EEA Report | No 10/2022

Trends and projections in Europe 2022

European Environment Agency

Cover design: EEA
Cover photo: © Sibylle Maus, Sustainably Yours/EEA
EEA Layout: Formato Verde

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Luxembourg: Publications Office of the European Union, 2022
(https://op.europa.eu/en/web/general-publications/publications)

ISBN 978-92-9480-505-8
ISSN 1977-8449
doi: 10.2800/16646

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Acknowledgements

This report was prepared by the EEA and its European Topic Centre on Climate Change Mitigation and Energy (ETC/CME). The ETC/CME is a consortium of European institutes that assists the EEA in providing support to EU policy in the field of climate change mitigation and energy. The authors were Hannah Förster, Sabine Gores, Christian Nissen, Anne Siemons and Christian Winger (Öko-Institut); Nele Renders (Vito); and Jorre De Schrijver, Melanie Sporer and Mihai Tomescu (EEA). The overall coordination of the report was carried out by Melanie Sporer and Jorre De Schrijver (EEA) and the ETC/CME task manager, Sabine Gores (Öko Institut).

Additional EEA support for the preparation of this report was provided by Suzanne Dael, Javier Espárrago, Eva Jensen, Cinzia Pastorello, Claire Qoul, Alejandra Bize López and Tommaso Selleri.

The EEA would like to thank the national focal points and experts of the EEA member countries, as well as the European Commission, for their cooperation during the preparation of this report. The EEA acknowledges the comments received and has included them in the report as far as is practically feasible.

About this report and its scope

This report explores the historical trends, most recent progress and projected future paths towards mitigating climate change through reduced greenhouse gas emissions, renewable energy gains and improved energy efficiency. It builds on data reported by the 27 EU Member States (EU-27), Iceland and Norway.

The report is accompanied by a technical background document, which describes the data sources and targets mentioned in this report in more detail.

Throughout the report, the following scope applies, unless noted otherwise:

- References to the EU relate to the EU-27.
- Projections are those reported by countries in 2021, and updated in 2022 by three Member States (Denmark, Ireland, Latvia) and Iceland, under Article 18 of the Governance Regulation.
- Global warming potentials from Intergovernmental Panel on Climate Change's Fourth Assessment Report (AR4) are used to represent greenhouse gas emissions.

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Executive summary

Parallel unfolding crises underline the urgency of climate action

In July 2021, the European Climate Law entered into force. All the pieces seemed to be in place for a head start in the energy and climate transition in Europe: a 2030 climate target in line with the binding pledge to achieve climate neutrality by 2050 was set, numerous legislative proposals aimed at reaching the ambitious targets had been made at both the EU and national levels, and key innovative technologies continued to improve.

However, circumstances have changed. While 2020 was marked by the COVID-19 crisis, 2021 saw a partial economic recovery with the removal of restrictions that had been imposed in response to the pandemic. At the same time, other crises emerged.

Over the past year, the impacts of climate change have been more apparent than ever: severe droughts, water scarcity, floods and record temperatures have emphasised yet again the potentially devastating effects of climate change. The mean annual temperature over European land areas in the last decade was about 2°C warmer than during the pre-industrial period (EEA, 2022c). Weather and climate-related extremes have led to rising costs in both human and monetary terms.

In addition, an energy supply crisis emerged from mid-2021 onwards, resulting in substantial increases in energy prices and uncertainty about energy supplies. This raises the stakes and makes achieving energy and climate policy objectives in the EU even more urgent.

These developments have only intensified in 2022: the Russian invasion of Ukraine further disrupted the European energy system, while the summer of 2022 saw unprecedented droughts in many European countries.

These unfolding crises have had a clear influence on the trends and projections for greenhouse gas (GHG) emissions in the EU, as shown in this report. Preliminary data indicate that the EU's GHG emissions and energy consumption increased in 2021 compared with 2020 levels, while the share of renewables in total energy consumption remained largely unchanged. This can be attributed mainly to the post-pandemic economic recovery, but other factors are also at play. By the end of 2021, rising gas prices had led to a switch in energy supplies to more affordable, carbon-intensive fuels, with an increase in the use of lignite and hard coal. These trends have continued in 2022 with the development of new fossil fuel energy infrastructure, and this may lead to carbon lock-in effects in the coming years.

At the same time, this report shows that the fundamental aspects of the transition towards climate neutrality are in place. The latest GHG emission data confirm that the 2020 targets, which were set in 2008 as an ambitious package, were all achieved or exceeded in 2020. Despite the increases in 2021, the levels of GHG emissions and energy consumption remained below both the 2020 targets and the 2019, pre-COVID levels. The share of renewables is expected to have stayed at about the level of 2020 in 2021, meaning that renewable energy production increased by the same extent as energy consumption over the last year.

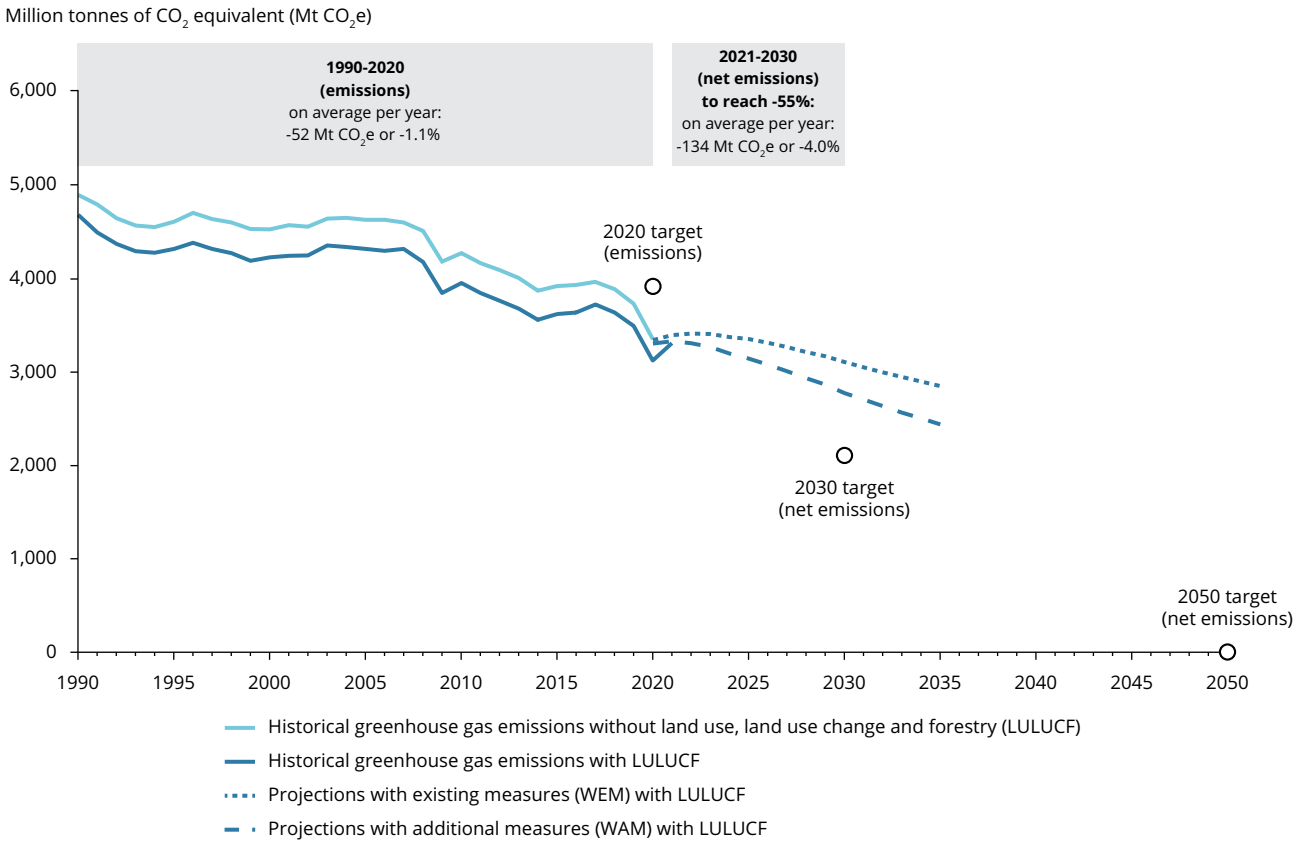
The data included in this report are based on data reported by the 27 EU Member States, Iceland and Norway, and present a historical snapshot in which changes in 2022 are not yet included. The rapidly changing circumstances make interpretation of the trends challenging. The conclusion, however, is clear. In these times of crisis, an increased focus on emission reductions, increasing renewable energy share and increasing energy savings will be crucial, for both economic recovery and climate action.

Greenhouse gas emissions rebounded in 2021, but remained below pre-COVID levels

Official GHG emission data reported by the 27 EU Member States confirm that the EU has fully achieved its 2020 climate and energy targets. The EU-27's 2020 GHG emissions were 32% below 1990 levels, thus by far exceeding the 2020 target of a 20% reduction. Part of this decrease in 2020 can be attributed to the pandemic, although emission levels were already below the 2020 target in 2018 and 2019.

Estimates from preliminary data, reported by Member States more recently, suggest that GHG emissions increased by 5% in 2021, compared with 2020 levels. These estimated emissions remain 6% below the pre-COVID level of 2019 however and more than 8 percentage points below the 2020 target (as illustrated in Figure ES.1).

Figure ES.1 Historical trends and future projections for greenhouse gas emissions



Note: The historical development of GHG emissions is shown both excluding the sector of land use, land use change and forestry (LULUCF) (grey solid line, labelled 'emissions') and including LULUCF (black solid line, labelled 'net emissions'). The grey line relates to the scope of the 2020 target, while the black line reflects the scope of the 2030 target. Both of these trend lines include approximated values for 2021. Projections are shown in dashed and dotted black lines and relate to the 2030 target's scope, starting from 2020. The projections are based on the most recent data submitted by Member States, which for Denmark, Ireland and Latvia are from 2022 and for all other Member States are from 2021. The top-left grey bar indicates the average annual change in emissions (including international (int.) aviation, but excluding LULUCF emissions and removals) that occurred between 1990 and 2020. The top-right grey bar indicates the change that will be necessary between 2021 and 2030 on an average annual basis to achieve a net reduction in emissions of 55% compared with 1990 levels, assuming the maximum contribution of net removals from the LULUCF sector to the Union target of 225 megatonnes of carbon dioxide equivalent (MtCO_2e) in 2030.

Sources: EEA (forthcoming a, forthcoming b, forthcoming c).

Achievements in GHG emissions reductions since 2005 vary at the sectoral level. Emissions in the EU-27 covered by the EU Emissions Trading System (ETS), which mainly covers the energy supply and industry sectors, were 37% below 2005 levels in 2021. These emissions were 7% higher than in 2020, but remained below the pre-COVID level of 2019, for similar industrial production levels. In the energy sector, renewable production continued to grow, but fossil fuel production saw a shift from the use of natural gas to the use of coal and lignite in the last months of 2021.

For the sectors covered by the Effort Sharing legislation, which establishes annual binding targets at Member State level for 2020 and subsequently for 2030, recent estimates for 2021 indicate that emissions increased by 4% from the year before. The most notable changes occurred in transport, with an estimated increase of 8% compared with 2020, but a decrease of 7% compared with 2019. Falling prices of electric vehicles and changes in commuting and travelling patterns after the COVID-19 pandemic may be determining factors in this sector.

In 2020, European forests and soils covered by the land use, land use change and forestry (LULUCF) sector removed 230 megatonnes of carbon dioxide equivalent (MtCO_2e) from the atmosphere, which equals about 7% of the EU's total GHG emissions. Preliminary estimates for 2021 suggest that the sink decreased in size by 8% compared with 2020, continuing the persistent decline in the size of the sink since 2014.

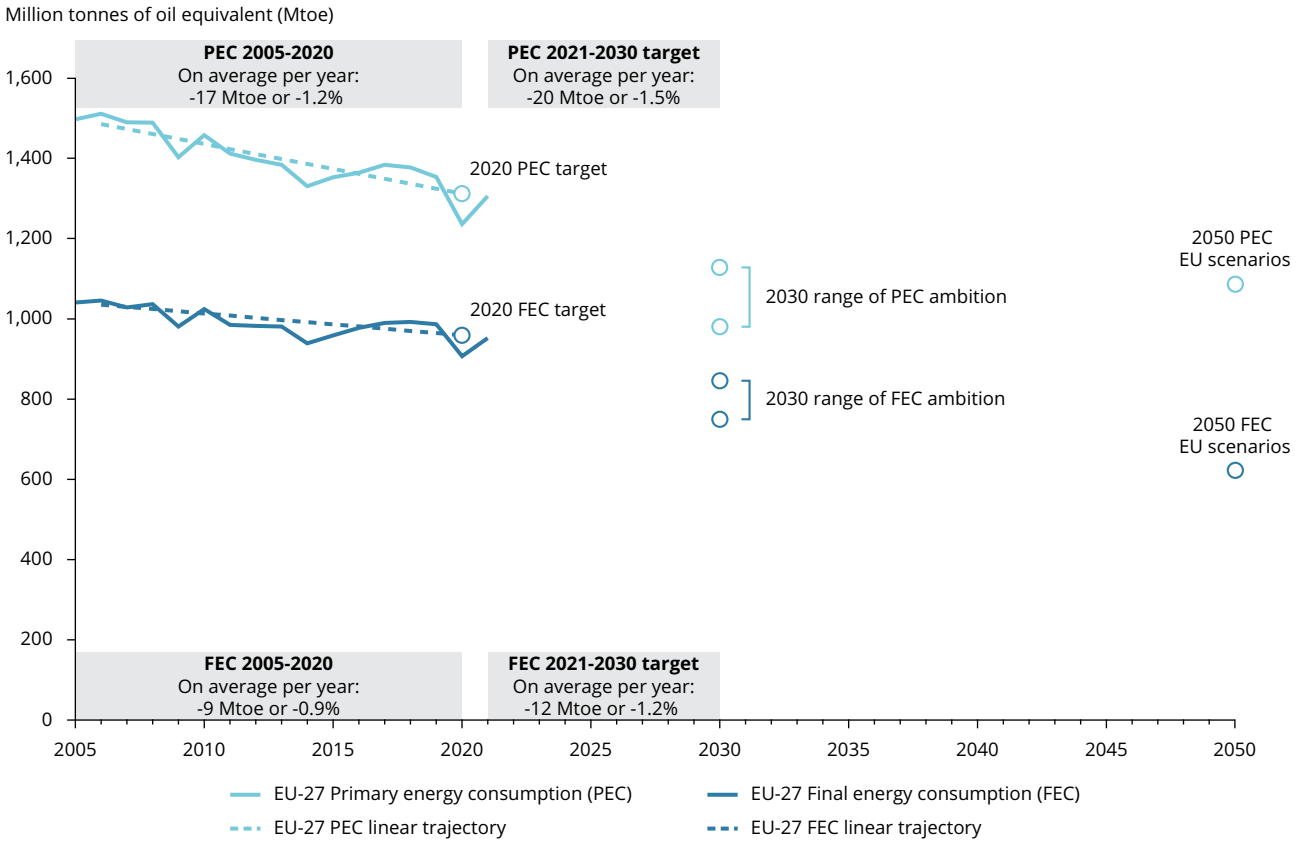
Energy consumption increased in 2021 but was still lower than the 2020 target, while the renewable energy share remained at 2020 levels

In 2020, final and primary energy consumption levels in the EU-27 were more than 5% below the intended targets for that year. As such, the EU-27 met its energy efficiency target for 2020 in the final year of the target period, after having not been on track to do so.

