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COURT
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Landscape Review

EU action on energy and climate change

2017

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Landscape Review | EU action on energy and climate change

ECA team

This ECA Landscape Review considers broad themes on the basis of the Court's research and accumulated knowledge and experience, and special reports by the ECA and other EU Supreme Audit Institutions since 2012. It is intended to serve as a basis for consultation and dialogue with the ECA's stakeholders and for the future audit work of the ECA.

This report was adopted by Audit Chamber I which specialises in sustainable use of natural resources. The task was led by ECA Member Phil Wynn Owen, Dean of Chamber I. The head of task was Olivier Prigent, with Bertrand Tanguy as deputy head of task.

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Adaptation to climate change: The process of adjusting to actual or expected climate change and its effects.

Anthropogenic emissions: Emissions derived from human activities, as opposed to those occurring naturally without human influence.

Carbon capture and storage (CCS): A set of technologies aimed at capturing, transporting, and storing CO_2 emitted from power plants and industrial facilities. The goal of CCS is to prevent CO_2 from reaching the atmosphere by storing it in suitable geological formations.

CO_2-equivalent (CO_2e): This unit is used to consolidate the volumes of all greenhouse gases in one single number. It represents the amount of carbon dioxide (CO_2) emissions that would cause the same climate warming, over a given period, as an emitted amount of a given greenhouse gas or mixture of greenhouse gases.

Cohesion Policy: EU policy aiming at improving economic, territorial and social cohesion within the EU by reducing the development gap among the various regions. Cohesion Policy is delivered through three main funds: the European Regional Development Fund (ERDF); the European Social Fund (ESF); and the Cohesion Fund (CF). Together with the European Agricultural Fund for Rural Development (EAFRD) and the European Maritime and Fisheries Fund (EMFF), they make up the **European Structural and Investment Funds (ESIF)**.

Conference of the Parties (COP): The supreme decision-making body of the United Nations Framework Convention on Climate Change (UNFCCC). All States that are Parties to the Convention are represented at the COP, at which they review the implementation of the Convention and any other legal instruments that the COP adopts and take decisions necessary to promote effective implementation. The EU and its Member States are both Parties to the Convention, and take part in meetings of the COP.

Cost-effectiveness: The relationship between resources used and results achieved. High cost-effectiveness is a requirement of EU spending.

European Economic Area (EEA): The EEA provides for the free movement of persons, goods, services and capital within the European Single Market. It includes all EU Member States and Iceland, Liechtenstein and Norway.

Effort-sharing: The emissions reductions of the sectors not covered by the EU Emissions Trading System are regulated by the 2009 Effort Sharing Decision (ESD). These sectors include transport (except aviation and international shipping), agriculture and forestry, buildings and waste, as well as industrial sectors not covered by the EU Emissions Trading System.

Feed-in tariffs: Tariffs which guarantee continuous retail prices for renewable energy plant operators for a given period.

Global warming potential (GWP): Relative measure of how much heat a tonne of a specific greenhouse gas traps in the atmosphere in comparison to the amount of heat trapped by a similar mass of carbon dioxide.

Greenhouse gases (GHG): Gases acting as a blanket in the Earth's atmosphere, trapping heat and warming the Earth's surface through what is known as the 'greenhouse effect'. The main greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and fluorinated gases (HFCs, PFCs, SF_6 and NF_3).

Glossary and abbreviations

Intergovernmental Panel on Climate Change (IPCC): The leading international scientific body for the assessment of climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988 to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socioeconomic impacts.

Intermittency: Sources of energy which do not continuously produce energy due to some factor which cannot be directly controlled, are described as intermittent. For example, wind turbines do not produce energy when no wind is blowing. Solar power plants do not produce at night, or when a thick cloud layer hides the sun.

International aviation/international shipping: In this report, international aviation/shipping refers to flights/shipping between the EU and a non-EU country airport/port. This distinction is made because, in greenhouse gases inventories, the emissions of international aviation/shipping and intra-EU aviation/shipping are counted separately.

Land use, land use change and forestry (LULUCF): Introduced in the Kyoto Protocol in 1997, LULUCF is defined by the United Nations Climate Change Secretariat as a 'greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities'.

Mitigation of climate change: A human intervention to reduce the sources, or enhance the capacity of sinks, of greenhouse gases.

Nationally Determined Contribution (NDC): In the context of the Paris Agreement, all Parties have, on a voluntary basis, to propose national greenhouse gas emission reduction targets through 'Nationally Determined Contributions' (NDCs). On a regular basis, the Parties will hold facilitative dialogues to take stock of the collective efforts to progress towards the long-term goal and update their NDCs.

Renewable energy: Energy collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, biomass and geothermal heat.

Retail energy prices and wholesale energy prices: Retail energy prices are the prices paid by the final consumer of energy. They include taxes, other surcharges and discounts which vary between Member States. Wholesale prices are prices paid to energy importers or producers by the providers that sell the energy products to final customers.

Sink: Any process, activity or mechanism that removes a greenhouse gas from the atmosphere.

Stranded assets: Assets that have suffered from unanticipated or premature closures, write-downs, devaluations or conversion to liabilities.

United Nations Framework Convention on Climate Change (UNFCCC): The United Nations Framework Convention on Climate Change (UNFCCC) is an international environmental treaty negotiated at the Earth Summit in Rio de Janeiro in 1992. The UNFCCC's objective is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. The UNFCCC is also the name of the United Nations Secretariat charged with supporting the operation of the Convention.

Executive summary

I

Energy played a key role in the EU's origin, when the six founding Member States established the European Coal and Steel Community in 1952, 65 years ago. Measures tackling climate change developed later. Energy and climate change are now closely interlinked, since energy production, mainly from the transformation and combustion of fossil fuels, and energy use – by e.g. industry, households and transport – account for 79 % of EU greenhouse gas emissions. As a result, effective action on energy production and its use is essential to tackle climate change. Energy and climate change raise many issues which are best dealt with by states working together. As a result, they are high on the EU's agenda.

II

This landscape review aims to provide an overview of what the EU is doing in this field; to summarise key audit work the European Court of Auditors (ECA) and other Supreme Audit Institutions (SAIs) in the EU have done to date; and to identify main challenges to inform the legislative debate and future audit work.

III

In both energy and climate change the EU sets a policy framework. Certain areas, such as the choice of the energy mix, remain within the competence of Member States. Internationally, the EU and its Member States have played a leading role in international climate agreements, such as the 2015 Paris Agreement.

IV

In the energy field, an important part of EU action is the establishment of an internal energy market to allow the free flow and borderless trade of gas and electricity across the EU. The internal energy market aims to deliver in a cost-effective way the EU's energy policy objectives of delivering affordable, competitively priced, sustainable and secure energy.

V

In November 2016, the Commission produced its so-called 'Clean Energy for All Europeans' package of proposals for further reforming the energy market. These proposals are currently under consideration by EU legislators, i.e. the European Parliament and the Council of the European Union.

VI

On climate change, most EU actions focus on mitigating climate change by reducing greenhouse gas emissions, while action on the adaptation to the effects of climate change remains largely unregulated.

VII

This strong focus on mitigation is reflected in the EU's climate and energy targets. The EU has set itself targets for 2020 and 2030 to reduce greenhouse gas emissions, increase the share of renewable energy in energy consumption and to make gains in energy efficiency. By 2050, the EU intends to reduce EU greenhouse gas emissions by between 80 % and 95 % compared to 1990 levels.

VIII

Approaches to cutting greenhouse gas emissions are different across sectors. With the EU Emissions Trading System (ETS), the EU has set a limit on overall emissions from some sectors of energy supply, energy-intensive industries and intra-EEA flights, and created a marketplace for emissions quotas, thereby 'putting a price' on carbon. For the other sectors, the approach has been to cut emissions by means of binding emissions reduction targets set for each Member State by the EU. Member States are individually responsible for defining and implementing national policies and measures to achieve those targets. These approaches are accompanied by both EU and national measures to increase renewable energy and energy efficiency.

IX

Even if efforts to cut greenhouse gas emissions are successful and the objective of the Paris Agreement – keeping the global temperature rise since the pre-industrial era below 2°C – is achieved, adaptation to a changing climate is necessary. Climate change already impacts the environment, society and the economy, with warming currently just over 1°C compared to the pre-industrial period. Europe's climate will be significantly different from today under a full 2°C temperature increase. The basis for EU action in the area of adaptation is the 2013 EU adaptation strategy, which encourages Member States to take action but does not make it mandatory.

X

The SAIs and the ECA have in recent years audited a wide field of different topics on energy and climate change. Audits on energy have made up the largest share of reports, with other topics, such as adaptation, receiving less attention. Although audit coverage has varied, a number of common findings can be identified. Audits have found that differences in the way Member States have implemented EU legislation and administered their energy markets have held back progress towards completing the EU's internal energy market. Notwithstanding the successful growth in renewables and decline in their costs globally, audits have found a lack of cost-effectiveness and obstacles to investments. Cost-effectiveness issues have also been regularly identified in energy efficiency audits; in the field of nuclear energy, SAIs have found significant cost increases and delays. Audits have also shown that the shift to low-carbon transport modes is not taking place to a sufficient degree. In the area of adaptation, audits have focused mainly on floods. Here, auditors have found issues in flood prevention, protection and response.

XI

This landscape review identifies seven areas of main challenges:

1. Energy and climate change governance
2. Evidence-based policy
3. The energy transition
4. Using research and innovation effectively
5. Planning for and tackling adaptation
6. Financing
7. Involving EU citizens

Introduction

Fundamentals of energy and climate change

01

Atmospheric carbon dioxide (CO_2) levels reached a new high of 400 parts per million at the end of 2015[1]. 2016 was the warmest year on record according to all major global surface temperature datasets: on average, the world was 1.1°C warmer than in the pre-industrial period. In 2016, the Arctic ice sheet shrank to its smallest size since satellite records began in 1979. France and Germany experienced significant flooding in May and June, but July and August were the driest months on record in France.

02

Climate change and its causes are no longer subject to serious scientific dispute. For nearly three decades, thousands of scientists from all over the world have been contributing scientific knowledge about climate change and its environmental and socio-economic impact through the Intergovernmental Panel on Climate Change (IPCC). According to the IPCC, human influence on the climate system is clear and is evident from the increasing greenhouse gas concentrations in the atmosphere and the warming observed[2]. The link between increasing greenhouse gas concentrations in the atmosphere and observed increases in the Earth's temperature is well understood (see ***Box 1***).

Box 1

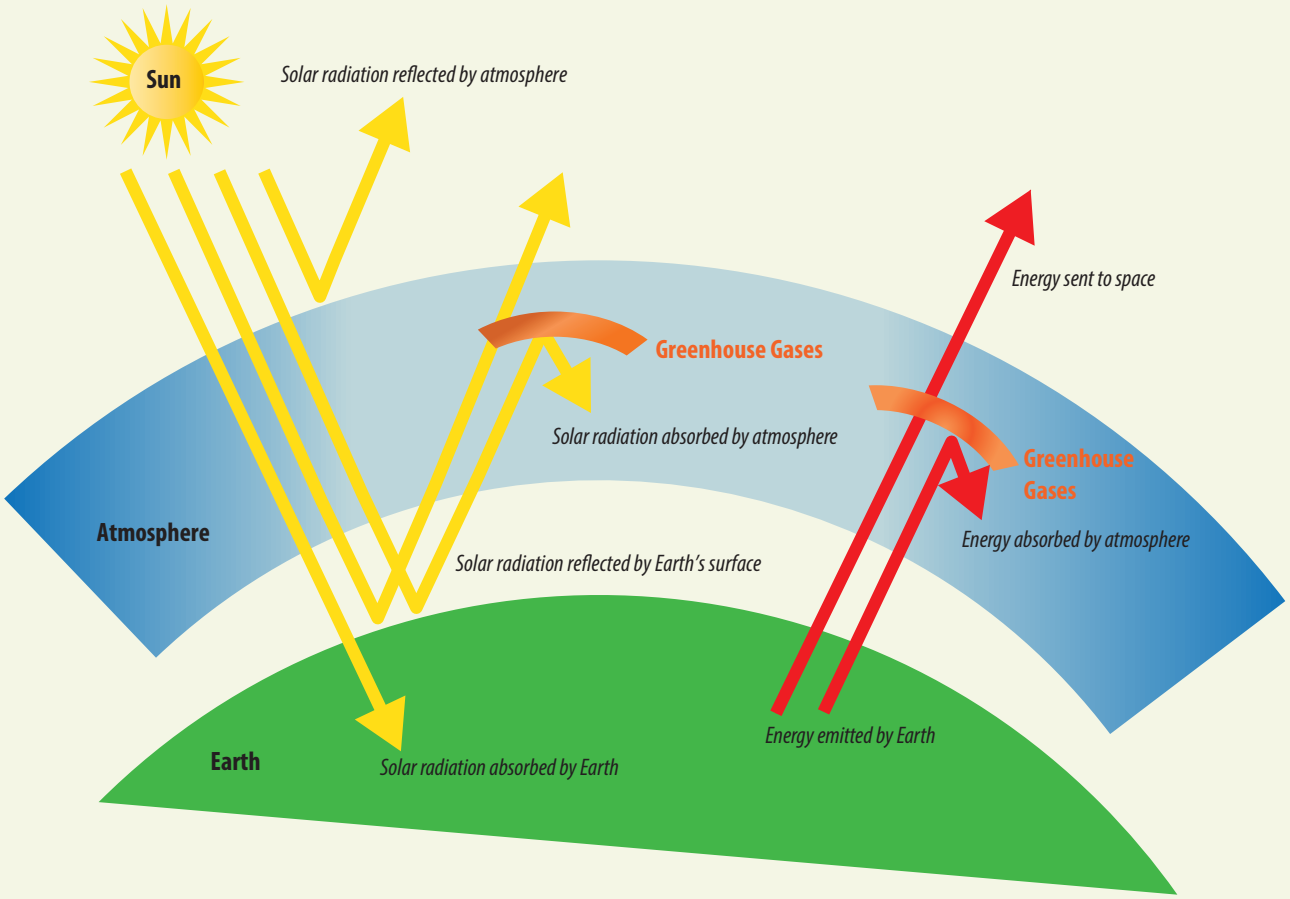
Why greenhouse gases warm the atmosphere

When sunlight reaches the Earth's atmosphere, a part of it is reflected from clouds and particles in the air back into space. Most of the light crosses the atmosphere and reaches the Earth's surface. Some of this light is reflected, in particular by light surfaces such as snow, and another part is absorbed by the Earth by dark surfaces such as vegetation or roads. The Earth also emits energy naturally in the form of infra-red radiation. When the energy reflected or emitted by the Earth's surface crosses the atmosphere, some of this energy is absorbed by the atmosphere.

The higher the concentration of greenhouse gases (GHGs) in the atmosphere, the higher the proportion of the energy absorbed by the atmosphere. This energy then heats the atmosphere, as in a greenhouse. In the long run, a hotter atmosphere changes the Earth's climate.

The greenhouse gas emitted in the greatest quantity is carbon dioxide (CO_2), which makes up around 80 % of the EU's total greenhouse gas emissions, followed by methane (CH_4) at 11 %, nitrous oxide (N_2O) at 6 % and fluorinated gases at 3 %.

Box 1



Source: European Court of Auditors.

03

Energy played a key role in the EU's origins, when the six founding Member States established a common market for coal and steel within the European Coal and Steel Community in 1952 and, in 1957, created the European Atomic Energy Community (Euratom). Since the 1990s, the EU has been working towards establishing an internal energy market to allow the free flow of energy across the EU.

04

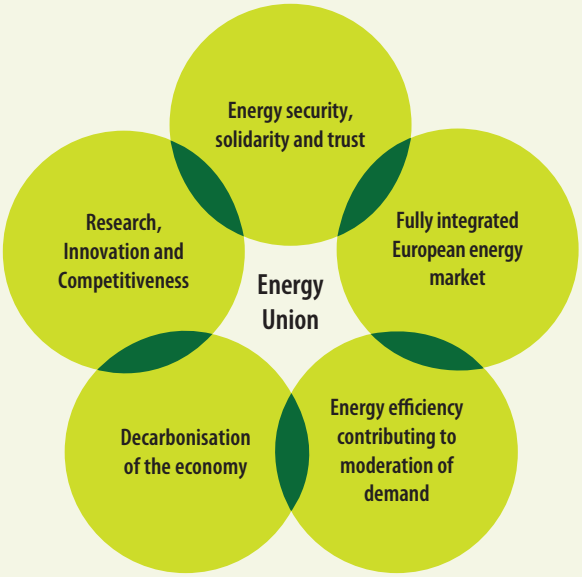
Energy and climate change are closely interlinked, since energy production, mainly from the transformation and combustion of fossil fuels, and energy use – by industry, households and transport for example – account for 79 % of EU greenhouse gas emissions. As a result, transforming energy production and use is essential to tackling climate change. Meeting energy needs while reducing greenhouse gas emissions is a key challenge for the EU and its Member States.

05

Building 'a resilient Energy Union with a forward-looking climate change policy' is therefore a key priority of the European Commission. The Energy Union strategy, with its five dimensions, provides the framework for achieving this priority (see ***Box 2***). To implement this strategy, the Commission has proposed several important draft pieces of legislation and non-legislative initiatives in energy and climate change in 2016, most notably the Clean Energy for All Europeans Package[3]. These will be debated in the Council and the Parliament during 2017 and 2018. From a financial point of view, the EU has committed to spending at least 20 % of its 2014-2020 budget on climate action, i.e. around 212 billion euro.

Box 2

Five closely related, mutually reinforcing dimensions of the framework strategy for a Resilient Energy Union



Source: Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy (COM(2015) 80 final of 25.2.2015).

The **energy security, solidarity and trust** dimension focuses on the diversification of energy sources, suppliers and routes, cooperation among Member States, and increased transparency on gas supply contracts.

The **fully integrated internal energy market** dimension aims at enabling the free flow of energy throughout the EU through adequate infrastructure and without any technical or regulatory barriers.

The **energy efficiency** dimension considers energy efficiency as 'an energy source in its own right', and encourages Member States to prioritise energy efficiency policies to reduce dependence on energy imports, reduce emissions and reduce energy bills.

The **decarbonisation of the economy** dimension says that 'an ambitious climate policy is an integral part of our Energy Union' and aims to make the EU the world leader in renewable energy.

The **research, innovation and competitiveness** dimension supports breakthroughs in low-carbon and clean energy technologies.

06

EU action in the area of energy and climate change encompasses the two complementary policy responses to climate change: mitigation and adaptation. **Mitigation** of climate change seeks to address the causes of climate change by reducing or limiting greenhouse gas emissions and by enhancing natural sinks of greenhouse gases. **Adaptation** aims at anticipating the effects of climate change and taking appropriate action to prevent or minimise the potential damage.

Aim and approach of this landscape review

07

This landscape review of EU action on energy and climate change aims to:

- provide an overview of what the EU is doing in this field;
- summarise key audit work we and other Supreme Audit Institutions (SAIs) in the EU have done to date; and
- identify main issues and challenges to inform the legislative debate and future audit work.

08

The report is structured as follows:

- **Part I** describes the main EU energy and climate change policies; greenhouse gas emissions from different sectors; the associated EU sectoral legislation; how this legislation has been implemented, and what funding has been provided, to help reach the EU's energy and climate targets;
- **Part II** provides an analysis of what has been audited in the area of energy and climate change by the ECA and the Member States' SAIs and an overview of their key findings. A summary of all ECA audit reports in the area is available on our website, together with a list of all SAIs reports studied;
- **Part III** highlights main challenges for the future, both to inform the legislative debate and to help to identify potential opportunities and challenges for public audit.

09

The landscape review is not an audit: it is a review largely based on publicly available information[4]. It is not based on any new audit work and does not present any new audit findings or recommendations. The Commission's replies to findings and recommendations made in the individual ECA reports quoted were published in those reports, available on our website. More details on our approach and sources are provided in an ***Annex***.

Part I – Energy and climate change: What the EU is doing

10

Part I describes what the EU is doing in energy and climate change. It includes information about the following:

- An overview of the **EU's competence** in the field, and of the work carried out at EU level to mitigate climate change. The section presents the main **EU energy and climate targets and objectives** and briefly describes the underlying policy framework and its two main pillars for reaching the emissions reduction targets: the **EU Emissions Trading System (EU ETS)**, and **effort-sharing**;
- **Mitigation** action in each greenhouse gas emitting sector: **energy supply, industry, buildings, transport, agriculture and forestry** and **waste**. Energy supply and use accounts for 79 % of EU greenhouse gas emissions, so it is given most emphasis;
- **Adaptation** to climate change, highlighting expected changes and impacts on society and environment;
- Other policies supporting the implementation of EU action on energy and climate change, i.e. **research and innovation**, **public and private financing** for climate-change mitigation and adaptation, and actions to **improve policy making and implementation**.

The EU's competence in the field of energy and climate change

11

Energy and climate change are two areas in which the EU and the Member States have **shared competence**[5]. This means that the EU and the Member States may legislate and adopt legally binding acts. Member States can exercise their own competence unless the EU has formulated and implemented energy or climate change policies and strategies[6].

12

The objectives of EU energy policy are set out in the Treaty on the Functioning of the European Union[7], which states that, in a spirit of solidarity between Member States, the aims of EU energy policy are to:

- ensure the functioning of the energy market;
- ensure security of energy supply in the Union;
- promote energy efficiency and energy saving and the development of new and renewable forms of energy; and
- promote the interconnection of energy networks.

13

The Treaty also stipulates that measures implemented in the framework of EU energy policy must not 'affect a Member State's right to determine the conditions for exploiting its energy resources, its choice between different energy sources and the general structure of its energy supply'. This is, however, subject to derogations. In particular, the EU's environment policy may provide for measures which significantly affect a Member State's choice between different energy sources and the general structure of its energy supply[8].

14

The EU's competence in the area of climate change derives from its competence in the area of environment policy. The objectives for EU environment policy, established in the Treaty, include[9]:

- preserving, protecting and improving the quality of the environment;
- protecting human health;
- using natural resources prudently and rationally; and
- promoting measures at international level to deal with regional or worldwide environmental problems, in particular climate change.

15

The Treaty also states that EU environment policy should rest on the principles of precaution, prevention, rectifying pollution at its source, and on the 'polluter-pays' principle[10]. As a general principle, environmental protection requirements must be integrated into the definition and implementation of the Union's policies and activities, in particular with a view to promoting sustainable development[11].

16

In both energy and climate change, depending on the exact subject, the EU has the competence to act on the international stage. For example, the EU may negotiate or enter into international agreements with third parties either alone or jointly with the Member States[12].

International climate agreements

17

Climate change cannot be tackled by the efforts of countries or regions acting alone. The EU recognises this[13]. The EU and its Member States only emit around 12 % of global greenhouse gas emissions[14], so they have played a leading role in negotiating international climate agreements under the **United Nations Framework Convention on Climate Change (UNFCCC)**[15], under which the Kyoto Protocol and the Paris Agreement were agreed.

18

The **Kyoto Protocol** was adopted in 1997 and entered into force in 2005. The protocol set, for 37 countries and the European Union, an objective to reduce greenhouse gas emissions by 5 % over the 2008-12 period compared to 1990 levels. The European Union committed itself to reducing its emissions by 8 % instead of 5 %[16]. Under the **Kyoto Protocol as amended in Doha in 2012**, the EU and its Member States had committed to reducing their greenhouse gas emissions by 20 % by 2020 compared to 1990 levels.

19

Under the **Paris Agreement**, governments agreed to keep the rise in global average temperature this century to 'well below' 2°C above pre-industrial levels, aiming to limit it to 1.5°C. Signatories of the Paris Agreement, including the EU and each Member State, submitted details of how they would contribute to this target[17]. According to the UNFCCC, these contributions will not be sufficient to limit the global increase in temperature to below 2°C[18]. The signatories therefore agreed to reconvene every five years to report to each other on the progress they had made and to establish more ambitious targets as required by the science. Recognising the adverse impacts of climate change, the signatories also included provisions in the Paris Agreement dealing with climate-change adaptation.

Box 3

The Paris Agreement: A global commitment

The Paris Agreement represents a global commitment to mitigate climate change: it has been signed in 2015 by 195 States, i.e. all UNFCCC members except Nicaragua and Syria. They represent 99.75 % of global emissions.

The United States of America is the source of 18 % of global emissions, making it the second-largest emitter after China (20 %). In June 2017, the President of the United States of America announced the withdrawal of the country from the Paris Agreement. The remaining 147 countries which had ratified the Agreement up to June 2017, are the source of 66 % of global emissions, thus exceeding the 55 % threshold which had been required for the agreement to enter into force.

20

Before the Paris Conference, developed countries had already committed to providing 100 billion USD each year by 2020 to support developing countries' efforts to mitigate and adapt to climate change. In the Paris Agreement, developed countries reaffirmed this and committed to increasing the level of support from 2025 onwards[19].

EU energy and climate framework

EU energy and climate targets and objectives

21

To fulfil its obligations under the Kyoto Protocol and the Paris Agreement, the EU has set itself various targets to mitigate climate change. These targets involve direct, quantified reductions in greenhouse gas emissions, as well as specific targets for renewable energy production and increased energy efficiency (see ***Box 4***).

Box 4

EU greenhouse gas reduction, renewable energy and energy efficiency targets and objectives

- **By 2020[20]:**
  - 20 % reduction in greenhouse gas emissions (from 1990 levels);
  - 20 % share of renewable energy in final energy consumption;
  - indicative target of improving energy efficiency by 20 % compared to projections of future energy consumption.
- **By 2030[21]:**
  - at least 40 % reduction in greenhouse gas emissions (from 1990 levels);
  - at least 27 % share of renewable energy in final energy consumption, binding at EU level;
  - indicative target of improving energy efficiency by at least 27 % compared to projections of future energy consumption, to be reviewed in 2020 having in mind an EU level of 30 %[22].
- **By 2050[23]:** the EU intends to reduce EU greenhouse gas emissions by between 80 % and 95 % compared to 1990 levels.

