IPPR

REPORT

SCUTTLING COAL

HOW ENDING UNABATED COAL GENERATION CAN STIMULATE INVESTMENT, CUT BILLS AND TACKLE CARBON POLLUTION

Jimmy Aldridge
and Will Straw

March 2015

Institute for Public Policy Research

ABOUT IPPR

IPPR, the Institute for Public Policy Research, is the UK's leading progressive thinktank. We are an independent charitable organisation with more than 40 staff members, paid interns and visiting fellows. Our main office is in London, with IPPR North, IPPR's dedicated thinktank for the North of England, operating out of offices in Newcastle and Manchester.

The purpose of our work is to conduct and publish the results of research into and promote public education in the economic, social and political sciences, and in science and technology, including the effect of moral, social, political and scientific factors on public policy and on the living standards of all sections of the community.

IPPR
4th Floor
14 Buckingham Street
London WC2N 6DF
T: +44 (0)20 7470 6100
E: info@ippr.org
www.ippr.org
Registered charity no. 800065

SMART IDEAS
for CHANGE

CONTENTS

ABOUT THE AUTHORS

Jimmy Aldridge is a research fellow at IPPR.

Will Straw is associate director for climate change, energy and transport at IPPR.

ACKNOWLEDGMENTS

We would like to express our gratitude to the members of our steering group who provided feedback on our thinking and guidance on our conclusions. The group included Greg Barker MP, Baroness Worthington, Lord Teverson, Alan Whitehead MP and Ben Caldecott.

We are very grateful to a number of colleagues who have reviewed this paper, including Dan Roberts from Frontier Economics, Professor Jim Skea from Imperial College London and Mike Thompson from the Committee on Climate Change. All views and any mistakes in the report remain the responsibility of the authors alone.

Thanks to the many colleagues across government, industry and in NGOs who took part in the research and provided feedback on our thinking. The following people attended a roundtable discussion at IPPR to discuss interim findings from the research: Keith Allott, Chris Littlecott, Jim Skea, Doug Parr, Geoffrey Norris, Katherine Mercer, Georgia Berry, Jenny Banks, Amy Clemitshaw, Lord Teverson, Simon Moore, Tony Dicicco, Philip Pearson, Mike Thompson, Claire Swadkin, James Court, and Thomas Reilly. Thanks to all of them for their contributions, which were very helpful in guiding the final stages of the research.

Special thanks to Dave Jones for undertaking the modelling that underpins this report, and for his expertise throughout the course of the project. Special thanks also go to Joss Garman, senior research fellow at IPPR, for his input and ever-valuable guidance, and to Nick Pearce, director of IPPR, for his comments on earlier drafts of the report.

Finally we would like to thank Keith Allott at the European Climate Foundation for making this research possible, and for the expert contributions he has provided throughout the course of the project.

Download
This document is available to download as a free PDF and in other formats at:
http://www.ippr.org/publications/scuttling-coal-ending-unabated-coal-generation

Citation
If you are using this document in your own writing, our preferred citation is:

Aldridge J and Straw W (2015) *Scuttling coal: How ending unabated coal generation can stimulate investment, cut bills and tackle carbon pollution*, IPPR. http://www.ippr.org/publications/scuttling-coal-ending-unabated-coal-generation

FOREWORD
GREG BARKER MP, LORD TEVERSON AND ALAN WHITEHEAD MP

On Valentine's Day 2015, David Cameron, Ed Miliband and Nick Clegg made an historic commitment to tackling climate change. The cross-party pledge included a commitment 'to accelerate the transition to a competitive, energy-efficient low-carbon economy and to end the use of unabated coal for power generation'.

This is a significant step forwards that will reassure investors in new clean energy that the UK is the right place to invest. Rightly, it highlights unabated coal generation as a major threat to tackling climate change and makes the phasing out of this polluting fuel a priority. In the short-to-medium term this means the replacement of coal-fired power stations with modern gas plants. In the longer term, we will need a massive increase in renewable energy, carbon capture and storage on any coal power generation in future, and – many would say – a new generation of nuclear reactors. Gas also works far more efficiently and cost-effectively alongside renewable energy than coal, and UK renewable energy is growing at an unprecedented rate.

Coal is the dirtiest fuel used in power generation: it is more than twice as polluting as natural gas. As well as the impact it has on climate change, burning coal releases vast quantities of harmful air pollutants that damage people's health and have an unacceptable cost to the UK economy.

Only around a fifth of the coal burned in the UK is from domestic sources. More than half comes from just two countries – Colombia and Russia. Russia supplies 35 per cent of our coal but less than 5 per cent of our gas. Many of the discussions in Europe around trade sanctions against Russia have focused on gas, but for the UK, Russian coal is the big issue. As things stand, a continued reliance on coal is a continued reliance on Russia.

The cross-party commitment to end unabated coal generation is to be greatly welcomed. However, in the second half of this decade we will need a more detailed plan to ensure that it actually happens, and that includes being more proactive in encouraging greater investment in gas. Since 2009 the UK has actually increased the amount of coal it burns. Just under a third of our power still comes from this dirty fuel. Although there are new policies in place that will start to limit coal, investors would undoubtedly welcome greater certainty over when this will happen. While investment in UK renewables has surged in recent years, and while we are on track to hit our target of 30 per cent of our electricity coming from renewable sources by 2030, the current abundance of coal in the system is clearly having a chilling effect on investment in the next generation of cleaner gas power stations.

This report published by IPPR explores some of the options available for phasing-out unabated coal generation. The authors argue that an emissions performance standard, similar to the one pioneered by Arnold Schwarzenegger when he was governor of California, which would limit carbon pollution from our dirtiest power stations and introduce absolute certainty that coal is going offline. Such a belt-and-braces policy would be good for investment in low carbon energy sources; it would also reduce the energy bills of millions of householders. IPPR's analysis is compelling, and should be considered very carefully. The government took powers in the Energy Act 2014 to put in place an emissions performance standard for 'new coal'. In the next parliament, those powers must be extended to 'old coal' too.

The commitment made by our party leaders to end the use of unabated coal in the UK was a great leap forward, but the next step must be to deliver on that promise.

SUMMARY

The UK has a coal problem. Our overreliance on polluting coal-fired power stations is driving up the cost of ensuring the security of the UK's power supplies. This is placing higher costs on households and businesses, and threatening our commitments to cut carbon pollution.

Although only 10 coal power stations are currently operational in the UK, they account for one fifth of our total carbon emissions and generate just under a third of our electricity. All but one is 44 years old or older, but none have publicly announced when they will close. Their carbon pollution will need to fall sharply if the UK is to meet its legally binding commitments to tackling climate change.

In February 2015 David Cameron, Ed Miliband and Nick Clegg made a joint pledge 'to accelerate the transition to a competitive, energy-efficient low-carbon economy and to end the use of unabated coal for power generation'. Yet the amount of electricity generated from coal has actually risen since 2009. This increase can be explained by the cheap price of coal relative to gas, which has made coal power very profitable. However, the cost of power has remained high, so consumers have not benefitted from these lower coal prices. The growth in the UK's dependence on coal has offset much of the progress that has been made elsewhere in the national effort to build a cleaner economy.

Delivering on this cross-party pledge to end coal generation will require a clear plan. However, under existing policies we cannot be sure how many more years the UK's coal power stations have ahead of them. The government says that it expects they will all be offline by 2027, but the assumptions they rely on to make this projection are very unlikely to become reality. For example, the government assume that alongside market conditions, the cost of complying with European air-pollution rules could make it prohibitively expensive for coal stations to stay online. However, these compliance costs have fallen dramatically in recent years as new, cheaper techniques have been developed. It also assumes that a large amount of low-carbon capacity will be delivered throughout the 2020s, yet there are concerns over how this will be funded and, in the case of nuclear, whether it can be built to schedule. The amount of low-carbon capacity deployed in the coming years may, therefore, be lower than the government projects.

These projections also assume that the carbon price, introduced by George Osborne in his 2011 budget, will increase from £14 at the start of 2015 to £78 by 2030. Such a high unilateral carbon price would be undesirable: it would damage important UK industries and hit family budgets hard, and is likely to be politically undeliverable. It would mean that the difference between the carbon price in the UK and in the rest of Europe would effectively quadruple, from a price difference of £9.55 now to £38 in 2030. Under this scenario, carbon prices would add a total of £85 to household electricity bills in 2030 (CCC 2014a). Given these pressures, every stakeholder that we spoke to in the course of our research thought the prospect of the carbon price sticking to the current trajectory to be implausible.

Since the current trajectory appears to be both undesirable and undeliverable, this report presents two alternative scenarios showing what would happen if the UK fell back into line with the rest of Europe. The first would adjust to the European carbon price in 2017; the second would hold the current price steady at £23 until the European price rises above that level. In both scenarios, cumulative coal generation would be far higher out to 2030 than in the government's projections. Furthermore,

under the first scenario in which the UK relies solely on the EU Emissions Trading Scheme price from 2017, the amount of coal power generation in the UK would, by 2030, be almost three times greater than the government's current projections.

These more realistic scenarios for the UK's carbon price going forward would contribute towards four problems.

1. **Coal harms the investment case for new gas capacity.** The government want to see between 15 and 30 gigawatts (GW) of new gas power generation capacity by 2030. The investment case for that new capacity is negatively impacted by the uncertainty surrounding the future of coal in the UK's energy mix. The added risk that this represents to investors ultimately increases the cost of delivering new capacity.
2. **Coal threatens the UK's ability to meet carbon targets.** The government's independent advisers, the Committee on Climate Change (CCC), recommend that the most affordable way of meeting the UK's legally binding greenhouse gas commitments[1] would be to reduce the carbon intensity of the power sector to between 50g and 100g of CO_2 per kilowatt hour (CO_2/kWh) by 2030. Given that coal-fired power generation has a carbon intensity of 930gCO_2/kWh, it must clearly play a very limited role if the sector's carbon intensity is to be brought within these limits. Even without a decarbonisation target, the CCC has advised that meeting the UK's fourth carbon budget – which has cross-party support – would mean that coal 'can have no role in the power system beyond the early 2020s'.
3. **Coal causes more air pollution, which damages public health.** Coal generation releases substantial amounts of particulate matter, sulphur dioxide and nitrogen oxides, which are damaging for people's health. Some estimates have suggested that this causes 1,600 premature deaths annually, and that it costs the UK economy between £1.1 and £3.1 billion each year.
4. **Continued reliance on imports from Russia**. Thirty-five per cent of the coal used for electricity generation in the UK comes from Russia, compared to just 5 per cent of the UK's gas. A move away from coal would mean a major move away from Russian imports.

These problems present a strong case for new policy interventions to phase-out coal. We have therefore modelled the impact of introducing an emissions performance standard (EPS) for all UK power stations which, in 2017, exceed a carbon intensity of 450gCO_2/kWh. Gas power stations and stations fitted with carbon capture and storage (CCS) would not be affected.

An EPS sets an annual limit on the carbon pollution that is permitted from any given coal power station. Some states in the US, including California, have adopted a similar approach as a means of reducing carbon pollution, and the UK already applies an EPS to any proposed new coal-fired plant.

We have modelled two EPSs. The first tightens from 450gCO_2/kWh in 2017 to 100gCO_2/kWh in 2030. The second is introduced at 450gCO_2/kWh in 2017 and then tightens at a rate that would allow the same levels of coal generation that DECC project under current policies, leading to a phase-out by 2025. We examine the impact that both have on our two carbon-price scenarios, described above.

Our modelling shows that an EPS on 'old coal' would deliver a controlled phase-out of unabated coal generation through the 2020s at a lower cost to the consumer than the government's current policy of pursuing an extremely high unilateral carbon price.

1 The 2008 Climate Change Act cements in law at least an 80 per cent reduction in greenhouse gas emissions from 1990 levels by 2050.

The modelling also indicates that reducing the carbon price while adopting no other measures would more than double cumulative future coal generation, as coal would become more profitable than gas, thus creating economic circumstances in which coal stations could stay online.

In our scenario in which the UK's carbon price floor is removed in 2017, a weak EPS would save consumers £10.63 each year to 2030, and a strong EPS would save them £11.31, but both would result in higher cumulative coal generation than current policies. Since the tax revenues expected from the carbon price floor would be lost from 2017 onwards, HM Treasury would have to recover £4,715 million in the next parliament.

However, in our scenario in which the UK carbon price is held at £23, a weak EPS would still save consumers £7.61 each year, and deliver a level of cumulative coal generation only slightly higher than under current policies. In the next parliament, the Treasury would see its revenues reduced by just £684 million: there would be no reduction until 2017/18, and nearly two thirds of this shortfall would come in the final year of the parliament (2019/20). These revenue shortfalls could be offset by looking at the effectiveness of expenditure on the energy-intensive industries package (worth £250 million), which a lower carbon price would make less necessary.

With a UK carbon price held at £23, a strong EPS would save consumers £8.41 and result in lower cumulative coal generation than under current government policies. In the next parliament, the Treasury would see a greater reduction in its revenues, by £716 million in the next parliament, but there would still be no reduction until 2017/18. Again, these revenue shortfalls could be offset with changes to the package of measures for energy-intensive industries. We believe that the £23 floor scenario is the most desirable trajectory for the carbon price in terms of balancing the needs of consumers and the need to generate revenues for public expenditure.

IPPR recommends that an EPS is introduced on top of this at 450gCO_2/kWh in 2017. The rate at which it is tightened would depend on the level of ambition that government has in terms of addressing the coal issue. In this report we have presented two options, which would have the following impacts.

Weak EPS

- Phase-out coal generation by 2027, and ensure that the UK stays on course in relation to its existing commitments to reducing carbon pollution.
- Save householders an average of £7.61 on their electricity bills each year.
- Reduce revenue for the Treasury by £684 million over the next parliament, compared to £4,715 million if the carbon price floor were cut altogether.
- Require that new gas power stations are built at a consistent and easily deliverable rate of just 1GW per year to 2030, in order to hit the government's target of securing 15GW of additional combined cycle gas turbines (CCGT) capacity by then.

Strong EPS

- Phase-out coal generation by 2025. This would not only ensure that the UK stays on course in relation to its existing commitments to reduce carbon pollution, but would also demonstrate international leadership on climate change with a 10-year plan to end the use of unabated coal for electricity generation.
- Save householders an average of £8.41 on their electricity bills each year.
- Reduce revenue for Treasury by £716 million over the next parliament.
- Require that the construction of new gas power stations is front-loaded in the period to 2025, but at a manageable and deliverable rate in order to hit the government's target of 15GW.

We recommend that government introduces a strong EPS that results in a phase-out of coal generation by 2025. Assuming that the revenues lost to HM Treasury can be found in the next parliament, this is the most compelling option in terms of balancing a reduction in coal generation with concerns over security of supply and affordability.

We also recommend that a 2030 target for decarbonising the power sector is set as soon as possible in order to provide certainty over future government policy. Finally, we recommend that carbon constraints are placed on all future capacity market contracts. This will ensure that security of supply objectives are brought into line with decarbonisation policies, and that consumers' money is not used to subsidise technologies that are penalised through other mechanisms.

This framework would deliver greater energy security at a lower cost than the government's current policy of pursuing a high unilateral carbon price. If introduced alongside an extension of a £23 carbon price, it would be a 'no regrets' policy. It would ensure that coal generation does not prevent the UK from achieving sustainability goals, and provide a clear international signal of the UK's leadership on tackling climate change.

1. INTRODUCTION

The UK has a coal problem. Our overreliance on polluting coal-fired power stations is threatening our commitments to cutting carbon pollution, while driving up the costs of ensuring security of supply and placing higher costs on households and businesses.

Electricity generation from unabated[2] coal-fired power stations must fall sharply if the UK is to meet its legally-binding carbon-reduction targets. The government has projected that unabated coal generation will have ceased entirely by 2027 (DECC 2014a), but a number of the assumptions that this projection is based on are challenged by this report.

