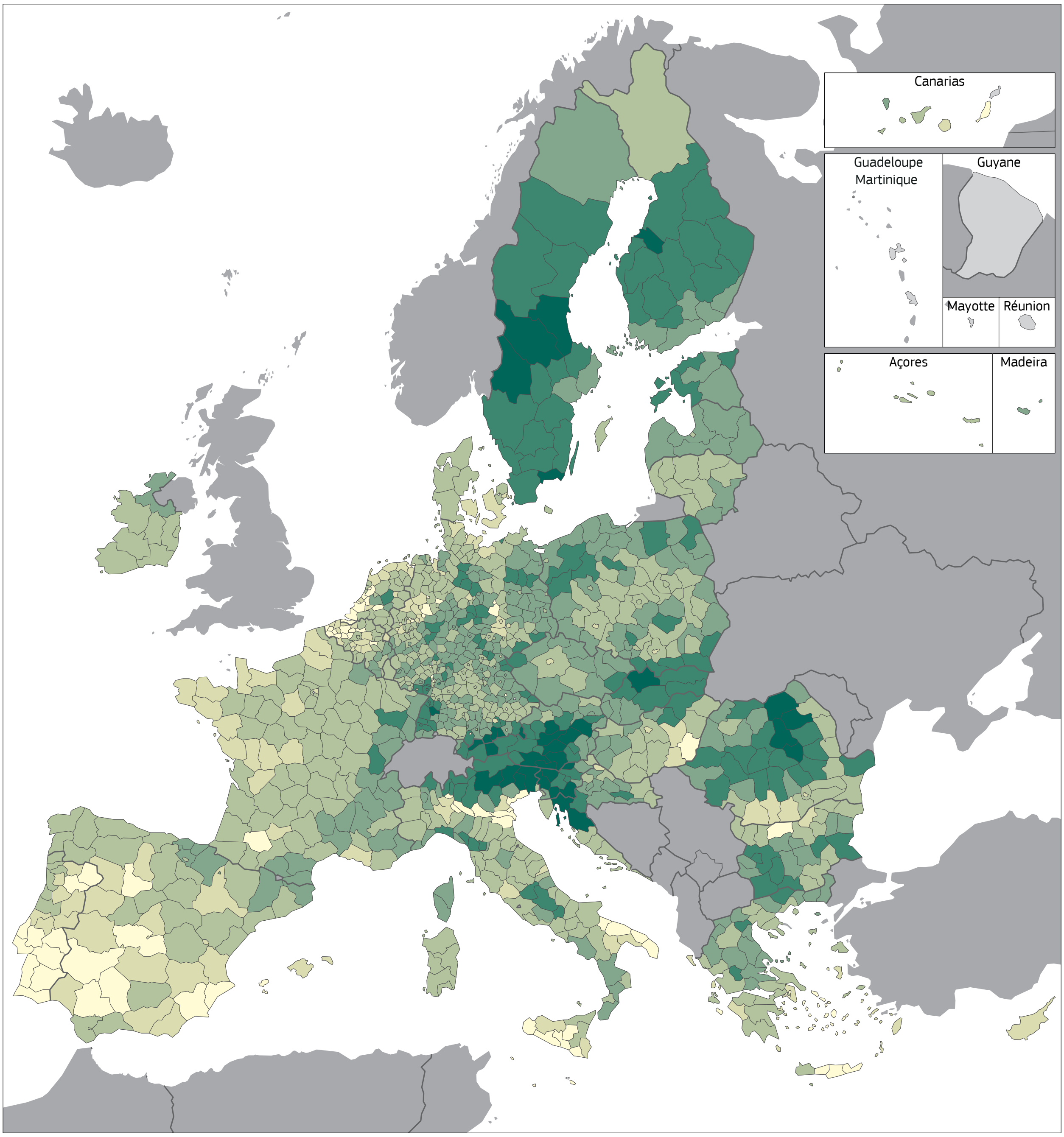
that underpins ecosystems, and the services they provide, remains under threat. Every six years, EU Member States report on the conservation status of habitats and species protected under the Birds and Habitats Directives. The latest assessment covers the period between 2013 and 2018[23]. At EU level, only 15 % of the habitats assessed have good conservation status, while 81 % have poor or bad conservation status. Grasslands, dunes, and wetland habitats show strong trends towards deterioration, while the status of forests is improving the most. Member State reports show considerable variation in the conservation status of habitats within their borders (Figure 4.5). With the exception of Cyprus, Estonia, Greece and Romania, Member States report that under 40 % of the habitats assessed have good conservation status. The figure is lowest for Belgium and Denmark, which report that over 70 % of their habitats are in a bad conservation state.

Only 27 % of species assessed are reported to have good conservation status, while for 63 % it is poor or very poor[24]. Only 6 % of all species show an improvement from the previous assessment. Reptiles and vascular plants have the largest proportion of species with good conservation status.

The reports show that the conservation status of species varies widely. Cyprus, Ireland, Estonia and Malta report the largest proportion (over 50 %) of species with good status. Animals account for almost 80 % of species with improving status and

23 Conservation status of habitats: https://www.eea.europa.eu/ims/conservation-status-of-habitats-under.

24 Conservation status of species: https://www.eea.europa.eu/ims/conservation-status-of-species-under.



Map 4.6 Average condition of forests in NUTS 3 regions, 2018

Index
- <= 0.45
- 0.45 – 0.50
- 0.50 – 0.60
- 0.60 – 0.65
- 0.65 – 0.70
- > 0.70
- no data

Forest condition is measured on a scale from 0 to 1, where 0 represents a degraded forest and 1 represents a reference condition based on primary or protected forests.
Source: DG REGIO, JRC and King Juan Carlos University of Madrid.

0 500 km

plants for 20 %. Belgium, Denmark, Estonia and Luxembourg report the largest proportion (over 20 %) of species with an improvement relative to the previous assessment, while Cyprus is the only Member State not to report a single species for which the status had worsened, though for over 75 % of species the assessment is 'unknown'.

3. Environmental challenges for health and regional development

A large majority of people in the EU are concerned about the state of the environment[25]. The pollution of air, water and soil has a direct impact on people's health. Exposure to pollutants increases the likelihood of respiratory diseases and cardiovascular and other health issues. The uneven distribution of environmental pollution is one of the reasons for disparities in health outcomes across the EU, with more vulnerable or disadvantaged groups exposed to more health risks[26].

Part of the European Green Deal, the zero-pollution action plan, is aimed at creating a toxic-free environment by reducing air, water and soil pollution to levels not considered harmful to health and natural ecosystems. Legislation, including binding targets on pollutant emissions, remains essential to keeping pollutant concentrations below these levels.

EUR 100 billion is allocated under Cohesion Policy for 2021–2027 to environmental action, to improving air quality, reducing noise, water management, waste recycling and rehabilitation of industrial sites and contaminated land. Support is also provided to investment in clean technologies, and in the broad range of products, services, and processes that utilise renewable materials and energy sources, which are key to achieving a zero-pollution society. In addition, a significant part of the budget is planned to go to investment in environmentally friendly production processes and the circular economy.

3.1 Air pollution across the EU causes persisting regional health inequalities

Despite progress made in the last decade on achieving better air quality standards, air pollution remains a major cause of premature death and disease and is the single largest environmental health risk in Europe. Fine particles of under 2.5 mm diameter ($PM_{2.5}$) are particularly harmful to human health. In 2020, they are estimated to have caused 253 000 premature deaths and resulted in 2 582 563 years of life lost across the EU. The estimated impact is largest in regions where solid fuel burning causes high $PM_{2.5}$ levels, mainly in Bulgaria, Croatia, and regions in Poland, Slovakia, Hungary and Romania (Map 4.7), with the largest of all in the Polish regions of Miasto Kraków, Katowicki and Sosnowiecki and the Bulgarian region of Vidin, where years of life lost are 2 000 or more per 100 000 inhabitants. The smallest is in Scandinavian regions, where $PM_{2.5}$ levels are low. LIFE[27] strategic integrated projects for better governance, and for supporting the development and implementation of air quality plans in combination with Cohesion funding, delivered promising results in various European hotspots such as the Po basin in Italy, the south of Poland (Malopolska, Silesia), Slovakia, Bulgaria and Hungary.

Air quality also varies according to the extent of urbanisation. Concentration of fine particulate matter and nitrogen dioxide is consistently higher in cities than in rural areas (Figure 4.6). The main source of fine particulate matter is the heating of buildings, which in 2020 was responsible for 58 % of emissions in the EU, while nitrogen dioxide is mainly caused by road transport, which accounted for 37 % of emissions[28]. Some 96 % of the urban population was exposed to levels of fine particulate matter above the latest guideline set by the World Health Organisation (WHO) (five milligrams per cubic metre). They were also exposed to levels of nitrogen dioxide exceeding the WHO guideline (10 milligrams per cubic metre).

25 Eurostat (2020).

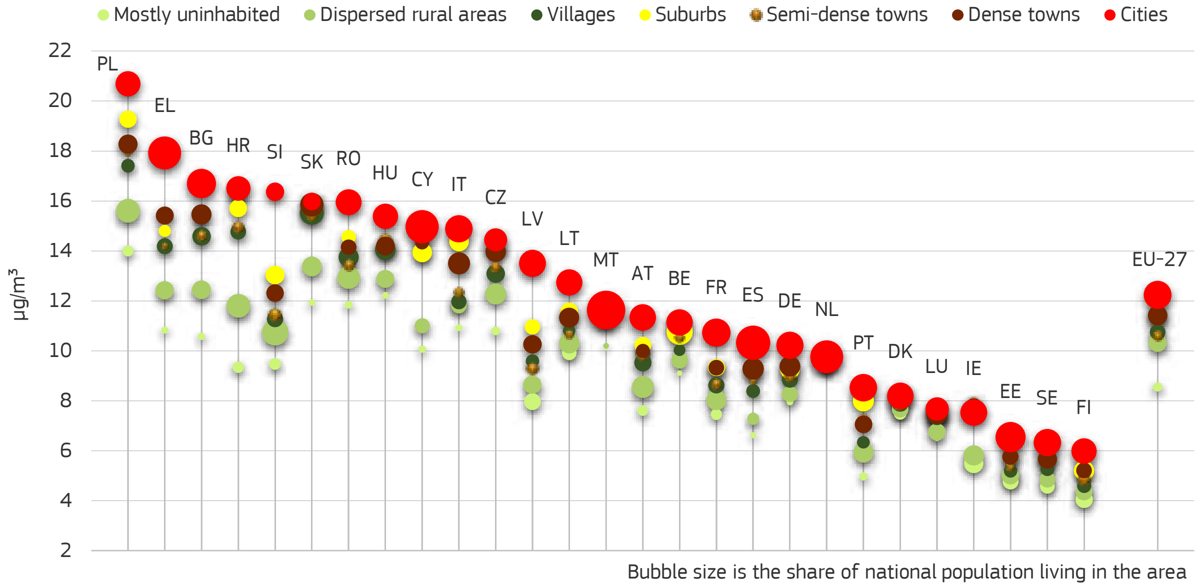
26 European Environment Agency (2018).

27 L'instrument financier pour l'environnement.

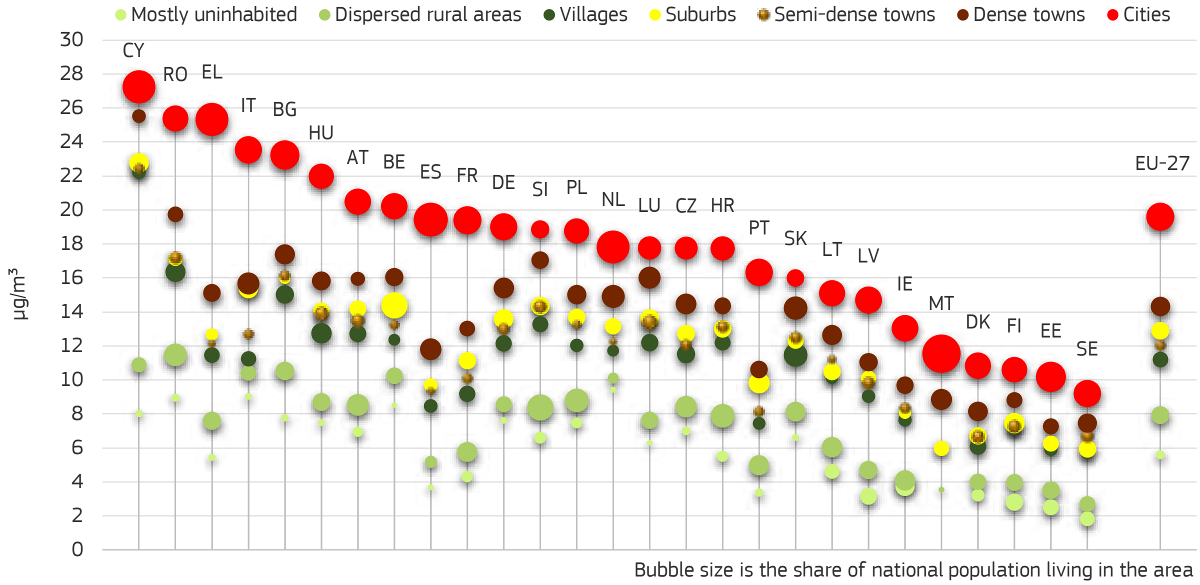
28 https://www.eea.europa.eu/publications/air-quality-in-europe-2022/sources-and-emissions-of-air.

