



Halfway There

Existing policies put Europe
on track for emission cuts
of at least 50% by 2030

sandbag

“We know that most politicians don’t want to talk to us. Good, we don’t want to talk to them either. We want them to talk to the scientists instead. Listen to them, because we are just repeating what they are saying and have been saying for decades.

We want you to follow the Paris Agreement and the IPCC reports. We don’t have any other manifesto or demands. You unite behind the science – that is our demand.”

-Speech to the European Economic and Social Committee,
by Greta Thunberg, Founder of the ‘School Strikes for the
Climate’ movement. (21st February 2019)

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sandbag
smarter climate policy

Executive Summary

2020 marks a halfway point for the EU. It will be 30 years since the first IPCC report, and 30 years to when the EU will be fully decarbonised. We will be half-way in time – but with 2018 GHG emissions at 24% below 1990 levels – we will be only around a quarter of the way there in effort. The EU is backloading action on climate change.

This report brings good news: Europe already has the policies in place it needs to halve its emissions by 2030, compared to 1990. We modelled all the policies already in place – like those of the Clean Energy Package, the mobility packages and announced coal phaseouts – and our results show this would deliver a cut of 50% in GHG emissions. This is more than the Commission’s Long-term Strategy modelling last year of 46%, in a large part because our report also models coal phase-outs that have been agreed.

This means discussion on Europe’s climate ambition in 2030 changes from “at least 40%”, to become “at least 50%”.

This report uses the established E3ME model from Cambridge Econometrics to investigate how recently agreed climate and energy policies would change EU greenhouse gas emissions reductions. Our model shows that when the EU’s new climate policies are included - especially including Member State coal phase-outs - EU emissions will fall faster than previously predicted. We also model how ambition can be increased further if moderate adjustments are introduced to the currently existing legislative framework, as well as if improvements are made in interactions between this wide-ranging portfolio of policies. We further discuss the impact of these interactions on the continuing EU ETS surplus.

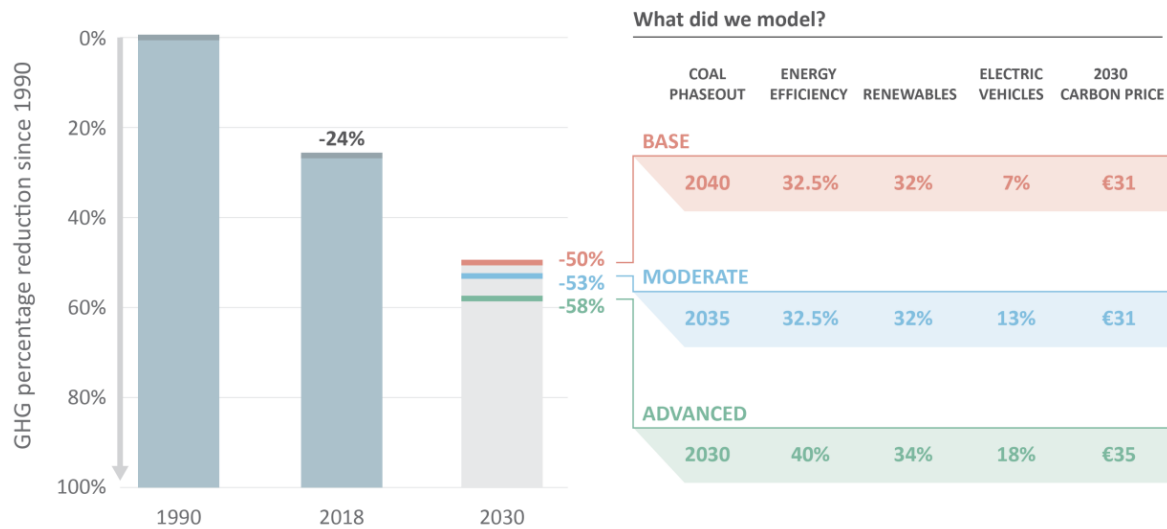
Key findings

- 1. Climate policies already agreed by the European Union and Member States are already on track to deliver 50% GHG reduction by 2030. *This means the new “business as usual” ambition now to be discussed should be at least 50%.***

The power sector is a very important driver, accounting directly for half of the EU’s emissions cuts from 2018 to 2030 as coal is replaced with renewable electricity. But it also indirectly contributes to the decarbonisation of other sectors as transport, industry and heating begin to be electrified using even more renewable electricity.

The main difference between the 50% reductions in this report, and the Commission’s Long-term Strategy modelling – which estimated reductions of 46% to 2030 – is that this report models all the announced coal phaseouts – and a 2040 coal phase-out for countries with no announcements yet – resulting in a low level of coal burn by 2030.

Chart 1: Existing policies set the EU on track for at least -50% reductions by 2030



2. With future adjustments to climate policies, a GHG reduction of 58% by 2030 is possible.

This report modelled a “Moderate” scenario which gave a 53% cut, and an “Advanced” scenario which gave a 58% cut. In order to achieve the step up from 50%, we adjusted five model assumptions critical to climate ambition: coal phase-out dates, energy efficiency, renewable energy penetration, electric vehicle penetration and carbon pricing. Emissions reductions above 58% are possible if further policies or more ambitious changes are considered.

3. Setting a tighter EU 2030 GHG target, above business as usual, would help strengthen the focus on better implementation of existing climate policies.

There have been so many additional policies agreed in the past 3 years, that the need for uprating the overall ambition has grown all the more necessary. It is crucial to ensure that overall carbon budget, as well as the Emissions Trading System (ETS) and Effort Sharing Regulation (ESR) carbon budgets, always support the coherence of all these measures. It takes a lot of policies working well together to avoid undesirable scenarios. For example to avoid electric cars powered by coal, or to avoid a dash-for-gas in the rush to phase-out coal.

Europe hit its 20% emissions reductions target for 2020 six years early. It is clear it will massively overshoot its current 40% target for 2030. The toolbox for fast emissions reductions has improved so much, that it is easy to be confident to set ambitious targets.

There is therefore a substantial opportunity for confidently adjusting the existing 2030 target, to go beyond the new business as usual of a 50% cut.

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1 Introduction

1.1 Context

In October 2014, the EU agreed a new set of climate and energy targets for 2030 (EUCO2014). The Heads of States endorsed a binding target of at least a 40% emissions reduction from 1990 levels by 2030¹. Consistent with EUCO2014, in late 2017 and early 2018 the EU enacted a series of reforms to both the EU Emissions Trading Scheme (EU ETS) and the Effort Sharing Regulation (ESR).

In December 2015 the EU helped create the Paris Agreement, when the world committed to *“pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels”*. To reflect this new ambition, in 2018 the European Commission has put forward a vision document for discussion, which has introduced two scenarios aimed at reaching net zero emissions by 2050. This process has been triggered by the European Council request from March 2018 that the Commission develops a long-term strategy for emissions reductions in the EU. This process will require further discussions at the institutional level, and endorsements by the European Parliament and the various specialised Ministerial Councils will be required. The discussion on a net-zero target is also taking place in the context of the need to upgrade the 2009 EU commitment of 80-95% reduction in emissions by 2050, a range too wide to be compatible with the strict temperature increase limitations foreseen in the Paris Agreement.

The EU has not changed its 2030 emission reduction target since 2014. Europe’s Nationally Determined Contribution (NDC) still stands at “at least a 40% reduction” in greenhouse gas emissions from 1990 to 2030 – despite the world changing radically in the last five years. There appears to be disconnect between the two levels.

Several converging trends now imply that a re-examination of targets and policies for 2030 is needed.

- Modelling by the Commission has clearly confirmed that the EU will surpass its existing 2030 overall targets. This is due to the reform of major EU climate and energy policies, including the 2030 package, coupled with continuing external trends, notably reductions in technology costs for renewables. Consequently, stronger overall targets will now be necessary.
- Since the EU is currently considering its 2050 goals, we can expect the EU to commit to net-zero emissions by the middle of the century. Although consideration of these goals is outside the scope of this report, they will clearly have direct implications for where emissions ought to be by 2030, to ensure a safe landing, as opposed to an abrupt fall, towards the longer-term goals and to ensure the overall credibility of the longer-term commitments. In particular, updated 2030 targets look likely to be necessary to put the European economy on a cost-effective path to its expected 2050 targets.
- The latest IPCC report released in October 2018² clearly indicated that short-term actions will be crucial if the world is to stay within a Paris Agreement compatible carbon budget. The IPCC report has further emphasized the need to accelerate the reductions in the next decade if the 1.5 degrees budget is not to be entirely used up before 2030.

Consistent with these new circumstances, the Environment Committee of the European Parliament passed a non-legislative resolution in October 2018 recommending increasing the 2030 target from

¹ http://www.consilium.europa.eu/uedocs/complementary_measures_Data/docs/pressdata/en/ec/145397.pdf

² https://report.ipcc.ch/sr15/pdf/sr15_spm_final.pdf

at least a 40% reduction to at least a 55% reduction from 1990 levels³. We welcome this resolution and find it to be in line with the findings of this report, which does show that such a level of emission reductions would be achievable simply through enhanced variants of the currently agreed policies.

In light of all these developments, Sandbag has produced this report to inform the continuing debate on the EU's decarbonisation targets for 2030. The report seeks to examine:

- the likely level of European emissions in 2030, assuming that the recently agreed 2030 Climate and Energy policies are fully implemented;
- the additional reductions that might be achievable as a result of further incremental changes in existing policies;

This report considers how interactions between policies can be addressed to increase policy effectiveness in the lead up to 2030, with a view to reaching higher targets than those set out in the current EUCO2014. Since the EU ETS interacts with a wide range of other policies, a thorough assessment of its performance over the next decade is included in the analysis.

Our June 2015 report, [The ETS in Context: Understanding and Managing EU ETS Policy Interactions](#), concluded that a portfolio of policies is necessary.

A lot has changed since June 2015:

- ETS reforms have been agreed which do, at least partially, tighten the on-going cap and permanently retire part of the surplus (via the Market Stability Reserve).
- The reforms allow Member States to voluntarily cancel allowances from their auction share in response to a transition from high carbon power generation.
- Several Member States have signed up to phase-out coal fired power generation and more are expected to follow.
- The Netherlands has committed to join the UK with a carbon price support approach to bolster the ETS price for power generators and more Member States may follow.
- EU-wide targets of 32% renewables and 32.5% energy efficiency improvements by 2030 have been agreed.

1.2 EU's GHG reductions to date

The European Environment Agency shows that the EU GHG emissions in 2017 were 22% below 1990 levels⁴.

In January, Sandbag published our 2018 emissions estimate, based on actual power generation data. This predicts a 3% fall in ETS emissions, due to the fall in coal and gas generation⁵. IEA data shows EU gas demand fell 3%, and oil demand remained around stable⁶. ***This would mean EU GHG emissions fell around 2% from 2017 to 2018, bringing them to 24% below 1990 levels.***

³ <http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+P8-TA-2018-0430+0+DOC+XML+V0//EN&language=EN>

⁴ See figure ES.1 in <https://www.eea.europa.eu/publications/trends-and-projections-in-europe-2018-climate-and-energy>

⁵ See <https://sandbag.org.uk/project/power-2018/>

⁶ See <https://www.iea.org/statistics/monthly/#gas>

The EEA also forecasts emissions will fall by 26% by 2020 versus 1990, based on Member State projections with existing measures. This exceeds the EU's 2020 target of a 20% reduction. EU climate ambition is already happening faster than the current target.

1.3 Existing modelling studies

The **European Commission** published its “*2050 Long Term Strategy*” document in November 2018⁷. This modelling shows 2030 emissions at 46% below 1990 levels excluding LULUCF (and 48-51% taking into account LULUCF). All scenarios to 2030 are broadly all the same, and only then diverge after 2030. Their modelling applies all the key Europe-wide agreed 2030 policies, including the latest 2030 Renewable and Energy Efficiency targets.

A report by the **European Climate Foundation and Climact** “*Net Zero by 2050*”⁸ concluded that Europe needs total GHG reductions of 55-65% by 2030 to be in line with a 2050 net-zero pathway.

A report by **Enerdata and I4CE** in April 2018 “*Mind the gap: Aligning the 2030 EU climate and energy policy framework to meet long-term climate goals examined the EU's 2030 package*”⁹, was published before the final Renewables and Energy Efficiency targets were agreed. The policy and interaction discussions are still relevant, but with the agreement of the renewables and energy efficiency targets since, it is possible to now understand the implications more clearly.

⁷ https://ec.europa.eu/clima/policies/strategies/2050_en

⁸ <https://europeanclimate.org/a-net-zero-emissions-european-society-by-2050-is-within-reach-but-getting-there-starts-today/>

⁹ <https://d1owejb4br3l12.cloudfront.net/publications/reports-presentations/long-term-EU-climate-energy-policy-framework-options.pdf>

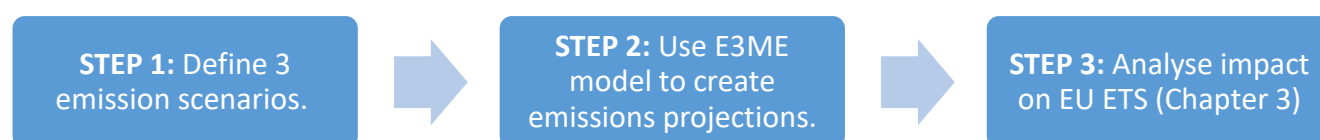
2 Modelling emissions

This chapter introduces the scenarios, the model, and the results. It finds that the existing policies in the “Base” scenario should already deliver 50% EU GHG emissions reductions by 2030, versus 1990 levels. A rapid coal phase-out is critical to this assumption - half of the emissions reductions are from coal power plants being replaced with renewable electricity. The “Moderate” and “Advanced” scenarios show even more GHG cuts are possible by a combination of sensible policies, to up to a 58% reduction.

Our analysis also shows that the EU Commissions’ 2050 modelling is not fully accounting for the announced national coal phase-outs. This is why their modelling projects a less ambitious 46% reduction in emissions with existing policies.

2.1 Modelling approach

To address the level of emissions reductions and distribution across sectors, including the effect of policy interactions, we have adopted a three-stage approach.



2.2 Defining the scenarios

This section assesses the effect of different policy combinations to quantify the extent of the emissions reductions that might be readily achievable by 2030. We examine three scenarios:

- **“Base Case”**: this is a reflection of all the European and Member State policies announced to date, including EU renewable and energy efficiency targets, and national coal phaseouts.
- **“Moderate”**: some strengthening of the Base Case, to construct a better interaction of policies. This includes ensuring all countries have phased out coal by 2035, all countries achieve stronger energy efficiency reductions, and a step up in EV penetration.
- **“Advanced”**: is our strongest ambition scenario and the best interaction of policies in the context of the current legislation options. All countries will have shifted away from coal power by 2030, achieved higher energy efficiency reductions and higher renewables, more EV’s, as well as a higher carbon price.

