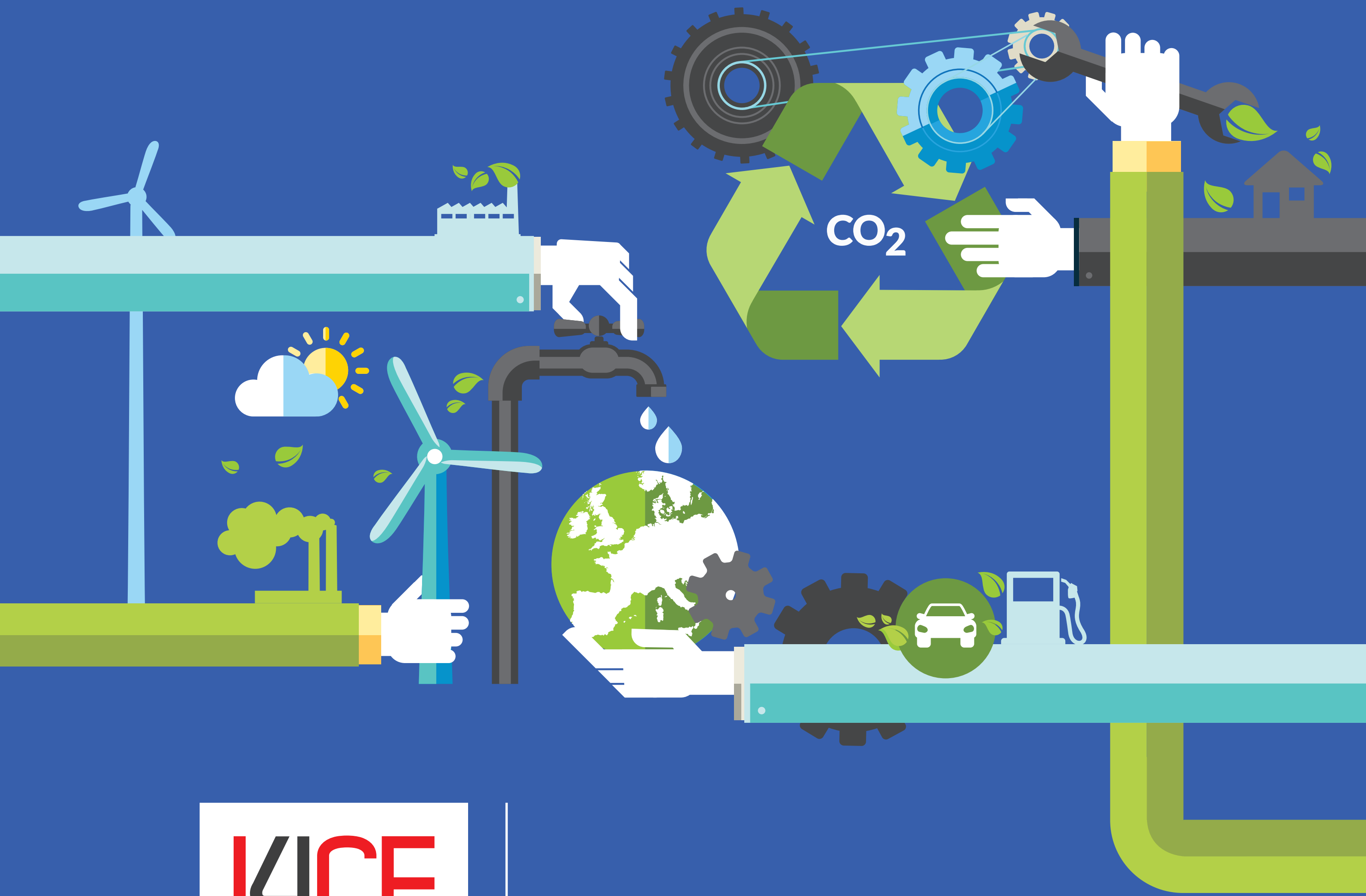

I4CE INSTITUTE FOR CLIMATE ECONOMICS
Une initiative de la Caisse des Dépôts et de l'Agence Française de Développement

MIND THE GAP

Aligning the 2030 EU climate and energy policy framework to meet long-term climate goals

For a better coordination of climate and energy policies through the regulation on the Governance of the Energy Union

June 2018

Charlotte **Vailles**, Émilie **Alberola**, Blaise **Farrokhi** (I4CE)
Cyril **Cassisa**, Jérémy **Bonnefous** (Enerdata)

Enerdata intelligence + consulting

This report was jointly produced by I4CE – Institute for Climate Economics and Enerdata within the framework of the research program COPEC II (COordination of EU Policies for Energy and CO_2 by 2030). Launched in April 2017, the research program aims at preparing policymakers for the revision of the 2030 EU climate and energy package. A first report, available **online**, was published in October 2017 on the EU ETS reform for the post-2020 period.

The authors take sole responsibility for findings or ideas presented in this report as well as any errors or omissions. This report does not reflect the opinion of any governments or private companies.

The authors would like to thank the members of this research program for their financial support: the French Ministry for the Ecological and Inclusive transition (Directorate General for Energy and Climate), the French Ministry for the Economy and Finance (Directorate General of Treasury and Directorate General for Enterprise), the UK Department For Business, Energy and Industrial Strategy, the EDF Group, Eurelectric, Finnish Energy and Energy Norway.

They would also like to thank external experts for their valuable inputs on the report: Jean-Yves Caneill (independent climate expert), Paula Coussy (IFPen) and Pierre Marion (IFPen).

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List of acronyms

AEA: Annual Emission Allocation
EEA: European Economic Area
EED: Energy Efficiency Directive
EPBD: Energy Performance of Buildings Directive
ESD: Effort Sharing Directive
ESR: Effort Sharing Regulation
EU: European Union
EUAs: European Union Allowances
EU ETS: European Union Emissions Trading System
GDP: Gross Domestic Product
GHG: Greenhouse Gas
IED: Industrial Emissions Directive
INECP: Integrated National Energy and Climate Plan
LMDI: Log Mean Divisia Index
LULUCF: Land Use, Land Use Change and Forestry
LRF: Linear Reduction Factor
MS: Member State
MSR: Market Stability Reserve
NDC: Nationally Determined Contribution
POLES: Prospective Outlook on Long-Term Energy Systems
RED: Renewable Energy Directive
WEM: With Existing Measures

Executive summary

Introduction

The **2030 climate and energy policy framework** is currently being negotiated in the European Union (EU). The first piece of this policy framework was the **revision of the EU emissions trading scheme (EU ETS)** for the period 2021-2030 on which an agreement was found between EU institutions in November 2017. An agreement was also found in December 2017 on the **Effort Sharing Regulation (ESR)**, which sets national emissions reduction targets for greenhouse gases (GHG) emissions in sectors not covered by the EU ETS. The other legislative pieces of the 2030 climate and energy framework are currently under negotiation. The EU Commission published in November 2016 legislative proposals on energy efficiency, renewable sources of energy, the organization of power markets and on the governance of the Energy Union, a text of particular importance, as it will aim at **ensuring the coherency of EU action on climate and energy**.

A policy window is currently open and the most should be made of this opportunity to **implement in the EU an ambitious policy mix to fulfill its commitment under the Paris Agreement**. As demonstrated by our first COPEC II report, counterproductive policy interactions undermine the functioning of the EU ETS and the trajectory of its emissions cap is not aligned to the EU long-term climate ambition. In order to extend these results, and to feed-in the ongoing negotiations on the Governance of the Energy Union and on other legislative pieces, this report provides:

- An **analysis of interactions between EU energy and climate policies**. The analysis is carried out on historical data (2005-2015) and on projections until 2030;
- Options on how to **better align policies to mitigate counteractive interactions** and **meet an increased EU long-term climate ambition** in line with the Paris Agreement.

A. The EU GHG emissions reduction target for 2030 is to be achieved through two policy instruments: the EU ETS and the ESR, which define carbon budgets over 2021-2030

The EU committed through its Nationally Determined Contribution (NDC) to reduce its GHG emissions by **at least 40% in 2030 compared to 1990 levels**. While the EU ETS sets an EU-wide cap on GHG emissions from large-scale facilities in the power and industrial sectors and on intra-European Economic Area (EEA) flights, the ESR sets an annual cap on GHG emissions from non-ETS sectors with the exception of land-use for each Member State – its Annual Emission Allocations (AEAs). The economy-wide GHG emissions reduction target in 2030 is to be achieved through a reduction in GHG emissions covered by the EU ETS and by the ESR of respectively 43% and 30% compared to 2005 levels in 2030.

The EU ETS and ESR, as they respectively allow the **carry-over of allowances and AEAs over the period (generally called "banking")**, **define carbon budgets**: cumulated GHG emissions over the period cannot be higher than the cumulated EU ETS cap in ETS sectors and than cumulated AEAs in non-ETS sectors.

a. The "carbon budget" approach creates some uncertainty: the compliance with the EU ETS and with the ESR does not ensure the achievement of the EU's NDC by 2030

This carbon budget approach makes sense because climate change depends on cumulated GHG emissions and not on the level of GHG emissions in a specific year. However, by definition, **the "budget" approach does not ensure the achievement of a given reduction target in GHG emissions in a specific year**. The devil is the detail of EU legislations: the NDC requires a reduction in GHG emissions in 2030, while the ESR and the EU ETS limit GHG emissions over a given period. This design difference creates **uncertainty about the ability of the EU ETS and the ESR to ensure the achievement of the EU's NDC in 2030**.

b. The carbon budgets defined by the EU ETS and the ESR should be calibrated accurately

The carbon budgets defined by the EU ETS and the ESR should be consistent with long-term global climate goals

In current legislations, the carbon budgets defined by the EU ETS and the ESR depend on historical GHG emissions. To be consistent with climate science, the **EU could evaluate its share of the global carbon budget compatible with an increase in temperatures of 2°C or 1.5°C** – based on the IPCC principles of capability, equality and responsibility. The **translation of this carbon budget and the "net-zero" emissions target in an updated 2050 roadmap** would enable an accurate calibration of the EU ETS and the ESR to achieve climate objectives.

This calibration should be done as soon as possible before 2030, using all possible windows offered by the Governance regulation timeline and other review processes. In particular, the agreed review of the EU ETS directive in the context of each global stocktake under the Paris Agreement will be the opportunity to **increase the Linear Reduction Factor (LRF) of the EU ETS cap** to a value compatible with the updated EU 2050 roadmap.

The carbon budgets defined by the EU ETS and the ESR should be calibrated so as to limit the formation of surplus in order to achieve 2030 climate target

Ideally, both the total carbon budget and a reduction over time in GHG emissions should be binding. Policy instruments defining carbon budgets should be calibrated so as to **keep within bounds the formation of surplus**. Limiting to a certain extent the intertemporal carry-over of unused allowances (as will be done with AEAs from the Effort Sharing over 2013-2020, which will not be transferrable to the 2021-2030 period) or adequately cancelling excess allowances may be options to get closer to the achievement of GHG emissions reduction targets through policy instruments defining carbon budgets.

The biannual assessment of EU progress towards meeting 2030 targets by the EU Commission proposed in the Governance Regulation is welcomed, as it will give visibility on how to **gradually bridge the gap to the achievement of 2030 climate targets**.

B. In the EU climate and energy framework, counterproductive policy interactions undermine the effectiveness of the EU ETS and the ESR

Different legislations aim at achieving EU objectives: reducing GHG emissions, deploying renewable sources of energy, increasing energy efficiency. Other legislative texts than the EU ETS and the ESR aim at reducing GHG emissions in different sectors of the economy. Furthermore, policies aiming at deploying renewable sources of energy and increasing energy efficiency also have an impact on GHG emissions covered by the EU ETS or by the ESR.

a. Historically, the increase in energy efficiency and the deployment of renewable energy sources contributed greatly to reducing GHG emissions across the EU

The decoupling of final energy demand and GDP was the most important driver in decreasing GHG emissions in the EU over 2005-2015

Between 2005 and 2015, GHG emissions in the EU decreased by around 900 MtCO_2e - a decrease of 16.7%. A quantified analysis of the contribution of different drivers to the variations in GHG emissions shows that the **decoupling of final energy demand and GDP** was the most important driver in decreasing GHG emissions in the EU over 2005-2015. The improvement in final energy intensity results from an increased efficiency of energy use, as well as structural changes in the EU economy. The **move towards less carbon-intensive fuels and improvements in the transformation efficiency of energy** also participated in the decrease in GHG emissions over 2005-2015, respectively -339 and -94 MtCO_2e. On the contrary, an increase in the population and in the GDP/capita contributed to an increase in GHG emissions over 2005-2015: respectively +143 and +348 MtCO_2e.

In order to better understand the contribution of the different drivers, in-depth sectoral analyses were carried out.

In the power sector, GHG emissions reductions mainly came from the deployment of renewables

In the power sector, GHG emissions reductions over 2005-2015 mainly came from the **deployment of renewable sources of energy**, which contributed to decrease GHG emissions by 359 MtCO_2e in total. Wind power contributed the most to GHG emissions reductions, with an estimated 186 MtCO_2e of cumulated emissions reductions over the period. Solar power and power from biomass and biofuels come next, with respectively 73 MtCO_2e and 69 MtCO_2e of emissions reductions. On the contrary, the decrease in the share of nuclear power over the period led to an increase in GHG emissions (+84 MtCO_2e).

The **decrease in power generation** was the second most important contributor to GHG emissions reductions (-43 MtCO_2e), followed by an **improvement in the fuel efficiency of thermal power plants** (-15 MtCO_2e). On the contrary, the **evolution of the carbon content of the different fossil fuels** slightly contributed to increasing GHG emissions (+8 MtCO_2e over the period).

As for the **evolution of the fossil fuels power mix**, while it contributed to reducing GHG emissions between 2005 and 2010, it was a net contributor to the increase in emissions from 2011 on. Indeed, during the period 2005-2010, the relative share of coal in power generation from fossil fuels decreased at the advantage of gas, and **the trend reversed from 2011 on**, with coal accounting in 2015 for two-thirds of power generation from fossil fuels. In total over 2005-2015, the **evolution of the fossil fuels mix was a net contributor to the increase in GHG emission**s (+25 MtCO_2e).

In both the iron and steel and the refining sectors, the decrease in demand and an increased energy efficiency greatly contributed to reducing GHG emissions

Equivalent analyses were carried out in the iron and steel sector and in the refining sector. In both cases, the **decrease in the demand** – respectively for iron and steel and for refined products – greatly contributed to the decrease in GHG emissions. In the iron and steel sector, **energy efficiency** was the most important driver in decreasing GHG emissions over 2005-2015, followed by the **relocation of production** outside the EU. In the refining sector, an **increased energy efficiency** also contributed to reducing GHG emissions, but this decline was counterbalanced by an increase in GHG emissions coming from the **growing complexity of refined products**.

b. Energy efficiency and renewable energy policies are expected to continue to significantly contribute to reducing GHG emissions in the post-2020 period

In total over 2021-2030, **energy efficiency and renewable energy policies are estimated to contribute to a reduction of 2.2 $GtCO_2e$** in GHG emissions covered by the EU ETS, under the assumption that specific policies are implemented to achieve 2030 targets for energy efficiency and renewable sources of energy. Over the EU ETS Phase IV, it is equivalent to 1.5 years of allowances– around 15% of the cumulated cap.

In sectors covered by the ESR, **energy efficiency and renewable energy policies are estimated to contribute to a reduction of 2.1 $GtCO_2e$** in GHG emissions over 2021-2030, which represents around 10% of cumulated AEAs.

c. These policy interactions undermine the effectiveness of the EU ETS and the ESR

A two-fold role can be expected from the EU ETS: **driving GHG emissions reductions** through its carbon price signal and **guaranteeing the achievement of climate targets** by setting a cap on GHG emissions.

Historically, the EU ETS had a minor impact on GHG emissions reductions – at least in the power sector

The ex-post impact of the EU ETS on GHG emissions reductions is difficult to assess as many factors come into play – e.g. the carbon price signal, the anticipations of stakeholders... In our quantified analysis of the historical contribution of different drivers to the variations in GHG emissions, we only evaluated the impact of the EU ETS on GHG emissions reductions in the power sector. It was estimated as **GHG emissions reductions coming from a coal-to-gas switch** in the years in which the price of EU allowances (EUAs) was within the range of the coal-to-gas switching price.

Given the relative coal and gas prices, and taking into account a large range of possible thermal efficiencies for coal and gas power plants, **the price of EUAs could only trigger a coal-to-gas switch in the 2005-2011 period**. Consequently, only the reductions in GHG emissions coming from the evolution of the fossil fuels mix in this period can be attributed to the carbon price signal induced by the EU ETS: around 50 $MtCO_2e$, which were more than offset by additional GHG emissions stemming from a gas-to-coal switch after 2011.

The depressed carbon price signal on the EU ETS is partly due to counteractive interactions with renewable energy and energy efficiency policies, which contributed to create an imbalance between supply and demand.

In the post-2020 period, counteractive interactions continue to undermine the effectiveness of the EU ETS and the ESR

Because of counteractive interactions, the EU ETS is not expected to drive GHG emissions reductions in the post-2020 period

Looking ahead to the post-2020 period, and taking into account the design parameters of the EU ETS in its Phase IV, **GHG emissions reductions coming from renewable energy and energy efficiency policies will be sufficient to respect the EU ETS cap in its Phase IV** – under the assumption that specific policies are implemented to achieve 2030 targets.

As GHG emissions reductions coming from other policies will be sufficient to respect the EU ETS cap, **its carbon price signal will be depressed** and it will not be able to drive low-carbon investments. Even the cheapest abatement options – such as switching from coal to gas in power generation for example – will be disregarded.

The Market Stability Reserve (MSR) is not sufficient to make the EU ETS resilient to the effect of other policies

The MSR, taking into account the parameters agreed on in the revised directive, absorbs a significant number of allowances: almost 3.3 billion until the end of Phase IV, out of which 2.6 billion are invalidated between 2023 and 2030. However, we estimate that **it will not be sufficient to mitigate the effect of other policies on the EU ETS while absorbing the historical surplus**. In spite of the MSR, the scarcity of allowances will not be sufficient to lead to a carbon price signal. Furthermore, in case of higher 2030 targets for energy efficiency and renewable energy policies – respectively 40% and 35% – the MSR would not be able to stabilize the surplus of allowances, which would reach almost 2.8 billion allowances in 2030.

The persistent formation of surplus undermines the role of the EU ETS and the ESR in guaranteeing the achievement of climate targets

Compliance with the EU ETS and the ESR does not guarantee the achievement of 2020 and 2030 climate targets. Counteractive interactions, as they contribute to the formation of the surplus of allowances and AEAs, emphasize this effect.

C. An enhanced governance approach to the EU climate and energy framework is required

a. Assessing the impact of policies on others is a necessary step

In the current climate and energy policies package, only the energy efficiency directive includes the requirement to assess its impact on other policies.

The proposed regulation on the Governance of the Energy Union, as **it aims at ensuring that the objectives of the Energy Union are met while ensuring policy coherency**, is a first interesting step. It would require in particular the assessment of interactions between policies and measures at the level of Member States. The EU Parliament is in favor of additionally requesting the assessment of interactions with Union climate policies and measures – in particular the EU ETS. However, the text in discussion today still **lacks concrete provisions to better align the policy package**.

It would be necessary to **carry out an ex-ante assessment of the interactions between energy and climate policies – at the national and EU levels, as well as annual ex-post assessments**. Provisions to adapt policies accordingly should be introduced – directly at the EU level and through recommendations by the Commission for an adaptation of policies in the Member States' Integrated National Energy and Climate Plans (INECPs).

b. Aligning EU climate and energy policies in the 2030 policy framework enables to mitigate counteractive interactions

To mitigate counteractive interactions, **an "alignment" of the EU ETS and of the ESR to account for GHG emissions reductions coming from other policies is proposed**: the idea is to remove from the EU ETS cap and from ESR AEAs the contribution of other policies to GHG emissions reductions.

The alignment of the EU ETS cap within the EU 2030 energy and climate framework restores its effectiveness: the surplus is quickly resorbed and the EU ETS becomes a driver of abatement

On the one hand, with the alignment of the EU ETS cap, **the surplus of EUAs is very quickly resorbed** and goes below the lower threshold of the MSR from 2023. On the other hand, the carbon price signal induced by the "Aligned" EU ETS leads to **a deployment of renewable energy sources sufficient to achieve EU 2030 target**. Furthermore, it leads to an **immediate switch to less carbon-intensive energy sources** and for example, it further drives down the share of coal in power generation. In 2030, GHG emissions in ETS sectors are 7% lower than in the situation without the "alignment" of the EU ETS cap, which corresponds to a reduction of 47% compared to 2005 levels.

In practice, this "alignment" of the EU ETS could be achieved through **provisions in the Governance Regulation to adapt policies directly at the EU level**. The reviews of the MSR in 2021 and 2026 will also be the opportunity to adapt the EU ETS to the effect of other policies on GHG emissions.

The alignment of AEAs incentivizes additional GHG emissions reductions in sectors covered by the ESR

Withdrawing from AEAs the contribution of energy efficiency and renewable energy policies to GHG emissions reductions in non-ETS sectors makes the ESR stringent from 2021 and prevents the formation of surplus. Besides, this stringency would incentivize Member States to **further reduce GHG emissions reductions in non-ETS sectors**. In 2030, GHG emissions in non-ETS sectors are 3% lower than in the situation without the "alignment" of AEAs, which corresponds to a reduction of **37% compared to 2005 levels**.

c. Aligning the EU 2030 policy framework to an increased long-term ambition sets the EU on a pathway more compatible with the goals of the Paris Agreement

Increasing EU long-term ambition in line with the objective of the Paris Agreement

EU current climate and energy policies and targets fall short of its commitments under the Paris Agreement. On the one hand, the EU set itself an objective of reducing GHG emissions by 80-95% in 2050 compared to 1990 levels. This objective was set in 2009, before the Paris Agreement and its objective of limiting the global average temperature increase to well below 2°C above pre-industrial levels. EU long-term ambition should be **reviewed accordingly and aim at net-zero emissions by 2050**.

Aligning the EU 2030 climate and energy framework to its increased long-term ambition

On the other hand, GHG emissions trends defined by the **2030 climate and energy framework as currently negotiated fall short of the EU 2050 objective**. Efforts would need to increase after 2030 to even enable the achievement of a reduction in GHG emissions of 80% in 2050. To have a sustainable decarbonisation pathway, an **anticipation of the suitable transformation of the energy system** to achieve drastic GHG emissions reductions in the long-term is required, as well as a **timely deployment of low-carbon solutions**.

An update of the 2050 roadmap consistently with the EU carbon budget and the "net-zero" emissions target, would **inform the adequate adaptation of climate and energy policies, at the EU-level and at the national level**.