Figure 4.6 Concentration of fine particulate matter ($PM_{2.5}$, upper panel) and nitrogen dioxide (NO_2, lower panel) by country and by refined degree of urbanisation, 2021

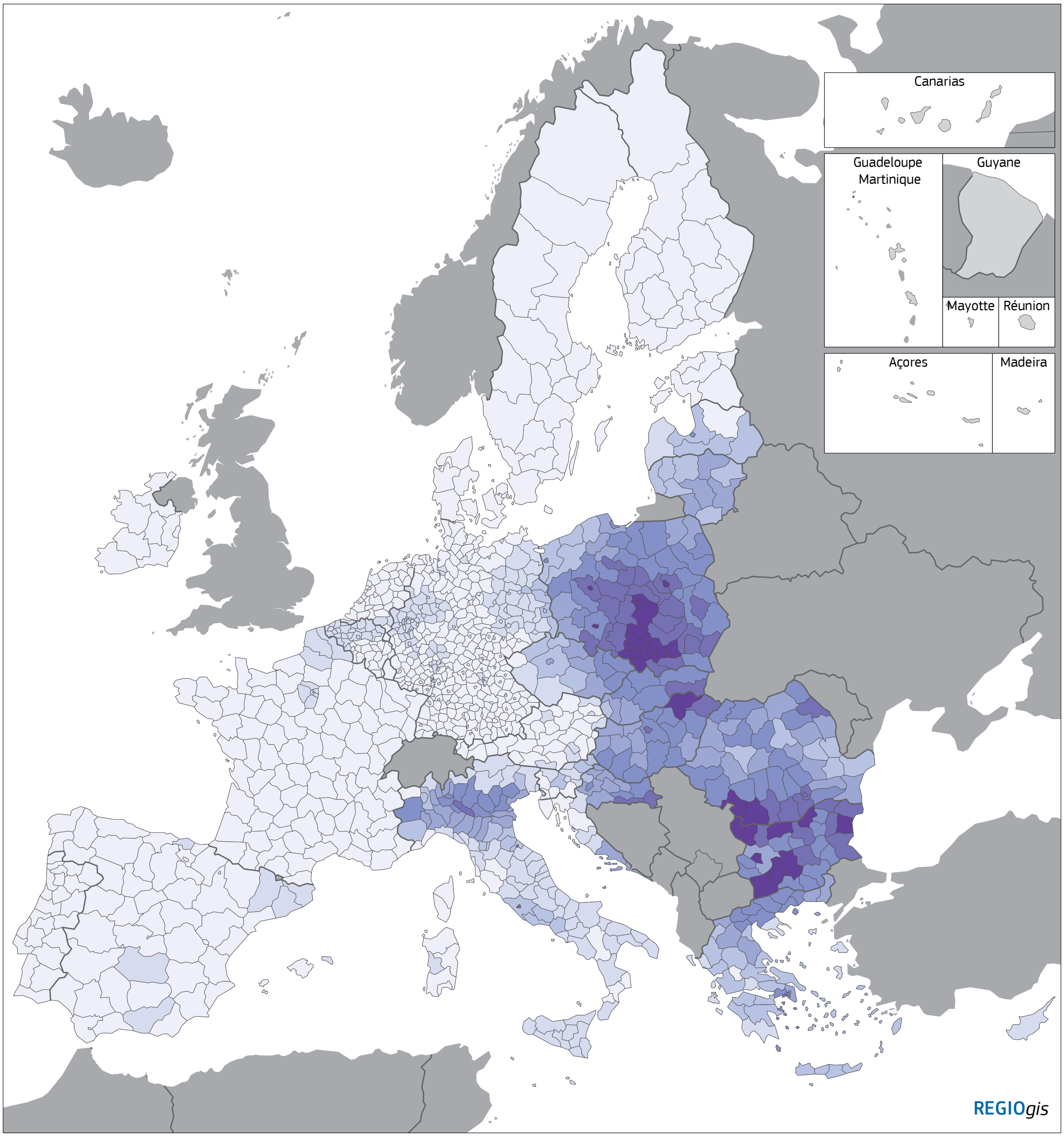
a) Concentration of fine airborne particulate matter ($PM_{2.5}$) by refined degree of urbanisation



b) Concentration of NO_2 by refined degree of urbanisation



Note: Countries ranked by the value of cities. A concentration of 1 µg/m³ means that one cubic metre of air contains one microgram of pollutant.
Source: EEA and DG REGIO calculations.



Map 4.7 Years of life lost attributed to exposure to $PM_{2.5}$ in NUTS 3 regions, 2021

Years of life per 100 000 inhabitants

- <= 400
- 400 – 600
- 600 – 800
- 800 – 1000
- 1000 – 1250
- 1250 – 1500
- > 1500
- no data

EU-27 = 584
Source: EEA.

0 500 km

Box 4.3 Regional disparities associated with air pollution in Europe

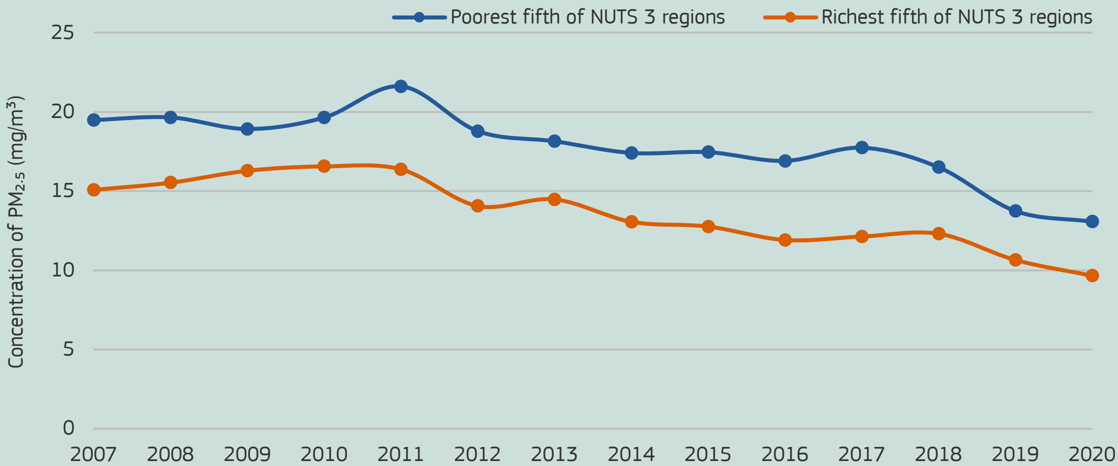
Figure 4.7 compares the average exposure to air pollution from fine particulate matter of those living in the poorest regions in the EU with that in the richest ones.

Despite improving trends in air pollution in both the richest and the poorest regions of the EU over the 2007–2020 period, inequalities remained with levels of $PM_{2.5}$ concentrations consistently higher by around one third in the poorest regions. This lack of progress in reducing air pollution exposure disparities seems to indicate that we are not progressing in reducing this important type of environmental inequality.

Between 2007 and 2020, air quality, measured as population-weighted concentrations of $PM_{2.5}$, improved in both the least disadvantaged (i.e. richest) and the most disadvantaged (i.e. poorest) quintiles of the EU-27's NUTS 3 regions. However, regions in the richest quintile had lower $PM_{2.5}$ levels to begin with (around 15 μg/m³ in 2007) than those in the poorest quintile (19.5 μg/m³ in 2007).

Energy poverty in the poorest regions can cause the burning of low-quality coal, wood and even waste to heat homes. This results in high emissions of pollutants, which often not only affect outdoor air quality but also degrade indoor air quality and consequently harm human health.

Figure 4.7 Population weighted concentrations of fine particulate matter in the richest and poorest NUTS 3 regions of the EU, 2007–2020



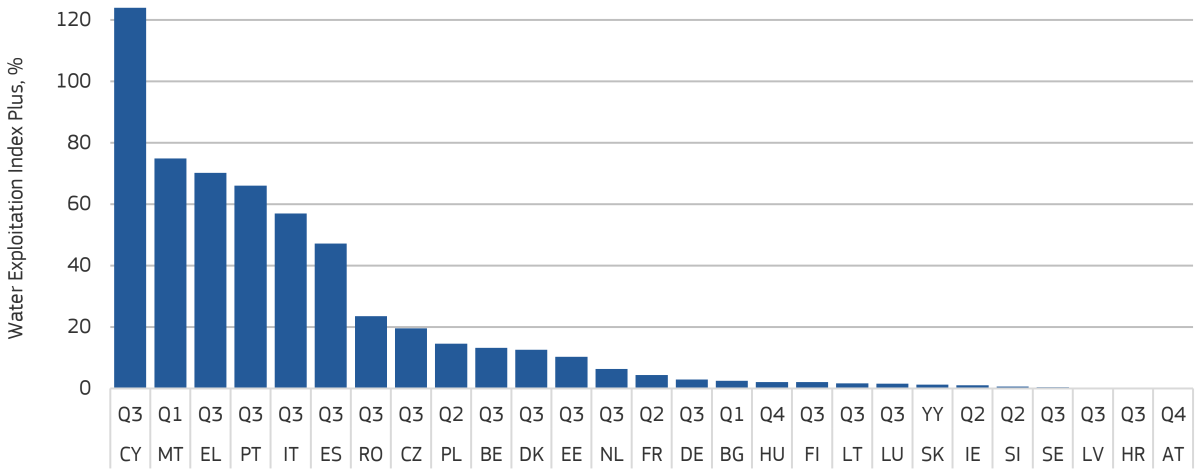
Note: The chart shows population-weighted concentrations of PM2.5 in the 20 % of NUTS 3 regions in the EU with the lowest GDP per head (in purchasing power standards – PPS – terms) along with those in the 20 % with the highest GDP per head.
Source: EEA.

The COVID-19 pandemic clearly demonstrated the impact of traffic on air quality in cities[29]. In 2020, concentrations of nitrogen dioxide fell sharply as a direct result of reductions in road transport caused by the restrictions imposed. Average concentrations over the year fell by up to 25 % in major cities in France, Italy and Spain, and during the first lockdown, in April 2020, concentrations at monitoring stations fell by up to 70 %.

Further reductions in emissions of air pollutants are needed to lower their concentration in the atmosphere. The EU's climate agenda, particularly the transition to non-emitting renewable energy sources, higher energy-efficiency and less-polluting combustion fuels, is aimed at achieving this.

29 https://www.nature.com/articles/s41598-021-04277-6; https://www.lifeprepair.eu/index.php/actions/air-quality-and-emission-evaluation/?lang=en#toggle-id-14.

Figure 4.8 The quarters when water was most scarce in EU Member States, 2019



Note: Based on the three-month period in 2019 when the Water Exploitation Index Plus (WEI+) was at its maximum.
Source: EEA.

3.2 Access to clean and safe water

Clean and safe water is an essential resource and Cohesion Policy contributes to ensuring the availability and security of water, through water-purification plants and distribution networks, especially in areas where the population has no access to adequate water provision. Cohesion Policy helps regions that are facing problems of water management, water quality treatment and flood prevention. It promotes a circular approach to water, in particular in water-stressed regions. Water scarcity[30] affected 29 % of the EU in at least one season in 2019. In general, it is more common in southern Europe, where around 30 % of the population live in areas with permanent water stress and up to 70 % of the population live in areas with seasonal water stress during the summer. Countries where water shortages were seasonally most acute were Cyprus (where water consumption exceeded renewable water availability), Malta, Greece, Portugal, Italy and Spain (Figure 4.8). Water abstraction for agriculture, public water supply and tourism imposes the most pressure on fresh water[31]. However, water scarcity is not limited to southern Europe. It extends to river basins across the EU, particularly in western Europe, where water shortages are caused primarily by high population density in urban areas, combined with high levels of abstraction for public water supply, energy and industry.

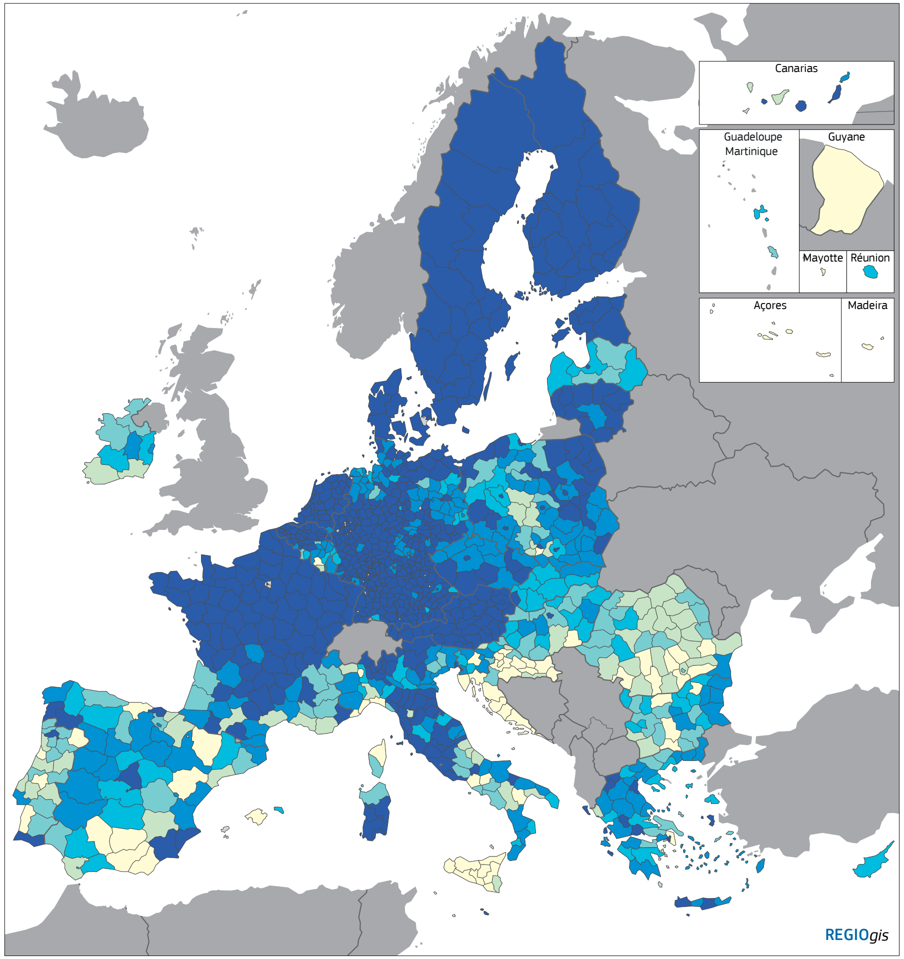
Pollution of fresh water by nutrients declined in the EU over the period 2000–2010, but remained unchanged up to 2019 (the last year for which data are available)[32]. This is largely because of discharges of nutrients from agricultural land, which have remained high. The lack of improvement in water quality across the EU is also evident from country reports produced under the Water Framework Directive, which show that only 40 % of surface water has a good ecological status.

To remedy this, full implementation of the Cohesion Policy investments and the management and mitigation measures specified in the EU's water legislation are needed. This means further reduction of pollutant emissions that reach water bodies, improving the capacity of ecosystems such as wetlands to retain pollutants and purify water, and eliminating differences in the implementation

30 Water scarcity means that the water exploitation index plus (WEI+), which is a measure of water consumption as a percentage of renewable freshwater resources available, is above 20 %.

