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Trends and projections in Europe 2017

Tracking progress towards Europe's climate and energy targets

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Abbreviations

AAU	Assigned amount unit
AEA	Annual emission allocation
AR4	Fourth Assessment Report of the IPCC
CER	Certified emission reduction
CM	Cropland management
CO_2	Carbon dioxide
COP 21	Paris climate conference
EEA	European Environment Agency
EED	Energy Efficiency Directive
Eionet	European environment information and observation network
ETC/ACM	European Topic Centre for Air Pollution and Climate Change Mitigation
ERU	Emission reduction unit
ESD	Effort Sharing Decision
EU	European Union
EU ETS	European Union Emissions Trading System
F-gas	Fluorinated gas
FM	Forest management
GDP	Gross domestic product
GHG	Greenhouse gas
GM	Grazing-land management
GWP	Global warming potential
ICAO	International Civil Aviation Organization
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change

LDC	Least developed country
LULUCF	Land use, land use change and forestry
MMR	Monitoring Mechanism Regulation
Mtoe	Million tonnes of oil equivalent
NDC	Nationally Determined Contribution
NEEAP	National energy efficiency action plan
NF_3	Nitrogen trifluoride
NREAP	National renewable energy action plan
QA/QC	Quality assurance and quality control
QELRC	Quantified emission limitation or reduction commitment
RED	Renewable Energy Directive
RES	Renewable energy source
RES-E	Renewable energy source use in electricity
RES-H/C	Renewable energy source use in heating and cooling
RES-T	Renewable energy source use in transport
RMU	Removal units
RV	Revegetation
SIDS	Small island developing state
UNFCCC	United Nations Framework Convention on Climate Change
WAM	With additional measures
WEM	With existing measures

Executive summary

Progress of the European Union and its Member States towards 2020 climate and energy targets

The 2017 edition of the European Environment Agency (EEA) *Trends and projections in Europe* report confirms that the European Union (EU) is well on track to meet its climate and energy targets for 2020. Official data for 2015 show that greenhouse gas (GHG) emissions have already decreased beyond the 20 % reduction target and energy use from renewable sources is steadily growing and getting closer to the 20 % target. Energy consumption levels, while currently considered to be on track to meet the EU energy efficiency target, have increased slightly meaning greater efforts are needed to reach this target (see Figure ES.1). Policies are playing an important role in driving the overall EU trends observed since 2005, in particular through a sustained increase in renewable energy use.

According to preliminary estimates for 2016, greenhouse gas emissions show only a modest decrease compared with 2015, when GHG emissions increased for the first time since 2010. The reduction in 2016 took place despite an increase in transport emissions. Primary energy consumption increased in 2016, for the second consecutive year. This increase follows a large drop in consumption in 2014, due to an exceptionally warm winter that resulted in a particularly low energy demand for heating.

Insufficient progress has been achieved so far towards the 10 % target for renewables set for the transport sector for 2020.

The report uses official data for 2015 to look at the progress of Member States towards their individual objectives for 2020 (see Figure ES.2). Here progress is mixed: while the EU is on track, the situation differs between Member States.

- 21 Member States are on track to meet their 2020 GHG targets under the Effort Sharing Decision, which cover national emissions from sectors outside the EU Emissions Trading System (ETS). All except Austria, Belgium, Finland, Germany, Ireland, Luxembourg and Malta project that their GHG emissions will be kept or reduced below their national targets in 2020, with the current set of policies and measures in place. Malta did not reach its 2015 ESD target.

- 25 Member States are on track to reach their 2020 renewable energy targets. All except France, Luxembourg and the Netherlands used more renewable energy than the minimum level indicated in the Renewable Energy Directive for 2015-2016.

- 23 Member States (all except Bulgaria, Estonia, France, Germany and the Netherlands) are on track to meet their 2020 energy efficiency targets on the basis of their consumption of primary energy in 2015. However, the overall ambition level of Member States is still insufficient: the sum of the 28 national targets for 2020 primary energy consumption does not match the reduction target determined at the EU level.

A total of 17 Member States are on track to deliver on their national targets in all three areas. This is an improvement on 2014, when the figure was 16. However, preliminary data indicate an overall deterioration of the situation in 2016 compared with 2015, in particular when it comes to progress towards national energy efficiency targets.

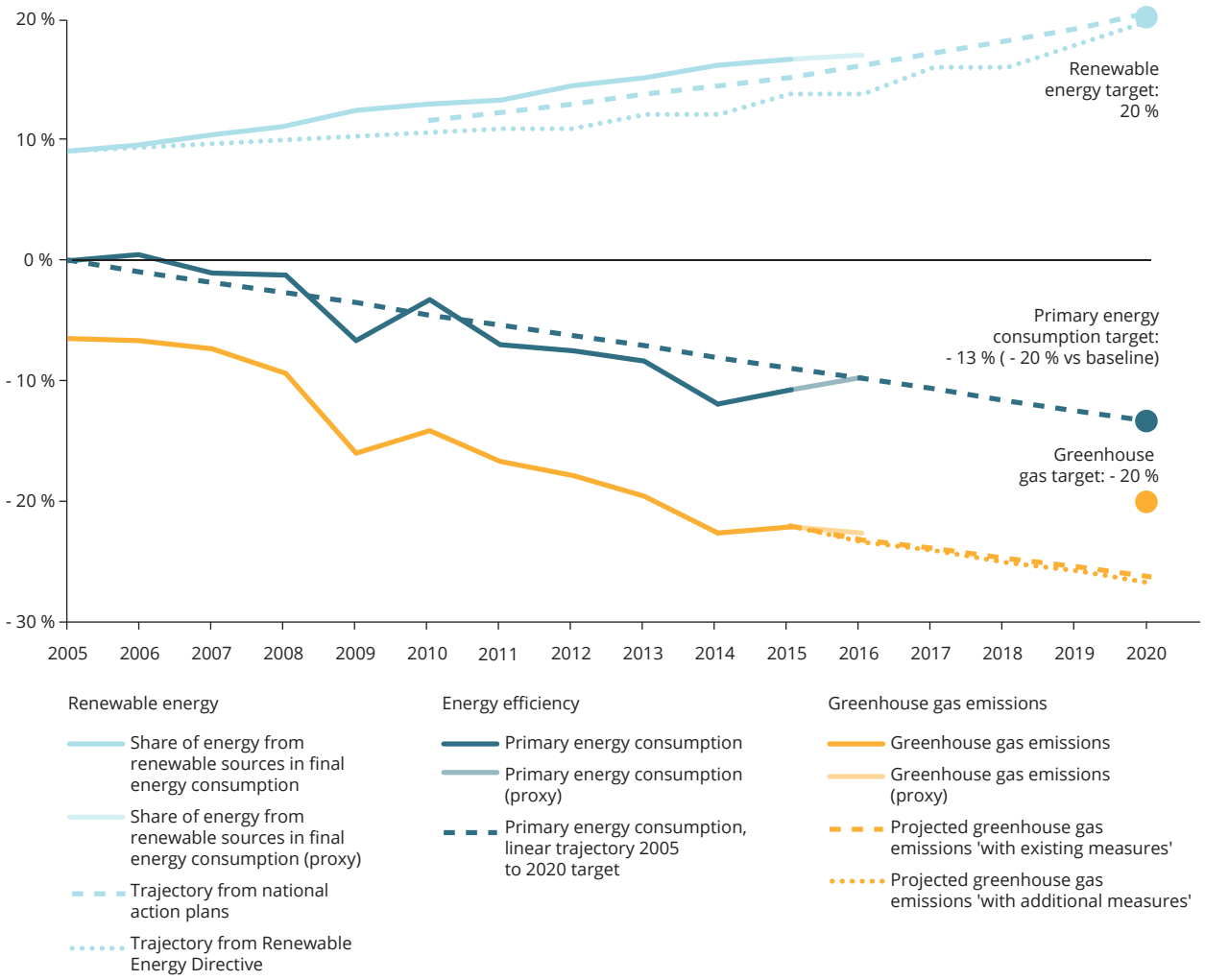
EU progress towards 2030 climate and energy targets

Although the EU remains on track to achieve its 2020 targets, current efforts need to be stepped up to achieve more ambitious longer term objectives.

For example, while projections show further decreases in EU GHG emissions beyond 2020, Member States project that the pace of these reductions will slow down. The reductions currently planned fall short of the 40 % reduction target for 2030.

Good progress towards the energy efficiency targets took place between 2005 and 2014, but the pace has slowed in recent years, increasing the uncertainty around the EU meeting its 2020 energy efficiency

Figure ES.1 EU progress towards 2020 climate and energy targets



Notes: For renewable energy, the figure represents the trend in the share of energy from renewable sources in gross final energy consumption since 2005. The 2020 renewable energy target corresponds to a share of 20 %.

The 2020 target for energy efficiency was defined as a 20 % saving in energy consumption compared to baseline projections. This is equivalent to a 13 % reduction of primary energy consumption (or an 8 % reduction in final energy consumption) from 2005 levels. The figure represents the relative change in primary energy consumption since 2005.

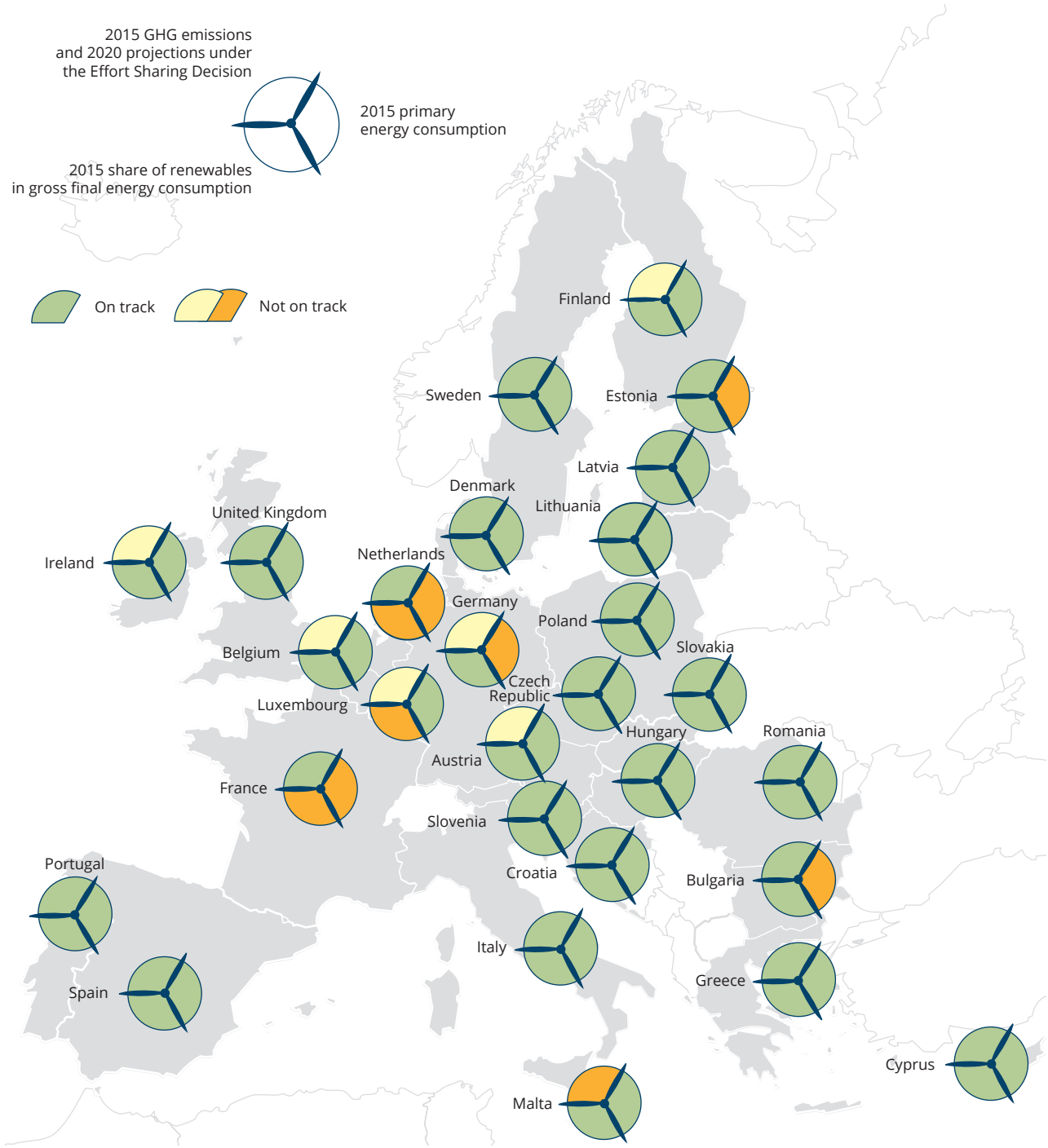
The 2020 target for greenhouse gas emissions corresponds to a 20 % reduction from 1990 levels. The trends and projections represented in the figure correspond to relative changes in emissions compared with 1990 levels. The projections are presented in the 'with existing measures' scenario, which reflects existing and currently adopted policies and measures.

Source: EC, 2013; EEA, 2011, 2016a, 2016b, 2016c and 2016d; EU, 2009 and 2012; European Council, 2007; Eurostat, 2016a, 2016b and 2016c.

objectives and, even more so, the target for 2030. Meeting the 2030 target for energy efficiency in the EU will require Member States to strengthen their efforts to keep energy consumption in check, particularly if current economic growth continues, and be steadfast in implementing relevant policies and measures in an adequate and timely manner.

Maintaining the current pace of renewable energy deployment across Europe would enable the EU to achieve the target of at least 27 % of final consumption of energy from renewable sources by 2030. However, this may not happen without additional efforts to overcome a number of difficulties:

Figure ES.2 Progress of Member States towards 2020 climate and energy targets in 2014



Note: The colours indicate whether countries are considered on track or not towards their 2020 climate and energy targets.

For greenhouse gases, orange means that 2015 emissions covered by the Effort Sharing Decision (ESD) were above the 2015 national ESD target. Yellow means that projected ESD emissions in the 'with existing measures' scenario for 2020 are above the 2020 national ESD target.

For renewable energy, orange means that the 2015 share of energy from renewable sources (RES) in gross final energy consumption was below the indicative level from the Renewable Energy Directive.

For energy efficiency, orange means that the 2015 consumption in primary energy was above a linear indicative trajectory between the 2005 level and the 2020 national target.

Further methodological details on how progress is measured are provided in Annexes 1, 2 and 3.

Source: National information reported by Member States to the EEA, the European Commission and Eurostat. See Chapters 3, 5 and 7 for further details, as well as Annexes 1, 2 and 3 for information on data and methodology.

- past regulatory changes have affected investors' confidence;
- the dated structure of current energy markets inhibits a more flexible operation of the system and prevents consumers and other players from participating actively in the market;
- barriers for cross-border electricity trade still exist;
- the grid and its interconnections need to be expanded.

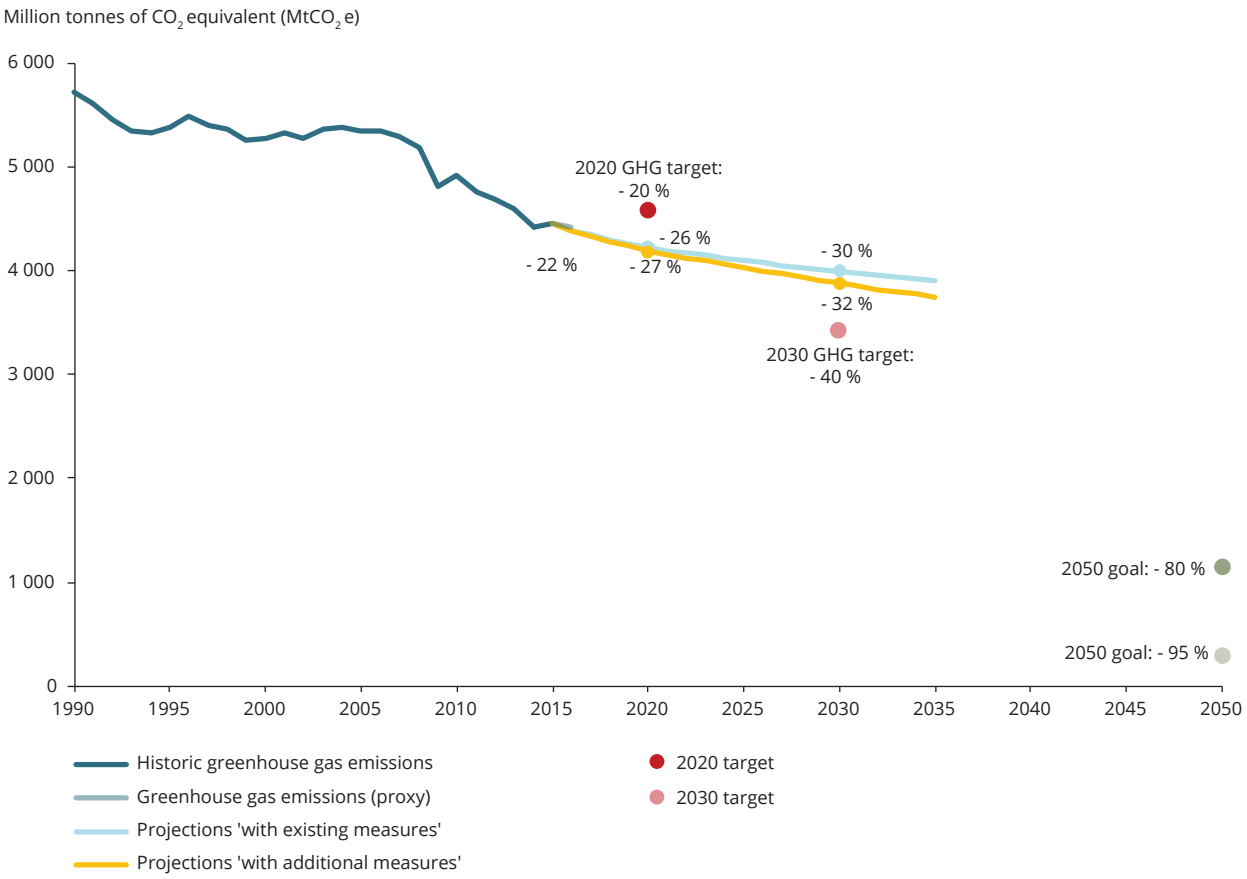
To address these issues and achieve the EU's 2030 climate and energy targets, as well as its international commitment under the Paris Agreement, policy proposals from the Commission are currently under discussion between Member States and at the European Parliament. These proposals include a revision of the EU ETS, a proposed Effort Sharing Regulation setting binding national emission limits on sectors outside the ETS, the integration of land use and forestry in the policy framework, the recast of the Renewable Energy and the Energy Efficiency Directives, and a proposal for governance of the Energy Union.

Where voluntary national efforts will replace the binding national targets for renewables post-2020, the new governance system will aim to ensure that national policies and measures adequately support the transition to a low-carbon, competitive EU economy and safeguard the achievement of the EU-level targets in 2030.

Outlook for greenhouse gas trends in 2050

The 2017 analysis of progress towards long-term decarbonisation targets in the EU has not changed

Figure ES.3 Greenhouse gas emission trends, projections and targets in the EU



Note: The greenhouse gas emission trends, projections and targets include emissions from international aviation, and exclude emissions and removals from the land-use sector. The 'with existing measures' (WEM) scenario reflects existing and adopted policies and measures, while the 'with additional measures' (WAM) scenario takes into account the additional effects of planned measures reported by Member States.

Source: EEA 2017b, 2017c, 2017d.

since the 2016 assessment: although the EU and its Member States are making good progress towards their short-term goals on climate and energy, they will have to intensify their efforts considerably to meet longer-term energy and decarbonisation objectives for 2050. The pace of GHG emission reductions after 2020 should actually increase in order to achieve targets, rather than slow down as is currently projected by Member States. Assuming the necessary emission cuts required to achieve the 2030 target actually take place, an even deeper reduction would still need to be achieved after 2030. This reduction will have to be two to three times greater than the decrease from current levels necessary to meet the 2030 target, which is itself greater than that achieved since 1990. In short, ambition levels need to be significantly stepped up.

Achieving the EU's long-term decarbonisation objective can take place only in the context of a major transformation of the EU's socio-technical systems such as the energy, food and mobility systems. As the effects of policies and measures often take time to materialise, action aimed at achieving the long-term targets cannot be delayed. Member States should take into consideration the long-term mitigation potential of their existing and planned measures. Few European countries have translated their national climate and energy objectives into corresponding investment needs and plans. Countries should identify and make available clear information on investment needs and priorities in order to strengthen investor confidence, increase investment attractiveness and provide certainty in terms of the direction and nature of forthcoming investable projects.

About this report

The 2017 edition of the annual European Environment Agency (EEA) report, *Trends and projections in Europe*, provides an updated assessment of the progress of the European Union (EU) and European countries towards their climate mitigation and energy targets. The report is based mainly on national data on greenhouse gas (GHG) emissions, renewable energy and energy consumption for 2015, preliminary ('approximated' or 'proxy') data for 2016 and projections reported by Member States concerning expected trends in GHG emissions until 2035.

EEA reports

This report is part of an annual series of EEA reports on climate change and energy. In particular, this report is linked to EEA report No 18/2017, *Trends and projections in the EU ETS in 2017 — The EU Emissions Trading System in numbers*, and EEA report, *Approximated EU GHG inventory: Proxy GHG emission estimates for 2016*. All EEA reports are available at: eea.europa.eu.

About the EEA

The EEA is an agency of the EU. It aims to support sustainable development and to help achieve significant and measurable improvement in Europe's environment by providing timely, targeted, relevant and reliable information to policymaking agents and the public. It is supported in its work by the European environment information and observation network (Eionet), a network of 39 European countries.

Authors

This report was prepared by the EEA and its European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM). The ETC/ACM is a consortium of European institutes that assist the EEA in its support to EU policy in the field of air pollution and climate change mitigation.

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1 Overall progress towards the European Union's '20-20-20' climate and energy targets

- The European Union (EU) is on track to meet its 2020 climate and energy targets. Official data for 2015 show that greenhouse gas (GHG) emissions have already decreased beyond the 20 % reduction target; the use of energy from renewable sources is steadily growing and getting closer to the 20 % target; energy consumption levels are currently considered on track, but are increasing slightly, which means that Member States need to make greater efforts to keep the EU on track towards its energy efficiency target.

- Approximated GHG emissions for 2016 ('proxy') from Member States and the European Environment Agency (EEA) show a slight decrease compared with 2015. Proxy GHG emissions are therefore 23 % below 1990 levels. In 2016, GHG emissions from stationary installations under the EU Emissions Trading System (ETS) decreased by 27 % compared with 2005 levels, while the emissions across sectors covered under the Effort Sharing Decision (ESD) decreased by an estimated 11 %. With proxy estimates for 2016, the EU-wide share of renewables in gross final energy consumption still increased, enabling the EU to be on track towards its 2020 objective. However, energy consumption showed an increase for two consecutive years, triggered by higher heat demand by households following slightly colder winter conditions in Europe as well as an increased activity in the transport sector. The progress in the transport sector remains insufficient in terms of achieving the 10 % sectoral target for renewable energy sources (RES) for 2020.

- Although the EU as a whole is on track for 2020, the situation differs across individual countries. In 2015, 27 Member States met their annual emission targets for GHG emissions (covering national emissions from sectors governed by the ESD). Malta has failed to reduce its GHG emissions to below its annual emission targets under the ESD since 2013. Twenty-five Member States met or exceeded their indicative trajectories under the Renewable Energy Directive; France, Luxembourg and the Netherlands remained below their trajectory. Twenty-three Member States were below their energy efficiency trajectory; Bulgaria, Estonia, France, Germany and the Netherlands were not making enough progress and exceeded the linear trajectory for primary energy consumption.

- A total of 17 Member States delivered on their national targets in all three areas in 2015. This number stays constant in 2016, according to approximated EEA estimates.

- Although the EU is expected to achieve its 2020 targets, achieving more ambitious longer term objectives requires current efforts to be stepped up. Member States and the European Parliament are currently discussing policy proposals for the period 2021-2030 in order to achieve the EU's international commitment under the Paris Agreement. These proposals include a revision of the EU ETS, a proposed Effort Sharing Regulation setting binding national emission targets on sectors outside the ETS, the integration of land use and forestry in the policy framework, the recast of the Renewable Energy and the Energy Efficiency Directives, and a proposal for a governance framework for the Energy Union.

- Once adopted, these new policies and measures will require timely and effective actions at national level. In the absence of binding national targets for energy efficiency improvements and renewables in the post-2020 period, policy implementation and effects will have to be regularly monitored and evaluated at both EU and national levels. This is planned, in particular, in the context of the new governance for the EU's Energy Union, in order to ensure that these policies and measures adequately support the transition to a low-carbon and competitive EU economy.

1.1 Progress of the European Union towards its '20-20-20' climate and energy targets

Based on the analysis of data and information reported by Member States in 2017, as well as additional estimates from the EEA, the EU is on course to meet each of its 2020 targets for GHG emissions, renewable energy and energy efficiency. In fact, the GHG target was already surpassed in 2014 (see Figure 1.1).

1.1.1 GHG emissions

In 2015, the EU achieved a reduction of GHG emissions of 22 % below 1990 levels. This reduction exceeds the 20 % reduction target set for 2020. Emissions in 2015 slightly increased compared with 2014, following an exceptionally warm year in almost all parts of Europe that resulted in a markedly low need for heating. Approximated estimates for emissions in 2016 show a decrease back to the level of 2014. Further details are discussed in Chapter 2.

1.1.2 Renewable energy

The steady deployment of RES in the EU's energy mix continues. The use of renewable energy continued to increase, standing at 16.7 % of gross final energy consumption in 2015 and getting closer to the 20 % target for 2020. This 2015 RES share is higher than the indicative average level for the years 2015 and 2016 as required by the Renewable Energy Directive (RED). In fact, early EEA estimates for 2016 indicate that the use of energy from renewable sources continued to increase, reaching 16.9 % of gross final energy consumption. The 2020 target could be attained if Member States sustain the pace at which they have deployed renewables so far. However, as we approach 2020, the trajectories for meeting the national targets are becoming steeper, while market barriers still persist in several Member States. Further details are discussed in Chapter 4.

1.1.3 Energy efficiency

Over the past decade, the trend in the EU's primary energy consumption has been decreasing at a pace that, if sustained until 2020, would be sufficient for the EU to meet its 20 % primary energy target. However, recent increases in primary energy consumption in 2014 and 2015, together with an update of the national indicative target in some MS in their 2017 National Energy Efficiency Action Plans (NEEAPs), makes the achievement of the EU 2020 target uncertain ([1]). Final energy consumption has been below the 2020 target since 2014, but in 2015 the gap narrowed significantly. Based upon the EEA's approximated estimates for 2016, primary and final energy consumption increased further. This means that, for the EU to remain on track towards its energy efficiency objectives, Member States must reinforce the implementation of current legislation and step up efforts to keep energy consumption in check. Further details are discussed in Chapters 6 and 7.

1.2 Progress towards the European Union's mid- and long-term climate and energy objectives

Although the EU and its Member States are making good progress towards their short-term goals on climate and energy, efforts will need to be considerably increased to meet the EU's long-term goal. For 2050, EU leaders have endorsed the objective of reducing Europe's GHG emissions by 80-95 % compared with 1990 levels, to contribute in a fair manner to limiting climate change and holding global warming to below 2 °C ([2]).

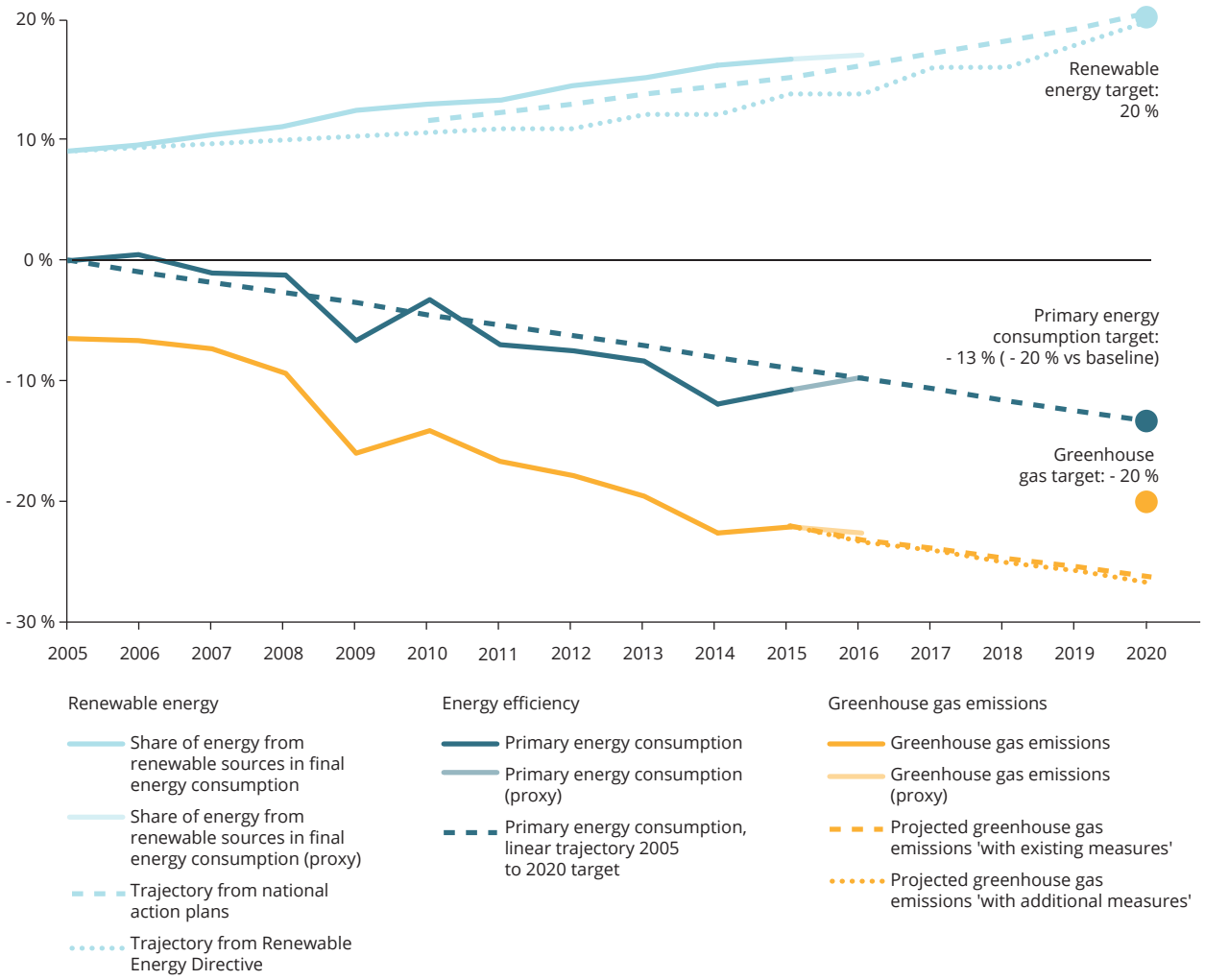
To ensure that the EU is on a cost-effective track towards meeting this long-term objective, EU leaders agreed on a climate and energy policy framework for the EU and endorsed new climate and energy targets for 2030 (European Council, 2014). The 2030 climate and energy framework may be outlined as follows:

- It includes a binding target of at least a 40 % reduction in domestic GHG emissions, compared with 1990 levels, with individual targets at the Member State level for emissions not covered by the EU ETS; this target has been communicated to the United Nations Framework Convention on Climate Change (UNFCCC) as the Nationally Determined Contribution (NDC) of the EU and its Member States under the Paris Agreement. The

([1]) Together these targets should contribute to achieving the EU's objective of reducing energy consumption by 20 % by 2020. However, a challenge in assessing EU progress is that the aggregation of individual Member States' targets does not add up to a 20 % EU-level reduction in energy consumption by 2020.

([2]) Adopted by 195 countries at the Paris Climate Conference (COP 21) in December 2015, the Paris Agreement sets out a global action plan to avoid dangerous climate change by limiting global warming to well below 2 °C. Governments agreed in particular to track progress towards the long-term goal through a robust transparency and accountability system.

Figure 1.1 EU progress towards 2020 climate and energy targets



Notes: For renewable energy, the figure represents the trend in the share of energy from renewable sources in gross final energy consumption since 2005. The 2020 renewable energy target corresponds to a share of 20 %.

The 2020 target for energy efficiency was defined as a 20 % saving in energy consumption compared to baseline projections. This is equivalent to a 13 % reduction of primary energy consumption (or an 8 % reduction in final energy consumption) from 2005 levels. The figure represents the relative change in primary energy consumption since 2005.

The 2020 target for greenhouse gas emissions corresponds to a 20 % reduction from 1990 levels. The trends and projections represented in the figure correspond to relative changes in emissions compared with 1990 levels. The projections are presented in the 'with existing measures' scenario, which reflects existing and currently adopted policies and measures.

Source: EC, 2013; EEA, 2011, 2016a, 2016b, 2016c and 2016d; EU, 2009 and 2012; European Council, 2007; Eurostat, 2016a, 2016b and 2016c.

target is split into a 43 % reduction in sectors covered under the EU ETS and a 30 % reduction in the sectors covered under the Effort Sharing legislation compared with 2005.

- It also includes a target to increase, at EU level, the share of RESs to at least 27 % of final energy consumption by 2030; this target is binding at EU level, but there are no fixed targets for individual Member States.
- Finally, it includes an indicative target at EU level of at least a 27 % improvement in energy efficiency in 2030 compared with projections of energy consumption (based on the European Commission's 2007 Energy Baseline Scenario (EC, 2008)). In June 2017, the European Council endorsed a 30 % energy efficiency target for 2030 (European Council, 2017). This target is equivalent to a reduction of primary energy consumption of about 23 % compared with 2005 consumption

levels. For final energy consumption, the 2030 target would be equivalent to a 17 % decrease from 2005 consumption levels. At the time of writing negotiations are still ongoing.

According to current projections, further measures will be required to meet the 2030 climate and energy targets:

- According to Member States' projections reported in 2017, a reduction of EU GHG emissions of between 30 % (on the basis of existing mitigation measures) and 32 % (accounting for planned mitigation measures) could be achieved by 2030, compared with 1990 levels. These projected reductions fall short of the 40 % target for 2030, in the sectors under both the EU ETS and the ESD. According to these 2017 projections, future cuts in national GHG emissions will take place mainly in the sectors covered by the ETS (between 35 % and 42 %, compared with 2005 levels), while in the sectors covered by the Effort Sharing legislation the projected reductions for 2030 are somewhat smaller (between 20 % and 22 %, compared with 2005 levels).

- Maintaining the current pace of RES deployment across Europe would enable the EU to achieve a RES consumption level above the target of 27 % of final energy consumption in 2030. So far, the EU has steadily increased the contribution of RES to gross final energy consumption, thanks to dedicated national support schemes and significant cost reductions achieved by some renewable energy technologies. Nevertheless, in the early 2010s, changes to support mechanisms for renewables, in particular cuts in feed-in tariffs in some Member States that were sometimes even applied retroactively, led to uncertainty on the market and may have caused some investors to hold back. Further action may be necessary to ensure that the EU meets its 2030 RES target.

- Good progress towards the energy efficiency targets took place between 2005 and 2014, but the pace has slowed in recent years, increasing the uncertainty around the EU meeting its 2020 energy efficiency objectives and, even more so, the target for 2030. Meeting the 2030 target for energy efficiency in the EU will require Member States to strengthen their efforts to keep energy consumption in check, particularly if current economic growth continues, and be steadfast in implementing relevant policies and measures in an adequate and timely manner.

Even if the 2030 EU targets were met, efforts would still need to be further enhanced in view of the EU's energy and decarbonisation objectives for 2050. After 2030, GHG emissions would need to decline at a much faster pace than anticipated today to reach the 2050 long-term goal, and renewable energy would need to grow even faster before 2050 to attain the minimum levels consistent with the EU's long-term decarbonisation objectives.

1.3 Towards an integrated governance of climate and energy policies in the European Union

The Energy Union Strategy (EC, 2015b), adopted in 2015, aims to ensure that Europe moves towards an integrated, secure, affordable and climate-compatible energy system by 2030. The strategy is structured around five closely related and mutually reinforcing dimensions:

- supply security;
- internal energy market integration;
- energy efficiency;
- decarbonisation;
- research and innovation.

The 2030 targets for climate, RES and energy efficiency, introduced with the EU's 2030 climate and energy policy framework, are an important part of the Energy Union Strategy and can be found under the decarbonisation pillar (2030 targets for climate and renewables) and energy efficiency (2030 target for energy efficiency improvements).

Progress towards the Energy Union objectives is monitored annually through the European Commission's State of the Energy Union reports (EC, 2015e). In November 2016, the European Commission also tabled a legislative proposal aiming to set up a reliable and transparent governance system for the Energy Union and to help ensure that the Union meets its climate and energy goals. The governance system rests on existing building blocks, such as the national climate programmes developed through EU legislation and aligned with the Paris Agreement, and the national plans for renewable energy and energy efficiency, developed under EU energy legislation. Furthermore, the Energy Governance proposal (EC, 2016h) specifically aims to streamline the existing planning, reporting and monitoring obligations of Member States to ensure coherence and adequacy of policies and measures at European Union, regional and national levels. This streamlining effort is expected to ensure the availability

of integrated and coherent national plans comprising data and information and integrated projections on GHG efficiency. This includes projections, as well as anticipated and realised effects of policies and measures. Such information will, in turn, improve the robustness of the assessment of progress towards the climate and energy targets presented in this report. It is expected that Member States will provide finalised integrated climate and energy plans by 2019.

1.4 Progress of Member States towards national 2020 climate and energy objectives

Not all Member States are performing well with respect to their national 2020 targets (see Table 1.1). However, the projected overachievements of the majority of Member States offset the slower progress projected in a few Member States.

- In 2015, all Member States, with the exception of Malta, met their annual GHG emission targets set under the ESD. Malta needs to ensure its compliance with the ESD through the flexibility mechanisms, such as buying annual emission allowances from Member States that have overachieved their targets.

- According to approximated estimates for 2016, four Member States (Belgium, Finland, Ireland and Malta) might have higher ESD emissions than their annual ESD targets. Following the latest GHG projections submitted in 2017, a total of 21 Member States project that they will meet their national GHG targets in 2020 with the current set of policies and measures in place. The other Member States will have to implement additional measures to reach targets domestically or use the flexibility mechanisms provided under the ESD. Austria, Belgium, Finland, Germany and Luxembourg can comply under the ESD with the transfer of annual emission allowances over time, while Ireland and Malta will need to make use of the opportunity to buy annual emission allowances from other Member States, if emissions develop as projected. Further details are provided in Chapter 3.

- A total of 25 Member States were making good progress towards their national renewable energy targets for 2015-2016 set in accordance with the RED. France, Luxembourg and the Netherlands were behind their indicative trajectories set for the period 2015-2016. The situation is expected to remain unchanged in 2016, according to the EEA proxy estimates and last year's trend. Further details of this are discussed in Chapter 5.

- All but five Member States (Bulgaria, Estonia, France, Germany and the Netherlands) were making good progress towards indicative national targets on primary energy consumption in 2015. However, as primary consumption increased across Europe in 2016, according to EEA proxy estimates, three additional countries (Austria, Belgium and Cyprus) will have to reduce energy consumption even faster in the coming years to reach their 2020 targets, while Estonia seems to have reduced primary energy consumption below the linear trajectory to 2020. Further details are provided in Chapter 7.