In particular, the roadmap would enable setting **appropriate long-term targets for the EU ETS and the ESR**, as well as **intermediate 2040 targets**, which would give more visibility to stakeholders while making the long-term target more tangible. This roadmap could also be used to **elaborate a corridor of trajectories for the social value of carbon in the EU**, which economic stakeholders could use as a reference, and on which public policies could lean.

At the national level, the Member States' INECPs and their long-term low emission strategies – as required by the proposed regulation on the Governance of the Energy Union – should also be **consistent with the updated EU 2050 roadmap**.

Finally, the policy framework should allow a **periodic ratcheting up of ambition** in line with the stocktakes of the Paris Agreement.

D. Conclusion and policy recommendations

The negotiations on the EU 2030 climate and energy framework, and in particular on the Governance of the Energy Union, are the opportunity to **implement in the EU a coherent and ambitious policy mix to fulfill its commitment under the Paris Agreement**.

The legislative texts as currently negotiated lack adequate provisions to mitigate **counterproductive interactions** which undermine the effectiveness of the 2030 climate and energy framework and jeopardize the achievement of climate targets. Furthermore, they **fall short of the EU long-term ambition**, which is itself insufficient to respect its commitment under the Paris Agreement.

A **two-fold alignment of the policy package is thus required**: within the 2030 climate and energy framework to mitigate counteractive policy interactions and with an increased long-term ambition.

10 POLICY RECOMMENDATIONS TO MAKE THE EU CLIMATE AND ENERGY POLICY FRAMEWORK CONSISTENT WITH THE PARIS AGREEMENT BEFORE 2030

STEP 1: Setting the EU long-term climate targets right

1. Evaluating the **EU carbon budget** in relation to the 2018 IPCC 1.5°C report, based on the principles of capability, equality and responsibility
2. Translating this carbon budget as well as the "net-zero" emissions target in an **updated 2050 EU roadmap**, jointly elaborated with representatives from all sectors through an openly carried out prospective exercise
3. Setting **appropriate and realistic 2050 targets** for sectors covered by the EU ETS and the ESR with **intermediate 2040 targets**

STEP 2: Defining a climate and energy policy framework aligned with long-term climate targets

- **At the EU level:**

'. **Calibrating EU policy instruments** (in particular the EU ETS and the ESR) according to the updated 2050 roadmap as soon as possible before 2030, using all possible windows offered by the Governance timeline and other review processes (i.e. for the EU ETS, building on the intended reviews in the light of the implementation of the Paris Agreement to appropriately increase the linear reduction factor of the cap)

5. Calculating a **corridor of social values of carbon in the EU** until 2050, aligned with long-term climate ambition, which economic stakeholders could use as a reference and on which could lean public policies
6. Assessing regularly EU progress towards meeting its targets and introducing provisions to allow a **periodic ratcheting up of ambition** in line with the stocktakes of the Paris Agreement

- **At the national level:**

7. Calling for an **alignment of Member States' long term low-carbon strategies** to the 2050 low-carbon roadmap
8. Making sure Member States' **10-year integrated national climate and energy plans (INECPs) are aligned to their long-term low emission strategy and to the 2050 EU roadmap**

STEP 3: Ensuring the coherency of the different pieces of the climate and energy policy framework

9. Carrying out **an ex-ante assessment** of the interactions between energy and climate policies – at the **national and EU levels**, as well as annual **ex-post assessments**
10. **Introducing provisions to adapt policies accordingly** as soon as possible – directly at EU level and through recommendations by the EU Commission for an adaptation of policies in the INECPsw

1. Introduction

A. The 2018 facilitative dialogue is the opportunity to rethink the EU climate ambition in coherence with the Paris Agreement's long term temperature goal

In November 2016, the EU ratified the Paris Agreement, under which it committed to **hold the increase in the global average temperature to well below 2°C above pre-industrial levels** and to pursue efforts to limit the temperature increase to 1.5°C. The EU submitted as its Nationally Determined Contribution (NDC) under the Paris Agreement the target of an **at least 40% domestic reduction in greenhouse gases emissions by 2030 compared to 1990**, which had been endorsed by the European Council in October 2014.

The NDCs in their current form appear to be insufficient in meeting the temperature goal of the Paris Agreement (UNFCCC, 2016). However, the Paris Agreement builds on an increasing ambition over time, with the submission of new or updated NDCs every five years from 2020. The **2018 Facilitative Dialogue aims at taking stock of collective efforts towards the long-term goal and at informing the preparation of NDCs prior to 2020**. It could be the opportunity to rethink climate ambition in the EU.

B. The most could be made of the ongoing negotiations on the EU 2030 climate and energy policy framework to implement an ambitious and consistent policy mix in the EU

In its conclusion of October 2014, the European Council concluded that the 2030 EU binding target of an at least 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990 was to be achieved through **reductions in ETS and non-ETS sectors amounting respectively to 43% and 30% compared to 2005**. Since then, EU institutions have been working on the implementation of this target in EU legislation. The first piece of this policy framework was the revision on the EU Emission Trading Scheme (EU ETS) for its Phase IV (2021-2030).

a. The recently agreed reform of the EU ETS will not be enough to mitigate counteractive interactions with other policies and the trajectory of its cap is not aligned to long-term ambition

Following a legislative proposal from the European Commission in July 2015, an agreement was found between the Parliament, the Council and the Commission in November 2017, and the revised EU ETS directive was published in March 2018. The reform of the EU ETS is meant to achieve the 43% reduction target in GHG emissions from ETS sectors in 2030, through an increase of the linear reduction factor (LRF) of the emissions cap. The negotiations focused notably on **measures aimed at strengthening the EU ETS**. Indeed, over the last years, a number of economic and political factors have led to a significant surplus of ETS allowances, creating an imbalance of supply and demand, and have contributed to depress carbon prices.

In particular, EU institutions agreed on the strengthening of the Market Stability Reserve (MSR), which will start operating in 2019 with the objective of regulating the long-term surplus by applying thresholds on the total amount of allowances circulating in the market. EU institutions voted to **double the withdrawal rate of the MSR to 24% in its first five years of operations and to limit the volume of allowances held in the MSR by cancelling excess allowances**. However, **a first report** (I4CE, Enerdata, IFPEN, 2017) from this research project concluded that the doubling of the withdrawal rate of the MSR would not be sufficient to mitigate the effect of other policies on the supply-demand balance of the EU ETS while absorbing the historical surplus of allowances.

Furthermore, the first report concluded that the trajectory of the EU ETS, as agreed in the reform for its Phase IV, is not aligned to EU long-term climate ambition.

b. EU institutions also found an agreement on the Effort Sharing for the post-2020 period

EU institutions also found an agreement in December 2017 on the revision of the text covering GHG emissions from non-ETS sectors, the Effort Sharing. It followed the EU Commission's legislative proposal from July 2016 on an Effort Sharing Regulation (ESR) in the 2021-2030 period. The ESR sets a national cap on GHG emissions from non-ETS sectors for each Member State –its annual emission allocations (AEAs) and aims at achieving a 30% reduction in GHG emissions from sectors covered in 2030 compared to 2005 levels.

c. A window of opportunity to implement a consistent and ambitious policy mix in the EU is still open with the ongoing negotiations on the other pieces of the EU 2030 climate and energy framework

In November 2016, the EU Commission published legislative proposals on energy efficiency, renewable sources of energy, the organization of power markets and on the governance of the Energy Union. The revised Energy Efficiency Directive (EED) and the revised Renewable Energy Directive (RED) will set notably EU 2030 targets for energy efficiency and renewable energy. The proposed regulation on the Governance of the Energy Union is a text of particular importance, as it aims at **guaranteeing the achievement of EU climate and energy objectives** while **ensuring the coherency of EU action on climate and energy**. To do so, the proposed regulation published by the EU Commission sets out an iterative dialogue process between the Commission and Member States. Trilogue negotiations between EU institutions on these three texts started in February 2018 and are expected to continue after the summer 2018.

The negotiations on the 2030 climate and energy framework and especially on the Governance regulation are the opportunity to implement in the EU a **consistent and ambitious policy mix**. The legislative proposal could be amended to mitigate counteractive interactions between policies, while increasing the climate ambition in line with the goals of the Paris Agreement, which could serve as a basis for the submission of a new NDC.

C. The preparation of long-term low emission strategies both in the EU and at the international level feeds into the revision of the mid-term policy framework

Under the Paris Agreement, all Parties are invited to communicate before 2020 mid-century, long-term low GHG development strategies. While some Member States (Germany, France, Czech Republic and the United Kingdom) already submitted their own long-term strategies, the EU has not submitted its own yet. In March 2018, the European Council published a communique to invite the Commission to present **a proposal for a Strategy for long-term EU GHG emissions reduction** in accordance with the Paris Agreement, by the first quarter of 2019.

2. Approach and objectives of the report

This report was produced within the framework of the research program COPEC II (COordination of EU Policies for Energy and CO_2 by 2030) launched in April 2017 by I4CE and Enerdata, in collaboration with IFPEN, with the aim of providing a factual, **independent and quantified analysis of climate and energy policies in the EU and of preparing policymakers for the revision of the 2030 climate and energy package**. COPEC II builds on the results from the research program COPEC I, which ran from September 2014 to December 2015. The program included the organization of thematic workshops which brought together partners, associate experts and sponsors. Two first workshops were jointly organized by I4CE, Enerdata and IFPEN in April and June 2017 respectively on the framework for free allocation in the EU ETS, and on the carbon price signal in the EU ETS.

The present report builds on the results from the last two workshops, organized by I4CE and Enerdata respectively in October and November 2017 on the **interactions within the 2030 climate and energy policy framework and on the ambition of EU climate and energy policies**.

A. Objectives of the report

A policy window is currently open and the most should be made of this opportunity to **implement in the EU an ambitious policy mix to fulfill its commitment under the Paris Agreement**. As demonstrated by **our first COPEC II report**, counterproductive policy interactions undermine the functioning of the EU ETS and the trajectory of its emissions cap is not aligned to the EU long-term climate ambition. In order to extend these results, and to feed-in the ongoing negotiations on the Governance of the Energy Union and on other legislative texts, this report provides:

- An **analysis of interactions between EU energy and climate policies**. The analysis is carried out on historical data (2005-2015) and on projections until 2030;
- Options on how to **better align policies to mitigate counteractive interactions** and **meet an increased EU long-term climate ambition** in line with the Paris Agreement.

B. Methodology

In order to analyze the ex-post interactions between EU climate and energy policies, **I4CE** carried out a quantification of the contribution of different drivers to the variations in GHG emissions over the 2005-2015 period, using an **index decomposition analysis**. Index decomposition analysis is now a widely accepted analytical tool for policymaking on energy and environmental issues and consists in decomposing an aggregate indicator to give quantitative measures of the relative contributions of a set of pre-defined factors leading to the change in the aggregate indicator. The methodology chosen is the **Log Mean Divisia Index (LMDI)**. The LMDI was chosen for its properties: it results in a perfect decomposition (i.e. it does not leave a residual term), it is consistent in aggregation (i.e. estimates for sub-groups may be aggregated in a consistent manner) and it is time reversible (i.e. results are consistent whether the decomposition is carried out prospectively or retrospectively).

Enerdata conducted the modelling of energy systems with the model POLES (Prospective Outlook on Long-term Energy Systems) with a threefold objective:

- To analyze the interactions between EU climate and energy policies until 2030;
- To evaluate the impact of different EU climate and energy targets on the evolution of energy systems and on GHG emissions reductions;
- To understand the impact of an alignment of the policy package, by respectively removing from the EU ETS cap and from the ESR AEAs the amount of GHG emissions reductions coming from renewable energy policies and energy efficiency policies in ETS and non-ETS sectors.

Three main scenarios were modelled with POLES. Their assumptions on the design of EU climate and energy policies are summarized in **Table 1**.

TABLE 1. ASSUMPTIONS IN MAIN POLES SCENARIOS

MAIN SCENARIOS	Assumptions on the design of EU climate and energy policies			
	EU ETS	ESR	2030 energy efficiency target	2030 renewable energy target
2017 Baseline	EU ETS 2017 trilogue deal	European Commission's proposal from July 2016	+30%	+27%
Aligned	Adjusted cap by withdrawing GHG emissions reductions coming from energy efficiency and renewable energy policies	Adjusted AEAs by withdrawing GHG emissions reductions coming from energy efficiency and renewable energy policies	+30%	+27%
AmbitionPlus	EU ETS 2017 trilogue deal	European Commission's proposal from July 2016	+40%	+35%

Theoretical scenarios were also modelled with POLES to **evaluate the contribution of the achievement of one target to the achievement of others**:

- "**No Policy**": in this counterfactual scenario, no climate and energy policies are implemented in the EU;
- "**GHG only**": in this counterfactual scenario, there are no EU targets for the deployment of renewables nor for energy efficiency. Only the EU ETS and the ESR are implemented;
- "**RE27 only**": in this counterfactual scenario, there are no EU targets for energy efficiency, and the EU ETS and the ESR are not implemented. It is assumed that specific policies are implemented to achieve a share of 27% of renewable energy sources in final energy consumption by 2030;
- "**EE30 only**": in this counterfactual scenario, there are no EU targets for renewable energy sources, and the EU ETS and the Effort Sharing Regulation are not implemented. It is assumed that specific policies are implemented to achieve a target of 30% of energy efficiency by 2030.

One of the outputs of POLES modelling is the carbon value in the different scenarios, which is not a market price. The carbon value represents the **cost of emissions reductions required to respect the constraint set by the EU ETS and by the ESR** considering a five-year sliding carbon budget.

Another theoretical scenario was modelled with POLES, to **quantify the impact of renewable energy and energy efficiency policies on GHG emissions reductions covered by the EU ETS and by the ESR** – the **EE&RE contribution** scenario. In this scenario, the EU ETS and the ESR function as if they were the only policy instruments (i.e. the carbon value is the same as in the "GHG only" scenario) but EU targets for renewable energy and energy efficiency are achieved.

Main assumptions in POLES scenarios are summarized in **Box 1**.

BOX 1. ASSUMPTIONS IN POLES SCENARIOS

General assumptions

- All scenarios are modelled with POLES until 2040.

Assumptions for other climate and energy policies

- After 2030, the support for renewable energy sources and energy efficiency measures is linearly decreasing, until being null in 2040, except in the AmbitionPlus scenario, in which the support in kept constant after 2030.

Carbon budget

- Stakeholders have a 5-year sliding anticipated vision on the carbon budget defined by the EU ETS and by the ESR.
- The surplus of EU ETS allowances is considered to be available and tradable.

For more details on the tools and models used for this report, as well as for assumptions, please refer to the Annexes.

3. The EU GHG emissions reduction target for 2030 is to be achieved through two policy instruments: the EU ETS and the ESR, which define carbon budgets over 2021-2030

The EU committed through its Nationally Determined Contribution (NDC) to reduce its GHG emissions by at least 40% **in** 2030 compared to 1990 levels. While the EU ETS sets an EU-wide cap on GHG emissions from large-scale facilities in the power and industrial sectors and on intra-EEA flights, the Effort Sharing Regulation (ESR) sets an annual cap on GHG emissions from non-ETS sectors with the exception of land-use for each Member State -its Annual Emission Allocations (AEAs). The economy-wide GHG emissions reduction target in 2030 is to be achieved through a reduction in GHG emissions covered by the EU ETS and by the ESR of respectively 43% and 30% compared to 2005 levels in 2030. (see **Figure 1**)

The Land Use, Land Use Change and Forestry (LULUCF) sector was included in the 2030 climate and energy framework and have to respect a “no-debit” rule: accounted CO_2 emissions have to be entirely compensated by an equivalent removal of CO_2 from the atmosphere through action in the same sector.

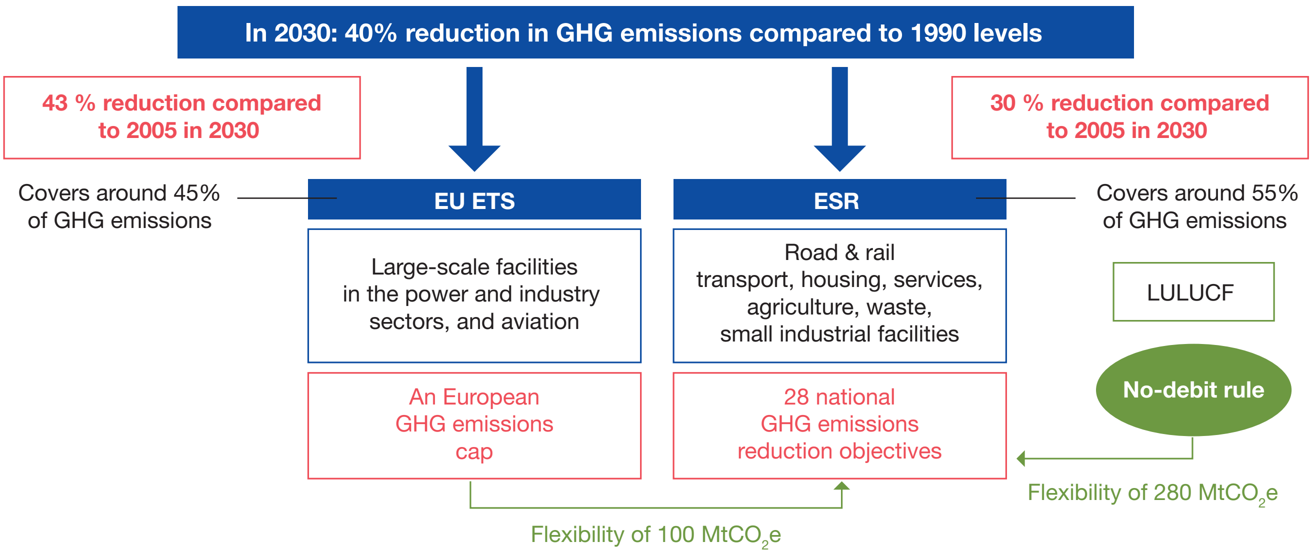
A. A revised EU ETS directive was adopted in March 2018

The EU Commission published a legislative proposal for a revised EU ETS directive for its Phase IV (2021-2030) in July 2015, notably to ensure a 43% reduction in GHG emissions covered by the EU ETS in 2030 compared to 2005. After more than two years of negotiations, EU institutions came to an agreement in November 2017, and the revised directive was officially promulgated in March 2018. The main elements of the reform of the EU ETS include:

- An **increase of the pace of reduction of the emissions cap** defined by the LRF, going from 1.74% in Phase III (2013-2020) to 2.2% from 2021, which is respectively equivalent to an annual reduction of the cap by 38 $MtCO_2e$ or 48 $MtCO_2e$;
- A **doubling of the MSR withdrawal rate** in the first 5 years of operation compared to what was agreed in the MSR decision in 2015 (equal to 24% from 2019 to end of 2023);

FIGURE 1. SPLIT OF 2030 GHG EMISSIONS REDUCTION TARGET BETWEEN THE EU ETS AND THE ESR

The EU-wide 2030 climate target is to be achieved through GHG emissions reductions in sectors covered by the EU ETS and by the ESR, with accounting flexibilities between the policy instruments



Note: LULUCF stands for Land use, land use-change and forestry. The “no-debit” rule aims at ensuring that accounted CO_2 emissions from land use are entirely compensated by an equivalent removal of CO_2 from the atmosphere through action in the same sector.
Source: I4CE, 2017

- The **cancellation of allowances from the MSR annually from 2023**: the volume of the MSR will be capped by the volume of the previous year's auctions;
- The possibility for Member States to **cancel a volume of allowances corresponding to the closure of electricity generation** in their territory due to national measures;
- New rules for free allocation, including:
  - the definition of a **new criterion for sectors deemed to be exposed to carbon leakage**;
  - the definition of a fixed share of total allowances to be given freely, with the possibility to increase it by 3 percentage points;
  - a decrease of benchmarks, that are the references of carbon intensity by product on which are calculated the amount of free allowances to installations;
- A **review of the provisions of the directive in the light of the Paris Agreement and the development of carbon markets in other major economies**, in particular:
  - the measures aimed at avoiding carbon leakage will have to be kept under review in the light of climate policy measures in other major economies;
  - in the context of each global stocktake under the Paris Agreement, the Commission may propose additional Union policies and measures, and notably propose a **further increase of the LRF.**

The deal reached on the EU ETS reform for its Phase IV is **more ambitious than the initial proposal from the Commission**. In particular, several measures were adopted to strengthen the EU ETS and mitigate the counterproductive effect of other policies on the EU ETS – such as the doubling of the withdrawal rate of the MSR or the possible cancellation of allowances by Member States.[1]

B. An agreement was also found on the Effort Sharing in December 2017

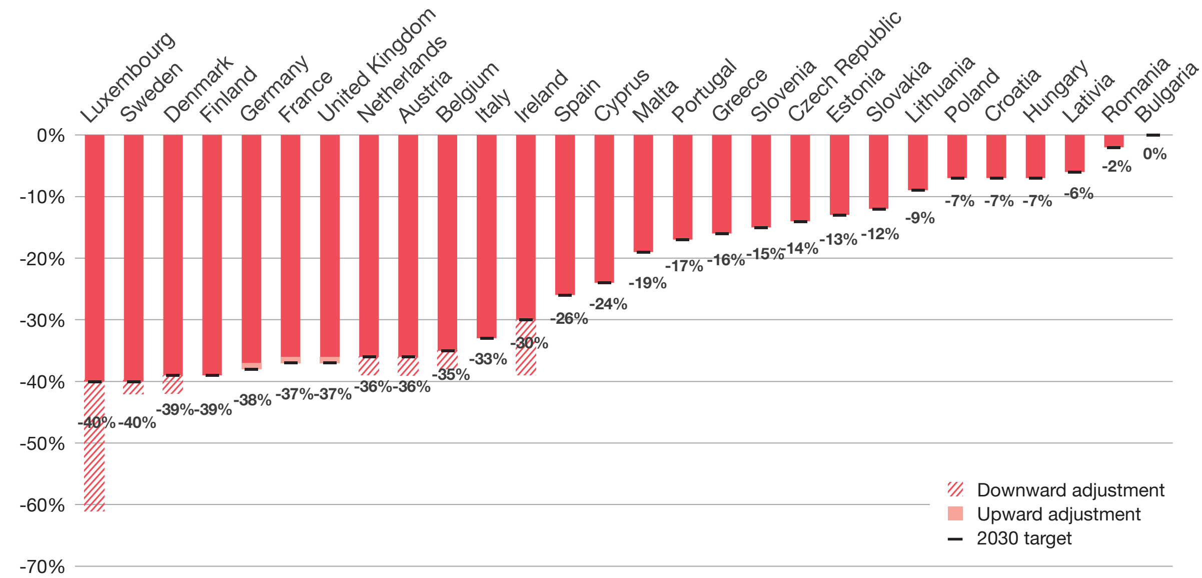
The Commission published in July 2016 a legislative proposal for the ESR, to establish **national binding annual GHG emissions targets in the period 2021-2030**, and achieve a 30% reduction compared to 2005 in 2030 in sectors covered (road and rail transports, housing, services, agriculture, waste, small industrial facilities). The ESR will succeed the Effort Sharing Decision (ESD), which establishes national emissions targets for Member States in non-ETS sectors between 2013 and 2020, and will follow the same principle.