31 European Environment Agency (2023b).

32 Maes et al. (2020).



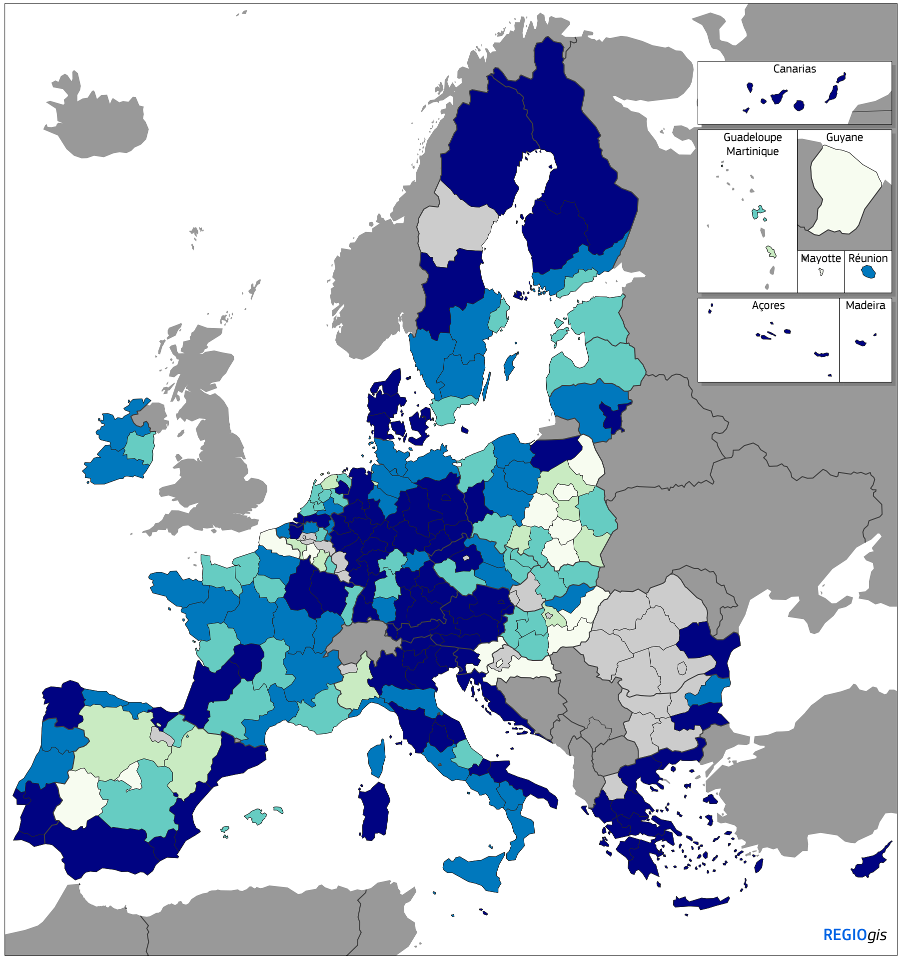
Map 4.8 Urban wastewater receiving more stringent treatment in NUTS 3 regions, 2020

% of generated load

- < 30
- 30 – 50
- 50 – 75
- 75 – 85
- 85 – 95
- >= 95
- no data

EU-27 = 85.5
Source: DG REGIO based on EEA data.

0 500 km



Map 4.9 Bathing water quality in NUTS 2 regions, 2022

% of stations with excellent quality

- <= 40.0
- 40.1 – 60.0
- 60.1 – 80.0
- 80.1 – 90.0
- > 90.0
- no data

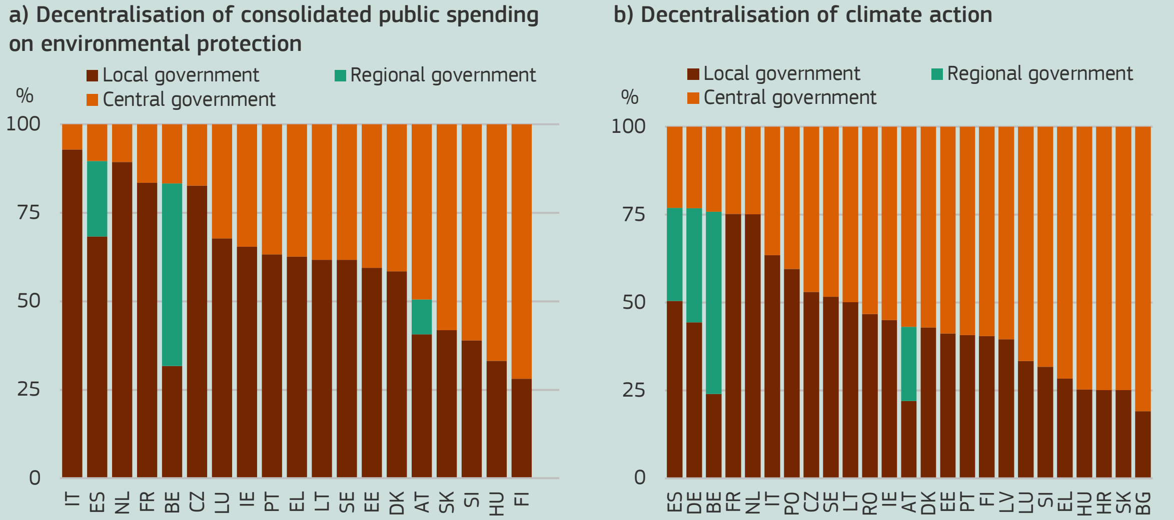
Sampling stations with excellent quality score, in regions with at least five stations.
Source: DG REGIO based on EEA data.

0 500 km

Box 4.4 Decentralisation of public spending on the green transition

Climate and environmental targets are commonly set at EU or national level, but sub-national governments are responsible for managing the green transition. The OECD has recently analysed fiscal federalism in respect of the ecological transition by collecting data on public spending on environmental protection and climate action by governance level[1]. Local authorities are largely responsible for public spending on environmental protection, particularly on waste and wastewater management. They are also responsible for a large share of public climate expenditure, though to a lesser extent. Sub-national governments in the EU accounted in 2019 for 66 % of climate-related public expenditure (1.7 % of GDP), but they face challenges, particularly smaller ones, in aligning with international green agendas because of capacity and political constraints. While ecological fiscal transfers offer a potential solution by linking grants to environmental protection, their use is limited. Local governments, especially municipalities, also have a key role in galvanising public support for ecological transition policies through participatory processes.

Figure 4.9 Share of public spending on environmental protection (left) and climate action (right) by governance level for a sample of Member States, 2022



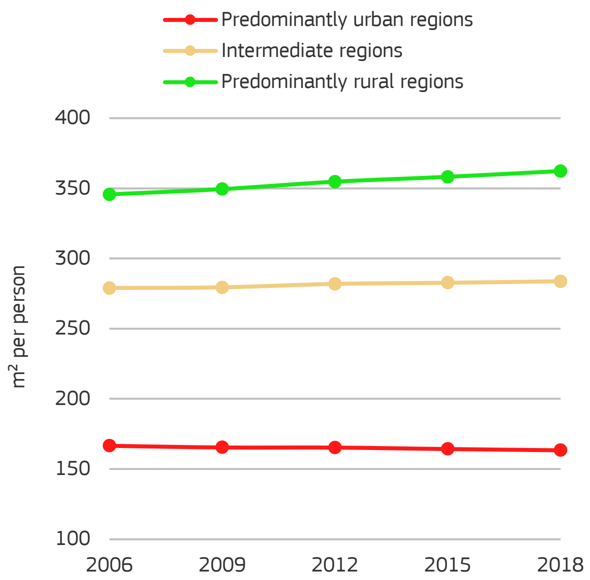
Note: Environmental protection includes wastewater treatment, waste management, pollution abatement and protection of biodiversity and landscape.
Source: OECD.

1 Dougherty and Montes Nebreda (2023).

of the Urban Wastewater Treatment Directive. In the EU, 93.5 % of urban wastewater receives secondary treatment and 85 % more stringent treatment. More investment in wastewater treatment along with reforms, good governance and sufficient administrative capacity remain necessary in many regions across the EU to avoid, in particular, overflows of sewage during periods of heavy rain (Map 4.8).

Continued efforts to improve water quality extend to bathing water as well. Water recreation is an important outdoor activity for many Europeans and hotter weather as a result of global warming is likely to increase the demand for safe water to bathe in, particularly in cities during the summer. Maintaining and increasing the number of places to bathe might, therefore, become an essential component of a climate adaptation strategy.

Figure 4.10 Built-up area trends in urban, intermediate and rural regions, 2006–2018



Source: EEA.

Of 21 551 bathing water sites in the EU in 2022, 85 % were assessed as being of excellent quality. In 20 regions, mainly in Austria, Greece and Cyprus, all sites were of excellent quality (Map 4.9). In several regions in Hungary, Slovakia and Poland, this was the case for under 60 % of sites, but the minimum water quality requirement was met almost everywhere. Two thirds of the sampling stations, however, are in coastal areas, which typically have better water quality than sites inland because of the more frequent renewal and greater self-purification capacity of water around the coasts[33].

3.3 Increasing soil-sealing and soil degradation

Population and economic growth increases demand for housing, infrastructure, and services. Growing built-up areas cover the soil with impervious surfaces, called soil-sealing, which is an important cause of soil degradation in the EU. Soil-sealing often affects fertile agricultural land, puts biodiversity at risk, and increases the risk of flooding and water scarcity. In places where the area of sealed soil expands faster than population, cities can spawl into the countryside. Sustainable land-use planning can minimise these impacts.

The extent of sealed soil is measured by mapping imperviousness, which has been monitored since 2006 by the Copernicus land monitoring service[34]. In 2018, the latest year for which data are available, the total impervious surface area of the EU was 111 895 square kilometres (km^2) or 252 square metres per person, 3.4 % up from 2006 (see Map 4.10, which shows in dark brown the regions where soil-sealing increased by more than the EU average over the 12 years, as well as the regions most affected by soil degradation and so where rehabilitation is most needed).

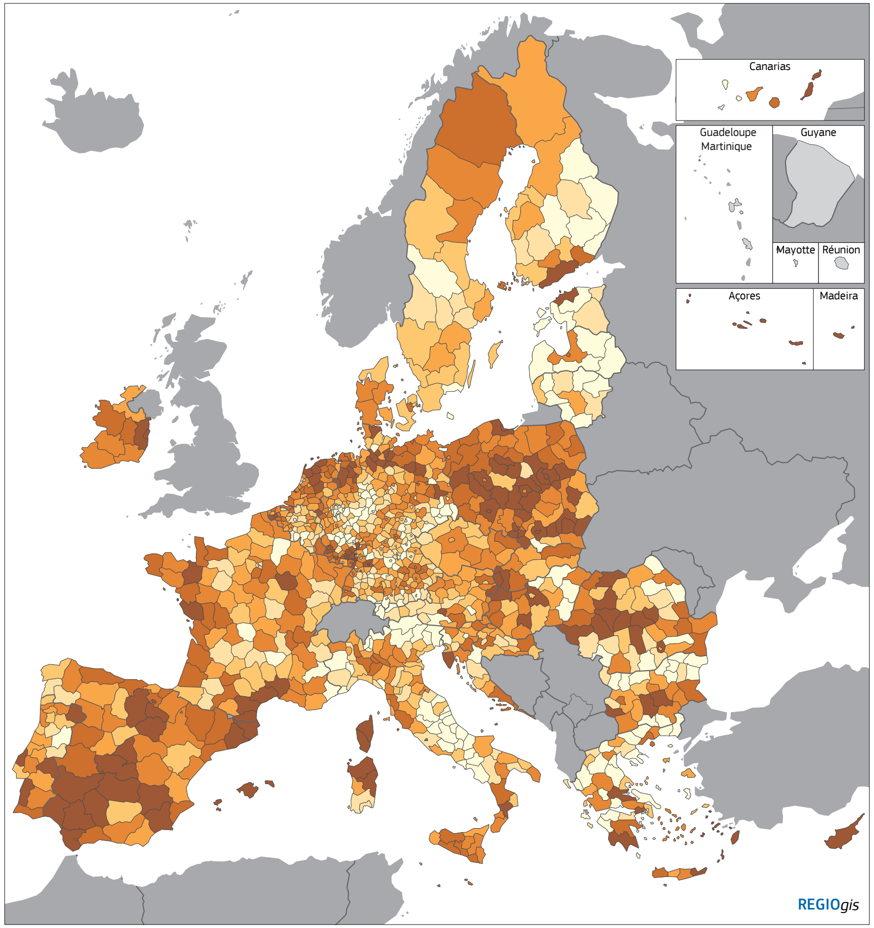
Land in rural NUTS 3 regions areas is less efficiently used for development than in urban regions, in the sense that it involves a larger impervious area per person (Figure 4.10). In predominantly rural regions, impervious land per person amounted to an average of 362 square metres per person, an increase of 4.8 % from 2006. Impervious land per person also increased in intermediate regions, while in predominantly urban regions, where it is less than half that in rural ones, it declined. Urban areas tend to have taller, more densely concentrated buildings and less land used for roads per person, meaning that land is used more efficiently than in other regions.

Most of the increase in impervious area between 2006 and 2018, 1 655 km^2, occurred in intermediate regions, while in rural regions, it increased by 1 002 km^2. As noted above, increasing soil-sealing, especially in rural areas, impairs the natural ability of soil to absorb and store rainwater. As a result, rainfall is more quickly converted into surface run-off, leading to rapid water flow that can overwhelm drainage systems and cause flooding. At the same time, the reduced infiltration of rainwater into the soil impairs the recharge of groundwater and can lead to water scarcity. To remedy this, land use needs to be made more efficient through better regulation, nature-based solutions (such as permeable pavements, green roofs and green urban infrastructure) and natural drainage systems (such as streams, rivers and wetlands) preserved and

33 European Environment Agency (2023c).

34 The Copernicus land monitoring service is one of six services provided by Copernicus, which is part of the EU space programme.

Map 4.10 Change in imperviousness and soil degradation processes in NUTS 3 regions



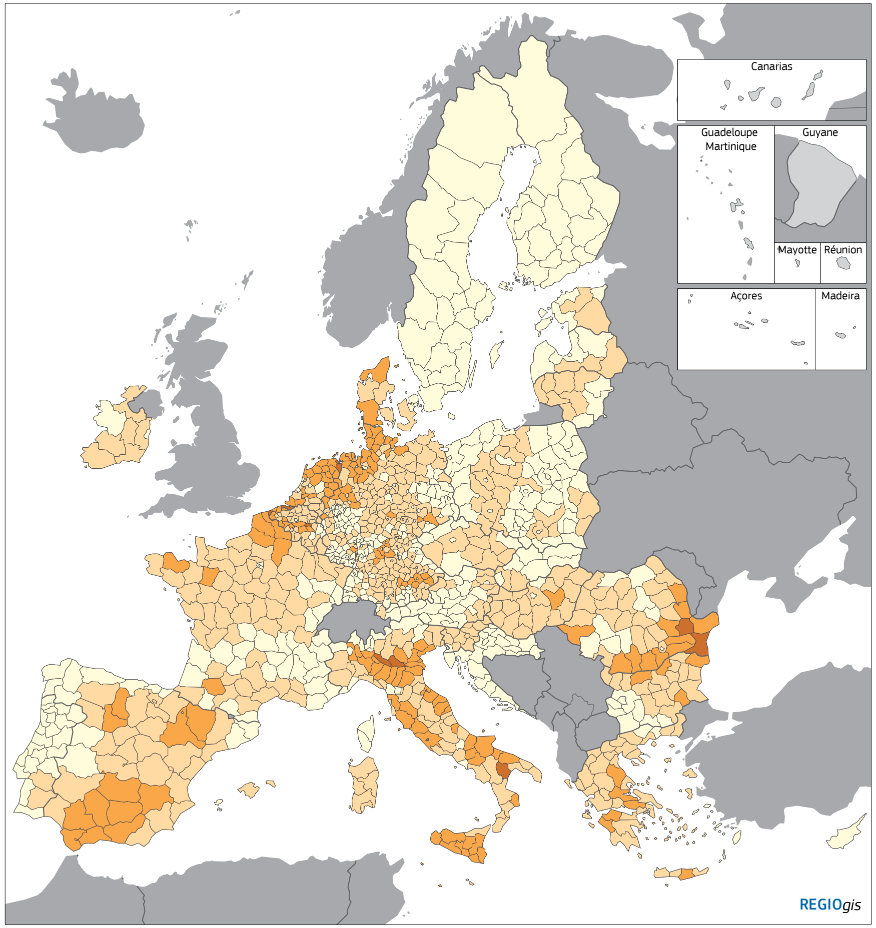
Change in imperviousness, 2006-2018

Total % change

- <= 1.5
- 1.5 – 2.0
- 2.0 – 2.5
- 2.5 – 3.0
- 3.0 – 4.0
- 4.0 – 5.0
- > 5.0
- no data

EU-27 = 3.4
Source: DG REGIO based on EEA harmonised imperviousness time series.