In total, 17 Member States (Croatia, Cyprus, the Czech Republic, Denmark, Greece, Hungary, Italy, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom) are considered on track in 2015 to meet all three of their national climate and energy targets for 2020 ([3]) (see Table 1.1). Austria, Belgium, Bulgaria, Estonia, Finland, France, Germany, Ireland, Luxembourg, Malta and the Netherlands are considered not on track in 2015 in at least one of the three policy domains. However, based on approximated estimates for 2016, only one Member State (Cyprus) will not remain on track, while Estonia will become on track due to decreased primary energy consumption. No Member State underperformed in all three domains.

Strong links exist between energy efficiency improvements, the deployment of renewable energy and reductions in GHG emissions. Some of the GHG emission savings resulting from better energy efficiency and more renewable energy use lead to reductions in industrial sectors falling under the EU ETS, such as when renewable electricity is generated and used (EEA 2017j, forthcoming). Other GHG emission savings contribute primarily to Member States' progress towards their national targets under the ESD, relating only to sectors that are not covered under the EU ETS. This is particularly the case for renewable and energy efficiency policies in the transport and buildings

([3]) Under the ESD, the national GHG emission targets for 2020 were set on the basis of Member States' relative wealth (measured by gross domestic product (GDP) per capita). Less wealthy countries are allowed emission increases in these sectors because their relatively higher economic growth is likely to be accompanied by higher emissions. This is particularly the case for Croatia, the Czech Republic, Hungary, Latvia, Lithuania, Romania, Slovakia and Slovenia. Furthermore, five Member States of the same group of countries performing well in all three policy objectives (Croatia, the Czech Republic, Latvia, Romania and Slovenia) have also voluntarily adopted positive limits (i.e. an increase within a specified constraint) on primary energy consumption for 2020.

sectors, where energy efficiency improvements and the development of RES have played roles of varying importance from one Member State to another with regard to making progress towards national ESD targets (EEA, 2016). With the EU-level 20 % GHG reduction target accounting both for national achievements and for reductions under the EU ETS, the interactions between GHG emissions, renewable energy and energy efficiency targets are strongest at EU level.

Table 1.1 Progress of Member States towards 2020 climate and energy targets

Member State	Greenhouse gas emissions		Renewable energy	Energy efficiency
	Current progress	Projected progress	Current progress	Current progress
	Gap to 2015 ESD emission target (2015)	Gap to 2020 ESD target (WEM)	Gap to 2015/2016 of RED trajectory (2015)	Gap to 2015 PEC indicative linear trajectory (2015)
	Percentage points (share of 2005 base-year emissions)		Percentage points (share of renewable energy in gross final consumption)	Percentage points (share of 2005 primary energy consumption)
Austria	4 %	- 2.4 %	4.8 %	1.6 %
Belgium	3 %	- 3.5 %	0.8 %	1.0 %
Bulgaria	10 %	21.7 %	5.8 %	- 1.9 %
Croatia	25 %	23.5 %	13.1 %	23.9 %
Cyprus	45 %	9.5 %	1.9 %	2.4 %
Czech Republic	4 %	8.5 %	5.9 %	8.9 %
Denmark	6 %	2.3 %	8.0 %	7.2 %
Estonia	4 %	0.3 %	7.5 %	- 1.3 %
Finland	3 %	- 0.7 %	6.5 %	9.1 %
France	8 %	6.1 %	- 0.8 %	- 2.3 %
Germany	3 %	- 3.3 %	3.3 %	- 0.9 %
Greece	23 %	17.8 %	3.5 %	9.7 %
Hungary	23 %	28.6 %	6.3 %	8.8 %
Ireland	3 %	- 17.0 %	0.3 %	5.7 %
Italy	9 %	8.5 %	7.0 %	8.9 %
Latvia	5 %	9.2 %	1.6 %	17.4 %
Lithuania	3 %	12.6 %	7.2 %	14.9 %
Luxembourg	5 %	- 2.6 %	- 0.5 %	9.1 %
Malta	- 12 %	- 11.5 %	0.5 %	12.1 %
Netherlands	14 %	10.0 %	- 1.8 %	- 1.2 %
Poland	5 %	8.4 %	1.1 %	4.0 %
Portugal	19 %	17.6 %	2.8 %	6.4 %
Romania	6 %	17.6 %	4.2 %	26.1 %
Slovakia	20 %	25.2 %	2.9 %	8.2 %
Slovenia	14 %	13.3 %	1.9 %	8.3 %
Spain	12 %	9.9 %	2.4 %	7.3 %
Sweden	15 %	14.8 %	10.0 %	8.8 %
United Kingdom	6 %	9.9 %	0.8 %	4.9 %

Notes: The percentage values in this table represent the difference between the parameter considered and the relevant target or indicative trajectory. A positive value indicates that a target is met. Further methodological details on how progress is measured are provided in Annexes 1, 2 and 3.

Sources: National information reported by Member States to the EEA, the European Commission and Eurostat. Approximated estimates for the year 2016 were not considered in this table. See Chapters 3, 5 and 7 for further details, as well as Annexes 1, 2 and 3 for information on data and methodology.

2 Progress of the European Union towards its greenhouse gas emission targets

- The European Union (EU) is well on track to achieve its greenhouse gas (GHG) emission reduction target of a 20 % decrease compared with 1990 levels by 2020. In 2015, GHG emissions were already 22 % less than 1990 levels. The latest national projections available from Member States indicate that by 2020, EU GHG emissions will remain well below the 2020 target.
- In 2015, emissions increased compared with 2014, when emissions were the lowest since 1990. A decrease in emissions is expected to have occurred in 2016 (according to preliminary estimates), which would bring EU GHG emissions back to 23 % below 1990 levels as in 2014.
- The pace of GHG emission reductions is projected to slow after 2020. A continuation of this slower pace will not be sufficient to achieve the EU's target of a 40 % reduction by 2030 (compared with 1990 levels). Much faster rates of GHG emission decreases are necessary to achieve an 80 %, or even a 95 %, decrease by 2050, even if the 2030 target is met.
- Emissions from stationary installations under the EU Emissions Trading System (EU ETS) in 2015 were 24 % less than in 2005 and, according to preliminary estimates ('proxy'), were 27 % less in 2016. These reductions were mainly the result of lower emissions in the energy industry sectors. Emissions covered by the Effort sharing Decision (ESD) show a decrease of 12 % in 2015 compared with 2005, but an increase compared with 2014. In 2016, preliminary estimates suggest again a small increase compared with 2015, resulting in an emission reduction of 11 % compared with 2005. Emission reductions in the ESD sectors were mainly a result of efforts in the buildings and industry sectors.

2.1 Progress in reducing total greenhouse gas emissions in the European Union

In 2015, the EU's total GHG emissions were at 4 452 million tonnes carbon dioxide equivalent ($MtCO_2e$), which is 22 % less than 1990 levels ([4]). With this, the EU is well on track to achieve its GHG emission reduction target of a 20 % decrease, compared with 1990 levels, by 2020. Preliminary estimates suggest that emissions in 2016 were 4 423 $MtCO_2e$, which is 23 % below 1990 levels. While emissions increased by 0.6 % in 2015 compared with 2014, they fell by 0.7 % from 2015 to 2016.

In 2017, Member States reported new national GHG projections. Compared with projections reported in previous years, emission levels were slightly lower than anticipated from the latest projections available from Member States. According to these national projections, aggregated EU GHG emissions are expected to decrease until at least 2035 (see Figure 2.1).

- According to the scenario 'with existing measures' (WEM), which reflects the effects of all adopted and implemented measures at the time the projections were prepared, GHG emissions will be reduced by 26 % by 2020 and by 30 % by 2030 (compared with 1990 levels).
- According to the scenario 'with additional measures' (WAM), which also takes into account the measures that were at planning stage at the time the projections were prepared ([5]), GHG emissions will decrease by 27 % by 2020 and by 32 % by 2030 (compared with 1990 levels).

Although the 2020 reduction target is expected to be met by a sufficient margin, the policies and measures currently accounted for in national projections alone will not be sufficient to deliver the savings needed

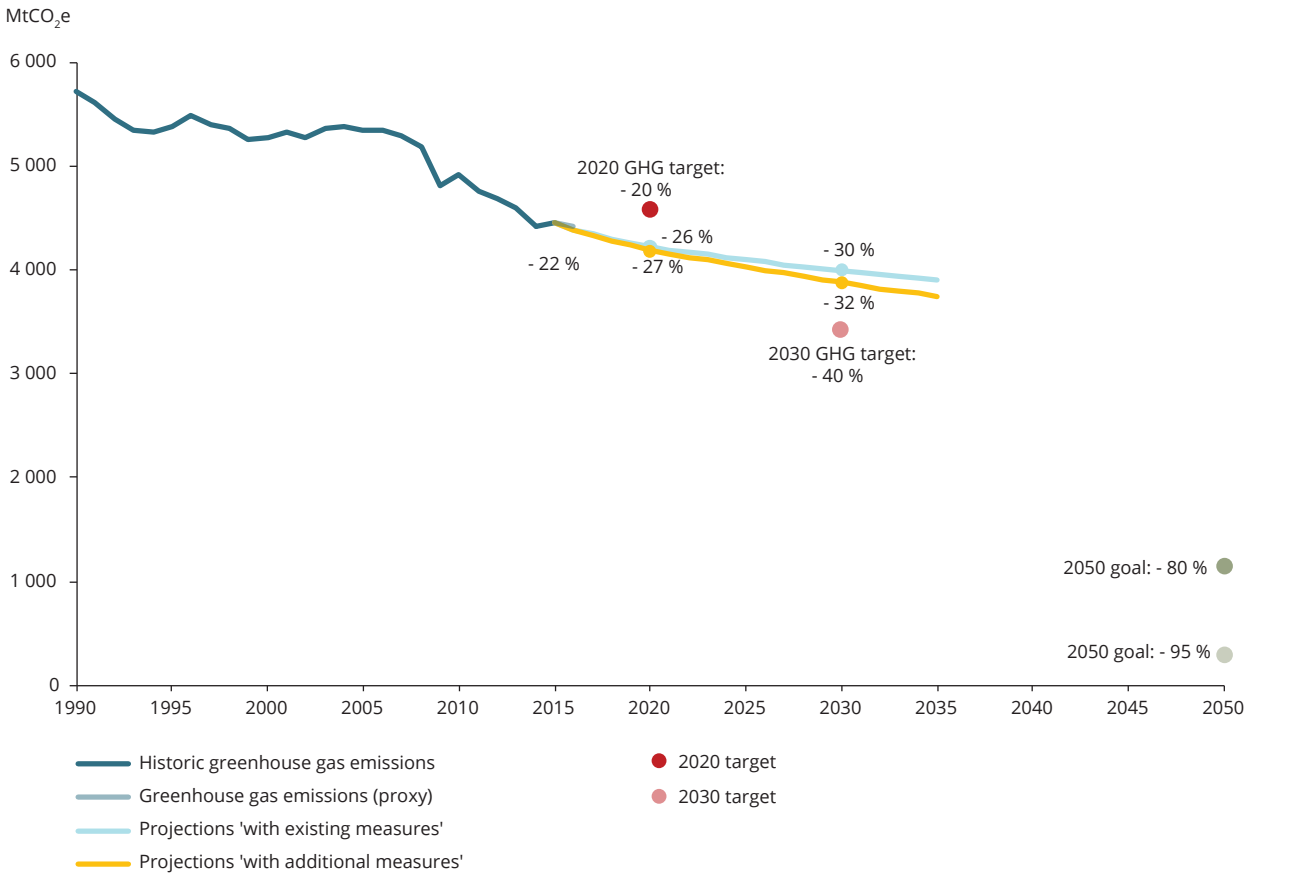
([4]) The EU's total GHG emissions exclude emissions from land use, land use change and forestry (LULUCF) and include all emissions from aviation (including international flights), covered under the EU target.
([5]) Not all Member States reported a WAM scenario. For further information on reporting of projections, please refer to Annex A1.2.8.

to achieve the EU's reduction target of at least 40 % by 2030 (compared with 1990 levels). The pace of GHG emission reductions is currently projected to slow after 2020, and achieving the mid- and long-term targets will require much faster reductions.

The European Commission has developed a number of policy proposals with regard to the EU's mid-term goals on climate and energy. These proposals are now being discussed by Member States and by the European Parliament. For example, these concern:

- a reform of the EU ETS to include a more stringent cap reduction after 2020 (EC, 2015d);
- new annual binding GHG emission targets for Member States for the period from 2021 to 2030, specifically covering emissions that are not covered by the EU ETS (a new 'effort sharing' between Member States), as well as new flexibilities to achieve these targets (EC, 2016g);
- the integration of the land use, land-use change and forestry (LULUCF) sector into the EU 2030 climate and energy framework (EC, 2016i);
- a European strategy to cut emissions from the transport sector (EC, 2016a);
- a proposal for the governance of the Energy Union and Climate Action, currently being negotiated with Member States (EC, 2016h) (among other things, this will require Member States to draft national energy and climate plans that include new information on their envisaged efforts post 2020, covering all five dimensions of the Energy Union, and Member States shall also submit long-term emission strategies);
- a revision and extension of the RED, setting the aim of increasing the share of renewables in the energy mix to at least 27 % by 2030 (EC, 2016f);

Figure 2.1 Greenhouse gas emission trends, projections and targets in the EU



Note: The greenhouse gas emission trends, projections and targets include emissions from international aviation, and exclude emissions and removals from the land-use sector. The 'with existing measures' (WEM) scenario reflects existing and adopted policies and measures, while the 'with additional measures' (WAM) scenario takes into account the additional effects of planned measures reported by Member States.

Source: EEA 2017b, 2017c, 2017d.

- an update of the Energy Efficiency Directive, including a new 30 % energy efficiency target for 2030 (European Council, 2017).

Even if the 2030 target is achieved, a faster pace of reductions in emissions will be required if the EU is to reach its long-term decarbonisation objective — a reduction of EU GHG emissions by 80-95 % by 2050, compared with 1990 levels. Such a reduction can take place only in the context of a major transformation of the EU's socio-technical systems, such as the energy, food, mobility and urban systems. As the effects of policies and measures often take time to materialise (e.g. increases in energy efficiency in buildings), long-term action should not be delayed and lock-in effects of investments should be considered. Member States tend to prioritise low-cost mitigation measures, but they should also take into consideration the long-term mitigation potential of far-reaching measures with long-term effects. Such measures are often postponed because of high initial costs or political controversies related to their implementation. However, investments in these measures often make economic sense even in the short term, as they contribute significantly to generating learning effects and thereby foster future cost reductions. Furthermore, measures also avoid damage (i.e. emissions) and, by adding avoided damage costs (see suggested cost rates: UBA, 2014) into the equation, measures associated with costs at first glance may actually render net benefits.

2.2 The European Union's policy framework for reducing greenhouse gas emissions

To achieve its short-term GHG emission target, the emissions covered by the EU ETS are subject to an EU-wide cap, while non-ETS emissions are subject to national targets as stated in the ESD:

- Emissions from large point sources, mostly from industrial installations, are covered by the EU ETS (EU, 2009a). These represent currently about 40 % of EU GHG emissions, and a large proportion of them stems from the power generation sector. Other activities covered by the EU ETS include cement production, iron and steel production, and oil refining. Since 2012, the EU ETS has covered GHG emissions from aviation (EU, 2009b). The mitigation of all ETS emissions is being addressed at EU level through a single ETS-wide emission cap ([6]) and a 'carbon market' through which emission allowances can be traded.

- GHG emissions not covered by the EU ETS are mainly addressed by the ESD (EU, 2009c). These emissions are produced by a more diverse range of sectors and activities, including road transport, energy consumption in buildings, agriculture (cattle and soils) and waste management. Since 2013, the ESD has set annual targets for each Member State from 2013 until 2020. Mitigation actions therefore take place at national level, through a combination of EU-driven policies and measures, and national initiatives. Member States are responsible for reducing or limiting emissions covered under the ESD individually, while ETS emissions are tackled at EU level.

- GHG emissions and removals from the LULUCF sector are not covered under the EU ETS or the ESD. LULUCF activities represent a net carbon sink, removing the equivalent of about 7 % of the EU's total GHG emissions every year. These removals are not taken into account in the EU's target under the 2020 climate and energy package. In 2016, the European Commission proposed to integrate this sector into the EU 2030 climate and energy framework from 2021 onwards. The legislative proposal for the post-2020 Effort Sharing legislation (i.e. the Effort Sharing Regulation) establishes a limited flexibility with the LULUCF sector. The tabled LULUCF regulation defines harmonised reporting and accounting rules to identify anthropogenic influence on emissions and removals in the sector.

GHG emissions in EU ETS sectors and in ESD sectors have been following slightly different trends since 1990 ([7]). The projections reported by Member States also show differences between these two categories (see Figure 2.2). These trends are described and analysed in the following sections.

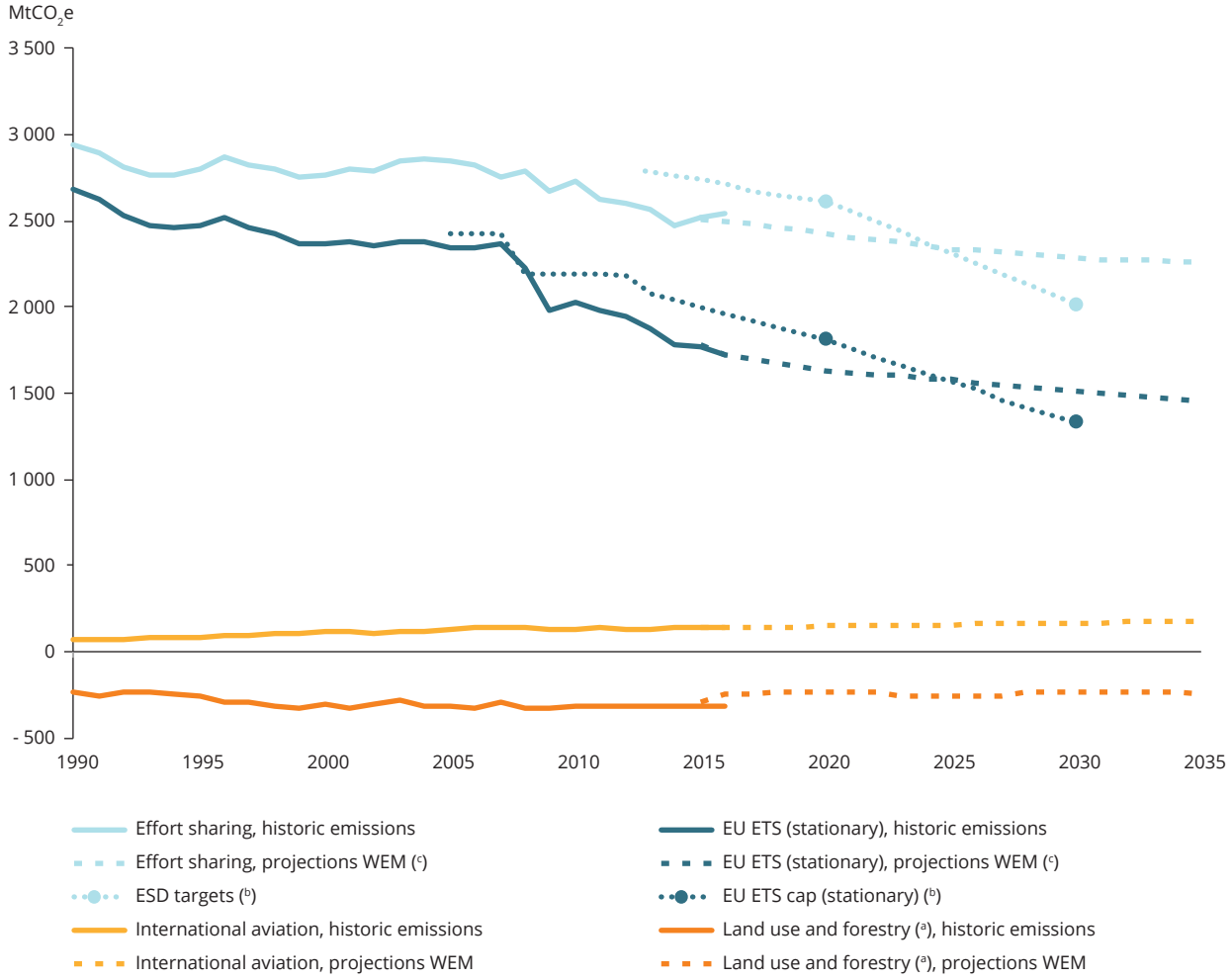
2.3 Emission trends under the European Union Emissions Trading System

GHG emissions from the sectors covered by the EU ETS have decreased significantly since 1990 (see Figure 2.3). The EU ETS target was defined to reduce emissions by 21 % between 2005 and 2020. In 2016, EU ETS

([6]) The cap has been set for all participants in the EU ETS, including the EU as well as Iceland, Liechtenstein and Norway. These three countries participate voluntarily in the EU ETS.

([7]) Although the ETS was introduced in 2005 and the ESD in 2013 (i.e. no ETS or ESD emissions existed before 2005), it is possible to reconstruct a time series dating back to 1990 by drawing up a correlation between ETS/ESD emissions and the source categories used to officially report national GHG inventories under the UNFCCC.

Figure 2.2 **Effort Sharing Decision (ESD), Emissions Trading System (ETS), land use, land-use change and forestry (LULUCF) and aviation emission trends and projections, 1990-2035**



Notes: (a) Net removals from land use, land use change and forestry (LULUCF) correspond to reported values, which differ from values accounted towards targets. The targets for the period from 2021 to 2030 are based on proposed legislation.

(b) The targets for the period from 2021 to 2030 are based on proposed legislation.

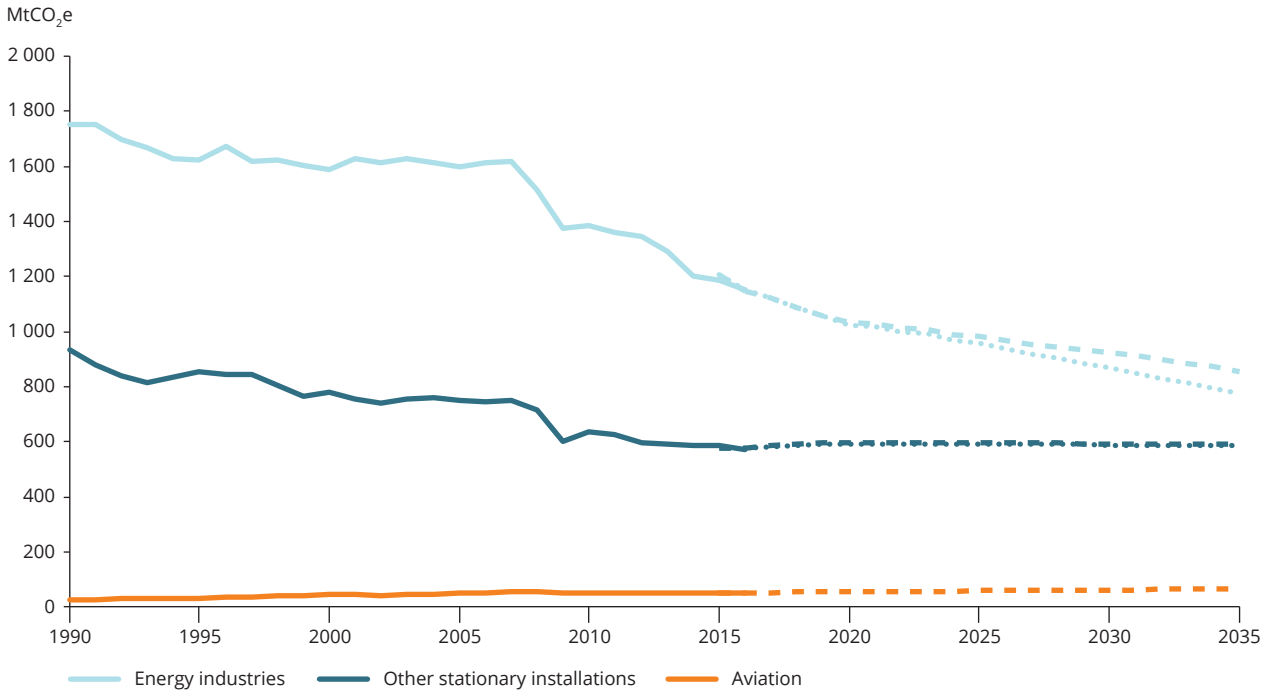
(c) The 'with existing measures' (WEM) scenario reflects existing policies and measures, while the 'with additional measures' (WAM) takes into account the additional effects of planned measures reported by Member States.

Sources: EC, 2015d; EEA, 2017c, 2017d, 2017f, 2017a, 2017b; EU, 2009a, 2013a, 2013b, 2017b.

emissions from Member States' stationary installations had already decreased by 27 % since 2005, and reached their lowest level since the start of the scheme in 2005 ([8]). The decrease since 2005 was mostly driven by reductions in emissions related to power generation. *Ex post* evaluation of climate policies show that the reduction in emissions was largely the result of changes in the combination of fuels used to produce heat and electricity, and in particular, a decrease in the use of hard coal and lignite fuels, better and more efficient installations, and a substantial increase in electricity generation from renewables, which almost doubled over the period. In addition, the reduced production volumes reduced emissions in this sector, too. Emissions from the other industrial activities covered by the EU ETS have also decreased since 2005, but they remained stable in the current trading period (2013-2016) (see Figure 2.3).

([8]) These values were derived including an estimate to reflect the current scope of the EU ETS.

Figure 2.3 Greenhouse gas emission trends and projections under the scope of the EU ETS, 1990-2030



Notes: Solid lines represent historical GHG emissions (available for the 1990-2016 period). Dashed lines represent projections of the WEM scenario. Dotted lines represent projections under the WAM scenario.

The EU ETS GHG emissions presented were estimated based on the attribution of GHG emissions, reported by source categories in national GHG inventories and national projections, to EU ETS sectors and/or Effort Sharing sectors.

Sources: EEA, 2017a, 2017b, 2017c, 2017d.

According to the projections submitted by Member States in 2017, future cuts in national GHG emissions will take place mainly under the EU ETS. With the existing measures in place, emissions from stationary installations under the EU ETS are projected to decrease by 6 % between 2016 and 2020, and by 6 % between 2020 and 2030. According to scenarios that consider planned measures, reductions of an additional three percentage points are projected for 2020 and 2030, compared with the reductions predicted by the scenario with existing measures. Most of the projected reductions by 2020 and 2030 are expected to occur in the energy industries sector, while emissions from other activities are envisaged to remain more or less stable during this period. The emissions from international aviation, however, nearly doubled between 1990 and 2014 and are expected to increase further by 2030.

2.4 Emission trends under the Effort Sharing Decision

GHG emissions from sectors covered by the ESD have decreased since 1990, albeit at a slower rate than those covered under the EU ETS. This reflects the diversity and mitigation potentials of the sectors covered by the ESD. In 2015, ESD emissions were 11.6 % below 2005 levels ([9]). This reduction is greater than the 9.3 % reduction objective for ESD emissions between 2005 and 2020 at EU level. However, GHG levels in 2015 increased by 1.7 % compared with the previous year and are estimated to increase again slightly by 0.85 % in 2016 according to preliminary estimates for 2016. In particular, emissions from buildings and the transport sector have been rising in recent years.

([9]) This is equivalent to a reduction of 12.7 % compared to base-year emissions 2005, see table A.1.2.

According to national projections based on the WEM scenario, ESD emissions could be 195 $MtCO_2e$ below the ESD target for 2020, and cumulative ESD emissions in the EU for the whole period 2013-2020 could be lower than the overall emission budget for all Member States under the ESD by 1 747 $MtCO_2e$ ([10]). In addition, if planned measures are taken into account, this cumulative surplus could increase to over 1 819 $MtCO_2e$. Despite the overall decrease of emissions at EU level, certain Member States have more difficulties than others in achieving their ESD targets (see Chapter 3).

For 2030, Member States project a 20 % reduction of ESD emissions compared with 2005 in the WEM scenario, and a 22 % reduction in the WAM scenario. These reductions remain insufficient compared with the 30 % reduction that non-ETS sectors should achieve by 2030, as a contribution to delivering the EU target of an at least 40 % domestic reduction in GHG emissions by 2030 compared with 1990 (see Figure 2.2). The 2030 targets thus require efforts from Member States beyond the measures that are currently implemented or planned.

Since 1990, the building sector has contributed most to absolute emission reductions in the sectors covered by the ESD. However, emissions from the transport sector, which is the largest contributor to GHG emissions under the ESD, increased continuously between 1990 and 2007. After a decrease between 2007 and 2014, emissions from this sector increased again in 2015 and 2016.

Member States have projected only limited decreases in ESD emissions between 2016 and 2030, particularly after 2020. The largest decreases are expected to take place in the building sector. In the transport and agricultural sectors, emissions are projected to remain relatively stable. The largest reductions in relative terms are projected to be achieved in emissions from industry, in particular product use and waste between 2015 and 2030. Implementing additional measures (i.e. at the planning stage up to early 2017) would lead to further minor decreases in emissions, especially in the transport sector (see Figure 2.4).

2.5 Emissions from land use, land-use change and forestry

Land use, land-use change (LULUCF) and forestry activities, which include the management of soils, trees, plants, biomass and timber, can result in both emissions (source) and removals (sink) of CO_2. In 2015, the EU's LULUCF sector represented a net reported carbon sink of about 304.9 $MtCO_2e$, despite Denmark, Ireland, Latvia, Malta and the Netherlands reporting net emissions from their LULUCF sectors. Over the past decade, the relatively large proportion of young forests and moderate harvest rates have led to a net carbon accumulation in European forests which means that more carbon is removed from the atmosphere than released.

While being a net sink, the sector was also a source of CO_2 emissions for some sub-categories. The largest source was land conversion, especially from forests to other land uses (also known as deforestation), and emissions from organic soils converted to cropland. Since 2000, the net reported annual LULUCF sink has been on average 312 $MtCO_2e$, with an unfavourable declining trend over the past 7 years. According to the EU Reference Scenario 2016 (EC, 2016d), the net reported LULUCF sink in the EU is expected to shrink by about 10 % between 2010 and 2020, partly due to higher emissions from increased harvest rates and despite expected lower emissions from cropland and grassland (due to less land conversion to cropland and emission reduction expected from agricultural soils).

The main component of the LULUCF sink is the carbon sink in managed forest land (- 373 $MtCO_2e$ in 2010 without applying any accounting rules). The managed forest land sink is driven by the balance of forest harvest and forest increment rates (accumulation of carbon in forest biomass as a result of tree growth). In 2030, forest harvest is projected to increase over time from 516 million m^3 in 2005 to 565 million m^3, due to growing demand for wood for material uses and energy production. Along with the ageing of EU forests — which reduces the capacity of forests to sequester carbon — the forest increments are projected to decrease from 751 million m^3 in 2005 to 725 million m^3 in 2030. As a consequence, the rate of accumulation of carbon and therefore the main component of the EU's LULUCF carbon sink in managed forest land will decline by 32 % until 2030. This is expected to be partially compensated by the continuation of increasing carbon removals from afforestation, and a decreasing trend in emissions from deforestation, which are projected to decline from 63 $MtCO_2e$ in 2005 to 20 $MtCO_2e$ in 2030 (EC, 2016d).

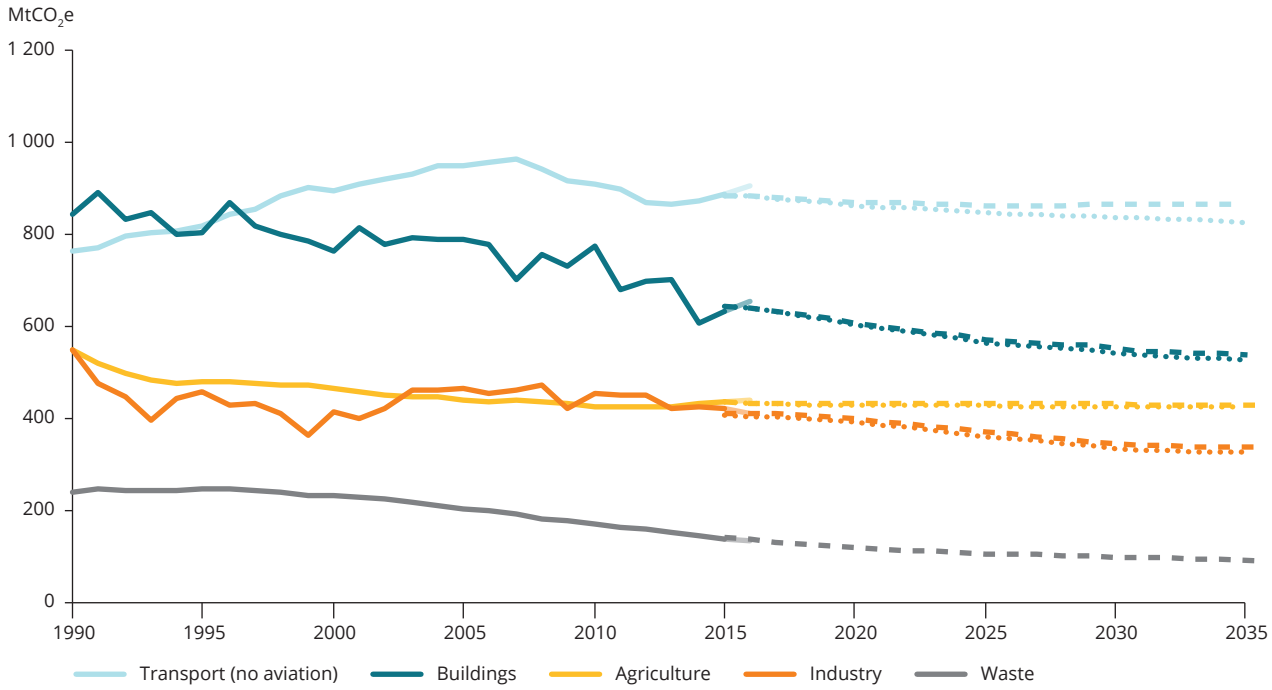
To address this unfavourable projected decrease of the EU's LULUCF net sink, the European Commission proposed a binding commitment for each

([10]) According to Decision 2017/1471 of 10 August 2017 (EU, 2017b), annual emission allocations (AEAs) for the years 2017-2020 were recalculated to adapt to updated GHG inventory methodologies and figures.

Member State covering GHG emissions and removals from forestry and other land uses, and an update of accounting rules to identify anthropogenic changes in the carbon balance of forests and soils, which are used to determine compliance with this commitment (EC, 2016i). These changes are expected to improve the identification of additional mitigation action, and to thereby enhance the contribution of the sector to climate action. Stronger incentives for action are also provided by enabling trade between Member States within the LULUCF sector and by creating a limited flexibility for the use of certain, robust LULUCF credits in other non-ETS sectors.

The proposal requires each Member State to ensure that accounted GHG emissions from land use are entirely compensated by an equivalent accounted removal of CO_2 from the atmosphere in non-ETS sectors (the 'no debit rule'). For instance, if a Member State converts forests to other land uses (deforestation) or increases emissions from cropland, it must compensate for the resulting emissions by planting new forests (afforestation) by improving the sustainable management of existing forests, croplands and grasslands, by cancelling allocations from the other non-ETS sectors, or by agreeing to buy credits from other Member States.

Figure 2.4 Greenhouse gas emission trends and projections under the scope of the Effort Sharing Decision, 1990-2030



Notes: Solid lines represent historical GHG emissions (available for the 1990-2015 period) and proxy emissions for 2016. Dashed lines represent projections in the 'with existing measures' (WEM) scenario. Dotted lines represent projections under the 'with additional measures' (WAM) scenario.

The Effort Sharing sector emissions presented are estimated based on the attribution of GHG emissions, reported by source categories in national GHG inventories and national projections, to EU ETS sectors and/or Effort Sharing sectors. The sector here summarised as 'industry' aggregates ESD emissions of energy supply, manufacturing and product use, i.e. inventory source categories 1.A1, 1.A.2, 1.B, 1.C and 2.

Sources: EEA, 2017a, 2017b, 2017c, 2017d, based on Member States' submissions.

3 Progress towards Member States' greenhouse gas emission targets

- Under the ESD, Member States must achieve 2020 targets on GHG emissions from the sectors that are not covered by the EU ETS. These targets range from a 20 % reduction to a 20 % allowed increase compared with 2005 base year levels. To ensure progress towards 2020 targets, the ESD also sets binding annual targets for each Member State and for each year of the 2013-2020 period. These annual targets are expressed in terms of emission budgets, as quantities of annual emission allocations (AEAs).
- According to the EU (2017b), AEAs for the years 2017-2020 were revised in 2016 to accommodate changes in the latest greenhouse gas inventory data and ensure consistency with reported emissions under the ESD.
- In 2015, all Member States except Malta met their annual ESD targets. For Malta, ESD emissions were higher than its ESD target (i.e. above the quantity of AEAs for that year).
- According to preliminary estimates, four Member States (Belgium, Finland, Ireland and Malta) have exhibited emissions higher than their ESD target for 2016. These Member States may therefore need to use the flexibilities provided under the ESD to ensure compliance.
- According to the latest projections available from Member States, with existing national policies and measures in place, 2020 ESD emissions will be lower than 2020 ESD targets in 21 Member States. For seven Member States (Austria, Belgium, Finland, Germany, Ireland, Luxembourg and Malta), existing measures will not be sufficient to meet their 2020 ESD targets.
- If no domestic measures are implemented in addition to those already included in projections, five of these seven Member States (Austria, Belgium, Finland, Germany and Luxembourg) could close the projected gap between the emission target in 2020 and actual emissions by transferring surplus AEAs from the earlier years to the later years of the period 2013-2020. Two Member States (Ireland and Malta) would need to rely on additional flexibilities to close their gaps, such as transferring AEAs from other Member States.