22

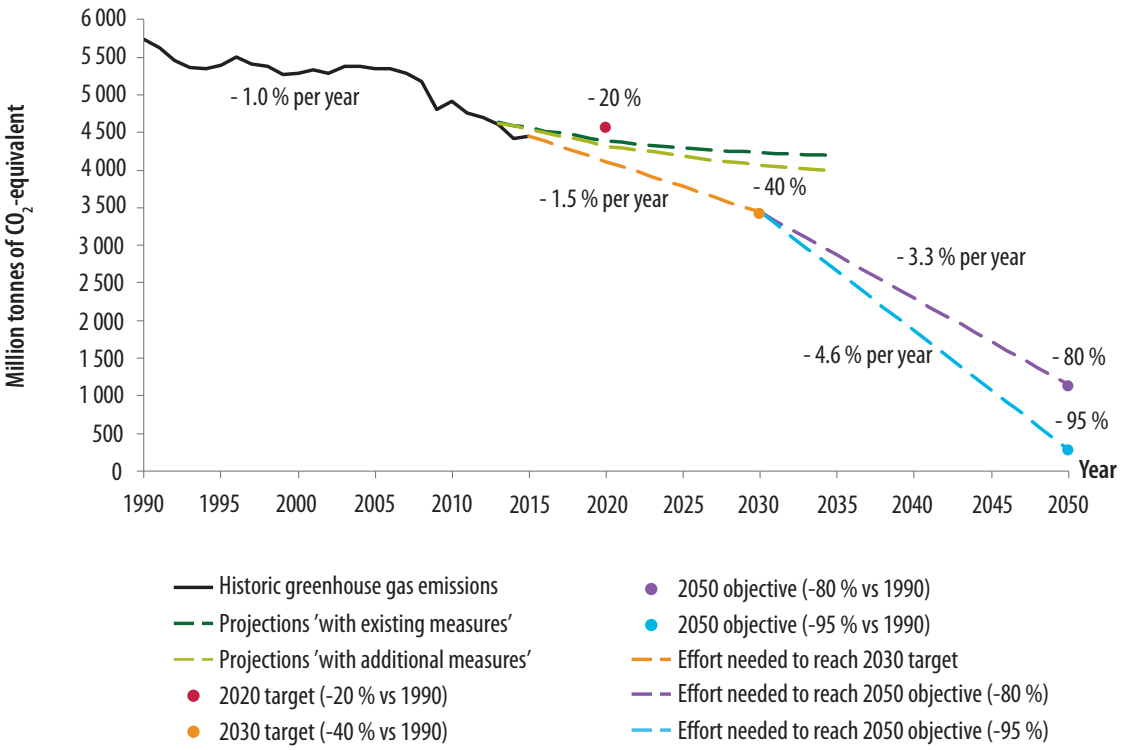
By 2014, the EU had already succeeded in reducing its greenhouse gas emissions by more than 20 % below 1990 levels[24]. However, in 2015, its emissions increased by 0.7 % compared to 2014.

23

Current trends, projections, and targets, with the reductions in emissions required to reach the targets, are shown on ***Figure 1***. It shows that the 2030 and 2050 greenhouse gas emissions reduction targets and objectives will not be achieved without significant additional efforts. To achieve the 2030 targets, annual emission reduction efforts will need to increase by half in the next decade. The most significant change, though, will be the one required beyond 2030, when the emission reduction rate will need to outpace historic levels by three to four times in order to achieve the 2050 objective.

Figure 1

EU greenhouse gas emission trends, projections and reduction targets and objectives



Source: European Environmental Agency, Trends and projections in Europe 2016 – Tracking progress towards Europe's climate and energy targets.

24

To reach these targets and objectives, the EU has set sub-targets for emissions cuts in sectors covered by the EU Emissions Trading System (EU ETS). In sectors which are not covered by the EU ETS, the EU shares the effort among Member States by setting binding national targets for reductions in greenhouse gas emissions – this is called 'effort sharing'. These policies – EU ETS and effort-sharing – are described in the following sections.

25

To track the progress achieved in reducing the EU's greenhouse gas emissions, the European Commission and the Member States report annually on their anthropogenic[25] greenhouse gas emissions to the UNFCCC. The EU has also put in place an internal emissions-reporting system[26]. This system is built around the EU greenhouse gas inventory, a compilation of Member State inventories drawn up by the Commission. The European Environmental Agency (EEA) performs annual quality checks of Member States' inventories in cooperation with Eurostat and the Commission's Joint Research Centre. Under the UNFCCC, international experts from non-EU countries should review the EU's greenhouse gases inventories at least once every five years.

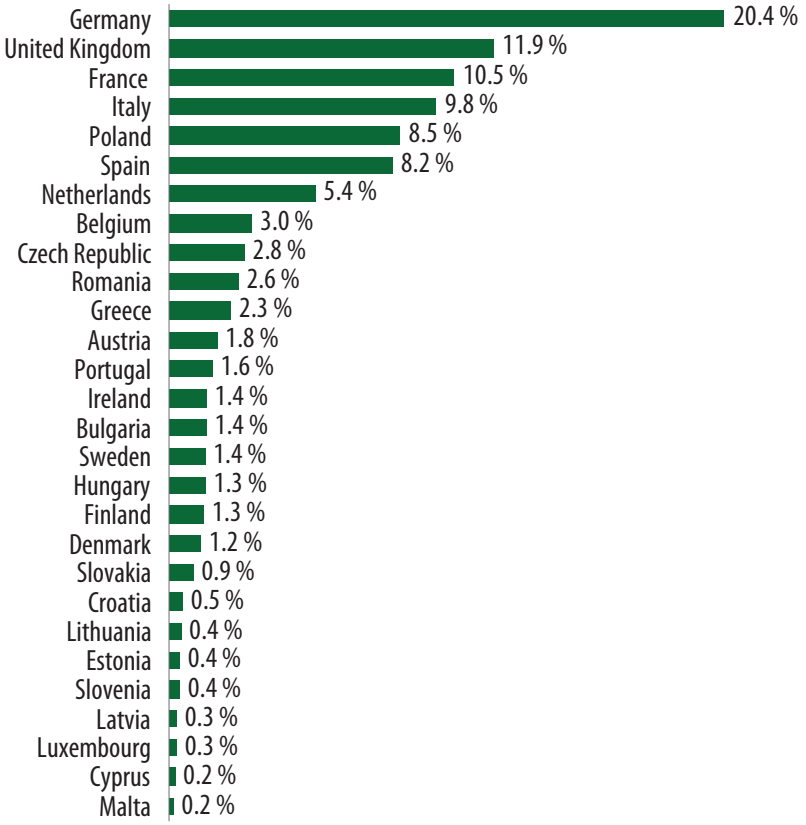
26

In 2015, the EU Member States (see ***Figure 2***) emitted approximately 4.6 gigatonnes of CO_2-equivalent (CO_2e)[27].

Figure 2

2015 emissions by Member State

(% of EU total greenhouse gas emissions, excluding LULUCF, including international aviation and international navigation. Total = 4.6 Gt of CO_2e)



Source: EEA greenhouse gas – data viewer, EEA, 2017.

The EU Emissions Trading System

Objective and main features

27

In 2005, the EU introduced the EU **Emissions Trading System** (EU ETS) 'to promote reductions of greenhouse gas emissions'[28]. The EU ETS was the world's first multi-country[29] and multi-sector scheme for trading allowances of greenhouse gas emissions. It restricts the emissions of power plants, large energy-intensive industrial installations, and, since 2012, aviation emissions from intra-EEA flights. These sectors account for about 45 % of EU greenhouse gas emissions.

28

The EU ETS is known as a **'cap-and-trade' system**[30]. The EU ETS sets a limit on overall annual greenhouse gas emissions: total emissions over a calendar year are 'capped'. Allowances, representing the right to emit one tonne of CO_2-equivalent, are either auctioned by governments or handed out for free to emitting installations. The allowances can be freely traded on the market. Each year, operators must surrender a number of allowances corresponding to their reported greenhouse gas emissions[31].

29

The first phase (2005-2007) of the EU ETS was a pilot. In the second phase (2008-2012), most of the allowances were given away for free. In the third, current, phase (2013-2020), the cap set at EU level decreases annually by a so-called 'linear reduction factor' of 1.74 %. The goal is to reduce greenhouse gas emissions in the EU ETS sector by 21 % below 2005[32] levels by 2020. Therefore, the EU ETS encourages the reduction of greenhouse gas emissions in a predictable way.

30

According to the polluter-pays principle, all EU ETS allowances should be auctioned. But since not all countries worldwide price greenhouse gas emissions to the same extent as the EU, the EU ETS can, in theory, impact negatively on the international competitiveness of EU industry. As a result, some companies might choose to relocate to countries with fewer constraints on greenhouse gas emissions, thus emitting greenhouse gases elsewhere. This phenomenon is referred to as '**carbon leakage**'. Sectors that can prove[33] they are exposed to the risk of carbon leakage, such as the steel industry, receive some **free allowances**[34]. In the power sector, which physically cannot relocate, nearly all allowances are **auctioned**[35].

Price of EU ETS allowances

31

A core element of the EU ETS is the carbon price. Setting an absolute ceiling (the 'cap') on emissions creates scarcity of supply. Limited supply and flexible demand should create a price signal for carbon allowances. In a well-functioning system, market actors would invest in emissions reductions in the most cost-effective way[36]. In theory, those with lower costs for reducing emissions will do so, and will sell their surplus allowances to those facing higher costs. With a declining cap, scarcity in the system would increase over time, driving up the carbon price and making more expensive emission reduction investment options more viable.

32

Companies will invest in low-carbon technologies as long as such investments are cheaper than buying allowances on the market. So the market price of EU ETS allowances needs to be sufficiently high to justify investment decisions in low-carbon technology[36]. Therefore, the market price of EU ETS allowances, not just the reduction of emissions, supports the transition to a low-carbon economy. Models used by the Commission in 2011 showed a price trajectory of 40 euro per tonne of CO_2e in 2020, 100 euro in 2030 and 250 euro by 2050[37]. However, from 30 euro at the beginning of phase 2, the allowance price decreased to around 5 euro at the beginning of 2017 (see ***Figure 3***). This is far below the price bracket of 36-72 euro which, according to the High-Level Commission on Carbon Prices, must be reached by 2020 if the temperature targets in the Paris Agreement are to be achieved[38]. The price decreased because supply of allowances was higher than demand. Indeed, at the end of 2015, there was still an oversupply of 1.8 billion allowances, equivalent to one year of EU emissions from the EU ETS sector[39]. This oversupply was due to the economic recession following the 2008 crisis as well as the growth of energy efficiency or renewable energy policies (see ***paragraph 168***).

Figure 3

Historical price of EU ETS allowances (euro/tonne of CO_2e)

Source: Monthly average of seven EUA futures contracts (ECA analysis based on Quandl data).

33

To restore a better balance between supply and demand, the Commission deferred the auctioning of 900 million allowances from 2014-2016 to 2019-2020 (known as 'back-loading') and established a permanent market stability reserve to store a part of the excess of allowances outside of the carbon market as of 2019.

34

Even with these measures, together with the Commission's legislative proposal[40] for the fourth EU ETS phase (2021-2030), the oversupply of allowances will last at least until around 2030[41].

Effort-sharing decision and proposed regulation

35

The emissions reductions of the sectors not covered by the EU ETS are regulated by the 2009 Effort Sharing Decision (ESD). These sectors include transport (except aviation and international shipping), agriculture and forestry, buildings and waste, as well as industrial sectors not covered by the EU ETS. Emissions from those sectors account for around 55 % of total EU emissions.

36

National emission targets for 2020 have been set on the basis of GDP per capita. The wealthiest Member States are required to reduce their emissions by 20 % by 2020 compared to 2005 levels. Less wealthy Member States are allowed to increase their emissions until 2020[42]. This is because the catch-up in their economic growth is expected to generate higher emissions. However, the Commission has noted that the targets set 'represent a limit on their emissions compared with projected business as usual growth rates. A reduction effort is thus required by all Member States'[43]. Member States are responsible for defining and implementing national policies and measures to limit emissions from the sectors covered by the ESD[44].

37

By 2020, these national targets are expected to contribute half of the EU's 20 % emissions reduction target, the other half coming from the EU ETS sectors. According to the Commission, which monitors compliance, the EU is on track to achieve the reductions from the sectors under the ESD[45].

38

The replacement of the ESD has been under discussion in the European Parliament and Council since 2016. The Commission's proposal includes binding annual greenhouse gas reductions by Member States to reduce emissions of the non-ETS sectors by 30 % by 2030 compared to 2005.

Sources of greenhouse gas emissions: the importance of the energy sector

39

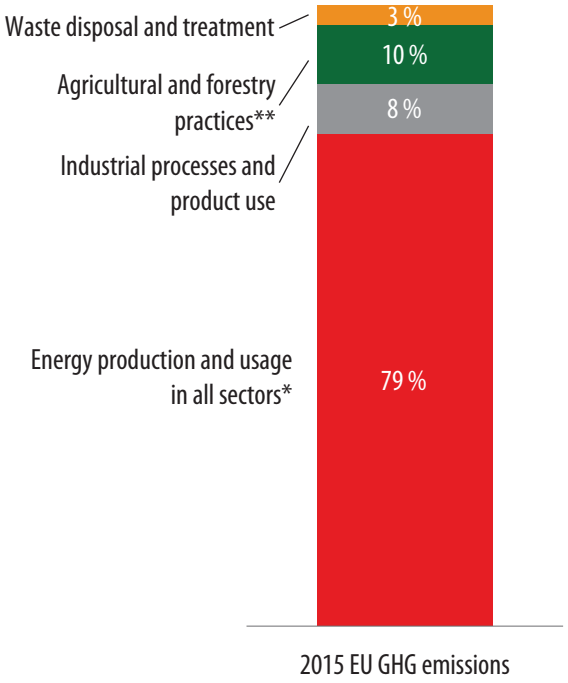
Energy production, mainly from the transformation and combustion of fossil fuels, and energy use by all economic sectors, account for 79 % of EU greenhouse gas emissions (see ***Figure 4***). Other greenhouse gas emissions come from industrial processes other than energy usage (see ***paragraphs 80 to 84***), from agricultural practices (see ***paragraphs 103 to 110***) or from waste management (see ***paragraphs 111 to 113***). These percentages are largely unchanged since 1990.

40

The 79 % accounted for in energy includes the production of electricity and heat generation as well as the burning of fuels in industry, buildings, transport and agriculture. Changes in the way we produce electricity and heat and in the way we use energy in our economy are therefore key to reducing greenhouse gas emissions[46].

Figure 4

2015 EU greenhouse gas emissions by source



* Including energy usage in international shipping and aviation.
** Excluding LULUCF.

Source: EEA greenhouse gas – data viewer, EEA, 2017.

41

Since greenhouse gas emissions are mainly caused by energy production and use, **energy efficiency** can have a significant impact in reducing greenhouse gas emissions. In addition, demand for energy investment and imports decrease and consumers save money. Energy efficiency has been described as the quickest and least costly way of addressing energy security, environmental and economic challenges[47]. This is why the EU has legislated to establish a set of measures across several greenhouse gas emitting sectors[48] and set itself energy efficiency targets for 2020 and 2030.

42

The EU has set itself a non-binding target of 20 % gains in energy efficiency by 2020 compared to projections of future primary energy consumption (see ***paragraph 21***)[49]. Member States decided themselves on their **indicative national energy efficiency targets**, which, in theory, should add up to the 20 % target set for the EU as a whole. However, according to the European Environmental Agency, they would result in a saving of 17.7 % of primary energy consumption by 2020, falling short of the 20 % EU target[50].

43

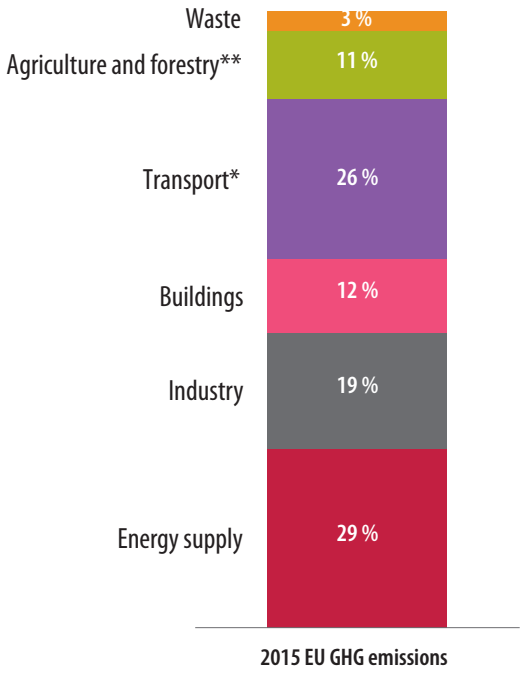
The EU 2030 energy efficiency target is to improve energy efficiency by 'at least 27 % at EU level' compared to projections of future energy consumption, with a review in 2020 'having in mind a 30 % target'. In 2016, the Commission has proposed increasing the target to 30 % and making it binding at EU level[51].

44

All economic sectors, such as industry, transport and agriculture, use energy. Another way to look at greenhouse gas emissions is to analyse emissions by sector (see ***Figure 5***) and not by source (see ***Figure 4***). On this basis, the energy supply sector, mainly electricity and heat production[52], produces 29 % of total emissions, making it the largest single producer of greenhouse gas emissions. It is followed by the transport sector (26 % of emissions), the industrial sector (19 %) and the buildings sector (12 %).

Figure 5

2015 EU greenhouse gas emissions by sector



* Including international shipping and aviation.
** Excluding LULUCF.

Source: EEA greenhouse gas – data viewer, EEA, 2017.

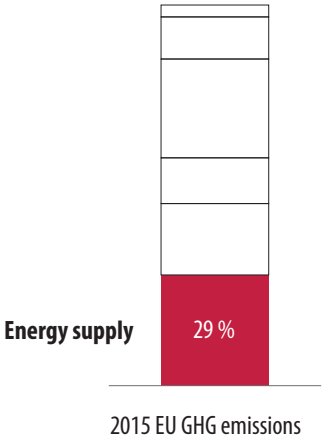
45
The following sections present the EU action taken to reduce greenhouse gas emissions in these sectors. For each sector, the small bar chart on the right-hand side shows how these emissions add up.

Energy supply

Overview of the energy supply sector

46

In 2015, 29 % of greenhouse gases were emitted by the energy supply sector, mainly from the generation of **electricity and heat**. Across the EU, electricity and heat were produced from five main sources: renewable energy, coal, nuclear energy, gas, and oil.



47

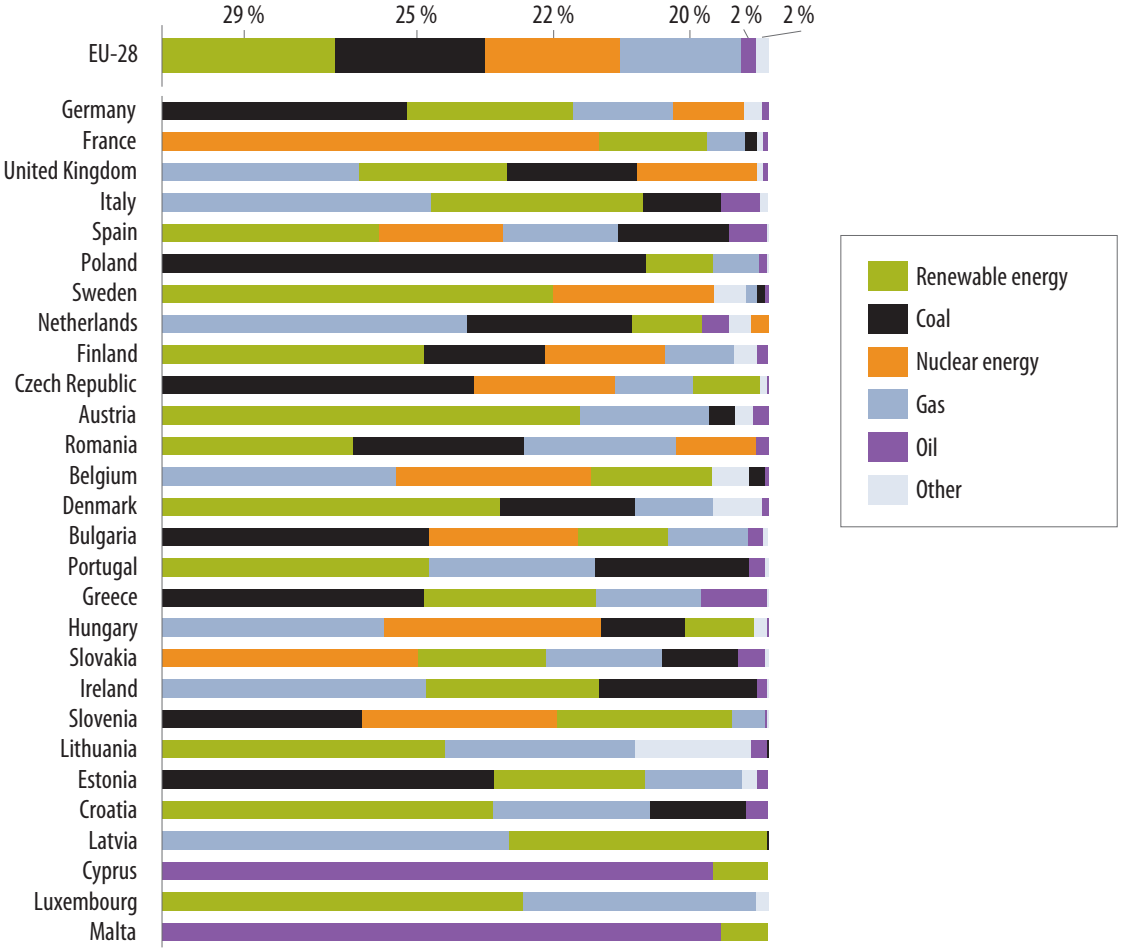
Member States have widely varying energy mixes, which explains why they face different challenges of security of supply and decarbonisation (see ***Figure 6***).

Figure 6

Main sources of electricity and heat generation in the EU and Member States in 2015

(sorted by decreasing amount of electricity and heat generation)

(% of total, based on tonnes of oil equivalent)



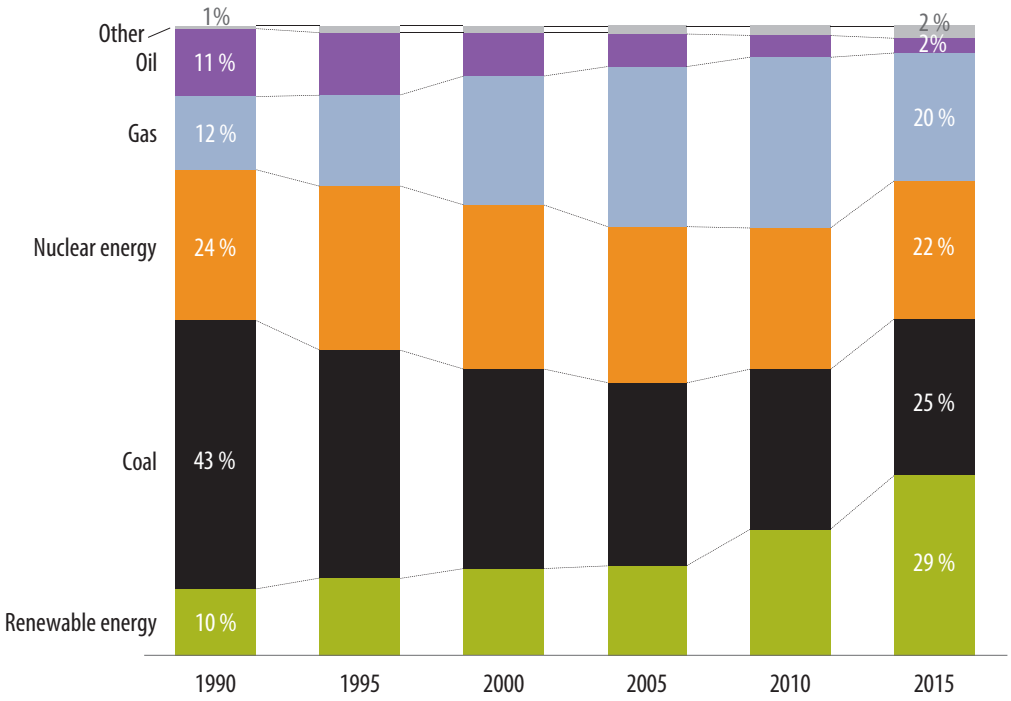
Source: Eurostat, 2017.

48

The last ten years have seen rapid growth in the use of renewable energy for electricity and heat generation across the EU (see ***Figure 7***). The share of gas increased until 2010, and has reduced since that date. The share of nuclear energy remained fairly stable. Coal and oil use declined. This growth in renewables was largely made up of the 387-fold increase in the use of wind energy between 1990 and 2015. In relative terms, the use of solar energy increased most; it increased by more than 7750 times between 1990 and 2015.

Figure 7

Evolution of the EU-28 energy mix for electricity and heat, 1990-2015



Source: Eurostat, 2017.

49

In the EU, **electricity** is generated by renewable sources, nuclear fission or the combustion of fossil fuels. The main renewable sources for electricity are hydropower, wind and solar.

50

The most important source for **heat** generation is gas, followed by coal and renewable sources. The main renewable sources for heat are solid biofuels[53], such as wood pellets, sawdust or dried manure, and renewable waste[54] incineration, such as food waste.

51

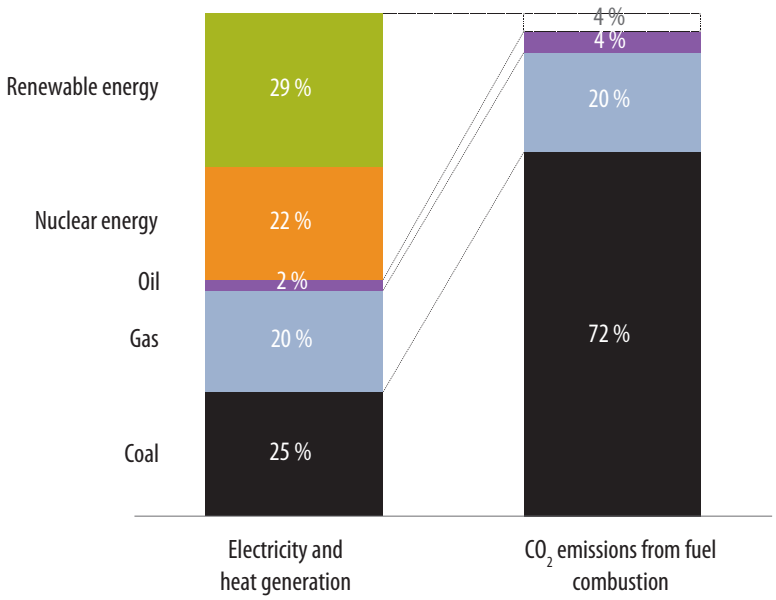
While electricity can be transported over long distances, this is more difficult with heat which, if transported at all, is usually distributed only locally through pipelines of hot water in towns or cities. Therefore, electricity and heat generation have very different production and distribution profiles. Because of these differences, decarbonisation of the electricity and heat sectors face distinct challenges.

52

Energy sources vary widely in how much greenhouse gas emissions they produce (see ***Figure 8***). As a result, changing the energy supply sector towards a decarbonisation of energy generation is vital for reducing emissions. In the following paragraphs, we briefly describe each of these energy sources, starting with those causing most greenhouse gas emissions.

Figure 8

Electricity and heat generated and CO2 emitted by different energy sources across 22 EU Member States* in 2015



* Bulgaria, Croatia, Cyprus, Lithuania, Malta and Romania are not included (data not available).

Source: CO_2 emissions from fuel combustion OECD (2017 preliminary edition), International Energy Agency, 2017; Eurostat; ECA analysis.

Coal

53
In 2015, coal accounted for around 25 % of electricity and heat generation in the EU, down from 90 % in the early 1950s[55]. It remains in widespread use in some Member States because it is cheaper and more readily available than other fossil fuels such as natural gas and oil[56]. It allows Member States which extract and use it to reduce their dependence on imports[57].

54
Coal emits more CO_2 per unit of energy produced than other fossil fuels. In 2015, one quarter of the EU's electricity and heat was produced from coal, but CO_2 emissions from coal made up 72 % of the EU's overall CO_2 emissions from electricity and heat generation (see ***Figure 8***).

