Sustainable Energy in the United Kingdom

Frameworks, policies, and measures

Background report to PM 2014:05

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Table of Contents

Abbrevations

CCS – Carbon Capture and Storage

DECC – Department of Energy and Climate Change

EMR – Energy Market Reform

ETS –: Emission Trading Scheme

FiT – Feed in Tariff

GHG – Greenhouse gases

RES-E – Renewable energy sources for electricity

RO– Renewables Obligation

Summary

British energy policy is based on three cornerstones: decarbonisation, energy security and affordability.

Spurred on by environmental awareness, the financial crisis and by declining revenue from its North Sea oil and gas fields, Britain has invested into low carbon energy technologies, such as offshore wind. Moreover, the country has set a legally binding target of reducing its greenhouse gas [GHG] emissions by at least 80 per cent by 2050.

In order to meet its decarbonisation target, a diversified strategy has been chosen. In this strategy, renewable energy, Carbon Capture and Storage [CCS] and nuclear power all receive subsidies and other forms of support as they are considered low carbon technologies.

Efforts are currently made to increase the share of renewables to 15 per cent of total energy production and 30 per cent of electricity production. A number of demand side policies are in operation such as a Feed in Tariff [FiT] system for small generators and the Renewables Obligation [RO] for larger generators. A Green Investment Bank has also been initiated, along with a carbon price floor. Currently, a new support system for low carbon power technologies is replacing an old system which solely focused on renewable energy. There are also instruments aimed at incentivising energy efficiency measures amongst households.

The emphasis given towards renewable energy is a relatively new component in the policy portfolio and is proving difficult to align with other priorities. It is for example unlikely that the targets set for renewable energy sources for electricity [RES-E] expansion will be met as a) developers are finding it increasingly hard to obtain equity and debt financing, b) there is a lack of policy consistency and c) the government is sending mixed messages towards the market which has reduced industry confidence. The same variables also help explain low investments in other low carbon technologies.

There are also fears that the decarbonisation targets will fail due to the trend of coal replacing natural gas capacity and by potential investments into shale gas which could create a lock in effect.

A telling sign of the limited support given to the decarbonisation targets is the £2.6 billion provided in subsidies (2011) to the fossil fuel sector in an attempt to sustain the country's oil and gas industry. To put this figure into perspective, £3.3 billion will be spent subsidising renewable energy in 2014–2015. It is questionable how the subsidy given to the fossil fuel sector is compatible with Britain's decarbonisation target. One reason for this allocation of capital is arguably the lack of a strong industrial and innovation policy linked to Britain's energy policy. Importantly, the ownership of RES-E generators is predominantly in the hand of utilities. The renewable energy industry also employs relatively few people. Indeed, the wind and marine energy sector, which are the two of the largest sectors, directly employ around 18 500 people. In the sector as a whole, some figures state a higher overall figure of 110 000. Thus there are relatively few stakeholders in the population, industry and amongst politicians who have an interest and stake in promoting renewable energy.

The second cornerstone in Britain's energy policy is energy security, and derives from concern regarding the security of Britain's electricity supply and its dependence on imported fossil fuel, especially Russian natural gas.

The country is currently heavily reliant on fossil fuels. By the second quarter of 2013, coal and gas provided 36.6 and 29.6 per cent respectively of total electricity production. A further 21.7 per cent derived from nuclear power whilst RES-E for 15.5 per cent.

With regard to the security of electricity supply, the development over the past years has displayed a worrying trend of underinvestment in new generation capacity. This has raised concerns of a capacity crunch already in 2015. The factors describing insufficient levels of investment into low carbon technologies have been explained above. Importantly, these factors lead to investments into low carbon technologies being deemed too uncertain and risky.

In an attempt to spur investments, a capacity market has been introduced. There are also attempts to address this challenge by reforming the energy market, mainly by providing additional financial incentives and predictability of income. It is too early to tell whether these measures will prove sufficient.

The third cornerstone in Britain's energy policy is affordability, which is linked to costs borne by customers as well as the tax payer. During the past few years, electricity and gas prices have risen substantially. This has challenged the legitimacy of the electricity market, ergo utility firms, and current energy policy. However, according to statistics from Europe's Energy Portal, prices are fairly low by a European comparison, which indicates consumption levels are a problem.

As such, energy efficiency measures designed to bring down costs for households are required. To complicate matters, subsidies provided to renewable energy and energy efficiency measures contribute to the rising cost of electricity as the cost is added onto the retail price of electricity. It is hoped the energy market reforms currently being implemented will reduce costs but it is yet too early to tell.

There has not been a consistent reaction to the spiralling cost of energy, although some costs have been shifted away from consumers to taxpayers. Efforts to increase energy efficiency have also been scaled back, thus arguably exacerbating one underlying cause of rising energy bills.

It is probable that the period of political uncertainty will continue, possibly until the 2015 elections. The increased state involvement in the energy market seen recently is likely to continue and increase. This is because previous policies which were based on the concept of minimal state involvement in the energy market are perceived to have failed.

Further reform of the energy market is also a clear possibility. Specifically, such a reform would aim to increase competition amongst energy suppliers. Finally, it is likely that investments will increase gradually due to energy market reforms currently being implemented. However, to spur investments, political uncertainty needs also be reduced.

1 Introduction

Since the mid-2000s Britain has been a firm advocate amongst the international community for increased action against climate change. Indeed, it has set a legally binding target of reducing its greenhouse gas [GHG] emissions by at least 80 per cent by 2050. The publication of the Stern review in 2006 spurred government action by for example expanding support given to the offshore wind sector. Moreover, as a response to the financial crisis of 2008, the former Prime Minister Gordon Brown called for a global green new deal. Several causes precipitated this response; concern for the effects of climate change has indeed been a driving force. Declining revenue from its North Sea oil and natural gas fields has also spurred action as it has led Britain to become more dependent on fossil fuel imports, contributing to its already dire trade deficit.