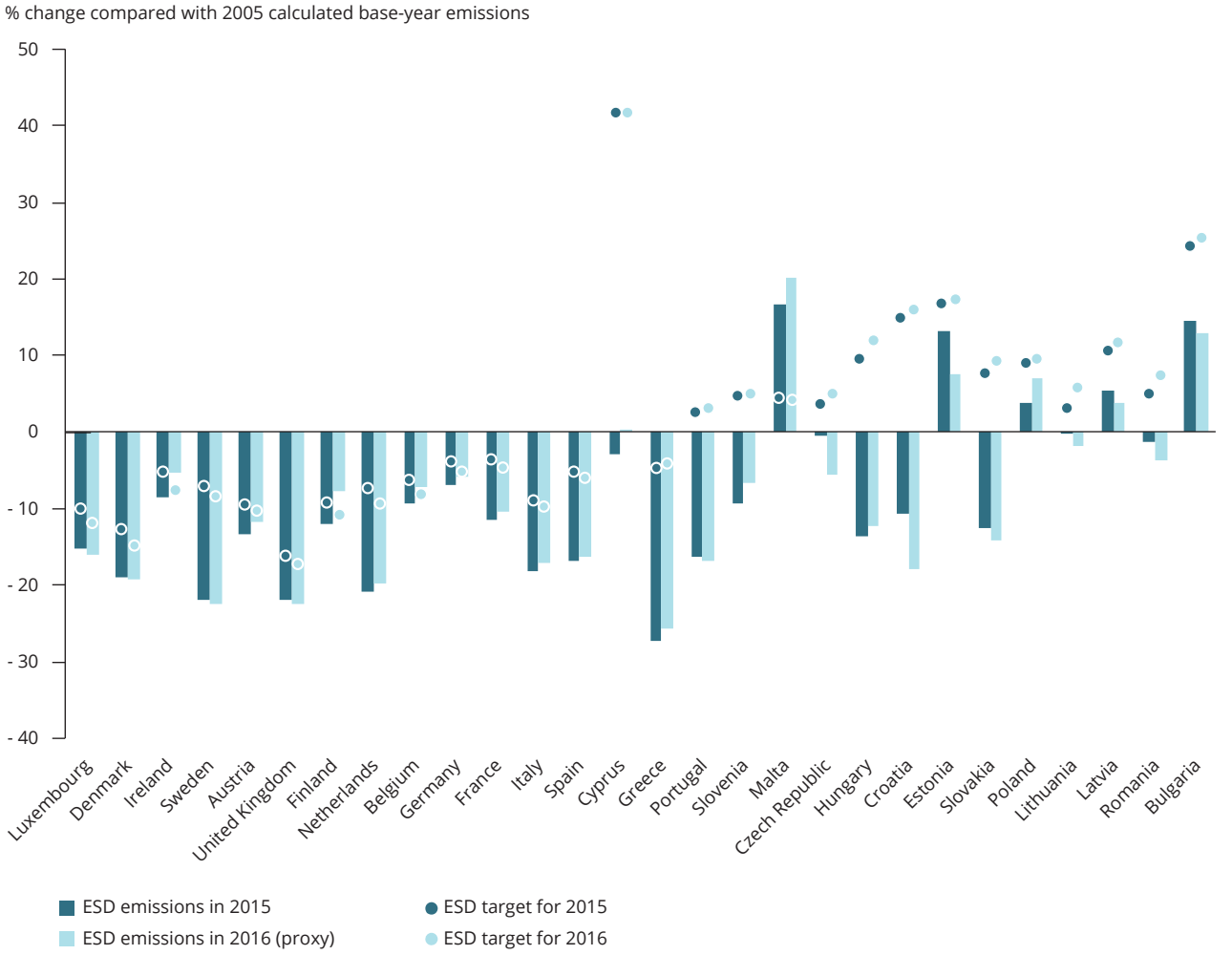
3.1 Current progress towards targets under the Effort Sharing Decision

In order to achieve the EU's objective of a 20 % reduction in total GHG emissions by 2020, compared with 1990, the ESD (EU, 2009c) sets national targets for each Member State on GHG emissions not covered by the ETS (EU, 2009d) ([11]). National ESD targets cover sectors such as transport, buildings, agriculture and waste management. Altogether, these sectors account for almost 60 % of total EU GHG emissions. Mitigation actions take place at national level, through a mix of EU-driven policies and measures and national initiatives. ESD targets range from 20 % reductions (Denmark, Ireland and Luxembourg) to 20 % allowed increases (Bulgaria), compared with 2005 base year levels. Taken together, the aggregated ESD targets for 2020 represent a 9.3 % reduction at EU level compared with 2005 base year levels. The ESD also sets annual targets for the period 2013-2020 to monitor progress across the EU, allow for corrective action and ultimately ensure the attainment of the EU's GHG emission target by 2020.

In 2015, all but one Member State exhibited ESD emissions that were below their 2015 targets (see Figure 3.1). The largest overachievements in 2015 in absolute terms were made in France

([11]) Consequently, there are no national targets on GHG emissions that cover total (economy-wide) emissions. LULUCF emissions are not covered by the ESD.

Figure 3.1 Current progress of Member States towards their Effort Sharing Decision (ESD) targets



Notes: Member States are ranked according to their 2020 ESD targets, from the largest required reduction (Luxembourg, which has a target of - 20 %) to the largest allowed increase (Bulgaria, which has a target of + 20 %) compared with 2005 base year levels.

Sources: EEA, 2017a, 2017b, 2017c; EU, 2013a, 2013b, 2017b.

(31.4 $MtCO_2e$), Italy (31.0 $MtCO_2e$) and Spain (27.6 $MtCO_2e$). Ten Member States (Croatia, Cyprus, Greece, Hungary, the Netherlands, Portugal, Slovakia, Slovenia, Spain and Sweden) passed their 2015 ESD target by more than 10 percentage points. Malta's emissions remained above its 2015 ESD targets by 0.1 million AEAs, which is equal to a gap of 12 %. Based on approximated estimates of ESD emissions for 2016, all but four Member States (Belgium, Finland, Ireland and Malta) are expected to have ESD emissions below their targets for that year.

To comply with the ESD, Malta has been balancing its surplus emissions by AEA purchases from Bulgaria, which had overachieved with respect to its targets.

3.2 Projected progress towards targets under the Effort Sharing Decision

The latest projections reported by Member States in 2017 show that there are diverse expectations with regard to ESD emission trends for the period 2016-2020. For many Member States, projections are consistent with past trends and show decreases in ESD emissions between 2016 and 2020.

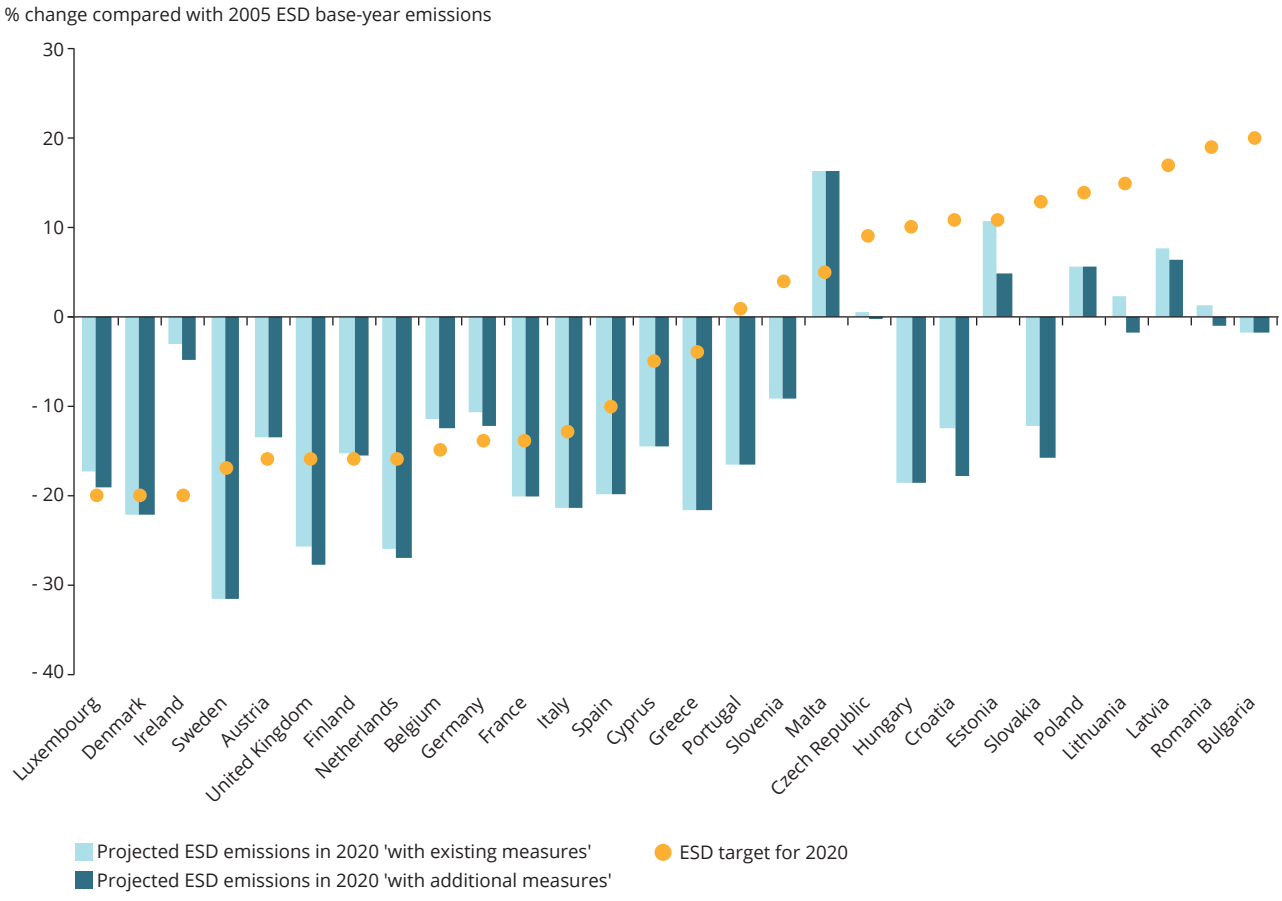
- Fourteen countries projected a constant decrease in their ESD emissions between 2016 and 2020 (Belgium, Bulgaria, Cyprus, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, the Netherlands, Portugal, Sweden and the United Kingdom).

- Eight countries projected an increase in their ESD emissions during this period (Croatia, Czech Republic, Greece, Ireland, Latvia, Poland, Romania and Slovakia).
- Three countries expect their emissions to first increase and then decrease (Austria, Slovenia and Spain).
- Two countries project their emissions to first decrease and then increase (Luxembourg and Malta).
- Lithuania's projected emissions remain nearly constant from 2016 to 2020.

Based on the latest national projections (submitted in 2017) for the period 2017-2020, 20 Member States expect that their ESD emissions will stay below their annual targets under the ESD in every year from 2017 to 2020, on the basis of the WEM scenario (see Figure 3.2).

Conversely, for eight Member States (Austria, Belgium, Estonia, Finland, Germany, Ireland, Luxembourg and Malta), national projections suggest that emissions could exceed their AEAs (i.e. annual ESD targets) for one or several years between 2017 and 2020 (see Table A.1.4 in Annex 1). Most of these eight Member States have rather ambitious 2020 targets under the ESD, ranging from + 5 % to - 20 % emission changes, compared with 2005 base year levels.

Figure 3.2 Projected progress of Member States towards their 2020 Effort Sharing Decision (ESD) targets



Notes: 17 Member States submitted a WAM scenario. For the other Member States (Austria, Bulgaria, Denmark, France, Greece, Italy, Malta, Poland, Slovenia, Spain and Sweden), the WEM scenario is shown instead. Denmark submitted a WAM scenario that was identical to its WEM scenario.

Sources: EEA, 2017d; EU, 2013a, 2013b, 2017b, based on Member States' submissions.

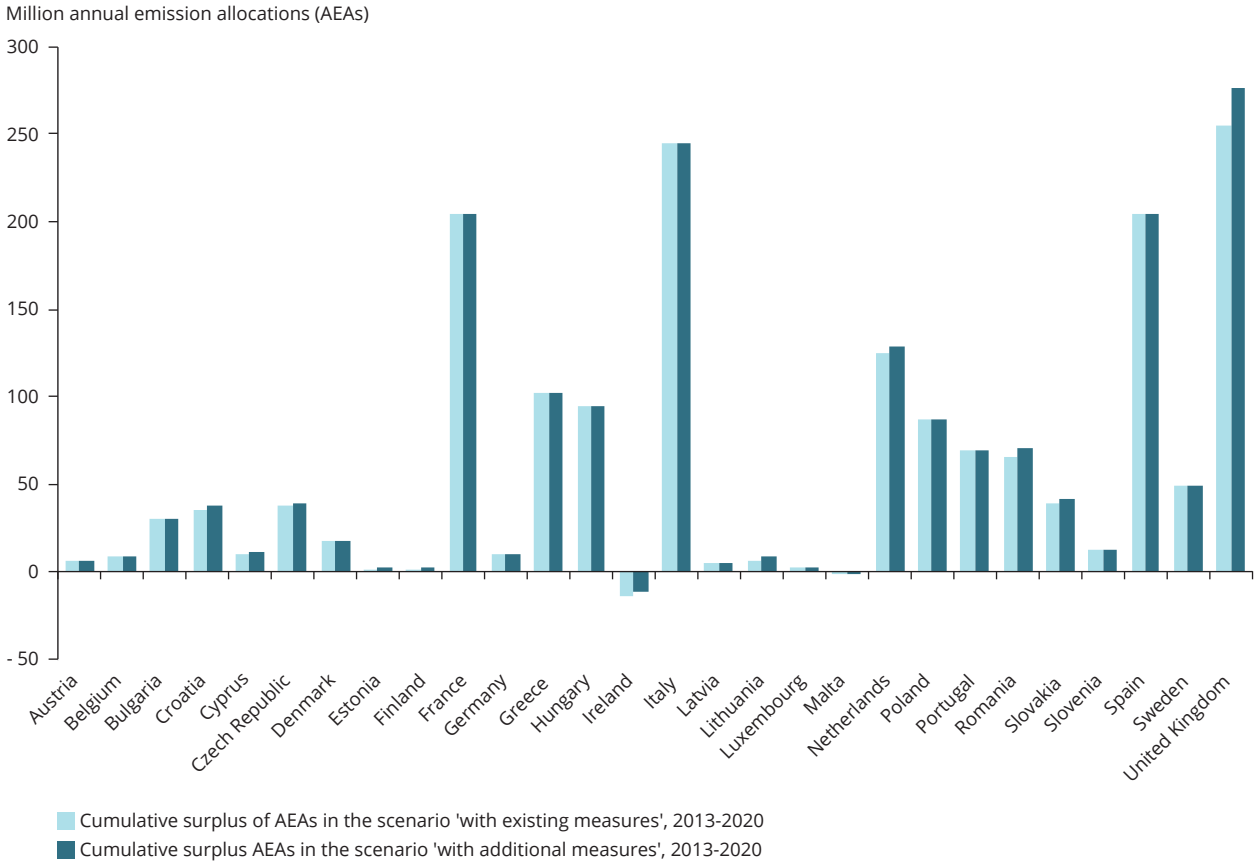
3.3 Cumulative gaps for 2013-2020 and use of the flexibilities provided under the Effort Sharing Decision

ESD emission targets, expressed in quantities of AEAs, can be considered as annual emission budgets that can be partly transferred from one year to another, as well as between Member States, under certain rules defined in the ESD. It is therefore possible to define an overall emission budget under the ESD for the whole period 2013-2020 for each Member State and at EU level. As historical and projected ESD emissions at EU level are below ESD targets, an overall surplus of between 1 700 and 1 800 million AEAs is expected by 2020 at EU level (see Section A1.5 in Annex 1).

At Member State level, the size of the expected cumulative AEA surpluses or deficits by 2020 differ greatly (see Figure 3.3). The largest cumulative surpluses are projected for the United Kingdom, Italy and France. Only two Member States (Ireland and Malta) expect a deficit of AEAs over the whole period. For Ireland this is so even in the case of a WAM scenario that considers additional measures. Currently planned or further additional measures will have to be implemented in due time, or these countries will need to purchase AEAs from other Member States or international project credits.

Austria, Belgium, Finland, Germany, Ireland and Luxembourg, and Malta, for which national projections suggest that ESD emissions will exceed ESD targets by 2020, can still meet their obligations under the ESD by enhancing national efforts to reduce their domestic emissions to levels below ESD target levels by 2020, as well as by using the flexibility provided for under the ESD (see Table A3.4), as described below:

Figure 3.3 Projected cumulative gaps with regard to Effort Sharing Decision targets, 2013-2020



Notes: A positive value represents a surplus of annual emission allocations (AEAs). A negative value represents a shortfall of AEAs. Seventeen Member States submitted a WAM scenario. For the other Member States (Austria, Bulgaria, Denmark, France, Greece, Italy, Malta, Poland, Slovenia, Spain and Sweden), the WEM scenario is shown instead. Denmark submitted a WAM scenario that was identical to its WEM scenario.

Sources: EEA, 2017a, 2017b, 2017c, 2017d; EU, 2013a, 2013b, 2017b, based on Member States' submissions.

- For Austria, a deficit of AEAs is projected for 2020 in the WEM scenario. A WAM scenario has not been submitted. Several policies that were reported under the WAM scenario in 2015 are now included in the WEM scenario, as they have been implemented. Additional measures would still be necessary to close the gap by 2020, however Austria could also achieve its ESD targets by using AEAs accumulated between 2013 and 2015. According to the updated projection, this would be sufficient to close the gap in ESD targets by 2020.

- For Belgium, projections indicate that deficits of AEAs could occur between 2018 and 2020 in the WEM scenario, with an estimated gap of 2.8 million AEAs in 2020. In the WAM scenario, this deficit could be reduced to 2.0 million AEAs in 2020 by implementing additional measures. In any case, according to current projections, Belgium could achieve its ESD targets for the whole period by using surplus AEAs already accumulated between 2013 and 2015.

- Finland projects its emissions to slightly exceed allocated AEAs in the years 2019-2020 (WEM scenario) and in 2020 (WAM scenario). According to the most recent projections, surplus AEAs from previous years are sufficient to compensate for this deficit under both scenarios.

- Germany's projections indicate a deficit of 15.6 million AEAs in 2020 under the WEM scenario and 8.1 million AEAs in the WAM scenario. This could be compensated by accumulated surplus AEAs from the years 2013-2016.

- For Ireland, projections show deficits under both scenarios from 2016 until 2020. Transferring surplus AEAs accumulated between 2013 and 2015 would not be sufficient for Ireland to comply each year until 2020. Ireland therefore needs to successfully implement additional measures or use other flexibilities. As reported by Ireland, the additional measures that would contribute to closing the gap in ESD sectors include additional energy efficiency measures, retrofits in the industry sector and thermal energy from renewable sources. In the transport sector, additional measures anticipate increased deployment of electric vehicles, more efficient traffic movement and 8 % of fuel for road transport from renewables by 2020 (falling short of the 10 % target set in the national renewable energy action plans (NREAPs)). Additional measures are also envisaged for the buildings (commercial and residential) sector, in which retrofit schemes, increased use of renewables and building regulations could contribute towards further GHG emission savings.

- For Luxembourg, deficits are projected for the year 2020, with a gap of 0.3 million AEAs (WEM scenario) and 0.1 million AEAs (WAM scenario) in 2020. This gap could be filled with the use of surplus AEAs from preceding years.

- For Malta, deficits are projected for the year 2020, with a gap of 0.1 million AEAs (WEM scenario). Malta has not submitted a WAM scenario. Malta already complied with its legal obligations in relation to 2013 and 2014 by purchasing surplus AEAs from Bulgaria. According to the inventory for 2015, the proxy inventory for 2016 and the national projections for the period 2017-2020, Malta will need additional flexibility mechanisms such as purchasing AEAs from Member States that have overachieved their targets each year.

Table 3.1 summarises the minimum conditions required to stay within the 2013-2020 ESD budget. Overall, based on national projections submitted in 2017, a net surplus of between 1 700 and 1 800 million AEAs (depending on the scenario considered) could accumulate by 2020 if all unused AEAs were carried over to subsequent years within the compliance period from 2013 to 2020. This projected surplus is higher than that calculated in the 2016 assessment (1 600 to 1 760 million AEAs) (EEA, 2016). The quantity of surplus AEAs would be more than sufficient to cover the potential deficits observed or expected in a limited number of Member States.

So far, the European Commission has performed compliance checks for only the years 2013 and 2014. Malta balanced its respective surplus emissions of 0.08 Mt and 0.12 Mt by AEA purchases from Bulgaria, which had overachieved its targets. Bulgaria declared that it would disburse the financial revenues from these AEA transfers solely to subsidise and administer activities aimed at climate change mitigation or adaptation. All other Member States except Sweden transferred surplus AEAs to subsequent years. Sweden invited Member States to follow its example by increasing ambitions under the ESD through annual cancellation of surplus AEAs. No additional use of flexible mechanisms (transfer of AEAs between Member States or additional flexibility through the purchase of emission credits outside the EU) has been reported.

Table 3.1 Minimum conditions for achieving the Effort Sharing Decision budget for the period 2013-2020

Use of flexibility mechanisms	Historical (2013, 2014, 2015)	Approximated historical (2016)	2017-2020 WEM ([a]) scenario	2017-2020 WAM ([c]) scenario
No use of flexibility mechanisms	27 Member States	24 Member States	19 Member States ([b])	20 Member States
Transfer of AEAs ([d]) between years only		Belgium, Finland, Ireland	Austria, Belgium, Estonia, Finland, Germany, Lithuania, Luxembourg	Austria, Belgium, Finland, Germany, Lithuania, Luxembourg
Additional flexibility mechanisms needed	Malta	Malta	Ireland, Malta	Ireland, Malta

Notes: ([a]) The 'with existing measures scenario' (WEM) includes adopted measures at the time of preparation of projections. The 'with additional measures' (WAM) scenario also includes planned measures.

([b]) Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, France, Greece, Hungary, Italy, Latvia, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

([c]) Austria and Malta did not report projections in a WAM scenario.

([d]) AEA, annual emission allocation.

4 Progress of the European Union towards its renewable energy targets

- The EU is currently on track to meet its renewable energy target, i.e. that 20 % of its energy should come from renewable sources by 2020. The share of energy from renewable sources in the EU's gross final energy consumption reached 16.7 % in 2015 and thus exceeded the level of the indicative trajectory set out in the RED.
- This good progress at the EU level is confirmed by preliminary estimates from the EEA, which show that renewable energy use in the EU is expected to increase to 16.9 % of gross final energy consumption in 2016.
- As regards the consumption of renewable energy in the transport sector, the EU reached a share of 6.7 % in 2015 (and 7.1 % in 2016, according to EEA preliminary estimates). This indicates that insufficient progress has been achieved so far towards the 10 % target set for the transport sector for 2020.
- If renewable energy use, as a proportion of gross final energy consumption, continues to grow at the same pace until 2030, the EU will exceed the 27 % minimum target for 2030. However, this may not happen without additional efforts, because a number of regulatory changes have already affected investors' confidence in renewables, one example being the retroactive cuts to feed-in tariffs. Other challenges for renewable energy progress include the outdated structure of the electricity market, which prevents consumers and other players from participating actively in the market, persistent barriers for cross-border trade of RES, and the need to expand the grid infrastructure to accommodate a growing share of decentralised RES.
- In view of the EU's longer term energy and decarbonisation objectives for 2050, the deployment of RES by the EU will need to accelerate.

4.1 Current progress on renewable energy

The EU is currently on track to meet its target of reaching, by 2020, a 20 % share of renewable energy in its gross final energy consumption ([12]). In 2015, the use of RES in the EU, as a proportion of gross final energy consumption, continued its steady growth, standing at 16.7 % of gross final energy consumption. This is an increase of 0.5 percentage points from the previous year. According to preliminary estimates from the EEA, the share of energy from renewable sources in the EU's gross final consumption of energy continued to increase in 2016, and is expected to reach a level of 16.9 %.

The RED sets binding national targets for 2020 for all Member States (EU, 2009d). These national targets, ranging from 10 % for Malta to 49 % for Sweden, reflect differing national circumstances and starting points. To ensure that these 2020 targets are achieved, the RED also sets indicative trajectories for the period between 2011 and 2020. Member States may reach their indicative RED targets domestically (by establishing adequate RES support measures) and through cooperation with other countries (between

([12]) Gross final energy consumption represents the energy delivered to end users (industry, transport, households, services including public services, agriculture, forestry and fisheries), as well as the consumption of electricity and heat by the energy sector for electricity and heat production. It also includes losses of electricity and heat during distribution and transmission.

local, regional and national authorities, planned statistical transfers or joint projects ([13])).

The RES share of 16.7 % achieved by the EU in 2015 exceeds the average EU share for the two consecutive years 2015 and 2016, in accordance with the indicative trajectory provided in the RED (13.8 %).

Preliminary estimates by the EEA indicate that the EU achieved, on average, a 16.8 % RES share over the 2-year period from 2015 to 2016, exceeding the average share of its indicative trajectory.

The RES share of 16.7 % in 2015 is higher than the aggregate ambition levels that Member States had planned to achieve by 2015 and 2016 (15.3 % and 16.1 %, respectively), according to the roadmaps reported in their 2010 NREAPs and assessed by the EEA (EEA, 2017i).

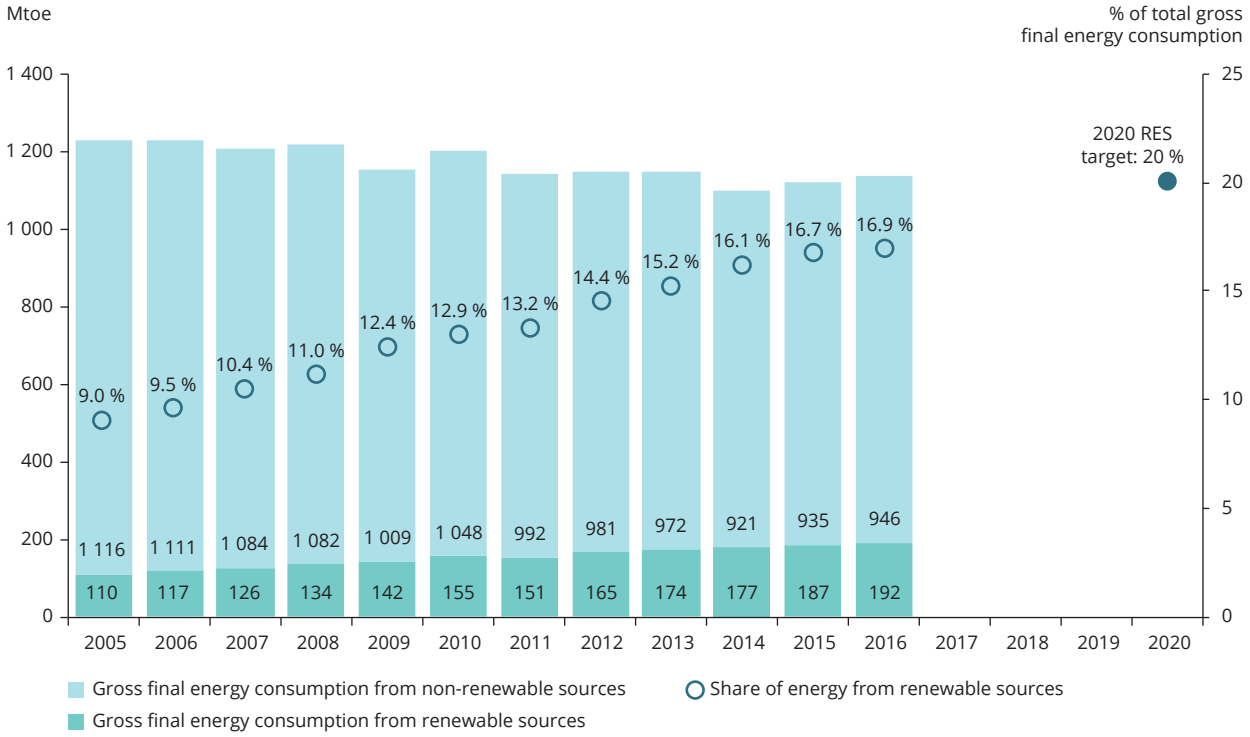
Between 2005 and 2015, the use of energy from renewable sources, as a proportion of gross final energy consumption, increased on average by 0.8 percentage points every year. This steady increase reflects a combination of two trends:

- dynamic developments in the use of renewable energy (in absolute terms); together with
- a decrease in final energy consumption.

While the consumption of renewable energy grew by almost 70 % between 2005 and 2015, total final energy consumption decreased by 9 % during the same period (see Figure 4.1).

Between 2014 and 2015, the consumption of renewable energy increased by 10 million tonnes of oil equivalent (Mtoe) (from 177 Mtoe to 187 Mtoe).

Figure 4.1 Gross final energy consumption from renewable and non-renewable energy sources, 2005-2016



Notes: Eurostat calculates the shares of renewable energy source (RES) consumption, and as part of this process normalises wind power and hydroelectricity generation, which are part of the RES share numerator. However, the total consumption of electricity included in the denominator is not normalised. In the figure above, non-normalised gross final energy consumption is displayed together with shares of RES consumption in which the numerator has been normalised.

Sources: EEA, 2017k; EU, 2009d; Eurostat, 2017d.

([13]) The RED foresees three main cooperation mechanisms among Member States in their pursuance of their national targets: 'statistical transfers' – where Member States agree to reattribute renewable energy production among themselves in their statistical accounting for target compliance, without any physical energy exchanges taking place; 'joint projects' – where the renewable energy from a particular project is shared between the parties, with or without a physical flow of the energy produced; and 'joint support schemes' – where Member States co-finance their renewable energy production independent of its location (within their territories).

The 16 % decrease in the gross final energy consumption of non-renewable sources between 2005 and 2015 clearly indicates a progressive substitution of fossil fuels by renewables. Yet between 2014 and 2015, the consumption of non-renewable sources as well as total final energy consumption increased from 921 Mtoe to 935 Mtoe, and from 1 098 to 1 122 Mtoe respectively. Thus, the overall trend to reduce energy consumption shifted in 2015, as in absolute terms the consumption of fossil fuels increased by more than that of RES.

4.2 Projected progress in the deployment of renewable energy sources

If the average annual percentage point increase in the RES share observed between 2005 and 2015 is maintained until 2020, the EU will achieve its 2020 target. This, however, may prove challenging, because a number of complex factors are at play, with uncertain outcomes. This includes the outdated structure of the electricity market, which prevents certain market players and consumers from participating actively in the market, the sub-optimal use of cross-border opportunities, and the slow expansion of the grid infrastructure, which at times prevents contributions from a growing share of centralised and decentralised RES. Together with changes in national RES supporting policies over past years, these factors may have caused some investors to hold back. At the same time, costs for new RES capacity are being reduced through economies of scale, better knowledge integration and increasing experience.

According to their 2010 action plans and the subsequent biennial progress reports ([14]), Member States plan to increase the share of energy from renewable sources at EU level to approximately 21 % by 2020, as analysed by the EEA (2017i). However, not all Member States reported RES projections, or specified the status of the policies and measures (e.g. existing or planned) on which their projections were based. This makes it difficult to use the RES projections to assess progress towards RES targets for all Member States in a consistent manner, as is done for GHG emissions.

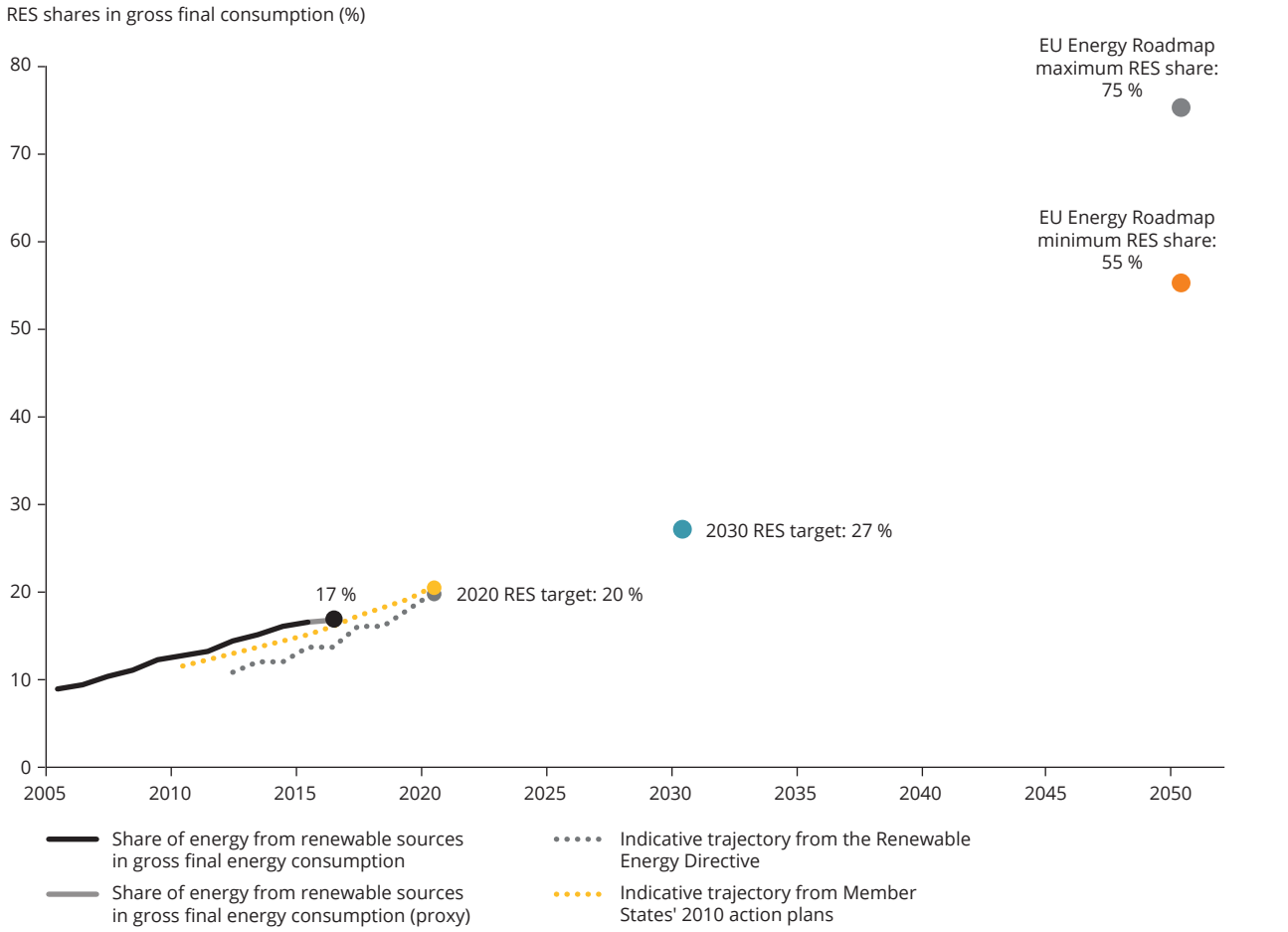
The European Commission made a proposal for a revised RED (RED II) in December 2016, confirming the objective of increasing the EU-wide share of RES consumption to a minimum of 27 % by 2030 (EC, 2016f). Negotiations on the RED II proposal are still ongoing. At this point, current national documents offer limited information regarding the continuation of efforts envisaged by countries after 2020. Currently, a proposal for a governance framework for the Energy Union is being negotiated with Member States (EC, 2016h). The framework will require Member States to draft national integrated energy and climate plans, and to submit new information on their envisaged efforts post-2020, but not before 2019, when national integrated energy and climate plans should be finalised.

Beyond 2030, the EU has no quantified target for renewable energy. However, to achieve the goal of reducing EU-wide GHG emissions by 80-95 % compared with 1990 levels by 2050, the EU-wide share of RES will need to increase significantly, to levels between 55 % and 75 % of gross final energy consumption (see Figure 4.2), in accordance with the decarbonisation scenarios presented in the European Commission's communication *Energy Roadmap 2050* (EC, 2011a, 2011b, 2011c). Achieving such a high proportion of RES consumption calls for considerably higher efforts post 2030, as the required growth rates of RES would have to be up to three times higher than the rates achieved between 2005 and 2015. A higher penetration of renewables in the EU energy supply before 2030 would balance the pace of growth required before 2050, but, for this purpose, further policy efforts and investments would be required in the short term.

In particular, the transport sector represents a challenge due to its significant reliance on fossil fuel-based technologies and infrastructure. Progress in increasing the use of renewable energy consumption in this sector has been relatively limited in the EU to date, with consequences for the sector's GHG emissions.

([14]) For the years up to 2020, Member States have to report, in their RED progress reports, the estimated excess/deficit production of energy from renewable sources relative to their national indicative RED trajectory.

Figure 4.2 **Share of energy from renewable energy sources (RES) in the EU's gross final energy consumption, 2005-2050**



Sources: EC, 2011b, 2011c, 2013b, 2013c; EEA, 2017k; EU, 2009d; Eurostat, 2017d.

4.3 The development of renewable energy for electricity, heating and cooling, and transport

RES are used in power generation, for heating and cooling, and in the transport sector. In addition to the overall 20 % target for renewable energy use in all sectors by 2020, a 10 % target must be achieved in the transport sector at EU level and by all Member States, in accordance with the RED. However, progress in this sector is much slower compared with overall RES growth rates for all sectors.

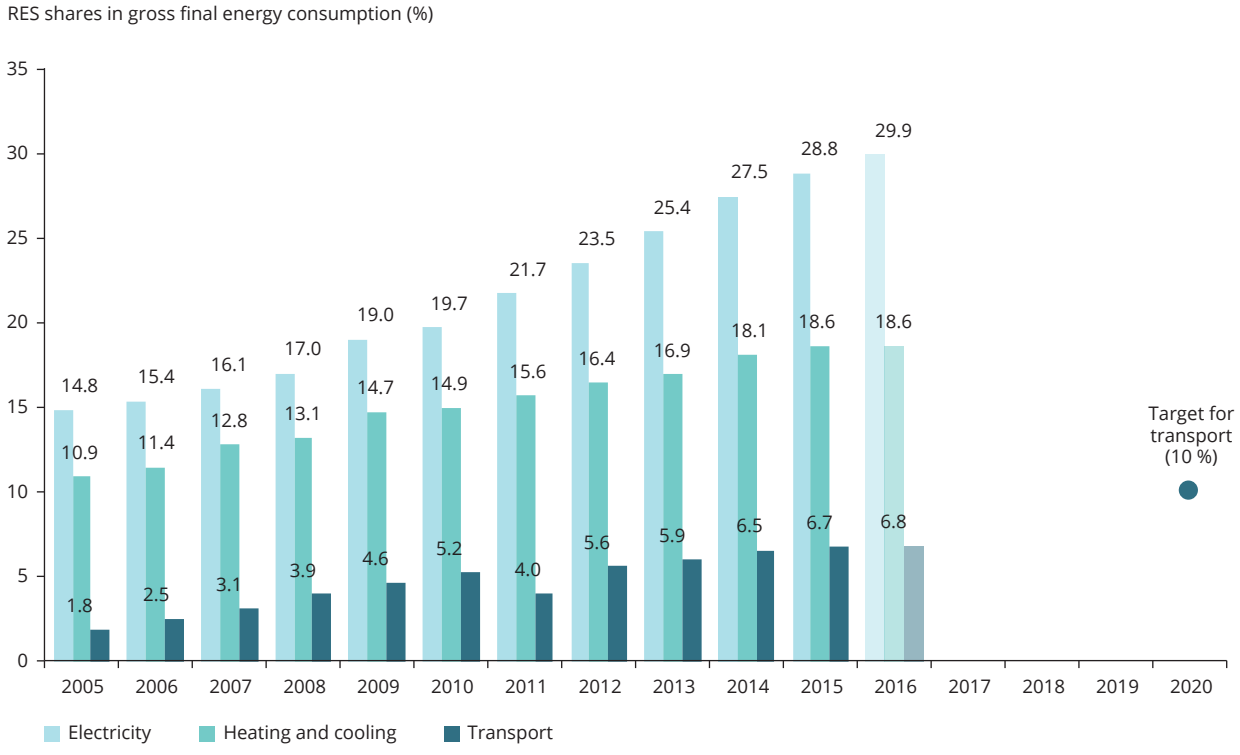
Between 2005 and 2015, with regard to electricity consumed in the EU, the RES share grew at an average of 1.4 percentage points per year. In 2015, about 29 % of the electricity consumed in the EU was generated from renewables, with the most important sources being hydropower, wind, solar energy and solid biofuels (EEA, 2017j). About 42 % of renewable electricity came from variable sources such as wind and solar power (Eurostat, 2017d). For 2016, the EEA's approximated estimates indicate that about 30 % of total electricity consumed was derived from RES, with more than 44 % of this share from wind and solar power (EEA, 2017k).