Table 1 describes in detail the assumptions that underpin our three modelled scenarios. Further detail on the assumptions is given in Annex A.

Table 1: Scenario assumptions

	Base Case	Moderate	Advanced
Coal Phase Out	Current national phase-out plans + latest coal phase out by 2040	Current national phase-out plans + latest coal phase out by 2035	Current national phase-out plans + latest coal phase out by 2030
Energy Efficiency	32.5% (in line with EUCO+33)	32.5% + all countries must meet individual targets.	40% (in line with EUCO40 scenario)
Renewable energy	32%	32%	34%
Electric Vehicles % light vehicle stock by 2030	7%	13%	18%
Carbon Pricing	Rising to €31/tCO ₂ by 2030	Rising to €31/tCO ₂ by 2030	Rising to €35/tCO ₂ by 2030

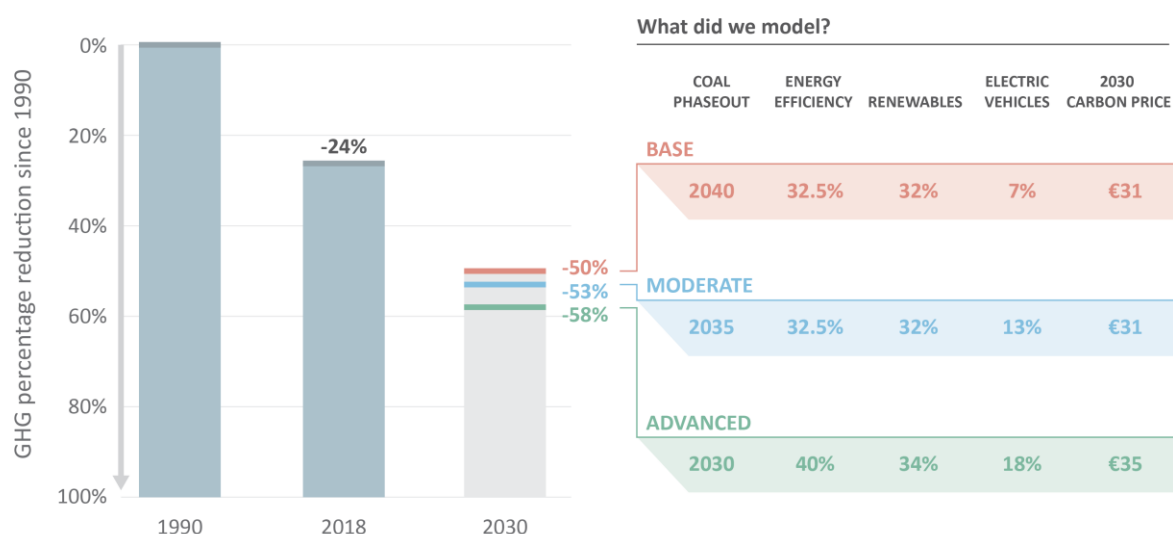
2.3 About the model

Cambridge Econometrics' E3ME model is a computer-based model of the world's economic and energy systems and the environment. It was originally developed through the European Commission's research framework programmes and is now widely used in Europe and beyond for policy assessment, for forecasting and for research purposes. Annex B provides a short summary of the E3ME model.

2.4 Model results

Chart 1 shows the results of each of the three model scenarios to 2030. The model results show that Europe's existing policies in the Base Case would cut EU emissions by 50%, relative to 1990 levels. The Moderate and Advanced scenarios, which have a selection of more ambitious policies, result in increased emissions reductions of 53% and 58% respectively.

Chart 1: Model scenario results, GHG emissions relative to 1990 (excluding LULUCF)



2.4.1 Emissions by sector

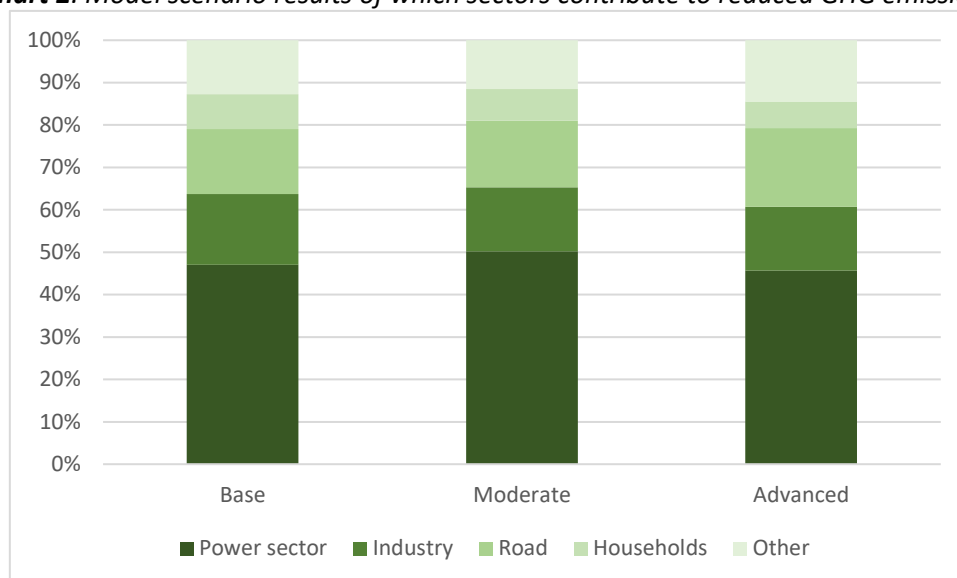
The power sector provides almost half the emissions reductions by 2030 in all three of the scenarios – see chart 2. Announced coal phase-outs provide large emission cuts in the “Base” scenario, and then more aggressive coal phase-outs in the “Moderate” and “Advanced” scenarios means even bigger CO₂ cuts.

The power sector indirectly leads to even more decarbonisation. Rising electricity consumption as electrification of transport, heat and industry picks up, means the power sector is decarbonising even as it is also responsible for decarbonisation in other sectors as well.

The next largest sources of savings are industry and road transport, which each account for about 15-17% and 15-19% respectively of the total reduction. Road transport is currently the largest source of emissions after power generation. Until now it has proved difficult to reduce emissions in this sector as increases in efficiency have been offset by growth in vehicle km travelled. However, this now looks set to change, with further increases in internal combustion efficiency, electrification – which makes a significant contribution by 2030, and some increase in the use of biofuels. Emissions from the road transport sector fall by about a sixth over the period, with reductions greatest in the second half of the 2020s. The next largest sector is households, which contribute a further 6-8% of the total. The other sectors together, including commercial buildings, account for about a 12-14% of the total.

If a sector makes little contribution to total emissions reductions, this does not imply that policy in that sector is necessarily ineffective. Without policy, emissions may have grown substantially. Improvements in energy efficiency have a crucial role to play across all sectors, ranging from building insulation to limiting electricity demand growth to reducing emissions from road transport.

Chart 2: Model scenario results of which sectors contribute to reduced GHG emissions

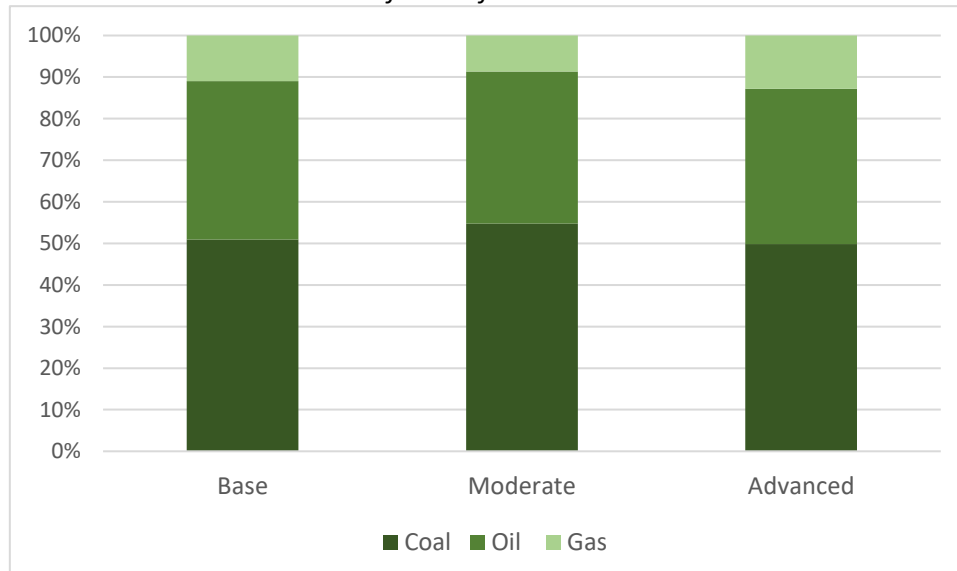


2.4.2 Emissions by fuel

All three scenarios burn less coal, oil and gas. Chart 3 shows to what degree they are responsible for the falling GHG emissions in each scenario.

It is coal that takes by far the biggest GHG reductions, providing at least 50% of the emissions reductions in all scenarios. Most of the reduction in coal is in the power sector. However, non-power coal also falls. Oil sees large falls as electrification of transport picks up pace. Gas sees its biggest drop in the “Advanced” scenario, where strict energy efficiency targets reduce gas space heating.

Chart 3: Model scenario results of which fuels contribute to reduced GHG emissions



2.4.3 Results by energy-intensity and carbon-intensity

The emissions reductions are achieved by (a) GDP growth becoming less energy-intensive, and (b) by energy becoming less carbon-intensive – see table 1. Both would need to improve significantly relative to the past. In particular though, the carbon-intensity of energy needs to show the biggest change – it has historically only improved by 1.1% per year, but would need to increase to 2.3% for the Base scenario and to 3.2% for the Advanced scenario.

Table 2: Model scenario results for energy-intensity and carbon-intensity improvements, 2018-2030

	Base Case	Moderate	Advanced	Actual 2005 to 2018
Energy-intensity of GDP <i>Energy/GDP</i>	2.4%	2.5%	3.0%	1.7%
Carbon-intensity of energy <i>CO2/Final Energy</i>	2.3%	2.7%	3.2%	1.1%

2.5 Comparison to European Commission 2050 Long-term Strategy modelling

The European Commission released its modelling for the Long-term 2050 Strategy in November 2018, which shows the Clean Energy Package should deliver GHG reductions of 46% by 2030, versus 1990 levels.

However, the “Base” scenario in this report is designed to measure a similar scenario and shows higher reductions of 50% by 2030. That 4% difference equates to around 230Mt of CO₂ emissions in 2030. What is the cause of this discrepancy?

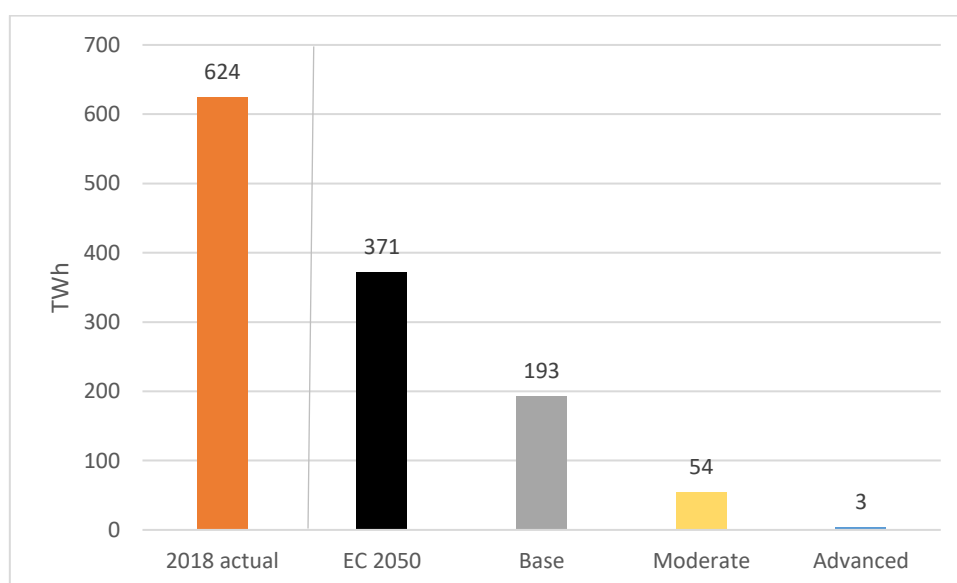
Most can be explained by the difference in coal generation – see chart 4. Coal generation in 2018 was 624TWh according to estimates by Sandbag¹⁰. According to the EC 2050 modelling, there will be still 371TWh of coal generation in 2030. Since the E3ME model scenario includes the latest coal announcements, it sees a much faster drop in coal emissions, even in the “Base” scenario. The difference between the Commission and the Base scenario is 178TWh. The expected lower coal generation in 2030 versus the EU Commission’s modelling is the primary driver of the higher ambition 50% that is achievable in our Base case.

Removing coal remains a key way to shift emissions over the next decade. The Commission's modelling in the Long-Term Strategy suggests that 12% of EU 2030 GHG emissions (excluding LULUCF) will be from coal power plants. Therefore a 2030 coal phase-out would reduce EU GHG emissions by 12% in 2030, against the Commission’s vision of BAU. This equals ~6% extra ambition against 1990 levels (since 1990 levels are almost double 2030 levels).

So where the Commission model outputs a 46% cut by 2030, a 2030 coal phase-out alone would increase that to a 52% cut in total EU emissions.

