Technical background document

Accompanying the report
Trends and projections in Europe 2022

European Environment Agency

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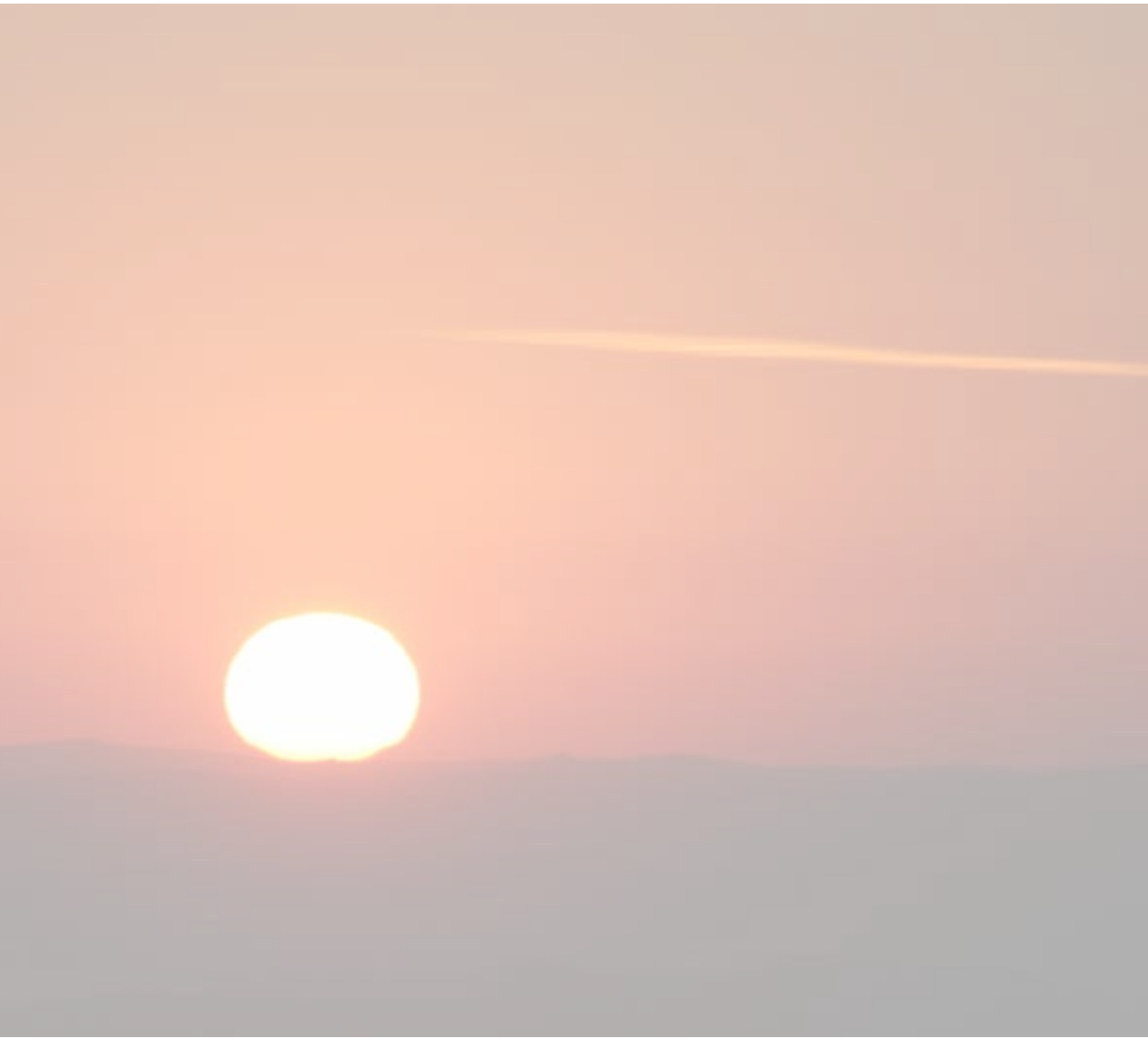

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1 Targets

The *Trends and projections in Europe 2022* report uses the most recent information available to assess achievement of the climate and energy targets 2020 and 2030. It includes data on emissions, energy consumption and renewable energy shares in 2020 and includes approximated data for the year 2021. Recent trends are used to illustrate the pace and direction of reductions in GHG emissions, deployment of renewable energy and gains in energy efficiency.

1.1 2020 targets

For 2020, the EU and its Member States have been working towards what are known as the '20-20-20' targets. These are targets to achieve the following by 2020:

- reduce greenhouse gas (GHG) emissions by 20% compared with 1990 levels;
- increase to 20% the share of energy from renewable sources in the EU's gross final energy consumption, with a minimum of a 10% share of renewables in the transport sector;
- reduce energy consumption by 20% compared with 2007 baseline projections for 2020.

These targets have been in effect since 2007, when the Council of the European Union committed the EU to becoming a highly energy-efficient, low-carbon economy by 2020 (Council of the European Union, 2007). To help Member States to meet the 2020 targets for GHG emissions, the EU adopted a climate and energy package in 2009. The package defined a single EU target for GHG emissions covered under the Emissions Trading System (ETS) (EU, 2003) and a set of national target trajectories for 2013-2020 for emissions within the scope of the Effort Sharing Decision (ESD) (EU, 2009a). For renewable energy, the Renewable Energy Directive (RED) (EU, 2009b) set binding targets for each EU Member State and provided indicative trajectories for 2011-2020. For energy efficiency, Member States set their own non-binding targets according to the Energy Efficiency Directive (EED) (EU, 2012).

By April 2022 Member States had to report on the achievement on their renewable and energy efficiency targets (Art. 27 of the Governance Regulation) (EU, 2018f). In 2010, the EU submitted a pledge to the United Nations Framework Convention on Climate Change (UNFCCC) to reduce its GHG emissions by 20% by 2020, compared with 1990 levels (EC, 2010). This was intended to contribute to the UNFCCC's ultimate objective: to stabilise global GHG concentrations 'at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system' (UN, 1992). In other words, it was intended to limit the global temperature increase to less than 2° C above average temperature levels before industrialisation. The EU has clarified that its accounting rules for its target under the UNFCCC are more ambitious than the current rules under the Kyoto Protocol. For example, international aviation is included, an annual compliance cycle for emissions under the ESD has been added, and there are higher quality standards for emission credits from the Kyoto Protocol's clean development mechanism, used under the EU ETS (UNFCCC, 2013a). Effort Sharing legislation targets for emission reductions.