Oil and gas

55
Around 22 % of the EU's electricity and heat is generated from oil and natural gas. In 2015, the EU imported 89 % of its oil and 69% of its natural gas[58]. National governments maintain control over reserves of oil and gas on their territory.

56
To limit greenhouse gas emissions from gas and coal, the EU has been supporting the development of carbon capture and storage (CCS) technologies[59]. However, these technologies are currently costly, and only at an early stage of development[60].

Nuclear energy

57
Nuclear power is produced by nuclear fission, a process which emits no greenhouse gases when it generates electricity[61]. In 2015, nuclear energy accounted for 22 % of electricity and heat generation in the EU. It made up 47 % of the EU's low-carbon electricity.

58

In 2017, there are 129 nuclear reactors in operation in 14 EU countries. A further 90 reactors exist which have been shut down; of these, 3 have been completely decommissioned. Over 50 of the EU›s currently operational reactors are estimated to be shut down by the end of 2025. A significant market for decommissioning nuclear plants is therefore developing in Europe[62].

59

According to a Commission report based on Member States' data, the estimated total cost for the management of spent fuel and radioactive waste is about 400 billion euro and approaches for disposal of intermediate level waste, high level waste and spent fuel, such as site selection or development of design, are not specific in most of the Member States[63].

60

Member States have adopted different policies towards nuclear energy. Some Member States, such as the Czech Republic, Hungary and the UK, are planning to build new nuclear power installations, while others are reducing their dependency on nuclear power –for example, in 2011, Germany decided to phase out nuclear energy by 2022 as part of its energy-transition policy, and France has decided to reduce its dependency on nuclear energy.

61

The EU deals with nuclear energy from several angles, some of which fall under the Euratom treaty:

- **nuclear safety** legislation establishes a framework to ensure nuclear safety e.g. of nuclear installations[64] and for the management of radioactive waste and spent fuel[65];
- **nuclear safeguards** legislation ensures that nuclear materials are used only for the purposes declared by their users;
- **nuclear research**, including a major contribution to the International Thermonuclear Experimental Reactor (ITER), aims to demonstrate the future feasibility of nuclear fusion[66] as a viable source of energy;
- **nuclear decommissioning:** the EU provides financial assistance to the decommissioning of eight Soviet-designed first generation nuclear reactors in Lithuania, Bulgaria and Slovakia.

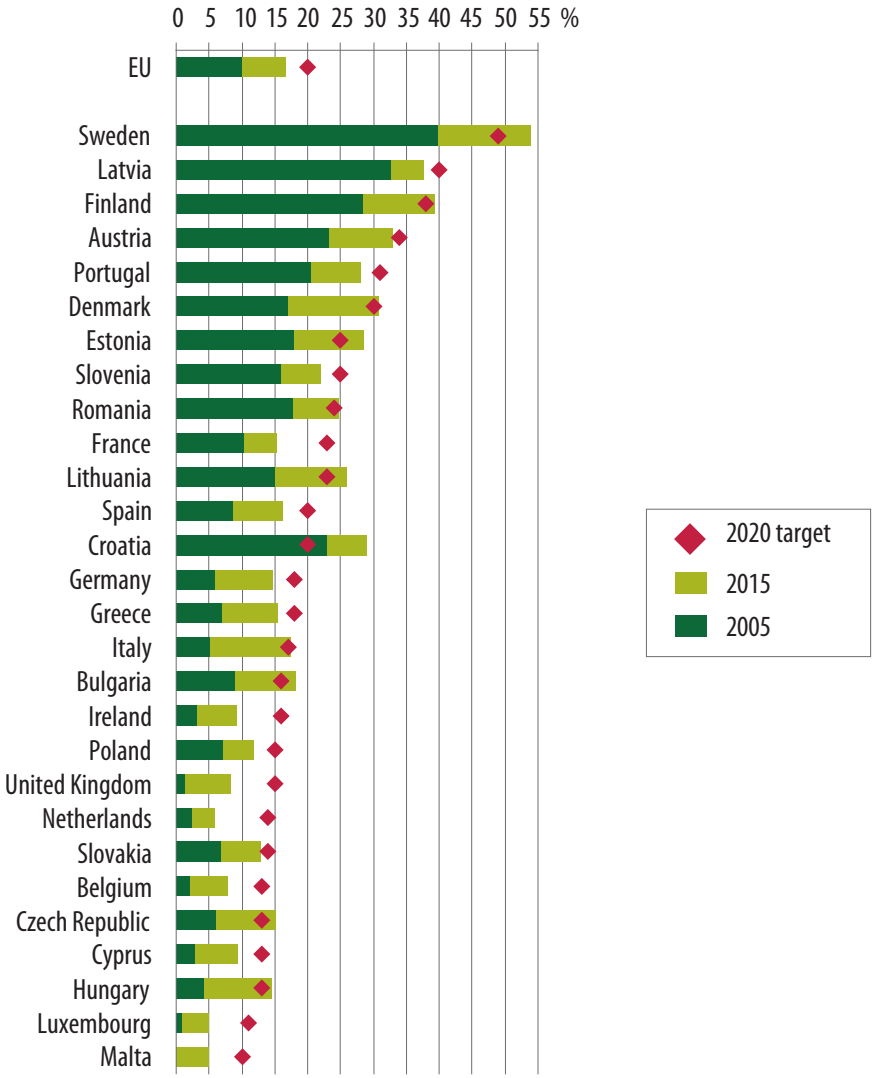
Renewable energy

62

By 2020, **20 % of the EU's final energy consumption** should come from renewables[67] (see ***paragraph 21***). This target includes the use of renewables in all sectors possible, i.e. their use in electricity and heat production but also in transport. ***Figure 9*** shows the binding national targets for all Member States, based on their relative wealth, and the progress made since 2005. In 2015, 16.7 % of EU gross final energy consumption came from renewable sources.

Figure 9

EU and national share of renewable energy in gross final consumption in 2005 and 2015 and 2020 targets (percent)



Source: Adapted from the Second Report on the State of the Energy Union, European Commission, 2017.

63

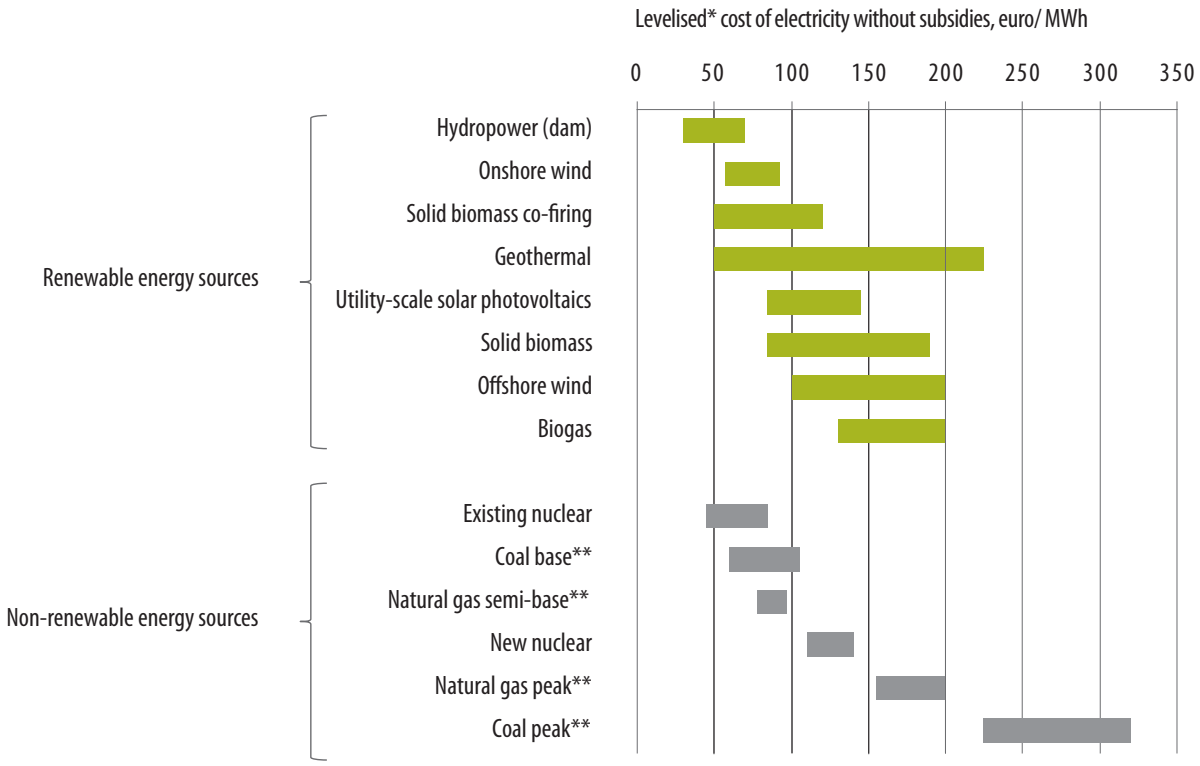
The 2030 target of a 27 % share of renewable energy in final energy consumption does not include targets for individual Member States[68].

64

The worldwide growth of, and investment in, renewable electricity production has led to a significant decrease of the cost of many renewable sources in the last decade. For example, the costs of utility-scale photovoltaics and wind energy respectively fell by 85 % and 65 % between 2009 and 2015[69]. A further decrease is expected[70]. As a result, several renewable energy technologies can now compete with traditional energy sources for producing electricity (see ***Figure 10***).

Figure 10

Competitiveness of renewable versus non-renewable electricity sources



* Method used to compare the cost of energy coming from different sources by taking into account the total cost of ownership of a power plant and the plant production over its lifetime.

** Base load power sources are power stations which can economically generate the electrical power needed to satisfy the minimum demand. Peak power sources are used to meet peak demand, e.g. in mornings or evenings, or when alternative sources are unavailable (e.g. wind farms when wind speed is low or when plants are maintained), but they have higher fuel costs.

Source: Adapted from European Energy Markets Observatory, 2015 and Winter 2015/2016 Dataset – Eighteenth Edition, Capgemini, 2016, p. 37 (BNE, Eurelectric – Capgemini analysis, EEMO18).

Internal energy market and security of supply

65

The internal energy market is the **regulatory and infrastructure set-up** which, once fully established, should allow the free flow and borderless trade of gas and electricity across the EU. It aims to deliver, in a cost-effective way, the EU's energy policy objectives of providing affordable, competitively priced, sustainable and secure energy[71]. It has also the potential to benefit the development of low-carbon energy sources: in an open energy market, renewable energy could flow across borders and be made available on a more permanent basis, where intermittency may previously have been an issue.

66

In order to develop an internal energy market, it is necessary both to establish rules for how the gas and electricity energy markets function and to ensure that there is adequate infrastructure in place for this purpose. The legislative framework for liberalising the national, often state-owned and monopolised, energy markets has been developed progressively (see ***Box 5***). More detailed rules are being laid down in guidelines and network codes[72] setting common technical standards.

Box 5

Development of the three energy packages to implement the internal energy market

Liberalisation of the electricity and gas market started with a **first legislative package** in 1996 for electricity, and in 1998 for gas[73].

The **second legislative package**[74] aimed at enabling new suppliers to enter Member States' electricity and gas markets and consumers to choose their suppliers[75].

After finding that an internal energy market had not emerged yet[76], the EU adopted a comprehensive **third package** in 2009, which includes:

- the unbundling of energy generation from the operation of transmission networks;
- new provisions to ensure independence of national regulators;
- the set-up of the Agency for the Cooperation of Energy Regulators (ACER), an EU agency to foster cooperation among European energy regulators[77];
- the creation of the European Networks for Transmission System Operators for Electricity (ENTSO-E) and European Networks for Transmission System Operators for Gas (ENTSO-G) to improve cross-border cooperation;
- the preparation of Ten-Year Network Development Plans (TYNPDs) by ENTSO-E and ENTSO-G to increase information on investments in electricity and gas transmission systems.

In 2016, the Commission published a package of legislative and non-legislative initiatives - the Clean Energy for All Europeans Package.

67

Member States are responsible for implementing the legislation and guidelines. The Commission monitors this implementation and has the power to open infringement procedures, which can lead to a case being filed before the European Court of Justice.

68

The plan was to complete the internal energy market by 2014[78]. Despite significant progress in some regions of the EU, the internal energy market has not yet been achieved[79]. Recognising this, the Commission issued a 'Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy' in 2015[80] (see ***paragraph 5***) and, in 2016, a package of legislative and non-legislative initiatives – the Clean Energy for All Europeans Package[81]. Both, the Energy Union Strategy and the 2016 Package do not only concern the development of the internal energy market but bring together several strands of policy – these are dealt with in the relevant sections of this landscape review.

69

The development of internal electricity and natural gas markets is the basis for **securing energy supply**[82] cost-effectively as they open up the possibilities for greater supply diversification by creating flexible trading within and between Member States. EU legislation on electricity and gas supply disruption is being updated. Proposals include shifting from a national to a regional, cross-border approach when dealing with supply disruptions[83].

70

Suitable infrastructure is just as necessary as market structures and effective regulation for the functioning of the internal energy market and the increase of security of supply. This includes infrastructure between and within Member States. The EU set an objective for the capacity of cross-border electricity[84] interconnections to be at least 10 % of the installed electricity production capacity in any given Member State[85] by 2020 and to be at least 15 % by 2030[86]. Interconnectors can facilitate the coupling of national energy markets, which should improve security of supply and decrease energy prices. The EU supports the development of cross-border infrastructure, for example by requiring streamlined permit granting procedures, by facilitating cost allocation between different Member States, and by partially funding selected infrastructure projects[87].

71

A 2017 Commission evaluation concludes that progress has been made, but highlights several remaining issues regarding the implementation of the internal energy market, such as the following[88]:

- Bottlenecks still exist due to missing or underused infrastructure in electricity and gas. For example, electricity interconnections and, where relevant, internal lines still need to be improved in south-western Europe, such as Spain and France, and in northern and eastern European countries such as Germany, Poland and the Czech Republic;

- National wholesale gas prices converged between 2013 and 2015, while price differences in the wholesale electricity market remained significant[89].

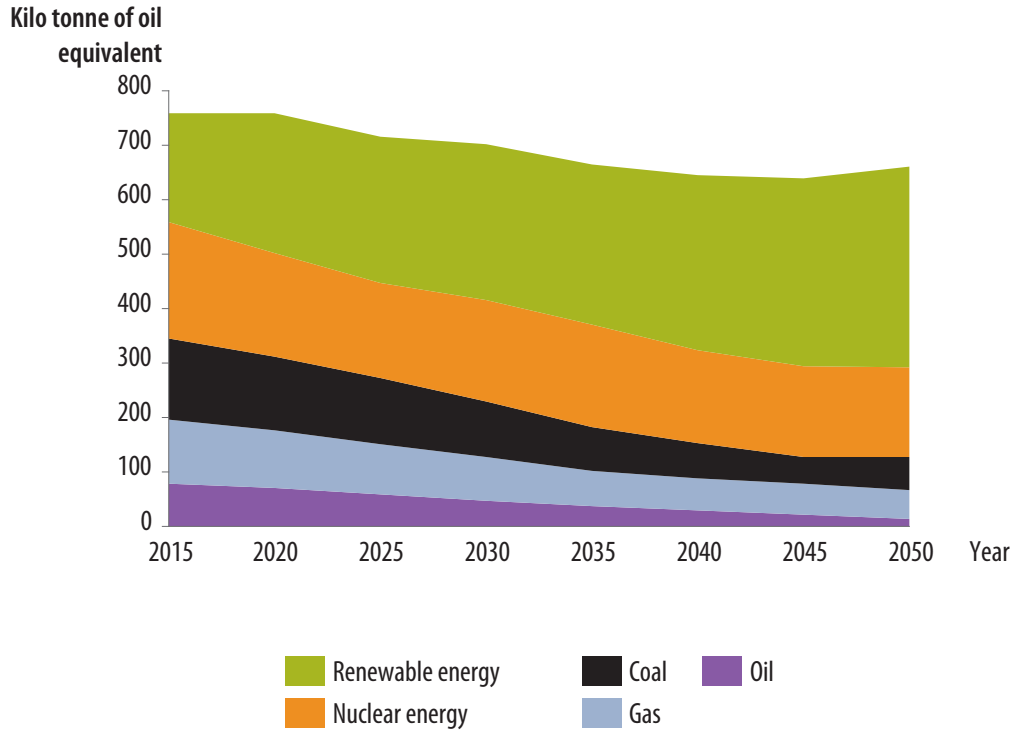
Transition to a low-carbon energy production

72

The transition to a low-carbon energy supply sector requires significant further changes in energy production[90]. Under the current policy framework[91], the energy mix of the future is projected to change (see ***Figure 11***), with a strong decline in EU domestic production for all fossil fuels (coal[92], oil and gas) and a move towards renewable energy. Additional renewable energy generation capacity is therefore needed.

Figure 11

Projection of EU energy production by fuel type



Source: European Commission, EU Reference Scenario 2016, 2016 (simulation of PRIMES model).

73

The growth in renewable energy sources will need to happen mostly in the electricity sector, since the potential for greater use of renewable sources for heat is currently more limited[93]. The profound transformation of the energy system poses several challenges. First, increasing and integrating certain **intermittent forms of renewables**, mostly wind and solar, in an electricity system, where supply and demand have to be constantly balanced and storage solutions are currently limited, poses **technical challenges**. Another challenge is the decentralisation of energy production, mostly renewables, in an electricity network and market built around a clear separation of producers, distributors and consumers[94].

74

In addition, **falling wholesale prices and generation overcapacity** create little incentive to invest in new capacities and networks. Further investments will need to be made in renewable generation, but current legislation 'does not ensure sufficient incentives for private investments in the new generation capacities and network'[95].

75

If government intervention in the electricity market is not carefully designed, however well intentioned, it can further distort the functioning of the energy market and may lead to higher costs, or unfair competition. Similar to other sectors, such **state aid** is therefore only permitted under certain circumstances within the EU, and Member States must comply with the guidelines on state aid issued by the Commission, especially in the renewable energy sector where the level of public support remains significant. From 2017, an open, competitive, bidding process to grant any aid to renewable energy infrastructure has been required[96].

76

To compensate for the intermittency of renewables, and since electricity storage[97] or demand management[98] solutions are not widespread yet, Member States maintain some conventional electricity production capacity to prevent possible electricity shortages when, for example, demand is high, but wind and sun are scarce. Electricity suppliers can be offered payments to keep means of non-intermittent electricity production (such as coal or gas generation facilities) available. These payments, known as '**capacity mechanisms**', are liable to distort competition if they are not designed properly[99].

77

EU energy companies have acknowledged that electricity produced from coal emits more greenhouse gas emissions than electricity produced from other sources (see ***paragraph 54***). In April 2017, electricity utilities from all Member States – except Poland and Greece – committed not to invest in new-build coal-fired power plants after 2020[100] in order to contribute to providing 'clean energy to Europeans'. The United Kingdom has also announced its intention to close all coal-fired power plants by 2025 and to fill the capacity gap mainly with new gas and nuclear power plants.

78

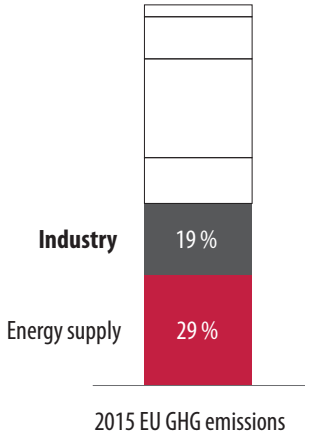
The closure of nuclear (see ***paragraph 58***) and coal power stations and coal mines, often significant regional employers, can create **social challenges**. The Commission[101] is considering how best to support structural transition in coal and carbon-intensive regions, in compliance with state aid rules, for example, by providing guidance on how to use existing funds and exchanging best practices[102].

79

To address many of these challenges, the Commission has proposed a range of legislative and non-legislative measures in November 2016. Ongoing discussions in Parliament and Council cover, for example, rules to further strengthen the internal energy market[103] including more regional cooperation between Member States; for the first time at EU level, some aspects of storage of electricity[104]; and the preparation of integrated national energy and climate plans intended to improve EU energy and climate governance[105].

Industry

80
Direct emissions from industry accounted for 19 % of EU greenhouse gas emissions in 2015. Indirect emissions due to electricity and heat usage are accounted for in the 'energy supply' category.



81
Around half of the industrial sector's emissions are caused by the burning of fuels. The remainder are emitted in industrial processes, such as during the production of cement, and in product use.

82
Large and energy-intensive industrial installations are included in the EU ETS, which is the main framework for the EU's mitigation action for this sector (see ***paragraph 27***). Around two thirds of industrial greenhouse gas emissions are covered by the EU ETS. The rest is covered by effort-sharing (see ***paragraphs 35 to 38***). Under the EU ETS, companies have to take into account the carbon price and, in theory, are thus incentivised to reduce their emissions. In practice, substantial free allowances are given to sectors exposed to international competition. The level of free allowances is set to slowly reduce over time as global climate action reduces 'carbon leakage' risks (see ***paragraph 30***).

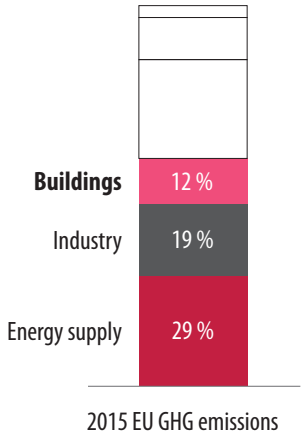
83
Emissions from industry are also influenced by EU action in other areas, such as energy efficiency measures[106] and air quality standards[107]. For example, large companies are required to carry out energy audits, at least every four years, to identify ways to reduce their energy consumption[108]. The Industrial Emissions Directive, setting emission limits for non-greenhouse gas emissions and minimal technology standards for installations, has also indirectly contributed to CO_2 reductions[109].

84
Emissions from product use consist mainly of fluorinated gases. These were introduced to replace the ozone-depleting chlorofluorocarbons used in many industrial and consumer applications such as refrigerators and air conditioners. Today, fluorinated gases account for around 2.7 % of total EU greenhouse gas emissions; emissions of these gases rose by 66% between 1990 and 2015. Since these gases have a high global warming potential[110], the EU has legislated to set an objective of reducing their emissions to two thirds of 2014 levels by 2030.

Buildings

85

On-site energy generation and the burning of fuels for heat or cooking in buildings account for 12 % of total EU greenhouse gas emissions. In addition, buildings consume electricity; for example, for lights, IT, heating and, increasingly, cooling. The greenhouse gas emissions arising from this are accounted for in the energy supply sector. In total, buildings consume 40 % of total energy in the EU[111].



86

Around 75 % of the buildings in the EU are not energy efficient[112]. The EU has therefore introduced several measures to achieve energy savings in buildings, such as a common certification of buildings' energy consumption[113], targets for the renovation of public buildings[114] and a 'nearly zero-energy building' standard, obligatory for new public buildings as of 2019, and for all buildings constructed as of 2021[112]. Investments in the energy efficiency of buildings face certain barriers, such as split incentives between the owners and tenants of buildings, large upfront costs and often long payback periods. In 2016, the Commission proposed a revision of its legislation on buildings[115].

87

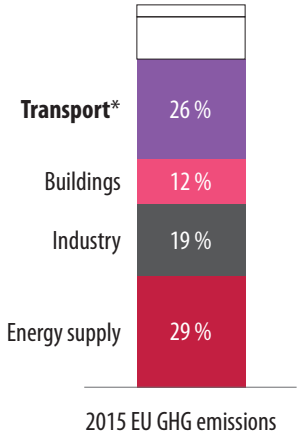
Apart from energy efficiency of buildings, EU action has focused on **energy-efficient domestic products**[116]. In cooperation with the Member States[117], the Commission has developed minimum mandatory energy consumption requirements for certain products[118] and introduced mandatory labelling to inform consumers[119]. According to the Commission, these product efficiency policies are expected to save the EU around the equivalent of the annual primary energy consumption of Italy and deliver almost half of the 20 % energy efficiency target by 2020[120].

Transport

The sector and its CO_2 emissions

88

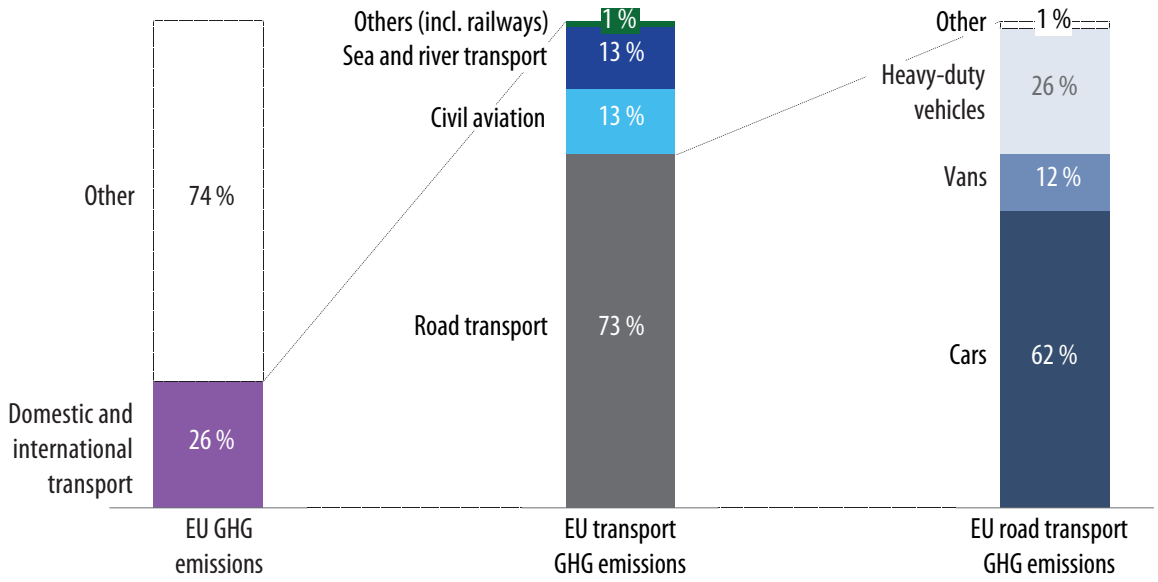
The transport sector currently accounts for 26 % of the EU's greenhouse gas emissions[121]. Around three-quarters of transport emissions come from road transport, and especially from cars (see ***Figure 12***).



* Including international navigation and aviation.

Figure 12

EU greenhouse gas emissions in the transport sector in 2015



Source: EEA greenhouse gas – data viewer, EEA, 2017; ECA analysis.

89
Emissions from other sectors have generally been declining since 1990, but emissions from the transport sector have not: significantly more greenhouse gases are currently being emitted than in 1990 and, after a declining trend between 2007 and 2013, the trend rose again in 2014 and 2015 due to higher transport demand linked to the economic recovery.

Road transport

90
The EU has set CO_2 emissions standards for cars and vans sold in the EU (see ***Box 6***). New cars have to carry labels with details of their CO_2 emissions[122].

Box 6

CO_2 emission limits for cars

The EU has set gradually decreasing targets for the fleet-average CO_2 emissions of the cars and vans produced by any given manufacturer[123]. By the end of 2020, emissions of new cars must not exceed 95 grams per kilometre: this is 40 % lower than the 2007 average emissions. For vans, the 2020 target is 147 grams of CO_2 per kilometre, 19 % less than the 2012 average emissions. These targets have been achieved earlier than anticipated.

