Trends and projections in Europe 2016 - Tracking progress towards Europe's climate and energy targets

European Environment Agency

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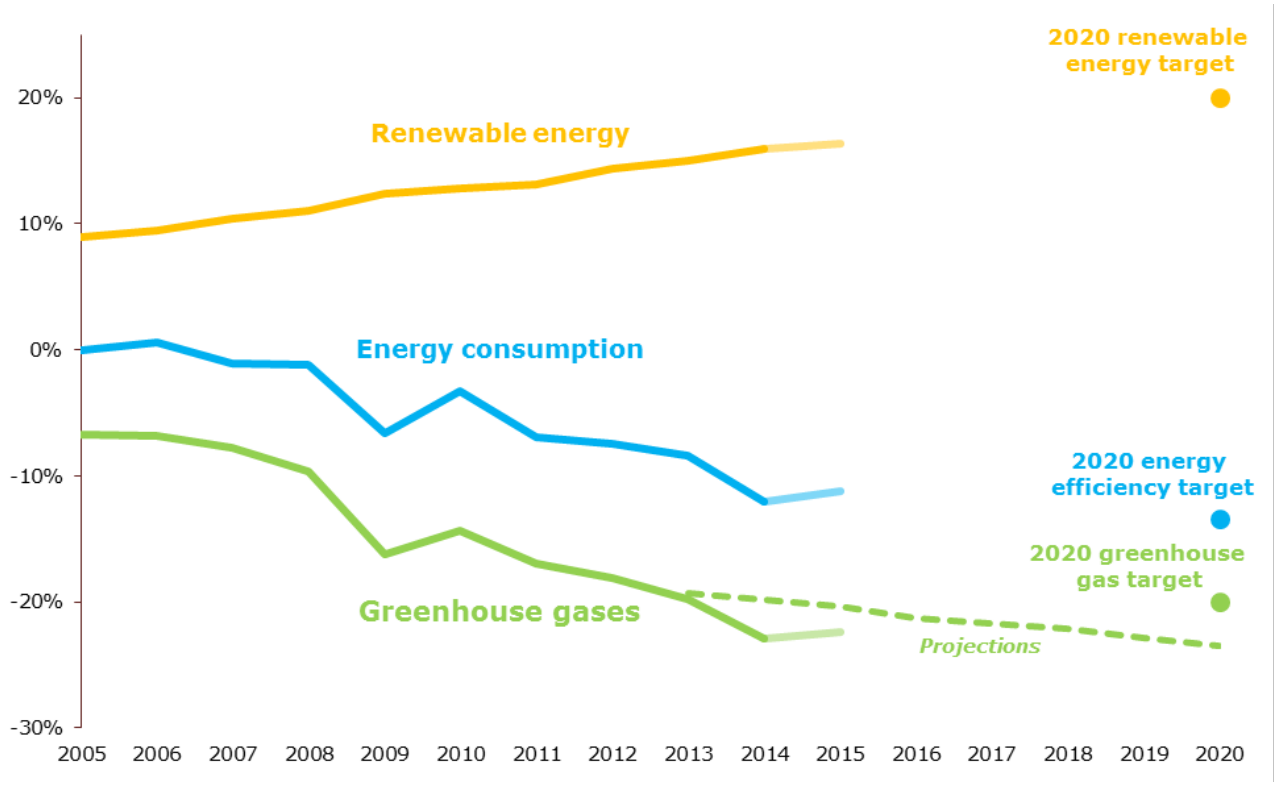
Executive summary

The 2016 edition of the European Environment Agency (EEA)Trends and projections in Europereport confirms that the European Union (EU) is well on track to meet its climate and energy targets for 2020. Despite a slight setback in 2015 concerning greenhouse gas (GHG) emissions and energy efficiency, GHG emissions have already decreased below the 20 % reduction target; renewable energy use is growing faster than initially planned by Member States in order to achieve the 20 % target level; and energy consumption is decreasing at a pace that will be sufficient to reach the 2020 energy efficiency target (see Figure ES.1).

According to preliminary estimates, energy consumption and greenhouse gas emissions slightly increased in 2015. These increases follow large reductions in 2014, due to an exceptionally warm winter that year that was responsible for particularly low energy demand for heating.

Policies are playing an important role in driving the overall EU trends observed since 2005, in particular through a continued increase in renewable energy use. However, the transport sector in general is a laggard, both in terms of reducing GHG emissions and achieving the 10 % sectoral target for renewables by 2020.

Figure 1 EU progress towards 2020 climate and energy targets



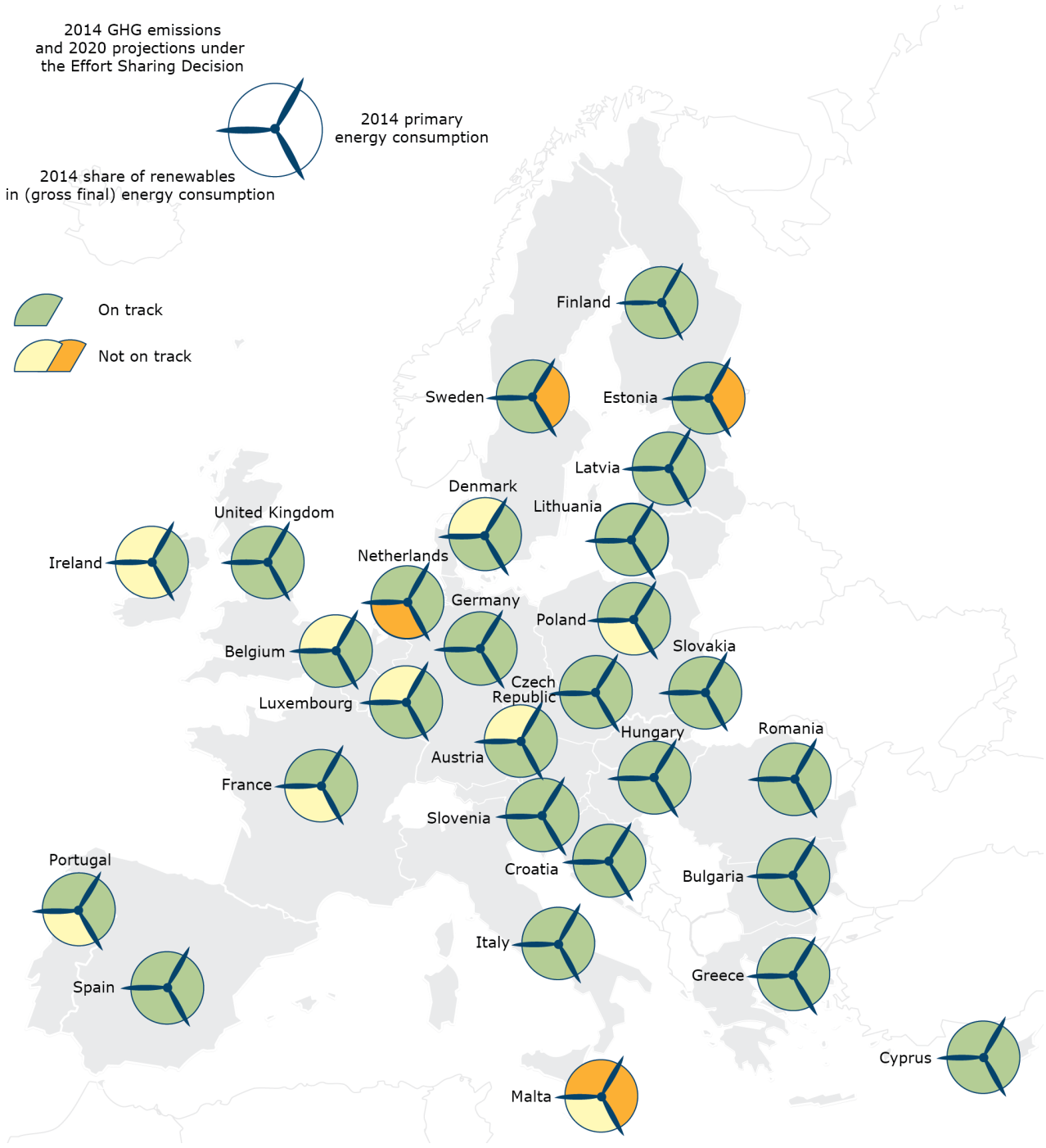
Note: For renewable energy, the figure represents the trend in the share of energy from renewable sources in gross final energy consumption since 2005. The 2020 renewable energy target corresponds to a share of 20 %.

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

Figure 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 2014 emissions covered by the Effort Sharing Decision (ESD) were above the 2014 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 2014 share of energy from renewable sources (RES) in gross final energy consumption was below the indicative level from the Renewable Energy Directive. Yellow means that the 2014 RES share was below the indicative level from the national action plan from 2010.

For energy efficiency, orange means that the 2014 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.

The report also uses official data for 2014 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.

- 22 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, Denmark, Ireland and Luxembourg 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 2014 ESD target.
- 22 Member States are on track to reach their 2020 renewable energy targets: all except France, Ireland, Malta, the Netherlands, Poland and Portugal used more renewable energy than the levels indicated in their national action plans for the year 2014. The Netherlands did not reach the minimum level indicated in the Renewable Energy Directive.
- 25 Member States (all except Estonia, Malta and Sweden) are on track to meet their 2020 energy efficiency targets, on the basis of their consumption of primary energy in 2014. However, some Member States show a lack of ambition with regard to reducing or limiting their energy consumption: the 28 Member States' self-defined 2020 targets for primary energy consumption do not amount to a level in line with 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 13. However, for the first time that this analysis is made, one Member State (Malta) is experiencing difficulties in staying on track in any of the three areas.

EU progress towards 2030 climate and energy targets

Although the EU is expected 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.

Maintaining the current pace of renewable energy deployment across Europe would enable the EU to achieve the target of sourcing at least 27 % of its gross final consumption of energy from renewable sources by 2030. However, this may not happen without additional effort, because regulatory changes affect investors' confidence in renewables, and market barriers still prevent new competitors from easily entering the renewable energy sector.

Concerning energy efficiency, continuing the current trends in energy consumption would be sufficient to achieve the 27 % target for energy efficiency in 2030. This would only require a somewhat limited change in the EU's energy system. Achieving the 2030 targets nevertheless requires not only the effective implementation of energy efficiency measures, but also a rapid change in consumer behaviour.

Policy proposals are currently under discussion between Member States and at the European Parliament in order to achieve the EU's 2030 objectives under the climate and energy framework and the Energy Union Framework Strategy. These include a revision of the EU ETS, new binding national targets on GHG emissions for the period from 2021 to 2030 under the Effort Sharing Regulation, and the integration of land use and forestry in the policy framework. The Commission is also scheduled to table proposals for revising the Renewable Energy and the Energy Efficiency Directives, as well as rules for the electricity market.

A new governance system is also being developed in order to ensure that these policies and measures adequately support the transition to a low-carbon, competitive EU economy. The proposed new governance includes (1) a structured, political dialogue between the Commission, Member States and other EU institutions; (2) streamlined planning, reporting and monitoring across the energy and climate fields; and (3) stronger regional cooperation.

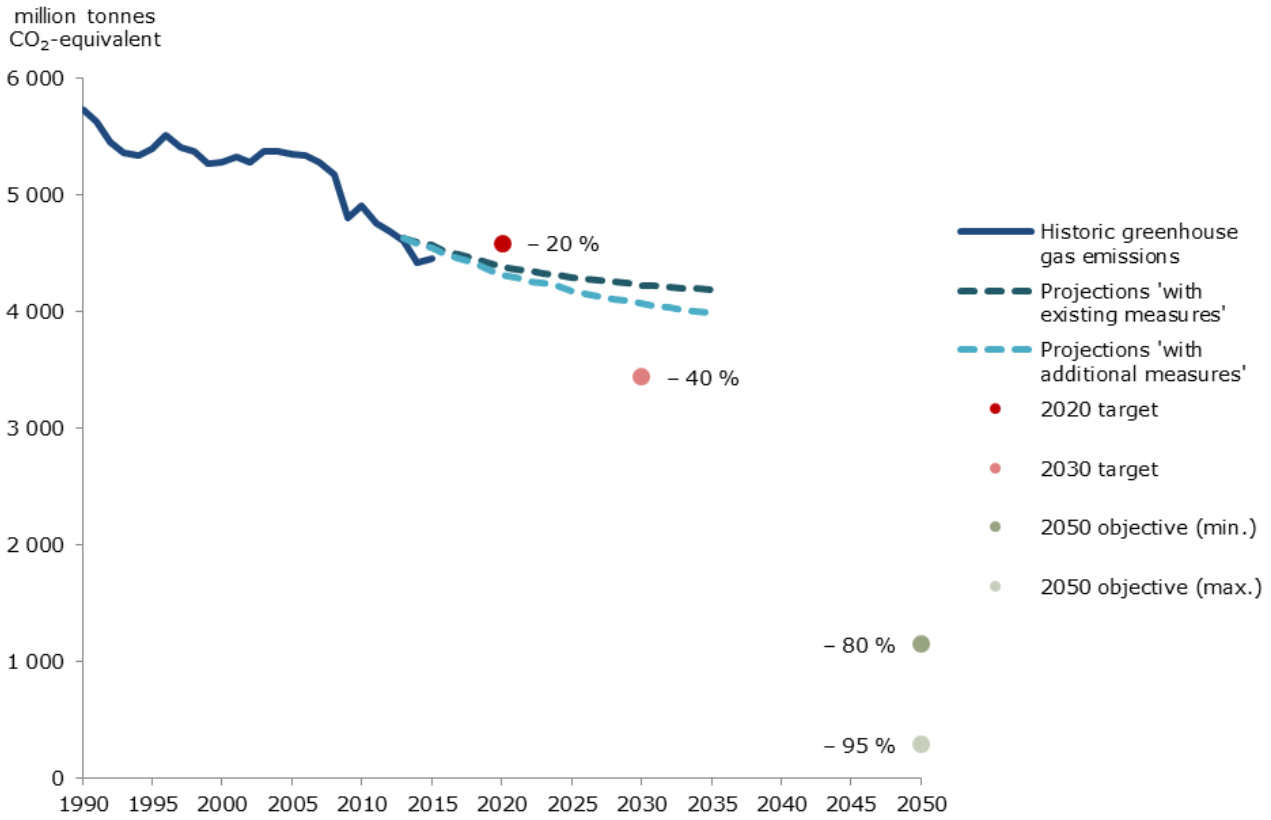
Outlook for greenhouse gas trends in 2050

The 2016 analysis of progress towards long-term decarbonisation targets in the EU has not changed since the 2015 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 between the 2030 target level (40 % below 1990 levels) and the EU objective for 2050 (at least 80 % below 1990 levels). 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 stepped up.

As underlined in the EEA report,The European environment - state and outlook 2015, 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, mobility and urban 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 tend to prioritise low-cost mitigation measures, but they should also take into consideration the long-term mitigation potential of other measures, including those that are often postponed because of high current costs or other difficulties related to their implementation. Investments in these measures often make economic sense, even in the short term, as they significantly contribute to the generation of learning effects and thereby foster future cost reductions.

Figure 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 policies and measures, while the 'with additional measures' (WAM) scenario takes into account the additional effects of planned measures reported by Member States. For the most part, these projections were reported in 2015 and therefore do not reflect the expected effects of recent policy proposals such as the reform of the EU ETS and other measures in non-ETS sectors for the period after 2020.

Source: EEA, 2016a, 2016b, 2016c and 2016d.

About this report

The 2016 edition of the annual EEA report,Trends and projections in Europe,provides an updated assessment of the progress of the EU and European countries towards their climate mitigation and energy targets. The report is mainly based on national data on GHG emissions, renewable energy and energy consumption for 2014, preliminary ('approximated' or 'proxy') data for 2015 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 the EEA report No 23/2016, Approximated EU GHG inventory: Proxy GHG emission estimates for 2015,and the EEA report No 24/2016, Trends and projections in the EU ETS in 2016 — The EU Emissions Trading System in numbers. All EEA reports are available at: eea.europa.eu.

About the EEA

The European Environment Agency (EEA) is an agency of the European Union. 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 European Environment Agency (EEA) and its European Topic Centre for 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 European Union (EU) policy in the field of air pollution and climate change mitigation.

The overall coordination of the report was carried out by François Dejean (EEA) and the ETC/ACM task manager, Sabine Gores (Öko-Institut, Germany).

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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 2014 show that greenhouse gas (GHG) emissions have already decreased beyond the 20 % reduction target; the use of energy from renewable sources as a proportion of energy consumption is growing faster than initially planned by Member States in order to achieve the 20 % target level; and energy consumption is decreasing at a pace that will be sufficient to reach the 2020 target (a 20 % reduction compared with baseline projections).
- Approximated ('proxy') estimates from Member States and the European Environment Agency (EEA) for 2015 confirm the overall EU trend (a 22 % reduction from 1990 levels), despite a slight increase in energy consumption and GHG emissions. These increases followed an exceptionally warm 2014, during which the amounts of energy used for heating, and the related GHG emissions, were unusually low. In 2015, a 24 % reduction in GHG emissions, compared with 2005 levels, was recorded for stationary installations under the EU Emissions Trading System (ETS), together with an estimated 12 % reduction in emissions across sectors covered under the Effort Sharing Decision (ESD). Progress remains insufficient in the transport sector, both in terms of reducing GHG emissions and achieving the 10 % sectoral target on renewables for 2020.
- Although the EU as a whole is on target for 2020, the situation observed differs across individual countries. In 2014, 27 Member States met their annual targets for GHG emissions (covering national emissions from sectors outside the EU ETS), 25 were on course to meet their energy efficiency targets and 22 were making progress towards renewable energy targets in line with their national action plans.
- A total of 16 Member States were in a position to deliver on their national targets in all three areas in 2014. This number declined to 15 in 2015: although the same 27 countries as in 2014 appeared to reach their national GHG targets in 2015, a number

of countries deviated from the course to meeting their renewable and energy efficiency targets. In 2014 (and 2013 and 2015), Malta failed to limit its GHG emissions to below its annual ESD targets, and stood behind trajectories for achieving its 2020 targets on renewable energy and energy consumption.

- Although the EU is expected to achieve its 2020 targets, achieving more ambitious longer term objectives requires current efforts to be stepped up. Policy proposals are currently under discussion between Member States and at the European Parliament in order to achieve the EU's 2030 objectives under the climate and energy framework and the Energy Union Framework Strategy. These include a revision of the EU ETS, new binding national targets on GHG emissions for the period from 2021 to 2030 under the Effort Sharing Regulation, and the integration of land use and forestry in the policy framework. Proposals are also expected before the end of 2016 to revise the Renewable Energy Directive and the Energy Efficiency Directive.
- Once adopted, these new policies and measures will require timely and effective actions at national level. Policy implementation and effects will also have to be regularly monitored and evaluated at both EU and national levels in a way that integrates energy and climate perspectives. 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 2015 and 2016, as well as additional estimates from the European Environment Agency (EEA), the European Union (EU) is on course to meet each of its 2020 targets for greenhouse gas (GHG) emissions, renewable energy and energy efficiency. In fact, the GHG target was already surpassed in 2014 and 2015 (see Figure 1.1).

GHG emissions

In 2014, the EU achieved a reduction of GHG emissions to 23 % below 1990 levels. This reduction exceeds the 20 % reduction target set for 2020. Approximated estimates for 2015 indicate that GHG emissions slightly increased in 2015, but remained well below the 2020 target level, at 22 % below 1990 levels. This increase observed in 2015 follows an exceptionally warm year (in 2014) in almost all parts of Europe, which resulted in a markedly low demand for heating energy compared with 2013. As such, the 2014–2015 trend can be considered a recovery from the exceptional decrease in emissions recorded in 2014. Further details of this are

discussed in Chapter 2.

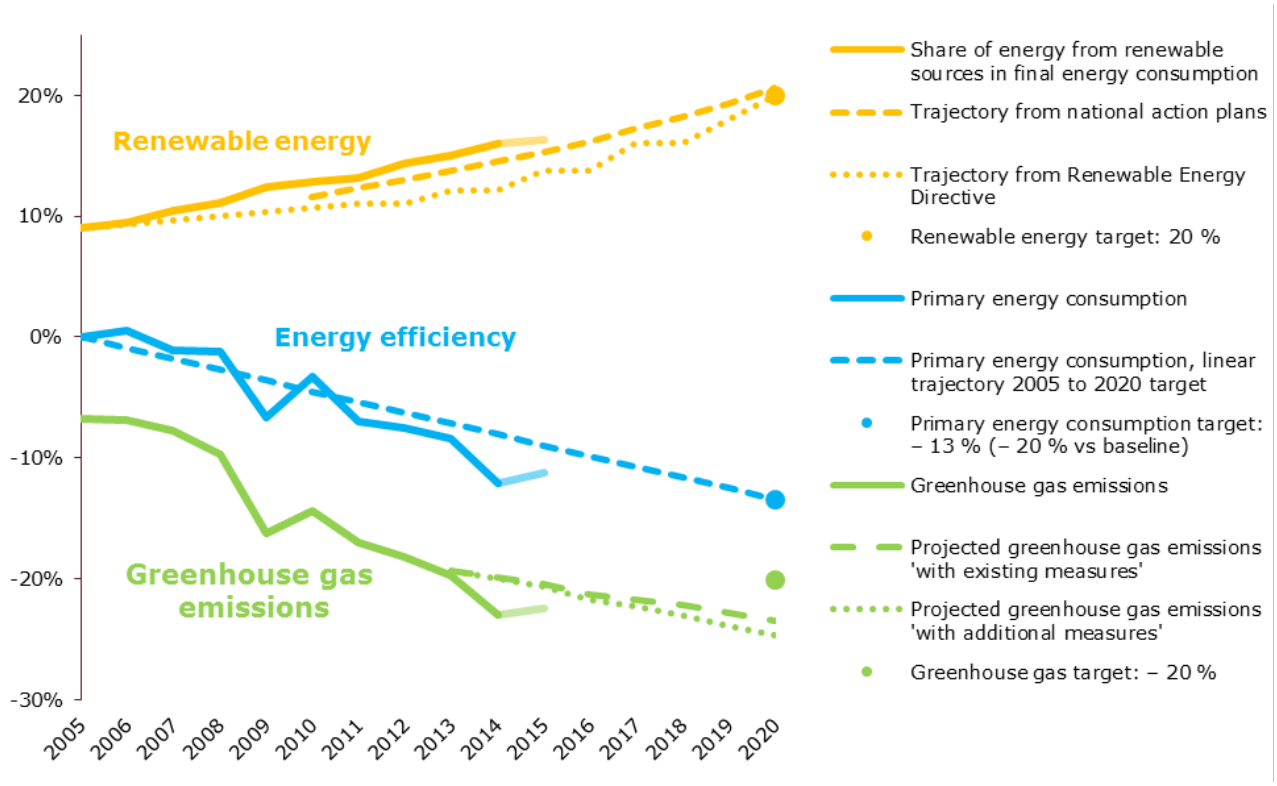
Renewable energy

The steady deployment of renewable energy sources (RESs) in the EU's energy mix continues. The use of renewable energy continued to increase, standing at 16.0 % of gross final energy consumption in 2014 and getting closer to the 20 % target for 2020. This 2014 RES percentage is higher than indicative levels set for that year in both the Renewable Energy Directive (RED) [1] and Member States' national renewable energy action plans (NREAPs). In fact, approximated estimates for 2015 indicate that the use of energy from renewable sources continued to increase, standing at 16.4 % of gross final energy consumption. The 2020 target could be attained if Member States sustain the speed at which they have been developing RESs so far. However, as we approach 2020, the trajectories for meeting the national targets are becoming steeper and more costly projects will have to be developed; however, market barriers persist in several Member States. Further details of this are discussed in Chapter 4.

Energy efficiency

The EU is reducing its energy consumption. Since 2005, the EU's primary energy consumption has been decreasing at a pace which, if sustained until 2020, would be sufficient for the EU to meet its 20 % primary energy target. Final energy consumption in 2014 was already below the target defined for 2020. For this trend to continue at EU level, several Member States must reinforce their implementation of European legislation. EU primary energy consumption decreased in 2014 and was 12 % below 2005 levels. However, this decrease can be partly explained by the warmer temperatures in 2014 than in 2013. Based upon approximated estimates for 2015, levels of primary energy consumption slightly increased again relative to the previous year, to a level 11 % below 2005. Further details of this are discussed in Chapter 6.

Figure 1.1 **EU progress towards 2020 climate and energy targets**



Note: The energy efficiency target for 2020 is defined as an absolute target, set at 20 % below the level in primary energy consumption projected for 2020 in the 2007 Energy Baseline Scenario of the European Commission. In this figure, this target is expressed as a relative change compared with 2005 levels of primary energy consumption in the EU, in order to show the required reduction in primary energy consumption over time. The year 2005 was chosen because it is used as a base year for GHG emission (in the EU ETS and under the ESD) and renewable energy targets. It also corresponds to a peak in energy consumption in the EU.

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

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 of reducing Europe's GHG emissions by 80–95 %, compared with 1990

levels.

To ensure that the EU is on a cost-effective track towards meeting this long-term objective, the European Council (i.e. the EU heads of state or government) agreed, in October 2014, on a climate and energy policy framework for the EU, and endorsed new climate and energy targets for 2030 (European Council, 2014). The framework 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;
- a target for RES consumption to be 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;
- an indicative target at EU level of at least a 27 % improvement in energy efficiency in 2030 compared with projections of future energy consumption (based on the European Commission's 2007 Energy Baseline Scenario (EC, 2008)), which is equivalent to a reduction of primary energy consumption by about 20 % compared with 2005 levels. For final energy consumption, the 2030 target would be equivalent to a 12 % decrease from 2005 levels. This target will be reviewed in 2016, with an EU level of 30 % in mind.

Progress towards these 2030 targets is not as evident as it is for 2020 targets:

- According to Member States' projections, a reduction of EU GHG emissions of between 26 % (on the basis of existing mitigation measures) and 29 % (accounting for planned national measures) could be achieved by 2030, compared with 1990 levels. These projected reductions fall short of the 40 % target for 2030. In the sectors covered by the Effort Sharing legislation (i.e. not under the EU Emissions Trading System (ETS)), the projected reductions for 2030, estimated to be between 16 % and 19 % compared with 2005 levels, would also fall short of the necessary 30 % reduction in these sectors.
- Maintaining the current pace of RES deployment across Europe would enable the EU to achieve RES consumption above the target of 27 % of final energy consumption in 2030. However, this may not happen without additional efforts, because a number of regulatory changes have already affected investors' confidence in renewables, and market barriers and fragmentation still represent challenges for new entrants.
- From 2020 onwards, the average reductions in both primary and final energy consumption necessary to reach the 2030 targets are slightly lower than those needed between 2005 and 2020 to meet the 2020 energy consumption target. Achieving the 2030 targets nevertheless requires not only the stringent implementation of energy efficiency measures, but also a rapid change in consumer behaviour.

Even if the 2030 EU targets are 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 in order to reach the 2050 long-term goal, and renewable energy would need to grow even faster before 2050 in order to attain the minimum levels consistent with the EU's long-term decarbonisation objectives.