The EU-wide emissions reductions target for non-ETS sectors – a 30% reduction in 2030 compared to 2005 – is divided into national targets for Member States expressed as a percentage change from 2005 levels, ranging from -40% to 0% (see **Figure 2**). National targets are differentiated

1 *More details on the respective positions of EU institutions on the revision of the EU ETS directive can be found in the first report published in October 2017 within the framework of COPEC II project : EU ETS : Last call before the doors close on the negotiations for the post-2020 reform.*

FIGURE 2. 2030 NATIONAL EMISSIONS REDUCTION TARGETS UNDER THE ESR (EXPRESSED AS A REDUCTION PERCENTAGE COMPARED TO 2005)

2030 national targets for sectors covered by the ESR range from -40% for Luxembourg to 0% for Bulgaria



Source: I4CE, with data from the European Commission according to the gross domestic product (GDP) per capita of Member States, and adjusted to take into account issues of cost-effectiveness[2]. 2030 targets are translated into linear trajectories, which define annual national caps on GHG emissions covered, the Member States' AEAs.

As under the ESD, Member States can resort to flexibilities to respect their AEAs: they may bank their excess AEAs, borrow AEAs from following years, and transfer AEAs to other Member States. The ESR introduces two new flexibilities: a flexibility with the EU ETS and a flexibility with the regulation covering LULUCF sectors.

Table 2 summarizes the positions of the EU Commission, the Parliament and the Council on main ESR design parameters ahead of trilogue negotiations, as well as what was agreed in the deal reached in December 2017.

2 *This adjustment is based on the difference between Member States' 2030 target based only on the GDP/ capita and GHG emissions reductions in a cost-effective scenario modelled by the Commission.*

TABLE 2. POSITIONS OF EU INSTITUTIONS ON MAIN ESR DESIGN PARAMETERS

Parameters		EU Commission	EU Parliament	EU Council	Trilogue deal
Target for covered GHG emissions	**AEAs 2021-2030**	Linear trajectory, **starting in 2020 on average 2016-2018 GHG emissions**	Linear trajectory, **starting in 2018** on lowest value between **average 2016-2018 GHG emissions and 2020 AEA**	Linear trajectory, **starting in 2020 on average 2016-2018 GHG emissions**	Linear trajectory, **starting in 2019 and 5 months or in 2020**, whichever results in a lower allocation for each MS **on average 2016-2018 GHG emissions**
	Long-term trajectory	No mention of long-term trajectory of GHG emissions reductions	**Long-term trajectory of GHG emissions reductions after 2030** (for each MS, linear trajectory from its 2030 AEA to 80% reduction/2005 in 2050)	No mention of long-term trajectory of GHG emissions reductions	No mention of long-term trajectory of GHG emissions reductions
Adjustment in AEAs	**Adjustment in 2021**	Increase of the 2021 AEA for MS with a positive target under 2020 ESD (total of **39 $MtCO_2e$**)		Increase of the 2021 AEA for MS with a positive target under the 2020 ESD +additional adjustment for Malta and Latvia (total of **41 $MtCO_2e$**)	
	Additional reserve		**"Early action" reserve** created with **90 $MtCO_2e$** for MS with **GDP/ capita in 2013 < EU average** and for which **cumulated 2013-2020 GHG emissions < cumulated AEAs**, conditioned to the achievement of EU 2030 target, distributed between eligible MS proportionally to their overachievement over 2013-2020	**"Safety" reserve** created with **115 $MtCO_2e$** for MS with **GDP/capita in 2013 <EU average** and for which **cumulated 2013-2020 GHG emissions < cumulated AEAs**, conditioned to the achievement of EU 2030 target For eligible MS, limited to 20% of excess AEA during 2013-2020	**"Safety" reserve** created with **105 $MtCO_2e$** for MS with **GDP/capita in 2013 <EU average** and for which **cumulated 2013-2020 GHG emissions < cumulated AEAs**, conditioned to the achievement of EU 2030 target For eligible MS, limited to 20% of excess AEA during 2013-2020
Interannual flexibilities	**Borrowing of AEAs**	Possible "borrowing" of **5% of AEA** over 2021-2030		Possible "borrowing" of **10% of AEA** over 2021-2025 and **5%** over 2026-2029	
	Banking of AEAs	**Unlimited** banking of excess AEA through out 2021-2030	Possible banking of excess AEA **limited to 10% of AEA** over 2021-2025 and **5%** over 2026-2030	**Unlimited** banking of excess AEA throughout 2021-2030	**Unlimited banking of 2021 excess AEA**, and from 2021-2029, possible banking of excess AEA **up to a level of 30% of AEA**
Flexibilities between MS	**Transfer of AEAs**	Possibility for a MS to **transfer** the exceeding part of its AEA to other MS			

THE EU GHG EMISSIONS REDUCTION TARGET FOR 2030 IS TO BE ACHIEVED THROUGH THE EU ETS AND THE ESR

Parameters		EU Commission	EU Parliament	EU Council	Trilogue deal
Flexibilities with other policy instruments	LULUCF	Possible use of maximum **280 $MtCO_2e$ net removals** from LULUCF sectors, split by MS If LULUCF emissions of a MS in 2021-2025 or 2026 -2030 exceed its GHG removals, this amount will be deducted from its AEAs			
	EU ETS	The **cancellation of up to 100 EUAs** may be used for compliance under the ESR for eligible MS (notification before 2020)		Same as in the Commission's proposal + possibility to revise downward twice the amount for eligible MS	
Compliance	Compliance cycle	Every **5 years**	Every **2 years**	Every **5 years**	
	Penalty	Excess GHG emissions multiplied by a factor of 1.08 are added to the following year's emissions + MS prohibited to transfer its AEA to other MS			
Review		Review by **2024** and **every five years** thereafter	Review within **six months following each global stocktake** under Paris Agreement		

Source: I4CE, 2018 from EU Commission, EU Parliament and EU Council

The ambition of the ESR GHG emissions reductions target is defined by:

- the 2030 target;
- the starting point of the trajectory of AEAs, and the additional adjustments and reserves;
- the flexibilities.

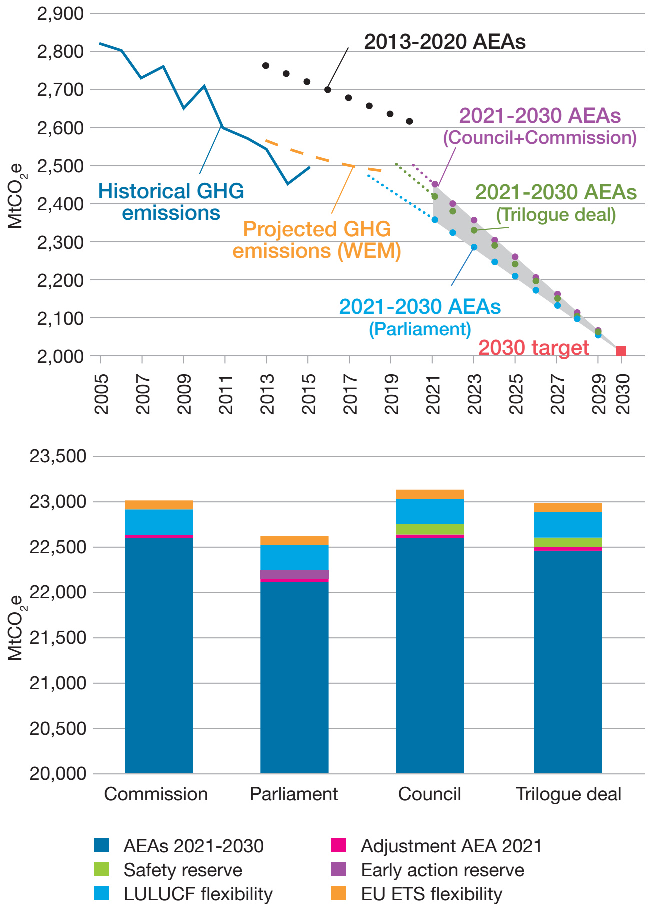
The 2030 target and the starting point of the linear trajectory define initial AEAs under the ESR, which are increased by additional reserves and the possible resort to flexibilities with other policy instruments (see **Figure 3**).

The EU Parliament position on the ESR would have reduced the total carbon budget defined by the ESR by 393 $MtCO_2e$ (-1.7%) compared to the EU Commission's proposal, and the EU Council would have increased it by 117 $MtCO_2e$ (+0.5%). The deal reached in the trilogue negotiations defines a **carbon budget for non-ETS sectors similar to the carbon budget defined by the initial Commission's proposal**.

Furthermore, the limitation of temporal flexibilities suggested by the Parliament, and to a lesser extent agreed on in the final deal, **reduces the possibility to use the whole carbon budget and thus increases the ambition of the regulation**. However, as the limit set in the final deal is loose (30% of the AEA), it is not obvious to which extent it will reduce the carbon budget set by the ESR.

FIGURE 3. LINEAR TRAJECTORIES OF TOTAL AEAS UNDER THE ESR (TOP) AND MAXIMUM CARBON BUDGET FOR SECTORS UNDER THE ESR (2021-2030)

The deal reached on the Effort Sharing defines a carbon budget for non-ETS sectors similar to the carbon budget defined by the initial Commission's proposal



Note: GHG emissions projections submitted by Member States to the European Commission as their "With Existing Measures" (WEM) scenario are used.

Source: I4CE, with data from the European Environment Agency, the Commission, the Council and the Parliament

C. The "carbon budget" approach creates some uncertainty: the compliance with the EU ETS and with the ESR does not ensure the achievement of the EU's NDC by 2030

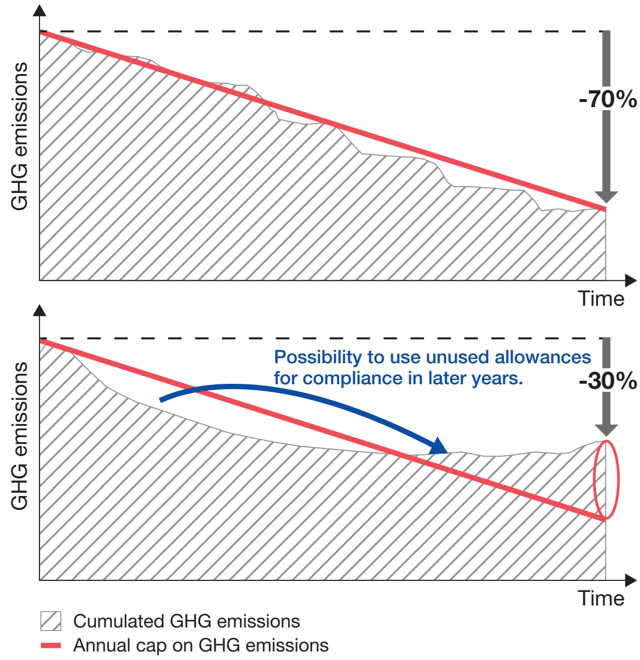
The EU ETS and ESR, as they respectively allow the **carry-over of allowances and AEAs over the period (generally called "banking")**, **define carbon budgets**: cumulated GHG emissions over the period cannot be higher than the cumulated EU ETS cap in ETS sectors and than cumulated AEAs in non-ETS sectors.

This carbon budget approach makes sense because climate change depends on cumulated GHG emissions and not on the level of GHG emissions in a specific year. However, by definition, **the "budget" approach does not ensure the achievement of a given reduction target in GHG emissions in a specific year** (see Figure 4). The devil is the detail of EU legislations: the NDC requires a reduction in GHG emissions in 2030, while the ESR and the EU ETS limit GHG emissions over a given period. This design difference creates **uncertainty about the ability of the EU ETS and the ESR to ensure the achievement of the EU's NDC in 2030**.

In the same way, the compliance with the EU ETS and with the ESD until 2020 does not ensure the achievement of EU 2020 climate target, which is split between a 21% reduction compared to 2005 in ETS sectors and a reduction of around 10% compared to 2005 in non-ETS sectors. As an order of magnitude, the cumulative surplus of AEAs under the ESD was equivalent to 744 $MtCO_2e$ in 2015. Using this entire surplus in 2020 – assuming no more surplus is created in 2016-2019 – would allow a **16% increase** in covered GHG emissions in 2020 compared to 2005 levels, while complying with the ESD.

FIGURE 4. ILLUSTRATION OF POSSIBLE GHG EMISSIONS TRAJECTORIES RESPECTING THE SAME CUMULATED CARBON BUDGET

A policy instrument defined as a carbon budget does not ensure a given reduction in GHG emissions in a specific year



Interpretation of the graph: this illustrative situation, a policy instrument defined as an annual cap on GHG emissions is implemented, with the possibility to carry-over unused emission allowances. **In both cases, the constraint on GHG emissions defined by the policy instrument is respected: cumulated GHG emissions are lower than the cumulated cap on emissions.** In the case at the top, GHG emissions are in the last year 70% below their reference level, while they are only 30% lower in the case at the bottom.

Source: I4CE, 2018

D. The carbon budgets defined by the EU ETS and the ESR should be calibrated accurately

a. The carbon budgets defined by the EU ETS and the ESR should be consistent with long-term global climate goals

In current legislations, the carbon budgets defined by the EU ETS and the ESR depend on historical GHG emissions. To be consistent with climate science, the **EU could evaluate its share of the global carbon budget compatible with an increase in temperatures of 2°C or 1.5°C** – based on the Intergovernmental Panel on Climate Change (IPCC) principles of capability, equality and responsibility. The **translation of this carbon budget and the "net-zero" emissions target in an updated 2050 roadmap** would enable an accurate calibration of the EU ETS and the ESR to achieve climate objectives.

Recommendation 1: Evaluating the **EU carbon budget** in relation to the 2018 IPCC 1.5°C report, based on the principles of capability, equality and responsibility.

Recommendation 2: Translating this carbon budget as well as the "net-zero" emissions target in **an updated 2050 EU roadmap**, jointly elaborated with representatives from all sectors through an openly carried out prospective exercise.

This calibration should be done as soon as possible before 2030, using all possible windows offered by the timeline of the regulation on the Governance of the Energy Union (see **section 6.B.a**) and other review processes. In particular, the agreed review of the EU ETS directive in the context of each global stocktake under the Paris Agreement will be the opportunity to **increase the LRF of the EU ETS cap** to a value compatible with the updated EU 2050 roadmap.

Recommendation 4: **Calibrating EU policy instruments** (in particular the EU ETS and the ESR) according to the updated 2050 roadmap as soon as possible before 2030, using all possible windows offered by the Governance timeline and other review processes (i.e. for the EU ETS, building on the intended reviews in the light of the implementation of the Paris Agreement to appropriately increase the linear reduction factor of the cap).

b. The carbon budgets defined by the EU ETS and the ESR should be calibrated so as to limit the formation of surplus in order to achieve 2030 climate target

Ideally, both the total carbon budget and a reduction over time in GHG emissions should be binding. Policy instruments defining carbon budgets should be calibrated so as to **keep within bounds the formation of surplus**. Limiting to a certain extent the intertemporal carry-over of unused allowances (as will be done with AEAs from the ESD, which will not be transferrable to the 2021-2030 period) or adequately cancelling excess allowances may be options to get closer to the achievement of GHG emissions reduction targets through policy instruments defining carbon budgets.

The biannual assessment of EU progress towards meeting 2030 targets by the EU Commission proposed in the Governance Regulation is welcomed, as it will give visibility on how to **gradually bridge the gap to the achievement of 2030 climate targets**.

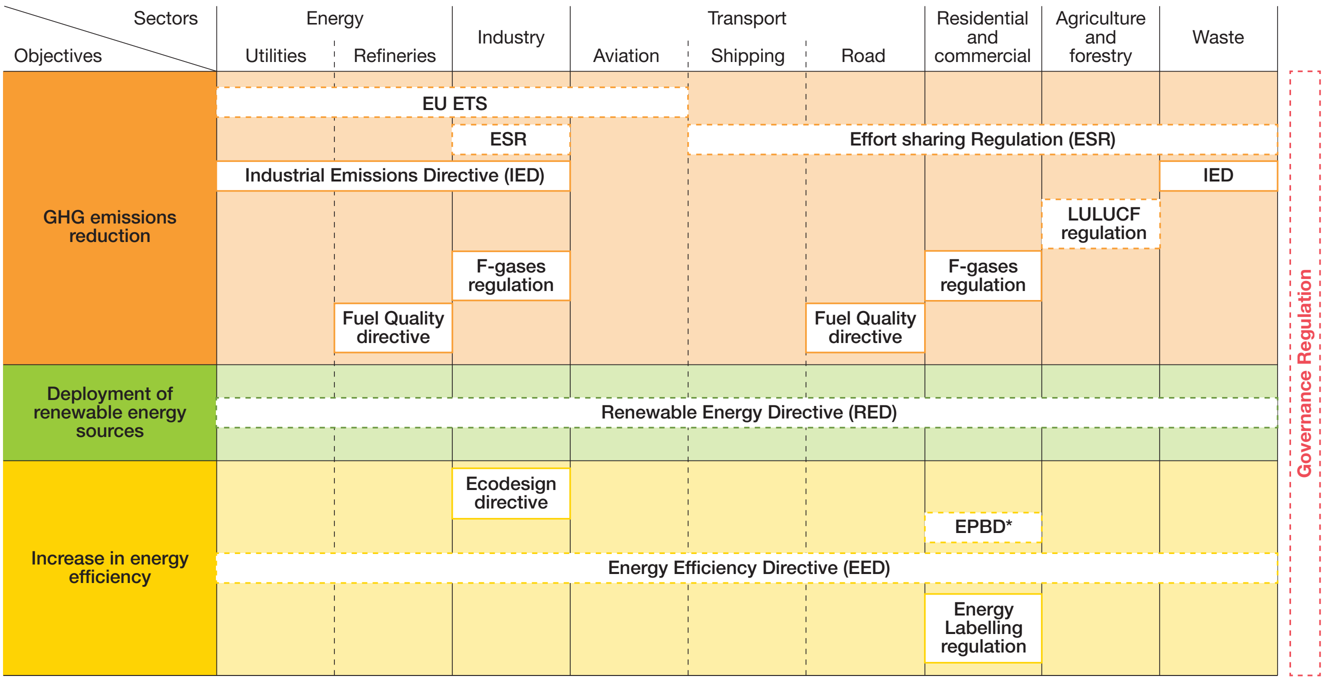
4. EU renewable energy and energy efficiency policies contribute to the achievement of GHG emissions reductions targets: insights from an ex-post analysis and from projections up to 2030

As shown in **Figure 5**, different legislations aim at achieving EU objectives: reducing GHG emissions, deploying renewable sources of energy, increasing energy efficiency. Other legislative texts than the EU ETS and the ESR aim at reducing GHG emissions in different sectors of the economy. Furthermore, policies aiming at deploying renewable energy sources and increasing energy efficiency also have an impact on GHG emissions covered by the EU ETS or by the ESR. The impact of renewable energy policies and energy efficiency policies on GHG emissions reductions is quantified through an ex-post analysis on 2005-2015 data and projections up to 2030.[3]

3 *Other policies than renewable energy and energy efficiency policies – in particular policies shown in Figure 5 such as the IED, the F-gases regulation, the Fuel Quality Directive…- have an impact on GHG emissions covered by the EU ETS or by the ESR, but their effect is not quantified in the present report.*

FIGURE 5. MAPPING EU LEGISLATIONS IN THE 2030 CLIMATE AND ENERGY POLICY FRAMEWORK

In the current climate and energy framework, only the energy efficiency directive requires the assessment of its impact on other policies. The proposed regulation on the Governance of the Energy Union is a first step towards a more coherent policy package but it does not include requirements to assess the impact of policies on one another at EU level



Legend: *In revision or revised as part of 2030 climate and energy framework* | *In force*

* EPBD: Energy performance of buildings directive

Interpretation of the graph: The different objectives in the left-end column are to be achieved through the legislative texts in the frame with the same color. Those legislative texts apply in the sectors in the respective columns.

Source: I4CE, 2018

A. Historically, the increase in energy efficiency and the deployment of renewable energy sources contributed greatly to reducing GHG emissions across the EU

a. The decoupling of final energy demand and GDP was the most important driver in decreasing GHG emissions in the EU over 2005-2015

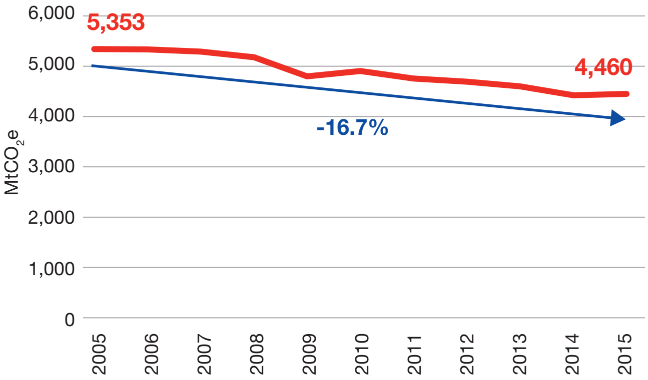
Between 2005 and 2015, GHG emissions in the EU decreased by around 900 $MtCO_2e$ – a decrease of 16.7% (see **Figure 6**). To understand the factors behind this decrease in GHG emissions, a quantified analysis of the contribution of different drivers to the variations in GHG emissions was carried out.[4]

The **decoupling of final energy demand and GDP** was the most important driver in decreasing GHG emissions in the EU over 2005-2015 (see **Figure 7**). The improvement in final energy intensity results from an increased efficiency of energy use, as well as structural changes in the EU economy. The **move towards less carbon-intensive fuels and improvements in the transformation efficiency of energy** also participated in the decrease in GHG emissions over 2005-2015, respectively -339 and -94 $MtCO_2e$.

