



House of Commons
Energy and Climate Change
Committee

The energy revolution and future challenges for UK energy and climate change policy

Third Report of Session 2016–17

*Report, together with formal minutes relating
to the report*

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The Energy and Climate Change Committee

The Energy and Climate Change Committee is appointed by the House of Commons to examine the expenditure, administration, and policy of the Department of Energy and Climate Change and associated public bodies.

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The Committee is one of the departmental select committees, the powers of which are set out in House of Commons Standing Orders, principally in SO No 152. These are available on the internet via www.parliament.uk.

Publication

Committee reports are published on the Committee's website at www.parliament.uk/ecc and in print by Order of the House.

Evidence relating to this report is published on the inquiries publications pages of the Committee's website.

[Energy Revolution HC 175](#)

[Leaving the EU: implications for UK climate policy HC 553](#)

[Leaving the EU: implications for UK energy policy HC 554](#)

Committee staff

The current staff of the Committee are Dr Farrah Bhatti (Clerk), Dr Marion Ferrat (Committee Specialist), Stephen Habberley (Committee Specialist), Becky Mawhood, (Committee Specialist), Jamie Mordue (Senior Committee Assistant), Henry Ayi-Hyde (Committee Support Assistant), and Nick Davies (Media Officer).

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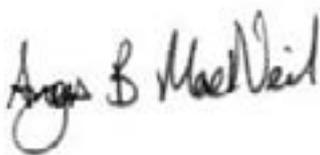
Foreword from the Chair of the Committee

Since the inception in 2008 of the Department of Energy and Climate Change (DECC), the House of Commons Energy and Climate Change Committee has performed a crucial role in examining the expenditure, administration, and policy of DECC and its associated public bodies. The Committee's existence has been vital in holding the Government to account on its energy and climate change goals. Over the course of three Parliaments the Committee has been at the forefront of scrutinising huge changes across these policy areas. From informing the development of 'electricity market reform' (designed to incentivise investment in secure low-carbon electricity) to seeking solutions for a more competitive retail market. From helping to shape Government's strategy for maximising economic recovery of offshore oil and gas to exploring new policies for the emerging shale gas sector. And, from holding energy companies to account on consumer prices to identifying how Government can better support new and existing energy technologies that make consumers' lives easier and their homes and businesses warmer and more energy efficient.

I am very proud of the work of Committee Members over the last year. None of this would have been possible without the immensely positive participation of our stakeholders. I am very grateful to all those who have taken time over the years to contribute to our work by sending us written evidence and correspondence, answering our questions in lively oral evidence sessions, and engaging with us through traditional and social media.

While the 'Machinery of Government' changes that led to DECC's responsibilities being merged into a new Department for Business, Energy and Industrial Strategy may have come as a surprise to many, they represent a huge opportunity to embed decarbonisation into mainstream business policies and ensure that a low-carbon approach is at the heart of Government's industrial strategy. Effective Parliamentary scrutiny is essential to making sure this opportunity is realised. In the short time we have had before the inevitable consequential changes to select committee structures were confirmed, my Committee has sought to bring to a conclusion as much as possible of its current work programme. This report contains our concluding thoughts on three ongoing inquiries. It also provides a very brief overview of our activities over the past year and our views on the big issues on the horizon for our successors.

Despite the loss of a dedicated energy and climate change committee I am confident that effective Parliamentary scrutiny on these crucial issues will continue, both within the House of Commons debating chamber and within the new select committee structures. I wish the Business, Energy and Industrial Strategy Committee all the best in holding the Government to account on tackling climate change, developing a low-carbon industrial and business strategy, and securing clean, reliable and affordable energy.



Angus Brendan MacNeil, Chair of the Energy and Climate Change Committee

1 Introduction

1. In the aftermath of the vote to leave the EU, we quickly launched calls for evidence to assess the implications on both energy and climate change policy. A week later the new Prime Minister announced the creation of a new Government department, the Department for Business, Energy and Industrial Strategy (BEIS), which brought together all of DECC with parts of the former Department for Business, Innovation and Skills (BIS). While there was no immediate change to our remit, operations or membership, House of Commons committee structures are designed to mirror those in Whitehall. In the short term we continued the crucial role we play in scrutinising the Government’s energy and climate change policies, but we acknowledged that changes to the Standing Orders of the House of Commons would be forthcoming and would likely result in scrutiny of energy and climate change policy falling to a BEIS Committee. The details of these likely changes became clear when the Government tabled a motion in the House of Commons on 15 September to disband our Committee and transfer date our responsibilities to the old BIS Committee, which is to be recast as the new BEIS Committee. The House as a whole agreed to this motion on 11 October, and we will be disbanded effective 17 October.

2. This report brings together our work on three current inquiries—Energy revolution, Leaving the EU: implications for UK climate policy, and Leaving the EU: implications for UK energy policy—along with our reflections on the last year and on potential future scrutiny priorities for our successor committee.

3. Chapter two provides an overview of our ‘Energy revolution’ inquiry, which sought to identify which innovations have the potential to revolutionise the energy sector and how well prepared Government is to deal with the effects of disruptive changes to this sector. We received 118 pieces of written evidence and 41 video submissions to this inquiry highlighting different innovative technologies. These can be accessed via our website.¹ We heard from 12 witnesses, and conducted a fact-finding visit to the United States to learn lessons from the successes in this sector in California and Washington State. We are grateful to all those who contributed to this inquiry, met with us in person and took the time to produce online material.

4. Our work on the impact of leaving the EU is less well developed as we have not had time to fully explore the issues through oral evidence sessions. The issue is nonetheless of huge importance and will shape the UK policy environment for years to come. Chapter three provides an overview of the submissions of written evidence we received in response to our inquiries into ‘Leaving the EU: implications for UK climate policy’ and ‘Leaving the EU: implications for UK energy policy’. This chapter does not seek to provide a comprehensive review of all the potential implications. Rather we have tried to focus on the issues most commonly raised by stakeholders and those with the most wide-ranging impacts. We hope that the issues we highlight in this chapter will be explored further by our successors on the BEIS Committee. More detailed views on the implications for energy and climate change policy can be found by referring to all the original written submissions which have been published on our website.²

1 Energy and Climate Change Committee, [Energy revolution inquiry page](#) [accessed 6 October 2016]; and UK Parliament Youtube channel, ‘[The energy revolution](#),’ accessed 6 October 2016

2 Energy and Climate Change Committee, [Leaving the EU: implications for UK energy policy publications page](#), and [Leaving the EU: implications for UK climate policy publications page](#)

5. Finally in chapter four, we reflect briefly on our work over the past year and set out our views on some of the potential issues on the horizon for our successor committee. We are grateful to all those who have contributed to our inquiries and to our wider programme of work.

Box 1: Working towards our goals

At the start of the Parliament, in July 2015, we carried out an extensive consultation with our stakeholders to identify what policy areas they considered should be (a) urgent scrutiny priorities, and (b) long-term priorities, for our Committee over the coming five years. Our subsequent report, *Our priorities for Parliament 2015–20*, provided an overview of the approach we took, the issues that were raised, and the immediate outcomes in terms of our planned work programme.* We also held an away day to reflect on the views of our stakeholders and identified three strategic goals:

- Goal 1: Holding the Government to account on achieving a balanced energy policy
- Goal 2: Setting the agenda on an innovative future energy system
- Goal 3: Influencing the long-term approach to climate targets

Our strategic goals have helped to guide our work to scrutinise the Department of Energy and Climate Change (DECC). In the last year we have conducted seven major inquiries which resulted in detailed reports on the changes Government ought to make, and we held numerous evidence sessions to scrutinise topical issues such as ‘The outcomes of Paris COP 21’, ‘The Competition and Market Authority’s energy market investigation’, and ‘UK new nuclear: status update’. Highlights from our inquiries over the last year are provided in Chapter four and full details of our work can be found on our webpage (www.parliament.uk/ecc).

* Energy and Climate Change Committee, First report of session 2015–16, [Our priorities for Parliament 2015–20](#), HC 368

2 The energy revolution: preparing for the future UK energy system

Introduction

6. The energy sector is changing. Economic, environmental, social and public health concerns, as well as national and international climate change ambitions, are shifting not only the way in which electricity and heat are generated, but also the way in which supply and demand are considered across the energy network. The emergence and rapid uptake of renewable technologies have created new pressures on the network, with a move away from the classical model of large, localised power generating stations feeding into the transmission network, towards a decentralised system, where generation and demand can be met at a distribution- and individual-level. The variable nature of renewable generation creates the need for baseload power and enough flexibility on the grid to manage peaks and troughs in generation so as to avoid black-outs if weather conditions are not propitious. These challenges require innovative solutions at all levels and an updated management of the electricity system.

7. Our *Low carbon network infrastructure* report explored some of these grid-level issues.³ We recommended an overhaul to network operation, system operators employing new tools to manage variable generation, and giving consumers a greater role in managing the UK's electricity load. We urged Government to address the network system as a whole and develop its change-readiness capability so as to meet the ambition of a low-carbon future. Following from this work, we wanted to look more specifically at which technologies and innovations developing today could positively disrupt and improve the energy system of tomorrow, transforming market structures and creating new patterns of demand and supply.

8. We were not looking for a silver bullet: solving the energy trilemma⁴ and creating a sustainable energy market will not be the product of one single innovation. The answer is likely to be an evolving combination of new technologies, new business models, and new interactions between consumers and their energy use. The themes raised in stakeholder responses are summarised below:

- Bioenergy, including biomethane, anaerobic digestion, “home incinerators” for burnable waste and biomass;⁵
- Novel business models, including novel price models, settlement reform, packaging DSR products and peer-to-peer energy trading;⁶

3 Energy and Climate Change Committee, First report of session 2016–17, *Low carbon network infrastructure*, HC 267

4 The trilemma relates to the challenge of meeting three goals: ensuring energy security, ensuring affordability for consumers, and meeting long-term decarbonisation goals

5 The Anaerobic Digestion and Bioresources Association ([REV0103](#)), Mr Chris White ([REV0008](#)), UK Parliament Youtube channel, ‘[The energy revolution](#),’ accessed 6 October 2016

6 Western Power Distribution ([REV0047](#)), Citizens Advice ([REV0063](#)), Swanbarton limited ([REV0067](#)), Mr Simon Hunt ([REV0068](#)), Scottish Renewables ([REV0078](#)), E.ON UK Plc ([REV0117](#)), UK Parliament Youtube channel, ‘[The energy revolution](#),’ accessed 6 October 2016

- Carbon capture;⁷
- Demand-side innovations, including community energy,⁸ local supply markets and trading,⁹ consumer behaviour and engagement,¹⁰ demand-side flexibility, demand-side management and demand-side response;¹¹
- Energy efficiency innovations, including improved insulation, use of buildings and efficiency of appliances;¹²
- Flexibility enablers, including innovative generator connections, demand-side measures, networks and grids;¹³
- Innovations in new fuels and fuel additives;¹⁴
- Developments in electricity generation,¹⁵ including solar technologies,¹⁶ floating offshore wind¹⁷ and tidal energy;¹⁸
- Innovations in policy, governance and regulation,¹⁹ including the need for a whole systems approach and balanced networks;²⁰
- Grid innovations, including distribution-level technologies,²¹ smart and micro-grids,²² interconnection²³ and improved transfer cables;²⁴

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- 7 Stag Energy Development Co. Ltd ([REV0056](#)), Cambridge Carbon Capture Ltd ([REV0066](#)), Origen Power Ltd ([REV0081](#))
- 8 Mr Moore ([REV0011](#)), Landmark Associates Ltd ([REV0034](#)), Act on Climate Ltd ([REV0122](#))
- 9 Mr McCann ([REV0036](#)), Electricity Storage Network ([REV0043](#)), Swanbarton limited ([REV0067](#))
- 10 Newcastle University Institute for Sustainability ([REV 051](#)), Citizens Advice ([REV 063](#)), Smart Energy GB ([REV0084](#)), EnerNOC ([REV0087](#)), Act on Climate Ltd ([REV0122](#)), UK Parliament Youtube channel, 'The energy revolution,' accessed 6 October 2016
- 11 Dunelm Energy ([REV0035](#)), Miss Carson ([REV0042](#)), Energy Managers Association ([REV0044](#)), Newcastle University Institute for Sustainability ([REV0051](#)), Energy Unlocked ([REV0086](#)), Tempus Energy Technology ([REV0100](#)), KiWi Power ([REV0109](#)), E.ON UK Plc ([REV0117](#)), National Grid ([REV0118](#)), UK Parliament Youtube channel, 'The energy revolution,' accessed 6 October 2016
- 12 InstaGroup Limited ([REV 009](#)), Mr McCann ([REV0036](#)), AECB ([REV0045](#)), UK Parliament Youtube channel, 'The energy revolution,' accessed 6 October 2016
- 13 Dunelm Energy ([REV0035](#)), Miss Carson ([REV0042](#)), Newcastle University Institute for Sustainability ([REV0051](#)), Innovate UK ([REV0053](#)), Scottish renewables ([REV0078](#)), Energy Unlocked ([REV0086](#)), E.ON UK Plc ([REV0117](#)), UK Parliament Youtube channel, 'The energy revolution,' accessed 6 October 2016
- 14 Unipart Rail ([REV0046](#)), Dearman ([REV0048](#)), Dr Richmond ([REV0080](#)), Siemens ([REV0095](#)), Institute of Physics ([REV0121](#)), Act on Climate Ltd ([REV0122](#)), Aum Energy Pte Ltd ([REV0129](#))
- 15 Atkins ([REV0058](#)), Osamu Ide ([REV0060](#)), Scottish Renewables ([REV0078](#)), Association for Project Management ([REV0091](#))
- 16 Western Power Distribution ([REV 047](#)), Solarmass Ltd ([REV0075](#)), Institute of Directors ([REV0099](#)), UK Parliament Youtube channel, 'The energy revolution,' accessed 6 October 2016
- 17 Scottish Renewables ([REV0078](#)), RSPB ([REV0133](#))
- 18 Kepler Energy ([REV0072](#)), UK Parliament Youtube channel, 'The energy revolution,' accessed 6 October 2016
- 19 Mr Woodgate ([REV0006](#)), Dunelm Energy ([REV0035](#)), Mr McCann ([REV0036](#)), AECB ([REV0045](#)), University of Exeter Energy Policy Group ([REV0089](#)), E3G ([REV0098](#)), Tempus Energy Technology ([REV0100](#)), Oxford University ([REV0102](#)), Orchard Partners London Ltd ([REV0107](#)), UK Parliament Youtube channel, 'The energy revolution,' accessed 6 October 2016
- 20 Scottish renewables ([REV0078](#)), The Royal Academy of Engineering ([REV0124](#)), Imperial College Centre and UKERC ([REV0128](#)), London South Bank University ([REV0130](#))
- 21 Electricity Storage Network ([REV0043](#)), Atkins ([REV 058](#)), Smart Generation Limited ([REV0069](#)), Siemens Plc ([REV0095](#)), Norther Powergrid ([REV0105](#)), Mr Day ([REV0115](#)), E.ON UK Plc ([REV0117](#))
- 22 Mr Moore ([REV0011](#)), Intel Corporation (UK) Ltd ([REV 083](#)), E.ON UK Plc ([REV 117](#))
- 23 PCAH ([REV0002](#)), Mr Moore ([REV0011](#)), Electrical Contractors' Association ([REV0097](#))
- 24 Enertechnos Limited ([REV0052](#)), UK Parliament Youtube channel, 'The energy revolution,' accessed 6 October 2016

- Innovations in the heat sector;²⁵
- The use and production of hydrogen and advances in materials for energy technologies;²⁶
- Advances in the nuclear sector, including new fuel and reactor technologies, Small Modular Reactors and fusion.²⁷ Submissions also discussed low energy nuclear reactions;²⁸
- Smart systems, the internet of things, software and cloud-based innovations;²⁹
- Electricity storage;³⁰
- Innovations in the transport sector;³¹
- Innovations in the water sector.³²

9. In the time we had we focussed on four categories of innovations: Storage, demand-side technologies, digital engagement, and nuclear innovations. During our final evidence session on 11 October and our fact-finding visit to the United States we focussed on questions of funding and the regulatory challenges for the integration of new technologies and business models. We consider each of our four innovation categories in the following sections.

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- 25 Mr Bowen ([REV0031](#)), Homeglow products ([REV0037](#)), Newcastle University Institute for Sustainability ([REV0051](#)), Heating and Hotwater Industry Council ([REV0077](#)), Energy and Utilities Alliance ([REV0088](#)), Calor Gas Ltd ([REV0090](#)), Oxford University ([REV0102](#)), Mr Browning ([REV0110](#)), HRS Energy ([REV0114](#)), Mr Day ([REV0115](#)), UK Parliament Youtube channel, '[The energy revolution](#),' accessed 6 October 2016
- 26 Dr Ahern ([REV0022](#)), Mr Zoepfl ([REV0024](#)), Electron Energy Research Ltd ([REV0061](#)), ITM Power ([REV0071](#)), Mr Williams ([REV0094](#)), UK Parliament Youtube channel, '[The energy revolution](#),' accessed 6 October 2016
- 27 Mr Bowen ([REV0031](#)), North Carolina State University ([REV0041](#)), Innovate UK ([REV0053](#)), Algometrics Ltd ([REV0062](#)), Centre for Nuclear Engineering, Imperial College London ([REV0065](#)), GE Hitachi ([REV0073](#)), Tokamak Energy Ltd ([REV0079](#)), UK Atomic Energy Authority ([REV0085](#)), Association for Project Management ([REV0091](#)), Institution of Mechanical Engineers ([REV0096](#)), National Nuclear Laboratory ([REV0112](#)), Nuclear Industry Association ([REV0120](#)), Institute of Physics ([REV0121](#)), The Royal Academy of Engineering ([REV0124](#)), Moltex Energy ([REV0125](#)), Energy Process Developments Ltd ([REV0126](#)), SNC Lavalin ([REV0127](#)), UK Parliament Youtube channel, '[The energy revolution](#),' accessed 6 October 2016
- 28 Mr Treat ([REV0013](#)), Mr Hall ([REV0015](#)), Mr Mottorshead ([REV0018](#)), Modern Device ([REV0019](#)), Mr Lynn ([REV0020](#)), Mr Hughes ([REV0021](#)), Mr Jenkins ([REV0023](#)), Dr Luk ([REV0025](#)), Mr Heale ([REV0026](#)), Mr Docherty ([REV0027](#)), Mr Beckett-Leonard ([REV0029](#)), Mr Dodgshun ([REV0038](#)), Electron Energy Research ([REV0061](#))
- 29 Mr Pearson ([REV0028](#)), Landmark Associates Ltd ([REV0034](#)), Demand Logic ([REV0049](#)), Innovate UK ([REV0053](#)), Control Networks Solutions ([REV0055](#)), Atkins ([REV0058](#)), Intel Corporation (UK) Ltd ([REV0083](#)), Smart Energy GB ([REV0084](#)), University of Exeter Energy Policy Group ([REV0089](#)), UK Power Networks ([REV0113](#)), E.ON UK Plc ([REV0117](#)), Heriot-Watt University ([REV0119](#)), The Royal Academy of Engineering ([REV0124](#)), London South Bank University ([REV0130](#)), UK Parliament Youtube channel, '[The energy revolution](#),' accessed 6 October 2016
- 30 PCAH ([REV0002](#)), Mr Messina ([REV0004](#)), Professor Garvey ([REV0012](#)), Mr Bowen ([REV0031](#)), Ayrenergy Ltd ([REV0032](#)), Mr Putson ([REV0040](#)), Western Power Distribution ([REV0047](#)), Dearman ([REV0048](#)), Newcastle University Institute for Sustainability ([REV0051](#)), OXIS Energy Ltd ([REV0054](#)), Hyperdrive Innovation ([REV0057](#)), UK Energy Storage Hub Oxford ([REV0059](#)), UK Hydrogen and Fuel Cell Association ([REV0074](#)), Renewable Energy Association ([REV0082](#)), Association for Project Management ([REV0091](#)), Good Energy Ltd ([REV0093](#)), Siemens ([REV0095](#)), Institution of Mechanical Engineers ([REV0096](#)), Electrical Contractors' Association ([REV0097](#)), Dr Saker ([REV0101](#)), Oxford University ([REV0102](#)), Renewable Energy System Ltd ([REV0104](#)), Northern Powergrid ([REV0105](#)), Doosan Babcock ([REV0106](#)), KiWi Power ([REV0109](#)), National Nuclear Laboratory ([REV0112](#)), UK Power Networks ([REV0113](#)), Scottish Power ([REV0116](#)), E.ON UK Plc ([REV0117](#)), National Grid ([REV0118](#)), Faradion ([REV0123](#)), The Royal Academy of Engineering ([REV0124](#)), London South Bank University ([REV0130](#)), RSPB ([REV0133](#)), UK Parliament Youtube channel, '[The energy revolution](#),' accessed 6 October 2016
- 31 Atkins ([REV0058](#)), Mr Beltran ([REV0064](#)), Nissan ([REV0076](#)), Calor Gas Ltd ([REV0090](#)), Electrical Contractors' Association ([REV0097](#)), Institute of Directors ([REV0099](#)), SSE ([REV0108](#)), The Royal Academy of Engineering ([REV0124](#)), RSPB ([REV0133](#))
- 32 Mr Slater ([REV0092](#))

Storage

10. Electricity storage allows electricity to be transferred not just across distances, but between time periods. Technologies are varied and encompass different levels of capacity, response time, cost and maturity. Small-scale storage, typically in battery form, can help Distribution Network Operators (DNOs) and individual consumers balance their systems at distribution level or ‘behind the meter’, and large-scale storage, such as Pumped Hydroelectric Storage and Compressed Air Energy Storage, can provide services at the national level to balance variable generation.

11. Approximately one third of all submissions to our inquiry highlighted storage as a group of technologies that could revolutionise the energy sector, by far the largest technology represented in the evidence.³³ These include batteries (lithium-ion, lithium sulphur, sodium-ion, redox-flow), fuel cells, large-scale storage/pumped-hydro, hydrogen (e.g. for transport), and thermal energy storage. We were also interested to hear about the concept of “virtual energy storage”, which was described to us as incorporating multiple technologies and processes including batteries, demand side management, heat storage, and coordinate these across gas, electricity or heat.³⁴

12. The important role played by storage was described by the Renewable Energy Association:

Energy storage helps provide not only security of supply and other important technical services to the grid network, but also a level of stability to the power market and wholesale electricity prices, therefore smoothing power supplies and intraday prices, saving consumers money.³⁵

UK Power Networks, a Distribution Network Operator (DNO), built and operates “the first multipurpose storage facility in the country in Leighton Buzzard”.³⁶ Barry Hatton, Director of Asset Management at UK Power Networks, told us that this facility had demonstrated “a range of services that storage can provide” and played a part in alleviating the capacity problem they were experiencing at that site: “We have been able to demonstrate the benefits that we thought we would get from the storage”.³⁷ UK Power Networks has taken a number of steps to enable storage at the distribution level.³⁸

13. There are also opportunities in the transport sector to integrate electric vehicles with the grid, as we discussed with Tesla Motors in the United States. Nissan, a car manufacturer, also told us that:

33 PCAH (REV0002), Mr Messina (REV0004), Professor Garvey (REV0012), Mr Bowen (REV0031), Ayrenergy Ltd (REV0032), Mr Putson (REV0040), Western Power Distribution (REV0047), Dearman (REV0048), Newcastle University Institute for Sustainability (REV0051), OXIS Energy Ltd (REV0054), Hyperdrive Innovation (REV0057), UK Energy Storage Hub Oxford (REV0059), UK Hydrogen and Fuel Cell Association (REV0074), Renewable Energy Association (REV0082), Association for Project Management (REV0091), Good Energy Ltd (REV0093), Siemens (REV 095), Institution of Mechanical Engineers (REV0096), Electrical Contractors’ Association (REV0097), Dr Saker (REV0101), Oxford University (REV0102), Renewable Energy System Ltd (REV0104), Northern Powergrid (REV0105), Doosan Babcock (REV0106), KiWi Power (REV0109), National Nuclear Laboratory (REV0112), UK Power Networks (REV0113), Scottish Power (REV0116), E.ON UK Plc (REV0117), National Grid (REV0118), Faradion (REV0123), The Royal Academy of Engineering (REV0124), London South Bank University (REV0130), RSPB (REV0133), UK Parliament Youtube channel, ‘The energy revolution,’ accessed 6 October 2016

34 The Royal Academy of Engineering (REV0124), London South Bank University (REV0130)

35 Renewable Energy Association (REV0082)

36 UK Power Networks (REV0113)

37 Q1 [Barry Hatton]

38 [Letter](#) from Barry Hatton, UK Power Networks, to the Committee, 12 October 2016

V2G [Vehicle to Grid] technology enables the electricity stored in electric vehicles to be used for purposes other than powering those vehicles. Our V2G technology allows electric vehicles to feed their power back into grid, making renewable sources even more widely available and affordable.³⁹

Barriers to deployment

14. We heard that while costs still have to fall for storage to reach its full economic potential, these are coming down rapidly with deployment.⁴⁰ However, despite the potential of storage to contribute to a balanced grid, to counter the need for carbon-intensive or nuclear baseload, and to provide cost savings for consumers,⁴¹ a number of challenges to its deployment remain. National Grid stated that there were currently two such challenges:

- The lack of clarity on the legal and commercial status of storage, particularly in relation to ownership of storage assets and the lack of a clear regulatory and legislative governing framework; and
- Insufficient incentives for investors due to current storage projects' complex revenue sources.⁴²

UK Power Networks added that:

As a result of our experience [at Leighton Buzzard], we have identified a number of commercial and regulatory barriers for the uptake of storage. We believe that at this point, all options should be left open for different commercial models and that storage should be a solution that network operators can own and deploy so we can always choose the least cost solution for customers.⁴³

Double-charging and definitions

15. Our *Low Carbon Network Infrastructure* inquiry outlined the need to urgently address regulatory barriers.⁴⁴ One such hurdle is the double charging of balancing charges for storage. Dr Jill Caaney, Director of the Electricity Storage Network, explained that barriers around the end-user levies were still in place because the UK's renewable incentive scheme was set up before storage came into play and "storage is not defined as not being an end user".⁴⁵ As a result, storage facilities are charged once for consuming the electricity they store, and then for supplying it back to the grid. The end-user of the electricity released is then also charged for consuming it. As a result, "everyone pays double and that has a material cost to projects".⁴⁶ Dr Caaney added that storage should face appropriate use of system charges, but that charges on the electricity passing through should be paid for "by

39 Nissan ([REV0076](#))

40 Q1 [Barry Hatton, Dr Nina Skorupska]

41 Q1 [Barry Hatton, Dr Nina Skorupska, Dr Jill Caaney]

42 National Grid ([REV0118](#))

43 UK Power Networks ([REV0113](#))

44 Energy and Climate Change Committee, First report of session 2016–17, [Low carbon network infrastructure](#), HC 267, para 64

45 Q3 [Dr Jill Caaney]

46 Q3 [Dr Jill Caaney]

the genuine end user”.⁴⁷ Dr Nina Skorupska, CEO of the Renewable Energy Association, agreed that charges should be based “on the actual power consumed”,⁴⁸ and stressed the need to consider the “thorny aspect of where storage sits within the UK legal and regulatory framework”.⁴⁹ The lack of clarity on this adds perceived risks for investors.