In order to meet the GHG emission reduction targets, the British government has largely implemented technology neutral policy tools aimed at promoting RES-E deployment into an electricity market suffering from a lack of competition. A number of other policies aimed at reducing energy usage and increasing energy efficiency has also been initiated. As the costs of these policies are incorporated into the retail electricity price, their increased deployment has led to rising electricity bills for consumers. Combined with stagnant real wages experienced by much of the British populace, the situation has become untenable. This has reduced the legitimacy both for the British energy market as a whole, but also for the country's energy policy. To further complicate matters, no easy solutions to the problem are to be found, causing politicians to call for more or less populist, short term responses. These responses threaten to exacerbate the problem in the long run.

The purpose of this report is to analyse British energy policy in order to provide a country comparison when developing new strategies and tools to promote a sustainable energy system in Sweden. The analysis will focus on three topics:

- Britain's energy priorities including future vision;
- Main challenges and crossroads;
- Principles/discourses used for influencing the energy system in its desirable direction.

To address these three topics, the report will be structured as follows.

First, the country's mid- and long-term energy strategies are shortly explained.

Second, the political economy of Britain's energy strategy is described which includes a description of current policy instruments.

Third, perceived challenges and crossroads are described before a final discussion is held concerning alternative future development pathways.

As stated above, this topic is politically charged and economic stakes are high, which is also mirrored in the debate, causing sources to be less objective. To counter this issue, great care has been taken to provide a balanced view. The scope of the report is mainly on the electricity sector, but particular aspects of the heat and transport sector will also be mentioned. The analysis is based on information gathered between October 10, 2013–November 25, 2013.

2 Medium and long term energy strategies

An analysis of Britain's' medium and long-term energy strategies allows for us to illuminate issues such as how Britain aims to have its future energy system constituted, what priorities are made, and what role different energy technologies will play in the future. As such, it also constitutes the base of the analysis.

2.1 Current energy mix

Figure 1 below describes the United Kingdom's total energy consumption as of 2012. The figure provides a clear picture of the United Kingdom's heavy reliance on fossil fuels and the marginal role played by renewables. Almost 90 per cent of consumption derives from fossil fuels and out of the remainder, more than half is nuclear. Only 5 per cent of total consumption comes from bioenergy, wind, hydro and solar.

Regarding electricity production, RES-E represents a substantial share, see Figure 2 below. In 2013, the sector provided around one sixth of total electricity production, whilst coal and natural gas provided two thirds combined. Nuclear power provided the absolute majority of remaining power.

Since 1990, the RES-E sector has grown more than eight fold in generation as seen in Figure 3. Currently, bioenergy and wind, both on and offshore provide the vast majority of production, with solar PV only constituting a small share.

Deployment of wind power is the main driver of increased RES-E generation, which in total rose by 5.8 per cent between 2012 and 2013. During this period generation from fossil fuel sources also decreased, contributing to the growing share of RES-E in the total electricity production. See Table 1 for more details.

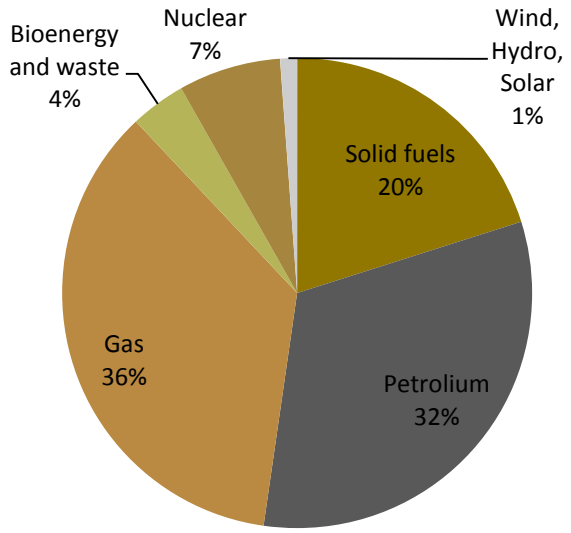

Figure 1 Final energy consumption 2012 (HM Government 2013b)

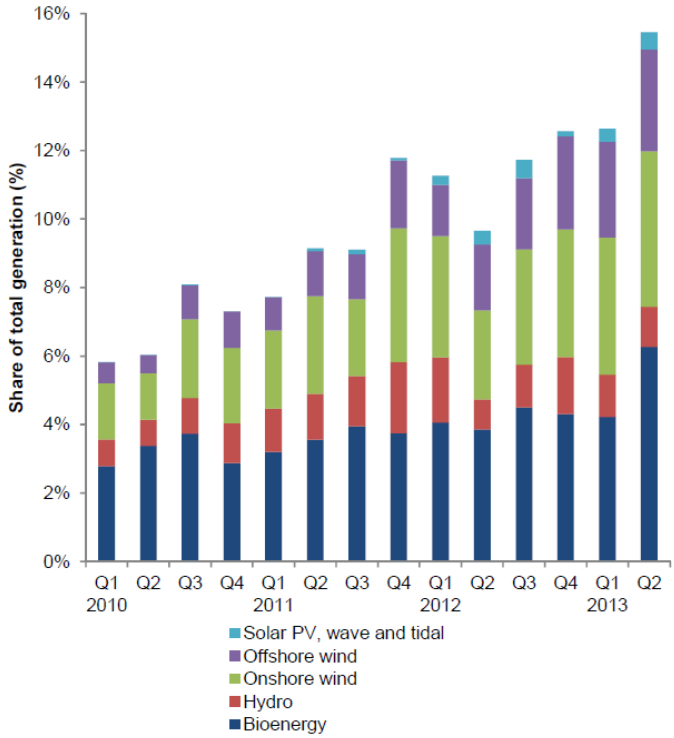

Figure 2 Renewables' share of electricity generation (DECC 2013b)