The ESD covers emissions from all sources outside the EU ETS, except for emissions from aviation ([1]) and international maritime transport and net emissions from land use, land use change and forestry (LULUCF). The ESD therefore includes a range of diffuse sources in a wide range of sectors such as transport (e.g. cars, lorries, shipping on inland waterways), buildings (heating in particular), services, small industrial installations, agriculture and waste. Such sources account for 63% of total GHG emissions in the 27 EU Member States (EU-27) in 2020.

The ESD sets individual annual binding targets for GHG emissions not covered by the EU ETS — known as annual emission allocations (AEAs) — for all Member States for the period 2013-2020 (EU, 2009a). In 2013, the European Commission determined the AEAs of Member States for the period 2013-2020, using reviewed and verified emission data for the years 2005, 2008, 2009 and 2010 (EU, 2013a). The AEAs were adjusted in 2013 to reflect the change in the scope of the EU ETS from

([1]) Emissions from aviation have been included in the EU ETS since 1 January 2012. In principle, the EU ETS should cover all flights departing from and/or arriving at airports in all EU Member States, as well as Iceland, Liechten-stein and Norway and closely related territories. However, since 2012, only flights departing from and arriving at airports located in these countries (and Switzerland in 2012) have been included in the EU ETS. Non-carbon dioxide emissions from domestic aviation remain covered under the ESD.

2013 onwards (EU, 2013b) and in 2017 to reflect updates in methodologies for reporting GHG inventories (EU, 2017).

Each Member State will contribute to this effort, according to its relative wealth in terms of gross domestic product (GDP) per capita. The national emission targets range from a 20% reduction for the richest Member States to a 20% increase for the poorest ones by 2020, compared with 2005 levels (see Table A1.1). For the EU-27 and the UK, this would deliver a reduction in emissions of approximately 9.3% by 2020, compared with 2005 levels, from those sectors covered by the ESD; for EU-27 the reduction would be 8.2%. To achieve annual compliance, Member States are allowed to use flexibility provisions, see section 2.1.5.

1.1.1 Renewable energy targets

To meet its target of increasing the use of renewable energy sources (RES) to 20% of gross final energy consumption by 2020, the EU adopted the RED (EU, 2009b) as part of the climate and energy package.

The RED includes legally binding national renewable energy targets for 2020, consistent with an EU-wide target of increasing RES use to 20% of gross final energy consumption by 2020 and to 10% of transport-related fuel consumption by the same year (EU, 2009a). The RED also sets an indicative trajectory for each Member State for the period 2011-2018, intended to ensure that each Member State achieves its 2020 targets. An interim indicative RED target for the EU can be derived from the minimum indicative trajectories of the Member States in the run-up to 2020 (RED, Annex I, Part B).

Under the RED, Member States had to submit national renewable energy action plans (NREAPs) in 2010 (EEA, 2011). These plans outline the pathways (i.e. the expected trajectories) that Member States anticipate using to reach their legally binding national renewable energy targets by 2020. In 2011 (and every 2 years since), Member States had to report on national progress towards the interim RED and expected NREAP targets. The NREAPs adopted by Member States in 2010 outline the expected trajectories for RES use, as a proportion of gross final energy consumption, towards the legally binding national 2020 RES targets.

The compliance of national renewable energy targets under the RED allows the use of statistical transfers between Member States. The 2020 target under the RED serves as a baseline for the indicative trajectories to Member State's contributions to the Union's binding 2030 target (see section 1.2.2).

1.1.2 Energy efficiency targets

In 2007, the Council of the European Union stressed the need to increase energy efficiency to achieve the 20% energy savings target for 2020, for primary energy consumption, and agreed binding targets for reductions in emissions of GHGs and renewable energy (Council of the European Union, 2007). Reducing primary energy consumption by 20% by 2020 is a non-binding objective for the EU.

The climate and energy package does not address the energy efficiency target directly, although the carbon dioxide (CO_2) performance standards for cars and vans (EU, 2009d, 2014, 2019), the revised EU ETS Directive and the ESD all contribute to fostering energy efficiency. Since the adoption of the package, the EU energy efficiency policy framework has advanced in line with the priorities identified in the 2006 action plan for energy efficiency (EC, 2006). The energy efficiency action plan was reviewed in 2011, after the following pieces of legislation were revised:

- the Ecodesign Directive (EU, 2012);
- the Energy Labelling Directive (EU, 2010a);
- the Energy Performance of Buildings Directive (EU, 2010b).

One of the key developments in the energy efficiency policy framework was the adoption of the EED in 2012, which was updated in 2018 (EU, 2018c). The EED establishes a common framework of measures for promoting energy efficiency within the EU and aims to help remove barriers and overcome market failures that impede efficiency in the supply and use of energy.

Article 3 of the EED requires Member States to express their targets in terms of an absolute level of primary energy consumption and final energy consumption in 2020, although Member States can choose the basis of their indicative energy efficiency targets (final or primary energy consumption, savings or intensity). The EEA's assessment of progress towards the 2020 energy efficiency targets is based on indicative values of final energy consumption to assess the consistency of progress among Member States. Primary energy consumption progress is also monitored. Target values are adopted as notified by Member States in their 2017 national energy efficiency action plans or in a separate notification to the European Commission (EC, 2019c, 2020c).

The EED stipulates that primary energy consumption in the EU-27 and the UK should not exceed 1 483Mtoe (million tonnes of oil equivalent) in 2020, and that final energy consumption in the EU-27 and the UK should not exceed 1 086Mtoe in 2020. These absolute targets were set using the European Commission's 2007 energy baseline scenario (EC, 2008), based on the PRIMES (Price-driven and Agent-based Simulation of Markets Energy System) model.

Apart from the indicative national targets, under the EED Member States had to implement a set of mandatory requirements, one of the most significant being establishing an energy efficiency obligation scheme or implementing alternative measures.