The substantial reduction in energy consumption in 2020 was largely driven by the COVID-19 pandemic, as the industry and transport sectors slowed or even stood still for several months in 2020. Estimated energy consumption levels for 2021 indicate that both primary and final energy consumption increased, by 6% and 5% respectively, compared with 2020 levels (as illustrated in Figure ES.2). Based on these preliminary values, energy consumption levels in 2021 remained just below the 2020 target levels.

This increase in energy use in 2021 can be largely attributed to the post-pandemic economic recovery. However, energy price increases from the second half of 2021 led to clear incentives to save energy. Moreover, reductions are expected in 2022 as a result of the effects of the energy supply crisis, with the European Commission seeking to address these new challenges through the REPowerEU plan.

Figure ES.2 Historical trends and outlooks on energy consumption



Note: FEC denotes final energy consumption, while PEC denotes primary energy consumption. The targets labelled '2030' reflect the current 2030 targets of an energy consumption reduction of at least 32.5% compared with projected 2030 energy use. The proposed levels of ambition from the 'Fit for 55' package depict increased 2030 ambition, with a 36% reduction in FEC and a 39% reduction in PEC (both compared with the 2007 reference scenario projection for 2030); or a 9% reduction compared with the projections of the 2020 reference scenario. In the REPowerEU plan, a further increase in the binding energy efficiency targets is proposed by the Commission, namely a 13% reduction in FEC and PEC in comparison with the projections of the 2020 reference scenario.

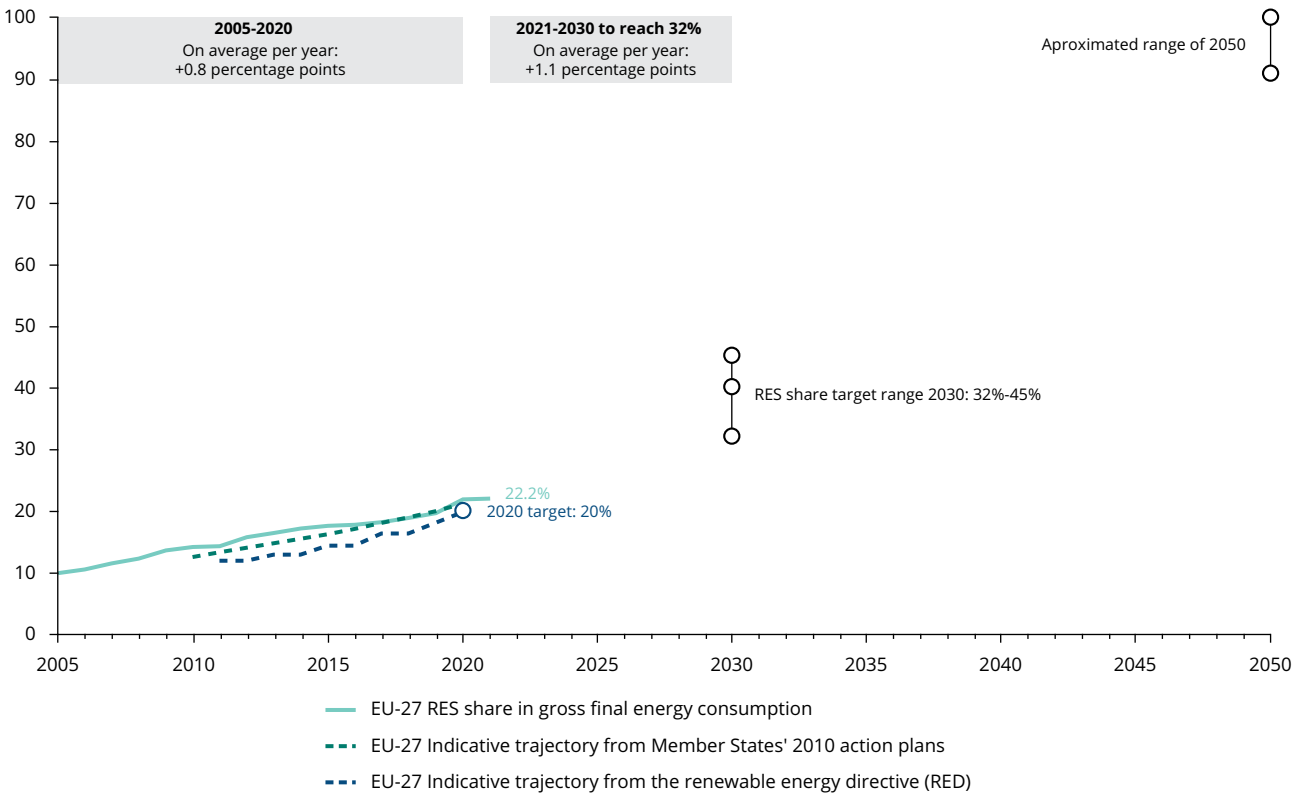
Sources: EC (2020a, 2021i, 2022c, 2022f); EEA (forthcoming a).

In the area of renewable energy generation, the EU-27 achieved a level of 22% of total energy consumption from renewable sources in 2020, thus meeting its 20% target (as shown in Figure ES.3). The greatest shares of renewable energy were observed in electricity consumption and, to a lesser extent, in heating and cooling. Assisted by a lower level of total energy consumption, the target of a 10% share of renewable energy sources in the transport sector was only just achieved in 2020.

Preliminary data suggest that the share of renewables in total energy consumption remained at 22% in 2021, and thus that the strong rate of increase in this share observed in recent years had paused. This could have been due to lower contributions from wind power and hydropower to energy production in 2021, alongside a rebound in energy consumption following the pandemic. As a result, the 2021 shares of renewables in electricity and transport are comparable to those of 2020. For heating and cooling, which contributes to half of total renewable energy use in the EU-27, estimates suggest a small increase in the renewable energy share, of 0.5%, in 2021.

Figure ES.3 Historical trends and outlook for renewable energy shares

Percentage of renewable energy sources (RES) share in gross final energy consumption



Note: The current 2030 target, adopted from the Renewable Energy Directive (2018/2001/EU), is for renewable energy sources to account for a 32% share of gross final energy consumption (RES share). The proposed target from the `Fit for 55' package is a more ambitious 40% RES share by 2030. The REPowerEU plan proposes a target of a 45% RES share by 2030 (EC, 2022c). The 2050 values represent the indicative RES shares as presented in Figures 5 and 8 of a Commission staff working document (EC, 2020a) of scenarios that achieve a reduction in GHG emissions of at least 55% by 2030.

Sources: EC (2020a, 2021h); EEA (forthcoming a, forthcoming b, forthcoming c); EU (2018); Eurostat (2022b).

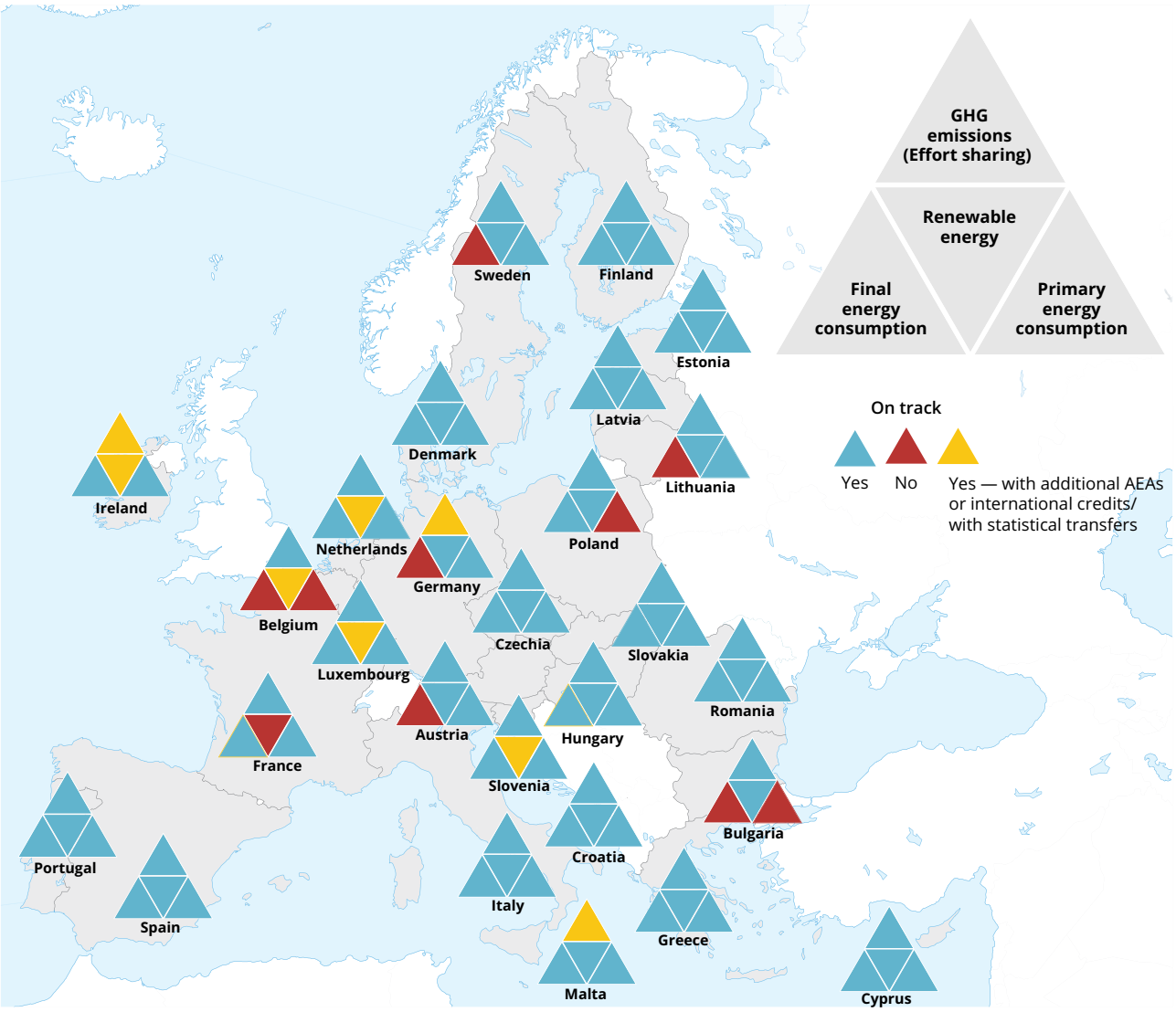
Most Member States expected to achieve their 2020 targets

The final 2020 figures confirm that most EU-27 countries achieved their national energy and climate targets (as illustrated in Figure ES.4).

A total of 24 EU countries (all except Cyprus, Ireland and Malta) had greenhouse gas emissions in 2020 that were below their national targets under the Effort Sharing Decision (ESD). Looking over the entire period 2013-2020, the Effort Sharing emissions from Germany, Malta and Ireland exceeded the national annual emissions allocations allocated for those countries. As in 2020 for all these four countries (Cyprus, Ireland, Malta and Germany) the effort sharing emissions exceeded the available national annual emission allocations, these countries need to use some of the 'flexibilities' available under the ESD to comply with their 2020 targets. If those four countries make sufficient use of such flexibilities, all EU-27 countries will have achieved their effort sharing targets as they did for previous years.

Regarding renewable energy, a total of 26 countries (all except France) met or exceeded their 2020 renewable energy share targets. To do so, five of these countries (Belgium, Ireland, Luxembourg, the Netherlands and Slovenia) made use of statistical transfers that they acquired from other countries (Czechia, Denmark, Estonia, Finland, Lithuania and Sweden). Concerning energy efficiency, 21 Member States reduced their final energy consumption enough to reach levels below their indicative 2020 targets. However, Austria, Belgium, Bulgaria, Germany, Lithuania and Sweden had not reduced their final energy consumption enough to meet their 2020 final energy targets, even given the effects of the COVID-19 pandemic. In relation to the indicative targets for primary energy consumption, 24 Member States met their 2020 targets, while this was not the case for Belgium, Bulgaria and Poland.

Figure ES.4 Member States progress towards 2020 national targets



Doubling of annual progress needed considering the 2030 climate target and energy supply crisis

In July 2021, the European Climate Law entered into force, establishing the goal of achieving climate neutrality by 2050 and increasing the 2030 target to a reduction of at least 55% in net GHG emissions by 2030, compared with 1990 levels. At the time of publishing this report, the co-legislators were negotiating elements of the EU's 2030 climate and energy framework, including the binding targets for renewable energy and energy efficiency. In its 'Fit for 55' package of July 2021, the European Commission proposed 2030 targets of a 40% renewable energy share and a reduction in energy consumption of 9%, compared with the 2020 reference scenario. However, in response to the current energy supply crisis, the REPowerEU plan of 2022 proposes higher targets still for 2030: a 45% renewable energy share and a 13% (rather than 9%) energy efficiency target. In addition, in July 2022 the EU Member States reached a political agreement on a voluntary reduction in natural gas use of 15% between 1 August 2022 and 31 March 2023.

For the vast majority of Member States, current projections of future GHG emissions predate the European Climate Law, and the 'Fit for 55' and REPowerEU proposals. It should therefore come as no surprise that these recent policy proposals are not yet reflected in national projections. Regarding net GHG emissions, aggregated projections from Member States indicate that the additional policies and measures that they intend to launch in the coming years will deliver a 41% reduction by 2030. These projections will be updated by all countries in March 2023. For energy efficiency and renewable energy, updated national contributions to EU targets will not be available until 2023, after the submission of draft NECP updates.

It is clear that in the coming years substantial emission reductions will need to be sustained to achieve climate neutrality in the long term. To reach the target of a 55% reduction in estimated net GHG emissions by 2030 compared with 1990 levels, emissions would need to decline by 134MtCO_2e per year on average in the period 2021-2030. This is less than the net emission cut accomplished between 2018 and 2019 (of 142MtCO_2e), but more than twice the average yearly reduction achieved between 1990 and 2020.

With regard to energy consumption, average annual reductions of 0.9% and 1.2% in final and primary energy consumption respectively were observed in the period 2005-2020. These annual reductions will have to substantially increase in the coming years — meeting the 2030 target newly proposed in the REPowerEU plan would require annual energy savings to more than double from 2022 onwards.

Since 2005, the share of renewable energy sources in gross final energy consumption has been growing at an average rate of 0.8 percentage points every year. To achieve the current 32% 2030 renewable energy share target, the growth in renewable energy share across the EU would have to increase to at least 1.1 percentage points per year on average. This growth would need to increase to 2.5 percentage points per year to meet the higher 2030 renewable energy target proposed in the REPowerEU plan.

Crucial times in the transition towards climate neutrality

The current unprecedented energy supply crisis and the 55% climate target for 2030 require an exceptional response. The year 2023 will be critical in this regard: with the submission of their draft updated NECPs, Member States will need to set targets and measures for the period up to 2030 that reflect the new EU ambitions and the goal of climate neutrality. In addition, dedicated REPowerEU chapters are to be included in national recovery and resilience plans.

Meanwhile, the current situation as regards energy and climate is precarious. Short-term measures to secure energy supplies and support the most vulnerable households are necessary and justified. However, energy savings and the production of renewable energy in Europe are the best solutions to the problems presented by the unfolding energy and climate crises. Investments should be made in this regard, to avoid infrastructural carbon lock-in effects. While presenting massive challenges, the recent, unprecedented energy price increases will ensure that investments made in energy saving measures and domestic renewable energy production will produce quicker-than-expected returns on investment.

