CARBON MARKET ANALYST

Animal Spirits versus the Big Picture: Why the outlook for the carbon price is still bullish

TO THE POINT

The short-term carbon price development is beholden to market sentiment. The price crash of early 2016 exemplifies the impact that sentiment can have on the carbon price outlook. As long as the market remains oversupplied, it is vulnerable to such mood swings. We expect the shaken confidence to result in a slow price recovery from current lows, leading to an average price of €6.6/t in 2016, some €1.1/t lower than the previous year.

We expect the carbon price to rise steadily to €10/t in 2020 and €26/t in 2030 in real 2015 euros. Our latest Base Case forecast of the market supply-demand balance shows that the market will likely become progressively tighter over time, which will likely guide the price higher.

The carbon price remains sensitive to external factors, such as complementary climate policies and macroeconomic variations, despite the Market Stability Reserve (MSR). This is mainly a result of the MSR's relatively low annual withdrawal rate of 12 percent which can only buffer a fraction of any variations in future emissions.

The majority of our price scenarios show an upward trajectory. To provide a comprehensive overview of possible carbon price developments, we have calculated 15 scenarios in addition to our Base Case by changing underlying assumptions. We find that, while complementary climate policies present significant downside risks to the carbon price, potential increases in EU's emission reduction targets can push the carbon price significantly higher. The greatest downside risk in the short term is posed by the possibility of low utility hedging demand.

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Base Case carbon price forecast

Price outlook	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
EUA price (nominal)	6.6	7.3	8.5	9	10	12	14	16	17	19	20	21	24	28	33
EUA price (real '15 euros)	6.5	7.1	8.1	9	10	11	12	14	15	16	17	18	19	22	26

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EU Carbon price outlook

Introduction

Last year, it appeared as if the carbon market was headed onto smoother waters after the EU agreed on the Market Stability Reserve (MSR) on 5 May 2015. In combination with the backloading, the MSR was – and still is – projected to bring the market into a position of relative balance between supply and demand. With the MSR deal in place, market volatility declined and the price trickled gradually higher throughout 2015 as a result of greater regulatory certainty. But the start of 2016 showed a drastically different picture. The price plunged and market volatility shot back up to where it was for the first half of 2015.

One message from January's price crash is that traders' confidence in the EU ETS is still delicate. Political agreements on market reforms help increase confidence in a more robust regulatory framework, but they cannot stabilize the market until there is a balance between supply and demand. As the market remains heavily oversupplied, it continues to be beholden to swings in sentiment – the market's animal spirits – often influenced by the wider energy complex or speculative trading activity.

In this context, we launch our latest EUA price forecast and sensitivity analysis. We provide our new base case outlook for carbon prices up to 2030 and a number of alternative scenarios. Our forecast is based on a new version of our econometric model, which we have updated to reflect the market participant behavior we saw in 2015.

We also provide a number of scenarios around our base case that describe the upside and downside risks posed by various price driving factors. Our sensitivity analysis reflects the fact that many of the risks facing the carbon price are external to the EU ETS. This is why we examine the importance of fuel price changes and policies for phasing out coal, enhancing energy efficiency and deploying renewable technologies, as well as GDP developments.

Uncertainty about the future also stems from dynamics that are specific to the EU ETS. Therefore, we examine the impact of assumptions about power hedging behavior. Finally, our report includes analysis of key policy-related uncertainties, such as the future of the aviation sector within the EU ETS, which is a source of net demand for allowances. We also explore the impact of potential changes to the EU ETS cap in the wake of the Paris Agreement.

The recent price plunge shows quite plainly that the European carbon price remains very fragile and unpredictable in the short-term. Even though our models reflect the long-term development of the carbon price taking into account the respective market situation, they are not capable of predicting short-term price swings. Our models capture market sentiment to a certain extent by making assumptions on market participant planning and investment horizons, fuel price developments etc., but they do not capture the market psychology component that is behind the recent bear-market. We want you to keep that in mind when looking at our long-term forecast.

To take into account the uncertainty inherent in forecasting future events, we have recently introduced specific probability categories in our assessment of future developments (see Annex 1).

> “Until there is a balance between supply and demand, the EU carbon price remains very vulnerable to sentiment swings

Looking back on 2015 – basis for calibrating the model

We look back on 2015 to calibrate our price forecasting model. Last year provided the first test case for how the carbon market reacts to a tightening in the supply and demand balance. It was the first year in the market's history to see, on an annual basis, a significantly greater amount of demand than supply. This resulted in a shortfall of 262 Mt between emissions and annual supply and a net demand of 394 Mt in the perceived market balance, which takes into account hedging and trader foresight (see Figures in Results section). The shortfall was largely a result of the backloading decision, which reduced 2015's auctioning supply by 300 Mt compared to what it would have been otherwise.

As we had expected, the market's tightening pushed the carbon price higher. The front year carbon price averaged €7.7/t over 2015, up €1.7/t on 2014's average price of €6/t. Yet the price rise was more tepid than we had anticipated and the price undershot the forecast we made a year ago in January when we predicted that the carbon price would average €8.5/t. We indentify three reasons: the poor market confidence during the MSR discussions, the Greek debt crisis, and the market's relative insensitivity to annual fundamentals.

Against our expectations, the carbon price consolidated over the first four months of 2015, averaging around the €7/t level where it stood at the end of 2014. The political discussions over the MSR caused uncertainty about the future of the market, which very likely dampened risk appetite in the market. The tide turned when in May the price rose to an average of €7.5/t, as lawmakers struck an agreement on the MSR, injecting the market with a fresh dose of confidence. Quarterly hedging demand also rose in the second quarter, lending further support. However, the unforeseen deterioration of the Greek debt crisis put a brake on the upward momentum of the carbon price in the May-June period.

The July signing of Greece's third bailout restored market confidence and the carbon price continued to rise on the back of healthy utility demand against the backdrop of low annual supply. Supportive of the price was the fact that both the power and industry sectors were short of allowances last year. The market's annual shortage led industrial market participants to use up some of their accumulated reserves of allowances with the overall market surplus declining from 1,938 Mt in 2014 to 1,676 Mt. Their gradual depletion likely led industrials to ask for progressively higher carbon prices to meet utilities' buying needs, resulting in the gradual rise in the carbon price. Yet the price increase in the second half of 2015 was slower than expected, which leads us to believe that industrials were more willing to offload allowances than we had anticipated. We have calibrated our model accordingly.

Model calibrations

Our carbon price model uses our estimate of the perceived market supply-demand balance to explain changes in the carbon price. The perceived market balance simulates the way market participants see the market balance as it includes utility hedging and assumptions about how forward-looking industrial participants are (see Annex 2 for more details).

Based on the developments we observed in 2015, and on historical data going as far back as 2005, we find that the relationship between the perceived market balance and the carbon price is non-linear – meaning that changes in the market balance influence the price more strongly when the price is high (and the market balance is tight) than when the price is low (and the market is highly oversupplied). Such asymmetry explains why industrials are willing to supply allowances to the market even at relatively low prices. We have updated our model to take into account this non-linearity, which leads us to update our base case price forecast.

Base case – main assumptions

Our key assumptions for the EU's overall policy framework until 2030 as well as assumptions for economic growth, industry performance and strategy are outlined below.

Steady economic growth

Our latest assumptions are for a GDP growth of 1.9 percent on average for the period 2016-2020, after which growth is expected to slow down, based on Oxford Economics' GDP forecast. Our latest analysis of power demand trends leads us to use a power demand growth of 0.8 percent for the next five years, after which growth is assumed to slow down to 0.4 percent in 2021-2025. For fuel prices, we use forward curves for the next three years in combination with the World Bank's Commodity Markets Outlook from January 2016.