Member States chose different approaches for setting national targets, based on primary or final energy consumption, primary or final energy savings, or energy intensity. Member States can also revise their targets and projections upwards or downwards at any point in time because of, for example, revised macro-economic assumptions or new methods of calculation. Each national target reflects the specific situation of the Member State that adopted it. Consequently, ambition levels vary greatly.

1.1.3 Overview of national targets 2020

Table A1.1 provides an overview of the EU and national targets for each of the topic areas covered in the Trends and projections in Europe 2022 report —GHG emissions, renewable energy and energy efficiency. They reflect the information provided throughout the report and are included here as a comprehensive reference.

Table A1.1 Main national climate and energy targets until 2020

Country/group	Participating in EU ETS	ETS target (2020)	ESD target (2020)	2020 ESD emission allocation	2005 ESD base-year emissions	Renewable energy target 2020 (RED)	Primary energy target 2020	Final energy target 2020
		Change vs 2005 (%)		Mt CO_2e		Gross final energy consumption (%)	Mtoe	
EU-27 and the UK		-21	-9	2 618.2	2 887.1	20	1 483.0	1 086.0
EU-27		-21	-8	2 267.2	2 469.3	20	1 312.0	959.0
Austria	×		-16	47.8	56.8	34	31.5	25.1
Belgium	×		-15	68.2	80.3	13	43.7	32.5
Bulgaria	Since 2007		20	26.5	22.1	16	16.9	8.6
Croatia	Since 2013		11	19.3	17.4	20	10.7	7.0
Cyprus	×		-5	4.0	4.2	13	2.2	1.9
Czechia	×		9	67.2	61.7	13	44.3	25.3
Denmark (a)	×		-20	32.1	40.1	30	16.9	14.7
Estonia	×		11	6.0	5.4	25	6.5	2.8
Finland	×		-16	28.5	33.9	38	35.9	26.7
France	×		-14	342.5	398.2	23	219.9	131.4
Germany	×		-14	410.9	477.8	18	276.6	194.3
Greece	×		-4	60.0	62.6	18	24.7	18.4
Hungary	×		10	52.8	48.0	13	24.1	14.4
Ireland	×		-20	37.7	47.1	16	13.9	11.7
Italy	×		-13	291.0	334.5	17	158.0	124.0
Latvia	×		17	10.0	8.5	40	5.4	4.5
Lithuania	×		15	15.2	13.3	23	6.5	4.3
Luxembourg	×		-20	8.1	10.1	11	4.5	4.2
Malta	×		5	1.2	1.1	10	0.8	0.6
Netherlands	×		-16	107.4	127.8	14	60.7	52.2
Poland	×		14	205.2	180.0	15	96.4	71.6
Portugal	×		1	49.1	48.6	31	22.5	17.4
Romania	Since 2007		19	89.8	75.5	24	43.0	30.3
Slovakia	×		13	25.9	23.0	14	16.4	9.2
Slovenia	×		4	12.3	11.8	25	7.1	5.1
Spain	×		-10	212.4	236.0	20	122.6	87.2
Sweden	×		-17	36.1	43.5	49	43.4	30.3
United Kingdom (a)	×		-16	350.9	417.8	15	177.6	129.2
Iceland	Since 2008					64.0		
Liechtenstein	Since 2008							
Norway	Since 2008					67.5		
Switzerland	Since 2020							
Turkey	-							

Notes: (a) The Faroe Islands and Greenland (Denmark), and the United Kingdom's overseas territories, are not part of the EU and therefore are not covered by the targets presented here.

×, yes; -, no.

Sources: EC (2019b); EU (2009a, 2009b, 2009c, 2012, 2013a, 2013b) Eurostat (2021).

1.2 2030 targets

The *Trends and projections in Europe 2022* report describes how current trends and developments may contribute to achieving the current 2030 targets for reducing GHG emissions, deploying renewable energy and making energy efficiency gains at European level, and also to reducing GHG emissions at Member State level. In 2021, the EU set a more ambitious target of a net 55% GHG emission domestic reduction compared with 1990. This target was submitted as an updated nationally determined contribution to the UNFCCC (Council of the European Union, 2020) and is enshrined in the European Climate Law (EU, 2021). This target replaces the binding EU target of a minimum 40% domestic reduction in GHG emissions by 2030 compared with 1990 (EC, 2014). This target was submitted to the UNFCCC as the EU's first nationally determined contribution (EC, 2015).

The current 2030 targets for GHG emissions, renewable energy and energy efficiency at the EU level are:

- A target of a at least a net 55% reduction in the EU-27's domestic GHG emissions (compared with 1990 levels). The maximum contribution of natural sinks from the LLULUCF sector to this target is limited to -225Mt CO_2e. A binding emission cap is set for the sectors covered by the EU ETS (EU, 2018a) and binding annual minimum targets for reducing GHG emissions from 2021 to 2030 are set for EU Member States for the sectors not covered by the EU ETS (EU, 2018e) but have not yet been aligned to the net 55% target level. Furthermore, the LULUCF Regulation (EU, 2018d) stipulates that 'EU Member States have to ensure that accounted GHG emissions from land use, land use change or forestry are offset by at least an equivalent removal of CO from the atmosphere in the period 2021 to 2030' (EC, 2018b).

- A binding target to increase the share of energy from renewable sources in the EU-27 to at least 32% of gross final energy consumption by 2030, including a clause allowing upwards revision by 2023, set in the RED (EU, 2018b).

- A target of at least a 32.5% improvement in energy efficiency by 2030 at EU level (compared with the Commission's 2007 energy baseline scenario), with a clause for an upwards revision by 2023, set in the EED (EU, 2018c).

The three targets mentioned above are currently being harmonised at EU level. Detailed legislative proposals to support the increase in ambition with revised instruments were published in July 2021 (EC, 2021a). Discussions on revisions are still ongoing between the European Commission, the European Parliament and the European Council. Member State's projections mostly did not take into account the latest increase in the level of ambition of the EU target or related proposals in the European Commission's 'Fit for 55' package.

In addition to the EU-27-wide targets for 2030, GHG emission reduction targets have been set for 2030 under the Effort Sharing Regulation at national level. In the *Trends and projections in Europe 2022* report, progress towards meeting the national 2030 GHG emission targets can therefore be measured, as these are established and binding at national level. National, non-binding contributions in the areas of renewable energy deployment and energy efficiency contributions have been set by Member States in the context of their national energy and climate plans (NECPs). Individual Member States are free to set their own higher national contributions and to adjust these upwards in future updates of their NECPs. Draft updated NECPs are due in June 2023 and final updated NECPs in June 2024.