It is impossible to predict with any certainty how coal operators will respond to the commercial and policy framework that is already in place, let alone to other developments over the next 10 to 20 years. In addition to changing commodity prices, operators must consider European air-pollution regulations, uncertain carbon prices, annual capacity auctions, the technical capabilities of their power stations, and competition from low-carbon generation.

Of the 19 gigawatts (GW) of unabated coal that is currently online in the UK,[3] it has been indicated that around a quarter (5GW) will come offline by 2023, although that may yet be reversed. The future of the remaining 14GW is uncertain, and will be contingent on commercial decisions. It is entirely possible that it will all have gone offline before the government's projected date of 2027, but equally, in the absence of new policy instruments, it could well remain on the system beyond the 2020s.

In this report we argue that the level of uncertainty around coal's future is damaging the investment case for alternative capacity, including new gas, and demand-side measures such as energy storage. As our analysis will show, this uncertainty is increasing the costs of maintaining secure supplies of electricity.

We assess the central policy that is affecting decisions around coal generation – the government's unilateral carbon price floor – and present original modelling which demonstrates that an alternative policy framework would deliver greater certainty for the power sector and reduce the energy bills of households and businesses.

Report structure

In chapter 2 we consider the patterns of coal generation since 2009, and explain how the favourable environment for coal, relative to gas, has resulted in increased levels of coal generation and a subsequent rise in carbon dioxide (CO_2) emissions. This has meant that in 2013 the UK was the second largest emitter of CO_2 from coal in Europe, behind only Germany.

In chapter 3 we set out the Department of Energy and Climate Change (DECC's) existing projections for coal generation over the next 15 years, and give a critique of the assumptions that underpin these projections.

Chapter 4 discusses the implications of high levels of coal generation for the UK – its impact on investment in alternative capacity, particularly combined cycle gas turbines

2 Unabated coal-fired power stations are those that have not been fitted with carbon capture and storage technology, and which therefore release carbon pollution into the atmosphere.

3 Accounting for around 22 per cent of the UK's total capacity.

(CCGTs), the threat it poses to the UK's carbon reduction targets, persistently high levels of Russian coal imports, and the dispersed impacts of air pollution.

Chapter 5 sets out a number of alternative scenarios for coal generation based on different projections of the price of carbon in the UK. We show that uncertainties around this price dramatically affect both the amount of coal that is likely to be burned over the next 15 years, and the date by which it is likely to be phased out.

We present the results of our modelling in chapter 6, in which we compare the levels of coal generation, costs to consumers, and the impact on revenue for the Treasury, under a series of different policy scenarios. We then demonstrate how unabated coal can be phased out through the 2020s at a lower cost to the consumer than would result from current government policies.

Chapter 7 considers some alternatives options for limiting coal generation other than the one modelled in chapter 6.

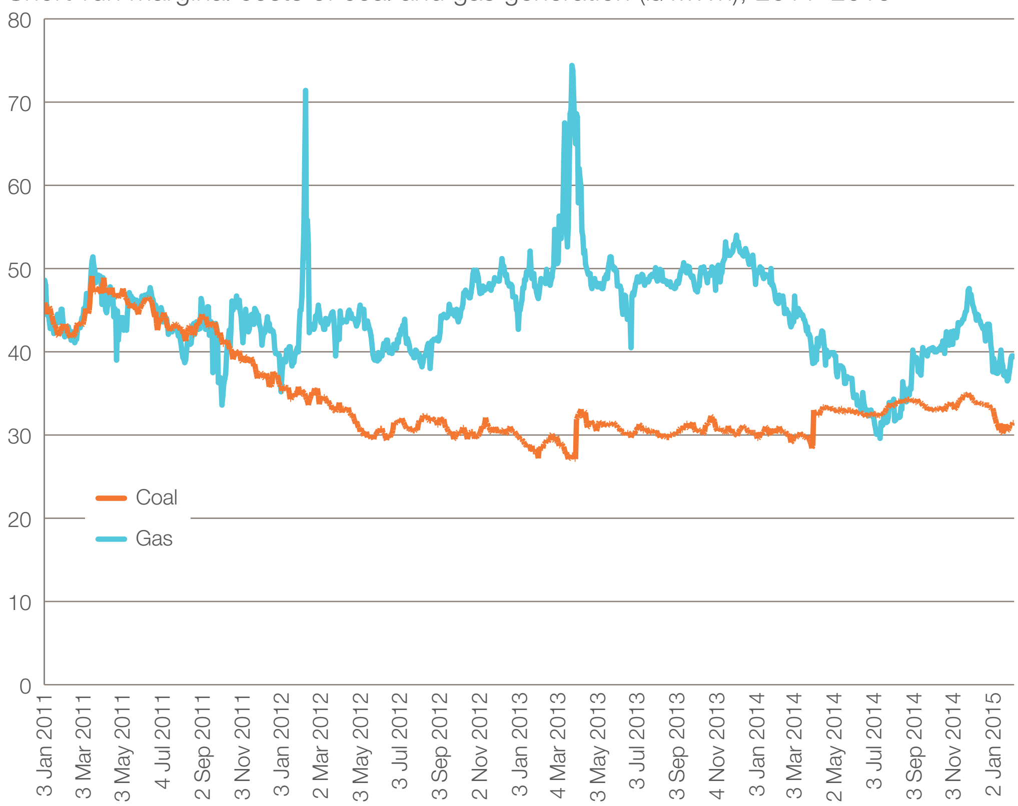
Finally, in chapter 8 we set out our recommendations and conclusions.

2. THE UK'S COAL PROBLEM

Coal-fired power stations have been a central pillar of the UK's electricity system since its beginnings in the late 19th century. Although levels of coal generation fell in the 1990s as new combined-cycle gas turbines (CCGTs) came online, they stabilised in 1999, at which point coal fulfilled around a third of UK electricity demand (DECC 2014b).

More recently, coal generation has increased due to the relative profitability of coal compared to gas. International coal prices fell by 19 per cent in 2012, 9 per cent in 2013, and 9 per cent in 2014 due to falling global demand and a structural oversupply in the market (ICE 2015; CCC 2014b). This was caused in part by an increase in the use of shale gas in the US, and a subsequent increase in US exports of coal. Gas prices increased by 10 per cent in 2012 and 16 per cent in 2013, driven by increasing global demand for gas which was partly due to the shutdown of nuclear capacity in the wake of the Fukushima incident in 2011 (CCC 2014b). However, in 2014 the price of gas fell by 26 per cent following a collapse in the price of oil (ICE 2015). This resulted in only a short period in which gas was more profitable than coal. Otherwise, coal generation has remained more profitable than gas for almost all of the period illustrated.

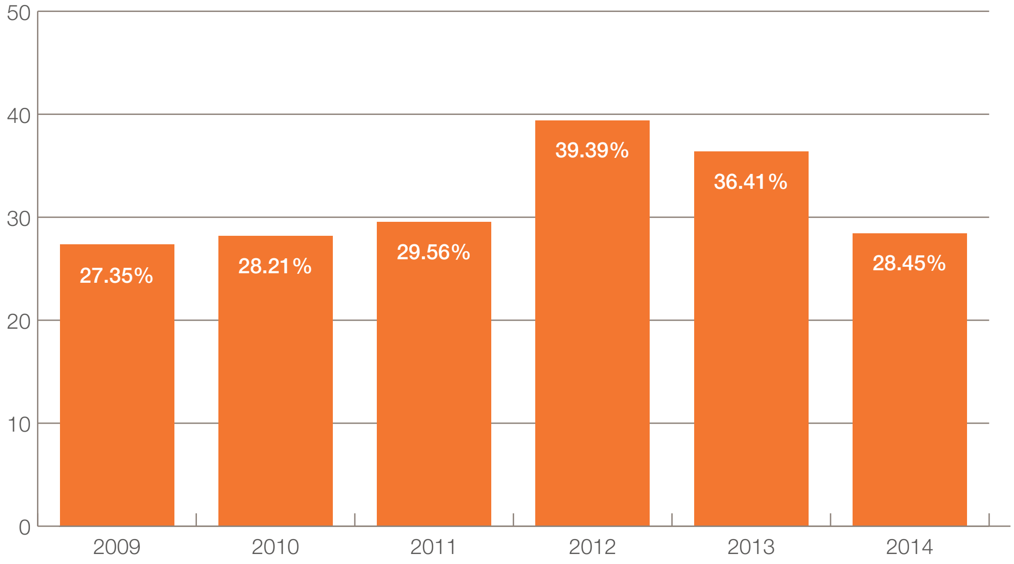
Figure 2.1
Short-run marginal costs of coal and gas generation (£/MWh), 2011–2015



Source: ICE 2015

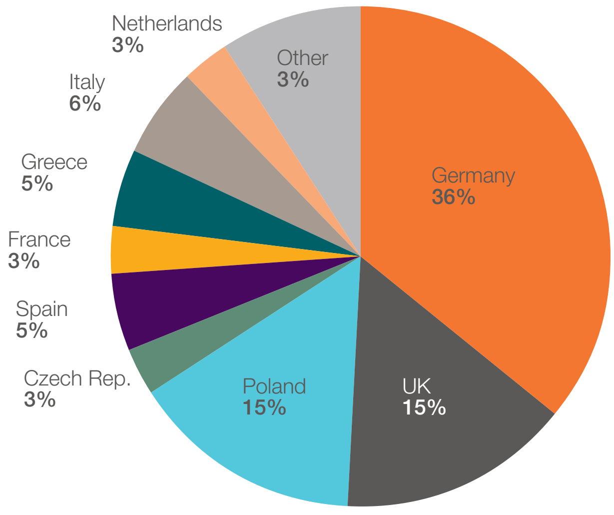
As a consequence, coal accounted for 28.5 per cent of total UK electricity generation in 2014 – a 1.1 percentage-point increase since 2009 (see figure 2.2). The sharp increase in 2012 was due to several coal stations running at very high levels before closing due to air pollution regulations introduced under the EU's Large Combustion Plant Directive (DECC 2015). These stations have now closed but levels of coal generation have remained high, as figure 2.2 below illustrates.

Figure 2.2
Coal as a percentage of total UK generation, 2009–2014



Source: DECC 2015
Note: This data includes an estimation of coal use in the fourth quarter of 2014, for which data was not available, which assumes an average of the levels over the first three quarters of 2014.

Figure 2.3
Percentage of CO_2 total emissions from coal within the EU emitted by each country, 2013



Source: Sandbag 2014

This has impacted on gas generation in the UK. In 2013 gas ran at a load factor[4] of just 27.9 per cent, while coal ran at 58.4 per cent (DECC 2014c). This has made it difficult for investors to justify supporting the new CCGT capacity that the government has indicated is required (DECC 2012). We discuss this issue further in chapter 4.

Coal-firing is the most carbon intensive form of electricity generation, producing 930g of CO_2 per kilowatt hour (CO_2/kWh) in 2013 – more than twice that of CCGTs, which produced 378gCO_2/kWh in the same year (CCC 2014b).[5] The increase in coal generation between 2009 and 2014 has therefore had a significant impact on the emissions of the power sector, and has offset much of the reduction in emissions caused by falling economic activity during the recession and greater renewable power capacity coming online (ibid).

The UK was the EU's second largest emitter of CO_2 from coal in 2013,[6] just above Poland, as figure 2.3 shows.

Despite fluctuations in the level of coal used in electricity generation, it has provided well over a third of the UK's total generation since 2009. Although some coal stations closed during this period, the relative profitability of coal ensured that the stations that remained ran at high levels. The following chapter sets out the government's projections for the future of coal generation.

4 Load factor is the ratio of the average output of a power station to its theoretical maximum output across a period of time (usually a year). It is usually expressed as a percentage.

5 These are averages for 2013.

6 Figures for 2014 are not yet available

3. WHAT NEXT FOR COAL GENERATION?

There is a political consensus in favour of capping carbon emissions. The Conservatives, Labour, the Liberal Democrats, the Greens and the Scottish National Party all support staying within the UK's rolling five-year carbon budgets, as set out in the Climate Change Act 2008. All of these parties have acknowledged that reducing carbon pollution from the power sector, including from coal-fired power stations, is necessary to meet these commitments (CCC 2009).

Furthermore, some parties have made pledges to introduce new climate change policies. For example, both the Labour party and the Liberal Democrats have said they would introduce a new legally-binding commitment to an almost zero-carbon power system by 2030. In the Committee on Climate Change (CCC's) initial advice to government in 2008, Adair Turner stated that in order to meet these targets,

> *'there can be no role for conventional coal generation in the UK beyond the early 2020s. This should be reflected by a very tight emissions limit being placed on any non-retrofitted plant beyond the early 2020s.'*
> CCC 2009

The Liberal Democrats have committed to introducing a ban on unabated coal-fired plants by 2025. Similarly, before coming into government David Cameron stated that

> *'all existing coal-fired power stations should be retro-fitted with CCS, and all future coal-fired power stations should be built with CCS. If we don't do this, we will not meet our carbon emissions targets.'*
> Cameron 2007

In 2013 Labour peers voted for an amendment to the Energy Bill which would have limited emissions from old coal stations.[7]

In February 2015 David Cameron, Ed Miliband and Nick Clegg signed a joint pledge to tackle climate change. It included a commitment 'to accelerate the transition to a competitive, energy-efficient low-carbon economy and to end the use of unabated coal for power generation.'[8] There is clearly acceptance across the political spectrum of the fact that unabated coal generation is a threat to decarbonisation, and needs to be addressed.

This chapter explores the scale of that threat by examining the projected future of coal generation.

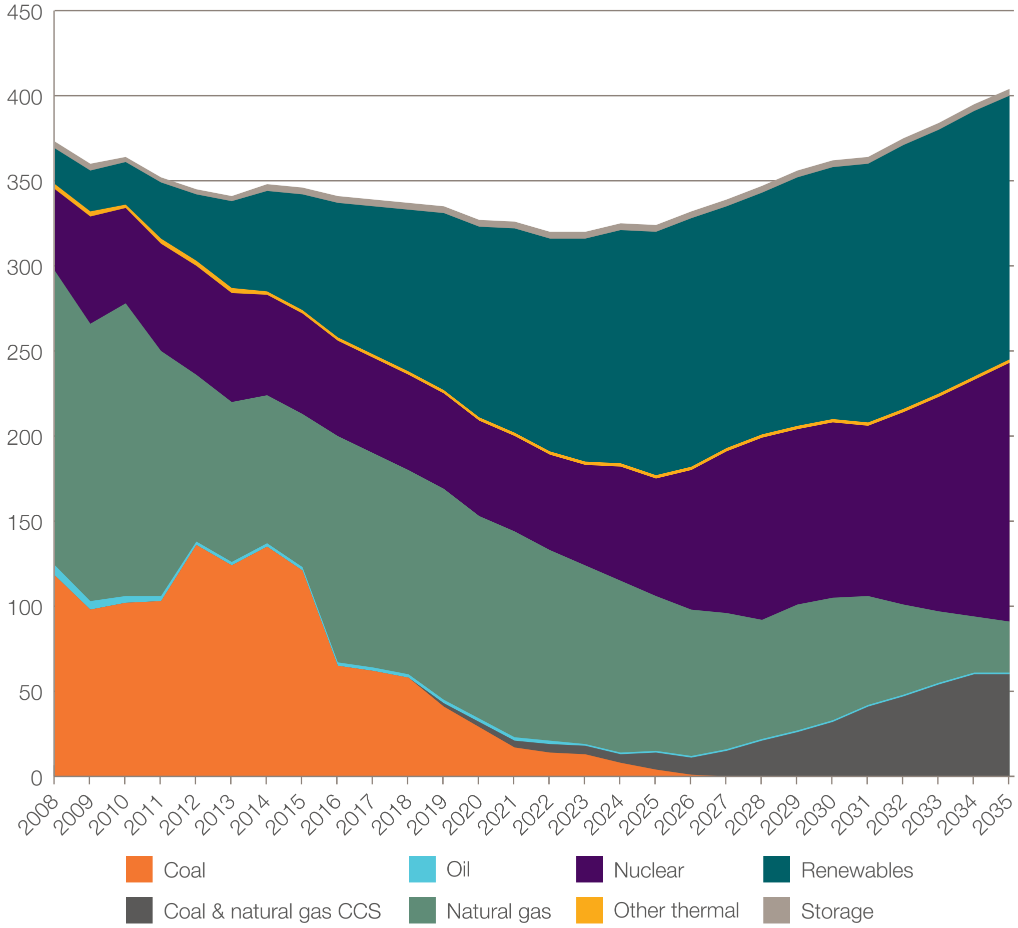
3.1 Projections for future coal generation

As figure 3.1 shows, DECC projects that coal generation will fall sharply over the next 10 years (DECC 2014a), and that unabated coal generation will be phased-out completely by 2027 under DECC's reference scenario.