Households, enterprises and governments can help to steer the climate and energy transition through the choices they make in response to the current situation. The production of renewable energy by consumers — 'prosumption' — is one of the pathways that could support the transition, as illustrated in the recent EEA report *Energy prosumers in Europe — citizen participation in the energy transition*. Decisive steps can be taken towards achieving climate neutrality, allowing the EU to quickly and definitively move away from its dependence on imported fossil fuels.

In recent months, important links between different crises have become evident. The energy crisis is putting pressure not only on power supply, but also on the agriculture sector. Meanwhile, the impact of climate change is itself disrupting energy supplies, for example by decreasing the availability of hydropower generation. A reduction in fossil fuel imports will not only reduce emissions, but may also contribute to the EU's economic development, and the response to these diverse crises must be rooted in an integrated, systemic approach to policymaking.

1
Greenhouse gas emissions and energy trends in the EU

Key messages

- By the end of 2020, the EU-27 had **fully achieved its 2020 climate and energy targets.** Greenhouse gas (GHG) emissions were 32% below 1990 levels([1]), which greatly exceeded the 2020 target of a 20% reduction. Renewable energy sources accounted for a 22% share of gross final energy consumption in 2020, two percentage points more than the target. The EU-27 also overachieved in terms of its 2020 energy efficiency target in the final year, after having not been on track to do so beforehand. The COVID-19 pandemic played an important role in this overachievement, while, for renewable energy and GHG emissions, the achievement of the 2020 targets were first and foremost the result of sustained efforts over the past decade.

- Early estimates indicate that GHG emissions have increased by 5% between 2021 and 2020. This increase is related to the **rebound of activities** during the economic recovery from the COVID-19 pandemic. When land use, land use change and forestry (LULUCF) emissions are also taken into account, the total net emission([2]) reduction in 2021 is estimated at 29% compared with 1990 levels.

- Between 2021 and 2030, **steeper GHG emission reductions** will be required to achieve a net reduction of 55% compared with 1990 levels and to ensure that the EU is on track to meet the 2050 target of climate neutrality. Projections([3]) indicate that additional policies and measures planned across the EU-27 will lead to a net emission reduction of 41% by 2030. Further introduction of policies and measures to reduce emissions in all sectors will be needed to achieve the net 55% target.

- To reach the 2030 target of 32% of energy consumption from renewable sources, the **continued introduction of renewable energy sources** for electricity generation needs to be sustained, especially in light of additional direct demands for electricity from different end-use sectors and for the production of fuels such as hydrogen. For heating, cooling, industrial transformation and transport purposes, the use of renewable energy sources will need to increase substantially. Technological and infrastructural developments, such as the spread of district heating and cooling networks, need to be initiated.

- Efforts towards reaching the 2030 energy efficiency target of at least 32.5% will require continuous **intensive reductions in energy consumption.** These reductions will need to go well beyond the national contributions set out by Member States in their national energy and climate plans (NECPs), as these indicate a collective gap in ambition of 4.6% from the current final energy consumption target for 2030.

- **Higher targets are being discussed** for both renewable energy and energy savings. In the context of the 'Fit for 55' package, the European Commission has proposed a target of 40% of energy consumption from renewable sources by 2030 and a reduction of 9% in energy consumption by 2030 compared with the 2020 reference scenario (EC, 2021c). In response to the current energy crisis, the REPowerEU plan (EC, 2022c) proposes raising these targets to 45% and 13%, respectively. To achieve these more ambitious objectives, substantial efforts and investments will have to be made.

([1]) Greenhouse gas emissions excluding emissions from land use, land use change and forestry (LULUCF) and including emissions from international aviation are aligned with the scope of the 2020 climate target.
([2]) Greenhouse gas emissions including LULUCF emissions are referred to as net emissions and are in line with the scope of the 2030 climate target
([3]) GHG emission projections reflected here stem from an aggregation of Member States' latest GHG emission projections submitted to the EEA. In the remainder of the report, these are called 'projections' without further reference.

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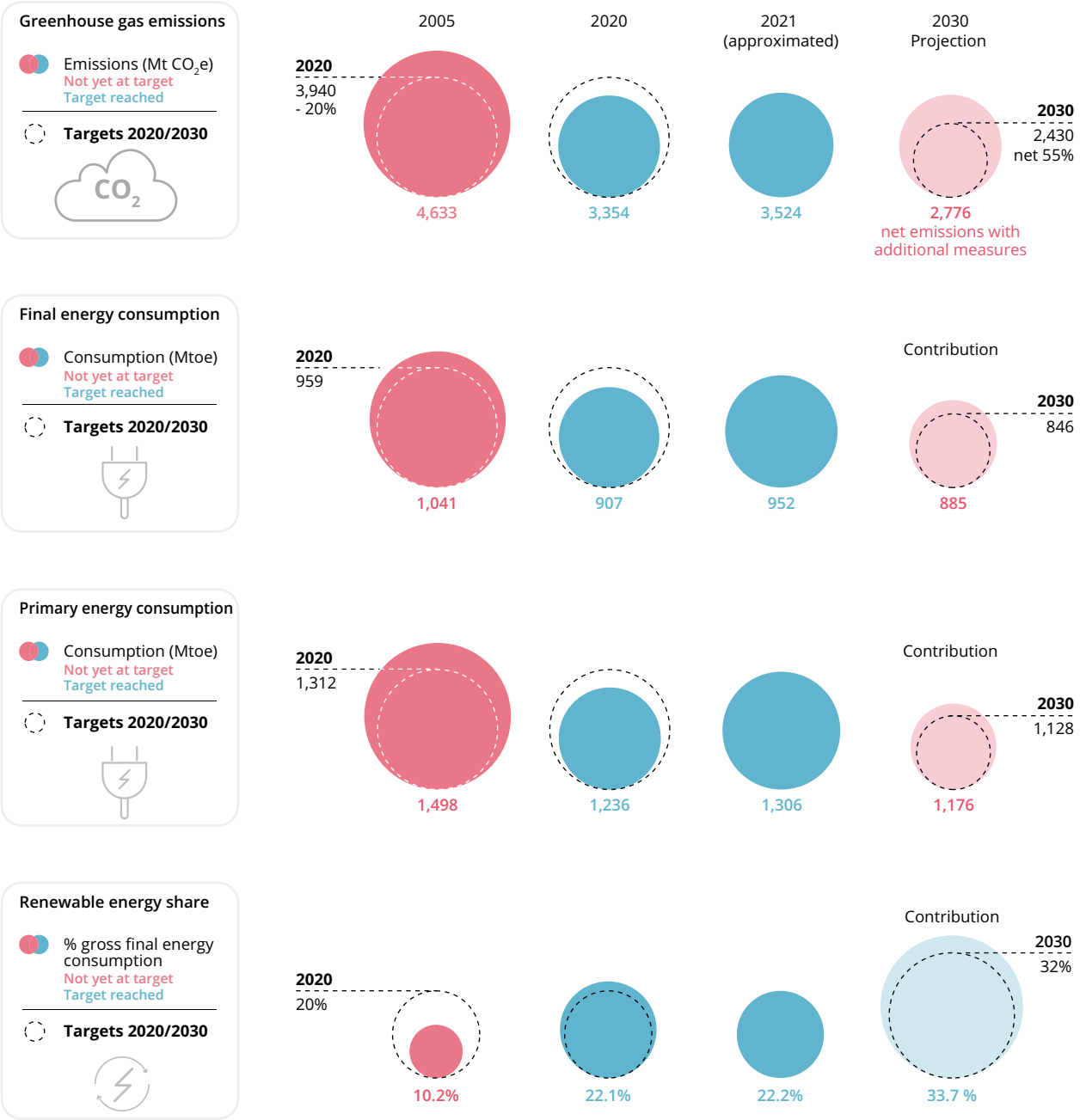
1.1 Achievement of 2020 emissions and energy targets and progress towards achieving 2030 targets

This report evaluates the achievement of the 20-20-20 targets for greenhouse gas (GHG) emission reductions, the deployment of renewable energy sources and improvements in energy efficiency. Its publication, in 2022, comes the second year after the 2020 milestone for meeting targets in each of these areas: targets of a 20% reduction in GHG emissions (compared with 1990 levels), of a 20% share of gross final energy consumption being accounted for by renewable energy sources, and of a 20% reduction in energy consumption (compared with 2005 levels). This is the first year in which official data for 2020 have been available from national GHG emission inventories. Thus, it is now possible to assess whether or not these targets have been achieved. Preliminary estimates are available for 2021, which is the first year on the path to meeting the EU's 2030 targets, which, in turn, represent the first milestone towards achieving climate neutrality by 2050.

This section synthesises key figures and the findings of indicators published by the EEA in 2022, reflecting the most recent data and information on GHG emissions, renewable energy and energy efficiency. Together, this information illustrates that by the end of 2020 the EU had made solid achievements in terms of its 2020 targets — but an intensification of efforts will be necessary if the EU is to meet its next set of targets in 2030.

Figure 1.1 shows how the 27 EU Member States (EU-27) progressed with respect to the 2020 targets, and are progressing towards the 2030 targets in four areas: GHG emissions, renewable energy, final energy consumption and primary energy consumption.

Figure 1.1 Achievement of 2020 targets and progress towards achieving 2030 targets in the EU-27



Note: Data on GHG emissions are shown as 'emissions' from 2005 to 2020 and as 'net emissions' for 2030, as the 2030 target refers to 'net emissions' whereas the 2020 target does not, international aviation is always included. The 2030 projection for GHG emissions 'with additional measures' (WAMs) stems from the aggregation of national projections reported to the EEA, while EU-27 energy consumption and renewable energy contributions for 2030 were calculated as the sum of the Member State contributions stated in final national energy and climate plans (NECPs) (EC, 2021f) . The EU energy efficiency target established for 2020 had included the United Kingdom but was translated into an EU-27 target after the United Kingdom left the EU (Council of the EU, 2019). The EU-27 energy efficiency targets shown in the figure have been published by Eurostat (2021a). For renewable energy, the sum of 2030 contributions are indicated as the upper end of the range (33.1%-33.7%) indicated in the European Commission's analysis of Member States' contributions (EC, 2020b).

Sources: EC (2020b); EEA (forthcoming a, forthcoming b, forthcoming c); Eurostat (2022b, 2022c).

1.2 EU-wide developments in emissions and energy

As illustrated in Figure ES.1, GHG emissions in the EU-27 have declined rapidly in recent years, falling to 32% below 1990 levels by 2020. This is equivalent to an average yearly emission reduction of 52 megatonnes of carbon dioxide equivalent ($MtCO_2e$) from 1990 to 2020. These emissions include those from international aviation but land use, land use change and forestry (LULUCF) contributions are not accounted for, thereby reflecting the scope of the 2020 target. The EU's GHG emissions have been below the 2020 target since 2018. A remarkable drop of 4% was achieved in 2019, which was strongly driven by a substitution of the use of coal by the use of gas and renewable energy sources in the EU power sector and is unrelated to the COVID-19 pandemic.

The effects of the COVID-19 pandemic were first seen in 2020. Unprecedented national lockdowns, travel restrictions and the closing of national borders in the first half of 2020 led to short-term improvements in the environment in Europe and largely account for the 10% decrease in GHG emissions in this year (EEA, 2022b). Preliminary estimates for 2021 indicate that, while recovering from the COVID-19 pandemic, GHG emissions increased by 5% compared with 2020.

In the coming years, momentous emission reductions will need to be sustained to achieve climate neutrality in the long term. To reach the target of a 55% reduction in emissions compared with 1990 levels by 2030, emissions would need to decline by $134MtCO_2e$ per year on average. This is less than the reduction in emissions accomplished between 2018 and 2019 ($156MtCO_2e$), but about twice the average annual reduction in emissions that was achieved between 1990 and 2020.

This is illustrated in Figure ES.1, where there is a notable gap between the steepest projections curve ('with additional measures') towards 2030 and the new net 55% target for 2030. Projections indicate that a net emission reduction of 41% will be achieved by 2030 through the introduction of additional policies and measures. While this would be sufficient to achieve the original 40% EU-wide reduction target, towards which most projections submitted by Member States in 2021 were still oriented, further efforts will be needed to achieve the net 55% target.

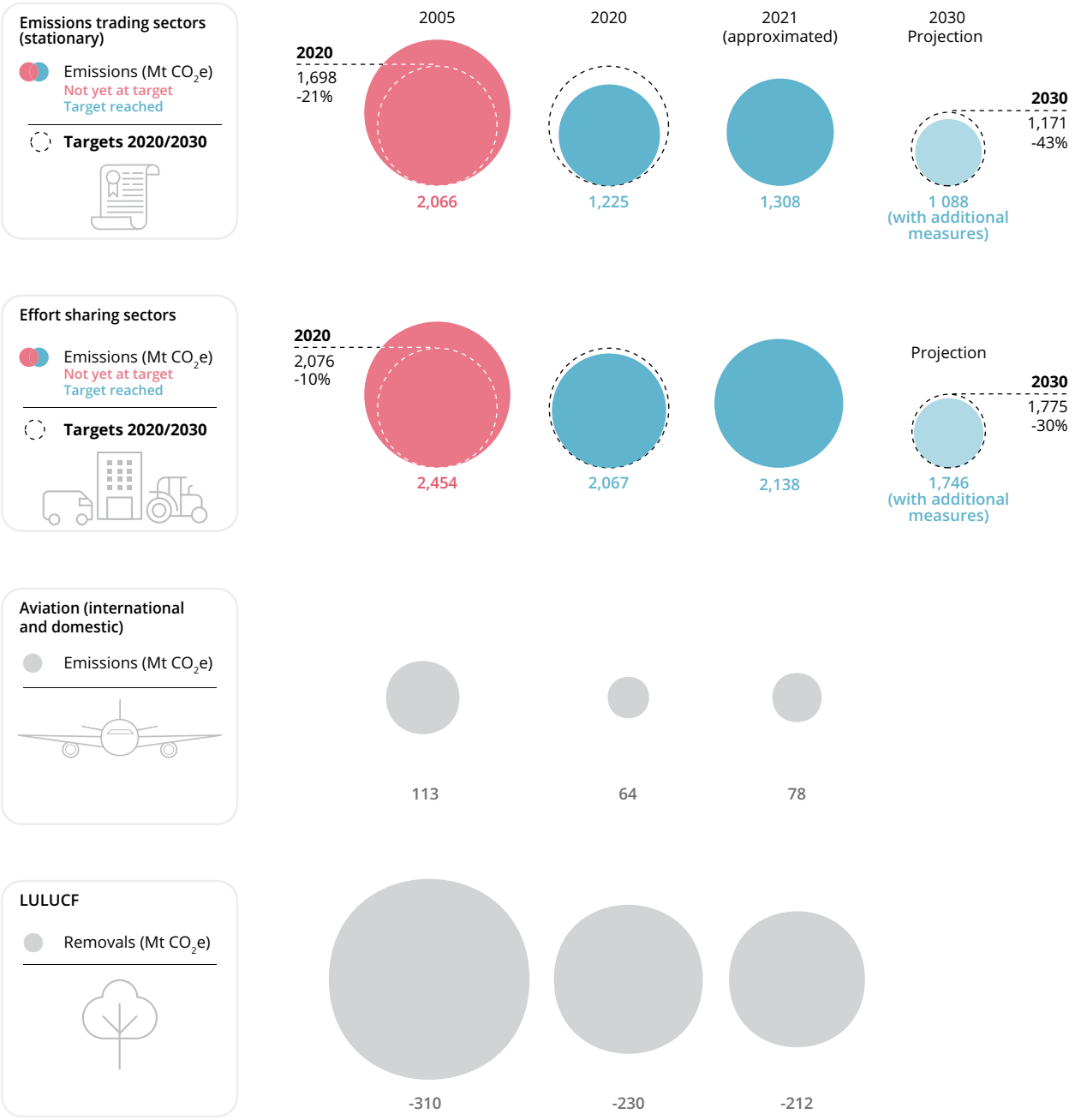
In July 2021, the European Commission proposed a comprehensive 'Fit for 55' policy package to set all relevant sectors on the path to the new 2030 climate target (EC, 2021a); these proposals are currently being discussed among co-legislators. In 2022, three EU Member States (Denmark, Ireland, Latvia) submitted updated GHG projections which together project only a minor additional reduction in emissions by 2030 of $6MtCO_2e$ compared to last year's projections at the EU level. These updated projections show diverging anticipated trends, with highest changes compared with last year's projections in the energy supply, transport and LULUCF sectors. Projections that will be reported in 2023 under the Regulation on the Governance of the Energy Union and Climate Action (Regulation (EU) 2018/1999) should be oriented to the new, more ambitious target.