In the EU heating and cooling sector, the RES share grew by 0.8 percentage points per year, on average, between 2005 and 2015. The most important sources for renewable heating and cooling throughout the EU are solid biomass, heat pumps and biogas, followed by solar thermal collectors (EEA, 2017, 2017j). The share of energy from renewable sources used in this sector amounted to 18.6 % in 2015, and was estimated to remain constant in 2016 (EEA 2017j). Heating from renewable sources is increasingly being used as a cost-efficient and secure alternative to fossil fuels (mainly natural gas) in Member States for district heating and at local levels.

In 2015, renewable energy represented only 6.7 % of energy consumption in the transport sector (see Figure 4.3). According to preliminary estimates from the EEA, this proportion had increased marginally to 7.1 % in 2016. After rapid growth between 2005 and 2010, the proportion of RES use in transport (RES-T) dropped in 2011 and has been increasing at a slower pace since 2012. This can be explained by a number of factors, including the following:

- The late transposition and implementation by some Member States of the legal provisions meant to ensure biofuel sustainability under the RED.
- The debate concerning the future of biofuel policy, in the light of the indirect displacement effects of conventional crop based biofuels on other land uses. Research has shown that the significance of actual GHG savings from biofuels produced from crops grown on agricultural land primarily for energy purposes remained too uncertain to support further growth of the sector. A political agreement was reached, resulting in a cap on the use of these fuels being adopted in 2015. Accordingly, such fuels should account for a maximum of 7 % of final energy consumption in transport by 2020 (EU, 2015a, 2015b). The Indirect Land Use Change (ILUC) Directive (EU, 2015b) also sets an indicative target of 0.5 % use for advanced biofuels by 2020 (e.g. fuels made from waste or algae). The Commission proposal for the Renewable Energy Directive after 2020 further requires Member States to promote targets for advanced biofuels post 2020 (0.5 % of transport fuels by 2021, rising to 3.6 % by 2030; EC, 2016f) and to gradually reduce the cap for conventional crop based biofuels to 3.8 % in 2030.
- The use of biofuels to reduce GHG emissions remains a relatively high-cost climate mitigation option. For example, it is estimated (not considering the indirect emissions related to land use change) that the mitigation costs of biodiesel would be in the range of EUR 100 to EUR 330 per avoided tonne of CO_2; for bioethanol fuels from sugars and straw, costs would range from EUR 100 to EUR 200 per tonne of avoided CO_2 (Joint Research Centre, 2015). These estimates depend to a large extent on the cost differentials between fossil fuels and biofuels.

Figure 4.3 Shares of energy use from renewable sources by sector in the EU



Notes: Percentages indicate the share of energy from renewable sources in gross final energy consumption of the corresponding sector. Data for 2016 are preliminary (proxy) estimates.

Sources: EEA, 2017k; EU, 2009d; Eurostat, 2017d.

5 Progress towards Member States' renewable energy targets

- Under the RED, Member States must achieve targets for the share of energy from renewable sources in their gross final consumption of energy in 2020. These targets range from 10 % to 49 %. To ensure progress towards these 2020 targets, the RED also sets indicative trajectories for the period from 2011 to 2020. Member States also set their own estimated trajectories in their NREAPs, reported in 2010 and updated by some Member States thereafter.
- In all Member States except three (France, Luxembourg and the Netherlands), the share of RES in 2015 was equal to, or higher than, the average for this period based on the indicative trajectories set under the RED. According to preliminary EEA estimates and last year's trend, this situation remained unchanged in 2016.
- With regard to the progress of Member States based on their own plans, 20 (all except France, Ireland, Luxembourg, Malta, the Netherlands, Poland, Portugal and Spain) reached or exceeded their anticipated NREAP trajectories in 2015. According to preliminary estimates, this number is expected to decrease to 19 Member States in 2016, as Cyprus and Slovenia were also unable to follow their NREAP trajectory for that year but the RES share for Spain is estimated to be above the NREAP trajectory.
- In 11 Member States (Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, Hungary, Italy, Lithuania, Romania and Sweden), the proportion of RES use in 2015 already exceeded the 2020 RED targets. Preliminary estimates for 2016 indicate that the same also holds true for 2016.
- Excess RES capacity may be used for transfers to support Member States that are having difficulty reaching their targets. The trading options provided for under the RED could provide benefits to the countries involved and help the EU achieve its 2020 RES target more cost-effectively.

5.1 Current progress towards renewable energy source targets

In order to achieve the EU's objective of a 20 % share of energy from renewable sources in its gross final energy consumption by 2020, the RED sets national targets for each Member State for 2020 (EU, 2009). These targets range from 10 % (Malta) to 49 % (Sweden). To monitor progress towards these 2020 targets, the RED sets out indicative trajectories for the period from 2011 to 2020. These indicative trajectories are expressed as average shares for 2-year periods, from 2011 to 2018, in addition to the 2020 target.

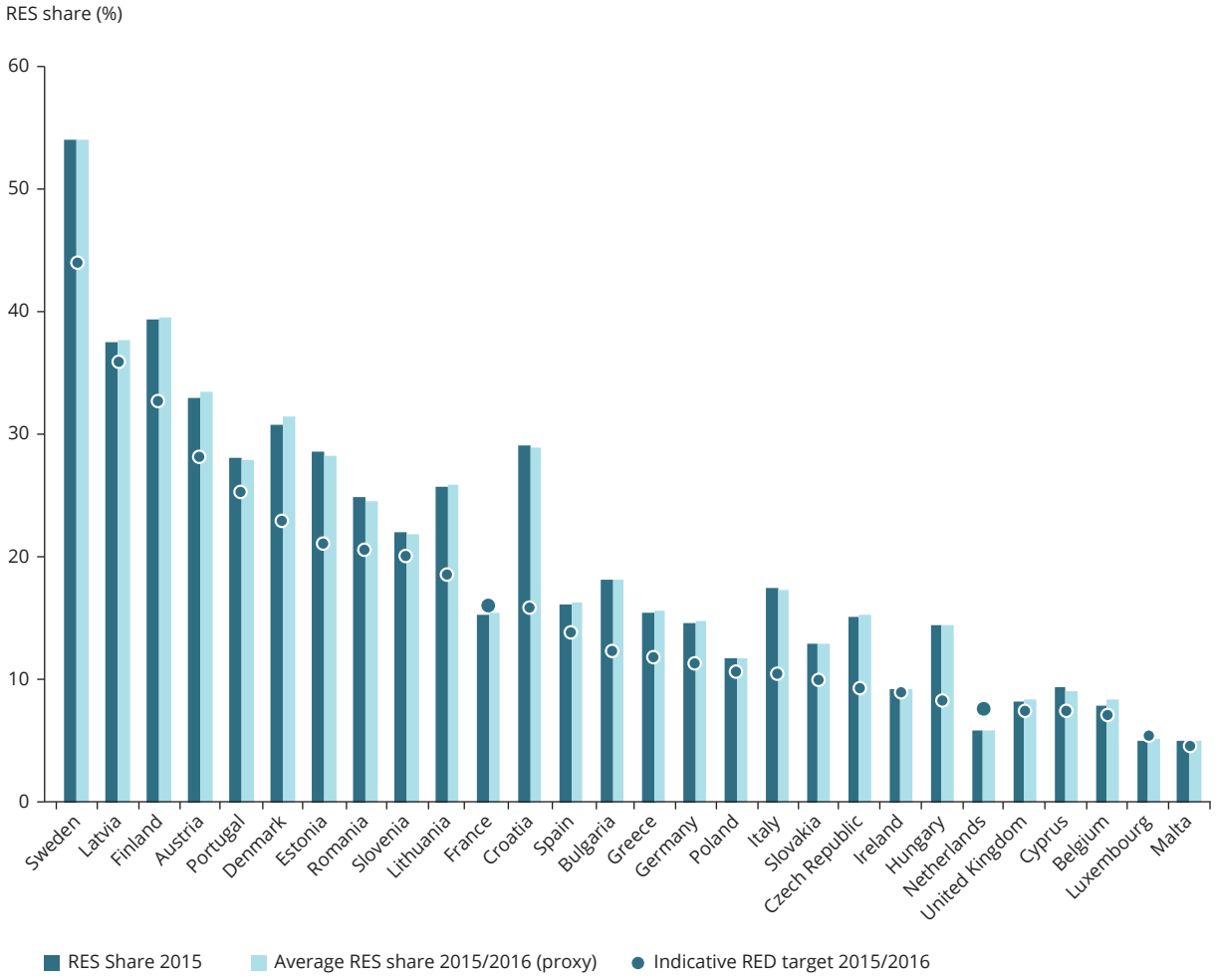
For the 2-year period from 2015 to 2016, officially reported national data are available only for 2015. In 2015, all Member States except three (France, Luxembourg and the Netherlands) exceeded their indicative trajectory set in the RED for the period 2015-2016 (see Figure 5.1). When the EEA early renewable energy estimate for 2016 is taken into account to calculate 2015-2016 average RES shares, the picture remains the same.

When considering current RES shares in relation to 2020 targets, in 2015, 11 Member States exceeded their national targets for 2020 set under the RED. These countries were Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, Hungary, Italy, Lithuania, Romania and Sweden (see Annex 3).

5.2 Progress towards the objectives of national action plans

Member States also set their own estimated trajectory to 2020 in NREAPs, which they reported in 2010 and which some updated thereafter. These action plans concern the development of renewable energy at the national level, and include expected trajectories as well as

Figure 5.1 **National shares of energy from renewable sources in relation to indicative Renewable Energy Directive (RED) trajectories**



Notes: For Croatia, data revision, which took place in 2016, revealed significantly higher amounts of biomass consumption, which drove the proportion of renewable energy use upwards.

RES, renewable energy source.

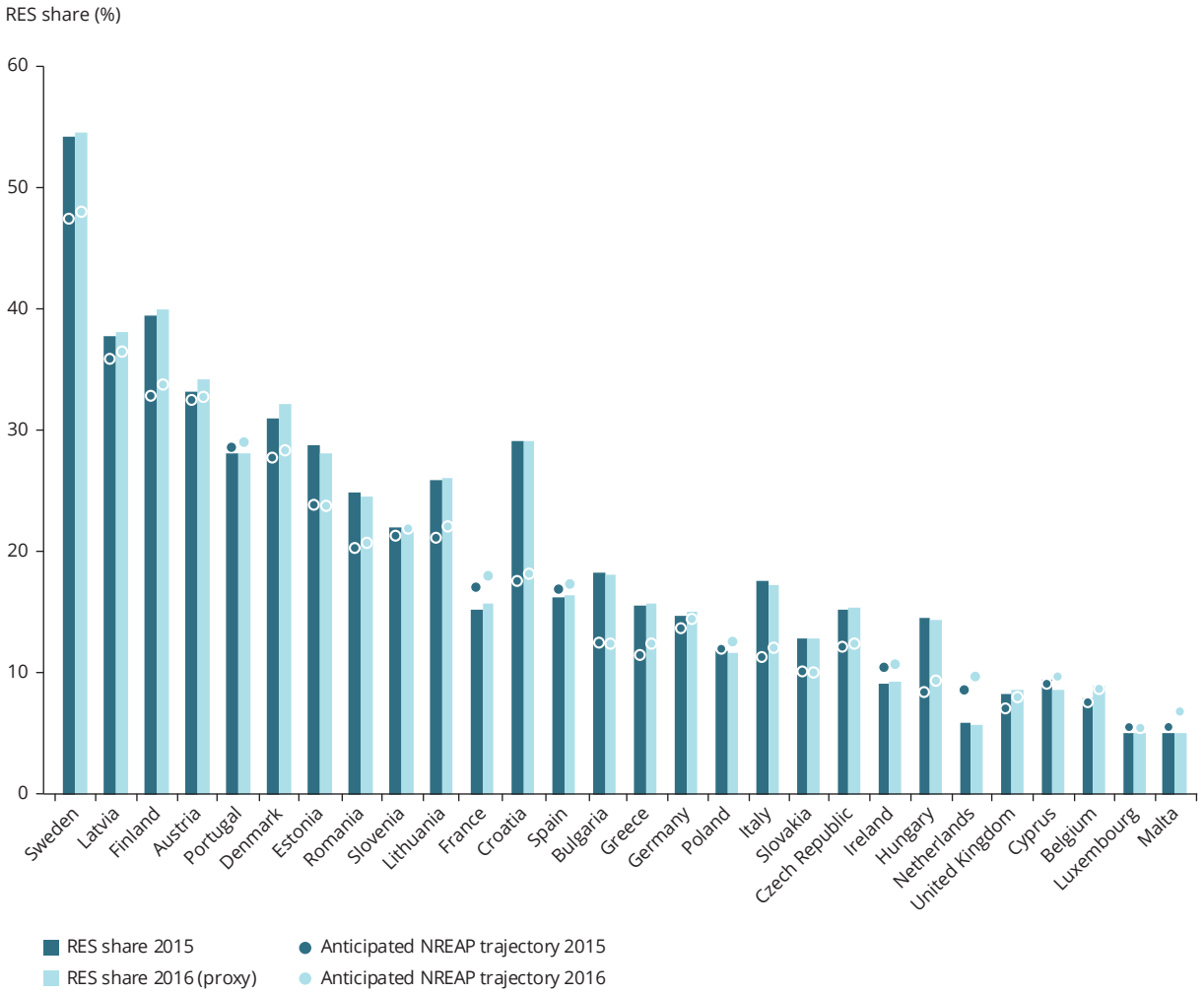
Sources: EC, 2013c; EEA, forthcoming; EU, 2009d; Eurostat, 2017d.

planned RES shares in the transport (RES-T), heating and cooling (RES-H/C), and electricity (RES-E) market sectors.

For most Member States, the anticipated trajectories set out in NREAPs are more ambitious than the indicative trajectories defined in the RED ([15]). For example, the indicative RES target for the period 2015-2016 set out in the RED for Denmark is 22.9 %, while this country planned to achieve a share of 28.2 % for energy from renewable sources in 2016, according to its NREAP. In contrast, Greece, Latvia, Romania and the United Kingdom have designed trajectories in their NREAPs that are, for some years, lower than those set out in the RED.

([15]) In its 2015 progress report on the promotion and use of energy from renewable sources submitted under Article 22 of the RED, Italy presented an updated RES trajectory, because of the unexpectedly quick development of the use of renewable energy compared with that expected in the 2010 NREAP. This was a consequence of the reduction in total final energy consumption and of the greater than anticipated increase in power generation from renewable sources. Such development is expected to continue until 2020. For the present assessment, the original NREAP trajectory was taken into account.

Figure 5.2 **National shares of energy from renewable sources in relation to trajectories from national action plans**



Notes: The countries are ranked by decreasing 2020 renewable energy source (RES) target levels. For Croatia, data revision, which took place in 2016, revealed significantly higher amounts of biomass consumption, which drove the proportion of renewable energy use upwards.

NREAP, National renewable energy action plans.

Sources: EC, 2013c; EEA, 2017k; EU, 2009d; Eurostat, 2017d.

In 2015, 20 Member States reached or exceeded the RES targets outlined in their NREAPs for that year (see Figure 5.2). However, for eight Member States (France, Ireland, Luxembourg, Malta, the Netherlands, Poland, Portugal and Spain) in 2015, the RES shares were below the anticipated trajectories laid out in their corresponding NREAPs.

Preliminary estimates by the EEA indicate that, in 2016, fewer Member States are expected to reach or exceed their NREAP trajectories than in 2015 (19 compared with 20). In addition to the countries that did not reach their NREAP trajectory in 2015, two further Member States (Cyprus and Slovenia) failed to stay above their NREAP trajectory in 2016, while the RES share of Spain is expected to lie above the NREAP trajectory.

5.3 Deployment of renewable energy between 2005 and 2015

The RES shares represent the ratio between renewable energy use and gross final energy consumption, at country and at EU level. Accordingly, the growth of the RES share in the Member States during the period 2005-2015 is a combined result of the development (in absolute terms) of renewable energy use alongside changes in gross final energy consumption. The latter has declined in 26 Member States since 2005 (see Figure 5.3). Aggregated at EU level, the gross final consumption of energy declined by 8.5 % between 2005 and 2015, while renewable energy consumption grew by almost 70 % over the same period (see Section 4.1).

Figure 5.3 Gross final energy consumption (total and from renewable sources) and shares of energy from renewable sources in the Member States, 2005-2015

Member State	Gross final energy consumption Total change 2005-2015 (%)	Gross final energy consumption from renewable sources Total change 2005-2015 (%)	Renewable energy share Percentage points change 2005-2015
Austria	- 1	37	9.1
Belgium	- 3	228	5.5
Bulgaria	- 4	86	8.8
Croatia	- 9	11	5.2
Cyprus	- 7	178	6.2
Czech Republic	- 7	97	8.0
Denmark	- 9	75	14.9
Estonia	- 2	60	11.2
Finland	- 3	32	10.5
France	- 9	44	5.7
Germany	- 3	112	7.9
Greece	- 20	76	8.4
Hungary	- 4	211	10.0
Ireland	- 11	186	6.3
Italy	- 14	100	9.9
Latvia	- 7	8	5.3
Lithuania	- 0.1	53	9.0
Luxembourg	- 12	211	3.6
Malta	50	4 727	4.8
Netherlands	- 11	107	3.3
Poland	6	81	4.9
Portugal	- 15	21	8.4
Romania	- 10	29	7.5
Slovakia	- 13	76	6.5
Slovenia	- 4	32	5.9
Spain	- 17	58	7.7
Sweden	- 5	27	13.3
United Kingdom	- 14	438	6.9

Notes: In Malta, there was an increase in gross final energy consumption from renewable sources of 4 727 % between 2005 and 2015, as renewable energy represented only a tiny fraction of the country's gross final energy use in 2005. At the same time, due to the very small absolute size of the country's renewable energy use in 2005, the data may not be fully representative and are thus not represented above. The data on total gross final energy consumption take into account adjustments with regard to the amounts of energy consumed in aviation, as stipulated under the RED.

Source: Calculated from Eurostat, 2017d.

5.4 Progress towards renewable energy source targets in the transport sector

The 10 % RES-T target at EU level translates into RES-T targets of 10 % for all Member States. In 2015, Austria (11.4 %), Finland (22 %) and Sweden (24 %) were the only three Member States with RES-T shares of more than 10 %. In the other Member States, RES-T shares varied from 0.4 % (Estonia) to 8.5 % (France and Slovakia).

In Portugal and Sweden, the use of biofuels compliant with sustainability criteria ([16]) increased considerably in 2015. In Sweden, fuel efficiency and renewable energy use in transport are stimulated through a number of tax incentives. Sweden has a high proportion of flexi-fuel vehicles, and numerous public buses run on

([16]) Only biofuels and bioliquids that comply with sustainability criteria defined at EU level can receive government support or count towards national renewable energy targets. These criteria ensure that the use of biofuels (in transport) and bioliquids (for electricity and heating) is done in a way that guarantees actual carbon savings and protects biodiversity. In particular, to be considered sustainable, biofuels must achieve minimum GHG savings in comparison with fossil fuels: they cannot be grown in areas converted from land with previously high carbon stock, such as wetlands or forests, and they cannot be produced from raw materials obtained from land with high levels of biodiversity, such as primary forests or highly biodiverse grasslands.

ethanol and biogas. Sweden also has a high proportion of renewable electricity consumption in rail transport.

In 2016, preliminary estimates indicate that the situation remained similar to that in 2015. Apart from Austria, Finland and Sweden, RES-T shares ranged from 0.5 % (Estonia) to 8.9 % (France) in the other Member States (see Table A2.2 in Annex 2).

5.5 Regional cooperation and statistical transfers

According to the latest progress reports on renewable energy submitted by Member States in 2015, 15 Member States (Bulgaria, Cyprus, Denmark, Estonia, Germany, Greece, Hungary, Ireland, Italy, Latvia, Poland, Romania, Slovakia, Spain and Sweden) expect to produce more energy from renewable sources than planned, for at least 1 year, before 2020. These Member States could, in principle, transfer any excesses to other Member States experiencing deficits. Several Member States have indicated that they would be willing to participate in such transfers. Updates to this information may occur when Member States submit their new progress reports at the end of 2017.

From 2012 to 2015, statistical transfers between Norway and Sweden took place. This is due to their joint electricity certificate market scheme, which started trading in 2012. According to this scheme, an electricity certificate issued in one country can be used to meet the quota obligation in the other country, and vice versa. The agreement between Norway and Sweden was updated in May 2017. Sweden has decided on a new national target in 2030 and will therefore extend the electricity certificate scheme for 10 more years. Norway will stop adding new projects to the scheme after 2021. The two countries will still have a common certificate scheme until 2045 (Swedish Energy Agency, 2017; Norwegian Water Resources and Energy Directorate, 2017).

Denmark, Germany, Latvia, Lithuania, Luxembourg and Portugal have also reported plans of joint projects or have expressed an interest in such projects in their 2015 progress reports.

In 2016, Denmark and Germany launched a first cross-border auction for ground-mounted photovoltaic (PV) installations (PV magazine, 2016). France and Germany have very recently agreed on holding joint renewables auctions (Federal Ministry for Economic Affairs and Energy, 2017).

6 Progress of the European Union towards its 2020 energy efficiency targets

- The EU is currently on track to meet its 20 % energy efficiency target for 2020. Recent statistics show, however, that energy consumption levels are increasing slightly. In 2015, the EU's primary energy consumption was 10.7 % below 2005, with an increase of 1.4 % compared with 2014. This increase in energy consumption means that Member States need to make greater efforts to keep the EU on track towards its 2020 target.
- Preliminary estimates from the EEA indicate that primary energy consumption continued to increase in 2016, for the second consecutive year. In 2016, primary energy consumption was 0.6 % higher compared with 2015, and 10.2 % below the 2005 level. This corresponds to a level just above the linear trajectory to 2020 (0.1 %).
- In 2015, final energy consumption in the EU was 9 % below the 2005 level and just below the level of its 2020 target, despite a 2 % increase compared with 2014. Preliminary estimates indicate that this increase continued in 2016. This resulted in final energy consumption being above the 2020 target, unlike the previous year.
- To reach the EU's currently proposed 30 % energy efficiency target for 2030, primary energy consumption will require a total reduction of 23 % compared with 2005 levels. This will only be achieved if Member States step up their efforts to keep primary energy consumption in check.

6.1 Current progress in reducing energy consumption

The Energy Efficiency Directive (EED) defines the EU energy efficiency target for 2020, which can be expressed in terms of either primary energy consumption or final energy consumption (EU, 2012). Meeting both targets will require a reduction in primary and final energy consumption by 20 % compared with levels projected for 2020 in the European Commission's Energy Baseline Scenario (EC, 2008). EU legislation does not set any specific indicative trajectory to monitor the progress of the EU towards the 2020 target.

This analysis tracks progress towards the energy efficiency target by considering an indicative linear trajectory between primary energy consumption levels in 2005 and the 2020 target level, and by comparing the levels of primary energy consumption in the assessment year with this linear trajectory. The EU is considered to be on track towards meeting its 2020 target if its primary energy consumption is on or below its linear trajectory. Conversely, if the EU's primary energy consumption level is above the linear trajectory, it will need to reduce or limit its energy consumption at a faster pace to meet the 2020 objective.

The EU target can also be expressed in terms of final energy consumption. While the EEA's methodology to track progress focuses on primary energy consumption, developments concerning final energy consumption complement the analysis in relation to the 2020 target, but they do not count in the present assessment of progress. Further details on the methodology are described in Annex 3.

In 2015, the EU was on track to achieve its target of improving energy efficiency by 20 % by 2020. Recent statistics show, however, that both primary ([17]) and final ([18]) energy consumption levels have been increasing since 2014.

([17]) Primary energy in the context of the EED means gross inland energy consumption minus non-energy use. Primary energy consumption measures the total energy demand of a country. It covers consumption of the energy sector itself, losses during transformation (e.g. from oil or gas into electricity) and distribution of energy, and final consumption by end users. It excludes energy carriers used for non-energy purposes (such as petroleum used not for combustion but for producing plastics).

([18]) Final energy consumption includes all energy delivered to the final consumer's door (in industry, transport, households and other sectors) for all energy uses. It excludes deliveries for transformation and/or own use of the energy-producing industries, as well as network losses.

According to preliminary estimates from the EEA, the EU's primary and final energy consumption increased again in 2016 (by 1.0 % and 1.8 %, respectively, compared with 2015) (EEA, 2017g; EEA, 2017h). This slight increase in energy consumption followed an observed modest boost in economic growth, while other factors may have also played a role, as discussed below.

The EU's 2020 target expressed in terms of primary energy consumption is equivalent to a 13.4 % reduction from 2005 levels. In 2015, the EU's primary energy consumption was 10.7 % lower than in 2005, decreasing at an annual average rate of 1.07 %, slightly faster than the minimum rate required to achieve the 2020 target (0.9 % per year). In 2015, it was still below the indicative linear trajectory drawn between the actual consumption level in 2005 and the targeted level for 2020, although not by as much as in 2014 (see Figure 6.1). The preliminary EEA estimates show that, following a 1 % increase compared with 2015, the EU's primary energy consumption in 2016 was above the indicative trajectory to 2020 (EEA, 2017h). This means that Member States will need to step up their efforts to keep the EU on track towards its 2020 targets.

Early estimates from an analysis under development by the European Commission ([19]) (EC, 2017g) show that the overall decrease in primary energy consumption between 2005 and 2015 was driven largely by a decrease in primary energy intensity (which led to a 19 % decrease in primary energy) and improvements in the efficiency of energy transformation (leading to a 2 % drop in primary energy consumption).

The EU's 2020 target for final energy consumption corresponds to an 8.9 % reduction from 2005 levels. In 2015, final energy consumption in the EU was 1 084 Mtoe, 9 % less than 2005 levels, and 2 Mtoe below the 2020 target. This gap was significantly narrower than in 2014, when final energy consumption was 24 Mtoe below the 2020 target (see Figure 6.1).

The decrease in final energy consumption between 2005 and 2015 was influenced by a number of factors, such as:

- structural changes towards less energy-intensive industrial sectors;
- improvements in end-use efficiency (especially in the residential sector);
- lower energy consumption in the transport sector (although an increase in energy consumption has been observed in this sector since 2014);
- the economic recession.

Overall, final energy consumption results from a mix of various elements, and the energy savings throughout this period are partially offset by the effects of activity, demographics and lifestyles (Odyssee-Mure, 2015).

Preliminary results from the analysis conducted by the European Commission (EC, 2017g) provide some further details on the reductions in final energy consumption in various sectors between 2005 and 2015:

- Energy consumption in the commercial sector ([20]) dropped by 11 % (- 54.9 Mtoe), due mainly to energy intensity gains (- 96.9 Mtoe) and, to a lesser extent, structural shifts (- 20.4 Mtoe). Increased activity over the period (measured through the gross value added of products and services) led to an overall increase in final energy consumption, despite the economic recession between 2008 and 2012. All commercial sectors, except 'wood, paper and construction', achieved energy intensity improvements. 'Transport equipment', 'textile and leather', 'metals and machinery', 'non-metallic minerals' and 'other manufacturing' sectors stood out with the highest improvements:
- Residential sector energy consumption dropped by 11 % (- 34 Mtoe) due to improvements in energy intensity. Warmer winters also contributed to lower energy demand for heating;
- Energy consumption in the transport sector decreased by 2.8 % (- 10.6 Mtoe) due to structural changes and intensity improvements. These improvements were partially offset by higher activity (e.g. increase in transport demand) in recent years.

([19]) Results of the draft report 'Assessing progress towards the EU energy efficiency targets using index decomposition analysis' (EC, 2017g) are still under review and might be subject to change once the final report is published.
([20]) 'Commercial sector' covers industry, services, agriculture, forestry and fishing in this context. For more information see EC, 2017g.

6.2 Projected progress towards the European Union's 2020 energy efficiency target

No mechanism currently requires Member States to regularly report projections of their energy consumption levels in a scenario reflecting existing policies and measures. Assessing and aggregating to EU level the projected progress of Member States towards their energy efficiency targets based on currently reported information is thus not possible.

Therefore, only an assessment based on past trends can be provided. The EU will achieve its 2020 target for energy efficiency expressed as primary and final energy consumption if the average annual decreases observed between 2005 and 2015 are maintained until 2020 for both. This, however, may prove to be challenging due to the effects of the observed economic recovery and the fact that the energy efficiency targets of Member States aggregated to EU level remain higher than the target set for the EU as a whole (see Chapter 7 for detailed analysis).

For the primary and final energy targets to be fulfilled, more effort has to be made at Member State level in implementing and further developing current policy frameworks.

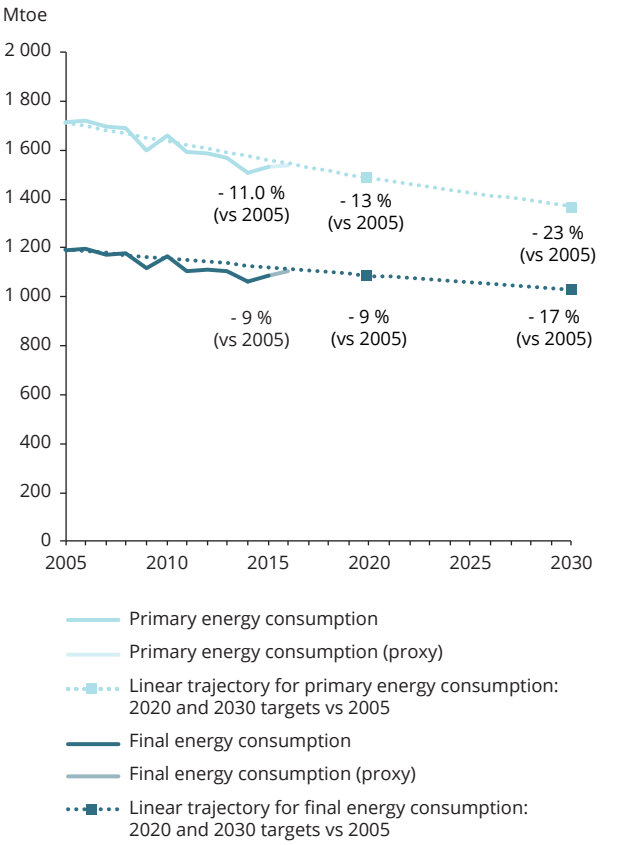
6.3 The 2030 targets on energy efficiency in the context of Energy Union

In November 2016, the European Commission released the 'Clean Energy for All Europeans' package, also known as the 'Winter Package'. It comprises legislative proposals on energy efficiency, renewable energy, electricity market design, security of electricity supply and governance aspects. One of its main goals is to 'put energy efficiency first', which makes explicit the relevance of energy efficiency for the clean energy transition (EC, 2016c).

In this context, the Commission proposed an update to the EED, including a new 30 % energy efficiency target for 2030 and an extension beyond 2020 of the energy efficiency obligation (which requires energy companies to achieve yearly energy savings of 1.5% of annual sales to final consumers). In June 2017, the Council endorsed a 30 % energy efficiency target (EC, 2016b; European Council, 2017) ([21]). Negotiations between the co-legislators on the Commission proposal to amend the EED (EC, 2017a) were still ongoing at the time of writing this report.

The 30 % energy efficiency target for 2030 is still set in comparison with the 2007 Energy Baseline Scenario of the European Commission (European Council, 2014). It translates into an absolute primary energy consumption of 1 321 Mtoe and an absolute final energy consumption of 987 Mtoe by 2030. These correspond to a 23 % and a 17 % reduction in primary and final energy consumption, respectively, relative to 2005 levels (European Council, 2017).

Figure 6.1 Primary and final energy consumption in the EU, 2005-2016, 2020 and 2030 targets



Notes: The 2020 target represents energy savings of 20 % from levels projected for 2020 in the Commission's Energy Baseline Scenario (EC, 2008). The indicative 2030 energy efficiency target represents an improved energy efficiency of at least 30 % compared with 2030 projections in the same Energy Baseline Scenario.

Sources: EC, 2008; EEA, 2017g, 2017h; European Council, 2014; Eurostat, 2017a, 2017b, 2017c.

([21]) On 7 September, members of the European Parliament's environment committee expressed their support for a still more ambitious target of 40 %. See http://www.euractiv.com/section/energy/news/meps-back-more-ambitious-energy-efficiency-target/, accessed 8 September 2017.

7 Progress towards Member States' energy efficiency targets

- Under the EED, Member States have set energy efficiency targets, which are translated into indicative, non-binding targets for primary and final energy consumption for 2020. For primary energy consumption, targets range from a 19.4 % reduction to a 20.4 % increase compared with 2005 levels. For final energy consumption, targets range from a 21.0 % reduction to a 65.8 % increase compared with 2005 levels. No indicative trajectory has been formally set to monitor progress towards these targets.
- In 2015, 23 Member States had reduced or limited the increase in their primary energy consumption to below that of the linear trajectories between 2005 levels and the 2020 targets. Five Member States (Bulgaria, Estonia, France, Germany and the Netherlands) had not achieved sufficient savings in primary energy consumption to stay below the linear trajectory level in that year.
- According to preliminary data from the EEA, three additional countries (Austria, Belgium, Cyprus) would exceed their linear trajectory threshold in 2016.
- For final energy consumption, only 19 Member States were on or below their target paths in 2015. Austria, Belgium, Bulgaria, France, Germany, Hungary, Lithuania, Malta and Slovakia had not sufficiently reduced their final energy consumption to stay below their final energy trajectories.
- Despite the good progress achieved overall since 2005, some Member States seem to have lowered their ambition with regard to their 2020 primary and final energy consumption target levels. National action plans on energy efficiency submitted in 2017 indicate that certain countries increased their absolute target levels of primary or final energy consumption for 2020. These changes increase the uncertainty surrounding the EU's ability to meet its 2020 objectives.

7.1 Progress towards national primary energy consumption targets

Member States set their own national non-binding targets for energy efficiency, which can be based on absolute primary or final energy consumption, absolute or relative primary or final energy savings or on energy intensity. The EED requires, however, that when doing so, Member States also express those targets in terms of absolute levels of primary and final energy consumption in 2020 (EU, 2012) ([22]).

For primary energy consumption, the targets range from a 19.4 % reduction (the United Kingdom) to a 20.3 % increase (Estonia), compared with 2005 levels. A total of 19 Member States have set targets to decrease primary energy consumption. The other nine Member States (Croatia, Czech Republic, Estonia, Finland ([23]), Ireland, Latvia, Poland, Romania and Slovenia) have set targets that are higher than their 2005 primary consumption levels ([24]). Member States can also revise their targets and projections upwards or downwards at any point. In fact, the 2017 national

([22]) Together these targets should contribute to achieving the EU's objective of reducing energy consumption by 20 % by 2020. However, a challenge in assessing EU progress is that the aggregation of individual Member States' targets does not add up to a 20 % EU-level reduction in energy consumption by 2020.
([23]) For Finland, this is explained by exceptionally low energy consumption in 2005 compared with other years.
([24]) The absolute levels of primary and final energy consumption in 2020, reported by Member States under the EED, allow the EEA to assess progress towards energy efficiency targets consistently across Member States. Member States themselves may monitor their progress to target following a national approach.

energy efficiency action plans NEEAPs ([25]) available from 18 Member States at the time of writing show that several countries appear to have revised their 2020 targets expressed in primary energy consumption to higher (less ambitious) absolute values.

Comparing primary energy targets reported to the Commission up to 2016 with absolute target levels reported in the 2017 NEEAPs, three Member States (Ireland, Sweden and the United Kingdom) have revised upwards their absolute levels for primary energy consumption, whereas one country (Slovenia) has revised their absolute levels downwards.

As neither Member States nor EU legislation set any indicative trajectory to monitor the progress of Member States towards their national 2020 targets, this analysis tracks progress towards energy efficiency targets by considering, for each Member State, an indicative linear trajectory between primary energy consumption levels in 2005 and 2020 targets, and by comparing the absolute levels of primary energy consumption in the assessment year with this linear trajectory. According to the EEA's methodology, a country is considered to be on track towards meeting its 2020 target if its primary energy consumption for 2015 is on or below its linear trajectory. Conversely, a country with primary energy consumption levels above its linear trajectory is considered not on track and needs to reduce or limit its energy consumption at a faster pace to meet its 2020 objective. Final energy consumption trends are also discussed in Section 7.2, below, to provide insights into energy consumption trends that are as complete as possible. However, final energy information is not used to track progress in the present assessment.

Between 2005 and 2015, primary energy consumption decreased in 26 Member States and increased only in Estonia and Poland. Twenty-three Member States reduced (or limited the increase in) their primary energy consumption to levels below their corresponding linear trajectories in 2015 (see Figure 7.1). If maintained until 2020, the pace of reductions (or limited increases) observed since 2005 should allow these countries to meet their 2020 targets. However, recent trends in primary energy consumption in several countries ([26]) raise uncertainty as to whether or not the 2020 targets will be met. In five countries (Bulgaria, Estonia ([27]), France, Germany and the Netherlands), primary energy consumption in 2015 was above these countries' linear trajectories. This was already the case in 2014 for Estonia. Conversely, while Malta was above the linear trajectory in 2014, its primary energy consumption in 2015 was below the trajectory.

In 2015, 22 Member States were already below their 2020 targets. The exceptions were Belgium, Bulgaria, France, Germany, the Netherlands and the United Kingdom.

According to preliminary EEA data for 2016 on primary energy consumption, three additional countries (Austria, Belgium and Cyprus) exceeded their linear trajectory threshold in 2016, in addition to the five above mentioned countries that were not on track in 2015. Estonia is expected to be back on track according to 2016 estimates.