16. We heard that the lack of a formal definition for storage was problematic. Amanda Lyne, Chair of the UK Hydrogen and Fuel Cell Association (UKHFCA), explained that “you cannot resolve many of the issues about a definition for storage because if you are going to treat it differently you have to know what it is that you are treating differently”.⁵⁰ She added that the European Parliament had just adopted a motion that would see a new asset class for storage (in addition to interconnectors, transmission, distribution, supply and generation), which will provide “flexibility and optionality on who can own and operate” storage assets.⁵¹ A separate asset class for electricity storage “would allow different entities in the system, including suppliers as well as distribution network operators, to use storage”.⁵² All the witnesses we heard from in our storage panel supported introducing a separate asset class for grid-level storage.⁵³

17. The pace of change in storage regulation has been slow. Dr Cainey explained that such changes inevitably took time, and that even a “quick fix”—a modification of the generation licence to incorporate storage as a sub-class—would take up to eighteen months.⁵⁴ The other route, primary legislation outlining a new asset class for storage, would take two to three years and require “a great deal of political will”.⁵⁵ She welcomed the fact that the Government had dedicated storage teams in place since 2015.⁵⁶

Route to market

18. The REA explained that storage also lacked a clear route to market in the UK because the main public mechanism that aims to support storage, the Capacity Market,⁵⁷ is not fit for this purpose.⁵⁸ The last two auctions “failed to deliver” significant energy storage.⁵⁹ Dr Skorupska explained that because storage was still quite a young technology, the length of contract was an important consideration; storage can currently qualify for four-year contracts whereas new build generators can acquire 15-year contracts.⁶⁰ She called for “an intelligent updating” of the Capacity Market, with a review of “all of those assumptions that were written and put into the capacity market many years ago”.⁶¹ Dr Cainey suggested that a number of “quick fixes” could be made to the Capacity Market during the annual review of its parameters that would better make use of the benefits of storage, mainly the fact that it can respond quickly to signals by the system operator.⁶² Dr Skorupska also

47 Q4 [Dr Jill Cainey]

48 Q6 [Dr Nina Skorupska]

49 Q6 [Dr Nina Skorupska]

50 Q6 [Amanda Lyne]

51 Q6 [Amanda Lyne]

52 Q11 [Dr Jill Cainey]

53 Qq11–12

54 Q8 [Dr Jill Cainey]

55 Q8 [Dr Jill Cainey]

56 Q8 [Dr Jill Cainey]

57 Refer to paragraph 32 for more detailed information about the Capacity Market

58 Renewable Energy Association ([REV 082](#))

59 Q6 [Dr Nina Skorupska]

60 Q6 [Dr Nina Skorupska]

61 Q14 [Dr Nina Skorupska]

62 Q14 [Dr Jill Cainey]

called for a change to the Capacity Market rule that projects receiving any other form of subsidy cannot currently bid into the Capacity Market. She explained that this “restriction around stacking of revenues for the energy storage projects” was precluding storage from delivering grid and cost-saving benefits, as “different types of energy storage can provide [...] different services”.⁶³

19. We heard that another potential route to market could be through the Contracts-for-Different (CfD) scheme. The Renewable Energy Association called for Government to “consider reforms to the CfD mechanism to enable ‘hybrid’ storage and renewables projects”.⁶⁴ A consultation on amending the CfD contracts and regulations—including storage consideration—was carried out earlier this year and the Government is due to produce its analysis of responses.⁶⁵ Dr Skorupska said that hybrid CfDs would be “a really great win” for the storage industry.⁶⁶

The need for urgency

20. These issues continue to make the economics of energy storage challenging,⁶⁷ but there is immense opportunity for the UK to harness the potential of the storage industry and become a world leader in this technology. Scottish Renewables said that “if current regulatory barriers were removed, some £7bn per annum of savings to consumers could also be achieved”.⁶⁸ We heard that “A recent report from Imperial College indicates that the potential savings in the operation of a decarbonised grid by deploying storage could reach £8[bn] per annum in 2030”.⁶⁹ The Electrical Contractors’ Association added “if implemented correctly, with the use of Smart Meters to change tariffs, then little or no public incentive would be required as savings would accrue by storing power at cheap rates and using and/or exporting at high rates”.⁷⁰

21. Despite the then Energy Minister telling us six months ago that she was “literally about to publish a call for evidence on smart energy systems”, which would address barriers to storage, we are still waiting for action from Government.⁷¹ Witnesses stressed the urgency of publishing this consultation quickly.⁷²

Encouraging deployment

22. Storage deployment has been more successful in the United States, thanks to the availability of the technology industry, state support and legislative incentives, with a plethora of storage developers located on the West Coast. Meeting with legislators and agencies in California, we learned that storage had been a priority for the state. The Storage Procurement Bill (AB2514), passed in 2010, requires the big investor-owned

63 Q14 [Dr Nina Skorupska]

64 Renewable Energy Association ([REV0082](#))

65 Department of Energy and Climate Change, [Contracts-for-Difference: Consultation on changes to the CfD contract and CfD regulations](#) (May 2016)

66 Q20 [Dr Nina Skorupska]

67 Renewable Energy Systems ([REV0104](#))

68 Scottish Renewables ([REV0078](#))

69 UK Energy Storage Hub Oxford ([REV0059](#))

70 Electrical Contractors’ Association ([REV0097](#))

71 Energy and Climate Change Committee, First report of session 2016–17, [Low carbon network infrastructure](#), HC 267, para 62

72 Q7 [Dr Nina Skorupska, Dr Jill Caine]

utilities to procure 1.3GW of storage by 2020.⁷³ It was designed to encourage California to incorporate energy storage into the electricity grid, give the correct signals and help create the appropriate infrastructure for further storage deployment. We heard from the Governor's office that that the Bill had created momentum in the storage sector and had played a key role in driving down costs, with storage expected to be market competitive in 2 to 3 years (see Annex 1 for a description of our meetings). Cumulus Energy Storage, a UK-US technology company focused on low-cost grid-scale rechargeable Copper/Zinc battery storage, told us that the legislative and policy signals in California had given the necessary signals for tech companies to invest and see commercial opportunities. We also heard, however, that while many demonstration projects existed in the United States, there was not yet any commercialisation of grid-scale storage.

23. Dr Cainey told us that while California's target had "certainly incentivised the market", the difficulty in the UK was knowing how much storage we want and how we would bring this to market.⁷⁴ She considered a Government strategy and commitment to storage may give enough of a signal without the need for a UK storage specific target.⁷⁵ She added "if you facilitate the markets and you make it a fair market and we see it being truly cost-reflective, which the markets are not at the moment, then the solutions will come, whatever those solutions are".⁷⁶ Amanda Lyne agreed that the focus should be on trying to enable change and allowing the market and the technology providers to respond.⁷⁷ Dr Skorupska, however, considered that a storage target tied to an industrial strategy would be a positive step forward. She told us "Let us go for a target, let us say a range that we want to go for and at the same time do the whole system architecture and do it in a sensible way".⁷⁸ We also heard that storage presented not only an energy solution but was a "key industrial strategy opportunity":

Energy storage is the hot topic [overseas.] If the UK can show a lead here, it could probably take advantage of that and help other countries to solve their low-carbon energy problems too. [...] The UK has always had the lead on developing and incorporating markets [but] we have to catch up with the likes of California and Japan, who are really showing and demonstrating the use of energy storage.⁷⁹

24. By breaking down some of the regulatory barriers faced by the storage industry and providing a signal to the market on its importance, the Government could help to unlock further investment in this sector. The Institute for Mechanical Engineers explained that:

Significant investment well beyond the current £50 million committed in the last budget is needed to create storage that lasts effectively beyond three hours. This would create a step change in the energy infrastructure allowing more connection to the current infrastructure as well as independent small and off-grid opportunities.⁸⁰

73 California legislative information, '[AB-2514 Energy storage systems \(2009–2010\)](#),' accessed 7 October 2016

74 Q17 [Dr Jill Cainey]

75 Q 17 [Dr Jill Cainey]

76 Q 17 [Dr Jill Cainey]

77 Q17 [Amanda Lyne]

78 Q18 [Dr Nina Skorupska]

79 Q2 [Dr Nina Skorupska]

80 Institute of Mechanical Engineers ([REV0096](#))

Renewable Energy Systems added that “having the right control system to maximise revenues [for storage projects] is vital to a successful project, meaning greater market deployment”.⁸¹

25. National Grid’s analysis of the UK energy market suggests there is a significant opportunity for greater storage, “equating to an extra 2–3GW of low-carbon generation by 2020, delivering over £100m p.a. of consumer value”.⁸² They added:

This potential will grow through the 2020s and 2030s as technology costs continue to fall. While current storage costs remain reasonably high, we anticipate cost reductions that will enable storage to compete with other flexibility providers. For example, battery capital costs are forecasted to fall by nearly 50% over the next five years.⁸³

Conclusions

26. **Storage presents a real opportunity for the UK. Strong public financial support and clear legislation in California have been vital in developing the storage industry and laying the foundation for the full integration of storage infrastructure in the grid. There are similar opportunities in the UK for legislation to help support investment in storage.**

27. *We reiterate our previous call on Government to move quickly on addressing regulatory barriers faced by storage: there must be a clear definition for storage, double-charging must come to an end, and a separate asset class for grid-level electricity storage should be established as a matter of urgency. The Government must also review the outdated Capacity Market rules and regulations in relation to storage, including considering increasing the contract length and addressing restrictions around stacking of revenues for storage projects. We further recommend that Government sets out a high-level public commitment to making the UK a world-leader in storage and sets a storage procurement target for 2020. The Government should also consider a possible subsidy framework for energy storage to accelerate deployment given the importance of storage to unlocking the full potential of renewable energy.*

Demand-side management

28. Demand-side response (DSR) emerged as a key technology in responses to our initial call for evidence.⁸⁴ It encompasses a range of mechanisms that encourage electricity users to reduce their consumption at certain times, thereby making energy demand an integral part of grid balancing. It can reduce costs to consumers and improve the efficiency of the entire energy system.⁸⁵ DSR also paves the way for new and innovative business models and tariffs for network operators, suppliers, demand aggregators and smaller businesses

81 Renewable Energy Systems ([REV0104](#))

82 National Grid ([REV0118](#))

83 National Grid ([REV0118](#))

84 Dunelm Energy ([REV0035](#)), Miss Carson ([REV0042](#)), Energy Managers Association ([REV0044](#)), Newcastle University Institute for Sustainability ([REV 051](#)), Energy Unlocked ([REV0086](#)), Tempus Energy Technology ([REV0100](#)), KiWi Power ([REV0109](#)), E.ON UK Plc ([REV0117](#)), National Grid ([REV0118](#)), UK Parliament Youtube channel, ‘[The energy revolution](#),’ accessed 6 October 2016

85 Innovate UK ([REV0053](#)), EnerNOC ([REV0087](#)), National Grid ([REV0118](#))

or individual customers.⁸⁶ National Grid told us that “roughly two-thirds of national demand sits in the industrial and commercial business sector and so initial focus should be on developing DSR in this sector”.⁸⁷ Scottish Renewables told us:

Demand Side Response (DSR) is intelligent energy usage for consumers and system operators. Giving the right price signals for consumers to turn down their usage, to use energy at different times, or by allowing third parties to control a consumer’s energy consumption can mean savings for consumers, better use of low-carbon electricity – resulting in reducing carbon emissions and better network management for the operator. Meeting just 5% of peak demand by DSR could save consumers £790 million.⁸⁸

Professor Jim Watson, from the UK Energy Research Centre, added that DSR helps to tackle the trilemma: “it can help meet the three main policy goals, so it can help to decarbonise while maintaining security, but crucially do that at a lower cost than if you did not have the demand-side response there”.⁸⁹

Unlocking the potential of demand-side response

29. Despite the potential of innovative DSR models to become a key piece of the puzzle in the future energy system, the full potential of its role in grid balancing is yet to be unlocked, with “a need to reform regulation and policy”.⁹⁰

30. We heard that technology maturity was not a barrier to the development of DSR, rather, the problem was the slow development of the DSR market.⁹¹ Sara Bell, CEO of Tempus Energy Technology, explained that “this is not about maturity, it is about whether there is a commercial opportunity”.⁹² Colin Calder, CEO of PassivSystems, added “the technology for doing this exists and as a company we will not enter the electricity demand-side response market until we see a sensibly organised market with less risk, fewer policy change, fewer barriers”.⁹³ National Grid described how it was trying to encourage growth in the DSR sector:

To facilitate the development of DSR products, National Grid has developed a framework called Power Responsive which enables businesses, suppliers and policy makers to shape the growth of demand side response collaboratively. The aim is to deliver it at scale by 2020. To achieve the desired growth, there is a need for increased promotion and awareness of the opportunities in DSR complimented by a simpler set of products with clear value for end users.⁹⁴

86 Energy Managers’ Association ([REV0044](#)), Western Power Distribution ([REV0047](#)), E.ON UK Plc ([REV0117](#))

87 National Grid ([REV0118](#))

88 Scottish renewables ([REV0078](#))

89 Q27 [Professor Jim Watson]

90 Q27 [Phil Sheppard]

91 Q28 [Sara Bell, Colin Calder]

92 Q28 [Sara Bell]

93 Q28 [Colin Calder]

94 National Grid ([REV0118](#))

National Grid said: “We are continuing our commitment [to Power Responsive] in a second year given the success of the campaign and the exciting challenge ahead to develop more flexible tools into the energy mix”.⁹⁵

31. Ultimately we heard there has been a lack of effective incentives for DSR providers and energy consumers. In August, National Grid announced that it would “not be procuring Demand Side Balancing Reserve (DSBR) for winter 2016/17”.⁹⁶ DSBR is one of its new balancing services targeted at large energy users who volunteer to reduce their demand during winter weekday evenings in return for a payment. Representatives from the DSR industry expressed frustration at the way in which National Grid had designed the DSBR mechanism and suggested this was an example of the inherent bias in the market towards supply-side rather than demand-side solutions.⁹⁷ National Grid explained that this decision was taken when it had become evident that a minimal amount of DSBR would be available across the peak period, and thus “the cost of procuring the volume of DSBR outweighed the expected benefit to consumers that it would provide”.⁹⁸ They stressed that “the cancellation of DSBR does not logically mean we are not committed to growing DSR. We are actively encouraging participation of DSR in our other balancing services”.⁹⁹ It was also acknowledged that the DSBR was a stop-gap policy and that in the long-run the Capacity Market was the mechanism to focus on.¹⁰⁰

32. The difficulties surrounding the treatment of DSR in the Government’s Capacity Market auctions have been well documented by this Committee and its predecessors.¹⁰¹ The Capacity Market provides a regular retainer payment to reliable forms of capacity (both demand and supply side), in return for the capacity being available when the system is tight. Generation and demand-side providers can compete for capacity payments in an auction held four years ahead of the year in which capacity is expected to be delivered (the “T-4 auction”), followed by a second auction one year ahead (the “T-1 auction”), if more capacity is needed. There are three main concerns regarding the ability of DSR companies to participate in the Capacity Market, as set out below.

33. The first issue is contract length. DSR aggregators can only acquire a one-year contract in the T-4 auctions, while new build power stations can acquire a 15-year contract.¹⁰² The Government has previously stated that:

Analysis of currently-available evidence indicates that DSR and existing generation do not require [...] significant up-front capital investment, which would potentially necessitate access to long-term capacity agreements. [...] DSR is a relatively low-cost solution and should therefore be able to compete effectively on the basis of one-year agreements.¹⁰³

95 [Briefing](#) from National Grid to the Committee, 12 October 2016

96 National Grid, [Letter on the Decision on DSBR Procurement for 2016/17](#) (August 2016)

97 Qq30–34 [Sara Bell, Colin Calder, Yoav Zingher]

98 [Briefing](#) from National Grid to the Committee, 12 October 2016

99 [Briefing](#) from National Grid to the Committee, 12 October 2016

100 Q32 [Phil Sheppard]

101 Energy and Climate Change Committee, [Implementation of Electricity Market Reform](#), Eighth Report of Session 2014–15, HC 664; Energy and Climate Change Committee, First Report of Session 2016–17, [Low carbon network infrastructure](#), HC 267

102 Q35 [Sara Bell, Colin Calder, Professor Jim Watson], KiWi Power ([REV0109](#))

103 HM Government, [Government Response to the Energy and Climate Change Committee Report on the Implementation of Electricity Market Reform](#), Cm 9090, June 2015

Witnesses disputed this, suggesting that it was a misconception that DSR does not require significant up-front investment and that businesses that might be interested in installing DSR infrastructure would “tell you to go away” if you suggested they make that investment for the sake of only one year’s worth of returns.¹⁰⁴

34. The second issue is the capital bond that aggregators are forced to put up when bidding for the one-year contracts, whereas incumbent power stations do not have to.¹⁰⁵ KiWi Power stressed that the bond issue represented a disproportionate amount of the total cost of a DSR project. Yoav Zingher, CEO of KiWi Power, explained that the cost amounted to between £5,000 and £10,000 per MWh, which “for a power station, [...] is less than 1% of the total cost. For demand-side response, it is 95% of the total cost”.¹⁰⁶ He added that “the biggest cost to doing business is the cost of paying the Government to allow me to do business”.¹⁰⁷

35. The third issue relates to the lead in time for providing DSR solutions. DSR aggregators were planning to make use of the T-1 auctions, which provide contracts for projects with a shorter one-year lead time. Kiwi Power told us that “aggregators feel that [the T-1 auctions] are now likely to be so small that one power station could out bid all the potential DSR [thereby removing] the primary route to market for DSR”.¹⁰⁸ They argued that Government should “reconsider reducing T-1 auction volume” and “exclude existing power stations from any reduced T-1 auction”.¹⁰⁹

36. Together these issues leave demand-side measures at a serious disadvantage. It is clear to us that current policy is still skewed towards generation to meet balancing needs and regulation is inhibiting the development of the demand-side. Scottish Renewables stressed that:

Ofgem has stated that “Non-traditional business models have the potential to transform the energy system, through increasing competitive pressure, unlocking more value for consumers, driving improved consumer engagement and enhancing system resilience”. In order to achieve this it is essential that changes to regulation should promote a level playing field for all market participants.¹¹⁰

Colin Calder added that:

There will need to be some form of financial support in the form of subsidies. Right now, every other form of energy in the market is attracting subsidies, whether it be renewables or even building new power plants today. It should not be for demand-side response to be left to find its own way into the market without some form of support.¹¹¹

37. We were interested to hear that California has had goals for demand-response for a few years, with the California Energy Commission setting demand-response procurement

104 Q35 [Sara Bell, Professor Jim Watson]

105 KiWi Power ([REV0109](#))

106 Q38 [Yoav Zingher]

107 Q36 [Yoav Zingher]

108 KiWi Power ([REV0109](#))

109 KiWi Power ([REV0109](#)), Q37 [Yoav Zingher]

110 Scottish renewables ([REV0078](#))

111 Q32 [Colin Calder]

targets for the three investor-owned utilities through a pay-as-bid auction.¹¹² California's three utilities have collectively contracted for more than 40MW of DSR resources.¹¹³ In the United States, we heard about the loading order used by utilities when capacity is tight, starting with DSR, followed by energy efficiency, renewables and fossil fuels. We heard some support for such an approach being utilised in the UK.¹¹⁴ However, while California has the largest market for demand-side management, we heard that it too has barriers to overcome in incentivising large businesses to reduce their load.

Conclusions

38. The right policy framework needs to be put in place to unlock the full potential of demand-side response (DSR) technologies. Getting DSR right will empower consumers, reduce bills, ease grid pressure, and lower carbon dioxide emissions. Without explicit market mechanisms and target capacity goals DSR will not be able to deliver best value for consumers.

39. Changes to Government policy with regards to DSR participation in the Capacity Market need to be implemented and we urge the Government to implement these in time for the upcoming T-4 and T-1 auctions in the winter 2016–17. The contract bond requirement for DSR providers bidding in the Capacity Market is an unnecessary cost for businesses. It should be removed, and if not, it must be reduced to a level that is a more reasonable percentage of the cost of the projects that are bidding. Government must update its evidence base to justify why it thinks the DSR projects should be limited to one-year contracts. Our view is that significantly longer contract periods should be available to DSR providers. Finally, the Government should reconsider its decision to reduce the volume of the T-1 auction.

40. The market should also be given a clear signal that DSR capacity is to be procured as a strongly preferred alternative to diesel generation plants. We recommend investigating the use of a merit order for meeting capacity needs in the UK when margins are tight, which places DSR high on the list.

41. The Government should itself become a beacon of good practice by demonstrating the use of flexible demand solutions in its buildings in Whitehall and around the country. Parliament should also use the opportunities of the restoration and renewal of the Palace of Westminster to embed flexible demand and other new energy technologies within the Parliamentary estate.