To support continuous reductions in GHG emissions in the EU-27, three key EU policies are in operation. The EU Emissions Trading System (ETS) and Effort Sharing legislation foster reductions in GHG emissions — the former through a cap-and-trade system that mainly targets large power stations, industrial plants and aviation, and the latter through setting national targets for emission reductions on a yearly basis in sectors mainly including road transport, buildings and agriculture, and in specific parts of the industrial sector. At the same time, the legislation on emissions and removals from LULUCF provides an accounting framework for net GHG emissions and removals from forest land and forest products and net emissions and removals from cropland, grasslands, wetland and settlements. Forests and the land sink play a critical role in sequestering carbon and thereby reducing emissions from other sectors.

Emissions from large-scale facilities in the power and industry sectors, which are covered by the EU ETS, have decreased significantly since 2005. The reductions here have been particularly strong in the energy-related industries. These include emissions from public electricity and heat production, petroleum refining and the manufacturing of solid fuels and other energy industries, as well as fugitive emissions from fuel.

Figure 1.2 illustrates that 2020 ETS emissions from stationary installations in the EU-27 were well below the cap set for that year. In 2020, emissions, largely as a result of the COVID-19 pandemic, were nearly 12% lower than in 2019. This notable reduction followed a 9% drop in emissions the previous year. In total, by 2020, EU ETS emissions from EU-27 Member States' stationary installations had fallen by 41% since 2005, overachieving the planned support to the 2020 target. With a 7% increase in EU ETS emissions between 2020 and 2021, due to some recovery from the COVID-19 pandemic and a shift from the use of natural gas to coal due to increasing gas prices (ETC/CM, forthcoming), EU ETS emissions were 37% below 2005 levels by 2021.

Figure 1.2 **Breakdown of greenhouse gas emission trends in the sectors covered by the EU Emissions Trading System, the Effort Sharing Regulation([a]) and the Land Use, Land Use Change and Forestry Regulation([b])**



Notes: The two figures above depicts the current EU ETS cap and the current 2030 target for the sectors covered by the Effort Sharing Regulation for the EU-27. To allow comparability between historical data and legal targets, the 2030 Effort Sharing legislation target is expressed in terms of global warming potentials from the Intergovernmental Panel on Climate Change's Fourth Assessment Report. Aviation consists of flights within the European Economic Area and flights from the European Economic Area to Switzerland and the United Kingdom, which are covered by the EU ETS, and international and some domestic flights, which are not covered by the EU ETS. This sector is shown separately here because its trends diverge substantially from those of other sectors: aviation emissions had been increasing consistently until a substantial drop in 2020 due to the effects of the COVID-19 pandemic.

([a]) Regulation (EU) 2018/842.

([b]) Regulation (EU) 2018/841.

Sources: EEA (2021a, forthcoming b).

National projections indicate that in 2030 total emissions covered by the EU ETS in the EU-27 will be 1,213MtCO_2e with existing measures and 1,088MtCO_2e with the implementation of additional measures, thus staying well below the cap of 1,171MtCO_2e and overachieving the original 2030 target of a 43% reduction in emissions compared with 2005. Actual progress will also be influenced by the development of ETS prices, progress in efficiency gains in the industry sectors and the deployment of innovative low-carbon solutions over the coming 8 years. Nevertheless, taking into account the proposed EU ETS emission reduction target of 61% by 2030 (relative to 2005) in the pending 'Fit for 55' legislation, additional abatement efforts will be necessary. The proposed amendment of the ETS Directive (2003/87/EC) extends emissions trading to the maritime transport sector and also introduces a new ETS for emissions from fuels used in buildings and for road transport.

In 2020, EU-27 emissions covered by Effort Sharing legislation, from sectors such as transport, buildings, agriculture, waste and non-ETS industry, were 16% below 2005 levels, a more modest reduction than in the ETS sector. From 2015 to 2019, emission levels exceeded those of 2014, then a strong decrease of 6% was observed between 2019 and 2020, with emissions in 2020 being affected by the COVID-19 pandemic. Estimates for 2021 indicate that emissions covered by Effort Sharing legislation increased by 3.5 % compared with 2020 levels (which is equivalent to a level 13% below that of 2005).

One of the greatest challenges for reducing emissions in the sectors covered by Effort Sharing legislation has been the transport sector. This is also reflected by an increase in final energy consumption in transport of 9% between 2005 and 2020. The evolution of GHG emissions and final energy consumption in the transport sector is strongly correlated with the economic context. Much of the observed decrease of 14% in transport emissions between 2019 and 2020 can be attributed to the COVID-19 crisis, as restrictions put in place had wide impacts on people's and goods' mobility patterns. Estimates for 2021 indicate that transport emissions increased by 8% compared with 2020, showing a partial rebound of mobility.

Projections of the effects of existing measures ('with existing measures' (WEM)) indicate that emissions from the sectors covered by national emission targets will decline from 2,139MtCO_2e in 2021 to 1,935MtCO_2e in 2030, thus missing the original 2030 target of a 30% reduction by 8 percentage points (or 160MtCO_2e). Taking into account additional measures ('with additional measures' (WAM)), projections indicate that emissions would amount to a level of 1,746MtCO_2e in 2030, meaning that the current 2030 target of 1,775MtCO_2e would be reached. However, to achieve the 40% reduction target for the sectors covered by Effort Sharing legislation as proposed in the pending 'Fit for 55' legislation, additional action would be required. See also Section 2.1 for further details on projected emissions within the individual sectors.

In 2020, 230MtCO_2e were removed from the atmosphere by forests and soils in the LULUCF sector, which equals about 7% of total GHG emissions. This sink corresponds to the balance of net removals of CO_2 by forest land and carbon stored in harvested wood products, on the one hand, and of net GHG emissions mainly from cropland or the conversion of land to settlements, on the other. From 1990 to 2020, the size of the sink was, on average, 298MtCO_2e, although with variations from year to year. Over the last decade, the size of the sink has declined persistently, with a decrease of almost 29% since 2010. In recent years, the EU saw declining removals from forest land.

The new 2030 target for GHG emission reductions is expressed as a net emission target (a net 55% reduction below 1990 levels). This 55% target takes into account net carbon removals yet limits contributions from the LULUCF sector to a level of 225 MtCO_2e. This means that other sectors will have to achieve continued and accelerated emission reductions. With a view towards achieving the climate neutrality target in 2050 and the aim of achieving net negative emission levels thereafter, the EU-27 will need to increase its natural sink size (EC, 2018). Therefore, the European Climate Law (EU Regulation 2021/1119) calls for an increase in the volume of the EU's carbon sink by 2030 to achieve the objective of climate neutrality by 2050. The revised proposal for the LULUCF Regulation in the context of the 'Fit for 55' package aims to achieve a net carbon removal of 310MtCO_2e in the EU in 2030. Preliminary estimates for 2021 suggest LULUCF removals of 212MtCO_2e, an 8% decrease compared with 2020. Member States' projections indicate that the EU's net natural sink would further decrease by 2030 to 190MtCO_2e with only existing measures in place and to 209MtCO_2e if additional measures currently planned by Member States are implemented. Therefore, to increase the size of the EU's land use sink, Member States need to implement additional measures such as planting more trees, restore drained organic soils and use harvested timber for long-lived products.

In the area of **renewable energy sources**, the EU-27 achieved a total level of 22% of total energy consumption from renewable energy sources in 2020 (see Figure ES.3). Thus, the EU achieved its 2020 target of a minimum 20% renewable energy share. The greatest shares of renewable energy were observed in electricity consumption and, to a more limited extent, in heating and cooling. At the same time, the EU-27 has performed less well in increasing the share of renewable energy sources used in the transport sector, with the 2020 target of a 10% share just being met (10.2%).

Preliminary data suggest that the EU-27's total share of renewable sources remained at about 22% in 2021. To reach the current 2030 target of a 32% renewable energy share, this share will need to increase by 1.1 percentage points annually, on average, from 2021 levels. To achieve this, it is essential that progress is made in improving energy efficiency, to reduce energy use from all sources, and that the introduction of

renewable sources for electricity generation is accelerated, to support the electrification, and thereby decarbonisation, of other sectors. For heating, industrial transformation, cooling and transport purposes, the use of renewable energy sources will also need to increase substantially. From modelling results published by the European Commission in 2021(EC, 2021g) , a total renewable energy share target of 40% in 2030 would result in a 41% share in heating and cooling, which would be 28 percentage points above the 2020 share. As required in the Regulation on the Governance of the Energy Union and Climate Action, in 2019 EU Member States formulated national energy and climate plans (NECPs) and, in these, set out national contributions for the continued introduction of renewable energy sources (EC, 2021f)(Link to NECPs). Cumulatively, these national contributions would lead to a slight overachievement of the 2030 32% renewable energy share target. However, this 32% renewable energy target was aligned with the original 40% GHG emission reduction target, and, to achieve the net 55% GHG emission reduction target, the renewable energy share in 2030 would need to be higher than 32%. The European Commission therefore proposed increasing the target to 40% in its Fit for 55 package. (EC, 2021h). In response to the current energy crisis, the REPowerEU plan proposes raising the renewables target to 45%, to accelerate the roll-out of renewable technologies in the EU and allow further decreases in fossil fuel imports.

Member States' deployment of renewable energy sources over the next decade would therefore need to exceed the contributions set out in their existing NECPs. The next NECP updates are due in mid-2023.

For **energy efficiency**, the outlook to the 2020 targets has been uncertain for several years and has often been marked by fluctuating trends. Unlike the EU's targets for GHG emissions, which are expressed as relative to the emission levels in 1990, the EU's targets for energy efficiency are based on projected energy consumption levels for the years 2020 and 2030 (Figure ES.2). These projections for primary and final energy consumption are derived from the European Commission's 2007 baseline scenario and the 2020 Reference Scenario.

In 2019, the EU-27 had only reduced energy consumption to a level of 2.9% above the 2020 target for final energy consumption and 3.2% above the target for primary energy consumption. This was followed by a substantial shift. In 2020, energy consumption for the EU-27 was 5.4% below the 2020 target for final energy consumption and 5.8% below the target for primary energy consumption (see Figure ES.2). This shift was largely driven by the effects of the COVID-19 pandemic, as the industry and transport sectors slowed and even stood still for several months in 2020. This means that the EU-27 met and overachieved the 2020 target in its final year, after having not been on track to do so.

Taking into account the substantial drop in energy consumption in 2020, the EU-27 therefore demonstrated an average annual decline in final energy consumption of 8.93 million tonnes of oil equivalent (Mtoe) from 2005 to 2020, or a decrease of 0.9% annually. In terms of primary energy consumption, the average annual reduction was 17.4Mtoe between 2005 and 2020, which corresponds to a 1.2% reduction per annum.

Preliminary data for 2021 indicate an increase in both final and primary energy consumption, of 5.0% and 5.6%, respectively, compared with 2020. Final and primary energy consumption remained just below the 2020 targets, namely 0.7% below and 0.5%, respectively. This increase in energy use can be largely attributed to recovery following the pandemic.

To reach the currently established efficiency target of at least 32.5% by 2030, intensified efforts are needed. Starting from the energy efficiency levels estimated for 2021, the average annual decline in final energy consumption in the EU-27 from 2021 to 2030 would need to be at least 12Mtoe or 1.2%. Primary energy consumption would need to decline by at least 20Mtoe, or 1.5%, per year. The efforts required to achieve this go beyond the currently established national contributions set forward by Member States in their NECPs. Taken together, these contributions indicate a gap in ambition from the original 32.5% energy efficiency target for 2030: Member States' contributions aim to achieve final energy consumption of 885Mtoe by 2030 (see Figure 1.1), which is 4.6% above the current final energy consumption target of 846Mtoe.

The energy price increase from the second half of 2021 led to clear incentives to save energy. Moreover, reductions are expected in 2022 as a result of the effects of the energy supply crisis. At the same time, proposals have also been put on the table to tighten up the EU 2030 target. In the proposal for the revised Energy Efficiency Directive, the European Commission has proposed more ambitious 2030 energy efficiency targets, corresponding to a reduction of 36% for final and 39% for primary energy consumption compared with the 2007 baseline projections (EC, 2021i); or a 9% reduction compared with the projections of the 2020 reference scenario. In the REPowerEU plan, a further increase in the binding energy efficiency targets is proposed by the Commission, namely a 13% reduction in final and primary energy consumption in comparison with the projections of the 2020 reference scenario.