Table 1: Economic growth assumptions for the base case

% growth / year	2016-2020	2021-2025	2026-2030
GDP, Base Case (Oxford Economics)	1.9	1.7	1.5
Power demand, Base Case	0.8	0.4	0.3
Industrial production, Base Case	0.5	0.4	0.2

In the industry sector, we expect tepid emissions-weighted growth in production of 0.5 percent in the next five years, as we expect overcapacity and international competition to continuously depress growth in the steel and refining sectors and for growth to continue to be strongest in the "other" sector, which consists of less carbon intensive industries. We run scenario forecasts with low and high growth rates to demonstrate the impact that alternative growth rates will have on the carbon price (see Scenario section below).

Slowly improving industry energy efficiency

We assume CO2 intensity in the industry sector to decline by 0.7 percent per year on average until 2020 and 1 percent per year thereafter, based on our in-house research, which takes into account recent trends, research on energy efficiency potential, and an assumption that the revision of the Energy Efficiency Directive will bring relatively low uptake of energy efficient technologies among industries. The Commission's energy efficiency communication of 2014 does not include specific measures for overcoming the energy efficiency barriers endemic to the industry sector. These intensity improvements exclude the abatement effects of the EU ETS, which will cause an additional CO2 intensity decline. All in all, we forecast that EU ETS emissions will decline 0.4 percent per year on average in the next four years and by 2 percent per year on average in 2021-2030.

Industry time horizon – how far away is the future?

In our base case we assume that industrial market participants are looking at the carbon market balance several years into the future when making buy or sell decisions. Previously we assumed that industrial planning horizons will increase from three years in 2015 to four years in 2016 and to five years in 2017 and beyond. We assumed such an increase to reflect the greater regulatory certainty provided by the MSR decision. With this price update, we change our assumptions slightly to account for the continued uncertainty that industrial companies face in the carbon market, given recent price volatility as well as persistent overcapacity concerns in many industry sectors. We now assume that the industrial forward-looking horizon remains equal to three years, unchanged from what we believe it used to be throughout the history of the carbon market. This assumption reflects findings from our market survey as well as growing evidence that some industrial sectors are impacted by the heat of falling commodity and product prices. This is an assumption that can change swiftly given the unresolved carbon leakage and benchmarking debate in light of the ETS phase 4 review.

EU 2030 ambition – what you see is what you get?

We have made only a few changes to our base case policy assumptions compared to our previous price forecast. In our model we assume the 2030 climate and policy framework to remain unchanged, with the 40-27-27 percent targets in place until 2030. These foresee an EU-wide 40 percent emission reduction (from 1990 levels), a 27 percent renewable energy share on final energy consumption and a 27 percent energy efficiency improvement compared to a business-as-usual pathway. The 2030 climate and energy framework is a delicately balanced political compromise, and we currently consider it somewhat unlikely (see Annex 1 for a description of our probability categories) that European leaders will manage to reach consensus to raise the overall framework's ambition for the 2030 timeframe. However, we note that recent debates have increased the likelihood of changing the energy efficiency target to 30 percent for 2030.

Should the ambition level of the emission reduction target be increased following the Paris Agreement's requirement to revise contributions in five year cycles, any additional effort will very likely be met by entitlements for international credits for EU governments and the ETS sectors. We have explored several scenarios to estimate the price effect of raising the 2030 EU climate ambition, beyond the current framework (see the scenario section below).

> "The ETS directive review will be finalized towards the end of 2017 at the earliest

We expect the ongoing revision of the EU ETS directive and the upcoming discussion on the Effort Sharing decision to run in parallel, and both legislative acts to be adopted by the Council and the European Parliament towards the end of 2017 at the earliest. Both acts will implement the October 2014 European Council conclusions, in essence making sure that ETS and non-ETS sectors contribute their agreed shares towards the EU-wide 40 percent emissions reduction target. Overall, we do not expect the ETS revision to have a significant effect on EUA price levels, as the supply side of the market until 2030 is to a large extent already defined by the 2.2 percent linear cap reduction factor agreed by European leaders in October 2014 and the decision on the MSR. In our base case we further assume that the EU ETS will not link to other trading schemes until 2030, except for the Swiss ETS. However, we think the EU will continue to have bilateral dialogues with several countries to prepare for future linking.

The same logic applies to the Effort Sharing decision. Although we think it will require a high political effort to broker a deal on this piece of legislation, we see a limited impact of the final deal on EUA prices. The only direct interplay between the ETS and non-ETS sectors is the option mentioned in the 2014 Council conclusions allowing richer member states a limited, one-off cancellation of EUAs, likely by reducing auction volumes to help meet non-ETS targets. We have not made any assumption yet on the quantity of this transfer of allowances as the size of this measure remains very unclear for the moment. We expect more clarity once the effort-sharing proposal is put forward before summer 2016.

Is the MSR decision set in stone?

In our base case we assume the MSR to start operating in 2019 and that there to be no changes to the mechanism until 2030. The fact that Poland has brought the MSR decision to the European Court of Justice, contesting among other matters the legality of an early start date in 2019 rather than 2021, has increased uncertainty regarding the mechanism. The court case will quite likely be pending for the next few years. However, we consider it very unlikely that Poland will win the court case.

A review of the MSR is foreseen three years after its start of operation, in 2021, with particular attention to be paid to the numbers determining the MSR operation. These include the withdrawal rate of currently 12 percent of the total number of allowances in circulation (TNAC), the upper and lower thresholds (833 Mt and 400 Mt) and the number of allowances to be released from the reserve (100 Mt). If deemed necessary, the Commission will submit a proposal to the co-legislators to change the MSR parameters and the mechanism's general set-up. Although this is a legislative opportunity to bring contested issues of the MSR debate to the table again, we assume in our base case that the review process will not result in the MSR being significantly altered. As the phase 4 review opens for changes to all elements of the ETS directive, the MSR parameters could in theory be revised before it starts operating. However, we do not see any political appetite to revise the MSR during the ongoing phase 4 review.

An uncertainty surrounding the MSR is in our view stems from the surrendering of EUAs by the aviation sector. The MSR decision foresees that the TNAC will be calculated based on verified emissions from stationary installations only, therefore indirectly excluding airline operators from this calculation. The current legal wording implies that the number of EUAs that will be surrendered by airlines will not be included in the TNAC calculation. According to our calculation, the aviation sector will demand approximately 135 million EUAs until 2020. Hence the real market balance will be 135 million tons shorter than the calculated TNAC.

Aviation - stopping the clock forever?

Since 2012, airline operators have been included in the EU ETS, which was initially intended to cover all flights from and to European airports. However, after hefty protests from countries like China, the US and others, the EU implemented a "stop-the-clock" provision ensuring that only emissions from flights within the European Economic Area (EEA) fall under the EU ETS, pending a decision in by the International Civil Aviation Organization (ICAO) on a global market measure (MBM) for the aviation sector. ICAO has identified three main types of MBM's: levies, emission trading and offsetting.

ICAO and the international maritime organisation (IMO) have come under increasing pressure to address emissions, as neither the aviation nor the shipping sectors are covered by the Paris Agreement. We consider it quite likely that ICAO will adopt a general agreement on an MBM in September 2016 as the main instrument to meet its goal of "carbon-neutral growth" from 2020. Based on that agreement we expect a system for offsetting emissions from international flights to be outlined and further developed in the years to come. We assume an aviation scheme will become operational by 2020. Such system would very likely allow for the use of different classes of internationally verified credits, such as from the CDM, from REDD and from any credits generated by the new sustainable development mechanism to be developed under the Paris Agreement.

We think that a decision by ICAO to have a global MBM in place from 2020 will suffice for the EU to prolong the stop-the-clock exemption for international flights beyond 31 December 2016, de facto indefinitely. We assume that the ICAO outcome will result in keeping intra-EU flights in the EU ETS until 2020, before these come under the purview of ICAO's scheme.

The wider EU landscape – (Br)exiting times ahead

A Europe in "polycrisis" was the term used by Commission President Juncker in his 19 January address to the European Parliament, with reference to a host of difficult issues facing the European Union – most notably the refugee crisis, the Greek debt crisis, the threat of terrorism, the difficult political situation in Poland and a possible Brexit.