However, the current testing procedure used to establish the emissions of their car fleet and monitor the progress towards the targets underestimates real-world emissions by around one third[124]. A new procedure will be used as of September 2017[125].

91
Heavy-duty vehicles (HDVs) such as lorries, buses and coaches accounted for 14 % of all vehicles on the EU's roads in 2015, and produced around 26 % of CO_2 emissions from road transport in the EU: 4 % of the EU's total greenhouse gas emissions[126]. Unlike cars and vans, HDVs are not subject to any CO_2 emissions standards. The 2014 EU strategy[127] aims to identify ways of monitoring the emissions HDVs produce[128], not ways of reducing them. The Commission[129] considers this strategy to be an essential first step towards future action. As a result, the Commission proposed new legislation for the monitoring and reporting of CO_2 emissions from new HDVs placed on the EU market[130].

Aviation, maritime and river transport and multimodal transport

92

Aviation accounted for 3.4 % of the EU's greenhouse gas emissions in 2015. Around 3.1 % of these emissions were caused by flights between EEA[131] and non-EEA countries; the rest were caused by flights within the EEA. By 2020, global international aviation emissions are projected to be around 70 % higher than in 2005. By 2050, it is forecast that they could increase again by up to seven times their 2005 levels[132].

93

Emissions from flights within the EEA are covered since 2012 by the EU ETS (see ***paragraph 27***). Flights between EEA countries and non-EEA countries are covered by an agreement reached under the International Civil Aviation Organisation (ICAO) in October 2016, according to which large airline companies[133] will have to compensate part of their emissions by acquiring international carbon credits[134]. Participation in this scheme will become mandatory in 2027. The ICAO has also introduced a standard to certify CO_2 emissions for aircraft.

94

Maritime and inland waterways transport accounted for 3.3 % of the EU's greenhouse gas emissions in 2015, most of which comes from international shipping, i.e. shipping between EU and non-EU ports[135]. International maritime transport accounts for about 2.1 % of global greenhouse gas emissions and a further increase in the range of 50 to 250 % by 2050 is projected[136]. These emissions are not accounted for in the EU's reduction targets and are not currently internationally regulated.

95

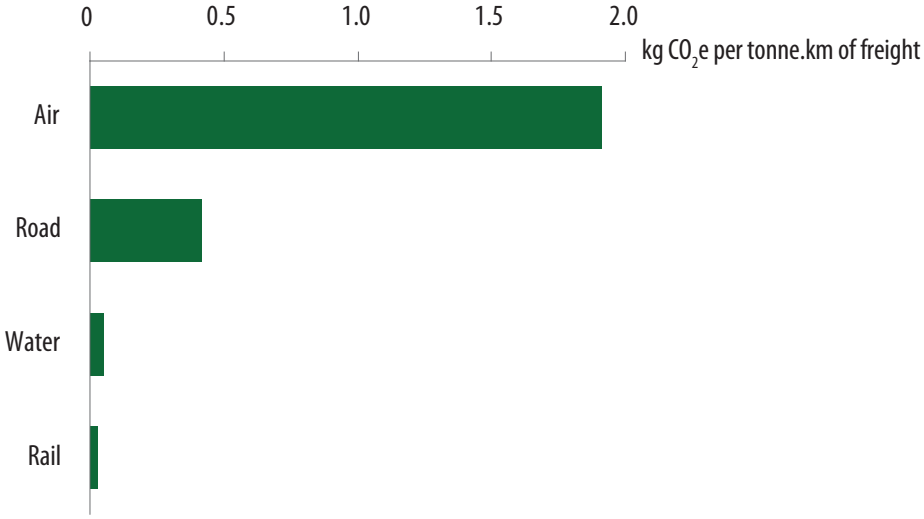
While the fuel consumption of ships is known, reporting and verification processes are still missing[137]. To tackle this problem, and to provide scope for potential emission reduction measures later, the EU has introduced a system for the monitoring, reporting and verification of greenhouse gases emitted by ships[138]. In parallel, the EU has also worked together with the International Maritime Organization (IMO), which reached a global agreement on a Monitoring, Reporting and Verifying scheme for shipping greenhouse gases in 2016[139].

96

Water and rail transport emit significantly less greenhouse gases per passenger or per tonne of freight than air and road transport (see ***Figure 13***). Therefore, using water and rail transport in combination with air and road transport can also help reduce transport greenhouse gas emissions. The EU supports the combination of transport modes through measures to eliminate restrictions[140] and through funding measures[141]. However, in 2015, 76 % of freight was still transported by road[142] (see also ***paragraph 173***).

Figure 13

Average CO_2e emissions conversion factors for freight transport, 2016



Source: ECA, based on: Greenhouse gas reporting - Conversion factors 2016, Department for Business, Energy & Industrial Strategy, United Kingdom, 2016.

Renewable fuels

97

The EU has also taken steps to reduce the emissions caused by all types of transport by encouraging the use of renewable fuels, mainly biofuels and electricity. By 2020, 10 % of all energy used in transport must come from renewable sources[143]. The EU also encourages the use of other forms of low-emissions alternative fuels, such as hydrogen and liquefied petroleum gas (LPG); it has set common standards for alternative-fuels infrastructure, such as recharging and refuelling stations, and requires Member States to develop an infrastructure policy[144].

98

Biofuels[145] account for around 70% of the renewable energy used in transport[146]. They are produced from biomass, such as biodegradable agricultural or forestry products, or from domestic or industrial waste. In principle, biofuels have the potential to emit less greenhouse gases than fossil fuels, because the amount of CO_2 emitted during the combustion of the biofuel was captured from the atmosphere when the source materials were being grown, and the oil which would have otherwise been burnt is still in the ground.

99

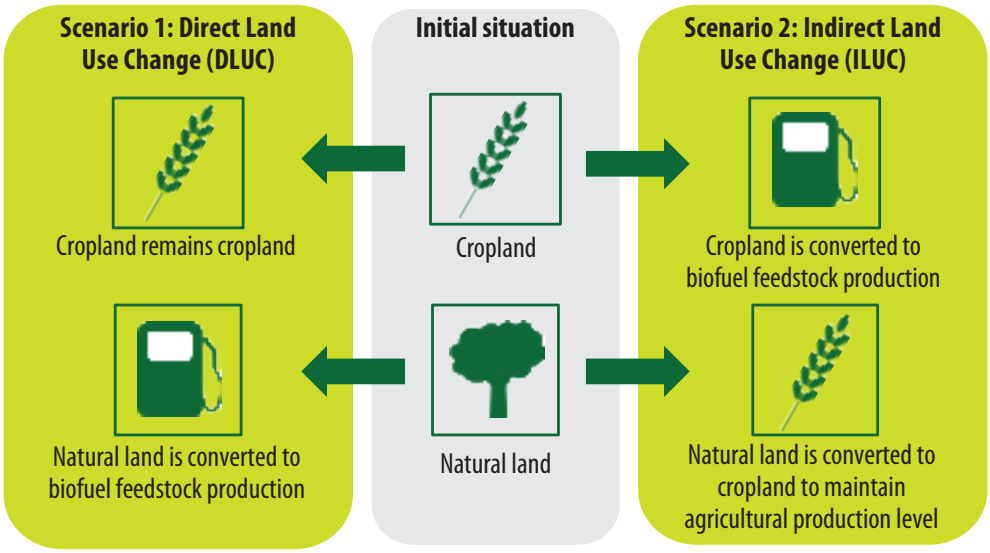
At the beginning of the 2000s, high crude-oil prices generated a renewed interest in biofuels. Biofuels were expected to decrease the dependency of oil-importing countries, generate new export opportunities for developing countries and contribute to reducing greenhouse gas emissions[147]. For these reasons, the EU set a minimum requirement for the share of renewable sources in transport (see ***paragraph 97***). This triggered investments in biofuel production capacity. However, biofuels are only effective in reducing greenhouse gas emissions if the emissions avoided by not burning fossil fuels are not cancelled out by greenhouse gas emissions during their full production lifecycle, during the cultivation, transportation and transformation of biofuels feedstock, or by changes in land use. For example, if a forested area is cleared to make space for biofuel production, the carbon storage capacity of the forest is lost.

100

Such **land-use change** can be **direct** or **indirect**. For example, if a forest is cleared to make space for cultivation of biofuels feedstock, the land-use change is direct (DLUC). If existing agricultural land is given over to biofuel cultivation, all else being equal, there would be a reduction in food production. This could thus make it necessary to clear more forest to make space for food production: In this case, the land-use change is described as indirect (ILUC - see ***Figure 14***).

Figure 14

Direct and indirect land-use change



Source: ECA.

101

The concerns regarding land-use change to cultivate biofuels and the resulting legislative debate limited the development of biofuels[148]. In 2013, biofuel consumption suffered from its first drop since the implementation of the first biofuels directive in 2003. The debate prompted the EU to set out **sustainability criteria** which biofuels must fulfil in order to be counted towards the 10 % renewable fuels target for transport. For example, biofuels grown on cleared land previously occupied by wetlands or forests are excluded. However, the criteria do not cover indirect land-use change, even though the carbon-storage capacity of the cleared forest is lost in both cases if the agricultural land surface has to remain unchanged. This is due to the fact that ILUC emissions cannot be directly observed and can only be modelled. To take these indirect effects into account, the share of biofuels from food crops that can be counted towards the 10 % target is capped[149].

102

Biofuels produced directly from food or feed crops are known as **first-generation** or **conventional biofuels**. Biofuels produced from waste, agricultural residues, non-food crops and algae are known as **advanced biofuels**. Advanced biofuels do not compete directly with food and feed crops for land. Biofuels from waste, such as used cooking oil, are already commercially available. Some other production processes of advanced biofuels, such as using straw residues, are at an early stage of development[150].

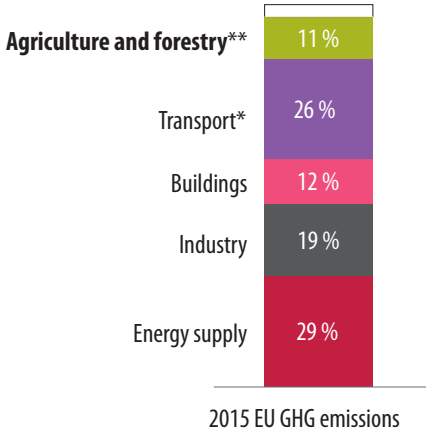
Agriculture and forestry

103

The EU agriculture sector accounted for 11 % of greenhouse gas emissions in 2015. Emissions from agriculture decreased by 20 % between 1990 and 2013, for example due to a reduction in cattle numbers and improvements in farm-management practices[151]. Since 2014, agriculture emissions have risen again.

104

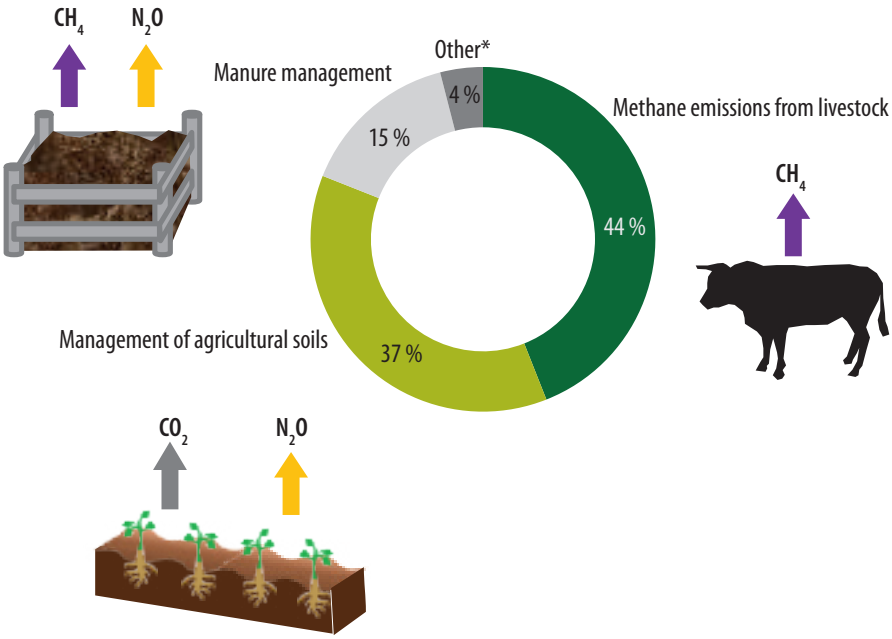
Agricultural greenhouse gas emissions are mainly nitrous oxide and methane, both of which are more potent greenhouse gases than CO_2[152]. Emissions come mainly from the digestion process of livestock and agricultural soil management (see ***Figure 15***).



* Including international navigation and aviation.
** Excluding LULUCF.

Figure 15

Agriculture greenhouse gas emissions by source, 2015



* 'Other' includes: liming, urea application, rice cultivation, field burning of agricultural residues, other carbon-containing fertilisers.

Source: EEA greenhouse gas – data viewer, EEA, 2017.

105

The EU regulates the agricultural sector mainly by means of the Common Agricultural Policy (CAP). Forestry policy remains a Member State competence, although some funding for forestry measures is available under the CAP. All recipients of direct payments under the CAP must comply with cross-compliance rules[153]. Some of these rules benefit the environment and also target climate change, for example by promoting the maintenance of organic matter in soil. Farmers receive additional payments – 'greening payments' – if they fulfil voluntary commitments which contribute to environmental and climate objectives[154].

106

The CAP also funds rural development measures, some of which target climate change, including investments in renewable energy or forestry measures to support carbon storage.

107

Solutions for reducing emissions in the agricultural sector exist, such as more efficient use of fertilisers or different cattle breeding practices[155]. However, there is an often-unchallenged premise that such solutions are more costly than mitigation actions in other sectors[156]. According to the Commission, only a relatively limited contribution to emission reductions can realistically be expected from the agricultural sector[157]. It has suggested integrating a part of the carbon storage potential of soils and vegetation in the Effort Sharing Regulation for 2030 (see ***paragraph 38***).

108

In climate policy, the concept of **LULUCF (Land Use, Land-Use Change and Forestry)** has been developed to take account of the storage and emission potential of this land-based sector (see ***Box 7***). In 2015, the LULUCF sector absorbed enough CO_2 to offset around **7 % of the EU's total greenhouse gas emissions**; in other words, it absorbed enough CO_2 to offset the total amount of greenhouse gases emitted by Spain. But, since 2008, the sector's storage capacity has been reduced as a result of factors such as the ageing of forests.

Box 7

Natural absorption of greenhouse gases by land, ocean and air

Land currently sequesters, or stores, around a third of annual global CO_2 gross emissions; oceans sequester a similar amount. The remainder is accumulated in the atmosphere. Forest and grassland growth, for example, leads to the accumulation of carbon in branches, leaves, roots and soil. This carbon is converted back into greenhouse gases when plants burn, die and decompose, or when they are used as fuel.

109

Up to now, the LULUCF sector's ability to store greenhouse gases has not been taken into account in the calculations of progress towards the EU's 2020 greenhouse gas emissions reduction targets. This is partly because the sector's effects on greenhouse gas emissions are much more difficult to assess than the effects of other sectors. At the same time, the sector's storage capacity is influenced by decisions taken in other sectors. For example, the increasing use of biomass to produce renewable energy, while reducing emissions in the energy supply sector, could bring about a reduction in carbon storage capacity (see ***paragraph 100***).

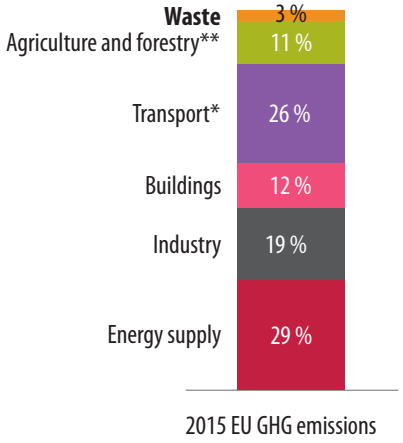
110

As a first step towards including LULUCF activities in its CO_2 reduction commitment, the EU has drawn up accounting rules, based on the UN rules for the Kyoto Protocol reporting[158]. In July 2016, the Commission proposed how the sector could be counted towards the 2030 greenhouse gas emissions reduction targets[159]. This would mean that emissions of other sectors could be offset by the storage capacity of LULUCF, up to certain limits[160]. The use of this flexibility mechanism 'could potentially cover an underachievement of the ESR target in 2030 of roughly two percentage points'[161].

Waste and the circular economy

111
The remainder of the EU's greenhouse gas emissions come from waste, which accounts for 3 % of the EU's total greenhouse gas emissions. Emissions from waste decreased by 42 % between 1990 and 2015.

112
The EU's action on waste, mostly through legislation, includes reducing greenhouse gas emissions directly by reducing emissions from landfill[162] and indirectly by preventing waste and by recycling materials which would otherwise have been extracted and processed. As a result, better waste management avoids emissions in other sectors of the economy, such as energy supply, agriculture, manufacturing and transport. For example, waste recycling in France saved the equivalent of 5 % of national greenhouse gas emissions in 2014[163].



* Including international navigation and aviation.
** Excluding LULUCF.

113
One concept supporting prevention and recycling of waste is the 'circular economy'[164]. For example, the design of a product can be altered to facilitate product reuse or recycling, by selecting different materials, standardising components and ensuring easy, end-of-life separation.

Adaptation

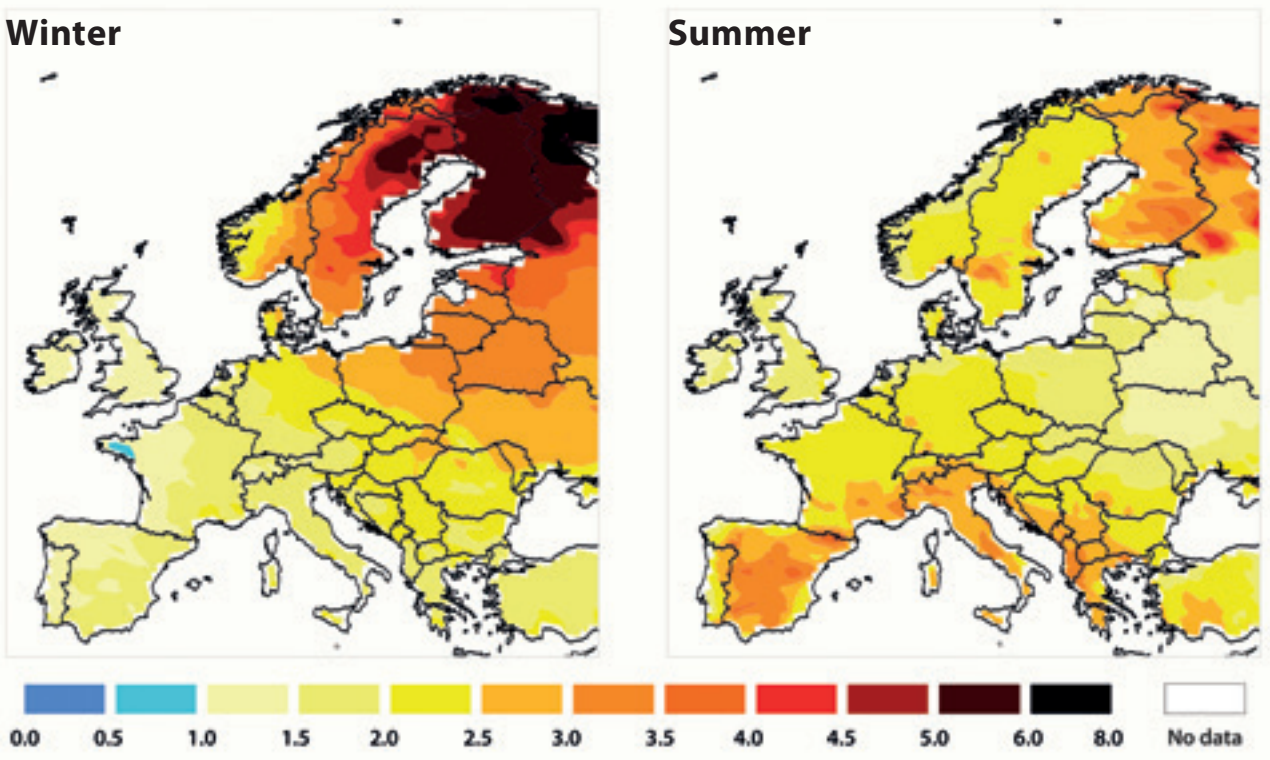
Expected changes in temperature and rainfall

114

Adaptation to climate change is 'the process of adjustment to actual or expected climate and its effects'[165]. On average, in 2016, the world was already 1.1°C warmer than in the pre-industrial period. Even if the objective of the Paris Agreement – keeping the global temperature rise this century well below 2°C – is achieved, adaptation to climate change is necessary. The 2°C increase scenario is a global average: even if it is achieved, temperatures will increase by far more than 2°C in certain regions (see ***Figure 16***). During the winter, temperatures could increase by an average of 5 to 8°C in some parts of Scandinavia. In the summer, temperatures could increase by an average of 3 to 4°C in most of Spain and in northern Scandinavia[166].

Figure 16

Seasonal temperature change, in °C, for 2071-2100, compared with 1961-1990 (2°C global increase scenario)



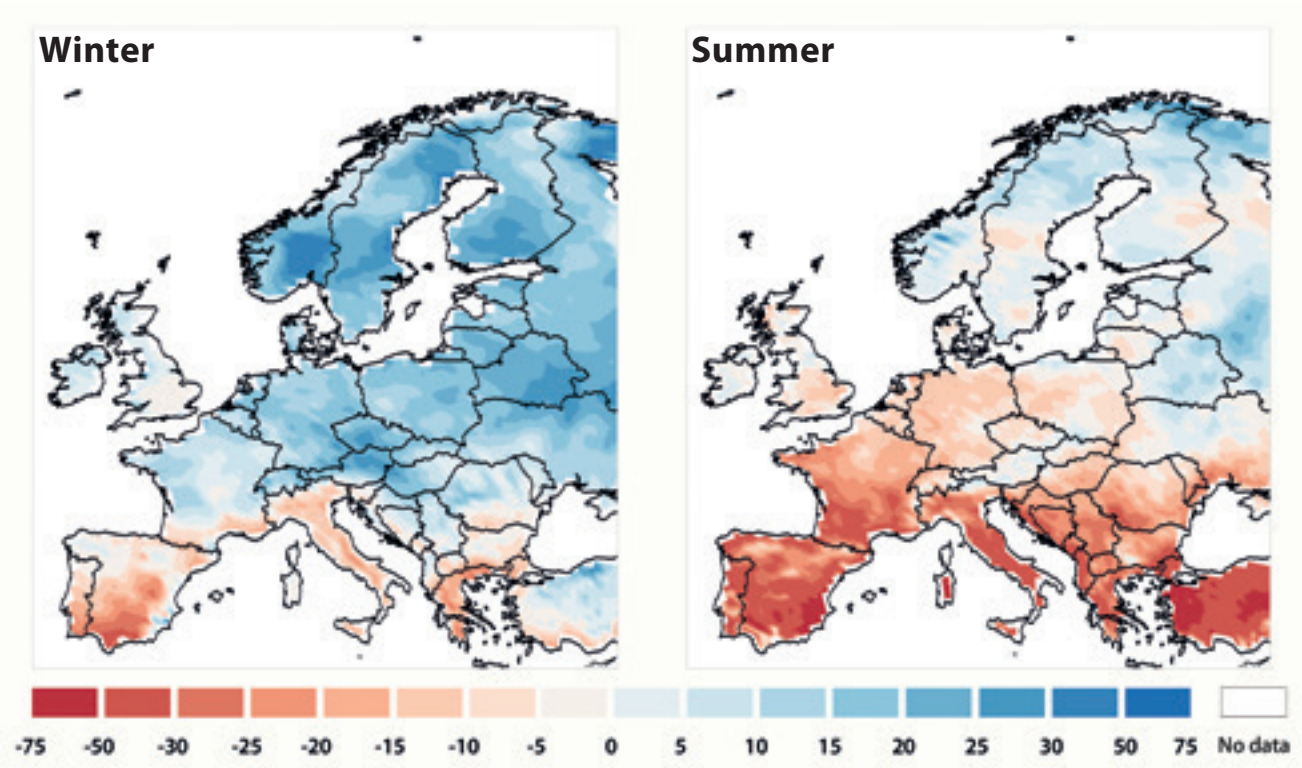
Source: Adapted from Climate Impacts in Europe, the JRC PESETA II project, 2014. Data from Dosio and Paruolo 2011 and Dosio et al 2012[167].

115

Changes in rain and snow patterns could also be significant (see ***Figure 17***). Winter precipitation could increase by more than 25 % in some parts of central Europe and Scandinavia. Summer precipitation levels could decrease by more than 50 % on much of the EU's Mediterranean coast.

Figure 17

Change in seasonal precipitation, in %, for 2071-2100, compared with 1961-1990 (2°C global increase scenario)



Source: Climate Impacts in Europe, the JRC PESETA II project, 2014. Data from Dosio and Paruolo 2011 and Dosio et al 2012[167].

116

These changes in precipitation levels will increase the risk of **flooding and soil erosion** in many parts of Europe. The annual number of floods requiring insurance pay-outs has tripled since 1980 (10 in 1980 to 38 in 2015 and 29 in 2016)[168]. An increase in the global mean sea level will result in more frequent and severe floods in coastal areas. Storms will become more destructive[169].

117

Soil erosion, combined with water shortages and higher temperatures which increase evaporation, increases the risk of **desertification.** Studies indicate that up to 44% of Spain, 33 % of Portugal, and nearly 20 % of Greece and Italy are at high risk of erosion[170]. These Member States will suffer from increased temperature and lower precipitation (see ***Figure 16*** and ***Figure 17***). Twelve EU Member States have declared that they are affected by desertification[171].

Impact of climate change on society

118

Climate change will also have wide-ranging societal consequences: for example, consequences for **human health**. Severe health risks and deaths may arise from extreme weather events such as storms and floods, periods of extreme heat or cold, or more widespread diseases. For example, from 1980 to 2013, two-thirds of all fatalities resulting from natural phenomena in the EU were caused by heatwaves[172].

119

Climate change will also impact key **economic sectors** and does so already[173]. **Agriculture** will be affected by water availability, temperature, new pests and invasive species. While yields could increase in northern areas, production in southern areas could decrease by 30 %[174]. Impacts on the marine environment will affect the **fishing industry**[175]. The **forestry sector** will see shifts in the range of tree species, an increase in the risk of forest fires and an increase in the prevalence of insect pests. Shorter snow seasons or drought and heatwaves will affect **tourism**.

120

Economic activity, and therefore **jobs**, could shift between economic sectors. While net effects remain uncertain, job opportunities could be created in areas such as reinforcing or constructing flood and coastal defences and in renewable energy[176].

121

Patterns in **energy demand** will change: there will be less demand for energy for heating in winter, and more demand for energy for cooling in summer. Energy-production capacity could be restricted, for example, due to lower hydropower or nuclear plant cooling capacity.