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2 Greenhouse gas emissions and energy trends at the sectoral level

Key messages

- **Achievements in emission reductions since 2005 vary across sectors. The highest reductions are observed in the energy supply sector, where emissions decreased by 43% between 2005 and 2020. Considerably more effort is needed in the transport and agriculture sectors, where emissions fell by only 15% and 2%, respectively, with reductions in the transport sector mainly related to the effects of the COVID-19 pandemic in 2020. While energy supply is widely covered by the EU Emissions Trading System (ETS), the transport and agriculture sectors are outside the EU ETS and are covered by national emission targets. Member States are responsible for reducing emissions in these sectors in addition to European measures through adopting or implementation of policies and measures at the national level.**

- **The latest greenhouse gas (GHG) emission projections show that considerable further emission reductions are expected by 2030 as a result of existing policies and measures. This is particularly true for the buildings sector, which covers energy consumption in private and commercial buildings, but also for energy consumption in agriculture, forestry and fisheries. Adopting additional policies and measures will also be important for achieving emission reductions across all sectors, particularly in the transport sector where emissions are projected to remain at about the 2020 level based on the contributions of existing measures alone.**

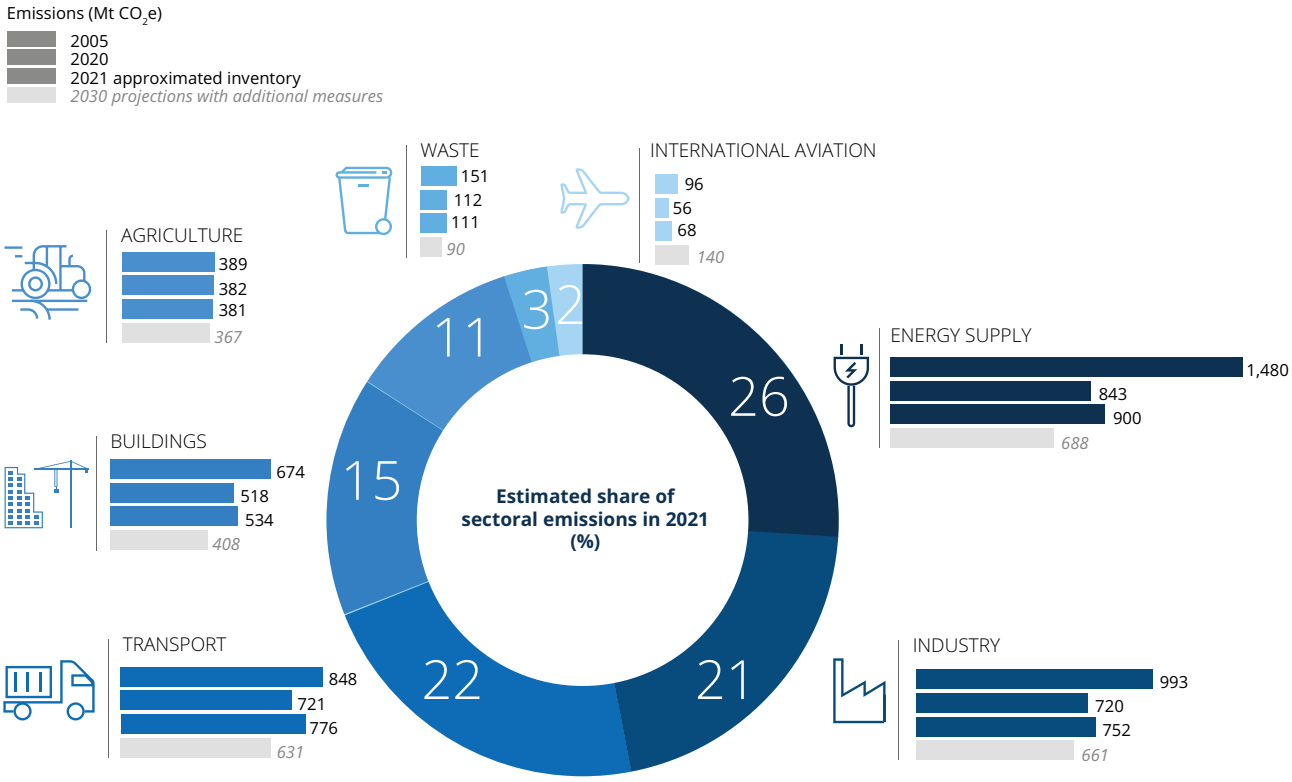
- **The parallel unfolding of recent crises (impacts of climate change, the COVID-19 pandemic, energy supply problems) will have an impact on energy consumption and GHG emissions. Emission figures for 2021 suggest that, for the energy sector, an increase in GHG emissions of 7% occurred compared to 2020. Replacing Russian natural gas is a major challenge for the EU energy system, including for keeping the trajectories to the 2030 climate and energy targets on track in the coming years. An EU-coordinated response that focuses on an accelerated roll-out of renewables and an enhanced focus on energy savings may lead to sustainable long-term change, as envisaged in the REPowerEU plan.**

Trends in greenhouse gas (GHG) emissions, energy efficiency and renewables in the EU-27 as outlined above are the result of a complex interplay of various factors and circumstances. This chapter takes a closer look at some specific sectoral trends. In addition, the importance of recent crises — the COVID-19, energy and climate crises — is briefly explained, with a focus on their impact on energy and GHG emissions.

2.1 Sectoral trends and projections

This section describes sectoral developments. Figure 2.1 provides an overview of historical and projected developments within each sector, as defined in the table note. The table also illustrates the various sectoral developments among the EU Member States, and selected details from the table are analysed in the subsequent paragraphs. This section highlights significant developments in individual EU Member States, and many of these developments were observed in smaller Member States. Greater percentage changes in smaller countries are important to note, even if they may not translate into large absolute values, as they highlight significant efforts made to bring about national progress and could inspire other countries.

Figure 2.1 Sectoral trends and progress towards achieving 2020 and 2030 targets in the EU-27



Notes: The energy supply sector covers GHG inventory categories 1.A.1 and 1.B; industry covers categories 1.A.2 and 2; transport covers category 1.A.3; buildings covers categories 1.A.4.and 1.A.5; agriculture covers category 3; waste covers category 5; 'international transport' is reported under memo items.

MS, Member State; MtCO_2e, megatonnes of carbon dioxide equivalent; WAM, with additional measures; WEM, with existing measures.

Sources: EEA (2021d, 2022b, forthcoming c); authors' own calculation.

The **energy supply** sector (e.g. power and heat production, oil and gas extraction and refining, and coal mining) is responsible for the greatest share of emissions in the EU-27, despite the fact that total emissions in this sector fell by about 43% between 2005 and 2020. Proxy estimates indicate that emissions increased by 7% between 2020 and 2021, mainly driven by a shift from the use of natural gas to other fossil fuels as a result of the soaring natural gas price and a higher energy demand in the context of recovery after the pandemic. Between 2019, that is, pre-pandemic, and 2021, energy sector emissions fell by 7% overall. The increase between 2020 and 2021 contrasts with that of the years before: since 2005, emission reductions had been observed, mainly due to a reduction in the carbon intensity of fuels, and especially the increased use of renewable energy sources.

Between 2005 and 2020, the share of renewable sources in electricity consumed in the EU-27 grew from 16% to 37%, which corresponds to an average increase of 1.4 percentage points per year. It has to be noted, however, that the increase in the share between 2019 and 2020 mainly resulted from an overall, pandemic-related reduction in total electricity production([4]). In 2021, the renewable share of electricity is estimated to have been 38%.

The energy supply sector is the largest of the sectors covered by the EU Emissions Trading System (ETS), through which a price on CO_2 emissions has applied since 2005. This CO_2 price has been an important driver of declining GHG emissions, especially as the price has risen in recent years from around EUR5/tCO_2 in 2017 to EUR25/tCO_2 in 2020, climbing to more than EUR80/tCO_2 in 2021 (EC, 2021k; Ember, 2022; ETC/CM, forthcoming). The price stayed in this range most of 2022, until the time of publication (Ember, 2022). In addition, many countries have set up subsidy schemes to support electricity production from renewable energy sources.

([4]) Based on Eurostat (2022a) data on production of electricity and derived heat by type of fuel [NRG_BAL_PEH__custom_3191933].

In the energy supply sector, current policies and measures are projected to deliver a reduction of a further 3 percentage points by 2030 compared with 2020 levels. It is projected that additional national policies and measures will lead to substantial additional reductions, and are projected to more than halve the emissions in this sector by 2030 compared with 2005 levels. While these emission reductions are anticipated, electricity demand in many Member States is expected to increase as a result of developments in other sectors. With expanding electrification in the transport and buildings sectors and additional electricity demand expected from industry, including for the production of hydrogen in line with the EU's ambitions proposed in the REPowerEU plan, the need for additional renewable energy capacity is growing in parallel. Furthermore, in the coming years, the way in which Russian natural gas imports are replaced will have a decisive impact on emissions in the energy supply sector.

At the country level, if additional policies and measures are considered, emissions are projected to decrease between 2005 and 2030 most in Luxembourg (-92%) and least in Belgium (-4%). These developments are mainly related to the closure of fossil fuel power plants in Luxembourg (Luxembourg, 2020; industri.lu, 2021) and the replacement of nuclear energy production by gas-fired power stations in Belgium (Belgium, 2019). Of the total reduction in emissions expected EU wide by 2030 in absolute terms compared with 2005, 26% is projected to be accounted for by the reduction in emissions in Germany, where nuclear power plants will have been decommissioned completely and a plan for phasing out coal has been agreed on (BMUV, 2021). Based on preliminary estimates for 2021, Czechia and Malta's renewable shares in electricity consumption were well below the EU average, at 14% and 10%, respectively.

In 2021, **industrial activities** emitted 21% of total GHG emissions in the EU-27. These emissions are the aggregate of the energy-related emissions of various industries (manufacturing, construction, cement production, etc.), the electricity and heat generation that takes place in the industrial installations (known as 'autoproducers') and process-related emissions. Total emissions from industry fell by 28% between 2005 and 2020. Preliminary estimates for 2021 suggest that industrial emissions stood at 24% below 2005 levels. This increase in emissions reflects the economic recovery after the COVID-19 pandemic. Compared with 2019, however, emissions in 2021 are estimated to have decreased by 3%.

A small decrease of 3 to 5 percentage points is expected between the current level and 2030 based on projections of **industrial emissions**. About 75% of emissions in this sector are covered under the EU ETS, but because of the free allocation of allowances to avoid carbon leakage and the higher costs for respective changes in processes, the ETS price for CO_2 has less of an effect in the industry sector than in the energy sector. The highest emission reductions are projected to take place in Denmark, with a decrease of 53% between 2005 and 2030 expected. This relates mainly to strongly decreasing energy-related emissions in the industry sector (Denmark, 2021). On the other hand, the historical increase in emissions in this sector in Malta due to the use of hydrofluorocarbons (HFCs) in refrigeration and air conditioning will be maintained according to projections (Reportnet, 2022).

The **transport** sector([5]) is the second largest source of emissions in the EU-27, and emissions from this sector are almost completely covered by national emission targets. Transport emissions decreased by 15% between 2005 and 2020, mainly as a result of lower transport activity due to the pandemic in 2020. Preliminary estimates for 2021 suggest that transport emissions increased by 8% compared with 2020, which equals a decrease of 7% since 2019. Only resolute efforts will be able to sustain this declining trend, as these 2021 emissions are only 8% below 2005 levels. The EU's stricter fleet-wide CO_2 targets, which started to apply in 2020, have already had a positive effect in decreasing the emissions of newly registered cars and vans. The average CO_2 emissions from new cars and vans registered in the EU, Iceland, Norway and the United Kingdom in 2020 decreased by 12% compared with 2019. An additional 12% decrease was observed in 2021, compared with 2020. This was largely due to the marked increase in the number of zero- and low-emission vehicles registered, with the share of battery electric cars in total new registrations rising to 10% in 2021 (EEA, 2021e).

Member States project that existing policies and measures will keep transport-related emissions at about the level of 2020 by 2030. Emission reductions are projected to occur only if policies and measures additional to those currently in place are implemented. With the implementation of these additional policies and measures, emissions from transport could fall to 26% below 2005 levels by 2030, which would be 19% lower than emission estimates for 2021. EU regulations on CO_2 standards for cars and vans and heavy-duty vehicles and the introduction of carbon pricing could be important for achieving more substantial emission reductions. In addition, the falling prices of electric vehicles and the changes in commuting and travelling patterns caused by COVID-19 could also be determining factors (see also the European Commission's mobility strategy (EC, 2022e)). The result of these measures should be a clear downward trend in emissions from the transport sector to achieve the 90% cut in transport-related GHG emissions by 2050, as outlined in the European Green Deal.

The highest relative emission reductions between 2005 and 2030 are projected to take place in Luxembourg (-54%). This reduction builds on the already achieved highest relative emission reduction between 2005 and 2020 in this country and on the effect of additional policies and measures already in place.

([5]) The Intergovernmental Panel on Climate Change's emission source sector 1.A.3, which does not include international aviation or shipping.

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In its national energy and climate plan (NECP), Luxembourg states that the decline in 'tank tourism' has made a significant contribution to this decline, in addition to the sharply increasing electrification of the transport sector (Luxembourg, 2019). Several EU Member States (Bulgaria, Croatia, Malta, Poland, Romania, Slovakia and Slovenia) project increases in emissions between 2005 and 2030, with the highest increase, even with additional policies and measures, of 80% projected in Romania. This increase is related to projected economic growth and the fact that Romania is considered a transit area. In Romania's projection report, it states that without a set of measures emissions would increase even further (Romania, 2020)).

Renewable energy sources accounted for 10.2% of the transport sector's gross final energy consumption in 2020. This proportion was 8.8% in 2019 and the strong increase between 2019 and 2020 is also related to the drop in overall transport demand due to the pandemic. Proxy estimates for 2021 show a stagnation at 10.2%([6]). Electromobility and blended biofuels are important options for reducing emissions and increasing renewable energy shares in transport across the EU-27. But the mere replacement of transport fuels puts pressure on the land use, land use change and forestry (LULUCF), agriculture and energy supply sectors, as these sectors' resources are also needed elsewhere. The initiatives outlined in the recast Renewable Energy Directive (RED II) balance these developments by reinforcing measures related to the sustainability of biofuels and promoting those based on waste-based raw materials. The energy crisis puts additional pressure on not only the power supply sector but also the agriculture sector, which is vulnerable to disruptions via, among other things, the fertiliser market. Addressing transport modes used and demand will become an additional important element of an integrated, systemic approach to policymaking.

Emissions from **international aviation** are shown in Figure 2.1 as reported in GHG inventories and covering emissions from voyages that depart in one EU Member State and arrive in any other EU or non-EU country. The emissions related to international aviation nearly doubled between 1990 and 2005 and grew by a further 39% between 2005 and 2019. Emissions are projected to increase even further, though at a slower pace. This sector has been strongly affected by the COVID-19 pandemic and, in 2020, emissions fell substantially to about the same level as in 1990. Preliminary estimates for 2021 indicate that international aviation emissions partially rebounded to a level of 26% above 1990 levels. Projections, which have widely not considered the full effects of the pandemic, suggest an increase by some additional percentage points between

([6]) From 2021, the recast Renewable Energy Directive (Directive (EU) 2018/2001) modifies the statistical multipliers available to Member States to promote certain forms of renewable energy use in transport. The EEA's early estimates for the renewable energy source share in transport shown in this report still use the old multipliers; the new approach will be incorporated from 2023.

2019 and 2030. Emissions from domestic and international flights between airports within the European Economic Area are covered under the EU ETS. Emissions from international flights are projected to increase in all Member States between 2005 and 2030, with emissions projected to more than double in seven countries (Bulgaria, Croatia, Latvia, Lithuania, Malta, Poland and Slovenia). Overall, historic and projected emission developments in this sector are not in line with reductions needed to achieve the long-term neutrality target in 2050.

At the EU level, shipping-related international emissions fell by 20% between 2005 and 2020, although emissions in 2020 were still considerably higher than in 1990. Preliminary estimates for 2021 indicate that international emissions from shipping decreased further slightly. These reported emissions are based on fuels sold and are not only linked to transport activities. The CO_2 emissions from the actual traffic of large ships calling at EU ports have been tracked since 2018 under the EU Monitoring, Reporting and Verification Regulation (Regulation (EU) 2015/757). Emissions from this sector are projected to return to approximately 2005 levels by 2030, with additional measures expected to have only small effects. This sector is characterised by high variation in the emissions of individual Member States. While some Member States reported little or no emissions because of their geographical locations, more than 75% of emissions were reported by five Member States in 2005 (Belgium, France, Greece, the Netherlands and Spain). Of these, three have projected considerable reductions between 2005 and 2030, of 20% (Greece), 26% (the Netherlands) and 47% (France), while two have projected increases, of 28% (Belgium) and 15% (Spain).

The 'Fit for 55' legislative package, currently under negotiation, contains various elements that deal with shipping and aviation. The ReFuelEU Aviation proposal aims to reduce the aviation sector's environmental footprint, while the FuelEU Maritime proposal focuses on reducing the GHG emission intensity of the energy used on board ships. The revision of the aviation rules under the EU ETS aims to increase the aviation sector's contribution to emission reductions and to prepare for the implementation of the International Civil Aviation Organization's Carbon Offsetting and Reduction Scheme for International Aviation, as appropriate, for international flights. In addition, the proposed extension of the EU ETS to include the maritime sector will cover CO_2 emissions from large ships calling at EU ports.