The British referendum on whether to stay a member of the European Union has been referred to as the single biggest "known unknown" for the European economy and the Union project as such. Prime Minister Cameron has renegotiated the UK's relations with the EU and plans to hold a referendum on 23 June 2016 to decide on the UK's future within the Union. Should the UK, Europe's second largest economy, decide to exit the Union, it would obviously have wide political and economical implications, for both partners.

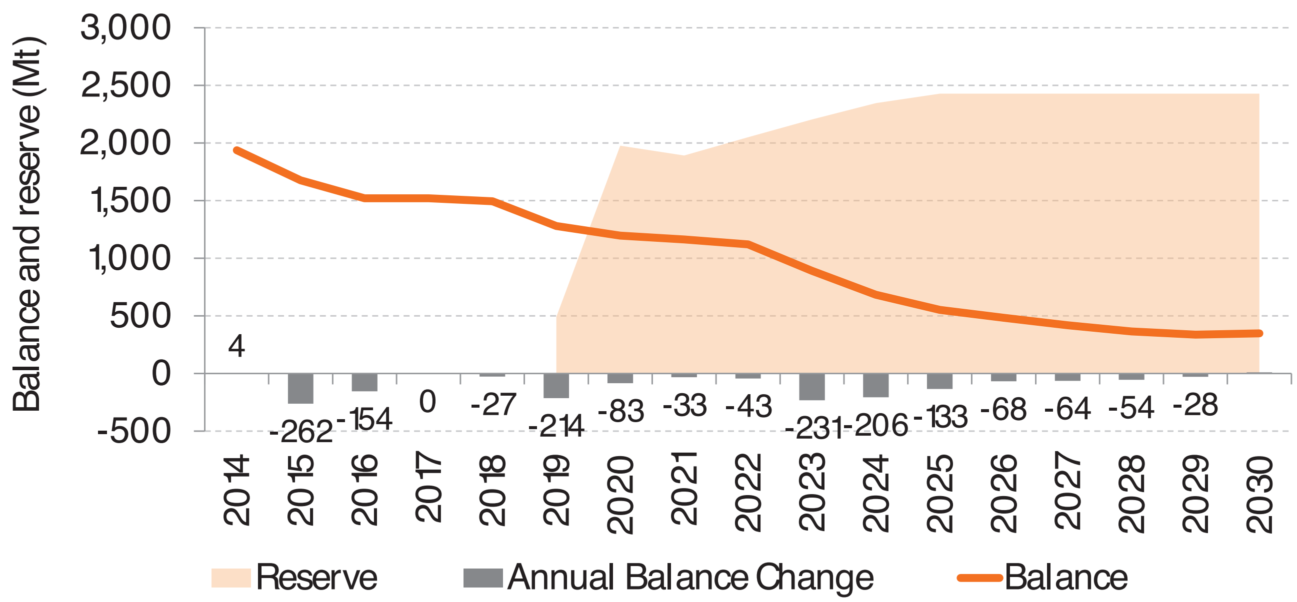
A UK exit from the EU would probably imply a full renegotiation of the relationship between the UK and the EU. It would quite likely mean that the UK will no longer be part of the Union's 2030 climate and energy framework. A Brexit would not necessarily impact the EU ETS to a large extent, as the UK would very likely continue to be a climate frontrunner in Europe, possibly with an ETS of its own that could be linked to the EU ETS. Another possibility would be the inclusion of the UK in the EEA, giving the UK the same status as that of Norway, Iceland and Liechtenstein.

Despite polls indicating a neck-and-neck outcome for the moment, for the sake of our price forecast we assume that the UK will continue to be part of the European Union in line with the renegotiation package agreed. As regards to climate and energy policies, we expect the UK to remain fully bound by the 2030 climate and energy framework and by the legislation to implement it; the revised Effort Sharing decision and EU ETS.

Results - Oversupply on the decline

Given the assumptions stated above, we expect the market oversupply to continue the decline started in 2015 (Figure 1). This year, we forecast the surplus to drop to 1.5 Gt, an annual tightening of the supply-and-demand balance of 154 Mt. This is largely driven by the last tranche of the backloading, which keeps this year's auctioning supply 200 Mt lower than it would have otherwise been. In the 2017-2018 period, we see a relatively stable market balance as we forecast emissions to decline roughly in line with the declining amount of allowances being supplied to the market. Beyond 2019, we project the supply reduction resulting from the MSR to outpace the likely decline of emissions, resulting in a gradual depletion of the market surplus.

Figure 1: Market supply and demand balance forecast, Base Case



Note that the market balance above is not the basis for the operation of the MSR (the so called Total Number of Allowances in Circulation –TNAC). This is because the market balance shown includes the amount of EUA demand from the aviation sector, whereas the TNAC does not, as explained above.

Most relevant for the carbon price is the perceived market balance. Our perceived market balance is comprised of several elements: demand from utilities based on the timing of their hedging activities and their free allocation; auctioning (present and future); and the perceived balance of industrial companies, equal to the accumulated difference between their free allocation and emissions from 2008 until the end of their forward looking horizon (which we assume to be three years into the future). Our perceived market balance also takes into account perceptions about future policy changes (see Annex 2 for more details). Our analysis shows that the perceived market balance can explain historical changes in the annual carbon price, and therefore we use it as the basis for price forecasting model.

> "Utilities' unwinding of hedges partly explains the 2016 price crash

We expect hedging demand to edge slightly higher this year and reach 1,002 Mt over 2016 (orange line in Figure 2). Our estimate of hedging demand takes into account the percentage of hedging expected to be performed (see table 5 below for details), future CO_2 emissions, and any unwinding of hedges. Based on our assumed hedging rates and our emissions forecast, we estimate that in 2016 utilities need 1,126 Mt to cover hedging needs for the next three years. However, we also estimate an unwinding of hedges in the order of 125 Mt in 2016. Unwinding of hedges can occur when utilities adjust downward their expectations for current and future emissions and thus find that they had purchased more carbon allowances than necessary. This situation can lead utilities to actively unwind hedges by selling the extra allowances, or it can lead utilities to curb their purchasing of EUAs (for simplicity we refer to either case as "unwinding"). In either case, the result is a net decrease in the amount of utility hedging demand. Our estimate for such unwinding is based on the difference between our emissions forecast published in 2015 for the period covered by utilities' hedging horizons and our current emissions forecast for the same period.

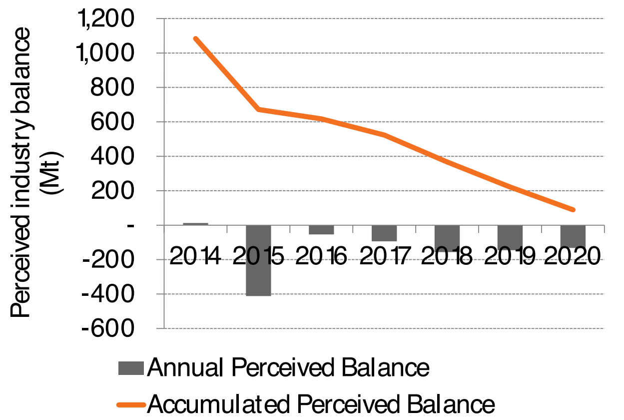
The amount of perceived auctioning supply, together with perceived power sector free allocation (grey bars in Figure 2) will rise in 2016, mainly as a result of the high auctioning supply in 2017 and 2018. As a result, we estimate that perceived supply will exceed hedging demand in 2016. Beyond 2016, we estimate that hedging demand will roughly match perceived supply from auctioning and power sector free allocation.

In the industry sector, we estimate a narrowing perceived supply-demand balance (Figure 3). Industries' perceived balance declines because their emissions are higher than their free allocation from 2015 onwards.

Combining the power and industry sector perceived balances (as well as demand from aviation), the total perceived balance describes the overall supply-demand picture in the carbon market (Figure 4). The perceived market balance declined in 2014 and 2015 largely as a result of the backloading as well as an increase in hedging demand in 2015. For 2016, we project a small increase in the perceived market balance for two reasons: unwinding of utility hedges; and market expectations for rising auctioning supply in 2017 and 2018.