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

The EU's 2030 climate and energy policy framework contributes to achieving the objectives of the EU's Energy Union Framework Strategy (EC, 2015b), which was adopted in 2015. The strategy aims to ensure that Europe moves towards an integrated, secure, affordable and climate-compatible energy system, and achieves its climate and energy goals for 2030. It is structured around five closely related and mutually reinforcing dimensions:

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

Progress towards these objectives is monitored annually through the European Commission's State of the Energy Union (EC, 2015a). On 30 November 2016, the European Commission also tables a legislative proposal on a new governance under the Energy Union in order to adapt planning, reporting and monitoring requirements to the new 2030 climate and energy framework (under EU legislation and the Paris Agreement [2]). It will specifically aim to streamline the existing planning, reporting and monitoring obligations of Member States and to minimise administrative burden. This streamlining effort is expected to ensure the availability of integrated and coherent national data and information on GHG emissions, renewable energy and energy 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.

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

Not all Member States are performing well individually with respect to their national 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. The Member States' progress is

summarised below:

- In 2014, all of the Member States, with the exception of Malta, met their annual GHG emission targets set under the ESD [3]. Proxy estimates indicate that a similar situation also occurred in 2015. A total of 23 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 five Member States (Austria, Belgium, Denmark, Ireland and Luxembourg) will have to implement additional measures to reach targets domestically or use the flexibility mechanisms provided under the ESD. These mechanisms allow Member States to transfer annual emission allowances over time and between Member States. Further details of this are provided in Chapter 3.
- A total of 22 Member States were making good progress towards their national renewable energy targets in 2014, but France, Ireland, Malta, the Netherlands, Poland and Portugal were behind the trajectories they had set in their national action plans. Furthermore, the Netherlands were also behind their indicative trajectory set in the RED. The situation is expected to have changed in 2015, with only 19 Member States remaining on track, according to proxy estimates by the EEA. Further details of this are discussed in Chapter 5.
- All but three (Estonia, Malta and Sweden) Member States were making good progress towards indicative national targets on primary energy consumption in 2014. However, as primary consumption increased across Europe in 2015, according to EEA proxy estimates, four countries were expected to fall behind their energy efficiency targets in 2015. Further details are provided in Chapter 7.

In total, 16 Member States (Bulgaria, Croatia, Cyprus, the Czech Republic, Finland, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Romania, Slovakia, Slovenia, Spain and the United Kingdom) were on track in 2014 to meet all three of their national climate and energy targets for 2020 (see Table 1.1). Ten of these countries need to limit only their GHG emissions or energy consumption, compared with 2005, to achieve their 2020 targets [4]. However, based on approximated estimates, not all of these 16 Member States remained on track in all three domains in 2015.

As opposed to previous years, in which no Member State underperformed in all three domains, Malta was found to be in a difficult situation in 2014, as it failed to keep its GHG emissions below its ESD target and has fallen behind trajectories for achieving its 2020 targets on renewable energy and energy consumption.

Strong links exist between energy efficiency improvements, the deployment of renewable energy and reductions in GHG emissions. However, not all of the GHG emission savings resulting from better energy efficiency and more renewable energy use contribute to Member States' progress towards their national targets since these relate to only sectors which are not

covered under the EU ETS. For example, most GHG savings resulting from the growth in the use of renewable energy take place in the power sector, which is covered under the EU ETS (EEA, 2016e). The link between the GHG emissions, renewable energy and energy efficiency targets is therefore stronger at EU level, for which all emissions are considered in the 20 % reduction target, than at Member State level, for which national targets do not cover ETS emissions. Renewable and energy efficiency policies nevertheless contribute to reducing emissions in the sectors covered by the ESD, particularly the transport and building sectors. Energy efficiency improvements and the development of RESs have played roles of varying importance from one Member State to another with regard to making progress towards national ESD targets (EEA, 2015).

Table 1-1 Progress of Member States towards 2020 climate and energy targets

Member State	GHG emissions		Renewable energy		Energy efficiency
	Current progress	Projected progress	Current progress		Current progress
	Distance to ESD target in 2014	Projected distance to 2020 ESD target (with existing measures)	Distance to trajectory from the RED in 2013/2014	Distance to trajectory from national plan in 2014	Distance to indicative linear trajectory in 2014
	Percentage points (as a proportion of 2005 base-year emissions)		Percentage points (share of energy from renewable sources in gross final consumption)		Percentage points (as a proportion of 2005 levels)
Austria	7	−4	6	1	4
Belgium	9	−5	2	1	3
Bulgaria	18	25	7	7	2
Croatia	27	20	13	11	29
Cyprus	32	38	3	1	4
Czech Republic	9	17	5	2	5
Denmark	9	−1	7	2	8
Estonia	4	13	6	3	−10
Finland	3	−0.04	6	6	4
France	9	3	0.04	−2	0.5
Germany	6	1	4	1	0.6
Greece	23	22	5	5	11
Hungary	25	38	3	2	14
Ireland	8	−12	1	−0.5	4
Italy	12	5	8	7	13
Latvia	4	10	3	4	15
Lithuania	8	18	6	4	18

Lithuania	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Luxembourg	5	−5	0.1	1	9
Malta	−11	21	1	−1	−7
Netherlands	18	5	−1	−2	2
Poland	8	8	2	−0.2	4
Portugal	21	26	3	−0.4	11
Romania	7	15	5	5	26
Slovakia	20	17	2	3	10
Slovenia	16	12	4	2	8
Spain	11	2	4	0.1	10
Sweden	15	11	10	6	−1
United Kingdom	8	3	1	1	6

Note: The percentage values in this table represent the difference between the parameter considered and the relevant target or indicative target. 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.

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.

End notes

[1] The indicative RED targets are set as an average for two consecutive years. Accordingly, the average EU-wide share of energy from renewable sources in 2013 and 2014 must equal or exceed 12.1 %.

[2] Adopted by 195 countries at the Paris climate conference (COP21) 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.

[3] These differentiated targets were set under the ESD. The ESD covers almost 60 % of total GHG emissions at EU level.

[4] 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 Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia. Furthermore, seven Member States of the same group of

countries performing well in all three policy objectives (Croatia, Estonia, Finland, Latvia, Poland, Romania and Slovenia) have also voluntarily adopted positive limits (i.e. an increase within a specified constraint) on primary energy consumption for 2020.

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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 2014, GHG emissions were already 23 % 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.
- A small increase in emissions is expected to have occurred in 2015 (according to preliminary estimates), which would bring EU GHG emissions to 22 % less than 1990 levels. Despite this increase from 2014, 2015 emissions are still likely to be less than all levels recorded between 1990 and 2013, thus the decreasing trend that started in 2005 has continued.The pace of GHG emission reductions is projected to slow down after 2020. A continuation of this pace will not be sufficient to achieve the EU's target of a 40 % reduction by 2030 (compared with 1990 levels). Even 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.

- Total GHG emissions can be separated into GHG emissions under the EU Emissions Trading System (ETS) for stationary installations and international aviation, and the Effort Sharing Decision (ESD). GHG emissions and removals under the land use, land-use change and forestry (LULUCF) sector are not counted toward the EU-wide reduction target for 2020.
- Emissions from stationary installations under the EU ETS in 2015 were 24 % less than in 2005. Preliminary estimates for ESD emissions in 2015 suggest a decrease of 12 % compared with 2005. These reductions were mainly as a result of efforts in energy industry sectors.

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

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 2014, the EU's total GHG emissions were 23 % less than 1990 levels[1], and preliminary estimates suggest that emissions in 2015 were 4 451 Mt CO_2-eq., which is 22 % less than 1990 levels. The 0.7 % increase observed in 2015 follows an exceptional 4.0 % reduction the previous year. Despite this small increase, 2015 levels remained below all historic levels observed between 1990 and 2013.

In 2014 and 2015, emission levels were also lower than anticipated by 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 1.1).

- 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 23 % by 2020 and by 26 % 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 [2], GHG emissions will decrease by 25 % by 2020 and by 29 % 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 will not be sufficient to deliver the savings needed to achieve the EU's reduction target of at least 40 % by 2030 (compared with 1990 levels). The pace of GHG emission reductions is actually projected to slow down after 2020, and achieving the mid- and long-term targets will require much faster reductions.

For this reason, a number of policy proposals developed by the European Commission are now being discussed among Member States and by the European Parliament. For example, these concern:

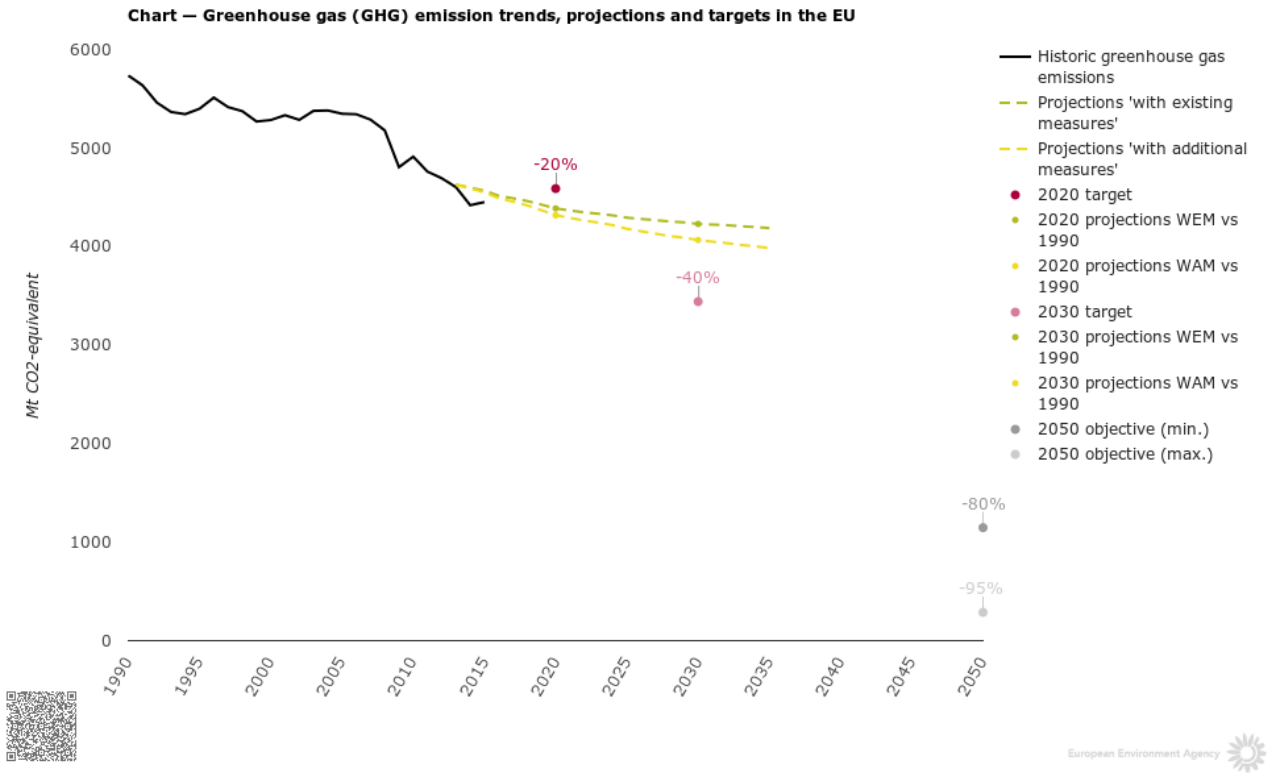
- a reform of the EU Emissions Trading System (EU ETS) to include a more stringent cap reduction after 2020 (EC, 2015);
- new annual binding GHG emission targets for Member States for the period from 2021 to 2030 (a new 'effort sharing' between Member States), specifically covering emissions that are not covered by the EU ETS, as well as new flexibilities to achieve these targets (EC, 2016a);
- the integration of the land use, land-use change and forestry (LULUCF) sector into the EU 2030 Climate and Energy Framework (EC, 2016b);
- a European strategy to cut emissions from the transport sector (EC, 2016c).

Further measures will be proposed in autumn 2016 to address energy efficiency and further develop renewable energy in the EU.

As GHG projections were, for the most part, reported by Member States in the first half of 2015, these proposals (or other policy developments at national level) are not reflected in the Member State projections [3].

Even if the 2030 target is achieved, a faster pace of emission reductions will be required if the EU is to reach its long-term (2050) decarbonisation objective — a reduction of EU GHG emissions by 80 to 95 % 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 of energy efficiency in buildings), long-term action should not be delayed. Member States tend to prioritise low-cost mitigation measures, but they should also take into consideration the long-term mitigation potential of other measures, which are often postponed because of the high current costs or other difficulties related to their implementation. However, investments in these measures often make economic sense, even in the short term, as they significantly contribute to the generation of learning effects and thereby foster future cost reductions.

Figure 2.1 GHG emission trends, projections and targets in the EU, 1990–2050



Click on the image for interactive data visualisation

Note: The GHG 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 policies and measures, while the 'with additional measures' (WAM) takes into account the additional effects of planned measures reported by Member States. For the most part, these projections were reported in 2015 and therefore do not reflect the expected effects of recent policy proposals such as the reform of the EU ETS and other measures in non-ETS sectors for the period after 2020.

Source: EEA, 2016a, 2016b, 2016c and 2016d.

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

To achieve its future GHG emission targets, the EU has adopted sectoral targets and relevant legislation, for the following divisions:

- Emissions from large point sources, mostly from industrial installations, are covered by the EU ETS (EU, 2009a). These represent about 40–45 % of EU GHG emissions and a large proportion of them falls under the power generation sector. Other activities

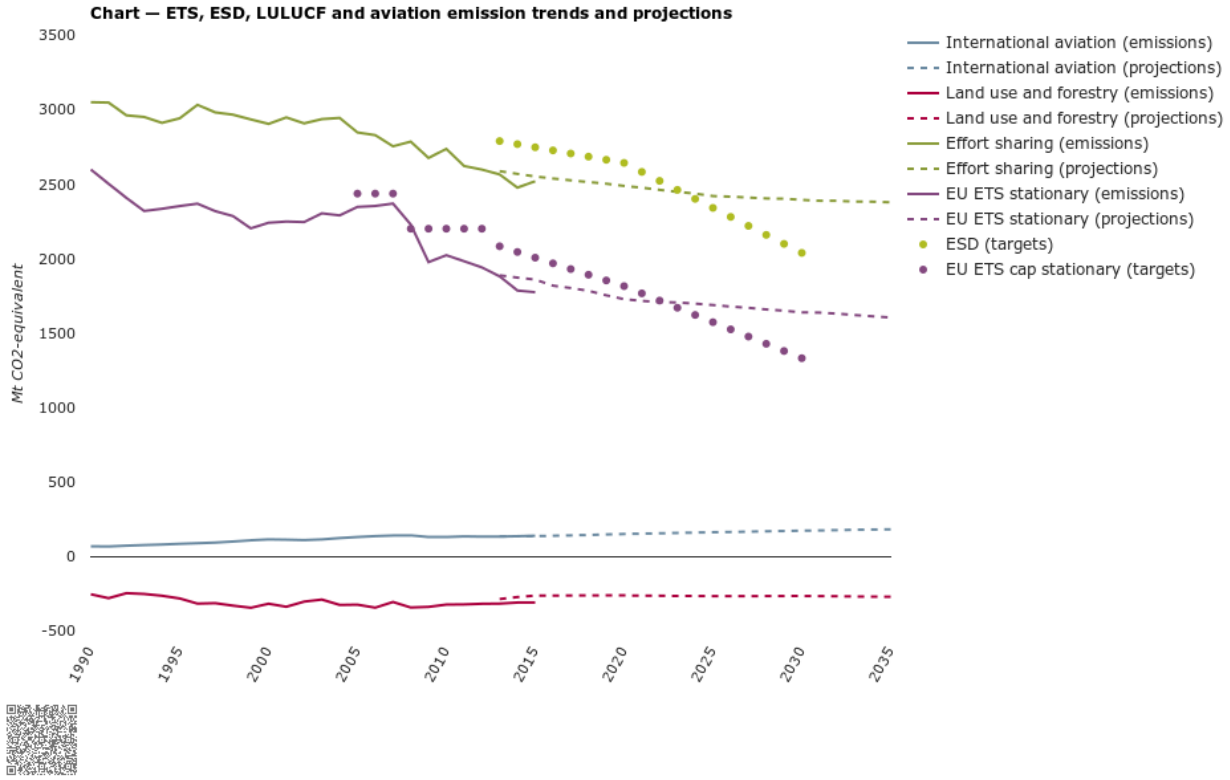
covered by the EU ETS include cement production, iron and steel production, and oil refining. Since 2012, the EU ETS covers GHG emissions from aviation (EU, 2008). The mitigation of all ETS emissions is being addressed at EU level through a single ETS-wide emission cap [4] and a 'carbon market' through which emission allowances can be traded.

- GHG emissions not covered by the EU ETS are covered under the Effort Sharing Decision (ESD) (EU, 2009b). These emissions are from a more diverse range of sectors or activities, including road transport, energy consumption in buildings, agriculture (cattle and soils) and waste management. Since 2013, The ESD sets 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.
- GHG emissions and removals from the LULUCF sector are not covered under either the EU ETS or the ESD. LULUCF activities represent a net reported 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 2020 target under the 2009 climate and energy package. However, in 2016, the European Commission proposed to integrate this sector into the EU 2030 Climate and Energy Framework from 2021 onwards [5].

Formally speaking, Member States are therefore responsible for reducing or limiting emissions covered under only the ESD, while ETS emissions are tackled at EU level.

GHG emissions in EU ETS sectors and in ESD sectors have been following different trends since 1990 [6]. The projections reported by Member States also show significant differences between these two categories (see Figure 1.2). These trends are described and analysed in the following sections.

Figure 2.2 ESD, ETS, LULUCF and aviation emission trends and projections, 1990–2035



Click on the image for interactive data visualisation

Note: (a) Net removals from land use, land-use change and forestry (LULUCF) correspond to reported values, which differ from values accounted towards targets.

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

The projected values, starting from 2013, are presented for the 'with existing measures' (WEM) scenario, which reflects existing policies and measures. These projections from Member States were reported, for the most part, in 2015 and therefore do not reflect the expected effects of recent policy proposals such as the reform of the EU ETS and other measures in non-ETS sectors for the period after 2020.

Source: EC, 2013a, 2013b, 2015 and 2016a; EEA, 2016a, 2016b, 2016c, 2016d and 2016e; EU, 2009a.

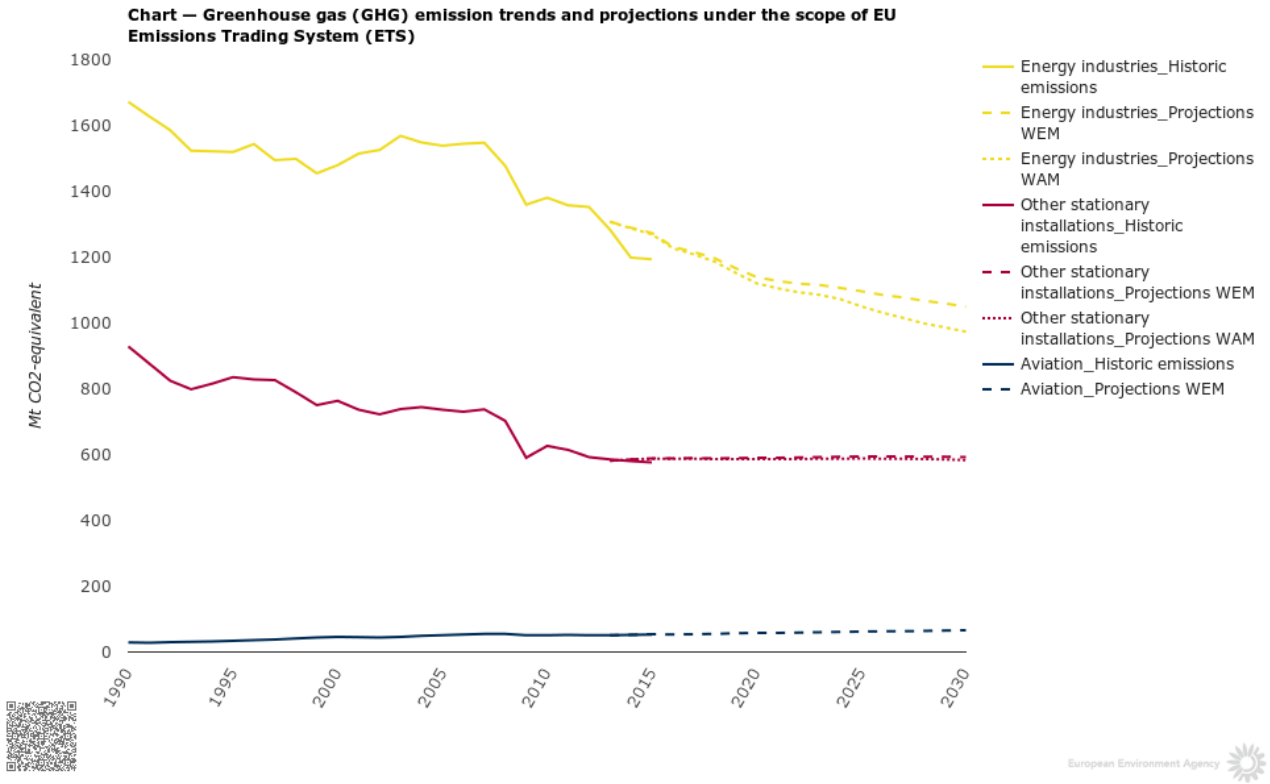
2.3 Emission trends under the European Union Emissions Trading System

GHG emissions from the sectors covered by the EU ETS have decreased significantly since 1990 (see Figure 1.3). The EU ETS target was defined in order to reduce emissions by 21 % between 2005 and 2020. In 2015, EU ETS emissions from Member States' stationary installations had already decreased by 24 % since 2005, and reached their lowest level since the start of the scheme in 2005 [7]. The decrease since 2005 was mostly driven by reductions in emissions

related to power generation. The reduction in emissions was largely the result of changes in the combination of fuels used to produce heat and electricity, in particular a decrease in the use of hard coal and lignite fuels, and a substantial increase in electricity generation from renewables, which almost doubled over the period. Emissions from the other industrial activities covered by the EU ETS have also decreased since 2005, but remained stable in the current trading period (2013–2015) (EEA, 2016f).

According to the projections submitted by Member States in 2015 and 2016, 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 7 % between 2015 and 2020, and by 5 % between 2020 and 2030. According to scenarios that consider additional measures, reductions of an additional four 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 relatively stable during this period. However, emissions from international aviation nearly doubled between 1990 and 2014 and are expected to increase further by 2030.

Figure 2.3 GHG emission trends and projections under the scope of the EU ETS, 1990–2030



Click on the image for interactive data visualisation

Note: Solid lines represent historic GHG emissions (available for the 1990–2015 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 non-ETS sectors.

2.4 Emission trends under the Effort Sharing

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 2014, ESD emissions were 13 % below 2005 levels. Preliminary estimates indicate that, in 2015, ESD emissions increased back to a level that is 11 % less than the 2005 level. However, this still represents a reduction that is greater than the 9 % reduction objective for ESD emissions between 2005 and 2020 at EU level.

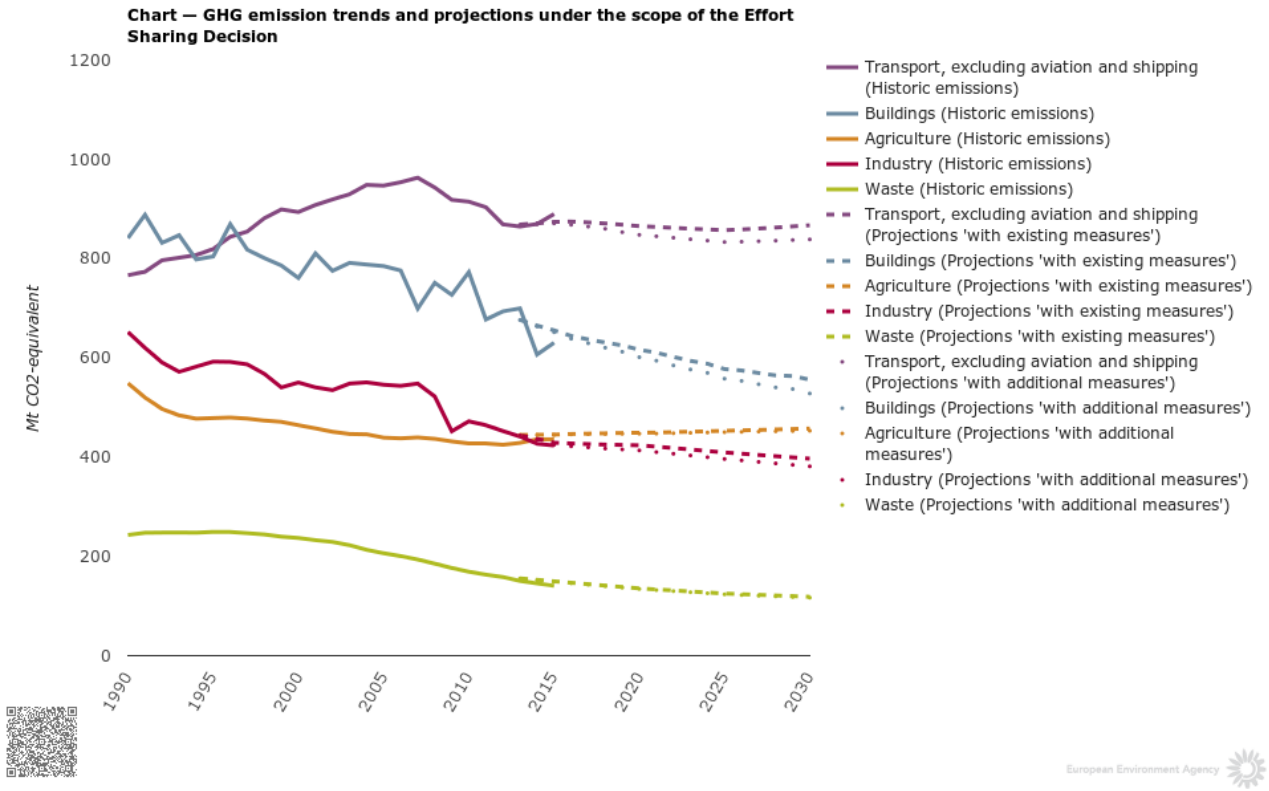
According to national projections based on the WEM scenario, ESD emissions could be 155 Mt CO_2-eq. below the ESD target for 2020, and cumulated ESD emissions in the EU for the whole 2013–2020 period could be lower than the overall emission budget for all Member States under the ESD by about 1 600 Mt CO_2-eq. In addition, if planned 'additional measures' are taken into account, this cumulated surplus could increase to over 1 700 Mt CO_2-eq. However, certain Member States experience more difficulties than others in achieving their ESD targets (see Chapter 2).

For 2030, Member States project a 16 % reduction of ESD emissions compared to 2005 in the WEM scenario, and a 19 % 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 greenhouse gas emissions by 2030 compared to 1990 (see Figure 1.2).

Since 1990, the building sectors have 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 2013, emissions from this sector increased again in 2014 and 2015.