Direct emissions from the **buildings** sector accounted for a total of 15% of EU-27 emissions in 2021. Based on preliminary estimates, emissions in this sector have fallen by 21% since 2005. Emissions from district heating and electricity consumption in buildings are not allocated to the buildings sector but, rather, are reported under the energy sector. Remaining emissions in the buildings sector are mainly covered by national emission targets under the Effort Sharing legislation.

The use of renewable energy sources for heating and cooling([7]) is increasing only slowly; between 2005 and 2020, the share of renewable sources used for heating and cooling grew by an average of 0.7 percentage points per year across the EU-27, and reached 23% in 2020. Preliminary estimates for 2021 suggest that this share has increased to 24%. Biomass-related fuels (including the biogenic part of municipal solid waste) contribute considerably to all fuels used for heating and cooling, amounting to 84% of all renewable energy sources used for heating and cooling in 2020 (EEA, 2020). Increases in these shares are limited by restricted availabilities. The share of energy from heat pumps in gross final energy consumption for heating and cooling for the EU-27 was still only 3% in 2020. The deployment of heat pumps has been increasing very slowly([8]), but it seems that this deployment will be accelerated by the current energy crisis generated by the Russian invasion of Ukraine. Among other measures related to buildings, the REPowerEU and EU SAVE plans aim to double the rate of deployment of heat pumps, resulting in a cumulative 10 million units across the EU over the next 5 years (EC, 2022b, 2022g). The uptake of heat pumps is an important measure not only for increasing the use of renewables in the buildings sector but also for achieving the EU's final energy consumption target, as well as national contributions to these targets. Because ambient heat is excluded from the definition of the target indicator for final energy consumption under the Energy Efficiency Directive (EU) 2018/2002, the shift from fossil fuel use to heat pump use will make the final energy consumption target easier to achieve.

With a view to 2030, important additional emission reductions in the buildings sector are expected, even with only existing policies and measures, leading to a projected reduction of 32% compared with 2005 levels. Additional policies and measures are expected to lead to an additional reduction of 7 percentage points. This is not half of the reduction as foreseen in the 2030 climate target plan, which sets out a reduction target of around 60% or more compared with 2015 levels (EC, 2022a). The highest reduction in emissions is projected for Denmark (-77%); this is related to a considerable increase in the use of biogas (Denmark, 2021)). Two Member States project emission increases between 2005 and 2030 in this sector: Malta (+21%) and Romania (+6%). In Romania, the projected emission increase relates to projected higher income levels per household, leading to increased energy consumption (Romania,

([7]) As defined under the Renewable Energy Directive, the heating and cooling sector includes the production of renewable district heating and cooling and all final consumption of renewable energy for heating, cooling and processing purposes.

([8]) Eurostat Shares.

2020) . In Malta, the high percentage increase is the result of projected changes in very low absolute numbers; nevertheless, a projected increase has been reported and this correlates with an increase in electricity use for air conditioning (Reportnet, 2022). To achieve the new climate targets, the European Commission has proposed introducing a price signal on CO_2 that would cover the buildings sector, as well as revising the Energy Efficiency Directive, the Renewable Energy Directive and the Energy Performance of Buildings Directive (EC, 2021e).

Emissions from **agriculture** account for about 11% of EU-27 emissions and are entirely covered by national emission targets under the Effort Sharing legislation. Agricultural emissions in 2019 and 2020 were about the same as in 2005; more notable reductions in this sector occurred before 2005. Preliminary estimates for 2021 indicate that agricultural emissions remained nearly constant. Projections based on existing policies and measures across the EU indicate that there will be nearly no emission reductions in agriculture by 2030, with additional policies and measures expected to have only a minor effect. The main contributor of emissions in this sector are livestock emissions. Member States such as Malta, which reduced its livestock holdings (EEA, 2022b), show the highest emission decreases in historical and projected developments. At the same time, emissions are projected to increase most in Bulgaria, by 49% between 2005 and 2030, nearly twice the increase already observed between 2005 and 2020. This increase is directly related to the growth projected in the agriculture sector in Bulgaria (Bulgaria, 2020). It will be particularly important to tackle emissions from livestock to bring the agricultural sector in line with the EU's emission reduction targets, especially as this sector is expected to dominate residual emissions in 2050 (EEA, 2021b).

The **waste** sector accounted for only 3% of GHG emissions in 2021 and is included in national emission targets under the Effort Sharing legislation. Waste-related emissions have declined considerably since 2005, amounting to a 26% reduction by 2020. Preliminary estimates for 2021 indicate that emissions from the waste sector have declined further only slightly to 27% compared with 2005 levels. Further reductions of an additional 12-14 percentage points are projected for 2030. Of the EU countries, the greatest projected reduction in waste-related emissions has been reported by Germany, with a reduction of 76% expected between 2005 and 2030, nearly halving current emissions. This projected reduction is mostly due to a reduction in methane emissions from dumped waste, which have fallen drastically since the ban on dumping of organic waste. In addition, measures for landfill ventilation and optimised gas collection are projected to be effective (BMUV, 2021). Meanwhile, emissions in Denmark and Malta have decreased since 2005 but are projected to increase again between now and 2030. Malta projects that emissions from incineration and biological treatment will increase initially in the coming years and then slowly decrease (Reportnet, 2022). In Denmark, biogas production from waste will increase substantially in the coming years, along with an increase in methane emissions resulting from leaks.

As described in Chapter 1, the **LULUCF sector** is a net sink at the EU level, but the sink was reduced by more than a quarter between 2005 and 2020. Projections based on existing measures indicate that the net sink will continue to decrease towards 2030. Additional policies and measures, as currently envisaged by Member States, are expected to bring removals in 2030 to the level of 2021.

To achieve the EU's 55% climate target for 2030, net removals in the LULUCF sector of up to 225 megatonnes of carbon dioxide equivalent ($MtCO_2e$) are included. In line with the European Climate Law, however, national LULUCF targets, as proposed in a revision of the LULUCF Regulation, amount to a total net removals target of 310 $MtCO_2e$ for 2030. If this EU LULUCF net removals target is achieved and the emission reduction targets in other sectors are met, the net emission reduction in the EU will reach about 56.5% by 2030 compared to 1990 levels. To reach this removal level in the LULUCF sector, urgent action is needed, as many mitigation options take several years to result in removals. To increase the carbon storage in forests, biomass products and enhance material substitution, a holistic assessment is needed to address the effects of increased harvesting, forest management practices and new forest areas (JRC, 2021). National information is not presented in Figure 2.1 because percentage changes in emissions and removals between years tend to show very high variation and need to be interpreted with caution.

2.2 Dynamics in selected sectors in times of crises

Since the start of the COVID-19 pandemic, several crises have unfolded in parallel that have had a substantial impact on Europe and the world, including in terms of emissions and energy use.

Recent years have been dominated by the **COVID-19 crisis**. Since March 2020, several lockdowns have resulted in a significant reduction in economic and social activities, including a sharp drop in industrial production in 2020. In 2021, there was an economic recovery, although this slowed down towards the end of the year. The COVID-19 pandemic had a substantial impact on energy consumption and thus on CO_2 emissions, linked to both reduced economic activity and behavioural changes.

The EU policy response has focused on a sustainable recovery from the pandemic, thereby facilitating the green and digital transitions. The EU's Recovery and Resilience Facility (EU, 2021) has committed billions of euros to supporting a sustainable recovery. In line with the commitment of the European Council to achieve a 'climate mainstreaming' target, that is, to use 30% of both the multiannual financial framework and NextGenerationEU budgets to fight climate change, it was stipulated that a minimum of 37% of expenditure in the

recovery and resilience plan of each of the EU countries should be allocated to climate-related issues.

Moreover, in 2021 unprecedented climate change impacts unfolded, with the situation being commonly referred to as the **climate crisis**. This included heatwaves (WHO, 2022), droughts, forest fires and flood events (Copernicus, 2021)), and affected both the economy and the well-being of Europeans. Record temperatures have also been recorded in 2022 in various European countries (Copernicus, 2022). In the last decade, the mean annual temperature over European land areas was 1.94°C to 2.01°C warmer than during the pre-industrial period (EEA, 2022c). Between 1980 and 2020, weather and climate-related extremes amounted to an average cost of EUR11.9 billion per year (EEA, 2022a).

Since mid-2021, a series of reductions in and halts to gas supplies from Russia to EU consumers sparked an **energy crisis**. The resulting unprecedented energy prices were heightened even more after Russia's invasion of Ukraine. Although the natural gas price has seen the most significant increase, prices of other fossil fuels such as oil and coal have also risen. The price of electricity reached historical heights, due to the strong influence of gas-fired plants on electricity prices in the short-term EU power markets. At the same time, the EU's dependence on Russia for the import of fossil fuels became very apparent, creating energy security concerns (EC, 2022c).

With the publication of the REPowerEU plan in May 2022, the European Commission aims to both end the EU's dependence on Russian fossil fuels and tackle the climate crisis. The measures included in the REPowerEU plan focus on energy savings, the diversification of energy supplies and an accelerated roll-out of renewable energy sources. In this regard, the Commission proposes increasing the energy targets previously formulated in the context of the 'Fit for 55' package. For energy efficiency, it proposes increasing the target from a 9% to a 13% reduction in energy consumption by 2030 compared with the 2020 reference scenario; for renewables, the proposal is to increase the target from a 40% to a 45% share in energy consumption.

To counteract gas shortages, the European Commission has proposed a Council Regulation for reducing gas demand by 15% between 1 August 2022 and 31 March 2023, while at the same time working on diversifying energy supplies (EC, 2022i). The Member States reached a political agreement on a voluntary reduction in natural gas demand by 15% this winter, and, after this agreement had been reached, the regulation entered into force in August 2022.

The examples in the following paragraphs demonstrate how these crises can affect the activities of sectors in the short and middle terms, highlighting the potential for positive change and potential challenges. There are some **common themes** across all sectors and Member States.

High energy prices lead to changes in established supply-and-demand situations. Global supply chains are affected and both businesses and households face higher costs. For all energy users, conserving energy becomes more important. Governments encourage energy conservation through large-scale campaigns; in addition, a change in behaviour occurs as a result of price elasticity in both companies and households. On the other hand, increased costs and uncertainty about gas supplies lead to the intensified utilisation and expansion of renewable energy sources and new technologies and a diversification of supply streams. Every sector and household is affected by the effects of high energy prices, but some are affected more than others. There is a need for targeted support for low-income households, which preferably focuses on structural measures that sustainably reduce energy consumption. In addition, indirect effects need to be considered: not only energy prices have increased as a result of the energy crisis, but food prices have also increased rapidly in recent months as the Russian invasion of Ukraine impacts on agricultural systems. From an overarching perspective, an integrated response is needed that takes into account the various aspects of the crises.

Energy-saving measures are the quickest and cheapest way to counteract the energy crisis. In addition, measures should be taken to diversify energy supplies in response to the natural gas supply insecurity. First, a switch to **fossil fuels other than natural gas** is in full progress: the use of coal-fired power plants already intensified in 2021 and the plan is to use oil as a backup fuel to make gas available for other uses. This leads to a higher demand for CO_2 emission certificates, which increases their price (Tollefson, 2022). With high CO_2 and energy prices, investments in alternative technologies will thus become more competitive more quickly than had been anticipated in absence of the energy crisis. This and the wish to become less dependent on energy imports, will speed up the implementation of plans to increase **renewable energy** capacities. To diversify energy supplies, the EU is also tapping into alternative gas supplies by importing **liquified natural gas (LNG)** and has become another participant in the international market for LNG. This may prompt other regions in the world to switch to fuels for generating electricity with a higher GHG emission intensity (Tollefson, 2022). The LNG supply is bound to infrastructure systems that are now expected to be ramped up very quickly. However, all infrastructural decisions, even in times of crisis, need to consider climate-neutrality targets to avoid severe lock-in effects.

Increased oil and gas prices specifically impact on households that rely on these energy sources to heat their homes, especially households with lower incomes that are prone to energy poverty, and those living in buildings with low energy efficiency (EC, 2022d). A challenge will be developing policies that provide targeted support during the energy crisis for those who need it most.

The prices for people's and goods' mobility based on fossil fuels across Europe dropped during the COVID-19 pandemic because of low demand. During the recovery from the COVID-19 pandemic, prices have risen again and the energy crisis has led to further increases and volatility as a result of low inventories (Kuik et al., 2022).

Increases in price levels have the potential to effect positive change when they come at the right time: they can provide incentives to switch to electric mobility and to transport people and goods by rail rather than road. The latter is already being considered in Europe's rail masterplan: 'The sector is committed to transforming the railway system, [...] to become the backbone of Europe's mobility and the logistic chain' (EC, 2021d).

Challenges to implementing those changes are capacity constraints of the existing rail system, long lead times for infrastructural change and delivery chain difficulties across the globe.

Several major industries in the EU exhibit a high gas intensity (Gunnella et al., 2022). Interrupted gas supply can thus lead to a slowdown of such heavy industry and a loss of value added, of up to an estimated 1.6% (with an EU average loss of approximately 0.7%) (Gunnella et al., 2022). Alternative sources for gas and power generation could help to avoid shortages in the EU-27 for around 12 months and replace up to two thirds of Russian gas imports. The REPowerEU plan addresses short-term challenges and also includes measures for the medium term such as building a hydrogen accelerator to supply EU industry with homegrown renewable hydrogen and mobilising additional funding for industrial decarbonisation (EC, 2022h). In addition, the European Commission's 'save energy' communication (EC, 2022b) focuses specifically on energy saving and highlights, among other things, the importance of energy audits to avoid heat loss and the replacement of fossil fuel systems with renewables.

Growing our food, the agriculture sector is vulnerable to disruptions in fertiliser markets (Tollefson, 2022), as has occurred during the current energy crisis. The prices of fertilisers and other energy-intensive products have risen. This is expected to lead to significant increases in input prices, translating into higher production costs, which in turn will trigger an increase in food prices. Price spikes may also trigger the use of less input, resulting in lower yields in the coming season, affecting food prices and food security in future years (FAO, 2022).

While alternatives to chemical fertiliser can be sought and farming practices can be changed, making such changes takes time; however, they would also provide co-benefits, in relation to climate change. In view of the need to mitigate and adapt to the climate crisis, changes in agricultural practices are needed and have already been discussed (EC, 2022j; EEA, 2019a).

Climate change impacts are already putting pressure on the land use sector. In extended dry periods, forest fires and droughts lead to land degradation, release carbon and destroy ecosystems as the basis of life, food, biodiversity and a resource for mitigation efforts. Forest fires impact negatively on the natural carbon sink, and a recent study shows that this risk may increase (Carnicer et al., 2022). During the current energy crisis, pressure on land use may increase when area competition becomes more intense: decisions have already been made on which land to use for biomass and which for food. Such competition for land use may be intensified during the Russian invasion of Ukraine.

The parallel unfolding of recent crises (the climate, COVID-19 and energy crises) needed and still needs immediate actions to be taken. Some of the responses to the COVID-19 pandemic contributed to an unprecedented drop in emissions between 2019 and 2020, but preliminary estimates for 2021 indicate that they have partially rebounded, to a level 28% lower than 1990 levels. Existing policies and measures are already addressing the climate crisis and contributed to reaching the 2020 target. However, projections indicate that these policies and measures, and even currently anticipated additional measures, will not be sufficient to reach the EU's targets and goals beyond 2020.