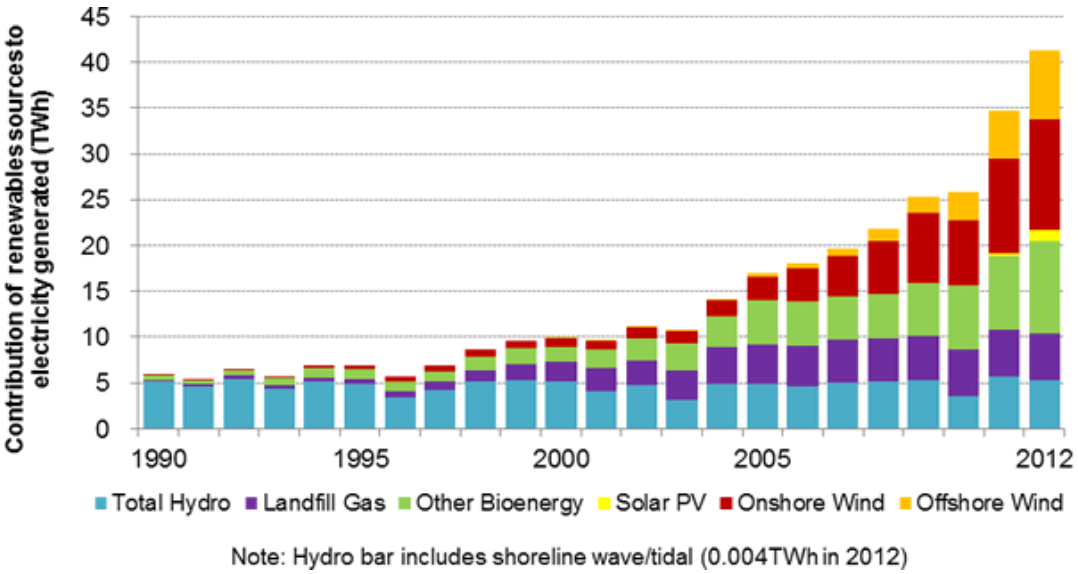

Figure 3 Growth of Electricity Generation (TWh) from Renewables since 1990 (DECC 2013c)

Table 1 Shares of electricity generation Q2 2012 and Q2 2013 (Extracted from chart 5.2 in DECC 2013a)

Type of electricity generation	Shares of electricity generation in % Q2 2012	Shares of electricity generation in % Q2 2013
Renewables	9.7	15.5
Coal	36.6	35
Gas	29.6	28.5
Nuclear	21.7	18.6
Oil	0.8	0.8
Other	1.6	1.6

2.2 Targets and technologies in a future energy mix

British energy policy is based on three cornerstones: energy security, decarbonisation and affordability. The Climate Change Act of 2008 legally binds the United Kingdom to by 2050 reduce its GHG emissions by at least 80 per cent below the level of 1990. The country aims to reach these targets by encouraging investments into the energy sector combined with reduced total energy consumption through increased energy efficiency. Due to uncertainties facing investments into the electricity sector, the government has initiated a three pronged strategy aiming at aggressively expanding deployment of low carbon technologies. These are RES-E, nuclear power and Carbon Capture and Storage [CCS] applied to fossil fuel plants.

Figure 4 below illustrates projected future GHG emission reductions. As shown, the emphasis is on introducing low carbon energy sources although energy efficiency is also seen an important source of savings.

Importantly, the government believes the energy mix needs to be electrified to a larger degree, with recent modelling suggesting that between 60–80 GW of new electricity capacity needs to be built by 2030 out of which 40–70 GW needs to come from the low carbon technologies.

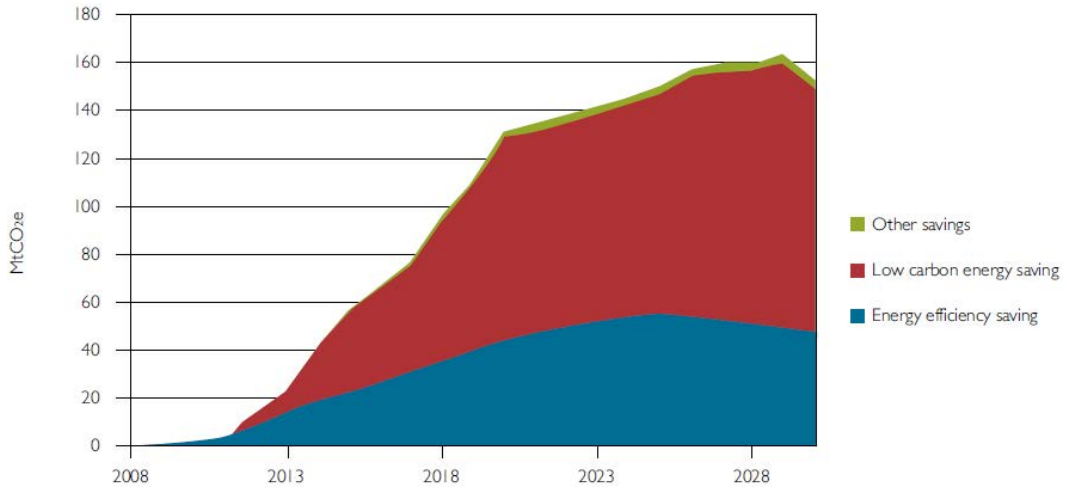

Figure 4 Projected saving of Green House Gas (GHG) emissions (mega tonnes CO2 equivalents) by type: 2010-2030 (DECC 2012d)

By 2020, 15 per cent of energy production (3.8 per cent in 2011) and 30 per cent of electricity production (11 per cent in 2011) is to derive from renewable sources.

By 2030, renewable energy is predicted to contribute with 35–50 GW of new capacity by 2030, with nuclear power providing a further 10–15 GW of capacity. Moreover, fossil fuel power plants equipped with CCS[1] are projected to contribute with 10 GW capacity by 2030.

2.3 Projections

In 2012, DECC announced the United Kingdom was on track for meeting its 2020 targets. RES-E generation as a percentage of electricity generation has indeed been increasing at a relatively fast pace as previous shown by Figure 2.

However, in order meet the 2020 targets exponential deployment of RES-E is needed. Problematically, investments into the RE sector have seemingly stalled due to:

- Difficulties for developers to obtain equity and debt financing;
- The government is sending mixed messages towards the market, thus reducing industry confidence,
- Uncertainty regarding policy consistency.

As such, the Renewable Energy Association and the European Renewable Energy Council [EREC] conclude the targets will probably not be met. Indeed, EREC ranks the United Kingdom as the EU member state with the second worst track record of progressing towards the 2020 targets. To reach targets, policy and political uncertainties would need to be reduced. The interconnected issue of affordable financing would also need to be addressed. Chapter five describes in further detail the challenges facing the British energy system.

[1] Potentially retrofitting both old power plants with CCS and incorporating the technology into new ones.