122

Extreme weather events, such as floods, drought and storms, and gradual changes, such as sea level rises, could cause more people to **migrate both within Europe and into Europe**[177]. For example, several reports[178] have suggested that a recent three-year drought in Syria was a contributory factor to the outbreak of the Syrian civil war. There is a risk of a lack of preparation for migration caused by climate change[179].

EU and national adaptation strategies

123

Since the impacts of climate change vary significantly between the EU's regions and even within Member States, it is likely that most adaptation initiatives will be taken at regional or local level. However, some impacts of climate change transcend the borders of individual Member States – a river basin flooded as a result of climate change, for example, could encompass the territory of more than one country.

124

Compared to early action in mitigation, the basis for EU action in the area of adaptation, the EU's strategy on adaptation to climate change, was adopted only in 2013[180]. It encourages Member States and cities to take action, rather than mandating it. For example, it states that Member States should adopt **a national adaptation strategy by 2017** and start implementing it by 2020. Certain cities launched a voluntary commitment based on the Covenant of Mayors initiative. The Commission offers support, for example, through its European Climate Adaptation Platform, Climate-ADAPT, which allows users to access and share data, good practices and information on expected climate change in Europe.

125

The Commission is monitoring and assessing the national adaption strategies and will consider proposing a legally binding instrument in 2017 if Member States' actions are deemed to be insufficient[181]. By April 2017, 22 Member States had adopted a national adaptation strategy[182].

126

Adaptation is also addressed, to varying extents, in EU sectoral legislation. For example, the Water Framework Directive[183] concerns water quality and quantity aspects, so it indirectly focuses on drought issues; the Floods Directive[184] deals with floods prevention; the Birds Directive[185] and the Habitats Directive[186], amongst others, address biodiversity protection.

Supporting EU action on energy and climate policies

127

Three key, cross-cutting themes support the EU's action in energy and climate policies:

- research and innovation;
- financing; and
- evidence-based policy-making and implementation.

Research and innovation

128

Achieving energy and climate change targets worldwide, and transforming the EU into a low-carbon society, will rely on the development of new technologies in a number of sectors such as energy supply and transport[187]. For most of these sectors, low-carbon alternatives are not available yet, let alone at competitive cost levels.

129

The EU Framework Programme for Research and Innovation, known as **Horizon 2020**, is the EU's main research and innovation **funding** instrument[188]. As part of its commitment to spending one euro out of five on climate action (see ***paragraph 133***), the EU has committed to spending at least 35 % of Horizon 2020 funding – 27 billion euro from 2014 to 2020 – on research for climate change mitigation and adaptation. In addition, initiatives such as the Integrated Strategic Energy Technology (SET) Plan have set targets at European level, to reduce the cost and improve the performance of key low-carbon technologies to make them more competitive against conventional energy sources and to accelerate the decarbonisation of the EU's energy system.

130

In several energy-related areas, Europe has a 'deployment deficit' as it struggles to bring promising innovations to market [189]. New, disruptive business models and services, societal innovation and new policy and financial mechanisms will be required to bring technologies to the market[190].

131

Several initiatives tried to address this. For example, the 2016 Commission initiative on accelerating clean energy innovation set out a range of measures to improve the regulatory, economic and investment **environment for innovation** in clean-energy technologies and systems[191]. The initiative emphasised the links to the Commission's agenda on growth and jobs and to the EU's competitiveness[191]. It further suggested that future EU funding should focus on:

- decarbonising the EU building stock by 2050: from nearly-zero energy buildings to energy-plus districts;
- strengthening EU leadership on renewables;
- developing affordable and integrated energy storage solutions; and
- electro-mobility and a more integrated urban transport system.

Public and private financing for climate-change mitigation and adaptation

132

The scale of the economic costs of climate change for the EU remain uncertain, but they are likely to be substantial (see ***Box 8*** for some estimates).

Box 8

Examples of estimates of the economic costs of climate change for the EU

Mitigation:

Between 2021 and 2030, each year, 1 115 billion euro needs to be invested in the following sectors to reach the EU's 2030 targets:

- 736 billion euro in the transport sector;
- 282 billion euro in the residential and service sectors;
- 78 billion euro in the grid, in generation and in industrial boilers; and 19 billion euro in industry[192].

Adaptation:

In a business-as-usual scenario, the changes in climate expected by 2080 would make households across the EU 190 billion euro worse off each year in today's terms, i.e. almost 2 % of the EU's current GDP, if no public adaptation measures are taken[193]. Delaying adaptation, or not acting at all, could substantially increase the total cost of climate change[194].

133

Financing will need to come from both public and private sources. The relatively small size of the **EU's budget** only allows it to finance a fraction of this work directly. To ensure coherence in legislative action and to make the best use of the EU budget, the EU has decided to incorporate, or 'mainstream', climate considerations into all policy and funding instruments. This included setting a target of spending one euro in every five, i.e. around 212 billion euro, on climate-related action under the EU's 2014-2020 financial framework.

134

The EU is also acting **internationally,** notably through financing climate action in developing countries (see ***paragraph 20***). For example, in 2015, the EU, EIB and Member States provided 17.6 billion euro to help developing countries tackle climate change[195].

135

Furthermore, the EU is increasingly making use of financial instruments to attract private investment, both from within the EU budget[196] and from outside, for example, with the **European Fund for Strategic Investments** (EFSI)[197] and **several private-public partnerships** with industry[198]. The EIB has also committed at least 25 % of its lending portfolio to low-carbon and climate-resilient growth.

136

Private sector investment might not be limited to mitigation, but could also include adaptation measures, both to build resilience to the consequences of climate change, and to benefit from new business opportunities it creates[199].

Evidence-based policy-making and implementation

137

Likewise, in the public sector, policy-makers, when designing new policies, should properly assess the likely effect of various policy options. The Commission aims to take political decisions 'in an open, transparent manner, **informed by the best available evidence** and backed by the comprehensive involvement of stakeholders'[200]. For example, it prepares **impact assessments**[201], which are mandatory for all initiatives with significant economic, environmental or social impacts[202], and carries out **evaluations** of the implementation of policies.

138

In impact assessments, the Commission relies extensively on **data** and **modelling** to compare policy alternatives. Data is provided by the European Environment Agency (EEA), Eurostat, or via several initiatives financed by the EU such as the Commission's Climate Services, Copernicus, or the portal Climate-Adapt[203]. Multiple models can be used to simulate, for example, energy supply, demand and prices; greenhouse gas emissions from various sectors; and social and economic outcomes. In the Commission, the Joint Research Centre (JRC) provides such modelling capacity.

139

All such models, while valuable, have certain limitations which their users need to be aware of[204]. Depending on the models used, these include:

- the sensitivity of results to individual assumptions, for example discount rates in calculating the return on investments;
- a limited level of detail such as effects on individual households[205]; and
- the difficulty of taking into account future technological breakthroughs, societal changes and the interrelated effects of climate change[206].

140

Despite such limitations, it is generally agreed that policy decisions should be informed by the prudent use of a variety of models and scenarios.

Part II – What the ECA and EU SAIs are doing in energy and climate change

The role of the EU Supreme Audit Institutions in energy and climate change

141

Supreme Audit Institutions (SAIs) perform independent, external audit on public financial management. They can play a key role in promoting the transparency, accountability, efficiency and effectiveness of public administrations. SAIs not only audit financial accounts and the legality and regularity of financial management, but also assess the value for money – economy, efficiency and effectiveness – of the full range of governmental activities in public administration[207].

142

SAIs of the EU Member States and the ECA, here collectively referred to as the **EU SAIs**, produce reports related to energy and climate change. They also cooperate in the area of energy and climate change, notably in the INTOSAI[208] and EUROSAI[209] Working Groups on Environmental Auditing and in the Contact Committee of the SAIs of the European Union. Cooperation includes the development of audit standards, guidelines, sharing of audit methodologies and reports; they also perform some audits together[210].

143

This report provides a synthesis of EU SAIs' work on energy and climate change over the past five years. It covers 269 reports by EU SAIs dealing with energy and climate between 2012 and March 2017[211]. It includes an overview of where EU SAIs have conducted performance audits and highlights, where possible, emerging patterns of findings. A list of the EU SAIs' audits and a summary of the 41 ECA reports included in this analysis is available on the ECA's website. This analysis follows the structure of Part I of this landscape review: it starts with audits in the energy sector and the EU ETS, followed by audits in other greenhouse gas-emitting sectors, audits on adaptation to climate change and audits on horizontal and cross-cutting topics. Finally, we also identify areas where less audit work has taken place.

Overview of the EU Supreme Audit Institutions' work in energy and climate change

144

The analysis of audit reports of EU SAIs shows that:

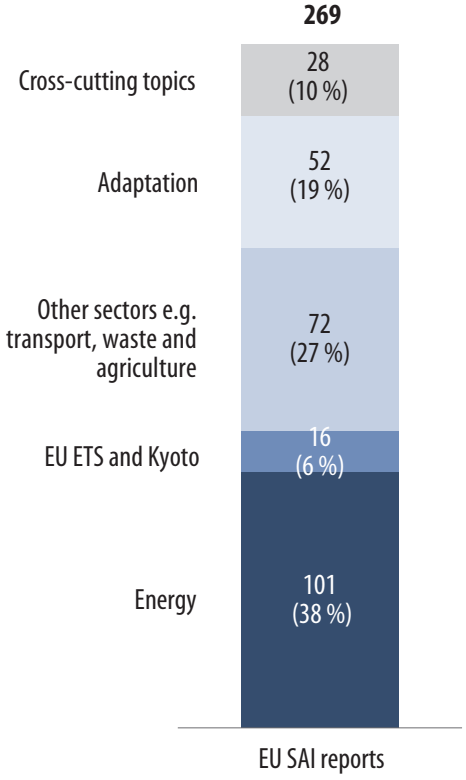
- EU SAIs have covered a wide range of different topics within the area of energy and climate change;
- They produced, on average, about 50 audits per year related to energy and climate change: around two audits per EU SAI per year;
- The distribution of audit reports amongst EU SAIs varies. The majority of SAIs replied to our survey that energy and climate change are ranked as a low priority in their work planning;

- Audits on energy made up the largest share of the reports done (38 % – see ***Figure 18***);
- Mitigation-related audits, i.e. on energy, EU-ETS and other sectors which emit greenhouse gases (190 reports) outnumber audits on adaptation (53 reports) by 4 to 1.

Figure 18

EU SAI audit reports about energy and climate change

Number of reports, per topic (percentage of reports)



Source: EU SAI reports (January 2012 - March 2017).

Energy

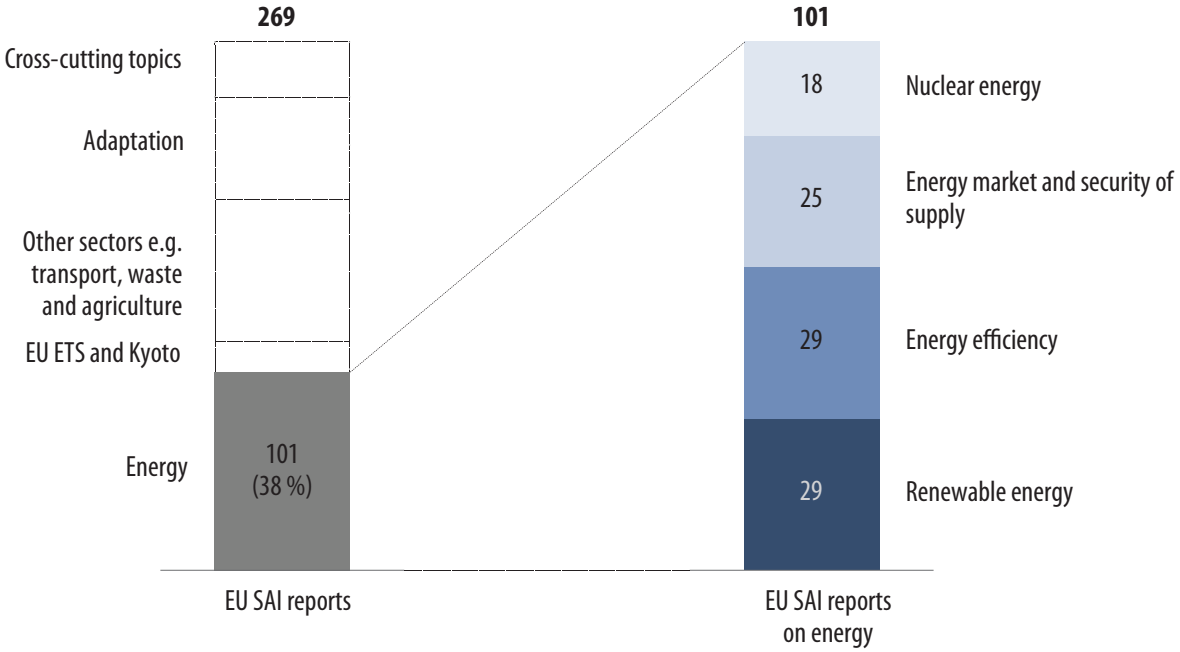
145

Most energy audits cover renewable energy and energy efficiency, and, in slightly lower numbers, the energy market and security of supply and nuclear energy (see ***Figure 19***). The following sections will deal with audit findings in each of these areas in turn, starting with the internal energy market and security of supply.

Figure 19

EU SAI audit reports about energy

Number of reports per topic



Source: EU SAI reports (January 2012 - March 2017).

Internal energy market and security of supply

146

The objective of the internal energy market is to allow the free flow and trade of gas and electricity across the EU (see ***paragraph 65***). A functioning internal energy market is the basis for the security of the EU's energy supply. EU SAIs audit reports have identified the following issues:

- Progress has been made, but the EU's objective of completing the internal energy market has not been reached, with differences remaining in the way Member States implement the EU legal framework and administer their markets;
- Energy infrastructure is not yet designed for fully integrated markets, and does not provide effective security of supply;
- Cooperation issues between Member States regarding cross-border infrastructure are still causing problems.

147

In 2015, the ECA[212] found that progress in **joining the markets** in Europe had been made, but that problems remained with the implementation of the EU legal framework. Important differences[213] in how Member States organised their energy markets were holding back progress towards completing the EU's internal energy market; they also meant that important differences in wholesale prices remained.

148

National SAIs had similar findings: the SAIs of Bulgaria in 2013[214] and France[215] in 2015, for example, published reports stating that energy trading conditions still did not resemble a free market, or that the promised benefits of open energy markets for SMEs and households had not yet become a reality.

149

The 2015 ECA audit also found that **energy infrastructure,** within and between Member States, was generally not yet designed for fully integrated markets, and therefore did not provide effective security of energy supply.

150

Our 2015 audit also showed that the electricity interconnection target (see ***paragraph 70***) between Member States had often not been met and that built infrastructure was not always used to full capacity. We also found that, besides the limited availability of physical interconnections between Spain and France, the integration of Spain and Portugal into the EU energy market required improvements to the internal electricity grid systems, both in Spain and in France.

151

Developing **cross-border cooperation** infrastructure requires cooperation amongst neighbouring Member States. Our 2015 audit found some good examples, such as the Baltic Energy Market Interconnection Plan (BEMIP), a cooperation between several Member States and the Commission[216].

152

But there are also examples of problems of infrastructure in one Member State leading to issues in a neighbouring country. For example, in 2014, the Polish SAI[217] found that unscheduled electricity flows from Germany through Poland to the Czech and Slovak grids were destabilising the Polish energy grid, limiting its capacity to accept power imports.

153

One of the few EU SAI audits considering the **energy transition** (see ***paragraphs 72 to 79***) in a comprehensive manner was the 2016 German SAI audit[218] on measures for the implementation of the energy transition in Germany. The audit found that the Federal Ministry of Economic Affairs and Energy lacked an overview of the total cost of energy transition, that different layers of government were not coordinated and that supported measures were selected without taking their cost-effectiveness into consideration. While it welcomed the government publishing a monitoring report, together with an independent evaluation, targets and evaluation of affordability and security of supply questions were not sufficiently addressed. The audit said that the German energy transition could not be implemented without taking into account the EU's internal energy market.

Renewable energy

154

On a global, macro level, recent years have seen rapid growth in renewable industries and falling costs, for instance of wind and solar. Yet on a micro, national and EU level, EU SAIs' reports on renewable energy, identified:

- obstacles to investments;
- lack of cost-effectiveness; and
- issues with monitoring and evaluation.

155

EU SAIs reports identified **obstacles which hampered investments** in renewable energy, in the following areas:

- Regulatory environment: Reports, including our 2014 audit[222], highlighted institutional and legal barriers and multiple revisions of the national legal frameworks, including retroactive changes in the subsidy regimes, as obstacles to investment. In 2012, the Italian SAI[219] underlined a highly variable legal framework between regions; and the Polish SAI[220] found delays in the preparation of new rules governing renewable energy production[221];

- Challenges in integrating electricity from renewables into the market: A 2016 Swedish SAI[222] audit highlighted the challenges in the electricity market. It found that the expected low electricity price did not provide enough incentives for the market to invest in the capacity necessary to balance the increasing share of intermittent renewable energy in the grid. Our 2014 audit found issues regarding renewable energy producers securing permits for grid connection;

- Limited use of the EU budget for renewable energy: While Member States mainly finance renewable energy from national funds, low use of available EU funds could hamper investment. Our 2014 report found a slow uptake of EU funds for renewable energy projects compared, for example, to energy efficiency projects. In the cases where EU funds were used, we found that the audited projects delivered outputs as planned and most of them were sufficiently mature and ready for implementation[223]. Between 2013 and 2015, the Italian[218] and Romanian[224] SAIs made similar findings on the limited use of EU funds for renewables.

156

Cost-effectiveness of measures and the **level of public support** were recurring themes in audit reports on renewable energy (see examples in ***Box 9***). We found in 2014 that cost-effectiveness had not been the guiding principle in planning and implementing renewable-energy projects. We also found instances where more public funding had been provided than was necessary for projects to be economically viable.

Box 9

Examples of SAI reports highlighting a lack of cost-effectiveness and a high level of public support for renewable energy projects

- In 2016, the German SAI[225] found that a market incentive programme for renewable energy heat production funded inefficient technologies and technologies which already had an established market. Moreover, this programme did not take into account whether applicants actually needed financial support.
- In 2014, the Czech SAI[226] found that the high level of financial operating aid provided to photovoltaic stations resulted in a payback period of about 7 years, even though renewable electricity feed-in tariffs would remain at the same level for more than 20 years.
- The Cypriot SAI[227] found that, between 2008 and 2013, renewable energy installations had been funded although their internal rate of return exceeded a defined threshold, leading to excessive funding.
- In 2014, the Danish SAI[228] noted that, since the cost of building solar power plants was falling and electricity prices (including taxes) were rising, these plants were receiving too much support.
- In 2014, the UK SAI[229] found evidence that early contracts for renewable energy had been awarded without competition, at prices which may provide higher returns for contractors than those needed to secure investment.

157

Insufficient **monitoring and evaluation** of renewable energy programmes was another theme identified in several SAI audits. For example, in 2016, the German SAI found that programmes lacked targets, leading to the inability to monitor their results[230]. Similarly, in 2014, a Czech SAI audit and an ECA audit[231] found that objectives and performance indicators set for the audited programmes were imprecise and/or not based on reliable baseline data.

Energy efficiency

158

In audits on energy efficiency, EU SAIs noted:

- delays in reaching targets and launching programmes;
- a lack of cost-effectiveness; and
- gaps in programme monitoring and evaluation.

159

Delays and associated risks in reaching EU or national targets were reported by several SAIs between 2013 and 2015. For example, the Portuguese[232] and the Slovak[233] SAIs reported delays in implementing energy efficiency measures for public buildings. The Czech[234] and Danish[235] SAIs calculated that their countries would miss their energy efficiency targets. The Slovak SAI (2015), the Bulgarian SAI (2015), the Romanian SAI (2014) and the Portuguese SAI (2013)[236] reported on delays in the launch of energy efficiency programmes due to complicated national regulations, and a lack of available staff to manage the programmes.

160

In our 2012 audit[237], we found that **cost-effectiveness had often been ignored** when energy-efficiency measures were being selected for public funding. These issues continued to be flagged in audits on public building renovation measures by the Polish SAI (2015), the Slovak SAI (2015) and the Romanian SAI (2014)[238]. In contrast, a 2017 Slovak audit report concluded that the national and EU funding spent on the renovation of residential buildings was cost-effective[239].

161

Weaknesses in **monitoring and evaluating** energy efficiency programmes were found by the German SAI (2016), the Slovak SAI (2015), the Polish SAI (2015), the Slovenian SAI (2013) and the Portuguese SAI (2013). For example, measures had poorly defined objectives[240] or no reliable indicators for measuring the achievement of objectives existed[241].

Nuclear energy

162

Most of the EU SAIs reports on nuclear energy related to the costs of running and maintaining or decommissioning nuclear power plants[242]. EU SAIs found:

- significant cost increases and uncertainties;
- a lack of adequate provision for costs or shortfalls in funding; and
- delays.

163

In 2016, we carried out an audit[243] to assess what progress had been made in three EU nuclear decommissioning assistance programmes in Lithuania, Bulgaria and Slovakia since our last audit in 2011. We found that progress had been made in low-radioactivity areas, such as turbine halls, but that the decommissioning of reactor buildings had yet to begin. Many decommissioning projects had been subject to **delays** and **cost increases**.

164

We found that the three Member States faced financial challenges, in particular Lithuania which, in 2015, had a financing gap of 1.56 billion euro until completion of decommissioning. Liabilities for future costs had not been properly accounted for in the three Member States.

165

Looking at the issue of final disposal, our audit found that total estimated costs of the three decommissioning programmes would double if the cost of final disposal of high-level waste and spent fuel were to be included. Talks regarding potential final disposal solutions were only at conceptual stages despite such solutions needing several decades to implement.

166

Other EU SAI reports show similar findings on cost increases and uncertainties. A 2014 French SAI[244] audit found that, between 2010 and 2013, the cost of nuclear energy had increased from 50 euro/MWh to 60 euro/MWh. This 21 % increase was due to **increasing maintenance costs** as a result of extensions to the operating life of some nuclear plants. The report also found increasing future costs and underlined the high uncertainty linked to the decommissioning costs and final disposal of nuclear waste. In 2016 the French SAI estimated the total maintenance costs of the French nuclear plants at 100 billion euros over the period 2014-2030[245]. The UK SAI reported in 2015 on cost increases and uncertainties of cost estimation in nuclear decommissioning[246].

The EU Emissions Trading System

167

Nearly all EU ETS-related EU SAI audits published after 2012 covered phase 2 of the system, which ran from 2008 to 2012. Only one SAI report[247] has addressed the third phase of the EU ETS, which runs from 2013 to 2020. These SAI reports called into question:

- the scheme's effectiveness, due to a surplus of allowances and the resulting low prices of allowances;
- the lack of sound justification for the national support provided to energy-intensive companies said to be at risk of carbon leakage; and
- specific aspects of implementation.

168

For several years, the price of EU ETS allowances has been significantly lower than forecast (see ***paragraph 32***). A 2012 cooperative audit, involving seven SAIs[248], found that these low prices were hampering the **effectiveness** of the EU ETS; the German[249] and French[250] SAIs reached a similar conclusion in 2014. The low EU ETS allowance prices reduced the incentive for companies to invest in cleaner technology to reduce emissions in the long term. Low prices were found to be mainly the result of an oversupply of allowances[251], but also due to the growth of energy efficiency[252] or renewable energy policies[253]. In 2014, when examining the 'back-loading' of allowances to address this EU ETS market imbalance (see ***paragraph 33***), the German SAI noted that these measures would not offer a long-term solution[254].

169

Two EU SAI audit reports dealt with the 'compensation' support granted by some Member States to companies relating to the risk of **'carbon leakage'** (see ***paragraph 30***). Reporting on the EU ETS and climate-related taxes, a 2012 Swedish report[255] concluded that Sweden's government, its agencies, and its parliament did not have a basis for assessing whether various industry sectors were actually at risk of carbon leakage. Examining compensation paid to electricity intensive industry in Germany, a 2016 SAI report[256] found that the responsible ministry had not investigated whether high electricity costs were actually encouraging companies to relocate or whether such costs were offset by gains in energy efficiency.

170

EU SAIs also assessed the **implementation of the EU ETS**, highlighting issues with:

- the effectiveness of the mechanisms by which emissions are reduced by investing in countries outside the EU (Luxembourg, 2014; Germany, 2014; Portugal, 2011)[257];
- Value Added Tax (VAT) fraud which affected emissions trading at least in 2008 and 2009 (Cooperative audit from Denmark, Finland, Latvia, Lithuania, Norway, Poland, Sweden, 2012; Germany, 2014; Portugal, 2011)[258]. Since that period, at least 22 Member States have begun to use the reverse charge mechanism to combat tax fraud; in theory, this should also reduce the risk of VAT fraud affecting the EU ETS;
- safeguards aimed at protecting market integrity which were not sufficiently robust and systems for monitoring and reporting emissions that were not harmonised and contained weaknesses (ECA, 2015)[259].

Transport

171

Relevant transport audits were concerned with the reduction of greenhouse gas emissions in the transport sector directly, or dealt with low-carbon transport modes, or a shift to such transport modes. Notwithstanding that audits on high-carbon methods of transport, such as road and air transport, might raise important value-for-money issues[260], such reports were not deemed relevant unless they directly addressed energy or climate change issues. Apart from audits on biofuels, we only found one audit on high-carbon modes of transport with such a direct link, namely a report on car emissions by the Maltese SAI[261].

172

The relevant EU SAI audits on transport noted:

- the shift in transport of goods from road to rail and maritime/inland waterways was not being achieved;
- issues with the design and effectiveness of biofuels policy.

173

Several EU SAI reports (Czech Republic, 2017 and 2014; Austria, 2015) found that the necessary **shift in the transportation of goods** from road to the less-carbon-emitting rail and maritime/inland waterways transport modes is not being achieved[262]. In 2015[263] and 2016[264], we found that both inland waterway transport and rail failed to compete with road transport. We also found, in 2016[265], ineffective and unsustainable investments in ports.

174

Biofuels schemes were audited by several EU SAIs (ECA, 2016; France, 2016 and 2012; Bulgaria, 2015; Portugal, 2014; Poland, 2014; Slovakia, 2014)[266]. In our 2016 report, we found weaknesses in the Commission's procedures for recognising and supervising voluntary schemes to certify sustainable biofuels[267]. Underlying statistics were unreliable, because there was nothing to stop Member States from including in their statistics biofuels whose sustainability was unverified.

175

In 2014 and 2015, Member States SAIs (Bulgaria, Portugal, Poland)[268] had found that intermediate national biofuel targets[269] had not been met. A 2016 report from France reported that the target for biodiesel might be achieved, but expressed doubts about the achievement of the bioethanol target[270]. The SAIs of Slovakia (2014) and France (2012) highlighted the limited impact of biofuels on energy independence[271] or total greenhouse gas emissions reductions[272].

Agriculture and forestry

176

Except for one ECA audit in 2012[273], all the EU SAI reports analysed in the sector of agriculture and forestry, and with a potential link to emission and storage of greenhouse gases, related solely to forestry. We found no reports on the greenhouse gas emissions from agriculture.