¹⁰ <https://sandbag.org.uk/project/power-2018/>

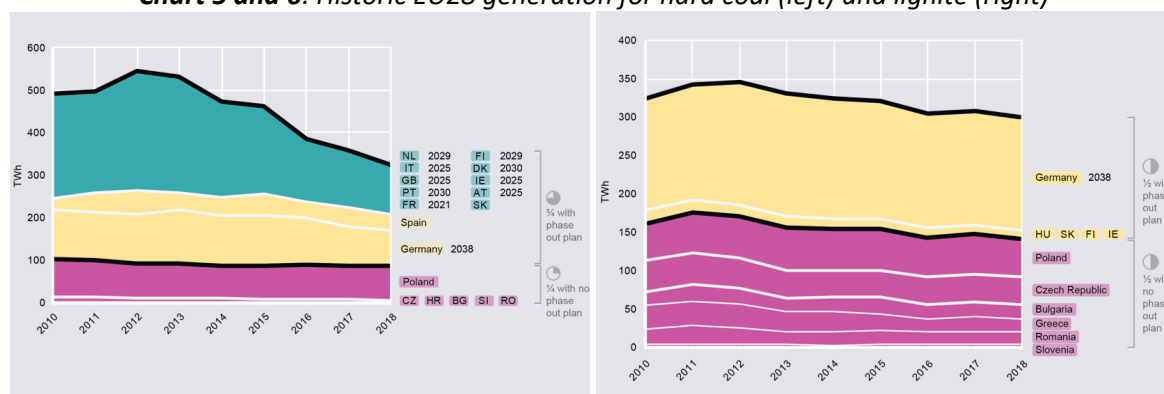
Chart 4: Model scenario results of coal generation in 2030



Charts 5 and 6 show how coal phase-outs will impact coal generation. Three-quarters of hard coal plants already have a phase-out date, assuming Spain follows through on its tentative announcement. Also, half of lignite generation has a phase-out now that Germany has made a commitment. Every phase-out is prior to 2030, so would mean coal power plant emissions fall to zero in those countries. The only exception is Germany whose phase-out date is 2038. Oeko Institut in March-2019 modelled the Coal Commission outcome and showed that even by 2030, coal generation would have fallen by 60%¹¹. The sharp drops in coal seen in the “Base” scenario in this paper are already commitments made.

The six lignite countries highlighted in chart 6 – Poland, Czech Republic, Bulgaria, Greece, Romania and Slovenia – would all need to make progress on a coal phase-out in order achieve the emissions reductions shown in the “Moderate” and “Advanced” scenarios.

Chart 5 and 6: Historic EU28 generation for hard coal (left) and lignite (right)



Source: Sandbag/Agora “European Power Sector in 2018”

¹¹ <https://www.oeko.de/fileadmin/oekodoc/Deutsche-Kohleverstromung-bis-2030.pdf>

2.6 Brexit

For the modelling for this report, we have included the UK in the EU policy framework. This is to allow for comparison of the results with both existing targets and existing modelling. At the time of writing, there are very few clues what the UK will do.

Even if Brexit happens, no decisions have yet been taken on the UK's future inclusion in the EU's climate and energy policies, or the EU's NDC under the UNFCCC framework. The UK has its own legally binding national targets, and while there would be some adjustments to modelling depending on the role of the UK, the general conclusions of this report would likely be largely unaffected¹².

However, as the UK has more ambitious targets for 2030, some additional reductions may be necessary in other Member States. We estimate the additional required reduction as equivalent to about 1% of the 1990 total, or around 60 million tonnes.

¹² See <https://sandbag.org.uk/project/brexit-eu-ets-greater-sum-parts/> for more on the implications of a UK departure from the EU ETS.

3 Is the EU ETS robust to faster 2030 emissions reductions?

This chapter shows that the ETS is still not robust to rapid emissions cuts. Given the large reductions in ETS emissions expected to occur to 2030, the surplus will begin to increase once again and further ETS reform is needed to ensure that carbon prices do not fall back to irrelevance. Further reform options available are analysed. A stronger Linear Reduction Factor (LRF) alone will not solve the problem.

3.1 Background

Annex C provides a brief recap of the EU's ETS story so far. It provides background information on how we have arrived at the current 1.54 billion tonne cumulative market surplus – a value close to the ETS's total 2017 emissions of 1.78 billion tonnes¹³. It also summarises the reform measures taken so far to address the surplus problem, i.e. the Backloading Decision and the introduction of the Market Stability Reserve (MSR).

The surplus build-up has, until recently, kept the ETS price at very low levels which fail to stimulate rapid innovation and investment. Continued operation of incumbent high carbon intensity technologies is not sufficiently discouraged.

The allowance prices applied for the Base Case and for the Moderate scenarios are the average of a poll of market analysts' price projections carried out by Carbon Pulse in the summer of 2018. These increase to €31 by 2030. The Advanced scenario uses higher prices of €35 by 2030. There is no feedback in the scenario modelling on the carbon price.

The following section examines how the surplus would develop under the emissions scenarios from the chapter above.

3.2 Mind the Gap!

Emissions are currently much lower than the cap. We estimate that 2018 emissions are already 11% below the current 2018 cap level. Under the scenarios in this report, the gap between the cap and emissions would increase to 15% in the Base scenario in 2030, 22% in the Moderate scenario and 28% in the Advanced scenario. This is shown in chart 7.

¹³ Scrape from EUTL

Chart 7: Current cap versus emissions projections

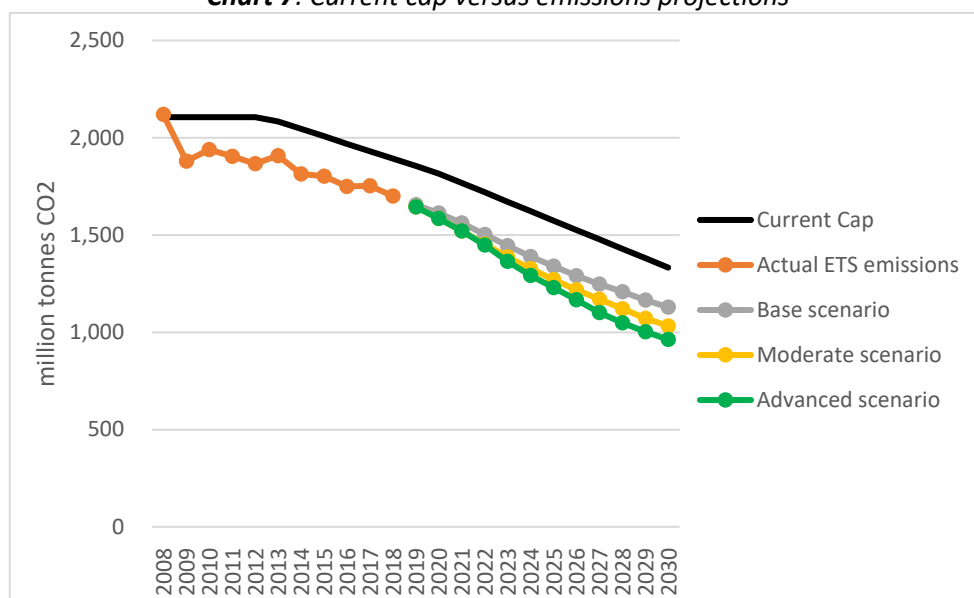


Table 3 shows how the 2030 total GHG emissions relate to the ETS cap, which is expressed relative to 2005 emissions. The cap is set at 43% reductions to 2005 levels, whereas the 3 emissions scenarios show emissions of 52-59% below 2005 levels.

Table 3: Comparison of 1990-2030 total GHG emissions and the 2005-2030 ETS cap

Scenario	2030 reductions in total GHG emissions, vs 1990	2030 reductions in EU ETS sectors, vs 2005
Cap in current legislation	40%+	43%
Base Case	50%	52%
Moderate	53%	56%
Advanced	58%	59%

Source: Sandbag calculation based on E3ME modelling.

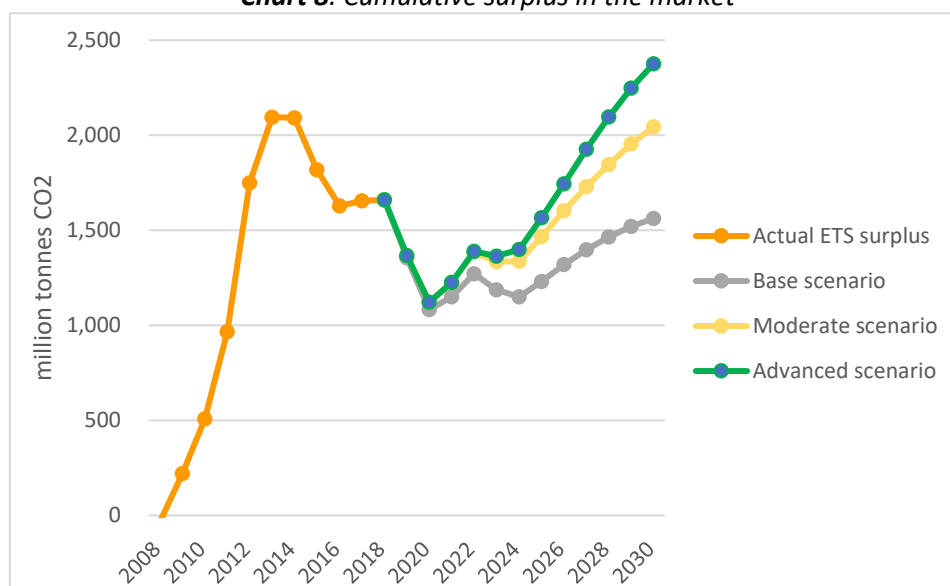
3.3 Development of the surplus

Sandbag has set up a flexible model to explore how the MSR will adjust ongoing stationary allowance supply under different demand projections, with different cap levels and allowance distribution choices and with different MSR parameter settings. Net demand for stationary allowances by the aviation sector can be included or excluded as required. There are very many settings possible in the model, all of which influence the development of the supply demand balance to a greater or lesser degree. However, the main model settings have been kept constant for this report (unless stated otherwise) and are described in Annex C.

Chart 8 shows the development of surplus under each of the scenarios. The temporary double-strength MSR agreed under the Phase 4 ETS reforms reduces the surplus market from 1.7 billion tonnes in 2018 to almost 1 billion tonnes by 2020. However, the surplus then begins to rise in all scenarios. By 2030, it would reach 1.6 billion tonnes in the Base Case, 2.0 billion tonnes in the

Moderate scenario and 2.4 billion tonnes in the Advanced scenario. **This shows the EU ETS is far from fixed.**

Chart 8: Cumulative surplus in the market



3.4 Further ETS reform options

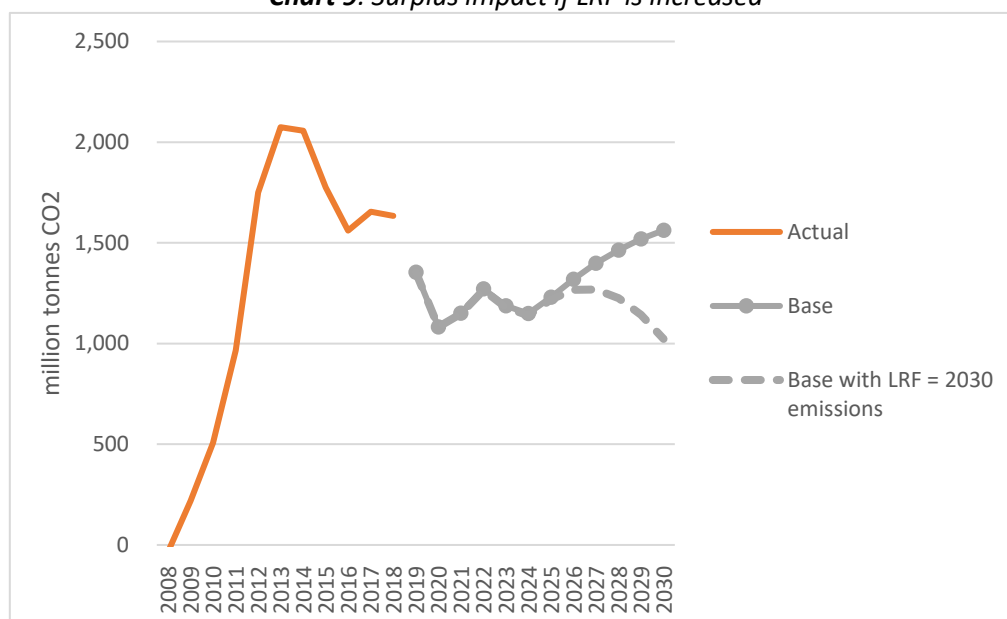
The fact that actual emissions levels are so far below the current cap lies at the heart of the weakness of the EU's ETS. The analysis above shows the current MSR is not sufficient to keep pace with the modelled emissions projections. The recent ETS Reform does leave room for the Directive to be reviewed in light of efforts undertaken to achieve the long-term objectives of the Paris Agreement. So what can be done to further reform the ETS to reduce the surplus and keep the carbon price from falling again?

3.4.1 Increase LRF – not the right tool

One commonly discussed reform proposal is to increase the rate at which the cap is reduced year over year, i.e. increase the linear reduction factor (LRF). The most likely time for such a cap change would be the start of the second half of the phase in 2026. If the LRF were increased to equal 2030 emissions in the Base Case, the modelling shows three interesting observations – see chart 9. First, the LRF reduction would need to be very big: it would need to double from today's 2.2%/year level to over 4% from 2026. Second, the surplus would still be 1 billion tonnes by 2030 so even this does not solve the surplus. Third, the downwards projection of the cap would become very steep¹⁴. **Therefore, increasing the LRF alone is not the right tool to solve the surplus.**

¹⁴ Extended modelling shows the cap would reach zero by 2043 under this LRF.

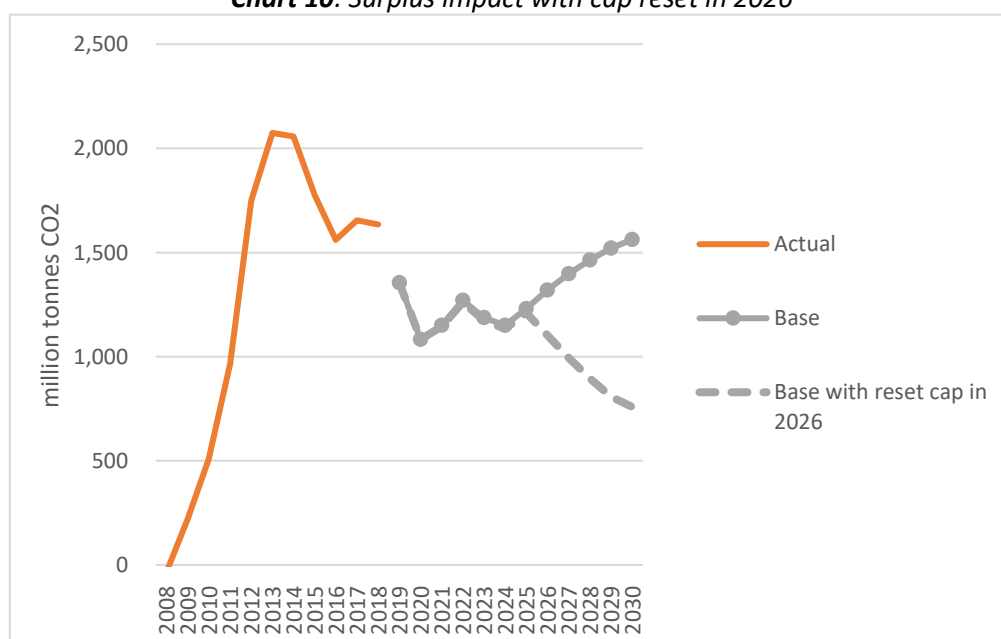
Chart 9: Surplus impact if LRF is increased



3.4.2 Reset the cap – preferred option

Sandbag has previously advocated for a one-off adjustment of the cap to emissions. Chart 10 shows how the surplus would develop if the cap was reset in 2026 by working backwards from the 2030 Base Case emissions expectation following the current LRF (i.e. no change in cap decline steepness, just a recalibration to better match actual emissions levels). This would bring the surplus under control, rather than let it increase. **Such a one-off reset of the cap in line with emissions would prevent renewed surplus build up whilst still allowing room for some cap to continue to 2050.** If emissions reductions continue to exceed expectations, this cap ratchet approach will need to be repeated (in line with the Paris Agreement process).