Member States have projected only limited decreases in ESD emissions between 2015 and 2030, particularly for after 2020. The largest decreases are expected to take place in the building sector. In the transport sector, emissions are projected to remain relatively stable, while agriculture emissions are anticipated to increase. Implementing the additional measures (i.e. at planning stage up to early 2015) would lead to minor further emission decreases, especially in the building and transport sectors (see Figure 1.4).

Figure 2.4 GHG emission trends and projections under the scope of the ESD, 1990–2030



Click on the image for interactive data visualisation

Note: Solid lines represent historic GHG emissions (available for the 1990–2014 period). Dashed lines represent projections in the 'with existing measures' (WEM) scenario. Dotted lines represent projections under the 'with additional measures' (WAM) scenario.

The non-ETS 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 non-ETS sectors.

Source: EEA, 2016a, 2016b, 2016c and 2016d.

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

Land use and forestry activities, which include the use of soils, trees, plants, biomass and timber, can result in both emissions and removals of CO_2. In 2014, the LULUCF sector represented a net carbon sink of about 308 Mt CO_2-eq. in the whole of the EU. The sector constituted a net reported sink for all EU Member States except Denmark, Ireland, Latvia and the Netherlands. The EU sink was dominated by CO_2 absorbed from existing and new forests. 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.

While being a net sink, the sector was also the source of CO_2 emissions. 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 use. Since 2000, the net reported annual LULUCF sink has been on average 320 Mt CO_2-eq., with a decreasing trend over the last 7 years. According to the EU Reference Scenario 2016 (EC, 2016d), the net reported LULUCF sink in the EU is expected to continue decreasing, by about 10 % between 2010 and 2020, despite a decrease in emissions from cropland and grassland (due to reduced rates of land conversion to cropland, and lower emissions expected from agricultural soils). The current EU forest sink could also potentially be affected by the increased use of bioenergy.

In order to address this overall projected decrease, in July 2016, the Commission proposed a binding commitment for each Member State covering GHG from forestry and agriculture, and an upgrade of accounting rules to determine compliance. These changes are expected to improve the identification of additional mitigation action, and to thereby enhance the environmental integrity of the sector. Stronger incentives for action are also provided by enabling trade between Member States within the LULUCF sector, and creating a limited flexibility for the use of certain, robust LULUCF credits with other non-ETS sectors.

The proposal requires, as a principal commitment, each Member State to ensure that accounted GHG emissions from land use are entirely compensated by an equivalent removal of CO_2 from the atmosphere in non-ETS sectors (the 'no debit rule'). In essence, if a Member State converts forests to other land uses (deforestation) or increases emissions from croplands, it must compensate for the resulting emissions by planting new forests (afforestation), by improving the sustainable management of existing forests, croplands and grasslands, by using allocations from the other non-ETS sectors, or by agreeing to trade emission credits with other Member States. Although Member States undertook this commitment under the Kyoto Protocol up to 2020, the proposal enshrines the commitment in EU law for the 2021–2030 period.

Endnotes

[1] This includes all emissions from aviation (including international flights), covered under the EU target.

[2] Not all Member States reported a WAM scenario. For further information on reporting of projections, please refer to B.3 in the annexes.

[3] A total of 26 Member States reported national projections of GHG emissions under EU reporting requirements in 2015. Eight Member States (representing about 19 % of total EU emissions) reported updated projections in 2016.

[4] 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.

[5] Up to 280 million tonnes of CO2 could be credited from certain land categories for national GHG targets (for GHG emissions outside the EU ETS) over the entire 2021–2030 period.

[6] 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 United Nations Framework Convention on Climate Change (UNFCCC).

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

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3. Progress towards Member States' greenhouse gas emission targets

- Under the Effort Sharing Decision (ESD), Member States must achieve 2020 targets on greenhouse gas (GHG) emissions from the sectors that are not covered by the European Union (EU) Emissions Trading System (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 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).
- In 2014, all Member States except one (Malta) met their annual ESD targets. For these countries, ESD emissions were lower than their ESD targets (i.e. below the quantity of AEAs for that year). According to preliminary estimates, a similar situation occurred in 2015. Malta will therefore need to use the flexibilities provided under the ESD to ensure current compliance for 2014 and 2015.

- According to the latest projections available from Member States, with already existing national policies and measures in place, 2020 ESD emissions will be lower than 2020 ESD targets in 23 Member States. For five Member States (Austria, Belgium, Denmark, Ireland and Luxembourg), existing domestic measures will not be sufficient to meet their 2020 ESD targets, even though they have been achieving their annual targets so far. Austria is the only one of these five countries that has reported additional measures that would be sufficient to meet the 2020 target if implemented on time.
- Of the five Member States that show insufficient projected progress for 2020, four Member States could decrease the projected gap, between the emission target and actual emissions, by transferring excess AEAs generated in the early years of the 2013–2020 period to the later years of the period. One Member State (Ireland) would also need to rely on additional flexibilities to close its gap, such as transferring AEAs from other Member States, if no additional domestic measures are implemented.

3.1 Current progress towards targets under the Effort Sharing Decision

In order to achieve the European Union's (EU's) objective of a 20 % reduction in total greenhouse gas (GHG) emissions by 2020, compared with 1990, the Effort Sharing Decision (ESD) (EU, 2009a) sets national targets for each Member State on GHG emissions not covered by the EU Emissions Trading System (ETS) (EU, 2009b). There are no national targets on GHG emissions that cover total (economy-wide) emissions. 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 % reduction at EU level compared with 2005 base-year levels. The ESD also sets annual binding targets for the 2013–2020 period, in order to monitor progress across the EU, allow for corrective action and ultimately ensure the attainment of the EU's GHG emission target by 2020.

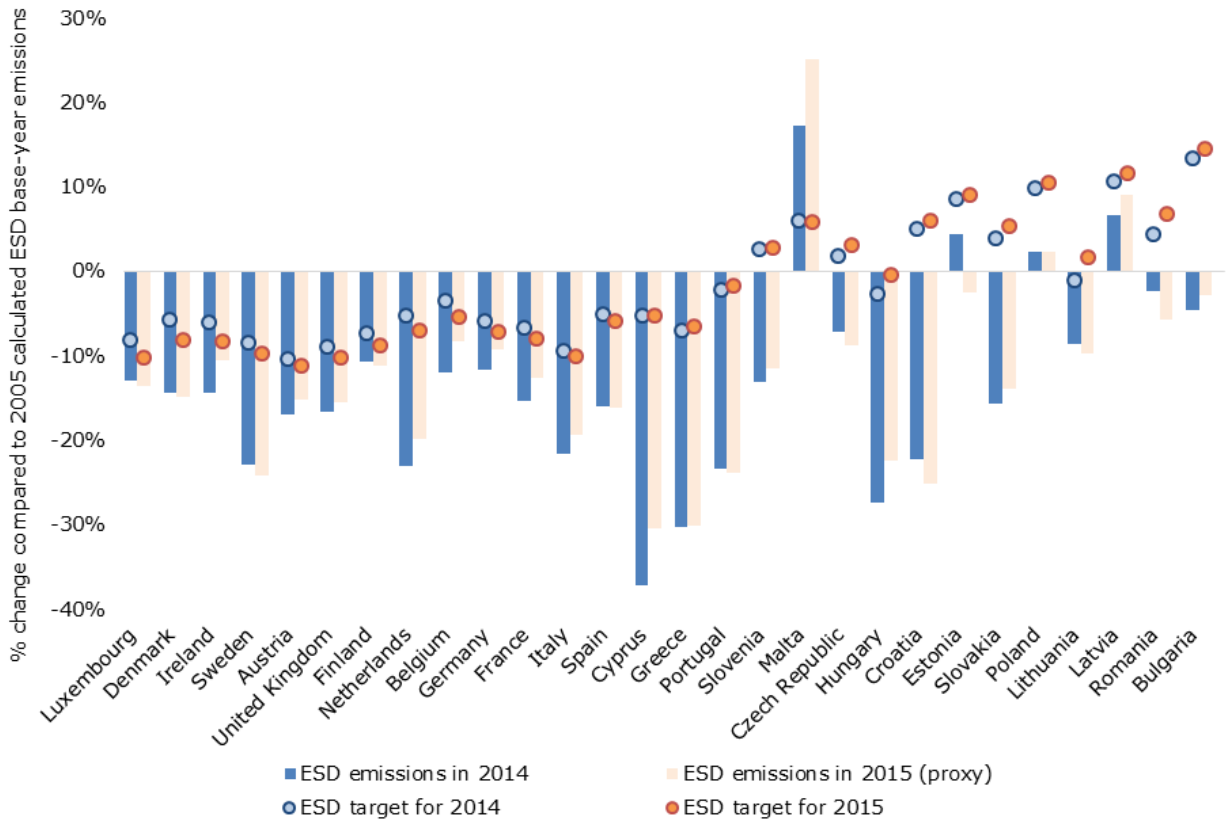
In 2014, all but one Member State exhibited ESD emissions that were below their 2014 targets (see Figure 2.1). The largest overachievements in 2014 in absolute terms were made in Italy (41 Mt CO_2-eq.), France (36 Mt CO_2-eq.) and the United Kingdom (30 Mt CO_2-eq.). Of the 18 Member States that achieved 2014 ESD emissions that were less than their 2005 base-year values, eight (Croatia, Cyprus, Greece, Italy, the Netherlands, Portugal, Spain and Sweden)

achieved ESD emissions that were over 10 % less than their targets. Despite having a target that was higher than its 2005 base-year levels, Malta's emissions remained above its 2014 ESD target (by 0.1 million annual emission allocations (AEAs), which is equal to a gap of 11 %).

A similar situation is expected for 2015, based on approximated estimates of ESD emissions: the same Member States as in 2014 are expected to have ESD emissions that are over 10 % below their targets, while Malta is expected to remain the only Member State with ESD emissions exceeding its ESD target for that year (by 0.2 million AEAs; equal to an 18 % gap).

As the differences between Malta's actual emissions and its targets for 2014 and 2015 are higher than 5 %, a limit up to which it is possible to borrow AEAs from the following year (60 000 AEAs) [1], Malta would need to use additional flexibilities, such as buying AEAs from other Member States, to comply with the ESD.

Figure 3.1 Current progress of Member States towards their ESD targets



Click on the image for interactive data visualisation

Note: 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.

Source: EC, 2013a, 2013b and 2017; EEA, 2016a, 2016b and 2016c.

3.2 Projected progress towards targets under the Effort Sharing Decision

The latest projections reported by Member States show that there are diverse expectations with regard to ESD emission trends for the 2015 to 2020 period. For many Member States, projections are consistent with past trends and suggest continuous decreases in ESD emissions between 2013 and 2020. However, projections do not account for the unusually large decrease that occurred in 2014 (due to particularly warm climatic conditions) and the subsequent rebound (increase in GHG emissions) observed in 2015 (see section 1.1).

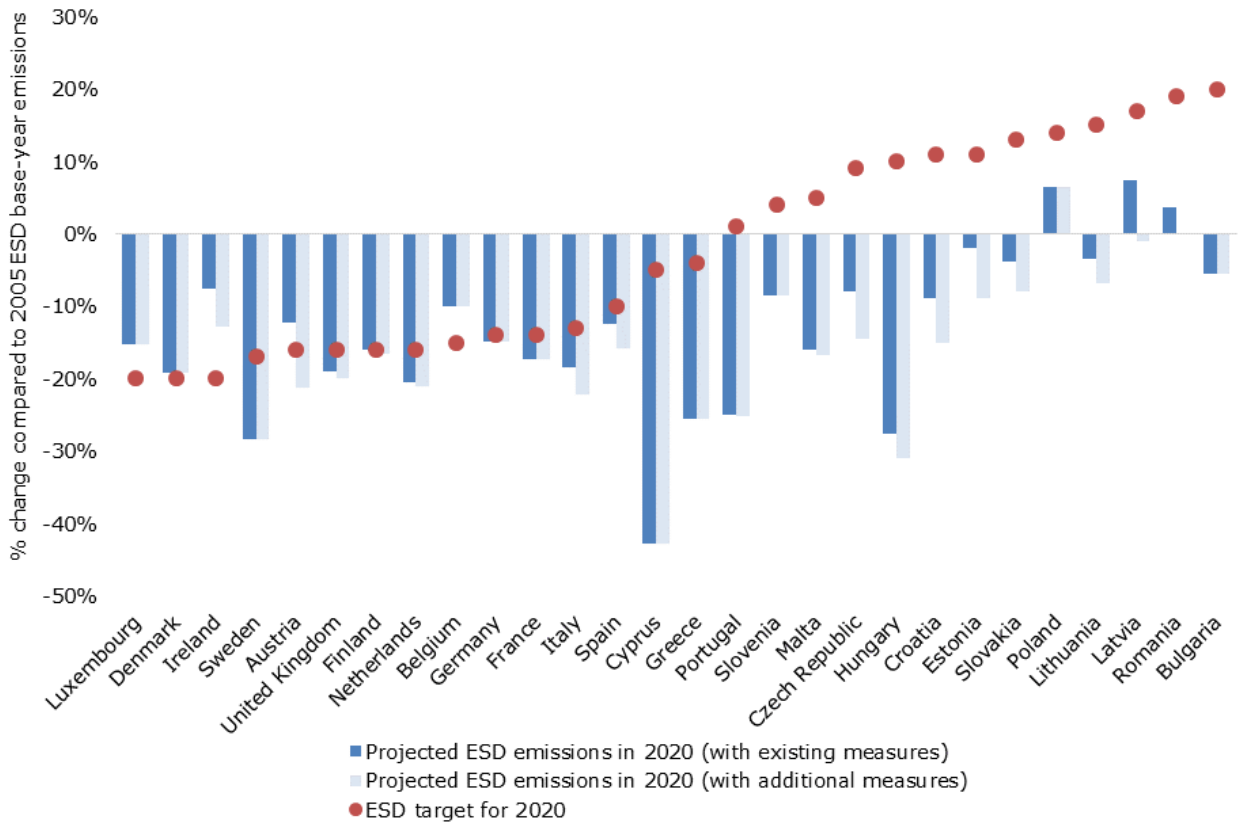
The vast majority of Member States projected that their ESD emissions will remain below their annual ESD targets during the whole compliance period (from 2013 to 2020):

- 16 countries projected a decrease in their ESD emissions between 2015 and 2020 (Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, the Netherlands, Portugal, Slovenia, Sweden and the United Kingdom).
- 10 countries projected an increase in their ESD emissions during this period (Croatia, Estonia, Ireland, Italy, Latvia, Lithuania, Poland, Romania, Slovakia and Spain).
- Two countries expect their emissions to decrease first and then increase (Luxembourg and Malta).

Based on the latest national projections (i.e. those submitted in 2015 or updated in 2016) for the 2016-2020 period, 23 Member States expect that their ESD emissions will stay below their annual targets under the ESD in every year from 2016 to 2020 [2], on the basis of the 'with existing measures' (WEM) scenario (see Figure 2.2). These Member States include Finland which, with a projected shortfall of only 0.04 percentage points, which is well within the margin of uncertainty, is considered to be able to reach its 2020 target with current measures in place.

Conversely, for five Member States (Austria, Belgium, Denmark, Ireland and Luxembourg), national projections suggest that emissions could exceed AEAs (i.e. annual ESD targets) for one or several years between 2016 and 2020 (see Table A3.3 in Annex 3). These five Member States all have 2020 targets under the ESD ranging from 15 % to 20 % reductions, compared with 2005 base-year levels. Denmark, Ireland and Luxembourg are the three Member States that have a 20 % reduction target for 2020 under the ESD.

Figure 3.2 Projected progress of Member States towards their 2020 ESD targets



Click on the image for interactive data visualisation

Note: Only 18 Member States submitted a 'with additional measures' (WAM) scenario. For the other Member States (Belgium, Bulgaria, Denmark, France, Germany, Greece, Luxembourg, Poland, Slovenia and Sweden), the WEM scenario is shown instead.

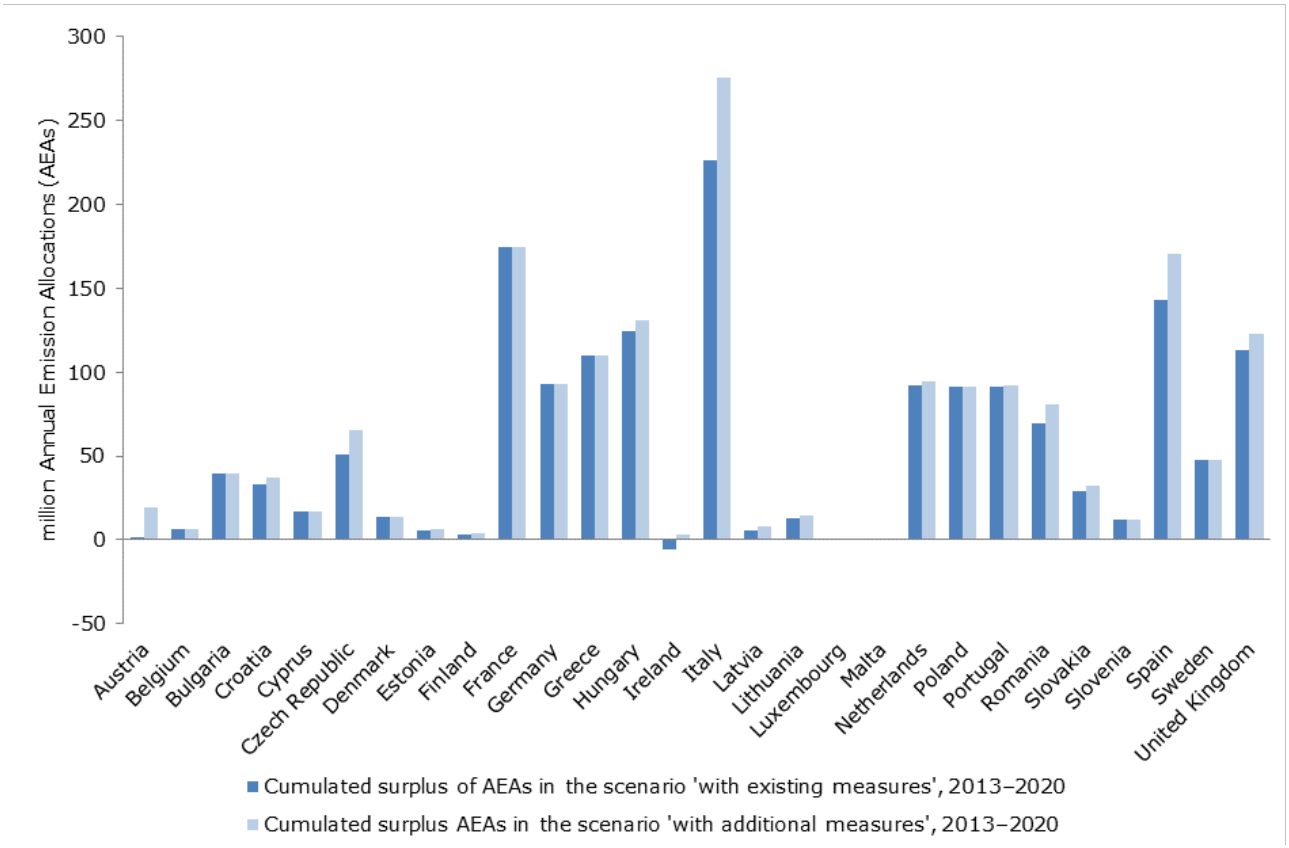
Source: EC, 2013a and 2013b; EEA, 2016d.

3.3 Cumulated 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 2013–2020 period for each Member State and at EU level. As historic and projected ESD emissions at EU level are below ESD targets, an overall surplus of between 1 600 and 1 760 million AEAs is expected by 2020 at EU level (see section A1.4 in Annex 1).

At Member State level, the size of the expected cumulated AEA surpluses or deficits by 2020 differ greatly (see Figure 2.3). The largest cumulated surpluses are projected for Italy, France and Spain. Only one Member State (Ireland) expects a deficit of AEAs in 2020 if no additional measures are implemented in due time or if no additional flexibilities (other than transfers of surplus AEAs from one year to the following year) are used.

Figure 3.3 Projected cumulated gaps with regard to ESD targets, 2013–2020



Click on the image for interactive data visualisation

Note: A positive value represents a surplus of AEAs. A negative value represents a shortfall of AEAs.

Only 18 Member States submitted a 'with additional measures' (WAM) scenario. For the other Member States (Belgium, Bulgaria, Denmark, France, Germany, Greece, Luxembourg, Poland, Slovenia and Sweden), the WEM scenario is shown instead.

Source: EC, 2013a, 2013b, 2016 and 2017; EEA, 2016a, 2016b, 2016c and 2016d.

Austria, Belgium, Denmark, Ireland and Luxembourg, 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 flexibility provisions provided for under the ESD (see Table

A3.4), as described below:

- For Austria, deficits of AEAs are projected for each year between 2016 and 2020 in the WEM scenario, while the 'with additional measures' (WAM) scenario suggests that there will be no deficit. Austria could therefore close its annual gaps by implementing the additional measures currently at planning stage, in particular in the transport sector (e.g. efficiency improvements of vehicles, modal shift to public or non-motorised transport, charging for external effects on noise or air pollution and tolls). 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 2017 and 2020 in the WEM scenario, with an estimated gap of 4.0 million AEAs in 2020. No WAM scenario is available and Belgium did not report on additional measures, so no statements can be made with regard to whether or not additional measures could close the estimated gap. Belgium could achieve its ESD targets in the whole period by using surplus AEAs accumulated between 2013 and 2016.
- For Denmark, projections show a small deficit (0.3 million AEAs) for the year 2020 only. Denmark would thus be able to achieve its ESD targets over the whole period by using surplus AEAs accumulated in the years prior to 2020.
- For Ireland, projections show deficits under both scenarios, starting from 2016 (WEM scenario) or 2017 (WAM scenario) until 2020. In the WEM scenario, 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. If additional measures are implemented, ESD targets could be reached by using surplus AEAs accumulated between 2013 and 2016. As reported by Ireland, the additional measures that would contribute to closing the gap in ESD sectors include additional energy efficiency measures, a targeted realisation of 40 % of electricity generation from renewables by 2020, the replacement of coal-fired electricity generation by natural gas, retrofits in the industry sector and thermal energy from renewable sources. In the transport sector, additional measures foresee increased deployment of electric vehicles, more efficient traffic movement and 10 % of fuel for road transport from renewables by 2020. 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. Despite the significant proportion of Ireland's ESD emissions that are contributed by the agriculture sector, compared with other Member States, only one additional measure is planned for this sector: it is envisaged that nitrification and urease inhibitors will be used in conjunction with nitrogen fertilizers, thereby reducing gaseous losses and reducing total fertilizer nitrogen use.

- For Luxembourg, deficits are projected for the years 2019 and 2020, with a gap of 0.5 million AEAs in 2020. This gap could be filled with the use of surplus AEAs from preceding years. No WAM scenario is available.

Table 4.1 summarises the minimum conditions required to stay within the 2013–2020 ESD budget. Overall, a net surplus of between 1 600 and around 1 760 million AEAs (depending on the scenario considered) could accumulate by 2020 if all unused AEAs are carried over to subsequent years within the compliance period from 2013 to 2020. This surplus is higher than the one calculated in the 2015 assessment (EEA, 2015) (1 500 to 1 700 million AEAs), which results from updated projections submitted in late 2015 and in 2016 by 8 Member States (Austria, Cyprus, Denmark, France, Greece, Hungary, Ireland and Luxembourg). The quantity of surplus AEAs would be largely sufficient to cover the potential deficits observed or expected in a limited number of Member States. So far, no 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 ESD budget for the 2013–2020 period

Use of flexibility mechanisms	Historic (2013 and 2014)	Approximated historic (2015)	2016–2020 WEM ([a]) scenario	2016–2020 WAM ([a]) scenario
No use of flexibility mechanisms	27 Member States (all excepted Malta)	27 Member States (all excepted Malta)	23 Member States ([b])	23 Member States plus Austria
Transfer of AEAs between years only			Austria, Belgium, Denmark, Luxembourg	Ireland ([c])
Additional flexibility mechanisms needed	Malta	Malta	Ireland	

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

([b]) The 23 Member States: Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom.

([c]) Belgium, Denmark and Luxembourg did not report projections in a WAM scenario.

Endnotes

[1] A Member State can carry forward (i.e. 'borrow') an emission allocation of up to 5 % from the following year, during the 2013–2019 period, in order to guarantee compliance (Article 3, EU, 2009a). A Member State can also carry over from a past year any surplus AEA. If it is not possible for a Member State to combine these two approaches to comply within a single year, it must make use of other flexible options under the ESD.

[2] The data presented here take into account projections submitted by Member States before 7 July 2016.

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4. Progress of the European Union towards its renewable energy targets

- The European Union (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 16.0 % in 2014. For the two-year period from 2013 to 2014, the average consumption of renewable energy as a proportion of gross final energy consumption exceeded the level of the indicative trajectory set out in the Renewable Energy Directive (RED).
- This good progress at the EU level is confirmed by preliminary estimates from the European Environment Agency (EEA), which show that renewable energy use in the EU increased to 16.4 % of gross final energy consumption in 2015.
- As regards the consumption of renewable energy in the transport sector, the EU reached a share of 5.9 % in 2014 (and 6.0 % in 2015 according to EEA preliminary estimates). This indicates that insufficient progress has been achieved so far towards the 10 % target 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, and market barriers and fragmentation still represent challenges for new entrants.
- In view of the EU's longer term energy and decarbonisation objectives for 2050, the speed with which the EU deploys RESs will need to increase.