177

The SAIs of Belgium (2016) and Romania (2014), as well as the ECA (2015), found various issues related to **deforestation**, such as non-systematic compensation of deforested land, or inadequate action against illegal logging[274]. An ECA report from 2014[275] concluded that EU funding for preventing **forest fires** and restoring damaged forests had not been managed well.

178

Other reports addressed the **cost-effectiveness** of forestry measures. In 2017, the Portuguese SAI criticised the selection of projects and the quality of ex-ante and ex-post evaluations[276]. In 2016, the Lithuanian SAI found high management costs, low absorption rates, and delays[277]. In 2015, the French SAI underlined the lack of coordination between forestry programmes[278].

Waste and the circular economy

179

EU SAI reports on waste covered mainly:

- the implementation and enforcement of waste legislation;
- the effectiveness of the management of municipal waste.

180

Several EU SAI reports (Portugal, 2015; Lithuania, 2013; Romania, 2013; ECA, 2012; and a 2012 joint report of eight national SAIs)[279] identified issues related to **poor or delayed implementation** of the waste legislation, in particular with regard to landfill.

181

Several, mostly more recent, reports (France, 2017; Latvia, 2017 and 2015; Estonia, 2016; Slovenia, 2015; UK, 2014; Lithuania, 2013) focused on the **effectiveness of the management of municipal waste**, such as waste from households, institutions and small businesses[280]. Audits found weaknesses in the governance of municipal waste management, such as the lack of appropriate set-up or oversight of the achievement of targets and low recycling rates.

182

The ECA's 2016 report on **food waste**[281] concluded that EU action to date had not been sufficient and that the EU strategy on food waste had to be strengthened and better coordinated.

Adaptation

183

Around 20 % of the EU SAI reports addressed adaptation to climate change. Of these, one third dealt with **flooding** (see ***Box 10*** for details of findings).

Box 10

Examples of audit findings on flood prevention, protection and responses:

- Fragmentation of responsibilities for flooding issues and lack of coordination between different layers of governments or authorities (Bulgaria, 2016; Germany, 2016; Italy, 2015)[282]
- Insufficient restrictions on urban planning in flood areas (Slovenia, 2014; France, 2012)[283]
- Delays in implementing flood management plans, programmes or projects (Bulgaria, 2016; Ireland, 2015; Italy, 2015; Poland, 2015; Slovenia, 2014)[284]
- Missing or out-of-date flood warning plans (Romania, 2014; France, 2012)[285]
- Poor maintenance of flood prevention infrastructure (ECA, 2014; United Kingdom, 2014; Slovenia, 2014; Poland, 2013 and 2012)[286]

184

Other audits dealt with issues such as **water supply and quality**[287], **disaster prevention and management** measures[288] and **biodiversity**.

185

Member States' **adaptation strategies** were addressed in 2012 by a cooperative audit by nine EU and non-EU SAIs[289]. The audit concluded that governments were not sufficiently prepared for the expected impact of climate change. The EU has since adopted a strategy for adapting to climate change, which encourages all Member States to adopt comprehensive adaptation strategies (see ***paragraph 124***).

Audits on cross-cutting topics

186

Approximately 10 % of audits concerned cross-cutting issues which can affect various economic sectors or areas of energy and climate measures. Four clusters emerged:

- climate and energy research;
- financing of mitigation and adaptation, including taxes;
- meta-audits/reviews, or audits of the whole energy and climate change area;
- evidence-based policy making and implementation.

187

Six EU SAIs specifically reported on **energy and climate research.** In 2014, the French SAI[290] highlighted that technological breakthroughs were needed in order for the energy transition to be successful, but that no existing mature technologies appeared to be able to ensure the security of the energy system in 2030, and that there was no guarantee that any future breakthroughs would be technically and economically accessible. Three reports (Denmark, 2013; Sweden, 2012; Finland, 2011)[291] covered general research programmes or particular projects. In their reports, SAIs generally underlined the importance of research and innovation for climate and energy but stated that its potential had not been fully explored or clearly understood. Three other audits (United Kingdom, 2017 and 2012; Poland, 2015)[292] concerned 'clean coal technologies' and highlighted ineffective procurement procedures and ineffective support for the development of such technologies.

188

Certain audits (e.g. Latvia, 2017; ECA, 2013 and 2016; Netherlands, 2014, Spain, 2012) concerned the **financing** of investments across sectors such as infrastructure in energy and transport in Member States, within and outside the EU[293]. For example, in our 2016 audit[294], we identified a serious risk that the target of spending at least 1 euro in every 5 of the EU budget on climate action between 2014 and 2020 would not be met. We found a more and better-focused climate action funding under the European Regional Development Fund and the Cohesion Fund, but no significant shift towards climate action in the areas of agriculture, rural development and fisheries. We also found that prompt action is required in the research area as the contribution from research funding is falling significantly behind.

189

Some audits dealt with climate-related taxes or the effect of tax system changes on green investments. For example, the Swedish SAI[295] found that government and agency reporting did not provide a comprehensive picture of the costs and effects of climate-related taxes. It also highlighted limitations on models used by the government to model economic effects. A 2016 French audit report[296] found that tax advantages and support given to environmentally unfavourable activities outweighing support given to sustainable activities.

190

Some SAIs produced audits on their **national climate change strategies**[297]. The SAIs of the Netherlands (2015), France (2014), Sweden (2013) and Finland (2012) published **meta-audits and overviews** which drew together their national findings in the area of energy and climate change[298].

191

Certain audit findings have been related to **data and methods used by governments to design and implement policies**. For example, our 2016 audit on energy security of supply[299] highlighted issues with gas-demand modelling. The 2012 Swedish SAI report also highlighted limitations of economic models used by their government[300].

Areas where limited audit work had taken place

192

EU SAIs have covered a variety of subjects in the area of energy and climate change, with many relevant findings. However, some areas of energy and climate have, so far, received less audit coverage:

- **adaptation** (see ***paragraph 144***);
- EU and national **greenhouse gases inventories** and Land Use, Land use Change and Forestry (**LULUCF**);
- the third phase of the **EU ETS** (see ***paragraph 167***);
- emissions from **road transport** (see ***paragraph 171***); and
- emissions from **agriculture** (see ***paragraph 176***).

193

We surveyed the 28 EU SAIs on the challenges they faced when auditing energy and climate. The most common issues raised were the low prioritisation of energy and climate topics; unclear policy objectives and therefore inadequate criteria for audit; and a lack of expertise.

194

Adaptation to climate change has been audited far less often than climate mitigation (see ***paragraph 144***). Of reports dealing with adaptation, one third were about floods. Some reports addressed water shortages in drinking water systems or in specific irrigation systems, but none had addressed the relationship between water scarcity and climate change. We also found no audits focused on adaptation in specific sectors such as agriculture, infrastructure planning, health, or biodiversity. There were some early audits on Member States' preparedness for adaptation around 2012, but none since the 2013 EU's adaptation strategy recommended that Member States draw up adaptation strategies.

195

When asked why adaptation had not been audited more, EU SAIs replied:

- adaptation is still a recent policy;
- adaptation measures often consist in small size, dispersed projects; when these projects are financed by municipalities, SAIs might lack an adequate audit mandate;
- adaptation measures are complex to audit, due to their cross-sectoral/cross-border and long-term nature; and
- certain Member State SAIs assessed the risk linked to adaptation as low.

196

Emissions reductions targets use **EU and national inventories of greenhouse gas emissions** as a baseline (see ***paragraph 26***). These inventories are also used to check whether Member States' emissions are in line with the Effort-Sharing Decision (see ***paragraph 35***) and the international commitments under the UNFCCC (see ***paragraph 18***). They may also play an important role in future under the Paris Agreement. We found one EU SAI audit from 2009[301] that had dealt with them directly. The Estonian SAI audited its national efforts to reduce greenhouse gas emissions and concluded that there was a risk that Estonia's emissions might be higher than declared, for several reasons:

- a lack of data and methodological weaknesses, not all sectors and pollutants had been included;
- the method used to calculate the amount of greenhouse gases absorbed by forests was flawed; and
- the effect of land-use changes had not been assessed.

197

The Romanian SAI[302] did not audit these inventories directly in 2011, but made reference to a 2010 UNFCCC report which had identified non-compliance issues in Romania's greenhouse gas inventory. As a result, Romania had been suspended from participating in the international emissions-trading scheme set up under the Kyoto Protocol. Lithuania[303] had faced similar issues in the first half of 2012. In 2011, the Portuguese SAI[304] found discrepancies between the emissions accounting methods used by the Portuguese authorities and those required by the Kyoto Protocol.

198

According to the EU SAIs, audit work on EU and national inventories of greenhouse gas emissions and Land Use, Land Use Change and Forestry had been limited because of the limited financial importance of these inventories and the lack of technical expertise.

Part III – Main challenges

199

Part I of this landscape review described what the EU is doing in the field of energy and climate change and part II highlighted findings made by EU SAIs in this field. Based on this work, we identified seven areas where we see major challenges in the field of energy and climate change. In each area, we identify the challenges to provide context for the current consideration of the major transformations underway, to stimulate debate among stakeholders, and to identify potential opportunities and risks for audit in the future.

1. Energy and climate change governance

200

The EU has set itself climate- and energy-related targets for the years 2020 and 2030 and objectives for 2050: to reduce greenhouse gas emissions, to improve energy efficiency and to increase renewable energy (see ***paragraph 21***). It has also set itself the goals of developing a functioning internal energy market, delivering security of supply, and integrating renewables. Much progress has been made (see ***paragraph 22***). Current projections show that more progress is needed to reach the 2030 targets and the 2050 objectives (see ***paragraph 23***).

201

The delivery of the EU's objectives can only be achieved through a mix of legislative and non-legislative measures at EU, national, regional and local levels. In both energy and climate change, the EU and the Member States have shared competence (see ***paragraph 11***) and need to work together in a spirit of solidarity and trust[305]. Member States retain sole competence in certain areas, such as their national energy supply mix.

202

Energy and climate change need to be addressed together. Energy production and consumption accounts for 79 % of EU greenhouse gas emissions (see ***paragraph 39***). In addition, choices in one Member State can affect the situation in other Member States and the achievement of overall EU targets. Effective governance systems are needed in the EU to manage and monitor energy and climate measures, to reduce risks, to avoid overlaps and to ensure progress, while finding cost-effective solutions.

203

The EU and national governments have committed to reduce greenhouse gas emissions (see ***paragraph 19***). Greenhouse gas inventories play a fundamental role in monitoring progress on greenhouse gas emission reduction targets (see ***paragraph 26***). The EU, Member State authorities and the UNFCCC verify these inventories, which often include complex estimations.

204

Tracking the extent to which financial commitments addressing the energy transition and climate change are delivered is challenging. The EU has committed to spending at least 1 euro in every 5 of its budget on climate action between 2014 and 2020 (see ***paragraph 133***). The ECA's 2016 audit showed that meeting this target was at serious risk (see ***paragraph 188***). Developed countries have committed to providing 100 billion USD each year by 2020 to support developing countries' efforts to adapt to and to mitigate climate change (see ***paragraph 20***), though responsibility for meeting this target has not been shared out.

205

Public audits can play an important role in ensuring public accountability on the achievement of governmental targets and commitments. Such audits can play a key role in maintaining citizens' trust in their governments and in the EU. However, the EU SAIs' roles have, to date, been limited with regard to auditing some important energy and climate governance systems and monitoring processes, such as greenhouse gases inventories (see ***paragraphs 196 to 197***).

2. Evidence-based policy

206

Policy-making and policy implementation should be informed by the best available data, modelling and analysis (see ***paragraph 137***). This is a challenge for energy and climate change topics because of their complexity, the relative novelty of some of the data, and the pace of change arising from both energy transitions and climate change.

207

The European Commission relies on a wide range of data, modelling techniques and impact analysis to help it assess alternative policy options for energy and climate (see ***paragraph 138***). Past audits have highlighted issues with data collection (see ***paragraphs 157 and 161***), models and impact analysis (see ***paragraph 191***).

208

Good data, analysis and models remain important tools for assessing energy and climate policy options, and will be needed for the integrated national energy and climate plans that Member States would have to prepare in the framework of the proposed Regulation of the Governance of the Energy Union (see ***paragraph 79***), if current proposals are agreed.

3. The energy transition

209

The production and consumption of energy accounts for 79 % of EU greenhouse gas emissions (see ***paragraph 39***). In the last decades, the EU has made progress towards making its energy sector more sustainable, affordable and secure. But the transition of the EU energy sector to low-carbon energy sources has much further to go and still faces many challenges.

210

A significant decline in EU energy production from fossil fuels is expected, alongside a continued growth in renewable energy production (see ***paragraph 48***). Energy production from renewable sources helps mitigate climate change and, by reducing the import dependency, they increase the EU's security of supply. At the same time, the integration of renewable energy production into the energy system presents challenges. Profound changes are still needed in the electricity system to deal with challenges such as the variability of energy production from intermittent renewable sources, storage, decentralised energy production and more dynamic demand management (see ***paragraphs 73 to 76***). Energy infrastructure within and between Member States is not yet fully designed for integrated markets (see ***paragraphs 68 to 71***). Similarly, the transport sector will have to undergo changes in energy use, switching to less carbon-intensive transport modes and using biofuels and alternative fuels, such as electricity (see ***paragraph 98***). Energy efficiency measures could further transform the energy system (see ***paragraphs 42 to 43***).

211

Infrastructure investments will need to be based on a long-term understanding of their climate and other impacts. For example, coal is the energy source which emits the largest relative amount of greenhouse gases (see ***Figure 8***). Investments in any new coal mines and coal-fired plants would lock energy companies into using these assets for decades, with no certainty that efficient and effective technology will be available to capture or to limit their greenhouse gas emissions (see ***paragraph 56***). In addition, such investment would lead to further overcapacity in a saturated market (see ***paragraph 74***), thereby leading to further difficulty in attracting investments in renewable energy capacity.

212

Existing assets may need to be shut down earlier than anticipated – becoming what is known as 'stranded assets' because of an increase in carbon price or a change in climate or energy legislation. Such investments, for example, in coal or nuclear plants, are often concentrated in certain regions which may heavily depend on the economic activity and jobs arising (see ***paragraph 77***). This creates a need for planning social adjustments, when closures of established energy industries are necessary to support the energy transition.

213

Apart from its effects on mitigating climate change, the energy transition can offer benefits in areas such as air quality improvement, reduction of import dependency and growth through green jobs has to be taken into account.

4. Using research and innovation effectively

214

Achieving longer term energy and climate targets will require new technologies to be developed and used widely in several sectors (see ***paragraphs 128 to 129***). Research and innovation must therefore play a key role in transforming the EU into a low-carbon society by delivering better performing and cost-competitive low-carbon technologies. Much progress has been achieved – for example, in renewable energy technologies – but there is still significant potential for further developments. The power sector will also require better and more cost-efficient energy storage and carbon capture technologies, such as for remaining gas-fired plants (see ***paragraphs 56 and 76***). Achieving significant emissions reductions in transport will require the development of alternative fuels (see ***paragraphs 97 to 102***), but vehicles using such fuels still suffer from technical constraints, such as limited range, and high costs.

215

It often takes many years for a new technology to become usable on an industrial scale. Therefore, extensive progress in developing the technologies needed to reduce emissions between 2030 and 2050 will have to be made in the next decade. There is currently no certainty that such future technological breakthroughs will be both technically possible and widely, economically accessible by 2030 (see ***paragraph 187***). The EU is still a major centre for climate change mitigation innovations and investments in research and development. Worldwide investment in renewable energy has resulted in decreasing costs and significant growth. However, in some fields, the EU still has a 'deployment deficit', as it struggles to commercialise promising, energy-related innovations (see ***paragraph 130***).

216

Energy innovation depends upon contributions by a wide range of stakeholders, from companies and consumers to local, regional and national authorities, to EU institutions. Market design and public authorities play a major role in providing an innovation-enabling environment. Public financing often plays only a relatively small part in this, but can still be key in certain fields such as early-stage innovation. The ECA's 2016 audit showed that the target of planning to spend 35 % of the Horizon 2020 budget on climate action was at risk (see ***paragraph 188***).

5. Planning for and tackling adaptation

217

The effects of climate change are already being experienced. Climate change will affect EU citizens in many ways, including increased incidence of droughts and flooding, forest fires, effects on food production, damage to private and public infrastructure and demands for greater protection, changing health risks, impacts on employment, migration, etc. (see ***paragraphs 118 to 122***). The EU and Member States need to plan to adapt. The Paris Agreement is the first international treaty which recognises the need for adaptation to climate change (see ***paragraph 19***). In 2013, the EU had already prepared an adaptation strategy and invited Member States to prepare their own national strategies (see ***paragraph 124***).

218

Climate, environmental, societal and economic models can be used to describe and forecast the impacts of climate change. This is an important but challenging task (see ***paragraphs 138 to 139***)[306]. For example, sea level rises or the desertification of some regions could trigger population movements within and to Europe (see ***paragraph 122***). It will be a great challenge for the EU and Member States correctly to anticipate and plan adaptation, reducing the need to act late, in response to events, which would cost more and put unforeseen pressure on public budgets.

6. Financing

219

In order to reach the EU's 2030 climate and energy targets, the Commission has estimated that about 1 115 billion euro investments will be needed annually over the 2020-2030 period: mostly in transport and in the residential and services sector (see ***Box 8***). These investments in climate change mitigation will need to come from both public and private sources. In the case of regulatory or market failures, states may step in, as they have done in the case of renewable energy (see ***paragraph 75***), helping to contribute to the global growth of this new industry and the resultant significant decrease of the cost of renewable energy (see ***paragraph 64***). A more robust carbon price would also be a powerful tool, with the potential to stimulate more private investment in low-carbon assets and energy efficiency (see ***paragraph 32***).

220

The costs of adapting to climate change are difficult to predict (see ***Box 8***), even more so the likely benefits of adaptation investments, posing challenges for the traditional assessments of value for money audit, cost-benefit analysis, and performance monitoring. Adaptation requires long-term planning and decisions about major infrastructure, such as water supply infrastructure, irrigation systems and flood defences. In the absence of the right incentives, market forces and conventional cost-benefit analyses may not lead to the optimal investments for such long-term adaptation measures. Public funding may need to be mobilised on a large scale to overcome market failures. But private-sector companies should also invest substantially in adaptation, because it is in their long-term interest to be climate-resilient and to explore the associated new business opportunities (see ***paragraph 136***).

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In the energy sector, one key challenge faced by the EU and the respective Member States is the decommissioning of nuclear power plants. In the EU, 90 nuclear power plants have already been shut down, but are not yet decommissioned. A further 50 currently operational reactors are estimated to be shut down by the end of 2025. According to the Commission, estimated total cost for the management of spent fuel and radioactive waste is about 400 billion euro (see ***paragraph 59***).

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A recent ECA audit of nuclear decommissioning in three EU Member States found that total estimated costs would double if the cost of final disposal of high-level waste and spent fuel were included (see ***paragraph 163***). According to a Commission report, concepts for disposal of intermediate level waste, high-level waste and spent fuel, such as site selection or development of design, are not specific in most of the Member States (see ***paragraph 59***).

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Decommissioning nuclear power plants and disposing of nuclear waste is therefore a pressing and costly challenge for the EU and its Member States. However, it also provides many opportunities for business and employment (see ***paragraph 58***).

7. Involving EU citizens

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The transition to a low-carbon economy will affect all sectors of the economy and society. It will affect how citizens live, travel, consume, plan and invest. In 2014, direct households' emissions represented 24 % of greenhouse gas emissions[307]. Consumption choices influence many other sources of greenhouse gas emissions. The integration of the citizen in the energy transition is now seen as essential, both for understanding, endorsing and paying for necessary transitions, and also to encourage active participation. This will require changes in behaviour, for example, both in how energy is produced and consumed. EU citizens can directly reduce EU emissions, for example by purchasing energy-efficient homes, using energy-efficient devices (see ***paragraphs 85 to 87***), producing renewable energy (see ***paragraphs 62 to 64***), and using sustainable transport (see ***paragraphs 90 and 96***).

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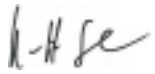
Citizens can be engaged on individual, local, city, regional, national and European levels, but local administrations are often closest to them. They have much potential to engage more citizens through bottom-up actions and movements such as the 'Covenant of Mayors for Climate & Energy' (see ***paragraph 124***).

This landscape review was adopted by Chamber I at its meeting of 21 June 2017.

For the Court of Auditors



Klaus-Heiner LEHNE
President

Annex - Approach

This landscape review is based on:

- Documentary analysis of EU directives, regulations, decisions, strategies, impact assessments, evaluations and studies, relevant EU case law and where appropriate, published academic research;
- Interviews with 21 Commission Directorates-General[308], including the Joint Research Centre (JRC), as well as with the European Environmental Agency (EEA), the Organisation for Economic Co-operation and Development (OECD) and the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC);
- Information visits to Germany, Spain and Poland;
- Liaison with the 28 EU SAIs:
  - Collection of more than 650 SAI performance audit reports dealing with energy, climate policy and investments related to mitigation and adaptation published since 2010. Selection of the most relevant reports[309] for in-depth reading: 269 EU SAI reports, including those of the ECA, published between January 2012 and March 2017[310];
  - Survey of SAIs about what they have audited and on the challenges they face. All SAIs responded. The results were presented at a SAI Contact Committee meeting in October 2016;
  - Seminar in January 2017 with SAIs, including presentation of preliminary results and deliberations on the challenges and opportunities for auditors in energy and climate change;
  - The references to individual SAI reports were checked with these SAIs and necessary corrections were made;
- Use of an expert in energy and climate-change economics;
- The draft was sent to the Commission for a check of the facts. The challenges presented in Part III were discussed with high-ranking officials at the Directorates-General for Energy, Climate Action and Research. Their comments were taken into account.

Endnotes

1 World Meteorological Organization, *WMO Statement on the State of the Global Climate in 2016*, 2017.

2 Intergovernmental Panel on Climate Change, *Intergovernmental Panel on Climate Change's Fifth Assessment Report*, 2009.

3 European Commission, *Clean Energy For All Europeans*, COM(2016) 860 final of 30.11.2016.

4 Landscape reviews 'consider broad themes on the basis of the Court's research and accumulated knowledge and experience [and] serve as an important basis for consultation and dialogue with the ECA's stakeholders and for future audit work of the ECA. They enable the Court to submit observations on matters which are not necessarily susceptible to audit per se but are nonetheless important for public accountability and the ECA's audit mission'.

5 Article 4 of the Treaty on the Functioning of the European Union.

6 Article 2(2) of the Treaty on the Functioning of the European Union.

7 Article 194 of the Treaty on the Functioning of the European Union.

8 Article 192(2) of the Treaty on the Functioning of the European Union. Such measures must be adopted by consensus in the Council.

9 Article 191(1) of the Treaty on the Functioning of the European Union.

10 Article 191 of the Treaty on the Functioning of the European Union.

11 Article 11 of the Treaty on the Functioning of the European Union.

12 Articles 3(2) and 216 of the Treaty on the Functioning of the European Union.

13 Council of the European Union, *Preparations for the 21th session of the Conference of the Parties (COP 21) to the United Nations Framework Convention on Climate Change (UNFCCC) and the 11th session of the Meeting of the Parties to the Kyoto Protocol (CMP 11), Paris 2015*, 2015; European Commission, *Communication from the Commission to the European Parliament and the Council: The Road from Paris: assessing the implications of the Paris Agreement and accompanying the proposal for a Council decision on the signing, on behalf of the European Union, of the Paris agreement adopted under the United Nations Framework Convention on Climate Change*, COM(2016) 110 final, 2016.

14 Climate Analytics, Paris Agreement ratification tracker.

15 For example, in 2015, the EU was part of a coalition of developed and developing countries, in favour of high ambition, that shaped the Paris Agreement. See also Oberthür, S., Groen, L., *Explaining goal achievement in international negotiations: the EU and the Paris Agreement on climate change*, Journal of European Public Policy, Volume 24, Published online 22.02.2017.

16 *Council Decision of 25 April 2002 concerning the approval, on behalf of the European Community, of the Kyoto Protocol to the United Nations Framework Convention on Climate Change and the joint fulfilment of commitments thereunder* (2002/358/EC), 2002.

17 In their National Determined Contributions (NDCs).

18 In its April 2016 update of the synthesis report on *Aggregate effect of the intended nationally determined contributions (INDCs)* (FCCC/CP/2016/2), the UNFCCC estimated that, at global level, the aggregate greenhouse gas emission level resulting from the implementation of these INDCs is expected to be higher by 36 % in 2030 compared with the emission level affordable under the 2°C scenario.

19 The Paris agreement does not quantify the goal. The 100 billion USD is mentioned in the decision of the 21st Conference of the Parties (COP21) decision (FCCC/CP/2015/L9).

20 European Commission, *20 20 by 2020: Europe's climate change opportunity* (2020 Climate and Energy Package), COM(2008) 30 final of 23.01.2008.

21 European Commission, *A policy framework for climate and energy in the period from 2020 to 2030* (2030 Climate and Energy Framework), COM(2014) 15 final of 22.01.2014.

22 The 2030 Climate and Energy Framework stated that the 2030 energy efficiency target will be reviewed in 2020 having in mind a 30 % target (*Conclusions of the European Council of 23 and 24 October 2014, EUCO 169/14*). The Commission proposed, in November 2016, an EU energy efficiency target of 30 % for 2030.

23 European Commission, *A roadmap for moving to a competitive low-carbon economy in 2050*, COM(2011) 112 final of 8.3.2011. The European Council and the European Parliament endorsed this approach proposed by the Commission in February 2013 and March 2013 respectively.

24 23 % in 2014 and 22 % 2015 (source: European Environment Agency, *Trends and projections in Europe 2016 – Tracking progress towards Europe's climate and energy targets*, 01.12.2016).

25 Emissions caused or produced by humans.

26 Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change (OJ L 165, 18.06.2013, p. 13).

27 A unit used for comparing the global-warming potential of emissions from various greenhouse gases using the global-warming potential of CO_2 as a reference. *Source: Approximated EU greenhouse gas inventory: proxy greenhouse gas estimates for 2015*, EEA Report No 23/2016, 08.11.2016.

28 Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 establishing a scheme for greenhouse gas emission allowance trading within the Community (OJ L 275, 25.10.2003, p. 32).

29 The EU and Iceland, Liechtenstein and Norway.

30 Other instruments, such as a direct carbon tax, also aim to reduce greenhouse gas emissions, but have different effects and characteristics. According to the Commission, the main advantages of such a cap-and-trade system, compared to other instruments such as a direct carbon tax, are: it guarantees an absolute reduction in emissions volume; auctions provide governments with an additional revenue stream; it is more predictable than national tax systems; it is cost-effective.

31 Since 2008, in case of failure to comply, there is a penalty of 100 euro per tonne of excess emission, plus the obligation to make up the shortfall.

32 The year 2005 is used as the reference year for ETS sectors because this is the first year for which comparable monitoring, reporting and verification data are available for all installations covered by the system. That is why this reference is different from the reference used for the other greenhouse gas reduction targets (year 1990).

33 These sectors have been identified by the EU by taking into account their trade intensity (i.e. their exposure to international competition) and the share of their greenhouse gas emission costs in their production processes.

34 Commission Decision 2011/278/EU of 27 April 2011 determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council (OJ L 130, 17.05.2011, p. 1).