7 http://www.theguardian.com/environment/2013/nov/04/house-lords-coal-power-stations

8 http://www.bloomberg.com/news/articles/2015-02-14/cameron-clegg-miliband-join-to-pledge-climate-action

Figure 3.1
DECC's projections of the UK's generation mix, 2008–2035 (reference scenario)



Source: DECC 2014a

If delivered, this projected total phasing out of coal generation would align with broader carbon reduction targets, and would allow sufficient time for new capacity to be built in its place. One might wonder, therefore, why anyone is concerned about coal use in the UK.

As with any modelling, this projection is underpinned by a number of assumptions, including three that are particularly relevant to coal generation. These three assumptions are about:

- the costs of implementing the Industrial Emissions Directive (IED), a European law designed to cut the output of local air pollutants
- the level of deployment of low-carbon power generation capacity
- the trajectory of the price of carbon in the UK and Europe.

In the following sections we will explore each of these assumptions in turn, demonstrating that the government is likely to be wrong in presuming that the existing policy framework will lead to a dramatically reduced role for unabated coal generation through the 2020s.

3.2 The Industrial Emissions Directive

The IED is a European directive aimed at controlling emissions of the air pollutants sulphur dioxide, nitrogen oxides and dust from large combustion plants. It does not limit carbon pollution.

There are a number of ways in which plant operators could respond to the IED.

1. Operators can opt in to the directive by fitting emissions control equipment that would ensure that they comply with the regulations.
2. They can opt out, which would mean they do not have to fit emissions control equipment, but can only run for a total of 17,500 hours between January 2016 and December 2022 – an average of 6.8 hours per day – and then close.
3. They can enter into the Transitional National Plan, which effectively gives operators four extra years to reduce their emissions down to IED levels or, if they fail to comply by 2020, be limited to running for 1,500 hours per year – an average of 4.1 hours per day.

The costs to the UK's coal operators of complying with the IED were thought to be prohibitive (AMEC 2012). The most significant cost was that of the equipment required to reduce nitrogen oxides – a technology known as selective catalytic reduction (SCR). Estimations of the cost of fitting SCR vary, but for an average 2GW plant it would be between £160 million and £676 million (Parsons Brinkerhoff 2014). However, in a report commissioned by DECC, Parsons Brinkerhoff indicated that it may be possible for operators to use a technique called selective non-catalytic reduction to comply with the IED in a manner that would be 'significantly cheaper in terms of capital cost' (ibid).

The barrier of IED compliance is also reduced by the payments available through the capacity market (see the box below). In the first capacity market, 8.9GW of coal received capacity contracts, securing payments of £293 million over the life of those contracts (Jones 2014).

DECC have argued that the capacity market will reduce wholesale prices, and that its net impact for operators is neutral. However, this presupposes a competitive market in which reductions in generation costs are passed through to consumers. The energy market is currently being reviewed by the Competition and Markets Authority, as it had 'reasonable grounds for suspecting that features of the energy market were preventing, restricting or distorting competition' (CMA 2015). Until this issue is resolved, it has been argued that capacity payments will provide additional support that will help coal operators to comply with the IED and continue to operate beyond 2023 (Littlecott 2014).

The capacity market

The capacity market is an annual auction designed to guarantee the security of the energy supply by providing additional payments to energy companies to ensure that they deliver energy or reduce demand when needed. DECC state that 'this will encourage the investment we need to replace older power stations and provide backup for more intermittent and inflexible low-carbon generation sources' (DECC 2014d).

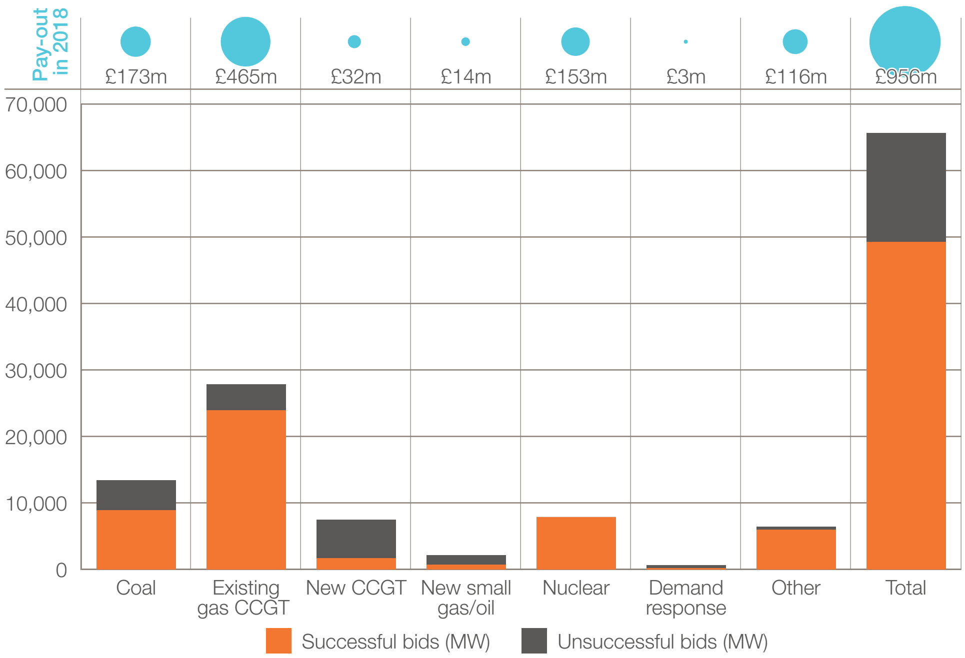
The total amount of capacity that is required is set in advance of each auction, and operators then bid to receive a contract. One-, three and or 15-year contracts are available.

The auction accepts bids from any form of generation capacity, other than the low-carbon capacity that is already benefiting from other support (such as contracts-for-difference).

Figure 3.2 below illustrates the results of the first auction held in December 2014, including the amount of subsidy going to each type of capacity and both successful and unsuccessful bids.

Figure 3.2

Results of the first UK capacity market auction (December 2014), by type of generation capacity, including successful and unsuccessful bids (in MW) and amount (£) to be paid out in 2018 only, in 2012 prices



Source: Jones 2014

The total amount to be paid out in 2018 (the first year affected by the auctions) is £956 million. £1.7 billion has been committed over the life of the contracts.

3.3 Levels of deployment of low-carbon capacity

Figure 3.1 shows that DECC projects a substantial increase in the deployment of renewable sources of energy in the current decade, a stable level of nuclear generation,[9] and a small contribution from coal and gas power stations with CCS installed. DECC forecasts that non-fossil generation, as a percentage of electricity consumption, will rise from 40 per cent to 80 per cent by 2030 (DECC 2014a).

If government policy is wholly successful then this scenario should become reality. However, there is significant uncertainty over whether existing policy and funding will deliver such substantial quantities of clean power over this time period.

For example, there are concerns that the budget for low-carbon subsidies[10] until 2020/21 is insufficient to bring forward the required levels of renewables, particularly offshore wind (Temperton and Schoenberg 2014). There have been warnings that there is also a lack of policy certainty beyond 2020/21 for all energy investors. This uncertainty is creating risks for all low-carbon projects (EAC 2014; CCC 2014b). Given the degree of controversy over the levies on household energy bills that are designed to support these investments, it is not clear that the government's existing policy of quadrupling the budget for low-carbon subsidies from £1.8 billion in 2011/12 to £7.6 billion in 2020/21 will be politically tenable (CCC 2014a). No decisions have yet been made about the

9 Given that 9.7GW of existing nuclear capacity is due to close in the next 10 years, this implies substantial new nuclear capacity coming online.

10 Known as the 'levy control framework', which places an annual limit on the amount that can be raised from consumer bills.

size of the budget during the 2020s, but the CCC has argued that it should be increased to around £10 billion annually by 2030 (CCC 2013).

The government's nuclear industrial strategy indicates that 12 new nuclear reactors, comprising 16GW of capacity, need to be built by 2030 (HM Government 2013). However, there have been significant difficulties in getting the first of these reactors, Hinkley Point C, negotiated and agreed.[11] EDF, the company leading the project, has still not made a final investment decision, and the approval of state aid for the project by the European Commission has recently been challenged by Austria, which could delay the project further.[12] Furthermore, the technology that is proposed for the new project at Hinkley does not have a good track-record of staying on time or budget.[13]

There is also uncertainty over whether the amount of CCS that DECC anticipates in its projections will be delivered. The development of the CCS industry in the UK has been delayed substantially. In 2010 the coalition agreement promised four new commercial-scale CCS demonstration projects, yet none have yet been delivered. Subsidies directed towards CCS have been cut by several billion pounds, and there is uncertainty over how much will be spent in the next parliament given that the technology will be competing against other low-carbon technologies for access to a limited subsidy pot (NAO 2013; ECCC 2014).

It is vital that a sufficient level of low-carbon capacity is deployed to decarbonise the UK's power sector. However, there is not enough certainty regarding whether it will be delivered for it to be relied upon to limit coal generation.

3.4 The carbon price floor

The carbon price floor (CPF), announced by the chancellor, George Osborne, in his 2011 budget and introduced in April 2013, is a controversial tax on domestic sources of carbon.

It consists of two elements: the EU Emissions Trading Scheme (ETS) carbon price (a pan-European levy on polluting industries), and a UK-only element – the carbon price support (CPS), which 'tops up' the carbon price set by the ETS. The trajectory that the government has set would mean that the UK's carbon price will hit £78 per tonne by 2030 (in 2014 prices) (DECC 2014a).

In the 2014 budget the chancellor announced that the CPS rate would be capped at £18 from 2016/17 to 2019/20. The CPF trajectory remains in place, but generators will only pay the difference between the ETS price and the trajectory up to the £18 cap (HM Treasury and HMRC 2011).

In practice, with reform of the ETS unlikely before 2020, the EU carbon price is likely to remain low, and so polluters are likely to pay close to the £18 domestic tax. After 2019/20, DECC currently assumes that the carbon price would rise linearly towards £78 by 2030. Figure 3.3 outlines this trajectory.

The CPF is controversial because it will drive up electricity prices for UK consumers for as long as fossil-fuel generation remains online. At the time of its implementation, IPPR argued that the CPF would fail to reduce carbon emissions or provide investor certainty, and would increase levels of fuel poverty in the UK (Maxwell 2011).

The CCC has said that the CPF is likely to be the primary driver of increases in household energy bills over the next decade (CCC 2014a). However, it is seen as an important source of revenue for the Treasury.

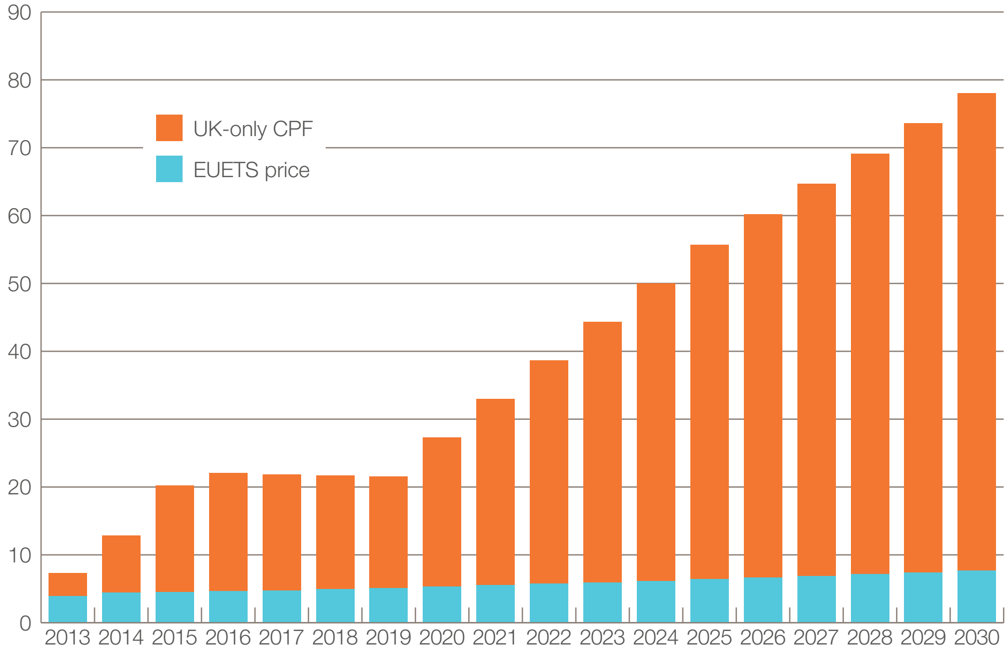
11 http://www.reuters.com/article/2014/11/18/edf-nuclear-idUSL6N0T85BN20141118

12 http://www.theguardian.com/environment/2015/jan/21/austria-to-launch-lawsuit-hinkley-point-c-nuclear-subsidies

13 http://www.ft.com/cms/s/0/adc90b3e-6f67-11e4-8d86-00144feabdc0.html#axzz3Pp2wo3EY

Figure 3.3

DECC's projection of the carbon price floor (£), 2013–2030



Source: DECC 2014a

Any measure that increases costs will inevitably come under scrutiny given the extent to which energy bills have placed a squeeze on living standards over the last 10 years. The average household energy bill increased from £650 in 2004 to £1,140 in 2013 – an increase 53 per cent above the rate of inflation (CCC 2014a). These rising costs have disproportionately affected the poorest families, who spend a larger share of their income on fuel costs.

Consumer Futures, among other consumer groups, has argued that

> *'[the] Carbon Floor Price and the EU-ETS… may strengthen the relative attractiveness of low carbon choices for industry, but they also increase fuel poverty, water down disposable incomes and dilute the international competitiveness of our economy.'*
>
> Consumer Futures 2013

The unilateral nature of the CPF means that it drives up the cost of electricity in the UK relative to other neighbouring countries. This impacts on the competitiveness of energy-intensive UK businesses because it can mean that their activities can be carried out more cheaply abroad. For example, manufacturer's association EEF claims that 'the unilateral Carbon Price Floor is a very real threat to the competitiveness of UK manufacturers and will do little to further the government's aim of decarbonising our electricity supplies' (Stace 2013). Trade unions and business groups including the Confederation of British Industry (CBI) argue that the CPF 'puts UK industry, particularly those that are energy-intensive and trade exposed, at a considerable competitive disadvantage' (CBI 2014; see also Orion Innovations 2014).

Perhaps counterintuitively, Greenpeace can also be counted among those that have criticised the UK's carbon tax policy, having denounced it as 'ineffective, adding to the squeeze on families and business while making negligible cuts in pollution' (Harvey 2012).

Until the ETS has been substantially reformed (which may happen in the early 2020s, through the introduction of a proposed market stability reserve) any carbon savings that are made in the UK as a consequence of the CPF simply release more ETS permits for the rest of Europe, and so result in no net carbon savings.[14]

If the CPF were to increase along the pathway to 2030 projected by DECC, it would push coal off the system, as figure 3.1 illustrates. However, the unpopularity of the CPF with consumers, business, and even environmental groups makes it unlikely that this will happen. The situation regarding CPF is similar to that of the fuel duty escalator, which has been frozen because of how controversial deliberate price increases are among voters. Given these pressures, every stakeholder that we spoke to in the course of our research for this report thought the prospect of the carbon price sticking to the current trajectory to be implausible.