4 *A decomposition analysis was carried out to quantify the contribution of different drivers to the variations in GHG emissions in the EU over the period 2005-2015 with the Log Mean Divisia Index (LMDI) method. Please refer to the Methodology (section 2.B.) and to Annexes (8.A.) for more details and for data sources.*

FIGURE 6. EU GHG EMISSIONS (2005-2015)

Between 2005 and 2015, EU GHG emissions decreased by around 900 $MtCO_2e$



Source: I4CE, with data from Eurostat and the IPCC

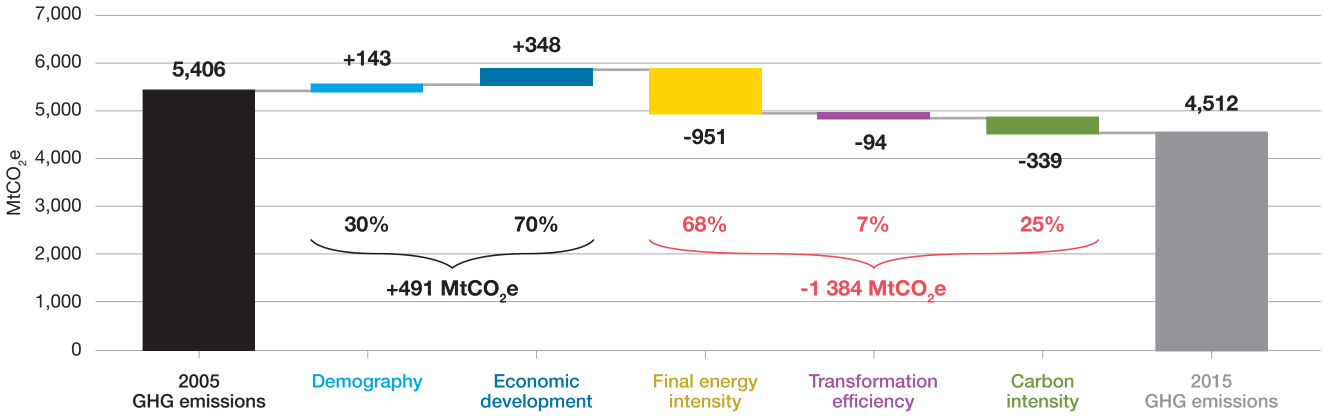
On the contrary, an **increase in the population and in the GDP/capita** contributed to an increase in GHG emissions over 2005-2015: respectively +143 and +348 $MtCO_2e$.

Significant annual variations are identified in the contribution of the different drivers to GHG emissions reductions (see **Figure 8**). The **increase in population has steadily contributed to an increase in GHG emissions**, as well as the **increase in GDP/capita**, except in 2009 and to a lesser extent in 2012.

The improvement in final energy intensity was a net contributor to GHG emissions reductions almost every year, as well as the decrease in the carbon intensity of the EU energy mix.

FIGURE 7. DRIVERS OF GHG EMISSIONS VARIATIONS IN THE EU (2005-2015)

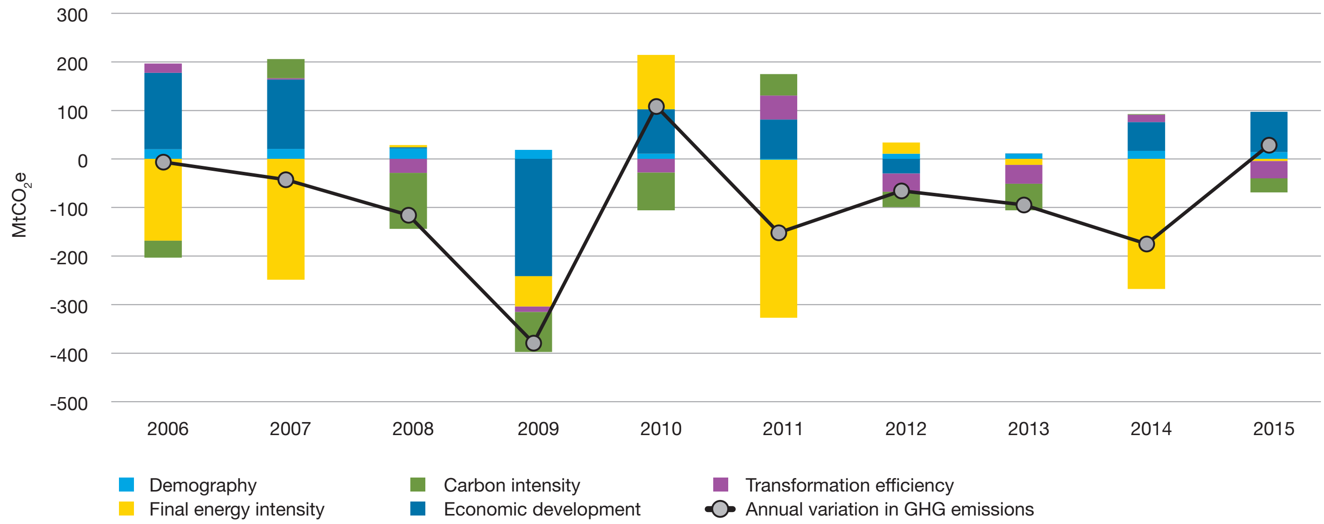
The decoupling of final energy demand and GDP was the most important driver of GHG emissions reductions in the EU over 2005-2015



Source: I4CE, 2017

FIGURE 8. ANNUAL DRIVERS OF GHG EMISSIONS VARIATIONS IN THE EU (2005-2015)

The improvement of final energy intensity contributed to decrease GHG emissions almost every year, as well as the decrease in the carbon intensity of the EU primary energy mix



Source: I4CE, 2017

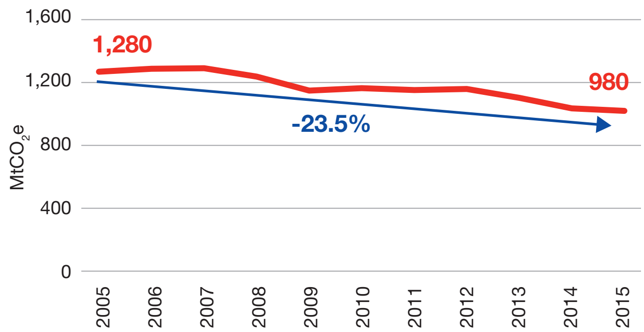
In order to better understand the contribution of the different drivers, in-depth sectoral analyses were carried out: for the power sector, the iron and steel sector, and the refining sector.

b. In the power sector, GHG emissions reductions mainly came from the deployment of renewables

GHG emissions from the power sector in the EU decreased by 300 $MtCO_2e$ over 2005-2015 in the EU – a decrease of 23.5% (see **Figure 9**).

FIGURE 9. GHG EMISSIONS FROM THE POWER SECTOR IN THE EU (2005-2015)

Between 2005 and 2015, GHG emissions from the power sector decreased by 300 $MtCO_2e$



Source: I4CE, with data from Eurostat and the IPCC

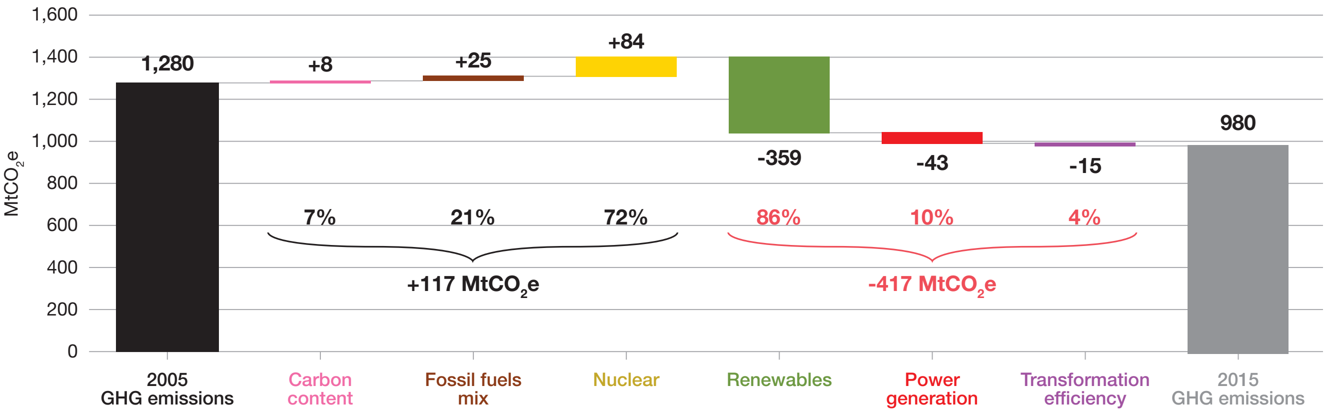
GHG emissions reductions mainly came from the **deployment of renewable sources of energy**, which contributed to decrease GHG emissions by 359 $MtCO_2e$ in total (see **Figure 10**). The overall **decrease in power generation** was the second most important contributor to GHG emissions reductions (-43 $MtCO_2e$), followed by an **improvement in the fuel efficiency of thermal power plants** (-15 $MtCO_2e$).

On the contrary, the decrease in the share of nuclear power over the period led to an increase in GHG emissions (+84 $MtCO_2e$), as well as changes in the fossil fuels power mix (+25 $MtCO_2e$), and to a lesser extent the **evolution of the carbon content of the different fossil fuels**[5] – especially of gas (+8 $MtCO_2e$).

5 *This variable does not reflect a switch from one fuel to the other (i.e. a coal-to-gas switch), but the variation in the average carbon content of each fuel, for example due to variations in the quality of gas.*

FIGURE 10. DRIVERS OF GHG EMISSIONS VARIATIONS FROM THE POWER SECTOR IN THE EU (2005-2015)

Over 2005-2015 GHG emissions reductions in the power sector mainly came from the deployment of renewable energy sources in the EU

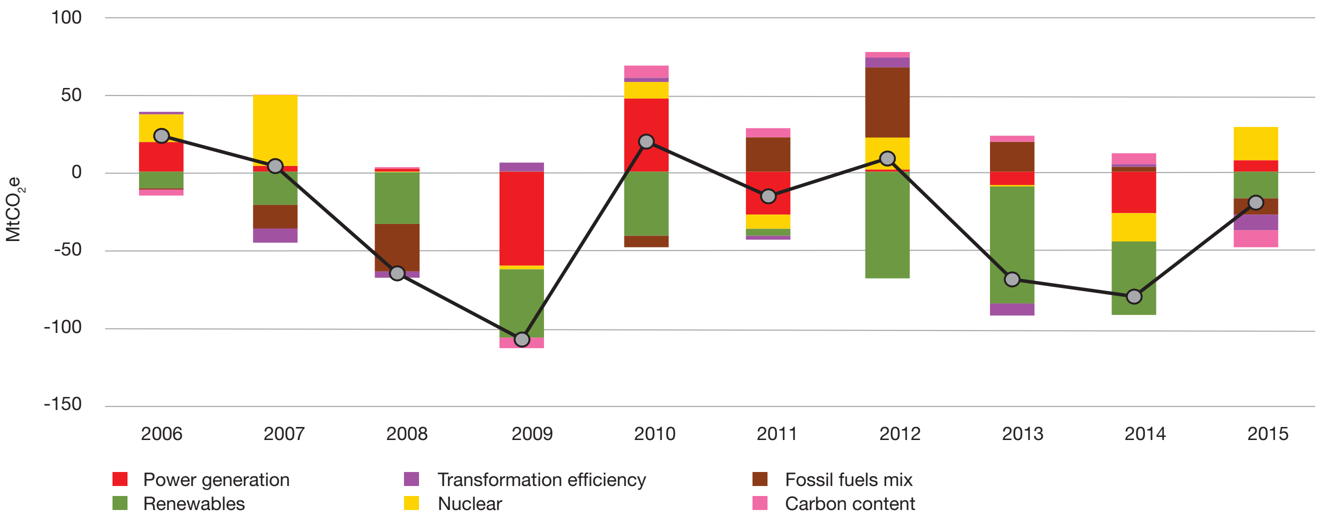


Source: I4CE, 2017

The analysis of annual drivers of GHG emissions variations from the power sector shows that the **deployment of renewables** steadily contributed to the decline of GHG emissions (see **Figure 11**). The **decrease in power generation in 2009** and the **recovery the subsequent year** had a significant impact on GHG emissions from the power sector (respectively **-60 $MtCO_2e$** and **+46 $MtCO_2e$**).

FIGURE 11. ANNUAL DRIVERS OF GHG EMISSIONS VARIATIONS FROM THE POWER SECTOR IN THE EU (2005-2015)

The deployment of renewable energy sources steadily contributed to GHG emissions reductions in the power sector

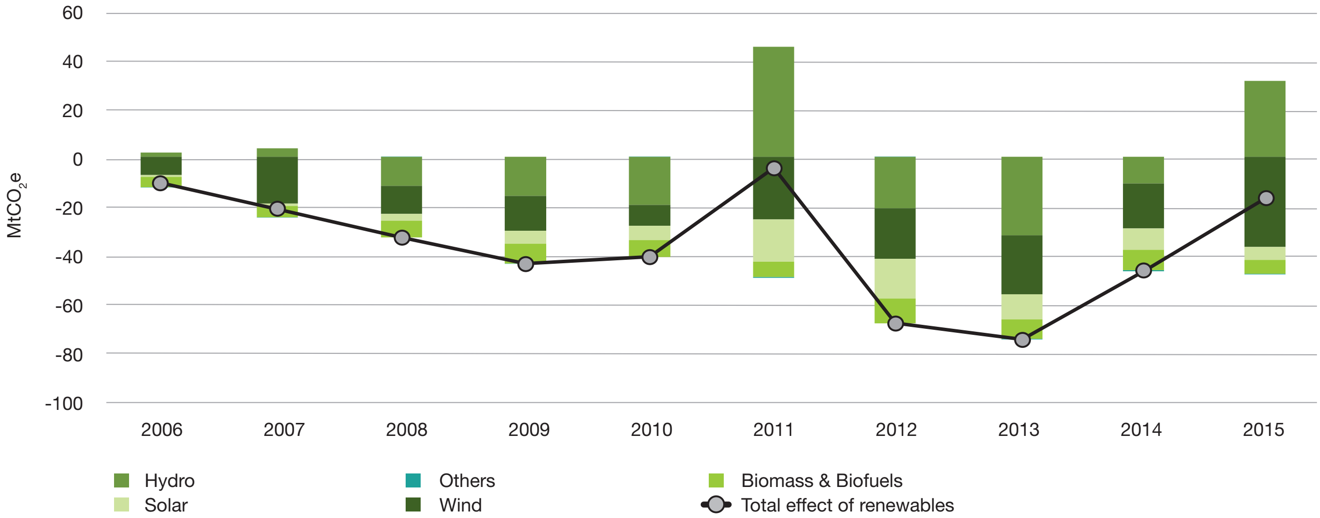


Source: I4CE, 2017

The annual contribution of the deployment of renewable energy sources to GHG emissions reductions **kept increasing from 2005 to 2015**, 2011 and 2015 excepted, due to the decrease in hydropower generation in those years. **Wind power** contributed the most to GHG emissions reductions, with an estimated **186 $MtCO_2e$** of cumulated emissions reductions over the period (see **Figure 12**). **Solar power** and power from **biomass and biofuels** come next, with respectively **73 $MtCO_2e$** and **69 $MtCO_2e$** of emissions reductions.

FIGURE 12. ANNUAL CONTRIBUTION OF THE DEPLOYMENT OF RENEWABLE ENERGY SOURCES TO VARIATIONS IN GHG EMISSIONS IN THE POWER SECTOR BY SOURCE (2005-2015)

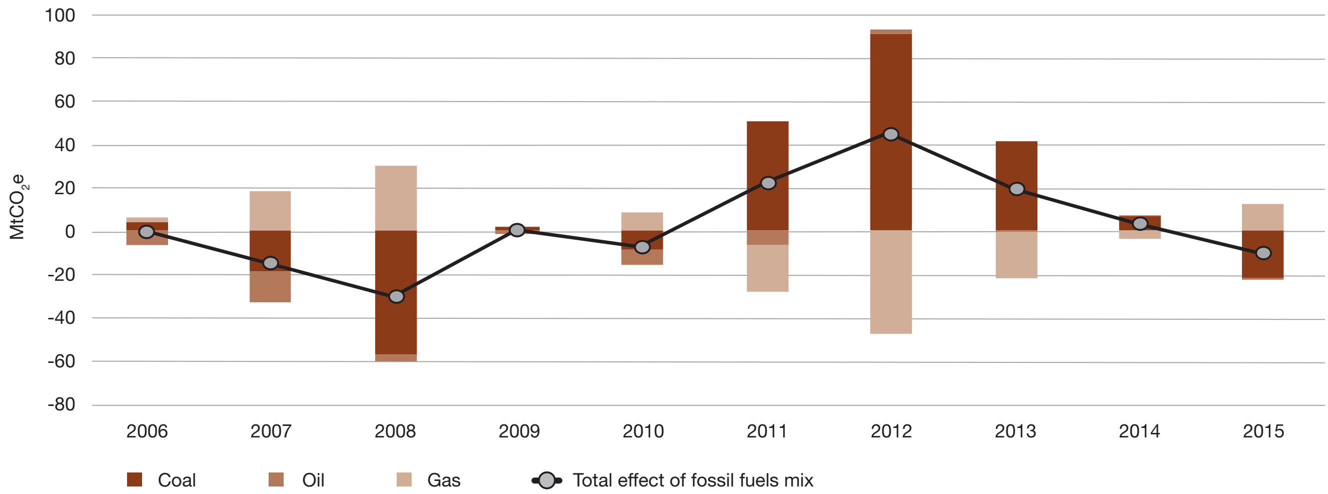
Wind power contributed the most to GHG emissions reductions in the power sector, with an estimated 186 $MtCO_2e$ of cumulated emissions reductions over the period



Source: I4CE, 2017

FIGURE 13. ANNUAL CONTRIBUTION OF CHANGES IN THE FOSSIL FUELS POWER MIX TO VARIATIONS IN GHG EMISSIONS IN THE POWER SECTOR BY SOURCE (2005-2015)

While the evolution of the fossil fuels power mix contributed to reducing GHG emissions between 2005 and 2010, it was a net contributor to the increase in emissions from 2011 on



Source: I4CE, 2017

Indeed, the share of renewable sources of energy in power generation increased from **15%** to **30%** between 2005 and 2015, with significant variations in the increase rate of the different sources:

- Hydropower remained more or less **stable**;
- Wind generation increased **fourfold**;
- Power generation from solar energy was multiplied by **67**.

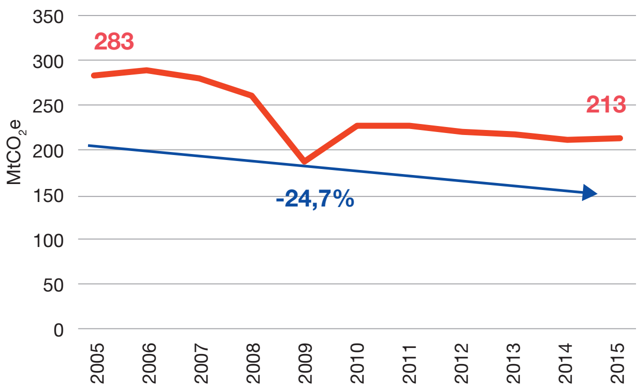
Figure 13 gives more details on the annual contribution of the evolution of the fossil fuels power mix to variations in GHG emissions from the power sector. While it contributed to **reducing GHG emissions between 2005 and 2010**, it led to an increase in emissions from 2011 on. Indeed, while between 2005 and 2010, **coal share in power generation from fossil fuels decreased at the advantage of gas**, the trend reversed from 2011 on, with coal accounting in 2015 for two thirds of power generation from fossil fuels. The evolution of the fossil fuels power mix (and in particular the coal-to-gas switch) led to **a decrease of 53 $MtCO_2e$ in GHG emissions over the period 2005-2010**, and **to an increase of 78 $MtCO_2e$ over 2011-2015**, due a subsequent gas-to-coal switch.

c. In the iron and steel sector, GHG emissions reductions mainly came from an increased energy efficiency and the relocation of production outside the EU

In the iron and steel sector, GHG emissions decreased by 70 $MtCO_2e$ over 2005-2015 – a decrease of 24.7% (see **Figure 14**).

FIGURE 14. GHG EMISSIONS FROM THE IRON AND STEEL SECTOR IN THE EU (2005-2015)

GHG emissions from the iron and steel sector decreased by 70 $MtCO_2e$ over 2005-2015

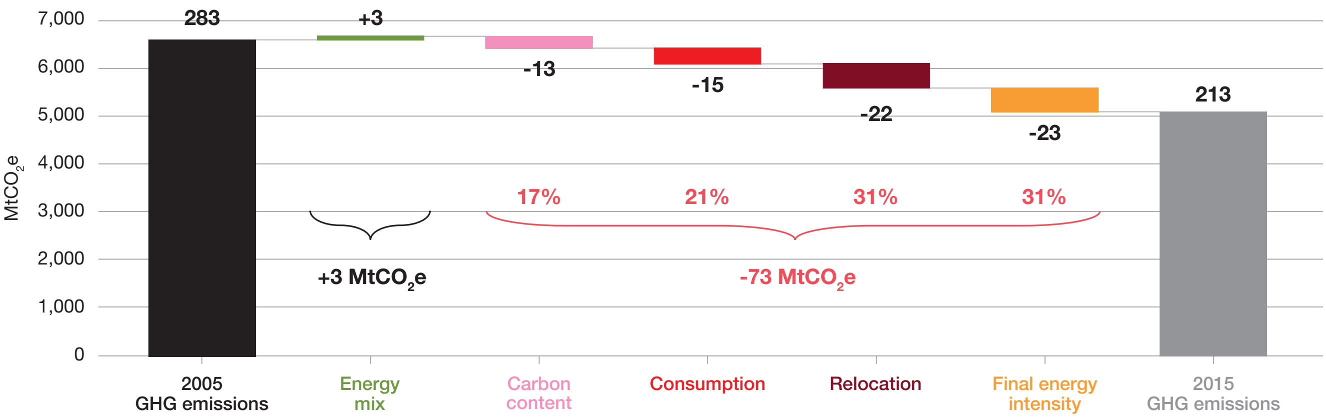


Source: I4CE, with data from Eurostat and the IPCC

The quantified analysis of the contribution of different drivers to the variations in GHG emissions from the iron and steel sector shows that **energy efficiency** was the most important driver in decreasing GHG emissions over 2005-2015 (see **Figure 15**). Its contribution is estimated to a reduction of **23 $MtCO_2e$** in total GHG emissions over the period. The **relocation of production outside the EU** was overall the second most important contributor to GHG emissions reductions (**-22 $MtCO_2e$**), followed by the **decrease in the demand for iron and steel products** (-**15 $MtCO_2e$).** Finally, the **carbon content of the fuels** used decreased over the period, leading to a decrease in GHG emissions of **13 $MtCO_2e$**, of which **10 $MtCO_2e$** are estimated to come from the decarbonisation of electricity.