The current energy crisis has not been considered in current projections. Upcoming projections will face the challenge of dealing with increased uncertainty in future energy prices, which are an important driver of projected emissions.

The current energy crisis has led to inflation, with a particular impact on energy and food prices. It has created a situation in which the EU needed and still needs to react quickly and thoroughly in view of potential energy shortages and volatile prices. While this challenges solidarity, it may also provide an opportunity: the experience of the COVID-19 pandemic has demonstrated that implementing changes quickly is possible. If the EU's coordinated responses to the current crises are socially just, while not letting the long-term goal of climate neutrality out of sight, the current crises may lead to sustainable long-term change. The REPowerEU plan contains helpful elements in this respect.

3 Greenhouse gas emissions and energy trends in European countries

Key messages

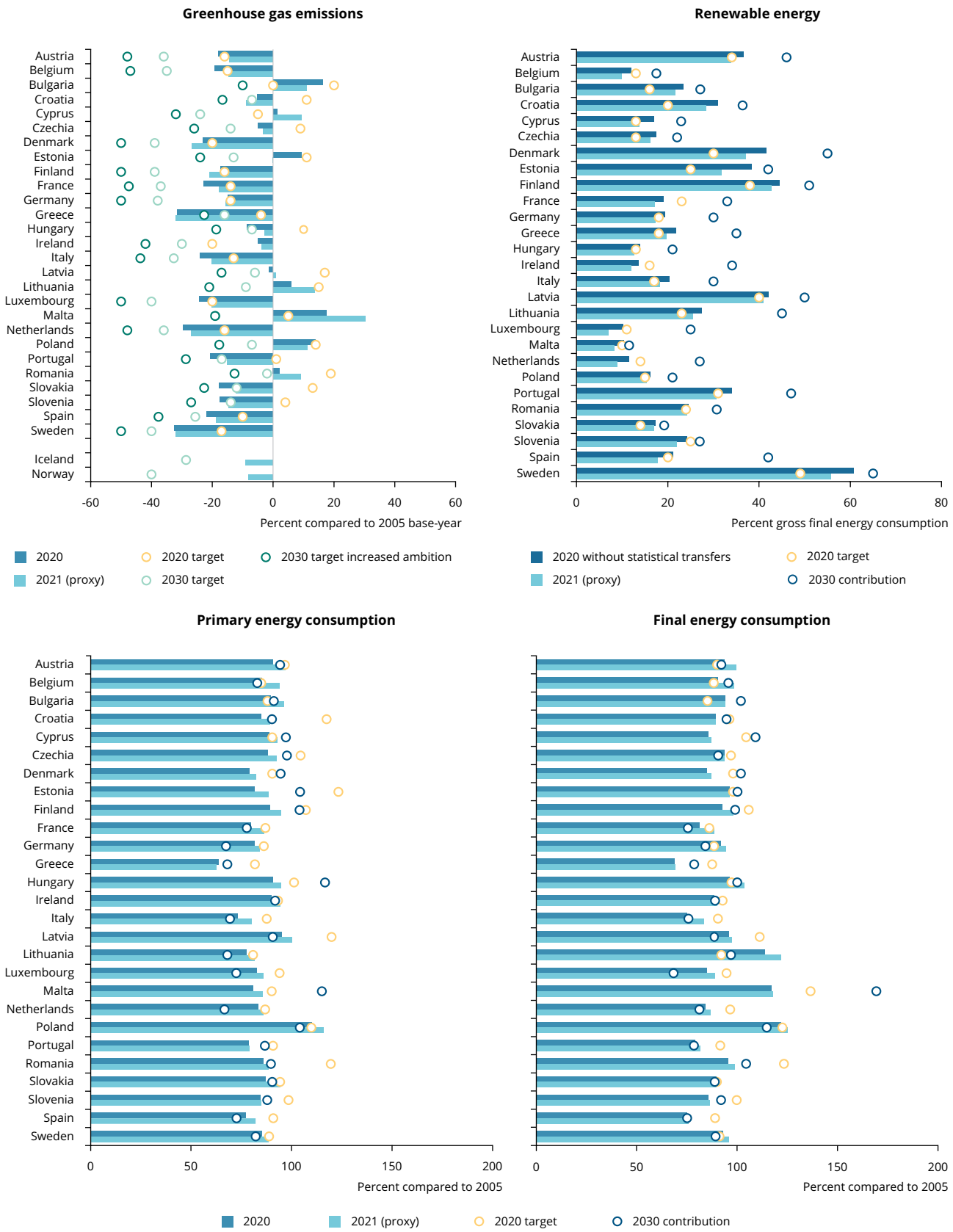
- **The EU met its 2020 climate and energy targets. At Member State level, several countries showed particularly strong overachievements, which was more than enough to make up for countries that could not achieve their national targets (under Effort Sharing legislation and for energy efficiency and renewable energy share) for 2020 without flexibilities. In total, 13 countries (Croatia, Czechia, Denmark, Estonia, Finland, Greece, Hungary, Italy, Latvia, Portugal, Romania, Slovakia and Spain) did not need to make use of flexibilities across any target area and stayed within their 2020 greenhouse gas (GHG) emission and energy consumption limits, while also meeting or exceeding their renewable energy share targets. By making use of Effort Sharing Decision flexibilities and/or statistical transfers under the Renewable Energy Directive, six more countries (Cyprus, Ireland, Luxembourg, Malta, the Netherlands and Slovenia) are on the way to meeting their 2020 targets across all dimensions.**
  - **Total GHG emissions decreased in 2020 at the EU level by 10% compared with 2019. In a total of 24 EU countries (all except Cyprus, Ireland and Malta), GHG emissions under the Effort Sharing legislation in 2020 were below their national targets. In two Member States (Croatia and Romania), emissions under the Effort Sharing legislation increased in 2020, partly because of emissions from the energy and industry sectors that are not covered by the EU Emissions Trading System (ETS).**
  - **A total of 26 countries (all except France) met or exceeded their 2020 renewable energy share targets. To do so, five countries (Belgium, Ireland, Luxembourg, the Netherlands and Slovenia) made use of statistical transfers they had acquired from other countries (Czechia, Denmark, Estonia, Finland, Lithuania and Sweden).**
  - **In the area of energy efficiency, 21 Member States reduced their final energy consumption enough to reach levels below their 2020 indicative targets. However, Austria, Belgium, Bulgaria, Germany, Lithuania and Sweden had not reduced their final energy consumption enough to meet their 2020 final energy targets, even given the effects of the COVID-19 pandemic([9]). In relation to the indicative targets for primary energy consumption, 24 Member States (all except Belgium, Bulgaria and Poland) met or were below their 2020 indicative targets.**
- **With a view to 2030, continued and stronger efforts will need to be made by the majority of EU countries, although some had already met their 2030 targets in 2020:**
  - **Croatia, Greece, Hungary, Portugal, Slovakia and Slovenia's GHG Effort Sharing emission levels were below their current emission limits for 2030 in 2020.**
  - **Belgium, Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, Greece, Hungary, Ireland, Italy, Malta, Romania and Slovenia's final energy consumption levels were below their targets for 2030.**
  - **No country's renewable energy share was at or above its 2030 target. These countries will need to maintain their progress through the coming decade to reach their national targets for 2030 — particularly during the recovery from the COVID-19 pandemic.**

While Chapter 2 reviewed progress in individual sectors and highlighted substantial sectoral shifts in selected European countries, this chapter looks more broadly at progress in all of the EU Member States in terms of emission reductions, renewable energy shares and energy consumption.

Figure 3.1 shows how EU countries fare today with respect to their 2020 and 2030 targets and contributions in the areas of Effort Sharing legislation emissions, renewable energy share, and energy efficiency in terms of final energy consumption and primary energy consumption. Under the Energy Efficiency Directive, countries set their own national, non-binding targets based on primary or final energy consumption, on primary or final energy savings, or on energy intensity. The directive requires that Member States also express those targets in terms of absolute levels of primary and final energy consumption, both of which are presented in Figure 3.1.

([9]) Sweden has opted for an energy intensity target, which has been translated into absolute values to allow for comparison with other Member States.

Figure 3.1 National achievement of 2020 targets and progress towards 2030 targets and contributions



Note: Black dots indicate the 2020 target, while white dots with a black outline indicate the currently available 2030 targets (under Effort Sharing legislation) or contribution (for renewable energy share and energy efficiency). For Effort Sharing legislation emissions and energy efficiency, the target or contribution is considered to have been met when the coloured bar is at or below the target or contribution. For renewable energy share, the target is met when the orange bar exceeds the indicated target or contribution. For Effort Sharing emissions, the current 2030 limitation targets of the Effort Sharing Regulation (ESR) and the revised targets for the increased EU ambition for 2030 as proposed in the 'Fit for 55' package are shown. The ESR targets for 2030 have been published using global warming potentials (GWPs) from the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC). To allow a comparison with reported greenhouse gas projections and historical inventory numbers, an estimate for annual emission allocations for 2030 in Fourth Assessment Report (AR4) of the IPCC has been conducted. As a reference, the ESD base year 2005 has been used for 2020 values and ESR base year 2005 has been used for 2030 and 2021 values, also estimated using GWPs from AR4.

Sources: EC (2021j); EEA (EEA, 2019b, 2022b, forthcoming a, forthcoming b, forthcoming c); ESA (2021); Eurostat (2022c, 2022d).

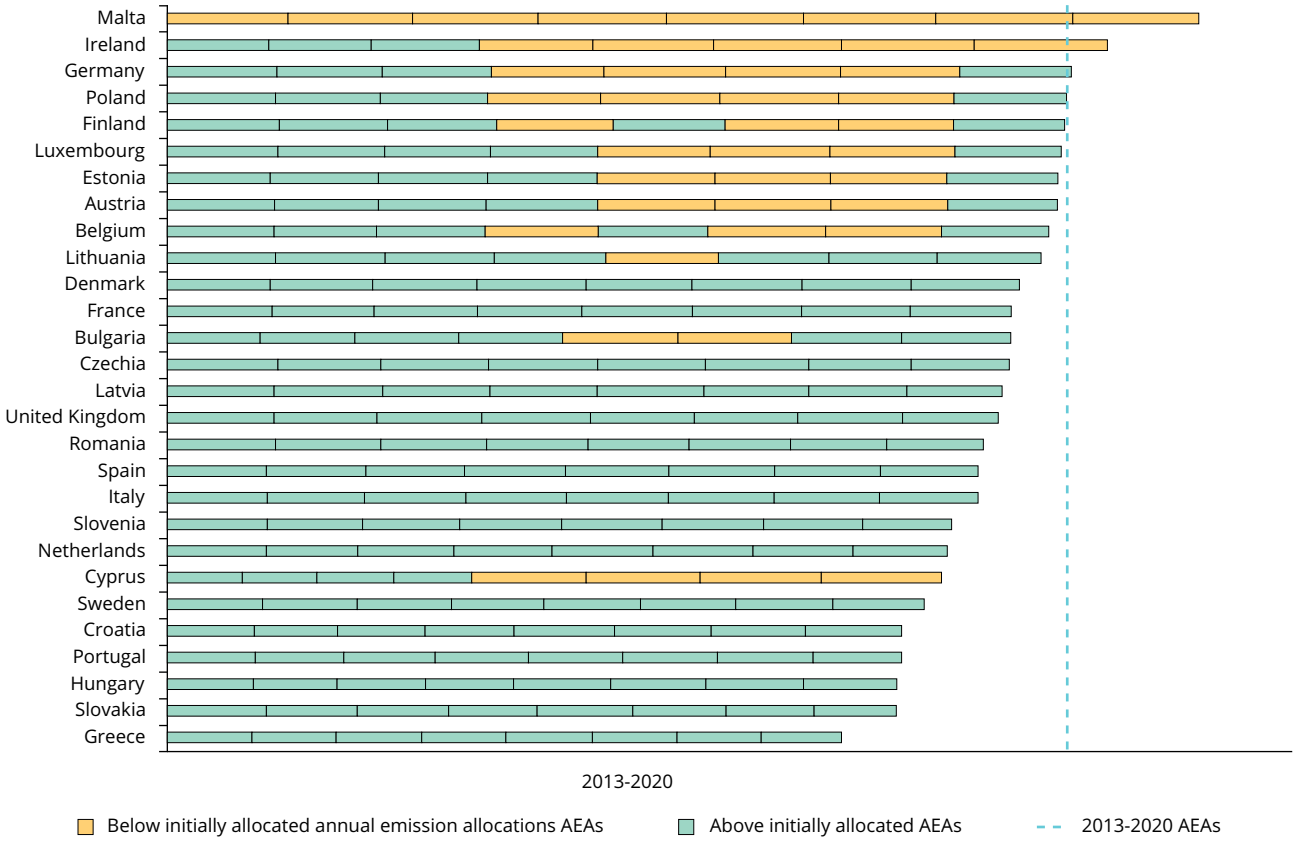
In the following sections, progress at the Member State level is reviewed briefly in each of the areas of greenhouse gas (GHG) emissions, renewable energy share and energy efficiency.

3.1 Effort Sharing legislation emissions

The Effort Sharing Decision (ESD) set 2020 national emission reduction targets for GHG emissions (those currently not covered by the EU Emissions Trading System (ETS)), expressed as percentage changes from 2005 levels. The national emission reduction targets are translated into annual emission allocations (AEAs), comprising a binding annual emission budget in megatonnes of carbon dioxide equivalent ($MtCO_2e$) for each Member State for each year from 2013 to 2020. Member States can use a number of flexibilities to comply with these binding annual targets.

A total of 24 EU countries (all except Cyprus, Ireland and Malta) had greenhouse gas emissions in 2020 that were below their national targets under the ESD. Looking over the entire period 2013-2020, the Effort Sharing emissions from Germany, Malta and Ireland exceeded the national annual emissions allocations allocated for those countries. As in 2020 for all these four countries (Cyprus, Ireland, Malta and Germany) the effort sharing emissions exceeded the available national annual emission allocations, these countries need to use some of the 'flexibilities' available under the ESD to comply with their 2020 targets. Only Cyprus is able to use national emission allocations from previous years. If those four countries make sufficient use of such flexibilities, all EU-27 countries will have achieved their effort sharing targets as they did for previous years.

Figure 3.2 Annual emission allocations compared to annual Effort Sharing emissions and in relation to the AEA budget 2013-2020



Note: Green segments indicate years in which Effort Sharing emissions were below the initially allocated AEAs for that year. Orange segments indicate years in which the Effort Sharing legislation emissions were above the initially allocated AEAs.

Sources: EEA (2021c) for Effort Sharing legislation emissions; EU (2013b, 2013a, 2017) for AEAs.

Germany complied with its annual emission limits for the years 2016-2018 by using surplus AEAs that it had banked from previous years. It complied in the year 2019 by borrowing AEAs from 2020. This borrowing of AEAs resulted in a shortage of AEAs for 2020. Therefore, Germany will have to use flexibilities in the form of purchasing AEAs from other Member States or using international credits to comply with its 2020 target. Since 2005, it is notable that emissions from transport, agriculture and small industry, not covered by the EU ETS, have not fallen significantly in Germany.

Ireland used both banked AEAs and international credits to comply with its annual emission limits for 2016-2019. As Ireland's 2020 emissions exceeded its AEAs for that year, it will need to purchase AEAs from other Member States or use international credits to comply with its 2020 target. An important explanation for this lies in the sectors of agriculture and transport, which account for more than 70% of emissions in the Effort Sharing legislation sectors and in which emissions did not decrease substantially.