4.1 Current progress on renewable energy

The European Union (EU) is currently on track to meet its target of reaching, by 2020, a 20 % share of energy from renewable energy in its gross final energy consumption [1]. In 2014, the

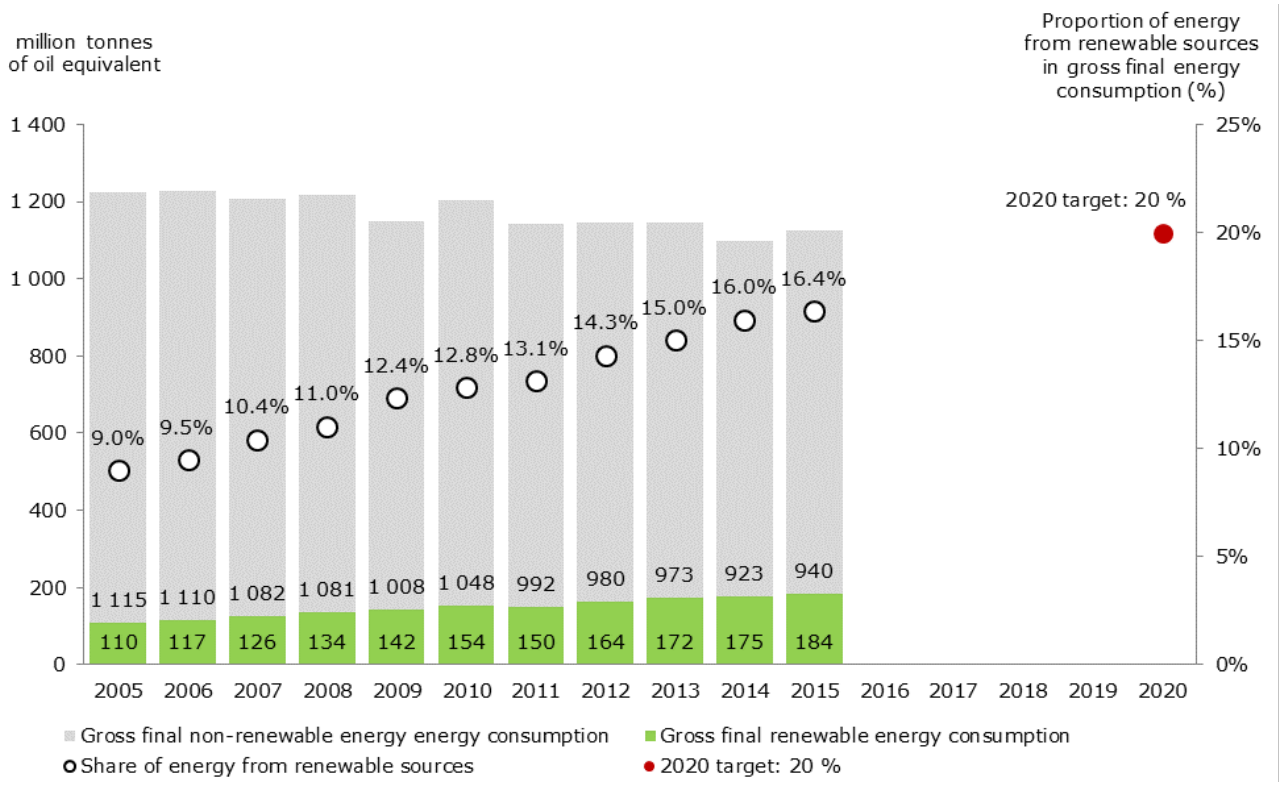
use of renewable energy sources (RESs) in the EU, as a proportion of gross final energy consumption, continued its steady growth, standing at 16.0 % of gross final energy consumption. This is an increase of one percentage point from the previous year. According to preliminary estimates from the European Environment Agency (EEA), the share of energy from renewable sources in the EU's gross final consumption of energy continued to increase in 2015, reaching a level of 16.4 %.

The Renewable Energy Directive (RED) sets national targets for 2020 for all Member States (EU, 2009). 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 local, regional and national authorities; planned statistical transfers; or joint projects).

The average RES share of 15.5 % achieved in the EU over the two-year period from 2013 to 2014 exceeded the average share from the indicative trajectory for these two consecutive years, as set in the RED (12.1 %). It also exceeded the indicative average share of 13.8 % set for the 2015–2016 period. Moreover, the RES share of 16.0 % in 2014 was also higher than the level that Member States had planned to achieve by 2014 and 2015 (14.5 % and 15.3 %, respectively), according to the roadmaps reported in their 2010 national renewable energy action plans (NREAPs).

Between 2005 and 2014, the use of energy from renewable sources, as a proportion of gross final energy consumption, increased by, on average, 0.8 percentage point 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 more than 59 % between 2005 and 2014, total final energy consumption decreased by 10 % during the same period (see Figure 4.1). Between 2013 and 2014, the consumption of renewable energy increased by 3 Mtoe (from 172 Mtoe to 175 Mtoe), while the consumption of non-renewable sources fell from 973 Mtoe to 923 Mtoe. The 17 % decrease in the gross final energy consumption of non-renewable sources between 2005 and 2014 clearly indicates a progressive substitution of fossil fuels by renewables.

Figure 4.1 Gross final energy consumption from renewable and non-renewable energy sources, 2005–2015



Note: Eurostat calculates the shares of 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.

The 2015 data are approximated estimates from the EEA.

Source: EU, 2009; Eurostat, 2016; EEA, forthcoming.

4.2 Projected progress in the deployment of renewable energy sources

If the average annual increase in RES share observed between 2005 and 2014 is maintained until 2020, the EU will achieve its 2020 target. This, however, may prove challenging, because of recent changes in national RES supporting policies, and persisting market barriers for new projects. Other complex factors are also at play, with uncertain outcomes. In particular, relatively low-priced RES development options are becoming scarcer as the easiest and least expensive options are gradually being exhausted. At the same time, costs for new RES capacity

are being reduced through economies of scale, better knowledge integration and increasing experience.

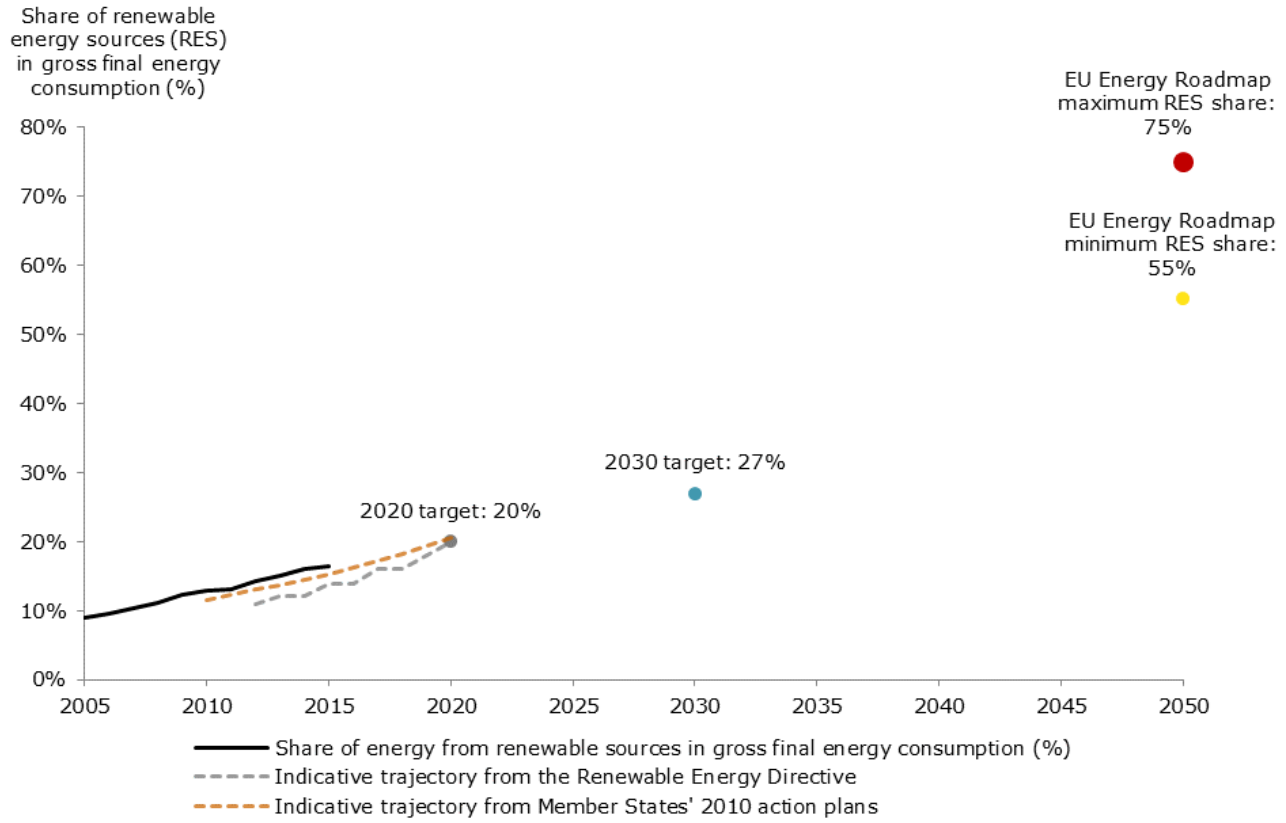
According to their 2010 action plans and biennial progress reports [2], Member States plan to increase the share of energy from renewable sources at EU level to approximately 21 % by 2020. However, not all Member States reported RES projections, or specified the status of the policies and measures (e.g. 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.

Furthermore, NREAPs and current RES projections do not reflect the recently endorsed objective to increase the EU-wide share of RES consumption to a minimum of 27 % by 2030. In this respect, current national documents offer limited information regarding the continuation of efforts foreseen by countries after 2020. The European Commission is expected to make a proposal for a revised RED in December 2016.

Beyond 2030, the EU has no quantified target for renewable energy. However, in order to achieve the goal of reducing EU-wide GHG emissions by 80–95 % below 1990 levels by 2050, the share of RES in the EU will need to increase significantly, to levels of between 55 % and 75 % of gross final energy consumption by 2050 (see Figure 4.2), in accordance with the decarbonisation scenarios presented in the European Commission's communicationEnergy Roadmap 2050(EC, 2011a and 2011b). Achieving such a high proportion of RES consumption calls for considerably higher efforts post 2030, as the required pace of RES growth would have to be up to three times that achieved between 2005 and 2014. A higher penetration of renewables before 2030 would balance the pace of growth required before 2050, but further policy efforts and investments would be required in the short term.

The transport sector represents one particular challenge. Because of its significant reliance on fossil fuel-based technologies and infrastructures, progress in developing the use of renewable energy and reducing GHG emissions in this sector has been relatively limited in the EU to date (see section 3.4).

Figure 4.2 Share of energy from renewable sources in EU's gross final energy consumption, 2005–2050



Source: EC, 2011b, 2013a and 2013b; EU, 2009; EEA, 2011 and forthcoming; Eurostat, 2016.

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

RESs are used in power generation, the heating and cooling sector, and the transport sector. In addition to the overall 20 % target for renewable energy use in all sectors by 2020, a 10 % target must also be achieved specifically in the transport sector, by all Member States. However, progress in this sector is much slower than if all sectors are considered together.

Between 2005 and 2014, with regard to electricity consumed in the EU, the RES share grew at an average of 1.4 percentage points per year. In 2014, more than 27 % of the electricity consumed in the EU was generated from renewables, with about 41 % of that from variable renewable electricity (wind and solar power). For 2015, EEA estimates indicate that more than 28 % of total electricity consumed was derived from RESs, with more than 42 % of this from wind and solar

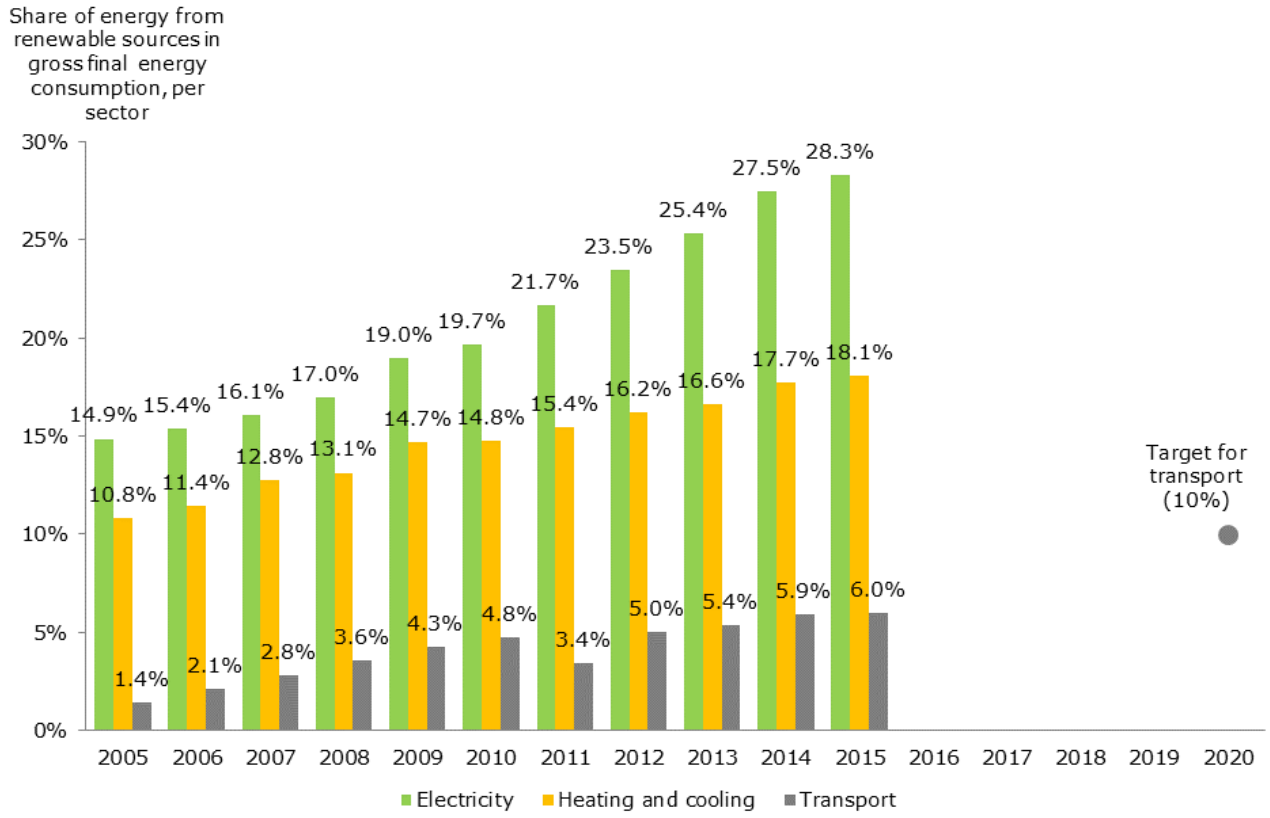
power (EEA, forthcoming).

In the EU heating and cooling sector, the RES share grew on average by 0.8 percentage points per year between 2005 and 2014. The share of energy from renewable sources used in this sector amounted to 17.7 % in 2014, and was estimated to have been 18 % in 2015 (EEA, forthcoming). Heating from RESs 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 2014, renewable energy represented only 5.9 % of energy consumption in the transport sector (see Figure 4.3). According to preliminary estimates from the EEA, this proportion increased marginally in 2015, up to 6.0 %. 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 legal framework concerning energy from biofuels produced from crops grown on agricultural land primarily for energy purposes remained uncertain until a political agreement was reached in 2012. A cap on the use of these fuels was adopted in 2015: such fuels should account for a maximum of 7 % of final energy consumption in transport by 2020 (EU, 2015a and 2015b). In 2017, each Member State will need to set a national target for advanced biofuels (e.g. fuels made from waste or algae).
- The use of biofuels to reduce GHG emissions remains a relatively high-cost 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 carbon dioxide (CO_2); for bioethanol fuels from sugars and straw, costs would range from EUR 100 to EUR 200 per tonne of avoided CO_2 (JRC, 2015).

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



Note: Percentages indicate the share of energy from renewable sources in gross final energy consumption of the corresponding sector. The 2015 data are approximated estimates from the EEA.

Source: EU, 2009; Eurostat, 2016; EEA, forthcoming.

End notes

[1] 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.

[2] 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.

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5. Progress towards Member States' renewable energy targets

- Under the Renewable Energy Directive (RED), Member States must achieve targets on 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 2020 targets, the RED also sets indicative trajectories for the period from 2011 to 2020. Member States have also set their own estimated trajectories in their national renewable energy action plans (NREAPs) reported in 2010.
- In all Member States except one (the Netherlands), the average share of renewable energy sources (RES) for the 2013–2014 period was equal to or higher than the average for this period based on the indicative trajectories set under the RED. According to preliminary European Environment Agency (EEA) estimates, in 2015, the RES share in three Member States (France, Luxembourg and the Netherlands) was below the 2015–2016 share set in their indicative RED trajectories.
- With regard to the progress of Member States based on their own plans, 22 (all except France, Ireland, Malta, the Netherlands, Poland and Portugal) reached or exceeded their anticipated NREAP trajectories in 2014. According to preliminary estimates, this number decreased to 19 Member States in 2015, as nine Member States were unable to follow their NREAP trajectory for that year (the same countries as in 2014, in addition to Belgium, Luxembourg and Spain).
- In nine Member States (Bulgaria, Croatia, the Czech Republic, Estonia, Finland, Italy, Lithuania, Romania and Sweden), the proportion of RES use in 2014 already exceeded the 2020 RED targets. Preliminary data indicate that this may have risen to 10 Member States, including Denmark, in 2015.
- 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 involved countries and help the European Union (EU) to achieve its 2020 RES target more cost effectively.

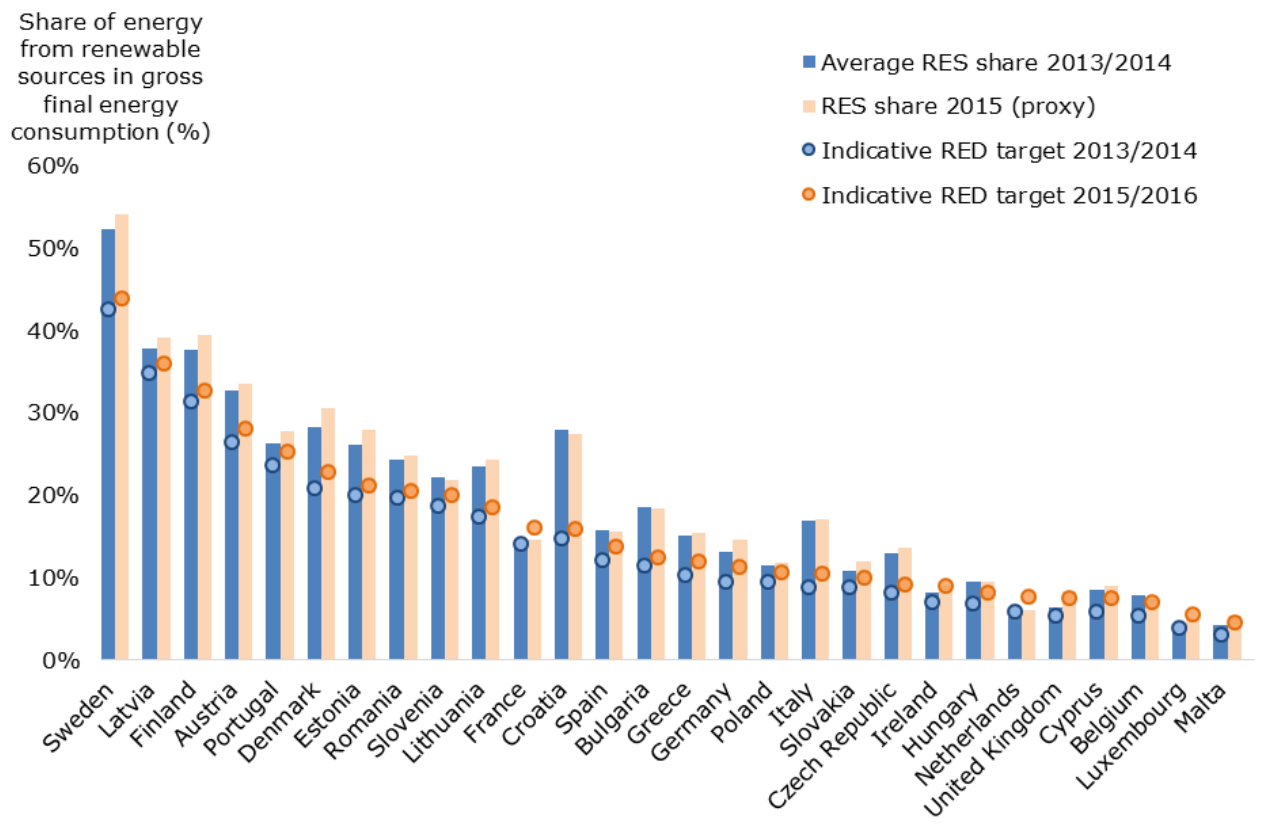
5.1 Current progress towards renewable energy source targets

In order to achieve the European Union's (EU's) objective of a 20 % share of energy from renewable sources in its gross final energy consumption by 2020, the Renewable Energy Directive (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 indicative trajectories for the period from 2011 to 2020. These indicative trajectories are expressed as average shares for two-year periods from 2011 to 2018, in addition to the 2020 target.

For the two-year period from 2013 to 2014, all Member States except one (the Netherlands) exceeded their indicative trajectory set in the RED (see Figure 5.1). According to approximated estimates from the European Environment Agency (EEA), the 2015 renewable energy source (RES) targets set in the indicative RED trajectories will not be met by three Member States (France, Luxembourg and the Netherlands) for the two-year period from 2015 to 2016 (see Figure 5.2). It is still possible that these countries will stay on course with their indicative RED trajectories by achieving 2016 RES shares that are sufficient to bring the 2015–2016 averages above the trajectory values.

When considering current RES shares in relation to 2020 targets, in 2014, nine Member States exceeded their national targets for 2020 set under the RED. These countries were Bulgaria, Croatia, the Czech Republic, Estonia, Finland, Italy, Lithuania, Romania and Sweden (see Annex 2). According to preliminary estimates from the EEA, in 2015, Denmark also increased its RES share to a level above its 2020 RES target.

Figure 5.1 National shares of energy from renewable sources in relation to indicative RED trajectories



Note: For Croatia, the share of energy from renewable sources changed considerably because of data revisions which took place in 2016. This revealed significantly higher amounts of biomass consumption which drove the proportion of renewable energy use upwards compared with the 2015 report.

Source: EU, 2009; EC, 2013; EEA, 2011 and forthcoming; Eurostat, 2016.

5.2 Progress towards the objectives of national action plans

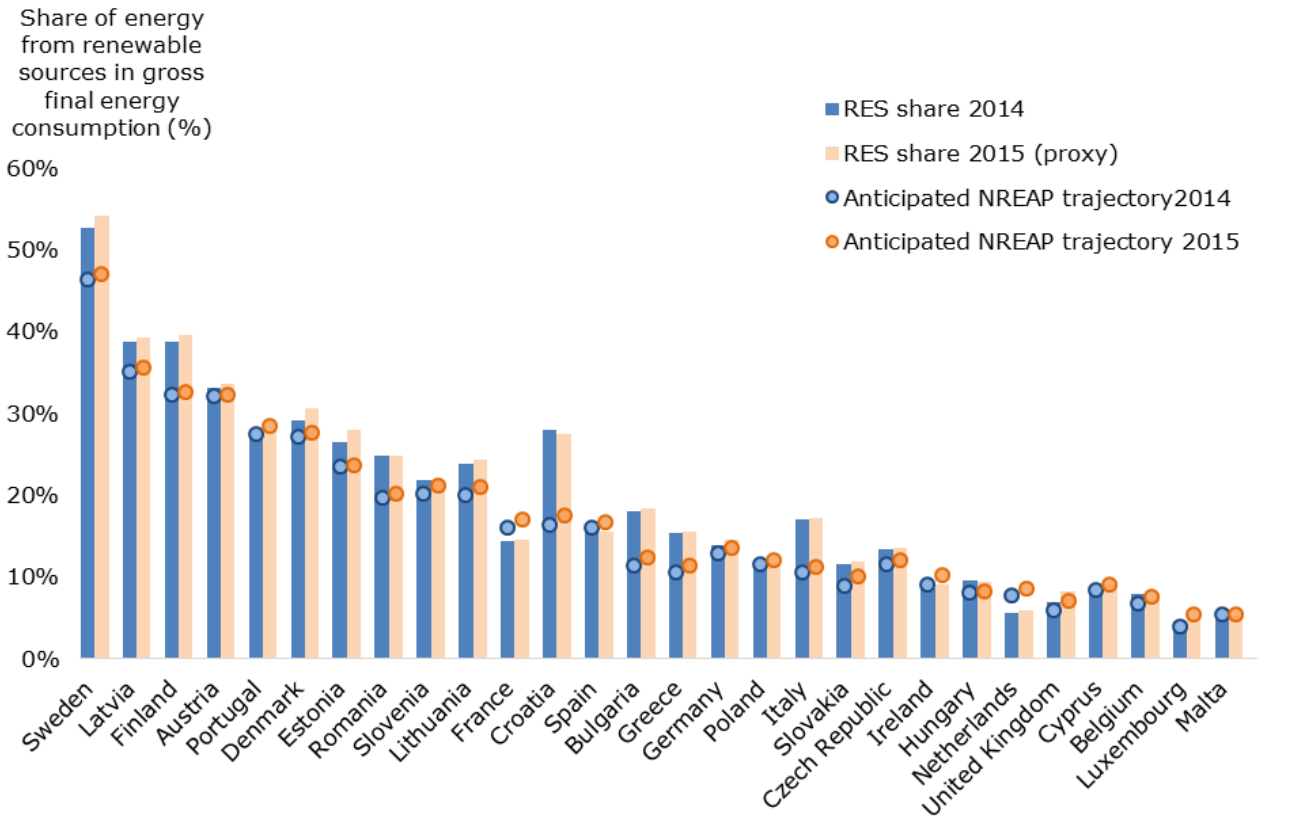
Member States also set their own estimated trajectory in national renewable energy action plans (NREAPs), which they reported in 2010. These action plans concern the development of renewable energy at the national level, and include indicative trajectories as well as planned RES shares in the transport (RES-T), heating and cooling (RES-H/C), and electricity (RES-E) sectors.

For most Member States, the anticipated trajectories set out in NREAPs are more ambitious than the indicative trajectories defined in the RED ([1]). For example, the indicative RES target for the 2013–2014 period set out in the RED for Denmark is 20.9 %, while this country planned to achieve a share of 27.3 % for energy from renewable sources in 2014 according to its NREAP. By contrast, Greece, Latvia, Romania and the United Kingdom have designed trajectories in their NREAPs which are, for some years, lower than those set out in the RED.

In 2014, 22 Member States reached or exceeded the RES targets outlined in their NREAPs for that year (see Figure 5.2). However, for six Member States (France, Ireland, Malta, the Netherlands, Poland and Portugal) in 2014, the RES shares were below the anticipated trajectories laid out in their corresponding NREAPs.

Preliminary estimates by the EEA indicate that, in 2015, fewer Member States exceeded their NREAP trajectories than in 2014 (19 compared with 22). In addition to the countries that did not reach their NREAP trajectory in 2014, four Member States (Belgium, Luxembourg, Poland and Spain) failed to stay above their trajectories in 2015.

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



Note: The countries are ranked by decreasing 2020 RES target levels. For Croatia, data on RES proportions were considerably different from those used in the 2015 assessment. This data revision, which took place in 2016 revealed significantly higher amounts of biomass consumption, which drove the proportion of renewable energy use upwards.

Source: EU, 2009; EC, 2013; EEA, 2011 and forthcoming; Eurostat, 2016.

5.3 Deployment of renewable energy between 2005 and 2014

The growth in the proportions of RES use in Member States during the 2005–2014 period is a combined result of the development of renewable energy use (in absolute terms), together with the decline in gross final energy consumption, in 27 Member States (see Figure 5.3). If gross final energy consumption was to increase without further RES deployment, the proportions of RES use would actually decrease.