Chart 10: Surplus impact with cap reset in 2026

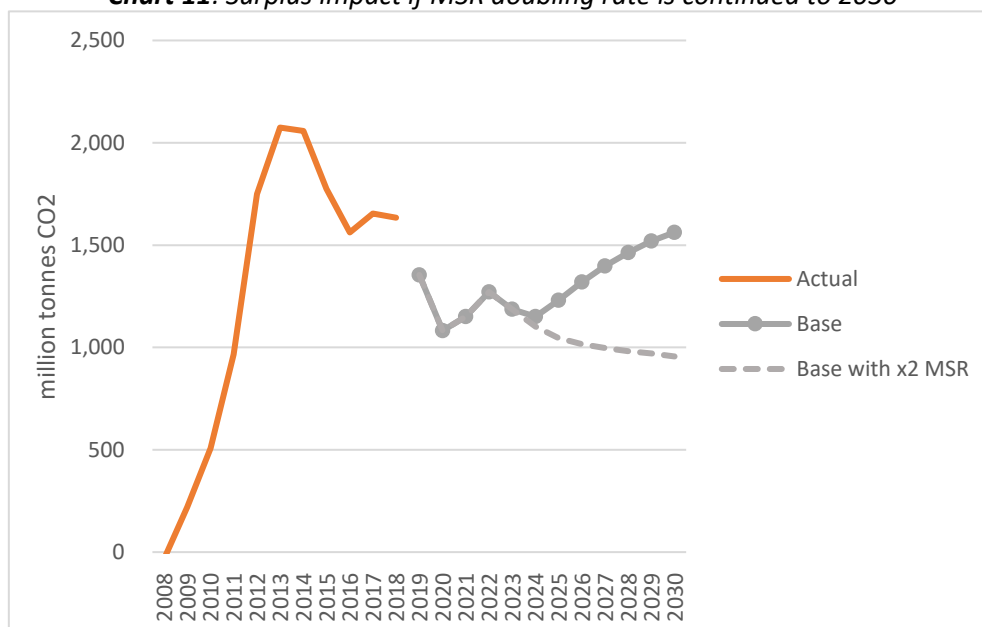


3.4.3 Strengthen MSR – not enough, unless extreme

Another option for reform is to strengthen the MSR. A review of the MSR is scheduled for 2021 so Sandbag has explored whether further reforms to the MSR rules could balance the market under the modelled scenarios.

Chart 11 shows that maintaining the MSR doubled rate, which is due to stop in 2023, would keep the surplus down to 1 billion tonnes by 2030. **Continuing the double-speed MSR will help reduce the surplus but it will not create tightness in the market.** Further MSR reform will need to be extreme (for example, at least tripling the withdrawal rate of allowances throughout the whole of Phase 4) to cope with the market's over-supply with the emissions reductions achievable under the three scenarios modelled for this report.

Chart 11: Surplus impact if MSR doubling rate is continued to 2030



4 Implications of policy interactions

A portfolio approach to climate policy is necessary for effective and accelerated emissions reductions. Transforming the European economy is a complex task and no single policy will achieve it. Even carbon pricing, the most wide-ranging policy, will not be sufficient on its own to create an efficient and effective transformation, or to deal with every one of the multiple market failures found in the energy sector and elsewhere. A rapid and effective transition will thus necessarily continue to require a closely managed mix of market and regulatory interventions.

In practice, there are many hundreds of policies in place at the EU and Member State level that affect GHG emissions. Many of these will interact, in that several policies may serve the same goal. Through their interactions, policies can help enhance each other's potential and accelerate reductions. For example, energy efficiency policies can accelerate the shift away from coal. If managed smartly, such synergies can be harnessed to save us time and money on the way to 2050. Carbon budgets have a role to play in this regard, as they can serve as the coordinating element in a wider system of climate policies. Their flexible and dynamic design is important in this regard and so is their coherence with the overall pathway the EU is set on.

In this section we consider further the effect of those interactions.

4.1. Potential complexity of interactions in overlapping policies

Measures to encourage electric vehicles (EVs) illustrate how complex interactions can be. There are many policies that can increase deployment of EVs, including capital grants, reduced taxes, higher taxes on internal combustion engine vehicles or on fuel, and preferential treatment, for example access to dedicated road lanes. Increased deployment of electric vehicles reduces emissions from surface transport and so can contribute to achieving targets for average vehicle emissions. Furthermore, electric motors are typically more than twice as efficient as internal combustion engines¹⁵, and so there is a net reduction in energy demand. These reductions can contribute to stronger energy efficiency targets.

However, other measures to increase efficiency may be weakened in response to the growth of EVs if policy makers seek only to meet fixed overall goals. For example, faster deployment of EVs may allow less rapid progress with improving the efficiency of internal combustion engine vehicles. Policy on EVs also potentially interacts with renewables targets, by affecting both renewable power generation and the amount of biofuels used in the transport sector.

Emissions decreasing in sectors covered by the ESR have the potential to increase in emissions in the EU ETS, depending on the source of the electricity. Increases in deployment of EVs may affect the timing of electricity demand and the amount of battery storage potentially available to the grid, which may again affect the fuel mix in the power sector. This can in turn affect the carbon price.

This is an example of a situation where if policy interactions are not managed smartly, with the help of an overarching or coordinating policy, the individual aims and goals of the separate policies can become at odds with each other. However, this is only a problem of policy management, for any

¹⁵ Typical values are a small sized diesel has an efficiency of around 1.76 MJ/km (this varies greatly with vehicle size) whereas a similar EV has an efficiency of 0.75 MJ/km.

policy that ultimately reduces emissions is never counterproductive to the overall goal of reaching a carbon-neutral EU by 2050. However, interactions have to be smartly managed, for these potentially contradictory short-term effects to be mitigated and even turned around to become positive interactions, accelerating the advancements in both policy areas, for a higher overall reduction level. This can be achieved through carbon budgets that ensure a relevant level of stringency through regular reviews, enhanced cooperation between Member States, flexibilities which aid synergic positive effects (such as project mechanisms) and relevant targets.

Taking account of all such interactions is very complex, and we are not aware of any model that does so in full. The E3ME model used for this work does not contain a representation of the EUA price that responds within the model to changes in total emissions. Indeed any modelling which tried to take account of all overlap would inevitably require assumptions about many unknown parameters, and for many policies there will be a lack of evidence about how they interact, and indeed there may be multiple interactions that are impossible to separate in practice. Instead of trying to take account of all interactions we here focus on the major themes governing the effect of policy interactions.

4.2. Benefits and drawbacks of interactions

In many respects our analysis indicates that the fundamental characteristics of the existing policy package are sound. They allow existing targets to be met or exceeded. In many cases different policies are clearly complementary. For example, efficiency standards for vehicles can help drive technology change in transport, and can thus contribute to achieving wider energy consumption goals, such as those set out in the Energy Efficiency Directive. Similarly, renewables targets are made easier by energy efficiency improvements, because the target is a proportion of overall energy, so reduced energy use implies the renewables target is less demanding in absolute terms. More efficient cars can be incentivised both by differential taxes on vehicles and on fuels.

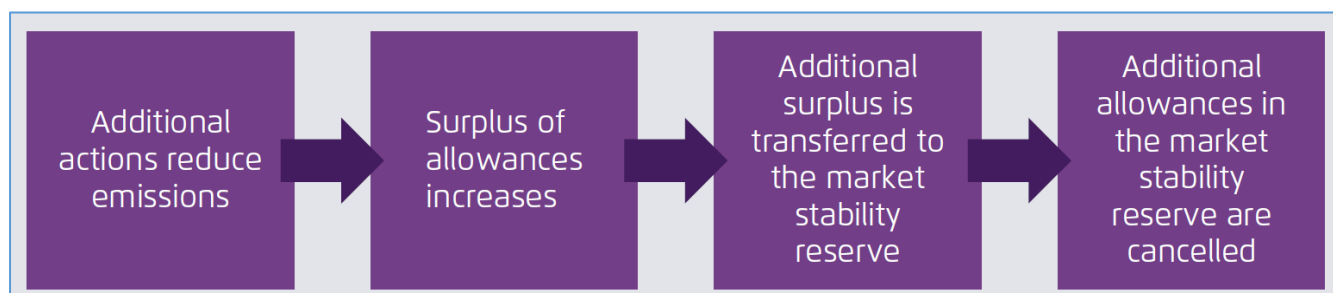
However there is a potential weakness arising from policy interaction if policies are not responsive to each other. Specifically, policies with wider, more aggregated coverage need to be responsive to variations in outcomes of policies that contribute to the wider goal, but are narrower in scope. The most significant examples of policies with wider coverage are the EU ETS and ESR. However there are other instances. To take the vehicle efficiency standards example, the effect of policy overlap is crucially dependent on whether average vehicle efficiency targets (in gCO₂/km) are adjusted in response to increased numbers of EVs and the amount of biofuels and whether the carbon budgets can be made dynamic to respond to shifting levels of demand and sectorial profiles covered.

The problem is thus not necessarily policy overlap in itself, it is interaction between policies which have a wide scope that encompasses other policies, where policy scope is contained or “nested” within a wider objective. Setting the objective for policy with wider scope needs to take into account the potential effects of policies with narrower scope nested within it.

4.3. The EU ETS and the “Waterbed hypothesis”

It is sometimes suggested that other policies which reduce emissions can be counter-productive, because, it is claimed, total emissions are always maintained within the fixed cap, and by implication additional actions do not reduce total emissions. This is sometimes called the “waterbed hypothesis”.

However previous work by Sandbag and others has shown that in practice that this does not hold¹⁶. While it is likely that there will be some price rebound effect from increasing the surplus this will at most only lead to a minority of the benefits being lost. The majority of emissions reductions from additional actions will be permanently retained, reflecting the continuing surplus of allowances and the operation of the MSR. With the MSR size limit in place there is a very clear pathway by which allowances freed up by additional actions, such as reduced coal burn or increased renewables, will add to the surplus, be transferred to the MSR then cancelled (see diagram).



Total emissions under the EU ETS will be correspondingly lower. There is now a clear mechanism by which additional actions reduce total emissions

4.4. The importance of measures to ensure robustness of the ESR

Chapter 3 shows that further action is essential to ensure the robustness of the EU ETS. The same is also true of the ESR. If interactions are properly managed, the non-traded sectors alone have the potential to lead to up to 50% reductions in the ESR alone (as compared to the current -30%)¹⁷, which would in fact enable the EU overall target to go beyond the 58%. Our ‘Advanced’ scenario is in fact not the most ambitious available to the EU, although it does build on good example of positive policy interactions (through an enhanced ETS and a transition out of the most carbon intensive forms of energy).

In order to secure the ESR is driving the highest reductions at the lowest cost, it is necessary to address the issues arising from exceeding the individual Member States target and the specific sectorial targets set for sectors under the ESR, an interaction which is less direct.

According to the European Environment Agency’s latest Trends and Projections report¹⁸ (based on inventory data from 2016), EU Member States are currently projected to significantly fall short of their ESR emissions targets for the year 2030. This is because of a misalignment between the cost-effective potential for reductions across the EU and the nationally oriented actual targets, a

¹⁶ See Sandbag’s initial report <https://sandbag.org.uk/project/puncturing-the-waterbed-myth/>, follow up work <https://sandbag.org.uk/2017/11/23/no-waterbed-effect/>. See also *Subsidies to renewable energy and the european emissions trading system: is there really a waterbed effect?* By Frederik Silbye, Danish Council on Climate Change Peter Birch Sørensen, Department of Economics, University of Copenhagen and Danish Council on Climate Change, March 2017. See also <https://energyathaas.wordpress.com/2018/04/15/carbon-markets-waterbeds-and-you/> and <https://www.nature.com/articles/s41558-018-0120-2>

¹⁷ <https://sandbag.org.uk/project/the-effort-sharing-dinosaur/>

¹⁸ <https://www.eea.europa.eu/publications/trends-and-projections-in-europe-2018-climate-and-energy>

misalignment, which Sandbag has documented in several previous reports. As the non-traded sectors represent the bulk of EU emissions, having such a wide range of targets for 2030 creates real difficulties in terms of the national distribution of these reduction requirements, percentage wise, when mapped against the sectorial profiles of specific Member States.

However, this ESR carbon budget is very much key to unlocking EU ambition levels, as it covers more than 50% GHG emissions in the EU and some of the sectors known to be further behind the decarbonisation curve than those covered by the EU ETS. Existing policies such as the renewables obligation will need to be more fully implemented by actions at the Member State level. Other sectorial policies, set at the EU level, will mean that for some MS, the overall target will be met by simply implementing those targets (ex. Romania or Bulgaria)¹⁹. Our Base scenario assumes that this is done. This section highlights some of the issues raised in respect of distribution across Member States and sectors.

This “shortness” is unevenly distributed, with some Member States retaining surplus allocations (AEAs) until 2030, others becoming short in the course of the decade, while others are already expected to be short in 2020. These differences can be evened out through trading in AEAs between Member States, however this does not necessarily lead to additional reductions. Following the previous revision of the Effort Sharing Directive, a new provision for a project-based mechanism was introduced in the context of this scheme. In a previous Sandbag report, we estimated that the additional benefit of using the surplus under the ESR to harness additional cost effective reductions, would result in a significant increase in ambition levels to 2030²⁰. This means that without re-opening the currently agreed ESR, Member States could still be driving higher ambition at the EU level, while still meeting their own targets more cost effectively, through this very helpful provision. There is much scope within the current ESR for additional emission reductions and national legislation will dictate where these will be most needed in the various MS. In a previous Sandbag report, we have mapped out the potential of reductions in these sectors to reach up to 50% reductions for these sectors alone by 2030, if the potential and reductions are better aligned across the individual targets²¹. This is a case of enhanced policy interaction within the currently existing framework and would take us to overall levels of emissions reductions beyond those modelled in this study (so beyond 58% reductions EU wide).