0 500 km



Average number of soil degradation processes

Number

- <= 1
- 2 - 1
- 3 - 2
- > 3
- no data

Source: JRC.

0 500 km

restored in upstream areas. The latter play a crucial role in intercepting and dispersing surface run-off, preventing flooding and replenishing groundwater.

Next to soil-sealing, soil is also degraded through erosion, excessive use of nutrients, heavy-metal contamination and the loss of its biodiversity and organic carbon, which are more widespread.

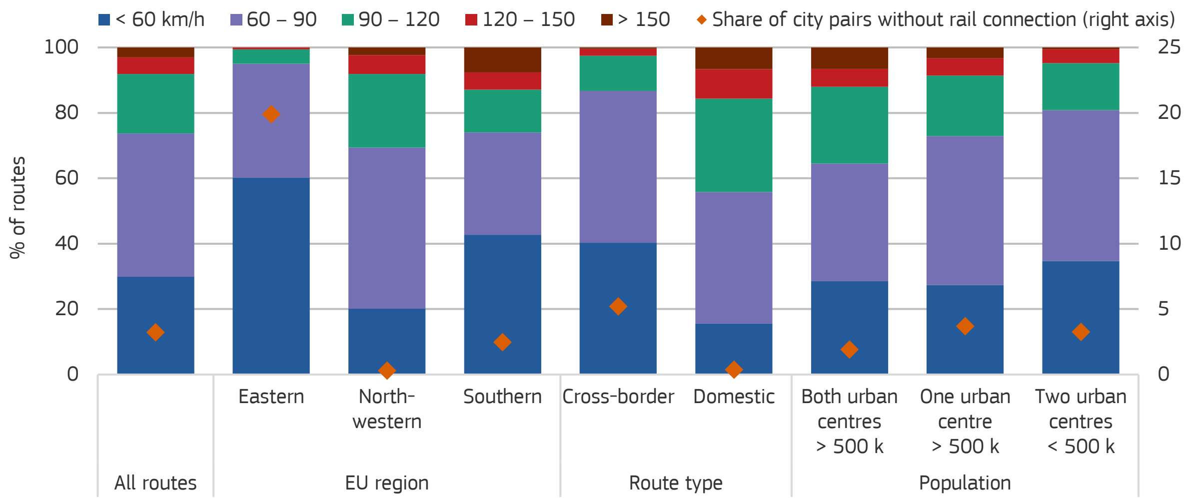
4. Shift towards climate-neutral transport

Transport-related GHG emissions have continued to rise in the EU (as noted in Section 2 above). In 1 in 3 NUTS 2 regions, transport is currently the largest emitter of GHGs. The main options to decarbonise transport are modal shift, for example to rail or active modes such as biking or walking, technological and operational measures to improve energy-efficiency, and a transition to zero- and low- emission energy carriers (i.e. electricity, advanced liquid biofuels and biogas, e-fuels and hydrogen). These options would often also have co-benefits for air quality.

4.1 Rail speed between EU cities[35]

In 2021, the Commission proposed an action plan to boost long-distance and cross-border passenger rail services. This built on efforts by Member States to make connections between cities faster by managing capacity better, co-ordinating timetabling, sharing rolling stock and improving infrastructure to stimulate new train services, including at night[36]. High-speed trains accounted for 31 % of total passenger-kilometres travelled by rail in the EU in 2019, in France and Spain close to 60 %[37]. However, over half of Member States do not have any high-speed railway lines at all. This section looks at the ability of high-speed rail to compete with short-haul flights in terms of travel time. It examines the speed of fast rail connections between large EU cities and compares this with the time taken by air. It focuses on the 1 356 connections between EU cities that are less than 500 km apart and have at least 200 000 inhabitants or are national capitals.

Figure 4.11 Speed of rail connections between urban centres, including by broad geographical area, population size, and route type, 2019

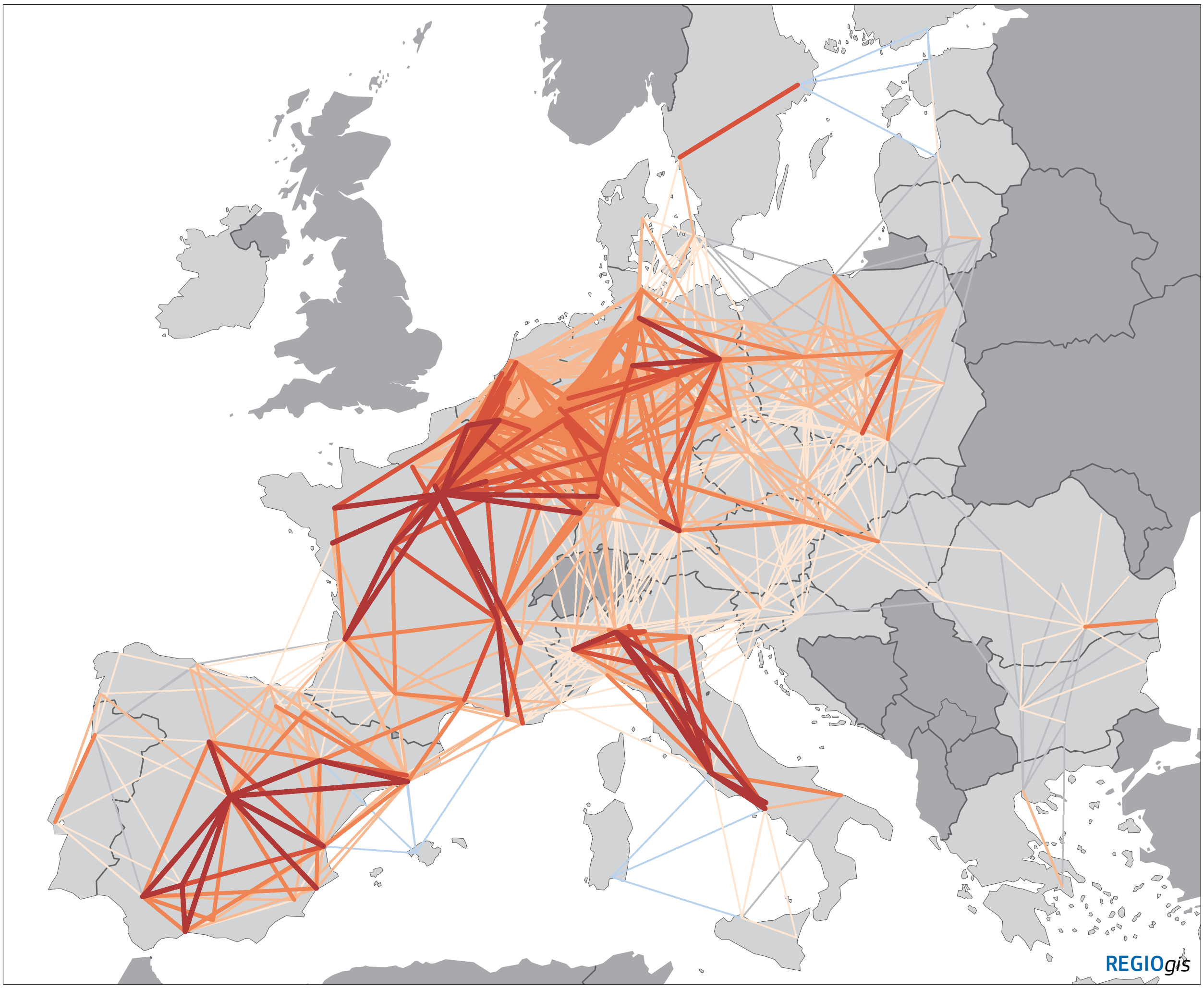


Note: Only pairs of urban centres with at least 200 000 inhabitants located within 500 km of each other are included.
Source: DG REGIO.

35 This section focuses on travel time and does not consider other aspects relevant to transport mode choices such as prices, comfort and safety Subsections 4.1-4.3 are largely based on Brons et al. (2023).

36 European Commission (2020).

37 This figure relates to all high-speed trains including tilting trains capable of travelling at 200 km/h, which do not necessarily require high-speed railway lines.



Map 4.11 Speed of rail connections between major urban centres in the EU, 2019

km/h
- < 60
- 60 – 90
- 90 – 120
- 120 – 150
- >= 150
- no connection within 10 hours
- overseas*

Speeds are based on optimal travel time on a weekday relative to the straight-line distance. Only urban centres located within 500 km from each other were considered. In addition, each pair of urban centres must contain an urban centre that has more than 500 000 inhabitants (or represents the national capital) and the other urban centre has to have at least 200 000 inhabitants.
*Overseas: links between city-pairs involving a sea crossing where neither a fixed railway link nor a train ferry is available.
Sources: DG REGIO, based on data from the International Union of Railways (UIC); national and regional rail operators; and JRC.

0 500 km

For most of the connections concerned, the straight-line speed[38] of the fastest train service[39] is low (Map 4.11). On only 3 % of the routes does the speed exceed 150 km per hour (km/h) (Figure 4.11). The share is largest in the southern EU (7.6 %), where both Italy and Spain have a well developed high-speed rail network. In the north-western EU, the number of high-speed connections, which are mainly in France and Germany, is similar but their share is smaller. Because of higher population density, the rail network is denser, consisting of more short-distance connections where rail speeds are lower. Nevertheless, the north-western EU has the largest share of rail connections faster than 90 km/h, and only a few city-pairs without a rail connection. The rail network is less developed in the eastern EU, with no connections with speeds above 150 km/h and a rail speed below 60 km/h on 60 % of routes, and with 1 out 5 five pairs of cities with at least 200 000 inhabitants without a rail connection.

Despite some progress towards technical inter-operability, rail travel across EU borders is still hindered by many obstacles. There are numerous gaps where national railways are not properly connected to each other[40]. Over 5 % of cross-border city-pairs lack a rail connection as against only 0.3 % of those in the same country[41]. Rail speeds on cross-border routes also tend to be lower than on domestic routes, around 40 % of cross-border routes having speeds of below 60 km/h compared with only 16 % on domestic routes. Moreover, on only 0.4 % of cross-border routes do rail speeds exceed 150 km/h.

The share of routes with speeds above 150 km/h is larger for those that connect large cities with populations of over 500 000 (7 %) than for routes between cities with populations of 200 000 to 500 000 (1 %) or between large and small cities (3 %). The difference is similar for the share of connections with speeds of over 90 km/h (36 % between large city-pairs and 19 % between small ones).

4.2 Comparing travel time of rail and flights between EU cities

Of the 1 365 connections between city-pairs, 297 are served by a direct flight[42]. Comparing the travel time of rail and air trips for each of these routes, for 68 of them the total travel time[43] by rail is shorter than that by air. The routes concerned are mainly between cities in the Netherlands, Belgium, Germany and France, both domestic and international (Map 4.12). While most connect capital cities, they also include connections between other cities. In addition, on some of the domestic routes in Spain, Italy and Poland, rail is faster, but these are all between the capital city and other major cities in the country. On 17 of the routes where rail is faster, the travel time advantage is as much as an hour or more. These routes are mainly in and between the Netherlands, Belgium, Germany and France, but they also include three domestic routes in Italy.

4.3 Why are some trips faster by rail than by air?

Rail trips are more likely to outperform flights on shorter-distance routes (Figure 4.13a). Air trips are, on average, faster than rail for distances of over 300 km, though there are still many routes over this distance where the reverse is the case.

38 The straight-line speed used here is defined as the travel time between stations divided by the straight-line distance. Straight-line speeds are determined not only by the rail operating speed, but also by the time spent in transfers, and any detours needed. As such, straight-line speed is always lower than operating speed. Note that for the smaller set of routes considered in Section 3, information on the actual distances by rail and the time spent in transfer could be obtained, which enabled the actual train operating speeds and the other two components of straight-line speed to be disentangled (see also footnote 19).

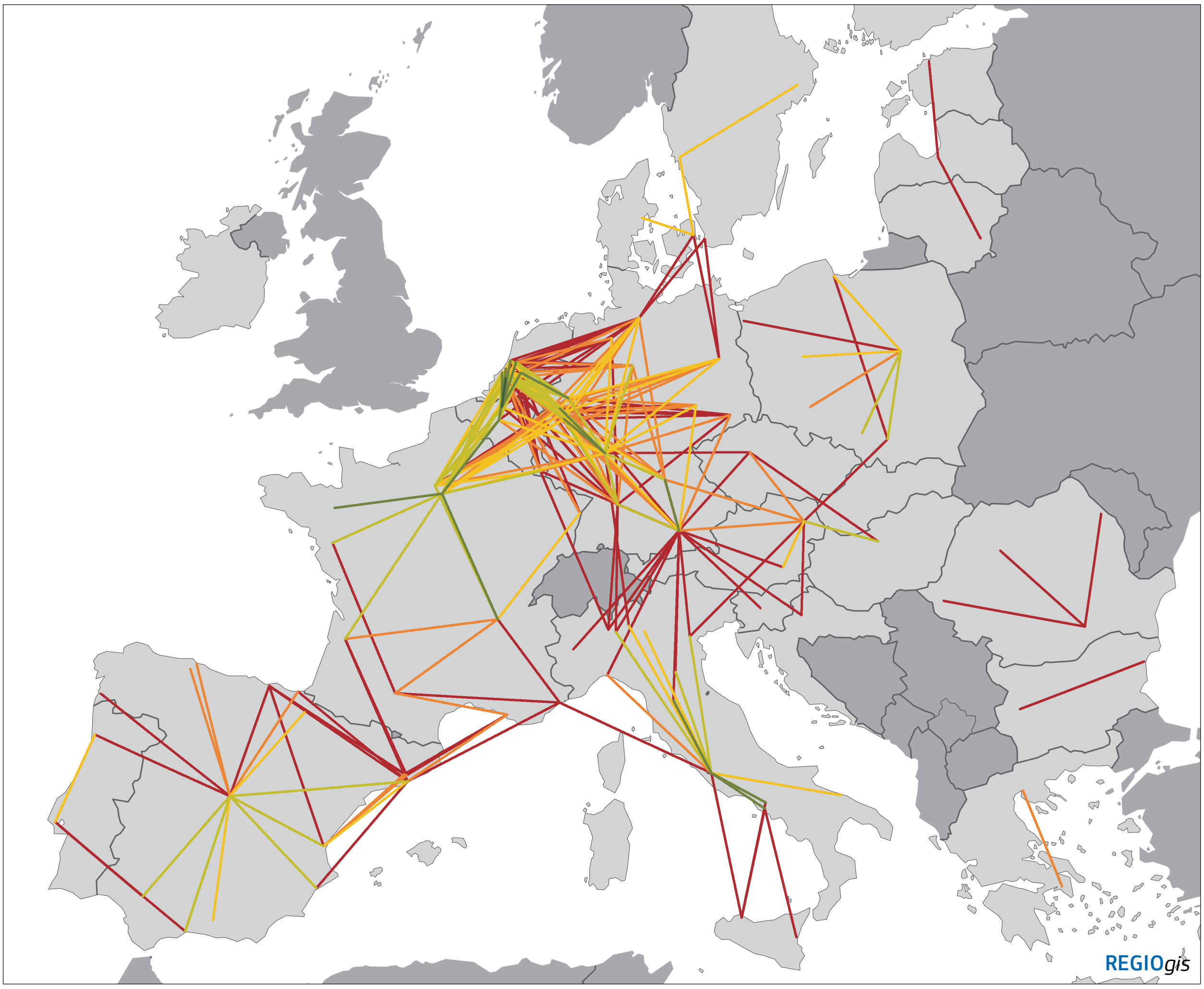
39 The fastest service available for departure during a weekday between 6:00 and 20:00 in 2019.