1.2.1 Effort Sharing legislation targets for emission reductions

The regulation on binding annual emission reductions by Member States from 2021 to 2030 (Regulation (EU) 1018/842, the Effort Sharing Regulation) (EU, 2018e) sets out binding annual GHG emission targets for Member States for the period 2021-2030. This regulation is the follow-up to the ESD, which established national emission targets for Member States in Effort Sharing sectors between 2013 and 2020. The regulation recognises the different capacities of Member States to act by differentiating targets according to GDP per capita across Member States. This ensures fairness, because the Member States with the highest incomes take on more ambitious targets than Member States with lower incomes. EU leaders recognised that an approach for high-income Member States based solely on relative GDP per capita would mean that, for some, the costs associated with reaching their targets would be relatively high. To address this, these targets have been adjusted to reflect cost-effectiveness for Member States with an above average GDP per capita while maintaining the overall GDP per capita-based reduction in emissions required from this group of Member States. The resulting 2030 GHG emission targets range from 0% to -40%, compared with 2005 levels.

The European Commission's proposal the for the revision of the Effort Sharing Regulation (EC, 2021e) increases the EU-wide emission reduction planned from 30% to 40% and sets more ambitious reduction targets at Member State level.

1.2.2 Renewable energy targets

In June 2018, the EU endorsed an EU-level, binding renewable energy target of at least 32% of the gross final energy consumption by 2030 (EU, 2018b). This target will be reached through the collective efforts of all Member States, and countries are free to set their own national contributions.

Under the Regulation on the Governance of the Energy Union and Climate Action (Regulation (EU) 2018/1999), Member States presented their NECPs. These included planned national objectives, targets and contributions related to all dimensions of the Energy Union, together with planned policies and measures and the anticipated investment needed to meet the national targets, objectives and contributions. For renewable energy these included not only 2030 targets but also indicative trajectories from 2021 onwards, with reference points in 2022, 2025 and 2027 (Art. 4.2 of the Governance Regulation) (EU, 2018f).

In July 2021 the European Commission proposed an increase of the renewable energy target, set in the RED, to 40% (EC, 2021b). In May 2022 the European Commission proposes in its REPowerEU plan to increase this target to 45% as part of a series of measures to reduce EU's dependence on Russian fossil fuels (EC, 2022).

1.2.3 Energy efficiency targets

On 14 June 2018, the European Commission, the Parliament and the Council reached a political agreement that includes a binding energy efficiency target for the EU to be achieved by 2030 of 32.5% compared with the 2007 baseline scenario, with a clause allowing an upwards revision by 2023 (EU, 2018c). The Governance Regulation (EU, 2018f) states that Member States should set indicative national energy efficiency contributions to achieve the 2030 targets based on primary or final energy consumption, primary or final energy savings, or energy intensity. Member States should also set an indicative trajectory for that contribution from 2021 onwards, based on their indicative contributions to the EU 2020 and 2030 targets. To address the more ambitious GHG reduction target, the European Commission proposed a reduction of 36% for final energy consumption and 39% for primary energy consumption (EC, 2021c). This is a reduction of 9% compared to the EU reference scenario 2020. In the REPowerEU plan the European Commission proposes a further reduction to 13% compared to the EU reference scenario 2020. As a short-term reaction to the military aggression of the Russian Federation against Ukraine, in July 2022, EU Member States committed to voluntary reduce gas demand by 15% between 1 August 2022 and 31 March 2023, with measures of their own choice.

1.2.4 Overview of national targets 2030

Table A1.2 provides an overview of the EU and national targets for each of the topic areas covered in the *Trends and projections in Europe 2022* report — GHG emissions, renewable energy and energy efficiency. They reflect the information provided throughout the report and are included here as a comprehensive reference.

1.3 Goals to 2050 and beyond

Although the 2030 targets provide a concrete objective in the medium term, they also provide a milestone towards achieving longer-term goals for greater reductions in GHG emissions in the EU-27. In the European Climate Law (EU, 2021) a binding objective of the EU achieving climate neutrality by 2050 is set out, in pursuit of the long-term temperature goal in point (a) of Article 2(1) of the Paris Agreement. The climate neutrality objective requires that all EU-wide GHG emissions and removals, as regulated in EU law, are to be balanced within the EU by 2050 at the latest, reducing emissions to net zero by that date. Thereafter, the EU will aim for negative emissions. It is also stated that the Regulation will be amended to include a 2040 climate target, based on a detailed impact assessment.

The impact assessment (EC, 2020a) published by the European Commission, together with the proposal to raise the EU's ambition, presented several scenarios on how this can contribute to the objective of net-zero GHG emissions in 2050. It previewed a set of actions required across all sectors of the economy and proposed the launch of revisions of key legislative instruments. When referring to the scenarios accompanying the Commission's impact assessment, the *Trends and projections in Europe 2022* report describes the levels depicted in the assessment's 55% reduction scenarios rather than specific values.

Table A1.2 Main EU and national climate and energy targets and contributions for 2030