35 This is in accordance with Commission Regulation (EU) 1031/2010 of 12 November 2010 on the timing, administration and other aspects of auctioning of greenhouse gas emission allowances pursuant to Directive 2003/87/EC of the European Parliament and of the Council establishing a scheme for greenhouse gas emission allowances trading within the Community, which ensures a harmonised process for the auctioning of allowances (OJ L 302, 18.11.2010, p. 1).

36 European Commission, *EU Climate Policy explained*, 2015.

37 European Commission, *Impact assessment accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*, *A Roadmap for moving to a competitive low carbon economy in 2050*, COM(2011) 112 final of 08.03.2011.

38 Carbon pricing leadership coalition, *Report of the High-Level Commission on carbon prices*, 2017.

39 European Environment Agency, *Trends and projections in the EU ETS in 2016*, EEA Report No 24/2016, 17.10.2016, p.77.

40 European Commission, *Proposal for a directive of the European Parliament and of the Council amending Directive 2003/87/EC to enhance cost-effective emission reductions and low-carbon investments*, COM(2015) 337 final of 15.07.2015.

41 European Environment Agency, *Trends and projections in the EU ETS in 2016 — The EU Emissions Trading System in numbers*, EEA Report No 24/2016.

42 This concerns 13 Members States, and ranges from an increase of 1 % for Portugal to an increase of 20 % for Bulgaria.

43 Commission's website: https://ec.europa.eu/clima/policies/effort_en.

44 This is in contrast to sectors covered by the EU ETS, in which emissions are regulated at EU level.

45 The report concluded that 'The ESD is still in the early stages of implementation. Nevertheless, it seems clear from the evidence gathered so far that ESD targets have been effective in stimulating new national policies and measures promoting effective reductions of greenhouse gas emissions within the ESD scope' (European Commission, *Report from the Commission to the European Parliament and the Council on evaluating the implementation of Decision No 406/2009/EC pursuant to its Article 14*, COM(2016) 483 final of 20.07.2016).

46 International Energy Agency, *World Energy Outlook Special Report 2015: Energy and Climate Change*, OECD/IEA, 2015.

47 International Energy Agency, *25 Energy Efficiency Policy recommendations*, 2011 update.

48 Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency (OJ L 315, 14.11.2012).

49 This means that EU primary energy consumption in 2020 should be 20 % below the projected primary energy consumption under a 'business-as-usual' scenario. 'Primary energy consumption' means gross inland consumption excluding all non-energy use of energy carriers (e.g. natural gas used not for combustion but for producing chemicals).

50 European Environment Agency, *Trends and Projections in Europe 2015 — Tracking progress towards Europe's climate and energy targets*, EEA Report No 4/2015.

51 European Commission, *Proposal for a Directive of the European Parliament and of the Council amending Directive 2012/27/EU on energy efficiency*, COM(2016) 761 final of 30.11.2016.

52 Electricity and heat production accounts for 87 % these emissions. The rest mainly comes from petroleum refining and manufacture of solid fuels.

53 Covers organic, non-fossil material of biological origin which may be used as fuel for heat production or electricity generation.

54 Waste produced by households, industry, hospitals and the tertiary sector which contains biodegradable materials that are incinerated at specific installations.

55 At that time, this covered Belgium, France, Italy, Luxembourg, Netherlands and West Germany.

56 See Figure 10.

57 43 % of coal and other solid fuels is imported *versus* 89 % of crude oil and 69 % of natural gas (*Source:* Eurostat, *Energy dependence*, 2017).

58 Not only for electricity and heat generation but also for transport, industry and buildings (*Source:* Eurostat, *Energy dependence*, 2017).

59 A set of technologies aimed at capturing, transporting, and storing CO_2 emitted from power plants and industrial facilities. The goal of CCS is to prevent CO_2 from reaching the atmosphere by storing it in suitable underground geological formations.

60 According to the Commission, 'increased R&D efforts and commercial demonstration are essential over the next decade' (see European Commission, Climate Action, *Carbon Capture and Geological Storage*).

61 The mining, processing and transport of nuclear fuel and disposal of used fuel does lead to some greenhouse gas emissions, but far less than fossil-fuel power plants (*Source:* Nuclear Energy Institute, *Life-Cycle Emissions Analyses*).

62 European Commission, *Nuclear illustrative programme presented under Article 40 of the Euratom Treaty – Final (after opinion of the European Economic and Social Committee)*, COM(2017) 237 final of 12.05.2017. See also European Commission, *Conclusions of the 10th European Nuclear Energy Forum*, European Nuclear Energy Forum, 2015.

63 The report points out that the data has not been verified by the Commission, that the figure includes, for some Member States, the cost for decommissioning, and that additional information on costs and assumptions should be included in Member States' programmes 'in order to be able to conclude that the reported figures are accurate and complete'. European Commission, *Report from the Commission to the Council and the European Parliament on progress of implementation of Council Directive 2011/70/EURATOM and an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects*, COM(2017) 236 final of 15 May 2017.

64 Council Directive 2014/87/Euratom of 8 July 2014 amending Directive 2009/71/Euratom and establishing a Community framework for the nuclear safety of nuclear installations (OJ L 219, 25.07.2014, p. 42).

65 Council Directive 2011/70/Euratom of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste (O L 199/48, 02.08.2011, p. 48). See also European Commission, *Report from the Commission to the Council and the European Parliament on progress of implementation of Council Directive 2011/70/EURATOM and an inventory of radioactive waste and spent fuel present in the Community's territory and the future prospects*, COM(2017) 236 final of 15.05.2017.

66 Fusion produces energy by fusing atoms with low atomic mass, such as hydrogen, at extremely elevated pressures and high temperatures.

67 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently (OJ L 140, 05.06.2009, p. 16).

68 European Commission, *A policy framework for climate and energy in the period from 2020 to 2030*, COM(2014) 15 final of 22 January 2014 (2030 Climate and Energy Framework). See also European Commission, *Proposal for a directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources*, COM(2016) 767 final/2 of 23.02.2017.

69 Energy Transitions Commission, *Better energy, greater prosperity, Achievable paths to low-carbon energy systems*, 2017.

70 See for example European Commission, *EU Reference Scenario 2016 – Energy, transport and GHG emissions, Trends to 2050*, 2016: The levelised costs of renewable energy between 2015 and 2025 are expected to decrease by 29 % for photovoltaics, 12 % for onshore wind, 17 % for off-shore wind. See also IRENA, *The Power to Change: Solar and Wind Cost Reduction Potential to 2025*, 2016: The investment costs of renewable energy between 2015 and 2025 could fall by 43-65 % for utility-scale photovoltaics, 26 % for onshore wind, 35 % for off-shore wind.

71 European Commission, *Progress towards completing the Internal Energy Market*, COM(2014) 634 final of 13.10.2014.

72 These are based on the Electricity Target Model and Gas Target Model, which define how markets should function. Some of the network codes are still under development.

73 Directives 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity (OJ L 27, 30.1.1997 p.20) and 98/30/EC of the European Parliament and of the Council of 22 June 1998 concerning common rules for the internal market in natural gas (OJ L 204, 21.07.1998, p. 1).

74 Directives 2003/54/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in electricity – Statements made with regard to decommissioning and waste management activities (OJ L 176, 15.07.2003, p. 37) and 2003/55/EC of the European Parliament and of the Council of 26 June 2003 concerning common rules for the internal market in natural gas (OJ L 176, 15.07.2003, p. 57).

75 Amongst other things, these measures require Member States to ensure that third parties can access transmission and distribution systems based on tariffs that would be applied to all eligible customers; to satisfy the EU competition rules, ensuring that no party is discriminated against; and to establish independent regulatory authorities responsible for securing effective competition and the efficient functioning of the market.

76 European Commission, *Inquiry into the European gas and electricity sectors*, SEC(2006) 1724 FIN of 10.01.2007.

77 Regulation (EC) No 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators (OJ L 211, 14.08.2009, p. 1).

78 In February 2011, the European Council set the objective of completing the internal energy market by 2014 and developing interconnections to end the grid isolation of certain Member States by 2015 (European Council, Council conclusions of 4 February 2011).

79 *European Parliament resolution of 13 September 2016 on Towards a New Energy Market Design*, 2015/2322(INI); European Commission, *A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy*, COM(2015) 80 final of 25.02.2015.

80 See also European Commission, *Second Report on the State of the Energy Union*, 01.02.2017.

81 European Commission, *Clean Energy For All Europeans*, COM(2016) 860 final of 30.11.2016.

82 See European Commission, *European Energy Security Strategy*, COM(2014) 330 final of 28.05.2014; European Commission, *A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy*, COM(2015) 80 final of 25.02.2015; European Council, *Outcome of the 3429th Council Meeting 14632/15, Transport, Telecommunications and Energy*, 26.11.2015; European Council, *Outcome of the 3472nd Council Meeting 9736/16, Transport, Telecommunications and Energy*, 07.06.2016; European Parliament, *European Parliament Resolution of 13 September 2016 on Towards a new Market Design*, (2015/2322(INI)) 13.09.2016.

83 Regulation (EU) No 994/2010 of the European Parliament and of the Council of 20 October 2010 concerning measures to safeguard security of gas supply (OJ L 295, 12.11.2010, p. 1); European Commission, *Proposal for a regulation concerning measures to safeguard the security of gas supply*, COM(2016)52/F1 of 16.02.2016; European Commission, *Proposal for a regulation of the European Parliament and of the Council on risk-preparedness in the electricity sector*, COM(2016) 862 final of 30.11.2016.

84 In the gas market, there is no direct interconnection target. Regulation (EU) No 994/2010 of the European Parliament and of the Council of 20 October 2010 (OJ L 295, 12.11.2010) concerning measures to safeguard security of gas supply seeks to ensure that there are alternative providers of gas available in every market. This rule obliges those Member States who are dependent on a single important pipeline, underground storage facility or other type of essential infrastructure, to make sure that demand on extremely cold days can be covered even if the main import infrastructure fails.

85 European Council, *Conclusions of the Barcelona European Council of 15 and 16 March 2002*. The target means that each Member State should have in place electricity cables that allow at least 10 % of the electricity that is produced by their power plants to be transported across its borders to neighbouring countries.

86 European Council, *Conclusions of the European Council 169/14 of 23 and 24 October 2014*.

87 Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure (OJ L 115, 25.04.2013).

88 European Commission, *Second Report on the State of the Energy Union*, 01.02.2017.

89 Wholesale prices are used to compare energy prices because, contrary to retail prices, they do not contain taxes, other surcharges and discounts.

90 European Commission, *Executive summary of the Impact Assessment*, SWD(2016) 410 final of 30.11.2016.

91 This does not incorporate the proposed 2030 Energy and Climate policy framework.

92 On 5 April 2017, the Union of Electric Industries, EURELECTRIC, announced its intention not to invest in new-build coal-fired power plants after 2020. The statement was not supported by its Polish and Greek member associations.

93 *Can Oxford save the world*, Oxford Today, Volume 29 No 2, Roger Highfield, 2017.

94 European Commission, *Commission Impact Assessment*, SWD(2016) 410 final of 30.11.2016; Capgemini, *European Energy Markets Observatory – 18th Edition*, 2016.

95 European Commission, *Evaluation Report covering the Evaluation of the EU's regulatory framework for electricity market design and consumer protection in the fields of electricity and gas – Evaluation of the EU rules on measures to safeguard security of electricity supply and infrastructure investment (Directive 2005/89)*, SWD(2016) 412 final of 30.11.2016. To address this issue, the Commission has put forward proposals on the market design.

96 Except for small installations and in certain exceptional cases to be justified by the Member State.

97 EU storage capacity is almost exclusively from pumped hydropower, mainly located in mountains. Other forms of storage are either in minimal use or at an early development stage (see Inline, *Energy storage technologies – will they be able to flourish within current regulatory frameworks?*, 03.08.2016).

98 Demand management consist of a reduction of consumption in times of supply scarcity. However, currently, few individual electricity customers are able to respond to price variations in real time and to reduce their consumption during peak hours when prices are high (see European Commission, *Final Report of the Sector Inquiry on Capacity Mechanisms*, COM(2016) 752 final of 30.11.2016).

99 In November 2016, the Commission proposed the characteristics of an ideal capacity mechanism, designed to avoid market distortions. European Commission, *Final Report of the Sector Inquiry on Capacity Mechanisms*, COM(2016) 752 final of 30.11.2016.

100 Eurelectric, *European electricity sector gears up for the energy transition*, 05.04.2017.

101 European Commission, *Second Report on the State of the Energy Union*, 01.02.2017.

102 European Commission, *Communication Clean Energy For All Europeans*, COM(2016) 860 final of 30.11.2016.

103 European Commission, *Proposal for a Directive on common rules for the internal market on electricity*, COM(2016) 864 final/2 of 23.02.2017.

104 The regulatory aspects of electricity storage have so far not been addressed at EU level. Currently, storage faces technological and regulatory issues (see European Commission, *Energy storage – the role of electricity*, SWD(2017) 61 final of 01.02.2017).

105 European Commission, *Proposal for a Regulation of the European Parliament and of the Council on the Governance of the Energy Union*, COM(2016) 759 final of 30.11.2016.

106 Especially through the *Energy Efficiency Directive* (Directive 2012/27/EU of 25.10.2012); See also Ademe, *Energy Efficiency Trends and Policies in Industry*, September 2015 for more details.

107 Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control) (OJ L 334, 17.12.2010, p. 17).

108 Article 8 of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency (OJ L 315, 14.11.2012, p. 1).

109 For example, in the UK, nine coal fired installations opted out of Directive 2001/80/EC of the European Parliament and of the Council of 23 October 2001 on the limitation of emissions of certain pollutants into the air from large combustion plants (OJ L 309, 27.11.2001), effectively closing prematurely.

110 Global warming potential is a relative measure of how much heat a tonne of a specific greenhouse gas traps in the atmosphere in comparison to the amount of heat trapped by a similar mass of carbon dioxide.

111 European Commission, *Putting energy efficiency first: consuming better, getting cleaner*, 30.11.2016.

112 European Commission, Proposal for a directive of the European Parliament and of the Council amending Directive 2010/31/EU on the energy performance of buildings, COM(2016) 765 final, 30.11.2016.

113 Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (OJ L 153, 18.6.2010, p. 13).

114 Energy Efficiency Directive (Directive 2012/27/EU, OJ L 315, 25.10.2012); 3% of floor space of public buildings occupied by central government should be renovated each year from 2014.

115 European Commission, *Revision of the Directive on the Energy Performance of Buildings*, COM(2016) 765 final of 30.11.2016. It covers topics including, amongst others, renovation targets, energy performance certificates, inspection, monitoring and control of energy use and the presence of electrical recharging points.

116 Such as cooking equipment, refrigerators, vacuum cleaners, washing machines, electronic equipment.

117 Through the comitology procedure, i.e. with the assistance of committees of representatives from EU countries.

118 Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (OJ L 285, 31.10.2009, p. 10).

119 Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products (OJ L 153, 18.6.2010, p. 1). The Commission has proposed an amendment to this directive (Proposal for a Regulation of the European Parliament and of the Council setting a framework for energy efficiency labelling and repealing Directive 2010/30/EU, COM(2015) 341 final of 15.7.2015).

120 European Commission, *Report on the indication of labelling and standard product information of the consumption of energy and other resources by energy-related products*, COM(2015) 345 final of 15.7.2015.

121 This figure does not include the electrical consumption of vehicles, for example trains, as emissions linked to electricity production are accounted for in the energy supply sector.

122 Directive 1999/94/EC of the European Parliament and of the Council of 13 December 1999 relating to the availability of consumer information on fuel economy and CO2 emissions in respect of the marketing of new passenger cars (OJ L 12, 18.1.2000, p. 16).

123 Regulations (EU) No 333/2014 (OJ L 103, 5.4.2014, p. 15) and (EU) No 253/2014 (OJ L 84, 20.3.2014, p. 38).

124 The International Council on Clean Transportation (ICCT) has estimated the gap between emissions measured and real world emissions at 35% (ICCT, *Quantifying the impact of real-world driving on total CO_2 emissions from UK cars and vans*, September 2015). This gap is due to, for example, tests performed in laboratory setting not being representative of real driving conditions (e.g. no optional equipment included) as well as the overestimation of the benefits of new technology. In addition, a number of tolerances and flexibilities can potentially be exploited by vehicles manufacturers. This received significant media and political attention in 2015, when it was discovered that a major EU car manufacturer had for several years been using software to manipulate the emissions performance of its cars (see, for example, European Environmental Agency, *Air quality in Europe — 2016 report*, 2016 and the 'Dieselgate' inquiry committee of the European Parliament). The debate concerned mostly the emission of nitrogen oxide (NOx) and other gases particularly harmful to human health, not CO_2. However, the two issues are linked, in the sense that the procedures for measuring emissions from cars underestimate both CO_2 and NOx emissions. In 2016, the Commission proposed to tighten the legislation (European Commission, *Proposal for a regulation on the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles*, COM(2016) 31 final of 27.01.2016). The Commission opened infringement procedures against eight Member States between December 2016 and May 2017.

125 A new global test procedure, the World Harmonised Light Vehicle Test Procedure, will be implemented to deliver more realistic and accurate carbon dioxide and fuel consumption values.

126 Lorries, road tractors, motor coaches, buses and trolley buses, special vehicles (*Source:* Eurostat).

127 European Commission, *Strategy for reducing Heavy-Duty Vehicles' fuel consumption and CO_2 emissions*, COM(2014) 285 final of 21.05.2014.

128 Monitoring and certifying emissions for HDV is more difficult than for cars. The large variety of models and a high degree of customisation make testing all models impossible. Therefore, trucks' emissions have to be simulated. For that purpose, the Commission has developed a computer tool (VECTO) to calculate CO_2 emissions from new vehicles.

129 European Commission, Climate action, *Reducing CO_2 emissions from Heavy-Duty Vehicles*.

130 European Commission, *Proposal for a regulation of the European Parliament and of the Council on the monitoring and reporting of CO2 emissions from and fuel consumption of new heavy-duty vehicles*, COM(2017) 279.

131 The EU and Iceland, Liechtenstein and Norway.

132 European Commission, Climate action, *Reducing emissions from aviation*.

133 Emitting more than 10 000 tonnes of CO_2e per year.

134 Certified Emission Reductions (CERs) and Emission Reduction Units (ERUs). See UNFCCC, *International Emissions Trading, United Nations Framework Convention on Climate Change*.

135 2.94 % of total EU Greenhouse gas emissions.

136 International Maritime Organisation, *Third IMO Greenhouse Gas Study 2014*.

137 European Commission, *Integrating maritime transport emissions in the EU's greenhouse gas reduction policies*, COM(2013) 479 final of 28.06.2013.

138 Regulation (EU) 2015/757 of the European Parliament and of the Council of 29 April 2015 on the monitoring, reporting and verification of carbon dioxide emissions from maritime transport (OJ L 123; 19.5.2015, p. 55).

139 In contrast to the EU scheme, the global scheme only applies to large ships (10 000 gross tonnes) and data will be collected in an anonymised form.

140 Such as taxes, administrative authorisations and quotas. See Council Directive 92/ 106/EEC of 7 December 1992 on the establishment of common rules for certain types of combined transport of goods between Member States (OJ L 368, 17.12.1992, p. 38).

141 Regulation (EU) No 1316/2013 of the European Parliament and of the Council of 11 December 2013 establishing the Connecting Europe Facility (OJ L 348, 20.12.2013, p. 129).

142 Down from 77 % in 2009. See Eurostat, *Freight transport statistics – modal split*.

143 Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (OJ L 140, 05.06.2009, p. 16).

144 Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure (OJ L 307, 28.10.2014, p. 1).

145 Mainly bioethanol (made from sugar and cereal crops) used to replace petrol, and biodiesel (made mainly from vegetable oils) used to replace diesel.

146 The remainder being electricity (Eurostat, *Shares (Renewables)*, 2017).

147 Wandesforde-Smith, G., Kurdusiewicz, I., *Bursting the Biofuel Bubble: Comparative Dynamics of Transitions to Freedom from Oil*, SSRN, March 2008, revised in March 2015; World Energy Council, *Biofuels: Policies, Standards and Technologies*, 2010.

148 European Commission, *Study on Technical Assistance in Realisation of the 2016 Report on Renewable Energy, in preparation of the Renewable Energy package for the Period 2020-2030 in the European Union*, ENER/C1/2014-688, 22.02.2017.

149 In 2015, the ILUC directive limited the share of biofuels from crops grown on agricultural land that can be counted towards the 2020 renewable energy targets to 7 % (Directive (EU) 2015/1513 of the European Parliament and of the Council of 9 September 2015 amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources (OJ L 239, 15.9.2015, p. 1-29)). In 2017, the Commission has proposed to lower this cap of 7 % to 3.8 % by 2030 (European Commission, *Proposal for a Directive on the Promotion of the Use of Energy from Renewable Sources*, COM(2016) 767 final/2 of 23.2.2017).

150 European Commission, *State of the Art on Alternative Fuels Transport Systems in the European Union*, July 2015.

151 European Commission Joint Research Centre, *An economic assessment of greenhouse gas mitigation policy options for EU agriculture*, 2016.

152 European Parliament, *The Consequences of Climate Change for EU agriculture, Follow-up to the COP21 – UN Paris Climate Change Conference*, AGRI Committee Study 2017. The global warming potential over a 100-year time span (GWP 100) of CO2 is 1, the GWP 100 value for methane is 21 and for nitrous oxide is 310. Based on UNFCCC figures.

153 Cross-compliance is based on two main sets of rules. The statutory management requirements are requirements selected from existing directives and regulations on environment, food safety, plant health, animal health and welfare. The standards for good agricultural and environmental conditions are additional rules applicable only to beneficiaries of CAP payments. They impose sustainable practices related to agricultural land and deal with the protection of water, of the soil and carbon stock, and the maintenance of land and landscape features.

154 'Green payments' compensate farmers for three practices beneficial for the environment and climate change:
- ecological focus areas on 5 % of the arable area, with a view to safeguarding and improving biodiversity on farms;
- crop diversification, with benefits for soil quality;
- maintenance of permanent grassland with its associated environmental benefits, in particular carbon sequestration, and protection of environmentally sensitive grassland (European Commission, *Review of greening after one year*, 2016).

155 See OECD, *Cost-effectiveness of greenhouse gas mitigation measures for agriculture: a literature review*, OECD Food, Agriculture and Fisheries Papers, 1.8.2015; JRC, *An economic assessment of GHG mitigation policy options for EU agriculture*, EcAMPA 1, 2015; JRC, *An economic assessment of GHG mitigation policy options for EU agriculture*, EcAMPA 2, 2016.

156 European Parliament, *The Consequences of Climate Change for EU agriculture, Follow-up to the COP21 – UN Paris Climate Change Conference*, AGRI Committee Study 2017, p. 10.

157 See for example European Commission, *Impact assessment accompanying the document proposal for a regulation of the European Parliament and of the Council on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 for a resilient Energy Union and to meet commitments under the Paris Agreement and amending Regulation No 525/2013 of the European Parliament and the Council on a mechanism for monitoring and reporting greenhouse gas emissions and other information relevant to climate change*, SWD(2016) 247 final of 20.07.2016, p. 22.

158 Decision No 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 (OJ L 165, 18.06.2013, p. 80).

159 European Commission, *Proposal for a regulation on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry into the 2030 climate and energy framework*, COM(2016) 479 final of 20.07.2016.

160 The proposed maximum amount for the EU is 280 million tonnes of CO_2 equivalent for the period 2020 to 2030, with limits set for each Member State (national ceilings are based on the weight of the agricultural sector in each of these Member States).

161 European Commission, *Impact assessment accompanying the document proposal for a regulation of the European Parliament and of the Council on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 for a resilient Energy Union and to meet commitments under the Paris Agreement and amending Regulation No 525/2013 of the European Parliament and the Council on a mechanism for monitoring and reporting greenhouse gas emissions and other information relevant to climate change*, SWD(2016) 247 final of 20.07.2016, p. 73.

162 Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste (OJ 182, 16.07.1999, p. 1) and Directive 2000/76/EC of the European Parliament and of the Council of 4 December 2000 on the incineration of waste (OJ L 332, 28.12.2000).

163 Ademe, *Recycling in France: Results of the environmental assessment*, May 2017.

164 European Commission, *Closing the loop – An EU action plan for the Circular Economy*, COM(2015) 614 final of 2.12.2015; European Commission, *First report on the implementation of the circular economy action plan*, COM(2017) 33 final of 26.01.2017.

165 *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, IPCC, 2014.

166 European Commission Joint Research Centre, *Climate Impacts in Europe*, the JRC PESETA II project, 2014. Data from Dosio and Paruolo 2011 and Dosio et al 2012.

167 Dosio, A., Paruolo, P. (2011). Bias correction of the ENSEMBLES high-resolution climate change projections for use by impact models: Evaluation on the present climate. Journal of Geophysical Research D: Atmospheres, 116(16), DOI: 10.1029/2011JD015934. Dosio, A., Paruolo, P., & Rojas, R. (2012). Bias correction of the ENSEMBLES high resolution climate change projections for use by impact models: Analysis of the climate change signal. Journal of Geophysical Research D: Atmospheres, 117(17), DOI:10.1029/2012JD017968.

168 Munich RE NatCatSERVICE.

169 The costs of a 100-year storm event could double by 2080 (*Source:* European Commission, *The climate change challenge for European regions*, March 2009).

170 P. Zdruli, *Land resources of the Mediterranean: Status, pressures, trends and impacts on future regional development*, International Centre for Advanced Mediterranean Agronomic Studies, 2012; and Zdruli, P., *Land resources of the Mediterranean: status, pressures, trends and impacts on future regional development*, Land Degradation & Development 25.4 (2014): 373-384.

171 Bulgaria, Cyprus, Greece, Spain, Hungary, Italy, Latvia, Malta, Portugal, Romania, Slovakia and Slovenia have declared to be affected by desertification under the United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification (UNCCD) (*Source:* European Commission, *Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions The implementation of the Soil Thematic Strategy and ongoing activities*, COM(2012) 46 final of 13.02.2012).

172 European Environment Agency, *Climate change, impacts and vulnerability in Europe 2016*, 2017.

173 For example, between 1980 to 2013, losses resulting from climate extremes across the EU have been estimated to be 368 billion euros. European Environment Agency, *Climate change, impacts and vulnerability in Europe 2016*, 2017. The EEA used the entire Munich RE dataset, which is one of the most comprehensive natural catastrophe loss databases.

174 European Commission Joint Research Centre, *Peseta II project*, the JRC PESETA II project, 2014.

175 For example, effects on fish health, see Marcogliese, D.J., *The impact of climate change on the parasites and infectious diseases of aquatic animals*, 2008; Wilcox, C., *Changing Oceans Breed Disease*, 01.07.2016. Temperature increase and changes in water composition can also trigger fish migrations.

176 The Commission has acknowledged an increasing demand for green jobs, with the energy efficiency sector expected to employ 2 million people by 2020, and the renewable energy sector 3 million. See the Commission Staff Working Document 'Exploiting the employment potential of green growth' of 18 April 2012.

177 European Environment Agency, *Climate change, impacts and vulnerability in Europe 2016*, 2017. European Commission, *An EU Strategy on adaptation to climate change*, COM(2013)216 final of 16.4.2013.