40 Sippel et al. (2018).

41 It should be noted that these routes, whether cross-border or domestic, may be served by long-distance bus connections, which could be a reason for there being no rail connection.

42 Based on SABRE airline data, these routes involve 57 million passenger trips a year. The difference compared with the 102 million trips from Eurostat data is inter alia because the SABRE data apply a minimum city size and a minimum number of flights and passengers per day. Note that some of the passengers will be connecting to another flight.

43 The total travel time includes the out-of-vehicle time components (See Box 4.5).



Map 4.12 Travel time of a rail-based trip compared with a flight-based trip, 2019

Difference in hours

- <= -2
- -2 – -1
- -1 – 0
- 0 – 1
- 1 – 2
- > 2

Note: Negative values indicate that the rail-based trip is faster than the flight-based trip.
Sources: DG REGIO (based on data from UIC), national and regional rail operators, JRC, and Eurostat.

0 500 km

This indicates that rail has the potential to compete with aviation on relatively long distances, providing that a sufficient train operating speed can be achieved (Figure 4.13b).

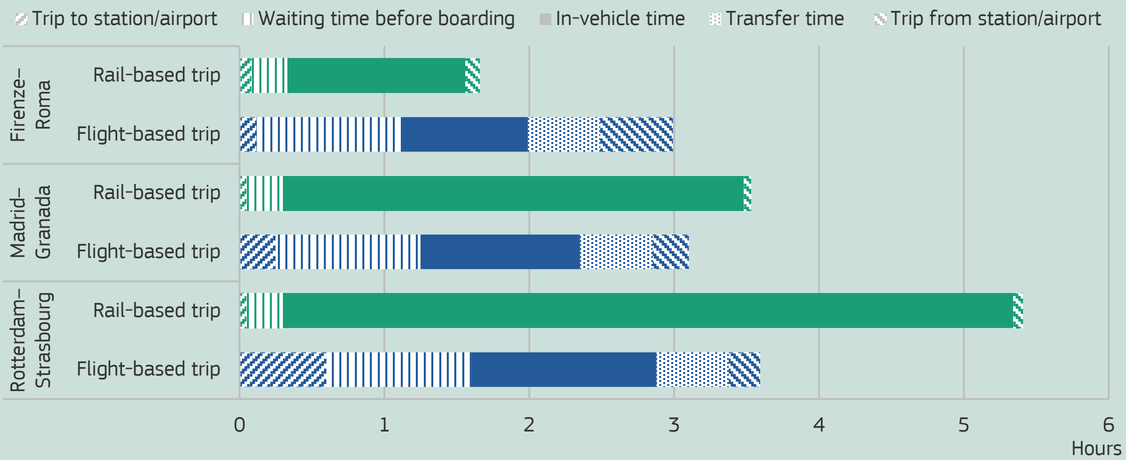
The total transfer time remains under an hour on almost all routes, with a few exceptions where transfer times are between one and two and a half hours (Figure 4.14a). As expected, trips are slower when the transfer times are longer. On all routes

Box 4.5 How can rail be faster than a flight?

Comparing the travel time of rail and air trips needs to go beyond time spent in a train or a plane to take account of the time needed to get to the airport or rail station, waiting times and actual departure and arrival times. People flying spend less time in a plane than rail passengers spend in a train[1], but they spend much more time travelling to and from the airport and in the airport itself. Trains can usually be boarded quickly and the train stations tend to be better connected to city centres than airports. This 'out-of-vehicle' time is either fixed (waiting/boarding) or otherwise independent of the distance of the trip (access to and from the station/airport), which means that rail tends to be faster on shorter distance trips.

This is illustrated in Figure 4.12, which compares the composition of total travel time of rail and air trips, including out-of-vehicle time[2], on three routes that are representative of different journey distances. For rail trips, the major part of travel time is in the train, so the total trip time varies closely with the distance travelled. For air trips, the in-plane time is actually shorter than the other elements, and the total trip time varies much less with the distance. On the shortest of the three routes, between Florence and Rome, the time taken by rail is shorter than by air, mainly because of the long out-of-plane time of the latter. On the medium-distance route between Madrid and Granada, though traveling by rail takes longer than by air, the difference is small. On the longest route between Rotterdam and Strasbourg, travelling by air clearly takes less time because of the considerably longer time spent in the train than in the plane.

Figure 4.12 Composition of city-to-city travel time for rail and air trips on selected routes (number of hours), 2019



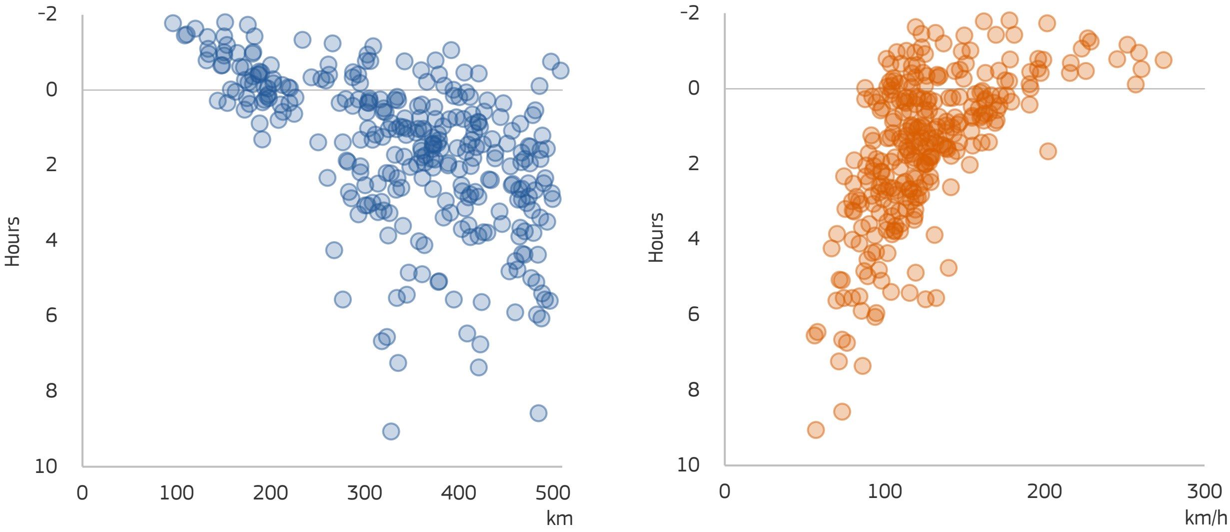
Note: Routes are selected to illustrate trips of different distances. Specifically, they are chosen as the routes closest to the bottom quintile, median and top quintile of the distribution of distances between urban centres. The in-vehicle time includes the taxiing time.
Source: DG REGIO and JRC based on SABRE airline data.

1 The only exception in the dataset is the trip by air from Rotterdam to Antwerp, the in-vehicle component of which consists of a flight between Amsterdam and Brussels.

2 The assumptions used for the present analysis are as follows. Time before boarding the first train – 15 minutes; check-in and boarding at the departure airport – 60 minutes; taxiing is included in the flight time; transfer time at the arrival airport (this includes the time needed to disembark from the plane, wait for luggage to arrive and transfer to the location where the transport connection to the city centre departs) – 30 minutes. A flight speed of 500 km/h is assumed. If more than one connection between airports is available linking the same urban centres, the travel time for the connection with the highest number of passengers is taken.

Figure 4.13 Difference in travel time by rail as opposed to air according to distance between city-pairs (number of hours) and average rail operating speeds, 2019

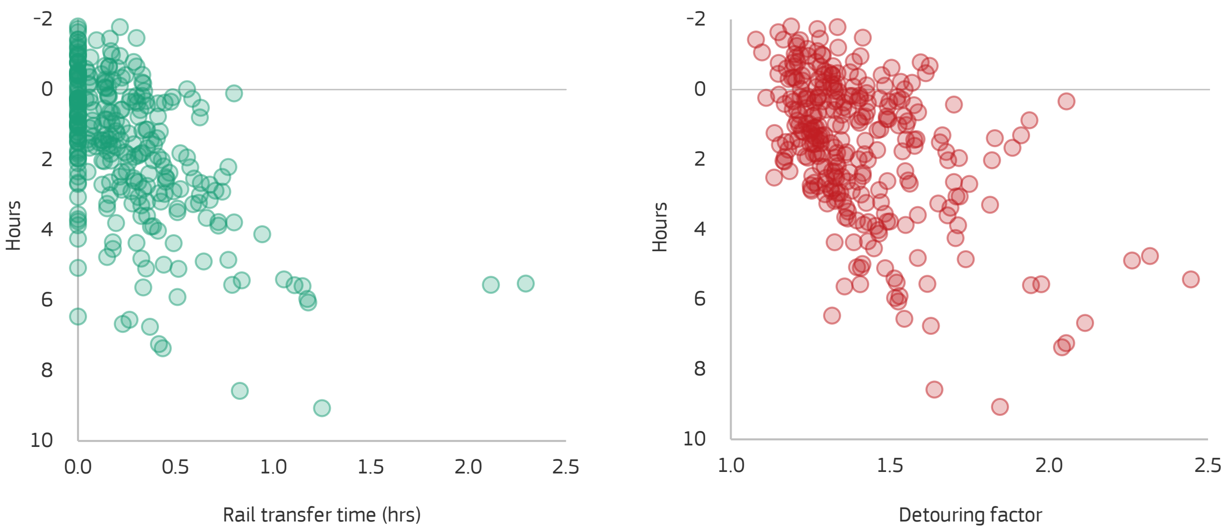
a) Distance of connections between cities-pairs **b) Average rail operating speed**



Note: Negative values on the vertical axis indicate that the total travel time by rail is less than that by air.
Source: DG REGIO and JRC based on SABRE airline data.

Figure 4.14 Difference in travel time by rail as opposed to air according to rail transfer time (hours) and the detour factor, 2019

a) Rail transfer time **b) Detour factor**



Note: Negative values on the vertical axis indicate that the total travel time by rail is less than that by air.
Source: DG REGIO and JRC based on SABRE airline data.

Table 4.2 Rail operating speed, transfer time and the detour factor of rail trips, 2019

	Rail operating speed (km/h)	Transfer time (hrs)	Transfer time (% of rail trip)	Detour factor
Cross-border routes	117	0.36	7.6	1.42
Domestic routes	138	0.12	2.5	1.37
All routes	126	0.25	5.3	1.40

Source: DG REGIO.

where the transfer time exceeds 30 minutes, rail travel is slower than air travel. The rail distance between city-pairs can be a lot longer than the distance 'as the crow flies'. Higher values for the detour factor are associated with longer relative travel time for rail (Figure 4.14b).

On cross-border routes, travelling by rail tends to be slower than on domestic routes by some 20 km/h on average (Table 4.2). The reasons include a slightly larger detour factor, but mainly the longer transfer time of 3 times more, on average, than on domestic routes.

Accordingly, improvements in rail connections could focus on cross-border routes to reduce journey times. The same goes for routes in eastern Member States where train speeds are lower than in other parts of the EU and there are more missing connections. In north-western and southern Member States, almost all cities are connected and rail trips tend to be faster. Nevertheless, for many routes, rail operating speeds are still too low to offer an appealing alternative to air. Increasing these could persuade more people to take the train and so reduce the number of flights.

4.4 Access to electric vehicle recharging points has increased but lags in rural regions

A transition to zero- and low-emission energy carriers (notably electricity) is needed to reduce dependence on oil and the environmental impact of road transport. This requires the development of an appropriate recharging and refuelling infrastructure network for vehicles using zero- and low-emission energy carriers, in particular a network of electricity charging points, which is sufficiently dense to make access easy. This sub-section examines the current availability of such points in the EU and the number which are 'nearby' defined as within a drive of 10 km.

In 2022, an average of 288 charging points could be reached within 10 km of driving in the EU, up from 122 in 2020, an increase of 135 % in two years (Table 4.3). These were clustered in an average of 87 charging pools[44] as against 46 two years earlier, the average number of charging points per pool increasing from 2.7 to 3.3. As a result, the average distance to the nearest charging point fell from 6.9 km in 2020 to 4.1 km in 2022, or by 40 %.

The charging points, however, are by no means evenly distribution across the EU. While most of the regions in the Netherlands, Flanders and Luxembourg have good access to charging points, as do various regions in Sweden, Germany, Austria and Spain (Map 4.13), this is far from the case in almost all the eastern Member States and Ireland. There are large variations between regions within some countries, such as Belgium and Italy, where the north is better served than the south, and Spain, where coastal regions have better access than those inland. Across the EU, capital city regions and other regions with large cities tend, in general, to be better endowed with charging points than others.