FIGURE 15. DRIVERS OF GHG EMISSIONS VARIATIONS FROM THE IRON AND STEEL SECTOR IN THE EU (2005-2015)

GHG emissions reductions from the iron and steel sector in the EU mainly came from an increased energy efficiency and from the relocation of production outside the EU



Source: I4CE, 2017

The evolution of the share of the different energy sources on the contrary contributed to an increase in GHG emissions over the period (**+3 $MtCO_2e$**).

d. The decline in the demand for refined products was the most important driver of GHG emissions reductions over 2008-2015

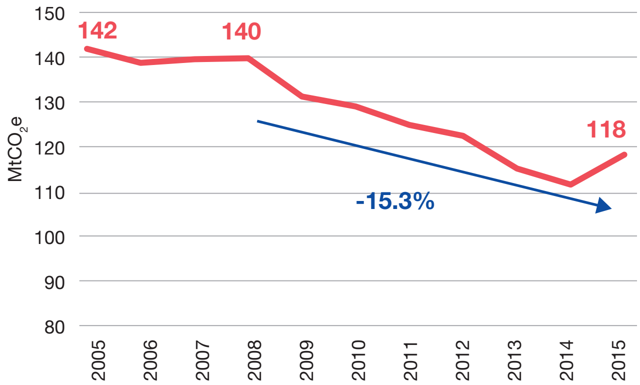
GHG emissions from the refining sector decreased by 22 $MtCO_2e$ during 2008 and 2015 – a decrease of 15.3% (see **Figure 16**).

Due to data availability, the quantified analysis of the contribution of different drivers to the variations in GHG emissions from the refining sector was only carried out on the 2008-2015 period.

The **decrease in the demand for refined products** was the most important driver in decreasing GHG emissions in the refining sector over 2008-2015, for a total of **17 $MtCO_2e$** over the period (see **Figure 17**). **Energy efficiency** was the second most important contributor to GHG emissions reductions (-6 $MtCO_2e$), followed by a **reduction in the carbon content of the respective fuels used**: **-5 $MtCO_2e$**, about half of which is estimated to come from the decarbonisation of electricity. Finally, the **evolution of the share of the different energy sources** also resulted in a decrease in emissions (**-2 $MtCO_2e$**). On the contrary, the **growing complexity of refined products** led to an increase in GHG emissions over the period (**+5 $MtCO_2e$**), as well as a relative **relocation of production in the EU** (**+3 $MtCO_2e$**).

FIGURE 16. GHG EMISSIONS FROM THE REFINING SECTOR IN THE EU (2005-2015)

GHG emissions from the refining sector were more or less stable between 2005 and 2008, and decreased by 22 $MtCO_2e$ between 2008 and 2015

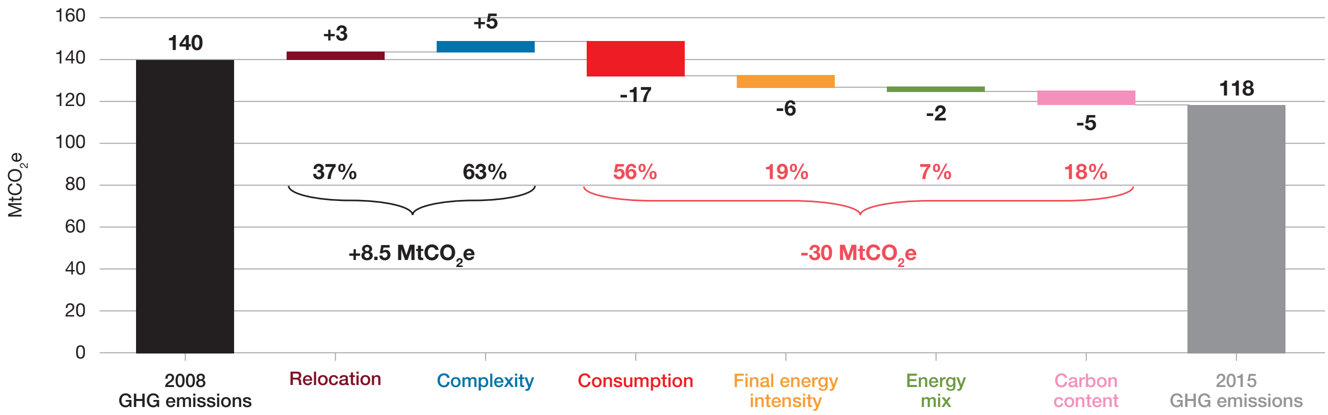


Note: GHG emissions in the refining sector were calculated from Eurostat data on final energy consumption by source in refineries. Consequently, they do not include GHG emissions coming from fluid catalytic cracking.

Source: I4CE, with data from Eurostat and the IPCC

FIGURE 17. DRIVERS OF GHG EMISSIONS VARIATIONS FROM THE REFINING SECTOR IN THE EU (2008-2015)

GHG emissions reductions mainly came from a reduction in the demand for refined products over 2008-2015



Source: I4CE, 2017

BOX 2. SUMMARY OF THE RESULTS FROM THE EX-POST QUANTIFIED ANALYSIS OF THE CONTRIBUTION OF DIFFERENT DRIVERS TO THE VARIATIONS IN EU GHG EMISSIONS

General trends

- GHG emissions in the EU decreased by **900 $MtCO_2e$** between 2005 and 2015. The analysis of general trends in the EU economy shows that the **decoupling of final energy demand and GDP** was the main driver for GHG emissions reductions, with an estimated **951 $MtCO_2e$** of emissions reductions coming from a **decreased energy intensity**.
- The move towards **less carbon intensive fuels** was the second most important driver of GHG emissions reductions (**-339 $MtCO_2e$** over 2005-2015).

Power sector

- In the power sector, GHG emissions reductions mainly came from the **deployment of renewables (-359 $MtCO_2e$** over 2005-2015), and in particular from the deployment of wind power **(-186 $MtCO_2e$).**
- While the evolution of the **fossil fuels mix for power generation** contributed to reducing GHG emissions between 2005 and 2010, it led to an increase in emissions from 2011 on. Over 2005-2015, it led to a net increase in GHG emissions **(+25 $MtCO_2e$).**

Industry

- In the iron & steel sector, **energy efficiency and the relocation of production outside the EU** were the most important drivers in decreasing GHG emissions over 2005-2015 (respectively **-23 and -22 $MtCO_2e$**).
- In the refining sector, the **decrease in the demand for refined products** was the most important driver in decreasing GHG emissions over 2005-2015 (**-17 $MtCO_2e$** over the period), followed by energy efficiency (**-6 $MtCO_2e$**).

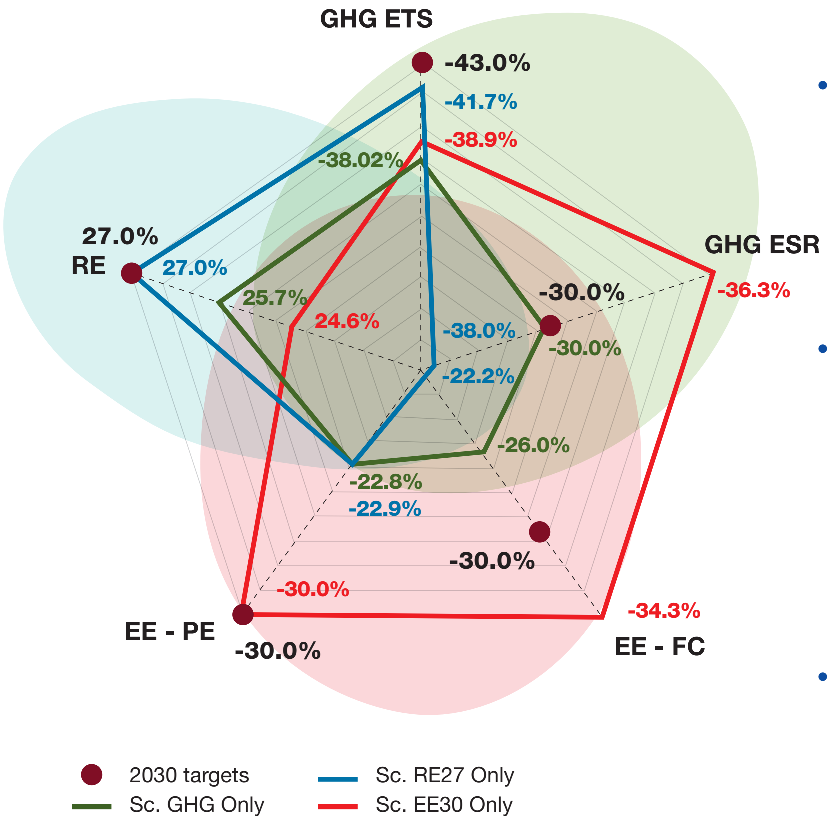
B. Energy efficiency and renewable energy policies are expected to continue to significantly contribute to reducing GHG emissions in the post-2020 period

a. The achievement of each EU 2030 climate and energy target contributes to the achievement of others

Understanding the interactions between EU 2030 climate and energy policies requires assessing the **contribution of the achievement of one target to the achievement of others**. The modelling of three theoretical scenarios with POLES is used to evaluate the contribution of targets and policies to the achievement of 2030 climate and energy targets:

FIGURE 18. ACHIEVEMENT OF EU 2030 TARGETS IN DIFFERENT POLES SCENARIOS

Policies implemented to achieve an EU target contribute to the achievement of the others



Legend:

GHG ETS	Reduction in GHG emissions from ETS sectors (compared to 2005 levels)
GHG ESR	Reduction in GHG emissions from non-ETS sectors (compared to 2005 levels)
RE	Share of renewable energy in gross final consumtion
EE - FC	Decrease in final energy consumption compared to 2007 Baseline scenario
EE - PE	Decrease in primary energy consumption compared to 2007 Baseline scenario

Source: Enerdata. 2017

- **"GHG only"**: in this counterfactual scenario, there are no EU targets for the deployment of renewables nor for energy efficiency. Only the EU ETS and the ESR are implemented.
- **"RE27 only"**: in this counterfactual scenario, there are no EU targets for energy efficiency and the EU ETS and the ESR are not implemented. It is assumed that specific policies are implemented to achieve a share of 27% of renewable energy sources in gross final consumption by 2030.
- **"EE30 only"**: in this counterfactual scenario, there are no EU targets for renewable energy sources and the EU ETS and the ESR are not implemented. It is assumed that specific policies are implemented to achieve a target of 30% of energy efficiency by 2030 (for both primary and final energy consumption).

- The achievement of the 2030 renewable energy target strongly reduces GHG emissions in ETS sectors and to a lesser extent in non-ETS sectors. As for the energy efficiency target, it strongly reduces GHG emissions in non-ETS sectors, and to a lesser extent in ETS sectors. Its achievement in terms of primary energy leads to the overachievement of the target in terms of final energy consumption.
- Conversely, the **EU ETS and the ESR by themselves contribute to the achievement of 2030 renewable energy and energy efficiency targets**. By construction, in the GHG only scenario, the EU ETS and the ESR are complied with (i.e. carbon budgets defined by European texts are respected). However, the EU GHG emissions reduction target for 2030 is not achieved due to the design of the EU ETS (the possibility to use the surplus of allowances and the release of additional allowances from the MSR on the market) (see **section 3.C.**).
- Additionally, the achievement of the renewable energy target contributes to the energy efficiency target in terms of primary energy. As for the achievement of the energy efficiency target, it contributes to the renewable energy target, as it decreases the absolute production of renewable energy required to achieve the 2030 target expressed as a share of gross final energy consumption.

Note: The central point of the figure corresponds to the achievement of the different 2030 targets in the « No Policy » scenario, a counterfactual scenario in which no climate and energy policies are implemented (-27% for EU ETS GHG emissions, -25% for ESR GHG emissions, 23% for renewable energy sources, -22% for final energy consumption, and -19% for primary energy consumption).

b. The achievement of EU 2030 targets for renewable energy and energy efficiency greatly contributes to GHG emissions reductions up to 2030

Prospective scenarios were modelled with POLES to **quantify the expected contribution of renewable energy and energy efficiency policies to GHG emissions reductions** in sectors covered by the EU ETS and by the ESR.

Their contribution is estimated as the difference in GHG emissions between two scenarios:

- The "GHG only" scenario, in which the only EU policy instruments are the EU ETS and the ESR;
- An intermediate scenario – "EE&RE contribution scenario" – in which the EU ETS and the ESR function as if they were the only policy instruments but in which EU targets for renewable energy and energy efficiency are achieved.[6]

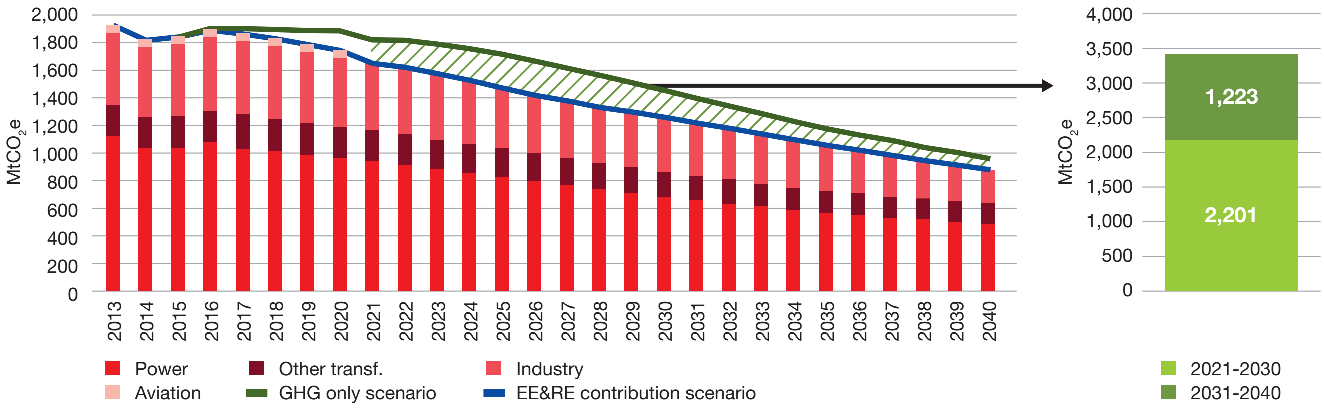
Energy efficiency and renewable energy policies are expected to contribute to 95 % of GHG emissions required from ETS sectors up to 2030

In total over 2021-2030, **energy efficiency and renewable energy policies are estimated to contribute to a reduction of 2.2 $GtCO_2e$** in GHG emissions covered by the EU ETS (see **Figure 19**), under the assumption that specific policies are implemented to achieve 2030 targets for energy efficiency and renewable energy.

6 *The carbon value, which represents the cost of emissions reductions required to respect the constraint set by the EU ETS and by the ESR, is the same as in the "GHG only" scenario. Please refer to the Annexes (8.B.) for more details on the methodology.*

FIGURE 19. GHG EMISSIONS COVERED BY THE EU ETS (LEFT) AND CONTRIBUTION OF ENERGY EFFICIENCY AND RENEWABLE ENERGY POLICIES TO GHG EMISSIONS REDUCTIONS COVERED BY THE EU ETS OVER 2021-2040 (RIGHT)

In total over 2021- 2030, energy efficiency and renewable energy policies are estimated to contribute to a reduction of 2.2 $GtCO_2e$ in GHG emissions covered by the EU ETS



Source: Enerdata, 2017

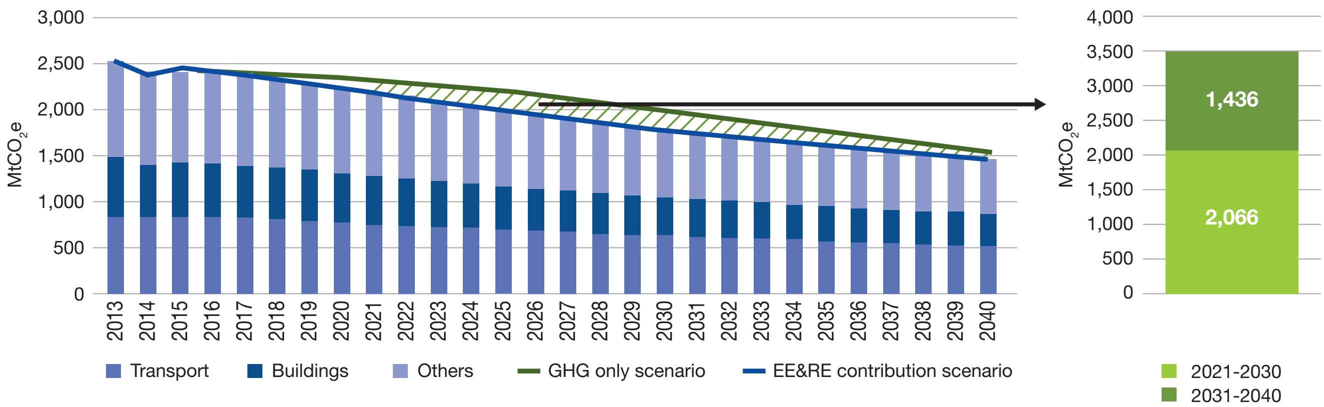
Over the EU ETS Phase IV, it is equivalent to **1.5 years of allowances**– around 15% of the cumulated cap. It represents **almost 95% of reductions required from ETS sectors over its Phase IV**, calculated as the difference between cumulated GHG emissions in the "No Policy" scenario – a counterfactual scenario in which no climate and energy policies are implemented – and the cumulated EU ETS cap over 2021-2030.

The contribution of renewable energy and energy efficiency policies to GHG emissions reductions represents more than 2.5 times the amount of reductions required from non-ETS sectors over 2021-2030

In sectors covered by the ESR, **energy efficiency and renewable energy policies are estimated to contribute to a reduction of 2.1 $GtCO_2e$** in GHG emissions over 2021-2030, under the assumption that specific policies are implemented to achieve 2030 targets for energy efficiency and renewable sources of energy (see **Figure 20**).

FIGURE 20. GHG EMISSIONS COVERED BY THE ESR (LEFT) AND CONTRIBUTION OF ENERGY EFFICIENCY AND RENEWABLE ENERGY POLICIES TO GHG EMISSIONS REDUCTIONS COVERED BY THE ESR OVER 2021-2040 (RIGHT)

In total over 2021-2030, energy efficiency and renewable energy policies are estimated to contribute to a reduction of 2.1 $GtCO_2e$ in GHG emissions covered by the ESR



Source: Enerdata, 2017

The contribution of renewable energy and energy efficiency policies to GHG emissions reductions corresponds to **around 10% of cumulated AEAs over 2021-2030**. It represents **more than 2.5 times the amount of reductions required from non-ETS sectors over 2021-2030**, calculated as the difference between cumulated GHG emissions in the “No Policy” scenario – a counterfactual scenario in which no climate and energy policies are implemented – and the cumulated AEAs over 2021-2030.

5. The contribution of renewable energy and energy efficiency policies to GHG emissions reductions is not appropriately taken into account, which creates counteractive interactions with the EU ETS and the ESR

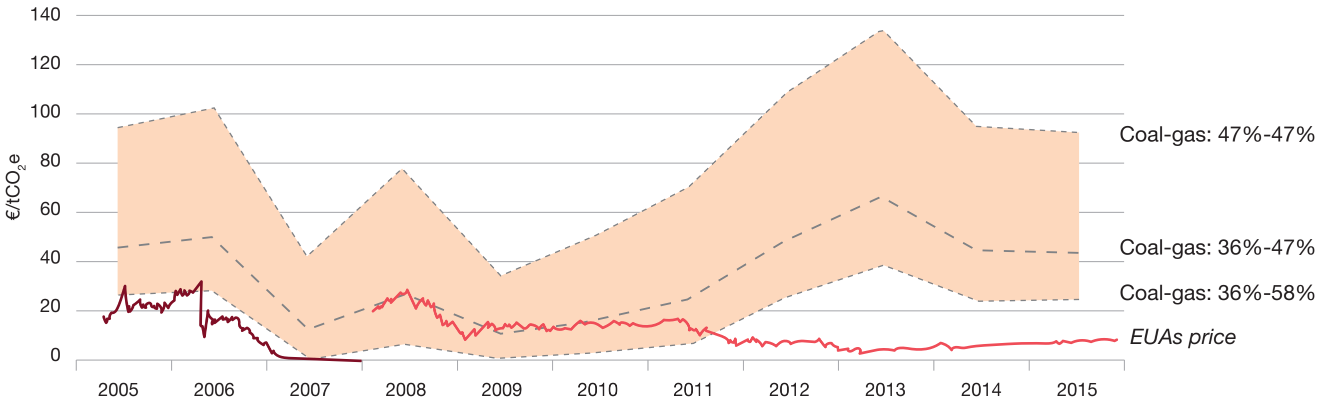
A two-fold role can be expected from the EU ETS: driving **GHG emissions reductions** through its carbon price signal and guaranteeing the **achievement of climate targets** by setting a cap on GHG emissions.

A. Historically, the EU ETS had a minor impact on GHG emissions reductions – at least in the power sector

The ex-post impact of the EU ETS on GHG emissions reductions is difficult to assess as many factors come into play – e.g. the carbon price signal, the anticipations of stakeholders... In our quantified analysis of the historical contribution of different drivers to the variations in GHG emissions, we only evaluated the impact of the EU ETS on GHG emissions reductions in the power sector. It was estimated as **GHG emissions reductions coming from a coal-to-gas switch** in the years in which the price of EU allowances (EUAs) was within the range of the coal-to-gas switching price. Given the relative coal and gas prices, and taking into account a large range of possible thermal efficiencies for coal and gas power plants, **the price of EUAs could only trigger a coal-to-gas switch in the 2005-2011 period** (see **Figure 21**). Consequently, only the reductions in GHG emissions coming from the evolution of the fossil fuels mix in this period can be attributed to the carbon price signal induced by the EU ETS. Our quantified analysis of the contribution of different drivers to the variations in GHG emissions reductions in the power sector (see **section 4.A.b.**) concluded that **changes in the fossil fuels power mix decreased emissions by 53 $MtCO_2e$ over 2005-2010**. These emissions reductions were more than offset by **additional GHG emissions stemming from a gas-to-coal switch after 2011 (+78 $MtCO_2e$)**. Consequently, only the **reduction of 53 $MtCO_2e$ over 2005-2010** may be attributed to the carbon price signal induced by the EU ETS.

FIGURE 21. CARBON SWITCHING PRICE FOR DIFFERENT COAL AND GAS GENERATION EFFICIENCY IN THE EU IN COMPARISON WITH THE EU ETS PRICE

From 2011 on, the price of EUAs has been well below the price level which would have triggered a coal-to-gas switch in power generation



Source: I4CE, from BP 2017 (Gas: Heren NBP Index; Coal: IHS Northwest Europe); and from ICE futures Europe (forward dec 2007 for EUAs price phase I and spot price for phases II & III).

The depressed carbon price signal on the EU ETS is partly due to counteractive interactions with renewable energy and energy efficiency policies, which contributed to create an imbalance between supply and demand.