Figure 5.3 Gross final energy consumption (total and from renewable sources) and shares of energy from renewable sources in Member States, 2005–2014

Member State	Gross final energy consumption	Gross final energy consumption from renewable sources	Renewable energy share
	Total change 2005–2014 (%)	Total change 2005–2014 (%)	Percentage points change 2005–2014
Austria	-3%	35%	9.3
Belgium	-8%	216%	5.6
Bulgaria	-9%	75%	8.7
Croatia	-14%	1%	4.1
Cyprus	-10%	156%	5.8
Czech Republic	-11%	96%	7.3
Denmark	-12%	61%	13.2
Estonia	0.0%	52%	9.0
Finland	-2%	32%	9.9
France	-10%	35%	4.7
Germany	-5%	96%	7.1
Greece	-25%	64%	8.3
Hungary	-15%	82%	5.0
Ireland	-14%	160%	5.8
Italy	-16%	90%	9.5
Latvia	-5%	14%	6.4
Lithuania	0.4%	41%	6.9
Luxembourg	-11%	187%	3.1
Malta	33%	4193%	4.5
Netherlands	-13%	92%	3.0
Poland	5%	74%	4.5
Portugal	-16%	15%	7.5
Romania	-11%	26%	7.2
Slovakia	-14%	57%	5.2
Slovenia	-5%	29%	5.9
Spain	-19%	56%	7.7
Sweden	-6%	22%	12.0
United Kingdom	-15%	336%	5.6
Norway	0.3%	16%	9.4

Note: In Malta, there was an increase in gross final energy consumption from renewable sources of 4 193 % between 2005 and 2014. Because of its absolute small size, however, 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, 2016.

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 2014, Finland (21.6 %) and Sweden (19.2 %) were the only two Member States with RES-T shares of more than 10 %. In the other Member States, RES-T shares varied from 0.2 % to 8.9 %.

In Finland, the use of biofuels compliant with sustainability criteria ([2]) increased significantly in 2014. 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 ethanol and biogas. Sweden also has a high proportion of renewable electricity consumption in rail transport.

In 2015, the situation remained similar to that in 2014 according to approximated estimates. Apart from in Finland and Sweden, RES-T shares ranged from 0.2 % to 8.3 % in the other Member States (see Table A2.2 in Annex 2).

5.5 Regional cooperation and flexibility mechanisms

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 one year, before 2020 ([3]). 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.

In 2012, 2013 and 2014, statistical transfers between Norway and Sweden took place (Eurostat, 2016). Norway and Sweden created a joint electricity certificate market 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.

Denmark, Germany, Latvia, Lithuania, Luxembourg and Portugal have also reported plans of joint projects or have expressed an interest in such projects. Denmark expected to establish a cooperation agreement with Germany in 2016, regarding the mutual opening of tenders for solar cells for plants located in the other country. In Germany, some tenders will be opened up to cross-border participation by foreign plants. In 2016, Latvia was planning to consider quantity and cooperation opportunities for statistical transfers of energy from RES in 2020. Lithuania signed a memorandum of understanding with Luxembourg in 2011 concerning cooperation on energy from renewable sources, including opportunities for statistical transfers and joint projects. Luxembourg reported that no final decision on a statistical transfer or a joint project had yet been taken for the 2013–2014 period, but has held and intensified target-oriented talks with various countries. Portugal registered an expression of intent to develop a joint project in the area of photovoltaic technology, but no agreement has been made so far between Portugal and other Member States.

End notes

[1] In its 2015 progress report on the promotion and use of renewable 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.

[2] 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 greenhouse gas 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.

[3] Excesses and deficits are reported in Table 7 of the progress reports on the promotion and use of renewable energy from renewable sources under Article 22 of the RED.

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

- The European Union (EU) is currently on track to meet its 20 % energy efficiency target for 2020. In 2014, its primary energy consumption (the total demand in energy) was 12.0 % below 2005 levels. Continuing this downwards trend at the same pace until 2020 would be sufficient for the EU to achieve its absolute primary energy consumption target, which is equivalent to a reduction of 13.4 % compared with 2005 levels.
- Preliminary estimates from the European Environment Agency (EEA) indicate that primary energy consumption increased by 1 % in 2015, back to 11 % below the 2005 level. Despite this slight increase, the EU remained on track to achieve its 2020 target on primary energy consumption.
- With regard to final energy consumption (which includes all energy delivered to final users but excludes the energy used by the energy industries themselves), in 2014 the EU had already decreased its final energy consumption to a level below its 2020 target.
- The reductions in the EU's energy consumption between 2005 and 2014 reflect the combined effects of the energy efficiency policies implemented across the EU and the continuing effects of the economic recession. Furthermore, the energy demand in 2014 was exceptionally low because of favourable climatic conditions (i.e. a particularly warm winter) which limited the energy demand for heating in Member States. As economies pick up again and the population continues to grow in some Member States, further efforts will be necessary to ensure that energy consumption continues to decrease.
- The EU's current 27 % energy efficiency target for 2030 will be reached if the reduction in primary energy consumption continues at the same pace as that achieved since 2005 to reach the 2020 target. Achieving the 2030 target in final energy consumption would require only a total reduction of 2.2 % from 2014 levels.

6.1 Current progress in reducing energy consumption

The European Union (EU) is currently on track to achieve its target of improving energy efficiency by 20 % by 2020. In 2014, it had reduced its primary [1] and final [2] energy consumption by 12.0 % and 10.9 %, respectively, compared with 2005 levels. According to preliminary estimates from the European Environment Agency (EEA), the EU's primary energy consumption increased slightly in 2015 (by 1 % compared with 2014) and final energy consumption increased by 2.5 % (EEA, 2016a and 2016b).

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 the target will require energy savings of 20 % from levels projected for 2020 in the Commission's Energy Baseline Scenario (EC, 2008). The present analysis tracks progress towards the 2020 targets by measuring energy consumption against 2005 levels. Using this reference year allows consistency in the assessment towards 2020 climate and energy targets across the whole report, since 2005 is the base year for expressing national greenhouse gas (GHG) targets under the Effort Sharing Decision (ESD), as well as national targets under the Renewable Energy Directive (RED). The year 2005 is also a relevant starting point for monitoring trends in energy consumption, since, along with 2006, it is one of the two years in which EU energy consumption reached its highest levels ever.

The EU's 2020 target expressed in terms of final energy consumption corresponds to an 8.8 % reduction from 2005 levels. In 2014, the EU had reduced its final energy consumption by 10.9 % compared with 2005 levels, to levels below the target set for 2020. This corresponds to an annual decrease of 1.2 % per year on average (see Figure 6.1).

The decrease in final energy consumption between 2005 and 2014 was influenced by a number of factors, such as structural changes towards less energy-intensive industrial sectors, improvements in end-use efficiency, lower energy consumption in the transport sector, as well as the economic recession (Odyssee-Mure, 2015). Furthermore, final energy consumption decreased by 4.1 % in just one year, between 2013 and 2014. The year 2014 was exceptionally warm, which resulted in less demand for heating in Member States than in previous years.

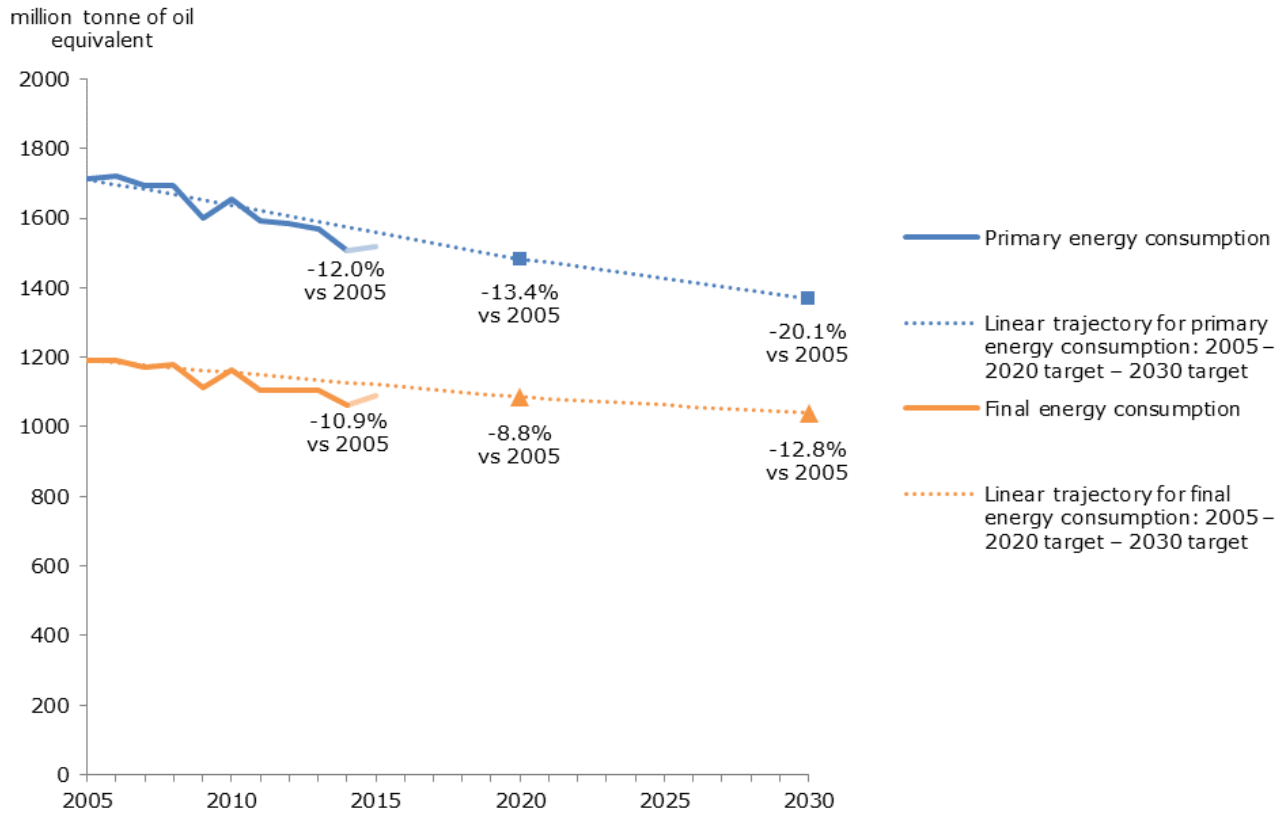
The EU's 2020 target expressed in terms of primary energy consumption is equivalent to a 13.4 % reduction from 2005 levels. In 2014, the EU's primary energy consumption was 11.8 % lower than in 2005. The average annual reduction in the EU's primary energy consumption between 2005 and 2014 (of 1.3 % per year) was more than the average annual reduction required to achieve the 2020 target (of 0.9 % per year between 2005 and 2020). In other words, in 2014, the EU's primary energy consumption was below an indicative linear trajectory drawn between the actual consumption level in 2005 and the targeted level for 2020. According to preliminary estimates from the EEA, the EU's primary energy consumption slightly increased in 2015 (by 1 % compared with 2014), although it still remained below the indicative linear

trajectory (EEA, 2016b).

The 12 % decrease in primary energy consumption between 2005 and 2014 was largely driven by the reduction in final energy consumption observed during that period. The other factors that contributed to this decrease are related to the production of final energy (e.g. electricity and heat) from primary energy as follows:

- The efficiency of the conversion of primary sources (e.g. coal and gas) into final energy has improved.
- There have been changes to the fuel mix for the production of electricity and heat:
  - The proportion of thermal generation (excluding combined heat and power (CHP)) has decreased.
  - The proportion of nuclear energy has decreased: the conversion efficiency of nuclear technology is considered lower than the average efficiency of thermal generation, so a decrease in the proportion of nuclear energy statistically improves the overall conversion efficiency of the energy system.
  - There proportion of renewable sources for electricity production (such as hydro, solar photovoltaic, wave and tidal, and wind) has increased: these renewable energy sources are considered to have 100 % transformation efficiency, so an increasing proportion statistically improves the overall conversion efficiency of the system. The increase in the consumption of renewables from 2005 — and the subsequent substitution of fossil fuels — is estimated to have contributed to a 2.0 % reduction in primary energy consumption in 2014 (EEA, 2014).

Figure 6.1 Primary and final energy consumption in the EU, 2005–2015, 2020 and 2030 targets



Note: 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 27 % compared with 2030 projections in the same Energy Baseline Scenario.

Source: EC, 2008; European Council, 2014; EEA, 2016a and 2016b; Eurostat, 2016a, 2016b and 2016c.

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. Assessing the projected progress of Member States ,— and subsequently of the EU — towards their energy efficiency targets based on Member States information, as is done for GHG emissions, is therefore not possible.

The EU will achieve its 2020 target on energy efficiency if the average annual decreases in primary and final energy consumption observed between 2005 and 2014 are maintained until 2020. This, however, may prove challenging considering the potential effects of an economic recovery and demographic trends on future energy consumption trends.

In its assessment of progress made by Member States towards the national energy efficiency targets for 2020, the European Commission concluded that, despite the achievements of previous years, additional efforts are needed, particularly in the building, transport and generation sectors. To close the remaining gap between current levels and the 2020 primary energy consumption target, Member States should accelerate their efforts in order to achieve their national energy efficiency targets for 2020, or go beyond them.

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

In October 2014, the European Council endorsed an indicative energy efficiency target of at least 27 % for 2030, in comparison with the 2020 Energy Baseline Scenario target of the European Commission (European Council, 2014). This Energy Baseline Scenario, based on the Price-driven and Agent-based Simulation of Markets Energy System Models (PRIMES), was used to set the 20 % target for 2020 (EC, 2011).

A 27 % improvement of energy efficiency by 2030 corresponds to:

- a primary energy consumption of 1 369 Mtoe in the EU, which is 20 % lower than in 2005 — this level corresponds to an average annual decrease of 0.8 % per year between the 2020 target and 2030 (compared with a 0.9 % average annual decrease between the 2005 level and the 2020 target);
- a final energy consumption of 1 039 Mtoe, which is 13 % lower than in 2005 — this translates to a 0.4 % average annual decrease between the 2020 target and 2030 (compared with the 0.6 % average annual reduction between 2005 and the 2020 target).

Considering this, actual reduction targets for 2030 are less ambitious than those for 2020 because the average annual reduction rates are lower than those required for the achievement of the 2020 targets. A 27 % energy efficiency target could be reached by 2030 by continuing, beyond 2020, the efforts made to reduce the EU's primary energy consumption between 2005 and 2020. Achieving the final energy consumption target in 2030 requires only a 2.2 % reduction from 2014 levels.

The target will be reviewed in 2016, following a review of the EED. A 30 % improvement of energy efficiency by 2030 would correspond to a 23 % decrease in primary energy consumption or to a 16 % decrease in final energy consumption, compared with 2005. Individual Member States are also free to set their own higher national targets.

End notes

[1] 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 the transformation (for example, 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).

[2] 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. See Box 5.1

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7. Progress towards Member States' energy efficiency targets

- Under the Energy Efficiency Directive (EED), Member States have to set indicative, non-binding targets on primary or final energy consumption for 2020. For primary energy consumption, Member States have set targets ranging from a 24 % reduction to a 22 % increase compared with 2005 levels. For final energy consumption, these targets range from a 22 % reduction to a 43 % increase compared with 2005 levels. No indicative trajectory has been formally set to monitor progress towards these targets. This analysis uses a simple approach for monitoring progress, which considers an indicative linear trajectory between 2005 energy consumption levels and 2020 targets.
- In 2014, 25 Member States had reduced or limited the increase of their primary energy consumption to below the linear trajectories drawn between 2005 levels and the 2020 targets. Three Member States (Estonia, Malta and Sweden) had not achieved sufficient savings in primary energy consumption. According to preliminary data, the situation improved in 2015 for Estonia and Sweden, for which primary energy consumption levels fell to below their corresponding linear trajectories. In contrast, in Bulgaria, France and Germany, primary energy consumption in 2015 increased to levels above their corresponding trajectories.

- Progress on reducing final energy consumption was more pronounced than for primary energy consumption. In 2014, 24 Member States were on or below their target paths. However, Germany, Lithuania and Slovakia had not sufficiently reduced their final energy consumption to remain below their linear trajectory, while Malta had already almost exceeded its 2020 target, which is equivalent to a 43 % increase compared with 2005.
- Despite the overall good progress achieved so far, some Member States show a certain lack of ambition with regard to reducing or limiting their primary energy consumption by 2020. Taken together, Member States' self-defined 2020 targets for primary energy consumption are 2.9 % higher than the European Union (EU) target set under the EED. In contrast, for final energy consumption, the sum of all 2020 targets from Member States is 0.8 % below the EU target.

7.1 Progress towards national primary energy consumption targets

In order to achieve the European Union's (EU's) objective of reducing its energy consumption by 20 % compared with the baseline scenario by 2020, the Energy Efficiency Directive (EED) requires Member States to set their own national non-binding targets for either primary or final energy consumption for 2020 (EU, 2012). For primary energy consumption, Member States have set targets that range from a 24 % reduction (Malta) to a 22 % increase (Croatia) compared with 2005 levels. A total of 21 Member States have targets to decrease primary energy consumption, while the 2020 primary energy consumption targets of seven Member States (Croatia, Estonia, Finland, Latvia, Poland, Romania and Slovenia) are higher than 2005 levels [1]. Member States can also revise their targets upwards or downwards at any point in time.

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 to energy efficiency targets by considering, for each Member State, an indicative linear trajectory between 2005 primary energy consumption levels and 2020 targets, and by comparing historic levels of primary energy consumption with this linear trajectory. A country is considered to be on track towards meeting its 2020 target if its primary energy consumption is below its linear trajectory. Conversely, a country with primary energy consumption levels above its linear trajectory needs to reduce or limit its energy consumption at a faster pace, in order to meet its 2020 objective.

Between 2005 and 2014, primary energy consumption decreased in 25 Member States. It increased in only Estonia, Finland and Poland. In 2014, 25 Member States reduced or limited the increase in their primary energy consumption to levels below their corresponding linear

trajectories between 2005 levels and 2020 targets (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, in Estonia, Malta and Sweden, primary energy consumption in 2014 was above these countries' linear 2005–2020 trajectories. In Estonia, which adopted a target equivalent to a 21 % increase by 2020, primary energy consumption had increased by 23 % in 2014 compared with 2005 levels. Based on the European Environment Agency (EEA) energy efficiency index (EEA, forthcoming), these countries could improve their 2020 outlook by paying particular attention to the residential sector (Sweden), and the services and transport sectors (Malta). In Estonia, improvements could be made particularly to the energy transformation and buildings sectors.

In 2015, primary energy consumption increased in 19 Member States according to preliminary estimates from the EEA (EEA, 2016). One reason for these increases is the rebound in energy consumption for heating in 2015, after the exceptionally warm winter of 2014. Although Germany's primary energy consumption decreased slightly, it passed above the linear trajectory for this country. Bulgaria and France also saw their consumption pass above their linear trajectories because their energy consumption increased by 3 % and 2 %, respectively. The situation seems to have improved for Estonia and Sweden in 2015. With the two largest annual decreases across the EU (11 % and 8 %, respectively), these two countries are expected to see their primary energy consumption pass below their corresponding linear trajectories in 2015.

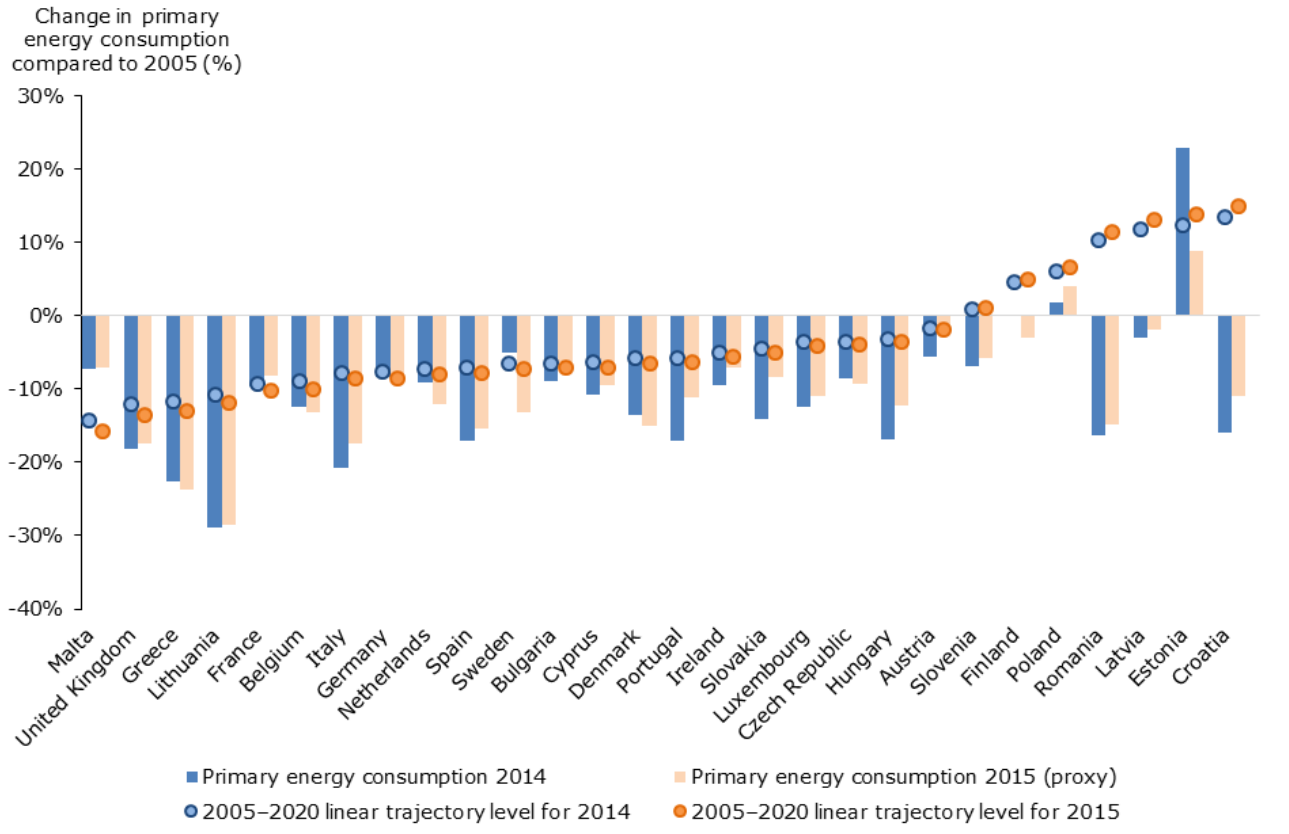
In 2014, 13 of the 21 Member States (Austria, Cyprus, the Czech Republic, Denmark, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Portugal, Slovakia and Spain), which had set reduction targets for 2020 compared with 2005, had already reached a level of primary energy consumption that is below their 2020 targets. According to preliminary estimates, all of these countries, except Austria, Cyprus and Ireland, are thought to have remained in this situation in 2015. Furthermore, four of the seven Member States that had set 2020 targets that are higher than 2005 levels (Croatia, Latvia, Romania and Slovenia) actually reduced their primary energy consumption between 2005 and 2014.

Member States have already put in place a wide range of energy efficiency measures that should go a long way towards meeting the 2020 energy efficiency objective; however, the challenge remains to fully implement and enforce these measures at the national level, particularly in the event of an economic recovery. Furthermore, Member States will need to achieve reductions beyond their targets if the EU is to meet its overall 2020 energy efficiency target related to primary energy (see section 7.2).

In 2015 and 2016, Member States adopted new measures or improved existing ones in order to fully implement the EED. This is a clear signal that the EU framework plays a key role in driving energy efficiency improvements. To overcome common barriers associated with energy efficiency improvements, such as a lack of transparency in the energy market, inadequate pricing of externalities and insufficient financing, Member States should emphasise the multiple

benefits of energy efficiency, such as enhancing the sustainability of the energy system, supporting strategic objectives for economic and social development (e.g. job creation), increasing well-being (e.g. health benefits and enhanced well-being resulting from retrofitting buildings) and promoting environmental goals (EEA, 2014).

Figure 7.1 Primary energy consumption and linear trajectory levels, 2014–2015



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.

Source: EC, 2015 and 2016; EEA, 2016; Eurostat, 2016b and 2016c.

7.2 Progress towards national final energy consumption targets

National 2020 targets on final energy consumption set by Member States under the EED range from –22 % (Slovakia) to +43 % (Malta) compared with 2005 levels. As for primary energy consumption, linear trajectories between 2005 levels and 2020 targets can be used to track the progress of Member States towards these targets. Paradoxically, of all Member States Malta has both the most stringent reduction target for primary energy consumption by 2020 (a 24 % reduction compared with 2005 levels) and the most lenient target for final energy consumption (a 43 % increase) by that same year.

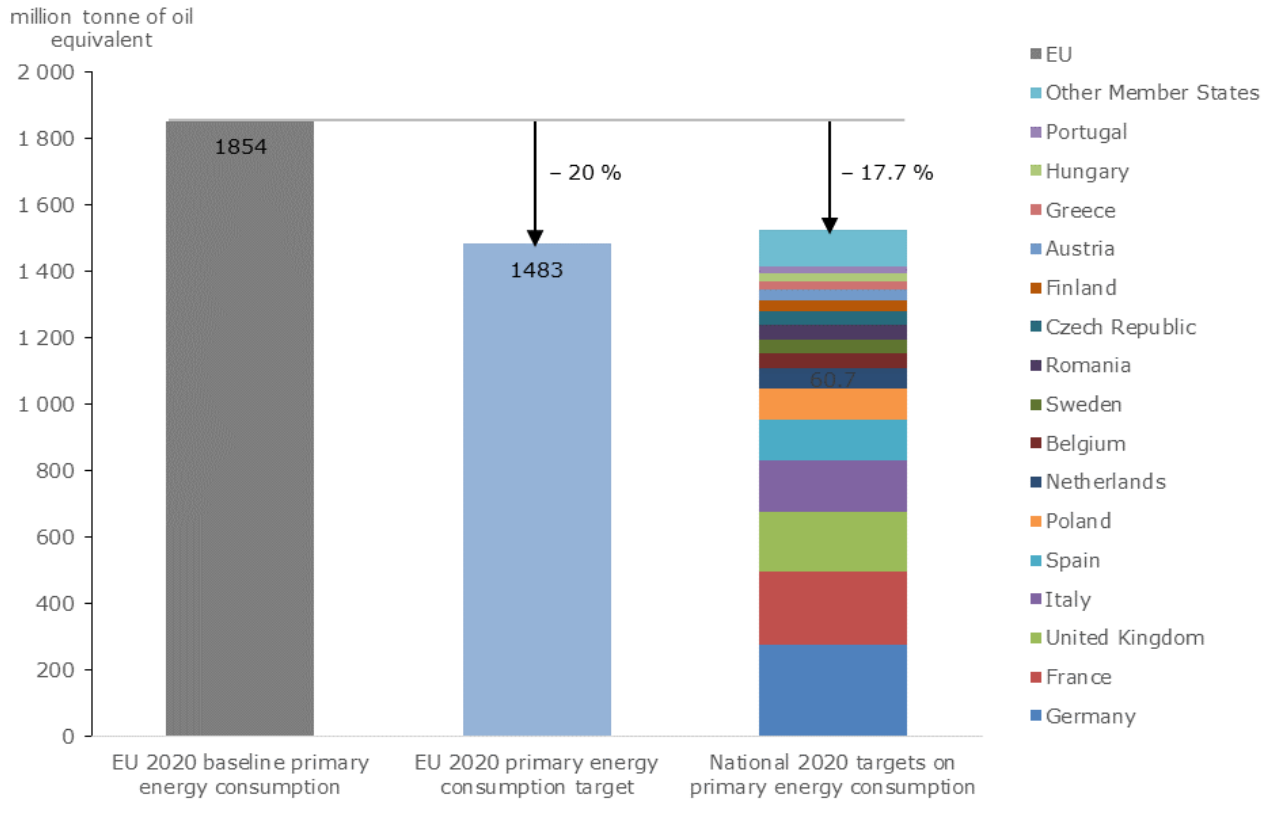
Although the EU's 2020 target on final energy consumption was already reached in 2014, a number of Member States still need to pursue their efforts to further reduce or limit their own consumption. In 2014, 24 Member States stood on or below their target paths. However, Austria, Germany, Lithuania and Slovakia had not sufficiently reduced their final energy consumption to stay below their trajectories. Despite a target of a 43 % increase by 2020 compared with 2005, Malta had already let its final energy consumption increase by more than 42 % by 2014, far exceeding the linear trajectory from 2005 to the 2020 target.