	GHG target (2030)	ETS target (2030)	ESR target (2030)	ESR target proposal (2030)	LULUCF target proposal (2030)	Renewable energy contribution 2030	Primary energy contribution 2030	Final energy contribution 2030
Member State	Change vs 1990 (%)	Change vs 2005 (%)			Mt CO_2e	Gross final energy consumption (%)	Mtoe	
EU-27	-40	-43 (proposal: -61)	-30	-40	-310.0	32.0 (proposal: 40.0)	1,128.0	846.0
Austria			-36	-48	-5.7	46.0	30.8	25.6
Belgium			-35	-47	-1.4	17.5	42.7	35.2
Bulgaria			0	-10	-9.7	27.1	17.5	10.3
Croatia			-7	-16.7	-5.5	36.4	8.2	6.9
Cyprus			-24	-32	-0.4	22.9	2.4	2.0
Czechia			-14	-26	-1.2	22.0	41.4	23.7
Denmark [a]			-39	-50	5.3	55.0	18.3	15.8
Estonia			-13	-24	-2.5	42.0	5.5	2.9
Finland			-39	-50	-17.8	51.0	34.8	24.9
France			-37	-47.5	-34.0	33.0	202.2	120.9
Germany			-38	-50	-30.8	30.0	216.0	185.0
Greece			-16	-22.7	-4.4	35.0	20.5	16.5
Hungary			-7	-18.7	-5.7	21.0	30.7	18.7
Ireland			-30	-42	3.7	34.1	13.7	11.2
Italy			-33	-43.7	-35.8	30.0	125.1	103.8
Latvia			-6	-17	-0.6	50.0	4.1	3.6
Lithuania			-9	-21	-4.6	45.0	5.5	4.5
Luxembourg			-40	-50	-0.4	25.0	3.5	3.1
Malta			-19	-19	0.0	11.5	1.1	0.8
Netherlands			-36	-48	4.5	27.0	46.6	43.9
Poland			-7	-17.7	-38.1	21.0	91.3	67.1
Portugal			-17	-28.7	-1.4	47.0	21.5	14.9
Romania			-2	-12.7	-25.7	30.7	32.3	25.7
Slovakia			-12	-22.7	-6.8	19.2	15.7	10.3
Slovenia			-15	-27	-0.1	27.0	6.4	4.7
Spain			-26	-37.7	-43.6	42.0	98.5	73.6
Sweden			-40	-50	-47.3	65.0	40.2	29.7

Notes: [a] The Faroe Islands and Greenland are not part of the EU and therefore are not covered by the targets presented here.
Not all NECP contributions are consistent with Member States' projections in their "With planned policies and measures" scenario (WPM), as submitted in final NECPs in 2020.

ESR, Effort Sharing Regulation.

Sources: EC (2019a, 2020b, 2021f, 2021b, 2021e); EU (2018e); European Council (2014).

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Data sources

The information in the *Trends and projections in Europe 2022* report is based on the latest official data on greenhouse gas (GHG) emissions and energy consumption in 2020, as reported by Member States to the European Commission and the EEA under the Governance Regulation (EU, 2018f) and the Monitoring Mechanism Regulation (MMR) (EU, 2013c) and to the European Commission under the Energy Statistics Regulation (EU, 2008). It also reflects approximated data for GHG emissions in 2021, as reported under the Governance Regulation in July 2022, and early EEA estimates of renewable energy shares and energy consumption in 2020. Designed to ensure monitoring of GHG emissions and related information that is necessary to track the EU's and Member States' progress towards the achievement of the 2030 and long-term objectives and targets in line with the 2015 Paris Agreement on climate change, the Governance Regulation has been in effect since 2019, replacing the MMR (EU, 2013c) which had been in place since 2013.

The Governance Regulation-related data are submitted by countries to the EEA's environment data repository, Reportnet ([2]), after which the EEA, supported by its European Topic Centre on Climate Change Mitigation (ETC/CM), performs quality control procedures in consultation with individual countries. For example, the national inventory data are quality checked, Emissions Trading System (ETS) data are verified, Effort Sharing legislation emission data are reviewed and projection data are quality checked. Reviews and quality-checking procedures ensure that potential over or underestimates in national inventory data are detected and corrected, and this helps to reduce the uncertainty inherent in projections.

The EEA and ETC/CM then compile the reported data and publish data sets, data viewers and related products on the EEA's website.

The following data sets are highlighted in the *Trends and projections in Europe 2022* report:

- GHG emission inventory for the period 1990-2020, reported under the MMR in March 2022;
- Effort Sharing emission data for the period 2013-2020 (2020 data reviewed in 2022);
- ETS emission data for the years 2005-2020, from the European Union Transaction Log (EUTL), extracted in July 2022;
- GHG emission projection data up until 2040, reported under Article 18 of the Governance Regulation in March 2021 and updates submitted in March 2022;
- approximated ('proxy') GHG emission data, renewable energy shares and energy consumption for the year 2021, partly reported by Member States in July 2022 and gap-filled with estimates by the EEA (national proxy data were not provided by Bulgaria);
- share of energy from renewable sources related to renewable energy use in Europe, reported under the Energy Statistics Regulation and the Renewable Energy Directive (RED), and published by Eurostat in its SHARES tool in 2022 (Eurostat, 2020c);
- EEA early estimates for the share of energy from renewable sources in gross final energy con-sumption in 2020;
- primary (PEC) and final energy consumption (FEC) (indicators FEC 2020-2030, PEC 2020-2030), reported in the Energy Statistics Regulation and published by Eurostat in its energy statistics database, extracted in April 2022;
- EEA early estimates for the primary and final consumption of energy in 2020.

([2]) https://reportnet.europa.eu/

2.1 Data sources for greenhouse gas emissions

The analysis presented in the *Trends and projections in Europe 2022* report is based on several sets of GHG emission data.

2.1.1 Historical trends in greenhouse gas emissions

GHG emission data for the period 1990-2020 are official data reported by the EU and Member States under the United Nations Framework Convention on Climate Change (UNFCCC) in their corresponding GHG inventory reports (EEA, 2020a) The EEA is responsible for the compilation of the EU GHG inventory. Together with the ETC/CM ([3]), the EEA implements a quality assurance and quality control (QA/QC) procedure (ETC/CME, 2021) to ensure the timeliness, completeness, consistency, comparability, accuracy and transparency of the inventories reported by Member States that are used in the *Trends and projections in Europe 2022* report.

In 2016, a comprehensive review of GHG emission data took place under Article 19 of the MMR, in the context of the annual compliance cycle under the Effort Sharing Decision (ESD). This concerned the years 2005, 2008-2010, 2013 and 2014. The years 2015, 2016, 2017 and 2019 were reviewed in 2017, 2018, 2019 and 2021 during the annual review cycle under Article 19 of the MMR and Article 38 of the Governance Regulation. In 2020, another comprehensive review of GHG emission data took place for the years 2005, 2016-2018, which forms the basis for the calculation of annual emission allocations (AEAs) for 2021-2030 under the Effort Sharing Regulation (ESR).