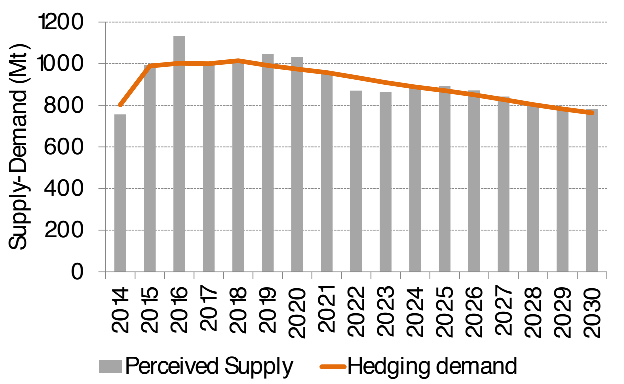
This expansion of the perceived oversupply in 2016 explains part of the reason for the current weakness of the carbon price. Yet,

Figure 3: Industry sector perceived balance*



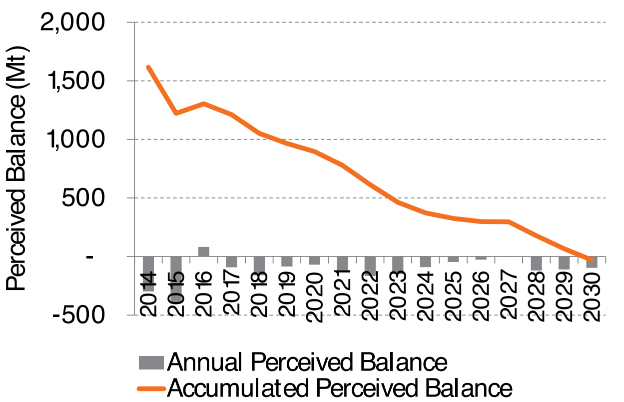
* The perceived balance in the industry sector is equal to the accumulated difference between their free allocation and emissions from 2008 until the end of their forward looking horizon (which we assume to be three years into the future)

Figure 2: Power sector perceived supply and demand balance



Perceived supply is a weighted average of the next three year's free allocation and auctioning supply.

Figure 4: Total perceived market balance

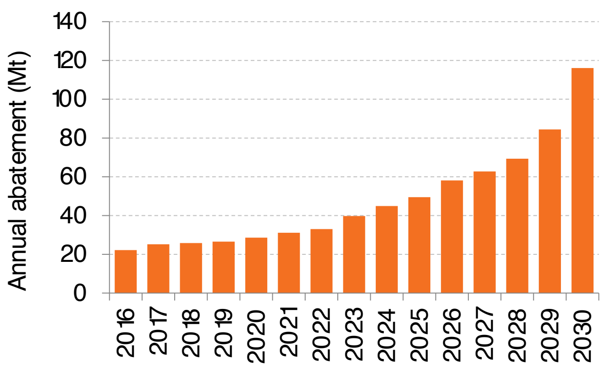


the extent of the price's downfall is far larger than what would be justified by the perceived market fundamentals. Our model suggests that this year's increase in the perceived market balance should lead to a lower real carbon price and an unchanged nominal carbon price after inflation. Based on our model and on the expectation that traders will want to take profit on the recent price drop, we expect a recovery in the price later this year. Since the slide of the carbon price is to a large extent the result of poor sentiment we should see a correction once the market regains confidence in the fundamental downward trajectory of the market's oversupply. However, January's price crash has brought the price to low levels, from which the carbon price will need some time to recover, particularly because of poor market sentiment following the price crash. After weighing these factors, we expect the carbon price to average €6.6/t in 2016.

Beyond 2016, we forecast a slow narrowing in the perceived market balance. The impetus for this will be the gradual depletion of industrials' surpluses, which they will have to use to cover the shortfall between their annual free allocation and annual emissions. The other reason for the tightening perceived balance is the start of the MSR withdrawing auctioning allowances from 2019. Given our assumed three year forward looking horizon for EU ETS market participants, we expect the market to begin to significantly price in the MSR in 2017.

The narrowing of the perceived market balance leads us to expect a steady increase in the carbon price in our Base Case (Table 2). By 2020, we expect the price to reach €10/t in real 2015 euro terms. As the MSR slowly brings the market into balance toward the late 2020s, it will likely exert an upward push on the carbon price. Toward 2030, we expect the price to begin rising quickly as the market approaches scarcity. We project that the market would theoretically turn short of allowances in 2034, and assume that market participants will begin covering this shortage in 2029 with additional abatement measures (see Figure 5). Thus we expect to see an additional demand for abatement in 2029 and beyond, which – given the expected cost of abatement measures, will quickly push the price higher.

Figure 5: Base case abatement (Mt)



Scenarios: The what if's

A carbon price forecast, as any other forecast, is an exercise in picking the most likely assumptions to predict a future development. We have stated above our base case assumptions and reasons why we believe them to be most realistic. However, the world can change quickly and assumptions may change over time. In order to provide an overview over carbon price developments under different assumptions we have calculated various scenarios by changing one assumption at a time. We looked at the effect of even lower gas prices relative to coal contracts for emissions, and hence for carbon prices. Given the discussions in the UK, Germany and Netherlands to phase-out emission intense hard coal and lignite plans we applied a scenario where we assume a phase-out of the entire coal generation fleet in Europe. We modeled the implications of changing power forward hedging patterns. Following the Paris Agreement, a debate on reviewing phase 4 of the ETS will likely include a discussion on headline targets. Obviously, our forecast remains highly sensitive to changing GDP assumptions.

GDP growth scenarios

We model carbon prices under two alternative growth scenarios, one featuring a 0.5 percent slower annual growth rate compared to our assumed Base Case and one featuring a 0.5 percent faster annual growth (see Table 3 below for the impact of this

Table 3: Demand growth assumptions

% growth/year	2016-2020	2021-2025	2026-2030
GDP, Base Case (Oxford Economics)	1.9	1.7	1.5
GDP, low growth	1.4	1.2	1.0
GDP, high growth	2.4	2.2	2.0
Power demand, Base Case	0.8	0.4	0.3
Power demand, low growth	0.5	0.2	0.1
Power demand, high growth	1.1	0.6	0.6
Industrial production, Base Case	0.5	0.4	0.2
Industrial production, low growth	-0.6	-0.7	-0.9
Industrial production, high growth	1.5	1.5	1.3

Table 2: Base Case carbon price forecast

Price outlook	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
EUA price (nominal)	6.6	7.3	8.5	9	10	12	14	16	17	19	20	21	24	28	33
EUA price (real '15 euros)	6.5	7.1	8.1	9	10	11	12	14	15	16	17	18	19	22	26

growth rate on our power demand growth and industrial growth assumptions). The results indicate that the carbon price remains sensitive to economic fluctuations despite the MSR.

The low growth scenario lowers the average 2021-2030 price by 17 percent, while the high growth scenario increases it by 58 percent as it leads the market into a scarcity sooner than projected in our Base Case, creating the need for extra abatement. We find the low GDP growth somewhat unlikely to materialize and the high growth quite unlikely.

Increased climate ambition in light of Paris

The European Commission is assessing the results of COP21, and its report, expected by end February, will help inform the Environment and European Council debates on the Paris Agreement in March. European leaders will discuss the results of COP21 in particular in light of the 2030 climate and energy framework. They will likely address the call in the Paris Agreement to regularly review contributions/reduction targets and to communicate them by 2020 – and again by 2025. The Paris outcome merely requests countries to communicate or update their contributions by 2020, meaning that the EU could consider the 2030 target by then. For the targets beyond 2030 there is a legal obligation to communicate a contribution (i.e climate target/Nationally Determined Contribution) in 2025 representing a progression beyond the current ambition level. The EU could decide to just extend the current cap trajectory to 2035 or 2040.