B. In the post-2020 period, counteractive interactions continue to undermine the effectiveness of the EU ETS and the ESR

a. The EU ETS is not expected to drive GHG emissions reductions in the post-2020 period

To analyze the expected role of the EU ETS during its Phase IV, in interaction with other policies, a 2017 Baseline scenario was modelled with POLES. This scenario represents the deal on the EU ETS reform agreed on in November 2017 and the Commission's proposals from November 2016 on 2030 targets for renewable energy and energy efficiency. Taking into account the design parameters of the EU ETS for its Phase IV, **GHG emissions reductions coming from renewable energy and energy efficiency policies will be sufficient to respect the EU ETS target in its Phase IV** – under the assumption that specific policies are implemented to achieve 2030 targets.

One of the outputs of POLES modelling is the carbon value, which represents the **cost of emissions reductions required to respect the carbon budget defined by the EU ETS.** The carbon budget corresponds to the supply of EU ETS allowances and the surplus of allowances in circulation, taking into account the action of the MSR. In the 2017 Baseline scenario, in spite of the MSR, the EU ETS does not constrain emissions reductions and the carbon value is thus equal to zero all along Phase IV.

This carbon value is not a market price; however, it indicates that fundamentals are not expected to drive the EUAs price up. A **depressed carbon price would not drive low-carbon investments**, and even the cheapest abatement options – such as switching from coal to gas in power generation for example – may be disregarded.

The situation is different for the ESR, but in the same way as the fact that GHG emissions reductions from energy efficiency policies and renewable energy policies are not accounted for in the EU ETS design will lower the price of EUAs and the incentive for additional emissions reductions, it will also **reduce the incentive for GHG emissions reductions in non-ETS sectors and some abatement options may be disregarded.**

b. The MSR is not sufficient to make the EU ETS resilient to the effect of other policies

The MSR, taking into account the parameters agreed on in the revised directive, absorbs a significant number of allowances: almost 3.3 billion allowances until the end of Phase IV. In total, **2.6 billion allowances are invalidated between 2023 and 2030**, almost 2.4 billion of which in 2023 (see Figure 22).

FIGURE 22. VOLUME OF THE MSR AND INVALIDATED ALLOWANCES IN THE 2017 BASELINE SCENARIO

Without the invalidation mechanism, there would be almost 3.3 billion allowances in the MSR in 2030. In total, 2.6 billion allowances are invalidated until 2030, almost 2.4 billion of which in 2023

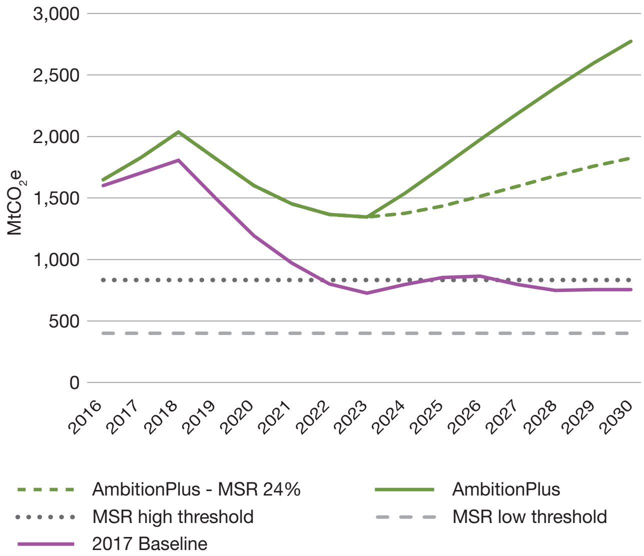
Source: Enerdata, 2017

However, we estimate that the MSR will not be able to mitigate the effect of other policies on the EU ETS while absorbing the historical surplus. In the Baseline 2017, the MSR struggles to stabilize the surplus by the end of Phase IV. The number of withdrawn allowances is not sufficient to have a scarcity of allowances and increase the carbon price signal by the end of Phase IV, as shown by the carbon value equal to zero.

In case of higher targets for renewable energy and energy efficiency, the MSR is **not able to stabilize the surplus of allowances**. An "AmbitionPlus" scenario is modelled with POLES, in which 2030 targets for renewable energy and energy efficiency are increased: respectively 35% and 40%. Under this configuration, the surplus of allowances increases to almost 2.8 billion allowances in 2030. With a 24% withdrawal rate for the MSR until 2030, the surplus would still exceed 1.8 billion allowances in 2030.

FIGURE 23. EVOLUTION OF THE SURPLUS OF ALLOWANCES ON THE EU ETS IN THE 2017 BASELINE AND THE AMBITIONPLUS SCENARIOS BY 2030

In case of higher 2030 targets for renewable energy and energy efficiency (respectively 35% and 40%), the surplus of allowances would reach almost 2.8 billion allowances in 2030 in spite of the MSR



Source: Enerdata, 2017

Furthermore, these results on the MSR do not take into account the possible implementation of national climate policies (i.e. coal phase-outs) nor unexpected economic downturns, which would increase the surplus of allowances. However, the MSR may have a psychological effect on the anticipations of stakeholders, which is not accounted for in the modelling.

c. The persistent formation of surplus undermines the role of the EU ETS and the ESR in guaranteeing the achievement of climate targets

As described in **section 3.C.**, compliance with the EU ETS and the ESR **does not guarantee the achievement of 2020 and 2030 climate targets**. Counteractive interactions, as they contribute to the formation of the surplus of EUAs and AEAs, emphasize this effect.

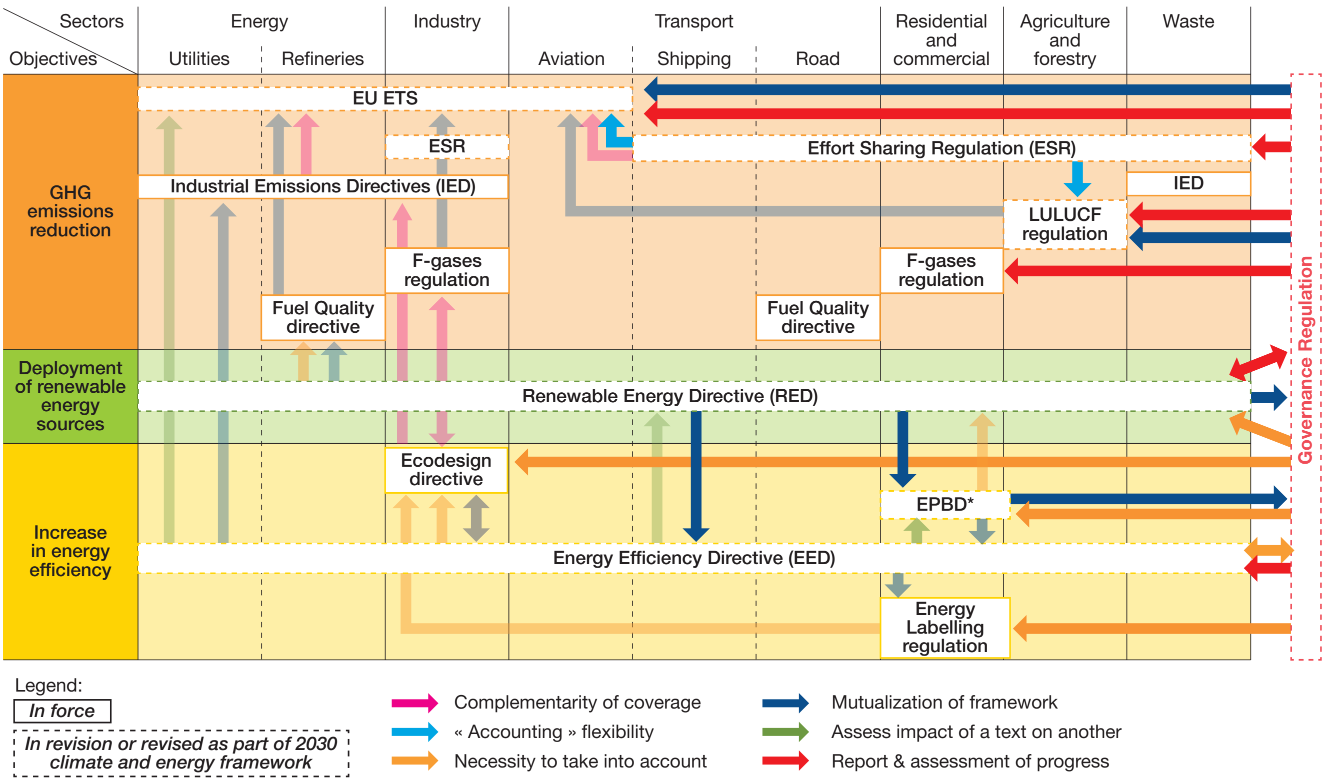
6. An enhanced governance approach to the EU climate and energy framework is required

A. Assessing the impact of policies on others in an unavoidable requirement

To design a coherent policy package and mitigate counteractive interactions between policies, a **necessary step consists in assessing the impact of policies on others**. Figure 24 represents the links between the different legislative texts of the climate and energy framework. The colors represent the nature of the links and nontransparent arrows represent links which were introduced with the revision of the 2030 climate and energy framework. For example, yellow arrows represent the requirement stated in legislative texts to explicitly take another into account. Some texts mutualize a legislative framework (indicated by dark blue arrows), some have a complementary coverage – either in terms of sectors or installations (indicated by pink arrows). There is an accounting flexibility between the ESR and the EU ETS on the one side, and between the ESR and the LULUCF regulation on the other (indicated by light blue arrows). Indeed, to a certain extent it will be possible to use EUAs and net removals from LULUCF sectors to comply

FIGURE 24. LINKS BETWEEN THE LEGISLATIVE TEXTS OF THE EU CLIMATE AND ENERGY FRAMEWORK

In the current climate and energy framework, only the energy efficiency directive requires the assessment of its impact on other policies. The proposed regulation on the Governance of the Energy Union is a first step towards a more coherent policy package but it does not include requirements to assess the impact of policies on one another at EU level



** EPBD: Energy performance of buildings directive.*

Interpretation of the graph: The arrows represent the links between the different legislative texts of the climate and energy framework. The colors represent the nature of the links. Nontransparent arrows represent links which were introduced with the revision of the 2030 climate and energy framework.

Source: I4CE, 2018

with the ESR (see **section 3.B.**). Green arrows represent the requirement to assess the impact of one text on another. In the current climate and energy policies package, **only the energy efficiency directive includes this requirement**.

Red arrows represent the requirement to report progress on the implementation of a legislative text under the proposed Governance regulation.

B. The proposed Governance Regulation is an interesting step towards a more coherent policy package

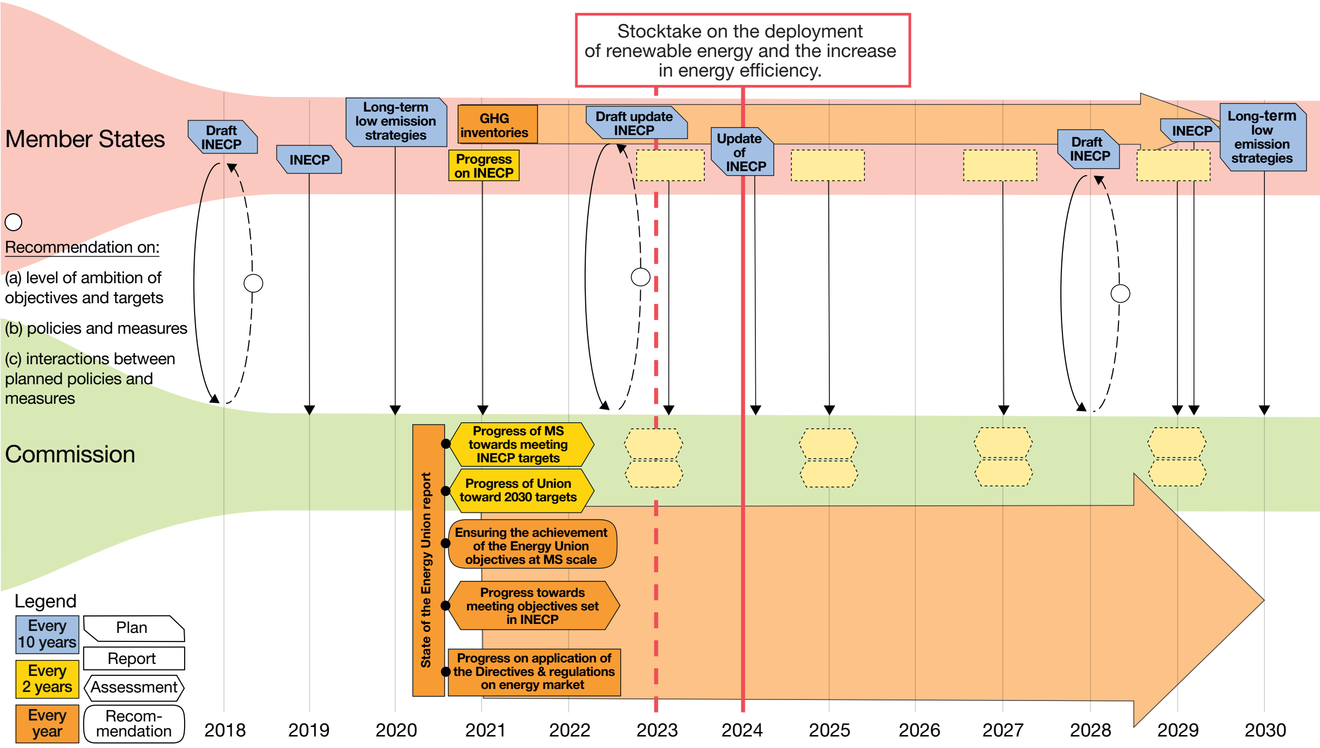
a. The EU Commission's proposal describes an iterative process between Member States and the Commission towards the achievement of EU climate and energy targets

The proposed regulation on the Governance of the Energy Union, as **it aims at ensuring that the objectives of the Energy Union are met while ensuring policy coherency**, is a first interesting step towards a more coherent policy package.

The EU Commission proposed an **iterative process** between Member States and the Commission (see **Figure 25**). Member States will have to draft **ten-year Integrated National Energy and Climate Plans (INECPs)**, describing

FIGURE 25. ITERATIVE PROCESS BETWEEN THE COMMISSION AND MEMBER STATES DESCRIBED IN THE COMMISSION'S PROPOSAL FOR A REGULATION ON THE GOVERNANCE OF THE ENERGY UNION

The proposed regulation on the Governance of the Energy Union aims at ensuring that the objectives of the Energy Union are met by implementing an iterative dialogue between Member States and the Commission



Source: I4CE, 2017

in particular national targets for renewable energy and energy efficiency, as well as policies and measures aimed at achieving these targets. They also will have to submit **long-term low emission strategies** with a fifty-year perspective.

Member States will be entitled to draft biennial reports on the progress towards meeting the objectives and targets described in their INECPs, as well as annual report on GHG inventories and on the use of EUAs auctioning revenues.

On its side, the Commission will be responsible for the assessment of:

- **Objectives set in the INECPs in view of achieving the Energy Union objectives** and in particular EU 2030 climate and energy targets;
- Member States' **progress towards meeting their INECP targets;**
- **EU progress towards meeting Energy Union objectives** and in particular EU 2030 targets.

The Commission will also be responsible for expressing adequate recommendations, either to individual Member States or to all of them. If necessary, it may take actions at EU level, such as managing a financing platform to invest in renewable energy.

According to the Commission's proposal, **a stocktake is planned in 2023** to ensure that the EU is on track to achieve its targets for renewable energy and energy efficiency. Furthermore, the Commission's proposal sets out the requirement for Member States to maintain from 2021 a share of renewable energy sources at least equal to their 2020 target, otherwise they should provide a contribution to the financial platform managed by the Commission.

b. The proposals of the Commission, the Parliament and the Council on the Governance regulation still lack provisions to better align the EU 2030 climate and energy policy package

The Commission's proposal would require the assessment of interactions between policies and measures only at the level of Member States. The EU Parliament is in favor of additionally **requesting the assessment of interactions with Union climate policies and measures** – in particular the EU ETS (see **Table 3**).

However, the text in discussion today still **lacks concrete provisions to better align the policy package.** To design a coherent policy package, it would be necessary to **carry out an ex-ante assessment of the interactions between energy and climate policies – at the national and EU levels, as well as annual ex-post assessments**. Provisions to adapt policies accordingly should be introduced – directly at the EU level and through recommendations by the Commission for an adaptation of policies in the Member States' INECPs.

Recommendation 9: Carrying out an **ex-ante assessment** of the interactions between energy and climate policies – at the national and EU levels, as well as **annual ex-post assessments.**

TABLE 3. POSITIONS OF THE COMMISSION, THE PARLIAMENT AND THE COUNCIL ON A SELECTION OF DESIGN PARAMETERS OF THE REGULATION ON THE GOVERNANCE OF THE ENERGY UNION

Parameters	EU Commission's proposal	EU Parliament's amendments	EU Council General Approach
INECP Content		Some elements added to the Commission's proposal, in particular a description of the **investment strategies** foreseen to meet the corresponding objectives and targets.	Several elements of the Commission's proposal for the INECP template are made unbinding.
Submission of long-term strategies	Submission by 1 Jan. 2020 and **every 10 years** thereafter. **50-year** perspective. Aligned with the objective of reducing EU GHG emissions by **80-95% in 2050** compared to 1990.	Submission by 1 Janvier 2019 and **every 5 years** thereafter **30-year** perspective. Aligned with **EU fair share of the 2050 and 2100 carbon budgets** consistent with a limitation of the increase in temperature to well below 2°C, in particular 1.5°C. Also aligned with a **target of net-zero GHG emissions** in the EU by 2050 and negative emissions soon thereafter.	Submission by 1 Jan. 2020 and **every 10 years** thereafter **30-year** perspective. Aligned with the objective of reducing EU GHG emissions **by 80-95% in 2050** compared to 1990.
Assessment of interactions between policies and measures	Assessment of interactions between policies and measures at the **national level.**	Assessment of interactions between policies and measures at the **national level and at the EU-level**, including an assessment of the impact of policies **on the operation of the EU ETS.**	Assessment of interactions between policies and measures **at the national level.**
Assessment of the trajectory towards the achievement of 2030 renewable energy	Assessment of EU share of renewable energy in 2023, in comparison with a linear trajectory to 2030 EU target.	Assessment at Member State level of the deployment of renewable energy at 3 reference points: • in 2021-22, 20% of the necessary increase in renewable energy share from 2020 target to 2030 target, • in 2023-25, 45%, • in 2025-27, 70%.	Assessment at Member State level of the deployment of renewable energy at 2 reference points: • in 2023, 22.5% of the necessary increase in renewable energy share from 2020 target to 2030 indicative value, • in 2025, 40%.
Coherence with the international climate context and the Paris Agreement	A Commission's report to the EU Parliament and Council by 28 Feb. 2026 and every 5 years on the operation of the Regulation, and the conformity with other Union legislation or future decisions relating to the UNFCCC and the Paris Agreement.	A Commission's report to the EU Parliament and Council **within 6 months of 2018 facilitative dialogue, and of the global stocktakes under the Paris Agreement** on the operation of the Regulation, and the conformity with other Union legislation or future decisions relating to the UNFCCC and the **adequacy of its contribution to the goals of the Paris Agreement**. Proposals from the Commission to enhance the Union's climate and energy action as appropriate. Within six months of the submission of a new NDC, submission by the Commission of the necessary legislative proposals.	A Commission's report to the EU Parliament and Council by 28 Feb. 2026 and every 5 years on the operation of the Regulation, **the progress towards the achievement of 2030 targets and the long-term objectives of the Paris Agreement**, and the conformity with other Union legislation or future decisions relating to the UNFCCC and the Paris Agreement.

Source: I4CE, 2018 from EU Commission, EU Parliament and EU Council

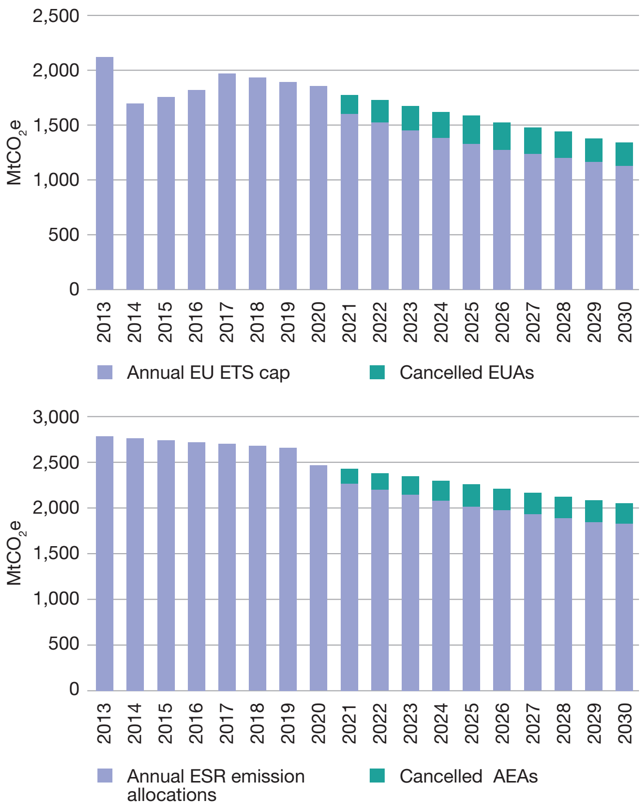
C. Aligning EU climate and energy policies in the 2030 policy framework enables to mitigate counteractive interactions

To mitigate counteractive interactions, **an "alignment" of the EU ETS and of the ESR to account for GHG emissions reductions coming from other policies is proposed**: the idea is to remove from the EU ETS cap and from ESR AEAs the contribution of other policies to GHG emissions reductions.

An additional scenario is modelled with POLES, the Aligned scenario, in which the annual ex-ante estimated contribution of energy efficiency and renewable energy policies – as presented in **section 4.B.b.** – is removed from the EU ETS cap and from Member States' AEAs in the period 2021-2030. In total, 2.2 billion allowances are cancelled from the EU ETS and total cumulative AEAs are reduced by 2.1 $GtCO_2e$ (see **Figure 26**).

FIGURE 26. EU ETS CAP (TOP) AND ESR ANNUAL EMISSION ALLOCATIONS (BOTTOM) OVER 2021-2030 IN THE ALIGNED SCENARIO

In the Aligned scenario, 2.2 billion allowances are canceled from the EU ETS cap and cumulative AEAs are reduced by 2.1 $GtCO_2e$ over 2021-2030



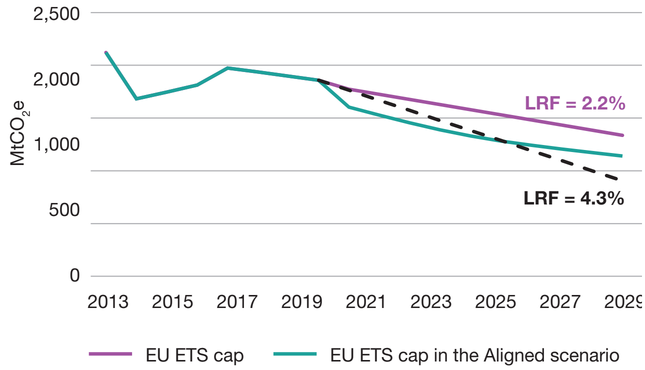
Source: Enerdata, 2017

In reality, this assessment should be carried out dynamically to evaluate the effective impact of renewable energy and energy efficiency policies, as well as other policies (i.e. emission standards, national coal phase out).