7.3 Aggregated ambition level of Member States' national 2020 targets

Taken together, the sum of all individual 2020 targets from Member States for their primary energy consumption add up to an overall EU level (of 1 526 Mtoe), which remains 3 % higher than the target defined for the EU under the EED (1 483 Mtoe) [2] (see Figure 7.2). This is a clear sign of the insufficient ambition of some Member States. It is difficult to determine specifically which Member States lack ambition, as national targets are not directly comparable, since they are set based on different baselines and take into account different national circumstances (including early measures), in addition to political ambition.

For final energy consumption, the sum of all 2020 targets from the 28 Member States (1 077 Mtoe) is 1 % lower than the EU target for final energy consumption (1 086 Mtoe) (see Figure 7.2). Therefore, achieving these national targets would now be sufficient to reach the EU-level target for final energy consumption — this was not the case in the 2015 analysis (EEA, 2015). This is the consequence of the revision, in 2016, of targets by three Member States (Denmark, Hungary and Ireland); in 2015, the sum of Member States' targets for final energy consumption was above the EU target.

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.

Source: EU, 2012; EC, 2015 and 2016.

End notes

[1] For Finland, this is explained by an exceptionally low energy consumption in 2005 compared with other years.

[2] This takes into account the revision by Croatia, Denmark, Ireland, Hungary and Slovenia of their targets in 2016. All of these countries adopted lower targets for primary energy

consumption (i.e. requiring further reductions).

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

- Iceland, Liechtenstein, Norway, Switzerland and Turkey are member countries of the European Environment Agency (EEA), but not of the European Union (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 reduction since 1990. For some, GHG emissions actually increased significantly.
- However, Iceland and Norway exhibit shares of renewable energy higher than any other EU Member State.

8.1 Greenhouse gas emissions

Iceland, Liechtenstein, Norway, Switzerland and Turkey are all Annex I countries to the United Nations Framework Convention on Climate Change (UNFCCC). Iceland, Liechtenstein and Norway have also closer association with the EU for a number of commitments on greenhouse gas (GHG) emission reductions. In particular:

- Iceland, Liechtenstein and Norway have been participating in the EU Emissions Trading System (ETS) since 2008.
- Iceland decided to jointly fulfil commitments with of the EU and its Member States in the second commitment period of the Kyoto Protocol to the UNFCCC, i.e. to reduce its GHG emissions by 20 % by the year 2020, compared to 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 to 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 an intention to participate in the joint action taking place in the EU to reduce emissions from sectors not covered by the EU ETS (i.e. in the Effort Sharing legislation for the period from 2021 to 2030). For the period from 2021 to 2030 Norway has made clear that it intends to fully participate in the reduction effort for the non-ETS sectors. As Member State targets range from 0% to -40%, on the basis of Gross Domestic Product (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 Commission's legislative proposal on a new effort sharing is adopted (EC, 2016b).

Historic GHG emissions in Iceland, Liechtenstein, Norway, Switzerland and Turkey followed very different trends between 1990 and 2014. Updated information on emission projections was only available for Norway and Switzerland (see Figure 3.1).

Iceland also set a long-term GHG mitigation target of between 50 % and 75 % by the year 2050 compared to GHG emissions in 1990. In 2014, Iceland's emissions had increased by 27 % compared to 1990 levels. Therefore Iceland does not currently seem to be on track to reach its target for 2020.

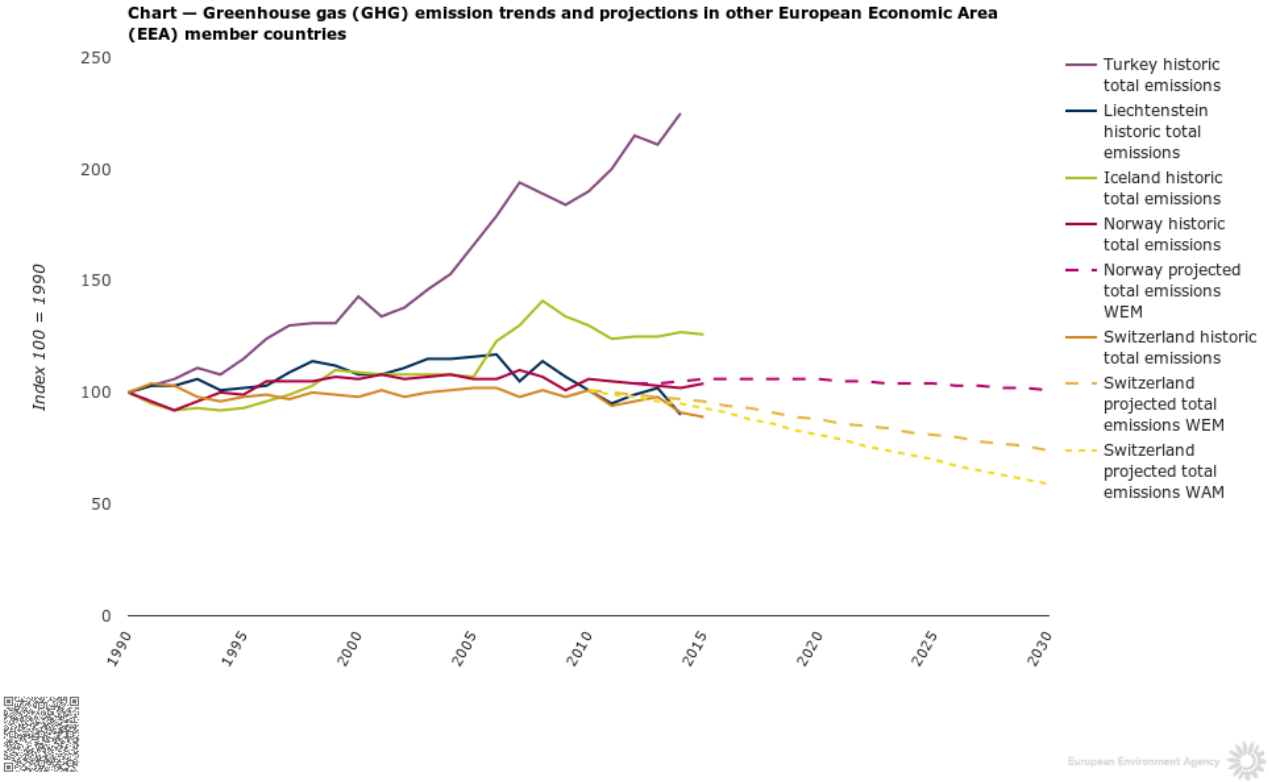
Liechtenstein also aims to emit at least 40 % less GHG emissions in 2030 compared to 1990 (Liechtenstein, 2015). To attain this target, Liechtenstein has also set itself a sectoral goal: GHG emissions from the energy sector will decrease by 20 % between 1990 and 2020. In 2014, Liechtenstein's emissions were 10 % 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 to 1990 under the UNFCCC [1].

Norway's target is to reduce its GHG emissions by 30 % in 2020 compared to 1990. According to its INDC (Norway, 2015), Norway aims to reduce its GHG emissions by at least 40 % in 2030, compared to 1990 [2]. Norway also aims to reduce emissions by the equivalent of 100 % of its own emissions by 2030, thus becoming climate neutral, achieved through emissions trading in the EU, international cooperation on emission reductions, other forms of emissions trading and project based cooperation. In 2014, GHG emissions had increased by 2% compared with 1990.

Switzerland's target is to reduce its GHG emissions by 20 % in 2020 compared to 1990. Like Norway, it also sets a more ambitious GHG reduction target of 30 % reduction in 2020 compared to 1990, provided that the international community agrees on a stricter climate policy. For 2030, Switzerland submitted an INDC to the UNFCCC which states its intention to reduce its GHG emissions by 50 % compared to 1990 levels ([10]). This target will partly be reached through the use of carbon credits from international mechanisms (Switzerland, 2015). In 2014, emissions in Switzerland were reduced by 9% compared to 1990 levels.

Turkey has submitted an INDC to the UNFCCC with a 21 % economy-wide cut in GHG emissions by 2030, compared to a business-as-usual scenario (Turkey, 2015). This implies an increase in GHG emissions limited to a level of 929 Mt CO_2-eq. in 2030, which is nearly 5 times the emissions of 1990. To reach its national target, Turkey aims to use carbon credits from international market mechanisms. In 2013, Turkey's GHG emissions had increased by 125 % compared to 1990.

Figure 8.1 Total GHG emission trends and projections in Iceland, Liechtenstein, Norway, Switzerland and Turkey, 1990–2030



Click on the image for interactive data visualisation

Note: Projections display total GHG emissions excluding LULUCF and international aviation. Solid lines represent historic 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 may exclude 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.

Source: Iceland, 2016; Liechtenstein, 2016; Norway, 2016; Switzerland, 2016; Turkey, 2016.

Endnotes

[1] Including emissions and removals from LULUCF.

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

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

1. Reporting requirements for greenhouse gas emissions

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

The initial purposes of the reporting requirements stipulated in the MMR are to enable the European Union (EU) to complete its reporting commitments under the United Nations Framework Convention on Climate Change (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 European Environment Agency (EEA).

Implementing provisions (EU, 2014a) 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 are used for the purposes of the LULUCF (land use, land-use change and forestry) Decision (EU, 2013b). Furthermore, a delegated act (EU, 2014b) defines the substantive requirements for an EU inventory system in order to fulfil the obligations pursuant to Decision 19/CMP.1.

2. Data sources for greenhouse gas emissions

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

Historic trends of greenhouse gas emissions

GHG emission data for the period from 1990 to 2014 are official data reported by the EU and Member States under the UNFCCC in their corresponding GHG inventory reports (EEA, 2016a

and 2016b). 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) [1], 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 projections 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 Effort Sharing Decision (ESD). This concerned the years 2005, 2008–2010, 2013 and 2014.

Approximated greenhouse gas emissions for 2015

Early 'approximated' (proxy) estimates of 2015 GHG emissions were reported by Member States to the European Commission under the MMR by 31 July 2016. These estimates were aggregated to EU level by the EEA (EEA, 2016c). Bulgaria, Cyprus, Lithuania and Romania did not submit proxy GHG inventories. The missing data were gap filled by EEA and ETC/ACM for the calculation of EU totals. For Luxembourg and Malta, which submitted after the deadline, gap filled estimates were taken into account for the calculation of EU totals, but the assessment of these countries progress towards ESD targets in 2015 was based on the reported data.

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

Data relative to the EU Emissions Trading System (ETS) are used to analyse emission trends in the EU ETS, but also to determine the level of emissions covered under the ESD. For the years 2005–2012, ETS emissions include estimates to reflect the scope of the EU ETS for the third trading period. These data are publicly available from the European Union Transaction Log (EUTL) [2] and the EEA ETS data viewer (EEA, 2016d). The data considered in the analysis were extracted from the EUTL on 13 September 2016.

Emissions covered under the Effort Sharing Decision

For the purpose of analysing emission trends in the ESD, historic 2005 ESD emissions are calculated using the latest GHG inventory data, from which ETS emissions and CO_2 emissions from domestic aviation are subtracted. ETS emissions include 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 2014 are consistent with the outcome of the 2016 comprehensive review of national GHG inventory data pursuant to Article 19(1) of the MMR, which was concluded on 30 August 2016. The data used by the Commission to determine Member States's compliance under the ESD for 2013 and 2014 will be made publicly available (EC, 2016 and 2017).

Long-term historic trends of Emissions Trading System and Effort Sharing Decision emissions

For Figure 1.2, Figure 1.3 and Figure 1.4, GHG emissions for the years 1990–2015 are split into those covered by the EU ETS and those covered by the ESD. These splits are based on the application of a fixed percentage for each of the main source categories defined by the Intergovernmental Panel on Climate Change (IPCC) for the reporting of national GHG inventories:

- energy sector (IPCC sectors 1.A.1, 1.B and 1.C): 90 % for ETS/10 % for ESD;
- the manufacturing and construction sector (IPCC sector 1.A.2): 71 % for ETS/29 % for ESD;
- the residential and commercial sectors (IPCC sectors 1.A.4 and 1.A.5): 1 % for ETS/99 % for ESD;
- the industrial processes sector (IPCC sector 2): 60 % for ETS/40 % for ESD;
- the transport (without aviation), agriculture and waste sectors (IPCC sectors 1.A.3, 3 and 5): 100 % for ESD;
- the aviation sector (IPCC sector 1A3a and memo item international bunkers): 34 % for ETS.

Projections for ETS and ESD are reported by source categories. The separation of ETS GHG emissions into source categories was partly carried out by applying average sectoral percentages to total ETS GHG emissions for Poland only.

The 2005 Effort Sharing Decision base-year emissions

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

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

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 to, for example, compare relative changes in ESD emissions with 2020 ESD targets expressed in percentage.

In this report, calculated 2005 ESD base-year emissions are used to express the distance between ESD emissions and ESD targets in a normalised way (see, for example, Figure 2.1 and Figure 2.2). 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 from one Member State to another (see section A3.3).

These calculated 2005 ESD base-year emissions may differ, sometimes significantly, from actual historic 2005 emissions under the ESD based on the latest GHG inventories, ETS verified emissions and EEA estimate of emissions for 2005–2012 to reflect the current scope of the EU ETS (see above).

Projections of greenhouse gas emissions

The report uses GHG projection data that are reported biennially by Member States under the MMR (EEA, 2016e). Mandatory reporting takes place every 2 years (2013, 2015, etc.). Member States must also report substantial changes to projections every other year (2014, 2016, etc.). Member States have submitted projections as follows:

- In 2015, all Member States except Greece submitted projections.
- In 2016, eight Member States (Austria, Cyprus, Denmark, France, Ireland, Greece, Hungary and Luxembourg) as well as Norway and Switzerland provided updated projections. All updated projections have been included until 7 July 2016.

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

- A 'with existing measures' (WEM) scenario, which considers the implementation of existing (already implemented) measures, can be applied.
- If available, a 'with additional measures' (WAM) scenario, which also considers the implementation of additional measures (at planning stage), can be applied. In 2015, 18 Member States reported projections on the basis of such WAM scenarios: Austria, Croatia, Cyprus, the Czech Republic, Estonia, Finland, Hungary, Ireland, Italy, Latvia, Lithuania, Malta, the Netherlands, Portugal, Romania, Slovakia, Spain and the United Kingdom. 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 2 of the annex "Background information - International climate commitments in Europe"

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 [3]. 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 quality assurance and quality control (QA/QC) procedure in order 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 inElements 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, 2015). If significant discrepancies can be observed between the inventory value for the reference year and the projected year, an alignment of the level of projections is performed. Such calibration is performed in order to match national projections with a common reference year for aggregated EU projections, which is the year 2013. When such calibration took place in 2015, national GHG inventory data as of 30 June 2015 were used. For updated projections, calibrations were performed in 2016 against national GHG inventory data from 15 January 2016. Calibrations took place for Bulgaria, Croatia, the Czech Republic, Malta, the Netherlands and Portugal.

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

Country	Sector	GHG emission projections (Mt CO_2-eq.)									
		WEM scenario					WAM scenario				
		2015	2020	2025	2030	2035	2015	2020	2025	2030	2035
EU	**Total GHG emissions**	**4 429.6**	**4 235.2**	**4 128.7**	**4 054.3**	**4 004.4**	**4 412.4**	**4 166.5**	**4 015.9**	**3 892.0**	**3 801.8**
EU	**Total GHG emissions including international aviation**	**4 567.4**	**4 387.1**	**4 292.5**	**4 228.6**	**4 188.0**	**4 550.1**	**4 318.3**	**4 179.7**	**4 066.3**	**3 985.4**
EU	Energy supply	1 404.6	1 269.3	1 222.1	1 172.4	1 141.8	1 400.4	1 248.6	1 174.7	1 094.7	1 035.9
EU	Manufacturing and construction industries	511.8	509.4	510.0	504.4	500.1	507.6	499.9	496.2	487.7	484.5
EU	Transport	892.3	884.5	877.2	887.9	892.2	889.3	867.1	853.3	859.5	856.2
EU	Residential and commercial	659.6	620.2	581.1	559.9	543.6	655.8	605.2	561.7	531.8	512.2
EU	Industrial processes and process use	366.3	367.3	360.2	353.6	354.9	365.8	364.2	356.2	348.4	348.9
EU	Agriculture	445.3	449.0	452.9	457.4	460.8	444.7	447.2	450.2	453.1	455.0
EU	Waste	149.8	135.6	125.2	118.6	111.0	148.8	134.4	123.5	116.8	109.1
EU	Emissions Trading System (stationary installations)	1 860.8	1 729.1	1 689.8	1 640.4	1 606.1	1 856.1	1 706.1	1 637.6	1 556.2	1 494.7
EU	Effort Sharing Decision	2 552.9	2 489.4	2 421.4	2 395.7	2 379.3	2 540.4	2 443.6	2 360.8	2 317.6	2 288.0
EU	Land use, land-use change and forestry	-261.8	-260.1	-265.3	-263.9	-269.8	-263.3	-262.5	-264.9	-262.7	-270.5
EU	International Aviation	137.7	151.9	163.8	174.3	183.6	137.7	151.9	163.8	174.3	183.6

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Note: (a) Reported projections calibrated by EEA, in order to bring consistency with historic emissions.

(b) Reported projections not quality checked by EEA.

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).

NE: Not estimated.

Source: EEA, 2016e.

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

The annual emission allocation (AEA) values for the period from 2013 to 2020 were defined in Commission Decision No 2013/162/EU (EC, 2013b) and adjusted according to Commission Implementing Decision No 2013/634/EU (EC, 2013c), in order to reflect the change in scope of the EU ETS in 2013.

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 2014 ESD targets is based on a comparison between ESD GHG emissions and ESD targets (AEAs) for 2014:

- Member States with historic emissions below their annual ESD target are considered to be **currently on track** towards their targets under the ESD.
- By contrast, Member States with historic emissions higher than their ESD target 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 **not projected to be on track** towards their targets.

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

Table A1.2 Current progress towards 2014 and 2015 ESD targets

Member State	2005	2014 progress under the ESD				2015 progress under the ESD (approximated)			
	ESD base-year emissions (Mt CO_2-eq.)	ESD target (Mt CO_2-eq.)	ESD emissions (Mt CO_2-eq.)	Absolute distance (Mt CO_2-eq.)	Relative distance (percent share of 2005 base-year in %)	ESD target (Mt CO_2-eq.)	ESD emissions (Mt CO_2-eq.)	Absolute distance (Mt CO_2-eq.)	Relative distance (percent share of 2005 base-year in %)
Austria	58.1	52.1	48.2	3.9	0.1	51.5	49.2	2.3	0.0
Belgium	79.6	76.9	70.1	6.8	0.1	75.3	73.0	2.3	0.0
Bulgaria	24.0	27.2	22.9	4.3	0.2	27.5	23.3	4.2	0.2
Croatia	18.9	19.8	14.7	5.1	0.3	20.0	14.1	5.9	0.3
Cyprus	6.3	5.9	3.9	2.0	0.3	5.9	4.3	1.6	0.3
Czech Republic	62.1	63.2	57.6	5.6	0.1	64.0	56.6	7.3	0.1
Denmark	38.1	35.9	32.6	3.3	0.1	35.0	32.4	2.6	0.1
Estonia	5.8	6.3	6.1	0.2	0.0	6.3	5.7	0.7	0.1
Finland	33.8	31.3	30.1	1.1	0.0	30.8	30.0	0.8	0.0
France	417.8	389.5	353.5	35.9	0.1	384.4	365.1	19.3	0.0
Germany	494.9	465.8	436.8	29.0	0.1	459.1	448.7	10.4	0.0
Greece	63.8	59.3	44.4	14.9	0.2	59.6	44.5	15.1	0.2
Hungary	52.9	51.5	38.4	13.1	0.2	52.6	41.0	11.6	0.2
Ireland	48.7	45.8	41.7	4.1	0.1	44.6	43.6	1.0	0.0
Italy	338.4	306.2	265.3	40.9	0.1	304.2	272.4	31.8	0.1
Latvia	8.5	9.4	9.0	0.3	0.0	9.4	9.2	0.2	0.0
Lithuania	13.4	13.3	12.3	1.0	0.1	13.7	12.1	1.5	0.1
Luxembourg	10.2	9.3	8.9	0.5	0.0	9.1	8.8	0.3	0.0
Malta	1.1	1.2	1.3	-0.1	-0.1	1.2	1.4	-0.2	-0.2
Netherlands	127.4	120.7	97.9	22.8	0.2	118.4	102.0	16.4	0.1
Poland	177.5	194.9	181.5	13.3	0.1	196.1	181.6	14.5	0.1
Portugal	50.7	49.6	38.8	10.8	0.2	49.9	38.6	11.3	0.2
Romania	74.3	77.5	72.5	4.9	0.1	79.3	70.0	9.3	0.1
Slovakia	23.5	24.4	19.8	4.6	0.2	24.7	20.2	4.6	0.2
Slovenia	12.1	12.4	10.5	1.9	0.2	12.4	10.7	1.7	0.1
Spain	238.0	225.6	199.8	25.9	0.1	223.7	199.4	24.3	0.1
Sweden	44.8	41.0	34.5	6.5	0.1	40.4	34.0	6.4	0.1
United Kingdom	389.4	354.2	324.4	29.8	0.1	349.7	328.7	21.0	0.1
EU	**2 914.0**	**2 770.1**	**2 477.5**	**292.5**	**0.1**	**2 749.1**	**2 520.7**	**228.4**	**0.1**

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Note: Gaps (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).

Approximated 2015 ESD emissions were estimated by the EEA on the basis of data submitted by Member States.

See section A3.2 with regard to the calculation of '2005 base-year emissions' by the EEA.

Source: EC, 2013b, 2013c and 2017; EEA, 2016a, 2016b, 2016c and 2016d; EU, 2009.

Table A1.3 Projected progress towards 2020 ESD targets

Member State	2005	2020 ESD target		Projected progress with existing measures by 2020			Projected progress with additional measures by 2020		
	ESD base-year emissions (Mt CO_2-eq.)	Relative target to 2020 (%)	Absolute target (Mt CO_2-eq.)	ESD emissions (Mt CO_2-eq.)	Absolute gap (Mt CO_2-eq.)	Relative gap (percent share of 2005 base-year in %)	ESD emissions (Mt CO_2-eq.)	Absolute gap (Mt CO_2-eq.)	Relative gap (percent share of 2005 base-year in %)
Austria	58.1	-16.0%	48.8	51.0	-2.2	-3.7%	45.7	3.1	5.3%
Belgium	79.6	-15.0%	67.7	71.6	-4.0	-5.0%			
Bulgaria	24.0	20.0%	28.8	22.7	6.1	25.5%			
Croatia	18.9	11.0%	21.0	17.2	3.7	19.9%	16.0	4.9	26.0%
Cyprus	6.3	-5.0%	5.9	3.6	2.4	37.8%	3.6	2.4	37.8%
Czech Republic	62.1	9.0%	67.7	57.2	10.5	16.9%	53.1	14.5	23.4%
Denmark	38.1	-20.0%	30.5	30.8	-0.3	-0.8%			
Estonia	5.8	11.0%	6.5	5.7	0.8	13.0%	5.3	1.2	19.9%
Finland	33.8	-16.0%	28.4	28.4	0.0	0.0%	28.2	0.2	0.5%
France	417.8	-14.0%	359.3	345.8	13.5	3.2%			
Germany	494.9	-14.0%	425.6	421.7	4.0	0.8%			
Greece	63.8	-4.0%	61.2	47.4	13.8	21.6%			
Hungary	52.9	10.0%	58.2	38.4	19.9	37.5%	36.5	21.7	41.0%
Ireland	48.7	-20.0%	39.0	45.0	-6.0	-12.4%	42.5	-3.5	-7.3%
Italy	338.4	-13.0%	294.4	276.2	18.2	5.4%	263.3	31.1	9.2%
Latvia	8.5	17.0%	9.9	9.1	0.8	9.6%	8.4	1.5	18.1%
Lithuania	13.4	15.0%	15.5	13.0	2.5	18.4%	12.5	2.9	21.9%
Luxembourg	10.2	-20.0%	8.1	8.6	-0.5	-4.7%			
Malta	1.1	5.0%	1.2	0.9	0.2	20.9%	0.9	0.2	21.8%
Netherlands	127.4	-16.0%	107.0	101.2	5.8	4.5%	100.6	6.4	5.1%
Poland	177.5	14.0%	202.3	189.0	13.4	7.5%			
Portugal	50.7	1.0%	51.2	38.1	13.1	25.9%	38.0	13.3	26.2%
Romania	74.3	19.0%	88.4	77.0	11.3	15.3%	74.4	14.0	18.8%
Slovakia	23.5	13.0%	26.5	22.6	3.9	16.8%	21.6	4.9	21.0%
Slovenia	12.1	4.0%	12.5	11.0	1.5	12.4%			
Spain	238.0	-10.0%	214.2	208.4	5.8	2.4%	200.2	13.9	5.8%
Sweden	44.8	-17.0%	37.2	32.1	5.1	11.4%			
United Kingdom	389.4	-16.0%	327.1	315.6	11.5	2.9%	311.9	15.2	3.9%
EU-28	**2 914.0**		**2 644.2**	**2 489.4**	**154.7**	5.3%	**2 443.6**	200.5	6.9%

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Note: Gaps 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 A3.2 with regard to the calculation of '2005 base-year emissions' by the EEA.

Source: EC, 2013b and 2013c; EEA, 2016e; EU, 2009.

4. Use of flexibilities under the Effort Sharing Decision

The assessment of progress towards the 2020 ESD targets does not directly take into account the possible use of flexibility options as permitted under the ESD, since these are specifically destined for compliance [4]. If these are taken into account, it is apparent that Malta will need to buy additional AEAs from other Member States or use international certificates to comply in the years 2013 to 2015. This is the case because the gaps between emissions and AEA amounts for these years are higher than the 5 % that is allowed to be borrowed from the following year (i.e. 0.06 million AEAs for Malta).

Taking into account WEM emissions, for all other countries apart from Ireland, the use of the flexibility to carry over AEAs that have not been used in previous years will be sufficient for compliance in the 2013 to 2020 period. Additional measures, as considered in WAM projections, would help Ireland to comply without the need to buy further AEAs.