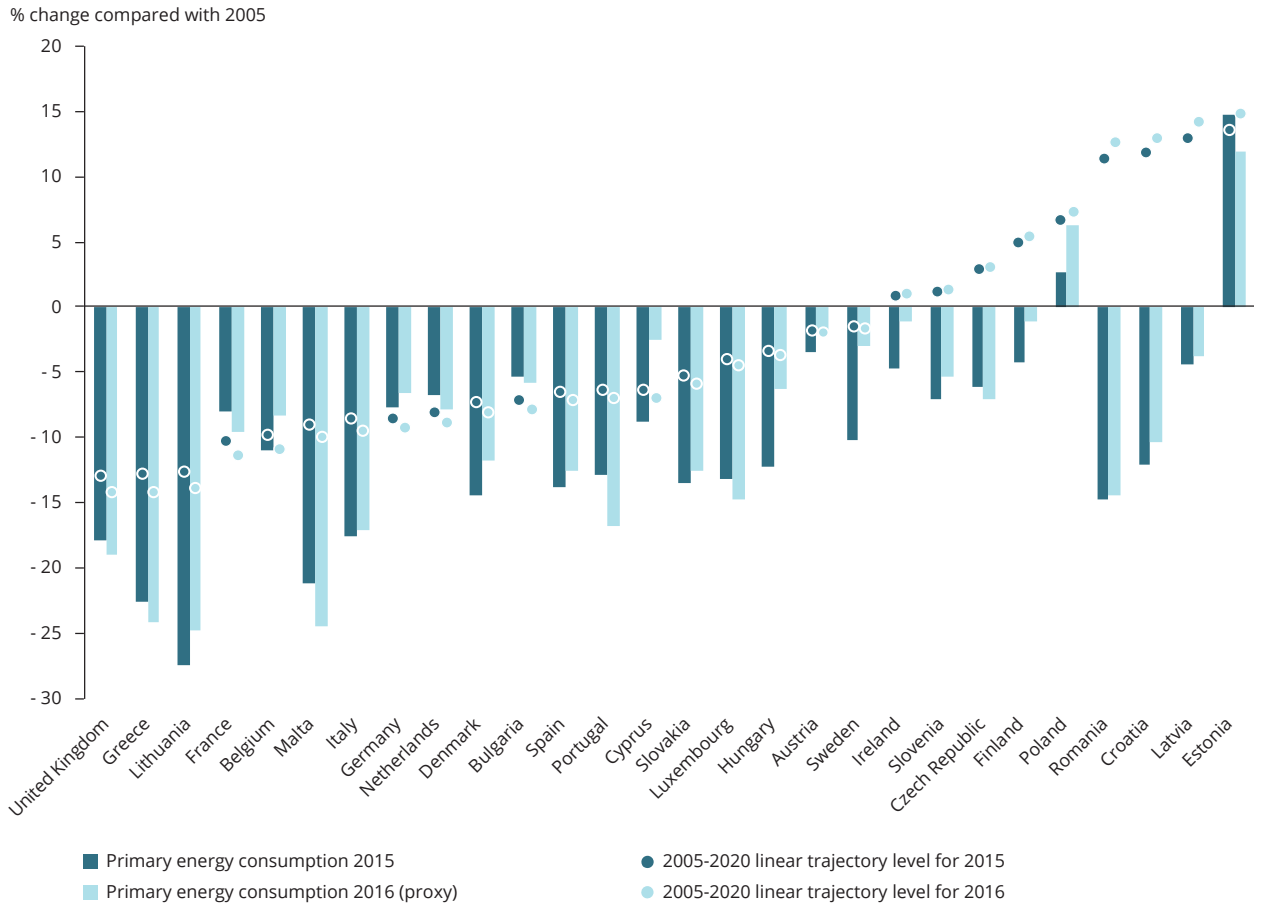
7.2 Trends towards national final energy consumption targets

National indicative 2020 targets for final energy consumption set by Member States under the EED range from - 21.0 % (Hungary) to + 65.8 % (Malta), compared with 2005 levels. Many Member States have updated their absolute levels for final energy consumption in their 2017 NEEAPs, where these have been made available ([28]). Four countries revised their absolute consumption target levels upwards (Cyprus, Ireland, Sweden and the United Kingdom).

In 2015, 19 Member States were in line with or below their linear final energy trajectories. However, Austria, Belgium, Bulgaria, France, Germany, Hungary, Lithuania, Malta and Slovakia had not sufficiently reduced their final energy consumption to stay below their linear trajectories. This is a significantly different situation from 2014, where 24 Member States were in line with or below their linear final energy trajectories.

([25]) By the time this report was finalised, not all Member States had published the final version of their 2017 NEEAPs, meaning that 2020 Member State targets may still be subject to change.
([26]) In 2015, 17 of the 28 Member States increased their primary energy consumption relative to 2014.
([27]) Estonia reports on primary energy consumption targets, but it tracks progress based on final energy consumption.
([28]) The absolute target levels of primary and final energy consumption in 2020 reported by Member States under the EED allow the EEA to assess progress towards energy efficiency targets consistently across Member States. Member States themselves may monitor their progress to target following a national approach.

Figure 7.1 Primary energy consumption and linear trajectory levels, 2015 and 2016



Note: The figure compares, for each Member State, primary energy consumption levels for a given year and the level of the indicative linear trajectory between 2005 and the relevant 2020 target on primary energy consumption.

Sources: EC, 2017d, 2017e; EEA, 2017h; Eurostat, 2017b, 2017c.

7.3 Aggregated ambition level of Member States' national 2020 targets

In the NEEAPs submitted by Member States in 2017 ([29]), absolute target levels for primary and final energy consumption have been revised to higher values in several cases, signalling that efforts to meet European targets might be slowing.

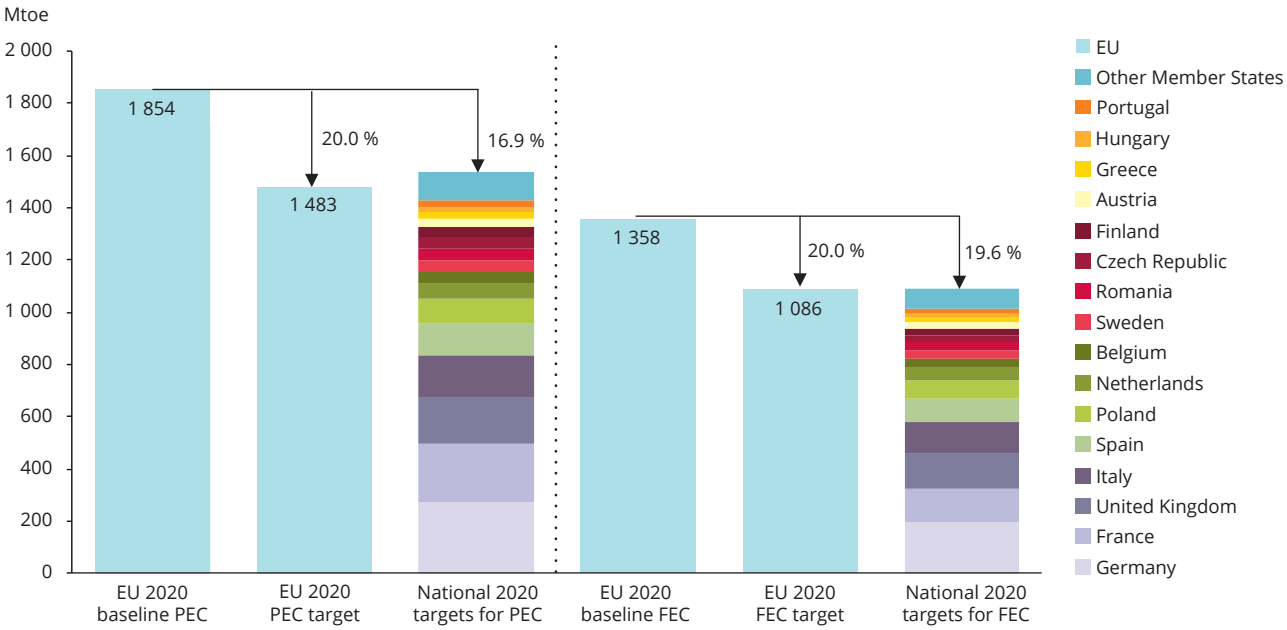
Taken together, the sum of all individual 2020 targets for primary energy consumption add up to 1 540 Mtoe, which is 3.8 % higher than the EU target (1 483 Mtoe) (see Figure 7.2).

For final energy consumption, the sum of Member States' 2020 targets adds up to 1 091 Mtoe, 0.4 % higher than the EU target for final energy consumption (1 086 Mtoe) (see Figure 7.2).

Therefore, contrary to the situation observed in 2014 (EEA, 2016), achieving these national targets would not be sufficient to reach the EU-level target for final energy consumption. This is a direct consequence of the 2017 revision of the targets by nine Member States and introduces further uncertainty to the tracking of progress at the EU level.

([29]) By the closing date for this report, the following countries had published their updated NEEAPs on the European Commission's website: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Ireland, Latvia, Malta, Netherlands, Slovakia, Spain, Sweden and United Kingdom.

Figure 7.2 Overall ambition level of national targets for primary and final energy consumption by 2020



Note: The Member States grouped as 'Other Member States' are those that have a 2020 target for primary energy consumption lower than 20 Mtoe and a 2020 target for final energy consumption lower than 15 Mtoe. In order of decreasing magnitude of 2020 targets, these countries are Denmark, Bulgaria, Slovakia, Ireland, Croatia, Slovenia, Estonia, Lithuania, Latvia, Luxembourg, Cyprus and Malta.

FEC, final energy consumption; PEC, primary energy consumption.

Sources: EC, 2017d, 2017e; EU, 2012.

8 Trends and projections in Iceland, Liechtenstein, Norway, Switzerland and Turkey

- Iceland, Liechtenstein, Norway, Switzerland and Turkey are member countries of the EEA but not of the EU. These countries share a number of environmental commitments with EU Member States, either under international conventions or by direct participation in EU policies.
- None of these countries has achieved substantial emission reductions since 1990. For some, GHG emissions have actually increased significantly.
- Renewable energy use, as a proportion of final energy consumption, is higher in Iceland and Norway than in any EU Member State.

8.1 Greenhouse gas emissions

Iceland, Liechtenstein, Norway, Switzerland and Turkey are all Annex I countries in the UNFCCC. Iceland, Liechtenstein and Norway also have a closer association with the EU for a number of commitments to reduce GHG emissions. In particular:

- Iceland, Liechtenstein and Norway have been participating in the ETS since 2008.
- Iceland decided to jointly fulfil commitments of the EU and its Member States to the UNFCCC in the second commitment period of the Kyoto Protocol, i.e. to reduce its GHG emissions by 20 % by 2020, compared with 1990 levels. As an Intended Nationally Determined Contribution (INDC) for the post-2020 agreement under the UNFCCC, Iceland has submitted its commitment to reduce GHG emissions by 40 % by 2030 compared with 1990 levels. It intends to fulfil this commitment jointly with the EU; the details of collective delivery are yet to be determined (Iceland, 2015).
- Norway and Iceland have expressed their intention to participate in the joint action taking place in the EU to reduce emissions from sectors covered under the Effort Sharing legislation. For the Effort Sharing legislation period from 2021 to 2030, Norway has stated that it intends to fully participate in the reduction effort for the Effort Sharing sectors. As Member States' targets range from 0 % to - 40 % on the basis of GDP per capita, Norway would be attributed an estimated numerical reduction target of 40 % below 2005 levels, and flexibility mechanisms will be available for Norway and Iceland as for Member States. Final targets for Iceland and Norway will be determined only when the European Commission's proposal on a new Effort Sharing legislation is adopted (EC, 2016g).

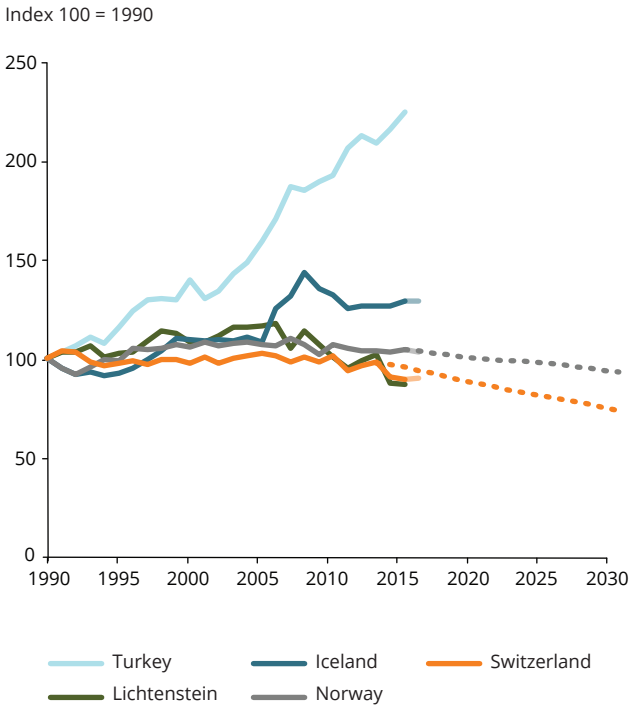
Historical GHG emissions in Iceland, Liechtenstein, Norway, Switzerland and Turkey followed very different trends between 1990 and 2015. Updated information on emission projections was available only for Norway (see Figure 8.1).

Iceland also set a long-term GHG mitigation target of between 50 % and 75 % by 2050 compared with GHG emissions in 1990. In 2015, Iceland's emissions had increased by 28 % compared with 1990 levels. Therefore, Iceland does not currently seem to be on track to reach its target for 2020.

Liechtenstein also aims to emit at least 40 % less GHG emissions in 2030 compared with 1990 (Liechtenstein, 2015). To attain this target, Liechtenstein has also set itself a sectoral goal: GHG emissions from the energy sector will decrease by 20 % between 1990 and 2020. In 2015, Liechtenstein's emissions were 13 % lower than in 1990. Additional efforts are therefore necessary if Liechtenstein is to reach its 2020 target. For 2030, Liechtenstein has committed to reduce its GHG emissions by 40 % compared with 1990, under the UNFCCC ([30]).

([30]) Including emissions and removals from LULUCF.

Figure 8.1 **Total greenhouse gas emission trends and projections in Iceland, Liechtenstein, Norway, Switzerland and Turkey, 1990-2030**



Notes: Projections display total GHG emissions excluding LULUCF and international aviation. Solid lines represent historical values, while dashed lines represent WEM projections.

Values shown for Iceland include inventory data, taking into account total CO_2 emissions from industrial processes. Iceland excluded these emissions for compliance in the first commitment period of the Kyoto Protocol.

Norway's INDC includes emissions and removals from LULUCF, which are not shown in this figure.

Sources: EEA, 2017b; Iceland, 2016; Liechtenstein, 2016; Norway, 2017; Switzerland, 2016; Turkey, 2016.

Norway's target is to reduce its GHG emissions by 30 % in 2020 compared with 1990. According to its INDC (Norway, 2015), Norway aims to reduce its GHG emissions by at least 40 % by 2030, compared with 1990 ([31]). Norway also aims to reduce emissions by the equivalent of 100 % of its own emissions by 2030, thus becoming climate neutral. This is to be achieved through emissions trading in the EU, international cooperation on emission reductions, other forms of emissions trading and project-based cooperation. In 2015, GHG emissions had increased by 4 % compared with 1990.

Switzerland's target is to reduce its GHG emissions by 20 % by 2020 compared with 1990. Like Norway, it has also set a more ambitious GHG reduction target of 30 % by 2020 compared with 1990, provided that the international community agrees on a stricter climate policy. For 2030, Switzerland submitted an INDC to the UNFCCC that states its intention to reduce its GHG emissions by 50 % compared with 1990 levels. This target will partly be reached through the use of carbon credits from international mechanisms (Switzerland, 2015). In 2015, emissions in Switzerland were reduced by 10 % compared with 1990 levels.

Turkey has submitted an INDC to the UNFCCC with a 21 % economy-wide cut in GHG emissions by 2030, compared with a business-as-usual scenario (Turkey, 2015). This implies an increase in GHG emissions that is limited to 929 $MtCO_2e$ by 2030. This is nearly five times the emissions of 1990. To reach its national target, Turkey aims to use carbon credits from international market mechanisms. In 2015, Turkey's GHG emissions had increased by 122 % compared with 1990. Since 2013, emissions have been decreasing slightly.

8.2 Renewable energy

The RED is a text with 'EEA relevance', i.e. it is relevant to member countries of the European Economic Area (not to be confused with the European Environment Agency). In accordance with the RED, Iceland and Norway submitted NREAPs to the European Commission with 2020 targets and details of development steps.

Iceland's 2020 target for RES under the RED was set at 72 % of gross final energy consumption ([32]), while the national target under the NREAP was set at 76.8 % by 2020 (see Table 8.1). Although these targets are higher than for most Member States, they are also lower than current levels. In 2015, the proportion of RES use already amounted to 70 % and exceeded its 2020

([31]) How emissions and removals from LULUCF will be accounted for is to be determined later. Norway's position is that the choice of accounting approach should not change the ambition level compared with when LULUCF is not included.

([32]) Although Iceland indicates in its 2014 NREAP that it assumes a national overall target of 72 % for the share of energy from renewable sources in gross final energy consumption of energy as its target for 2020 under the RED, a 64 % RES target by 2020 is mentioned as the binding target for Iceland in Annex IV (Energy) of the Agreement on the European Economic Area.

target. This is because of the exceptional potential for hydropower and geothermal energy in this country. These energy sources are mainly used for district heating and the production of electricity.

Norway's indicative RED trajectory target for 2020 is that renewable energy should account for 68 % of gross final energy consumption. Norway is ahead of its indicative RED target for 2015-2016 and its anticipated NREAP trajectory for 2015. In 2015, renewable energy accounted for 69 % of gross final energy consumption in Norway and, therefore, in this year, Norway had already exceeded its 2020 RES target by one percentage point.

No information is available from EU sources on the proportions of RES use and targets for Liechtenstein, Switzerland or Turkey.

8.3 Energy efficiency

Statistics on energy consumption are available from the European Commission for Iceland, Norway and Turkey. Between 1990 and 2014, primary energy consumption increased in these three countries, although to greatly varying extents (from 7 % in Norway to 51 % in Iceland); over the same period, primary energy consumption in the EU increased by 12 % (Eurostat, 2017b, 2017c). Although Norway and Turkey experienced a relatively steady increase over the whole period, Iceland experienced a pronounced jump in primary energy consumption after 2005. Between 2005 and 2014, the primary energy consumption of Iceland, Norway and Turkey increased by 88 %, 8 % and 46 %, respectively.

In Switzerland, final energy consumption decreased by 10 % between 2005 and 2014 (IEA, 2016).

Table 8.1 Iceland and Norway's progress on renewable energy

Country	2015 share of RES (%)	2020 target under the RED (%)	2020 target under NREAP (%)	Distance to 2020 target in 2015 (percentage points)
Iceland	70.19	64.0 ([a])	76.8	6.2
Norway	69.43	67.5	67.5	1.9

Note: NREAP, National renewable energy action plan; RED, Renewable Energy Directive; RES, renewable energy source.

([a]) Although Iceland indicates in its 2014 NREAP that it assumes a national overall target of 72 % for the share of energy from renewable sources in gross final energy consumption as its target for 2020 under the RED, a 64 % RES target by 2020 is mentioned as the binding target for Iceland in Annex IV (Energy) of the Agreement on the European Economic Area.

Sources: EFTA, 2016; EU, 2009; Eurostat, 2017d; Iceland, 2014; Norway, 2013.

Figure 8.2 Primary energy consumption in Iceland, Norway and Turkey, 1990-2015

Sources: Eurostat, 2017b, 2017c.

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Annex 1 Progress towards greenhouse gas emission targets: data and methodology

A1.1 Reporting requirements for greenhouse gas emissions

The assessments of progress towards GHG emission targets presented in this report are based, for the most part, on information submitted by Member States under Regulation (EU) No 525/2013, the Monitoring Mechanism Regulation (MMR) (EU, 2013e).

The purposes of the reporting requirements stipulated in the MMR are to enable the EU to complete its reporting commitments under the UNFCCC, and to evaluate the projected progress of the EU and its Member States towards fulfilling their GHG mitigation commitments under the Kyoto Protocol, in annual reports prepared by the European Commission and the EEA.

Implementing provisions (EU, 2014d) provide a structure and format for the reporting of GHG inventories and approximated GHG inventories, information on policies and measures, GHG projections and the use of auctioning revenue and project credits, and they are used for the purposes of the LULUCF Decision (EU, 2013d). Furthermore, a delegated act (EU, 2014c) defines the substantive requirements for an EU inventory system to fulfil the obligations pursuant to Decision 19/CMP.1.

A1.2 Data sources for greenhouse gas emissions

The analysis presented in this report is based on several sets of GHG emission data.

A1.2.1 Historical trends in greenhouse gas emissions

GHG emission data for the period from 1990 to 2015 are official data reported by the EU and Member States under the UNFCCC in their corresponding GHG inventory reports (EEA, 2017a, 2017c). The EEA is responsible for the compilation of the EU GHG inventory and, together with the European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM) ([33]), it implements a quality assurance and quality control (QA/QC) procedure (EC, 2013a) in order to ensure the timeliness, completeness, consistency, comparability, accuracy and transparency of the inventories reported by Member States and used in this 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 ESD. This concerned the years 2005, 2008-2010, 2013 and 2014. The year 2015 was reviewed in 2017 in the course of the annual review cycle under Article 19 of the MMR.

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, 2013a). Thus all the emission estimates used in this report were calculated using GWPs from the IPCC's AR4.

A1.2.2 Approximated greenhouse gas emissions for 2016

Early 'approximated' (proxy) estimates of 2016 GHG emissions were reported by Member States to the European Commission under the MMR by 31 July 2017. These estimates were aggregated to EU level by the EEA (EEA, 2017b). Bulgaria, Cyprus and Romania did not submit proxy GHG inventories. For those countries, proxies have been calculated by the EEA and the ETC/ACM.

A1.2.3 Greenhouse gas emissions in the European Union Emissions Trading System since 2005

Data relative to the EU ETS are used to analyse emission trends but also to determine the level of emissions covered under the ESD. For the years 2005-2012, ETS emissions include estimates to reflect

([33]) The ETC/ACM is a consortium of European institutes contracted by the EEA to carry out specific tasks in the fields of air pollution and climate change mitigation.

the scope of the EU ETS for the third trading period. These data are publicly available from the European Union Transaction Log (EUTL) ([34]) and the EEA ETS data viewer (EEA, 2017f). The data considered in the analysis were extracted from the EUTL on 20 July 2017.

A1.2.4 Emissions covered under the Effort Sharing Decision

For the purpose of analysing emission trends in the ESD, historical ESD emissions are calculated using the latest GHG inventory data, from which ETS emissions, 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 years 2005-2012.

The ESD GHG emission data for the years 2013 and 2015 are consistent with the outcome of the 2016 and 2017 reviews of national GHG inventory data pursuant to Article 19 of the MMR. The data used by the European Commission to determine Member States' compliance under the ESD for 2013, 2014 and 2015 are made publicly available (EU, 2016, 2017a; EC, 2017b).

A1.2.5 Long-term historical trends in Emissions Trading System and Effort Sharing Decision emissions

For Figures 2.3 and 2.4, GHG emissions for the years 1990-2016 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 for each of the main source categories defined by the IPCC for the reporting of national GHG inventories, based on Member States' projections submitted in 2017. Projections for ETS and ESD are reported by source categories in Member States' submissions.

The 'industry' sector in Figure 2.4 aggregates ESD emissions of source categories 1.A1., 1.A.2, 1.B, 1.C and 2.

A1.2.6 Annual emission targets (annual emission allocations) under the Effort Sharing Decision for the period from 2013 to 2020

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 recalculated to reflect updates in methodologies for reporting of GHG inventories (see EU, 2017b). This recalculation ensures that the originally intended level of effort (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 Effort Sharing Decision, as the current reported emissions already take into account the methodological updates.

Following, Commission Decision (EU) 2017/1471 (EU, 2017b), 2005 ESD base-year emissions and AEA values for 2017-2020 used throughout this report differ from the values presented in previous reports.

A1.2.7 The 2005 Effort Sharing Decision base-year emissions

The 2005 'ESD base-year emissions' are calculated by the EEA, so as to be consistent with both:

- the relative 2020 ESD target (as a percentage of 2005 emissions) defined in the ESD (EU, 2009c);
- the absolute 2020 ESD target determined by the European Commission (EU, 2013a, 2013b, 2017b) ([35]).

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

ESD base-year emissions = 2020 absolute target/ (1 + % of 2020 ESD target).

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

In this report, calculated 2005 ESD base-year emissions are used to express the distance between

([34]) The EUTL automatically checks, records and authorises all transactions in the EU ETS.

([35]) Following the 2016 comprehensive review of Member States' historical GHG inventory estimates, the 2005 ESD base-year emissions and the AEAs for the years 2017-2020 were recalculated. Therefore, the 2005 ESD base-year emissions used throughout this report differ from the values presented in previous reports. As recent inventory updates lowered emission estimates for most EU Member States, the absolute emission targets correspondingly decreased for most EU Member States.

ESD emissions and ESD targets in a normalised way (see, for example, Figures 3.1 and 3.2). The distance, calculated as the absolute difference between emissions and targets divided by 2005 base-year emissions, is expressed in percentage points (a proportion 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 actual historical 2005 emissions under the ESD based on the latest GHG inventories.

A1.2.8 Projections of greenhouse gas emissions

The report uses GHG projection data that are reported biennially by Member States under the MMR (EEA, 2017d). Mandatory reporting takes place every 2 years (2015, 2017, etc.). Member States must also report substantial changes to projections every other year (2014, 2016, etc.). In 2017 all 28 Member States and Norway submitted projections under the MMR.

Under the MMR, Member States report projections in two scenarios:

- A WEM scenario, which considers the implementation of existing (already implemented) measures, can be applied.

- If available, a WAM scenario, which also considers the implementation of additional measures (at planning stage), can be applied. In 2017, 18 Member States reported projections on the basis of such WAM scenarios: Belgium, Croatia, Cyprus, the Czech Republic, Estonia, Finland, Germany, Hungary, Ireland, Latvia, Lithuania, Luxembourg, the Netherlands, Portugal, Romania, Slovakia and the United Kingdom. Denmark submitted a WAM scenario that is equal to its WEM scenario. For the aggregation of a WAM scenario at EU level, Member States that have not reported a WAM scenario have been gap-filled using the WEM scenario.

An overview of projected emissions for both scenarios is presented in Table A1.1.

Member States reported projections for total and sectoral GHG emissions, as well as a split of these projections between those covered by the EU ETS and those covered by the ESD, by source categories. Although projections of total emissions are relevant to the assessment of the EU's progress towards its 20 % reduction target by 2020, the assessment of the projected progress of Member States towards their national 2020 targets, set under the ESD as part of the climate and energy package, is based on projection data on emissions not covered by the EU ETS, i.e. 'ESD projections'.

The EEA 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 this 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* (EC, 2015a). If significant discrepancies can be observed between the inventory value for the reference year and that for the projected year, an alignment of the level of projections is performed. Such calibration is performed to match national projections with a common reference year for aggregated EU projections, which is the year 2015. In 2017 no such calibration took place.

Table A1.1 Projected greenhouse gas emissions from Member States, Norway and Switzerland

GHG emission projections ($MtCO_2e$)	WEM scenario					WAM scenario				
EU-28	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**4 315**	**4 068**	**3 935**	**3 825**	**3 730**	**4 314**	**4 034**	**3 866**	**3 709**	**3 570**
Energy supply	1 343	1 172	1 119	1 055	988	1 342	1 161	1 087	991	900
Manufacturing and construction industries	469	474	470	459	456	468	469	464	454	445
Transport	902	890	882	886	889	902	881	866	859	849
Residential and commercial	647	609	574	555	540	647	605	567	545	530
Industrial processes and process use	375	373	353	340	336	375	372	350	337	334
Agriculture	437	431	431	431	430	437	428	427	425	424
Waste	142	118	106	99	91	142	117	104	96	88
Emissions Trading System (stationary installations)	1 786	1 629	1 580	1 518	1 450	1 788	1 619	1 550	1 457	1 360
Effort Sharing Decision	2 515	2 423	2 338	2 289	2 262	2 511	2 399	2 299	2 234	2 191
Land use, land-use change and forestry	- 291	- 234	- 254	- 233	- 244	- 292	- 235	- 251	- 229	- 240
International Aviation	142	149	159	169	179	142	149	159	169	179

Austria	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**78.9**	**75.4**	**72.7**	**69.8**	**67.3**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	11.4	9.4	8.7	8.4	7.8	NE	NE	NE	NE	NE
Manufacturing and construction industries	10.5	10.7	10.8	10.9	11.1	NE	NE	NE	NE	NE
Transport	22.6	22.7	22.5	21.5	20.2	NE	NE	NE	NE	NE
Residential and commercial	8.9	8.4	7.3	6.4	5.5	NE	NE	NE	NE	NE
Industrial processes and process use	16.7	15.5	14.9	14.3	14.3	NE	NE	NE	NE	NE
Agriculture	7.2	7.3	7.3	7.4	7.5	NE	NE	NE	NE	NE
Waste	1.7	1.3	1.1	0.9	0.8	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	29.5	26.2	25.5	25.0	24.6	NE	NE	NE	NE	NE
Effort Sharing Decision	49.3	49.1	47.2	44.6	42.6	NE	NE	NE	NE	NE
Land use, land-use change and forestry	- 4.8	- 7.7	- 8.1	- 4.6	- 4.9	NE	NE	NE	NE	NE

Belgium	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**118.1**	**114.7**	**111.9**	**114.1**	**114.1**	**118.1**	**113.9**	**111.0**	**111.8**	**112.1**
Energy supply	22.1	19.0	17.8	20.6	20.4	22.1	19.0	17.7	19.1	19.3
Manufacturing and construction industries	13.4	13.8	13.4	13.2	13.1	13.4	13.8	13.4	13.2	13.1
Transport	26.7	27.2	28.1	29.2	30.4	26.7	26.4	27.3	28.4	29.5
Residential and commercial	24.8	23.7	23.1	22.5	21.9	24.8	23.7	23.1	22.5	21.9
Industrial processes and process use	19.7	19.9	19.1	18.6	18.3	19.7	19.9	19.1	18.6	18.3
Agriculture	9.8	9.6	9.2	9.1	9.1	9.8	9.6	9.2	9.1	9.1
Waste	1.7	1.4	1.1	0.9	0.9	1.7	1.4	1.1	0.9	0.9
Emissions Trading System (stationary installations)	44.8	43.6	42.2	45.0	44.9	44.8	43.6	42.1	43.5	43.7
Effort Sharing Decision	73.3	71.0	69.7	69.2	69.2	73.3	70.2	68.9	68.3	68.3
Land use, land-use change and forestry	- 3.4	- 3.7	- 3.7	- 3.8	- 3.9	- 3.4	- 3.7	- 3.7	- 3.8	- 3.9

Table A1.1 Projected greenhouse gas emissions from Member States, Norway and Switzerland (cont.)

GHG emission projections ($MtCO_2e$)	WEM scenario					WAM scenario				
Bulgaria	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**59.1**	**59.0**	**55.7**	**55.5**	**54.9**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	31.7	32.6	28.9	28.1	27.2	NE	NE	NE	NE	NE
Manufacturing and construction industries	3.1	3.2	3.2	3.3	3.3	NE	NE	NE	NE	NE
Transport	8.0	7.1	6.6	6.2	6.3	NE	NE	NE	NE	NE
Residential and commercial	2.1	2.3	3.0	3.9	4.1	NE	NE	NE	NE	NE
Industrial processes and process use	5.1	4.8	4.9	4.9	4.9	NE	NE	NE	NE	NE
Agriculture	5.0	5.0	5.2	5.4	5.6	NE	NE	NE	NE	NE
Waste	4.1	4.0	3.8	3.7	3.5	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	36.2	37.3	33.8	33.2	32.4	NE	NE	NE	NE	NE
Effort Sharing Decision	22.8	21.7	21.8	22.2	22.5	NE	NE	NE	NE	NE
Land use, land-use change and forestry	- 10.8	- 11.3	- 11.8	- 12.3	- 12.7	NE	NE	NE	NE	NE
Note: Reported projections calibrated by EEA to align them with historic emissions.										

Croatia	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**23.8**	**24.0**	**24.2**	**24.7**	**24.5**	**23.8**	**22.4**	**20.9**	**19.6**	**17.9**
Energy supply	5.7	5.3	5.0	5.0	4.4	5.7	5.0	4.2	3.6	2.7
Manufacturing and construction industries	2.3	2.5	2.5	2.6	2.7	2.3	2.5	2.4	2.4	2.4
Transport	5.6	5.4	5.5	5.6	5.6	5.6	5.4	5.1	4.8	4.3
Residential and commercial	3.5	3.4	3.4	3.4	3.3	3.5	3.4	3.1	2.8	2.6
Industrial processes and process use	2.8	3.0	3.1	3.1	3.2	2.8	2.4	2.5	2.5	2.6
Agriculture	2.4	2.5	2.6	2.7	2.8	2.4	2.3	2.3	2.4	2.5
Waste	1.6	1.9	2.1	2.3	2.4	1.6	1.4	1.2	1.0	0.8
Emissions Trading System (stationary installations)	8.7	8.7	8.5	8.6	8.2	8.7	8.1	7.3	6.8	6.0
Effort Sharing Decision	15.1	15.2	15.6	16.0	16.3	15.0	14.3	13.5	12.7	11.8
Land use, land-use change and forestry	- 5.2	- 3.1	- 2.7	- 2.4	- 2.3	- 5.2	- 3.1	- 2.7	- 2.4	- 2.3
Note: Reported projections calibrated by EEA to align them with historic emissions.										

Cyprus	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**7.8**	**6.9**	**7.1**	**7.2**	**7.4**	**8.2**	**6.0**	**6.0**	**5.8**	**5.5**
Energy supply	2.4	1.7	1.8	2.0	2.1	2.7	0.8	0.9	0.8	0.6
Manufacturing and construction industries	0.6	0.6	0.6	0.5	0.5	0.6	0.6	0.6	0.5	0.5
Transport	1.8	1.7	1.7	1.7	1.6	1.8	1.7	1.6	1.5	1.4
Residential and commercial	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Industrial processes and process use	1.5	1.5	1.5	1.5	1.4	1.5	1.5	1.5	1.5	1.4
Agriculture	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Waste	0.5	0.4	0.5	0.6	0.6	0.5	0.4	0.5	0.5	0.6
Emissions Trading System (stationary installations)	4.1	3.3	3.5	3.6	3.8	4.4	2.5	2.6	2.4	2.2
Effort Sharing Decision	3.7	3.6	3.6	3.6	3.6	3.7	3.6	3.5	3.4	3.3
Land use, land-use change and forestry	- 0.7	- 0.7	- 0.7	- 0.7	- 0.7	- 0.7	- 0.7	- 0.7	- 0.7	- 0.7
Note: Reported projections calibrated by EEA to align them with historic emissions.										

Table A1.1 Projected greenhouse gas emissions from Member States, Norway and Switzerland (cont.)

GHG emission projections ($MtCO_2e$)	WEM scenario					WAM scenario				
Czech Republic	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**124.8**	**122.5**	**113.6**	**108.8**	**101.6**	**124.7**	**122.1**	**113.2**	**107.8**	**100.0**
Energy supply	57.7	54.7	47.2	45.5	42.5	57.7	54.7	47.2	45.5	42.5
Manufacturing and construction industries	10.1	9.7	9.4	9.9	9.9	10.1	9.7	9.3	9.9	9.8
Transport	17.1	18.6	18.1	15.9	12.8	17.1	18.3	17.8	15.6	12.6
Residential and commercial	11.2	11.3	11.0	10.6	10.7	11.2	11.3	11.0	10.6	10.7
Industrial processes and process use	15.3	14.8	14.2	13.2	12.6	15.3	14.8	14.2	13.2	12.6
Agriculture	8.4	8.6	9.1	9.7	9.9	8.2	8.6	9.0	9.3	9.5
Waste	5.1	4.9	4.6	4.1	3.3	5.1	4.9	4.7	3.8	2.4
Emissions Trading System (stationary installations)	67.2	60.5	53.7	54.4	52.1	67.2	60.5	53.6	54.3	52.0
Effort Sharing Decision	57.6	61.9	59.9	54.4	49.5	57.4	61.6	59.6	53.5	48.0
Land use, land-use change and forestry	- 6.2	- 2.5	- 3.5	- 3.5	- 3.9	- 6.2	- 3.0	- 4.0	- 3.9	- 4.4
Note: Reported projections calibrated bcy EEA to align them with historic emissions.										

Denmark	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**48.4**	**44.8**	**48.7**	**50.9**	**49.2**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	13.6	11.6	15.4	17.7	16.2	NE	NE	NE	NE	NE
Manufacturing and construction industries	3.9	3.5	3.8	4.0	4.2	NE	NE	NE	NE	NE
Transport	12.3	12.3	12.2	12.0	11.5	NE	NE	NE	NE	NE
Residential and commercial	5.0	4.3	4.2	4.2	4.1	NE	NE	NE	NE	NE
Industrial processes and process use	2.0	1.9	1.8	1.8	1.9	NE	NE	NE	NE	NE
Agriculture	10.4	10.6	10.6	10.7	10.7	NE	NE	NE	NE	NE
Waste	1.2	0.6	0.6	0.6	0.6	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	15.8	13.5	17.8	20.3	19.2	NE	NE	NE	NE	NE
Effort Sharing Decision	32.5	31.1	30.8	30.5	29.8	NE	NE	NE	NE	NE
Land use, land-use change and forestry	3.5	- 1.0	- 1.6	- 1.3	- 2.1	NE	NE	NE	NE	NE

Estonia	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**18.0**	**19.3**	**19.0**	**17.0**	**16.4**	**18.0**	**18.8**	**17.9**	**15.2**	**14.2**
Energy supply	12.3	12.8	12.2	10.0	9.5	12.3	12.5	11.8	9.4	8.7
Manufacturing and construction industries	0.5	0.7	0.7	0.8	0.8	0.5	0.7	0.7	0.8	0.8
Transport	2.3	2.4	2.5	2.6	2.5	2.3	2.1	1.8	1.5	1.3
Residential and commercial	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7
Industrial processes and process use	0.5	1.0	1.0	1.0	0.9	0.5	1.0	1.0	1.0	0.9
Agriculture	1.3	1.5	1.6	1.6	1.7	1.3	1.5	1.6	1.6	1.7
Waste	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2
Emissions Trading System (stationary installations)	11.9	13.3	12.9	10.9	10.4	11.9	13.1	12.6	10.3	9.7
Effort Sharing Decision	6.1	6.0	6.1	6.1	6.0	6.1	5.7	5.3	4.9	4.6
Land use, land-use change and forestry	- 2.4	- 2.1	- 1.9	- 1.7	- 1.5	- 2.4	- 2.1	- 1.9	- 1.7	- 1.5

Table A1.1 Projected greenhouse gas emissions from Member States, Norway and Switzerland (cont.)

GHG emission projections ($MtCO_2e$)	WEM scenario					WAM scenario				
Finland	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**55.7**	**56.3**	**49.8**	**48.8**	**47.4**	**55.7**	**56.2**	**47.2**	**44.1**	**42.4**
Energy supply	18.1	19.3	14.2	14.3	13.8	18.1	19.3	13.5	13.2	12.8
Manufacturing and construction industries	7.2	7.0	6.6	6.1	5.7	7.2	7.0	6.5	6.0	5.5
Transport	11.1	10.8	10.3	10.0	10.0	11.1	10.7	8.8	7.2	6.6
Residential and commercial	4.7	4.6	4.4	4.2	4.1	4.7	4.6	4.3	4.0	3.9
Industrial processes and process use	5.9	6.4	6.5	6.6	6.4	5.9	6.4	6.3	6.2	6.3
Agriculture	6.6	6.6	6.4	6.4	6.4	6.6	6.6	6.4	6.4	6.4
Waste	2.2	1.6	1.3	1.1	1.0	2.2	1.6	1.3	1.1	1.0
Emissions Trading System (stationary installations)	26.1	27.3	22.3	22.2	21.5	26.1	27.3	21.5	21.1	20.5
Effort Sharing Decision	29.4	28.8	27.4	26.4	25.7	29.4	28.7	25.5	22.8	21.8
Land use, land-use change and forestry	- 8.6	- 8.4	- 2.0	- 1.9	- 8.6	- 8.6	- 8.4	- 2.0	- 1.9	- 8.6

France	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**457.1**	**430.1**	**407.5**	**396.1**	**390.5**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	46.3	57.2	57.0	56.1	56.9	NE	NE	NE	NE	NE
Manufacturing and construction industries	50.5	51.9	49.3	48.3	47.8	NE	NE	NE	NE	NE
Transport	132.5	116.4	112.8	112.4	114.3	NE	NE	NE	NE	NE
Residential and commercial	87.6	71.1	63.8	59.4	55.3	NE	NE	NE	NE	NE
Industrial processes and process use	44.5	43.3	37.4	34.6	33.6	NE	NE	NE	NE	NE
Agriculture	78.4	75.3	74.3	73.2	72.0	NE	NE	NE	NE	NE
Waste	17.4	15.0	12.9	12.1	10.6	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	99.6	107.2	105.3	104.5	104.8	NE	NE	NE	NE	NE
Effort Sharing Decision	353.0	318.2	297.4	286.9	280.8	NE	NE	NE	NE	NE
Land use, land-use change and forestry	- 35.8	- 51.9	- 52.5	- 55.7	- 58.8	NE	NE	NE	NE	NE

Germany	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**895.2**	**816.4**	**793.1**	**734.5**	**669.3**	**894.1**	**805.6**	**760.2**	**682.0**	**592.3**
Energy supply	347.4	290.7	302.1	274.7	227.9	346.5	285.0	279.6	239.3	183.3
Manufacturing and construction industries	113.2	113.1	108.1	101.3	97.5	112.8	110.8	106.3	100.2	92.1
Transport	160.9	159.1	152.7	150.0	148.9	160.8	158.4	149.7	139.0	127.7
Residential and commercial	134.4	118.3	102.5	90.5	80.4	134.6	118.6	101.2	88.0	77.3
Industrial processes and process use	61.4	60.3	54.4	47.0	45.1	61.4	60.1	52.4	46.9	44.8
Agriculture	67.0	66.3	66.3	65.1	64.5	67.0	64.2	64.3	63.1	62.5
Waste	10.9	8.6	7.0	5.9	5.0	10.9	8.5	6.6	5.5	4.6
Emissions Trading System (stationary installations)	444.0	387.7	393.6	360.5	311.3	445.7	384.4	375.3	330.5	269.0
Effort Sharing Decision	449.0	426.5	397.3	371.9	355.9	446.1	419.0	382.8	349.4	321.3
Land use, land-use change and forestry	- 14.6	29.1	11.2	19.2	18.7	- 14.6	29.1	11.2	19.2	18.7

Table A1.1 Projected greenhouse gas emissions from Member States, Norway and Switzerland (cont.)