However, the impact on the generation mix, particularly on coal, of the reform or removal of the CPF would be considerable. Coal-burning would become significantly more profitable than other, cleaner forms of generation.

3.5 Summary

If any of DECC's three assumptions explored above do not hold true, coal generation could continue at higher levels than DECC projects (see figure 3.1).

DECC base their modelling around the policy framework that is currently in place, and do not model for policy failure. The remainder of this report focusses on the likelihood of policy failure in relation to the carbon price. Failures relating to the IED or the deployment of low-carbon generation are not discussed further, but would result in greater coal burn.

In the following chapter we explain why high levels of coal generation could be damaging for the UK, and why it is therefore necessary to establish greater certainty about the future of coal.

14 Potential reforms to the ETS are set out in detail in Garman J (2014) *Europe's Power: Re-energising a progressive climate and energy agenda*, IPPR. http://www.ippr.org/publications/europes-power-re-energising-a-progressive-climate-and-energy-agenda

4. THE IMPACT OF CONTINUED COAL GENERATION

The preceding chapters have shown that coal has been resurgent in the UK in recent years, and that there are sufficient uncertainties around existing policies to make it possible that coal generation will continue beyond the mid-2020s. There are four reasons why this apparent eventuality should be avoided.

This chapter looks at each of these reasons in turn, before examining the counter-arguments in favour of maintaining coal generation.

4.1 Coal harms the investment case for gas and CCS

The government's gas generation strategy indicates that achieving a carbon intensity of 100gCO_2/kWh will require between 35GW and 41GW of CCGT capacity in 2030, up from the 32GW online today. It also estimates that 21GW of CCGT capacity will retire between 2012 and 2030 (DECC 2012). Under these calculations, 24–30GW of new CCGT capacity is required by 2030. However, in the recent energy and emissions projections from November 2014, it was assumed that 15GW of CCGT capacity will be required by 2030 (DECC 2014c). Although the exact figure varies, the government clearly wishes to see substantial investment in new gas capacity.

However, the continued presence of 19GW of coal capacity on the system directly threatens the available market for new CCGTs. Both coal and gas plants will be operating as peaking plants[15] when intermittent, renewable capacity is generating. If the short-run marginal costs of coal are lower than those of gas, then gas generation may not be required to meet demand. The case for gas investment is therefore harmed by uncertainty over the future of coal generation.

Shell CEO Ben van Beurden has stated that

> *'a combination of policy and market conditions, including the availability of cheap coal, and the low carbon price are leading to some unintended outcomes: the carbon reductions delivered by significant investments in renewable energy are being cancelled out by growing coal-based power generation. And at the same time, gas, a low-carbon energy source, is being squeezed out of the European power market. This is not the most cost-effective way to decarbonise.'*
> van Beurden 2013[16]

These concerns are borne out in the results of the government's recent capacity auction. 8.5GW of new CCGT capacity bid into the auction, but only one plant was successful – Trafford Power, at 1.7GW. Meanwhile, 8.9GW of coal was awarded capacity (National Grid 2014a). This clearly demonstrates that there is an appetite for investment in new CCGTs, but the failure of six such plants to win capacity contracts suggests that the current policy framework is not yet attracting the necessary investment.

We argue that creating greater certainty around the future of coal would bring forward the gas capacity that the government says is required at the lowest cost.

15 That is, a backup power station that operates when there is high demand for, or shortfalls in, the supply of electricity.

16 When he delivered this speech, on 11 July 2013, Ben van Beurden was Shell's downstream director.

It would also improve the investment case for CCS and innovative demand-side measures such as energy storage which reduce the need for additional generation capacity. The danger of prolonging investment in alternative capacity is that it would necessitate a spike in the build-rate when coal-fired power stations do eventually close. This could be expensive as well as having negative security implications which we discuss further in chapter 5.

4.2 Coal threatens the UK's decarbonisation targets

The 2008 Climate Change Act cemented in law a reduction in greenhouse gas emissions of at least 80 per cent relative to 1990 levels by 2050. The CCC has indicated that the most affordable route to achieving this is to reduce the carbon intensity of the power sector from its current level of around 500gCO_2/kWh to between 50 and 100gCO_2/kWh by 2030.

In its Fourth Carbon Budget report the CCC state that 'the carbon-intensity of [an] unabated coal plant is sufficiently high that it can have no role in the power system beyond the early 2020s' (CCC 2010). Imperial College London recently modelled a number of different scenarios for coal generation, and found that the target of a carbon intensity of 100gCO_2/kWh would be missed in all but one scenario in which the carbon price reaches £75 per tonne by 2030. They state that 'the continued use of unabated coal could significantly undermine the potential for Britain to meet targets for emissions from power generation in 2030' (Gross et al 2014).

Twenty per cent of the UK's total emissions come from coal generation (DECC 2014a). A continuation of such high levels would clearly be incompatible with the wider process of decarbonisation.

A target for decarbonising the power sector

To ensure that carbon budgets are met in the most cost-effective way, the CCC argue that a target is required to decarbonise the power sector to a carbon intensity of between 50 and 100gCO_2/kWh by 2030.

Both Labour and the Liberal Democrats have committed to introducing this target if they are in government after the general election.

Ed Miliband has stated:

> *'It is Governments which set the low carbon targets and correct market failures; and the degree of support for policies shown by governments is a major part of perceived risk for investors. To attract the investment we need, governments must cover that risk and commit to a clear goal of decarbonising the power sector by 2030, as the independent Committee on Climate Change has recommended.'*
>
> Miliband 2012

Although not committed to this specific measure, the Conservatives are committed to the CCC's first four carbon budgets, which imply a sharp reduction in the grid's carbon intensity.

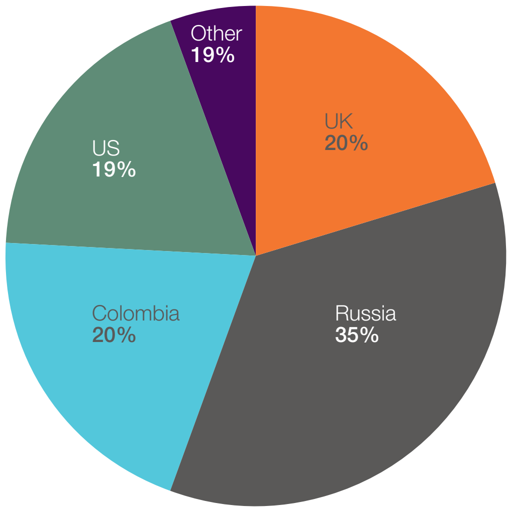
This 2030 target has also been accepted by a wide range of stakeholders, including the Energy and Climate Change Select Committee, the CBI, the Institution of Mechanical Engineers, the Scottish government and the Carbon Capture and Storage Association.

IPPR supports the target because it would provide more time for the transport and heat sectors to develop cost-effective routes to decarbonisation, and give the energy sector certainty over the direction of government policy (McNeil 2013).

4.3 Coal increases the UK's dependence on imported and unstable energy sources

In 2013 the UK burned 49 million tonnes of coal, of which 80 per cent was imported. Figure 4.1 below gives a breakdown of the origins of the coal used in UK electricity generation.

Figure 4.1
The origins of steam coal used in electricity generation, 2013



Source: Authors' calculations based on DECC 2014e

It is particularly concerning that 35 per cent of coal burned for generation in the UK, and 45 per cent of all imported coal, comes from Russia. In response to the crisis in Ukraine and the annexation of Crimea the EU has introduced a number of sanctions against Russia,[17] and has spent considerable time exploring ways in which Europe's gas supply can be diversified away from Russia[18]. Less, however, has been said about coal imports from Russia. Since very little of the UK's natural gas comes from Russia, a move away from coal would substantially reduce the UK's reliance on Russian fuel imports.

4.4 Air pollution

The principal source of air pollution in the UK is from road traffic (Rowney 2014). However, air pollutants from the UK's coal-fired power stations have also been shown to contribute significantly to ill health and the costs of treating it (HEAL 2013).

Coal generation releases substantial amounts of particulate matter, sulphur dioxide and nitrogen oxides, which are damaging to health. Long-term exposure to these air pollutants can cause chronic respiratory diseases such as chronic bronchitis, emphysema and lung cancer, and cardiovascular diseases such as myocardial infarctions, congestive heart failure, ischemic heart disease and heart arrhythmias. Acute effects include respiratory symptoms as well as exacerbated asthma attacks. Children, older people and patients with an underlying condition tend to be more susceptible to the effects of this air pollution (ibid).

17 http://europa.eu/newsroom/highlights/special-coverage/eu_sanctions/index_en.htm
18 http://www.bloomberg.com/news/2014-03-20/eu-readies-natural-gas-plan-to-cut-reliance-on-russia-in-months.html

The air pollutants from coal generation can be dispersed over long distances, and have impacts outside of the UK. It is therefore difficult to calculate their attributable impacts, but a recent study by the Health and Environment Alliance attributed 1,600 premature deaths a year to air pollution from UK coal generation, as well as 68,000 additional days of medication, 363,266 working days lost and more than a million incidents of lower respiratory symptoms. They estimate that this is costing the UK economy between £1.1 and £3.1 billion each year (ibid).

Reducing coal generation would ameliorate the effects outlined above, improve the health of those affected, and lead to reduced health costs.

4.5 Examining the arguments in favour of coal generation

Aside from the arguments against coal outlined above, proponents of coal argue that it has a number of benefits. This includes improving security of supply for the power sector, reducing energy bills and providing jobs. We address these three points in turn.

Does coal supply security?

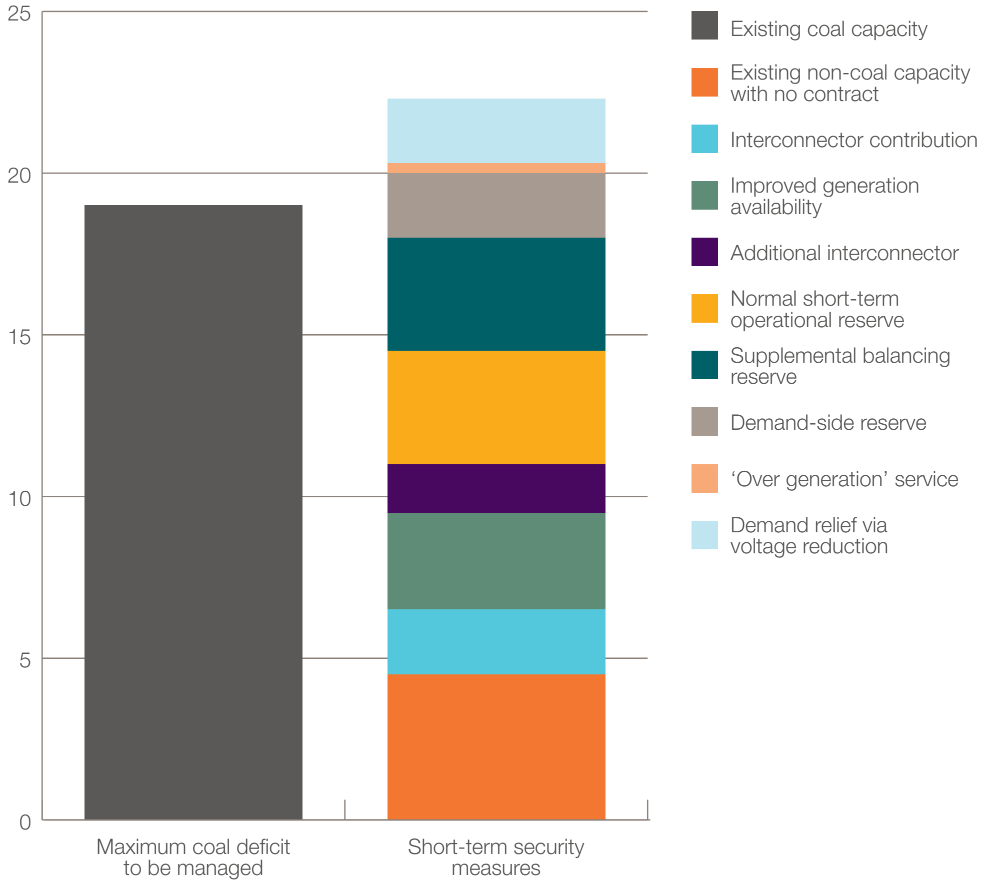
Energy security is an important objective of energy policy. The National Grid's recent *Winter Outlook* stated that the current 'average cold spell' margin, the buffer of extra capacity available to meet peak demand in the UK, is 4.1 per cent. This is down relative to previous years, mainly because of planned closures, a number of breakdowns and new plants not coming online quickly enough to replace them. National Grid makes clear that this is a short-term issue, and they have introduced a number of measures to compensate for it, including a supplemental balancing reserve and a demand-side balancing reserve. These have effectively increased the margin to 6.1 per cent, which is well within the reliability standard set by the government (National Grid 2014b).

The energy consultancy Trilemma have shown that even if all of the UK's coal capacity were to come offline at once, short-term measures equivalent to 17.8GW of capacity could be brought forward to address the resultant deficit, before any new capacity has even been built (Skillings et al 2015).

Over the longer term, the issue of tight capacity margins is managed through the capacity market. As the boxed-out text above explains, the capacity market ensures that secure supplies are guaranteed in advance, with auctions four years and one year before the 'delivery year'.[19] As is evidenced by the capacity market that ran at the end of 2014, there is more than enough capacity to meet demand in 2018/19: 65GW of capacity entered the auction, where only 49GW was required. Without the 8.9GW of coal capacity that received contracts there would, therefore, still be sufficient capacity. However, of the 8.5GW of new CCGT capacity that bid into the 2014 capacity market, only 1.7GW was successful (National Grid 2014a). The gas industry has made clear to us in the course of our research for this report that additional CCGT capacity could be brought online rapidly.

19 The capacity market has a number of flaws which we discuss in chapter 7. However, the modelling underpinning this paper assumes that it remains in place as it is. Even if the capacity market were reformed, it is highly likely that government would maintain policies to ensure security of supply.

Figure 4.2
Combined measures available for ensuring short-term security of supply (in terms of capacity, in GW)



Source: Adapted from Skillings et al 2015

Does coal reduce energy bills?

As we explained in chapter 1, coal generation was cheaper than gas over the period 2009– 2014. In the context of rising electricity bills, 'cheap' coal generation looked like an attractive option. However, the design of the UK's electricity market means that when coal is cheap, generators make larger profits, and savings are not passed on to consumers.

Theoretically, an energy market will rank power stations in order of increasing variable cost and select the cheapest available station until demand is met (Staffell and Green 2012). The price required by the most expensive station (known as the 'marginal plant') is the price that all generators receive. For the vast majority of the time the marginal plant in the UK is CCGT. This means that any power station generating at a cost lower than that of this CCGT plant will make a profit. Consumers do not benefit from this as they still pay the wholesale cost plus all the other costs the supplier adds on to a bill. So when coal is cheap for generators it is profitable, but is not necessarily cheaper for households or businesses.

The UK market is not perfect, and there are many factors influencing the dispatch of generation. Despite this, gas has remained the marginal plant for the majority of the 2009–2014 period, which has made coal very profitable.

Does coal provide jobs?

The UK coal industry has been a significant provider of jobs since the industrial revolution. Today there are 3,715 jobs in UK coal-mining, and approximately 3,000 in coal-fired power stations (DECC 2014e). A reduction in unabated coal generation will clearly have an impact on these jobs in the short term. However, a controlled phase-out of unabated coal generation will stimulate investment elsewhere in the industry – not least in CCS, an industry that the TUC estimates could create a total of between 15,000 and 30,000 jobs annually by 2030 (CCSA and TUC 2014).

CCS could offer a lifeline to the coal industry in the UK by developing a new domestic market that is aligned with the decarbonisation of the economy. However, the uncertainty surrounding the future of 19GW of unabated coal generation is damaging the investment case for CCS as well as for CCGT.