Malta's emissions exceeded its AEAs for each of the years in the period 2013-2020. Malta will therefore also need to use flexibilities to comply with its 2020 target, as they did for each of the years in 2013-2019. The difference between AEAs and emissions can largely be attributed to the transport and industry sectors not covered by the EU ETS, as emissions have risen sharply over the last decade in both sectors.

Cyprus' emissions exceeded its AEAs for each of the years in the period 2017-2020. It saved surpluses from the period 2013-2016 to cover the deficit in recent years. Also for 2020 Cyprus has a sufficient surplus of AEAs from previous years to comply.

The EU-wide 2030 target of a 40% reduction in emissions by 2030, compared with 1990 levels, was translated into a reduction in Effort Sharing legislation emissions by 30% by 2030 compared with 2005 levels. The current national 2030 Effort Sharing legislation emission reduction targets range from 0% (Bulgaria) to 40% (Luxembourg and Sweden) compared with 2005 base-year levels. No country's emission target would permit an increase in emissions.

In 2021, according to preliminary data, gaps([10]) between emission levels and the 2030 Effort Sharing legislation targets ranged from 49% above the national target (Malta) to 16% below the national 2030 target (Greece). Effort Sharing emissions in Croatia, Greece, Slovakia and Slovenia in 2021 were also estimated to be lower than these countries' national 2030 targets.

On 14 July 2021, the European Commission proposed a revision of national Effort Sharing legislation targets and AEAs for the period 2021-2030 to reflect the increased ambition for 2030 and to continue to recognise the different capacities of the Member States to take action. The new 2030 targets are proposed to range from 10% to 50% below 2005 levels.

3.2 Renewable energy

For the period up to 2020, national, binding targets for shares of energy from renewable sources — known as 'RES shares' — were set in the Renewable Energy Directive (RED). EU Member States also set out their respective paths towards achieving their 2020 RES share targets in their national renewable energy action plans (NREAPs).

For 2030, the national energy and climate plans (NECPs) indicate how Member States intend to contribute to achieving the EU-wide RES share target. The European Commission's assessment of the NECPs finds that, at the EU level, the combined commitments of the Member States will lead to a total RES share of between 33.1% and 33.7% by 2030, which is consistent with the 32% target (EC, 2020b).

In all of the EU Member States, as well as in Iceland and Norway, RES shares increased, albeit at different rates, between 2005 and 2020. The differences between RES shares and targets presented in Figure 3.1 highlight the use of statistical transfers for compliance with the RED for 2020, where RES shares were below targets.

The three examples described below show how developments in RES shares can vary.

Hungary exhibited its greatest RES share in 2013, with a total of 16.2%. Since then, Hungary's RES share has decreased every year up to 2019 when it stood at 12.6%. The reason for this decline can be explained by Hungary's growth in energy consumption, which has outpaced its growth in renewables. Between 2019 and 2020, the overall RES share grew by 1.3 percentage points. The reason for this increase can be explained by the combination of a 3% decline in overall gross final energy consumption between 2019 and 2020 and a 6% growth in gross final energy consumption from renewable energy sources. Electricity generation from solar energy increased by around 64% between 2019 and 2020.

The Netherlands saw an increase of 5 percentage points in its RES share between 2019 and 2020. Its overall gross final energy consumption declined by 8% between these years and at the same time the final energy consumption from

([10]) The gaps were calculated according to the formula ((2030 ESR target)-(2021 ESR emissions))/2021 ESR emissions, where the ESR target has been translated from the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (AR4).

renewable sources increased by 47%. Statistical transfers of 1,174 kilotonnes of oil equivalent (ktoe) contributed to more than half of that increase. The use of solid biofuels for electricity generation more than doubled between 2019 and 2020 and electricity generation from solar energy grew by 62%.

Denmark's RES share declined by 5 percentage points between 2019 and 2020. Its overall gross final energy consumption declined by 3% between these years and at the same time the final energy consumption from renewable sources declined by 20%. However, this is because Denmark provided statistical transfers of 1,419ktoe to other Member States so they could comply with their 2020 RES share targets. Despite this, Denmark still met its 2020 RES share target.

Six EU countries (Czechia, Denmark, Estonia, Finland, Lithuania and Sweden) supported seven other EU countries (Belgium, Germany, Ireland, Luxembourg, Malta, the Netherlands and Slovenia) by providing statistical transfers to meet or overachieve (Germany and Malta) their 2020 RES share targets. In total, 1,910ktoe were statistically transferred for 2020 across the 27 EU Member States (EU-27). This is equivalent to less than 1% of total RES production in 2020.

The use of biomass as a renewable source for heating and cooling purposes as defined by the RED is widespread across the EU-27, accounting for 84% of renewable energy consumption for heating and cooling in 2020 (EEA, 2020). As the potential for using biomass is restricted in the EU and because Land Use, Land Use Change and Forestry (LULUCF) Regulation targets need to be achieved, there are limits on any further large increases in this sector. In 2019, more than 35% of gross final energy consumption for heating and cooling came from biomass in Latvia (42%), Finland (40%) and Sweden (38%) (Eurostat, 2021c). The sustainability requirements for biomass in the recast Renewable Energy Directive (RED II) are applicable from July 2021 and aim to ensure an overall balance in the use of this resource for energy purposes.

In contrast, the utilisation of heat pumps started from low levels in 2005, and several Member States have increased their utilisation continually and significantly since then. The three countries with highest shares of energy from heat pumps in gross final energy consumption for heating and cooling in 2020 were Malta (15%), Portugal (10%) and Sweden (10%).

In terms of progress towards targets, all EU countries except France achieved national RES shares in 2020 that surpassed their national 2020 targets set in the RED. The same holds true for Iceland and Norway.

Yet, there is still a long way to go to achieve the RES contributions set by countries for 2030 in their NECPs, which indicates that the use of renewable energy sources needs to increase significantly this decade. Distances between 2021 RES contributions to intended contributions for 2030 range from 24 percentage points (Spain, whose 2030 target is a 65% RES share) to only 2 percentage points (Slovakia, whose 2030 target is a 19% RES share).

3.3 Energy consumption

Between 2005 and 2020, final energy consumption decreased in 24 EU countries and increased in three countries, namely Lithuania (+14%), Malta (+17%) and Poland (+22%), despite the COVID-19 pandemic. These increases are largely explained by the strong growth in transport demand (+53% in Lithuania, +23% in Malta and +78% in Poland) and in the services sector in Malta (+93% between 2005 and 2020) (Eurostat, 2021b). On the other hand, the strongest decreases in final energy consumption can be observed in Greece, Italy, Portugal and Spain, with, respectively, decreases of 31%, 25%, 21% and 25% between 2005 and 2020.

Under the Energy Efficiency Directive, EU-27 countries set their own national non-binding targets for energy efficiency for 2020. These targets can be based on primary or final energy consumption, on primary or final energy savings, or on energy intensity. National indicative 2020 targets for final energy consumption set by Member States range from -15% (Bulgaria) to +37% (Malta), compared with 2005 levels (EC, 2021b). A total of 21 countries set targets to decrease their final energy consumption, while six countries (Cyprus, Finland, Latvia, Malta, Poland and Romania) set targets that are higher than their 2005 final consumption levels. Countries' frequent revisions of their voluntary targets for 2020, especially in recent years, give rise to challenges for the transparent and consistent evaluation of national and EU progress towards the 2020 targets.

In 2020, 21 of the 27 EU Member States were in line with or below their 2020 indicative targets for final energy consumption (see Figure 3.1). However, the remaining six (Austria, Belgium, Bulgaria, Germany, Lithuania and Sweden([11])) had not reduced their final energy consumption enough to meet their 2020 final energy consumption targets. The countries showing the highest deviation from their indicative 2020 targets are Bulgaria (+10%) and Lithuania (+23%), despite the COVID-19 pandemic, indicating shortcomings in the energy efficiency policies implemented in these countries. In relation to the indicative targets for primary energy consumption, 24 Member States

([11]) Sweden has opted for an energy intensity target in which the assumed levels of growth in both gross domestic product (GDP) and energy consumption impact on the target level. This energy intensity target has not been included in this assessment, to allow for comparison with other Member States.

were in line with or below their 2020 targets, while this was not the case in the other three (Belgium, Bulgaria and Poland).

The pandemic recovery in 2021 resulted in more Member States having an estimated primary and final energy consumption above their indicative 2020 targets, according to preliminary estimates for 2021. Nine Member States (Austria, Belgium, Bulgaria, France, Germany, Hungary, Lithuania, Poland and Sweden) are estimated to have been above their 2020 targets for final energy consumption in 2021. Similarly, the primary energy consumption of eight Member States (Austria, Belgium, Bulgaria, Cyprus, Ireland, Lithuania, Poland and Slovakia) is estimated to have been above their 2020 targets in 2021.

Similar to the 2020 targets, EU-27 countries set their own national, non-binding contributions for energy efficiency in 2030 in their NECPs (EC, 2020b). Together, their intended contributions to the 2030 energy efficiency targets total 1,176 million tonnes of oil equivalent (Mtoe) for primary energy consumption and 885 Mtoe for final energy consumption, in comparison with the current EU 2030 targets of 1,128 Mtoe for primary energy and 846 Mtoe for final energy consumption. This collective effort to reduce energy consumption will not be sufficient to reach the EU's 2030 target of reducing energy consumption by at least 32.5% — a target that has not yet been adjusted in line with the increased ambition for 2030 emission reductions or the REPowerEU ambitions.

17 Member States intend to reduce their national final energy consumption levels by 2030 compared with 2021 levels, ranging from a reduction of 1.1% (Ireland) to a reduction of 23.2% (Luxembourg). The other ten Member States already had final energy consumption levels in 2021 below their intended contributions to final energy consumption in 2030 (Bulgaria, Croatia, Cyprus, Denmark, Estonia, Finland, Greece, Malta, Romania and Slovenia). With regard to primary energy consumption, achieving intended 2030 contributions will require consumption decreases compared with 2021 levels in 15 Member States, ranging from a decline of 2.6% (Austria) to a decline of 22.6% (the Netherlands). The other twelve Member States already had primary energy consumption levels in 2021 that were below their respective 2030 primary energy contributions.

4
Increased ambition towards 2030

The achievement of the 20-20-20 climate and energy targets was driven by a number of developments, including substantial efforts delivered by climate and energy policies in previous decades and the unprecedented drops in greenhouse gas (GHG) emissions and energy use in the target year 2020, largely caused by the outbreak of the COVID-19 pandemic in late 2019.

Entry into the next decade has occurred against the backdrop of additional crises — the Russian invasion of Ukraine, which brings additional risks and uncertainties in energy and product supply, and the intensified impacts of climate change, causing heatwaves, droughts and floods. The character and ambition of the Union's short-term response to these multiple crises will significantly influence changes in GHG emissions between now and 2030 and either accelerate or hamper efforts to reach climate neutrality by 2050.

The EU's '2030 climate and energy framework' is still in flux: at the time of publishing this report, co-legislators were negotiating substantial adjustments to the 2030 objectives. To achieve the binding climate target of a net 55% reduction in emissions, the Commission put a package of specific legislative proposals on the table in July 2021, negotiations on which are already well advanced. For renewable energy, a target of 40% of energy consumption from renewable sources in the EU by 2030 has been set; for energy efficiency, the (recalibrated) energy saving target is to reduce energy consumption by 9% by 2030 compared with a new 2020 Reference scenario.

The assessment of progress towards the 2030 climate and energy targets in this report is primarily based on existing legally binding targets. This means, for assessing the EU's progress towards achieving overall GHG emission reductions, the net 55% reduction target is considered because it was enshrined in the European Climate law in June 2021. For the improvement targets in the areas of renewable energy and energy efficiency, the targets of the '2030 climate and energy framework', supporting a total emission reduction of 40% were considered, since new EU targets for these policy areas to support the increased ambition of a net 55% reduction have not yet been confirmed. For renewable energy and energy efficiency, a range of ambitions is shown in the graphs. The current legally established 2030 target for renewable energy is a share of 32%, while for energy efficiency the EU has set binding targets of reducing energy consumption through improvements in energy efficiency by 2030 by at least 32.5%, relative to a 2007 'business as usual' scenario.

The world today is considerably different from that of July 2021. The Russian invasion of Ukraine has pushed the EU to the facts: commitment to energy conservation and the roll-out of renewable energy sources is a matter not only of climate policy, but also of energy independence and energy security.

In May 2022, in response to the uncertainty of the EU's energy supply caused by the war in Ukraine, the European Commission put forward the REPowerEU plan to rapidly reduce the EU's dependence on Russian fossil fuels, diversify energy supplies at the EU level and accelerate the green transition. The plan builds on the Fit for 55 legislative proposals and outlines a set of actions to accelerate the energy transition. The main pillars of the plan are to:

- save energy;
- diversify suppliers;
- quickly substitute fossil fuels for other forms of energy by accelerating the clean energy transition;
- smartly combine investments and reforms.

The plan supports the fast implementation of all Fit for 55 proposals and sets out higher targets for renewable energy and energy efficiency. To this end, the Commission proposes:

- an increase in the binding target in the Energy Efficiency Directive to 13% reduction compared to the 2020 Reference Scenario and additional savings and energy efficiency gains through the Energy Performance of Buildings Directive;
- an increase in the 2030 renewable energy target to 45%.

With these more ambitious energy targets, ambitions in the national energy and climate plans (NECPs) will also require to be stepped up. Under the Regulation on the Governance of the Energy Union and Climate Action, Member States are required to submit draft updates to their NECPs in 2023 and final updates in 2024. This will provide an opportunity for Member States to set new national targets and define new national contributions for 2030. The Commission intends to publish guidance later this year on Member States' NECP updates and will report on progress towards implementation of the REPowerEU plan, among other things, through the State of the Energy Union and Climate Action reports.

Further reading

EEA indicators:

- Total greenhouse gas emissions
- Greenhouse gas emissions under the EU ETS
- Progress towards national greenhouse gas emission targets
- Greenhouse gas emissions from agriculture
- Greenhouse gas emissions from land use land use change and forestry
- Greenhouse gas intensity of electricity generation
- Greenhouse gas emissions from energy use in buildings
- Greenhouse gas emissions from transport in Europe
- Primary and final energy consumption
- Share of energy from renewables
- Use of renewable energy for transport in Europe
- New registrations of electric vehicles

Abbreviations

AEA	Annual emission allocation
AR4	Fourth Assessment Report of the Intergovernmental Panel on Climate Change
CO_2	Carbon dioxide
EEA	European Environment Agency
ESR	Effort Sharing Regulation
ETC/CME	European Topic Centre on Climate Change Mitigation and Energy
ETS	Emissions Trading System
EU	European Union
EU-27	27 Member States of the European Union (post-Brexit)
FEC	Final energy consumption
GHG	Greenhouse gas
GWP	Global warming potential
ktoe	Kilotonnes of oil equivalent
LNG	Liquified natural gas
LULUCF	Land use, land use change and forestry
$MtCO_2e$	Megatonnes of CO_2 equivalent
Mtoe	Million tonnes of oil equivalent
NECP	National energy and climate plan
NREAP	National renewable energy action plan
PEC	Primary energy consumption
RED	Renewable Energy Directive
RED II	Recast Renewable Energy Directive
RES	Renewable energy source
WAM	With additional measures
WEM	With existing measures

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Trends and projections in Europe 2022
2022 — 41 pp. — 21 x 29.7 cm

978-92-9480-505-8
doi: 10.2800/16646

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TH-AL-22-009-EN-N
doi: 10.2800/16646

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