Digital engagement of energy consumers

42. In the digital era of smart phones and cloud-based applications, the 'internet of things' opens up a realm of opportunities for a smarter energy system, greater consumer engagement in energy use, and new models of energy trading and governance.¹¹⁵ Intel corporation told us that:

112 California Public Utilities Commission, [Decision resolving several phase two issues and addressing the motion for adoption of settlement agreement on phase three issues](#) (December 2014)

113 Green Tech Media, '[California Picks Winners for First-Ever Auction of Distributed Energy as Demand Response](#),' accessed 10 October 2016

114 Q27 [Colin Calder]

115 University of Exeter Energy Policy Group ([REV0089](#)), Scottish Power ([REV0116](#))

Digitization in the energy sector continues apace. By 2016, the global market for smart grid technologies, which includes sensors, management and control technologies, communication networks, and software, will be worth \$80.6 billion: a growth of 28.7% from 2011. By 2020, the global smart grid market is forecast to exceed \$400 billion. In the EU, policies are encouraging the development of decentralized electricity generation in which electric vehicles, energy storage and flexible demand are all expected to play a significant role.¹¹⁶

43. Approximately 15% of the submissions to our energy revolution inquiry noted that digital solutions were important in driving change in the UK energy sector,¹¹⁷ highlighting opportunities in the buildings,¹¹⁸ electricity¹¹⁹ and heat¹²⁰ sectors, as well as opportunities for new pricing models and new ways of trading energy.¹²¹ Innovate UK told us:

Through the convergence of [the] internet of things, digital creativity and new business models the future energy system will be dominated by energy assets of almost every conceivable type and size. Systems will manage their energy in sophisticated autonomous ways to provide significant levels of distributed generation, storage, new grid support flexibility, peer to peer energy trading which will minimise new infrastructure investment while creating value add utility, information and services to end users.¹²²

44. In the United States, we discussed the opportunities of a smart and interconnected energy system with several interlocutors. We heard that the California Public Utilities Commission was looking at how new planning processes feed into the smart grid, particularly to identify where distributed energy can be most ideally located. We also heard about the University of Washington Clean Energy Institute's research on the role and meaning of smart grids, including questions around how much flexibility was needed, how to optimise it, and what market mechanisms could be used to deliver this. We visited Nest labs, a producer of self-programming, self-learning thermostats and other home automation systems, and heard about the range of products trialled and commercialised by the company and their success in driving down energy costs for consumers. During our meeting with Nest labs, we heard that the first phase of Nest's smart thermostat study in the UK found an average of 6–8% savings in households. The Behavioural Insights Team (a social purpose company part-owned by the UK Government) concluded in their 2015–16 report that “the results of this research have provided statistically significant evidence that the [Nest Learning Thermostat] saves substantial amounts of energy”.¹²³

116 Intel corporation ([REV0083](#))

117 Mr Pearson ([REV0028](#)), Landmark Associates Ltd ([REV0034](#)), Demand Logic ([REV0049](#)), Innovate UK ([REV0053](#)), Control Networks Solutions ([REV0055](#)), Atkins ([REV0058](#)), Intel Corporation (UK) Ltd ([REV 083](#)), Smart Energy GB ([REV0084](#)), University of Exeter Energy Policy Group ([REV0089](#)), UK Power Networks ([REV0113](#)), E.ON UK Plc ([REV0117](#)), Heriot-Watt University ([REV0119](#)), The Royal Academy of Engineering ([REV0124](#)), London South Bank University ([REV0130](#)), UK Parliament Youtube channel, 'The energy revolution,' accessed 6 October 2016

118 Demand Logic ([REV0049](#)), Innovate UK ([REV0053](#)), Control Network Solutions ([REV0055](#))

119 Heating and Hotwater Industry Council ([REV0077](#)), Intel Corporation (UK) Ltd ([REV0083](#)), EnerNOC ([REV0087](#)), The Royal Academy of Engineering ([REV0124](#))

120 Heating and Hotwater Industry Council ([REV0077](#))

121 Citizens Advice ([REV0063](#)), Swanbarton ([REV0067](#)), Smart Energy GB ([REV0084](#)), Electrical Contractors' Association ([REV0097](#)), E.ON UK Plc ([REV0117](#))

122 Innovate UK ([REV0053](#))

123 The Behavioural Insights Team, [Update Report 2015–16](#) (September 2016)

Data protection and privacy

45. Large datasets such as those provided by smart energy systems open up opportunities for innovation and unlock new lines of research, but also raise issues around how to ensure consumer privacy is respected. The World Economic Forum said that “one of the greatest individual challenges posed by new information technologies is privacy. We instinctively understand why it is so essential, yet the tracking and sharing of information about us is a crucial part of the new connectivity”.¹²⁴ Victoria MacGregor, Director of Energy at Citizens Advice, explained that “robust protections are in place around the smart-meter rollout around data privacy and interoperability, but that does tend to fade away as you start moving into the smart home”.¹²⁵ She added:

We think that interoperability and interchangeability as principles are absolutely vital for consumers, because it stops existing monopoly companies taking advantage. Then we do get quite a lot of consumers contacting us with concerns about data privacy. Transparency and consumer control over their data—again as key principles as we move to a new system—whether that be in regulating or in policy, are things that we think are absolutely vital to give people the confidence to move to these new services.¹²⁶

46. *The Government must stay on top of the developing challenges associated with data protection and privacy. While these issues are being considered in relation to the smart-meter roll-out, the Government needs to ensure that it is thinking ahead about these issues in the context of more fully-connected smart homes and businesses.*

Approaches to engage consumers

47. The full potential of the digital energy economy will require consumer consent and engagement in an area that is not typically on people’s minds. Stimulating and supporting people to rethink how they use energy and to optimise their use of smart and connected devices will be vital. Energy Unlocked told us that:

A number of companies heading in this direction such as Tesla, SolarCity and NEST are now household names, and the valuations show that these companies are capturing energy consumers’ imagination. Many others are not yet in the public eye but are working to apply new technologies and business models to the energy sector.¹²⁷

Sacha Deshmukh, CEO of Smart Energy GB, suggested that consumers will be able to engage in the same way in the energy market as any other aspect of their life when it is digitised. He explained that energy is an enabler and that:

There will be a marketplace where energy is much more closely aligned with other elements of our lifestyles and consumers will engage in that more deeply. Until that time, lots of people are doing their best to help consumers

124 World Economic Forum, ‘[The Fourth Industrial Revolution: what it means, how to respond](#),’ accessed 8 October 2016

125 Q62 [Victoria MacGregor]

126 Q62 [Victoria MacGregor]

127 Energy Unlocked ([REV0086](#))

to engage in an analogue market. That is a good thing—it is not good to have a load of people stuck on deals that are not great—but it is only ever going to be suboptimal until it is digitised.¹²⁸

48. Consumer-driven change in the energy market can be a result of direct engagement and consumer interest, of systems smart enough to adapt to consumer preferences and reduce energy use without direct consumer actions, or through the use of intermediaries who manage changes on behalf of individuals. Citizens Advice explained:

New entrants with superior customer service and/or better technology can act as intermediaries between energy companies and consumers, taking control of supplier choice. [...] The primary benefits of intermediaries should be cost and convenience. If implemented successfully, intermediaries should make it easier for consumers to reduce the price they pay for energy, the time spent searching, and potentially the quantity they consume. In practice this means helping consumers find the cheapest energy tariff, reduce the time they spend using electrical appliances, and improve the energy efficiency of appliances.¹²⁹

49. However, the ability to engage in the market will not necessarily mean greater consumer engagement. EnerNOC explained that:

Software will make it possible for many more customers to participate, but for the customers to want to do so, there has to be enough benefit to them for it to be worthwhile. The best way to achieve this is by allowing customers access to all relevant markets – either to buy directly at market prices, or to sell their demand-side flexibility in competition with supply-side resources. While the largest customers will participate directly if offered the chance, smaller customers need help and encouragement.¹³⁰

50. Citizens Advice warned that the use of intermediaries “could also lead to a ‘digital divide’ whereby participant customers increasingly avoid costs passed on to others”.¹³¹ Victoria MacGregor added:

Levels of engagement are low and there is a real risk that as we move forward, you would see the benefits of the new systems just going to that engaged minority. We would want to make sure that we are guarding against that.¹³²

51. UK Power Networks told us about their ‘energywise’ project in Tower Hamlets in London, which supports vulnerable customers in managing their household energy usage, whilst helping to also reduce peak demand and cut the cost of strengthening the electricity network:

Customer engagement has been fundamental to ‘energywise’ especially as many of those involved with the trial do not have English as a first language. We have, therefore, worked with charities such as National Energy Action, local trusted community groups that have included social housing landlords

128 Q56 [Sacha Deshmukh]

129 Citizens Advice ([REV0063](#))

130 EnerNOC ([REV0087](#))

131 Citizens Advice ([REV0063](#))

132 Q56 [Victoria MacGregor]

and a community centre. This project has given us invaluable insight on how to engage better with vulnerable and fuel poor customers. The energywise recruitment campaign received a positive response from the community in East London.¹³³

52. While network companies may realise benefits from helping consumers reduce their energy use, the benefits for energy supply companies are less clear and it is these suppliers that have the closer relationship with customers. EnerNOC told us that:

It is not necessarily in the electricity retailer's interests for customers to work with third-parties to analyse their data intensively and find potential savings. To maximise its value, it has to be straightforward for customers to access their data and share it with third-party software providers, on as close to a real-time basis as the installed metering system allows.¹³⁴

Sacha Deshmukh also acknowledged that there was an issue with how much consumers believed that energy suppliers and the energy industry as a whole were really trying to get them the best deal, adding that “consumers are ready to be served by a marketplace that works a lot better”.¹³⁵ Simon Roberts, CEO of the Centre for Sustainable Energy, told us that “there is no policy driver in the market for those energy suppliers to do something different except where it might benefit themselves”.¹³⁶ He argued that unless there was a driver in the market such as a demand reduction obligation for energy suppliers, the UK would remain behind the curve and would have to “play catch-up”.¹³⁷ He told us that if energy companies had such an obligation, they would act on it.¹³⁸ Sacha Deshmukh considered that more “upstream” interventions were needed and that there was the need for “a fundamental move on from the way in which the market has worked previously”.¹³⁹

53. Messaging will be key to increased customer engagement, as we previously explored in our *Home energy efficiency and demand reduction* report.¹⁴⁰ We heard that “placing behavioural insights at the heart of the way in which we develop the new system” was vital.¹⁴¹ Victoria MacGregor explained that:

Fundamentally, the energy market does not work with the way that people actually think and make decisions. If we can see policymakers and regulators using more behavioural science and behavioural insights in framing these new developments, that will make it much easier for consumers to make better choices.¹⁴²

She added that Citizens Advice would like to see the Behavioural Insights Team be much more involved in energy policy-making going forward, to “help markets work in a way

133 UK Power Networks ([REV0113](#))

134 EnerNOC ([REV0087](#))

135 Q55 [Sacha Deshmukh]

136 Q57 [Simon Roberts]

137 Q57 [Simon Roberts]

138 Q59 [Simon Roberts]

139 Q60 [Sacha Deshmukh]

140 Energy and Climate Change Committee, Fourth Report of Session 2015–16, [Home energy efficiency and demand reduction](#), HC 552

141 Q56 [Victoria MacGregor]

142 Q56 [Victoria MacGregor]

that people actually think and act”.¹⁴³ Simon Roberts added that behavioural science was not the answer as such but that the Government and regulator “should absolutely embed all of that understanding” when designing programmes such as the smart-meter roll-out.¹⁴⁴

54. *It is vital to communicate effectively to consumers the benefits of smart meters and intelligent devices to manage energy use in homes and businesses. However, the Government must also develop methods to nudge the energy sector towards embracing the opportunities arising from developing a smarter market in which consumers are more engaged and where reduction of demand is valued over increasing supplies of energy. The Government should investigate the pros and cons of alternative approaches to do this, including the potential for a demand reduction obligation.*

55. *It is clear that the digitisation of the energy system alongside the increasing availability of “internet of things”-enabled technologies and appliances will revolutionise not only the energy market but also the consumer experience. Government will want to ensure that this opportunity for UK households is not held back by regulation or a lack of understanding within Whitehall.*

Nuclear innovations

56. Contributors to our inquiry highlighted two nuclear energy technologies that could revolutionise the energy system: Small Modular Reactors (SMRs)¹⁴⁵ and nuclear fusion technologies, including small spherical tokamaks.¹⁴⁶

Small modular reactors

57. Innovate UK told us:

Small modular reactors (SMRs) have the potential to supply cheaper, secure, flexible, low carbon energy. They have the significant benefits of providing more flexible operation, allowing improved grid balancing, modular construction to facilitate ‘additive’ power generation, alternative uses and potentially lower full life cycle costs.¹⁴⁷

Developing the SMR industry could create jobs across the development and supply chains and place the UK at the forefront of the nuclear industry.¹⁴⁸

143 Q57 [Victoria MacGregor] 11.28

144 Q58 [Simon Roberts]

145 The International Atomic Energy Agency defines ‘small’ reactors as those that produce the equivalent electric power of less than 300 MWe. SMRs are designed in a way that allows them to be manufactured at a plant, brought to site fully constructed, and installed module by module, thereby potentially improving manufacturing efficiency and cost while reducing construction time and financing costs. Innovate UK ([REV0053](#)), Algometrics Limited ([REV0062](#)), Centre for Nuclear Engineering, Imperial College London ([REV0065](#)), GE Hitachi Nuclear Energy ([REV0073](#)), Institution of Mechanical Engineers ([REV 096](#)), National Nuclear Laboratory ([REV0112](#)), Nuclear Industry Association ([REV0120](#)), Institute of Physics ([REV 121](#)), The Royal Academy of Engineering ([REV0124](#)), Moltex Energy ([REV0125](#)), Energy Process Developments Ltd ([REV0126](#))

146 Innovate UK ([REV0053](#)), Centre for Nuclear Engineering, Imperial College London ([REV0065](#)), Tokamak Energy Ltd ([REV0079](#)), United Kingdom Atomic Energy Authority ([REV0085](#)), Institution of Mechanical Engineers ([REV0096](#))

147 Innovate UK ([REV0053](#))

148 GE Hitachi ([REV0073](#))

58. Our predecessor Committee conducted an inquiry into *Small nuclear power* in 2014 to explore its place in the UK.¹⁴⁹ It concluded that SMRs could play a role in delivering low carbon energy at lower upfront capital cost compared to large conventional nuclear reactors but that the commercial viability of SMRs remained unclear. It recommended the Government take a proactive role in driving forward the development and deployment of these reactors in the UK.

59. In 2015, the Government announced that it would invest £250 million in a nuclear research and development programme to enable the UK to be a global leader in innovative nuclear technologies.¹⁵⁰ In March 2016, it launched the first phase of its SMR competition to gauge market interest among technology developers, utilities, potential investors and funders in developing, commercialising and financing SMRs in the UK.¹⁵¹ It is too early to comment in detail on the extent to which Government's approach is driving forward the development and deployment of SMRs. This may be an issue that our successors wish to scrutinise in the future.

60. ***The Government hopes to establish the UK as a global leader in the Small Modular Reactor (SMR) market. Our successors may in due course wish to investigate progress on the development and deployment of SMRs.***

Fusion

61. We heard both in the UK and the US that nuclear fusion, though many years away from demonstration and commercialisation, could be a revolutionary innovation “because it would produce abundant base load power with no CO₂ emissions”.¹⁵² In the United States, we heard that the main challenges to the development of the technology were the difficulty of starting the reactions, technical complexity, high capital costs, and long engineering and development timescales. We discussed different fusion technologies and the various programmes and funding for nuclear fusion. We heard the US industry's worry that, once the development difficulties had been overcome, fusion technologies would hit lengthy regulatory requirements that could set back product commercialisation for many years after it is technically deployable. We also touched upon the public perception of nuclear technologies and how the difference between nuclear fusion and fission could be communicated.

62. The UK Atomic Energy Agency set out in detail the UK's involvement in fusion research both in a domestic and international setting:

The UK's national fusion laboratory, Culham Centre for Fusion Energy (CCFE) [...] is a leading player in the worldwide fusion programme. [...]

The project that will confirm if [a commercially viable fusion machine] is possible is under construction at Cadarache in southern France. ITER is a €15 billion experiment backed by Europe, China, India, Japan, Russia, South Korea and the US. [...] ITER – expected to begin operating in the mid 2020s – will produce 500 megawatts of fusion power [...]. Although it

149 Energy and Climate Change Committee, Fourth Report of Session 2014–15, *Small nuclear power*, HC 347

150 HM Treasury, ‘[Spending review and autumn statement 2015](#),’ accessed 9 October 2016

151 Department for Business, Energy & Industrial Strategy, ‘[Small Modular Reactors Competition Phase One](#),’ accessed 8 October 2016

152 Centre for Nuclear Engineering, Imperial College London ([REV0065](#))

will not be connected to the grid, a successful ITER will enable the project's partners to proceed with plans for fusion power stations using the tokamak design.¹⁵³

63. The Centre for Nuclear Engineering at Imperial College London added that:

Capital costs (mostly materials) [of Small Spherical Tokamaks] will reduce rapidly. [...] The USA and UK are currently the world leaders in SST technology and Tokamak Energy Ltd located in Oxfordshire are working closely with US teams at MIT and Princeton in developing the technology.¹⁵⁴

64. Fusion is an innovation for the next generation. In the United States, the prospect of over-regulation was clearly a worry. The UK is already involved in fusion projects and is home to some of the world-leading companies exploring this field. There is an opportunity to be a pioneer and world-leader in this area. Such is the potential of this technology, the Government should monitor and engage with developments in fusion research and plan ahead to minimise regulatory barriers to development and deployment.

Economic opportunities of the energy revolution

65. It is unlikely that one single innovation will emerge to solve the issues faced by the energy sector.¹⁵⁵ Rather, the energy transition will be led by the successful integration of a number of existing and developing technologies that, together, will improve the entire system. The UK is a world-leader in many of the clean technologies discussed in this report and their development provides an opportunity for UK jobs and the UK economy. These technologies need to be supported so that a real market can develop.¹⁵⁶

66. The Institute of Physics told us that “realising any of these potentially revolutionary advancements will require sustained investment in research through the science budget”.¹⁵⁷ In the United States, we learned that energy innovation can be optimised by close partnership between academia, where many innovations begin, industry, which is placed to carry them to market, and government, which best understands the public need. In Washington State, the Department of Commerce is putting money into the University of Washington’s Clean Energy Institute because of its outward-facing, entrepreneurial focus. By doing so, it has created the right environment for companies creating cutting edge clean energy products to develop in Washington State. Energy Unlocked said “what these innovators care about are market conditions that level the playing field for their new solutions, and a policy and regulatory framework that does not overprescribe what the future will bring”.¹⁵⁸

67. By harnessing the opportunities presented by the current energy transition, it would be possible to create the right environment for the UK to be the global leader in the green technology sector. To do so, the UK needs to get regulation right,¹⁵⁹ as we have explored across the different technologies discussed in this report.

153 United Kingdom Atomic Energy Authority ([REV0085](#))

154 Centre for Nuclear Engineering, Imperial College London ([REV0065](#))

155 Innovate UK ([REV0053](#)), University of Exeter Energy Policy Group ([REV0089](#)), Association for Project Management ([REV0091](#))

156 Atkins ([REV0058](#)), The Royal Academy of Engineering ([REV0124](#))

157 Institute of Physics ([REV0121](#))

158 Energy Unlocked ([REV0086](#))

159 Tempus Energy Technology ([REV0100](#)), University of Exeter Energy Policy Group ([REV0089](#))

68. The independent environmental consultants E3G explained that “a fundamental rethink of market and regulatory arrangements is required before we can take full advantage of these innovations”.¹⁶⁰ Siemens also stressed the importance of deploying these technologies in the marketplace:

We also need changes to markets and for government to create opportunities for large-scale deployment of these technologies so that we can learn what they really cost and what part they can play in the UK’s future energy landscape.¹⁶¹

69. Legislation therefore needs to promote innovation, a level playing field for all low-carbon technologies, and the right regulatory framework for new market entrants across the board.¹⁶² The UK has all the tools in hand to lead this transition. But what it needs now is certainty of policy direction to support the “vibrant start up scene in the UK”.¹⁶³ The Government needs to seize the opportunity presented by the ‘green tech’ sector and develop a governance regime capable of delivering policy coherence along the value chain, across borders and between sectors.¹⁶⁴

70. Technological leadership can be lucrative, but often occurs on longer timescales than private investment is comfortable with so there is a role for Government in driving energy innovation. The UK has world-leading universities: leveraging these to attract and retain international talent, and support innovation throughout its cycle, is crucial to achieving an energy revolution. The Government should support efforts to get the next generation of students interested in (1) energy research, and (2) the policy implications of their research. The Government should embrace tripartite collaboration between academia, industry and government where projects help to address the UK’s long-term decarbonisation goals.

71. The energy revolution presents a huge economic opportunity for the UK. With the appropriate strategy, policies and regulatory framework in place, Britain can become a world leader in the green technology sector. The Government should make green technology a top priority in its forthcoming industrial strategy.

160 E3G ([REV0098](#))

161 Siemens Plc ([REV0095](#))

162 UK Hydrogen and Fuel Cell Association ([REV0074](#)), Tempus Energy Technology ([REV0100](#))

163 Dunelm Energy ([REV0035](#))

164 E3G ([REV0098](#))

3 Leaving the EU: implications for UK energy and climate change policy

Introduction

72. The UK energy sector has extensive links with the EU through trade, directives and interconnection. Successive UK Governments have championed the liberalisation and decarbonisation agendas within the EU, including the development of the single market in energy. A larger, harmonised energy market with fewer trade barriers should in theory promote competition, reduce consumer prices, and increase security of supply. The 2013 House of Lords EU Sub-Committee D report, *No country is an energy island: Securing investment for the EU's future*, concluded that there are “clear benefits to be derived from working within the EU on the energy challenge”.¹⁶⁵

73. With regards to climate change, the UK has committed itself to action through national and international means. Domestically, the UK has in place the Climate Change Act 2008, which includes a commitment to an 80% reduction in emissions by 2050 relative to 1990 levels. The Act also established a system of five-yearly “carbon budgets”, as stepping stones along the way. Internationally, the UK as an EU Member State is currently subject to a number of EU climate-related directives. It is also a signatory, through its EU membership, to the EU’s nationally determined contribution to the 2015 UN climate change agreement (the “Paris Agreement”).

74. The Committee on Climate Change (CCC) has published its assessment of the impact of the vote to leave the EU on UK climate policy. It noted that the UK, alongside other Member States, has played a key role in developing mechanisms to control emissions, particularly where a co-ordinated approach has made sense. It concluded:

If these mechanisms continue to be strengthened through the 2020s as required by the EU’s climate ambition they would cover 55% of the emissions reduction required in the UK to 2030. In areas where these are working effectively, the UK should either remain in these schemes (where coordination continues to make sense) or replicate them at UK level.

According to the CCC, areas of effective working include product and efficiency standards, the EU Emissions Trading System and sectoral targets, such as biofuels uptake.¹⁶⁶

75. In this chapter we set out our stakeholders’ views on the implications of the vote to leave on EU-derived energy and climate change policies, and for the UK’s role in international climate change negotiations. We particularly focus on seven areas:

- the EU Emissions Trading System;
- the EU Effort Sharing process (emissions reduction in non-traded¹⁶⁷ sectors);

165 House of Lords European Union Committee, 14th Report of Session 2012–13, [No Country is an Energy Island: Securing Investment for the EU's Future](#), HL Paper 161

166 Committee on Climate Change, [Meeting Carbon Budgets – Implications of Brexit for UK climate policy](#), October 2016.

167 Agriculture, buildings, transport and waste

- the Paris Agreement and future international climate negotiations;
- the Internal Energy Market;
- security of supply and the role of EU interconnection;
- EU funding streams; and
- investor confidence.

At the end of the chapter we provide a brief summary of views on other EU-derived policies and legislation, comment briefly on the proposal to repeal the European Communities Act 1972, and set out some guiding principles for the exit negotiations.

EU Emissions Trading System

76. The future of the UK's involvement in the EU Emissions Trading System (EU ETS) prompted considerable debate among those submitting evidence. Under the ETS a cap is set on the amount of certain greenhouse gases that specific installations can emit.¹⁶⁸ Over time the cap is lowered so that total emissions fall. Companies receive or buy emission allowances which they can trade with one another as needed.¹⁶⁹ A robust carbon price within the System is an important driver for investment in climate change mitigation technologies.¹⁷⁰

77. At the start of the decade, fluctuations in the price of carbon in the form of EU ETS allowances resulted in uncertainty for investors in low carbon technologies. In response the then coalition Government introduced in 2013 a 'Carbon Price Floor' (CPF) of £16 per tonne. This means that UK industry effectively pays a top-up if the EU market price for carbon falls below this level. Following a fall in the EU market price of carbon to £4, the Government announced in 2014 that the UK's CPF would be capped at £18 per tonne from 2016 to 2020 to limit the competitive disadvantage faced by business and to reduce energy bills for consumers.¹⁷¹ At the time of writing the EU carbon price was €6, or £5.30.¹⁷² This means that while companies based across the EU pay this amount to emit a tonne of carbon dioxide, UK companies also pay an additional £12.70 to HM Treasury for every tonne emitted.

78. Most respondents agreed on the principle of emissions trading as a cost-effective means of decarbonisation, although recognised the need for further reforms to the system. The EU ETS was described as "the single most important policy instrument for the potential reduction of greenhouse gases in Europe",¹⁷³ and it was pointed out that emissions trading would account for 50% of the emissions reduction required by 2020

168 The gases and sectors covered are: carbon dioxide (CO₂) from power and heat generation; energy-intensive industry sectors including oil refineries, steel works and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals; and commercial aviation; nitrous oxide (N₂O) from production of nitric, adipic, glyoxal and glyoxalic acids; and perfluorocarbons (PFCs) from aluminium production

169 European Commission, '[The EU Emissions Trading System](#),' accessed 27 September 2016

170 Carbon Capture and Storage Association ([EUC0017](#)) para 8

171 House of Commons Library, '[Carbon Price Floor](#),' May 2014

172 Carbon Pulse, '[EU Market: EU carbon prices rocket past €6 as power, coal surges](#),' accessed 6 October 2016

173 Aldersgate Group ([EUC0048](#)) para 9

under the Climate Change Act.¹⁷⁴ In this section we discuss the benefits of remaining an active participant in the EU ETS, as well as alternatives such as developing a UK ETS that could link to the EU System or introducing carbon taxes.