With the average efficiency of an old coal-fired power station at 37 per cent, and an average age of 46 years old, there is no prospect of retrofitting CCS equipment into these stations. The Carbon Capture and Storage Association told us that 'given their age and relative inefficiency I can see no economically viable way in which existing UK coal plants could be retrofitted with CCS'.[20]

CCS will be applied to newer and more efficient stations. We argue that continuing to run old coal-fired power stations is harming opportunities for the development of CCS. This is more damaging for employment in the medium and long terms. The source of future employment in the energy sector will be the low-carbon sector, which already accounts for one million jobs (Carbon Trust and Shell 2013).

Why should the UK move ahead of Europe?

There is a risk that any unilateral policy such as a rising carbon price floor or an emissions performance standard could result in surplus allowances being freed up across the rest of the EU. This would mean that any reduction in UK carbon emissions would be accompanied by a commensurate increase in emissions across the rest of the EU.

The European Commission's proposal for a market stability reserve is designed to address this by automatically regulating the supply of permits in order to adjust for a change in the level of demand for permits (EC 2014). It would mean that in future an unexpected event like the global financial crisis would not result in an oversupply of permits when demand is reduced due to economic recession. It would also respond to a reduction in demand due to a policy being enacted in an individual country or group of countries in order to deal with a specific problem such as the continuation of coal generation in the energy system.

The market stability reserve is due to be implemented by 2020/21, meaning that any unilateral UK EPS will not distort the ETS market, so long as it begins to bite *after* 2020/21. Germany and the UK have both been pushing for early implementation in 2017, and there have been some efforts to reach a compromise within the European parliament which could mean implementation by 2019. Regardless of whether and when the market stability reserve commences, it would be sensible for the UK to seek broader agreement across the EU with regard to tackling coal generation.

The UK and Germany account for more than half of the EU's CO_2 emissions from coal. The emissions of both countries have increased in recent years, as coal has become cheaper than gas. Since both countries have shown leadership on tackling climate change – with the implementation of the Climate Change Act in the UK and *Energiewende* in Germany – a bilateral concordat between the UK and Germany on the need to tackle coal would send a strong signal to the rest of Europe, and indeed

20 Luke Warren, chief executive of the Carbon Capture and Storage Association, in personal communication with the authors, 5 February 2015.

the world, on the need to reduce their coal use. A coordinated approach from Germany and the UK could help to neuter criticism from internal vested interests which claim that these countries are acting alone.

The German government is expected to publish a draft law in the first half of 2015 setting out how they will reduce their own reliance on coal. Late last year, Sigmar Gabriel, federal minister for economic affairs and energy, and Barbara Hendricks, federal minister for the environment, published a 'climate action plan' (Appunn 2015). This set a goal of reducing German CO_2 emissions by 4.4 million tonnes per year, leading to a total cut of 22 million by 2020. A cut on this scale would be consistent with the decommissioning of around 9GW of coal capacity (Morris 2014).

A UK–Germany concordat on coal could be extended to include France. A report recently commissioned by Sigmar Gabriel and his opposite number in France, Emmanuel Macron (minister for the economy, industry and digital affairs) called for the energy sector to become a prime example of a 'borderless sector'. The report states that a 'benign attitude vis-à-vis the damages [sic] of coal' in Germany is holding back the transition to a more environmentally friendly economy (Enderlein and Pisani-Ferry 2014).

Other countries are also making progress. China's coal consumption fell by 2.9 per cent in 2014,[21] and in June 2014 the Obama administration announced its objective of reducing carbon pollution from the US power sector by 30 per cent by 2030 relative to 2005 levels.[22]

4.6 Summary

The amount of coal used in meeting energy demand in the UK has actually risen since 2009. This has offset much of the progress made in reducing carbon emissions elsewhere in the economy. If coal generation continues at high levels, the UK will not only endanger future carbon budgets but also threaten investment in new capacity, maintain damaging levels of air pollution, and continue to rely on imports from countries such as Russia and Colombia.

The government's projections that coal generation will end in 2027 are based on assumptions that we have challenged, particularly the undesirable and undeliverable increase to a £78 UK-only carbon price. In the next chapter we therefore set out some alternative projections for the future of coal generation based on different, and perhaps more realistic, carbon price trajectories.

21 http://www.businessspectator.com.au/news/2015/3/3/energy-markets/china-nearing-peak-coal-after-29-fall-year

22 http://www.theguardian.com/environment/2014/jun/02/obama-rules-coal-climate-change

5. THREE SCENARIOS FOR THE UK'S CARBON PRICE

There are 10 coal-fired power stations currently online in the UK, and none have publicly announced closure dates. Yet DECC projects that all of these stations will be offline by 2027. As this report has outlined, there are a number of uncertainties around whether current policies will deliver this outcome, including whether sufficient alternative capacity will be delivered as intended, and whether compliance with the IED will become cheaper.

Since it is difficult to model these outcomes, this chapter focuses on one other uncertainty, which is controlled by government – the carbon price. We set out three potential pathways for the carbon price out to 2030, allowing us to compare the level of coal generation, the rate at which new CCGT capacity would be required, and the impact on consumer bills under each scenario. In the next chapter we model the impact of additional policies on each of these scenarios.

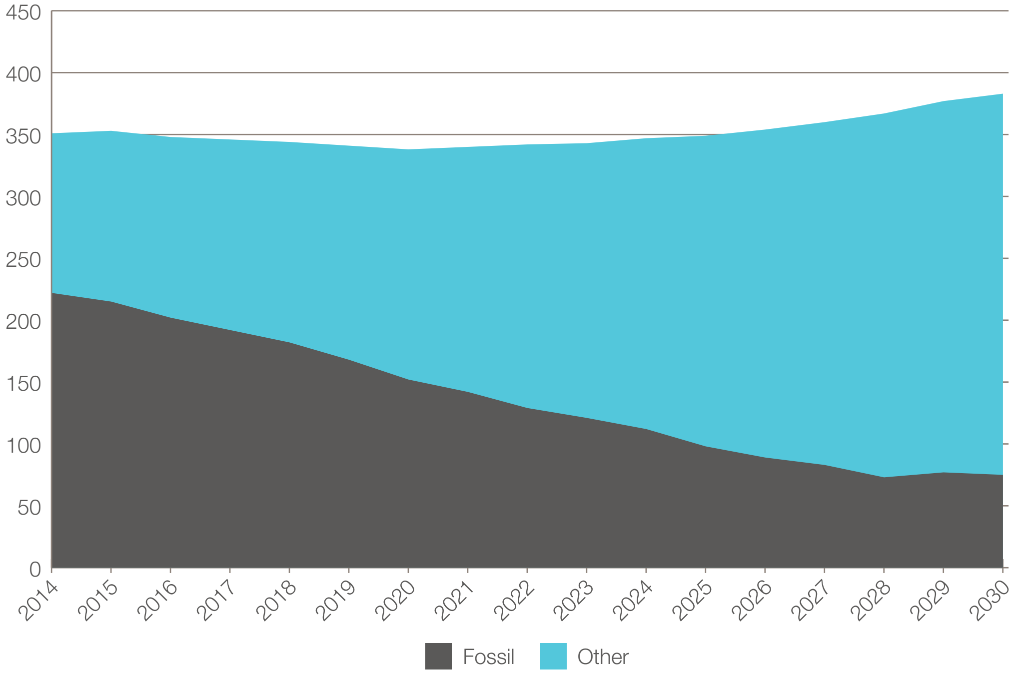
5.1 Assumptions

Within our modelling there are a number of assumptions that must be explained.

1. We assume that all unabated coal capacity must be closed in 2030. Although the CCC has said that coal capacity running at very low load factors does not necessarily threaten carbon budgets (CCC 2014b), we argue that there are other reasons to phase-out unabated coal generation, including air pollution and the desire to move away from Russian fuel imports. We take 2030 as a final deadline in order to determine the cheapest and most secure way of getting to that point.
2. We use DECC's projections for the role of fossil-fuel generation between 2014 and 2030, which assumes that 15GW of new CCGT capacity will be built, and that the total demand for fossil-fuel generation will be halved. These projections are illustrated in figure 5.1 below. This fall in fossil generation is predicated on increasing low carbon capacity and an increased contribution through interconnectors.[23] We also assume that the current capacity market rules remain in place.
3. In all scenarios we use the same coal and gas price assumptions, from DECC's base case (see appendix) in the energy and emissions projections from November 2014 (DECC 2014a).

23 'Interconnectors' refer to cross-border transmission capacity connecting different European member states.

Figure 5.1
DECC 'reference scenario' assumptions about the UK's electricity generation mix (GWh), by type of fuel, 2014–2030



Source: DECC 2014a

5.2 Scenarios

Each of our scenarios is based on a different carbon price trajectory: this is the only price that varies. The trajectories are as follows.

DECC's scenario

DECC's carbon price is taken from its updated energy and emissions projections for 2014 (DECC 2014a; see appendix). It is based on current government policy which sees the carbon price rising to £78 per tonne by 2030.

Our working assumption is that the carbon price trajectory in DECC's scenario is very unlikely to transpire. We therefore set out two other scenarios under which the UK's carbon price could be brought back into line with the ETS price. One would adjust it immediately in 2017, while the other would hold the current price steady at £23 until the ETS rises above £23.

The ETS-only scenario

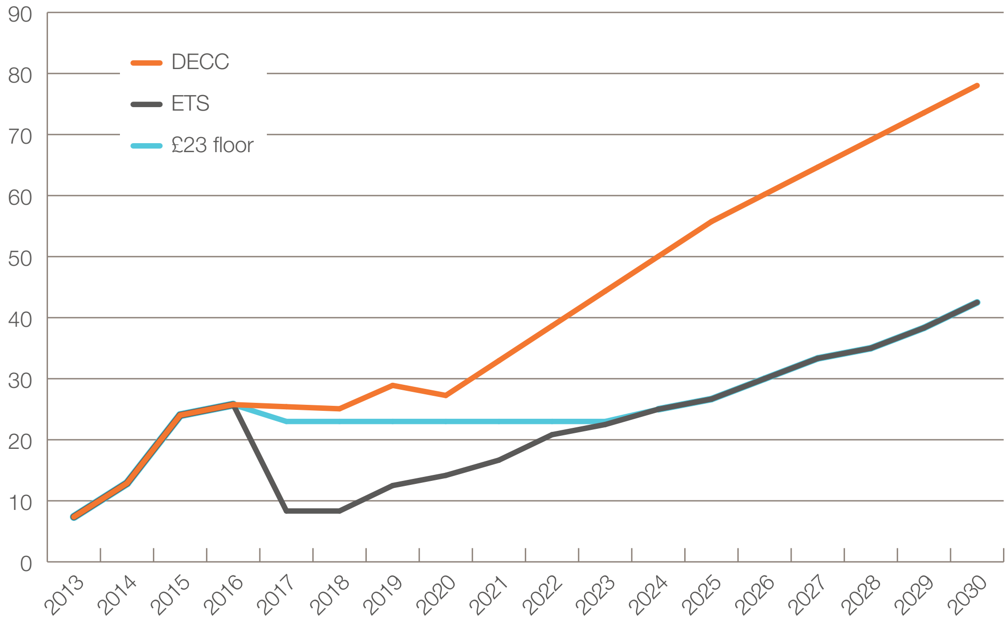
This scenario assumes that the unilateral CPF is scrapped in 2017, so that only the ETS price applies in the UK. We chose 2017 as the date for this change because it allows a reasonable period for a new government to consult and budget for it. The ETS price that we use is a forecast from Point Carbon (Schjølset 2014). This assumes that a market stability reserve is introduced to the EU ETS from 2017 and has the effect of driving up the Europe-wide price of carbon, as appears likely to occur at the time of writing (Morris 2015). Our forecast assumes that the ETS price rises above £10 per tonne in 2019, and then rises to £42 per tonne by 2030.

The £23 floor scenario

Under this scenario we assume that the CPF (ETS plus CPS) remains frozen from April 2015 at £23 (that is, a €7 ETS price plus an £18 CPS rate). We project a UK carbon price that stays fixed at this level until the ETS rises above £23. This is similar to existing government policy, but assumes that the price is frozen at £23 until the rest of Europe comes into line, rather than the UK domestic price being up to £18 above the ETS price. We assume the same ETS trajectory as in the ETS-only scenario.

These three carbon price forecasts are illustrated in figure 5.2 below.

Figure 5.2
Carbon price forecasts (£) under our three scenarios, 2013–2030



Source: Authors' calculations based on DECC 2014a and Schjølset 2014

5.3 Results of the three scenarios

As table 5.1 below shows, the ETS-only scenario would provide the greatest benefit to consumers and businesses, but would remove expected carbon tax revenue from the Treasury that has already been budgeted. The £23 floor is a compromise under which consumers benefit but revenue to the Treasury is maintained to some extent until the ETS price exceeds £23. We believe this scenario is the most likely to become reality, because government, consumers and industry would all benefit from it.

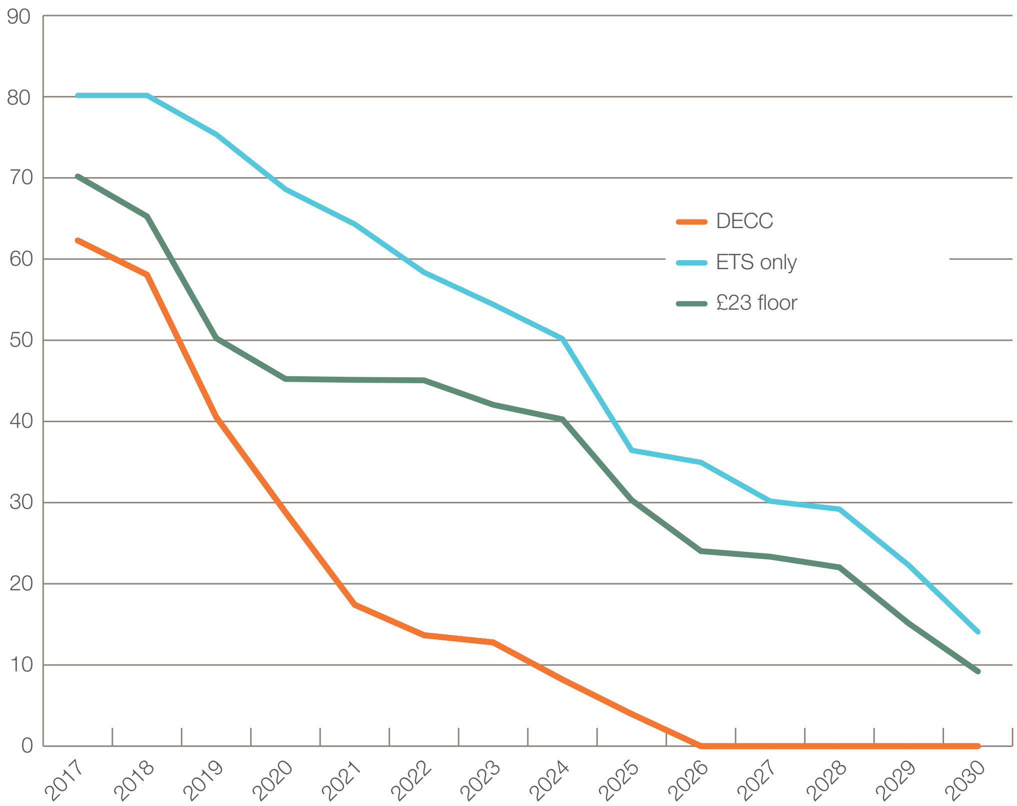
Table 5.1
Outcomes of each of our three scenarios

Scenarios	Cumulative coal generation, 2017–2030	Capacity of coal plants remaining in operation in 2030	Total impact on bills (annual average, 2017–2030)	Impact on household electricity bill (annual average, 2017–2030)
DECC	246TWh	0GW	£0 (base case)	£0 (base case)
ETS only	695TWh	5GW	-£1,291 million	-£11.04
£23 floor	525TWh	3GW	-£886 million	-£7.57

Source: Authors' calculations based on DECC 2014a and Schjølset 2014

The problem with these scenarios is that under both the ETS-only and £23 floor scenarios we can expect levels of coal generation out to 2030 to be far higher than under the base scenario, as figure 5.3 below demonstrates. Cumulative coal generation in the ETS-only scenario is 695TWh – 449TWh more than under DECC's scenario. In the £23 floor scenario, cumulative coal generation between 2017 and 2030 will be 525TWh, which is 279TWh more than under DECC's scenario. Significantly, a number of coal power plants would still be online in 2030 under both of our scenarios.