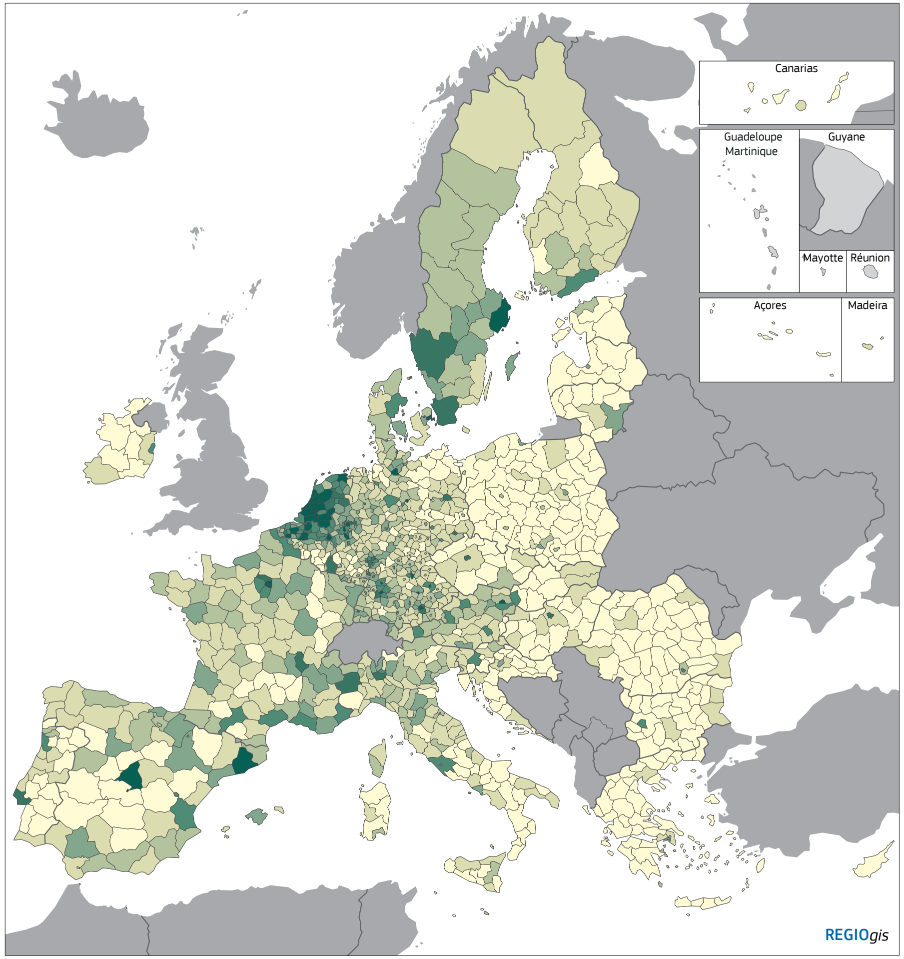
The number of charging points obviously affects the average distance to the nearest one (Map 4.14). This is less than 1 km in Luxembourg,

Table 4.3 Availability of nearby (within 10 km) electric vehicle recharging points and pools in the EU, 2020 and 2022

	Recharging points	Recharging pools	Recharging points per pool	Distance to nearest (km)
2020	122	46	2.7	6.9
2022	288	87	3.3	4.1
Increase 2020–2022	135 %	89 %	24 %	-40 %

Source: DG REGIO and JRC based on data from European Alternative Fuels Observatory (EAFO), Eurostat and TomTom.

44 A recharging pool is a structure in a specific location where one or more recharging points are available (see also: https://alternative-fuels-observatory.ec.europa.eu/general-information/recharging-systems).



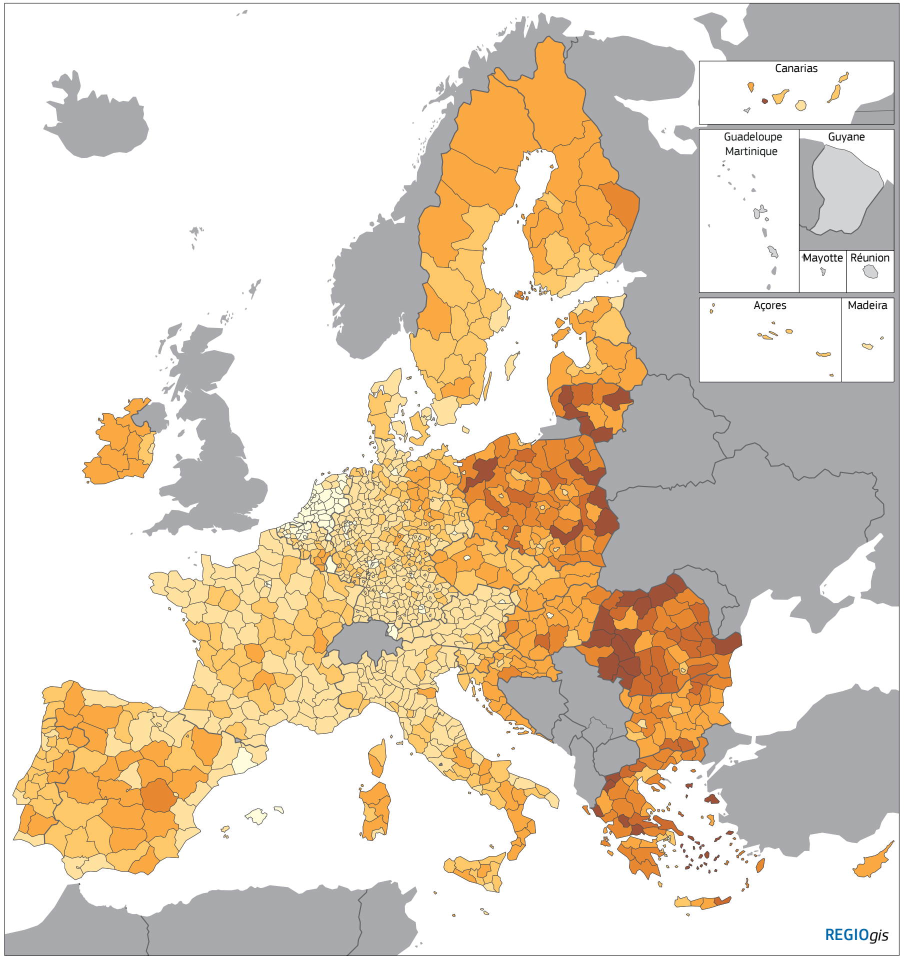
Map 4.13 Electric vehicle charging points within a 10-km drive, 2022

Number of points

- < 20
- 20 – 50
- 50 – 100
- 100 – 200
- 200 – 400
- 400 – 600
- >= 600
- no data

EU-27 = 287.8
Population-weighted average of figures by 1 km² grid cell.
Location data as of 31 December 2022.
Source: JRC based on data from EAFO, Eurostat and TomTom.

0 500 km



Map 4.14 Distance to the nearest electric vehicles charging point, 2022

km

- < 1
- 1 – 3
- 3 – 5
- 5 – 10
- 10 – 15
- 15 – 20
- >= 20
- no data

EU-27 = 4.1
Population-weighted average distance by road of figures by 1 km² grid cell.
Location data as of 31 December 2022.
Source: JRC based on data from EAFO, Eurostat and TomTom.

0 500 km

Table 4.4 Availability of nearby (within 10 km) electric vehicle recharging points and pools by urban-rural typology, 2022

	Recharging points	Recharging pools	Recharging points per pool	Distance to nearest (km)
EU-27	**288**	**86.6**	**3.3**	**4.1**
Urban	620	182.8	3.4	1.6
Intermediate	82	27.5	3.0	4.4
Rural	23	8.4	2.7	8.4

Source: DG REGIO and JRC based on data from EAFO, Eurostat and TomTom.

most regions in the Netherlands, and some in Belgium and Germany, as well as in a number of capital city regions. At the other extreme, the distance to the nearest charging point averages over 20 km in many regions in Poland, Romania, Greece and Lithuania, which is likely to limit the take-up of electric vehicles.

In urban regions across the EU, there was an average of 620 charging points within 10 km in 2022, over twice the EU average, with the average in intermediate regions, and more especially rural ones, being much lower than the EU average (Table 4.4). The average number of charging points per pool (3.4) was also larger than in intermediate (3.0) and rural regions (2.7), while in rural regions the average distance to the nearest charging station was 8.4 km, 5 times more than in urban regions.

The greater availability of charging points in urban regions reflects the higher demand from a larger population living more closely together. However, the difference in availability is more than demographic differences imply, indicating that this represents less of a constraint on owning an electric vehicle in urban regions than in others.

4.5 Hydrogen refuelling points are currently concentrated in a small part of the EU

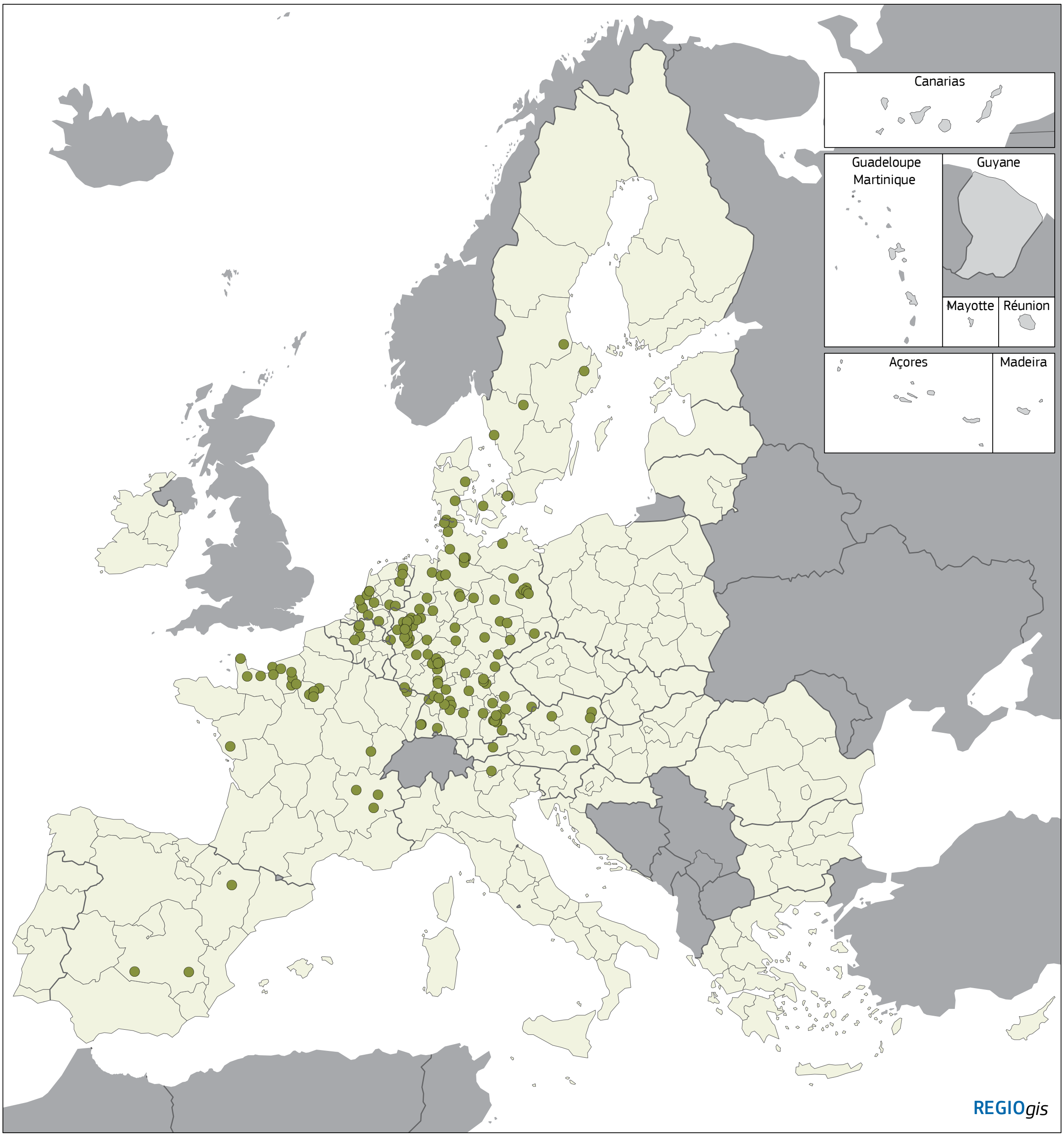
Hydrogen made from renewable energy is also a source of energy with potential to power vehicles in a clean and efficient way. It is envisaged as a significant part of the future fuel mix for transport, at the same time enhancing energy security and reducing dependence on oil, GHG emissions and air pollution[45]. Hydrogen refuelling points currently cover only a small part of the EU, being concentrated in north-western Member States, with 63 % of them located in Germany and another 25 % in France and the Netherlands and none in eastern Member States (Map 4.15). The importance of hydrogen for freight transport is illustrated by the fact that many of the refuelling points are located along inland waterways connecting the large ports of Rotterdam, Le Havre and Antwerp with major cities (Paris, Brussels) and conurbations (the Ruhrgebiet).

5. The challenges of a just transition

Achieving a just and equitable climate transition is a critical challenge. While the shift to sustainability offers the potential for new jobs and economic growth, there are also significant potential costs, particularly for workers in fossil fuel industries and low-income households.

The transition away from fossil fuels will necessitate restructuring in some sectors with inevitable job losses, potentially affecting workers (and their families) with limited skills or opportunities to relocate. In addition, the costs associated with implementing climate-friendly technologies and policies could affect lower-income households disproportionately, exacerbating existing social inequalities, if no access to support to implement energy-efficient solutions is provided to them.

45 https://transport.ec.europa.eu/transport-themes/clean-transport/clean-and-energy-efficient-vehicles/green-propulsion-transport/hydrogen-and-fuels-cells-transport_en.



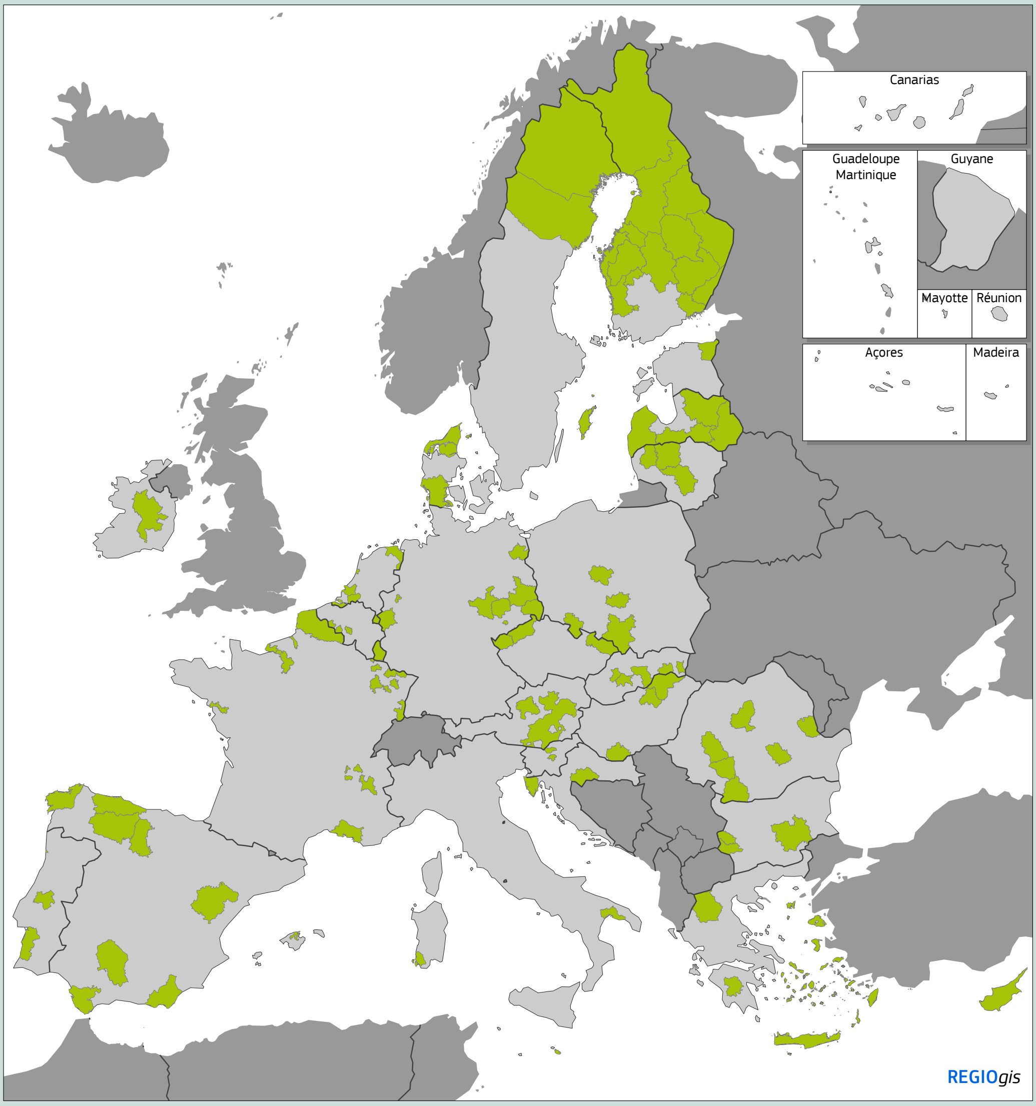
Map 4.15 Hydrogen refueling stations, 2023

● Refuelling stations

Situation in June 2023.
Source: EAFO.