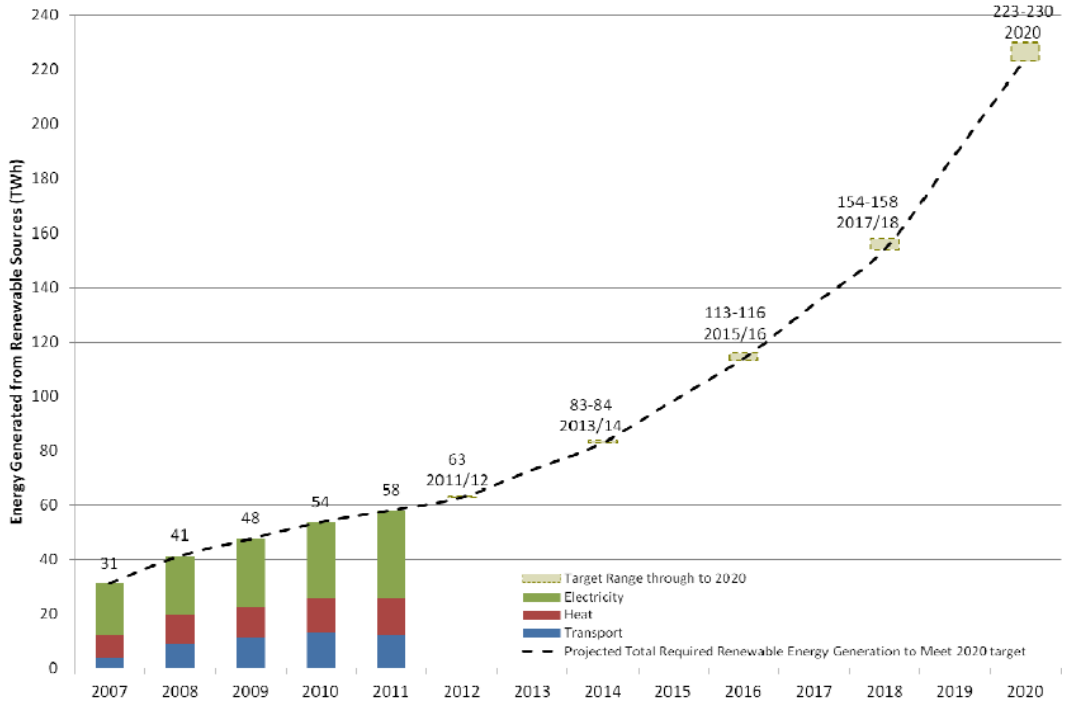

Figure 5 Energy generated from renewable sources (TWh) 2007-2020 (DECC 2012a)

3 Development and toolbox of British energy policy

In the late 1980s, Britain obliged its electricity suppliers to provide a certain share of electricity from non-fossil fuel sources, enabling the continued use of nuclear power and the introduction of RES-E. Due to the nature of the program, wind power was favoured amongst renewable energy technologies with large companies dominating the market. Further support was deployed in 1997 as the new government wished to provide more substantial support to the renewable energy sector. It also questioned the building of new unsubsidised nuclear power stations and supported the continued liberalisation of the energy market. Under the Renewables Obligation [RO] scheme, the market was allowed to choose which technologies to invest in, due to unwillingness by the Government to 'pick winners'. The RO was to bring about price reductions via intensified competition.

However, the cost of the RO actually increased and deployment remained weak (2/3 of targets were reached). Despite alterations, criticism over its design grew, especially concerning risks facing investors such as unstable wholesale prices and volatile certificate prices. Moreover, the design favoured utility firms as they were better able to handle risk.[2] Another criticism was the lack of support provided to less mature and thus more expensive innovative technologies. The criticism, along with the introduction of more ambitious GHG emission reduction targets, induced reforms, such as differentiated support for technologies depending on their maturity. Moreover, in 2010, a FiT was introduced for installations up to 5 MW in size.

In 2010, the Conservatives and the Liberal Democrats entered into a coalition government which was promised to be 'the greenest government ever'. The Liberal Democrats were strong supporters of renewable energy and advocated for the RO to be replaced by a comprehensive FiT, in which CCS and nuclear power was later included. The new attention provided to renewables, CCS and nuclear power was arguably partly caused by the declining production of North Sea oil and gas.

Currently, a FiT has been provided to the new nuclear power station being built at Hinkley Point. Moreover, a new energy bill is being amended by parliament concerning a comprehensive energy market reform which would end the RO and adopt a FiT. There is however considerable ambivalence within the Government concerning its future energy policy, partly caused by rising electricity bills which in turn have challenged the legitimacy of the country's electricity market and energy policy.

Britain's policy community is characterised as being relatively closed with tight industrial ties. The country has a strong tradition of market liberal economic policies and as such its energy policy is largely separated from its innovation and industrial policies, the latter two being rather weak. State interference in the electricity market beyond simple regulation has been viewed as undesirable, with price signals provided by the market being the preferred driver of innovation and investment. As stated above, this stance has come under pressure recently, a point which will be further developed in chapter 4 and 6.

Importantly, despite the rapid deployment of RES-E in the United Kingdom, employment growth has been low. Indeed, the wind and marine energy sector employs around 18 500

[2]By 2005 a full 82 per cent of wind power generation capacity was owned by the six largest utilities.

people but the trade body Renewable UK believes 70 000 jobs could be created in the sector over the next decade, depending on government policy[3]. Consequently, there are relatively few stakeholders who hold an interest in the sector. Inversely, there is substantial interest in, and backing both, from industry and the Conservative party in developing the country's shale gas reserve, CCS and nuclear power.

3.1 Policy instruments

The United Kingdom has multiple policy instruments aimed at incentivising the deployment of renewable electricity, heat and transport. However, there are currently great fluctuations concerning the number, design and implementation period of policies.

Below follows a selection of policies deemed most important, separated into those aimed at the fossil fuel sector, fostering supply and demand for low carbon technologies, incentivising energy efficiency, increasing sustainable transport and securing electricity supply.