Figure 5.3
Coal generation (TWh) under each of the three scenarios, 2017–2030

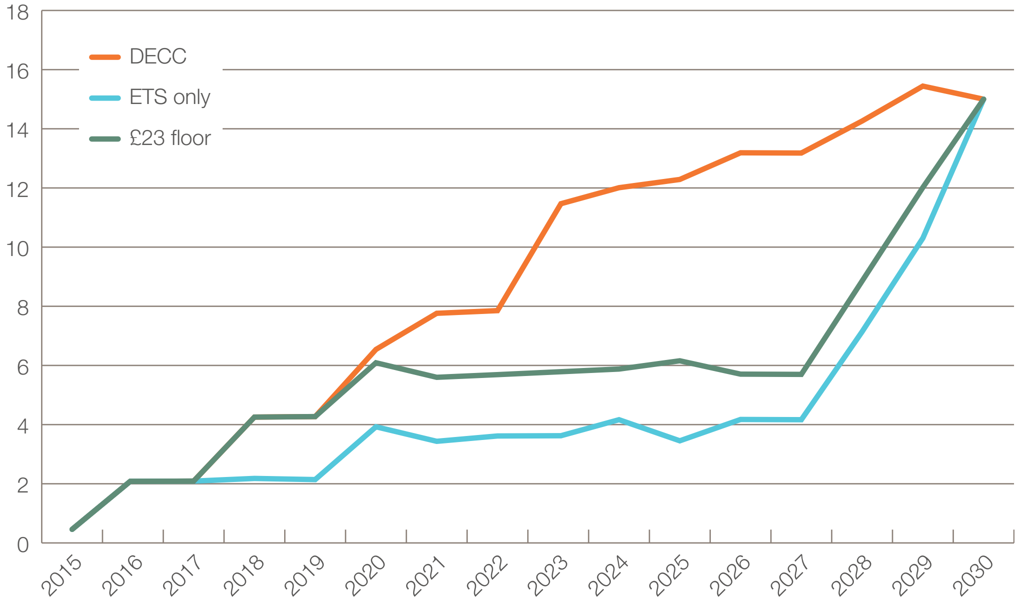


Source: Authors' calculations based on DECC 2014a and Schjølset 2014.

This modelling therefore suggests that if the CPF trajectory is not implemented as planned, levels of coal generation will be significantly higher than they would otherwise have been through the 2020s, and some coal power stations will remain online in 2030.

One interesting outcome is the implied build-rates of CCGTs. In all three scenarios, 15GW of CCGT capacity must be built in order to replace coal and meet demand – it is just a question of when this capacity will get built. The results of our analysis show that in the absence of additional policy, a reduced carbon price would push back CCGT development to the end of the 2020s: between 9 and 11GW would be required in the space of four years, rather than being spread across the 2020s as under DECC's scenario. This would drive up the costs of capacity contracts in the capacity market by £198–£204 million each year from 2017 to 2030.

Figure 5.4
Cumulative new-build of CCGT capacity (cumulative GW) under each of the three scenarios, 2014–2030



Source: Authors' calculations based on DECC 2014a and Schjølset 2014

5.3 Summary

Our analysis shows that without additional policies, the only way to ensure that coal generation ceases and an appropriate amount of CCGT is brought on-stream before 2030 is for the carbon price to follow DECC's published trajectory. However, this would result in a carbon price of £78 per tonne by 2030 – a price that we believe would be both undeliverable and undesirable.

The modelling indicates that reducing the carbon price alone would more than double cumulative future coal generation, as coal would become more profitable than gas, and coal stations would stay online.

We therefore argue that an alternative framework is needed: one that provides more certainty for investors in new low-carbon capacity; ensures a steady build-rate of CCGTs throughout the 2020s; can be delivered at a lower cost than current policy; and is consistent with the mechanics of the ETS, so that it does not raise emissions elsewhere in the EU. The following chapter considers how such a framework can be delivered.

6. AN ALTERNATIVE POLICY FRAMEWORK FOR LIMITING COAL GENERATION

AN EMISSIONS PERFORMANCE STANDARD

In this chapter we set out the impact that an emissions performance standard (EPS) would have on coal generation, CCGT build-rates, and costs to the consumer. An EPS was introduced in the Energy Act 2014 to prevent the building of new unabated coal stations.

Emissions performance standards

An EPS sets a limit on the emissions of CO_2 per unit of power. Any new fossil-fuel power station in the UK must comply with an EPS of 450gCO_2/kWh, with some exemptions for CCS projects. Existing coal-fired power stations are not covered by the policy.

The 450gCO_2/kWh rate is averaged over a year, which means that a power station can still run if it has a carbon-intensity greater than the EPS limit, but at a reduced load factor. In practice, every power station is given a total tonnage allowance of CO_2 that they must remain within each year.[24] This tonnage is calculated using a station's installed electrical capacity (in MW), and assuming that without the EPS the station would run at a load factor of 85 per cent.[25]

The averaging of the EPS rate over a year is important as it allows operators the flexibility to choose how to comply. By contrast, a flat rate of 450gCO_2/kWh would close all coal-fired power stations immediately.

The EPS modelled in this chapter would, when first introduced in 2017, be applied to all UK power stations with a carbon intensity greater than 450gCO_2/kWh. It would subsequently be tightened, reaching 100gCO_2/kWh in 2030. The rate would be reduced linearly, so that the sector has absolute clarity over the rate going forwards.

6.1 The impact of an EPS on coal generation

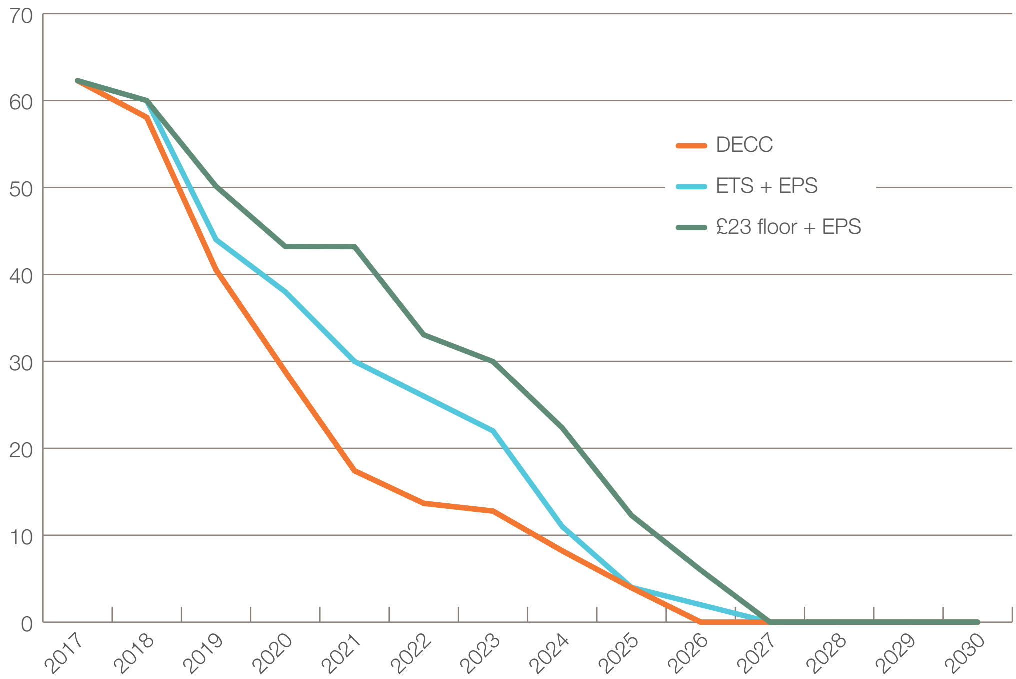
The graph below illustrates the levels of coal generation that would occur if an EPS were applied to the ETS-only scenario and to the £23 floor scenario. DECC's scenario is also plotted for reference.

Under both of our scenarios, an EPS would have the effect of stopping coal generation in 2027. In both, cumulative coal generation is higher than under DECC's scenario, but the £23 floor comes close, with total coal generation of 299TWh over the period 2017–2030, compared to 246TWh under DECC's scenario.

24 A plant's total allowance is equal to 450kg/MWh multiplied by the number of hours in a year, multiplied by 0.85, multiplied by plant capacity. Source: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48375/5350-emr-annex-d--update-on-the-emissions-performance-s.pdf

25 In the modelling presented in this report, an EPS is calculated relative to 'installed capacity'. An EPS on new plant, by contrast, uses 'expected capacity' (which is 85 per cent of installed capacity).

Figure 6.1
Projected coal generation (GWh) with an EPS applied, under three scenarios, 2017–2030



Source: Authors' calculations based on DECC 2014a and Schjølset 2014

6.2 The impact of an EPS on CCGT build

Under both scenarios the reduction in coal generation is controlled, which gives clear signals to investors in alternative capacity. The graph below shows how an EPS affects the rate at which the required 15GW of CCGT capacity by 2030 is built, with DECC's scenario included for reference. Under all three scenarios we project a manageable, almost linear build-rate, unlike under the ETS-only and £23 floor scenarios with no EPS applied (see figure 5.4).[26]

6.3 The costs and benefits of an EPS

The table below illustrates the costs and benefits of each scenario. It shows that in both scenarios electricity bills are lower than they would have been under DECC's existing carbon-price trajectory. The impact on consumer bills is the sum of changes to the wholesale price and the cost of capacity payments. Further detail of the methodology used in the modelling that underpins this work is given in the appendix.

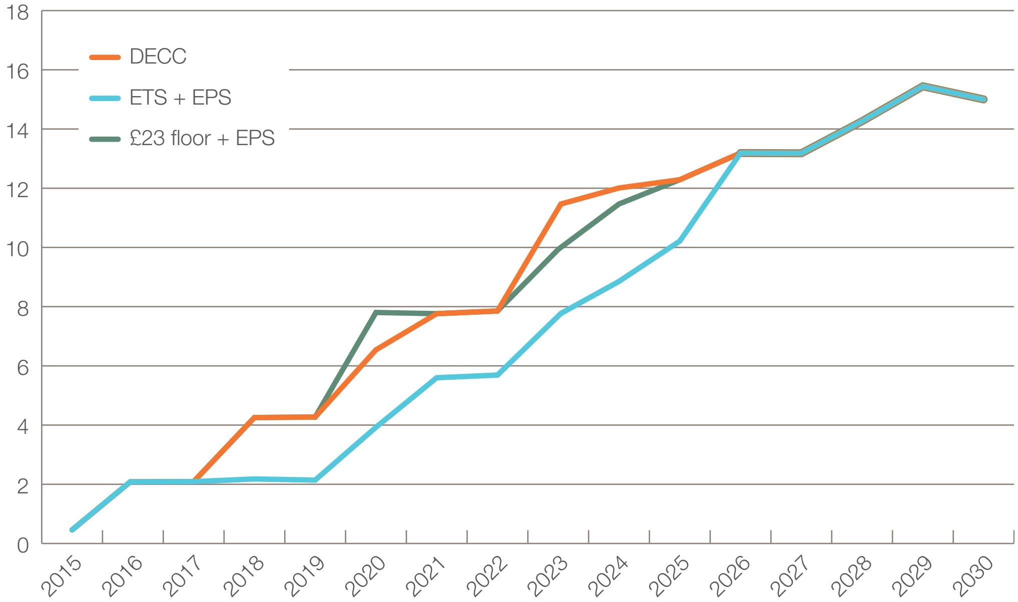
26 The economic benefits of a more predictable CCGT build-plan were not modelled, but they could potentially be substantial. With an EPS on old coal, investors in CCGT have a clearer view of their addressable market. This reduces the policy risk that is priced into the cost of capital, and thus lowers the cost of delivering new capacity.

Table 6.1
Costs and benefits of each policy scenario

Scenarios	Cumulative coal generation 2017–2030	Capacity of coal plants remaining in operation in 2030	Total annual impact on bills (annual average, 2017–2030)	Impact on household electricity bill (annual average, 2017–2030)
DECC	246TWh	0GW	£0m (base case)	£0m (base case)
ETS + EPS	362TWh	0GW	-£1,244m	-£10.63
£23 floor + EPS	299TWh	0GW	-£891m	-£7.61

Source: Authors' calculations based on DECC 2014a and Schjølset 2014

Figure 6.2
Cumulative new-build of CCGT capacity (cumulative GW) under each of the three scenarios with an EPS applied, 2014–2030



Source: Authors' calculations based on DECC 2014a and Schjølset 2014

Consumers stand to save most under the ETS-only scenario, with a saving of £10.63. However, this would be offset by a significant fall in Treasury revenues of £4,715 over the course of the next parliament (2015–2020). The introduction of an EPS results in a modest reduction of the benefit for consumers (it reduces annual average savings from £11.04 per year to £10.63 under this scenario; see table 5.1).

Under the £23 floor scenario consumers would save £7.61 once an EPS is introduced (compared to £7.57 without it). Treasury revenues would be less adversely affected than under the ETS-only scenario, with a loss of revenue of £684 million over the course of the next parliament; furthermore, unlike the ETS scenario, the costs to the Treasury would be back-loaded, meaning revenue implications of just £162 million by the third year of the next parliament (that is, 2017/18). These revenue shortfalls could be offset by looking at the effectiveness of expenditure on the energy-intensive industries package (worth £250 million) and other measures to mitigate the cost of the low-carbon transition for internationally-exposed businesses (BIS 2013). Since a £23 carbon price would significantly reduce the competitiveness effect of a higher unilateral carbon price, the need for compensation of this kind would be reduced.

Table 6.2
Impact on Treasury revenues (£) of an EPS under the ETS-only and £23 floor price scenarios (relative to DECC base scenario)

Scenario	2015/16	2016/17	2017/18	2018/19	2019/20	*Total*
ETS + EPS	£0m	£0m	-£1,746m	-£1,616m	-£1,353m	*-£4,715m*
£23 floor + EPS	£0m	£0m	-£162m	-£106m	-£416m	*-£684m*

Source: Authors' calculations based on DECC 2014a and Schjølset 2014

We believe that the £23 floor scenario is the most desirable trajectory for the carbon price, as it best balances the needs of consumers and the Treasury. Furthermore, the option of adding an EPS to this trajectory is a very compelling one.

Why an EPS does not increase costs?

In the scenario in which the UK CPF is frozen at £23 per tonne, coal remains on average £6/MWh cheaper than gas. This calculation uses DECC's projections for coal and gas prices.

Our modelling shows that the EPS keeps cumulative coal burn to 299TWh, compared to 525TWh without an EPS. However, this reduced coal generation has a minimal impact on the electricity price because, for the vast majority of the time, the price is already set by gas. In our scenario the electricity price increases by only £0.60/MWh – a very slight increase, which would add less than £2 to an annual household bill.

However, there is an offsetting cost reduction from a lower capacity-market clearing price. An EPS would bring forward new CCGT capacity. Since the annual running costs of coal are twice as high as existing gas, an EPS would mean cheaper gas would be more likely to set the capacity price than more expensive coal. The magnitude of this difference closely offsets the difference in the power price.

The offsetting nature of these two effects means the net cost difference of an EPS is very close to zero.

If future gas prices are lower than DECC's projections, and current forward market coal and gas prices play out, then an EPS would result in even greater savings for bill-payers.

6.4 Possible risks of an EPS

Our analysis shows that an EPS would introduce greater certainty over the future of coal generation than the current policy framework, which is centred on a rising unilateral carbon price. It is, however, important to recognise that there are issues that could potentially result from an EPS, including the following.