0 500 km

Box 4.6 A just transition to climate neutrality



Map 4.16 JTF territories included in approved territorial just transition plans (Dec. 2023)

JTF territory included in approved territorial just transition plans

Sources: DG REGIO.

0 500 km

The Just Transition Fund (JTF) supports regions that rely on fossil fuels and high-emission industries in their green transition. The fund alleviates the socio-economic costs triggered by climate transition, supporting the economic diversification and reconversion of the territories that are highlighted in Map 4.16. Member States have identified these territories in their territorial just transition plans.

The JTF is one of the three pillars that make up the just transition mechanism. The other two pillars are a dedicated programme under 'InvestEU' and a public sector loan facility.

At the same time, the green transition also provides promising opportunities for job creation. By 2030, an estimated 2.5 million new high-quality jobs could emerge in the EU, particularly in renewable energy and other sustainable sectors[46], with workers having the chance to acquire new skills and to take up employment in the sectors concerned, as well as new employment opportunities for underrepresented groups such as women and young people through reskilling and upskilling.

To ensure a just transition, it is essential that policies are responsive to these changes, and measures are designed to realise the opportunities that arise. This is particularly important in less developed regions, which tend to be less prepared for the transition to a climate-neutral economy and are likely to have more difficulty in reaping the potential benefits. Therefore, the Commission provides support with the JTF (Box 4.6) to EU regions worst affected by the transition to climate neutrality. The JTF supports the economic diversification and reconversion of the territories concerned, as well as upskilling and reskilling of workers, investments in small and medium-sized enterprises, creation of new firms, research and innovation, environmental rehabilitation, clean energy, job-search assistance and transformation of existing carbon-intensive installations.

It is equally essential to prioritise social equity and provide support for workers affected and their households. Investing in retraining programmes through JTF support can help people acquire the skills to take up green economy jobs, while financial support can reduce the burden on low-income households and create a more equitable transition path.

5.1 Progress toward a just transition in fossil and energy-intensive industries

This section presents regional statistics on current employment in carbon-dependent or carbon-intensive sectors in the EU and identifies the areas and activities where the green transition is creating new jobs. It also assesses the territorial impact of extending the ETS to fuels for residential heating and transport. Coal and carbon-intensive regions in the EU that are identified as most severely affected by transition process, receive support from the JTF to support the diversification of their economies in the affected sectors.

Almost 340 000 people were directly and indirectly employed in the coal industry in the EU in 2018. The jobs concerned are highly concentrated, with 60 % in just seven regions (Śląskie and Łódzkie in Poland, Sud-Vest Oltenia in Romania, Yugoiztochen in Bulgaria, Severozápad in Czechia, Köln and Brandenburg in Germany, and Dytiki Makedonia in Greece) (Map 4.17). It is estimated that between 54 000 and 112 000 direct jobs could be lost by 2030[47].

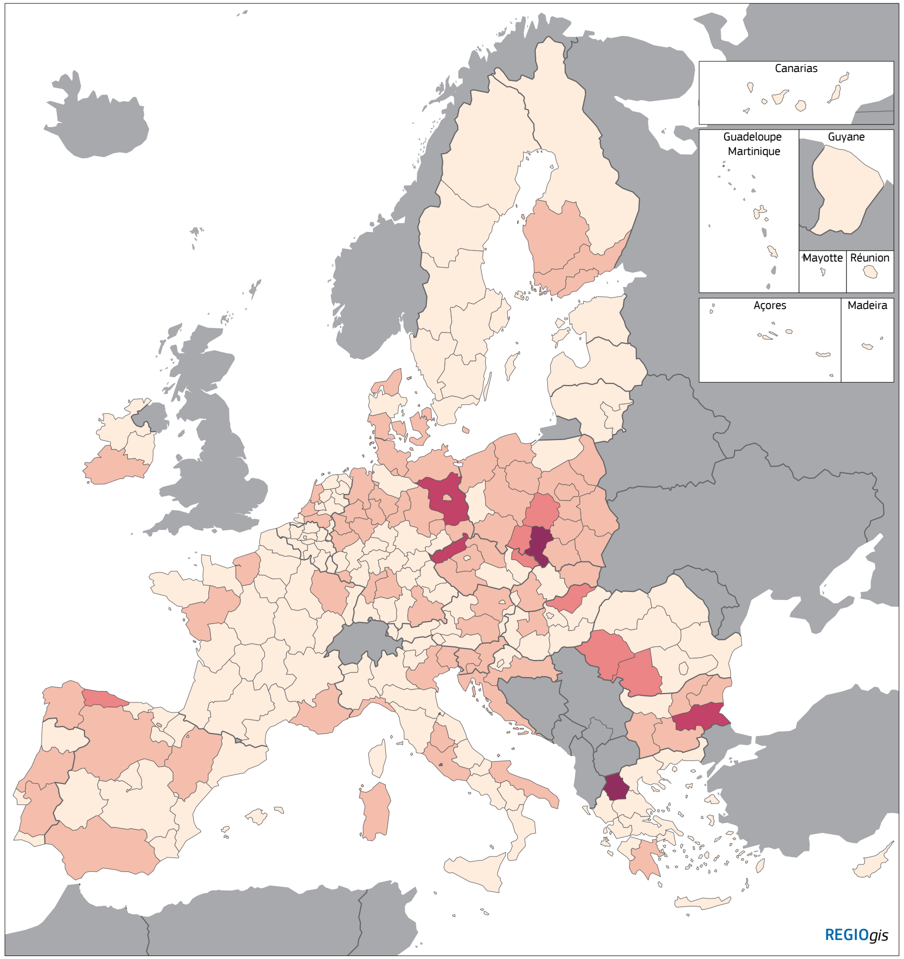
The peat and oil shale industries are smaller. The former is estimated to employ, directly and indirectly, just under 12 000 and the latter almost 7 000, all in Estonia, the only country in the EU with such an industry. Closing down these industries could have a significant impact on local and regional employment and will require economic restructuring.

More people work in carbon-intensive industries. In 2020, nearly 6 million people were employed in the car, steel, minerals, paper, chemicals, coke and petroleum sectors, 3 % of total employment in the EU. The main employment clusters in these sectors are in central Europe (Map 4.18).

The coal industry and carbon-intensive manufacturing face transformational challenges given the EU commitment to becoming climate-neutral by 2050. This means phasing out coal and shifting to low-carbon technologies, such as those based on hydrogen, and using carbon capture and storage where decarbonisation is not yet possible. It also means helping to mitigate the socio-economic and environmental impact of the transition on regions and the people living there. Case studies of fossil fuel phase-out (coalmining in the UK, oil refining in Croatia, and peat extraction in Finland) have shown that carbon-dependent industries are often deeply rooted in

46 Cedefop (2021).

47 Alves Dias et al. (2021).



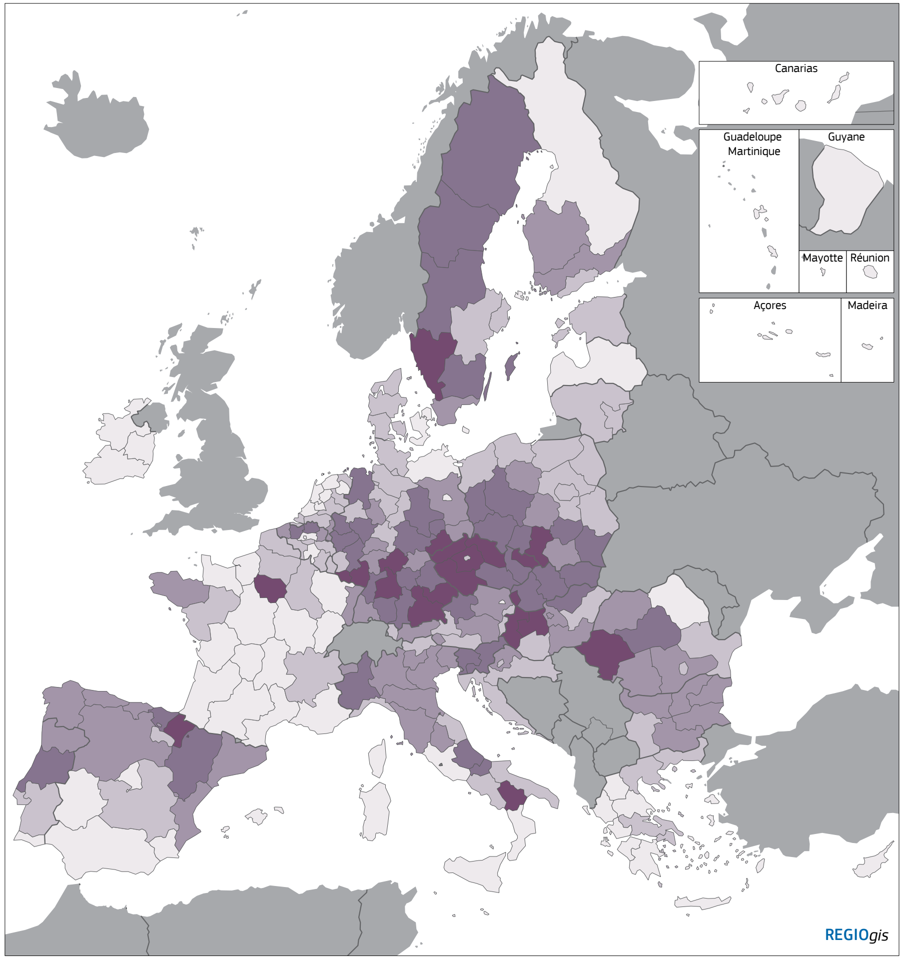
Map 4.17 Employment in the coal industry in NUTS 2 regions, 2018

% of total employment

- none
- <= 0.8
- 0.8 – 2.3
- 2.3 – 4.8
- > 4.8

Direct and indirect jobs in coalmining and coal-fired power plants.
Source: JRC.

0 500 km



Map 4.18 Employment in carbon-intensive manufacturing in NUTS 2 regions, 2020

% of total employment

- <= 1.2
- 1.2 – 2.4
- 2.4 – 3.9
- 3.9 – 6.1
- > 6.1

Direct employment in paper and pulp (NACE17), coke and refined petroleum products (NACE19), chemicals (NACE20), non-metallic minerals (NACE23), basic metals (NACE24), and motor vehicles (NACE29).
Source: Eurostat.

0 500 km

local culture and identity[48]. The industries are concentrated in a few places and job losses have been shown to have long-term adverse physical, mental and social effects on the people and communities concerned. Attempting to retrain the workers losing their jobs is insufficient. There needs to be long-term cohesive educational, financial and social support to ensure a just transition. The support involved needs to be early and targeted, with collaboration with existing local support networks and alignment of interests among key stakeholders. The case studies highlight the importance of place-based measures, centred on partnership.

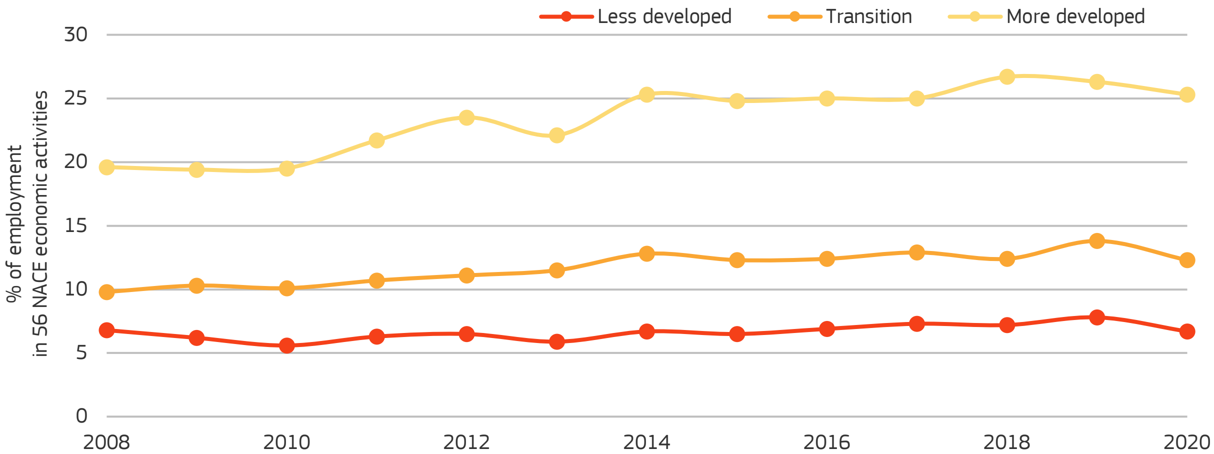
5.2 Competitiveness and sustainability of sectors in the climate and energy transition

The transition to a competitive green economy is underway, but the pace varies between regions. The regional competitive environmental sustainability indicator[49] has been developed to show the share of employment in 56 NACE (nomenclature of economic activities) sectors that are systematically more competitive and sustainable than the EU median (Map 4.19). Sectoral competitiveness is measured by labour productivity and sustainability by GHG emissions per worker. The indicator has been calculated for the years 2008–2020 and shows the shift in employment towards greener and more productive sectors over this period.

In 2019, the average region had 17 % of employment in sectors that were both more competitive and more sustainable than the EU median. The share was largest in southern Germany, northern Austria, southern Ireland, and southern Scandinavia, as well as in capital city regions. Between 2008 and 2020, the share increased by significantly more in more developed regions than in less developed or transition ones (Figure 4.15), widening the difference between them.