The required adaptation of the EU ETS cap to account for GHG emissions reductions coming from energy efficiency and renewable energy policies is substantial: a LRF of **4.3%** over 2021-2030 would result in the same cumulated EU ETS cap as in the Aligned scenario (see **Figure 27**). In that case, the EU ETS cap in 2030 would be equal to 905 $MtCO_2e$, a 62% reduction compared to 2005 levels.

FIGURE 27. EU ETS CAP CORRESPONDING TO THE SAME CUMULATED CARBON BUDGET AS IN THE ALIGNED SCENARIO

A LRF of 4.3% from 2021 would result in the same cumulated cap as in the Aligned scenario



Source: I4CE and Enerdata, 2017

a. The alignment of the EU ETS cap within the EU 2030 energy and climate framework restores its effectiveness: the surplus is quickly resorbed and the EU ETS becomes a driver of abatement

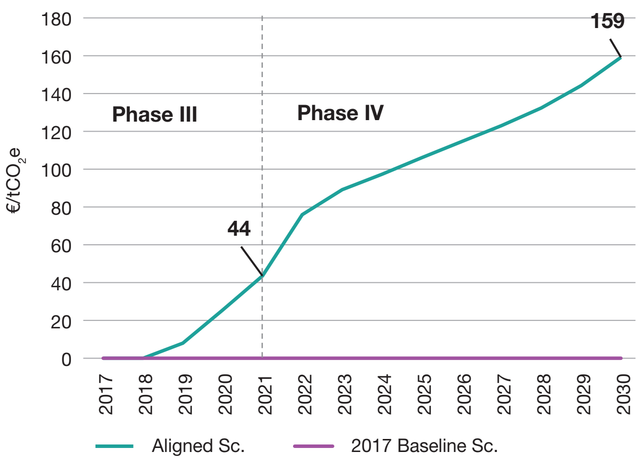
On the one hand, with the alignment of the EU ETS cap, **the surplus of EUAs is very quickly resorbed** and goes below the lower threshold of the MSR from 2023. On the other hand, the carbon value, representing the cost of GHG emissions reductions required to respect the constraint set by the EU ETS, increases from 2018[7] to reach 44€/tCO_2e in 2021, while it stays at 0 until 2030 in the 2017 Baseline scenario (see **Figure 28**).

7 *In the modelling, stakeholders have a 5-year vision on the carbon budget.*

AN ENHANCED GOVERNANCE APPROACH TO THE EU CLIMATE AND ENERGY FRAMEWORK IS REQUIRED

FIGURE 28. EU ETS CARBON VALUE IN THE ALIGNED SCENARIO AND IN THE 2017 BASELINE SCENARIO

In the Aligned scenario, the carbon value increases from 2018 to reach 44€/tCO_2e at the beginning of Phase IV



*Note: The carbon value in POLES is **not** the EU ETS market price. It represents the cost of GHG emissions reductions required to respect the constraint set by the EU ETS considering a sliding 5-years carbon budget.*

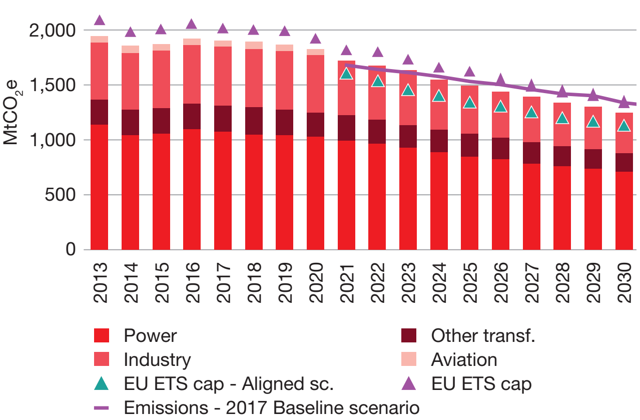
Source: Enerdata, 2017

The increase of the carbon value leads to **a deployment of renewable energy sources sufficient to achieve EU 2030 target**. Furthermore, it leads to an **immediate switch to less carbon-intensive energy sources** and for example, it further drives down the share of coal in power generation.

In 2030, GHG emissions in ETS sectors are **7% lower** than in the situation without the "alignment" of the EU ETS cap, which corresponds to a reduction of **47% compared to 2005 levels** (see Figure 29).

FIGURE 29. EU ETS EMISSIONS BY SECTOR IN THE ALIGNED SCENARIO

The "alignment" of the EU ETS cap leads to further reductions in GHG emissions covered by the EU ETS



Source: Enerdata, 2017

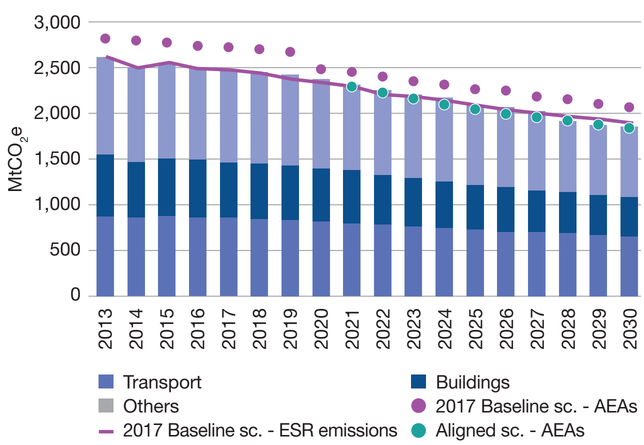
In practice, this "alignment" of the EU ETS could be achieved through **provisions in the Governance Regulation to adapt policies directly at the EU level**. The reviews of the MSR in 2021 and 2026 will also be the opportunity to adapt the EU ETS to the effect of other policies on GHG emissions.

b. The alignment of AEAs incentivizes additional GHG emissions reductions in sectors covered by the ESR

Withdrawing from AEAs the contribution of energy efficiency and renewable energy policies to GHG emissions reductions in non-ETS sectors makes the ESR stringent from 2021[8] and prevents the formation of surplus. Besides, this stringency would incentivize Member States to **further reduce GHG emissions reductions in non-ETS sectors**. In 2030, GHG emissions in non-ETS sectors are 3% lower than in the situation without the "alignment" of AEAs, which corresponds to a reduction of **37% compared to 2005 levels** (see Figure 30).

FIGURE 30. GHG EMISSIONS COVERED BY THE ESR BY SECTOR IN THE ALIGNED SCENARIO

The "alignment" of AEAs leads to further reductions in GHG emissions covered by the ESR



Source: Enerdata, 2017

Recommendation 10: Introducing provisions to adapt policies accordingly as soon as possible – directly at EU level and through recommendations by the EU Commission for an adaptation of policies in the INECPs.

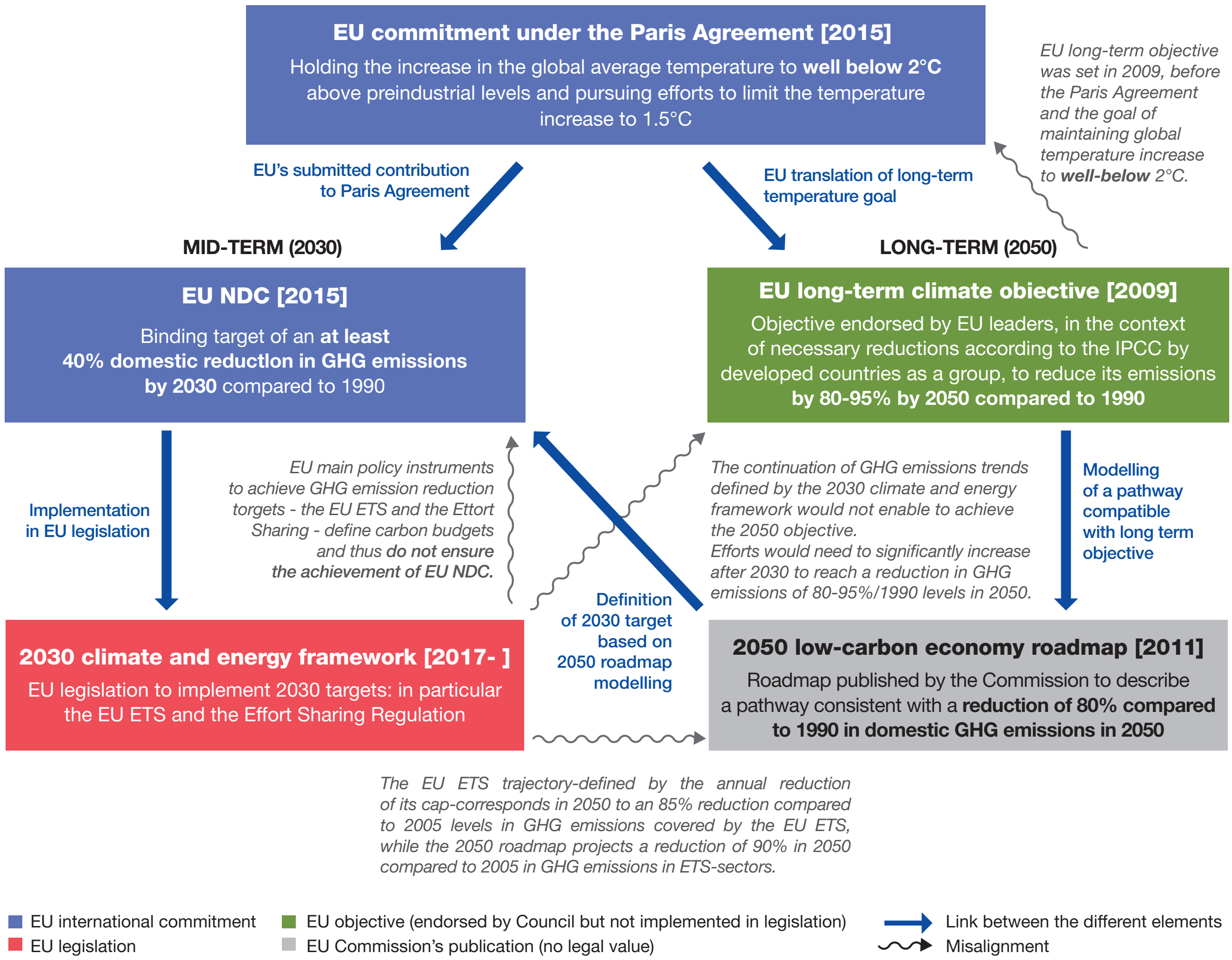
8 *It is assumed that the surplus accumulated on the ESD in the period 2013-2020 hides the upcoming stringency of the ESR*

D. Aligning the EU 2030 policy framework to an increased long-term ambition sets the EU on a pathway more compatible with the goals of the Paris Agreement

Figure 31 shows the declination at the EU-level of its commitments under the Paris Agreement. The EU committed to hold the increase in the global average temperature to **well below 2°C** above pre-industrial levels and to pursue efforts to limit the temperature increase to **1.5°C.** This temperature goal was translated in a **long-term objective of reducing EU GHG emissions by 80-95% in 2050** compared to 1990, set by the European Council in 2009 in the context of necessary reductions by developing countries as a group according to the IPCC. The Commission published in 2011 a **2050 Energy Roadmap**, describing a pathway consistent with a reduction of 80% in domestic GHG emissions in 2050 compared to 1990 levels. The 2030 target of a reduction of at least 40% in GHG emissions compared to 1990 was based on this modelling exercise, and it is currently being translated into EU legislation.

FIGURE 31. EU CLIMATE AND ENERGY POLICIES BROUGHT INTO COMPARISON WITH ITS CLIMATE COMMITMENT UNDER THE PARIS AGREEMENT

EU current climate and energy policies and targets fall short of its commitments under the Paris Agreement: currently negotiated climate and energy policies are not sufficient to meet EU long-term ambition, which itself is not consistent with the global temperature goal of the Paris Agreement



Source: I4CE, 2018

a. Increasing EU long-term ambition in line with the objective of the Paris Agreement

The EU long-term objective of reducing GHG emissions by 80-95% in 2050 compared to 1990 levels was thus set in 2009, before the Paris Agreement and its objective of limiting the global average temperature increase to well below 2°C above pre-industrial levels.

EU long-term ambition should be **reviewed accordingly and aim at net-zero emissions by 2050**.

b. Aligning the EU 2030 climate and energy framework to its increased long-term ambition

GHG emissions trends defined by the **2030 climate and energy framework as currently negotiated fall short of the EU 2050 objective**. In the 2017 Baseline scenario, efforts would need to increase after 2030 to even enable the achievement of a reduction in GHG emissions of 80% in 2050 (see **Figure 32**). Furthermore, the EU ETS trajectory – defined by the annual reduction of its cap – corresponds in 2050 to an 85% reduction compared to 2005 levels in GHG emissions covered by the EU ETS. The 2050 Roadmap – consistent with a reduction in total GHG emissions of 80% in 2050 compared to 1990 – projects a reduction of 90% in 2050 compared to 2005 in GHG emissions in ETS-sectors.[9]

9 *For more details, please refer to the first COPEC II report published in October 2017 on the revision of the EU ETS for its Phase IV: EU ETS: Last call before the doors close on the negotiations for the post-2020 reform.*

To have a sustainable decarbonisation pathway, an **anticipation of the suitable transformation of the energy system** to achieve drastic GHG emissions reductions in the long-term is required, as well as a **timely deployment of low-carbon solutions**.

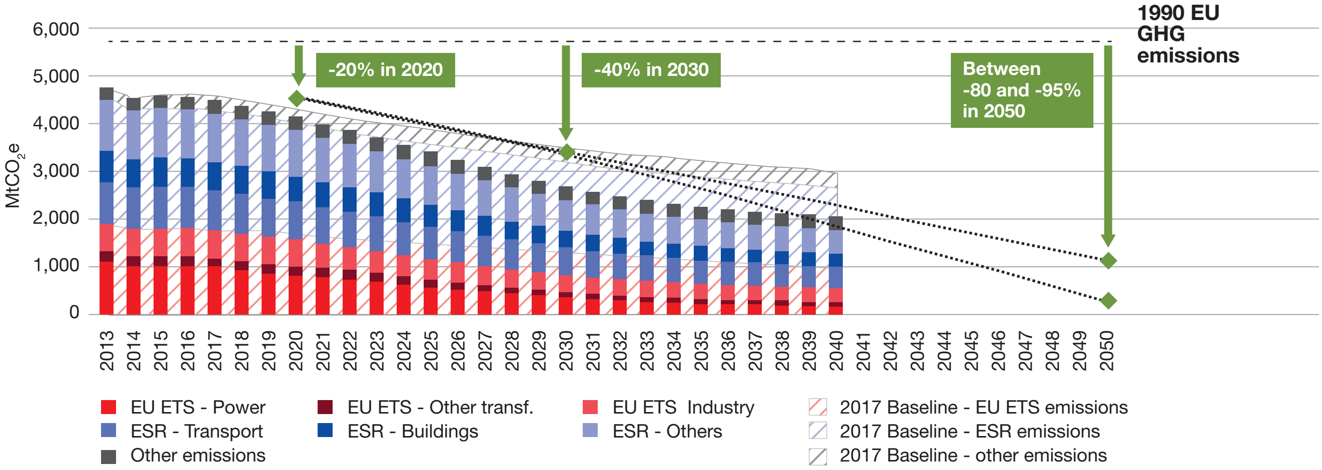
In the “AmbitionPlus” scenario, 2030 targets for renewable energy and energy efficiency are increased: respectively 35% and 40%. In this scenario, **renewable energy and energy efficiency solutions are quickly scaled up**, which sets the EU on a pathway more compatible with long-term climate ambition (see **Figure 32**). In such a configuration, counteractive interactions of other policies with the EU ETS and the ESR would need to be mitigated to avoid a lock-in of carbon-intensive technologies, as described in **section 6.C**.

An update of the 2050 roadmap consistently with the EU carbon budget and the “net-zero” emissions target, as described in **section 3.D.a.**, would **inform the adequate adaptation of climate and energy policies, at the EU-level and at the national level**.

In particular, the roadmap would enable setting **appropriate long-term targets for the EU ETS and the ESR**, as well as **intermediate 2040 targets**, which would give more visibility to stakeholders while making the long-term target more tangible. This roadmap could also be used to **elaborate a corridor of trajectories for the social value of carbon in the EU**, which economic stakeholders could use as a reference, and on which public policies could lean.

FIGURE 32. GHG EMISSIONS IN THE EU IN THE AMBITIONPLUS AND 2017 BASELINE SCENARIOS PARALLELED WITH EU CLIMATE TARGETS PATHWAY

GHG emissions trends defined by the 2030 climate and energy framework as currently negociated fall short of the EU 2050 objective. A timely deployment of low-carbon options is necessary to set the EU on a pathway more compatible with long-term ambition



Source: I4CE and Enerdata, 2018, with data from the European Environment Agency

Recommendation 3: Setting **appropriate and realistic 2050 targets for sectors covered by the EU ETS and the ESR** with intermediate 2040 targets.

Recommendation 5: **Calculating a corridor of social values of carbon in the EU until 2050, aligned with long-term climate ambition,** which economic stakeholders could use as a reference and on which could lean public policies.

At the national level, the Member States' INECPs and their long-term low emission strategies – as required by the proposed regulation on the Governance of the Energy Union – should also be **consistent with the updated EU 2050 roadmap**.

Recommendation 7: Calling for an alignment of **Member States' long term low-carbon strategies to the 2050 low-carbon roadmap.**

Recommendation 8: Making sure Member States' 10-year **integrated national climate and energy plans (INECPs) are aligned to their long-term low emission strategy and to the 2050 EU roadmap.**

Finally, the policy framework should allow a **periodic ratcheting up of ambition** in line with the stocktakes of the Paris Agreement.

Recommendation 6: Assessing regularly EU progress towards meeting its targets and introducing provisions to allow a **periodic ratcheting up of ambition** in line with the stocktakes of the Paris Agreement.

7. Conclusion and policy recommendations

The negotiations on the EU 2030 climate and energy framework, and in particular on the Governance of the Energy Union, are the opportunity to **implement in the EU a coherent and ambitious policy mix to fulfill its climate commitment under the Paris Agreement**.

An ex-post analysis of the contribution of different drivers to variations in GHG emissions reductions showed that the **deployment of renewable energy sources and an increased energy efficiency contributed greatly to reducing GHG emissions over 2005-2015**. In our projections to 2030, renewable energy policies and energy efficiency policies continue to be the main drivers of GHG emissions reductions in sectors covered by the EU ETS and the ESR, under the assumptions that specific policies are implemented to achieve 2030 targets.

These emissions reductions, as they are not appropriately taken into account, create **counteractive interactions with the EU ETS and the ESR**. The EU ETS carbon price signal is depressed and is not able to drive low-carbon investments, and surplus is created on the EU ETS and on the ESR, jeopardizing the future achievement of climate targets. The agreed reform of the EU ETS – and in particular the strengthening of the MSR – is not expected to be sufficient to mitigate the effect of other policies.

The Governance regulation will aim at guaranteeing the achievement of climate and energy targets while ensuring policy coherency. The version currently under negotiations **lacks adequate provisions to mitigate counterproductive interactions** and could be amended to **better align the policy package.**

Furthermore, legislative texts under negotiations fall short of the EU long-term ambition: efforts would need to increase after 2030 to achieve a reduction of 80% in EU GHG emissions in 2050 compared to 1990 levels. EU long-term ambition is itself insufficient to respect its commitment under the Paris Agreement and should be increased and **aim at net-zero emissions by 2050**.

A **two-fold alignment of the EU policy package is thus required**: within the 2030 climate and energy framework to mitigate counteractive policy interactions and with an increased long-term ambition.

Ten policy recommendations are defined, to make the EU climate and energy policy framework consistent with the Paris Agreement before 2030, by:

1. **Setting the EU long-term climate targets right**, taking into account the goals of the Paris Agreement;
2. Defining a **climate and energy policy framework aligned with long-term targets** at the EU and national levels;
3. Ensuring the **coherency of the policy framework** and mitigating counteractive interactions.

10 POLICY RECOMMENDATIONS TO MAKE THE EU CLIMATE AND ENERGY POLICY FRAMEWORK CONSISTENT WITH THE PARIS AGREEMENT BEFORE 2030

STEP 1: Setting the EU long-term climate targets right

1. Evaluating the **EU carbon budget** in relation to the 2018 IPCC 1.5°C report, based on the principles of capability, equality and responsibility
2. Translating this carbon budget as well as the “net-zero” emissions target in an **updated 2050 EU roadmap**, jointly elaborated with representatives from all sectors through an openly carried out prospective exercise
3. Setting **appropriate and realistic 2050 targets** for sectors covered by the EU ETS and the ESR with **intermediate 2040 targets**

STEP 2: Defining a climate and energy policy framework aligned with long-term climate targets

- **At the EU level:**

'. **Calibrating EU policy instruments** (in particular the EU ETS and the ESR) according to the updated 2050 roadmap as soon as possible before 2030, using all possible windows offered by the Governance timeline and other review processes (i.e. for the EU ETS, building on the intended reviews in the light of the implementation of the Paris Agreement to appropriately increase the linear reduction factor of the cap)

5. Calculating a **corridor of social values of carbon in the EU** until 2050, aligned with long-term climate ambition, which economic stakeholders could use as a reference and on which could lean public policies
6. Assessing regularly EU progress towards meeting its targets and introducing provisions to allow a **periodic ratcheting up of ambition** in line with the stocktakes of the Paris Agreement

- **At the national level:**

7. Calling for an **alignment of Member States’ long term low-carbon strategies** to the 2050 low-carbon roadmap
8. Making sure Member States’ **10-year integrated national climate and energy plans (INECPs) are aligned to their long-term low emission strategy and to the 2050 EU roadmap**

STEP 3: Ensuring the coherency of the different pieces of the climate and energy policy framework

9. Carrying out **an ex-ante assessment** of the interactions between energy and climate policies – at the **national and EU levels**, as well as annual **ex-post assessments**
10. **Introducing provisions to adapt policies accordingly** as soon as possible – directly at EU level and through recommendations by the EU Commission for an adaptation of policies in the INECPsw

8. Annexes

A. LMDI: methodology and data sources

The quantification of the contribution of different drivers to the variations in GHG emissions over the 2005-2015 period was carried out using an **index decomposition analysis**. Index decomposition analysis is now a widely accepted analytical tool for policymaking on energy and environmental issues and consists in decomposing an aggregate indicator to give quantitative measures of the relative contributions of a set of pre-defined factors leading to the change in the aggregate indicator. The methodology chosen is the **Log Mean Divisia Index (LMDI)**. The LMDI was chosen for its properties: it results in a perfect decomposition (i.e. it does not leave a residual term), it is consistent in aggregation (i.e. estimates for sub-groups may be aggregated in a consistent manner) and it is time reversible (i.e. results are consistent whether the decomposition is carried out prospectively or retrospectively).