GHG emission projections ($MtCO_2e$)	WEM scenario					WAM scenario				
Greece	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**95.7**	**91.5**	**93.4**	**86.0**	**83.6**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	42.0	33.5	35.2	26.5	23.6	NE	NE	NE	NE	NE
Manufacturing and construction industries	5.2	5.9	6.3	6.9	7.2	NE	NE	NE	NE	NE
Transport	17.1	19.2	18.7	18.2	17.8	NE	NE	NE	NE	NE
Residential and commercial	6.7	7.9	7.9	8.0	7.9	NE	NE	NE	NE	NE
Industrial processes and process use	11.9	11.2	11.4	12.2	12.8	NE	NE	NE	NE	NE
Agriculture	8.3	9.2	9.4	9.6	9.9	NE	NE	NE	NE	NE
Waste	4.5	4.7	4.6	4.6	4.5	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	49.8	42.0	44.5	37.2	35.0	NE	NE	NE	NE	NE
Effort Sharing Decision	45.5	48.9	48.3	48.3	48.0	NE	NE	NE	NE	NE
Land use, land-use change and forestry	3.1	- 1.7	- 1.2	- 0.7	- 0.3	NE	NE	NE	NE	NE

Hungary	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**61.1**	**58.0**	**59.2**	**58.8**	**59.5**	**61.1**	**57.9**	**58.9**	**58.3**	**58.8**
Energy supply	14.7	12.9	13.0	12.1	12.2	14.7	12.9	13.0	12.1	12.2
Manufacturing and construction industries	4.3	4.2	4.4	4.6	4.8	4.3	4.2	4.4	4.6	4.8
Transport	12.2	11.7	13.8	14.9	15.4	12.2	11.7	13.7	14.7	15.1
Residential and commercial	12.1	10.7	9.7	8.8	8.0	12.1	10.7	9.7	8.8	8.0
Industrial processes and process use	7.3	7.0	7.0	7.3	7.9	7.3	7.0	7.0	7.3	7.9
Agriculture	6.7	7.4	7.7	7.9	8.1	6.7	7.4	7.7	7.9	8.1
Waste	3.8	4.0	3.6	3.3	3.0	3.8	4.0	3.4	2.9	2.6
Emissions Trading System (stationary installations)	19.6	18.9	19.6	19.3	20.1	19.6	18.9	19.6	19.3	20.1
Effort Sharing Decision	41.5	39.1	39.6	39.5	39.3	41.5	39.0	39.3	38.9	38.7
Land use, land-use change and forestry	- 6.5	- 3.4	- 3.3	- 3.2	- 3.1	- 6.5	- 4.2	- 4.8	- 3.8	- 4.2

Note: Reported projections calibrated by EEA to align them with historic emissions.

Ireland	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**59.9**	**61.6**	**65.4**	**66.5**	**69.2**	**59.9**	**59.1**	**62.3**	**62.9**	**64.8**
Energy supply	11.8	10.2	11.6	12.8	14.6	11.8	8.7	9.6	10.5	11.6
Manufacturing and construction industries	4.5	5.3	5.4	5.6	6.2	4.5	5.2	5.2	5.4	6.0
Transport	11.8	13.3	15.1	14.9	14.8	11.8	13.1	14.8	14.7	14.6
Residential and commercial	8.4	8.7	9.1	9.3	9.6	8.4	8.3	8.6	8.6	8.8
Industrial processes and process use	3.1	3.2	3.5	3.7	4.1	3.1	3.2	3.5	3.7	4.1
Agriculture	19.2	20.2	20.1	19.6	19.5	19.2	20.0	20.0	19.4	19.4
Waste	1.0	0.6	0.5	0.5	0.5	1.0	0.6	0.5	0.5	0.5
Emissions Trading System (stationary installations)	16.8	15.9	17.6	19.3	21.9	16.8	14.3	15.5	16.8	18.8
Effort Sharing Decision	43.1	45.6	47.7	47.1	47.3	43.1	44.8	46.8	46.0	46.0
Land use, land-use change and forestry	4.3	4.6	6.0	7.5	7.6	4.3	4.6	6.0	7.5	7.6

Table A1.1 Projected greenhouse gas emissions from Member States, Norway and Switzerland (cont.)

GHG emission projections ($MtCO_2e$)	WEM scenario					WAM scenario				
Italy	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**433.0**	**425.9**	**407.1**	**392.1**	**384.0**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	113.4	107.2	100.0	85.5	81.5	NE	NE	NE	NE	NE
Manufacturing and construction industries	52.6	52.5	51.5	52.5	53.2	NE	NE	NE	NE	NE
Transport	106.0	104.4	102.7	103.5	102.9	NE	NE	NE	NE	NE
Residential and commercial	82.2	82.6	79.3	77.7	75.6	NE	NE	NE	NE	NE
Industrial processes and process use	30.0	33.5	29.9	30.3	30.6	NE	NE	NE	NE	NE
Agriculture	30.0	30.5	30.6	30.6	30.3	NE	NE	NE	NE	NE
Waste	18.8	15.2	13.1	12.0	9.8	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	156.2	161.0	152.7	140.1	132.2	NE	NE	NE	NE	NE
Effort Sharing Decision	274.7	262.7	251.9	249.2	248.4	NE	NE	NE	NE	NE
Land use, land-use change and forestry	- 36.2	- 24.4	- 39.7	- 41.5	- 43.4	NE	NE	NE	NE	NE

Latvia	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**11.4**	**11.6**	**11.8**	**12.2**	**12.6**	**11.4**	**11.4**	**11.5**	**11.6**	**12.0**
Energy supply	1.9	1.8	1.5	1.4	1.6	1.9	1.7	1.3	0.9	1.3
Manufacturing and construction industries	0.6	0.8	1.0	1.4	1.6	0.6	0.8	1.0	1.4	1.4
Transport	3.1	3.0	3.2	3.3	3.4	3.1	3.0	3.2	3.3	3.4
Residential and commercial	1.4	1.4	1.3	1.2	1.2	1.4	1.4	1.3	1.2	1.2
Industrial processes and process use	0.7	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.8
Agriculture	2.9	3.1	3.3	3.4	3.4	2.9	3.0	3.2	3.3	3.3
Waste	0.7	0.7	0.6	0.7	0.6	0.7	0.7	0.6	0.7	0.6
Emissions Trading System (stationary installations)	2.4	2.4	2.4	2.5	2.8	2.4	2.3	2.2	2.1	2.4
Effort Sharing Decision	9.0	9.2	9.5	9.7	9.8	9.0	9.1	9.3	9.5	9.5
Land use, land-use change and forestry	1.5	2.7	2.9	3.4	3.4	1.5	2.7	2.9	3.4	3.4

Lithuania	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**20.2**	**21.3**	**21.4**	**22.1**	**22.9**	**19.8**	**18.9**	**18.2**	**17.9**	**18.2**
Energy supply	3.5	3.7	3.7	4.0	4.3	3.2	2.4	2.1	1.9	2.0
Manufacturing and construction industries	1.1	1.2	1.2	1.3	1.3	1.0	0.4	0.3	0.2	0.1
Transport	5.2	5.6	5.9	6.3	6.7	5.1	5.3	5.5	5.7	5.9
Residential and commercial	1.3	1.3	1.3	1.3	1.2	1.3	1.2	1.1	1.0	0.9
Industrial processes and process use	3.5	3.9	3.8	3.7	3.7	3.5	3.9	3.8	3.7	3.7
Agriculture	4.7	5.0	5.0	5.1	5.2	4.7	5.0	5.0	5.1	5.2
Waste	1.0	0.6	0.5	0.4	0.4	1.0	0.6	0.5	0.4	0.3
Emissions Trading System (stationary installations)	7.0	7.9	7.9	8.3	8.6	6.7	6.1	5.7	5.5	5.5
Effort Sharing Decision	13.4	13.6	13.7	14.0	14.5	13.3	13.0	12.7	12.7	12.9
Land use, land-use change and forestry	- 7.9	- 8.0	- 8.0	- 8.0	- 8.0	- 8.5	- 8.7	- 8.8	- 9.0	- 9.2

Table A1.1 Projected greenhouse gas emissions from Member States, Norway and Switzerland (cont.)

GHG emission projections ($MtCO_2e$)	WEM scenario					WAM scenario				
Luxembourg	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**10.3**	**9.8**	**9.7**	**9.5**	**9.3**	**10.3**	**9.6**	**9.1**	**8.5**	**8.0**
Energy supply	0.5	0.2	0.2	0.2	0.3	0.5	0.2	0.2	0.2	0.3
Manufacturing and construction industries	1.1	1.1	1.1	1.2	1.2	1.1	1.1	1.1	1.2	1.2
Transport	5.7	5.6	5.7	5.7	5.6	5.7	5.5	5.1	4.7	4.3
Residential and commercial	1.6	1.5	1.3	1.2	1.1	1.6	1.5	1.3	1.2	1.1
Industrial processes and process use	0.6	0.6	0.5	0.5	0.4	0.6	0.6	0.5	0.5	0.4
Agriculture	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Waste	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Emissions Trading System (stationary installations)	1.7	1.4	1.4	1.4	1.3	1.7	1.4	1.4	1.4	1.3
Effort Sharing Decision	8.6	8.4	8.3	8.1	8.0	8.6	8.2	7.7	7.2	6.7
Land use, land-use change and forestry	- 0.4	- 0.3	- 0.3	- 0.3	- 0.3	- 0.4	- 0.3	- 0.3	- 0.3	- 0.3

Malta	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**2.2**	**1.6**	**1.6**	**1.7**	**1.8**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	0.9	0.4	0.3	0.3	0.3	NE	NE	NE	NE	NE
Manufacturing and construction industries	0.0	0.1	0.1	0.1	0.1	NE	NE	NE	NE	NE
Transport	0.6	0.5	0.4	0.4	0.4	NE	NE	NE	NE	NE
Residential and commercial	0.2	0.2	0.3	0.4	0.4	NE	NE	NE	NE	NE
Industrial processes and process use	0.2	0.2	0.3	0.3	0.3	NE	NE	NE	NE	NE
Agriculture	0.1	0.1	0.1	0.1	0.1	NE	NE	NE	NE	NE
Waste	0.1	0.2	0.2	0.2	0.2	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	0.9	0.3	0.3	0.3	0.3	NE	NE	NE	NE	NE
Effort Sharing Decision	1.3	1.3	1.4	1.4	1.5	NE	NE	NE	NE	NE
Land use, land-use change and forestry	0.0	0.0	0.0	0.0	0.0	NE	NE	NE	NE	NE
Note: Reported projections calibrated by EEA to align them with historic emissions.										

Netherlands	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**197.9**	**172.1**	**175.5**	**171.1**	**159.5**	**197.9**	**170.7**	**172.2**	**168.3**	**154.6**
Energy supply	72.1	52.3	58.6	57.6	48.9	72.1	52.3	58.2	59.0	48.9
Manufacturing and construction industries	25.0	24.2	24.3	23.2	21.6	25.0	24.0	24.2	22.9	21.3
Transport	31.8	30.4	30.7	30.8	31.5	31.8	30.4	29.8	28.9	29.0
Residential and commercial	36.1	33.2	30.8	29.1	27.0	36.1	31.9	28.9	27.0	24.7
Industrial processes and process use	10.8	10.8	10.4	10.2	10.6	10.8	10.8	10.4	10.2	10.7
Agriculture	18.7	18.8	18.7	18.7	18.6	18.7	18.8	18.7	18.7	18.7
Waste	3.4	2.5	2.0	1.6	1.3	3.4	2.5	2.0	1.6	1.3
Emissions Trading System (stationary installations)	97.6	77.6	84.2	82.7	73.2	97.6	77.4	83.6	83.7	72.9
Effort Sharing Decision	100.3	94.6	91.3	88.5	86.3	100.3	93.2	88.6	84.5	81.7
Land use, land-use change and forestry	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
Note: Reported projections calibrated by EEA to align them with historic emissions.										

Table A1.1 Projected greenhouse gas emissions from Member States, Norway and Switzerland (cont.)

GHG emission projections ($MtCO_2e$)	WEM scenario					WAM scenario				
Norway	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**53.9**	**51.8**	**50.5**	**48.3**	**46.5**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	19.0	18.7	18.5	17.3	16.7	NE	NE	NE	NE	NE
Manufacturing and construction industries	3.8	3.8	3.7	3.6	3.6	NE	NE	NE	NE	NE
Transport	13.2	12.7	12.1	11.4	10.5	NE	NE	NE	NE	NE
Residential and commercial	3.5	2.9	2.8	2.8	2.7	NE	NE	NE	NE	NE
Industrial processes and process use	8.5	8.3	8.0	8.0	7.8	NE	NE	NE	NE	NE
Agriculture	4.5	4.4	4.4	4.4	4.5	NE	NE	NE	NE	NE
Waste	1.3	1.0	0.9	0.7	0.7	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	25.5	25.6	25.4	24.3	23.7	NE	NE	NE	NE	NE
Effort Sharing Decision	27.1	24.8	23.7	22.5	21.4	NE	NE	NE	NE	NE
Land use, land-use change and forestry	- 26.6	- 23.5	- 22.6	- 21.3	- 19.6	NE	NE	NE	NE	NE

Note: Reported projections not quality check by EEA. Norway reported GHG projections until 2030 therefore the time series to year 2035 was extended by linear extrapolation of the trend (2025-2030) by the ETC/ACM.

Poland	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**393.6**	**386.4**	**373.7**	**358.8**	**358.8**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	185.2	176.9	163.9	147.6	147.6	NE	NE	NE	NE	NE
Manufacturing and construction industries	30.3	27.6	29.8	30.1	30.1	NE	NE	NE	NE	NE
Transport	47.7	50.8	51.7	55.8	55.8	NE	NE	NE	NE	NE
Residential and commercial	56.6	53.2	49.0	45.3	45.3	NE	NE	NE	NE	NE
Industrial processes and process use	32.4	34.3	35.2	35.5	35.5	NE	NE	NE	NE	NE
Agriculture	30.6	33.3	34.2	34.8	34.8	NE	NE	NE	NE	NE
Waste	10.6	10.2	9.9	9.7	9.7	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	204.8	196.2	187.2	172.7	172.7	NE	NE	NE	NE	NE
Effort Sharing Decision	188.6	190.1	186.3	186.0	186.0	NE	NE	NE	NE	NE
Land use, land-use change and forestry	- 26.7	- 22.3	- 16.8	- 13.0	- 13.0	NE	NE	NE	NE	NE

Portugal	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**70.5**	**63.0**	**58.7**	**55.8**	**52.0**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	19.5	13.6	11.1	9.4	7.2	NE	NE	NE	NE	NE
Manufacturing and construction industries	7.0	6.9	6.9	6.8	6.8	NE	NE	NE	NE	NE
Transport	15.7	15.0	14.9	14.7	14.6	NE	NE	NE	NE	NE
Residential and commercial	4.6	4.5	4.6	4.7	4.8	NE	NE	NE	NE	NE
Industrial processes and process use	6.1	6.6	5.7	6.0	5.5	NE	NE	NE	NE	NE
Agriculture	8.5	8.1	7.9	7.2	6.9	NE	NE	NE	NE	NE
Waste	9.2	8.3	7.6	7.0	6.3	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	27.2	22.0	19.9	18.5	16.6	NE	NE	NE	NE	NE
Effort Sharing Decision	42.8	40.5	38.3	36.8	34.8	NE	NE	NE	NE	NE
Land use, land-use change and forestry	- 10.0	- 7.6	- 7.9	- 8.3	- 8.7	NE	NE	NE	NE	NE

Table A1.1 Projected greenhouse gas emissions from Member States, Norway and Switzerland (cont.)

GHG emission projections ($MtCO_2e$)	WEM scenario					WAM scenario				
Romania	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**116.5**	**118.2**	**119.0**	**126.3**	**130.9**	**116.5**	**116.3**	**116.2**	**122.9**	**126.0**
Energy supply	41.1	38.8	34.7	37.8	38.2	41.1	38.5	34.4	37.6	38.0
Manufacturing and construction industries	12.5	13.0	13.5	14.0	14.8	12.5	12.7	13.3	14.0	14.1
Transport	15.7	17.8	19.3	20.3	20.9	15.7	17.4	18.9	19.9	20.5
Residential and commercial	10.8	11.5	12.3	13.2	13.9	10.8	11.3	12.0	12.5	13.3
Industrial processes and process use	11.9	12.7	13.9	14.8	15.6	11.9	12.7	13.9	14.8	15.6
Agriculture	18.7	19.2	20.6	21.9	23.4	18.7	18.4	19.1	19.9	20.6
Waste	5.8	5.2	4.6	4.3	4.1	5.8	5.2	4.6	4.3	4.0
Emissions Trading System (stationary installations)	42.3	41.7	39.1	42.9	44.3	42.3	41.5	39.0	42.9	43.9
Effort Sharing Decision	74.2	76.5	79.9	83.4	86.6	74.2	74.7	77.2	79.9	82.1
Land use, land-use change and forestry	- 18.3	- 17.0	- 18.1	- 16.5	- 16.8	- 18.3	- 16.0	- 12.8	- 9.9	- 10.6

Slovakia	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**41.1**	**40.3**	**40.4**	**40.7**	**40.9**	**40.9**	**38.9**	**38.5**	**38.6**	**38.7**
Energy supply	8.9	8.0	7.9	7.7	7.5	8.8	7.5	7.4	7.2	7.0
Manufacturing and construction industries	7.3	7.2	7.2	7.3	7.2	7.2	7.2	7.1	7.2	7.2
Transport	6.7	7.0	7.5	8.0	8.2	6.7	6.8	7.0	7.2	7.3
Residential and commercial	4.7	4.7	4.5	4.4	4.3	4.6	4.3	4.2	4.1	4.0
Industrial processes and process use	9.1	8.9	8.9	9.2	9.6	9.1	8.8	8.8	9.0	9.3
Agriculture	3.0	3.0	2.8	2.7	2.7	3.0	2.8	2.6	2.5	2.5
Waste	1.5	1.5	1.5	1.5	1.4	1.5	1.5	1.5	1.5	1.4
Emissions Trading System (stationary installations)	21.2	20.2	20.3	20.6	20.8	21.1	19.5	19.6	19.9	20.2
Effort Sharing Decision	19.9	20.2	20.0	20.2	20.1	19.8	19.3	18.9	18.7	18.6
Land use, land-use change and forestry	- 5.2	- 5.3	- 4.8	- 4.5	- 4.7	- 5.2	- 5.3	- 4.8	- 4.5	- 4.7

Slovenia	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**16.7**	**17.9**	**17.2**	**16.3**	**15.3**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	4.8	5.8	5.1	4.3	3.9	NE	NE	NE	NE	NE
Manufacturing and construction industries	1.5	1.7	1.9	2.1	2.2	NE	NE	NE	NE	NE
Transport	5.3	5.4	5.4	5.2	4.7	NE	NE	NE	NE	NE
Residential and commercial	1.6	1.4	1.2	1.1	1.0	NE	NE	NE	NE	NE
Industrial processes and process use	1.2	1.3	1.3	1.3	1.2	NE	NE	NE	NE	NE
Agriculture	1.8	1.9	1.9	1.9	1.9	NE	NE	NE	NE	NE
Waste	0.5	0.4	0.4	0.4	0.3	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	6.0	7.2	6.7	6.2	5.8	NE	NE	NE	NE	NE
Effort Sharing Decision	10.7	10.7	10.4	10.1	9.4	NE	NE	NE	NE	NE
Land use, land-use change and forestry	- 5.6	- 5.6	- 5.6	- 5.6	- 5.6	NE	NE	NE	NE	NE

Table A1.1 Projected greenhouse gas emissions from Member States, Norway and Switzerland (cont.)

GHG emission projections ($MtCO_2e$)	WEM scenario					WAM scenario				
Spain	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**335.7**	**333.0**	**324.4**	**330.5**	**341.9**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	90.8	91.0	76.8	78.2	80.4	NE	NE	NE	NE	NE
Manufacturing and construction industries	41.2	45.8	49.4	47.4	49.2	NE	NE	NE	NE	NE
Transport	83.7	87.1	88.8	95.7	102.0	NE	NE	NE	NE	NE
Residential and commercial	39.8	39.8	41.1	42.7	44.9	NE	NE	NE	NE	NE
Industrial processes and process use	30.8	32.5	33.0	32.0	31.2	NE	NE	NE	NE	NE
Agriculture	36.0	28.4	27.7	27.3	26.9	NE	NE	NE	NE	NE
Waste	13.5	8.3	7.5	7.3	7.2	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	136.8	141.0	130.1	128.8	133.2	NE	NE	NE	NE	NE
Effort Sharing Decision	196.3	189.1	191.0	198.1	204.9	NE	NE	NE	NE	NE
Land use, land-use change and forestry	- 38.8	- 33.0	- 30.9	- 29.7	- 29.5	NE	NE	NE	NE	NE

Sweden	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**53.7**	**49.9**	**47.7**	**45.6**	**43.6**	**NE**	**NE**	**NE**	**NE**	**NE**
Energy supply	9.9	10.3	10.4	10.0	9.4	NE	NE	NE	NE	NE
Manufacturing and construction industries	7.6	7.7	7.2	6.9	6.6	NE	NE	NE	NE	NE
Transport	18.2	15.4	14.3	13.6	13.1	NE	NE	NE	NE	NE
Residential and commercial	3.3	2.7	2.6	2.5	2.4	NE	NE	NE	NE	NE
Industrial processes and process use	6.4	6.3	6.2	6.1	6.0	NE	NE	NE	NE	NE
Agriculture	6.9	6.4	6.1	5.9	5.4	NE	NE	NE	NE	NE
Waste	1.4	1.1	0.9	0.7	0.6	NE	NE	NE	NE	NE
Emissions Trading System (stationary installations)	19.2	19.7	19.7	19.2	18.4	NE	NE	NE	NE	NE
Effort Sharing Decision	34.0	29.7	27.5	26.0	24.8	NE	NE	NE	NE	NE
Land use, land-use change and forestry	- 50.5	- 43.3	- 44.3	- 42.2	- 40.5	NE	NE	NE	NE	NE

Switzerland	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**51.5**	**47.1**	**43.5**	**40.0**	**NE**	**50.1**	**43.4**	**37.4**	**31.6**	**NE**
Energy supply	4.7	4.8	5.6	6.3	NE	4.6	4.6	4.6	4.6	NE
Manufacturing and construction industries	5.9	5.6	5.2	4.8	NE	5.6	5.1	4.4	3.8	NE
Transport	15.0	13.3	11.8	10.2	NE	14.0	11.0	8.9	6.7	NE
Residential and commercial	15.0	13.0	11.0	9.3	NE	15.0	12.5	9.9	7.8	NE
Industrial processes and process use	4.1	3.7	3.3	2.8	NE	4.1	3.6	3.2	2.6	NE
Agriculture	6.1	6.0	6.0	6.0	NE	6.1	5.9	5.7	5.5	NE
Waste	0.7	0.6	0.6	0.6	NE	0.7	0.6	0.6	0.6	NE
Emissions Trading System (stationary installations)	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Effort Sharing Decision	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Land use, land-use change and forestry	1.0	1.0	1.0	0.9	NE	1.3	1.9	2.6	2.5	NE

Table A1.1 Projected greenhouse gas emissions from Member States, Norway and Switzerland (cont.)

GHG emission projections ($MtCO_2e$)	WEM scenario					WAM scenario				
United Kingdom	**2015**	**2020**	**2025**	**2030**	**2035**	**2015**	**2020**	**2025**	**2030**	**2035**
Total GHG emissions	**508.8**	**436.2**	**405.3**	**403.1**	**401.7**	**508.8**	**427.5**	**396.6**	**378.0**	**366.3**
Energy supply	153.8	91.1	74.2	77.4	77.9	153.8	91.1	74.0	60.6	49.1
Manufacturing and construction industries	51.2	52.5	50.5	47.2	44.9	51.2	51.3	49.1	45.8	44.3
Transport	114.8	114.0	110.5	108.0	106.9	114.8	108.6	105.2	103.0	102.3
Residential and commercial	92.6	95.4	93.5	97.4	100.9	92.6	93.4	91.6	95.6	99.7
Industrial processes and process use	33.7	26.6	22.5	19.2	17.4	33.7	26.6	22.4	19.2	17.3
Agriculture	43.9	42.4	41.2	41.2	41.2	43.9	42.4	41.2	41.2	41.2
Waste	18.9	14.2	13.1	12.6	12.4	18.9	14.2	13.1	12.6	12.4
Emissions Trading System (stationary installations)	188.0	124.8	107.1	110.2	109.5	188.4	124.5	106.4	92.8	80.6
Effort Sharing Decision	319.0	309.4	296.1	290.8	289.9	318.7	301.2	288.2	283.1	283.5
Land use, land-use change and forestry	- 11.7	- 12.4	- 10.8	- 8.4	- 6.3	- 11.7	- 12.4	- 10.8	- 8.4	- 6.3

Notes: Projections for emissions under the Emissions Trading System concern stationary installations only (aviation not included).

Total GHG emissions do not include emissions from international aviation or net emissions or removals from land use, land use change and forestry (LULUCF).

GHG, greenhouse gas; NE, not estimated; WAM, with additional measures; WEM, with existing measures.

Common reporting format sector mapping: Energy supply = 1A1 + 1B + 1C, Manufacturing and construction industries = 1A2, Transport = 1A3, Residential, commercial and other = 1A4 (including energy-related emissions from Agriculture, forestry and fishing) + 1A5, Industrial processes = 2, Agriculture = 3, Waste = 5, LULUCF = 4.

Source: EEA, 2017d.

A1.3 Tracking progress towards targets under the Effort Sharing Decision

The progress of Member States towards their targets under the ESD is assessed by comparing ESD GHG emission levels with the relevant annual targets under the ESD. The assessment does not take into account the possible use of flexibility options as permitted under the ESD and is therefore not an assessment of compliance under the ESD.

The assessment of current progress towards 2015 ESD targets is based on a comparison between ESD GHG emissions and ESD emission targets (AEAs) for 2015:

- Member States with historical emissions below their annual ESD emission target are considered to be currently on track towards their targets under the ESD.
- In contrast, Member States with historical emissions higher than their ESD emission targets are considered not to be currently on track towards their targets under the ESD.

The assessment of projected progress towards 2020 ESD targets is based on a comparison between projected domestic ESD GHG emissions in the WEM scenario in 2020 and ESD targets (AEAs) for 2020:

- Member States with WEM projections lower than their 2020 target are projected to be on track towards their targets.
- Member States with WEM projections higher than their 2020 target are projected not to be on track towards their targets.

All the data used for this assessment (ESD GHG emissions and absolute annual ESD emission targets (AEAs)) are consistent with the scope of the EU ETS for the period from 2013 to 2020.

Table A1.2 Current progress towards 2015 and 2016 Effort Sharing Decision (ESD) emission targets

Member State	2005	2015 progress under the ESD				2016 progress under the ESD (approximated)			
	base-year emissions	ESD target	ESD emissions	Absolute gap	Relative gap	ESD target	ESD emissions	Absolute gap	Relative gap
	$MtCO_2e$	$MtCO_2e$	$MtCO_2e$	$MtCO_2e$	% (share of 2005 base year)	$MtCO_2e$	$MtCO_2e$	$MtCO_2e$	% (share of 2005 base year)
Austria	56.8	51.5	49.3	2.2	3.9	51.0	50.2	0.8	1.5
Belgium	80.3	75.3	72.7	2.6	3.2	73.8	74.5	- 0.7	- 0.9
Bulgaria	22.1	27.5	25.4	2.1	9.6	27.7	25.0	2.8	12.6
Croatia	17.4	20.0	15.6	4.4	25.5	20.2	14.3	5.9	34.0
Cyprus	4.2	5.9	4.1	1.9	44.6	5.9	4.2	1.7	41.5
Czech Republic	61.7	64.0	61.3	2.7	4.3	64.7	58.1	6.6	10.6
Denmark	40.1	35.0	32.5	2.5	6.2	34.1	32.3	1.8	4.4
Estonia	5.4	6.3	6.1	0.2	3.7	6.4	5.8	0.5	9.8
Finland	33.9	30.8	29.9	0.9	2.7	30.3	31.3	- 1.0	- 3.0
France	398.2	384.4	353.0	31.4	7.9	379.4	357.0	22.4	5.6
Germany	477.8	459.1	444.1	15.1	3.2	452.4	450.4	2.0	0.4
Greece	62.6	59.6	45.4	14.2	22.6	59.9	46.5	13.5	21.5
Hungary	48.0	52.6	41.4	11.2	23.3	53.8	42.1	11.6	24.2
Ireland	47.1	44.6	43.0	1.6	3.4	43.5	44.5	- 1.0	- 2.2
Italy	334.5	304.2	273.3	31.0	9.3	302.3	277.5	24.8	7.4
Latvia	8.5	9.4	9.0	0.4	5.1	9.5	8.9	0.7	7.8
Lithuania	13.3	13.7	13.3	0.4	3.1	14.0	13.0	1.0	7.7
Luxembourg	10.1	9.1	8.6	0.534	5.26	8.9	8.5	0.4	4.21
Malta	1.1	1.2	1.3	- 0.1	- 12.2	1.2	1.3	- 0.2	- 16.0
Netherlands	127.8	118.4	101.1	17.3	13.5	116.1	102.7	13.5	10.5
Poland	180.0	196.1	186.8	9.4	5.2	197.4	192.8	4.6	2.5
Portugal	48.6	49.9	40.6	9.2	19.0	50.1	40.4	9.7	20.0
Romania	75.5	79.3	74.6	4.7	6.3	81.1	72.7	8.4	11.2
Slovakia	23.0	24.7	20.1	4.7	20.3	25.1	19.7	5.4	23.4
Slovenia	11.8	12.4	10.7	1.7	14.1	12.4	11.0	1.4	11.6
Spain	236.0	223.7	196.2	27.6	11.7	221.8	197.8	24.0	10.2
Sweden	43.5	40.4	33.9	6.5	15.0	39.8	33.7	6.1	13.9
United Kingdom	417.8	349.7	326.0	23.7	5.7	345.2	324.4	20.8	5.0
EU	**2 887**	**2 749**	**2 519**	**230**	**8.0**	**2 728**	**2 503**	**226**	**7.8**

Notes: Distances to targets (i.e. surpluses of emission allocations compared with existing emissions) are calculated as 'ESD target' – 'ESD GHG emissions'. A positive value indicates a surplus of AEAs (emissions lower than the target) while a negative value indicates a shortfall of AEAs (emissions lower than the target).

See Section A1.2 in Annex 1 with regard to the calculation of '2005 base-year emissions' by the EEA.

Sources: EEA, 2017a, 2017c, 2017c, 2017f; EU, 2009c, 2013a, 2013b, 2017b, based on Member States' submissions.

Table A1.3 Projected progress towards 2020 Effort Sharing Decision (ESD) targets

Member State	2005	2020 ESD target		Projected progress with existing measures by 2020			Projected progress with additional measures by 2020		
	Base-year emissions	Relative target to 2020	Absolute target	ESD emissions	Abolute gap	Relative gap	ESD emissions	Abolute gap	Relative gap
	$MtCO_2e$	%	$MtCO_2e$	$MtCO_2e$	$MtCO_2e$	% (share of 2005 base year)	$MtCO_2e$	$MtCO_2e$	% (share of 2005 base year)
Austria	56.8	- 16.0	47.8	49.1	- 1.4	- 2.4	49.1	- 1.4	- 2.4
Belgium	80.3	- 15.0	68.2	71.0	- 2.8	- 3.5	70.2	- 2.0	- 2.5
Bulgaria	22.1	20.0	26.5	21.7	4.8	21.7	21.7	4.8	21.7
Croatia	17.4	11.0	19.3	15.2	4.1	23.5	14.3	5.0	28.9
Cyprus	4.2	- 5.0	4.0	3.6	0.4	9.5	3.6	0.4	9.5
Czech Republic	61.7	9.0	67.2	61.9	5.3	8.5	61.6	5.6	9.0
Denmark	40.1	- 20.0	32.1	31.1	0.9	2.3	31.1	0.9	2.3
Estonia	5.4	11.0	6.0	6.0	0.0	0.3	5.7	0.3	6.1
Finland	33.9	- 16.0	28.5	28.8	- 0.3	- 0.7	28.7	- 0.1	- 0.4
France	398.2	- 14.0	342.5	318.2	24.3	6.1	318.2	24.3	6.1
Germany	477.8	- 14.0	410.9	426.5	- 15.6	- 3.3	419.0	- 8.1	- 1.7
Greece	62.6	- 4.0	60.0	48.9	11.1	17.8	48.9	11.1	17.8
Hungary	48.0	10.0	52.8	39.1	13.7	28.6	39.0	13.8	28.7
Ireland	47.1	- 20.0	37.7	45.6	- 8.0	- 17.0	44.8	- 7.2	- 15.2
Italy	334.5	- 13.0	291.0	262.7	28.3	8.5	262.7	28.3	8.5
Latvia	8.5	17.0	10.0	9.2	0.8	9.2	9.1	0.9	10.5
Lithuania	13.3	15.0	15.2	13.6	1.7	12.6	13.0	2.2	16.9
Luxembourg	10.1	- 20.0	8.1	8.4	- 0.3	- 2.6	8.2	- 0.1	- 0.9
Malta	1.1	5.0	1.2	1.3	- 0.1	- 11.5	1.3	- 0.1	- 11.5
Netherlands	127.8	- 16.0	107.4	94.6	12.8	10.0	93.2	14.1	11.0
Poland	180.0	14.0	205.2	190.1	15.1	8.4	190.1	15.1	8.4
Portugal	48.6	1.0	49.1	40.5	8.6	17.6	40.5	8.6	17.7
Romania	75.5	19.0	89.8	76.5	13.3	17.6	74.7	15.1	20.0
Slovakia	23.0	13.0	25.9	20.2	5.8	25.2	19.3	6.6	28.7
Slovenia	11.8	4.0	12.3	10.7	1.6	13.3	10.7	1.6	13.3
Spain	236.0	- 10.0	212.4	189.1	23.3	9.9	189.1	23.3	9.9
Sweden	43.5	- 17.0	36.1	29.7	6.4	14.8	29.7	6.4	14.8
United Kingdom	417.8	- 16.0	350.9	309.4	41.5	9.9	301.2	49.8	11.9
EU-28	**2 887.1**		**2 618.2**	**2 422.8**	**195.3**	**6.8**	**2 398.8**	**219.3**	**7.6**

Notes: Distances to targets are calculated as 'ESD target' – 'ESD GHG emissions'. A positive value indicates a surplus of AEAs (emissions lower than the target), while a negative value indicates a shortfall of AEAs (emissions lower than the target).

See Section A1.2 in Annex 1 with regard to the calculation of '2005 base-year emissions' by the EEA.

Sources: EEA, 2017d; EU, 2009c, 2013a, 2013b, based on Member States' submissions.

A1.4 Use of flexibilities under the Effort Sharing Decision

The assessment of progress towards the ESD targets does not take into account the possible use of flexibility options as permitted under the ESD, which can be used by Member States for compliance under the ESD ([36]). If these are taken into account, it is apparent that only Malta will need to buy additional AEAs from other Member States or use international project credits to comply in the years 2013 to 2015.

Taking into account WEM emissions, for all countries other than Ireland and Malta the use of the flexibility to carry over AEAs that have not been used in previous years will be sufficient for compliance in the period 2013-2020.

A1.5 Annual and cumulative gaps between emissions and Effort Sharing Decision targets

Table A1.4 Distance between historical or projected Effort Sharing Decision (ESD) emissions and annual ESD targets, 2013-2020

Member State	Scenario	Inventory	Inventory	Inventory	Proxy	Projections			
		2013	2014	2015	2016	2017	2018	2019	2020
Austria	WEM	2.5	3.9	2.2	0.8	0.0	- 0.5	- 1.0	- 1.4
	WAM					0.0	- 0.5	- 1.0	- 1.4
Belgium	WEM	4.1	6.8	2.6	- 0.7	0.6	- 0.7	- 1.8	- 2.8
	WAM					0.6	- 0.7	- 1.8	- 2.0
Bulgaria	WEM	4.7	4.3	2.1	2.8	3.5	3.9	4.4	4.8
	WAM					3.5	3.9	4.4	4.8
Croatia	WEM	4.5	5.1	4.4	5.9	3.6	3.7	3.9	4.1
	WAM					3.9	4.3	4.7	5.0
Cyprus	WEM	2.0	2.0	1.9	1.7	0.5	0.5	0.4	0.4
	WAM					2.2	0.5	0.5	0.5
Czech Republic	WEM	1.0	5.6	2.7	6.6	5.9	5.7	5.5	5.3
	WAM					6.1	5.9	5.8	5.6
Denmark	WEM	3.1	3.3	2.5	1.8	2.4	2.1	1.5	0.9
	WAM					2.4	2.1	1.5	0.9
Estonia	WEM	0.5	0.2	0.2	0.5	- 0.1	- 0.1	- 0.02	0.02
	WAM					0.2	0.2	0.3	0.3
Finland	WEM	0.2	1.1	0.9	- 1.0	0.5	0.2	- 0.04	- 0.3
	WAM					0.5	0.3	0.05	- 0.1
France	WEM	28.0	35.9	31.4	22.4	19.1	20.8	22.5	24.3
	WAM					19.1	20.8	22.5	24.3
Germany	WEM	12.3	29.0	15.1	2.0	- 9.1	- 11.1	- 13.1	- 15.6
	WAM					- 2.5	- 4.2	- 5.9	- 8.1
Greece	WEM	14.8	14.9	14.2	13.5	11.6	11.2	11.1	11.1
	WAM					11.6	11.2	11.1	11.1
Hungary	WEM	12.0	13.1	11.2	11.6	9.3	11.0	12.4	13.7
	WAM					9.3	11.0	12.5	13.8

([36]) A Member State can carry forward (i.e. 'borrow') an emission allocation of up to 5 % from the following year, during the period from 2013 to 2019, in order to guarantee compliance. A Member State can also carry over from a past year any surplus emission allocations. It is also possible to use other flexibilities under the ESD, such as buying AEAs from other Member States or using international project credits under the Kyoto Protocol up to a certain limit.