The quantity of missing emission reductions could amount to several hundred million tons per year by 2030. Given that the ESR targets do not permit the application of credits from outside the EU, the additional reductions to cover the overall shortness will need to come from policies within the EU. This could result in AEA prices that are multiples of current EUA prices. The price is very uncertain however, it really depends on the abatement costs of available policy measures in the various Member States. There is no public market price that could inform and inspire potential sellers to develop additional emission reduction policies.

As of January 2019, we had no knowledge yet of the Member State-level renewable and energy efficiency targets that MS will undertake in their National Energy and Climate Plans for the 2020-2030 period. On the basis of the “With additional measures” forecasts in the Trends and Projections report, it can be expected that even with the new NECP targets, there will remain an gap in reductions that will need to be closed with ESR measures.

¹⁹ <https://sandbag.org.uk/wp-content/uploads/2018/04/Climate-of-Cooperation-ESR-report-Sandbag-March-2018.pdf>

²⁰ <https://sandbag.org.uk/project/the-effort-sharing-dinosaur/>

²¹ <https://sandbag.org.uk/project/the-effort-sharing-dinosaur/>

As some Member States are much shorter than others, it would be economically reasonable for them to purchase AEAs instead of trying to achieve more expensive reductions at home. Thus, we can expect in theory that a meaningful AEA price would emerge. By a “meaningful” price we mean one that does incentivise Member States to undertake additional emission reduction measures –not only for the purposes of reducing emissions at home, but also to help the compliance efforts of other Member States by selling them AEAs.

The ESR is in principle a backstop to the RES and EE targets. If RES and EE targets are weak, Member States will still be required to reduce emissions in order to reach their ESR target, or to buy from other MS. If RES and EE targets will be ambitious, the ESR demand will of course become lower. The difficulty of meeting the targets is also strongly dependent on economic cycles, which are difficult to predict and the nature of the sectors covered. However, some of the sectors still have massive potential for reductions and there are many low hanging fruit left under the budget (i.e. methane emissions in Romania).

Overall scarcity of AEAs is not the only thing that matters for the effectiveness of AEA trading. Lack of price information, and weak market intermediaries, or the inability of sellers to find good projects can also result in an ineffective market, which in turn makes ESR compliance more expensive for the EU as a whole.

Potential areas of intervention

Considering that the Member State-level ESR targets for 2030 were only adopted recently in May 2018 and many Member States are already anticipating that a significant effort will be needed to reach these targets, it is unlikely that there would be much political appetite among Member States to tighten those targets in the near future. However, a cost-effective and successful implementation of the ESR could also help in creating political room for the tightening of the overall EU. This would then create a virtuous cycle and inspire an ESR target better aligned with the 2050 pathways to carbon neutrality. This target would then have to minimise the very wide range of individual Member States targets currently practiced under this carbon budget, and instead have targets around a median, as to best reflect EU level cost effective potential.

This change in architecture will most certainly be needed at some point until 2050. Currently the individual targets are not in line with the cost-effective potential available in each MS and are spread across too wide of a range, creating a distorted requirement for the EU wide level. Instead, we could be reaching as much as 50% reduction EU wide in these sectors alone, if countries were supported through a more cooperative policy frameworks, emphasizing the need to carry out joint projects for reductions across Member-States, as demonstrated in an earlier report. If the ESR alone would get close to its potential of 50% reductions by 2030, with our Advanced scenario, the EU could reach levels of ambition beyond 58% reductions by 2030.

There are a number of EU-level and national measures that could do a lot to make the ESR more successful and cost-effective even without reopening the ESR Regulation: These are – inter alia – the following:

- a) Moving sectors from the ESR to the ETS: EUAs in the ETS would be expected to be cheaper than AEAs, due to the cheaper emission reduction opportunities available there. Thus, if an ESR sector is able to function in the ETS (e.g. it has large enough participants and the monitoring can be specific enough), it could be useful to move it into the EU ETS. This can be done on an EU-level, or on a Member State-level. The most suitable sectors would be: district heating installations (regardless of thermal heat input), combustion installations between 10 and 20 MW, and upstream transport fuel production. In these sectors it is very unlikely that a Member State government would be able to achieve reductions at a lower

cost than the EUA price (barring the introduction of a meaningful carbon tax, which is politically controversial). Admittedly, this measure is not so much making the ESR as such more efficient, but it does help compliance with targets.

- b) Help the participation of private sector investors in identifying and realising ESR emission reductions: At the moment, the ESR structure is not very appealing to the private sector as the market is illiquid, there is no price signal and AEAs can only be held by states. This is a problem because the private sector would be able to discover and explore emission reduction opportunities that are difficult for the government to exploit. This is especially true in Member States that do not have a shortage in AEAs and thus there is no incentive for the government to find these reduction opportunities. If it is allowed to participate in the ESR in a controlled way, the private sector could introduce projects with pioneering technologies in areas of the economy where command and control measures are not feasible. To ensure this, the ESR system should allow authorised private participants to hold and transfer AEAs.
- c) Improve price transparency in the ESR: In the Green Investment Schemes that were ESR's precursors in the Kyoto period, the sale price of allowances was kept secret, and as a result, deals were usually individually negotiated on a bilateral basis, which is of course very costly. It would be very important to have more information on prices in the 2020-30 ESR period, because in the absence of a clear and public price signal, the Member States which have no shortage of AEAs will not be interested in developing projects with emission reductions and thus supply of AEAs would remain limited, which would drive up prices. At present, the ESR has no rules on price transparency and thus Member States or a group of Member States are free to decide to make prices public
- d) Standardised monitoring methodologies should also be developed: These would ensure that AEA transfers are coupled with actual and credible emission reductions. Such methodologies can also be developed on a voluntary basis, provided that they are credible.

Furthermore, if the Paris Agreement process results in compelling the EU to adjust the ESR targets, it would be important to do this in a way that does not upset the balance among Member States set out in the Effort Sharing Regulation. To do this, the EU could introduce a uniform correction factor (similar to the one under the EU ETS) that could bring ESR allocations in line with new targets in a fair way. This would however require a full amendment of the ESR Regulation.

Another option would be to shift more of the EUAs set aside for auctioning to the ESR sector. This is similar to the opt-in argument above. If a Member State finds that it is very costly to reduce emissions in the ESR, it might be cheaper for it to use its EUAs for ESR compliance instead of selling them. The reduction of supply would of course put an upward pressure on EUA prices, but that is only to be welcomed. At present, the ESR limits the amount of EUAs that can be brought into the ESR in order to ensure that EUA supplies remain predictable. Allowing more EUAs in the ESR could however be an effective and fast way of tightening climate targets.

5 ANNEX A: Defining the model scenarios

In this section we examine the potential of major strands of policy and the assumptions that are used to define the model scenarios:

- Phasing out coal plant in power generation (except any which has CCS, which none currently does)
- Energy Efficiency
- Renewables
- Electrification of road transport
- Carbon pricing

5.1 General assumptions

Some assumptions are common across the scenarios, including the following:

- Compound annual average real terms GDP growth over the period 2018 to 2030 is assumed to be 1.43% p.a. This is in line with the assumption used by the Commission in its modelling studies, and very similar to, for example, the rate that is projected by accounting firm PWC²².
- International fuel prices
- Technology costs
- No use of international offsets in meeting either EU ETS or ESR goals, following 2020.

The model covers around 75% of the EU's GHG emissions, excluding LULUCF. The EU's overall target is set for total greenhouse gases. The rate of reduction in out-of-scope emissions has historically been higher than for in-scope. We assume that out-of-scope emissions fall at the same rate as the model predicts for in-scope GHG's.

5.2 Coal phase-out in power generation

The most important assumption concerns national level coal phase-outs in the power sector. In 2018, coal used in power generation produced approximately 631 million tonnes of CO₂ emissions, about one sixth of the EU total, and 37% of emissions under the EU ETS. Sandbag analysis shows this has fallen by 31% since 2012, and is expected to continue falling rapidly as renewables generation replaces coal generation²³.

In response to its environmental effects, Member States have increasingly started to reduce their use of coal, cease to build new plants and commit to coal phase outs. Many western European Member States have already committed to coal phase-outs by 2030 or before, and Germany has committed to a 2038 phase-out, perhaps to bring it forward to 2035. The effectiveness of such

²² <https://www.pwc.com/gx/en/world-2050/assets/pwc-the-world-in-2050-full-report-feb-2017.pdf#page=20>

²³ <https://sandbag.org.uk/project/power-2018/>

measures is likely to be enhanced by continuing commercial pressure on coal plants. Carbon Tracker finds that 97% of coal plant being cashflow-negative by 2030²⁴ (Carbon Tracker assumes a carbon price of €20/t by 2030), which is likely to support phase-out.

The EU does not have an explicit coal phase-out policy, but current Directives and those under discussion affect coal generation. These include the Large Combustion Plant (LCP) and Industrial Emissions (IED) directive, and BREF (Best Available Techniques Reference documents), which sets limits for air pollution emissions. An emissions performance standard has been agreed for Capacity Markets, which will prevent coal plants being purposefully or inadvertently subsidised to stay open.²⁵ Additionally, the Commission is running a regional platform for transitioning coal communities, to reduce the societal impact of phasing out coal²⁶. Together these factors are likely to increase phase-out across the EU.

Scenario assumptions for Coal phase-out in the power sector

Base	Moderate	Advanced
Coal phase out by latest <u>2035</u> in the power sector in most countries, with faster phase out in UK (2025), NL (2029), FR (2021), AT (2025), SE (2023), DK (2030), IT (2025), FI (2029). Slower phase out for eastern European member states (excluding CZ, Slovenia and Hungary) to <u>2040</u>	More rapid phase-out of coal use; most EU Member States achieve zero use of coal by <u>2030</u> Exception for eastern European member states (excluding Czech Republic, Slovenia and Hungary) to phase out by <u>2035</u>	More rapid phase-out of coal use; all EU Member States achieve zero use of coal by <u>2030</u>

5.3 Energy efficiency

Energy efficiency is governed by the Energy Efficiency Directive. It consists of an overall target for energy consumption specified in absolute terms, and various subsidiary policies designed to improve energy efficiency. The target affects all sectors, although many of the subsidiary policies are targeted at the buildings sector.

The assessment of energy efficiency measures needs to take account of rebound effects. If energy use is made more efficient, and thus cheaper, some of the benefits will usually be taken in the form of extra services. For example, increasing home insulation can reduce energy use, but some of the benefits are taken in the form of warmer homes. These effects are especially large in the Advanced Policies scenario as this contains major investment in energy efficiency. Across all scenarios, 30% subsidy for heat pumps and solar thermal is assumed.

²⁴ <https://www.carbontracker.org/reports/lignite-living-dead/> (December 2017)

²⁵ Capacity Payments: The final agreement to supercharge coal (Feb 2018)
<https://sandbag.org.uk/project/capacity-payments-final-ingredient-supercharge-coal/>

²⁶ <https://ec.europa.eu/energy/en/topics/oil-gas-and-coal/coal-and-other-solid-fuels>

We make the assessment by referring to modelling work carried out on behalf of the European Commission referred to as the EUCO scenarios which are described [here](#).

Scenario assumptions for Energy Efficiency

Base	Moderate	Advanced
Energy efficiency measures in line with the EUCO+33 scenario ²⁷ , scaled down to a 32.5% target.	Strengthening of the ESR with a constraint that all countries must meet their individual targets.	Energy efficiency target increased to 40%, based on the EUCO40 scenario ²⁸

5.4 Renewables

Renewables are governed by the Renewables Directive. It covers a range of renewables energies, including wind power, hydro, solar PV, solar thermal, and biomass. They are deployed across both the ESR and ETS sectors.

The contribution to reducing emissions is not in the same proportion as the use of renewable energy across sectors. In particular, if renewables in the power sector displace coal and lignite burnt at low efficiency in power generation, there a much larger reduction in emissions than, for example, displacing gas burnt in a residential boiler. A combination of the difference in fuel displaced and the efficiency of fuel use leads to emissions reductions in the power sector from displacing coal and lignite being greater by a factor of approximately three to five compared with using the same amount of renewable energy in building heating²⁹. Displacing gas in the power sector has a little less than twice the emissions reductions of displacing gas from heating.

Scenario assumptions for Renewables

Base	Moderate	Advanced
A 32.5% target for the share of renewables in the energy mix	A 32.5% target for the share of renewables in the energy mix	Renewables target increased to 35% of energy coming from renewable sources in 2030, following an upwards revision in 2023.

²⁷ More information on the EUCO scenarios can be found at: <https://ec.europa.eu/energy/en/data-analysis/energy-modelling> including detailed scenario descriptions: https://ec.europa.eu/energy/sites/ener/files/documents/20170125_-_technical_report_on_euco_scenarios_primes_corrected.pdf

²⁸ More information on the EUCO scenarios can be found at: <https://ec.europa.eu/energy/en/data-analysis/energy-modelling> including detailed scenario descriptions: https://ec.europa.eu/energy/sites/ener/files/documents/20170125_-_technical_report_on_euco_scenarios_primes_corrected.pdf

²⁹ Based on emissions factors for coal and lignite plant of 800-1200g/kWh, gas power plant 400g/kWh and gas in boilers for heating 240g/kWh.

5.5 Electrification of light vehicles

Road transport is responsible for just under a quarter of total EU emissions of carbon dioxide (CO₂). Emissions are expected to decrease as a result of:

- Increasing efficiency of internal combustion engines
- Use of biofuels
- Electric vehicles
- Broader trends including in mode of transport, for example use of public transport and cycling.

Vehicle kilometres travelled are assumed to increase at 0.8% p.a. This is broadly in line with the PRIMES reference scenario. It is possible that there will be a rebound effect due to the low running costs of electric vehicles, and that consequently passenger km may be above the levels assumed. Conversely, shifts to other modes of transport may limit increases in passenger km.

The largest contributor to emissions reductions in our Base Case scenario is improvement in Internal Combustion. This is because ICE vehicles account for a large majority of sales over the next decade, and so remain the majority of the vehicle fleet in 2030. However, the uncertainties around the deployment of electric vehicles are especially large, and consequently their contribution potentially varies significantly. For this reason, we have examined widely varying scenarios for electric vehicle deployment.

Markets for electric vehicles are growing rapidly. Growth has been supported by a range of policies in many countries, including differential taxation, capital grants, provision of charging infrastructure, other incentives such as reductions in congestion charging, and tightening regulation of pollution in city centres. A large majority of Member States (25 of 28) now have some form of tax incentives in place for EVs³⁰, often supported by other measures. However, levels of support vary substantially across Member States.