3.1.1 The fossil fuel sector

According to the Overseas Development Institute [ODI], the United Kingdom was the fifth largest subsidizer of fossil fuels in 2011 at an amount of £2.6 billion. The aim is seemingly to provide support to Britain's declining offshore oil and gas sector. It is questionable how this subsidy is compatible with Britain's aim of decarbonizing its economy. To put the subsidy into perspective, under the levy control framework (to be explained in more detail in section below) the upper limit allowed for subsidising renewable technology was £3.3 billion in 2014–2015.

There are also considerable attempts at developing Britain's shale gas reserves, pushed by a faction in the Conservative party led by the Chancellor George Osborne. In order to incentivize development, the chancellor has provided a tax break for would-be developers. Shale gas is still in its exploratory phase and there are attempts to expand the rate of exploration. The extraction process' feasibility is not yet clear due to both technical as well as economic factors. However, the largest hinder facing the extraction of Britain's shale gas reserves is popular protest. Importantly, the resistance against the technology unites both environmentalists as well as the rural population which often constitutes the Conservative party's heartland.

[3] Reuters and the Renewable Energy Association both state the number to be 110 000. Discrepancy in numbers probably relate to which sectors are included.

3.1.2 Fostering low carbon technologies

Britain has multiple policy tools aimed at fostering low carbon technologies, the most important of which are summarised in Table 2 and which are subsequently described in detail below.

Table 2 Policy tools for low carbon technologies

Name	Type	Description
R&D	Supply	Develops new technology
Green Investment Bank	Demand	Provides affordable capital
Carbon Price Floor	Demand	Provides stable cost for carbon emitters, lowering competitiveness
Renewable Heat Initiative	Demand	Provides subsidies for renewable heat generation
Renewables Obligation	Demand	Provides subsidies for renewable electricity generation
FiT for small installations	Demand	Provides subsidies for renewable electricity generation
Contracts for Difference	Demand	New subsidy form aimed at low carbon technologies

Supply side policies for low carbon technologies:

An important supply side tool is publicly funded R&D. According to the United Kingdom Energy Research Centre, publicly funded R&D for the energy sector fell sharply in the 1980s-1990s. Support has recently increased, along with concerted attempts to increase coherence in the research portfolio. The amount is still rather low; between 2011 and 2015 the government is investing a mere £200 million into R&D of low carbon technologies. This can be compared to Germany which under a similar time period is investing €3.5 billion into R&D connected to its renewable energy targets. British scientists do however have other sources of funding, such as from trusts and research councils.

Demand side policies for low carbon technologies:

Britain has a number of demand side tools worth mentioning. In May 2012 the Green Investment Bank [GIB] was launched with a capital portfolio of £3.8 billion. The bank has a double bottom line; its goal is to promote investment into 'green' technology although financial returns are of equal importance. The GIB is likely to focus its support towards offshore wind and energy from waste but it could also invest into nuclear energy. The capital portfolio is rather small, limiting its influence.

Another, indirect, form of demand side policy for low carbon technologies is the carbon price floor which was introduced in 1 April 2013 at a rate of £16 per tonne of carbon dioxide (tCO2). It is to reach £30/tCO2 in 2020, in 2009 prices. The revenue raised is retained by the treasury.

The Renewable Heat Initiative [RHI] is a demand side policy aimed at incentivising investments into renewable heat generation. The scheme concerns non-domestic buildings and from the spring of 2014 domestic buildings will also be included. The scheme provides financial support to the owner of the heating system, paid at a set rate per unit of renewable heat produced. The support is provided over a period of 20 years. Support will be given to installations of air source heat pumps, biomass systems, ground source heat pumps and

solar thermal technologies. The support rates will vary depending on the technology installed, and DECC intends to introduce a degression rate similar to the CfD scheme in order to limit the costs of the scheme. Until the RHI is fully operational for domestic houses, the Renewable Heat Premium Payment (RHPP) acts as an intermediate support scheme for installing renewable heating technologies in domestic houses.

The Renewables Obligation [RO] was initiated in 2002. It requires electricity suppliers to provide a specified percentage of their electricity from RES-E sources. Thus, it provides an obligation for electricity firms to either invest in, or purchase power from, RES-E sources. They receive a subsidy for purchasing the electricity and if they fail to reach the specified percentage, the firms are penalised. As such, it is a type of demand policy. Importantly, the electricity market reform [EMR] which is aimed to replace the RO after 2017 lacks this feature.

As described in chapter 2, a FiT system for small scale electricity production for up to 5 MW was introduced in 2010, with the EMR described below proposing it being increased for up to 10 MW facilities. Most technologies qualify for the scheme such as solar PV and wind turbines. The scheme is administrated by energy regulator Ofgem, but the key decision in terms of government policy is conducted by DECC. The FiT disseminated solar PV systems at a faster rate than predicted, which was partly due to falling solar PV prices. In order to limit costs caused by higher than expected dissemination, the government decided to cut subsidies by half in 2011.

As there have been insufficient levels of investments into RES-E, nuclear power and CCS facilities, a policy reform was deemed necessary. It is hoped the EMR will be sufficient to improve conditions for investors. Specifically, the EMR consists of a form of Feed-in Tariff called Contracts for Difference (CfDs).

CfDs are intended to provide certainty to investors in low-carbon generation such as renewables, nuclear energy and CCS facilities. It does so by ensuring a stable, fixed return for generators known as a strike price. Generators receive revenue from selling their electricity into the market as usual. When the market price is below the strike price they also receive a top-up payment from suppliers for the additional amount. Conversely if the market price is above the strike price, the generator must pay back the difference. The strike price for new investments will be reduced over time using degression rates, thus promoting the economic competitiveness of new energy technologies.

The CfD will be complemented by a number of support mechanisms:

- The Emissions Performance Standard (EPS) which sets a limit on the amount of emissions new power stations can emit and
- The carbon price floor described above. Further, the government also intends to ensure the availability of long-term contracts needed to secure the financing of independent renewable generators.

To recognize differing risk profiles and cost competitiveness of technologies, the CfD will vary across technologies. In the long run the aim is that the conditions will be standardized across technologies.

Figure 6 below illustrates the role of the strike price under the CfD scheme.