From 2015 onwards, Member States' GHG inventories are based on the use of global warming potentials (GWPs) from the Intergovernmental Panel on Climate Change (IPCC)'s Fourth Assessment Report (AR4) (UNFCCC, 2013b). Thus, all the emission estimates used in the *Trends and projections in Europe 2022* report were calculated using GWPs from the IPCC's AR4.

Early approximated estimates of 2021 GHG emissions were reported by Member States under the Governance Regulation by 31 July 2022. These estimates were aggregated to EU level by the EEA (forthcoming_b). Bulgaria did not submit proxy GHG inventories, so proxies were calculated by the EEA and the ETC/CM. Gap-filling of aviation data was done by applying Eurocontrol data. International aviation was gap-filled for Bulgaria, Denmark, Luxembourg and Portugal. Domestic aviation was gap-filled for all Member States except Estonia, Finland, France and Malta. Gap-filling of international navigation data was done by applying Eurostat monthly data about supply and transformation of oil and petroleum products (Eurostat 2022). Data from Member States' 2021 projections was applied to gap-fill LULUCF. Gap-filling was done for two Member States; Denmark and Croatia.

The methodology and data sources are laid out in detail in the ETC report Approximated EU GHG inventory (EEA, forthcoming_b).

2.1.2 Greenhouse gas emissions in the EU Emissions Trading System since 2005

Data in the EU ETS are used to analyse emission trends and to determine the level of emissions covered under the ESD. For the years 2005-2012, ETS emissions include estimates to reflect the scope of the EU ETS for the third trading period (2013-2020). These data are publicly available from the EUTL ([4]) and the EEA ETS data viewer (EEA, 2020b) The data considered in the trend analysis were extracted from the EUTL on 1st July 2022. Data used to determine the ESD emissions for the period 2013-2020 were extracted from the EUTL on 8 March of each year of the ESD review of that year (as agreed by Working Group 1 under the EU Climate Change Committee in its session on 18 May 2015).

2.1.3 Emissions covered under the Effort Sharing Decision

For analysing emission trends in the ESD, historical Effort Sharing emissions for the period 2005-2012 are calculated using the latest GHG inventory data, from which ETS emissions, carbon dioxide (CO_2) emissions from domestic aviation and nitrogen trifluoride (NF_3) emissions are subtracted. ETS emissions include EEA estimates to reflect the scope of the EU ETS for the third trading period for the period 2005-2012 (ETC/CME, 2019).

ESD emissions for 2005 that are calculated with the latest inventory data are different from ESD base-year emissions, which are used to compare Member States' progress towards achieving national targets and make comparisons between Member States. The calculation of base-year emissions is explained in Section 2.1.6.

The Effort Sharing GHG emission data for the years 2013-2019 are consistent with the outcome of the 2016, 2017, 2018, 2019, 2020and 2021 reviews of national GHG inventory data pursuant to Article 19 of the MMR. These annual verified ESD data, are set out in Commission implementing decisions and were used to determine Member States' compliance under the ESD for the years 2013 to 2019. The reviewed data for 2020 are expected to be published in the fourth quarter of 2022.

([3]) The ETC/CME is a consortium of European institutes contracted by the EEA to carry out specific tasks in the fields of climate change mitigation and energy.
([4]) The EUTL automatically checks, records and authorises all transactions in the EU ETS.

2.1.4 Long-term trends in Emissions Trading System and Effort Sharing Decision emissions

GHG emissions for the years 1990-2010 are split into those covered by the EU ETS and those covered by the ESD. These splits are based on the application of a percentage of each of the main source categories defined by the IPCC for the reporting of national GHG inventories, based on Member States' projections submitted in 2021. Projections for the ETS and ESD are reported by source categories in Member States' submissions.

2.1.5 Annual emission targets (annual emission allocations) under the Effort Sharing legislation

The AEA values for the period from 2013 to 2020 were defined in Commission Decision No 2013/162/EU (EU, 2013a) and adjusted in accordance with Commission Implementing Decision No 2013/634/EU (EU, 2013b) to reflect the change in scope of the EU ETS in 2013.

Following the 2016 comprehensive review of Member States' historical GHG inventory estimates, the AEAs for the years 2017-2020 were revised to reflect updates in the methodologies for reporting GHG inventories (EU, 2017). This recalculation ensures that the level of effort originally intended (as a percentage) is maintained for each Member State in the ESD. The recalculation also ensures consistency between the targets and the emissions reported by the Member States for compliance with the ESD, as the current reported emissions already take account of the methodological updates.

AEA values for 2017-2020 used throughout the *Trends and projections in Europe 2022* report follow Commission Decision No 2013/162/EU (EU, 2013a), (Implementing Decision No 2013/634/EU (EU, 2013b) and Decision No 2017/1471 (EU, 2017).

The ESR defines Member States' minimum contributions required to achieve the EU's 2030 target of a 30% reduction in emissions compared with 2005 in ESR sectors (see Table A1.2). Absolute AEA values for the period from 2021 to 2030 were determined in the year 2020 (EU, 2020). They were based on the Effort Sharing legislation emissions for 2005 and the period 2016-2018, following a comprehensive review covering these years conducted in 2020.

The adjustments pursuant to Article 10(2) listed under Annex IV of the ESR are already considered in the AEA amounts for 2021 for the eligible Member States.

The ESD allows Member States to use flexibility provisions to meet their annual targets, with certain limitations:

- Within a Member State, any overachievement in a year during the period 2013-2019 can be carried over to subsequent years, up to 2020. Up to 5% of a Member State's AEA may be carried forward from the following year during the period 2013-2019. Member States may transfer up to 5% of their AEAs to other Member States, which may use this emission allocation until 2020 (ex ante). Any overachievement in a year during the period 2013-2019 may also be transferred to other Member States, which may use this emission allocation until 2020 (ex post). The latter can take place only after emission data for the relevant year have been confirmed.
- For annual compliance the use of a limited amount of international project credits is allowed.