Econometric analysis suggests that the transition to more competitive and sustainable regional economies is positively associated with investment co-funded by the ERDF, CF and European Social Fund[50]. This is particularly true in respect of competitiveness and the restructuring towards higher value-added sectors, which is especially evident in less developed regions that receive most funding. Improvements in sustainability, however, are much

Figure 4.15 Trends in the regional competitive environmental sustainability indicator by category of region for Cohesion Policy, 2008–2020

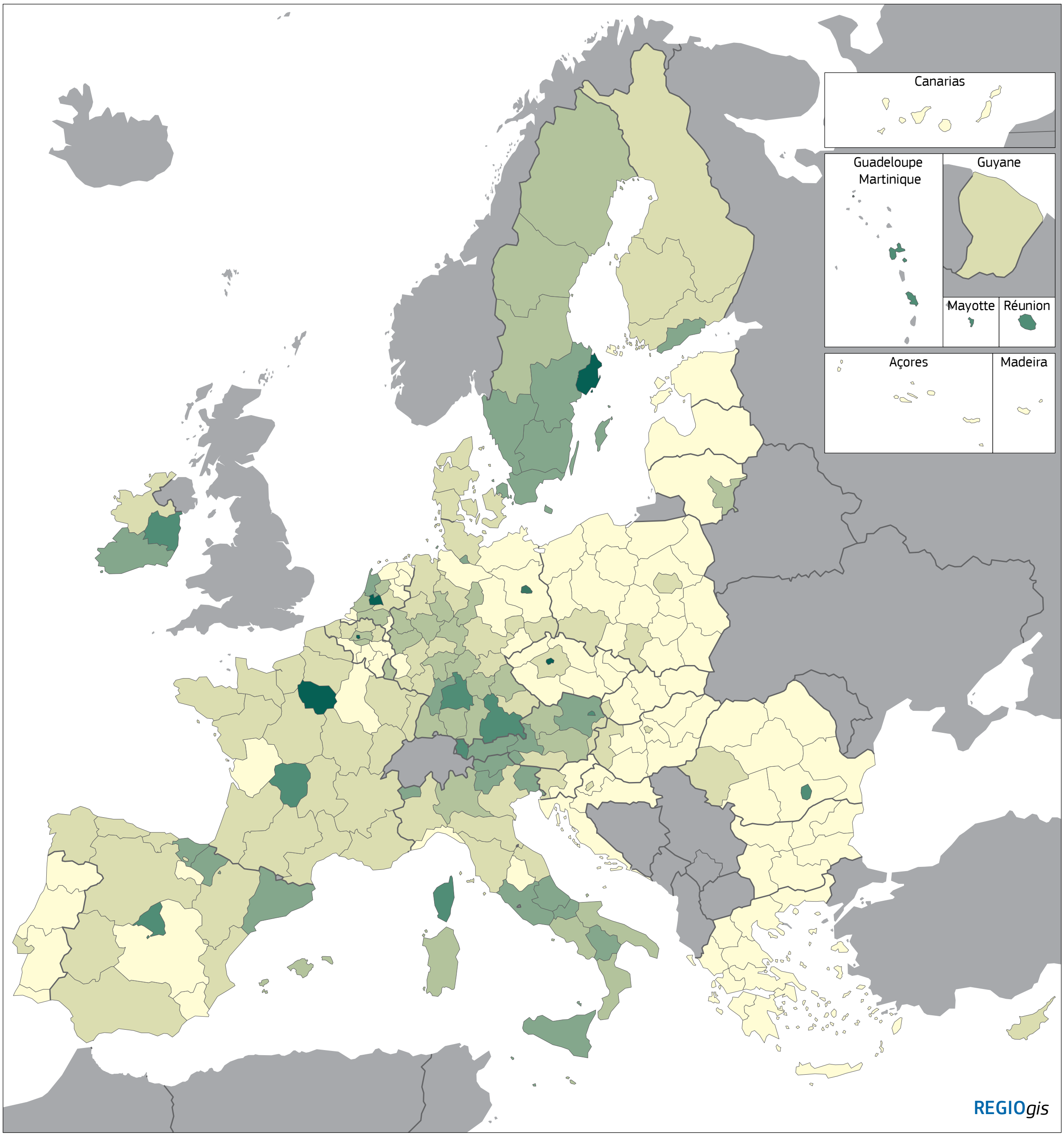


Note: Share of employment in 56 NACE sectors that are systematically more competitive and more sustainable than the EU median (%).
Source: JRC.

48 Kaizuka (2022).

49 Marques Santos et al. (2023) and update for 2019 and 2020 in Marques Santos et al. (2024).

50 For more details see Marques Santos et al. (2023).



Map 4.19 Regional competitive environmental suitability indicator, 2019

% of total employment

- <= 10
- 10 – 20
- 20 – 30
- 30 – 40
- 40 – 50
- 50 – 60
- > 60

Share of employment of 56 NACE sectors that are systematically more competitive and more sustainable than the EU median.
Source: JRC.

0 500 km

less evident, suggesting that this is more difficult to achieve and that the transition to a low-carbon economy requires more time and effort. Factors such as R&D, the quality of government, and the qualifications of the workforce seem to be important in this regard. Adequate policy-making, reforms and investment are essential to implement the transition to a low-carbon economy and adjust to new circumstances in a way that spurs employment, competitiveness and economic growth, with a focus on leveraging circular economy principles and deploying clean technology solutions to drive innovation and efficiency across industries.

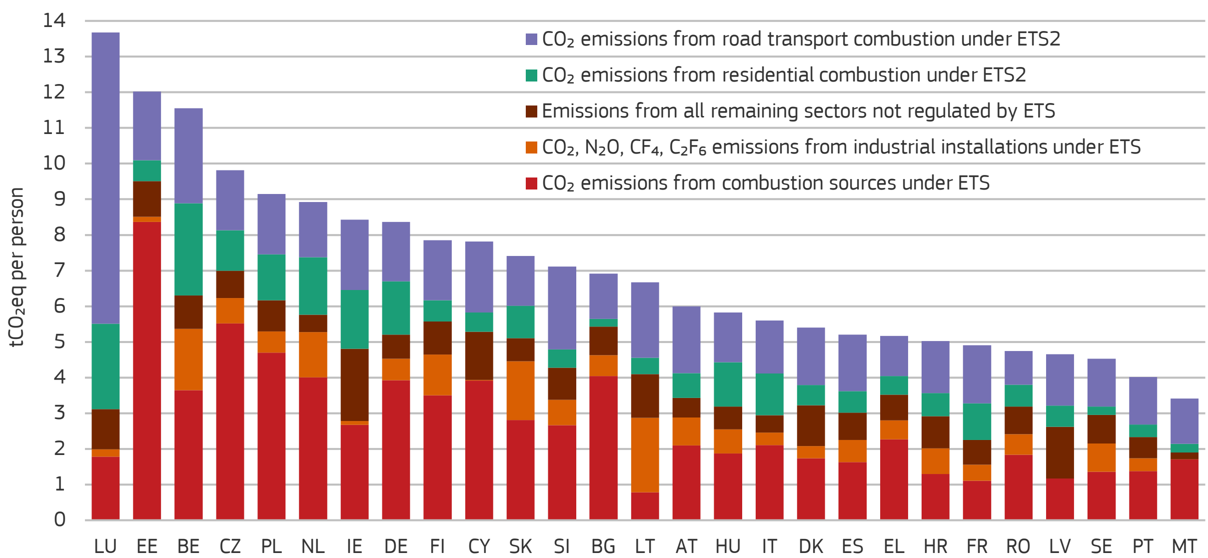
5.3 Longer-term impact of the extension of the ETS and the transformation of industrial and service sectors

The ETS is designed to limit emissions of GHGs from power generation and large industrial plants through a cap-and-trade mechanism. In 2021, the ETS covered 40 % of GHGs emitted in the EU. In 2023, the EU approved a new ETS for fuel combustion in buildings, road transport and a few other sectors. The emissions concerned account for another 40 % of EU emissions and so are equally important for achieving climate objectives. The share of emissions covered varies between countries and regions. The share is largest in Luxembourg (Figure 4.16), mainly because of international through traffic.

While GHG emissions from household energy consumption declined by 30 % between 1990 and 2021, those from road transport, which remains highly dependent on oil and petrol, increased by 18 %.

Higher prices for carbon fuels give an incentive for innovation and help to reduce emissions, but they tend to hit poorer households harder. The extension of the ETS means that climate action will become more tangible for people, as they will be directly affected in heating their homes and using their cars as taxes are imposed or increased from 2027 under the system. Across the EU, households spend an average of between 3 % and 10 % of their income on heating and fuel (Figure 4.17). Although household expenditure on heating fuels in the EU increases with household disposable income[51] – for the 20 % of households with the highest income (i.e. in the top quintile of the income distribution), expenditure is around twice as high as for the 20 % with the lowest levels – it increases less than in proportion. It, therefore, represents

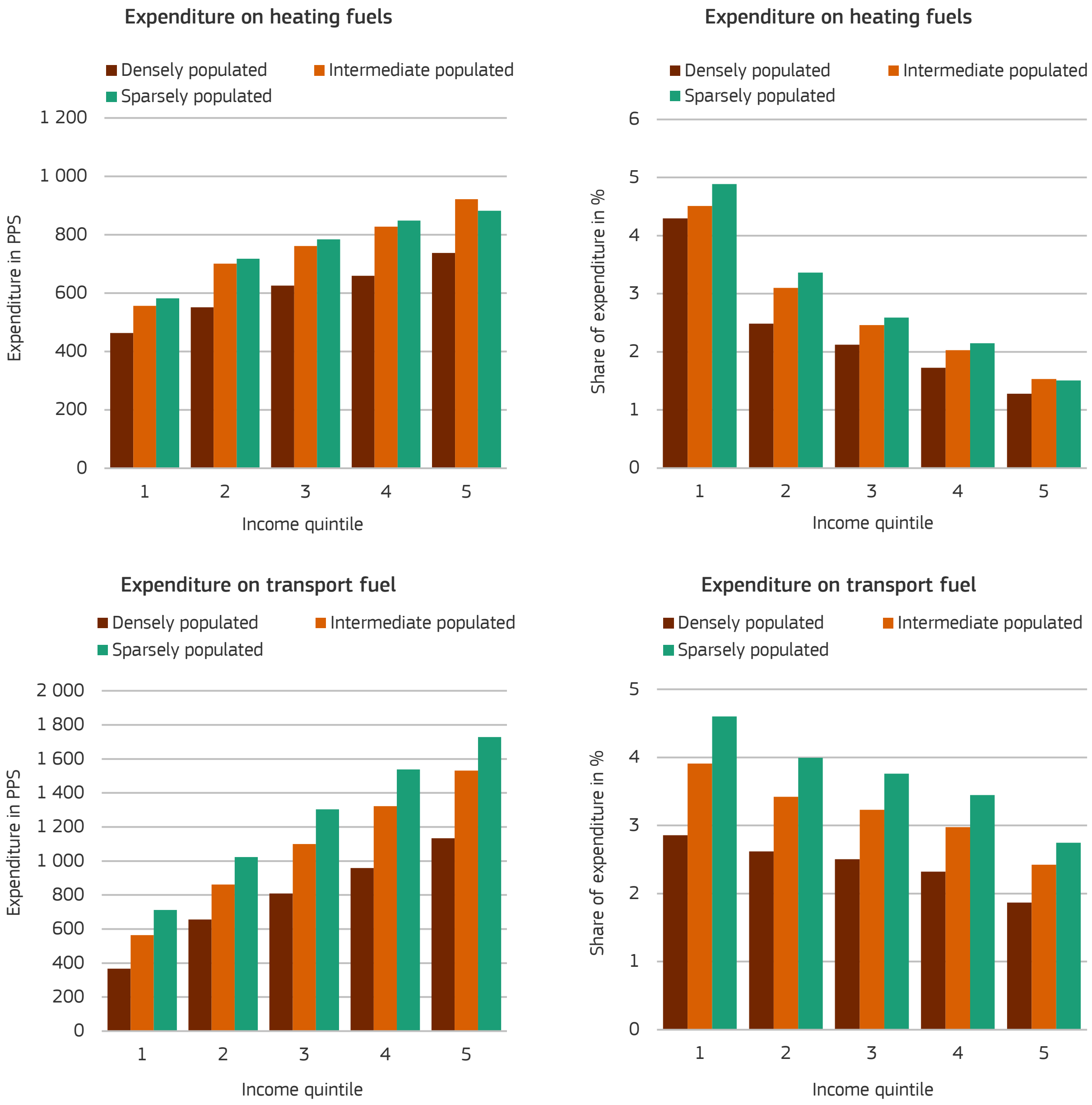
Figure 4.16 Emissions under the ETS and ETS2



Source: EDGAR (JRC).

51 Koukoufikis and Uihlein (2022); Ozdemir and Koukoufikis (2024).

Figure 4.17 Average expenditure and share of household income going on fuel for heating and transport by income quintile, EU, 2020



Note: Data for CZ, IE, IT, PL, PT, RO, FI and SE are not yet available for 2020; for CZ in 2015, population weights were adjusted with European Union statistics on income and living conditions (EU-SILC) weighted total number of households.
Source: JRC based on Eurostat.

a larger share of overall expenditure for the households in the bottom quintile than for those in the top. Fuel price increases, therefore, affect poorer households more because more of their budget goes on heating, posing increased risks of energy poverty. Households living in densely populated areas systematically spend less on heating than those in intermediate or sparsely populated areas, irrespective of income levels.

Total expenditure on fuel for transport is highest for all income groups in rural areas, and lowest in urban areas. The share decreases as income increases. As expected, the share of expenditure for transport fuels is larger in rural areas than others because of the greater use of private cars and motorcycles and a lower availability of public transport.

Extending the ETS to include fuel for heating and transport will therefore have a particularly large impact on low-income households in rural areas. The sharp increase in energy prices in 2022 seems to have led households to seek alternatives for heating their homes–firewood and heat pumps in particular. The price of firewood and pellets[52], therefore, was 54 % higher in the EU in November 2022, when it peaked, than the year before, and in Austria, Denmark, the three Baltic States, and Slovenia, twice as high, while sales of heat pumps in the EU increased by 39 % in 2022[53].

6. Key messages

The green transition has the potential to reduce regional inequalities, but it could equally lead to them widening. On the one hand, it is expected to create new jobs, provided it is supported by appropriate policies, especially in rural, less developed regions that have high potential for the development of wind and solar power and for carbon capture and storage in natural ecosystems. On the other hand, there is evidence that the green transition favours more developed regions, attracting investment and skilled workers there, while posing challenges for employment and households in low-income rural areas, in particular, and potentially exacerbating social inequalities.

Addressing these challenges requires deepening the territorial approach to implementing the green transition in an equitable way. This can be done by supporting vulnerable regions through co-financing investment in renewable energy, energy-efficiency, clean and circular technologies, carbon-free vehicles and the corresponding infrastructure, and retraining and education, taking into account the 'do no significant harm' principle to balance trade-offs. This is particularly important in less developed regions, which tend to be less prepared for the transition to a climate-neutral economy and to have more difficulty in reaping the potential benefits. It is equally important to prioritise social equity and provide support for the workers affected, through retraining so that they have the skills to take up green jobs, and to help mitigate the burden on low-income households. As the green transition unfolds, minimising the impact on energy costs is vital to prevent heightened risks of energy poverty. Also, rural-proofing can help make policies on climate adaptation, energy, transport or employment fit for purpose.

Climate risk management and adaptation to climate change is becoming increasingly important to mitigate the escalating costs of extreme weather events, floods, forest fires and water shortages. Better preparedness and increased climate resilience, such as by protecting and restoring ecosystems, depend on pro-active territorial policies to help vulnerable regions reduce the economic costs of disaster mitigation, infrastructure repairs and the consequences for healthcare, and so ensure their financial stability.

52 According to the Eurostat harmonised index of consumer prices (other solid fuels comprise coke, briquettes, pellets, firewood, charcoal and peat).

53 European Heat Pump Association (2023).

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