Regulatory change

A downside of regulatory measures, in contrast to market mechanisms, is that they are vulnerable to political interference. It may be possible for a future government to remove a regulation such as an EPS if it does not align with their policy objectives. However, the entire energy market is vulnerable to political interference and, indeed, the freeze in the CPF has shown that market pricing mechanism are not immune to this.

Energy efficiency

An EPS may work against energy efficiency if it is accompanied by a reduction in the CPF as we recommend. Our policy would result in reduced wholesale power prices, which could lead to higher levels of consumption. Unfortunately, when looked at from a purely economic perspective, energy efficiency and affordability do work against one another. The first requires high prices, the second low. In practice, high energy prices in recent years have not been accompanied by big increases in efficiency. IPPR has previously argued that energy efficiency policy in the UK requires a radical change of approach (Platt et al 2013) – one that ensures that incentives to greater efficiency remain in place despite lower power prices.

Replacement capacity

An EPS may remove coal from the system with greater certainty but, because a 'true' carbon price is not captured in wholesale market prices, the policy could create distortions that prevent the pursuit of the most cost-effective path.

6.5 Summary

The analysis above demonstrates that an EPS on 'old coal' would deliver a controlled phase-out of unabated coal generation at a lower cost than the government's current trajectory for carbon prices. It would also provide a far clearer signal to potential investors in new capacity, because there would be transparency and clarity over the rate at which the EPS is reduced.

We have shown that high levels of coal generation threaten investment in alternative capacity, have the potential to undermine the decarbonisation of the power sector, maintain a dependency on undesirable supplies of coal, and damage people's health through air pollution. We therefore argue that unabated-coal generation needs to be phased out in a controlled manner which gives certainty to the wider energy sector. The current policy framework does not provide that certainty.

An EPS is a 'no regrets' policy that would ensure that unabated coal is phased out through the 2020s even if the carbon price does not rise as quickly as DECC projects. It may be the case that the ETS is successfully reformed, with the proposed market stability reserve delivering a high carbon price throughout the 2020s, which would ensure that coal operators close anyway. However, if the ETS does not deliver, or if the CPF is removed, then an EPS would provide the certainty that industry requires.

We have set out a clear case for introducing an EPS on old unabated coal. The next chapter examines an alternative option for the design of the EPS, and details our recommendations for changes to the wider policy framework affecting coal.

7. ALTERNATIVE POLICY OPTIONS FOR CONSTRAINING COAL GENERATION AND ENSURING SECURITY

Our analysis shows that the UK has a coal problem, and that current policies will only address it if the carbon price follows an ambitious trajectory that will load costs onto consumers and impact on our economic competitiveness. If, as seems likely, this trajectory is not maintained then additional policies will be needed to constrain coal. Our analysis shows that an EPS can tackle coal while maintaining security of supply and delivering savings to the consumer. In this chapter we set out a more ambitious design for an EPS and identify the costs and benefits of moving faster. We also discuss the wider policy framework affecting coal – specifically the capacity market and a 2030 power sector decarbonisation target.

7.1 A stronger EPS

An EPS can be set at any level. In the previous chapter we modelled an EPS that began at 450gCO_2/kWh because this aligns with the existing EPS for new-build coal stations. We then examined a tightening of this EPS over time in order to align with a sector-wide carbon intensity of 100gCO_2/kWh by 2030.

We have also modelled a stronger EPS option that closely tracks the levels of coal generation that DECC has projected will occur under existing policies. This option would result in the total phase-out of coal by 2025.[27] Figure 7.1 below illustrates the levels of coal generation that would occur under this stronger EPS option with a £23 carbon floor price scenario. We have also shown the EPS modelled in the previous chapter for comparison.

Cumulative coal generation would be extremely low under the strong EPS, with total generation of 209TWh over the period 2017–2030, compared to 246TWh under DECC's scenario and 299TWh under the weaker EPS.

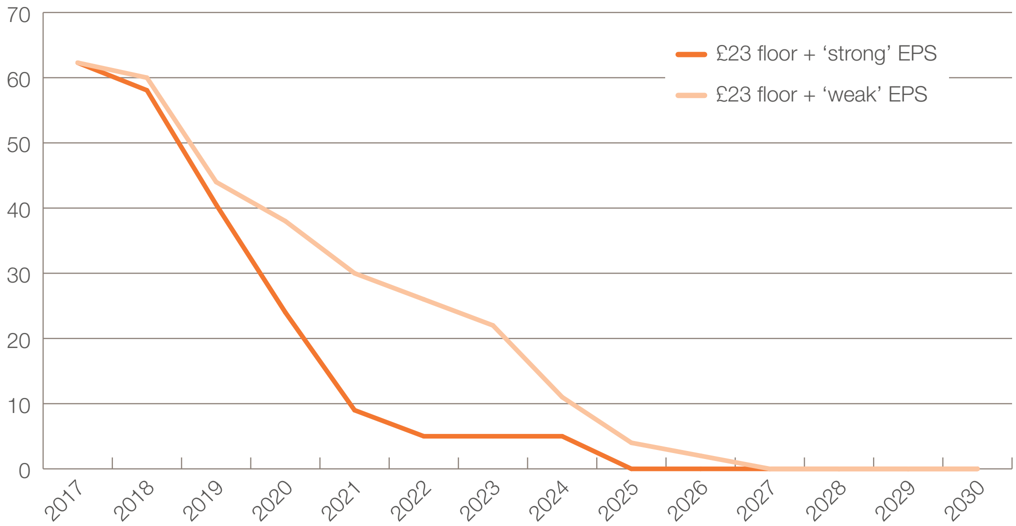
Table 7.1
Costs and benefits of each policy scenario

Scenarios	Cumulative coal generation, 2017–2030	Capacity of coal plants remaining in operation in 2030	Total annual impact on bills (annual average, 2017–2030)	Impact on household electricity bill (annual average, 2017–2030)
DECC	246TWh	0GW	£0m (base case)	£0 (base case)
£23 floor + EPS	299TWh	0GW	-£891 m	-£7.61
£23 floor + strong EPS	209TWh	0GW	-£985 m	-£8.41

Source: Authors' calculations based on DECC 2014a and Schjølset 2014

27 This EPS option is designed to allow the same level of generation as the DECC scenario. However, it results in lower coal generation than this scenario because coal operators do not take full advantage of the permitted running hours and instead decide to close earlier.

Figure 7.1
Projected coal generation (GWh) under a weak EPS option and a stronger alternative option, with a £23 carbon floor price applied under both scenarios, 2017–2030



Source: Authors' calculations based on DECC 2014a and Schjølset 2014

Our modelling shows that this option delivers an £8.41 annual saving to consumers relative to the DECC scenario, compared to £7.61 under the weaker EPS. There would be a greater reduction in revenue to HM Treasury from the CPF due to lower levels of coal generation, but the difference is relatively small. Over the next parliament the revenue shortfall would be £716 million but, as with the weaker EPS, it would be back-loaded. There would be revenue implications of just £162 million by the third year of the next parliament (2017/18). Again, as with the weaker EPS, these revenue shortfalls could be offset by looking at the effectiveness of expenditure on the package of measures for energy-intensive industries.

Table 7.2
Impact on Treasury revenues of an EPS under the ETS-only and £23 floor price scenarios (relative to DECC base scenario)

Cost against baseline (£m)	2015/16	2016/17	2017/18	2018/19	2019/20	*Total*
£23 floor + EPS	£0	£0	-£162	-£106	-£416	*-£684*
£23 floor + strong EPS	£0	£0	-£162	-£120	-£434	*-£716*

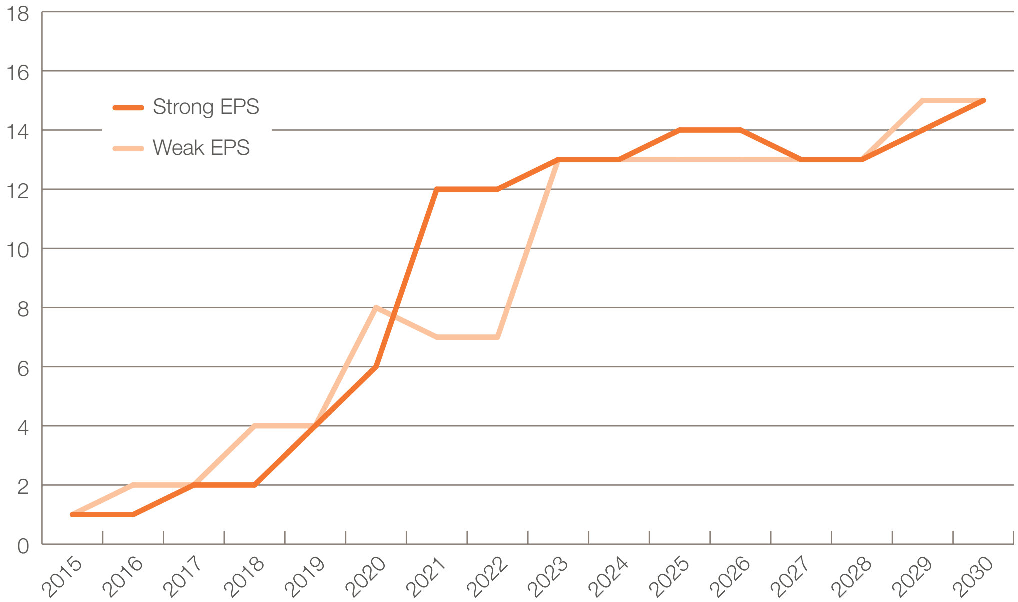
Source: Authors' calculations based on DECC 2014a and Schjølset 2014

The build-rate required to deliver 15GW of CCGT by 2030 is would be steeper in the early 2020s under the strong EPS than under the weaker one, but this rate would still be manageable.

Our central argument in this report is that the existing policy framework does not provide sufficient certainty to ensure that unabated coal generation is phased out. This creates a number of problems, as we have outlined. We therefore argue that further policy intervention is required to introduce some clarity for the sector over the future of unabated coal. Our central recommendation is that an EPS is introduced by 2017.

However, an EPS can be designed to meet the government's requirements, and it is the government that decides how quickly coal generation should be phased out. The analysis in this section demonstrates that there is a compelling case for applying a strong EPS that phases out coal by 2025. This would save the consumer £8.41 on their annual bills in every year to 2030.

Figure 7.2
Cumulative new-build of CCGT capacity (cumulative GW) under the strong and weak EPS scenarios, 2015–2030



Source: Authors' calculations based on DECC 2014a and Schjølset 2014

In order to ensure security of supply it is vital that incentives are in place to encourage new capacity. A strong EPS necessitates a faster build-rate of CCGT, but must also be accompanied by continued deployment of low-carbon capacity. Earlier in the report we raised concerns regarding the certainty of future low-carbon deployment but, as we discuss below, this would be greatly improved by the introduction of a target to largely decarbonise the power sector by 2030.

A new government taking office in May 2015 and committing to a 10-year phase-out of unabated coal generation would show strong leadership on climate change in a year when the international community will seek to agree a deal at the meeting of the United Nations Framework Convention on Climate Change in Paris in December.

If government is to act to end the use of unabated coal for electricity generation, it is important that the wider policy framework aligns with this intention. In the following section we argue that the capacity market offers an incentive for coal operators to remain online, and must therefore be reformed.

7.2 Carbon constraints on capacity market contracts

Following consultation, the government decided to introduce a market-wide capacity market because it 'offers the surest way to ensure security of supply against a range of scenarios' (DECC 2011). This meant that any provider of capacity could bid for contracts apart from providers of low-carbon capacity who are rewarded through other mechanisms such as feed-in tariffs and contracts for difference. The market was opened to all capacity, regardless of carbon intensity.

IPPR has argued previously that a market-wide capacity market is an inefficient way of guaranteeing security of supply, and that a targeted strategic reserve would reduce costs and provide greater control over the nature of spare capacity (Platt et al 2014).

One of the principal issues with current design of the capacity market is that it procures capacity for security reasons that are incompatible with the government's other overarching objective of decarbonisation at the lowest cost. For example, 8.9GW of coal capacity received contracts in the 2014 capacity market. It has been argued that these payments could be used by coal operators to cover the capital costs of complying with the IED (Littlecott 2014). If this were to occur it would obviously increase the chance of coal capacity remaining online through the 2020s, and would work against the CPF. As we explain in the introduction, the consumer is therefore paying to both penalise and incentivise coal generation at the same time.

One way to ensure that the capacity market is aligned with the process of decarbonisation would be to introduce a carbon constraint on the contracts that are awarded. There are two options for how this can be achieved.

1. Making any power station that receives a capacity market contract, and which has a carbon intensity above a set limit, subject to an EPS.
2. Disallowing any station over a set carbon intensity to bid into the capacity market.

This carbon intensity limit could be set at a level that does not impact on the less carbon-intensive generation, such as new gas, that the government does want to incentivise.[28] An advantage of this option is that it would not require a change to the Electricity Market Reform (EMR) programme,[29] and could be put in place using secondary legislation.

A disadvantage of it is that if coal operators wanted to run at higher levels they could simply choose not to enter the capacity market. The carbon intensity limit would penalise coal relative to other generation, but would not necessarily regulate it off the system. However, it would bring the governments' policies on security of supply and decarbonisation into line with one another. If coal generation is to be phased-out, as the leaders of all three main parties have pledged that it will be, then it seems counterintuitive to be subsidising it through the capacity market. We recommend that carbon constraints are placed on all future capacity market contracts.[30]

7.3 A target to decarbonise the power sector by 2030

There is broad support for a target to largely decarbonise the power sector by 2030. We believe that a target of this kind would provide certainty over the future direction of government policy. However, the target would require underlying policies to ensure that it is met. In relation to coal, high levels of generation could continue without further policy intervention. We therefore believe that an EPS on coal provides one useful mechanism for decarbonising the power sector.

The final chapter that follows brings together our analysis and sets out our recommendations.

28 A mechanism designed in this way may capture small diesel generators, 40MW of which got contracts in the 2014 auction.

29 https://www.gov.uk/government/policies/maintaining-uk-energy-security--2/supporting-pages/electricity-market-reform

30 Our modelling assumes that the existing capacity market rules are maintained. If coal capacity was removed from the capacity market it would impact on the overall costs of the EPSs that we model. However, since the annual running costs of coal are twice as high as existing gas, an EPS would mean cheaper gas would be more likely to set the capacity market price than more expensive coal. Thus, removing coal from the capacity market would bring forward new CCGT capacity and result in lower costs and greater savings for the consumer.

8. CONCLUSIONS AND RECOMMENDATIONS

Between 2009 and 2014, the proportion of UK electricity that came from coal increased by 1.1 per cent, with a significant peak in 2012. Most of the environmental gains from the deployment of low-carbon power and the fall in demand due to the recession were cancelled out by this increase. The coal stations that are currently generating about one-third of the UK's electricity are old and inefficient: to stay online, most of them will require investment to make them compliant with the IED and extend their lives. Before this investment takes place, we have a unique opportunity to phase-out the UK coal fleet while ensuring that the UK decarbonises its power sector in line with the CCC's recommendations, security of supply is maintained *and* costs to households and businesses are reduced.

The government's existing policy trajectory, which has the carbon price rising to £78 by 2030, would result in coal being phased-out by 2027. Since this trajectory involves an escalation of the UK's unilateral carbon price above and beyond the EU price, the pressure that it would put on households and businesses makes it extremely unlikely that this pathway would be adhered to – which in any case would be undesirable as it would be unlikely to contribute to lower emissions across Europe.

However, if this trajectory is not followed, the levels of low-carbon capacity deployment that the UK requires, and the falling costs of IED compliance, would make a total phase-out of coal unlikely without additional policy measures.

Our modelling in chapter 6 demonstrates that adding an EPS onto either the ETS scenario or a scenario in which the carbon floor price is frozen at £23 would – compared to DECC's current plans for the carbon price – result in savings for consumers.

In order to maintain revenues for the Treasury in the short term, the CPF should be frozen at £23 from April 2015, and maintained at that level until the ETS price exceeds it.