The ESR for 2030 targets maintains existing flexibilities under the current ESD with some adjustments:

- Banking of unused AEAs is capped at a total of 30% of the cumulative AEA of the year in question from 2022 to 2029.
- Borrowing is limited to 10% of the AEA of the following year from 2021 to 2025 and to 5% from 2026 to 2029.
- A Member State may transfer up to 5% of its AEA for a given year to other Member States in the years 2021-2025 and up to 10% in the years 2026-2030. The recipient Member State can use these AEAs for the same year or for later years.
- International project credits are excluded, as the EU target is to be met domestically.
- There is a new flexibility to use credits from the land use sector. Land mitigation units from afforested land, managed cropland and managed grassland allow the 27 EU Member States to use up to 262 million credits over the entire period 2021-2030 in the whole of the EU to comply with their national targets. All Member States are eligible to make use of this flexibility, but those with a larger proportion of emissions from agriculture have greater access to it. In line with EU leaders' guidance, this recognises that there is a relatively low mitigation potential for emissions from the agricultural sector. Iceland and Norway also have access to this flexibility, since both are part of the ESR and LULUCF Regulation for the period 2021-2030.
- The ESR allows nine Member States the choice of using a limited amount of ETS allowances for offsetting emissions in the Effort Sharing sectors in the period 2021-2030. It concerns Member States that have national reduction targets significantly above both the EU average and their cost-effective reduction potential or that did not allocate any EU ETS allowances for free to industrial installations in 2013. The Member States having this option are Austria, Belgium, Denmark, Finland, Ireland, Luxembourg, the Netherlands, Malta and Sweden.
  Iceland and Norway are also eligible, as they have agreed with the EU to implement the ESR.

The maximum limit that can be used annually in the period 2021-2030 is set at 2% of each country's Effort Sharing emissions in 2005, except for Ireland, Luxembourg and Iceland, which are allowed a limit of up to 4%. Six Member States, as well as Iceland and Norway, have given notice that they intend to use their full amounts of this flexibility, whereas Belgium intends to use 1.89%. The Netherlands and Sweden have decided not to use the flexibility. Member States may request downwards revisions of their percentages for later years during the compliance period in 2024 and 2027, respectively.

AEAs have been published using GWPs from the Fifth Assessment Report. To allow a comparison with reported GHG projections and historical inventory numbers, we estimated AEAs for 2021-2030 from AR4.

2.1.6 The 2005 Effort Sharing Decision base-year emissions

The 2005 **ESD base-year emissions** are calculated by the EEA to be consistent with both:

- the relative 2020 Effort Sharing target (as a percentage of 2005 emissions) defined in the ESD (EU, 2009a);
- the absolute 2020 Effort Sharing target determined by the European Commission (EU, 2017 and EU, 2013b).

The EEA calculates the 2005 ESD base-year emissions as follows:

ESD base year emissions = 2020 absolute target/(1 + 2020 Effort Sharing target).

These calculated ESD base-year emissions can also be used, for example, to compare relative changes in Effort Sharing emissions with 2020 Effort Sharing targets expressed as percentages.

In the *Trends and projections in Europe 2022* report, calculated 2005 ESD base-year emissions are used to express the distance between Effort Sharing emissions and Effort Sharing targets in a normalised way. The distance, calculated as the absolute difference between emissions and targets divided by 2005 ESD base-year emissions, is expressed in percentage points (a share of 2005 base-year emissions). It is then directly comparable with targets and reductions as percentages of 2005 levels and allows relevant comparisons between Member States.

These calculated 2005 ESD base-year emissions reflect the current scope of the EU ETS (EU, 2013b) and the outcome of the comprehensive ESD review in 2016 and may therefore differ, sometimes significantly, from emissions in the Effort Sharing sectors for the year 2005 that are estimated based on the latest GHG inventories and ETS data.

It is important to note that the 2005 ESR base-year emissions are part of the abovementioned determination of AEAs under the ESR and based on the results of the 2020 comprehensive review. These take into account the GHG inventory data for 2005 in 2020 and will be relevant for discussing the trends in Effort Sharing emissions for the period 2021-2030.

To allow a comparison with reported GHG projections and historical inventory numbers, we estimated AEAs for 2021-2030 from AR4. Due to changes in the scope of the Effort Sharing legislation and inventory revisions, ESR base-year estimates from AR4 are about 1% lower than ESD base-year emissions.

2.1.7 Projections of greenhouse gas emissions

The *Trends and projections in Europe 2022* report uses GHG projection data that were reported by Member States under Article 18 of the Governance Regulation in 2022 (EEA, 2021). Mandatory reporting of projections takes place every 2 years (2015, 2017, 2019, 2021). Member States must also report substantial changes to projections every other year (2014, 2016, 2018, 2020). In 2022, Denmark, Iceand, Ireland and Latvia submitted updated projections.

Under Article 18 of the Governance Regulation, Member States report projections under three scenarios:

- A with existing policies and measures (WEM) scenario considers the implementation of existing (already implemented) measures.
- If available, a with additional and planned policies and measures (WAM) scenario is reported too. It considers the implementation of additional measures (at the planning stage).
- If available, Member States also report projections without policies and measures (WOM).

In 2021, 22 Member States reported WAM scenarios; Denmark, France, Germany, Malta and Sweden provided only a WEM scenario. The updated 2022 projections of Ireland and Latvia included a WAM scenario.

EU scenarios are only calculated for WEM and WAM projections. To aggregate a WAM scenario at EU level, data for the five Member States that did not report a WAM scenario in 2021 were gap-filled using the WEM scenario.

Iceland, Norway and Switzerland did submit WEM projections in 2021, but only Switzerland also submitted WAM and WOM projections.

Member States' reported projections include total and sectoral GHG emissions by source category as well as the split of these projections between those covered by the EU ETS and those

covered by the Effort Sharing sectors. Total GHG projections are used to assess progress towards achieving the EU's 40% reduction target by 2030, and 'Effort Sharing projections' are used to assess Member States' progress towards achieving their national 2030 targets, set under the ESR.

The EEA, together with its ETC/CM, implements a QA/QC procedure to ensure the timeliness, completeness, consistency, comparability, accuracy and transparency of the projections reported by Member States and used in the *Trends and projections in Europe 2022* report. This procedure is described in *Elements of the Union system for policies and measures and projections and the quality assurance and control (QA/QC) programme as required under Regulation (EU) No 525/2013* (ETC/CME, 2021). If significant discrepancies are observed between the inventory value for the reference year and that for the projected year, the levels of the projections are aligned. Such calibration is performed to match national projections with the GHG inventory, which is the year 2019 for projections submitted in 2021 and 2020 for updated projections submitted in 2022. In 2021 and 2022, no such calibration took place.