5. Annual and cumulated gaps between emissions and Effort Sharing Decision targets

Table A1.4 Annual absolute gaps between historic and projected ESD emissions, and annual ESD targets, 2013–2020

Member State	Projection scenario	2013	2014	2015	2016	2017	2018	2019	2020
Austria	WEM	2.5	3.9	2.3	-0.5	-1.0	-1.5	-1.9	-2.2
	WAM				1.6	1.4	1.2	3.0	3.1
Belgium	WEM	4.1	6.8	2.3	1.1	-0.2	-1.5	-2.7	-4.0
	WAM								
Bulgaria	WEM	4.7	4.3	4.2	4.4	4.8	5.3	5.7	6.1
	WAM								
Croatia	WEM	4.5	5.1	5.9	3.3	3.4	3.5	3.6	3.7
	WAM				3.6	3.9	4.2	4.6	4.9
Cyprus	WEM	2.0	2.0	1.6	2.2	2.2	2.3	2.3	2.4
	WAM				2.2	2.2	2.3	2.3	2.4
Czech Republic	WEM	1.0	5.6	7.3	4.3	5.8	7.4	8.9	10.5
	WAM				6.2	8.3	10.4	12.5	14.5
Denmark	WEM	3.1	3.3	2.6	1.8	1.6	1.1	0.4	-0.3
	WAM								
Estonia	WEM	0.5	0.2	0.7	0.7	0.7	0.8	0.8	0.8
	WAM				1.0	1.0	1.1	1.1	1.2
Finland	WEM	0.2	1.1	0.8	0.5	0.4	0.2	0.1	0.0
	WAM				0.6	0.5	0.3	0.2	0.2
France	WEM	28.0	35.9	19.3	22.9	20.5	18.2	15.9	13.5
	WAM								
Germany	WEM	12.3	29.0	10.4	12.4	10.3	8.2	6.1	4.0
	WAM								
Greece	WEM	14.8	14.9	15.1	12.4	12.8	13.1	13.5	13.8
	WAM								

Hungary	WEM	12.0	13.1	11.6	15.2	16.3	17.5	18.7	19.9
	WAM				15.9	17.3	18.8	20.2	21.7
Ireland	WEM	4.7	4.1	1.0	-0.3	-1.7	-3.2	-4.6	-6.0
	WAM				0.7	-0.3	-1.5	-2.5	-3.5
Italy	WEM	34.8	40.9	31.8	29.4	26.6	23.8	21.0	18.2
	WAM				36.2	34.9	33.6	32.4	31.1
Latvia	WEM	0.5	0.3	0.2	0.9	0.9	0.8	0.8	0.8
	WAM				1.2	1.3	1.4	1.4	1.5
Lithuania	WEM	1.2	1.0	1.5	1.3	1.6	1.9	2.2	2.5
	WAM				1.5	1.8	2.2	2.6	2.9
Luxembourg	WEM	0.2	0.5	0.3	0.4	0.2	0.0	-0.2	-0.5
	WAM								
Malta	WEM	-0.1	-0.1	-0.2	0.2	0.2	0.2	0.2	0.2
	WAM				0.3	0.3	0.3	0.2	0.2
Netherlands	WEM	14.7	22.8	16.4	9.4	8.5	7.6	6.7	5.8
	WAM				9.7	8.9	8.1	7.3	6.4
Poland	WEM	7.5	13.3	14.5	9.0	10.1	11.2	12.3	13.4
	WAM								
Portugal	WEM	10.7	10.8	11.3	10.4	11.1	11.8	12.4	13.1
	WAM				10.4	11.1	11.8	12.6	13.3
Romania	WEM	2.9	4.9	9.3	9.5	10.0	10.4	10.9	11.3
	WAM				11.4	12.0	12.7	13.3	14.0
Slovakia	WEM	2.9	4.6	4.6	2.7	3.0	3.3	3.6	3.9
	WAM				3.2	3.6	4.1	4.5	4.9
Slovenia	WEM	1.4	1.9	1.7	1.2	1.3	1.4	1.4	1.5
	WAM								
Spain	WEM	27.3	25.9	24.3	20.7	17.0	13.2	9.2	5.8
	WAM				23.6	21.1	18.6	16.0	13.9
Sweden	WEM	6.4	6.5	6.4	6.0	5.8	5.6	5.3	5.1
	WAM								
United Kingdom	WEM	19.3	29.8	21.0	7.4	7.6	8.2	8.3	11.5
	WAM				7.7	8.4	10.4	11.3	15.2
EU	**WEM**	**224**	**293**	**228**	**189**	**180**	**171**	**161**	**155**
	WAM				**209**	**205**	**202**	**201**	**201**

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Note: 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).

The data are based on ESD emissions for 2013 and 2014 as determined after the 2016 comprehensive review of national GHG inventories, approximated inventory data for 2015 and projections for the 2016–2020 period. No national approximated GHG data were available for four Member States (Bulgaria, Cyprus, Lithuania and Romania). For these, the EEA GHG emission proxy was used instead. Inconsistencies in the time series between 2015 and 2016 might be observed for some countries. This is likely because projections for the period 2013–2020 were prepared before actual 2014 and 2015 emissions were available. For the aggregation of projections in the WAM scenario at EU level, WAM projections of Member States which did not report a WAM scenario have been gap-filled using the WEM scenario projections.

Source: EC, 2013b, 2013c, 2016 and 2017; EEA, 2016a, 2016b, 2016c, 2016d and 2016e.

Table A1.5 Cumulated absolute gaps between historic and projected ESD emissions, and annual ESD targets, 2013–2020

Member State	Projection scenario	2013	2013–2014	2013–2015	2013–2016	2013–2017	2013–2018	2013–2019	2013–2020
Austria	WEM	2.5	6.4	8.7	8.2	7.2	5.7	3.8	1.7
	WAM				10.3	11.7	12.9	15.9	19.0
Belgium	WEM	4.1	10.9	13.3	14.4	14.2	12.8	10.1	6.1
	WAM								
Bulgaria	WEM	4.7	9.0	13.2	17.6	22.4	27.6	33.3	39.5
	WAM								
Croatia	WEM	4.5	9.6	15.5	18.9	22.3	25.9	29.5	33.2
	WAM				19.1	23.0	27.2	31.8	36.7
Cyprus	WEM	2.0	4.0	5.6	7.8	10.0	12.3	14.6	17.0
	WAM				7.8	10.0	12.3	14.6	17.0
Czech Republic	WEM	1.0	6.6	13.9	18.2	24.1	31.5	40.4	50.9
	WAM				20.1	28.4	38.8	51.3	65.8
Denmark	WEM	3.1	6.4	9.0	10.8	12.4	13.5	13.9	13.6
	WAM								
Estonia	WEM	0.5	0.8	1.4	2.2	2.9	3.7	4.4	5.2
	WAM				2.4	3.4	4.5	5.6	6.8
Finland	WEM	0.2	1.3	2.1	2.7	3.1	3.2	3.3	3.3
	WAM				2.8	3.3	3.6	3.8	4.0
France	WEM	28.0	63.9	83.2	106.1	126.6	144.8	160.7	174.2
	WAM								
Germany	WEM	12.3	41.4	51.8	64.2	74.5	82.7	88.7	92.7
	WAM								
Greece	WEM	14.8	29.6	44.7	57.2	69.9	83.0	96.5	110.3
	WAM								
Hungary	WEM	12.0	25.1	36.7	51.8	68.2	85.7	104.4	124.2
	WAM				52.5	69.9	88.6	108.9	130.6
Ireland	WEM	4.7	8.8	9.8	9.5	7.8	4.6	0.0	-6.1
	WAM				10.5	10.3	8.8	6.3	2.8
Italy	WEM	34.8	75.7	107.5	137.0	163.6	187.4	208.4	226.5
	WAM				143.7	178.6	212.2	244.6	275.7
Latvia	WEM	0.5	0.8	1.0	1.9	2.7	3.6	4.4	5.2
	WAM				2.2	3.5	4.9	6.3	7.8
Lithuania	WEM	1.2	2.2	3.7	5.0	6.6	8.4	10.6	13.0
	WAM				5.2	7.0	9.2	11.8	14.7
Luxembourg	WEM	0.2	0.7	1.0	1.4	1.5	1.5	1.3	0.8
	WAM								
Malta	WEM	-0.1	-0.2	-0.4	-0.2	0.1	0.3	0.5	0.8
	WAM				-0.2	0.1	0.3	0.6	0.8
Netherlands	WEM	14.7	37.5	53.9	63.3	71.8	79.4	86.1	91.9
	WAM				63.6	72.4	80.5	87.8	94.2
Poland	WEM	7.5	20.9	35.4	44.5	54.6	65.8	78.1	91.4
	WAM								
Portugal	WEM	10.7	21.5	32.7	43.1	54.1	65.9	78.3	91.5
	WAM				43.1	54.2	66.1	78.6	91.9
Romania	WEM	2.9	7.8	17.1	26.6	36.6	47.1	57.9	69.3
	WAM				28.5	40.5	53.2	66.5	80.5
Slovakia	WEM	2.9	7.5	12.1	14.8	17.8	21.1	24.7	28.7
	WAM				15.3	18.9	23.0	27.5	32.4
Slovenia	WEM	1.4	3.3	5.0	6.2	7.5	8.9	10.4	11.9

	WAM								
Spain	WEM	27.3	53.2	77.5	98.2	115.2	128.3	137.6	143.3
	WAM				101.1	122.2	140.8	156.8	170.7
Sweden	WEM	6.4	12.9	19.4	25.4	31.2	36.8	42.1	47.2
	WAM								
United Kingdom	WEM	19.3	49.1	70.1	77.5	85.1	93.3	101.5	113.0
	WAM				77.8	86.2	96.6	107.9	123.1
EU	**WEM**	**224**	**517**	**745**	**934**	**1 114**	**1 285**	**1 446**	**1 600**
	WAM				**954**	**1 159**	**1 361**	**1 562**	**1 762**

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Note: 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 cumulated gap takes only previous years' gaps into account, but does not take any possible use of the flexibilities provided under the ESD (such as trading ESD emission allocations or buying international certificates) into account.

The data are based on ESD emissions for 2013 and 2014 as determined after the 2016 comprehensive review of national GHG inventories, approximated inventory data for 2015 and projections for the 2016–2020 period. No national approximated GHG data were available for four Member States (Bulgaria, Cyprus, Lithuania and Romania). For these, the EEA GHG emission proxy was used instead. Inconsistencies in the time series between 2015 and 2016 might be observed for some countries. This is likely because projections for the period 2013–2020 were prepared before actual 2014 and 2015 emissions were available. For the aggregation of projections in the WAM scenario at EU level, WAM projections of Member States which did not report a WAM scenario have been gap-filled using the WEM scenario projections.

Source: EC, 2013b, 2013c, 2016 and 2017; EEA, 2016a, 2016b, 2016c, 2016d and 2016e.

End notes

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

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

[3] Poland was the only Member State not to report on the split of ETS GHG emissions into source categories.

[4] 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.

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Annex 2 Progress towards renewable energy targets: data and methodology

1 Reporting requirements related to renewable energy

Under the Renewable Energy Directive (RED), Member States need to report on their progress towards the deployment of energy from renewable sources (EU, 2009). 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.

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.

Historic trends for the share of energy from renewable sources in gross final energy consumption

The assessment of progress towards objectives and targets for the use of energy from renewable sources (RES) is, for the most part, based 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, 2016).

Share of RES in gross final energy consumption in 2014

The shares of RES in gross final energy consumption in 2014 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 (hydro over 15 years and wind over five years). For details on the normalisation rules, see the SHARES manual provided by Eurostat (Eurostat, 2016). 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 %.

Approximated shares of renewable energy use in 2015

The approximated shares of renewable energy use in 2015 were estimated by the EEA and will be published in early 2017 (EEA, forthcoming).

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 2011–2018 period were taken from Part B of Annex I of the RED (EU, 2009).

Anticipated national RES trajectories for the period from 2010 to 2020

Anticipated national RES trajectories for the 2010–2020 period were derived from information submitted by Member States to the European Commission in 2010, in the context of their national renewable energy action plans (NREAPs). These trajectories reflect how Member States themselves anticipate their renewable energy deployment to develop up to 2020 (EEA, 2011; EC, 2013).

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, 2016). Approximate 2015 values were estimated by the EEA (EEA, forthcoming).

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 two sets of indicative targets for the period until 2020:

- indicative targets set under the RED, which are always defined for a period of two years (e.g. for 2013/2014 and 2015/2016);
- anticipated renewable energy deployment as reported in NREAPs via the anticipated NREAP trajectories on a yearly basis.

Assessments of progress take place using the following methodology:

- A Member State is considered **on track (green)**if:
  - its average 2013/2014 share of energy from renewable sources matched or exceeded its indicative 2013/2014 RED target;
  - its 2014 share of energy from renewable sources reached or exceeded its anticipated NREAP trajectory.
- A Member State is considered **not on track (yellow)** if it did not reach its anticipated NREAP trajectory in 2014.
- A Member State is considered **not on track (orange)** if its average 2013/2014 share of energy from renewable sources was below its 2013/2014 indicative RED target.

Table A2.1 Current progress towards indicative trajectories under the RED

Country	RES shares		RED indicative trajectory			
			Trajectory shares		Distance to trajectory	
	2013–2014 average (%)	2015 (approximated) (%)	2013–2014 (%)	2015–2016 (%)	2013–2014 (percentage points)	2015 vs 2015–2016 trajectory (percentage points)
Austria	32.7	33.6	26.5	28.1	6.2	5.5
Belgium	7.8	7.3	5.4	7.1	2.3	0.3
Bulgaria	18.5	18.4	11.4	12.4	7.1	6.1
Croatia	28.0	27.5	14.8	15.9	13.1	11.6
Cyprus	8.5	9.1	5.9	7.4	2.6	1.6
Czech Republic	12.9	13.6	8.2	9.2	4.7	4.4
Denmark	28.2	30.6	20.9	22.9	7.3	7.7
Estonia	26.0	27.9	20.1	21.2	5.9	6.8
Finland	37.7	39.5	31.4	32.8	6.3	6.7
France	14.2	14.5	14.1	16.0	0.0	–1.5
Germany	13.1	14.5	9.5	11.3	3.6	3.3
Greece	15.2	15.5	10.2	11.9	4.9	3.6
Hungary	9.5	9.4	6.9	8.2	2.6	1.2
Ireland	8.2	9.0	7.0	8.9	1.2	0.1
Italy	16.9	17.1	8.7	10.5	8.2	6.6
Latvia	37.9	39.2	34.8	35.9	3.0	3.3
Lithuania	23.4	24.3	17.4	18.6	6.0	5.7
Luxembourg	4.1	5.0	3.9	5.4	0.1	–0.5
Malta	4.2	5.3	3.0	4.5	1.2	0.8
Netherlands	5.2	6.0	5.9	7.6	–0.7	–1.7
Poland	11.4	11.8	9.5	10.7	1.9	1.1
Portugal	26.3	27.8	23.7	25.2	2.7	2.5
Romania	24.4	24.7	19.7	20.6	4.7	4.2
Slovakia	10.9	11.9	8.9	10.0	2.0	1.9
Slovenia	22.2	21.8	18.7	20.1	3.5	1.7
Spain	15.8	15.6	12.1	13.8	3.7	1.8
Sweden	52.3	54.1	42.6	43.9	9.7	10.2
United Kingdom	6.3	8.2	5.4	7.5	0.9	0.8
EU	**15.5**	**16.4**	**12.1**	**13.8**	**3.4**	**2.6**
Iceland	73.2		66.0	67.3	7.2	
Norway	66.3		61.0	62.4	5.3	

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

Source: EU, 2009; Eurostat, 2016; EEA, forthcoming.

Table A2.2 Current progress towards national action plan trajectories

Member State	RES shares		National action plan trajectory			
			Trajectory shares		Distance to trajectory	
	2014 (%)	2015 (approximated) (%)	2014 (%)	2015 (%)	2014 (percentage points)	2015 (percentage points)
Austria	33.1	33.6	32.1	32.3	1.0	1.3
Belgium	8.0	7.3	6.8	7.5	1.2	–0.2
Bulgaria	18.0	18.4	11.4	12.4	6.6	6.0
Croatia	27.9	27.5	16.4	17.5	11.5	10.0
Cyprus	9.0	9.1	8.4	9.0	0.6	0.1
Czech Republic	13.4	13.6	11.6	12.0	1.8	1.6
Denmark	29.2	30.6	27.2	27.6	2.0	3.0
Estonia	26.5	27.9	23.4	23.6	3.1	4.3
Finland	38.7	39.5	32.2	32.6	6.5	6.9
France	14.3	14.5	16.0	17.0	–1.7	–2.5
Germany	13.8	14.5	12.8	13.5	1.0	1.0
Greece	15.3	15.5	10.5	11.4	4.8	4.1
Hungary	9.5	9.4	8.0	8.3	1.5	1.1
Ireland	8.6	9.0	9.1	10.3	–0.5	–1.3
Italy	17.1	17.1	10.5	11.2	6.6	5.9
Latvia	38.7	39.2	35.0	35.6	3.7	3.6
Lithuania	23.9	24.3	20.0	21.0	3.9	3.3
Luxembourg	4.5	5.0	3.9	5.4	0.6	–0.4
Malta	4.7	5.3	5.4	5.5	–0.7	–0.2
Netherlands	5.5	6.0	7.7	8.5	–2.2	–2.5
Poland	11.4	11.8	11.6	12.1	–0.2	–0.3
Portugal	27.0	27.8	27.4	28.4	–0.4	–0.6
Romania	24.9	24.7	19.7	20.1	5.2	4.6
Slovakia	11.6	11.9	8.9	10.0	2.7	1.9
Slovenia	21.9	21.8	20.1	21.2	1.8	0.6
Spain	16.2	15.6	16.1	16.7	0.1	–1.1
Sweden	52.6	54.1	46.3	47.0	6.3	7.1
United Kingdom	7.0	8.2	6.0	7.0	1.0	1.2
EU	**16.0**	**16.4**	**14.5**	**15.3**	**1.5**	**1.1**
Iceland	77.1		66.0	67.3	11.1	
Norway	69.2		64.0	64.6	5.2	

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

Source: EC, 2013; EEA, 2011 and forthcoming; Eurostat, 2016.

Table A2.3 RES shares per sector, 2014 and 2015

Member State	RES-E (%)		RES-H/C (%)		RES-T (%)	
	2014	Proxy 2015	2014	Proxy 2015	2014	Proxy 2015
Austria	70.0	70.0	32.6	33.9	8.9	8.3
Belgium	13.4	12.8	7.8	7.6	4.9	3.3
Bulgaria	18.9	19.3	28.3	29.1	5.3	5.3
Cyprus	7.4	8.3	21.8	22.3	2.7	2.2
Czech Republic	13.9	14.0	16.7	17.4	6.1	6.0
Germany	28.2	30.0	12.2	12.7	6.6	6.4
Denmark	48.5	50.8	37.8	40.0	5.8	5.3
Estonia	14.6	16.8	45.2	46.9	0.2	0.2
Greece	21.9	22.5	26.9	27.2	1.4	1.4
Spain	37.8	36.0	15.8	15.3	0.5	0.5
Finland	31.4	32.6	51.9	52.3	21.6	22.0
France	18.3	18.5	17.8	18.0	7.8	7.8
Croatia	45.3	40.0	36.2	35.0	2.1	2.1
Hungary	7.3	7.1	12.4	12.4	6.9	6.7
Ireland	22.7	24.0	6.6	6.6	5.2	5.9
Italy	33.4	33.3	18.9	19.0	4.5	4.7
Lithuania	13.7	15.2	41.6	42.8	4.2	4.3
Luxembourg	5.9	6.1	7.4	7.6	5.2	5.9
Latvia	51.1	52.4	52.2	53.3	3.2	3.3
Malta	3.3	4.5	14.6	14.0	4.7	5.0
Netherlands	10.0	10.2	5.2	5.9	5.7	5.6
Poland	12.4	13.3	13.9	14.2	5.7	5.9
Portugal	52.1	50.4	34.0	35.2	3.4	6.7
Romania	41.7	39.7	26.8	25.9	3.8	3.9
Sweden	63.3	65.2	68.1	68.4	19.2	24.2
Slovenia	33.9	33.0	33.3	33.3	2.6	2.6
Slovakia	23.0	23.3	8.7	9.4	6.9	6.5
United Kingdom	17.8	22.3	4.5	5.5	4.9	4.2
EU	**27.5**	**28.3**	**17.7**	**18.1**	**5.9**	**6.0**

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.

The values for 2015 are approximated estimates from the EEA.

Source: Eurostat, 2016; EEA, forthcoming.

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Annex 3 Progress towards energy efficiency targets: data and methodology

1 Reporting requirements for energy efficiency/energy consumption

Under Article 3 of the Energy Efficiency Directive (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.

2 Data sources for energy consumption

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

Historic trends of primary and final energy consumption

The assessment of progress towards energy efficiency targets is, for the most part, based on information reported by Member States to Eurostat under the Energy Statistics Regulation, and published by Eurostat via its energy statistics database (Eurostat, 2016a, 2016b and 2016c).

Approximated estimates for primary and final energy consumption in 2015

Early estimates of 2015 primary and final energy consumption were prepared by the European Environment Agency (EEA, 2016a and 2016b).

National targets on primary and final energy consumption

The 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 national energy efficiency action plans (NEEAPs) or in a separate notification to the European Commission in 2015 (EC, 2015). The most recent updates were reported by Denmark and Hungary in 2016 (EC, 2016).

3 Tracking progress towards energy efficiency targets

The analysis of 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 2014 (or 2015) 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 renewable energy sources (RESs) and greenhouse gas (GHG) emissions, reliable projections and/or targets for interim years until 2020 on energy consumption 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 historic trends and the trends deemed necessary to achieve 2020 targets. To remain consistent with the assessments

presented for GHG emissions and RESs, the year 2005 was chosen as a single base year, to allow for the comparable assessment of trends across Member States. This methodology does not take into account the level of ambition of the national target (which varies significantly across the European Union (EU)), nor does it capture the complexity of the national context (economic development, ability to attract financing for energy efficiency projects, etc.). Several Member States defined their 2020 targets in terms of final energy consumption (instead of primary energy consumption): Austria, Croatia, the Czech Republic, Estonia, Finland, France, Greece, Lithuania, Latvia, Slovakia and the United Kingdom. For the purpose of cross-country comparison, the officially reported primary energy consumption target was taken into account in this assessment.

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

Country	Primary energy consumption (Mtoe)			Linear trajectory 2005–2020 target (Mtoe)			Distance to trajectory (percentage points, share of 2005 levels)	
	2005	2014	2015 (approximated)	2014	2015	2020	2014	2015 (approximated)
Austria	32.5	30.6	31.7	31.9	31.8	31.5	3.9	0.4
Belgium	51.4	45.0	44.6	46.8	46.2	43.7	3.5	3.3
Bulgaria	18.9	17.2	17.7	17.7	17.5	16.9	2.5	−0.9
Croatia	9.1	7.7	8.1	10.3	10.5	11.1	29.4	25.8
Cyprus	2.5	2.2	2.2	2.3	2.3	2.2	4.3	2.4
Czech Republic	42.2	38.6	38.2	40.7	40.5	39.6	5.0	5.3
Denmark	19.3	16.7	16.4	18.1	18.0	17.4	7.7	8.5
Estonia	5.4	6.6	5.9	6.1	6.1	6.5	−10.5	5.0
Finland	33.4	33.4	32.4	34.9	35.0	35.9	4.3	8.0
France	259.9	234.5	238.4	235.9	233.2	219.9	0.5	−2.0
Germany	317.2	290.8	290.8	292.9	290.1	276.6	0.6	−0.2
Greece	30.6	23.7	23.4	27.1	26.7	24.7	10.9	10.8
Hungary	25.4	21.1	22.3	24.6	24.5	24.1	13.8	8.8
Ireland	14.7	13.4	13.7	14.0	13.9	13.5	4.4	1.6
Italy	181.5	143.8	150.0	167.4	165.8	158.0	13.0	8.7
Latvia	4.5	4.4	4.4	5.0	5.1	5.4	14.8	14.9
Lithuania	7.9	5.6	5.7	7.1	7.0	6.5	18.1	16.5
Luxembourg	4.8	4.2	4.2	4.6	4.6	4.5	8.8	7.0
Malta	1.0	0.9	0.9	0.8	0.8	0.7	−6.9	−8.7
Netherlands	69.0	62.7	60.6	64.0	63.5	60.7	2.0	4.1
Poland	87.7	89.1	91.2	92.9	93.5	96.4	4.3	2.6
Portugal	24.9	20.7	22.1	23.5	23.3	22.5	11.2	4.7
Romania	36.7	30.8	31.3	40.5	40.9	43.0	26.5	26.2
Slovakia	17.8	15.3	16.3	16.9	16.9	16.4	9.5	3.3
Slovenia	7.0	6.5	6.6	7.1	7.1	7.1	7.8	6.9
Spain	135.9	112.6	114.9	126.3	125.2	119.9	10.1	7.6
Sweden	48.7	46.2	42.3	45.5	45.2	43.4	−1.4	5.9
United Kingdom	222.8	182.4	183.9	195.7	192.7	177.6	6.0	4.0
EU	**1 712.6**	**1 506.5**	**1 520.2**	**1 574.8**	**1 559.5**	**1 483.0**	**4.0**	**2.3**

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.

Source: EC, 2015 and 2016; EEA, 2016b; Eurostat, 2016b and 2016c.

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Background information - 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 global average 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 greenhouse gas (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 Intergovernmental Panel on Climate Change (IPCC).
- The European Union (EU), its Member States and other European Environment Agency (EEA) member countries are committed to limiting or reducing their GHG emissions under international commitments, in particular the United Nations Framework Convention on Climate Change (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.

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

In 1992, countries across the globe adopted the United Nations Framework Convention on Climate Change (UNFCCC) in order to cooperatively consider options for limiting average global temperature increases and the resulting climate change. Under the UNFCCC, developed country parties (Annex I parties) [1] 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 greenhouse gas (GHG) emissions by an average of 5 % compared with 1990 levels.

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, quantified emission limitation and reduction commitments (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 (see Table A1.1). The Doha Amendment's entry into force is subject to acceptance by at least three-quarters of the Parties to the Kyoto Protocol [2]. Although the EU and its 28 Member States, and Iceland, Liechtenstein, Norway and Switzerland (i.e. all European Environment Agency (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 to 15 % of global emissions (EC, 2013).

The EU has been at the forefront of international efforts towards a global climate deal. After limited participation in the Kyoto Protocol and the 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 °C above pre-industrial levels, aiming to limit the increase to no more than 1.5 °C, 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 (intended nationally determined contributions (INDCs)). These are not yet sufficient to keep global warming levels below 2 °C, 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 opened for signature for 1 year on 22 April 2016 and will enter into force after 55 countries that account for at least 55 % of global emissions have deposited their instruments of ratification.

2. Achievements of the European Union under the first commitment period of the Kyoto Protocol (2008-2012)

The Kyoto Protocol was ratified by the European Union (EU) when it was constituted of 15 Member States. Under the first commitment period, the 15 EU Member States (EU-15) pledged to jointly reduce their GHG emissions by 8 % compared with base-year levels (base-year levels are roughly equivalent to 1990 levels) [3]. To determine the contribution of each Member State in meeting this overall target, differentiated emission limitation or reduction targets were agreed for each of the 15, pre-2004 Member States under an EU accord known as the Burden-sharing Agreement (EC, 2006).