There have already been calls for the reassessment of Europe's ambition, based on the argument that EU climate ambition is determined on the basis of a reduction pathway framed to keep global warming below 2 degrees, and that the Paris Agreement is to hold global warming "well below" 2 degrees and to "pursue efforts" to limit it to 1.5 degrees. Parliamentarians from several political groups have spoken in favour of such reassessment within the 2030 framework.

Even though the main focus in the coming years will be on the implementation of the 2030 climate and energy framework, the Paris outcome will ensure that the political debate concerning EU climate ambition is kept alive.

To account for this political debate we have constructed three scenarios simulating a more ambitious European reduction pathway towards 2030. Figure 6 illustrates the effect of a 45 percent and a 50 percent overall EU emission reduction target implemented from 2021 on the EUA price path over the next decade.

The higher ambition scenarios result in significantly higher carbon prices (Figure 6). As mentioned above, we see the market turning short of allowances in 2034 in our base case. Under the high ambition scenarios, the market turns shorter sooner (see Table 4), resulting in a relatively quick increase in the carbon price to incentivize additional fuel switching and other abatement measures.

This is a theoretical exercise as it assumes no use of international credits. Realistically, we think that any attempt to reach agreement among European leaders to increase the EU's climate ambition will have to allow for use of EU-external reductions. This would ease the price effect illustrated below. In Paris, a new market mechanism was agreed, with the detailed provisions for this mechanism to be negotiated in the next few years.

The extent to which international credits will be used to meet any additional climate ambition remains to be seen. We do not rule out the possibility that the EU divides the additional ambition between domestic reductions (including additional domestic ETS reductions) and international credits. In this case the carbon price path will fall somewhere in between our base case and the respective scenario price path, depending on the extent of credit usage allowed.

In a third scenario we assume that the EU maintains its ambition level for 2030, but that it decides to steepen its emission reductions after 2030. Such an outcome could be the result of a political debate based on the first global stock-taking in light of Paris taking place in 2023. The Commission will provide an assessment on this matter before 2020 and outline a long term climate strategy for the EU that accounts for the long term targets agreed in Paris.

A post-2030 revision of EU's ambition could provide an opportunity for the Commission to align the EU ETS linear reduction factor with an 80 percent reduction in emissions by 2050 compared to 1990 (the lower end of EU's 80-95% 2050 goal). The Commission's 2050 roadmap states that such a reduction requires roughly 90 percent reduction in ETS sectors. Yet, the Commission's proposal for a 2.2 percent linear reduction factor will result in a reduction in EU ETS sectors of 84 percent by 2050. We calculate that it will take a linear reduction factor of 2.5 percent from 2030 to put the EU ETS on track for a 90 percent reduction by 2050, and assume this factor in our post-2030 high ambition scenario. We assume that no credit usage is allowed to cover the additional reductions.

Table 4: Impact of higher ambition on the EU ETS cap

Scenario	ETS target for 2030, reductions from 2005 emission levels	Linear reduction factor (Mt)	Linear Reduction factor (%)	Market turns short
40% 2030 target (Base Case)	43%	48	2.2%	2034
45% 2030 target	49%	62	2.8%	2031
50% 2030 target	54%	74	3.4%	2028
Higher ambition after 2030	43%	48/55 before/ after 2030	2.2/2.5% before/ after 2030	2034

Our model estimates that the carbon price up to 2030 will be only slightly influenced by the assumed higher ambition after 2030. We calculate that this will lift the projected 2029 and 2030 carbon prices by around 1 percent. The slightly higher carbon prices induce more abatement, leading to a slightly move oversupplied market before 2030.

ICAO struggles to implement the aviation scheme by 2020

In our Base Case we assume that a global market based measure will be in place in 2020 which will exempt intra-European flights from the coverage of the EU ETS. However, the ICAO process has been slow in the past and even if the intention is to have an MBM scheme in place by 2020, the real start of operating such scheme could be delayed further. Should ICAO delay the implementation of its MBM system, the EU ETS may continue to cover intra-EU aviation further out in time under an extended 'stop the clock' rule. In such scenario, the aviation sector will be part of the ETS until 2025. Should this situation materialize, we estimate there will be an additional 130 Mt of net demand for EUAs, resulting in a €2/t higher average carbon price over the 2021-2030 period.

Coal is the new nuclear – a phase-out scenario for Europe

In this scenario we assume all European countries to take a political decision to phase out lignite and hard coal generation from 2020, shutting down plants after 35 to 40 years of operation and applying a moratorium on building new plants.

We assume such development to be sparked by national policies, for example through the adoption of a lignite phase-out scheme in Germany as recently proposed by think-tank Agora (see our recent analysis "Cleaning the German energy system"). The UK (by 2025) and the Netherlands (by 2020) have also recently announced plans to end coal generation.

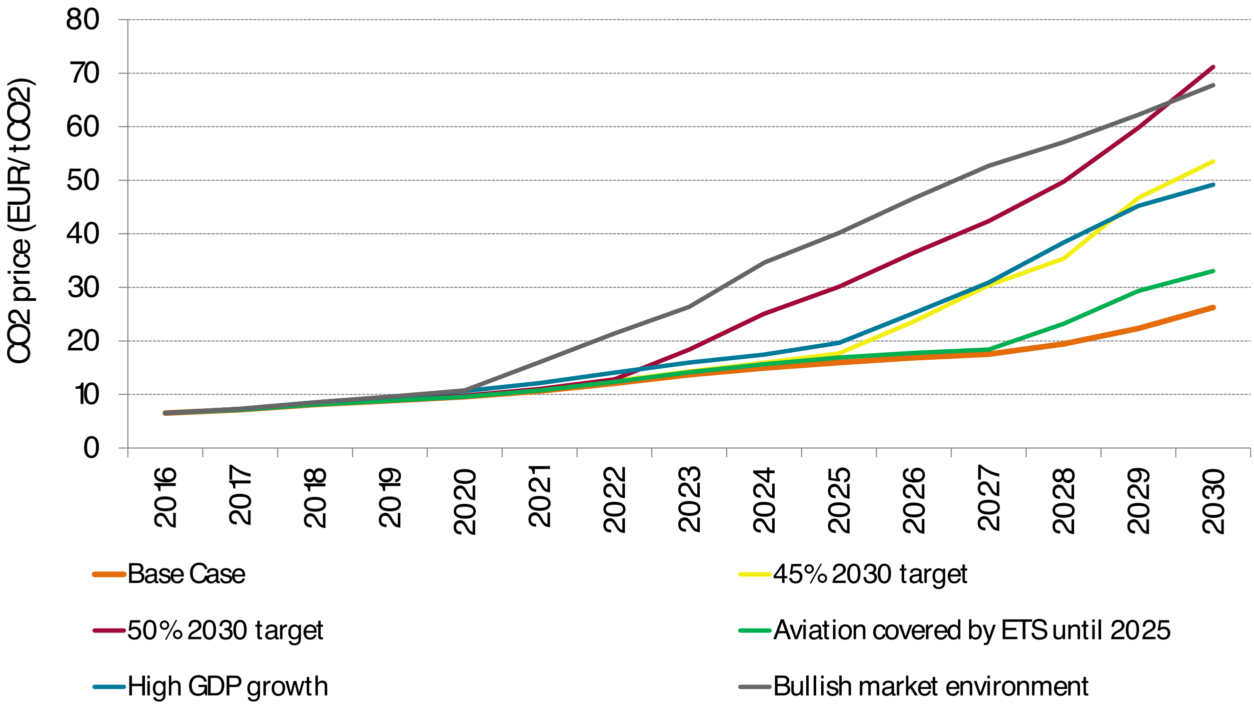
Our coal phase-out scenario will, according to our emissions model, result in a reduction of power emissions compared to our base case of 1,473 Mt (20%) for the 2021-2030 period. Based on our price model, we estimate that this will push the carbon price lower by 25 percent in the 2021-2030 period. Our coal phase-out scenario also lowers our price forecast for 2020 by one euro, while leaving the forecast for prices up to 2019 unchanged.