Table A1.4 Distance between historical or projected Effort Sharing Decision (ESD) emissions and annual ESD targets, 2013-2020 (cont.)

Ireland	WEM	4.7	4.1	1.6	- 1.0	- 3.7	- 4.8	- 6.5	- 8.0
	WAM					- 3.4	- 4.4	- 6.0	- 7.2
Italy	WEM	34.8	40.9	31.0	24.8	28.4	28.4	28.3	28.3
	WAM					28.4	28.4	28.3	28.3
Latvia	WEM	0.5	0.3	0.4	0.7	0.7	0.7	0.7	0.8
	WAM					0.7	0.7	0.7	0.9
Lithuania	WEM	0.5	0.4	0.4	1.0	0.5	1.0	1.3	1.7
	WAM					0.8	1.4	1.8	2.2
Luxembourg	WEM	0.2	0.5	0.5	0.4	0.4	0.2	- 0.03	- 0.3
	WAM					0.4	0.2	0.0	- 0.1
Malta	WEM	- 0.1	- 0.1	- 0.1	- 0.2	- 0.1	- 0.1	- 0.1	- 0.1
	WAM					- 0.1	- 0.1	- 0.1	- 0.1
Netherlands	WEM	14.7	22.8	17.3	13.5	15.7	14.9	13.6	12.8
	WAM					16.0	16.0	14.8	14.1
Poland	WEM	7.5	13.3	9.4	4.6	10.8	12.2	13.6	15.1
	WAM					10.8	12.2	13.6	15.1
Portugal	WEM	10.7	10.8	9.2	9.7	6.0	6.9	7.7	8.6
	WAM					6.0	6.9	7.7	8.6
Romania	WEM	2.9	4.9	4.7	8.4	9.0	10.4	11.8	13.3
	WAM					9.7	11.5	13.3	15.1
Slovakia	WEM	2.9	4.6	4.7	5.4	5.1	5.3	5.6	5.8
	WAM					5.5	5.9	6.2	6.6
Slovenia	WEM	1.4	1.9	1.7	1.4	1.5	1.5	1.5	1.6
	WAM					1.5	1.5	1.5	1.6
Spain	WEM	27.3	25.9	27.6	24.0	26.8	25.1	23.9	23.3
	WAM					26.8	25.1	23.9	23.3
Sweden	WEM	6.4	6.5	6.5	6.1	5.6	5.9	6.1	6.4
	WAM					5.6	5.9	6.1	6.4
United Kingdom	WEM	19.3	29.8	23.7	20.8	39.4	40.6	39.7	41.5
	WAM					41.9	45.0	46.1	49.8
EU	**WEM**	**223**	**292**	**230**	**226**	**194**	**195**	**193**	**195**
	WAM					**206**	**211**	**213**	**219**

Notes: A positive value (green shading) indicates a surplus of AEAs (emissions lower than the target), while a negative value (red shading) indicates a shortfall of AEAs (emissions lower than the target). The darker the colour, the larger the gap (red) or the surplus (green).

The calculations do not take into account any possible use of the flexibilities provided under the ESD (such as trading ESD emission allocations or buying international certificates). For this calculation, recalculated annual emission allocations (AEAs) for the years 2017-2020 were considered (EC, 2017h).

The data are based on ESD emissions for 2013, 2014 and 2015 as determined after the 2016 comprehensive review of national GHG inventories, approximated inventory data for 2016 and projections for the period 2017-2020. No national approximated GHG data were available for three Member States (Bulgaria, Cyprus and Romania). For these, the EEA GHG emission proxy was used instead. For the aggregation of projections in the 'with additional measures' (WAM) scenario at EU level, WAM projections of Member States which did not report a WAM scenario have been gap-filled using the 'with existing measures' (WEM) scenario projections.

Sources: EEA, 2017a, 2017c, 2017c, 2017d, 2017f; EU, 2013a, 2013b, 2017b, based on Member States' submissions.

Table A1.5 Cumulative gaps between historical and projected Effort Sharing Decision (ESD) emissions and annual ESD targets, 2013-2020

Member State	Scenario	Inventory	Inventory	Inventory	Proxy	Projections			
		2013	2014	2015	2016	2017	2018	2019	2020
Austria	WEM	2.5	6.4	8.7	9.5	9.4	8.9	7.9	6.6
	WAM					9.4	8.9	7.9	6.6
Belgium	WEM	4.1	10.9	13.5	12.8	13.4	12.7	10.9	8.1
	WAM					13.4	12.7	10.9	8.9
Bulgaria	WEM	4.7	9.0	11.1	13.9	17.4	21.3	25.6	30.5
	WAM					17.4	21.3	25.6	30.5
Croatia	WEM	4.5	9.6	14.1	20.0	23.5	27.3	31.2	35.3
	WAM					23.9	28.2	32.9	37.9
Cyprus	WEM	2.0	4.0	5.8	7.6	8.1	8.6	9.0	9.4
	WAM					9.8	10.4	10.9	11.3
Czech Republic	WEM	1.0	6.6	9.3	15.8	21.7	27.4	32.9	38.1
	WAM					22.0	27.9	33.6	39.2
Denmark	WEM	3.1	6.4	8.9	10.7	13.1	15.1	16.6	17.6
	WAM					13.1	15.1	16.6	17.6
Estonia	WEM	0.5	0.8	1.0	1.5	1.4	1.4	1.4	1.4
	WAM					1.7	2.0	2.2	2.6
Finland	WEM	0.2	1.3	2.2	1.2	1.7	1.9	1.8	1.6
	WAM					1.8	2.0	2.1	1.9
France	WEM	28.0	63.9	95.3	117.7	136.8	157.7	180.2	204.5
	WAM					136.8	157.7	180.2	204.5
Germany	WEM	12.3	41.4	56.4	58.4	49.3	38.2	25.1	9.5
	WAM					56.0	51.8	45.9	37.8
Greece	WEM	14.8	29.6	43.8	57.3	68.8	80.0	91.1	102.2
	WAM					68.8	80.0	91.1	102.2
Hungary	WEM	12.0	25.1	36.3	47.9	57.2	68.2	80.6	94.3
	WAM					57.2	68.2	80.7	94.5
Ireland	WEM	4.7	8.8	10.4	9.3	5.6	0.8	- 5.7	- 13.7
	WAM					5.9	1.5	- 4.4	- 11.6
Italy	WEM	34.8	75.7	106.7	131.5	159.8	188.2	216.5	244.9
	WAM					159.8	188.2	216.5	244.9
Latvia	WEM	0.5	0.8	1.3	1.9	2.6	3.3	4.0	4.8
	WAM					2.6	3.3	4.0	4.9
Lithuania	WEM	0.5	0.9	1.3	2.3	2.8	3.7	5.0	6.7
	WAM					3.1	4.4	6.2	8.5
Luxembourg	WEM	0.2	0.7	1.2	1.6	2.0	2.1	2.1	1.8
	WAM					2.0	2.1	2.2	2.1
Malta	WEM	- 0.1	- 0.2	- 0.3	- 0.5	- 0.7	- 0.8	- 0.9	- 1.0
	WAM					- 0.7	- 0.8	- 0.9	- 1.0
Netherlands	WEM	14.7	37.5	54.8	68.2	84.0	98.9	112.5	125.3
	WAM					84.3	100.2	115.1	129.2

Table A1.5 Cumulative gaps between historical and projected Effort Sharing Decision (ESD) emissions and annual ESD targets, 2013-2020 (cont.)

Poland	WEM	7.5	20.9	30.2	34.8	45.6	57.8	71.4	86.5
	WAM					45.6	57.8	71.4	86.5
Portugal	WEM	10.7	21.5	30.7	40.4	46.4	53.3	61.0	69.5
	WAM					46.4	53.3	61.1	69.7
Romania	WEM	2.9	7.8	12.5	21.0	29.9	40.3	52.2	65.5
	WAM					30.7	42.2	55.5	70.6
Slovakia	WEM	2.9	7.5	12.2	17.6	22.7	28.0	33.5	39.3
	WAM					23.1	29.0	35.2	41.8
Slovenia	WEM	1.4	3.3	4.9	6.3	7.8	9.3	10.8	12.4
	WAM					7.8	9.3	10.8	12.4
Spain	WEM	27.3	53.2	80.8	104.8	131.6	156.7	180.6	204.0
	WAM					131.6	156.7	180.6	204.0
Sweden	WEM	6.4	12.9	19.4	25.5	31.1	36.9	43.1	49.5
	WAM					31.1	36.9	43.1	49.5
United Kingdom	WEM	19.3	49.1	72.7	93.5	133.0	173.5	213.3	254.8
	WAM					135.5	180.5	226.6	276.4
EU	**WEM**	**223**	**515**	**745**	**971**	**1 164**	**1 359**	**1 552**	**1 747**
	WAM					**1 176**	**1 387**	**1 600**	**1 819**

Notes: A positive value (green shading) indicates a surplus of AEAs (emissions lower than the target), while a negative value (red shading) indicates a shortfall of AEAs (emissions lower than the target). The darker the colour, the larger the gap (red) or the surplus (green).

The calculation of the cumulative gap takes only previous years' gaps into account, and does not take into account any possible use of the flexibilities provided under the ESD (such as trading ESD emission allocations or buying international certificates). For this calculation, recalculated annual emission allocations (AEAs) for the years 2017-2020 were considered (EC, 2017h).

The data are based on ESD emissions for 2013, 2014 and 2015 as determined after the 2016 comprehensive review of national GHG inventories, approximated inventory data for 2016 and projections for the period 2017-2020. No national approximated GHG data were available for three Member States (Bulgaria, Cyprus and Romania). For these, the EEA GHG emission proxy was used instead. For the aggregation of projections in the 'with additional measures' (WAM) scenario at EU level, WAM projections of Member States which did not report a WAM scenario have been gap-filled using the 'with existing measures' (WEM) scenario projections.

Sources: EEA, 2017a, 2017b, 2017c, 2017d, 2017f; EU, 2013a, 2013b, 2017b, based on Member States' submissions.

Annex 2 Progress towards renewable energy targets: data and methodology

A2.1 Reporting requirements related to renewable energy

Under the RED, Member States need to report on their progress towards the deployment of renewable energies (EU, 2015b). Reporting under the RED takes place biennially in a standardised format. Furthermore, under the Energy Statistics Regulation, Member States also report data on their renewable energy deployment to Eurostat.

A2.2 Data sources related to renewable energy deployment

The analysis presented in this report is based on several sources relating to renewable energy use in Europe.

A2.2.1 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 RES is based, for the most part, on information reported by Member States to Eurostat under the Energy Statistics Regulation and the RED, and published by Eurostat via its SHARES tool (Eurostat, 2017d).

A2.2.2 Share of RES in gross final energy consumption in 2015

The shares of RES in gross final energy consumption in 2015 were estimated by Eurostat, based on national data transmission under Regulation (EC) No 1099/2008 on energy statistics (EU, 2008). In accordance with the accounting rules in the RED, electricity generated by hydro- and wind power were normalised to account for annual variations (hydropower over 15 years and wind power over five years). For details on the normalisation rules, see the SHARES manual provided by Eurostat (Eurostat, 2017d). Because of their insular and peripheral geography, Cyprus and Malta's gross inland consumption is disproportionally high for aviation, and they are thus strongly affected by current technological and regulatory constraints. Therefore, they have exemptions with regard to the amounts by which they exceed the EU's average gross final consumption of energy in aviation in 2005 as assessed by Eurostat, i.e. 4.12 %.

A2.2.3 Approximated shares of renewable energy use in 2016

The approximated shares of renewable energy use in 2016 were estimated by the EEA and will be published in early 2018 (EEA, 2017k). National information on approximated shares have been provided by Germany, Malta, Spain and the United Kingdom.

A2.2.4 The 2020 RES targets and indicative trajectories for the period from 2011 to 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, 2009d).

A2.2.5 Anticipated national RES trajectories for the period from 2010 to 2020

Anticipated 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 NREAPs, also taking into account 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, 2013c).

A2.2.6 The shares of energy from renewable sources on a sectoral level

The report also presents data on RES use on a sectoral level (for electricity, heating and cooling, and transport). These data are based on Eurostat's SHARES tool (Eurostat, 2017d). Approximate 2016 values were estimated by the EEA (EEA, 2017k).

A2.3 Tracking progress towards renewable energy targets

The progress of Member States towards their targets under the RED is assessed by comparing the share of energy from renewable sources in gross final energy consumption with the indicative trajectory set under the RED for the period 2015-2016. This assessment is complemented by preliminary estimates for the year 2016.

Assessments of progress are made using the following methodology:

- A Member State is considered **on track (green)** if its 2015 share of energy from renewable sources matched or exceeded its indicative 2015-2016 indicative trajectory under the RED.
- A Member State is considered **not on track (orange)** if its 2015 share of energy from renewable sources was below its 2015-2016 indicative trajectory set under the RED.

Table A2.1 Current progress towards indicative trajectories under the Renewable Energy Directive

Member State	RES shares		Renewable Energy Directive: 2020 target		
			Target	Gaps to target	
	2015	2016 (approximated)	2020	2015	2016
	%	%	%	percentage points	percentage points
Austria	33.0	34.0	34.0	- 1.0	0.0
Belgium	7.9	8.9	13.0	- 5.1	- 4.1
Bulgaria	18.2	18.0	16.0	2.2	2.0
Croatia	29.0	29.0	20.0	9.0	9.0
Cyprus	9.4	8.7	13.0	- 3.6	- 4.3
Czech Republic	15.1	15.4	13.0	2.1	2.4
Denmark	30.8	32.0	30.0	0.8	2.0
Estonia	28.6	27.9	25.0	3.6	2.9
Finland	39.3	39.7	38.0	1.3	1.7
France	15.2	15.6	23.0	- 7.8	- 7.4
Germany	14.6	14.7	18.0	- 3.4	- 3.3
Greece	15.4	15.7	18.0	- 2.6	- 2.3
Hungary	14.5	14.3	13.0	1.5	1.3
Ireland	9.2	9.2	16.0	- 6.8	- 6.8
Italy	17.5	17.2	17.0	0.5	0.2
Latvia	37.6	37.8	40.0	- 2.4	- 2.2
Lithuania	25.8	26.0	23.0	2.8	3.0
Luxembourg	5.0	5.2	11.0	- 6.0	- 5.8
Malta	5.0	5.9	10.0	- 5.0	- 4.1
Netherlands	5.8	5.8	14.0	- 8.2	- 8.2
Poland	11.8	11.5	15.0	- 3.2	- 3.5
Portugal	28.0	27.9	31.0	- 3.0	- 3.1
Romania	24.8	24.4	24.0	0.8	0.4
Slovakia	12.9	12.8	14.0	- 1.1	- 1.2
Slovenia	22.0	21.7	25.0	- 3.0	- 3.3
Spain	16.2	17.4	20.0	- 3.8	- 2.6
Sweden	53.9	54.2	49.0	4.9	5.2
United Kingdom	8.2	8.9	15.0	- 6.8	- 6.1
EU-28	**16.7**	**16.9**	**20.0**	**- 3.3**	**- 3.1**
Iceland (a)	70.2		72.0	- 1.8	
Norway	69.4		68.0	1.4	

Notes: A distance to trajectory is calculated as 'RES share' – 'RES target'. A positive value indicates a RES share higher than the relevant indicative trajectory.

RES, renewable energy source.

Sources: EEA, 2017k; EU, 2009d; Eurostat, 2017d.

Table A2.2 Current progress towards national action plan trajectories

Member State	RES shares		National action plan trajectory			
			Trajectory shares		Gaps to trajectory	
	2015	2016 (approximated)	2015	2016	2015	2016 (approximated)
	%	%	%	%	percentage points	percentage points
Austria	33.0	34.0	32.3	32.6	0.7	1.4
Belgium	7.9	8.9	7.5	8.6	0.4	0.3
Bulgaria	18.2	18.0	12.4	12.4	5.8	5.6
Croatia	29.0	29.0	17.5	18.1	11.5	10.9
Cyprus	9.4	8.7	9.0	9.7	0.4	- 1.0
Czech Republic	15.1	15.4	12.0	12.4	3.1	3.0
Denmark	30.8	32.0	27.6	28.2	3.2	3.8
Estonia	28.6	27.9	23.6	23.7	5.0	4.2
Finland	39.3	39.7	32.6	33.6	6.7	6.1
France	15.2	15.6	17.0	18.0	- 1.8	- 2.4
Germany	14.6	14.7	13.5	14.4	1.1	0.3
Greece	15.4	15.7	11.4	12.4	4.0	3.3
Hungary	14.5	14.3	8.3	9.3	6.2	5.0
Ireland	9.2	9.2	10.3	10.7	- 1.1	- 1.5
Italy	17.5	17.2	11.2	12.0	6.2	5.2
Latvia	37.6	37.8	35.6	36.3	2.0	1.5
Lithuania	25.8	26.0	21.0	22.0	4.8	4.0
Luxembourg	5.0	5.2	5.4	5.4	- 0.4	- 0.2
Malta	5.0	5.9	5.5	6.8	- 0.5	- 0.9
Netherlands	5.8	5.8	8.5	9.7	- 2.7	- 3.9
Poland	11.8	11.5	11.9	12.5	- 0.1	- 0.9
Portugal	28.0	27.9	28.4	28.9	- 0.4	- 1.0
Romania	24.8	24.4	20.1	20.6	4.7	3.8
Slovakia	12.9	12.8	10.0	10.0	2.9	2.8
Slovenia	22.0	21.7	21.2	21.8	0.8	- 0.1
Spain	16.2	17.4	16.7	17.3	- 0.5	0.1
Sweden	53.9	54.2	47.0	47.7	6.9	6.5
United Kingdom	8.2	8.9	7.0	8.0	1.2	0.9
EU-28	**16.7**	**16.9**	**15.3**	**16.1**	**1.4**	**0.7**
Iceland	70.2		66.0	67.3	4.2	
Norway	69.4		64.0	0.0	5.4	

Notes: The distance to a trajectory is calculated as 'RES share' – 'RES target'. A positive value indicates a RES share higher than the relevant anticipated trajectory from the NREAP.

RES, renewable energy source.

Sources: EC, 2013c; EEA, 2011, 2017k; Eurostat, 2017d

Table A2.3 Renewable energy source (RES) shares per sector, 2015 and 2016 (2016 = preliminary estimate)

Member State	RES-E		RES-H/C		RES-T	
	2015	Proxy 2016	2015	Proxy 2016	2015	Proxy 2016
	%	%	%	%	%	%
Austria	70.3	72.7	32.0	34.1	11.4	11.4
Belgium	15.4	17.1	7.6	7.9	3.8	5.8
Bulgaria	19.1	19.6	28.6	27.7	6.5	6.5
Croatia	45.4	45.1	38.6	37.8	3.5	3.8
Cyprus	8.4	8.4	22.5	21.7	2.5	2.2
Czech Republic	14.1	14.1	19.8	21.0	6.5	5.8
Denmark	51.3	52.9	39.6	41.8	6.7	7.0
Estonia	15.1	13.6	49.6	50.5	0.4	0.5
Finland	32.5	33.1	52.8	53.8	22.0	20.8
France	18.8	19.1	19.8	20.2	8.5	8.9
Germany	30.7	32.0	12.9	12.9	6.8	6.9
Greece	22.1	23.2	25.9	24.9	1.4	2.5
Hungary	7.3	7.4	21.3	21.0	6.2	6.3
Ireland	25.2	26.4	6.4	6.4	6.5	5.9
Italy	33.5	34.3	19.2	18.3	6.4	6.1
Latvia	52.2	52.7	51.8	53.1	3.9	3.8
Lithuania	15.5	17.9	46.1	47.9	4.6	3.5
Luxembourg	6.2	6.6	6.9	6.9	6.5	7.1
Malta	4.2	5.7	14.1	14.1	4.7	6.5
Netherlands	11.1	12.3	5.5	5.2	5.3	4.5
Poland	13.4	14.9	14.3	14.0	6.4	5.4
Portugal	52.6	52.1	33.4	34.2	7.4	6.2
Romania	43.2	40.4	25.9	26.2	5.5	5.5
Slovakia	22.7	22.6	10.8	10.9	8.5	8.2
Slovenia	32.7	33.0	34.1	34.7	2.2	2.1
Spain	36.9	36.9	16.8	17.5	1.7	5.2
Sweden	65.8	64.7	68.6	68.9	24.0	26.6
United Kingdom	22.4	24.6	5.5	6.2	4.4	4.5
EU-28	**28.8**	**29.7**	**18.6**	**18.6**	**6.7**	**7.1**

Note: RES-E: energy from renewable sources for electricity production; RES-H/C: energy from renewable sources for heating and cooling; RES-T: energy from renewable sources in the transport sector.

Sources: EEA, 2017k; Eurostat, 2017d.

Annex 3 Progress towards energy efficiency targets: data and methodology

A3.1 Reporting requirements for energy efficiency/energy consumption

Under Article 3 of the EED (EU, 2012), Member States had to set their own indicative national energy efficiency targets. 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. In some Member States, the targets may still be subject to change in the coming years.

A3.2 Data sources for energy consumption

The analysis presented in this report is based on several sources relating to energy consumption in Europe.

A3.2.1 Historical trends in primary and final energy consumption

The assessment of progress towards energy efficiency targets is based, for the most part, on information reported by Member States to Eurostat under the Energy Statistics Regulation, and published by Eurostat via its energy statistics database (Eurostat, 2017a, 2017b, 2017c).

A3.2.2 Approximated estimates for primary and final energy consumption in 2016

Early estimates of 2016 primary and final energy consumption were prepared by the EEA (EEA, 2017h; Eurostat, 2017a). National estimates have been provided by Estonia, Germany and Malta.

A3.3.3 National targets on primary and final energy consumption

The EEA's assessment of progress towards energy efficiency targets is based on the targets set under Article 3 of the EED in 2013, including updates as notified by Member States in their 2014 and 2017 NEEAPs or in a separate notification to the European Commission in 2017 (EC, 2017a, 2017g). 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, that allows the EEA to assess progress towards energy efficiency targets consistently across Member States.

A3.3 Tracking progress towards energy efficiency targets

Analysis of the progress made towards achieving energy efficiency targets at national levels involves assessing whether or not the efforts undertaken since 2005 have been sufficient to reduce or limit primary energy consumption at a pace sufficient to meet the 2020 target. This question can be addressed by comparing 2015 (or 2016) levels with a linear trajectory between 2005 and the 2020 national target.

This linear assessment is applied to track energy efficiency progress for the following reasons:

- Unlike RES and GHG emissions, reliable projections and/or targets on energy consumption for interim years until 2020 are not available at Member State level.
- No other indicators/parameters/methodologies with a transparent, well-established and statistically known relationship to primary energy consumption are available.

Therefore, this assessment is based on the comparison between average historical trends and the trends deemed necessary to achieve 2020 targets. To remain consistent with the assessments presented for GHG emissions and RES, the year 2005 was chosen as a single base year, to allow for the comparable assessment of trends across Member States.

For the purpose of cross-country comparison, absolute target levels of primary energy consumption as reported by Member States are taken into account in this assessment. This methodology does not consider the level of ambition of the national target (which

varies significantly across the EU), nor does it capture the complexity of the national context (economic development, ability to attract financing for energy efficiency projects, etc.). Since the methodology is based on absolute primary energy consumption values, it may differ from the approach adopted by Member State themselves.

The numeric results of this assessment per Member State are shown in greater detail in Table A3.1 below.

Table A3.1 Member States' progress towards their 2020 energy efficiency targets

Member State	Primary energy consumption			Linear trajectory 2005–2020 target			Distance to trajectory	
	2005	2015	Proxy 2016	2015	2016	2020	2015	Proxy 2016
	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	Mtoe	% (share of 2005 levels)	
Austria	32.4	31.3	31.8	31.8	31.8	31.5	1.6 %	- 0.1 %
Belgium	51.3	45.7	47.0	46.2	45.7	43.7	1.0 %	- 2.5 %
Bulgaria	18.9	17.9	17.8	17.5	17.4	16.9	- 1.9 %	- 2.1 %
Croatia	9.1	8.0	8.2	10.2	10.3	10.7	23.9 %	23.3 %
Cyprus	2.5	2.2	2.4	2.3	2.3	2.2	2.4 %	- 4.5 %
Czech Republic	42.5	39.9	39.5	43.7	43.8	44.3	8.9 %	10.2 %
Denmark	19.3	16.5	17.0	17.9	17.8	17.2	7.2 %	3.7 %
Estonia	5.4	6.2	6.0	6.1	6.2	6.5	- 1.3 %	3.0 %
Finland	33.4	32.0	33.0	35.0	35.2	35.9	9.1 %	6.6 %
France	260.3	239.4	235.4	233.4	230.7	219.9	-2.3 %	- 1.8 %
Germany	317.3	292.9	296.2	290.2	287.5	276.6	-0.9 %	- 2.8 %
Greece	30.6	23.7	23.2	26.7	26.3	24.7	9.7 %	10.1 %
Hungary	25.4	22.3	23.8	24.5	24.4	24.1	8.8 %	2.5 %
Ireland	14.7	14.0	14.5	14.8	14.8	14.9	5.7 %	2.1 %
Italy	181.5	149.6	150.6	165.8	164.3	158.0	8.9 %	7.6 %
Latvia	4.5	4.3	4.3	5.1	5.1	5.4	17.4 %	18.0 %
Lithuania	8.0	5.8	6.0	7.0	6.9	6.5	14.9 %	10.9 %
Luxembourg	4.8	4.1	4.1	4.6	4.6	4.5	9.1 %	10.3 %
Malta	1.0	0.8	0.7	0.9	0.9	0.8	12.1 %	14.5 %
Netherlands	69.0	64.3	63.6	63.5	62.9	60.7	- 1.2 %	- 1.0 %
Poland	87.7	90.0	93.1	93.5	94.1	96.4	4.0 %	1.1 %
Portugal	24.9	21.7	20.7	23.3	23.1	22.5	6.4 %	9.7 %
Romania	36.7	31.3	31.4	40.9	41.3	43.0	26.1 %	26.9 %
Slovakia	17.8	15.4	15.6	16.9	16.8	16.4	8.2 %	6.8 %
Slovenia	7.0	6.5	6.6	7.1	7.1	7.1	8.3 %	6.6 %
Spain	135.9	117.1	118.9	127.0	126.1	122.6	7.3 %	5.4 %
Sweden	48.7	43.7	47.3	48.0	47.9	47.6	8.8 %	1.3 %
United Kingdom	222.8	183.0	180.4	194.0	191.1	179.6	4.9 %	4.8 %
EU	**1 713.2**	**1 529.6**	**1 539.1**	**1 559.7**	**1 544.4**	**1 483.0**	**1.8 %**	**0.3 %**

Note: The distance to a trajectory is calculated as 'linear trajectory value' – 'primary energy consumption'. A positive value indicates an energy consumption below the linear trajectory.

Sources: EC, 2017a, 2017g; EEA, 2017g, 2017h; Eurostat, 2017a, 2017b, 2017c.

Annex 4 Domestic climate and energy targets in the European Union

- The European Council has endorsed the objective of reducing Europe's GHG emissions by between 80 % and 95 % by 2050, compared with 1990 levels, in the context of necessary reductions to be collectively achieved by developed countries, according to the IPCC.
- The EU also adopted, unilaterally, a set of three climate and energy targets for 2020: a 20 % reduction in its GHG emissions compared with 1990 levels; renewable energy use equal to 20 % of gross final energy consumption (with a minimum of 10 % in the transport sector); and a 20 % reduction in energy consumption, compared with a hypothetical 2020 level based on a business-as-usual scenario.
- To meet the 2020 GHG target, in 2009 the EU adopted a climate and energy package, which comprises a legislative set of binding targets. This package defined a single target for all EU emissions covered by the EU ETS and a set of national targets for all other emissions not covered by the EU ETS. The ETS target corresponds to a reduction of about 21 % of ETS emissions by 2020 compared with 2005, while for the other emissions, the target is an overall reduction of about 9 % under the ESD, compared with 2005. The ESD sets annual national targets for each year of the period between 2013 and 2020.
- To meet the 2020 target on renewable energy, the RED sets different binding targets, which are to be achieved by 2020, for each Member State and provides indicative trajectories for the period from 2011 to 2020.
- With regard to energy efficiency, Member States have set their own non-binding targets for energy consumption by 2020 under the EED. These targets take various forms, and some of them may be subject to later revision.
- For 2030, the European Council agreed in October 2014 to endorse an EU binding target of at least a 40 % reduction in domestic GHG emissions by 2030 compared with 1990 levels, which corresponds to a 43 % reduction in the ETS sectors and a 30 % reduction in the Effort Sharing sectors by 2030, compared with 2005. For the Effort Sharing sectors, Member States will set binding annual GHG targets between 2021 and 2030, with additional flexibilities to allow for a fair and cost-efficient achievement of these targets. Member States have also set a target, which is binding at the EU level, of achieving a level of renewable energy consumption that is at least 27 % of the total energy consumed in the EU by 2030. For energy efficiency, an indicative target has been set at EU level, of at least a 27 % reduction in energy consumption by 2030 compared with projections of future energy consumption, based on the current criteria. In June 2017 the European Council agreed on a higher energy efficiency target for 2030 of 30 %, which is still under discussion.
- 'Energy Union and Climate' was identified as one of 10 priorities at the start of the Juncker Commission's term. This priority comprises five 'dimensions' ('supply security', 'a fully integrated internal energy market', 'energy efficiency', 'climate action — emission reduction' and 'research and innovation'). All of these dimensions are now reported on annually in the State of the Energy Union, which adds further momentum to the transition to a low-carbon, secure and competitive economy.

A4.1 The '20-20-20' targets for 2020

The EU has a long-term goal of reducing Europe's GHG emissions by 80 % by 2050, compared with 1990 levels. In the context of its commitments and the negotiations at international level, in March 2007 the European Council committed the EU to becoming a highly energy-efficient, low-carbon economy by achieving three domestic climate and energy objectives by 2020 (Council of the European Union, 2007):

- to reduce GHG emissions by 20 % compared with 1990 levels;
- to increase to 20 % the share of energy from renewable sources in the EU's gross final energy consumption;
- to improve the EU's energy efficiency by 20 %.

To achieve these domestic commitments, in 2009, the EU adopted the climate and energy package, which comprises various pieces of legislation (EU, 2009a, 2009c, 2009d, 2009e, 2009f). The package introduced a clear approach to achieving the 20 % reduction in total GHG emissions, compared with 1990 levels, which is equivalent to a 14 % reduction compared with 2005 levels. This 14 % reduction objective is to be achieved through a 21 % reduction compared with 2005 levels for emissions covered by the ETS, and a 9 % reduction for sectors covered by the ESD (EU, 2009c).

A revision of the ETS Directive (EU, 2009a) introduced a single 2020 target for all EU emissions covered by the EU ETS (as well as ETS emissions from the three participating non-Member States, namely Iceland, Liechtenstein and Norway). The ETS essentially covers emissions from large industrial installations, as well as emissions from aviation. ETS emissions represent about 40-45 % of total EU GHG emissions. The 2020 cap corresponds to a reduction of about 21 % in ETS emissions by 2020, compared with 2005 levels. The sectors covered under the EU ETS are therefore expected to contribute the largest proportion of emission reductions in the context of meeting the EU's 2020 GHG emissions target. For allowances allocated to the EU ETS sectors, annual caps have been set for the period from 2013 to 2020; these decrease by 1.74 % annually. For further details on the EU ETS in the period 2013-2020, see EEA, 2017k.

For all other emissions not covered by the EU ETS, the ESD has set annual binding targets for each year of the period between 2013 and 2020, for each Member State.

These EU-internal rules under the '2020 climate and energy package' underpin the EU implementation of the 2020 target under the UNFCCC (see Annex 5).

A4.2 The 2030 climate and energy framework

To ensure that the EU is cost-effectively attaining its long-term objective, EU leaders agreed, in October 2014, on a 2030 climate and energy policy framework for the EU, and endorsed the following targets (European Council, 2014):

- A binding target of at least a **40 % domestic reduction in GHG emissions**, compared with 1990 levels, was agreed. The 40 % domestic reduction target for GHG emissions will ensure that the EU is on track to cost-effectively meeting its objective of cutting emissions by at least 80 % by 2050. This target will be delivered collectively, with a 43 % reduction in the ETS sectors and a 30 % reduction in the Effort Sharing sectors by 2030, compared with 2005 levels. In the EU ETS, the annual factor that reduces the cap on the maximum permitted emissions will be changed from 1.74 % to 2.2 % from 2021 onwards. In Effort Sharing sectors, the methodology for setting the national reduction targets, with all the elements as applied in the ESD for 2020, will be slightly amended for 2030. Efforts will be distributed on the basis of relative GDP per capita, but targets for Member States with a GDP per capita above the EU average will be adjusted relatively, to reflect cost-effectiveness in a fair and balanced manner. All Member States will contribute to the overall EU reduction in 2030, with the targets ranging from 0 % to - 40 %, compared with 2005 levels.
- A target for renewable energy consumption of at least 27 % of total energy consumption was set. This target is binding at EU level, but there are no fixed targets for individual Member States. This target is intended to provide flexibility for Member States to set their own more ambitious national objectives for increased renewable energy use, and to support them, in line with the state aid guidelines, as well as take into account their degree of integration in the internal energy market.
- The European Council endorsed a target at EU level of 30 % for improving energy efficiency, compared with projections of future energy consumption, based on the current criteria (i.e. projections of energy consumption in 2030 from the 2007 Energy Baseline Scenario from the European Commission) (European Council, 2017).

Neither the renewable energy target nor the energy efficiency target will be translated into nationally binding targets. Individual Member States are free to set their own higher national targets.

These targets for 2030 were submitted to the UNFCCC on 6 March 2015 as an INDC for the Paris Agreement of December 2015.

The European Commission proposed in 2016 to integrate the LULUCF sector into the EU 2030 climate and energy framework from 2021 onwards. The current proposal (EC, 2016i) suggests a 'no debit rule' requiring each Member State to compensate net accounted emissions from the LULUCF sector by emission reductions in Effort Sharing sectors (see Section 2.5). The proposal also includes modified accounting rules.

The adoption of the Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy (EC, 2015b) underlined the importance of meeting the 2030 targets, as 'Energy Union and Climate' was identified as one of 10 priorities at the start of the Juncker Commission's term. This priority comprises five 'dimensions' (i.e. 'supply security', 'a fully integrated internal energy market', 'energy efficiency', 'climate action — emission reduction' and 'research and innovation'), which have been henceforth reported on annually in the State of the Energy Union (latest report from 2017: EC, 2017c). The annual reporting of progress is considered essential so that issues can be identified in a timely fashion and addressed, if necessary, through further policy interventions.

A4.3 National targets and compliance under the Effort Sharing Decision

A4.3.1 Targets for 2020

The ESD covers emissions from all sources outside the EU ETS, except for emissions from aviation ([37]) and international maritime transport, and net emissions from LULUCF. The ESD therefore includes a range of diffuse sources in a wide range of sectors such as transport (cars, trucks), buildings (in particular heating), services, small industrial installations, agriculture and waste. Such sources currently account for almost 60 % of total GHG emissions in the EU.

The ESD sets individual annual binding targets for GHG emissions not covered by the EU ETS for all Member States for the period from 2013 to 2020 (AEAs) (EU, 2009c). In 2013, the European Commission determined the AEAs of Member States for the period from 2013 to 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 ETS scope from 2013 onwards (EU, 2013b) ([38]) and in 2017 to reflect updates in methodologies for reporting of GHG inventories (EU, 2017b).

Each Member State will contribute to this effort, according to its relative wealth in terms of 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 Figure A4.1). At EU level, this will deliver approximately 9.3 % emission reductions by 2020, compared with 2005 levels, from those sectors covered by the ESD. The least wealthy countries are allowed to increase emissions in these sectors because their relatively high economic growth is likely to be accompanied by higher emissions. Nevertheless, their targets still represent a limit on emissions, and a reduction effort will be required by all Member States; they will need to introduce policies and measures to limit or lower their emissions in the various ESD sectors.

A4.3.2 Proposed 2030 targets

On 20 July 2016, the European Commission presented a legislative proposal, the 'Effort Sharing Regulation', which sets out binding annual GHG emission targets for Member States for the period 2021-2030 (EC, 2016g). The proposal is the follow-up to the ESD, which established national emission targets for Member States in Effort Sharing sectors between 2013 and 2020. The proposal recognises the different capacities of Member States to take action by differentiating targets according to GDP per capita across Member States. This ensures fairness because 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

([37]) 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, Liechtenstein 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-CO_2 emissions from domestic aviation remain covered under the ESD.

([38]) According to Article 27(2) of Regulation (EU) 525/2013, the European Commission is to examine the impact of the use of the 2006 IPCC guidelines for national GHG inventories and significant changes brought about by the UNFCCC methodologies by December 2016, and may revise Member States' AEAs, as provided in the ESD, accordingly.

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. In line with the guidance of the European Council, the resulting 2030 GHG emission targets range from 0 % to - 40 %, compared with 2005 levels (see Figure A4.1).

A4.3.3. Allowed flexibilities under the ESD

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

- Within the Member State itself, any overachievement in a year during the period from 2013 to 2019 can be carried over to subsequent years, up to 2020. Up to 5 % of a Member State's annual emission allocation may be carried forward to the following year during the period from 2013 to 2019. Where the emissions of a Member State are below that annual emission allocation, excess emission reductions can be carried over to the subsequent years.

- 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*).

Member States may use emission credits from the Kyoto Protocol's flexible mechanisms in accordance with the following provisions:

- The use of project-based emission credits is capped on a yearly basis up to 3 % of 2005 ESD emissions in each Member State.

- Member States that do not use their 3 % limit for project-based credits in any specific year can transfer their unused credits for that year to other Member States, or bank it for their own use until 2020.

- Member States fulfilling additional criteria (Austria, Belgium, Cyprus, Denmark, Finland, Ireland, Italy, Luxembourg, Portugal, Slovenia, Spain and Sweden) may use credits from projects in least developed countries (LDCs) and small island developing states (SIDS) for up to an additional 1 % of their verified emissions in 2005. These credits are not bankable or transferable.

Overall, a maximum of Kyoto emission credits equivalent to 750 $MtCO_2$ at EU level can be used during the period 2013-2020. As most Member States are expected to meet their ESD targets (see Section 3.1) without the flexibility provisions, while other Member States can meet their ESD targets through intra-EU transfers of AEAs, the use of project credits is expected to be significantly smaller.