178 Kelley, C. et al., *Climate change in the Fertile Crescent and implications of the recent Syrian drought*, 2015; Gleick, P.H., *Water, Drought, Climate Change, and Conflict in Syria*, 2014; Voski, A., *The Role of Climate Change in Armed Conflicts across the Developing World and in the Ongoing Syrian War*, 2016. See also the ECC Platform library on the role of climate change in the civil war.

179 Richard Youngs, *Climate Change and EU Security Policy: An Unmet Challenge*, Carnegie Europe, 21.05.2014.

180 European Commission, *An EU Strategy on adaptation to climate change*, COM(2013)216 final of 16.04.2013.

181 European Commission, *An EU Strategy on adaptation to climate change*, COM(2013)216 final of 16.04.2013, page 6.

182 Croatia, Cyprus, Bulgaria, Hungary, Latvia, Luxembourg did not submit their national adaptation strategy (Climate-ADAPT website).

183 Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy (OJ L 327, 22.12.2000, p. 1).

184 Directive 2007/60/EC on the assessment and management of flood risks (OJ L288, 06.11.2007, p. 27).

185 Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (OJ L 20, 26.01.2010, p. 7).

186 Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (OJ L 206, 22.07.1992, p. 7).

187 European Commission, *A Roadmap for moving to a competitive low carbon economy in 2050*, COM(2011) 112 final of 08.03.2011; Rockström, J. Gaffney, O., Rogelj, J. *et. al., A roadmap for rapid decarbonisation*, Science, Volume 355 Issue 6331, 24.03.2017.

188 Innovation and research are also funded under the European Structural and Investments Funds or under the NER 300 programme for demonstrating environmentally safe carbon capture and storage (CCS) and innovative renewable-energy technologies on a commercial scale. NER 300 stands for the 300 million emission allowances from the ETS 'New Entrants' Reserve' which funds this programme. The Commission has proposed to extend this programme for phase 4 of the ETS (see paragraph 34).

189 I24C and Cap Gemini, *Scaling Up Innovation in the Energy Union*, 2016, referred to in the European Commission, *Communication on accelerating clean energy innovation*, COM(2016) 763 final of 30.11.2016; European Commission, *Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation* (C/2015/6317) of 15.09.2015.

190 I24C, *Scaling up innovation in the Energy Union*, 2016, p. 14.

191 European Commission, *Communication on accelerating clean energy innovation*, COM(2016) 763 of 30.11.2016, 2016.

192 European Commission, *Impact assessment accompanying the document 'Proposal for a Directive of the European Parliament and of the Council amending Directive 2012/27/EU on Energy Efficiency'*, SWD(2016) 405 final/2 of 6.12.2016, Table 22 (Scenario EUCO30 – *Source:* Primes model).

193 Ciscar, M. et al., *Climate Impacts in Europe. The JRC PESETA II Project*, 2014.

194 A model used by the OECD shows that if firms and households were unable to adapt at all to climate change, the costs associated with it could double (OECD, *The Economic Consequences of Climate Change*, 03.11.2015).

195 European Commission, *Implementing the Paris Agreement – Progress of the EU towards the at least -40 % target*, COM(2016) 70 final of 08.11.2016.

196 For example, the Natural Capital Financing Facility (NCFF), LIFE for energy efficiency (NCFF and PF4E), or Green for Growth fund (GFG).

197 The EFSI plan aimed to leverage 315 billion euro of total investment between 2015 and 2017. It has been extended under EFSI 2.0 to leverage 500 billion euro in 2015-2020. See European Commission, *Strengthening European Investments for jobs and growth: Towards a second phase of the European Fund for Strategic Investments and a new European External Investment Plan*, COM(2016) 581 final of 14.09.2016; *Implementing the Paris Agreement – Progress of the EU towards the at least -40 % target*, COM(2016) 707 final of 08.11.2016.

198 The industry and the European authorities have launched several public private partnerships, such as the Sustainable Process Industry through Resource and Energy Efficiency (European Commission, Research & Innovation).

199 See for example A.T. Kearney, *Adapting to the Inevitable*, A.T. Kearney's foresight series, Thinkforward, 2013; Pauw, W. P. et al., *Private finance for adaptation: do private realities meet public ambitions?*, 2014.

200 European Commission, *Better Regulation package*, 2016.

201 See the glossary or the Commission's website for more details about impact assessments (Commission, Better Regulation, *Guidelines on Impact Assessment*).

202 See the Commission's website for a comprehensive list of all impact assessments (Commission, *Impact Assessments*).

203 Climate Services provide data that support mitigation, adaptation and disaster risk management. Copernicus, previously known as Global Monitoring for Environment and Security and a key component of these services, is a European system for monitoring the Earth. It collects data from earth observation satellites and in situ sensors. One of its six thematic areas is climate change. The portal Climate-Adapt supports Europe in adapting to climate change by collecting and distributing information from research projects, case studies and best practices.

204 The Commission has recognised such limitations, see for example European Commission, *A Roadmap for moving to a competitive low carbon economy in 2050*, SEC(2011) 288 of 08.03.2011, 2011 and European Commission, *EU Reference Scenario 2016*, 2016.

205 For example, general equilibrium or macroeconomic models, which are used to assess the economic implications of policies, usually model income effects of one representative household. To analyse the distributional impacts across household income groups additional model extensions and model data are needed.

206 For example, climate change impacts water resources in many forms and subsequently impacts also water availability for hydropower; global warming influences the demand for heating and cooling.

207 INTOSAI, *Lima Declaration laying down fundamental principles of public auditing adopted by the International Organization of Supreme Audit Institutions*, 1977.

208 INTOSAI is the International Organisation for Supreme Audit Institutions.

209 EUROSAI is the European Organisation of Supreme Audit Institutions.

210 For example, the 2010 INTOSAI WGEA guidelines *Auditing the Government Response to Climate Change: Guidance for Supreme Audit Institutions*, 2010, or the 2012 *EUROSAI WGEA – Cooperative Audit: Adaptation to Climate Change – are Government prepared?*. Guidelines and reports are available at the INTOSAI WGEA and EUROSAI WGEA websites.

211 We also read public audit reports published earlier than 2012 when they addressed specific energy and climate challenges which were not, or rarely, covered in our sample. We also read reports from some regional public audit offices. However, we did not include these reports in our statistics, which should reflect the overall activity of EU national SAIs only and during the period January 2012 to March 2017 only.

212 Special Report No 16/2015 *Improving the security of energy supply by developing the internal energy market: more efforts needed*, ECA, 2015.

213 For example, different trading mechanisms; state interventions; development and implementation of network codes; and level of market integrity and transparency.

214 *Price regulation and its control by the Bulgarian Energy Regulator's on electricity, water and gas for the period 2007-2013*, Сметна палата на Република България, Bulgaria, 2013.

215 *The opening of the electricity market to competition: A non-completed construction*, Cour des Comptes, France, 2015.

216 Lithuania, Poland, Latvia, Denmark, Estonia, Sweden, Finland and Germany.

217 *The functioning and safety of the electricity grid*, Najwyższa Izba Kontroli, Poland, 2014.

218 *Measures for the implementation of the energy transition by the Federal Ministry of Economic Affairs and Energy*, Bundesrechnungshof, Germany, 2016.

219 *Renewable energy, savings and energy efficiency in the framework of the EU cohesion policy*, Corte dei Conti, Italy, 2012.

220 *Development and use of the renewable energy sources of electricity*, Najwyższa Izba Kontroli, Poland, 2012.

221 In Poland, the relevant provisions were adopted in 2015.

222 *Conditions for secure power transmission – Governance of Svenska Kraftnät in implementing the energy transition*, Riksrevisionen, Sweden, 2016.

223 Special Report No 6/2014 *Cohesion policy funds support to renewable energy generation - has it achieved good results?*, ECA, 2014.

224 *Performance audit on electrical energy market in the period 2010-2014*, Curtea de Conturi, Romania, 2015.

225 *Measures for the implementation of the energy transition by the Federal Ministry of Economic Affairs and Energy*, Bundesrechnungshof, Germany, 2016.

226 *Finances earmarked for the support of energy production from renewable energy*, Nejvyšší kontrolní úřad, Czech Republic, 2014.

227 *Renewable energy sources*, Ελεγκτική Υπηρεσία της Δημοκρατίας της Κύπρου, Cyprus, 2016.

228 *Report on the amendment of the legislation concerning the support for photovoltaics*, Rigsrevisionen, Denmark, 2014.

229 *Early contracts for renewable electricity*, National Audit Office, United Kingdom, 2014.

230 *Measures for the implementation of the energy transition by the Federal Ministry of Economic Affairs and Energy*, Bundesrechnungshof, Germany, 2016.

231 E.g. *Finances earmarked for the support of energy production from renewable energy*, Nejvyšší kontrolní úřad, Czech Republic, 2014; Special Report No 6/2014 *Cohesion policy funds support to renewable energy generation – has it achieved good results?*, ECA, 2014.

232 *Audit on the energy efficiency program in public administration*, Tribunal de Contas, Portugal, 2013.

233 *Auditing energy savings in public administration*, Najvyšší Kontrolný úrad, Slovakia, 2015.

234 *State budget funds provided for support of energy savings*, Nejvyšší kontrolní úřad, Czech Republic, 2015

235 *Energy savings in public institutions*, Rigsrevisionen, Denmark, 2015.

236 E.g. *Auditing energy savings in public administration*, Najvyšší Kontrolný úrad, Slovakia, 2015; *Projects on the energy efficiency of the housing stock and residential buildings in Bulgaria in the period 2012 to 2015*, Сметна палата на Република България, Bulgaria, 2015; *Performance audit of public funds for thermal rehabilitation of housing in Bucharest in 2010-2014*, Curtea de Conturi, Romania, 2014; *Audit on the energy efficiency program in public administration*, Tribunal de Contas, Portugal, 2013.

237 Special Report No 21/2012 *Cost-effectiveness of cohesion policy investments in energy efficiency*, ECA, 2012.

238 E.g. *Energy efficiency investments in public facilities*, Najwyższa Izba Kontroli, Poland, 2015; *Auditing energy savings in public administration*, Najvyšší Kontrolný úrad, Slovakia, 2015; *Performance audit of public funds for thermal rehabilitation of housing in Bucharest in 2010-2014*, Curtea de Conturi, Romania, 2014.

239 *Audit of funds disbursed to housing support – blocks of flats insulation*, Najvyšší Kontrolný úrad, Slovakia, 2017.

240 E.g. *Measures for the implementation of the energy transition by the Federal Ministry of Economic Affairs and Energy*, Bundesrechnungshof, Germany, 2016; *Efficiency of implementation of measures for the efficient energy use*, Računsko sodišče, Slovenia, 2013.

241 E.g. *Auditing energy savings in public administration*, Najvyšší Kontrolný úrad, Slovakia, 2015; *Energy efficiency investments in public facilities*, Najwyższa Izba Kontroli, Poland, 2015; *Audit on the energy efficiency program in public administration*, Tribunal de Contas, Portugal, 2013.

242 While we included audits on nuclear safety in our statistics, we did not integrate the related audit work in this section.

243 Special Report No 22/2016 *EU nuclear decommissioning assistance programmes in Lithuania, Bulgaria and Slovakia: some progress made since 2011, but critical challenges ahead*, ECA, 2016.

244 *The cost of nuclear energy: Update 2014*, Cour des Comptes, France, 2014.

245 *The maintenance of nuclear plants*, Cour des Comptes, France, 2016.

246 *Progress on the Sellafield site: an update*, National Audit Office, United Kingdom, 2015.

247 *Expenditure of subsidies for electricity-intensive companies to compensate increased electricity prices due to emissions trading*, Bundesrechnungshof, Germany, 2016.

248 *Emissions trading to limit climate change: Does it work?*, Denmark, Finland, Latvia, Lithuania, Norway, Poland, Sweden, 2012.

249 *Federal State income from the emission trading system*, Bundesrechnungshof, Germany, 2014.

250 *The implementation by France of the package Energy-Climate*, Cour des Comptes, France, 2014.

251 E.g. *Climate-related taxes – Who pays?*, Riksrevisionen, Sweden, 2012; *Compliance of the Greenhouse Gas Emission Allowances Administration with Legal Requirements and Effectiveness of the System in Latvia*, Latvijas Republikas Valsts Kontrole, Latvia, 2012; *Audit on CO_2 control and reduction mechanisms – National Allocation Plan for Emission Allowances 2008-2012 and Portuguese Carbon Fund*, Tribunal de Contas, Portugal, 2011.

252 *Energy efficiency in industry - effects of central government action*, Riksrevisionen, Sweden, 2013.

253 *Finnish Climate Change Policies – A summary of audits*, Valtiontalouden tarkastusvirasto, Finland, 2012.

254 *Federal State income from the emission trading system*, Bundesrechnungshof, Germany, 2014.

255 *Climate-related taxes – Who pays?*, Riksrevisionen, Sweden, 2012.

256 *Expenditure of subsidies for electricity-intensive companies to compensate increased electricity prices due to emissions trading*, Bundesrechnungshof, Germany, 2016.

257 E.g. *Special report regarding the implementation of the Kyoto protocol*, Cour des Comptes, Luxembourg, 2014; *Federal State income from the emission trading system*, Bundesrechnungshof, Germany, 2014; *Audit on CO_2 control and reduction mechanisms – National Allocation Plan for Emission Allowances 2008-2012 and Portuguese Carbon Fund*, Tribunal de Contas, Portugal, 2011.

258 E.g. *Emissions trading to limit climate change: Does it work?*, Denmark, Finland, Latvia, Lithuania, Norway, Poland, Sweden, 2012; *The VAT fraud on carbon quotas*, Cour des Comptes, France, 2012; *Functioning of the greenhouse gas Emissions Administration System and ETS*, Najwyższa Izba Kontroli, Poland, 2012.

259 Special Report No 6/2015 *The integrity and implementation of the EU ETS*, ECA, 2015.

260 For example, a 2014 ECA audit found poor value for money in EU-funded airport infrastructure, resulting in oversizing of infrastructures and in over-capacity (Special Report No 21/2014 *EU-funded airport infrastructures: poor value for money*, ECA, 2014). In the Special Report No 5/2013 *Are EU Cohesion Policy funds well spent on roads?* (ECA, 2013), we concluded that the road projects partly delivered results and fulfilled their purpose, but that insufficient attention was paid to ensuring cost-effectiveness of the projects.

261 *Vehicle Emissions Control Schemes*, Ufficcju Nazzjonali tal-Verifika, Malta, 2012.

262 E.g. *Funds earmarked for the interoperability on the current railways*, Nejvyšší kontrolní úřad, Czech Republic, 2017; *Sustainable Freight Transport – Intermodal Network; Follow-up Audit*, Rechnungshof, Austria, 2015; *Financial means for the development and modernisation of waterways and ports and the development of the multimodal freight transport*, Nejvyšší kontrolní úřad, Czech Republic, 2014.

263 Special Report No 1/2015 *Inland Waterway Transport in Europe: No significant improvements in modal share and navigability conditions since 2001*, ECA, 2015.

264 Special Report No 8/2016 *Rail freight transport in the EU: still not on the right track*, ECA, 2016.

265 Special Report No 23/2016 *Maritime transport in the EU: in troubled waters — much ineffective and unsustainable investment*, ECA, 2016.

266 E.g. Special Report No 18/2016 *The EU system for the certification of sustainable biofuels*, ECA, 2016; *Biofuels: improved results, necessary adjustments*, Cour des Comptes, France, 2016; *EU and National objectives for the production and use of biofuels for the period 2008-2012*, Сметна палата на Република България, Bulgaria, 2015; *Audit on biofuels production and blending*, Tribunal de Contas, Portugal, 2014; *The use of biofuels and biocomponents in transport*, Najwyższa Izba Kontroli, Poland, 2014; *Meeting the Slovak objectives and targets defined by the EU in the field of biofuels for transport*, Najvyšší Kontrolný úrad, Slovakia, 2014; *Biofuels support policy*, Cour des Comptes, France, 2012.

267 Special Report No 18/2016 *The EU system for the certification of sustainable biofuels*, ECA, 2016.

268 E.g. *EU and National objectives for the production and use of biofuels for the period 2008-2012*, Сметна палата на Република България, Bulgaria, 2015; *Audit on biofuels production and blending*, Tribunal de Contas, Portugal, 2014; *The use of biofuels and biocomponents in transport*, Najwyższa Izba Kontroli, Poland, 2014.

269 Indicative trajectory referred to in the Renewable Energy Directive and setting indicative national targets for each period of two years between 2011 and 2018.

270 *Biofuels: improved results, necessary adjustments*, Cour des Comptes, France, 2016.

271 *Biofuels support policy*, Cour des Comptes, France, 2012.

272 *Meeting the Slovak objectives and targets defined by the EU in the field of biofuels for transport*, Najvyšší Kontrolný úrad, Slovakia, 2014.

273 In 2012, the ECA published an audit on the additional money allocated to the CAP under the 'health check', part of which was supposed to provide funding for EU priorities such as climate change renewable energy and energy efficiency investments by agricultural holdings (Special Report No 8/2012 *Targeting of aid for the modernisation of agricultural holdings*, ECA, 2012).

274 *Special report regarding forest regeneration works to improve the environment quality through the afforestation of damaged lands, ecological restoration and sustainable management of forests*, Curtea de Conturi, Romania, 2015; *Deforestation and compensation – Implementation of deforestation compensation duty and the functioning of the Forest Compensation Fund*, Cour des Comptes, Belgium, 2016.

275 Special Report No 24/2014 *Is EU support for preventing and restoring damage to forests caused by fire and natural disasters well managed?*, ECA, 2014.

276 *Forest Permanent Fund, Fund for the Conservation of Nature and Biodiversity and Baixo Sabor Hydroelectric Fund*, Tribunal de Contas, Portugal, 2017.

277 *Implementation of the Programme of Funding of General Forestry Needs*, Valstybės kontrolė, Lithuania, 2016.

278 *The aid to the industry forest-wood*, Cour des Comptes, France, 2014.

279 E.g. *Audit on the licensing and operation of solid waste landfills*, Tribunal de Contas, Portugal, 2015; *Performance of regional waste management systems*, Valstybės kontrolė, Lithuania, 2013; *Effectiveness and efficiency of funds use in actions of waste management and greening of areas affected by industrial activities for the period 2011- 2013*, Curtea de Conturi, Romania, 2013; *Coordinated audit on the enforcement of the European Waste Shipment Regulation*: Joint report based on eight national audits from Bulgaria, Greece, Hungary, Ireland, Netherlands, Norway, Poland, Slovenia, 2012; Special Report 20/2012 *Is structural measures funding for municipal waste management infrastructure projects effective in helping Member States achieve EU waste policy objectives?*, ECA, 2012.

280 E.g. *Domestic waste management in Ile-de-France: Targets not reached*, Cour des Comptes, France, 2017; *Is the charge for household waste management calculated by SIA 'ZAAO' traceable?*, Latvijas Republikas Valsts Kontrole, Latvia, 2017; *Activity of the state and local governments in the organisation of treatment of household waste*, Riigikontroll, Estonia, 2016; *Management of municipal waste*, Računsko sodišče, Slovenia, 2015; *Municipal Waste Management Compliance with Planned Objectives and Legal Requirements*, Latvijas Republikas Valsts Kontrole, Latvia, 2015; *Oversight of three PFI waste projects*, National Audit Office, UK, 2014; *Performance of regional waste management systems*, Valstybės kontrolė, Lithuania, 2013.

281 Special Report No 34/2016 *Combating Food Waste: an opportunity for the EU to improve the resource-efficiency of the food supply chain*, ECA, 2016.

282 E.g. *The effectiveness of prevention and overcoming the consequences of floods*, Сметна палата на Република България, Bulgaria, 2016; *Duties of the managing bodies of the National Flood Protection Program*, Bundesrechnungshof, Germany, 2016; *Strategic plans and programmes to reduce the hydrogeological risk*, Corte dei Conti, Italy, 2015.

283 E.g. *Efficiency of the use of European funds for flood protection*, Računsko sodišče, Slovenia, 2014; *Lessons learned from the 2010 floods on the Atlantic coast (Xynthia) and in the Var*, Cour des Comptes, France, 2012.

284 E.g. *Development of plans for managing flood risk*, Сметна палата на Република България, Bulgaria, 2016; *Strategic planning for flood risk management*, Office of the Comptroller and Auditor General, Ireland, 2015; *Strategic plans and programmes to reduce the hydrogeological risk*, Corte dei Conti, Italy, 2015; *Reducing the effects of droughts and floods by enhancing small-scale water retention*, Najwyższa Izba Kontroli, Poland, 2015; *Efficiency of the use of European funds for flood protection*, Računsko sodišče, Slovenia, 2014.

285 E.g. *Performance audit regarding the efficiency and effectiveness of programs and measures taken in order to prevent and remove the effects of floods in Romania during the 2005-2013*, Curtea de Conturi, Romania, 2014; *Lessons learned from the 2010 floods on the Atlantic coast (Xynthia) and in the Var*, Cour des Comptes, France, 2012.

286 E.g. Special Report No 4/2014 *Integration of EU water policy objectives with the CAP: a partial success*, ECA, 2014; *Strategic flood risk management*, National Audit Office, United Kingdom, 2014; *Efficiency of the use of European funds for flood protection*, Računsko sodišče, Slovenia, 2014; The functioning of the system of flood protection for the river Serafa, Najwyższa Izba Kontroli, Poland, 2013; *Execution of the tasks in the Oder river basin water management in the Opolskie region with particular regard to flood protection*, Najwyższa Izba Kontroli, Poland, 2012; *Water resource management for agriculture (rural development programme 2007-2013)*, Najwyższa Izba Kontroli, Poland, 2012.

287 For example, auditing the implementation of the European Water Framework Directive: *Implementation of the European Framework Directive on Water in the Walloon region – Assessment of the water bodies quality management*, Cour des Comptes, Belgium, 2016; *Management of Water Resources in Cyprus*, Ελεγκτική Υπηρεσία της Δημοκρατίας της Κύπρου, Cyprus, 2016.

288 This covers both inside and outside the EU. For example, in our 2016 report on the EU's response to disasters outside the EU, we assessed how the EU had responded to three recent international disasters, including the 2014 floods in the Western Balkans. We concluded that the EU facilitated on-the-ground coordination of EU Member State response efforts – including through the provision of EU satellite maps and experts – to improve the decision-making process, as well as facilitating a coordinated, phased withdrawal of EU teams (Special Report No 33/2016 *Union Civil Protection Mechanism: the coordination of responses to disasters outside the EU has been broadly effective*, ECA, 2016). For an example of audit on mechanisms dealing with disasters inside a Member States, see *The prevention fund against major natural risks*, Cour des Comptes, France, 2016.

289 *Adaptation to climate change – are governments prepared?*, EUROSAI, 2012. SAIs from within and outside the EU contributed: Austria, Bulgaria, Cyprus, European Court of Auditors, Malta, Netherlands, Norway, Russia and Ukraine.

290 *The implementation by France of the package Energy-Climate*, Cour des Comptes, France, 2014.

291 E.g. *Report on public funding provided to energy research, development and demonstration*, Rigsrevisionen, Denmark, 2013; *Swedish climate research – what are the Swedish costs and effects?*, Riksrevisionen, Sweden, 2012; *Support for energy and climate technology*, Valtiontalouden tarkastusvirasto, Finland, 2011.

292 *Carbon Capture and Storage: the second competition for government support*, National Audit Office, United Kingdom, 2017; *Carbon capture and storage: Lessons from the competition for the first UK demonstration*, National Audit Office, United Kingdom, 2012; *Alternative methods of coal use to produce gas and liquid fuels*, Najwyższa Izba Kontroli, Poland, 2015.

293 The only audit report we found which dealt with climate finance in developing countries was one that we had published in 2013: Special Report No 17/2013 *EU climate finance in the context of external aid*, ECA, 2013.

294 Special Report No 31/2016 *Spending at least one euro in every five from the EU budget on climate action: ambitious work underway, but at serious risk of falling short*, ECA, 2016.

295 *Climate-related taxes – Who pays?*, Riksrevisionen, Sweden, 2012.

296 *The efficiency of tax expenditures related to sustainable development*, Cour des Comptes, France, 2016. The audit report uses the term 'sustainable' taxes expenditure, which in their audit concerns mainly the environmental and climate dimensions of sustainability.

297 E.g. *Are Funds Intended for Reducing Climate Changes, Administered by the Ministry of Environmental Protection and Regional Development, Planned and Used in an Effective Manner and in Accordance with Requirements Set Forth in Regulatory Enactments?*, Latvijas Republikas Valsts Kontrole, Latvia, 2017; *The implementation by France of the package Energy-Climate*, Cour des Comptes, France, 2014. *Mitigating climate change*, Valtiontalouden tarkastusvirasto, Finland, 2011.

298 E.g. *Energy policy: need for coherence*, Algemene Rekenkamer, Netherlands, 2015; *The implementation by France of the package Energy-Climate*, Cour des Comptes, France, 2014; *Climate for the money? Audits within the climate area 2009-2013*, Riksrevisionen, Sweden, 2013; *Finnish Climate Change Policies – A summary of audits*, Valtiontalouden tarkastusvirasto, Finland, 2012.

299 Special Report No 16/2015 *Improving the security of energy supply by developing the internal energy market: more efforts needed*, ECA, 2015.

300 *Climate-related taxes – Who pays?*, Riksrevisionen, Sweden, 2012.

301 *State's efforts of reducing greenhouse gas emissions*, Riigikontroll, Estonia, 2009.

302 *Findings on the management and trading of greenhouse gas emissions certificates*, Curtea de Conturi, Romania, 2011.

303 *Trading System of Greenhouse Gas Emissions Allowances*, Valstybės kontrolė, Lithuania, 2012.

304 *Audit on CO_2 control and reduction mechanisms*, Tribunal de Contas, Portugal, 2011.

305 Treaty on the Functioning of the European Union (see paragraph 12).

306 See also OECD, *The Economic Consequences of Climate Change*, OECD Publishing, Paris, 2015.

307 *Source:* Eurostat.

308 Directorate Generals for Economic and Financial Affairs, Internal Market, Industry, Entrepreneurship and SMEs, Competition, Employment, Social Affairs and Inclusion, Agriculture and Rural Development, Energy, Mobility and Transport, Climate Action, Environment, Research and Innovation, Maritime Affairs and Fisheries, Financial Stability, Financial Services and Capital Markets Union, Regional and Urban Policy, Migration and Home Affairs, Justice and Consumers, Neighbourhood and Enlargement Negotiations, International Cooperation and Development, European Civil Protection and Humanitarian Aid Operations, Eurostat and the Secretariat-General.

309 We did not retain audit reports related to:
- financial statements (financial audits);
- energy companies;
- local infrastructure projects not related to climate e.g. road construction;
- road/ rail/ air safety or maintenance;
- toll collection;
- medical waste;
- water quality or water pollution;
- natural disasters with no link with climate change;
- agriculture with no link with energy or climate change;
- biodiversity with no link to climate change (e.g. performance of national parks);
- administrative competences of national or regional organisations, administrative processes (authorisations, concessions, etc.) or contract compliance;
- other topics with limited links with energy and climate change.

310 228 reports from national SAIs and 41 reports from the ECA.

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