Although the 15 pre-2004 Member States had a joint target, 11 of the 13 countries that became EU Member States in 2004, 2007 or 2013 ratified the Kyoto Protocol separately and therefore had individual targets under the Kyoto Protocol's first commitment period. The EU-28 did not have a target under the first commitment period. Cyprus and Malta did not have targets either, as they became Annex I parties to the convention (i.e. the UNFCCC) in 2013 and 2010, respectively (UNFCCC, 2009, 2011).

Of the other EEA member countries, Iceland, Liechtenstein, Norway and Switzerland had individual targets under the Kyoto Protocol's first commitment period. Turkey, which acceded to the Kyoto Protocol in February 2009, had no quantified emission reduction commitment. Despite being an Annex I party to the UNFCCC, Turkey was not included in the Kyoto Protocol's Annex B in which individual targets for Annex I parties are listed, because it was not a party to the UNFCCC when the Kyoto Protocol was adopted [4].

The EU and its Member States have met their commitments under the Kyoto Protocol's first commitment period (2008–2012). For the whole 2008–2012 period, the EU's total emissions, excluding Cyprus and Malta, which had no targets, were around 19 % below the sum of base-year emissions, not including the additional reductions as a result of carbon sinks (from the land use, land-use change and forestry (LULUCF) sector) and international credits. The EU-15 achieved an overall reduction of 11.7 % domestically, not including the additional reductions resulting from carbon sinks (from the LULUCF sector) and international credits.

3. 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.

Table 0.1 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 %

Source: UNFCCC, 2012a.

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

First commitment period

For the first commitment period under the Kyoto Protocol, the targets (expressed in emission budgets for the whole period) were based on the following methodological assumptions and conditions:

- The gases covered are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF_6), consistent with the GHGs covered by the reporting requirements under the UNFCCC;
- Emissions of non-CO_2 gases are converted into CO_2-equivalent (CO_2-eq.) emissions using global warming potential (GWP) values included in the Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (IPCC, 1996);
- 1990 is defined as the base year, but flexibility rules can be applied on fluorinated gases (F-gases) and for economies in transition contained in Article 3(5) of the Kyoto Protocol;
- The target covers the following sectors: energy, industrial processes and product use (IPPU), agriculture and waste. Emissions or removals from LULUCF are included, while emissions from international aviation and shipping are excluded;
- Certain emission credits can be used to achieve targets, under the Kyoto flexible mechanisms.

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:

- In addition to the gases covered in the first commitment period, the target for the second commitment period also covers nitrogen trifluoride (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, 2014)).
- 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 to 2010.
- New accounting rules for emissions removals from LULUCF according to the relevant

decisions made at COP 17 in Durban (UNFCCC, 2012b).

- Emissions of non-CO_2 gases are converted into CO_2-equivalent emissions using the GWP values included in the Fourth Assessment Report of the IPCC (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 allows for different base years according to the flexibility rules for 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) [5] from joint implementation projects and the possible recognition of units from new market-based mechanisms are all possible in order to achieve targets (still capped under EU domestic legislation). Sector coverage remains the same.

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, in order 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 °C 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 Effort Sharing Decision (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 the least developed countries (LDCs) and small island developing states (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 market-based mechanisms to 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 2008–2012 period into subsequent periods).
- The target covers the gases CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, consistent with the GHGs covered under the reporting requirements under the convention (UNFCCC, 2013b).

5. 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) [6], 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, 2013b). This legislation harmonises EU reporting on LULUCF with Kyoto Protocol requirements, but 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.

6. 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 aerodromes from other countries have not been included in the EU ETS. This exclusion, first resulting from the 'stop the clock' decision (EU, 2013a) was made in order 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, the ICAO decided on a roadmap for the development of a global market-based mechanism to tackle aviation emissions. By 2016, the body will decide on a mechanism to be implemented by 2020.

The EU decided to continue with a reduced scope in the 2013–2016 period (EU, 2014). Only flights between aerodromes 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.

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 historic emissions in this sector between 2004 and 2006 (221.4 Mt CO_2 for all participating countries) [7]. The cap for the 2013–2020 period is equivalent to 95 % of baseline emissions (EU, 2009). 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.

Endnotes

[1] 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).

[2] As of 28 May 2015, 32 countries had ratified the Doha Amendment. Decisions on the implementation of Article 3.7 ter of the Doha amendment, on the carry-over, from one commitment period to the next, and rules on reporting for parties without commitments for the second commitment period are still pending under the UNFCCC.

[3] The target refers to 1990 as a single base year, but is subject to the flexibility rules, regarding fluorinated gases (F-gases) and economies in transition, of Article 3(5) of the Kyoto Protocol. This paragraph stipulates that parties included in Annex I undergoing the process of transition to a market economy, whose base year or period was established by Decision 9/CP.2 of the COP, are to use that base year or period for the implementation of their commitments. Furthermore, 1995 may be used as a base year for hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6). Accordingly, 1990 is used as a base year for emissions of carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) for all countries except Bulgaria (1988), Hungary (average of 1985 to 1987), Slovenia (1986), Poland (1988) and Romania (1989); and 1995 is used as a base year for F-gases (HFCs, PFCs and SF6) for all countries except Austria, Croatia, France, Italy and Slovakia (all 1990), and Romania (1989).

[4] See also the UNFCCC's Kyoto Protocol target information online (UNFCCC, 2013a).

[5] A Kyoto unit representing an allowance to emit 1 tonne of CO 2-eq. 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).

[6] A Kyoto unit representing an allowance to emit 1 metric tonne of CO 2-eq. RMUs are issued for emission removals from LULUCF activities under Article 3, paragraphs 3 and 4.

[7] The annual average of CO2 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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Background information - Domestic climate and energy targets in the EU

- The European Council has endorsed the objective of reducing Europe's greenhouse gas (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 Intergovernmental Panel on Climate Change (IPCC).
- The European Union (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 Emissions Trading System (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 Effort Sharing Decision (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 Renewable Energy Directive (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 Energy Efficiency Directive (EED). These targets take various forms, and some of them may be subject to later revision.
- In October 2014, the European Council agreed 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 non-ETS sectors by 2030 compared with 2005. For the non-ETS 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, as well as an indicative target, at EU level, of at least a 27 % improvement in energy efficiency by 2030 compared with projections of future energy consumption, based on the current criteria.
- '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.

1. The "20-20-20" targets for 2020

The European Union (EU) has a long-term goal of reducing Europe's greenhouse gas (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 (European Council, 2007):

- to reduce GHG emissions by 20 % compared with 1990 levels;
- to increase to 20 % the proportion of renewable energy sources (RES) 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, 2009b, 2009c, 2009d, 2009e and 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 Emissions Trading System (ETS), and a 9 % reduction for sectors covered by the Effort Sharing Decision (ESD) (EU, 2009b).

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 Norway, Iceland and Liechtenstein). The ETS essentially covers emissions from large industrial installations, as well as emissions from aviation. ETS emissions represent about 40 to 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 2013–2020 period, see EEA, 2016.

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 United Nations Framework Convention on Climate Change (UNFCCC) (see section A1.3).

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 meet 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 non-ETS 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 non-ETS 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 gross domestic product (GDP) per capita, but targets for Member States with a GDP per capita above the EU average will be adjusted relatively, in order 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 with 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.
- An indicative target was set at EU level of at least 27 % 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). The target will be reviewed in 2016, having in mind an EU level of 30 %.

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 intended nationally determined contribution (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 proposal includes also modified accounting rules.

The adoption of the Framework Strategy for a Resilient Energy Union with a Forward-Looking

Climate Change Policy (EC, 2015a) underlined the importance of meeting the 2030 targets as the priority '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 are all now reported on annually in the State of the Energy Union (EC, 2015b). 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.

3. National targets and compliance under the Effort Sharing Decision

Targets for 2020

The ESD covers emissions from all sources outside the EU ETS, except for emissions from aviation [1] and international maritime transport, and net emissions from 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 (annual emission allocations (AEAs)) (EU, 2009b). 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 (EC, 2013a). The AEAs were later adjusted to reflect the change in ETS scope from 2013 onwards (EC, 2013b) [2].

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 A2.0.1). At EU level, this will deliver an approximately 9 to 10 % reduction in emissions by 2020, compared with 2005 levels, from those sectors covered by the decision. The least wealthy countries are allowed to increase emissions in these sectors because their relatively higher 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.

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, 2016a). The proposal is the follow-up to the ESD, which established national emission targets for Member States in the non-ETS 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 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 A2.0.1).

Allowed flexibilities under the ESD

The ESD allows Member States to use flexibility provisions in order 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 period may be carried forward from 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 2013 to 2019 period 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 according to 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 the 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 Mt CO_2 at EU level can be used during the 2013 to 2020 period. As most Member States are expected to meet their ESD targets (see section 3.4) 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.

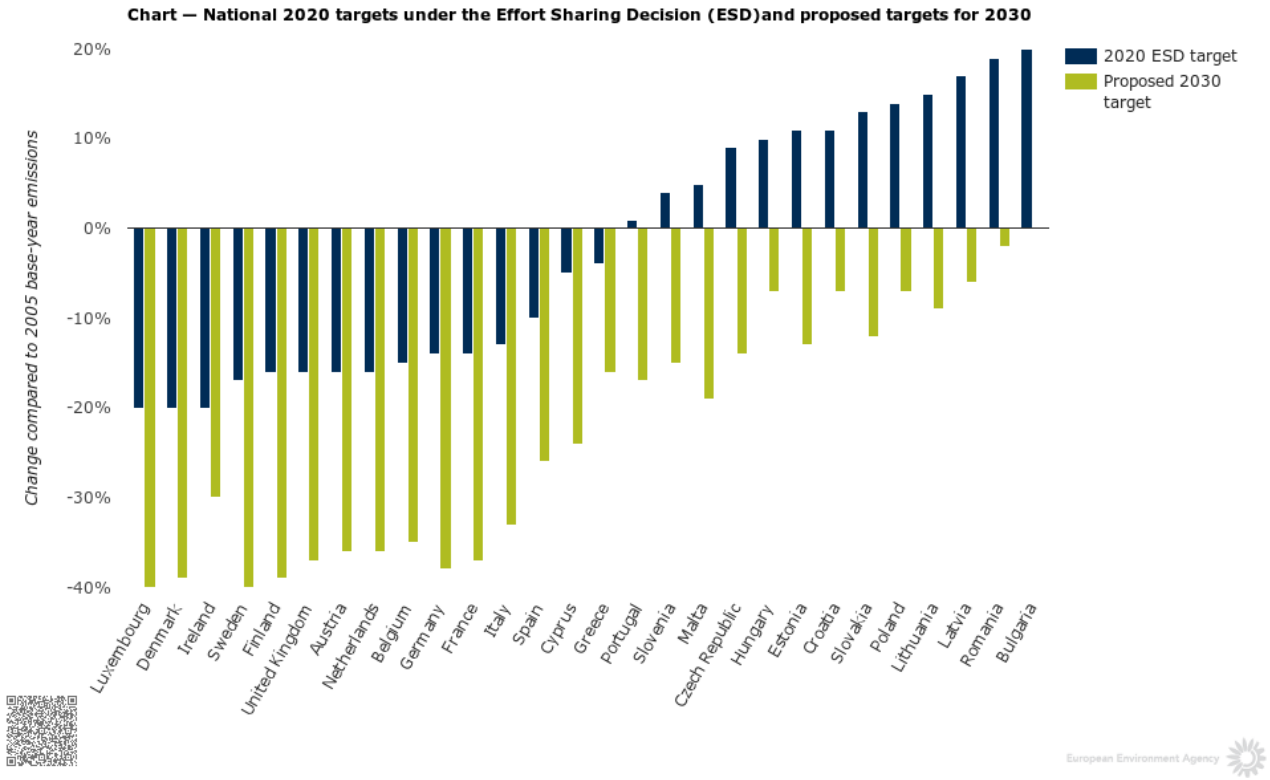
Any Member State exceeding its annual AEA, even after taking into account the flexibility provisions and the use of Kyoto emission credits, will have to take corrective measures as laid down in the ESD and will be subject to the following consequences:

- a deduction from the AEA for the next year of the excess non-ETS 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 non-ETS targets maintains 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 non-ETS sectors with EU ETS allowances that would normally have been auctioned. EU wide, this cannot be more than 100 million tonnes CO_2 over the 2021–2030 period. Eligible Member States have to notify the Commission before 2020 of the amount of this flexibility that they will use 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. In order to stimulate additional action in the land-use sector, the proposal allows Member States to use up to 280 million credits over the entire 2021–2030 period from certain land-use categories, in order 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.

Figure 1. National 2020 targets under the Effort Sharing Decision and proposed targets for 2030



Note: The targets are expressed relative to 2005 ESD base-year emissions. These base-year emissions calculated on the basis of relative and absolute 2020 targets (for details on ESD base-year emissions, please see section A3.4).

The absolute 2020 and 2013 targets used for the calculations are consistent with the global warming values in the IPCC Fourth Assessment Report (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).

Source: EU, 2009b; EC, 2016a.

4. Renewable energy targets for 2020

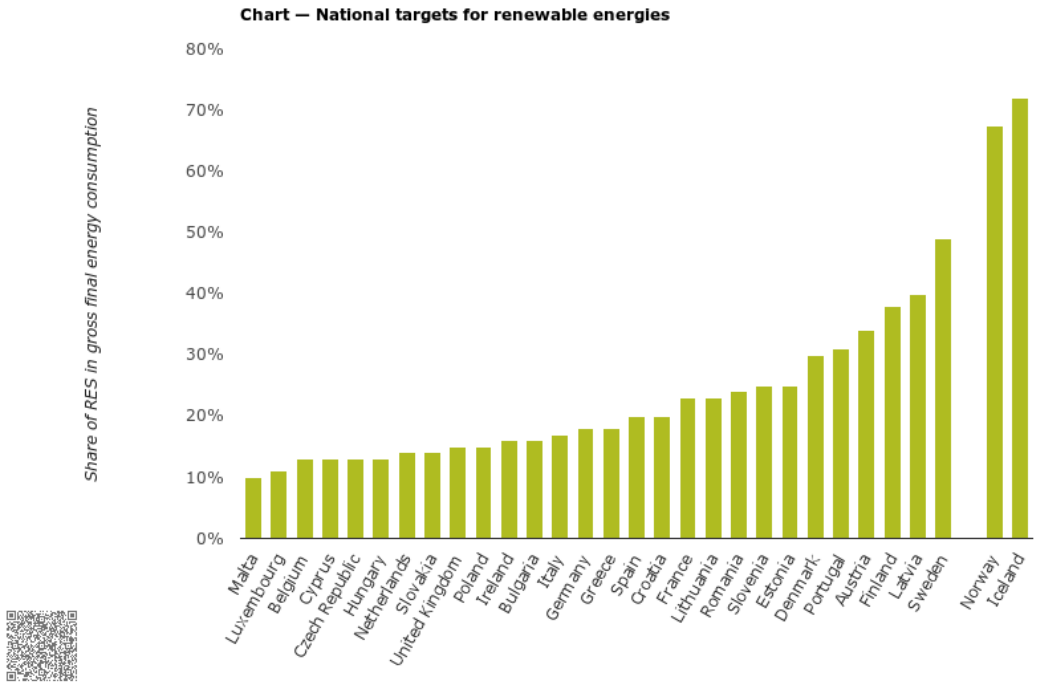
In order to meet its target of increasing the use of RES to 20 % of gross final energy consumption by 2020, the EU adopted the Renewable Energy Directive (RED) (EC, 2009c) as part of the climate and energy package.

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 (EC, 2009b). The RED also sets an indicative trajectory for each Member State for the 2011 to 2018 period, intended to ensure that each Member State achieves its 2020 targets. An interim indicative RED target for the EU can be derived from the minimum indicative trajectories of the Member States in the run-up to 2020 (RED, Annex I, Part B).

Under the RED, Member States had to submit national renewable energy action plans (NREAPs) in 2010 (EEA, 2011). These plans outline the pathways (i.e. the expected trajectories) that Member States anticipate using to reach their legally binding national renewable energy targets by 2020. In 2011 (and every 2 years 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 (see Section 1.2).

Figure 2 National renewable energy targets for 2020



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

Source: EC, 2009c.

5. Energy efficiency targets for 2020

In 2007, the European Council (European heads of state or government) stressed the need to increase energy efficiency in order 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, 2009d and 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);
- the Energy Labelling Directive (EU, 2010a);
- the Energy Performance of Buildings Directive (EPBD) (EU, 2010b).

One of the key developments in the energy efficiency policy framework was the adoption of the Energy Efficiency Directive (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 million tonnes of oil equivalent (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, 2011), 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.

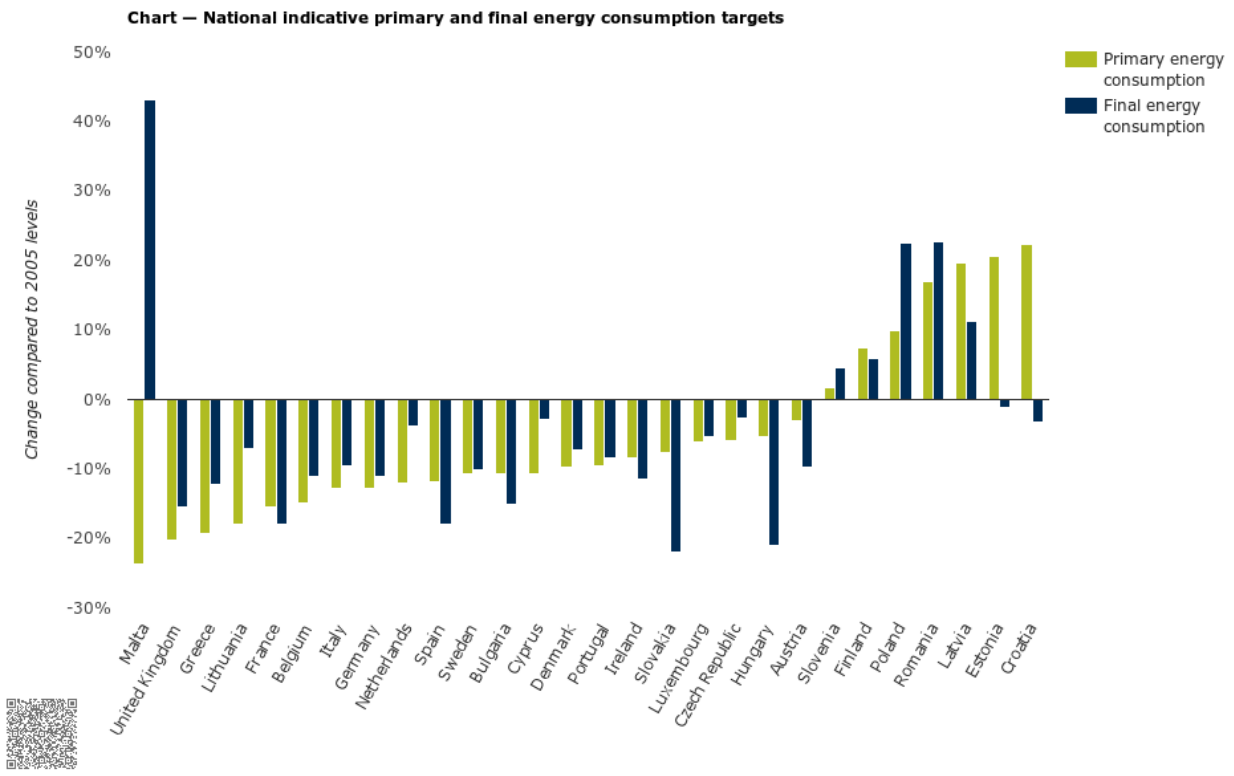
Member States have adopted different base years against which the progress towards national energy efficiency targets will be measured. Member States also chose different approaches for setting national targets. A total of 10 Member States (Austria, Belgium, Cyprus, Denmark, Hungary, Ireland, Italy, 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, 16 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 (including Malta, which has a 24 % reduction target in primary energy consumption, alongside a +40 % target for final energy consumption, compared with 2005). Five other Member States have placed a cap on the potential increase in either primary or final energy consumption over the period.

In some Member States, the targets may still be subject to change in the upcoming years. This is because some countries are currently holding nationwide debates on the future of their energy systems. Depending on the outcome of these debates, energy efficiency targets might be modified. A total of 12 Member States (Austria, Bulgaria, Croatia, Cyprus, France, Greece, Italy, Poland, Slovakia, Spain, Sweden and the United Kingdom) revised their energy efficiency targets in their triennial national energy efficiency action plans (NEEAPs) submitted under the EED.

Figure A2.0.3 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).

Figure 3 National indicative energy efficiency targets for 2020, expressed in primary or final energy consumption



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.

Source: EC, 2015c and 2016b; EU, 2012; Eurostat, 2016a, 2016b and 2016c.

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 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 nitrogen trifluoride (NF_3), flexibilities regarding base years and the use of global warming potential (GWP). The differences are summarised in Table 2. For details, please see EEA, 2014, as well as Section A1.3.

Table 1 Main national climate and energy targets

Country	Participating in EU ETS	2020 ETS target, relative to 2005 ETS emissions (%)	2020 ESD target, relative to 2005 ESD base-year emissions (%)	2020 ESD emission allocation (million annual emission allocations)	2020 renewable energy target on the RES share in gross final energy consumption (%)	Primary energy target 2020 (Mtoe)	Final energy target 2020 (Mtoe)
Austria	Yes		– 16.0	48.8	34.0	31.5	25.1
Belgium	Yes		– 15.0	67.7	13.0	43.7	32.5
Bulgaria (a)	Since 2007		20.0	28.8	16.0	16.9	8.6
Croatia (b)	Since 2013		11.0	21.0	20.0	11.1	7.0
Cyprus	Yes		– 5.0	5.9	13.0	2.2	1.8
Czech Republic	Yes		9.0	67.7	13.0	39.6	25.3
Denmark [a]	Yes		– 20.0	30.5	30.0	17.4	14.4
Estonia	Yes		11.0	6.5	25.0	6.5	2.8
Finland	Yes		– 16.0	28.4	38.0	35.9	26.7
France	Yes		– 14.0	359.3	23.0	219.9	131.4
Germany	Yes		– 14.0	425.6	18.0	276.6	194.3
Greece	Yes		– 4.0	61.2	18.0	24.7	18.4
Hungary	Yes		10.0	58.2	13.0	24.1	14.4
Ireland	Yes		– 20.0	39.0	16.0	13.5	11.2
Italy	Yes		– 13.0	294.4	17.0	158.0	124.0
Latvia	Yes		17.0	9.9	40.0	5.4	4.5
Lithuania	Yes		15.0	15.5	23.0	6.5	4.3
Luxembourg	Yes		– 20.0	8.1	11.0	4.5	4.2
Malta	Yes		5.0	1.2	10.0	0.7	0.5
Netherlands	Yes		– 16.0	107.0	14.0	60.7	52.1
Poland	Yes		14.0	202.3	15.0	96.4	71.6
Portugal	Yes		1.0	51.2	31.0	22.5	17.4
Romania	Since 2007		19.0	88.4	24.0	43.0	30.3
Slovakia	Yes		13.0	26.5	14.0	16.4	9.0
Slovenia	Yes		4.0	12.5	25.0	7.1	5.1
Spain	Yes		– 10.0	214.2	20.0	119.9	80.1
Sweden	Yes		– 17.0	37.2	49.0	43.4	30.3
United Kingdom [a]	Yes		– 16.0	327.1	15.0	177.6	129.2
EU		**– 21**	**– 9.4**	**2 644.2**	**20.0**	**1 483.0**	**1 086.0**
Iceland	Since 2008				72.0		
Liechtenstein	Since 2008						
Norway	Since 2008				67.5		
Switzerland							
Turkey [d]							

Note: ([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.

Source: EC, 2013a, 2013b, 2016b and 2016c; EU, 2009a, 2009b, 2009c and 2012.

Table 2 Technical details concerning EU climate-related targets

	International commitments			Unilateral EU commitments		
				2020 climate and energy package		2030 climate and energy framework
	Kyoto Protocol (CP1)	UNFCCC	Kyoto Protocol (CP2)	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
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)

Source: EC, 2007, 2013a and 2013b; EU, 2009b and 2014b; IPCC, 1996 and 2007; UNFCCC, 1998, 2012 and 2013.

End notes

([1]) Emissions from aviation have been included in the EU ETS since 1 January 2012. In principle, the EU ETS should cover all flights departing from and/or arriving at airports in all EU Member States, as well as Iceland, Liechtenstein and Norway and closely related territories. However, since 2012, only flights departing from and arriving at aerodromes located in these countries (and Switzerland in 2012) have been included in the EU ETS. Non-CO2 emissions from domestic aviation remain covered under the ESD.

([2]) 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.

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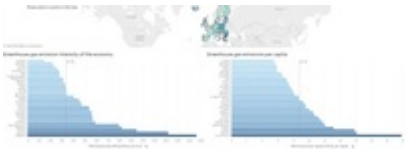
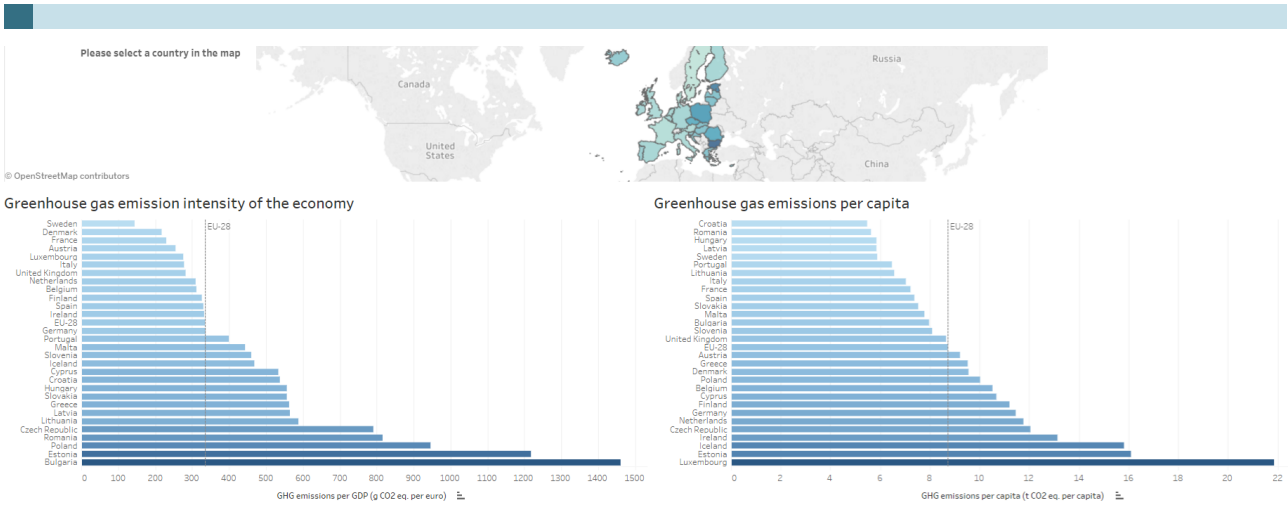
Country profiles - greenhouse gases and energy





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