Four different LMDI were carried out with different factors:

1. A decomposition of total GHG emissions in the EU;
2. A decomposition of GHG emissions from the power sector;
3. A decomposition of GHG emissions from the iron and steel sector;
4. A decomposition of GHG emissions from the refining sector.

a. Total GHG emissions

Total GHG emissions were disaggregated as follows:

$$GHG\ emissions = Population \times \frac{GDP}{Population} \times \frac{Final\ energy\ consumption}{GDP} \times \frac{Gross\ inland\ consumption}{Final\ energy\ consumption} \times \frac{GHG\ emissions}{Gross\ inland\ consumption}$$

Applying the LMDI resulted in the following decomposition for the variations in GHG emissions:

$$\Delta GHG\ emissions = Demography\ effect + Economic\ development\ effect + Final\ energy\ intensity\ effect + Transformation\ efficiency\ effect + Carbon\ intensity\ effect$$

Table 4 describes the variables used in the decomposition of total GHG emissions in the EU.

TABLE 4. DESCRIPTION OF THE VARIABLES IN THE DECOMPOSITION OF TOTAL GHG EMISSIONS IN THE EU

Effects	Variables	Description
Demography	$Population$	Effect of the evolution of the population
Economic development	$\frac{GDP}{Population}$	Effect of the evolution of the GDP/capita
Final energy intensity	$\frac{Final\ energy\ consumption}{GDP}$	Effect of the evolution of the amount of final energy used per unit of GDP
Transformation efficiency	$\frac{Gross\ inland\ consumption}{Final\ energy\ consumption}$	Effect of the evolution of the fuels conversion efficiency
Carbon intensity	$\frac{GHG\ emissions}{Gross\ inland\ consumption}$	Effect of the evolution of the carbon intensity of the primary energy mix

Data series for the GDP come from the World Bank; data series for population, final energy consumption and gross inland consumption come from Eurostat; data series for GHG emissions were calculated using gross inland consumption by source and IPCC default emissions factors.

b. GHG emissions from the power sector

GHG emissions from the power sector were disaggregated as follows:

$$GHG\ emissions = Total\ power\ generation \times \frac{Power\ generation\ from\ fossil\ fuels}{Total\ power\ generation} \times \sum_i \frac{Power\ generation\ from\ source\ i}{Power\ generation\ from\ fossil\ fuels} \times \frac{Fuel\ input\ of\ source\ i}{Power\ generation\ from\ source\ i} \times \frac{GHG\ emissions\ from\ source\ i}{Fuel\ input\ of\ source\ i} \qquad i = coal,\ oil,\ gas$$

Applying the LMDI resulted in the following decomposition for the variations in GHG emissions:

$$\Delta GHG\ emissions = Power\ generation\ effect + Renewables\ effect + Nuclear\ effect + Fossil\ fuels\ mix\ effect + Transformation\ efficiency\ effect + Carbon\ content\ effect$$

Table 5 describes the variables used in the decomposition of GHG emissions from the power sector in the EU.

TABLE 5. DESCRIPTION OF VARIABLES IN THE DECOMPOSITION OF GHG EMISSIONS FROM THE POWER SECTOR

Effects	Variables	Description
Power generation	*Total power generation*	Effect of the evolution of the amount of electricity and heat production
Renewables	$\frac{Power\ generation\ from\ fossil\ fuels}{Total\ power\ generation}$	Effect of the evolution of the share of renewable sources in the power mix
Nuclear		Effect of the evolution of the share of nuclear in the power mix
Fossil fuels mix	$\frac{Power\ generation\ from\ source\ i}{Power\ generation\ from\ fossil\ fuels}$	Effect of the evolution of the share of the different fossils fuels
Transformation efficiency	$\frac{Fuel\ input\ of\ source\ i}{Power\ generation\ from\ source\ i}$	Effect of the evolution of the fuel efficiency of thermal power plants
Carbon content	$\frac{GHG\ emissions\ from\ source\ i}{Fuel\ input\ of\ source\ i}$	Effect of the evolution of the fossil fuels' carbon content

Data series for power generation and fuel input from the different sources come from Eurostat; data series for GHG emissions were calculated using the fuel input by source and IPCC default emissions factors.

c. GHG emissions from the iron and steel sector

GHG emissions from the iron and steel sector were disaggregated as follows:

$$GHG\ emissions = Apparent\ steel\ use \times \frac{Production\ of\ crude\ steel}{Apparent\ steel\ use} \times \frac{Final\ energy\ consumption}{Production\ index} \times \sum_w \frac{Final\ energy\ consumption\ of\ source\ w}{Final\ energy\ consumption} \times \frac{GHG\ emissions\ from\ source\ w}{Final\ energy\ consumption\ of\ source\ w}$$

$$w = coal,\ oil, gas,\ biomass\ \&\ biofuels,\ electricity$$

Applying the LMDI resulted in the following decomposition for the variations in GHG emissions:

$$\Delta GHG\ emissions = Demand\ effect + Relocation\ effect + Final\ energy\ intensity\ effect + Energy\ mix\ effect + Carbon\ content\ effect$$

Table 6 describes the variables used in the decomposition of GHG emissions from the iron and steel sector in the EU.

TABLE 6. DESCRIPTION OF VARIABLES IN THE DECOMPOSITION OF GHG EMISSIONS FROM THE IRON AND STEEL SECTOR

Effects	Variables	Description
Demand	$Apparent\ steel\ use$	Effect of the evolution of the demand for iron and steel
Relocation	$\frac{Production\ of\ crude\ steel}{Apparent\ style\ use}$	Effect of the evolution of the relocation of iron and steel production outside or inside the EU
Final energy intensity	$\frac{Final\ energy\ consumption}{Production\ of\ crude\ steel}$	Effect of the evolution of the amount of final energy used for a given production volume
Energy mix	$\frac{Final\ energy\ consumption\ of\ source\ w}{Final\ energy\ consumption}$	Effect of the evolution of the energy mix
Carbon content	$\frac{GHG\ emissions\ from\ source\ w}{Final\ energy\ consumption\ of\ source\ w}$	Effect of the evolution of the fuels' carbon content

Data series for the production of crude steel and the apparent steel use come from the Worldsteel association; data series for final energy consumption by source come from Eurostat; data series for GHG emissions were calculated using the energy consumption by source and IPCC default emissions factors.

d. GHG emissions from the refining sector

GHG emissions from the refining sector were disaggregated as follows:

$$GHG\ emissions = Final\ demand\ for\ refined\ products \times \frac{Production\ of\ refined\ products}{Final\ demand\ for\ refined\ products} \times \frac{Activity\ levels}{Production\ of\ refined\ products}$$
$$\times \frac{Final\ energy\ consumption}{Activity\ levels} \times \sum_w \frac{Final\ energy\ consumption\ of\ source\ w}{Final\ energy\ consumption} \times \frac{GHG\ emissions\ from\ source\ w}{Final\ energy\ consumption\ of\ source\ w}$$
$$w = coal,\ oil, gas,\ biomass\ \&\ biofuels,\ electricityv$$

Applying the LMDI resulted in the following decomposition for the variations in GHG emissions:

$$\Delta\ GHG\ emissions = Demand\ effect + Relocation\ effect + Complexity\ effect + Final\ energy\ intensity\ effect + Energy\ mix\ effect + Carbon\ content\ effect$$

Table 7 describes the variables used in the decomposition of GHG emissions from the refining sector in the EU.

TABLE 7. DESCRIPTION OF VARIABLES IN THE DECOMPOSITION OF GHG EMISSIONS FROM THE REFINING SECTOR

Effects	Variables	Description
Demand	*Final demand for refined products*	Effect of the evolution of the demand for refined products
Relocation	$\frac{Production\ of\ refined\ products}{Final\ demande\ for\ refined\ products}$	Effect of the evolution of the relocation of refining activities outside or inside the EU
Complexity	$\frac{Activity\ levels}{Production\ of\ refined\ products}$	Effect of the evolution of the complexity of refined products
Final energy intensity	$\frac{Final\ energy\ consumption}{Activity\ levels}$	Effect of the evolution of the amount of final energy used for a given activity level
Energy mix	$\frac{Final\ energy\ consumption\ of\ source\ w}{Final\ energy\ consumption}$	Effect of the evolution of the energy mix
Carbon content	$\frac{GHG\ emissions\ from\ source\ w}{Final\ energy\ consumption\ of\ source\ w}$	Effect of the evolution of the fuels' carbon content

Data series for the production and the demand for refined products, as well as data series for the final energy consumption by source come from Eurostat; data series for GHG emissions were calculated using the energy consumption by source and IPCC default emissions factors. Consequently, they do not include GHG emissions coming from fluid catalytic cracking.

Activity levels are expressed in Complexity Weighted Ton (CWT) and were calculated by IFPEN, 2015 value is an estimate. Details on the calculation of CWT can be found in the Annexes of the first COPEC II report – EU ETS: Last call before the doors close on the negotiations for the post-2020 refom.

B. POLES modelling

Enerdata offers the world recognized POLES model to provide quantitative, scenario-based, empirical and objective analyses. As POLES model is used by many members of the energy sector (industry, governments, European Commission, etc.), it is very well adapted to forecast the effects of different energy-related engagements (GHG emissions limitations, promotion of renewables and energy efficiency, energy security issues, etc.). In addition, with its global coverage and the endogenous calculation of demand, supply and energy prices, POLES model is very relevant to capture all the impacts of energy and climate policies and to ensure that all the forecasts are coherent within the global environment.

a. Overview of POLES model

POLES[10] *(Prospective Outlook on Long-term Energy Systems)* is a world energy-economy partial equilibrium simulation model of the energy sector, with complete modelling from upstream production to final user demand and GHG emissions. The simulation process uses dynamic year-by-year recursive modelling, with endogenous international energy prices and lagged adjustments of supply and demand by world region, which allows the full description of pathways to 2050.[11]

POLES offers a mixed approach based on:

- a "top-down" modelling for sectorial demand, which is directly related to activity, prices and technologies through econometric equations;
- and a "bottom-up" approach for the power sector (explicit representation of each type of technology as well as their costs).

10 https://www.enerdata.net/solutions/poles-model.html

11 For examples of academic studies with POLES model, see Mima, S. and Criqui, P. (2015); Kitous, A. and Criqui, P. (2010).

TABLE 8. POLES GENERAL ASSUMPTIONS

Activity Variables	GDP	• 2000-present: **World Bank** • Forecasts EU-28: Growth rate of **EC reference scenario (2016)** • Forecasts Rest of EU30 and other regions: **IMF** up to 2020 and then **CEPII** up to 2050 (Centre for Prospective Studies and International Information*)
	Value Added	• 2000-present: **World Bank, OECD**
	Population	• 2000-present: **World Bank** • Forecasts EU-28: Growth rate of **EC reference scenario (2016)** • Forecasts Rest of EU30 and other regions: «2015 Revision of World Population Prospects» UN median scenario**.
Other Activity Data	Steel apparent consumption and production	• 2000-present: historical data and short term outlook up to 2 years in the future from **World Steel Association**
	Transport activity and mileages	• Enerdata compiled statistics: - EU countries – **Eurostat** - Non-EU countries – **International Road Federation**
	Dwellings numbers and surfaces	• Enerdata compiled statistics • **World Bank**
Fossil fuel & Electricity prices	Import and end-user domestic prices (Power sector, industry, Buildings)	• Enerdata compiled statistics • **IEA & National sources**
	Oil price	• Spot Price of **Brent** (annual average)
	Gas market prices	• Europe/African market (spot): **Zeebrugge spot** (annual average) • Americas market: **USA pipeline** • Asian market: **Japan LNG**
	Coal market prices	• Europe/African market (spot): **Amsterdam-Rotterdam-Antwerp spot** (annual average) • Americas market: **USA** • Asian market: **Japan**
Energy Consumption	Power, industry, buildings, agriculture and transports	• Enerdata compiled statistics based on **IEA & national sources**

** French research institute (Centre d'Etudes Prospectives et d'Informations Internationales) providing long-term GDP forecasts based on the MaGE model.*
*** United Nations website:* https://esa.un.org/unpd/wpp/

TABLE 8. POLES GENERAL ASSUMPTIONS *(suite)*

Electricity generating capacity	All technologies	• Enerdata compiled statistics**: IEA & national sources**, quality assured by Enerdata and Enerdata's **Power Plant Tracker database**
	Nuclear and CCS	• Capacity forecasts are exogenous taken from **PRIMES 2016 reference scenario** for EU28 since their developments are highly uncertain and follow more political decisions than competition on costs in the following decades.
Historical emissions	CO_2-energy	• Enerdata from **IEA**. Calculated based on energy consumption and standard emission factors per toe (single global value)
	CO_2-process	• Enerdata from **IEA**
	Non-CO_2	• **UNFCCC data** (Annex I countries), **EDGAR** database (non-Annex I countries); weighted averages on GWPs for HFCs and PFCs
	Global Warming Potentials	• **AR4**
Fossil Fuel Resources		• **IEA** (Oil, gas and coal reserves and production, gas directional trade) • **CEDIGAZ** (Gas production) • **BGR** (Bundesanstalt für Geowissenschaften und Rohstoffe, German Federal Institute for Geosciences and Natural Resources, for Ultimately recoverable resources and unconventional oil and gas reserves and production) • **Enerdata's Market Research team** (international and national databases compiled by Enerdata)
Renewable energy potentials		• Based on **World Resources Institute** (arable land surfaces and annual irradiation), **Wind Atlas** (wind speeds), **DLR** (solar irradiation)
Technology Costs and details	Power	• **IEA** (data used in World Energy Outlook 2016) • **TECHPOL** (produced by GAEL Energy (EDDEN) in several CNRS and European research projects)
	Transport	• **TECHPOL, IEA,** California Natural Gas Vehicle Partnership , **Deutsche Bank**
	Buildings	• **EURIMA, BPIE**, literature review
	Sectoral load curves	• **ENTSO-E**, literature review

Carbon Value modeling in POLES

GHG emissions reduction in POLES is modeled through the introduction of a proxy for GHG mitigation policies. The "**carbon value**" (carbon tax, price of allowances, implicit carbon price) is added to the price of energy proportionally to the carbon content of the fuel, in each module where fossil fuels are combusted.

Impact of the carbon value in the power sector

Current costs per power plant technology are calculated for different annual load durations and are used as a basis for the cost comparison of new capacities. Fossil fuel technologies are directly impacted by the carbon value in their Levelized Cost of Electricity (LCOE).

Impact of the carbon value on energy demand

The carbon value affects the global envelope for substitutable energy consumption through its implication on energy prices. It also affects the competition between new equipment that is needed to fill the energy demand gap[12].

Carbon pricing instruments in POLES like Emissions Trading Schemes are assessed through the required carbon value to respect a given GHG emissions cap. POLES' carbon value is **not** a market price.

In COPEC II, POLES provides two distinguished values:

- **ETS carbon value**: Carbon value needed to achieve the GHG emissions reduction target of ETS sectors which equals the marginal abatement cost of these GHG emissions reductions.
- **Non-ETS carbon value**: Carbon value needed to achieve the GHG emissions reduction target of non-ETS sectors which equals the marginal abatement cost of these GHG emissions reductions.

12 The gap is the difference between new consumption and remaining scrapped capital

b. Definition of COPEC II scenarios and methodology for calibration

The calibration of POLES model is necessary to model the implementation of different climate and energy targets by 2020 and 2030 respecting the chosen policy designs.

TABLE 9. ASSUMPTIONS ON THE DESIGN OF EU CLIMATE AND ENERGY POLICIES IN COPEC II SCENARIOS

SCENARIOS	Assumptions on the design of EU climate and energy policies			
	EU ETS	ESR	2030 energy efficiency target	2030 renewable energy target
2017 Baseline	EU ETS 2017 trilogue deal	European Commission's proposal from July 2016	+30%	+27%
Aligned	**Adjusted cap** by withdrawing GHG emissions reductions coming from energy efficiency and renewable energy policies	**Adjusted AEAs** by withdrawing GHG emissions reductions coming from energy efficiency and renewable energy policies	+30%	+27%
AmbitionPlus	EU ETS 2017 trilogue deal	European Commission's proposal from July 2016	**+40%**	**+35%**
No Policy	None	None	None	None
GHG only	EU ETS 2017 trilogue deal	European Commission's proposal from July 2016	None	None
RE27 only	None	None	None	+27%
EE30 only	None	None	+30%	None
EE&RE contribution	Carbon value trajectory of "GHG Only" scenario	Carbon value trajectory of "GHG Only" scenario	+30%	+27%

EU ETS design parameters in POLES

Table 10 describes the EU ETS parameters which were modelled in the 2017 Baseline scenario.

TABLE 10. COPEC II 2017 BASELINE SCENARIO: EU ETS DESIGN IN POLES

			COPEC II 2017 BASELINE	METHODOLOGY
EU-ETS	Covered sectors and emissions		100%	• Shares by sector calculated from CITL v19 • Shares remain constant between 2014 and 2040 (except for aviation)
EU-ETS	Annual cap		Yes	• Phase III: Fixed installations +Aviation • Phase IV: Fixed installations • Extension to 2040: Phase IV LRF
EU-ETS	5 year sliding EU carbon budget		Yes	• Actors consider the available carbon budget (allowances+surplus+MSR) with a 5-year vision ahead
EU-ETS	Banking of allowances		Illimited	• Surplus is transferable year by year, phase by phase
EU-ETS	MSR	Cancellation of allowances		• The volume of the MSR is capped by the volume of the previous year's auctions
EU-ETS	MSR	Intake rate	24% from 2019 to 2023 (inclusive) and then 12%	• Doubling of the MSR withdrawal rate in the first 5 years of operation: 24% over 2019-2023 (inclusive)

The design of the EU ETS in the 2017 Baseline scenario is based on the outcome of the trilogue negotiations reached in November 2017 and promulgated in the revised directive in March 2018[13].

The shares of EU ETS emissions to POLES scope[14] are calculated from:

- Updated version of EU ETS verified emissions[15]: The shares are calculated until 2014 from CITL_v19 for sectors covered by the EU ETS in POLES.
- Aviation data from European commission statistics[16]: Shares of intra- and extra-EEA aviation until 2014 (Shares of aviation activity within the EEA space and overseas, based on EU ETS verified emissions)

The shares of EU ETS emissions by sector and country in POLES are assumed to remain constant from 2014 to 2040.

Emissions from intra-EEA aviation are included into in the EU ETS from 2016 to 2020. Due to the uncertainty after 2020 on the coverage of emissions from aviation, emissions from aviation are not included in the EU ETS from the beginning of Phase IV.

13 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32018L0410

14 *2016 Enerdata project for BEIS on EU ETS*

15 https://data.europa.eu/euodp/data/dataset/data_european-union-emissions-trading-scheme-eu-ets-data-from-citl-7

16 http://ec.europa.eu/eurostat/fr/data/database

ESR design parameters in POLES

Table 11 describes the ESD and ESR design parameters which were modelled in the 2017 Baseline scenario.

TABLE 11. COPEC II 2017 BASELINE SCENARIO: ESD/ESR DESIGN IN POLES

		COPEC II 2017 BASELINE	METHODOLOGY
ESD/ESR	Covered sector and emissions	Non-ETS sectors present in POLES Building & Transport	• POLES emissions are adjusted to 2013-2015 verified emissions
	Annual cap	Yes	• 2013-2020: total AEAs of Member States under the ESD • 2021-2030: The starting point of the linear trajectory (in 2020) defining Member States' AEAs is calculated from their 2016-2018 emissions, endogenously calculated • Extension to 2040: continuation of the linear trajectory of AEAs after 2030
	5 year sliding EU carbon budget	Yes	• Actors consider the available carbon budget (AEAs+surplus) with a 5 year-vision
	Banking within each phase	Yes	• Surplus is bankable year by year BUT NOT phase by phase

The Effort Sharing covers GHG emissions that are not covered by the EU ETS including from small industries, buildings, rail and road transports, agriculture and waste. The gases covered are carbon dioxide (CO_2), methane (CH4), nitrous oxide (N2O), HFCs, PFCs, NF3 and SF6.

However, POLES does not allow to cover 100% of non-ETS emissions. Thus, we assumed an equivalent distribution of emission reduction efforts for covered POLES non-ETS emissions and the rest of emissions from other sectors. A constant coefficient is calculated on verified effort sharing emissions provided by the Commission over 2013-2015[17].

This constant coefficient is applied to POLES non-ETS emissions until 2040.

We implicitly consider that flexibilities on the ESR are sufficient to result in a unique carbon value in the EU.

17 https://www.eea.europa.eu/data-and-maps/daviz/ghg-emission-trends-and-projections#tab-chart_3

c. Additional modelling results

Table 12 indicates the achievement of 2030 EU targets for the deployment of renewable energy sources, the increase in energy efficiency and the reduction in GHG emissions in the different scenarios.

TABLE 12. ACHIEVEMENT OF 2030 EU CLIMATE AND ENERGY TARGETS IN THE DIFFERENT COPEC II SCENARIOS

2030	EU 2030 target	No Policy sc.	RE Only sc.	EE Only sc.	GHG Only sc.	2017 Baseline Sc.	Aligned sc.	Ambition Plus sc.
GHG emission reduction (vs 1990)	-40.0%	-27.4%	-34.7%	-38.5%	-38.2%	-39.9%	-46.3%	-54.3%
GHG EU ETS reduction (vs 2005)	-43.0%	-26.9%	-41.7%	-38.9%	-38.0%	-43.0%	-47.0%	-63.3%
GHG ESR reduction (vs 2005)	-30.0%	-25.0%	-25.5%	-36.3%	-30.0%	-35.3%	-37.2%	-45.5%
Share of **renewable energy sources** in gross final consumption	27.0%	22.5%	27.0%	24.6%	25.7%	27.1%	27.8%	35.0%
Energy efficiency: Reduction in final consumption	-30.0%	-21.8%	-22.2%	-34.3%	-26.0%	-32.5%	-33.5%	-40.8%
Energy efficiency: Reduction in primary consumption	-30.0%	-18.5%	-22.9%	-30.0%	-22.8%	-29.9%	-30.0%	-40.0%

Note: The color background indicates if the scenario reaches (light blue) or not (dark blue) the EU target.

Source: Enerdata, 2017

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I4CE
24 avenue Marceau
75008 Paris

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INSTITUTE FOR CLIMATE ECONOMICS
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www.i4ce.org

Création-réalisation : SophieBerlioz.fr