Some Member States already have targets for phasing out sales of vehicles running on petrol or diesel. France and the UK both seek to phase out sales by 2040³¹. In addition to the EU wide transport sector targets set out above, some Member States have gone further, and have announced national targets related to the move to electric vehicles. The Netherlands wants all new cars to be emission free by 2030. Austria, Denmark, Ireland, Portugal and Spain have set official targets for electric car sales and Sweden has set a target of a 70% reduction on emissions from transport by 2030.

Irrespective of their contribution to meeting 2030 targets, it remains important that EVs are strongly encouraged by policy. More rapid deployment of EVs is essential for meeting subsequent

³⁰ https://www.acea.be/uploads/publications/EV_incentives_overview_2018.pdf

³¹ <http://www.bbc.co.uk/news/uk-40723581> <http://www.bbc.co.uk/news/world-europe-40518293>

decarbonisation targets, when they will form a much larger proportion of the market as the vehicle stock is replaced.

Emissions depend on the stock of vehicles. Even if sales rise rapidly the vehicle stock will change more slowly as existing vehicles remain on the road for some years. The scenarios for share of sales are based on studies of other technology transitions, and other modelling work in this area. They are chosen to represent the substantial uncertainty in growth in the 2020s. The net effect of EV deployment on emissions depends crucially on how the electricity they consume is produced, and this is built in to the modelling described in Section 3.

The European Union recently settled upon a 2030 target for electric vehicles which implies up to 40% of new vehicle sales could be EVs in 2030, somewhat more than our Moderate Scenario (although robust implementation of vehicle standards by the European Commission will be necessary to avoid loopholes in this policy).³²

Scenario assumptions for Electric Vehicles

Base	Moderate	Advanced
17% of vehicle sales	31% of vehicle sales	50% of vehicle sales
7% of vehicle stock	13% of vehicle stock	18% of vehicle stock

5.6 Carbon Pricing (ETS and non-ETS)

The EU ETS provides EU wide carbon pricing for large emitters, and is reviewed in detail in Section 4 with further detail on ETS prices in Annex C. In addition, there are national carbon prices in the form of carbon taxes in approximately 12 Member States (depending on the definition adopted for what constitutes a carbon tax)³³. The levels of carbon taxes in place vary by more than an order of magnitude. For example, taxes are less than €5/tonne in Latvia and Estonia but over €50/tCO₂ in Sweden and Finland. The French carbon tax is currently €44.60/tCO₂.

Coverage of carbon tax also varies. The UK tax, which is current £18/ tCO₂, is unusual in that it applies to the power sector only, being intended to add to the EUA price. In contrast the tax in France covers sectors outside the EU ETS.

The largest taxes measured by revenues are in France, Sweden, the UK and Finland. These reflect high prices in Sweden and Finland, and larger volumes in the larger member states, France and the UK. The French tax raises the most revenue of any of the Member State carbon taxes, due to a

³²

<https://www.transportenvironment.org/sites/te/files/publications/Impact%20of%20Cars%20CO2%20limits%20loopholes%20in%20EV%20sales%20and%20CO2%20reduction.pdf>

³³ World Bank State and Trends of Carbon Pricing Report 2018

<https://openknowledge.worldbank.org/bitstream/handle/10986/29687/9781464812927.pdf> Finland, Poland, Sweden, Denmark, Slovenia, Estonia, Latvia, Ireland, UK, France, Spain, Portugal. This list applies a broad definition of a carbon tax.

combination of relatively high price, and moderately wide coverage (at nearly 40% of emissions) in a large Member State.

The clearest example of the effectiveness of a carbon tax in reducing emissions is provided by the UK's carbon price support. UK emissions from coal plant reduced by about 90% between 2012 and 2017. Various factors contributed to this reduction, including the planned closure of some plants and the effects of regulation of other pollutants. Nevertheless, modelling has shown that the increase in the carbon price since 2014 has accounted for three quarters of the total reduction in emissions due to generation from coal achieved by 2016³⁴. Prices under the EU ETS have not so far been high enough to lead to similar changes in the fuel mix in the EU power sector as a whole.

The Netherlands has also announced a carbon floor price, which will commence in 2020. It will start at €18/t rising to €43/tCO₂ in 2030³⁵.

Scenario assumptions for Carbon Pricing (Emissions Trading System price)

Base	Moderate	Advanced
2019: €18.25	Same as Base	2019: €35
2020: €19.35		2020: €40
2021: €19.00		2021: €40
2025: €24.40		2022 onwards: €35
2030: €31.50		

³⁴ <https://www.auroraer.com/insight/carbon-price-thaw-post-freeze-future-gb-carbon-price-2/>

³⁵ <https://www.spglobal.com/platts/en/market-insights/latest-news/coal/101717-new-dutch-coalition-government-plans-co2-floor-price-of-eur18mt-lawmaker>

6 ANNEX B: Model Description

6.1 Introduction

E3ME is a computer-based model of the world's economic and energy systems and the environment. It was originally developed through the European Commission's research framework programmes and is now widely used in Europe and beyond for policy assessment, for forecasting and for research purposes. This model description provides a short summary of the E3ME model. ***For further details, please read the full model manual available online from www.e3me.com.***

Although E3ME can be used for forecasting, the model is more commonly used for evaluating the impacts of an input shock through a scenario-based analysis. The shock may be either a change in policy, a change in economic assumptions or another change to a model variable. The analysis can be either forward looking (ex-ante) or evaluating previous developments in an ex-post manner. Scenarios may be used either to assess policy, or to assess sensitivities to key inputs (e.g. international energy prices).

For ex-ante analysis a baseline forecast up to 2050 is required; E3ME is usually calibrated to match a set of projections that are published by the European Commission and the International Energy Agency but alternative projections may be used. The scenarios represent alternative versions of the future based on a different set of inputs. By comparing the outcomes to the baseline (usually in percentage terms), the effects of the change in inputs can be determined.

6.2 Comparison with CGE models and econometric specification

E3ME is often compared to Computable General Equilibrium (CGE) models. In many ways the modelling approaches are similar; they are used to answer similar questions and use similar inputs and outputs. However, underlying this there are important theoretical differences between the modelling approaches.

In a typical CGE framework, optimal behaviour is assumed, output is determined by supply-side constraints and prices adjust fully so that all the available capacity is used. In E3ME the determination of output comes from a post-Keynesian framework and it is possible to have spare capacity. The model is more demand-driven and it is not assumed that prices always adjust to market clearing levels.

The differences have important practical implications, as they mean that in E3ME regulation and other policy may lead to increases in output if they are able to draw upon spare economic capacity. This is described in more detail in the model manual.

The econometric specification of E3ME gives the model a strong empirical grounding. E3ME uses a system of error correction, allowing short-term dynamic (or transition) outcomes, moving towards a long-term trend. The dynamic specification is important when considering short and medium-term analysis (e.g. up to 2020) and rebound effects, which are included as standard in the model's results.

Key strengths of E3ME

In summary the key strengths of E3ME are:

- The close integration of the economy, energy systems and the environment, with two-way linkages between each component.
- The detailed sectoral disaggregation in the model's classifications, allowing for the analysis of similarly detailed scenarios.
- Its global coverage, while still allowing for analysis at the national level for large economies.
- The econometric approach, which provides a strong empirical basis for the model and means it is not reliant on some of the restrictive assumptions common to CGE models.
- The econometric specification of the model, making it suitable for short and medium-term assessment, as well as longer-term trends

6.3 E3ME basic structure and data

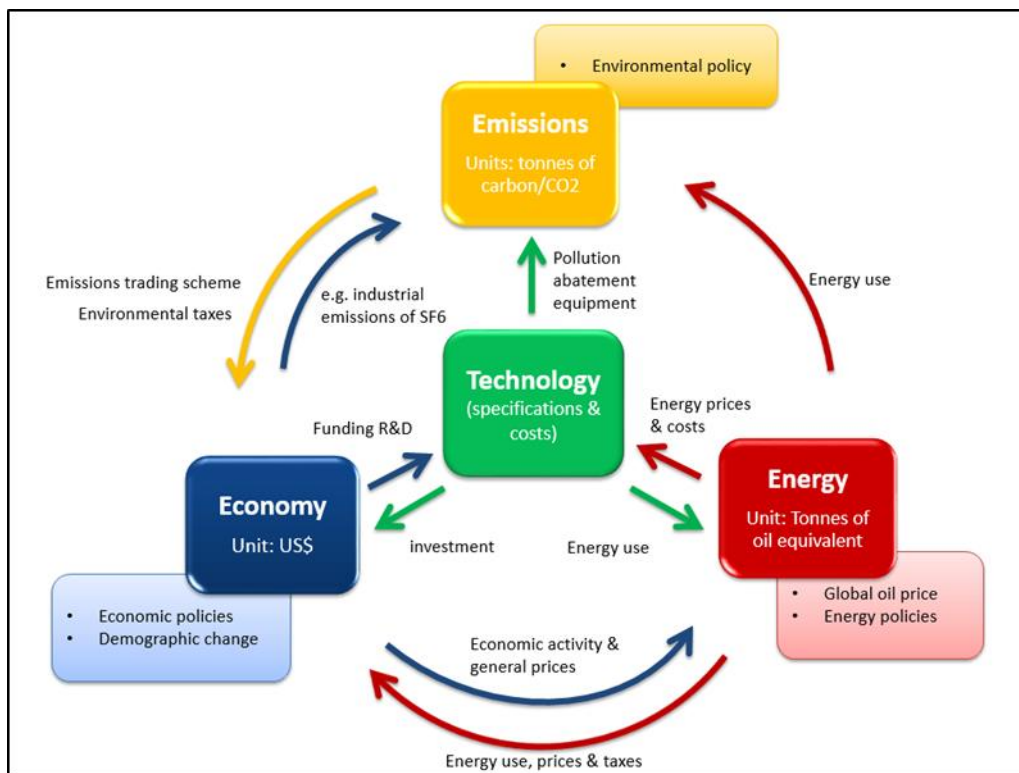
The main dimensions of E3ME are:

- 59 countries – all major world economies, the EU28 and candidate countries plus other countries' economies grouped
- 44 or 70 (Europe) industry sectors, based on standard international classifications
- 28 or 43 (Europe) categories of household expenditure
- 22 different users of 12 different fuel types
- 14 types of air-borne emission (where data are available) including the 6 GHG's monitored under the Kyoto Protocol

6.4 E3ME as an E3 model

The graphic below shows how the three components (modules) of the model - energy, environment and economy - fit together. Each component is shown in its own box. Each data set has been constructed by statistical offices to conform with accounting conventions. Exogenous factors coming from outside the modelling framework are shown on the outside edge of the chart as inputs into each component. For each region's economy the exogenous factors are economic policies (including tax rates, growth in government expenditures, interest rates and exchange rates). For the energy system, the outside factors are the world oil prices and energy policy (including regulation of the energy industries). For the environment component, exogenous factors include policies such as reduction in SO₂ emissions by means of end-of-pipe filters from large combustion plants. The linkages between the components of the model are shown explicitly by the arrows that indicate which values are transmitted between components.

The economy module provides measures of economic activity and general price levels to the energy module; the energy module provides measures of emissions of the main air pollutants to the environment module, which in turn can give measures of damage to health and buildings. The energy module provides detailed price levels for energy carriers distinguished in the economy module and the overall price of energy as well as energy use in the economy.



6.5 The power sector model

The power sector in E3ME is represented using a novel framework for the dynamic selection and diffusion of innovations, initially developed by J.-F. Mercure (Mercure, 2012), called FTT:Power (Future Technology Transformations for the Power sector). This is the first member of the FTT family of technology diffusion models. It uses a decision-making core for investors wanting to build new electrical capacity, facing several options. The model is based on theories of technology diffusion, with rates of diffusion affected by relative market shares and technology prices. The detailed technology representation allows for a range of policy options, including:

- Feed-in-Tariffs
- Investment subsidies for renewables
- Public sector construction
- Forced phase-out of old technologies

Many of the policies are characterised by long lag times due to the lifetimes of the plants that are built. However, the model can show rapid transitions as technologies gain market penetration, reinforced by cost reductions that result from learning rates.

7 ANNEX C: Detailed EU ETS update

7.1 Background

Covering approximately 40% of EU emissions³⁶, the [EU's Emissions Trading System](#) is intended to be a cornerstone carbon pricing policy to support the EU's portfolio of climate and energy policies. Participation is compulsory. It covers carbon dioxide (CO₂) emissions by power generators and other highly emitting industry sectors such as iron and steel, cement, mineral oil and chemicals. Some aviation emissions are also covered as are additional greenhouse gases such as perfluorocarbons (PFCs) from primary aluminium manufacturing and nitrous oxide (N₂O) from chemicals manufacture³⁷. With the notable exception of process emissions in the cement and lime sector (calcination of limestone) and in the iron and steel sector (iron oxide reduction), most of the CO₂ emissions are energy related.

The 'cap and trade' approach sets a maximum allowed quantity of emissions for a specific number of years in the form of a steadily declining annual cap. We are now in Phase 3 of the system which runs from 2013 to 2020. Starting from 2,084 MtCO₂e in 2013 and reaching 1,816 MtCO₂e in 2020, the Phase 3 cap for stationary installations totals 15,603 MtCO₂e across the 8-year period. The cap for 2020 was set to achieve a 21% reduction in stationary emissions compared to 2005. Phase 4 of the system will run from 2021 to 2030 and the cap totals 15,504 MtCO₂e across the 10-year period. It was set to achieve a 43% reduction in stationary emissions by 2030 compared to 2005 as part of the October 2014 EU Council commitment to reduce the overall greenhouse gas emissions of the Union by at least 40% below 1990 levels by 2030.

At the end of each compliance year, emitters must surrender one allowance for each tonne they emit (CO₂e).

Allowances reach the market via auction and via free allocation and may be freely traded amongst all emitting participants as well as with other non-emitting carbon market participants. A Union Registry tracks the allowance holdings of the market participants.

All allowances issued since the start of Phase 2 in 2008 are valid. Allowances may be banked from year to year and from phase to phase but they may not be borrowed from future phases. This means that emissions in the final years of any ETS phase may exceed the target final year cap value if emissions have been lower than the cap in previous years, i.e. if a surplus of unused available allowances has built up from previous years.

Market forces are supposed to find the right carbon trading price to stimulate least-cost emissions abatement by balancing the price to emit a tonne of greenhouse gas to the investment required to abate a tonne. The price is intended to support investment to transition from fossil fuel combustion to renewable energy sources under the Renewable Energy Directive (RED), to prompt investments for higher output per unit of energy consumed under the Energy Efficiency Directive (EED), to promote carbon capture storage and utilisation (CCSU) and to encourage the transition to low carbon industrial materials and processes.