By 2020, Member States had submitted their national energy and climate plans (NECPs) to the European Commission, including GHG projections that differ from the projections Member States reported in 2021. This is because of calibration with the most recent GHG inventory data and to differences in considered existing and additional policies and measures.

2.2 Data sources for renewable energy

2.2.1 Historical trends in the share of energy from renewable sources in gross final energy consumption

The assessment of progress towards objectives and targets for the use of renewable energy sources (RES) is based, for the most part, on information reported by Member States to Eurostat under Regulation (EC) No 1099/2008 on energy statistics (EU, 2008) and the RED and published by Eurostat via its SHARES tool (Eurostat, 2020c).

2.2.2 Share of energy from renewable sources in gross final energy consumption in 2020

The shares of RES in gross final energy consumption as well as information on statistical transfers stem from Eurostat, based on national data transmitted under the Energy Statistics Regulation. In accordance with the accounting rules in the RED, electricity generated by hydro- and wind power was normalised to account for annual variations (hydropower over 15 years and wind power over 5 years). For details of the normalisation rules, see the SHARES manual provided by Eurostat (Eurostat, 2022). Because of their insular and peripheral geography, Cyprus and Malta's gross inland energy consumption is disproportionally high for aviation, and they are thus strongly affected by current technological and regulatory constraints. Therefore, they have exemptions on the amounts by which they can exceed the EU's average gross final consumption of energy in aviation in 2005 as assessed by Eurostat.

2.2.3 Approximated shares of renewable energy use in 2021

Approximated shares of renewable energy use in 2020 were estimated by the EEA (EEA, forthcoming_C)

2.2.4 2020 targets for energy from renewable sources and indicative trajectories for the period 2011-2018

The 2020 RES targets for each Member State were taken from Part A of Annex I of the RED, and the indicative trajectories for the period 2011-2018 were taken from Part B of Annex I of the RED (EU, 2009b) (see Table A1.1).

2.2.5 National renewable energy action plan trajectories for the period 2010-2020

National RES trajectories for the period 2010-2020 were derived from information submitted by Member States to the European Commission in 2010, in the context of their adopted national renewable energy action plans, and also considering some updates made thereafter. These trajectories reflect how Member States themselves anticipate that their renewable energy deployment will develop up to 2020 (EEA, 2011; EC, 2013).

2.2.6 The 2030 targets for energy from renewable sources

The 2030 RES targets for each Member State were taken from the assessment of NECPs, reported by Member States under the Governance Regulation by 2020. These NECPs included planned national objectives for national contributions to the EU target on renewable energies (see Table A1.2).

2.2.7 The share of energy from renewable sources on a sectoral level

The report also presents data on RES deployment on a sectoral level (for electricity, heating and cooling, and transport). These data are based on Eurostat's SHARES tool (Eurostat, 2022). Approximate 2020 values were estimated by the EEA (EEA, forthcoming_C).

2.3 Data sources for energy efficiency

Under Article 3 of the Energy Efficiency Directive (EED) (EU, 2012), Member States have to set their own indicative national energy efficiency targets for 2020 and for 2030. Depending on country preferences, these targets are based on primary or final energy consumption, primary or final energy savings, or energy intensity. Each national target reflects the specific situation of the Member State that adopted it.

Related to the 2030 targets, the revised EED (Directive (EU) 2018/2002) (EU, 2018c) asks Member States not only to set indicative national energy efficiency contributions towards achieving the EU's 2030 targets (notified as part of their NECPs) but also to set an indicative trajectory for primary and final energy consumption for that contribution from 2021 onwards.

The definition of final and primary energy to track progress to 2020 and 2030 targets excludes ambient heat of heat pumps and non-energy uses but includes energy consumption for international aviation (Eurostat, 2019). Currently, transformation losses and consumption from blast furnaces are included in final energy consumption but are proposed to be excluded with the Commission's EED recast, as to align with the Energy Statistics Regulation (EC) 1099/2008. (EU, 2008; EC, 2021d).

2.3.1 Historical trends in primary and final energy consumption

The assessment of progress towards achieving energy efficiency targets is based, for the most part, on information reported by Member States to Eurostat under the Energy Statistics Regulation and is published by Eurostat via its energy statistics database (Eurostat, 2020a, 2020b).

2.3.2 Approximated estimates for primary and final energy consumption in 2020

Early estimates of 2021 primary and final energy consumption were prepared by the EEA (EEA, 2022a). National estimates, sometimes only for selected fuel types or sectors, were collected for Austria, Germany, Denmark, Finland, France, Hungary, Ireland, Lithuania, Netherlands, Portugal, Slovenia and Italy.

2.3.3 National energy efficiency targets for 2020

The 2020 energy efficiency targets for each Member State were taken from 2017 national energy efficiency action plans and their updates, as notified by Member States in their annual progress reports, as reported under the EED (EU, 2012). Countries' frequent revisions of their voluntary targets for 2020, especially after 2017, raise challenges for a transparent and consistent evaluation of national and EU progress towards achieving the 2020 targets.

2.3.4 National energy efficiency targets for 2030

The 2030 energy efficiency targets for each Member State were taken from the assessment of NECPs, reported by Member States under the Governance Regulation at the end of 2019 and 2020. These NECPs included planned national objectives for national contributions to the EU target on energy efficiency (see Table A1.2).

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Abbreviations

AEA	Annual emission allocation
AR4	Fourth Assessment Report of the Intergovernmental Panel on Climate Change
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
EEA	European Environment Agency
EED	Energy Efficiency Directive
ESD	Effort Sharing Decision
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)
EUTL	European Union Transaction Log
FEC	Final energy consumption
GDP	Gross domestic product
GHG	Greenhouse gas
GWP	Global warming potential
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land use, land use change and forestry
MMR	Monitoring Mechanism Regulation
Mt	Million tonnes
Mtoe	Million tonnes of oil equivalent
NECP	National energy and climate plan

PEC	Primary energy consumption
QA/QC	Quality assurance and quality control
RED	Renewable Energy Directive
RES	Renewable energy source
UNFCCC	United Nations Framework Convention on Climate Change
WAM	With additional measures
WEM	With existing measures
WOM	Without policies and measures

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