Any Member State exceeding its annual AEA, even after taking into account the flexibility provisions and the use of Kyoto Protocol emission credits, will have to take corrective measures as laid down in the ESD and will be subject to the following consequences:

- a deduction from the AEA for the next year of the excess Effort Sharing emissions multiplied by 1.08 (8 % interest rate);

- the development of a corrective action plan — the European Commission may issue an opinion, possibly taking into account comments from the Climate Change Committee;

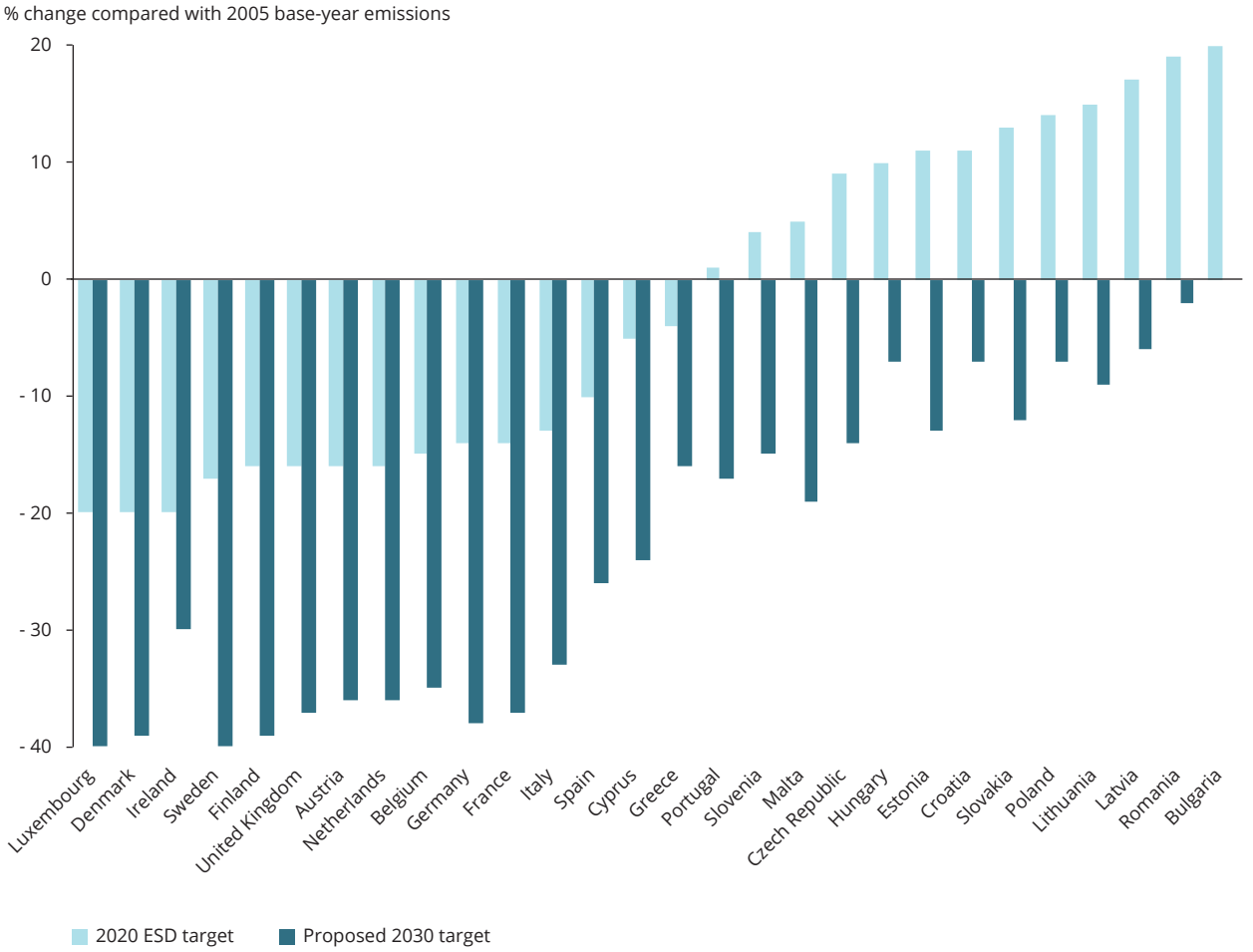
- the transfer of emission allocations and project-based credits from the account of that Member State will be temporarily suspended while the Member State is in a state of non-compliance with its ESD obligations.

The proposed 'Effort Sharing Regulation' for 2030 targets maintain existing flexibilities under the current ESD (e.g. banking, borrowing, buying and selling) and provides two new flexibilities to allow for a fair and cost-efficient achievement of the targets. These new flexibilities are as follows:

- A new one-off flexibility to access allowances from the EU ETS: this allows eligible Member States to achieve their national targets by covering some emissions in the Effort Sharing sectors with EU ETS allowances that would normally be auctioned. The amount of allowances used for that purpose may not exceed 100 $MtCO_2$ over the period 2021-2030 in the whole EU. Eligible Member States have to notify the Commission before 2020 of the amount of the allowances they aim to use under this flexibility over the period. Since the transfer is strictly limited in volume, and decided beforehand, predictability and environmental integrity are maintained.

- A new flexibility to access credits from the land use sector: to stimulate additional action in the land use sector, the proposal allows Member States to use up to 280 million credits over the entire period 2021-2030 from certain land use categories

Figure A4.1 National 2020 targets under the Effort Sharing Decision(ESD) and proposed targets for 2030



Notes: The targets are expressed relative to 2005 ESD base-year emissions. These base-year emissions are calculated on the basis of relative and absolute 2020 targets (for details on ESD base-year emissions, please see Section A1.2 in Annex 1).

The absolute 2020 and 2013 targets used for the calculations are consistent with the global warming values in the IPCC AR4 (IPCC, 2007) and take into account the change in the scope of the ETS from the second to the third period (2013 to 2020).

Sources: EC, 2016g; EU, 2009c.

to comply with their national targets. All Member States are eligible to make use of this flexibility, but more access is available for Member States with a larger proportion of emissions from agriculture. In line with EU leaders' guidance, this recognises that there is a relatively low mitigation potential for emissions from the agriculture sector.

A4.4 Renewable energy targets for 2020

To meet its target of increasing the use of RES to 20 % of gross final energy consumption by 2020, the EU adopted the RED (EU, 2009d) 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, 2009c). 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 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 thereafter), 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.

In contrast, no national targets for renewable energy have been set for 2030.

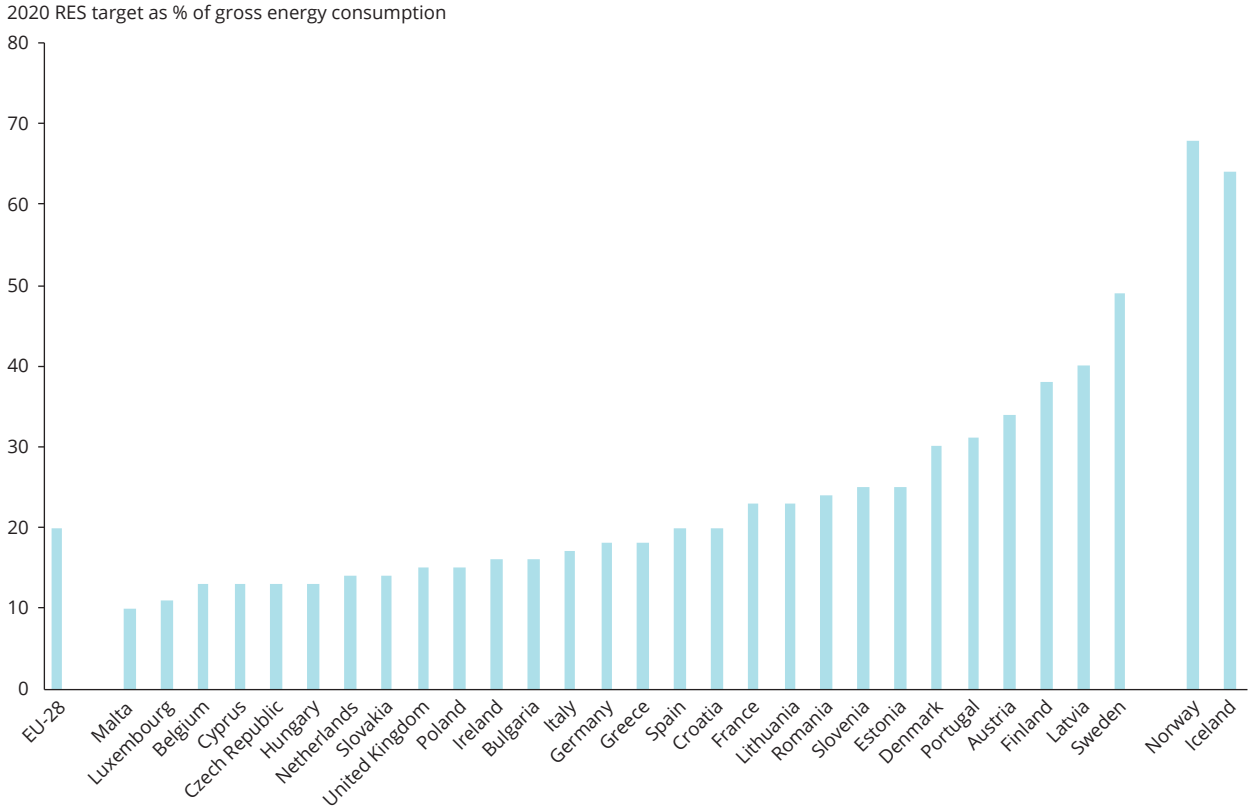
A4.5 Energy efficiency targets for 2020

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

The climate and energy package does not address the energy efficiency target directly, although the CO_2 performance standards for cars and vans (EU, 2009f, 2014a), 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 Action Plan for Energy Efficiency 2006 (EC, 2006). The energy efficiency action plan was reviewed in 2011, after revisions of the following pieces of legislation:

- the Ecodesign Directive (EU, 2009g, 2012);
- the Energy Labelling Directive (EU, 2010a);
- the Energy Performance of Buildings Directive (EPBD) (EU, 2010b).

Figure A4.2 National renewable energy targets for 2020



Notes: The targets for Iceland and Norway, which are not EU Member States, were agreed and are included in the annex of the European Economic Area agreement. For the sake of simplicity, the report refers to these as RED targets.

RES, renewable energy source.

Source: EU, 2009d.

One of the key developments in the energy efficiency policy framework was the adoption of the EED in 2012 (EU, 2012). The EED establishes a common framework of measures for the promotion of 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. The EED stipulates that primary energy consumption in the EU should not exceed 1 483 Mtoe in 2020, and that final energy consumption in the EU should not exceed 1 086 Mtoe in 2020. These absolute targets were set using the European Commission's 2007 Energy Baseline Scenario (EC, 2008), based on the Price-driven and Agent-based Simulation of Markets Energy System Models (PRIMES). Implementing the EED was expected to lead to a 15 % reduction in primary energy consumption compared with the 2007 Energy Baseline Scenario, with an additional 2 % reduction expected from the transport sector (Groenenberg, 2012).

Under the EED, Member States had to set indicative national targets and implement a set of mandatory requirements, one of the most significant being the establishment of an Energy Efficiency Obligation (EEO) scheme, or the implementation of alternative measures.

Member States have adopted various base years against which the progress towards national energy efficiency targets will be measured. Member States also chose different approaches for setting national targets. A total of 10 Member States (Austria, Belgium, Cyprus, Denmark, Hungary, Ireland, Italy, Latvia, Malta and Poland) chose to focus their targets on primary energy consumption, while 12 (Croatia, Estonia, Finland, France, Greece, Lithuania, Luxembourg, the Netherlands, Spain, Slovakia, Slovenia and the United Kingdom) chose to focus their national targets on gross final energy consumption. Another two (Bulgaria and Sweden) have focused on primary energy intensity. Each national target reflects the specific situation of the Member State that adopted it. As a consequence, ambition levels vary greatly. Compared with 2005 levels, currently 18 Member States have aimed to reduce final as well as primary energy consumption; for six Member States, targets show an increase in final as well as primary energy consumption. Four other Member States intend to keep the potential increase in either primary or final energy consumption to a certain limit over the period.

In some Member States, the targets are still subject to change. This is because some countries are currently holding nationwide debates on the future of their energy systems and they are allowed to adjust their targets when they review their triennial NEEAPs submitted under the EED. In fact, in 2017, 18 Member States had submitted their revised NEEAPs before the finalising of this report.

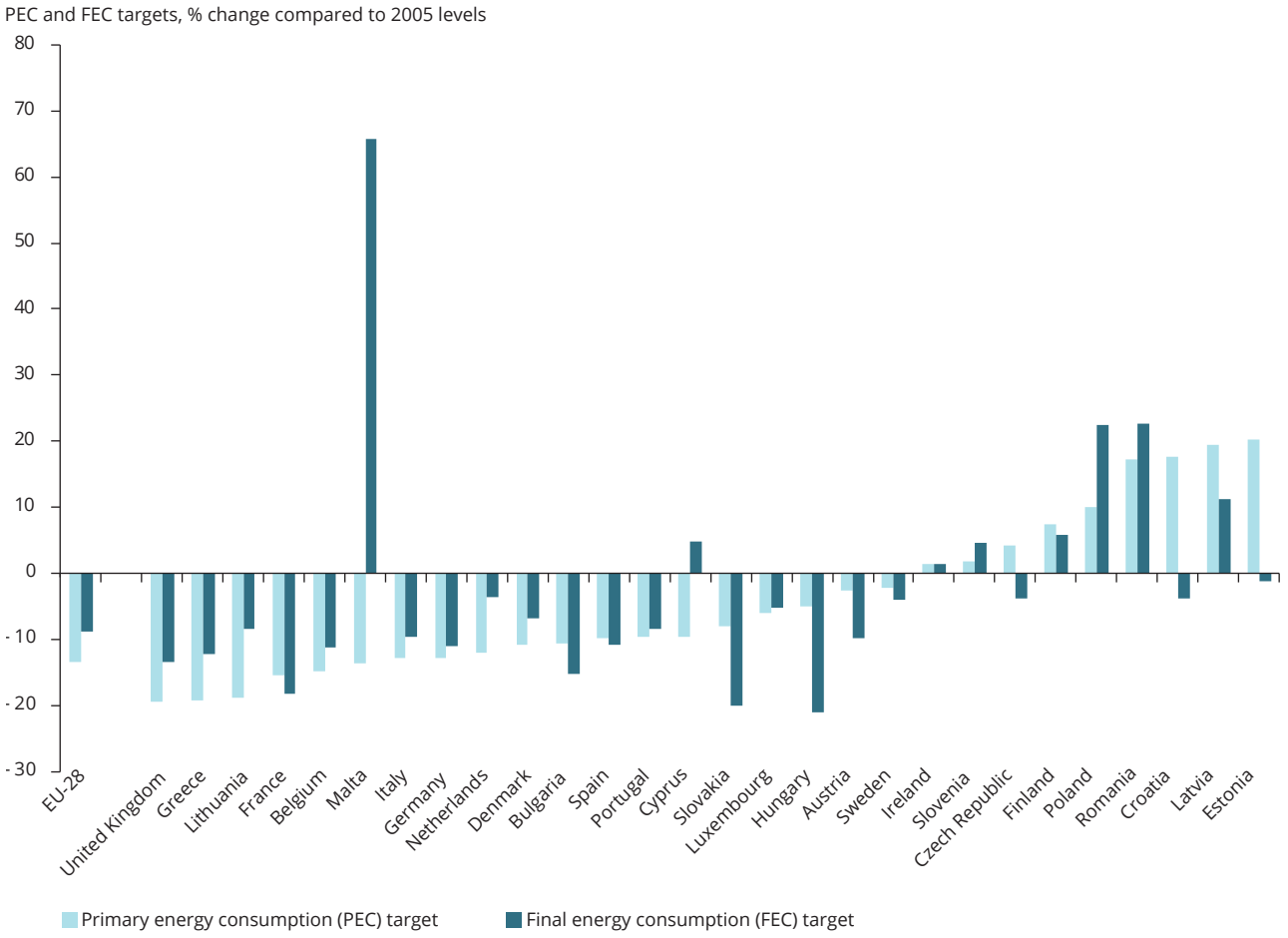
Figure A4.3 shows the national targets set by each Member State under the EED, compared with 2005 levels, for primary and final energy consumption. The year 2005 is used here to serve as a common reference, although the EED does not explicitly use it as a common base year.

In contrast, no national targets for energy efficiency have been set for 2030 (see Section 1.2).

A4.6 Overview of 2020 national climate and energy targets

The main targets that apply to Member States under international and EU commitments are presented in Table A4.1. The scope of existing EU legislation that implements a domestic 20 % target commitment is different from that of the Kyoto target for the second commitment period. For this reason, the total allowed emissions or the 'emissions budget' under the climate and energy package cannot be directly compared with the corresponding quantified emission limitation or reduction commitment (QELRC). Some of the main differences between the climate and energy package and the second commitment period, in terms of emissions included and the methodologies used to determine emissions, relate to the treatment of emissions from international aviation, emissions and removals from LULUCF, the use of units from flexible mechanisms, the coverage of NF_3, flexibilities regarding base years and the use of GWP. The differences are summarised in Table A4.5. For details, please see EEA, 2014b, as well as Annex 5.

Figure A4.3 National indicative energy efficiency targets for 2020, expressed in primary energy consumption (PEC) or final energy consumption (FEC)



Note: The national targets for 2020 reported by Member States under the EED were first calculated in absolute terms and then compared with 2005 levels.

Sources: EC, 2015c, 2017d, 2017e; EU, 2012; Eurostat, 2017a, 2017b, 2017c.

Table A4.1 Main national climate and energy targets

	Participating in EU ETS	ETS target (2020)	Effort Sharing Decision target (2020)	2020 ESD emission allocation	2005 ESD base-year emissions	Renewable target 2020 (RED)	Primary energy target 2020	Final energy target 2020
		% vs. 2005		Mt		% gross final energy consumption	Mtoe	
EU28		**- 21**	**- 9**	**2 618.2**	**2 887.1**	**20**	**1 483**	**1 086**
Austria	x		- 16	47.8	56.8	34	32	25
Belgium	x		- 15	68.2	80.3	13	44	33
Bulgaria	since 2007		20	26.5	22.1	16	17	9
Croatia	since 2013		11	19.3	17.4	20	11	7
Cyprus	x		- 5	4.0	4.2	13	2	2
Czech Republic	x		9	67.2	61.7	13	44	25
Denmark (a)	x		- 20	32.1	40.1	30	17	14
Estonia	x		11	6.0	5.4	25	6	3
Finland	x		- 16	28.5	33.9	38	36	27
France	x		- 14	342.5	398.2	23	220	131
Germany	x		- 14	410.9	477.8	18	277	194
Greece	x		- 4	60.0	62.6	18	25	18
Hungary	x		10	52.8	48.0	13	25	14
Ireland	x		- 20	37.7	47.1	16	15	13
Italy	x		- 13	291.0	334.5	17	158	124
Latvia	x		17	10.0	8.5	40	5	5
Lithuania	x		15	15.2	13.3	23	6	4
Luxembourg	x		- 20	8.1	10.1	11	4	4
Malta	x		5	1.2	1.1	10	1	1
Netherlands	x		- 16	107.4	127.8	14	61	52
Poland	x		14	205.2	180.0	15	96	72
Portugal	x		1	49.1	48.6	31	23	17
Romania	since 2007		19	89.8	75.5	24	43	30
Slovakia	x		13	25.9	23.0	14	16	9
Slovenia	x		4	12.3	11.8	25	7	5
Spain	x		- 10	212.4	236.0	20	123	87
Sweden	x		- 17	36.1	43.5	49	48	32
United Kingdom (a)	x		- 16	350.9	417.8	15	180	132
				EEA member countries				
Iceland	since 2008							
Liechtenstein	since 2008							
Norway	since 2008							
Switzerland	-							
Turkey	-							

Notes: ESD, Effort Sharing Decision; EU ETS, European Union Emissions Trading System; Mtoe, million tonnes of oil equivalent; RED, Renewable Energy Directive.

(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.

Sources: EC, 2017d; EU, 2009a, 2009c, 2009d, 2012, 2013a, 2013b.

Table A4.2 Technical details concerning EU climate-related targets

	International commitments			Unilateral EU commitments		
	Kyoto Protocol (CP1)	UNFCCC	Kyoto Protocol (CP2)	2020 climate and energy package		2030 climate and energy framework
				EU Emissions Trading System	Effort Sharing Decision	
Target year or period	First commitment period (2008-2012)	2020	Second commitment period (2013–2020)	2013-2020	2013-2020	2030
Emission target	- 8 %	- 20 %	- 20 %	- 21 % compared with 2005 for ETS emissions	Annual targets for Member States. In 2020, - 9 % compared with 2005 for ESD emissions	At least - 40 %
Other targets		Conditional target of - 30 % if other parties take on adequate commitments		RED: renewable energy use — 20 % of gross final energy consumption; EED: increase in energy efficiency by 20 %		Renewable energy use — at least 27 % of energy consumption; At least a 27 % increase in energy efficiency
Base year	1990; Kyoto Protocol flexibility rules for fluorinated gases (F-gases) and economies in transition	1990	1990, but subject to flexibility rules. 1995 or 2000 may be used as base year for F-gases or nitrogen trifluoride (NF_3)	1990 for overall emission reduction target; 2005 targets broken down into ETS and non-ETS emissions		1990 for emission reduction target
LULUCF	Included afforestation, reforestation and deforestation (ARD) and other activities if elected	Excluded	Included ARD and forest management (FM), other activities if elected (new accounting rules)	Excluded		Included; details to be finalised prior to 2020
Aviation	Domestic aviation included; international aviation excluded	Domestic aviation included; international aviation partly included	Domestic aviation included; international aviation excluded	Domestic and international aviation (partly) included in EU ETS	Aviation generally excluded, some domestic aviation included (operators below ETS *de minimis* thresholds)	Not specified yet; expectation of market mechanisms for aviation under the International Civil Aviation Organization (ICAO)
Use of market mechanisms	Use of Kyoto Protocol flexible mechanisms subject to Kyoto Protocol rules	Subject to quantitative and qualitative limits	Use of Kyoto Protocol flexible mechanisms subject to Kyoto Protocol rules	Subject to quantitative and qualitative limits	Subject to quantitative and qualitative limits	None

Table A4.2 Technical details concerning EU climate-related targets (cont.)

	International commitments			Unilateral EU commitments		
	Kyoto Protocol (CP1)	UNFCCC	Kyoto Protocol (CP2)	2020 climate and energy package		2030 climate and energy framework
				EU Emissions Trading System	Effort Sharing Decision	
Carry-over of units from preceding periods	Not applicable	Not applicable	Subject to Kyoto Protocol rules including those agreed in Doha Amendment	Since the second trading period, EU ETS allowances can be banked into subsequent ETS trading periods	No restriction of carry-over within the 2013-2020 period	Banking in the EU ETS is confirmed; the legislative proposal(s) for non-ETS emissions are still pending
Gases covered	Carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6)	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3	CO_2, N_2O, PFCs	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 included; NF_3 not included	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6, NF_3
Sectors included	Energy, industrial processes and product use (IPPU), agriculture, waste, LULUCF	Energy, IPPU, agriculture, waste, aviation	Energy, IPPU, agriculture, waste, LULUCF	Power and heat generation, energy-intensive industry sectors, aviation	Transport (except aviation), buildings, non-ETS industry, agriculture (except forestry) and waste	100 %
Source for global warming potential values	IPCC Second Assessment Report (SAR)	IPCC SAR; inventory data (including historical data) based on the IPCC Fourth Assessment Report (AR4) from 2015 onwards	IPCC AR4	IPCC AR4		IPCC AR4
Countries included	15 pre-2004 EU Member States (additional Kyoto Protocol targets for the other Member States)	28 EU Member States	28 EU Member States plus Iceland	28 (Iceland, Liechtenstein and Norway also covered under EU ETS)		28 (Iceland and Norway intend to collectively deliver their international commitment with EU)

Note: EED, Energy Efficiency Directive; LULUCF, land use, land use change and forestry; RED, Renewable Energy Directive.

Annex 5 International climate commitments in Europe

- The Paris Agreement, which was adopted by 195 countries in December 2015, sets a long-term goal of ensuring that the increase in the average global temperature is well below 2 °C above pre-industrial levels, with the aim of limiting the increase to no more than 1.5 °C. The agreement is due to enter into force in 2020.
- The European Council has endorsed the objective of reducing Europe's GHG emissions by between 80 % and 95 % by 2050, compared with 1990 levels, in the context of necessary reductions to be collectively achieved by developed countries, according to the IPCC.
- The EU, its Member States and other EEA member countries are committed to limiting or reducing their GHG emissions under international commitments, in particular the UNFCCC and its Kyoto Protocol. For the first commitment period (2008-2012), the EU-15 had a common reduction target of 8 % compared with base year levels (close to 1990 levels). For the second commitment period (2013-2020), the EU and Iceland committed to cutting their emissions by 20 %, compared with base-year levels, by 2020.

A5.1 The UNFCCC, the Kyoto Protocol and the Paris agreement

In 1992, countries across the globe adopted the UNFCCC to cooperatively consider options for limiting average global temperature increases and the resulting climate change. Under the UNFCCC, developed country parties (Annex I parties) ([39]) are specifically obliged to commit to adopting national policies and to take corresponding measures for the mitigation of climate change.

The Kyoto Protocol was the first international legally binding agreement signed under the UNFCCC. It specifies the mitigation obligations of the Annex I parties that signed the agreement. It was signed in 1997 and entered into force in 2005. The first commitment period of the Kyoto Protocol ran from 2008 until 2012. In this first period, 37 industrialised countries committed to reducing GHG emissions by an average of 5 % compared with 1990 levels. The EU (comprising 15 Member States at that time) pledged to jointly reduce its GHG emissions by 8 % compared with base year levels. This target was fulfilled.

In Doha, Qatar, in 2012 (at the 18th session of the Conference of the Parties (COP 18) and the eighth meeting of the Parties to the Kyoto Protocol (CMP 8)), the second commitment period (2013-2020) was delineated; the Doha Amendment (UNFCCC, 2012a) includes new QELRCs for Annex I parties intending to take part in the second commitment period. Overall, the Doha Amendment sets an emission reduction objective of 18 % less than 1990 levels for all parties to the Kyoto Protocol for the second commitment period. The Doha Amendment's entry into force is subject to acceptance by at least three quarters of the Parties to the Kyoto Protocol ([40]). Although the EU and its 28 Member States, and Iceland, Liechtenstein, Norway and Switzerland (i.e. all EEA countries) agreed on QELRCs for the second commitment period, other countries, such as Canada, Japan, New Zealand and Russia, did not submit targets for the second commitment period (despite having targets under the first commitment period). Overall, emissions by countries with targets for the second commitment period make up only 14-15 % of global emissions (EC, 2013d).

([39]) A party is a state (or regional economic integration organisation such as the EU) that agrees to be bound by a treaty and for which the treaty has entered into force. Annex I parties are those listed in Annex I of the UNFCCC; they comprise industrialised countries that were members of the Organisation of Economic Co-operation and Development (OECD) in 1992, as well as countries with economies in transition (UNFCCC, 2014).

([40]) Since COP 21 in 2015, all necessary decisions on methodological issues have been adopted by the Conference of Parties. Still, as of 6 July 2017, only 79 countries have ratified the Doha Amendment.

The EU has been at the forefront of international efforts towards a global climate deal. After limited participation in the Kyoto Protocol and a lack of an agreement in Copenhagen in 2009, the EU has been building a broad coalition of developed and developing countries in favour of high ambition; this shaped the successful outcome of the Paris conference (COP 21). The Paris Agreement is a bridge between today's policies and climate neutrality before the end of the 21st century. Governments have agreed on a long-term goal of ensuring that the increase in global average temperature does not exceed 2 ºC above pre-industrial levels, aiming to limit the increase to no more than 1.5 ºC, as this would significantly reduce risks and the impacts of climate change.

Before and during the Paris conference, countries submitted comprehensive national climate action plans (INDCs). These are not yet sufficient to keep global warming levels below 2 ºC, but the agreement will help towards achieving this target. The EU was the first major economy to submit its intended contribution to the new agreement, in March 2015. It is already taking steps to implement its target to reduce emissions by at least 40 % by 2030. The agreement entered into force on 4 November 2016, when 55 countries, which collectively account for at least 55 % of global emissions, had deposited their instruments of ratification. As of July 2017, 153 of 197 countries have ratified the Paris Agreement.

A5.2 Progress of the European Union under the second commitment period of the Kyoto Protocol (2013-2020)

For the second commitment period of the Kyoto Protocol, the EU, its 28 Member States and Iceland agreed to a joint QELRC corresponding to a 20 % reduction compared with the base year; they declared that they intended to fulfil this commitment jointly, under Article 4 of the Kyoto Protocol. The three other EEA member countries, Liechtenstein, Norway and Switzerland, also agreed on QELRCs for the second commitment period.

The Council adopted, on 13 July 2015, the legislation necessary for the EU to formally ratify the second commitment period of the Kyoto Protocol. The Council adopted two decisions:

- Council decision on the ratification of the Doha Amendment to the Kyoto Protocol establishing the second commitment period;
- Council decision on the agreement between the EU, its Member States and Iceland, necessary for the joint fulfilment of the second commitment period of the Kyoto Protocol.

In parallel with ratification by the EU, the individual Member States and Iceland will finalise their national ratification processes; however, the second commitment period has not yet been ratified by the EU.

A5.3 Methodological details related to targets under the Kyoto Protocol and the UNFCCC

A5.3.1 Second commitment period

The main amendments to Kyoto Protocol rules for the second commitment period (from 2013 to 2020), compared with the rules that were applicable in the first commitment period (from 2008 to 2012), are as follows:

Table A5.1 Emission reduction commitments by EU and EEA countries for the Kyoto Protocol's second commitment period (2013-2020)

Party	QELRCs submitted by parties (2013-2020)
	Reduction compared with base-year emissions (%)
EU	20.0
Iceland	20.0
Liechtenstein	16.0
Norway	16.0
Switzerland	15.8

Note: QELRC, Quantified emission limitation and reduction commitment.

Source: UNFCCC, 2012b.

- In addition to the gases covered in the first commitment period, the target for the second commitment period also covers NF_3.
- An ambition mechanism allows a party to adjust its commitment by increasing its ambition during a commitment period.
- Surplus assigned amount units (AAUs) from the first commitment period of the Kyoto Protocol can be carried over according to specific accounting rules (for further details, see EEA, 2014b).
- The AAUs of a party for the second commitment period can be adjusted in order to prevent an increase in its emissions for the 2013 to 2020 period, beyond its average emissions for the years 2008-2010.
- There are new accounting rules for emissions removals from LULUCF, in accordance with the relevant decisions made at COP 17 in Durban (UNFCCC, 2012a).
- Emissions of non-CO_2 gases are converted into CO_2 equivalent emissions using the GWP values included in the AR4 (IPCC, 2007).

However, a number of rules are unchanged for the second commitment period. As in the first commitment period, the target for the second commitment period refers to 1990 as a single base year, but it allows for different base years according to the flexibility rules for fluorinated gases (F-gases) and economies in transition (as described above). For the newly added GHG NF_3, either 1995 or 2000 may be used as the base year. Base years for individual Member States have not yet been set for the second commitment period. The use of certified emission reductions (CERs) from the clean development mechanism, emission reduction units (ERUs) ([41]) from joint implementation projects and the possible recognition of units from new market-based mechanisms are all possible to achieve targets (still capped under EU domestic legislation). Sector coverage remains the same.

A5.3.2 Convention (the United Nations Framework Convention on Climate Change)

In 2010, the EU submitted a pledge to reduce its GHG emissions by 20 % by 2020, compared with 1990 levels, to contribute to achieving the ultimate objective of the UNFCCC: 'to stabilise GHG concentrations at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system', or, in other words, to limit the global temperature increase to less than 2 ºC above temperature levels before industrialisation. The EU clarified that the accounting rules for its target under the UNFCCC are more ambitious than the current rules under the Kyoto Protocol; for example, international aviation has been 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 (CDM) used under the ETS (UNFCCC, 2013b). Accordingly, the following assumptions and conditions apply to the EU's target of a 20 % reduction under the UNFCCC:

- Emissions or removals from LULUCF are not included (but moving to the higher target of 30 % would require some contribution from LULUCF).
- The target refers to 1990 as a single base year, not allowing for different base years for F-gases or economies in transition, as under the Kyoto Protocol.
- Emissions from international and domestic aviation are partly included in the target; furthermore, the target covers the IPCC sectors of energy, industrial processes and product use (IPPU), agriculture and waste.
- A limited number of CERs, ERUs and units from new market-based mechanisms may be used to achieve the target: under the EU ETS, the use of international credits is capped (up to 50 % of the reduction required from EU ETS sectors by 2020 can be achieved through the use of carbon credits). Quality standards also apply to the use of international credits in the EU ETS, including a ban on credits from LULUCF projects and certain industrial gas projects. In the ESD sectors, the annual use of international credits is limited to up to 3 % of each Member State's ESD emissions in 2005, with a limited number of Member States being permitted to use an additional 1 % from projects in LDCs and SIDS, subject to conditions. These caps thus define the concept of the supplementary use of market-based mechanisms for the fulfilment of targets, and indicate that the EU applies more ambitious rules with regard to the use of

([41]) A Kyoto unit representing an allowance to emit 1 tonne of CO_2e. ERUs are issued for emission reductions or emission removals from joint implementation project activities by converting an equivalent quantity of the party's existing AAUs or removal units (RMUs).

market-based mechanisms towards its target under the UNFCCC than would be applied in the context of the Kyoto Protocol.

- The carry-over of surplus AAUs from the first commitment period of the Kyoto Protocol is not possible (but surplus EU emission allowances allocated under the EU ETS can be banked from the period 2008-2012 into subsequent periods).

- The target covers the gases CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorinated compounds (PFCs) and sulfur hexafluoride (SF_6), consistent with the GHGs covered under the reporting requirements under the convention (UNFCCC, 2013b).

A5.4 Land use, land use change and forestry activities under the Kyoto Protocol

In addition to policies and measures that target sources of GHG emissions, countries can use policies and measures to protect their existing terrestrial carbon stocks (e.g. by reducing deforestation), and further enhance terrestrial carbon stocks (e.g. by increasing the area or carbon density of forests).

The following LULUCF activities are included under the Kyoto Protocol:

- Afforestation, reforestation and deforestation (ARD) since 1990 (mandatory activities covered by Article 3.3 of the Kyoto Protocol), for land that has been subject to direct, human-induced conversion from a non-forest to a forest state, or vice versa, are included.

- Forest management (FM), cropland management (CM), grazing-land management (GM) and revegetation (RV) are included. Although CM, GM and RV are voluntary, FM has been a mandatory activity since the second commitment period under Article 3.4 of the Kyoto Protocol. These activities pertain to land that has not undergone conversion since 1990 but is otherwise subject to a specific land activity. Parties account for net emissions or removals for each activity during the commitment period by issuing removal units (RMUs) ([42]), in the case of net GHG removals from LULUCF activities, or by cancelling Kyoto units in the case of LULUCF activities that are a net source of GHG emissions. LULUCF activities can therefore be used to offset emissions from other sources if removals are higher than emissions from this sector. In the first commitment period, the number of RMUs that could be issued by each party under FM was capped (UNFCCC, 2006). For the second commitment period, FM activities are accounted for against an 'FM reference level', i.e. a country-specific level of business-as-usual emissions or removals. RMUs are issued only if FM removals are higher or emissions are lower than the agreed FM reference level. Otherwise, Kyoto units are cancelled.

RMUs can be accounted for at the end of a commitment period or annually. According to Decision 13/CMP.1, parties must indicate the frequency of accounting with their initial reports. For each activity under Article 3.3 and Article 3.4, parties have elected to account for emissions or removals either annually during the commitment period, or only once at the end of this period. The decision on frequency of accounting determines when parties can issue RMUs or cancel other units in the case of emissions from Article 3.3 and Article 3.4 activities.

For the second commitment period, new accounting rules apply for the accounting of emissions and removals in the LULUCF sector. In particular, additional activities for wetland management can be accounted for on a voluntary basis. Guidelines for these new rules were developed by the IPCC and adopted by the UNFCCC. Subsequently, the rules were almost entirely transferred into EU law in the form of EU Decision 529/2013/EU 'on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land use change and forestry and on information concerning actions relating to those activities' (EU, 2013c). This legislation harmonises EU reporting on LULUCF with Kyoto Protocol requirements, but it also goes beyond these requirements. Under EU rules, Member States must also report on agricultural activities (CM and GM), irrespective of whether or not these activities are elected under the Kyoto Protocol.

LULUCF emissions and removals are not included in the EU domestic 2020 target under the climate and energy package. The rules from the First and Second Commitment Period of the Kyoto Protocol and from Decision 529/2013/EU, however, form the basis for the integration of LULUCF into the EU's 2030 climate framework.

([42]) A Kyoto unit representing an allowance to emit 1 metric tonne of CO_2e. RMUs are issued for emission removals from LULUCF activities under Article 3, paragraphs 3 and 4.

A5.5 Emissions from aviation

Although GHG emissions from domestic and international aviation have been partly included in the EU's target under the UNFCCC since 2012 as part of the EU ETS, only emissions from domestic aviation are included in its targets under the Kyoto Protocol. Domestic aviation from the EU Member States amounts to less than 0.5 % of total GHG emissions without LULUCF, whereas the international aviation of EU Member States totals about 3 % of total emissions.

In principle, the EU ETS covers all flights arriving at, and departing from, airports in all EU Member States, Norway, Iceland and Liechtenstein and closely related territories. However, since 2012, flights to and from airports in other countries have not been included in the EU ETS. This exclusion, first resulting from the 'stop the clock' decision (EU, 2013d), was made to facilitate the negotiation of a global agreement on aviation emissions in autumn 2013 by the General Assembly of the International Civil Aviation Organization (ICAO). At its 38th meeting in autumn 2013, ICAO decided on a roadmap for the development of a global market-based mechanism to tackle aviation emissions. In 2016, ICAO agreed on a Resolution for a global market-based measure to address CO_2 emissions from international aviation as of 2021. The agreed Resolution sets out the objective and key design elements of the global scheme, as well as a roadmap for the completion of the work on implementing modalities. The Carbon Offsetting and Reduction Scheme for International Aviation, or CORSIA, aims to stabilise CO_2 emissions at 2020 levels by requiring airlines to offset the growth of their emissions after 2020.

The EU decided to continue with a reduced scope in the period 2013-2016 (EU, 2014b). Only flights between airports located in countries in the European Economic Area are included in this scope. Flights to and from outermost regions, as per Article 349 of the Treaty on the Functioning of the European Union (TFEU), are covered if they occur only in the same outermost region. In light of the progress on the global measure, the European Commission has proposed continuing the current approach beyond 2016. This proposal is currently considered by the European Parliament and the Council of the European Union.

More than 1 200 aviation operators are currently included in the EU ETS. The cap for aviation in the EU ETS is based on average historical emissions in this sector between 2004 and 2006 (221.4 $MtCO_2$ for all participating countries) ([43]). The cap for the period 2013-2020 is equivalent to 95 % of baseline emissions (EU, 2009b). Whereas aircraft operators may use EU aviation allowances (EUAAs) as well as EU allowances (EUAs) from the stationary sectors, stationary installations are not permitted to use aviation allowances for compliance. In addition, some international credits can be used by aircraft operators: up to 14 % of their verified emissions in 2012, and, from 2013 onwards, each aircraft operator is entitled to use international credits up to a maximum of 1.5 % of its verified emissions during the period from 2013 to 2020, without prejudice to any residual entitlement from 2012.

([43]) The annual average of CO_2 emissions in the years 2004, 2005 and 2006 forms the baseline for historical aviation emissions, based on data from the European Organisation for the Safety of Air Navigation (Eurocontrol) and fuel consumption information provided by aircraft operators.

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