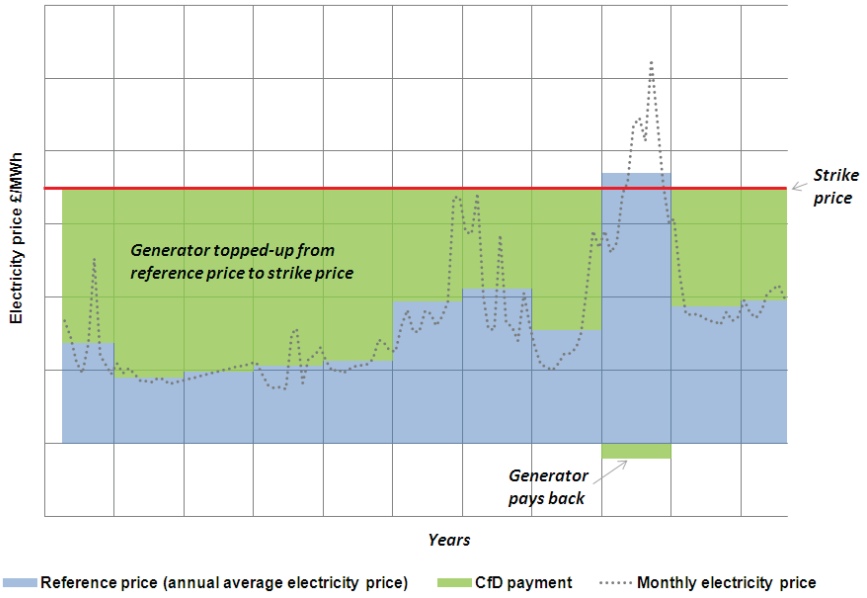

Figure 6 Illustrative example of the strike price under CfD scheme (Bourne, 2013)

The government's long term aim is an energy market where low carbon generators compete fairly under a robust and stable carbon price. However, the government is aware of the fact that many low carbon technologies are at different stages of development and on different cost curves. Therefore it argues the aim to be realistic first in 10 to 15 years' time. It is doubtful if the aim to let low carbon generators compete fairly in 10 to 15 years' time is realistic due to the highly uncertain cost development of technologies. For example, it is doubtful whether CCS will be cost competitive, nuclear power is becoming increasingly expensive, whilst the cost of RES-E technologies are reducing. As such, due to uncertainties regarding the development of costs, it is possible that differentiated support schemes will need to continue to exist in the future.

3.1.3 Incentivising energy efficiency

As stated in chapter 2, energy efficiency is regarded as vital in order to reach the GHG emission reduction targets. In the United Kingdom, increasing the energy efficiency of the nation's housing stock is prioritised.

As such, in late 2012 the government launched its flagship energy saving scheme called the Green Deal [GD]. It is directed towards helping businesses and households through the deployment of energy efficiency technologies. After an assessment is made to identify potential energy saving actions, property owners can receive loans to finance investment such as loft, cavity or solid wall insulation, double glazing, a new boiler or 'micro-generation' systems such as solar panels.[4] The idea is that the borrower will be able to repay the loan due to lower energy bills. An important aspect of the loan is also that it is written on the building and not the borrower personally.

[4] The property owner pays for the assessment to be made.

The Green Deal has however not lived up to expectations. Out of 100.000 households who have received an assessment of their home, a mere 1200 households are in the process of receiving finance. High interest rates on loans are seen as one of the causes for this low number. The measure will end at the end of March 2014.

As a complement to GD, the Energy company obligation (ECO) was also introduced at the beginning of 2013, replacing two previous schemes, the Carbon Emissions Reduction Target (CERT) and the Community Energy Saving Programme (CESP). This scheme places a legal obligation on the larger energy suppliers to deliver energy efficiency measures to domestic energy users. The ECO is primarily designed to help low income households who may face difficulties in taking advantage of the GD scheme. The costs of the ECO are spread across all household energy bills in Britain. The ECO is seemingly more successful than the Green Deal.

There are also further ongoing policies concerning energy saving in UK (excluding EU wide policy) worth mentioning:

- Smart Metering and Billing
- Smart metering and Billing for SMEs
- CRC Energy Efficiency Scheme (CRC)
- Climate Change Agreements
- Carbon Trust programmes

3.1.4 Promoting sustainable transport

In the area of sustainable transport, the government is focusing primarily on upholding EU regulations concerning CO2 emissions from cars and vans. The government has introduced a Plug-In Car Grant which provides 25 per cent (up to £5,000) of the cost of an ultra-low-emission-vehicle. In addition the Renewable Transport Fuel Obligation (RTFO) has been introduced. This scheme obliges suppliers of fuel used for road transport to ensure that a percentage of their fuel is from renewable, sustainable sources. Otherwise, a substitute amount of money is paid.

3.1.5 Securing electricity supply

As shown in chapter two, Britain is receiving an increasing share of its electricity generation from RES-E. As these are intermittent in nature, there are fears of blackouts during periods of high demand and low supply. Moreover, the government fears that a depression of wholesale prices, similar to the one seen in Germany, will reduce investments. In Germany, the fall in wholesale prices is caused by RES-E sources having lower marginal costs of production. It also leads to electricity from fossil fuel plants being uneconomical as they have higher marginal operating costs.

Currently, there is considerable under-investment in new electricity generation infrastructure whilst old fossil fuel plants are being decommissioned. It is feared a cause might be the effect renewables could have on wholesale prices. To counter this potential threat, the government will subsidise power plants which are both flexible and reliable by introducing a Capacity Market auction. The Capacity Market will be technology neutral and all existing and new forms of capacity will be eligible to participate, except for plants already supported by CfD, small scale Feed in Tariffs or the Renewables Obligation. The proposed capacity mechanism will work as follows:

- A forecast of future peak demand will be made;
- The total amount of capacity needed to ensure security of supply will be contracted through a competitive central auction a number of years ahead;
- Providers of capacity successful in the auction will enter into capacity agreements, committing to provide electricity when needed in the delivery year (in return for a steady capacity payment) or face penalties;
- Existing and new providers of capacity will be able to enter capacity auction in order to incentivise extra investment now and in the future and to incentivise good repair and maintenance practices where it would be more cost effective to ensure existing plant remains open;
- In the delivery year, providers will be paid for their capacity, and the costs shared between electricity suppliers.