Low gas-coal price ratio

We model the impacts of 50 percent lower gas-coal ratio up to 2030 compared to our Base Case assumptions. We find it quite unlikely that gas prices will remain at half of current low levels until 2030. Prices could see some recovery after 2020 especially as the recent trend toward phasing out coal dampens coal prices and increase gas demand to some extent. Yet this scenario presents a potential downside risk, particularly in the short term.

We estimate that this scenario will lower power sector emissions by 445 Mt (9%) in the 2016-2030 period and by 1,173 Mt (13%) in the 2021-2030 period. Our model estimates this reduction in emissions will dampen the carbon price significantly in the short term. We estimate the resulting carbon price will average €8/t in 2020 in real 2015 euro terms, 14 percent lower than our Base Case forecast for 2020 (see Table 6 below for detailed results).

Figure 6: Carbon Price Upside Risk Scenarios
All prices in real 2015 euros



30/40 percent Energy Efficiency target

The EU will review the energy efficiency target before 2020 and consider a 30 percent target, with the Commission revision proposals on energy efficiency legislation expected in 2016. Before taking office as Commission President, Mr. Juncker called for a 30 percent energy efficiency target as a minimum requirement. With an even higher ambition in mind, the European Parliament called for a 40 percent improvement, which it reconfirmed ahead of the Paris COP. We expect an assessment of both the 30 and 40 percent targets to take place in the context of the review of the Energy Efficiency directive scheduled for later this year. The Commission will quite likely propose a higher target, leading us to believe that of the triple 2030 targets, the energy efficiency target is the most likely to be increased.

The increase of the energy efficiency target from 27 percent to 30 percent and 40 percent will reduce EU ETS emissions by 161 Mt and 1,316 Mt, respectively, for the 2021-2030 period, according to our estimates. In the case of a 40 percent energy efficiency target, we expect the Commission to use a higher benchmark when it determines the amount of free allocation industries should receive in 2021-2030, resulting in a lower amount of free allocation. All in all, we forecast that the additional energy efficiency will lower the average 2021-2030 carbon price by 5 and 24 percent in the 30 percent and 40 percent energy efficiency scenarios respectively compared to our base case. Higher energy efficiency ambition will, in the absence of any strengthening of the EU ETS, result in a more oversupplied market throughout the 2021-2030 period (see Table 6 for detailed results).

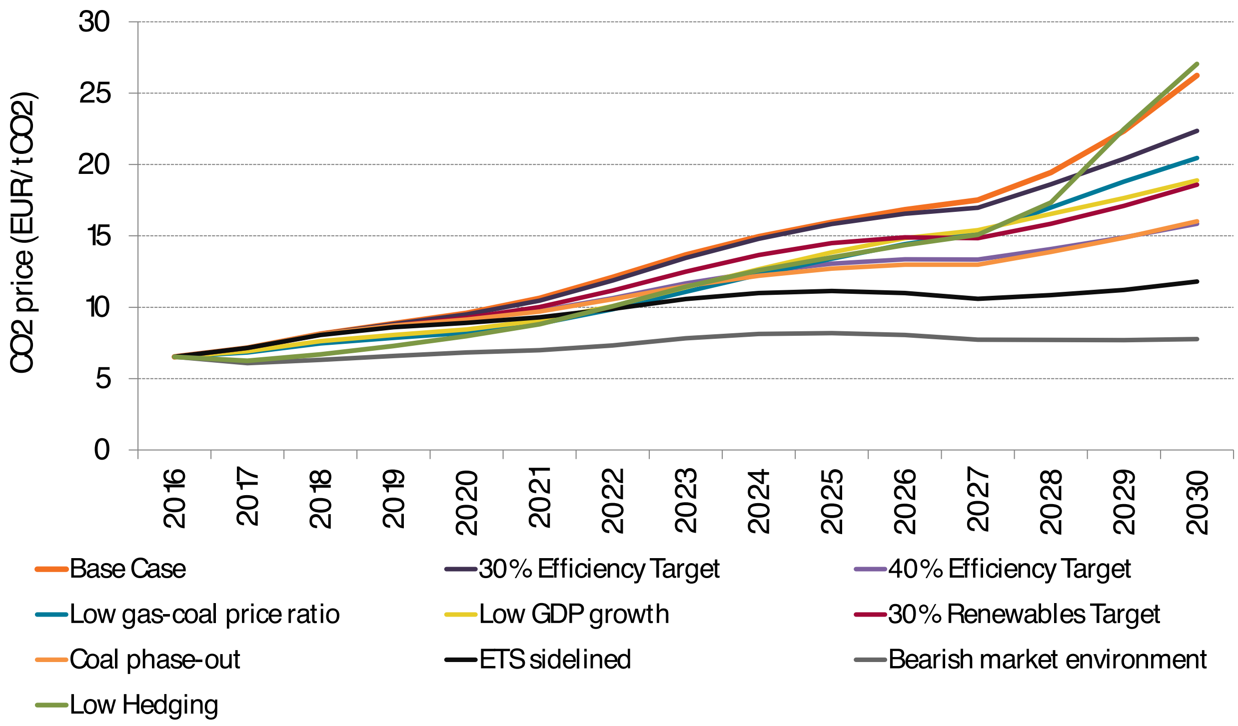
> "Any ramp-up of complementary climate policies will undermine the stance of the EU ETS as EU's flagship climate policy

30 percent Renewable Energy target

According to the Commission's 2030 climate and energy framework proposal and impact assessment, a 40 percent emission reduction target would in itself encourage a greater share of renewables of at least 27 percent. Still, amongst the large member states, only Germany has been in favour of a 30 percent renewable target, while others, such as the UK, wanted the emissions reduction target to be the central target, and serve as the trigger for renewable uptake and efficiency improvements. Despite the "at least" prefix to all targets of the climate and energy framework, a renewable target increase seems politically unrealistic at the moment. The aim of the upcoming review of the renewable directive is to adjust it to fit the current ambition level.

For the purposes of this scenario we assuming a higher deployment of renewables in line with a 30 percent target. We estimate this would reduce power sector emissions by 748 Mt (9%) for the 2021-2030 period. We project that the additional renewable generation will reduce the average 2021-2030 price by 16 percent compared to our base case. We forecast that the carbon market will remain oversupplied all the way until 2030. (see Table 6 for detailed results).

Figure 7: Carbon Price Downside Risk Scenarios
All prices in real 2015 euros



ETS sidelined (40-30-40, coal phase-out)

European leaders agreed in October 2014 that the reformed EU ETS with an MSR in place would be the main European instrument to achieve the 40 percent emission reduction target. Policy makers wanted to ensure that the EUA price is the main trigger initiating abatement needed to reach the climate target. At the same time it should help the EU achieve its renewable and energy efficiency goals.

In Brussels, there is an ongoing debate on both the overlap amongst the tri-partite climate & energy goals as well as the interplay with national energy policies. Overlapping or complementary policies can significantly undermine the effect of the EUA price signal, as they accomplish the required emission reductions, but at a higher cost. Any increase in renewable or energy efficiency ambition without a strengthening of the EU ETS will prevent the carbon market from being the central pillar of European climate policy that the Commission and the European Council conclusions of October 2014 declare it to be.

In the "ETS sidelined" scenario, we explore the effect on EUA prices of maintaining the current emissions reduction target of 40 percent by 2030, while increasing the renewables and energy efficiency targets. We assume that EU policy makers agree in 2020 to lift the 2030 renewable target to 30 percent and the energy efficiency target to 40 percent. We also assume that a European coal phase-out is implemented as described above.

In this scenario, European emissions drop more rapidly than in our base case, but these reductions are triggered by other factors than the carbon price. We estimate emissions in the EU ETS will be 1,979 Mt (12%) lower in the 2021-2030 period than in our base case. Our model projects that the carbon price will rise modestly, reaching €12/t in 2030 in real 2015 euro terms. The average carbon price over the period 2021-2030 will be 37% lower than in our base case as the EU ETS will remain chronically oversupplied. As a result, the EU ETS will trigger fewer emission reductions, according to our model, which estimates the EU ETS will incentivize 589 Mt of abatement in 2021-2030 in our Base Case and only 266 Mt of abatement in the ETS Sidelined scenario. Therefore, some of the emission reductions accomplished by complementary policies (323 Mt in 2021-2030) will be cancelled out by the EU ETS.