79. On the benefits of remaining in the EU ETS, a key argument we heard was that the UK profited because it was a relatively small partner in the ETS and could take advantage of the cost-saving opportunities and increased liquidity that a larger market created.¹⁷⁵ Given the UK's influential voice in the development and refinement of the ETS, its remaining a part of the ETS was also considered beneficial to the System's functioning.¹⁷⁶ Stakeholders thought that the UK remaining in the System would help stabilise the long-term price signal for carbon and ensure the constant and cost-effective reduction of carbon in the European Economic Area.¹⁷⁷ The Committee on Climate Change noted that the System makes up 82% of industry's required emissions reduction by 2030 and concluded that "the ETS has the potential to be a least-cost approach without creating competitiveness challenges for industry".¹⁷⁸ It was pointed out that improvements in the System, such as clearer price signals and improved governance, were due to be introduced in phase IV (from 2021 onwards) and the UK should remain in the System to take advantage of these.¹⁷⁹ The risks of remaining part of the EU ETS without a voice in its future development were played down, given that decisions about the next phase, applying from 2021 to 2030, would be made in 2017 when the UK as an existing EU member could still play a full part in negotiations and decisions.¹⁸⁰ We were also reminded that UK-based energy intensive industries in construction product manufacturing tend to be part of large European or international companies, so leaving the EU ETS would be "highly complex in respect of their company carbon trading policies".¹⁸¹ One environmental organisation cited some potential advantages of leaving the scheme, including an end to net carbon accounting so that emissions reduction had to be delivered domestically. But on balance it concluded that political reality, the possibility of lower climate ambition and the potential to improve the EU ETS meant the UK should remain in the System.¹⁸²

80. Stakeholders also considered the future of the CPF. We heard that any decision to leave the EU ETS might necessitate reform of CPF. If investors thought one price setting mechanism was more dependable than the other, "this could influence the bankability of carbon pricing as an investment signal if the CPF were used as a substitute for the EU ETS if we left the latter scheme".¹⁸³ The CPF was also considered to have led to higher generation costs, distorted price signals and unnecessarily large imports via interconnectors of

174 Aldersgate Group ([EUC0048](#)) para 16

175 Grantham Research Institute at the London School of Economics ([EUC0032](#)) para 6. The UK accounted for only 11% of emissions regulated under the ETS between 2013 and 2015, compared with Germany's 25%. See also Shell International Petroleum Co Ltd ([EUC0015](#)) p2, and Greenpeace, ([EUC0052](#))

176 International Emission Trading Association ([EUC0003](#))

177 See for example Ashden sustainable solutions, better lives ([EUC0025](#)); Carbon Capture and Storage Association ([EUC0017](#)) para 8; CPL Industries ([EUC0028](#)) para 3; E.ON ([EUC0038](#)) para 16; European Federation of Energy Traders ([EUC0029](#))

178 Committee on Climate Change, [Meeting Carbon Budgets – Implications of Brexit for UK climate policy](#), October 2016

179 Engie ([EUC0046](#)) para 4

180 Oil & Gas UK ([EUC0033](#)) para 5b

181 Construction Products Association ([EUC0042](#)) para 9

182 Greenpeace ([EUC0052](#)). Net carbon accounting is the process whereby the UK's non-traded sector (agriculture, waste, transport, buildings) emissions are accounted for, but the emissions attributed to the traded sectors does not correspond to the actual UK territorial emissions in those sectors. Instead it corresponds to the UK's share of EU ETS cap (the total emissions permitted in the European traded sector)

183 Citizens Advice ([EUC0030](#))

cheaper electricity not paying an equivalent carbon price. The Government was therefore urged to ensure the CPF was more aligned long term with the EU ETS.¹⁸⁴ Some called for its outright abolition,¹⁸⁵ while others valued it for the signal it sent to other countries on the UK's commitment to climate change, and the revenue it could generate to potentially replace EU funding for low carbon research and development.¹⁸⁶

81. We heard that the international direction of travel was towards global expansion of linked emissions trading schemes, and that the EU ETS was a key part of meeting short- and long-term emissions reduction targets.¹⁸⁷ The most obvious alternative to remaining in the EU ETS is for the UK to establish its own ETS, linked into the wider EU ETS market, and potentially to other global ETSs. A linked system was considered by a number of stakeholders as the second-best option,¹⁸⁸ and if pursued should be fully compatible with the EU ETS, bringing its features in line with EU directives, as Norway did prior to joining the EU ETS in 2007.¹⁸⁹ When considering the merits of implementing a UK ETS linked to the EU System, decision makers were urged to bear in mind the ongoing implementation delays that Switzerland has experienced with its own linked system.¹⁹⁰ It was also suggested that setting up a domestic scheme would be “costly and complex”.¹⁹¹

82. EEF, representing manufacturers, said a linked system might not necessarily be the best course of action. Instead it recommended that Government and industry work together to assess the most cost-effective way of meeting emissions reduction targets, with any scheme aiming to better incentivise industrial decarbonisation, reflect the different abatement potential between sectors and the impact of embedded emissions from imports.¹⁹² Some of the energy intensive industries suggested that a range of alternatives might be available which could be more specifically designed around sectors of the UK economy.¹⁹³ One suggestion was that sites or sectors could be given individual targets similar to the ‘Climate Change Agreement’ scheme. The British Ceramic Federation argued that a scheme based on site targets would “reduce the dependence on the vagaries of the market price of carbon and allows each installation and/or sector to agree a realistic long term target while protecting against loss of manufacturing to other countries”.¹⁹⁴

83. We also heard that carbon pricing could be implemented as a direct carbon tax. Whilst favouring the option to remain in the EU ETS for many of the reasons set out above, Citizens Advice noted that a direct carbon tax might be “administratively simpler, able to target (if desired) a broader set of greenhouse gas emitting activity, and should still have broadly similar economic and cost implications for both affected industry and

184 E.ON ([EUC0038](#))

185 BASF ([EUC0041](#))

186 Engie ([EUC0046](#)) para 5

187 Vattenfall ([EUC0055](#)); see also Aldersgate Group ([EUC0048](#)) para 9

188 Grantham Research Institute at the London School of Economics ([EUC0032](#)); University of East Anglia ([EUC0039](#)); International Emissions Trading Association ([EUC0003](#)); Citizens Advice ([EUC0030](#))

189 European Federation of Energy Traders ([EUC0029](#)) para 2

190 European Federation of Energy Traders ([EUC0029](#)) para 2

191 Aldersgate Group ([EUC0048](#)) para 18. See also Greenpeace ([EUC0052](#))

192 EEF ([EUC0047](#)) para 8

193 CF Fertilisers, ([EUC0051](#))

194 British Ceramic Federation, ([EUC0013](#)) para 18. See also The Scotch Whisky Association ([EUC0014](#)) para 8

for consumers”.¹⁹⁵ We did however hear other concerns that a UK-only carbon tax would add costs to consumers and, without compensation, reduce the competitiveness of UK products.¹⁹⁶

84. The EU Emissions Trading System (ETS) is highly valued as a policy instrument for reducing greenhouse gas emissions across the EU. The System requires reform but stakeholders are optimistic that the next reformed phase of the EU ETS—with clearer price signals more closely aligned to the UK’s carbon price floor and improved governance—will better incentivise low carbon investment and reduce emissions. Several therefore make the case for the UK’s continued participation in the System after it has left the EU. Government should bear in mind the challenges associated with alternative options. These include the potentially costly and complex option to establish a UK ETS linked to the EU System, and the politically difficult creation of a direct carbon tax. Government must consider the impact of any alternative approaches on consumers and the competitiveness of UK industry.

EU Effort Sharing

85. The proposed EU Effort Sharing Decision would establish binding annual greenhouse gas emission targets for Member States and an EU-wide reduction target of 30% (relative to 2005 levels) by 2030. It would include emissions from most sectors not included in the EU ETS, such as transport (except aviation and international maritime shipping), buildings, agriculture and waste.¹⁹⁷ On leaving the EU, the UK would not be bound by Effort Sharing, because it exists to distribute the EU’s collective target and European Free Trade Association (EFTA) states in the European Economic Area (EEA) have their own.¹⁹⁸ We heard however that some such states (Norway and Iceland) intend to participate jointly in Effort Sharing, one reason being to take advantage of ‘flexibility mechanisms’ that may enable states to count emission reductions in another Member State towards their own national targets.¹⁹⁹ The proposed UK contribution is a reduction of 37%, higher than the overall EU target of 30%. Stakeholders pointed out that any UK withdrawal from the scheme would therefore mean that remaining participants had to contribute more to meet the overall non-traded target.²⁰⁰ One respondent said that retaining the Effort Sharing Decision, alongside a joint ETS policy, would avoid a “burdensome process recalibrating [...] already agreed and communicated climate targets”.²⁰¹ Stakeholders also explained that the proposed UK target closely aligns with that in the UK’s domestic fifth carbon budget, and that the UK is likely to exceed its proposed EU target so remaining in the Effort Sharing scheme would be cost-effective and not pose a problem to competitiveness.²⁰²

86. Stakeholders agree that there is little risk to the UK in signing up to its proposed contribution to EU Effort Sharing proposals up to 2030, as it aligns closely with the UK’s domestic targets. Renegotiating these proposals could be burdensome. We note

195 Citizens Advice ([EUC0030](#))

196 Mineral Products Association ([EUC0022](#)) para 21.4.3

197 European Commission, [Factsheet on the Commission’s proposal on binding greenhouse gas emission reductions for Member States \(2021–2030\)](#), accessed 29 September 2016

198 University of East Anglia, ([EUC0039](#))

199 University of East Anglia, ([EUC0039](#))

200 EDF Energy ([EUC0021](#)) para 19; Mineral Products Association, ([EUC0022](#)) para 23; Energy UK, ([EUC0049](#)) para 16

201 Vattenfall UK ([EUC0055](#)). See also E3G ([EUC0037](#)) para 4

202 EEF ([EUC0047](#)) paras 11, 12; Energy UK ([EUC0049](#)) para 16; RSPB ([EUC0008](#))

that because of the UK’s higher than average contribution to the proposed target, the onus would be on the rest of the EU to step up its ambition and push forward more stretching emissions reduction targets for the remaining Member States.

Paris Agreement and future international climate negotiations

87. Together, the emissions reduction achieved in due course through the EU ETS and Effort Sharing Decision make up the 40% reduction target set out in the EU’s Intended Nationally Determined Contribution (INDC) to the 2015 UN climate change negotiations in Paris (COP21). The EU’s 28 members submitted one collective INDC, and the UK’s pledge was part of this submission; there was no individual UK INDC. In October 2016 the European Parliament formally approved the agreement’s ratification, paving the way for the EU Council to adopt the Decision and, in parallel, for Member States to ratify the Paris Agreement individually.²⁰³ The Prime Minister announced in September that the UK would ratify it “before the end of the year”.²⁰⁴

88. We heard that following the vote to leave the EU there were “no obvious implications” for the UK’s COP21 pledge, given that Parliament has agreed to the fifth carbon budget, which covers the UK’s required contribution to the EU’s INDC up to 2030.²⁰⁵ On the detail of reviews, modifications and future negotiations, we were also told that the UK could opt to complete the initial phase of the Paris Agreement—up to 2030—without modification; and that the decision over whether and how the UK and EU targets might subsequently diverge—during the second phase, post-2030—would not need to be decided until the 2023–2025 review of Nationally Determined Contributions (NDCs) for 2030, although the question could arise earlier in the 2018–2020 review.²⁰⁶

89. One scenario for the second phase of the Paris Agreement also suggested was for the UK and the EU to reach an agreement on joint fulfilment, like that envisaged between the EU and Norway for 2030. Respondents also pointed out that while EEA countries such as Norway and Iceland expect to meet their 2030 targets as part of collective efforts with the EU and its Member States, they submitted their own INDC prior to the Paris negotiations. We were told that, given the UK will have probably left the EU when obligations under the agreement commence in 2021, it too would need to submit its own NDC in due course.²⁰⁷

90. There were warnings about the potential implications of the UK leaving the EU bloc, such as a loss of influence in international negotiations.²⁰⁸ We were also told there would be “substantial benefits” in maintaining alignment with the EU on negotiation positioning.²⁰⁹ If the UK left, given that it has been reducing emissions faster than the EU as a whole, other EU states would have to increase their efforts to cut emissions,²¹⁰ might struggle to deliver on their commitments,²¹¹ or might come under pressure to reduce

203 European Commission, [Paris Agreement to enter into force as EU agrees ratification](#), 4 October 2016

204 The Guardian, [Theresa May: UK to ratify Paris climate change deal this year](#), 20 September 2016

205 techUK ([EUC0043](#)) paras 4,5

206 University of East Anglia ([EUC0039](#))

207 EEF ([EUC0047](#)) para 19

208 Greenpeace ([EUC0052](#))

209 E3G ([EUC0037](#))

210 Ashden sustainable solutions, better lives, ([EUC0025](#)). The UK reduced its annual emissions by about 38 per cent by 2015 compared with 1990 whilst the EU’s emissions as a whole were 24.4 per cent lower in 2014 than they were in 1990.

211 Max Fordham LLP ([EUC0007](#)) para 4; UK Health Alliance on Climate Change ([EUC0012](#)) para 2

them.²¹² A number of stakeholders referenced the UK's leading role in recent climate change negotiations. Some advocated a continued joint approach with the EU;²¹³ others thought the UK alone could continue to exert influence.²¹⁴

91. **The recent vote to leave the EU does not change the UK's requirement to reduce emissions in line with the Paris Agreement and domestic legislation. The required levels of emissions reduction through to the early 2030s, during the fifth carbon budget period, have already been set by the UK Parliament. We have highlighted the prevailing stakeholder view that the Government consider maintaining UK participation in the EU ETS and in the EU Effort Sharing process, both of which will contribute significantly to the EU's Nationally Determined Contribution up to 2030.**

92. *The Government should explore the options for maintaining a relationship with the EU on climate change negotiations going forward. After 2030 there may continue to be value in pursuing the joint fulfilment of climate change goals. In this way the UK might retain its positive influence over EU nations and, by maintaining a progressive climate change agenda among that group of nations, exert greater influence elsewhere in the world too.*

Internal Energy Market

93. The Internal Energy Market (IEM, also known as the single energy market²¹⁵) is a long-term project to liberalise and harmonise the energy markets of individual EU Member States. Between 1996 and 2009 the EU adopted three legislative packages on market access, transparency and regulation, consumer protection, interconnection, and adequate levels of supply.²¹⁶ These have enabled new gas and electricity suppliers to enter Member States' markets, and have ensured that both domestic and industrial consumers are free to select their own suppliers. Related EU policies focus on the security of energy supplies and the construction of trans-European networks to transport gas and electricity.²¹⁷ New ambitions to realise a 'fully-integrated internal energy market' were laid out in the EU Energy Union Strategy,²¹⁸ launched in February 2015.²¹⁹ The fully-integrated IEM will use interconnectors to allow unconstrained trade of energy across the EU, thereby maximising competition.

94. In this section we cover stakeholder views on the future relationship with the IEM, the related issue of European Network Codes which aim to harmonise cross-border trading of electricity and gas, and the special circumstances affecting Northern Ireland.

212 UK Environmental Law Association ([EUC0016](#)) para 2.4.3

213 Engie ([EUC0046](#)) para 12; Energy UK ([EUC0049](#)) para 14; Greenpeace ([EUC0052](#))

214 Aldersgate Group ([EUC0048](#)) para 24; UK Petroleum Industry Association ([EUC0011](#)), EDF Energy ([EUC0021](#)) para 18

215 The term 'single energy market' is interchangeably used by respondents to denote the IEM in its current form, and the IEM in its future fully-integrated status. For clarity we use the terms IEM and fully-integrated IEM throughout this report.

216 European Parliament, [Fact sheets on the European Union: Internal Energy Market](#), accessed 27 September 2016

217 European Parliament, [Fact sheets on the European Union: Internal Energy Market](#), accessed 27 September 2016

218 The EU Energy Union Strategy aims to coordinate the transition of the European energy system to one that is low carbon, competitive and secure. It is based around the five interrelated principles of: security of supply, a fully-integrated internal energy market, energy efficiency, climate action - emission reduction, and research and innovation. European Commission, [Priority: Energy Union and Climate](#), accessed 27 September 2016.

219 European Commission, A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy [COM/2015/080](#), February 2015.

95. Almost 70% of respondents highlighted the UK's relationship with the IEM as an importance influence on the future cost, security and decarbonisation objectives of the British energy system.²²⁰ 53% of respondents were in favour of continued access to the IEM or the single market more broadly.²²¹ 17% noted the importance of the issue, but did not provide a clear preference for the UK's future relationship.²²² No respondents suggested that the UK should leave the IEM.

96. Respondents claimed that the IEM has provided policy stability, increasing the UK's ability to attract new energy infrastructure investment, and that continued participation in the IEM would reduce any investment hiatus arising from exiting the EU.²²³ The IEM is expected to facilitate the continued use and future construction of interconnectors, and could help to reduce the loss of access to EU funds (discussed further in paragraphs 118 to 120).²²⁴ Stakeholders also thought that participation would enable the UK to capitalise on the economies of scale that a pan-European energy market affords, with noted financial benefits relating to energy storage, cross-border balancing, reduced system redundancy, market coupling and capacity market integration.²²⁵ These views reflect the findings of a Vivid Economics report commissioned by National Grid prior to the referendum.²²⁶ The report explored the potential energy sector impacts of a vote to leave, with a specific focus on the UK's potential departure from the IEM. It concluded that the greatest risk was higher investment costs, and estimated that the foregone benefits of the IEM could cost the UK economy £500 million per year by the early 2020s.²²⁷ The UK Energy Research Centre and the University of Exeter Energy Policy Group considered Vivid Economics' analysis to be "broadly plausible... [although] a lot of weight should not be put on a precise figure at this stage".²²⁸

97. Participation in the IEM is subject to the acceptance of a wide range of EU legislation and regulations, which the UK has to date played a leading role in developing.²²⁹

220 Chatham House ([EUE0016](#)); RenewableUK ([EUE0055](#)); European Federation of Energy Traders (EFET) ([EUE0056](#))

221 E3G ([EUE0011](#)), VPI Immingham ([EUE0012](#)), National Farmers' Union ([EUE0013](#)), Chatham House ([EUE0016](#)), The Scotch Whisky Association ([EUE0017](#)), BEAMA ([EUE0021](#)), Major Energy Users Council ([EUE0023](#)), School of Law, University of Reading ([EUE0024](#)), Gemserv ([EUE0025](#)), UK Energy Research Centre ([EUE0026](#)), Mineral Products Association ([EUE0027](#)), techUK ([EUE0029](#)), Valero Energy Ltd ([EUE0030](#)), Citizens Advice ([EUE0032](#)), EDF Energy ([EUE0033](#)), Energy Intensive Users Group ([EUE0036](#)), Low Carbon ([EUE0038](#)), Energy and Utilities Alliance ([EUE0039](#)), Chartered Institution of Building Services Engineers ([EUE0040](#)), Energy Networks Association ([EUE0041](#)), British Ceramic Confederation ([EUE0042](#)), ENGIE ([EUE0043](#)), Centre for Energy, Petroleum and Mineral Law and Policy ([EUE0044](#)), Energy Policy Group, University of Exeter ([EUE0048](#)), Aldersgate Group ([EUE0050](#)), DONG Energy ([EUE0051](#)), ADBA ([EUE0053](#)), European Federation of Energy Traders (EFET) ([EUE0056](#)), Renewable Energy Systems Ltd (RES) ([EUE0059](#)), Sustainable Energy Association ([EUE0061](#)), EEF, the Manufacturers Organisation and UK Steel ([EUE0062](#)), Energy Institute ([EUE0063](#)); The Renewable Energy Association (REA) ([EUE0066](#)), Greenpeace UK ([EUE0070](#)), E.ON UK ([EUE0073](#)), Vattenfall ([EUE0074](#)), RSPB ([EUE0076](#)), National Grid ([EUE0079](#))

222 Carbon Connect ([EUE0005](#)), ELEXON Limited ([EUE0014](#)), InterGen ([EUE0049](#)), Scottish Renewables ([EUE0052](#)), RenewableUK ([EUE0055](#)), Carbon Capture and Storage Association ([EUE0064](#)), AES UK & Ireland ([EUE0065](#)), ScottishPower ([EUE0067](#)), UK Onshore oil and gas (UKOOG) ([EUE0072](#)), Oil & Gas UK ([EUE0075](#)), UK Environmental Law Association ([EUE0077](#)), Scottish Centre for Carbon Storage ([EUE0078](#))

223 Chatham House ([EUE0016](#)), Aldersgate Group ([EUE0050](#)), European Federation of Energy Traders (EFET) ([EUE0056](#))

224 E3G ([EUE0011](#)), Chatham House ([EUE0016](#)), Aldersgate Group ([EUE0050](#)), E.ON UK ([EUE0073](#))

225 E3G ([EUE0011](#)), Chatham House ([EUE0016](#)), European Federation of Energy Traders (EFET) ([EUE0056](#)), E.ON UK ([EUE0073](#)), National Grid ([EUE0079](#))

226 Vivid Economics, [The impact of Brexit on the UK energy sector](#), March 2016

227 National Grid ([EUE0079](#))

228 UK Energy Research Centre ([EUE0026](#)), para 9, Energy Policy Group, University of Exeter ([EUE0048](#))

229 E3G ([EUE0011](#)), Chatham House ([EUE0016](#)), UK Energy Research Centre ([EUE0026](#)), EDF Energy ([EUE0033](#)), Energy Intensive Users Group ([EUE0036](#)), The Renewable Energy Association (REA) ([EUE0066](#)), E.ON UK ([EUE0073](#))

Stakeholders were concerned that this influence would greatly reduce if membership to the IEM were rescinded but access to the market retained. Respondents emphasised that while continued access to the IEM is important, this should not mean that the UK is bound by all future developments to IEM rules without the opportunity to shape them.²³⁰

98. Looking forward, E3G told us that the existing Energy Community Treaty may provide a model for continued IEM participation.²³¹ The Treaty allows some southern and eastern non-EU Member States to participate in the market, and counts Norway and Turkey amongst its observers. It requires non-EU countries to adopt the EU's *acquis communautaire* related to energy, and in return provides technical and investment support with regards to energy security.²³² National Grid proposed that any future relationship with the IEM should include: the free trade of energy; ongoing implementation of existing EU energy packages and network codes; and an agreement for the UK to help develop and to implement future EU policy, codes and market design. National Grid further emphasised that if such a relationship seems unlikely to be secured, the Government will need to conduct a detailed analysis to ensure that risks to the current energy policy framework are understood and minimised.²³³

99. *Stakeholders are in favour of continued UK access to the Internal Energy Market (IEM). In deciding the nature of the UK's future relationship with the market, the Government will need to weigh the costs of associated legislation and regulation against the economic, security of supply and carbon reduction benefits afforded by IEM membership. We recognise that negotiations around this will be affected by broader issues, including freedom of movement. We note that:*

- *If IEM participation is to be pursued the Government will need to explore potential membership models, such as the Energy Community Treaty.*
- *If continued IEM participation looks doubtful, the Government should undertake a thorough assessment to ensure that policy risks are understood and minimised.*
- *In the event that the UK loses its membership of but retains access to the IEM, the Government will need to identify new routes to shape the development of IEM policy. Without this the UK risks losing its role as an IEM 'rule-maker', instead becoming a 'rule-taker'.*

Network codes

100. The European Network Codes (ENCs) are intended to harmonise cross-border trading of electricity and gas. They govern both grid connection and system operation, and take precedence over domestic network codes where differences arise.²³⁴ The ENCs are being developed collaboratively by the Agency for the Cooperation of Energy Regulators

230 ELEXON Limited ([EUE0014](#)), Chatham House ([EUE0016](#)), EDF Energy ([EUE0033](#)), Energy Networks Association ([EUE0041](#)), Aldersgate Group ([EUE0050](#)), EEF, the Manufacturers Organisation and UK Steel ([EUE0062](#)), ScottishPower ([EUE0067](#)), UK Onshore oil and gas (UKOOG) ([EUE0072](#))

231 E3G ([EUE0011](#)), Energy Community, Treaty Establishing the Energy Community, [L 198, 20/07/2006](#)

232 UK Energy Research Centre, [The EU referendum: Implications for UK Energy Policy](#), May 2016

233 National Grid ([EUE0079](#))

234 Ofgem, [Electricity - Transmission Networks - EU Legislation](#), accessed 28 September 2016; Ofgem, [Gas - Wholesale Market - EU Legislation](#), accessed 28 September 2016.

(ACER) and the European Networks of Transmission System Operators for Electricity and Gas (ENTSO-E and ENTSO-G respectively), although ultimately it is ACER that makes final recommendations on the adoption of individual codes.²³⁵

101. Respondents noted that abidance by the ENC is expected to be a condition of participating in the IEM.²³⁶ Respondents had mixed views on the usefulness of specific ENC rules, and were divided on whether resignation from the ENC (following the UK's departure from the EU) would have a positive or negative impact on the domestic energy market. It was noted that large parts of the ENC are not covered by domestic network codes, and so resignation would leave substantial gaps in the UK's electricity and gas market design.²³⁷

102. To date the UK has had considerable influence over the development of the ENC—as for the IEM—which are modelled on the UK framework.²³⁸ This influence would reduce if the UK loses its representation on ACER, becoming a 'rule-taker'. However, retention of member or observer status on ENTSO-E and ENTSO-G could allow the UK to participate in ENC development and consultation.²³⁹ In light of these concerns, several respondents recommended that Ofgem seek to retain membership of ACER and likewise National Grid seek to retain membership of ENTSO-E and ENTSO-G.²⁴⁰

103. *Continued participation in the Internal Energy Market is expected to entail compliance with the European Network Codes (ENCs). Ofgem and National Grid should therefore seek to retain membership of ACER, ENTSO-E and ENTSO-G so that the UK can continue to shape the development of new codes. If on the other hand the UK sought to resign from the European Network Codes, the Government must take care to ensure that resultant gaps in domestic network codes are filled. We set out further conclusions regarding ENCs in relation to interconnectors (see paragraph 117).*

Northern Ireland

104. The governance and operation of Northern Ireland's energy system differs significantly to that of Great Britain. Energy policy is devolved in the region, and the Northern Ireland and Republic of Ireland electricity markets operate as one under the Single Electricity Market of the island of Ireland (SEM).²⁴¹ Northern Ireland is highly dependent on energy imports, with wind being the only indigenous resource exploited at commercial scale.²⁴² It has an electricity interconnection with Scotland, and is projected to have an electricity

235 European Commission, [Electricity network codes and guidelines](#), accessed 28 September 2016.

236 UK Energy Research Centre ([EUE0026](#)), Citizens Advice ([EUE0032](#)), British Ceramic Confederation ([EUE0042](#))

237 Centre for Energy, Petroleum and Mineral Law and Policy ([EUE0044](#)), European Federation of Energy Traders (EFET) ([EUE0056](#)), Vattenfall ([EUE0074](#))

238 E3G ([EUE0011](#)), Citizens Advice ([EUE0032](#)), EDF Energy ([EUE0033](#))

239 Citizens Advice ([EUE0032](#)), European Federation of Energy Traders (EFET) ([EUE0056](#))

240 Chatham House ([EUE0016](#)), School of Law, University of Reading ([EUE0024](#)), Citizens Advice ([EUE0032](#)), Energy Networks Association ([EUE0041](#)), European Federation of Energy Traders (EFET) ([EUE0056](#)), National Grid ([EUE0079](#))

241 The acronym SEM is used by some respondents to denote the EU single energy market. For the purpose of this report SEM always refers to the Single Electricity Market of the island of Ireland.

242 AES UK & Ireland ([EUE0065](#))

supply deficit from 2021.²⁴³ The gas markets of Northern Ireland and the Irish Republic are operated separately, but the networks are physically connected. Northern Ireland has two gas interconnections with Scotland, which supply the majority of the island's gas.²⁴⁴

105. Respondents noted that leaving the EU will have substantial implications for Northern Ireland's energy system.²⁴⁵ As an EU Member State, the Republic of Ireland will continue to be subject to IEM legislation, affecting the options available for ongoing operation of the SEM. An added complication is that the SEM is currently transitioning to the Integrated Single Electricity Market (I-SEM), a new model based on the IEM which is expected to deliver economic and security of supply benefits. I-SEM will entail greater physical and financial connection between the electricity systems of Northern Ireland and the Irish Republic, and market players are already making significant investments in preparation.²⁴⁶

106. We heard calls for Government to carefully consider Northern Ireland's particular position as a participant in the SEM, to avoid pursuing trade or energy policy negotiations that unintentionally disadvantage Northern Irish consumers, and to protect investor confidence by providing clarity on Northern Ireland's ongoing energy policy as soon as possible.²⁴⁷ It was suggested that negotiations on Northern Ireland's energy system may require a differentiated approach from Great Britain.²⁴⁸

107. Northern Ireland's electricity system is highly integrated with that of the Republic of Ireland, which will continue to be bound by Internal Energy Market (IEM) rules. The Government should carefully consider how any changes to the UK's relationship with the IEM will have particular significance for Northern Ireland. It may be appropriate to differentiate between the approach taken for Northern Ireland and that for Great Britain.