We recommend that an EPS is introduced on all UK power stations that, in 2017, exceed a carbon intensity of 450gCO_2/kWh. Gas power stations and stations fitted with carbon capture and storage (CCS) would not be affected. The EPS should be progressively tightened from 2017 onwards.

The rate at which it is tightened will depend on how ambitious the government is about addressing the coal issue. We have presented two options, which would have the following impacts.

Weak EPS

1. Phase-out coal generation by 2027, and ensure the UK stays on course in relation to its existing commitments to reduce carbon pollution.
2. Save householders an average of £7.61 on electricity bills each year.
3. Reduce revenue for Treasury by £684 million over the next parliament, compared to £4,715 million if the carbon price floor were to be cut altogether.
4. Require that new gas power stations are built at a consistent and easily deliverable rate of just 1GW per year to 2030 in order to hit the government's target of 15GW.

Strong EPS

1. Phase-out coal generation by 2025. This would ensure that the UK stays on course in relation to its existing commitments to reduce carbon pollution, but would also demonstrate international leadership on climate change with a 10-year plan to end the use of unabated coal for electricity generation.
2. Save householders an average of £8.41 on electricity bills each year.
3. Reduce revenue for Treasury by £716 million over the next parliament.
4. Require that the construction of new gas power stations is front-loaded in the period to 2025 but at a manageable and easily deliverable rate in order to hit the government's target of 15GW.

Under either option, this framework would deliver greater security at lower cost than DECC's scenario of a high carbon price and, if added to a £23 floor scenario, would offer a balanced and sustainable means of contributing to the UK's climate and sustainability goals. Critically, it would ensure that coal generation does not prevent the UK from decarbonising its power sector.

We recommend that government introduces a strong EPS that results in a phase-out of coal generation by 2025. Assuming that the revenue lost to the Treasury can be found in the next parliament, this is the most compelling option which would deliver the greatest savings to the consumer and leaves the most room within carbon budgets for other technologies.

We also recommend that a 2030 target for decarbonising the power sector is set as soon as possible in order to provide certainty over future government policy. Finally, we recommend that carbon constraints are placed on all future capacity market contracts so that policies for security of supply are brought into line with policies for decarbonisation, and consumer money is not used to incentivise technologies that will later be phased out with an EPS.

We argue that without additional policy intervention, coal generation poses an unacceptable threat to investment in new capacity, perpetuates the UK's reliance on imported Russian coal, threatens decarbonisation targets and harms people's health. Explicitly phasing-out coal generation is a necessary step in the wider process of decarbonising and securing an affordable supply of electricity. The framework set out in this report offers a 'no regrets' option for achieving that goal.

REFERENCES

AMEC (2012) *Updated Impact Assessment of the Industrial Emissions Directive (IED): Large Combustion Plants: Final Supporting Report,* Department for Environment, Food and Rural Affairs. http://www.defra.gov.uk/industrial-emissions/files/LCP-Finalised-July-2012.pdf

Appunn K (2015) 'Climate targets force Germany to tackle coal,' *Clean Energy Wire*. http://www.cleanenergywire.org/dossiers/energy-transition-and-climate-change

Department for Business, Innovation and Skills [BIS] (2013) 'Compensation scheme for energy intensive businesses', press release, 20 March 2013. https://www.gov.uk/government/news/compensation-scheme-for-energy-intensive-businesses

Cameron D (2007) 'Speech at Chongqing University in China', 20 December 2007, SayIt. http://conservative-speeches.sayit.mysociety.org/speech/599724

Carbon Capture and Storage Association [CCSA] and Trades Union Congress [TUC] (2014) *The economic benefits of carbon capture and storage in the UK*, Trades Union Congress. http://www.tuc.org.uk/sites/default/files/carboncapturebenefits.pdf

Carbon Trust and Shell (2013). Low carbon entrepeneurs: the new engines of growth. http://www.carbontrust.com/media/310425/low-carbon-entrepreneurs.pdf

Committee on Climate Change [CCC] (2009) 'No role for conventional coal beyond 2020s', article, 23 April 2009. http://www.theccc.org.uk/news-stories/no-role-for-conventional-coal-beyond-2020s-23-april-2009/

Committee on Climate Change [CCC] (2010) *The Fourth Carbon Budget: Reducing emissions through the 2020s*. http://archive.theccc.org.uk/aws2/4th%20Budget/CCC-4th-Budget-Book_plain_singles.pdf

Committee on Climate Change [CCC] (2013) *Next steps on Electricity Market Reform – securing the benefits of low-carbon investment*. http://www.theccc.org.uk/wp-content/uploads/2013/05/1720_EMR_report_web.pdf

Committee on Climate Change [CCC] (2014a) *Energy prices and bills – impacts of meeting carbon budgets*. http://www.theccc.org.uk/wp-content/uploads/2014/12/Energy-Prices-and-Bills-report-v11-WEB.pdf

Committee on Climate Change [CCC] (2014b). *Meeting Carbon Budgets – 2014 Progress Report to Parliament*. http://www.theccc.org.uk/wp-content/uploads/2014/07/CCC-Progress-Report-2014_web_2.pdf

Confederation of British Industry [CBI] (2014) letter from John Cridland to Rt. Hon George Osborne MP, dated 18 February 2014. http://www.cbi.org.uk/media/2602945/cbi_budget_submission_embargoed_3_march.pdf

Department of Energy and Climate Change [DECC] (2011) *Planning our electric future: technical update*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/42822/3884-planning-electric-future-technical-update.pdf

Department of Energy and Climate Change [DECC] (2012) *Gas generation strategy*, the Stationery Office. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65654/7165-gas-generation-strategy.pdf

Department of Energy and Climate Change [DECC] (2014a) 'Annex J: Total electricity generation by source', *Updated energy and emissions projections: 2014*, spreadsheet. https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2014

Department of Energy and Climate Change [DECC] (2014b) 'Coal in 2013'. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/357548/Coal_2013.pdf

Department of Energy and Climate Change [DECC] (2014c) 'Chapter 5: Electricity', *Digest of United Kingdom energy statistics*. https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

Department of Energy and Climate Change [DECC] (2014d) 'Electricity Market Reform: Capacity Market', webpage. https://www.gov.uk/government/collections/electricity-market-reform-capacity-market

Department of Energy and Climate Change [DECC] (2014e) 'Chapter 2: Solid fuels and derived gases', *Digest of United Kingdom energy statistics*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/337589/chapter_2.pdf

Department of Energy and Climate Change [DECC] (2015) 'Energy trends section 5: electricity'. https://www.gov.uk/government/statistics/electricity-section-5-energy-trends

Enderlein H and Pisani-Ferry J (2014) *Reforms, Investment and Growth: An agenda for France, Germany and Europe*, Hertie School of Governance. http://www.economie.gouv.fr/files/files/PDF/rapport_enderlein_pisani-en.pdf

Energy and Climate Change Committee [ECCC] (2014) *Energy and Climate Change – Ninth Report: Carbon capture and storage*. http://www.publications.parliament.uk/pa/cm201314/cmselect/cmenergy/742/74202.htm

Environmental Audit Committee [EAC] (2014) '2. Providing information to direct finance', *Green finance*. http://www.publications.parliament.uk/pa/cm201314/cmselect/cmenvaud/191/19105.htm

European Commission [EC] (2014) 'Proposal for a DECISION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and amending Directive 2003/87/EC'. http://ec.europa.eu/clima/policies/ets/reform/docs/com_2014_20_en.pdf

Gross R, Speirs J, Hawkes A, Skillings S and Heptonstall P (2014) *Could retaining old coal lead to a policy own goal? Modelling the potential for coal fired power stations to undermine carbon targets in 2030*, Imperial College London. https://workspace.imperial.ac.uk/icept/Public/ICEPT%20WWF%20Coal%20Report.pdf

HM Government (2013) *The UK's Nuclear Future*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/168048/bis-13-627-nuclear-industrial-strategy-the-uks-nuclear-future.pdf

HM Treasury and HM Revenue and Customs [HMRC] (2011) *Carbon price floor consultation: the Government response*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/190279/carbon_price_floor_consultation_govt_response.pdf

Harvey F (2012) '"Carbon floor price" plans dealt a blow by MPs', *Guardian*, 26 January 2012. http://www.theguardian.com/environment/2012/jan/26/carbon-floor-price-blow

Health and Environment Alliance [HEAL] (2013) *The unpaid health bill: How coal power plants make us sick*. http://www.env-health.org/IMG/pdf/heal_report_the_unpaid_health_bill_how_coal_power_plants_make_us_sick_final.pdf

Intercontinental Exchange [ICE] (2015) accessed 28 January 2015. https://www.theice.com/index

Jones D (2014) 'UK Capacity Market: Is the Capacity Market slowing UK power decarbonisation?', Sandbag. http://www.sandbag.org.uk/site_media/pdfs/reports/Capacity_Mech_19-Dec-14.pdf

Littlecott C (2014) 'Keeping coal alive and kicking: Hidden subsidies and preferential treatment in the UK Capacity Market', E3G. http://www.e3g.org/docs/E3G_Briefing_-_Keeping_coal_alive_and_kicking_-_hidden_subsidies_and_preferential_treatment_in_the_UK_capacity_market.pdf

Maxwell D (2011) *Hot Air: The carbon price floor in the UK*, IPPR. http://www.ippr.org/publications/hot-air-the-carbon-price-floor-in-the-uk

McNeil C with Hutchinson A (2013) 'Energy pathways to 2030. An overview of choices for the government', slidepack. http://www.slideshare.net/ippr/target-2030-presentation-22-feb13

Miliband E (2012) 'Government must lead the way to a more sustainable capitalism', Green Alliance blog, 24 September 2012. http://greenallianceblog.org.uk/2012/09/24/government-must-lead-the-way-to-a-more-sustainable-capitalism/

Morris C (2014) 'Germany considers nuclear-style phase out for coal', *Renewables International*, 26 November 2014. http://reneweconomy.com.au/2014/germany-considers-nuclear-style-phase-out-for-coal-19724

Morris D (2015) 'Parliament makes landmark decision on fixing Europe's carbon market', blog, Sandbag. http://www.sandbag.org.uk/blog/2015/feb/24/parliament-makes-landmark-decision-fixing-europes-/

National Audit Office [NAO] (2013) *The levy control framework*, Stationery Office. http://www.nao.org.uk/wp-content/uploads/2013/11/10303-001-Levy-Control-Framework.pdf

National Grid (2014a) *Final Auction Results: T-4 Capacity Market Auction 2014*. https://www.emrdeliverybody.com/Shared%20Documents/Final%20Auction%20Results%20Report_v3.pdf

National Grid (2014b) *Winter Outlook Report 2014/15*. http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/FES/Winter-Outlook/

Orion Innovations (2014a) 'Walking the carbon tightrope: Energy intensive industries in a carbon constrained world', Trades Union Congress. http://www.tuc.org.uk/economic-issues/industrial-issues/energy/manufacturing/walking-carbon-tightrope

Parsons Brinkerhoff (2014) *Coal and Gas Assumptions: DECC*. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/315717/coal_and_gas_assumptions.PDF

Platt R, Aldridge J and Washan P (2013) *Help to heat: A solution to the affordability crisis in energy*, IPPR. http://www.ippr.org/publications/help-to-heat-a-solution-to-the-affordability-crisis-in-energy

Platt R, Williams J, Pardoe A and Straw W (2014) *A new approach to electricity markets: How new, disruptive technologies change everything*, IPPR. http://www.ippr.org/publications/a-new-approach-to-electricity-markets-how-new-disruptive-technologies-change-everything

Schjølset S (2014) 'The MSR: Impact on market balance and prices', slidepack, Thomson Reuters Point Carbon. http://ec.europa.eu/clima/events/docs/0094/thomson_reuters_point_carbon_en.pdf

Rowney M (2014) *The long road to ruin: Why the UK needs to reform motoring taxes*, IPPR. http://www.ippr.org/publications/the-long-road-to-ruin-why-the-uk-needs-to-reform-motoring-taxes

Sandbag (2014) *Europe's failure to tackle coal: Risks for the EU low-carbon transition*. http://www.sandbag.org.uk/site_media/pdfs/reports/Europes_failure_to_tackle_coal.pdf

Skillings S, Baker P and Smart A (2015) 'Assessing the balance of risks associated with coal plant closure', Trilemma UK. http://www.trilemma-uk.co.uk/sitebuildercontent/sitebuilderfiles/assessing_the_balance_of_risks_associated_with_coal_plant_closure.pdf

Stace G (2013) 'Why the Carbon Floor Price tax should be scrapped', 31 October 2013. http://www.businessgreen.com/bg/opinion/2303740/why-the-carbon-price-support-tax-should-be-scrapped

Staffell I and Green R (2012) 'Is there still merit in the merit order stack? The impact of dynamic constraints on optimal plant mix', British Institute of Energy Economics. http://www.biee.org/wpcms/wp-content/uploads/Staffell-Merit-in-the-Merit-Order-Stack.pdf

Temperton I and Schoenberg M (2014) 'Your levy control framework beer mat', Climate Change Capital. http://www.climatechangecapital.com/images/docs/Your_Levy_Control_Framework_Beer_Mat.pdf

van Beurden B (2013) 'Shell's recommendations for a more competitive EU energy policy by 2030', speech to the European Parliament, 11 July 2013. http://www.shell.com/global/aboutshell/media/speeches-and-articles/2013/launch-shells-new-lens-scenarios-in-eu.html

APPENDIX

Full results of IPPR's modelling of different carbon-price scenarios

Scenario			Model output							Net impact on bill-payer / taxpayer				
	Carbon price	EPS	1. Cumulative coal burn, 2017–2030	2. Coal plant capacity in operation post-2023	3. Coal plant capacity remaining in operation in 2030	4. Wholesale price (average, 2017–2030)	5. Capacity market price (average 2017–2030)	6a. Treasury receipts from CO_2 tax (£/year average, 2017–2030)	6b. Change in capacity market payment (£/year average, 2017–2030)	7. Impact of wholesale price on bills (£/year average, 2017–2030)*	8. Total impact on bills (£/year average, 2017–2030)	9. Total impact on household bills (£/year average, 2017–2030)**	10. Impact on treasury receipts (£/year average, 2017–2030)	11. Net impact across bill payers and HM Treasury (£/year average, 2017–2030)***
DECC (base scenario)	CPF, which rises to £78/t by 2030	-	246TWh	5GW	0GW	£40.84/MWh	£19/kW	£1,131m	-	-	-	-	-	-
ETS only	Point Carbon forecast only*	-	695TWh	13GW	5GW	£33.76/MWh	£24/kW	£0m	£204m	-£1,495m	-£1,291m	-£11.04	£1,131m	-£160m
ETS + EPS	Point Carbon forecast only*	450g/kWh in 2017, rising to 100g/kWh 2030	362TWh	9GW	0GW	£34.55/MWh	£21/kW	£0m	£85m	-£1,328m	-£1,244m	-£10.63	£1,131m	-£113m
£23 floor	Highest of £23/t or Point Carbon forecast*	-	525TWh	11GW	3GW	£35.71/MWh	£24/kW	£399m	£198m	-£1,084m	-£886m	-£7.57	£732m	-£154m
£23 floor + weak EPS	Highest of £23/t or Point Carbon forecast*	450g/kWh in 2017, rising to 100g/kWh 2030	299TWh	7GW	0GW	£36.31/MWh	£21/kW	£383m	£66m	-£957m	-£891m	-£7.61	£748m	-£142m
£23 floor + strong EPS	Highest of £23/t or Point Carbon forecast*	EPS in line with DECC scenario	209TWh	3GW	0GW	£36.36/MWh	£18/kW	£369m	-£37m	-£948m	-£985m	-£8.41	£762m	-£223m

Source: Original IPPR modelling based on data from DECC 2014a and Schjølset 2014
Note: 'Point Carbon forecast' refers to Schjølset 2014.
*** Figures in column 7 = [5] x 37GW vs DECC**
**** Figures in column 9 = 8 + 7**
***** Figures in column 11 = 9 + 10**