These effects can materialise even without a formal change to the renewables and energy efficiency targets. Even though we find it very unlikely that the EU will raise its targets as assumed in this scenario, we think that domestic policy measures could ramp up climate ambition in a bottom-up fashion with a similar end result of greater renewables deployment and enhanced energy efficiency, which may have a similar effect on carbon prices as the ones reflected in this scenario. Already today, several member states have implemented a more ambitious climate and energy agenda than that of the overall headline targets. This trend could extend further in the future should Brussels fail to unite the entire EU-28 in adopting a more ambitious emission reduction agenda.

Low hedging

Hedging – the practice of utilities to sell expected power generation ahead of time and buy the necessary carbon allowances – determines the timing of demand for carbon allowances from the power sector, and thus exerts a significant influence on the carbon price. In our base case scenario, we assume that power forward hedging – expressed as the percentage of power generation sold in a given year – stays at its four year historical average. The resulting hedging percentages that are used in our model are detailed in Table 5

We presume that historical hedging rates represent a reasonable approximation of the future. Utilities determined their hedging strategies accounting for the fundamental transition in the power sector away from thermal generation and toward distributed zero-marginal cost generation technologies. This shift is driving lower the wholesale power prices, and with it, the clean dark spread given that carbon prices increase over time. In a market where the prevailing expectation is for a falling spread, utilities have an incentive to sell power as soon as possible to lock-in a higher margin. Given the continuous decarbonization of the energy sector, we expect this trend to continue, providing rationale for high rates of hedging. RWE accelerated its hedging in the first three quarters of 2015 compared to the amount of

Table 5: Assumed hedging rates

% of thermal power generation hedged	2015	2016	2017	2018	2019-2030
Base Case					
Y	18	19	9	11	10
Y+1	31	41	38	39	39
Y+2	30	31	31	31	31
Y+3	23	23	23	23	23
Low hedging Scenario					
Y	18	16	35	47	56
Y+1	31	13	17	19	19
Y+2	30	13	15	15	15
Y+3	23	10	10	10	10

hedging it performed in the same quarters in 2014.

On the other hand, decarbonization is brining uncertainties to power sector operators, which make it harder to plan far way in advance. For instance, declining prices for coal and gas create risks that utility spreads may rise in the future rather than fall. This may constrain the ability of utilities to increase their hedging activities. We observe a consolidation in the hedging rates of several utilities, including Vattenfall and Enel. CEZ also slowed down its hedging in 2014 and hasn't shown a recovery so far in 2015.

To model the downside risk posed by hedging, we forecast the carbon price under the assumption of lower hedging demand. For this scenario, we assume that the percentage of power generation hedged for future power generation declines by roughly half, leading utilities to sell a greater share of their power generation in the current year. We find this scenario somewhat unlikely. Table 5 provides the resulting hedging rates.

As illustrated in Figure 7, we project that low hedging as assumed by this scenario will push the price lower in 2017, when we project the price to fall to 6.4 euros in nominal terms from 6.6 in 2016.

Our model projects a rising carbon price from 2018 onwards due to the declining supply of allowances driven mainly by the introduction of the MSR in 2019, which outweighs the downside effect of weak hedging demand.

Bearish market environment (40-30-40, coal phase-out, low GDP, low hedging)

To illustrate the compounded bearish risk posed by all downside risks taken together, we model a low-price scenario. This scenario assumes a renewables development in line with a 30% target for 2030, energy efficiency improvements in line with a 40% energy efficiency target for 2030, an EU-wide coal-phase-out, low GDP growth, and low hedging demand as described above. We do not assume a low gas-coal price ratio because we believe there is limited potential for this in an event of a coal phase-out.

In this scenario, we expect carbon prices to flat line around 8 euros until 2030, as the carbon market is projected to remain heavily oversupplied. Our model estimates an average oversupply of 1,537 Mt over the 2021-2030 period.

Table 6: EU ETS Scenario Matrix (all prices in real 2015 euros)

Prices in real 2015 €/t, (for scenarios, percentage change from the Base Case)	2016	2017	2018	2019	2020	Average 2021-2025	Average 2026-2030	Oversupply average (2016-2020)	Oversupply average (2021-2030)
Base Case	6.5	7.1	8.1	9	10	13	20	1,403 Mt	637 Mt
45% 2030 target (w/o credits)	6.5 (0%)	7.1 (0%)	8.1 (0%)	9 (0%)	10 (1%)	14 (6%)	38 (85%)	1,403 Mt	575 Mt
50% 2030 target (w/o credits)	6.5 (0%)	7.1 (0%)	8.1 (0%)	9 (1%)	10 (2%)	19 (45%)	52 (153%)	1,403 Mt	563 Mt
Higher ambition after 2030	6.5 (0%)	7.1 (0%)	8.1 (0%)	9 (0%)	10 (0%)	13 (0%)	21 (0%)	1,403 Mt	639 Mt
Aviation covered by ETS until 2025	6.5 (0%)	7.1 (0%)	8.1 (0%)	9 (0%)	10 (0%)	14 (4%)	24 (19%)	1,403 Mt	568 Mt
Low Hedging	6.5 (0%)	6.3 (-13%)	6.7 (-18%)	7 (-18%)	8 (-17%)	11 (-16%)	19 (-6%)	1,395 Mt	585 Mt
Low GDP growth	6.5 (0%)	6.9 (-3%)	7.6 (-6%)	8 (-9%)	8 (-12%)	11 (-15%)	17 (-19%)	1,526 Mt	973 Mt
High GDP growth	6.5 (0%)	7.3 (2%)	8.5 (5%)	10 (8%)	11 (11%)	16 (18%)	38 (84%)	1,332 Mt	453 Mt
30% energy efficiency target for 2030	6.5 (0%)	7.1 (0%)	8.1 (0%)	9 (0%)	9 (-1%)	13 (-1%)	19 (-7%)	1,403 Mt	658 Mt
40% energy efficiency target for 2030	6.5 (0%)	7.1 (0%)	8.1 (0%)	9 (-2%)	9 (-4%)	12 (-14%)	14 (-30%)	1,403 Mt	934 Mt
30% renewables target for 2030	6.5 (0%)	7.1 (0%)	8.1 (0%)	9 (-1%)	9 (-3%)	12 (-8%)	16 (-21%)	1,394 Mt	817 Mt
EU-wide coal phase-out	6.5 (0%)	7.2 (0%)	8.1 (0%)	9 (-2%)	9 (-5%)	11 (-16%)	14 (-31%)	1393 Mt	976 Mt
Low gas-coal price ratio	6.5 (0%)	6.8 (-4%)	7.5 (-8%)	8 (-11%)	8 (-14%)	11 (-18%)	17 (-16%)	1,634 Mt	1,161 Mt
ETS sidelined	6.5 (0%)	7.1 (0%)	8.1 (-1%)	9 (-3%)	9 (-7%)	10 (-23%)	11 (-46%)	1,402 Mt	1,163 Mt
Bearish market environment	6.5 (0%)	6.1 (-15%)	6.3 (-22%)	7 (-26%)	7 (-29%)	8 (-43%)	8 (-62%)	1,469 Mt	1,537 Mt
Bullish market environment	6.5 (0%)	7.3 (2%)	8.5 (5%)	10 (8%)	11 (12%)	28 (106%)	57 (180%)	1,333 Mt	417 Mt

Bullish market environment (45-27-27, high GDP, aviation until 2025)

To illustrate how high the carbon price might go under an optimistic scenario, we model the carbon price under an increased 2030 GHG target of 45%, high GDP, and aviation demand for EUAs until 2025. In this scenario, the market turns short in 2026, leading to a rapid rise in the carbon price.