Security of supply

108. The UK has been a net importer of energy since 2004. In 2015 the UK imported 6% of electricity consumption and 42% of gas. All electricity imports and 69% of gas imports arrive via interconnectors with Europe.²⁴⁹ Chatham House emphasised the important role of EU coordination in maintaining the security of energy supplies and price stability. Coordinated investment in infrastructure such as reversing-flow equipment has increased the efficiency of existing pipelines, and helped to ensure that storage facilities are adequately stocked. Coordination in diplomatic relations has increased the UK's voice in negotiations with major fossil fuel producing nations.²⁵⁰

243 Eirgrid Group, [All-Island Generation Capacity Statement 2016–2025](#), accessed 30 September 2016

244 Chatham House ([EUE0016](#)), Ofgem, [Electricity - Transmission Networks - Electricity interconnectors](#), accessed 30 September 2016

245 E3G ([EUE0011](#)), Chatham House ([EUE0016](#)), EDF Energy ([EUE0033](#)), European Federation of Energy Traders (EFET) ([EUE0056](#)), Renewable Energy Systems Ltd (RES) ([EUE0059](#)), AES UK & Ireland ([EUE0065](#))

246 AES UK & Ireland ([EUE0065](#))

247 E3G ([EUE0011](#)), Chatham House ([EUE0016](#)), EDF Energy ([EUE0033](#)), European Federation of Energy Traders (EFET) ([EUE0056](#)), Renewable Energy Systems Ltd (RES) ([EUE0059](#)), AES UK & Ireland ([EUE0065](#))

248 AES UK & Ireland ([EUE0065](#))

249 Department for Business, Energy & Industrial Strategy, [UK Energy in Brief 2016](#), July 2016

250 Chatham House ([EUE0016](#))

109. The short-term impacts of the vote to leave on electricity and gas supply are expected to be limited. Stakeholders expected energy trading across interconnectors to continue,²⁵¹ and noted that the UK has access to diverse gas supplies through pipelines with Europe, LNG terminals and domestic production.²⁵² Looking forwards to the 2020s, respondents were concerned that increased investor uncertainty arising from exiting the EU may exacerbate existing difficulties in bringing forward new-build electricity capacity.²⁵³ Planned plant closures, delays to new nuclear, sudden reductions in renewable energy support and the failure of the Capacity Market to incentivise new gas had been recognised as serious threats to domestic electricity supply before the referendum.²⁵⁴

110. In the longer term stakeholders were concerned that the UK's departure from the EU could end its involvement with coordinated actions and processes, thereby undermining the security of fossil fuel supplies. Whilst the UK may develop bilateral agreements, its voice may have less diplomatic weight alone than as part of the EU bloc.²⁵⁵ It could also result in the UK's exclusion from the EU's proposed 'solidarity principle', a policy designed to ensure that Member States receive immediate assistance in the event of a gas supply crisis. Respondents considered this an important backstop arrangement, with AES UK & Ireland suggesting that if excluded, alternative back-up arrangements may be required to assure future investors of the security of gas supplies.²⁵⁶ Increased uncertainty could also delay the development of indigenous fossil fuel resources such as shale gas.²⁵⁷

111. The UK is heavily dependent on Europe for its electricity and gas imports. Pan-European coordination has helped to improve the UK's security of supply. The Government should seek to build investor confidence, to avoid exacerbating difficulties in bringing forward investment in new electricity capacity and new indigenous resources. The Government should also examine the role of the 'solidarity principle' in managing potential gas crises, specifically how the UK can continue to participate. If excluded from the 'solidarity principle' the UK Government must urgently investigate alternative back-up arrangements to ensure security of supply in the event of a crisis.

Interconnectors

112. Interconnectors are high-voltage cables and major pipelines that carry electricity, natural gas or oil between countries. They enable energy to be shifted from areas of low demand and low wholesale prices to areas of high demand and high wholesale prices, facilitating cross-border trading and allowing variable renewables to be managed more cost-effectively. Interconnection construction costs compare favourably to those for new generation plant.²⁵⁸ Expansion of intra-European interconnections is central to the EU's Energy Union Strategy, with a target for all Member States to have electricity interconnections equivalent to 10% of national generation capacity by 2020.

251 E3G ([EUE0011](#)), UK Energy Research Centre ([EUE0026](#)), Citizens Advice ([EUE0032](#)), Energy and Utilities Alliance ([EUE0039](#)), RenewableUK ([EUE0055](#)), National Grid ([EUE0079](#))

252 E.ON UK ([EUE0073](#))

253 Chatham House ([EUE0016](#))

254 Energy and Climate Change Committee, Third Report of Session 2015–16, *Investor confidence in the UK energy sector*, HC 542

255 Chatham House ([EUE0016](#)), UK Energy Research Centre ([EUE0026](#))

256 Chatham House ([EUE0016](#)), AES UK & Ireland ([EUE0065](#)), E.ON UK ([EUE0073](#))

257 Chatham House ([EUE0016](#))

258 Chatham House ([EUE0016](#)), BEAMA ([EUE0021](#)), Aldersgate Group ([EUE0050](#)); RenewableUK ([EUE0055](#)), Policy Exchange, *Getting Interconnected. How can interconnectors compete to help lower bills and cut carbon?*, June 2014

113. At present the UK has four electricity interconnectors with the EU, with a combined capacity of 4GW.²⁵⁹ Capacity is due to double by 2020, with construction of interconnectors to France, Belgium and Norway. Plans for additional electricity interconnections are being discussed with Denmark, Iceland and Ireland.²⁶⁰ The UK also has five natural gas interconnectors to the EU and Norway, as well as direct pipelines between some North Sea fields and non-UK facilities.²⁶¹ These allow gas to be delivered to the EU from both the North Sea and LNG tankers at UK terminals.

114. We expressed our support for significant interconnector expansion in our report on *Low Carbon Network Infrastructure*, which emphasised the important role played by interconnectors in balancing the electricity system.²⁶² Many respondents were in favour of greater interconnection,²⁶³ however some proposed that interconnector policy should be reviewed, in particular the 10% target.²⁶⁴ The UK Energy Research Centre considered the UK's departure from the EU unlikely to halt the construction of new interconnectors.²⁶⁵

115. As noted in paragraph 93, the IEM has been specifically designed to facilitate the use and expansion of interconnections. It is unclear what legal arrangements will be required to allow trading across existing and planned interconnectors if the UK resigns its IEM membership. The Government will need to take care to prevent trade from being distorted by any differences in energy market design, for example restrictions that undermine price-driven interconnector flows between the UK and Europe.²⁶⁶ Further, it is possible that the EU network codes and regulations which currently govern cross-border transactions and system operation will need to be retained—irrespective of our membership—in order for the UK and EU energy markets to remain operationally integrated.²⁶⁷ Existing gas (and planned electricity) interconnections between Norway and the UK demonstrate the potential viability for the UK of operations outside a direct EU framework. However trading across these has been heavily influenced by EU rules, with which Norway is largely expected to comply.²⁶⁸ Once outside the EU the UK may therefore be required to abide by EU interconnector regulations with limited power to influence their design.²⁶⁹

116. *Interconnections improve security of supply, facilitate cross-border trading and enable grid-balancing to be managed more cost-effectively. Substantial expansion of interconnection has been proposed for the coming decade, and we support this. The Government should continue to progress planned and proposed new interconnections with Europe.*

259 National Infrastructure Commission, [Smart Power](#), March 2016

260 UK Energy Research Centre ([EUE0026](#)), Aldersgate Group ([EUE0050](#))

261 UK Energy Research Centre ([EUE0026](#))

262 House of Commons Energy and Climate Change Committee, *Low Carbon Network Infrastructure*, [HC 267](#), June 2016

263 Carbon Connect ([EUE0005](#)), Dr Feroze Duggan ([EUE0009](#)), E3G ([EUE0011](#)), National Farmers' Union ([EUE0013](#)), Chatham House ([EUE0016](#)), The Scotch Whisky Association ([EUE0017](#)), UK Energy Research Centre ([EUE0026](#)), Citizens Advice ([EUE0032](#)), Low Carbon ([EUE0038](#)), Energy Networks Association ([EUE0041](#)), British Ceramic Confederation ([EUE0042](#)), Aldersgate Group ([EUE0050](#)), RenewableUK ([EUE0055](#)), Energy Institute ([EUE0063](#)), Construction Products Association ([EUE0069](#)), National Grid ([EUE0079](#))

264 VPI Immingham ([EUE0012](#)), EDF Energy ([EUE0033](#)), British Ceramic Confederation ([EUE0042](#)), ENGIE ([EUE0043](#)), InterGen ([EUE0049](#))

265 UK Energy Research Centre ([EUE0026](#))

266 European Federation of Energy Traders (EFET) ([EUE0056](#))

267 UK Energy Research Centre ([EUE0026](#))

268 Citizens Advice ([EUE0032](#))

269 Chatham House ([EUE0016](#)), RenewableUK ([EUE0055](#))

117. *The European Network Codes (ENCs) may need to be retained to ensure the functionality of energy trading and system operations across interconnectors with Europe. As noted in paragraph 103, Ofgem and National Grid should seek to retain membership of ACER, ENTSO-E and ENTSO-G so that the UK can continue to shape the development of new ENCs. If the UK resigns from the IEM and the ENCs, the Government must take care to ensure that interconnector trade and operations are not distorted by differences between European and UK energy market design.*

EU funding

118. We heard from Chatham House that the UK has received very substantial funding for energy infrastructure projects from EU institutions in recent years.²⁷⁰ For example:

- The European Investment Bank (EIB) has provided over €9 billion in long-term loans over the past five years.²⁷¹ The UK is the biggest recipient of the EIB's Climate Awareness Bonds for renewable energy and energy efficiency, securing 24% of total available funds.²⁷²
- Structural and regional funds have provided €1.6 billion to support the transition to a low-carbon economy over the period 2014–20;²⁷³
- The European Energy Programme for Recovery, launched in 2009, has awarded over €400 million to support projects including carbon capture and storage, offshore wind and electricity interconnection with Ireland.²⁷⁴
- The Connecting Europe Facility, which provides funding to infrastructure projects that benefit at least two Member States, awarded £59 million to the UK under its 2014 and 2015 calls. The UK is fourth highest recipient of funds under the scheme.²⁷⁵

The EU is also a major funder of low carbon research and development, with 85% of energy funds allocated through Horizon 2020 being earmarked for renewables, energy efficiency and smart grids.²⁷⁶

119. Respondents welcomed the Government's guarantee to underwrite the payment of Horizon 2020 awards made before the UK leaves the EU.²⁷⁷ However, they also highlighted the need for clarity on the retention of funds awarded by other schemes, and the UK's longer term access to EU funds and financial institutions.²⁷⁸ Particular concerns were

270 Chatham House ([EUE0016](#))

271 European Investment Bank, [Finance contracts signed](#), accessed 11 October 2016. Multi-criteria list filtered as follows: from - 2012, to - 2016, region - European Union, country - United Kingdom, sector - energy.

272 Shankleman, J., [Brexit May Lose U.K. Billions in Funding for Climate, Renewables](#), 2 February 2016, accessed 11 October 2016

273 European Commission, [European Structural and Investment Funds - Country Data for: United Kingdom](#), accessed 11 October 2016

274 European Commission, [European Energy Programme for Recovery - Project Maps](#), accessed 11 October 2016

275 Chatham House ([EUE0016](#))

276 Aldersgate Group ([EUE0050](#))

277 HM Government, [Chancellor Philip Hammond guarantees EU funding beyond date UK leaves the EU](#), 13 August 2016

278 BEAMA ([EUE0021](#)), Aldersgate Group ([EUE0050](#)), RenewableUK ([EUE0055](#)), Carbon Capture and Storage Association ([EUE0064](#))

raised regarding funds for the demonstration of carbon capture and storage.²⁷⁹ Noting the dependence of some energy projects on EU finance, stakeholders emphasised that if access cannot be preserved, the Government should commit to replacing EU funds and institutions with credible alternatives.²⁸⁰ Suggestions included the reallocation of funds from the UK's current contributions to the EU budget, reconsideration of the sale of the Green Investment Bank, and the utilisation of the British Business Bank to fill the gap left by the European Investment Fund (an EIB subsidiary that provides finance to start-ups and venture capitalists).²⁸¹

120. Several stakeholders specifically questioned the extent of EIB finance that the UK might be able to access after leaving the EU.²⁸² The EIB does lend to non-EU Member States, but 90% of its funds are spent within the EU, based on EU priorities.²⁸³ The UK, however, is one of the Bank's largest shareholders. E3G suggested that maintaining close links with the EU, and contributing to the EU budget, would increase the likelihood of being able to access EIB finance.²⁸⁴ RenewableUK noted that if the UK ceases to be an EIB shareholder then the scale of lending received will be considerably reduced.²⁸⁵ Participation in the Innovation Fund (the successor of NER300, which is administered by the EIB) is expected to be conditional on remaining within the EU ETS.²⁸⁶

121. The EU has provided substantial financial support for energy infrastructure and R&D in the UK. The Government should provide clarity to Parliament on whether funds awarded from EU schemes other than Horizon 2020 will be retained and/or underwritten. The Government should also ascertain whether access to EU financial institutions and funds, including but not limited to the European Investment Bank, will be available to British applicants in the longer term. It should develop credible alternatives where this is not possible.

Investor confidence

122. One of our previous inquiries, *Investor Confidence in the UK Energy Sector*, investigated stakeholder concerns about the impact of significant changes to energy policy following the 2015 general election.²⁸⁷ Submissions to the current inquiry indicated that investor confidence concerns not only persist, but are exacerbated by the additional policy uncertainty created by the EU referendum result.²⁸⁸ Since the referendum there have already been some suggestions of energy investment decisions being postponed.²⁸⁹ Looking forward, the Renewable Energy Association observed that investor appetite will also be affected by changes to passporting arrangements and financial regulation

279 The Geological Society ([EUE0054](#)), Energy Institute ([EUE0063](#)), Carbon Capture and Storage Association ([EUE0064](#)), UK Onshore oil and gas (UKOOG) ([EUE0072](#)), Scottish Centre for Carbon Storage ([EUE0078](#))

280 E3G ([EUE0011](#)), Citizens Advice ([EUE0032](#)), RenewableUK ([EUE0055](#)), Carbon Capture and Storage Association ([EUE0064](#)), Greenpeace UK ([EUE0070](#))

281 E3G ([EUE0011](#)), BEAMA ([EUE0021](#)), RenewableUK ([EUE0055](#))

282 E3G ([EUE0011](#)), Chatham House ([EUE0016](#)), Scottish Renewables ([EUE0052](#)), RenewableUK ([EUE0055](#))

283 Chatham House ([EUE0016](#))

284 E3G ([EUE0011](#))

285 RenewableUK ([EUE0055](#))

286 RenewableUK ([EUE0055](#))

287 House of Commons Energy and Climate Change Committee, Low Carbon Network Infrastructure, [HC 267](#), June 2016

288 UK Energy Research Centre ([EUE0026](#)), Chartered Institution of Building Services Engineers ([EUE0040](#)), Aldersgate Group ([EUE0050](#)), RenewableUK ([EUE0055](#)), AES UK & Ireland ([EUE0065](#)), The Renewable Energy Association (REA) ([EUE0066](#))

289 UK Energy Research Centre ([EUE0026](#))

arising from the UK's departure.²⁹⁰ A sustained period of uncertainty could lead to the deferral of investment in critical infrastructure, with ramifications for future energy security.²⁹¹ It could also discourage international investors from developing associated manufacturing facilities in the UK.²⁹² Stakeholders highlighted the need for assurances on the continuation of existing policy commitments and support mechanisms, as well as clarity on the Government's long-term energy objectives once the UK has left the EU.²⁹³

123. *The vote to leave has reduced already-weak investor confidence in the energy sector. The Government should promote investment by providing clear signals on the direction of domestic energy policy to be followed throughout, and after, the exit negotiations, for example through the timely publication of a detailed Emissions Reduction Plan.*

Further EU-derived policies and legislation

124. In this section we set out a brief overview of other EU-derived policy and legislation along with issues, raised by stakeholders, which the Government may want to consider as it develops its negotiating strategy.

- a) **Energy Efficiency Directive:** The EU has set itself a 20% energy savings target by 2020 when compared to the projected use of energy in that year. We heard that:
 - The Energy Company Obligation (ECO), Energy Savings Opportunity Scheme (ESOS), and Heat Networks (Metering and Billing) Regulations 2014, all introduced to fulfil some of the Directive's requirements, are not perfect but should be retained.²⁹⁴
 - ECO is in need of revision, given that from 2017 it will target only fuel-poor homes.²⁹⁵
 - With regard to ESOS, more focus is required on energy "productivity", instead of "arbitrary targets" for energy use reduction "regardless of whether such reductions are economic or environmentally effective."²⁹⁶
 - Outside the EU the UK could use taxation to promote environmental objectives, for example by reducing VAT on energy efficient materials and products, which EU law currently prevents.²⁹⁷
- b) **Energy Labelling Framework Directive and Eco-design Framework Directive:** Two directives that aim to increase the energy efficiency of products, reduce

290 The Renewable Energy Association (REA) ([EUE0066](#))

291 UK Energy Research Centre ([EUE0026](#)), AES UK & Ireland ([EUE0065](#)), Vivid Economics, [The impact of Brexit on the UK energy sector](#), March 2016

292 Aldersgate Group ([EUE0050](#))

293 Energy and Utilities Alliance ([EUE0039](#)), Institution of Building Services Engineers ([EUE0040](#)), Carbon Capture and Storage Association ([EUE0064](#)), AES UK & Ireland ([EUE0065](#)), The Renewable Energy Association (REA) ([EUE0066](#))

294 Max Fordham LLP, ([EUC0007](#)) Chartered Institution of Building Services Engineers ([EUE0040](#))

295 Mineral Wool Manufacturers Association, ([EUC0027](#)). See also Energy and Climate Change Committee, [Home Energy Efficiency and Demand Reduction](#), Fourth Report of Session 2015–16, HC 552

296 Energy Intensive Users Group ([EUC0031](#))

297 University of East Anglia ([EUC0039](#)), BEAMA ([EUE0021](#)), Valero Energy Ltd ([EUE0030](#)), Energy Institute ([EUE0063](#))

energy consumption, lower carbon dioxide emissions, increase environmental protection, provide consumers with information, and ensure common standards across the EU. We heard that:

- Measures are a “highly cost-effective” intervention to mitigate climate change, because they fit with manufacturers’ design cycles and are therefore cheap to implement; they are long-lasting, as new groups of customers continue to buy the products; and have generated significant energy savings.²⁹⁸
 - Significant political and administrative investment would be required by the Government to develop similar systems in the UK to those in the EU.²⁹⁹
 - The Government should retain EU standards for energy-related products (or develop UK standards that match and track these) to facilitate trade, to ensure UK consumers benefit from efficient, cost-effective products, and to avoid low quality products being dumped on the UK market.³⁰⁰
 - The CCC considers this to be one area of emissions reduction where the UK should either remain in the EU scheme or replicate it at UK level, as the directives “drive up the efficiency of electrical goods on sale and remove the least efficient goods from the market”.³⁰¹
- c) **Energy Performance of Buildings Directive:** All new buildings must have nearly zero or very low energy need by 2020. We previously concluded: “Zero carbon homes was a positive and ambitious policy, which could have saved future homeowners money on their energy bills. It should be reinstated. Alternatively, the Government should set out a similar policy that will ensure that new homes generate no net carbon emissions and are inexpensive to heat and light.”³⁰² We heard that:
- Emissions from buildings account for 40% of final energy consumption,³⁰³ and this large proportion of UK emissions is “still not under control”.³⁰⁴ Legislation transposing the Directive should be retained, or similar UK legislation put in place.³⁰⁵
 - Prior to the vote to leave the EU, the EPB target had provided some certainty for manufacturers and others, after UK policies such as the Code for Sustainable Homes and the Zero Carbon Homes target had been cancelled.³⁰⁶

298 Environmental Change Institute, University of Oxford ([EUC0002](#))

299 Dr Katherine Watts ([EUC0004](#)) para 20

300 E3G ([EUC0037](#)), Chatham House ([EUE0016](#)), BEAMA ([EUE0021](#)), Citizens Advice ([EUE0032](#)), E3G Energy and Utilities Alliance ([EUE0039](#)), Aldersgate Group ([EUE0050](#)), E.ON UK ([EUE0073](#))

301 Committee on Climate Change, [Meeting Carbon Budgets – Implications of Brexit for UK climate policy](#), October 2016

302 Energy and Climate Change Committee, [Home Energy Efficiency and Demand Reduction](#), Fourth Report of Session 2015–16, HC 552, summary

303 Construction Products Association ([EUC0042](#)) para 7

304 UK Environmental Law Association ([EUC0016](#)) para 2.5.2. See also Mineral Wool Manufacturers Association ([EUC0027](#)) para 1

305 techUK, ([EUC0043](#)) para 7, LendLease ([EUC0053](#)) paras 7–9, Max Fordham LLP ([EUC0007](#)), Chartered Institution of Building Services Engineers ([EUE0040](#)), E.ON UK ([EUE0073](#))

306 Construction Products Association ([EUC0042](#)) para 7, Ashden sustainable solutions, better lives, ([EUC0025](#)), Chartered Institution of Building Services Engineers ([EUE0040](#)), Aldersgate Group ([EUE0050](#))

- Energy Performance Certificates (EPCs) and Display Energy Certificates (DECs) have underpinned energy efficiency improvements by ensuring consumption is measured and visible in new homes, the private rented sector and public sector buildings. They should be retained.³⁰⁷
- d) **EURATOM Treaty and regional management of nuclear waste:** EURATOM aims to facilitate the development of Europe’s nuclear industries, and to prevent nuclear materials intended for civilian use from being diverted to military use. The feasibility of regional geological repositories for high-level radioactive waste is being explored. We heard that:
- Continuation of the EURATOM Treaty should be carefully considered. Changes to the UK’s role in EURATOM and the International Atomic Energy Agency will have significant implications for nuclear safeguards.³⁰⁸
 - If the Government cannot negotiate the right to deposit waste in future regional depositories there will be an enhanced need to develop nuclear waste storage facilities in the UK.³⁰⁹
- e) **Regulation of Energy Market Integrity and Transparency (REMIT); Market Abuse Regulation (MAR):** REMIT is designed to increase the transparency and stability of EU wholesale energy markets whilst combating insider trading and market manipulation. MAR addresses similar issues, but includes spot commodity contracts and emissions allowances. It has stricter monitoring and disclosure requirements than REMIT. We heard that:
- The Government should retain REMIT, or replace it with very similar legislation.³¹⁰
 - Replication (rather than retention) of REMIT risks undermining formal inter-regulator cooperation and data sharing. It could increase the regulatory burden on UK market players, as those that continue to trade energy products will remain subject to REMIT.³¹¹
 - Similar issues apply to MAR.³¹²
- f) **Renewable Energy Directive:** The EU has a target of 20% final energy consumption from renewables by 2020. It has a further target of 27% by 2030. The 2020 target includes overall national targets, and the UK has sub-targets for electricity, heat and transport.³¹³ We recently stated: “If the UK misses or reneges on its commitment to the 2020 goals, this will undermine confidence

307 Citizens Advice ([EUE0032](#)), Ricardo Energy & Environment ([EUE0035](#)), Chartered Institution of Building Services Engineers ([EUE0040](#)), BRUFMA ([EUE0045](#)), Kingspan Insulation Ltd ([EUE0046](#)), Sustainable Energy Association ([EUE0061](#))

308 EDF Energy ([EUE0033](#)), Institution Of Mechanical Engineers ([EUE0068](#)), National Grid ([EUE0079](#))

309 UK Environmental Law Association ([EUE0077](#))

310 Ricardo Energy & Environment ([EUE0035](#)), Energy Intensive Users Group ([EUE0036](#)), British Ceramic Confederation ([EUE0042](#)), European Federation of Energy Traders (EFET) ([EUE0056](#)), Vattenfall ([EUE0074](#))

311 Centre for Energy, Petroleum and Mineral Law and Policy ([EUE0044](#)), European Federation of Energy Traders (EFET) ([EUE0056](#))

312 European Federation of Energy Traders (EFET) ([EUE0056](#)), Vattenfall ([EUE0074](#))

313 The UK’s overall national target is 15%; its sub-targets are 30% renewable electricity, 12% renewable heat and 10% renewable transport.

in its commitment to future targets, including the 2050 decarbonisation objective. Whatever the Government's plans, it must commit to and deliver on credible renewables commitments that maintain consistency with its long-term obligations".³¹⁴ We heard that:

- Targets for increasing biofuel uptake under the Renewable Energy Directive should either be adopted domestically or an alternative approach should be developed that delivers equivalent emissions reduction.³¹⁵
- g) **Single market:** The EU as one territory without any internal borders or other regulatory obstacles to the free movement of goods, and services, capital and people. The question of whether and how to retain access to the single market will be at the heart of the UK Government's thinking. This will be influenced by wider considerations about the UK's future relationship with the EU, particularly with regard to the free movement of labour. We heard that:
- The UK should seek to avoid future tariffs on energy products, as well as the goods and services that supply the energy sector and low carbon manufacturing facilities.³¹⁶ Tariff-free access to the single market should be prioritised for sectors that have, or are likely to have, trade surpluses with the EU, such as electric vehicles and offshore wind.³¹⁷
 - A recent Energy Institute survey of 543 energy professionals showed a widely perceived shortage of qualified workers across almost every area of the UK energy sector.³¹⁸ It is important that the UK retains access to skilled workers from the EU and beyond, with minimum bureaucracy, to fill this gap.³¹⁹
- h) **State aid rules:** Designed to prevent Member States' governments providing unfair advantage to specific companies or sectors over competitors in other Member States, unless the advantage is justified for general economic development. We heard that:
- State aid rules have limited the discretion of British politicians, but usually in ways that have been beneficial for UK energy consumers.³²⁰
 - State aid is expected to be necessary for market access whether in the current IEM form, through the World Trade Organisation, or an alternative approach. Government should therefore set public expectations accordingly.³²¹

314 Energy and Climate Change Committee, [2020 Renewable Heat and Transport Targets](#), Second Report of Session 2016–17, HC 173, summary

315 Committee on Climate Change, [Meeting Carbon Budgets – Implications of Brexit for UK climate policy](#), October 2016

316 E3G ([EUE0011](#)), Chatham House ([EUE0016](#)), Citizens Advice ([EUE0032](#)), EDF Energy ([EUE0033](#)), Energy and Utilities Alliance ([EUE0039](#)), Kingspan Insulation Ltd ([EUE0046](#)), European Federation of Energy Traders (EFET) ([EUE0056](#)), EEF, the Manufacturers Organisation and UK Steel ([EUE0062](#)), Ecotricity ([EUE0071](#)), Oil & Gas UK ([EUE0075](#))

317 E3G ([EUE0011](#))

318 Energy Institute, [Energy Barometer 2015: Views from UK energy professionals](#), (December 2015), pp 24–25

319 BEAMA ([EUE0021](#)), Citizens Advice ([EUE0032](#)), EDF Energy ([EUE0033](#)), Energy Institute ([EUE0063](#)), Oil & Gas UK ([EUE0075](#)), National Grid ([EUE0079](#))

320 Citizens Advice ([EUE0032](#))

321 E3G ([EUE0011](#)), Citizens Advice ([EUE0032](#)), EDF Energy ([EUE0033](#)), RenewableUK ([EUE0055](#)), Carbon Capture and Storage Association ([EUE0064](#)), E.ON UK ([EUE0073](#))

- i) **UK-Norway Framework Agreement on Cross-Boundary Petroleum Co-operation; Offshore Safety Directive (OSD): The Framework Agreement enables cooperation on cross-border North Sea oil and gas projects. The OSD aims to minimise risks from offshore oil and gas operations. We heard that:**
- The terms and conditions of the UK-Norway Framework Agreement assume compliance with EU law on the single market. If the UK exits the market, it is likely the agreement will need to be renegotiated or replaced.³²²
 - Until 2013 there was little EU legislation on offshore oil and gas operations. Oil and Gas UK claimed the OSD does little to improve safety (beyond UK regulations), and were concerned that future EU legislation may undermine competitiveness and the UK strategy for maximising economic recovery of petroleum.³²³
- j) **Vehicle emissions regulations:** EU legislation on mandatory emission reduction targets for new cars. By 2021, phased in from 2020, the fleet average to be achieved by all new cars is 95 grams of CO₂ per km.³²⁴ We heard that:
- The UK needs to meet this target to continue to trade with the EU bloc, as 57.5% of all UK car exports were to the EU in 2015.³²⁵
 - The UK should set new UK vehicle emission standards that match and track EU ones.³²⁶
 - The CCC considers vehicle emissions to be one area of emissions reduction where the UK should either remain in the EU scheme or replicate it at a UK level: “These standards are a key instrument in cutting UK emissions, covering around a quarter of the reduction required across the economy to 2030”.³²⁷

Repealing the European Communities Act 1972

125. A large body of climate-related EU legislation currently exists, and this has been transposed into UK law through the European Communities Act (ECA) 1972 and other parent legislation.³²⁸ The Government has recently announced that it will introduce a Great Repeal Bill, which will remove the ECA from the statute book, effective from the date upon which the UK formally leaves the EU. The Government’s intention is that at this point existing EU law would be converted into UK law. We heard some support for the general idea of grandfathering all energy-relevant EU policy into UK legislation, at least as a temporary measure, as this might provide policy stability and bolster investor

322 UK Energy Research Centre (EUE0026); [Framework agreement between the Government of the United Kingdom of Great Britain and Northern Ireland and the Government of the Kingdom of Norway concerning Cross-Boundary Petroleum Co-operation](#) Treaty Series No. 20 (2007)

323 Oil & Gas UK (EUE0075), [Maximising economic recovery of UK petroleum: the MER UK strategy](#) (2016)

324 European Commission, [Reducing CO₂ emissions from cars](#), accessed 3 October 2016

325 Ashden sustainable solutions, better lives (EUC0025)

326 E3G, (EUC0037)

327 Committee on Climate Change, [Meeting Carbon Budgets – Implications of Brexit for UK climate policy](#), October 2016

328 They include the Large Combustion Plant Directive, the Industrial Emissions Directive, the Emissions Trading Directive, the Renewable Energy Directive, the Energy Performance of Buildings Directive, the Energy Efficiency Labelling Directive, the Energy Efficiency Directive and the Eco-design Framework Directive.

confidence.³²⁹ However, subject to the details of the outcome of the exit negotiations, concerns have been expressed about the enforceability of retained legislation. Professor Andrew Jordan, from the University of East Anglia, said in July that:

were all the legislation to be grandfathered outside the EU framework—in other words, carried across but without the European Environment Agency, the European Commission and the European Court of Justice—there is a real risk it would become zombie legislation; it would not have that power behind it to keep it updated and properly enforced.³³⁰

126. EU-derived legislation retained in UK law will need to be reviewed and amended in the light of the UK’s relationship with the EU once it has formally left. It is essential that Parliament has adequate time to fully scrutinise any proposed legislative changes. There are also questions about how relevant such laws will remain once the UK is no longer in the EU, and how enforceable they will be when the directives from which they are derived no longer apply and there is no longer any recourse to the European Court of Justice.

Guiding principles for the EU exit negotiations

127. The UK’s departure from the EU is not expected to change the general direction of UK energy policy, since this is perceived to be driven primarily by the Climate Change Act 2008, and domestic concerns about supply security and affordability. However, the absence of external enforcement and accountability mechanisms could weaken the imperative to deliver on policy targets. EU energy and climate change policies have historically played an important role in underpinning UK policy and providing a ‘double-lock’ to decarbonisation commitments. This has bolstered investor confidence by providing policy stability beyond the five-year domestic parliamentary cycle. As the UK Government prepares for the exit negotiations, we set out the following guiding principles:

- **In the absence of certainty on the status of policies derived from the EU, build investor confidence by providing clarity on the long-term strategic domestic energy and climate change policy framework.**
- **Maximise the future opportunities to cooperate with the EU and other partners to retain the UK’s wider international standing in climate leadership and as a hub for low carbon innovation.**
- **Avoid a rushed decision on the Internal Energy Market. Participation is highly valued by UK stakeholders, and it is important to ensure that the energy sector has a voice in future changes to rules and regulations that may affect it after the UK has formally left the EU.**

329 E3G ([EUE0011](#)), EDF Energy ([EUE0033](#)), Chartered Institution of Building Services Engineers ([EUE0040](#)), Aldersgate Group ([EUE0050](#)), European Federation of Energy Traders (EFET) ([EUE0056](#)), The Renewable Energy Association (REA) ([EUE0066](#))

330 House of Lords, [European Union Energy and Environment Sub-Committee](#), 20 July 2016, p9

- **Maintain the ease of UK-EU trade across interconnectors to secure supply and reduce costs, and seek tariff-free access to goods and services that supply the energy sector and low carbon manufacturing facilities.**
- **Ensure that arrangements are in place to provide the energy sector with a skilled and mobile workforce, while recognising public concerns about levels of migration.**

4 ECC legacy and the need for continued scrutiny

128. Our current work addresses only a portion of our scrutiny priorities over Parliament 2015–20. This chapter sets out a brief overview of our work from the last year and our thinking on other key issues going forward. It provides recommendations to the Business, Energy and Industrial Strategy Committee, the House, and the wider policy community on key issues on which to hold Government to account.

Highlights from 2015–16

A clear strategy for carbon capture and storage

129. Our first substantive report of the 2015–16 Parliamentary Session, *Future of carbon capture and storage in the UK*, looked at the Government’s sudden decision to cancel its £1 billion CCS commercialisation competition.³³¹ We concluded that “pulling the plug on the competition without warning was damaging both to the relationship between Government and the industry, and to investment into the UK” and that:

With gas and without CCS, [the UK] will not remain on the least cost path to [its] statutory decarbonisation target. If Government is committed to its climate change targets, it cannot afford to sit back and simply wait and see if CCS will be deployed at the moment when it is needed.³³²

We therefore urged Government to devise promptly a new strategy for CCS.³³³

130. In its response the Government promised to look carefully at all options and provide further details on the next steps for CCS once it had engaged further with industry, reflected on our recommendations, and those from Lord Oxburgh’s CCS Advisory Group.³³⁴

131. Lord Oxburgh’s CCS Advisory Group published its report in September 2016. It concluded that:

UK action on CCS now will deliver lowest cost to the consumer. There is no justification for delay. Heavy costs will be imposed on current and future UK consumers by a continued failure to enact an effective CCS policy.³³⁵

The Advisory Group set out six detailed recommendations, including the need to create a CCS Delivery Company which would “initially be government owned but could

331 Energy and Climate Change Committee, Second report of session 2015–16, [Future of carbon capture and storage in the UK](#), HC 692

332 Energy and Climate Change Committee, Second report of session 2015–16, [Future of carbon capture and storage in the UK](#), HC 692

333 Energy and Climate Change Committee, Second report of session 2015–16, [Future of carbon capture and storage in the UK](#), HC 692

334 Energy and Climate Change Committee, First Special Report of Session 2016–17, [The future of carbon capture and storage in the UK: Government Response to the Committee’s Second Report of Session 2015–16](#), HC 497

335 [Lowest Cost Decarbonisation for the UK: The Critical Role of CCS](#), Report to the Secretary of State for Business, Energy and Industrial Strategy from the Parliamentary Advisory Group on Carbon Capture and Storage, September 2016

subsequently be privatised”, akin to companies set up to deliver the 2012 Olympics or Crossrail. We hope our successors will maintain the pressure on Government to set out more detailed plans for the next steps for carbon capture and storage in the UK.

Restoring investor confidence and developing a robust Emissions Reduction Plan

132. Our report, *Investor confidence in the UK energy sector*, published in March 2016, set out the factors that were combining to damage investor confidence and made detailed recommendations on urgent and longer-term actions the Government ought to take to address these.³³⁶ In the short-term for example we sought clarity on the Contracts-for-Difference (CfD)³³⁷ auctions that are due to take place this decade. We would like to see details on which technologies can participate in upcoming CfD rounds, and in particular that the UK Government will seek official clearance of remote island CfDs by the European Commission in time to participate in these auctions.³³⁸ Our report also sought clarity on how the Levy Control Framework (LCF)³³⁹ is managed pre-2020. The LCF lacks transparency, as well as post-2020 clarity, which concerns us given its centrality to energy policy. In the longer-term, we explained that “the ‘Carbon Plan’ [now referred to by Government as the ‘Emissions Reduction Plan’] for achieving the fifth carbon budget would represent an ideal opportunity for rebuilding confidence in the direction of travel for the energy sector”. We also touched on this issue in our report, *Setting the fifth carbon budget*.³⁴⁰ We set out in our investor confidence report detailed principles the Government needs to follow as it develops the Emissions Reduction Plan over the course of this year. The Plan was to be published by the end of 2016 but there are now worrying suggestions that this timeline may slip.

133. We did not receive a Government response to our investor confidence report within the usual two-month timeframe (as outlined in the Osmotherly rules).³⁴¹ We waited over 16 weeks for this reply, but the document we received failed to respond to any of our specific recommendations, instead providing loose replies to themes from the summary and not engaging with any material beyond page four of the report. We declined to publish this document at the time, to avoid any indication that this discharged the Government’s obligation of response. We expressed our dissatisfaction in the strongest terms directly to the then Energy Minister and subsequently in a letter to the then DECC Secretary of State.³⁴² We have also raised this issue in person³⁴³ with Greg Clark since he was appointed Secretary of State for BEIS. As we bring our activities to a conclusion we remain immensely disappointed that the Government has still not provided a proper response to

336 Energy and Climate Change Committee, Third report of session 2015–16, [Investor confidence in the UK energy sector](#), HC 542

337 Contracts-for-Difference (CfDs): Contracts designed to support low-carbon electricity generators by effectively fixing the price they receive per unit of electricity. A ‘strike price’ is set for generators who are paid the difference between this and the wholesale price of electricity (where the latter is lower) for every unit generated. If the strike price is lower than the wholesale price, the generator has to repay the difference.

338 [Letter](#) from Andrea Leadsom MP dated 27 June 2016

339 Levy Control Framework: A system to control and cap levy-funded spending currently covering Contracts for Difference, Feed-in Tariffs and the Renewables Obligation.

340 Energy and Climate Change Committee, Fifth Report of Session 2015–16, [Setting the fifth carbon budget](#), HC 659

341 Cabinet Office, [Giving evidence to select committees: guidance for civil servants](#), October 2014, para 68

342 Q 294 [Angus Brendan MacNeil to Andrea Leadsom] [Oral evidence](#) on Investor confidence in the UK energy sector, 29 June 2016, HC 478

such an important report. We append to this report a copy of the unsatisfactory response we received on 28 June from Government, which we are publishing now in the interest of transparency.

134. We urge our successors to press the Government on the timeline for developing its Emissions Reduction Plan to meet the fourth and fifth carbon budgets. Delaying the publication and implementation of a robust plan risks further uncertainty on the direction of UK energy and climate policy which could damage investor confidence and call into question the UK's ability to meet its long-term decarbonisation targets. Our report, Investor confidence in the UK energy sector, set out a number of detailed recommendations and questions that remain ignored by Government. The Government's engagement with this report has been wholly inadequate, and we urge our successors and other Members to continue to press for an adequate response.

Building momentum on energy efficiency

135. Energy efficiency can play a significant role in helping the UK tackle the energy trilemma, but our report, *Home energy efficiency and demand reduction*, exposed flaws in policy here.³⁴³ We expressed major concerns about the Government's decision to use a supplier obligation—a revised version of the Energy Company Obligation (ECO)—to tackle fuel poverty. We called on Government to reinstate the Zero Carbon Homes policy. In the light of the failed Green Deal scheme, we set out detailed actions the Government should take to stimulate the 'able-to-pay' market. The Government did not agree with our recommendations on fuel poverty or Zero Carbon Homes.³⁴⁴ However, it recognised the need to learn lessons from the Green Deal and suggested it was considering a range of options, although no further details have been forthcoming. We hope our successors will build on our work and push for effective action from Government to help stimulate the take-up of energy efficiency measures.

Getting legislation right for a smarter, fairer, more competitive energy sector

136. On 21 January the Government published draft legislation on energy with the stated aim of increasing competition in the energy market and reducing energy costs for consumers.³⁴⁵ The draft legislation contained a package of measures on wide-ranging issues including the roll-out of smart meters, next-day switching, settlement arrangements for electricity, and competitive tendering for onshore transmission. We carried out detailed pre-legislative scrutiny of these measures and made a number of practical suggestions on how Government could amend the draft measures to make them clearer and to ensure that consumers benefit.³⁴⁶ While the Government has responded to our report—and agreed with many of our proposed changes—it has not yet introduced a Bill in Parliament to bring forward the draft measures. When it does so, we hope Members will use our work to refine the legislation further.

343 Energy and Climate Change Committee, Fourth Report of Session 2015–16, [Home energy efficiency and demand reduction](#), HC 552

344 Energy and Climate Change Committee, Third Special Report of Session 2016–17, [Home energy efficiency and demand reduction: Government Response to the Committee's Fourth Report of Session 2015–16](#), HC 542

345 DECC Policy Paper, [Draft Legislation on Energy](#), 21 January 2016

346 Energy and Climate Change Committee, Sixth Report of Session 2015–16, [Pre-legislative scrutiny of the Government's draft legislation on energy](#), HC 776

137. Upcoming legislative changes will not be limited to those that we scrutinised in draft form earlier this year. The Competition and Market Authority’s (CMA) Energy Market Investigation concluded in June and some of its recommendations on improving competition will require changes to the law. We carried out an evidence session with various stakeholders and the CMA soon after the investigation’s final report was published.³⁴⁷ While stakeholders accepted the broad thrust of the CMA’s report some elements of the package of remedies provoked concerns. We highlighted two such concerns in a letter to the Secretary of State for BEIS: privacy issues relating to the proposed database of customers that have not switched off a Standard Variable Tariff for three or more years; and rolling back recent changes which forced price comparison websites to show as default the ‘whole of the market’ deals rather than only those for which they are paid commission.³⁴⁸ We hope that our successors will maintain a watching brief on implementation of the CMA’s remedies.

138. Our wide-ranging report, *Low carbon network infrastructure*, also highlighted potential legislative changes needed to ensure the energy network is able to adapt to a low carbon future.³⁴⁹ For example, we urged the Government to make the changes necessary to enable Ofgem to regulate district heating networks. In its response the Government indicated that it was keen to accelerate the deployment of such networks and was “working with Ofgem, relevant trade bodies and wider industry to consider [our proposals], alongside a range of other approaches”.³⁵⁰ Our report further observed that current regulatory conditions for storage were hindering its development. We urged the Government to “publish its plans, as soon as possible, for exempting storage installations from balancing charges, and from all double-charging of network charges”.³⁵¹ This is a subject we investigated further through our work on the energy revolution (see chapter two). Our report also called for major changes to the way in which the electricity system is operated. This included a more active role for Distribution Network Operators in managing the flows on local networks and the creation of an Independent System Operator, which would effectively break away National Grid’s system operation role from its role in owning and maintaining the transmission network. In its response Government told us it was “now considering the case for changes to the status quo”.³⁵² It is essential that our successors continue to press the Government for timely action to ensure that energy networks are ready to maximise the benefits from a low-carbon future.

A renewed cross-Government effort to decarbonise heat and transport

139. Our most recent report, *2020 renewable heat and transport targets*, warned the Government that on its current course, the UK would fail to achieve its legally binding targets due to a lack of effective cooperation between Government departments.³⁵³

347 [Oral evidence](#) on Competition and Markets Authority’s Energy Market Investigation, 5 July 2016, HC 315

348 [Letter](#), dated 19 July 2016, to Rt Hon Greg Clark MP regarding the CMA energy market investigation

349 Energy and Climate Change Committee, First Report of Session 2016–17, [Low carbon network infrastructure](#), HC 267

350 Energy and Climate Change Committee, [Low carbon network infrastructure: Government Response to the Committee’s First Report of Session 2016–17](#), Fifth Special Report of Session 2016–17, HC 738

351 Energy and Climate Change Committee, First Report of Session 2016–17, [Low carbon network infrastructure](#), HC 267

352 Energy and Climate Change Committee, [Low carbon network infrastructure: Government Response to the Committee’s First Report of Session 2016–17](#), Fifth Special Report of Session 2016–17, HC 738

353 Energy and Climate Change Committee, Second Report of Session 2016–17, [2020 renewable heat and transport targets](#), HC 173

In addition to providing practical suggestions to Government on how to tackle decarbonisation of heat and transport, we noted the recent ‘Machinery of Government’ changes could present broader opportunities in this policy area. We explained that bringing energy and climate change policy into a larger department with wider responsibilities for business and industrial strategy could enable more joined-up thinking on a low-carbon economy and place clean growth at the heart of a more influential department. However, we warned that the worst case scenario would be that energy and climate change issues get buried by conflicting concerns. The onus will now be on the BEIS Committee to ensure that the new Department for Business, Energy and Industrial Strategy maximises the opportunities to place the decarbonisation agenda at the heart of business, energy and industrial strategy.

Scrutiny priorities going forward

140. While we readily accept that decisions on future inquiries will ultimately be a decision for the BEIS Committee itself, we thought it might be helpful to highlight some areas we consider to be important.

- First and foremost on our agenda was our work to assess the implications of leaving the EU on energy and climate change policy. We have produced an overview in this report of our preliminary thinking on this subject, based solely on the written evidence we received. Many of the issues we raised warrant further, more detailed analysis.
- Also high on our agenda was the need to look in more detail at arrangements for securing electricity supply. We considered this to be particularly urgent in the light of planned plant closures, delays to new nuclear, sudden reductions in renewable energy support, and the failure of the Capacity Market to incentivise new gas-fired power stations.
- We have already referred in this report to the urgency to press the Government on the timeline for developing its Emissions Reduction Plan to meet the fourth and fifth carbon budgets. Once published it would be helpful to assess the extent to which the plan provides the much needed certainty required on the UK’s direction and the domestic policy framework.
- An essential area of ongoing scrutiny is the impact of energy policy on consumer bills, and in particular the extent to which the retail market is operating in a competitive way that encourages consumer engagement. This subject was thoroughly scrutinised in the last Parliament by our predecessors but has received less attention since the 2015 election as much hope had been placed on the remedies expected to emerge from the CMA’s Energy Market Investigation. The implementation of changes arising from this inquiry will need to be closely followed.
- We saw compelling evidence on the advantages of electrifying the road transport system. There is no doubt that the technology is developing quickly and its appeal to consumers is clear. There are public health benefits as well as industrial and economic ones. Government should continue to encourage the uptake of electric vehicles and our successor Committee may want to monitor progress.

- A final area of interest was community energy. This is the term commonly used to refer to projects or programmes designed to manage energy, generate energy, purchase energy, and reduce energy use amongst a group of people within a particular location or with a particular interest. We consider Government's approach to supporting community energy groups and projects to be under-scrutinised.

141. In our report, *Our priorities for Parliament 2015–20*, we produced a table of issues and highlighted the action we had taken on each one in 2015. We have updated this table as a record of our activities and it is provided in Annex 2. The BEIS Committee will no doubt wish to develop its own view on the priority areas for scrutiny in the months and years ahead. The fresh perspective of a new Committee will be welcome and we encourage a diverse range of stakeholders to engage positively with our successors to help shape their thinking.