4 Future Challenges

In recent years, four challenges concerning the development of Britain's energy system have been iterated. These are:

- Uncertainty regarding security of supply and whether emission reduction targets will be met;
- A lack of investments and regulatory reform;
- How to control costs;
- Political uncertainty.

4.1 Uncertainty regarding security of supply and reaching emission reduction targets

There are fears concerning the security of Britain's energy supply. These fears derive from two factors: the issue of a looming capacity crunch and the dependence on imported fossil fuel, especially Russian natural gas.

In 2012, the National Grid and the Office of Gas and Electricity Markets [Ofgem] warned of a looming capacity crunch in 2015. This was due to fears that a reduction in capacity due to the decommissioning of old fossil fuel plants would not be balanced out by sufficient new capacity coming online. However, according to Bloomberg New Energy Finance and other experts, it is unlikely this will occur, as new RES-E capacity and energy efficiency measures will hopefully be able to offset the capacity deficit. Moreover, mothballed plants could be restarted in the event of a looming crisis. The event of a capacity crunch also depends on whether current economic growth is sustained as it would increase demand for electricity, thus making it more likely. The capacity market mechanism described in chapter four is the government's attempt at spurring investment which indeed will reduce the risk of a future capacity crunch.

There are also fears of being reliant on imported natural gas, not least during times of regional elevated demand such as during cold winters. This fear is partly caused by the unwillingness to be dependent on Russian gas as its gas exports have been used as a political weapon in the past.

Another, interconnected challenge is reaching the emissions reductions targets. This is caused by three factors:

First, natural gas has become uncompetitive compared to coal due to the shale gas revolution in the USA and the collapsed Emissions Trading Scheme. In 2011, 40 per cent of Britain's electricity derived from natural gas, by 2012, it had fallen to 27 per cent. Coal emits substantially higher levels of carbon emissions.

Second, if there are substantial investments made into shale gas, a lock-in effect of investments could occur. It would also risk shifting investments away from low carbon technologies.

Third, the current uncertain environment over government policy is negatively affecting incentives to invest into low carbon technologies. This is especially true of RES-E investments. Investments need to increase in order to meet emission reductions.

4.2 Lack of investments and regulatory reform

Until 2020, DECC estimates up till £110 billion will need to be invested into Britain's energy infrastructure. Specifically, around £75 billion will need to be invested into new electricity generation whilst a further £35 billion is needed for the country's electricity transmission and distribution grids. However, Britain is facing a lack of investments into the energy sector. The government believes the lack of investments to be caused by:

- Uncertainties and risks surrounding these types of investments and;
- The current market structure.

There are indeed multiple uncertainties facing different technologies. Specifically, these uncertainties concern associated risk, security, the ability to deliver and underlying economics. Examples are concerns over the economic viability of CCS and the very high (and seemingly increasing) cost of nuclear energy. These uncertainties are both technical in nature, but also institutional as it is the current market structure which in many ways exacerbates these risks.

The current market structure does so by delivering insufficient reliability and predictability. The government claims that since the privatization of the energy and electricity markets, affordable and reliable power has been provided. Moreover, it argues the RO has helped deploy new technologies. However, it concedes that investments have been insufficient because:

- Nuclear and renewables have high upfront costs and low ongoing costs.
- Technologies are at different stages of development.
- Non fossil fuel plants are more exposed to gas or carbon price volatility whilst fossil fuel plants incorporate these costs into the electricity price.
- The cost of carbon is not internalized. Lord Stern called this the 'greatest market failure of all time'.
- The carbon price is volatile and it is thus hard to make long-term investment decisions.
- The market may fail to provide sufficient generation to meet demand as this would require high electricity prices at times of elevated demand.

Thus, the market structure which has existed post privatization has provided an insufficiently conducive environment for investments to occur within. The challenge is thus to provide an environment which sufficiently incentivizes investments. The government has initiated a two pronged strategy to address this issue.

First, it is hoped that the EMR described in chapter 3 will provide the institutional reform needed to incentivize investments by introducing the CfD. Arguably; it could be seen an attempt to copy the large scale deployment of RES-E seen in Germany. The introduction of CfD could indeed incentivize investors to invest as returns are guaranteed.

Second, Britain is not to focus on one technology group such as renewables. Instead it is opting to also subsidise CCS and nuclear energy. It is hoped these two revisions will reduce and balance the risks and uncertainties by providing subsidies and guaranteed returns.

However, as the EMR is still being introduced, it is too early to know whether it will spur sufficient investments. The lack of strike prices past 2021 could reduce investor confidence as it signals a lack of policy consistency. Moreover, the EU commission is investigating whether the recent agreement between the Government and EDF concerning the building of a new nuclear power station at Hinkley Point is a form of unfair state aid. This could hinder further investments into nuclear power in the near future. Moreover, the continued political uncertainty, described below in chapter 4.4, is continuing to reduce investor confidence. Consequently, the EMR might be insufficient.

4.3 How to control costs

During the past months, one of the largest political issues in Britain has been rising energy and electricity costs. This debate has two features, the first being the issue of increasing fuel poverty, the other being who should pay for subsidies provided to the energy sector.

4.3.1 Rising retail electricity prices

In the housing act of 2001, fuel poverty was meant to be eradicated by 2016. Instead, costs have risen over the last decade, contributing to a recent rise in fuel poverty. The price increase is partly due to rising international prices and to utilities requiring funds to enable investments. However, price increases are arguably also caused by a poorly functioning energy market as utility firms profits from households have increased substantially, rising by 77 per cent during the past year alone. According to Ofgem, utility profit per household has increased from £30 in 2011 to £53 in 2013. The rising prices and resulting profits per household in the face of stagnating wages have led to the energy market's legitimacy being challenged. Indeed, a recent opinion poll found that 70 per cent of the British population wished for the energy sector to be nationalized.

A comparison of British gas and electricity prices to other European countries shows that prices are close to the average. According to *Europe's Energy Portal*, the United Kingdom has one of the lowest natural gas prices in Europe, with the Danish price of natural gas being more than double as high (measured in € per kWh). Retail electricity prices are also average. This indicates that the issue in Britain is not so much the price of energy itself but the high levels of consumption caused by a poor housing stock. Thus, it is essential that energy efficiency measures are increased.