Conclusion

The overarching conclusion from this report is that the carbon price remains sensitive to external factors, including complementary policies and macroeconomic fluctuations, despite the MSR. This is mainly a result of the MSR's relatively low annual withdrawal rate of 12 percent which can only buffer a fraction of emission reductions resulting from overlapping policies, as well as the relatively high MSR threshold of 833 Mt. Policy makers may choose to strengthen the MSR. One such opportunity is the first scheduled review of the MSR in 2021. Yet, we note that any possibility for a change in the parameters of the MSR is too uncertain at this stage for us to include in this outlook.

> "As designed, the Market Stability Reserve fails to deliver a stable carbon price

In addition to complementary policies and macroeconomic shocks, the carbon market is beholden to sentiment. The price crash of early 2016 exemplifies the impact that sentiment changes can have on the carbon price outlook. As long as the market remains oversupplied, it is vulnerable to such mood swings. We expect the shaken confidence to result in a slow price recovery from current lows, leading to an average price of €6.6/t in 2016, some €1.1/t lower than the previous year.

We also expect that, even if the market experiences similar crises of confidence in the future, such episodes will be short-lived. In all markets, trading noise tends to diminish over the long term. As market participants zoom out, the image will become less pixilated and the fundamental big picture of the carbon market – of a gradually declining market oversupply – will become clearer.

Therefore, over the long term, we believe that the market will continue to be driven by the perceived market supply and demand fundamentals. Thus, we expect prices to move upward as the oversupply declines over time. Our model expects the EUA price to average €7/t in 2017, reach €10/t in 2020 and €26/t in 2030 in real 2015 euro terms. In all scenarios we have explored, except for the scenarios involving low hedging demand, we expect the price to rise in 2017 and continue rising beyond. What this means for market participants is that the recent price crash offers an opportunity to purchase carbon allowances and hedge the risk of an increasing carbon price in the future.

The implication of our new price forecast is that the carbon market will drive less abatement up to 2030 than we had previously projected. We now forecast that the EU ETS will incentivize abatement in the order of 26 Mt per year on average in the 2016-2020 period. Annual EU ETS abatement will then rise to 59 Mt per year on average in the 2021-2030 period. The relatively slow increase in the carbon price that we now forecast will lead some companies to put off abatement activities, which will increase the amount of abatement they will have to perform toward 2030 and beyond as the EU ETS runs out of surplus allowances. As a result, abatement costs for companies will be relatively low until 2020 and eventually rise sharply around 2030 and beyond.

2030 is still 14 years away. If we look 14 years back in time, we find ourselves in 2002 in the middle of discussions on how to design the EU ETS directive which was agreed in October 2003. Around the same time, the CDM rules were drafted in Marrakesh (December 2001). Back then, no one foresaw the development of carbon markets as we know them today. It is a useful reminder that forecasting developments until 2030 is a challenging undertaking based only on what we know today, much of which is informed by historical developments. But history may change quickly. Based on current knowledge, we are very confident that our price forecast reflects the future in the best way possible. Should any important price determining factors turn out differently from what we have assumed, the scenarios outlined in this report delineate the possible deviations from our outlook that we would expect.

Annex 1: Probability guidelines

The analysis of future events requires effective communication of the degree of uncertainty associated with the numerous possible ways the future can unfold. As of January 2016, we make use of specific language in our analyses to describe probability ranges as indicated by the table below.

The purpose of this strategy is to enable you, our reader, to easily understand the precise probability that we attach to a future event. Using specific language also allows us to transparently update probabilities in light of new information, helping you make sense of new developments. Finally, this framework helps us measure the performance of our predictions over time and provide accurate forecasts.

Probability	Percent
Extremely likely	95-100%
Very likely	82-94%
Quite likely	69-81%
Somewhat likely	56-68%
Even chance	**45-55%**
Somewhat unlikely	32-44%
Quite unlikely	19-31%
Very unlikely	6-18%
Extremely unlikely	0-5%

Annex 2: The Point Carbon price forecasting model

Our price forecasting model consists of three modules (see flowchart below).

The first module is an econometric model. This model simulates how changes to the market's supply and demand influence the carbon price. It does so by relating historical annual percent changes in EUA price with the historical changes in the "perceived" EU ETS supply and demand balance. The perceived market balance is calculated as the sum of the perceived balances in the power, industry and aviation sectors.

We calculate the balance in the power sector as the difference between demand – emissions (historical and forecast emissions using a least cost dispatch optimization model) and assumed forward hedging rates – and supply – weighted average free allocation based on expected free allocation over utilities hedging horizons (which are assumed to extend three years into the future). We further take into account perceived auctioning supply by calculating a weighted average auctioning based on expected auctioning over the next three years.

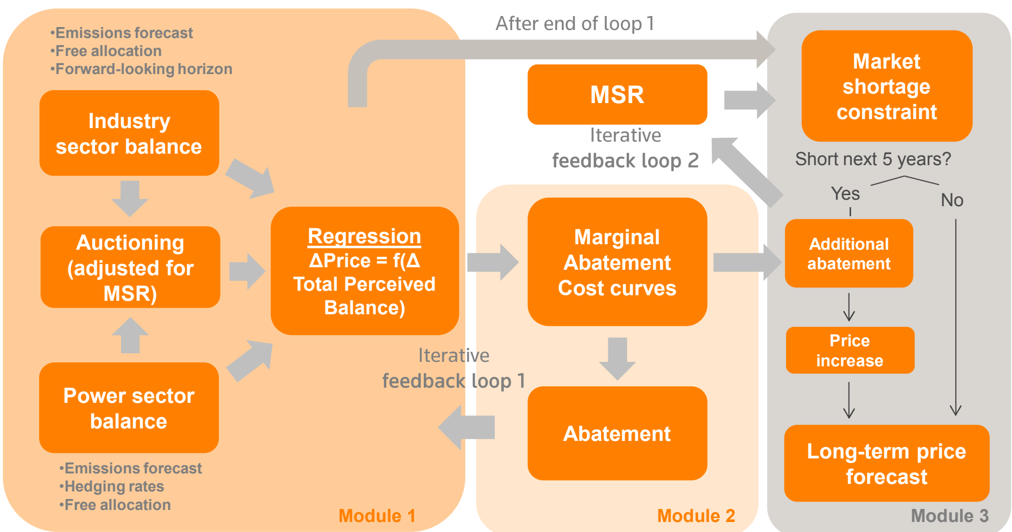
In the industrial sectors, the balance is equal to the accumulated difference between their free allocation and emissions (forecast using econometric models based on macroeconomic forecasts by Oxford Economics, and in-house analysis of production and CO2 intensity trends from 2008) until the end of their forward looking horizon (which we assume to be three years into the future).

When we calculate future supply, we also take into account market participants' expectations about any potential legislative changes. We expect market participants to evaluate different scenarios regarding the potential future cap changes and weigh them based on probabilities, representing their expectations for the chance of each scenario. For example, we find that changing expectations regarding the backloading decision help explain some of the historical fluctuations in the carbon price.

The second module of our price forecasting model simulates the interaction between the future EUA price expected by the market and the amount of abatement in the EU ETS. We use a feedback loop to estimate the impact of abatement on the carbon price and to forecast the future carbon prices and abatement levels. Our model uses marginal abatement cost curves for the power and industry sectors. Fuel switching abatement in the power sector is calculated by a power dispatch model, while abatement in the industry sector is based on currently available abatement options and takes into account irreversibility and inter-temporal effects of investment decisions.

The third module provides a constraint, which specifies that market participants cannot be short of EUAs for their annual compliance needs. The module simulates the market's reaction to a potential future shortage by calculating companies' abatement assuming they aim to minimise costs. We assume that market participants would begin to cover shortages by beginning to abate emissions five years in advance. The higher abatement needs caused by any impending shortages has a bullish effect on the price, which is calculated based on our marginal abatement cost curves.

Figure 8: Price Forecasting Model Structure



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