Conclusions and recommendations

Energy revolution

Storage

1. Storage presents a real opportunity for the UK. Strong public financial support and clear legislation in California have been vital in developing the storage industry and laying the foundation for the full integration of storage infrastructure in the grid. There are similar opportunities in the UK for legislation to help support investment in storage. (Paragraph 26)
2. *We reiterate our previous call on Government to move quickly on addressing regulatory barriers faced by storage: there must be a clear definition for storage, double-charging must come to an end, and a separate asset class for grid-level electricity storage should be established as a matter of urgency. The Government must also review the outdated Capacity Market rules and regulations in relation to storage, including considering increasing the contract length and addressing restrictions around stacking of revenues for storage projects. We further recommend that Government sets out a high-level public commitment to making the UK a world-leader in storage and sets a storage procurement target for 2020. The Government should also consider a possible subsidy framework for energy storage to accelerate deployment given the importance of storage to unlocking the full potential of renewable energy.* (Paragraph 27)

Demand-side management

3. The right policy framework needs to be put in place to unlock the full potential of demand-side response (DSR) technologies. Getting DSR right will empower consumers, reduce bills, ease grid pressure, and lower carbon dioxide emissions. Without explicit market mechanisms and target capacity goals DSR will not be able to deliver best value for consumers. (Paragraph 38)
4. *Changes to Government policy with regards to DSR participation in the Capacity Market need to be implemented and we urge the Government to implement these in time for the upcoming T-4 and T-1 auctions in the winter 2016–17. The contract bond requirement for DSR providers bidding in the Capacity Market is an unnecessary cost for businesses. It should be removed, and if not, it must be reduced to a level that is a more reasonable percentage of the cost of the projects that are bidding. Government must update its evidence base to justify why it thinks the DSR projects should be limited to one-year contracts. Our view is that significantly longer contract periods should be available to DSR providers. Finally, the Government should reconsider its decision to reduce the volume of the T-1 auction.* (Paragraph 39)
5. *The market should also be given a clear signal that DSR capacity is to be procured as a strongly preferred alternative to diesel generation plants. We recommend investigating the use of a merit order for meeting capacity needs in the UK when margins are tight, which places DSR high on the list.* (Paragraph 40)

6. *The Government should itself become a beacon of good practice by demonstrating the use of flexible demand solutions in its buildings in Whitehall and around the country. Parliament should also use the opportunities of the restoration and renewal of the Palace of Westminster to embed flexible demand and other new energy technologies within the Parliamentary estate. (Paragraph 41)*

Digital engagement of energy consumers

7. *The Government must stay on top of the developing challenges associated with data protection and privacy. While these issues are being considered in relation to the smart-meter roll-out, the Government needs to ensure that it is thinking ahead about these issues in the context of more fully-connected smart homes and businesses. (Paragraph 46)*
8. *It is vital to communicate effectively to consumers the benefits of smart meters and intelligent devices to manage energy use in homes and businesses. However, the Government must also develop methods to nudge the energy sector towards embracing the opportunities arising from developing a smarter market in which consumers are more engaged and where reduction of demand is valued over increasing supplies of energy. The Government should investigate the pros and cons of alternative approaches to do this, including the potential for a demand reduction obligation. (Paragraph 54)*
9. *It is clear that the digitisation of the energy system alongside the increasing availability of “internet of things”-enabled technologies and appliances will revolutionise not only the energy market but also the consumer experience. Government will want to ensure that this opportunity for UK households is not held back by regulation or a lack of understanding within Whitehall. (Paragraph 55)*

Nuclear innovations

10. *The Government hopes to establish the UK as a global leader in the Small Modular Reactor (SMR) market. Our successors may in due course wish to investigate progress on the development and deployment of SMRs. (Paragraph 60)*
11. *Fusion is an innovation for the next generation. In the United States, the prospect of over-regulation was clearly a worry. The UK is already involved in fusion projects and is home to some of the world-leading companies exploring this field. There is an opportunity to be a pioneer and world-leader in this area. Such is the potential of this technology, the Government should monitor and engage with developments in fusion research and plan ahead to minimise regulatory barriers to development and deployment. (Paragraph 64)*

Economic opportunities of the energy revolution

12. *Technological leadership can be lucrative, but often occurs on longer timescales than private investment is comfortable with so there is a role for Government in driving energy innovation. The UK has world-leading universities: leveraging these to attract and retain international talent, and support innovation throughout its cycle, is crucial to achieving an energy revolution. The Government should support efforts*

to get the next generation of students interested in (1) energy research, and (2) the policy implications of their research. The Government should embrace tripartite collaboration between academia, industry and government where projects help to address the UK's long-term decarbonisation goals. (Paragraph 70)

13. *The energy revolution presents a huge economic opportunity for the UK. With the appropriate strategy, policies and regulatory framework in place, Britain can become a world leader in the green technology sector. The Government should make green technology a top priority in its forthcoming industrial strategy. (Paragraph 71)*

Leaving the EU

EU Emissions Trading Systems

14. The EU Emissions Trading System (ETS) is highly valued as a policy instrument for reducing greenhouse gas emissions across the EU. The System requires reform but stakeholders are optimistic that the next reformed phase of the EU ETS—with clearer price signals more closely aligned to the UK's carbon price floor and improved governance—will better incentivise low carbon investment and reduce emissions. Several therefore make the case for the UK's continued participation in the System after it has left the EU. Government should bear in mind the challenges associated with alternative options. These include the potentially costly and complex option to establish a UK ETS linked to the EU System, and the politically difficult creation of a direct carbon tax. Government must consider the impact of any alternative approaches on consumers and the competitiveness of UK industry. (Paragraph 84)

EU Effort Sharing

15. Stakeholders agree that there is little risk to the UK in signing up to its proposed contribution to EU Effort Sharing proposals up to 2030, as it aligns closely with the UK's domestic targets. Renegotiating these proposals could be burdensome. We note that because of the UK's higher than average contribution to the proposed target, the onus would be on the rest of the EU to step up its ambition and push forward more stretching emissions reduction targets for the remaining Member States. (Paragraph 86)

Paris Agreement and future international climate negotiations

16. The recent vote to leave the EU does not change the UK's requirement to reduce emissions in line with the Paris Agreement and domestic legislation. The required levels of emissions reduction through to the early 2030s, during the fifth carbon budget period, have already been set by the UK Parliament. We have highlighted the prevailing stakeholder view that the Government consider maintaining UK participation in the EU ETS and in the EU Effort Sharing process, both of which will contribute significantly to the EU's Nationally Determined Contribution up to 2030. (Paragraph 91)
17. *The Government should explore the options for maintaining a relationship with the EU on climate change negotiations going forward. After 2030 there may continue to*

be value in pursuing the joint fulfilment of climate change goals. In this way the UK might retain its positive influence over EU nations and, by maintaining a progressive climate change agenda among that group of nations, exert greater influence elsewhere in the world too. (Paragraph 92)

Internal Energy Market

18. *Stakeholders are in favour of continued UK access to the Internal Energy Market (IEM). In deciding the nature of the UK's future relationship with the market, the Government will need to weigh the costs of associated legislation and regulation against the economic, security of supply and carbon reduction benefits afforded by IEM membership. We recognise that negotiations around this will be affected by broader issues, including freedom of movement. We note that:*
 - *If IEM participation is to be pursued the Government will need to explore potential membership models, such as the Energy Community Treaty.*
 - *If continued IEM participation looks doubtful, the Government should undertake a thorough assessment to ensure that policy risks are understood and minimised.*
 - *In the event that the UK loses its membership of but retains access to the IEM, the Government will need to identify new routes to shape the development of IEM policy. Without this the UK risks losing its role as an IEM 'rule-maker', instead becoming a 'rule-taker'. (Paragraph 99)*
19. *Continued participation in the Internal Energy Market is expected to entail compliance with the European Network Codes (ENCs). Ofgem and National Grid should therefore seek to retain membership of ACER, ENTSO-E and ENTSO-G so that the UK can continue to shape the development of new codes. If on the other hand the UK sought to resign from the European Network Codes, the Government must take care to ensure that resultant gaps in domestic network codes are filled. We set out further conclusions regarding ENCs in relation to interconnectors (see paragraph 117). (Paragraph 103)*
20. *Northern Ireland's electricity system is highly integrated with that of the Republic of Ireland, which will continue to be bound by Internal Energy Market (IEM) rules. The Government should carefully consider how any changes to the UK's relationship with the IEM will have particular significance for Northern Ireland. It may be appropriate to differentiate between the approach taken for Northern Ireland and that for Great Britain. (Paragraph 107)*

Security of supply

21. *The UK is heavily dependent on Europe for its electricity and gas imports. Pan-European coordination has helped to improve the UK's security of supply. The Government should seek to build investor confidence, to avoid exacerbating difficulties in bringing forward investment in new electricity capacity and new indigenous resources. The Government should also examine the role of the 'solidarity principle' in managing potential gas crises, specifically how the UK can continue to participate. If*

excluded from the 'solidarity principle' the UK Government must urgently investigate alternative back-up arrangements to ensure security of supply in the event of a crisis. (Paragraph 111)

22. *Interconnections improve security of supply, facilitate cross-border trading and enable grid-balancing to be managed more cost-effectively. Substantial expansion of interconnection has been proposed for the coming decade, and we support this. The Government should continue to progress planned and proposed new interconnections with Europe. (Paragraph 116)*
23. *The European Network Codes (ENCs) may need to be retained to ensure the functionality of energy trading and system operations across interconnectors with Europe. As noted in paragraph 103, Ofgem and National Grid should seek to retain membership of ACER, ENTSO-E and ENTSO-G so that the UK can continue to shape the development of new ENCs. If the UK resigns from the IEM and the ENCs, the Government must take care to ensure that interconnector trade and operations are not distorted by differences between European and UK energy market design. (Paragraph 117)*

EU funding

24. *The EU has provided substantial financial support for energy infrastructure and R&D in the UK. The Government should provide clarity to Parliament on whether funds awarded from EU schemes other than Horizon 2020 will be retained and/or underwritten. The Government should also ascertain whether access to EU financial institutions and funds, including but not limited to the European Investment Bank, will be available to British applicants in the longer term. It should develop credible alternatives where this is not possible. (Paragraph 121)*

Investor confidence

25. *The vote to leave has reduced already-weak investor confidence in the energy sector. The Government should promote investment by providing clear signals on the direction of domestic energy policy to be followed throughout, and after, the exit negotiations, for example through the timely publication of a detailed Emissions Reduction Plan. (Paragraph 123)*

Repealing the European Communities Act 1972

26. *EU-derived legislation retained in UK law will need to be reviewed and amended in the light of the UK's relationship with the EU once it has formally left. It is essential that Parliament has adequate time to fully scrutinise any proposed legislative changes. There are also questions about how relevant such laws will remain once the UK is no longer in the EU, and how enforceable they will be when the directives from which they are derived no longer apply and there is no longer any recourse to the European Court of Justice. (Paragraph 126)*

Guiding principles for the EU exit negotiations

27. The UK's departure from the EU is not expected to change the general direction of UK energy policy, since this is perceived to be driven primarily by the Climate Change Act 2008, and domestic concerns about supply security and affordability. However, the absence of external enforcement and accountability mechanisms could weaken the imperative to deliver on policy targets. EU energy and climate change policies have historically played an important role in underpinning UK policy and providing a 'double-lock' to decarbonisation commitments. This has bolstered investor confidence by providing policy stability beyond the five-year domestic parliamentary cycle. As the UK Government prepares for the exit negotiations, we set out the following guiding principles:
- In the absence of certainty on the status of policies derived from the EU, build investor confidence by providing clarity on the long-term strategic domestic energy and climate change policy framework.
 - Maximise the future opportunities to cooperate with the EU and other partners to retain the UK's wider international standing in climate leadership and as a hub for low carbon innovation.
 - Avoid a rushed decision on the Internal Energy Market. Participation is highly valued by UK stakeholders, and it is important to ensure that the energy sector has a voice in future changes to rules and regulations that may affect it after the UK has formally left the EU.
 - Maintain the ease of UK-EU trade across interconnectors to secure supply and reduce costs, and seek tariff-free access to goods and services that supply the energy sector and low carbon manufacturing facilities.
 - Ensure that arrangements are in place to provide the energy sector with a skilled and mobile workforce, while recognising public concerns about levels of migration. (Paragraph 127)

Highlights from 2015–16

28. *We urge our successors to press the Government on the timeline for developing its Emissions Reduction Plan to meet the fourth and fifth carbon budgets. Delaying the publication and implementation of a robust plan risks further uncertainty on the direction of UK energy and climate policy which could damage investor confidence and call into question the UK's ability to meet its long-term decarbonisation targets. Our report, Investor confidence in the UK energy sector, set out a number of detailed recommendations and questions that remain ignored by Government. The Government's engagement with this report has been wholly inadequate, and we urge our successors and other Members to continue to press for an adequate response.* (Paragraph 134)

Annex 1: Committee visit to California and Washington, 11–16 September 2016

Monday 12 September

California Environmental Protection Agency and Air Resource Board

The California Environmental Protection Agency (CalEPA) is California's environmental authority. It develops, implements and enforces laws regulating air, water and soil quality, pesticide use and waste recycling and reduction. We met with Matthew Rodriguez and Alexa Kleysteuber, Secretary and Deputy Secretary for Environmental Protection, respectively, as well as Edie Chang and Margaret T Minnick, from the CalEPA Air Resources Board.

We learned that California pursues aggressive climate policies because it is already seeing the effects of climate change. It has put in place a range of programmes, including:

- A renewable portfolio requiring 33% of electricity generation from renewables by 2020 (solar, wind and small hydro), which California is confident it will meet;
- A new goal of 50% reduction by 2030 set by the Governor and a commitment to reducing emissions by 80–95% of 1990 levels by 2050;
- A phase out of nuclear energy, mainly due to concerns around seismic risks;
- A range of energy efficiency programmes that have kept California's energy usage flat;
- Programmes to decarbonise the transport sector, which accounts for 37% of California's emissions, including change to zero emission vehicles and cleaner fuels;
- California's cap and trade programme, covering 85% of emissions (including industrial base and the use of fuels in cars). By law, 25% of the revenues have to benefit disadvantaged communities. California's ETS is already linked with Quebec and work is being done to link it with Ontario by next year.

We discussed the strong cross-party and popular support for low carbon policies in California and the details of the cap-and-trade system (including the potential for aviation to be brought in at a later stage). We learned that while the ETS led to higher wholesale prices in California than neighbouring states, retail prices were low thanks to successful energy efficiency programmes. We also discussed the challenge of creating a narrative around decarbonisation and framing it as an opportunity. California has been able to take advantage of the perception that new technologies and opportunities are taking place, and has been able to maintain an industrial base while attracting venture capitalists. California has been leading in terms of job development, particularly following the growth of the solar industry, with a GDP increase of 2% driven by the clean tech industry. However, we heard that putting exact numbers on the lag between the announcement of political

will and the arrival of dividend was not straightforward. We were particularly interested to hear that the state of California has a goal of installing 1.3GW of electricity storage by 2020.

Governor's Office

We met with Ken Alex, Senior Policy Advisor to Governor Jerry Brown and Director of the Governor's Office of Planning and Research. We learned about California's energy sector developments since the energy crisis in the 2000s. We discussed several of the Governor's policies, including:

- California's storage procurement requirement. We discussed the beginning of the storage bill seven years ago, with the purpose of creating a special procurement category for storage. While the bill was slowed down by a three-year regulatory hiatus, it created momentum in the storage sector, with every storage company in the world now in California. We heard that the storage price curve was dropping rapidly and that storage was being called "the new solar". The Governor's office expects storage to be market competitive in 2 to 3 years;
- Community Choice Aggregation programmes. Communities in California can buy power on behalf of their residents and businesses through a local government structure called a CCA or Community Choice Aggregator, thus encouraging cities and counties to compete with the major utilities. We heard that a CCA requires two thirds of elected jurisdictions, with four or five currently in operation. We discussed whether the market structure was adapted and potential issues around contributions to wider distribution and transmission costs;
- Energy efficiency policies, including insulation, appliance standards and demand management. We heard that while the UK was putting as much effort into energy efficiency as California, the latter understands that efficiency goes beyond building insulation: it must also focus on managing demand. California also has many standards on appliances and has a requirement for new residential buildings to be net zero by 2025 and commercial ones by 2030.

California Energy Commission

The California Energy Commission is California's foremost energy policy and planning agency and one of several entities dealing with oversight of energy and environmental issues. We met with Robert Oglesby, Executive Director, and several members of his team. We discussed the CEC's role on both the generation and the efficiency side of energy policy, and California's electricity generation portfolio, including the phase-out of nuclear and reduction in fossil natural gas, the shrinking share of large hydro-power in the state's energy portfolio (about 14%, with no new hydro as other generation resources grow) and the drive to higher proportions of renewable generation and increased energy efficiency. We discussed the growing importance of storage in California's electricity grid. There is 1.3GW of storage to be procured over the coming years and more will be needed. We heard that a portfolio of storage, demand response and integration of generation resources would be needed, and that there was a drive to go beyond the California energy system.

We heard about the ways in which California invests public money and stimulates investment to create opportunities in the energy sector, in particular to generate a zero emission transport landscape. We learned about the range of research programmes supported by the CEC and the interplay between federal and state funding for R&D. We touched upon the question of risk versus return when investing in innovation and of annual oversight.

We discussed the importance of long-term targets, intervening milestones and clear market signals to provide both policy direction and investor confidence to drive innovation. We heard about how recent and upcoming legislation will provide these signals, in particular the 2030 renewables target and energy efficiency in buildings. Challenges in the water sector were also touched upon.

Tuesday 13 September

Cumulus Energy Storage

Cumulus Energy Storage is a UK-US technology company focused on low-cost grid-scale rechargeable Copper/Zinc battery storage. We met Darron Brackenbury, Chief Operating Officer, and Michael Hurwitz, Chief Technology Officer. We discussed the benefits of storage for the deployment of renewable energy, for the electricity grid market and energy intensive industries, in terms of flexibility, load shifting, grid balancing and costs saved. We heard about some of the hurdles to the deployment of storage, including technical understanding of the systems in which batteries can be deployed, and the challenge of dispatching stored electricity over the longer timescales required by the grid.

Cumulus Energy's copper-zinc batteries are designed to be deployed at grid-scale and are roughly 12 months to production. We learned about the battery technology in more detail (including comparisons to other batteries such as Lithium or Vanadium), the company's funding, research and development and production line. Most R&D is being carried out in California, due to the access to a huge talent pool of engineers, from hardware to software specialists.

We discussed California's 1.3GW storage target and what it sets to achieve: give the correct signals and help create the appropriate infrastructure for further storage deployment. The CEC triennial plans—with comprehensive documentation and clarity over funding—go a long way in providing policy certainty and the appropriate framework for investment. However, we heard that a California electricity system consisting solely of renewables, storage and demand-response was still a long way in the future, and would require half of electricity demand to be matched with storage. While there are many demonstration projects, there is yet no commercialisation of grid-scale storage.

We were interested in perceptions of the UK as place to drive innovation in this sector and heard that while UK energy policy was going in the right direction, there were concerns about market access following the EU referendum.

We also discussed costs, both in terms of the uncertain costs of batteries linked to the changing grid infrastructure, and opportunities brought by storage to get a better price on renewables

California Public Utilities Commission

The California Public Utilities Commission (CPUC) regulates privately owned electric, natural gas, telecommunications, water, railroad, rail transit, and passenger transportation companies. We met with Marc Monbouquette, Regulatory Analyst in the Energy Division of the CPUC.

We discussed the role of private utilities in innovation and operation, and the need to identify optimal opportunities for the electricity system to take on more load. We heard about the drive to change the regulatory system from cost-based to performance- and incentive-based.

We were interested to hear more about the Community Choice Aggregation programmes (CCAs), overseen by the CPUC. It is important to identify places where distributed energy can invest and there is a need to invest in community infrastructure and dispatch and control tools. We learned that the PUC was working out how new planning processes feed into the investment network and the smart grid. It is important to let the market respond to identified needs on the system where distributed energy can be being most ideally located. We heard that the ability of the grid to cope with novelties was important, and that this may require updates. We heard that increasing amounts of distributed energy meant that it was important to look at the grid more organically, identify where customers are using distributed energy and use this information in forecasts to feed into network. The question of who pays for grid infrastructure improvements was an important one.

Advanced Energy Economy

Advanced Energy Economy (AEE) is a national trade association of business leaders in the clean energy technology sector. Its business focus it is to build markets for its member companies through advocacy at federal, state and city level to enable growth in the advanced energy market. We met with Graham Richard, CEO of AEE, and a number of the organisations' members. We discussed the US market for clean technologies, and the need to focus on market growth, jobs and economic growth—rather than climate—to drive emissions reductions. We heard that the single biggest driver for clean energy was price, and hedging against natural gas prices. A second important driver often forgotten is the battle for talent and the appeal of clean industries and companies to the young workforce. Corporate goals are also an important driver.

We heard about the current climate change and environmental legislation in California, and the ongoing struggle to extend policies (in particular the cap and trade programme extension, with ongoing discussions on how revenues should be spent causing regulatory uncertainty). We discussed the role of AEE in helping large companies wanting to buy clean power to tackle regulatory barriers. For example, it has helped companies to keep track of all regulations affecting storage by building a database using predictive analytics to search every piece of legislation. Companies can use this resource for business development analytics to understand where a piece of legislation may be blocking a clean energy development.

We touched on the role of storage, and the idea that customer control as well as the market and grid are the drivers of storage. Demand side measures (both demand reduction and demand side response) were also discussed, including barriers to the penetration of DSR

contracts and the difficulty of getting large loads to respond rapidly to the needs of the grid. California has the largest market for demand-side management programmes but it is highly fragmented.

We heard that success in advanced energy is a whole systems approach, moving away from siloes and regulatory policies and towards an integrated system thinking—to get to a system where shifting to low carbon technologies and sources is more appealing to shareholders and rate payers. We discussed the growing importance of sociological and consumer empowerment drivers, in addition to the traditional trilemma of cost, sustainability and security. Storage is most demanded once all five drivers are considered. We discussed the drivers for the change in consumer attitudes towards clean energy—and the acceptance of green technology. California’s 500 000 advanced energy jobs and the 17% growth in the sector last year has been turning a cost into an opportunity. Once again, we heard that consistency in policy support and signals was key. A robust unified business voice advocating solutions is also crucial to the shift to low carbon systems, with a strong alliance of leadership from the private sector, public sector (mayors in particular) and non-profit foundations.

The Breakthrough Institute

The Breakthrough Institute is an eco-modernist thinktank that looks at the role of technology in addressing environmental challenges. We met with Ted Nordhaus, founder of the institute, and Alex Trembath, Director of Communication. We heard about the institute’s perspective that the clean energy debate has been overly focussed on environmental consciousness and ideas of behaviour and consumption in the developed world, and has ignored the fact that the bulk of future carbon emissions will result from populations in developing nations reaching the right level of development and access to energy.

We discussed the penetration of different renewable technologies worldwide, and the requirements for a decarbonised grid, including the need for dispatchable baseload following and baseline. We were interested to hear about the idea of a capacity factor threshold, whereby once annual generation reaches a nominal cap factor on a grid for a particular renewable technology, there is a non-linear increase in the difficulty of further penetration. We heard that while storage was an important part of the solution, radical breakthroughs will be needed before the seriousness of the capacity threshold issue can be eliminated.

We discussed the origin of the fracking revolution in the United States, whereby the development of the shale gas industry benefitted from well-established and stable institutions. We also discussed the nuclear industry and how other industries drive radical innovation. We heard that smaller, specialised, innovative businesses were a key driver.

Wednesday 14 September

Tesla Motors

Tesla Motors is an American automotive and energy storage company that designs, manufactures, and sells electric cars, electric vehicle powertrain components, and battery

products. We met Daniel Witt Manager for Business Development Policy and Sarah Van Cleve, Energy Storage Policy Manager. We also had the opportunity to tour the Tesla factory itself.

We learned about the history of Tesla, the development of its products, and its mission to accelerate the world's transition to sustainable energy. We heard about Tesla's aim to show that electric vehicles could be competitive, that such technologies could have implications for the wider energy sector, and that there was a need to change consumer behaviour alongside developments in the vehicle fleet.

We discussed pathways to scalability and the learning still to be done to not only scale sales and services capabilities but also fuelling capabilities. We discussed ways to make electric vehicles available to a wider demographic and the need to focus efforts on appropriate policies to charge and leverage investments existing in the electric infrastructure.

We heard about Tesla's ambitions to look at other forms of transport, including long-range shipping and buses and the link to behaviour change and shift away from personal vehicle ownership. There are also opportunities at the grid level to turn vehicles into a stationary storage industry and facilitate the introduction of renewables. We discussed other Tesla products such as the Powerwall and Powerpack that have the opportunity to provide frequency regulation as well as load shifting. There is a potential to aggregate individual owner's benefits and it is important to ensure that utilities and energy markets have the right tools in place for customers to sell back electricity to the market to support the wider grid infrastructure.

Nest Labs

Nest Labs is a producer of self-programming, self-learning, sensor-driven, Wi-Fi-enabled thermostats, smoke detectors, and other home automation systems. Founded in 2010 by former Apple engineers, the company was acquired by Google in 2014. Centred around the home, Nest's mission is to provide safety, security and energy management. We met Nest's CEO, Marwan Fawaz, and a number of members of his team, including Scott Kohler (Product and Regulatory Affairs Counsel), Ben Bixby (Director, Energy and Enterprise) and Tom vonReichbauer (Chief Business Officer).

We learned about the range of Nest products, in particular its self-regulating, self-programming thermostat that can adapt to consumer habits. We discussed questions of interoperability and the drive for a universal operating system and open interface for home efficiency to maximise market take-up of the range of products available. We touched on issues of data privacy and Nest's principles of transparency, whereby clear privacy boundaries mean that data is used strictly for product development and management of energy devices, not to advertise or market products. We heard that the first phase of their study in the UK found an average of 6–8% savings in households and discussed the interplay between smart thermostats and smart meters.

We discussed the importance of consumer engagement, both regarding the products themselves and the control capabilities, and discussed the role of sellers in communicating the benefits of smart thermostats. We noted that opportunities across the housing stock, such as social housing, were immense but that appropriate engagement and utility-led

energy solutions were key. We heard that the product was cost effective, paying for itself in two years, and that an appropriate financing mechanism for households who are not able to pay costs upfront was now needed.

Thursday 15 September

UniEnergy Technologies

Founded in 2012, UniEnergy Technologies (UET) is a company specializing in developing and delivering electrical energy storage solutions for the evolving electrical grid and utility sectors. The battery technology is based on a new vanadium electrolyte formulation. We met Dr. Gary Yang, Chief Executive Officer, and Rick Winter, President and Chief Operations Officer and had the opportunity to tour UET's facilities.

We heard that the storage industry was now at an “inflexion point,” with an increasing role to play due to the growth in renewables, the decentralisation of the electricity system and the need for more resilient, consistent and predictable power. Extreme weather events in USA have already led to losses of \$200bn.

We discussed political consensus and consumer buy-in for spending on new low carbon technologies and the need to look at economic and social increases in productivity, public health and other co-benefits of a decarbonised power grid. We heard that there have been significant policy shifts in the United States and other countries such as Australia and South Africa, not only at the political level but also at the corporate one, with large companies such as Google or Microsoft wanting to “go 100% green”. These corporate policy shifts also require the buffer capacity that is made possible with storage, thereby helping the industry. We learned that the US military is also looking at decarbonising military bases around the world.

We discussed the vanadium battery technology and heard that UET's industrial-scale product was a field-proven fully-integrated package suitable for plug in deployment and linking with local utilities. There are 20 installations in total, including in Germany and Italy. The company is now at an inflection point with its production ramp and is working towards full factory integration. The fully integrated system reaches 75% efficiency, which is lower than lithium systems but provides stable capacity that does not fade over time. We heard about the importance of comparing whole systems efficiency and cost, as well as duration of use, when comparing technologies.

We touched upon questions of regulation and of the UK issue of double-charging for storage. We heard that the multiple benefits of (frequency, ancillary, backup, reliability) need to be monetised and that this could be helped by a carbon tax. We also discussed the need for government support to get low-carbon projects off the ground and deal with the 5–10 years return on investment typical for renewables.

Helion Energy

Helion Energy is a company carrying out applied research on a new nuclear fusion technology. Its goal is to develop a technology that is scalable, low cost and efficient and

build the world's first commercial fusion plant. We met Dr David Kirtley, Helion founder and CEO and Chris Pihl, Chief Technology Officer. We also toured Helion Energy's laboratories and met several researchers from their team.

We learned about the physical process of stellar fusion and the different technologies that have been developed so far to recreate this physical process and harness it to produce energy. We heard about the benefits of fusion as a potential electricity generation technology (fuelled by isotopically heavy water, large energy content at low cost, clean products, lack of waste or carbon emissions, absence of the possibility of catastrophic failure or nuclear proliferation concerns), and about the main challenges to the development of the technology (difficulty to start the reactions, technical complexity, high capital costs). We were told that while the physics were well understood, the engineering and development timescales were very long.