In simple terms, one might consider that if the total amount of emissions remains under the cap then the policy target is achieved. However, the trading price has remained stubbornly below the levels needed to support significant investment in clean low carbon technologies because the system

³⁶ 1,780MtCO₂e stationary plus aviation under ETS (scr EUTL) of 4,468MtCO₂e total excluding LULUCF for 2017 (scr EEA Trends and Projections 2016 fig plus 0.6% growth)

³⁷ N₂O from the production of chemicals and PFCs from the production of primary aluminium

has been plagued by a *huge* build-up of excess allowances. Targeted ETS emissions reductions achieved since the recession period are primarily being delivered by the impact of other EU-wide and national policies, rather than via the ETS carbon price signal.

By definition, the supply of emissions allowances is fixed by the cap. However, demand can vary a great deal and if low demand persists compared to the cap then, inevitably, there will be an accumulation of a significant market surplus. Economy-wide shocks, such as reduced overall activity levels due to recession³⁸ combined with low carbon technology breakthroughs, result in significant drops in demand for emissions allowances. Successful implementations of other emissions abatement policies can also lower demand faster than expected when originally setting the cap. This is exactly what has happened to the EU's ETS.

The paragraphs below describe how the allowance oversupply situation developed, what has been done so far to better balance supply to demand, and show how the oversupply, and measures to contain it, have been reflected in the ETS allowance price over time.

7.2 Surplus build up 2008 to 2017 (impact of Linking Decision and Backloading Decision)

The recent economic recession, together with additional influential abatement policies such as the Large Combustion Plants Directive (LCPD) and the Industrial Emissions Directive (IED), the Energy Efficiency Directive (EED) and the Renewable Energy Directive (RED), resulted in much less demand for ETS allowances than anticipated when determining cap trajectory. At the same time, the cap schedule continued releasing additional volumes of ETS allowances to market thus adding to the ever-increasing surplus. Even amendments to the Auctioning Regulation, agreed early in the current (2013-2017) phase to delay market release of 900 million allowances until the end of the phase³⁹, proved insufficient to balance supply to demand short-term. Also, flaws in the Phase 2 and 3 allowance distribution approaches have left many industrial emitters with high levels of free allocation and relatively little need to engage in the carbon market. Market oversupply was made much worse by the Linking Decision which allows approximately 1.6 billion Kyoto Mechanism CDM and JI offsets into the allowance supply for compliance between 2008 and 2020.

The solid blue line in Chart C1 below illustrates the build-up of 1.54 billion surplus EU ETS allowances to date since 2008. The broken blue line shows what it would have been without the use of offsets. The chart covers both aviation allowance supply and demand and stationary installation supply and demand. It is easy to see that the Backloading Decision⁴⁰ to delay the auctioning of 900 million allowances from 2014 (400 million), 2015 (300 million) and 2016 (200 million) was simply not enough to counteract the inclusion of offsets following the 2004 Linking Decision⁴¹. The Backloading Decision did, however, reduce the surplus to below annual emissions levels⁴².

Chart C1: Development of the 1.54 billion cumulative EU ETS allowance supply demand balance from 2008 to 2017

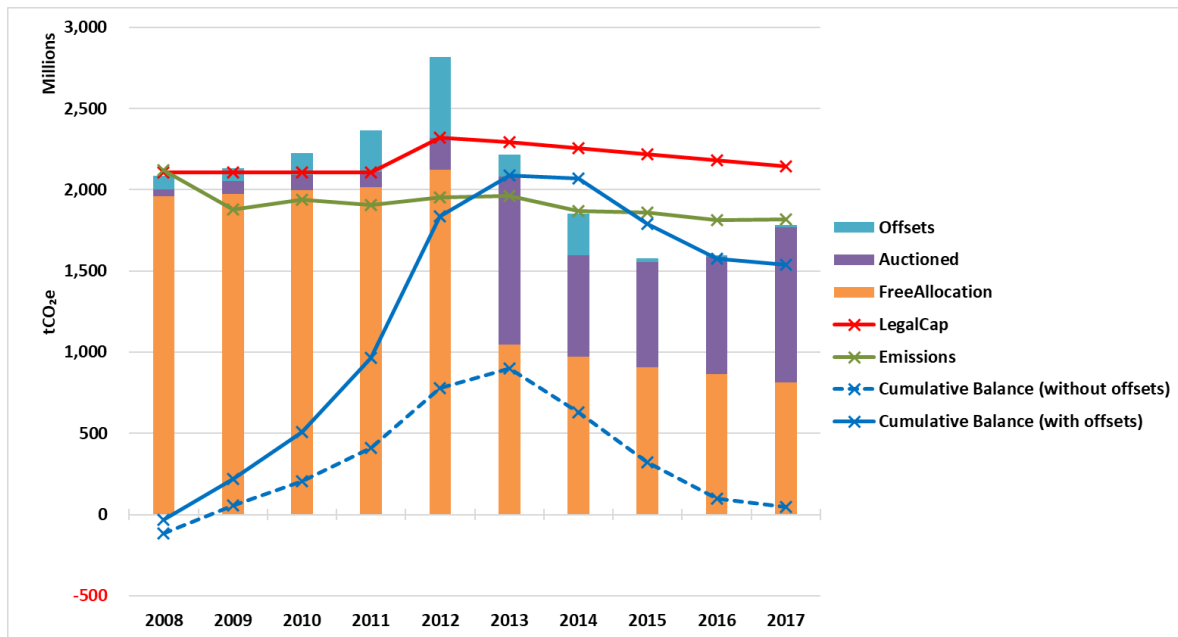
³⁸ A future demand shock as a result of economic crisis is not beyond the bounds of possibility. Several economic commentators are already raising awareness of increasing global financial risks. For example, Nouriel Roubini as reported in [The Guardian 13 Sep 2018](#); IMF [Global Financial Stability Report October 2018: A Decade after the Global Financial Crisis: Are We Safer?](#)

³⁹ Backloading Decision see [here](#)

⁴⁰ Backloading Decision see [here](#)

⁴¹ Approximately 1.49 million of an estimated 1.6 million total offset entitlement has already been used for compliance

⁴² Prior to the MSR Decision, the 900 million allowances delayed under backloading would have been due to return to market in 2019 and 2020



Data scr: EUTL, updated NAPs, DG Clima, EEX, ICE and additional specific Member State auction info

7.3 Net demand for stationary allowances by compliance participants in the aviation sector

EU aviation emissions have been covered under EU ETS since 2012⁴³. Demand for allowances from the aviation sector is slightly higher than the available supply of auctioned and freely allocated aviation allowances and accounts for a further net demand of ~103 million stationary allowances to date (2017).

It should be noted that the cumulative balance of 1.54 billion for 2017 shown in the above section differs from the total number of allowances in circulation (TNAC) reported by the Commission for the purposes of calculating MSR withdrawals⁴⁴. This is because the Commission's definition of TNAC (the number to which the MSR withdrawal % is applied to determine the number of allowances to be diverted from auctioning into the reserve) only considers stationary allowances. It does not take the net demand for stationary allowances by the aviation sector into account.

Aviation is a fast-growing sector and Sandbag estimates there could be an ~663 million additional demand from 2018 to 2030 if this sector remains under the ETS.

Ongoing inclusion of EU aviation emissions under the ETS will depend on the International Civil Aviation Organization's (ICAO) operationalisation of its Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

7.4 Market Stability Reserve (MSR)

A second attempt to correct the EU ETS supply demand balance problem was agreed in 2015 in the form of the Market Stability Reserve (MSR)⁴⁵. The MSR Decision established lower and upper

⁴³ See Commission website [here](#) for further details about what has been included and when

⁴⁴ Commission TNAC figure is 1.65 billion; see [here](#)

⁴⁵ See [here](#)

thresholds of desired allowance market circulation. A lower threshold of 400 million allowances is considered the minimum number of allowances needed in circulation for appropriate market liquidity. Market balances above the upper threshold of 833 million is considered to require action to reduce annual supply by temporarily diverting a proportion of the allowances due to be released under the planned auction schedule into the MSR. It was also agreed to divert the 900 million backloaded allowances directly into the reserve. However, even this market intervention was not enough to revitalise ETS carbon pricing. After a brief, slight rally during 2015, prices dropped back down to the doldrums at the start of 2016 and further carbon pricing policy interventions became inevitable. Reforms for Phase 4 of the EU ETS (2021-2030) which included changes to the operation of the MSR, were agreed at the end of last year.

7.5 Main EU ETS changes for Phase 4 (2021-2030)

The ETS Reforms for Phase 4 influence both the supply of allowances and the distribution of the allowances. The main details are summarised below and include a slight tightening of the cap to the current Phase 4 total of 15,504 MtCO₂e.

Supply:

- The rate at which the cap is reduced from year to year has been increased slightly by changing the Linear Reduction Factor (LRF) from 1.74% to 2.2% (of scope adjusted 2010 emissions).
- The rate at which allowances are sucked into the MSR will be doubled for the first 5 years of its operation.
- From 2023 onwards, it is planned to cancel allowances held in the MSR above the total number of allowances auctioned during the previous year (unless otherwise decided at the first review of the MSR which is due within 3 years after its start).
- Member States may now cancel part of their auction share in the event of electricity generation closures as a result of national measures.
- Some unused allowances from Phase 3 will be diverted from the Market Stability Reserve to the Phase 4 New Entrants Reserve and to the Innovation Fund. Allowances from the Phase 4 free allocation share and auction share will also be diverted to the Innovation Fund.

Distribution:

- The criteria for qualifying for carbon leakage protection have been updated. Detailed data collected for 2016 to 2018 will be used to establish which sectors meet these criteria. This is expected to result in far fewer industry sectors qualifying to receive 100% of benchmarked free allocation across the phase.
- Instead of completely phasing out free allocation to sectors not assessed as at risk from carbon leakage by 2027, non-carbon leakage exposed participants will continue to receive 30% of benchmarked free allocation until 2026. Such free allocation will then be phased out by equal amounts to reach zero in 2030.
- The existing benchmarks for calculating levels of free allocation to eligible industry sectors (established in 2011) will be adjusted downwards by a maximum of 15x1.6% for the 2021 to 2025 period and 20x1.6% for the 2026 to 2030 period and a minimum of 15x0.2% and 20x0.2%. Detailed emissions and production data will be collected from installations for 2016 and 2017 to establish what reductions to apply per sector within the 1.6 to 0.2% range for 2021 to 2025. Data will be collected for 2021 and 2022 to establish the reductions for 2026 to 2030. The hot metal benchmark will receive the minimum benchmark reduction for

the 2021 to 2025 period. There are a number of exceptions to the general NACE level 4 sector classifications.

- Existing cessation, partial cessation and significant capacity expansion rules have been changed to allow for more dynamic allocation related to reported actual production levels (based on 2 year rolling averages). Allowances level changes will be sourced from or returned to the New Entrant Reserve.
- Up to 3% of the auction share may be diverted to free allocation in order to prevent, or at least delay, the application of a cross-sectoral correction factor (CSCF) 'haircut' in the event of benchmarked free allocation applications exceeding the maximum number of allowances available for free allocation. If the whole 3% is not required, then 50 million allowances will be added to the Innovation Fund and the Modernisation Fund may also be increased by up to 0.5% of the total cap.

Funds:

- Specific funds from auction revenues will be established to support modernisation (available only to specific qualifying Member States) and innovation (available to all Member States).
- Solidarity support and Article 10c derogations will continue but with additional controls (specific qualifying Member States).
- New flexibilities have been introduced to allow transfers between the various auction pots (standard treasury revenues, solidarity revenues and modernisation funds).
- Limited additional Article 10c derogations are available if accompanied by other auction transfers.

7.6 Past, current and anticipated ETS price signals

As can be seen in Chart C2 below, as the system became increasingly bogged down in surplus supply from 2008 onwards, the ETS allowance price remained persistently low. There was a slight rally as a result of the Backloading Decision which limited auctioning in 2014, 2015 and 2016 and after the original MSR Decision of 2015, but this proved short-lived.

The market has recently responded to the ETS Reform and MSR changes with a significant price rally, but prices are still significantly lower than anticipated at the system's introduction.

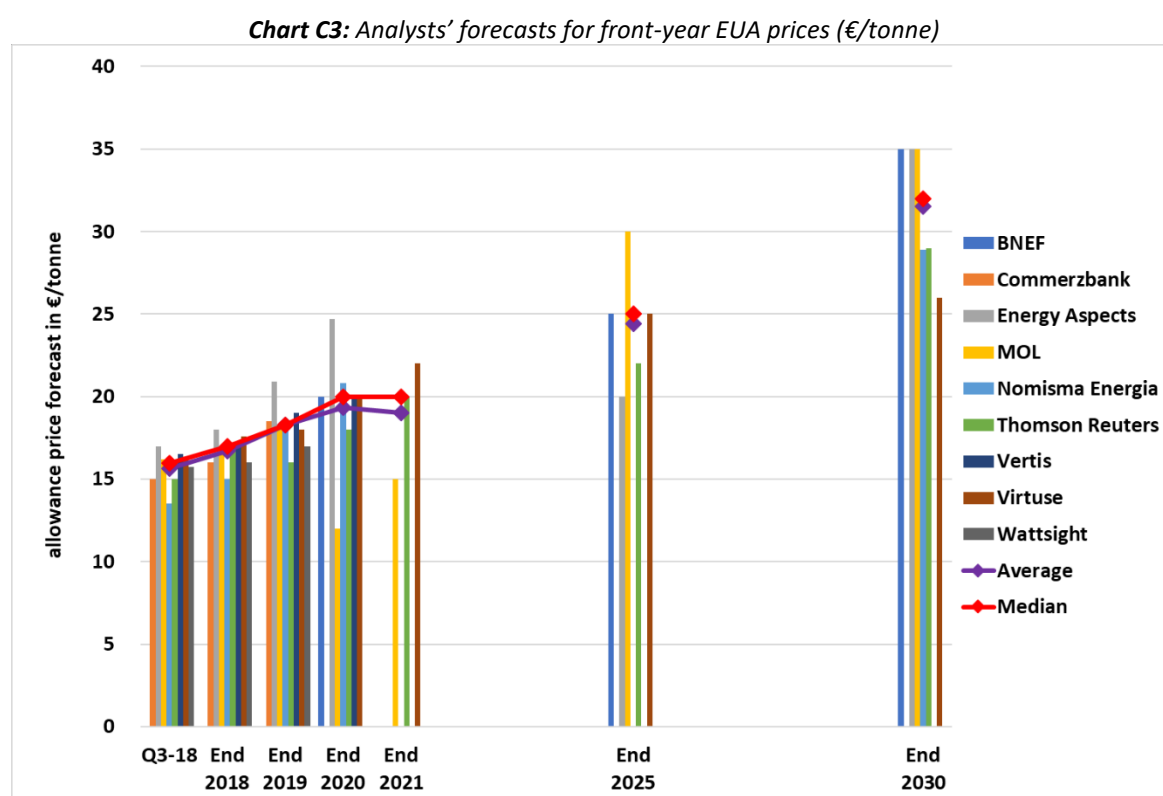
Chart C2: EU ETS allowance prices from 07 Apr 2008 to 21 Feb 2019



Data Source: Closing ECX EUA Futures prices, Continuous Contract #1. Non-adjusted price based on spot-month continuous contract calculations. Raw data from ICE via Quandl. As seen in the [Sandbag carbon price viewer](#).