4.3.2 Costs of subsidizing CCS, nuclear power and RES-E

Subsidies given towards low carbon technologies are included in the retail price of electricity. As such, the expansion of especially RES-E is partly responsible for the price increase. As of 2013, 11 per cent of the retail price of electricity derived from such investments. Unsurprisingly, these investment costs have become a political issue in Britain in the current era of fiscal tightening, rising prices and stagnating wages.

It is hoped that the EMR will reduce a household's electricity bill by £100 by 2030, although uncertainties abound. The ERM reform also has the potential of reducing windfall

profits in the energy sector which have been substantial due to the inefficient RO system. As strike prices provide a guaranteed return, the investment risk is also reduced, which should reduce the interest rate of loans, thus making investments cheaper, a factor which is of upmost importance to spur investments.

However, it is not certain the ERM will deliver lower retail prices, or if the strategy is the most cost-efficient alternative. Some of the most important uncertainties are listed below:

- It is still being implemented with details still emerging and as such it is too early to state anything with certainty;
- Recently published strike prices have been initially put at too low a level for solar PV, and later set at too high a level. This indicates that windfall profits might continue in the future system.
- The government is trying to exempt certain industry from CfD associated costs, thus probably shifting the costs to the retail price of electricity.
- The Hinkley Point nuclear power station will receive a strike price set until 2058 with a guaranteed price of £92.50 per MWh which is more than twice the current market rate. Moreover, the cost of the two nuclear reactors is £16 billion and the state has provided £10 billion of loan guarantees. This cost is around double the amount that the government five years ago thought would be the maximum cost of a nuclear power station. It is unlikely this investment will prove to be economically sound, not least seeing the falling price of RES-E generation. For example, the strike price for onshore wind will be £90 in 2008/2019.

It might be the case that the state is aware it is providing high windfall profits both for nuclear power and also for some forms of renewables in order to spur investments. In any case, the cost effectiveness of the EMR is in doubt.

Consequently, uncertainties abound over the future cost and supply of energy. Not unsurprisingly, the issue has developed into one of the most significant political debates in contemporary British politics. The debate is of importance as the strategy chosen will have large implications on other aspects of the energy system and the economy as a whole. It is the nature of this debate which is the final challenge.

4.4 Political uncertainty

Recently, energy policy has moved from being a largely depoliticised subject to one of great political importance. Labour initiated the debate by calling for a price freeze on electricity, the breaking up of utility firms and the creation of a stronger regulatory body. In effect the proposal is an attempt to reform current market structures.

The government's response has been uncoordinated. The Liberal Democrats, who control the department for Energy and Climate Change are strong supporters of the green measures and as such have defended current policies. Meanwhile, the Conservatives have instead targeted current policies. This is arguably caused by the party facing pressure from the populist United Kingdom independence Party [UKIP] to end subsidies to the RES-E sector. Consequently, the government decided to shift a part of the cost from consumers onto general taxation, along with postponing the deadline for energy companies to fulfil energy efficiency duties under the ECO. The response has provided a short-term respite but has not addressed underlying systemic factors behind rising electricity prices. Indeed, by cutting back on energy efficiency measures, it can be argued the problem has been

exacerbated in the longer term. Moreover, future tax payers and customers will face the costs of the Hinkley Point nuclear power deal when it goes online. As such, uncertainty abounds.

4.5 Conclusion

To conclude, the challenges facing Britain's energy system and energy policy are all connected to the unsolved problem of finding a system which incentivises investments in a way that minimises costs to both the consumer and tax payer. The current inability to address this underlying problem is causing potential investors to halt future investments plans and also to pull out of projects which are in the pipeline. One of the more recent examples came from RWE cancelling its £4 billion Atlantic Array offshore wind power farm, stating that mixed messages from the government undermined its ability to raise finances. It can be hoped the recently published strike prices will reintroduce certain investor confidence.

5 Possible development pathways

As stated above, the current political situation is highly uncertain and fluid. It is probable this situation will continue, possibly until the 2015 elections. This is not surprising as it takes time for institutional alignment to occur behind a solution, and as such uncertainty is to be expected.

This chapter will shortly discuss three possible, and not mutually excluding, development pathways. These are:

- Continued and increased state involvement in the energy market
- Further reform of the energy market is a clear possibility
- Reduced political uncertainty will increase investments

5.1 Increased state involvement in energy markets

During the last few years there has been a shift away from a market liberal model to one based on interventionist state policies. The paradigm has shifted from one based on using technology neutral policies for promoting low carbon technologies to one of technology specific policies. There is an attempt to retain certain features of the market liberal model by introducing auctions into the strike price model in the medium term. This might work for the RES-E sector but probably not for the nuclear power sector, not least as it increases investment risks.

This shift has occurred because former policies which were based on the concept of minimal state involvement in the energy market, are perceived to have failed to deliver both sufficient investments in electricity generation and adequate regulation of utility firms. Another reason is low ETS prices which were meant to shift investments into low carbon technologies. However, as ETS prices are too low, they are hindering this steering mechanism from being efficient.

This shift of governance regime is not only being seen in the energy sector, but also in the wider infrastructure sector and is caused by government concerns over insufficient infrastructure investments. As such, it is likely this shift will continue and be further strengthened. However, as there is currently no political unanimity around a solution, experimentation in government intervention is likely.

5.2 Further reform of energy markets are a possibility

The legitimacy of the current energy market is being challenged by rising costs for consumers. It is possible the EMR will provide sufficient incentives for investors. However it will not reduce consumer costs in the short term and will thus not address the source of discontent with the current energy market. The challenge could be addressed if wages start to increase and if the cost of energy imports are reduced and reflected in retail prices. Alternatively, energy efficiency could be promoted. If neither occurs, some sort of action to increase the legitimacy of the system could occur. One alternative to this would be Labour's suggested policy reforms.

5.3 Reduced political uncertainty will increase investments

It is likely that when political uncertainty is reduced, investments into low carbon technologies will increase. This is especially true of RES-E technologies such as wind power and solar PV. The uncertainty regarding the commerciality of CCS will however act as a continued drag on future investments. Moreover, investment into the nuclear power sector is still uncertain pending the investigation by the EU commission into unfair state aid and prevailing high costs of new power stations.

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