Chart C3 below illustrates a range of carbon market analysts' on-going price projections in July 2018. Given the 1.54 billion surplus at the end of 2017 (equivalent to almost 90% of stationary emissions), it is fair to ask what is driving these long-term prices.

There appears to be little doubt that ETS carbon pricing is entering a new stage but can the ETS price signal really remain high enough to drive investment for deep decarbonisation? There is some future tightening of allowance *supply* as a result of the Phase 4 Reform⁴⁶, but Sandbag cautions that the system, and hence price discovery by the market, may still not be responding appropriately to potential future significant *demand* changes.



Source: CarbonPulse POLL July 5, 2018 (BNEF's forecasts are average price views for those years; Energy Aspects' Phase 3 forecasts are mostly taken from averaging those of the adjacent two quarters)

To share insights on recent market behaviours (compliance participants and well as pure financial participants), Sandbag consulted carbon risk management and procurement firm, Redshaw Advisors. Their experiences with ETS compliance participants suggest that many industrial emitters have been lulled into a false sense of security by the persistence of the market oversupply to date and some are now starting to wake up to their carbon price exposure. The realisation that the MSR changes represent a major structural change in the market has driven recent increased activity by a variety of participants.

Due to their large exposure to the ETS price, power generators have always followed hedging strategies for their carbon needs. This involves buying a significant proportion of future compliance requirements in advance and holding them to lock in the price. Redshaw noted that some highly exposed emitters have started to buy a higher percentage of their compliance requirements for future years. This has been coupled with increased speculator interest. A Financial Times' opinion piece in April 2018, 'EU carbon allowance market to shake its over-supply problem', was very

⁴⁶ For example, it is estimated that during 2019 (the first withdrawal year), the MSR will divert about 390 million allowances from auctioning to the reserve - an amount equivalent to ~22% of 2017 stationary emissions.

influential in attracting new speculators to the EU's ETS carbon market. In addition, as annual free allocation drops relative to annual compliance requirement levels for more industrial emitters, those with higher compliance costs are becoming more active market participants. Increasing price volatility has probably sparked their interest too.

The price is not just determined by how many allowances are out in the market - it matters where the allowances are held. The above market behaviour changes, together with the near-term annual supply tightening resulting from the MSR have all combined to decrease the availability of the allowances in circulation. Industrial emitters with spare free allowances accumulated since 2008 are increasingly likely to hang on to allowances to cover future compliance. They are considered less likely than financial participants to take the lost opportunity cost of a positive trade into account, so these allowances do not become available to other market participants.

Redshaw Advisors also stress that if gas supply becomes tight, there is risk that speculators could stimulate an upwards carbon price spiral. Higher carbon prices encourage fuel switching to gas. This tightens gas supply which in turn makes coal supply more attractive. More coal means more demand for allowances and hence higher carbon prices which in turn may encourage further speculation.

Under an unambitious straight-line projection from 2017 emissions to a 43% reduction compared to 2005 by 2030, Sandbag anticipates that the cumulative market balance will still be about 1.2 billion in 2019 even after the MSR has absorbed its ~390 million. Redshaw estimates that utilities hold ~500 million allowances, industrials ~300 million and that there is ~200 million speculative length. Together, this already accounts for 1 billion of the market circulations. If utilities and industrials increase their hedge position by 25% (800×1.25), then all the available allowances will be accounted for so further price rises could follow – even with a 1.2 billion surplus.

7.7 Main Sandbag supply demand model settings

- 2005 base value 2.338 billion
- Cumulative supply demand balance for 2017 reset to Commission 2017 TNAC figure
- Net demand for stationary allowances by the aviation sector is excluded from the calculations unless otherwise stated (this is to be consistent with the Commission TNAC calculation approach)
- UK assumed to remain in the EU ETS post-Brexit
- 57% auction share 2021-2025, reduced to 52% auction share 2026-2030 to avoid a uniform haircut to the stationary free allocations (cross-sectoral correction factor)
- 65.5 million added to Modernisation Fund across 2026-2030 as a result of less than total 3% derogation from auctioning to free allocations across Phase 4
- 42.2 million added to Innovation Fund in 2026 as a result of less than total 3% derogation from auctioning to free allocations across Phase 4
- Main portion of Modernisation Fund split evenly across the timeline
- Main portion of Innovation Fund split 50:50 in 2021 and 2022
- Net zero change in the New Entrants Reserve from production level changes (i.e. amount returned to NER due installation activity reductions matches amount released from the NER due to installation activity increases)
- Only 50% of total available NER comes to market ore Phase 4 (0% in 2021 ramping up to 10% in 2030)
- No voluntary Member State auction cancellations
- Sandbag projections for rest of Phase 3 Art10c derogation, NER & offset use

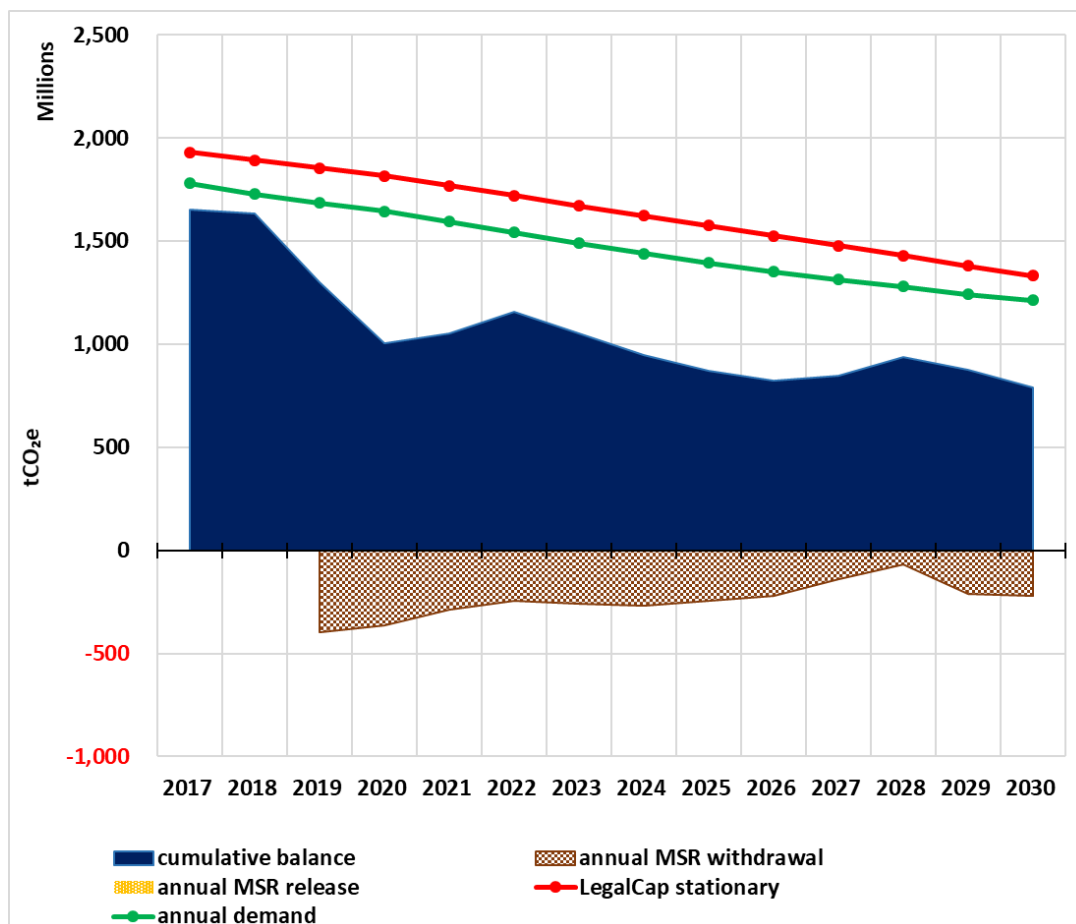
- All unused Phase 3 Art10c derogation carried over to Phase 4 except for 55.8 million allowances for Poland auctioned in 2019
- 40% Art10c derogation from Art10(2)(a) auctioning for all qualifying Member States (except for Poland where slightly less as have more to carry over from Phase 3) and no further transfers from Art10(2)(b) to Art10c or Art10d.

7.8 Modelling further reforms to the MSR rules

Just lowering the MSR thresholds will have no effect market balances during Phase 4 because, under a 51.7% emissions reduction projection achieved for the Base Case policy scenario, the balance never gets even close to the current upper threshold of 833 million.

Just maintaining the doubled withdrawal rate throughout the whole phase is also not enough to hold a steady supply demand balance between the current upper and lower MSR thresholds throughout the phase. Without the impact of aviation demand, the surplus remains stubbornly above 1 billion until 2027, only dropping to 956 million by 2030. As can be seen in Chart C4 below, even if we include demand for stationary allowances from the aviation sector, the balance swings up to almost a billion in 2028 before declining again to arrive, at last, within the current thresholds by 2030.

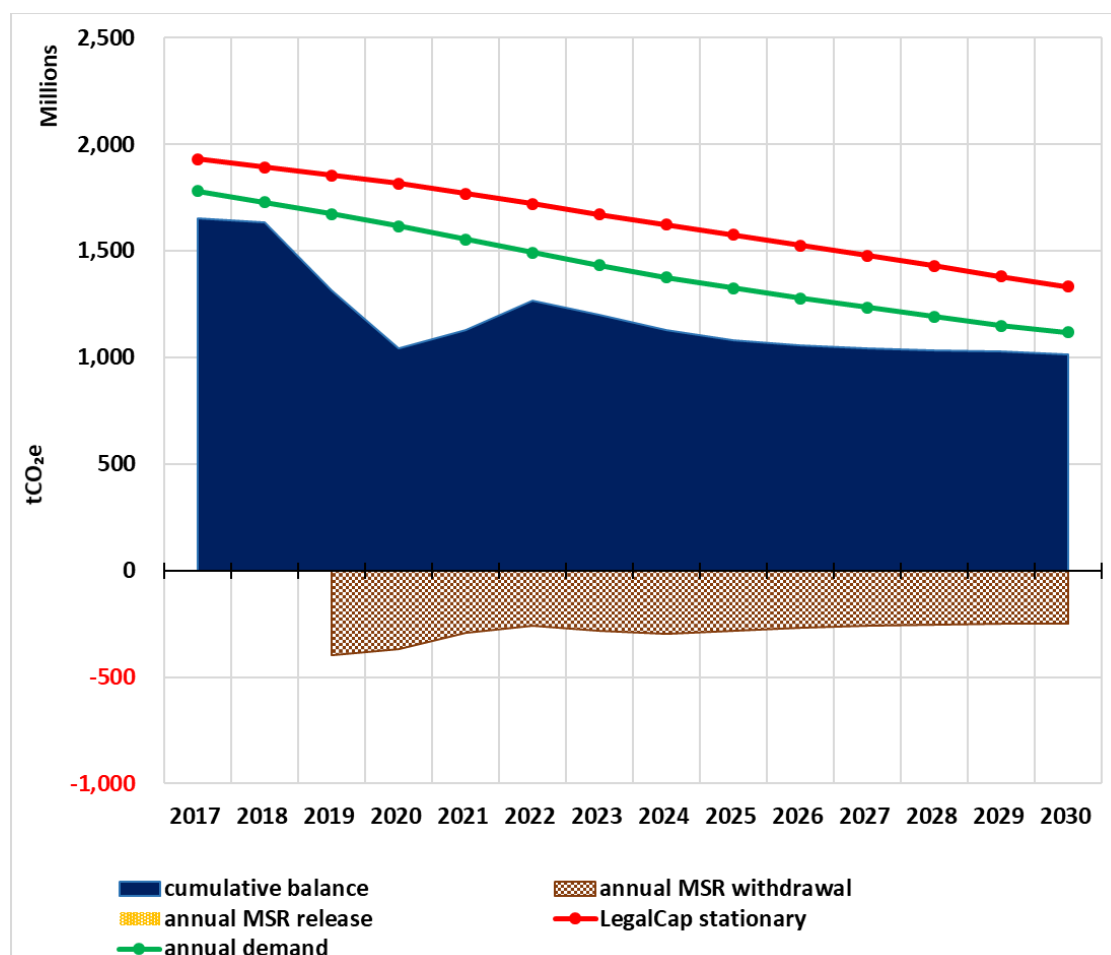
Chart C4: Even including aviation demand, with doubled MSR withdrawal across the whole phase, the surplus reaches 936 million in 2027 before dropping to 792 million in 2030 under the Base Case policy scenario



If we were to double the withdrawal rate throughout the whole phase **and** lower the thresholds, the MSR would still barely cope with the allowance demand reductions under the Base Case scenario (even with aviation demand) and certainly not cope with the faster demand reduction under the further two scenarios with moderate additional policies and with additional policies.

Chart C5 below illustrates what would happen under the Moderate scenario (55.8% ETS emissions reduction compared to 2005) with MSR withdrawal rates doubled throughout the whole phase and with lower thresholds. The thresholds were set to recalculate to an upper threshold of between 45% and 50% of the rolling average of the previous three years' emissions and with the ratio between the upper and lower threshold level maintained at 833:400. The thresholds reduce predictably, in line with emissions. For this 55.8% emissions reduction projection the upper threshold reduces in 2022 (to 712 million), again in 2025 (to 625 million) and again in 2028 (to 549 million). The market remains above 1 billion throughout the phase - even if fast growing net demand from aviation is included.

Chart C5: Even including aviation demand, and with doubled MSR withdrawal across the whole phase and MSR thresholds reducing in line with emissions, the surplus remains above 1 billion under the Moderate scenario



About this report

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The logo for Sandbag, featuring the word "sandbag" in a bold, lowercase, blue sans-serif font.



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