We discussed different fusion start-ups, the various programmes and funding for nuclear fusion, and what regulatory barriers could exist in the future if the technology is commercialised. We also touched upon the public perception of nuclear technologies and how the difference between nuclear fusion and fission could be communicated.

Friday 16 September

University of Washington Clean Energy Institute

The Clean Energy Institute is a research institute at the University of Washington. Its mission is to accelerate the adoption of a clean energy future with a strong focus on next generation solar energy and storage systems, as well as their integration with the grid. We met with Professor Daniel Schwartz, Director, Professor David Ginger, Associate Director, Professor Daniel Kirschen, Associate Professor Jihui Yang and Dr Sarah Holliday, along with a number of students and staff of the institute. We also met with Brian Young, the Governor's Clean Technology Industry Sector Lead. We had the opportunity to tour several laboratory facilities.

We learned that energy had contributed greatly to the economic development Washington State. It has a unique electricity profile: it is the 20th largest electricity system on Earth and the grid averages 75% of hydropower. Hydro and other renewables have made electricity in the state some of the cheapest in the world, with the carbon-free nature of the state's portfolio attracting businesses. The Department of Commerce wants to create the right environment for companies creating cutting edge clean energy products to develop in Washington State.

We heard that the institute's research covered three strands: Basic research on advanced materials and manufacturing, education and workforce development (including outreach and PhD and postdoctoral training, and research and education infrastructure. We discussed the institute's drive to involve business and the private community with early stages of research, and give young students and researchers opportunities to take their work into the marketplace and become the next generation of innovators and company leaders. We heard that clean energy economy research was one of the fastest growing components of Washington State and that the societal value placed on research will be important for increasing funding in the future. However we also heard that rate of returns

on investment in clean tech were lower than in software development, which made it challenging to attract investment in a software capital like Seattle and required private investment to come in at regular intervals to drive innovation.

We heard about the drive to create a new geography for clean energy innovation, whereby those bringing in initial funding and people can identify where this can be done at lowest risk for them and their investors. With its liquid work environment, the Silicon Valley will provide opportunities for students and young researchers, and public funding should reflect this. The Department of Commerce is putting money into the CEI because of its outward-facing, entrepreneurial focus. Other unis also have entrepreneurial centre but CEI brings it to next higher level. The University of Washington also has a centre for commercialisation that helps mentor start-ups and spin offs.

We heard that it was difficult for academics to quantify the impact on return of an R&D project. While the gross value added of such investments is hard to determine three years into the centre's life, it already has value in being a point of entry for big businesses such as Amazon or Microsoft. We heard that communication was an important part of the institute's success, with researchers publishing material beyond traditional scientific papers and CEI having a strong outreach and communication programme to reach a wide range of communities.

The institute focusses much of its research on solar energy, because it has the largest technical potential of US renewable and is the most scalable of renewable technologies. While its growth has been impressive, it is still important to make solar cheaper and distribute it more effectively. We heard that Capex costs were an issue for solar, and that new technologies will be an opportunity to drive down this cost. We heard about research on new PV materials and the need to look beyond one single material and towards the entire device when comparing technologies.

We heard about the institute's research on the grid, including the role and meaning of smart grids, the impact of the penetration of renewables, and the need for greater flexibility on the grid (through the ramp-up of conventional generation, demand response, storage—the best but most expensive solution). We discussed questions around how much flexibility was needed, how to optimise it and what market mechanisms can be used to deliver this flexibility.

We discussed research on electricity storage, and the issue that investors struggled to know where and how much they should invest. We heard about two important federal Government projects in the area of battery storage, motivated by legislation: EV everywhere (whereby the number of plug in hybrid vehicles on the road should be larger than traditional combustion engines by 2022) and the Clean energy standard (aiming for 80% of electricity generated from clean sources by 2035). We were told that major challenges for battery storage were to improve safety, provide a high energy density and lower the cost. We heard that system costs today were a third of those ten years ago, showing the opportunity for rapid cost-reduction if research funding is available.

Annex 2: Actions taken on issues raised by stakeholders

Table 1: Committee actions across the main scrutiny areas raised by stakeholders in our July 2015 consultation

Issue raised	Overview of Committee action
Biomass	In our report, <i>2020 renewable heat and transport targets</i> , we looked at the role of bioenergy in meeting the UK's targets and issues of bioenergy sustainability. We questioned the Secretary of State on the issue of biomass subsidies during a session on the DECC annual report and accounts.
Building regulations/zero carbon homes	Building regulations are outside our remit but we looked at the implication of the Government's decision to end the zero carbon homes policy in our report, <i>Home energy efficiency and demand reduction</i> . We also discussed this with the Secretary of State during a session on DECC priorities, and with the CCC during a session on its 2015 progress report to Parliament.
Carbon capture and storage	Our report, <i>Future of CCS in the UK</i> , looked at the implications of the Government's decision to cancel £1 billion funding for CCS.
Climate finance	We have not had time to consider this topic in detail.
CMA energy market investigation	We carried out an evidence session on this soon after the CMA's final report was published. We also wrote to the Secretary of State about our concerns. Prior to the CMA's report publication we discussed these matters with Ofgem and DECC during the annual reports and accounts sessions.
Coal	We have not had time to consider this topic in detail.
Community-ownership	We discussed this briefly with Ofgem during a session on the annual reports and accounts but have not had time to consider this topic in more detail.
COP21	We held a session with the Secretary of State to discuss the outcomes of COP21 and next steps for the UK.
Decarbonising the economy	In our report, <i>Setting the fifth carbon budget</i> , we looked at the Government's plans for decarbonisation. We also discussed the Emissions Reduction Plan in our report, <i>Investor confidence in the UK energy sector</i> .
Energy costs and carbon pricing	We discussed carbon pricing with the CCC during a session on its 2015 progress report to Parliament. We discussed balancing costs and energy costs to manufacturers and industrial users at a session on security of supply with National Grid and also during a joint meeting on steel with other committees.
Energy efficiency, fuel poverty	We looked at this in detail in our report, <i>Home energy efficiency and demand reduction</i> .
Energy from Waste	We have not had time to consider this topic in detail.
Feed-in-Tariffs	We investigated changes to Feed-in-Tariffs and the broader framework for supporting renewables in our report, <i>Investor confidence in the UK energy sector</i> .
Gas in the UK energy system	We discussed the role of gas with the Energy Minister during a session on investor confidence. We also talked to National Grid about the Capacity Market and wider issues during a session on security of supply. We spoke to the CCC about the role of gas during a session on its 2015 progress report to Parliament.

Issue raised	Overview of Committee action
Health	We looked at some aspects of the health benefits of energy efficiency improvements in our report, <i>Home energy efficiency and demand reduction</i> .
Heat	We looked at decarbonisation of heat in our report, <i>2020 renewable heat and transport targets</i> .
Hydropower	We have not had time to consider this topic in detail.
Incentivising renewables	In our report, <i>Investor confidence in the UK energy sector</i> , we investigated aspects of the framework for supporting renewables.
Interconnectors	The role of interconnectors for UK security of supply was discussed in a session on security of supply with National Grid, and in more detail in our report, <i>Low carbon network infrastructure</i> .
International	We looked at international climate policy in a session with the Secretary of State to discuss the outcomes of COP21 and next steps for the UK. In addition to the work described in this report, we also held a session ahead of the EU referendum to look at the potential implications of a vote to leave. We have sought to draw on international best practice through the course of a number of inquiries, including our work on <i>Low carbon network infrastructure</i> and <i>Energy revolution</i> .
Investor confidence	This issue was covered in our report, <i>Investor confidence in the UK energy sector</i> .
Low carbon subsidies	We questioned the Energy Minister and Secretary of State on this issue during various one-off sessions. Our report, <i>Investor confidence in the UK energy sector</i> , also touched on this subject.
Maximising economic recovery in the domestic oil and gas sector	We held a general session with the Oil and Gas Authority and also followed up with a wider group of witnesses at a session on maximising economic recovery.
Networks, smart grids, storage, decentralised system	These issues were covered in our report, <i>Low carbon network infrastructure</i> .
Nuclear	We held a series of sessions on new nuclear over the course of the last year and exchanged correspondence with both the UK and French governments.
Research and Development and innovation	In addition to the work highlighted in this report (see chapter 2 on Energy revolution), we discussed the drivers of innovation with the CCC during a session on its 2015 progress report to Parliament. We also looked at network innovation in our report, <i>Low carbon network infrastructure</i> .
Role of Ofgem	The relationship between Ofgem and National Grid was discussed at the session on security of supply. We also talked in detail to Ofgem about its role and responsibilities during a session on its annual report and accounts.
Security of Supply	We held a session on security of supply and winter capacity margins with National Grid and followed up our concerns in writing. We have not had time to do more detailed work on this issue but consider it to be a priority area for future scrutiny.
Smart-meter rollout	We discussed the roll-out with both Ofgem and DECC during the annual reports and accounts sessions. We also discussed it in the course of our work on <i>Pre-legislative scrutiny of Government's draft legislation on energy</i> .

Issue raised	Overview of Committee action
Shale gas	We discussed this briefly with the CCC during a session on its 2015 progress report to Parliament. We have not had time to consider this topic in more detail.

Further details on these actions can be accessed via our website, www.parliament.uk/ecc, which includes transcripts of all public evidence sessions, written submissions from stakeholders, and copies of reports and correspondence.

Appendix: Government's response to our work on investor confidence in the UK energy sector

Government response as sent to us on 28 June 2016

Introduction

The Department of Energy and Climate Change welcomes the Committee's interest in analysing investor confidence in the UK Energy sector.

DECC fully recognises that significant investment is needed in our energy sector and remains committed to ensuring a pipeline of investment continues over the course of this Parliament and beyond. That is why we are taking action to maintain the momentum of Contracts for Difference (CfD) auctions for less established technologies including offshore wind and are taking steps to reform the Capacity Market.

To date, the UK has seen significant investment in the energy sector. While Europe experienced a drop off in renewables investment by 30% in 2015, the UK saw a record increase in investment, (up to £13bn), up by 25% on 2014 figures. There is no hard evidence to suggest that the cost of financing has increased for renewables or other technologies.

The Committee has concluded that there are six factors which have had an impact on investor confidence in the UK Energy sector and has made three recommendations based on these findings.

Conclusions

Conclusion 1

Sudden and numerous policy announcements have marred the UK's reputation for stable and predictable policy development.

This Government has made a series of decisions since the election which we believe are necessary to protect hardworking families by keeping bills low, while continuing to attract investment into our energy system.

After the election, projections in May 2015 showed a significant overspend on renewable support under the Levy Control Framework (LCF). To protect families and businesses that ultimately have to pay these costs, we decided to act swiftly and introduce a package of reforms to get costs under control. We are also delivering on our manifesto commitment to halt new subsidies for onshore wind and give people the final say on onshore wind developments in their community.

The Government's record on renewable electricity speaks for itself—we are projected to have 35% of electricity derived from renewable sources by 2020¹ and rather than stalling, investment in renewables has increased by 42% in the UK since 2010, whilst over the same period it has fallen by 64% in the rest of Europe.

The Secretary of State set out a clear vision for the Government's energy policy last November, and we have seen feedback from a range of investors and energy companies that DECC's actions since then have increased certainty and investor confidence, by moving towards a market based system and removing market distortions. This includes providing further clarity on the Capacity Market, on Contracts for Difference (CfD) auctions over the next four years, and on taxation for the UK's oil and gas industry.

Conclusion 2

A lack of transparency in the decision-making process [particularly on the LCF] has led investors to question the Government's rationale for policy changes and to wonder “what will be next?”

DECC has taken action to control the LCF, ensuring bills are kept as low as possible and providing support to technologies that need it most. For example, the measures announced in December 2015 to close the Renewables Obligation early to small-scale solar and introduce caps for future tariffs on Feed-in-Tariffs (FITs) are forecast to save £500m from the current projected LCF spend in 2020/21.

The Government does not accept that the decision-making process has not been transparent. DECC has shown clear transparency by publishing details of the assumptions which underpin the LCF modelling, consistent with protecting commercially sensitive information. Strike prices for signed CfDs are available on the LCCC website. Renewables Obligation and FITs Scheme deployment data are published monthly on the Renewable Energy Planning database and the Ofgem website.² We will continue to consult on major policy decisions, such as our reforms to the Capacity Market.

Conclusion 3

There has been insufficient consideration of investor impacts, exemplified by insufficient consultation and engagement ahead of policy decisions.

Evidence-based research remains at the foundation of DECC's policy making process, which includes analysis of quantitative data, written consultations, and meetings with investors and operators. Ahead of the proposed changes to the FITs Scheme, DECC consulted widely, receiving 55,000 responses.

On policy decisions related to onshore wind, DECC met with hundreds of stakeholders in England, Scotland and Wales to hear their views and carefully assess the evidence, ensuring that any policy decisions will strike the right balance between the public interest

1 Calculated on the basis of January 2016 LCF projections, as used in the OBR's March 2016 Economic and fiscal outlook. http://budgetresponsibility.org.uk/docs/dlm_uploads/Fiscal_supplementary_tables_March_2016.xls

2 <https://www.renewablesandchp.ofgem.gov.uk/Public/ReportManager.aspx?ReportVisibility=1&ReportCategory=0>

of protecting consumer bills and the interests of onshore wind developers and investors. In addition, some measures—such as to halt the spread of onshore windfarms—were clear manifesto commitments.

Key industry stakeholders have praised us for our ability to engage, listen and respond to concerns. Renewable Energy Association has said “Praise has to be given to DECC ministers in their willingness to listen and change”.

Conclusion 4

Policy inconsistency and contradictory approaches have sent mixed messages to the investment community about the direction of travel. Examples of this include: claiming to want to decarbonise at lowest cost while simultaneously halting onshore wind; giving local people a say in wind consents but not shale gas; and emphasising the important role of gas while scrapping support for carbon capture and storage.

DECC has been clear on its policy priorities. We are committed to providing secure, affordable and clean energy that our families and businesses can rely on now and in the future. Doing this is critical for our economy, national security and household budgets.

We need to bring about the transition to low-carbon energy generation as cost-effectively and securely as possible, and the Secretary of State has made clear that our generation strategy is based on delivering more offshore wind, nuclear and new gas, to ensure a secure supply of energy.

Continuing to provide subsidies to the same technologies will not be sufficient to reach the Government’s commitment to reduce emissions by at least 80% by 2050 from 1990 levels. As well as delivering on our manifesto commitment to end new subsidy for onshore wind, we are clear that we need to continue investing in less mature technologies, so that they are able to realise their potential, as solar and onshore wind have done. For this reason, DECC is doubling its spend on early stage research and development to £500m by 2020, alongside other international partners and private sector individuals within the Mission Innovation initiative launched at COP21 in 2015.

Conclusion 5

The lack of a long-term vision has made it more difficult for investment committees to make decisions about projects that are, by their nature, long-term endeavours.

The UK’s Climate Change Act provides a long-term decarbonisation target and five-yearly carbon budgets that provide certainty for investors beyond political cycles.

The Secretary of State’s November 2015 speech also set out a clear direction for energy and climate change policy over the course of this Parliament. In her speech, the Secretary of State set out her vision and made key commitments to offshore wind support, new nuclear, building new gas-fired power stations, and a focus on innovation. Over the course of this year we will provide more detailed information on how the offshore wind and the reformed capacity market auctions will work, to provide even greater clarity.

In addition, DECC published its Single Departmental Plan (SDP) on 19 February 2016, providing a clear statement on the Department's policy direction. The SDP sets out the Department's strategic objectives and policy priorities alongside a plan for delivery and a set of headline performance metrics to monitor progress.

Conclusion 6

A policy “cliff-edge” in 2020, does not provide sufficient visibility about the size of the future Levy Control Framework (LCF) budget or what will happen to the Carbon Price Floor. This is a problem when projects can take five years or longer to go from conception to completion.

The Government will clarify the future of the cost control framework for low carbon energy in due course. However, we are already making clear how funding will be made available for key technologies.

DECC has announced that £290m of annual support will be made available for offshore wind from 2021/22 onwards. We are also setting out our expectations for cost reductions in the offshore wind industry, ensuring that investors have long-term visibility and understand what levels need to be achieved to secure ongoing subsidy support. Support costs for offshore wind will be capped at £105/MWh for projects commissioning in 2021/22 and are expected to cost below £85/MWh by 2026 (2011/12 prices).

Furthermore, at Budget 2016 the Chancellor announced that Carbon Price Support rates would increase with RPI in 2020/21, with a further announcement on the longer term future of the Carbon Price Floor to be made at Autumn Statement 2016.

We are also in active negotiations with developers on new nuclear projects to provide secure baseload energy for the UK with plants expected to be built in the second half of the 2020s and are in the process of setting out our plans for the next Capacity Market auction to run at the end of this year.

Recommendations

Recommendation 1

The Committee recommends that DECC provides further clarity on how existing policy mechanisms will be used, particularly the LCF beyond 2020 and details on CfD auctions.

The Office for Budget Responsibility published the most up to date Levy Control Framework projections on 16 March 2016, and as highlighted above, an additional £730m of annual support has been confirmed for this Parliament for less established technologies including offshore wind commissioning between 2021/22 and 2025/26. We will set out more information in due course on the next CfD allocation round for less established technologies, which we intend to hold by the end of 2016.

Recommendation 2

The Committee recommends that DECC creates a credible long term vision for the future of the UK's energy system and considers the idea of a 'Carbon Plan' to deliver the fifth carbon budget.

As highlighted earlier, the Secretary of State set out her vision and clear priorities for this Government's energy policy in November. We are committed to ensuring the success of these priorities over the course of this Parliament.

We had already announced that we will publish our Emissions Reduction Plan by the end of 2016, which is the successor to the 2011 Carbon Plan. The Emissions Reduction Plan will set out our policies and proposals for meeting the UK's carbon budgets. DECC will continue to engage closely with other Government Departments on the development of this plan over the coming months.

Recommendation 3

The Committee recommends that DECC pays particular attention the LCF, ensuring that it is fit for purpose and addresses issues surrounding lack of transparency.

DECC is committed to keeping energy bills low, encouraging further investment in the energy sector and creating opportunities for industry jobs across the UK.

As set out earlier in our response to Conclusion 2 above, DECC has shown transparency by publishing details of the assumptions which underpin the LCF modelling, consistent with protecting commercially sensitive information. Strike prices for signed CfDs are available on the LCCC website. Renewables Obligation and FITs Scheme deployment data are published monthly on the Renewable Energy Planning database and the Ofgem website.³

In addition, DECC regularly monitors changes in wholesale fossil fuel prices and the impact on support for renewable energy.

3 <https://www.renewablesandchp.ofgem.gov.uk/Public/ReportManager.aspx?ReportVisibility=1&ReportCategory=0>

Formal Minutes

Thursday 13 October 2016

Members present:

Angus Brendan MacNeil, in the Chair

Rushanara Ali Alistair Carmichael
Tom Blenkinsop James Heappey

Draft Report (*The energy revolution and future challenges for UK energy and climate change policy*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 141 read and agreed to.

Chair's foreword agreed to.

Annexes agreed to.

Appendix agreed to.

Resolved, That the Report be the Third Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available (Standing Order No. 134).

[The Committee adjourned.]

Witnesses

Energy Revolution inquiry HC 175

The following witnesses gave evidence. Transcripts can be viewed on the [inquiry publications page](#) of the Committee's website.

Tuesday 11 October 2016

Question number

Barry Hatton, Director of Asset Management, UK Power Networks, **Amanda Lyne**, Chair, UK Hydrogen and Fuel Cell Association, **Dr Nina Skorupska**, Chief Executive Officer, Renewable Energy Association, and **Dr Jill Caaney**, Director, Electricity Storage Network

[Q1–25](#)

Yoav Zingher, Co-Founder and Chief Executive Officer, Kiwi Power, **Phil Sheppard**, Director of SO Operations, Network Capability, National Grid, **Sara Bell**, Founder and Chief Executive Officer, Tempus Energy Technology, **Professor Jim Watson**, Director, UK Energy Research Centre, and **Colin Calder**, Founder and Chief Executive Officer, PassivSystems

[Q26–49](#)

Sacha Deshmukh, Chief Executive, Smart Energy GB, **Simon Roberts**, Chief Executive, Centre for Sustainable Energy, and **Victoria MacGregor**, Director of Energy. Citizens Advice

[Q50–64](#)

Published written evidence

Energy Revolution inquiry HC 175

The following written evidence was received and can be viewed on the [inquiry publications page](#) of the Committee's website.

REV numbers are generated by the evidence processing system and so may not be complete.

- 1 A.R.DAY ([REV0115](#))
- 2 Act on Climate Ltd ([REV0122](#))
- 3 AECB the association for environment conscious building ([REV0045](#))
- 4 Algometrics Limited ([REV0062](#))
- 5 Association for Project Management (APM) ([REV0091](#))
- 6 Atkins ([REV0058](#))
- 7 Aum Energy Pte Ltd ([REV0129](#))
- 8 Ayrenergy Ltd ([REV0032](#))
- 9 Bill Jenkins ([REV0023](#))
- 10 Calor Gas Ltd ([REV0090](#))
- 11 Cambridge Carbon Capture Ltd ([REV0066](#))
- 12 Carlos Beltran ([REV0064](#))
- 13 Centre for Nuclear Engineering, Imperial College ([REV0065](#))
- 14 Citizens Advice ([REV0063](#))
- 15 Control Network Solutions ([REV0055](#))
- 16 David Bowen ([REV0031](#))
- 17 David Pearson ([REV0028](#))
- 18 Dearman ([REV0048](#))
- 19 Demand Logic ([REV0049](#))
- 20 Den Tread ([REV0013](#))
- 21 Doosan Babcock ([REV0106](#))
- 22 Dr Brian Ahern ([REV0022](#))
- 23 Dr Craig Richmond ([REV0080](#))
- 24 Dr Dan Saker ([REV0101](#))
- 25 Dr Robert Luk ([REV0025](#))
- 26 Dunelm Energy ([REV0035](#))
- 27 E.ON UK PLC ([REV0117](#))
- 28 E3G ([REV0098](#))
- 29 Electrical Contractors' Association (ECA) ([REV0097](#))
- 30 Electricity Storage Network ([REV0043](#))
- 31 Electron Energy Research Ltd. ([REV0061](#))
- 32 Electron Energy Research Ltd. ([REV0132](#))

- 33 Energy Managers Association ([REV0044](#))
- 34 Energy Policy Group, University of Exeter ([REV0089](#))
- 35 Energy Process Developments Ltd ([REV0126](#))
- 36 Energy Unlocked ([REV0086](#))
- 37 EnerNOC ([REV0087](#))
- 38 Enertechos Limited ([REV0052](#))
- 39 EUA ([REV0088](#))
- 40 Faradion ([REV0123](#))
- 41 GE Hitachi Nuclear Energy ([REV0073](#))
- 42 Good Energy Ltd ([REV0093](#))
- 43 Heating and Hotwater Industry Council ([REV0077](#))
- 44 Heriot-Watt University ([REV0119](#))
- 45 Homeglow products ([REV0037](#))
- 46 HRS Energy ([REV0114](#))
- 47 Hyperdrive Innovation ([REV0057](#))
- 48 Imperial College Centre and UKERC ([REV0128](#))
- 49 Innovate UK ([REV0053](#))
- 50 InstaGroup Limited ([REV0009](#))
- 51 Institute for Sustainability, Newcastle University ([REV0051](#))
- 52 Institute of Directors ([REV0099](#))
- 53 Institute of Physics ([REV0121](#))
- 54 Institution of Mechanical Engineers ([REV0096](#))
- 55 Intel Corporation (UK) Ltd ([REV0083](#))
- 56 ITM Power ([REV0071](#))
- 57 Kepler Energy ([REV0072](#))
- 58 KiWi Power ([REV0109](#))
- 59 Landmark Associates Ltd. ([REV0034](#))
- 60 Lee Slater ([REV0092](#))
- 61 London South Bank University ([REV0130](#))
- 62 Miss Jenny Carson ([REV0042](#))
- 63 Modern Device ([REV0019](#))
- 64 Moltex Energy ([REV0125](#))
- 65 Mr Adrian Williams ([REV0094](#))
- 66 Mr Brian Woodgate ([REV0006](#))
- 67 Mr Chris White ([REV0008](#))
- 68 Mr Dominic McCann ([REV0036](#))
- 69 Mr Gordon Docherty ([REV0027](#))
- 70 Mr Greg Beckett-Leonard ([REV0029](#))

- 71 Mr Paul Dodgshun ([REV0038](#))
- 72 Mr Rex Mottershead ([REV0018](#))
- 73 Mr Richard Moore ([REV0011](#))
- 74 Mr Simon Hunt ([REV0068](#))
- 75 Mr Stephen Browning ([REV0110](#))
- 76 Mr Stephen Heale ([REV0026](#))
- 77 Mr Terry Putson ([REV0040](#))
- 78 National Nuclear Laboratory ([REV0112](#))
- 79 Nationalgrid ([REV0118](#))
- 80 Nissan ([REV0076](#))
- 81 North Carolina State University ([REV0041](#))
- 82 Northern Powergrid ([REV0105](#))
- 83 Nuclear Industry Association (NIA) ([REV0120](#))
- 84 Orchard Partners London Ltd ([REV0107](#))
- 85 Origen Power Ltd ([REV0081](#))
- 86 Osamu Ide ([REV0060](#))
- 87 Oxford University ([REV0102](#))
- 88 OXIS Energy Ltd ([REV0054](#))
- 89 PCAH ([REV0002](#))
- 90 Ph.D. Fred Zoepfl ([REV0024](#))
- 91 Professor Seamus Garvey ([REV0012](#))
- 92 REA ([REV0082](#))
- 93 Renewable Energy Systems Ltd ([REV0104](#))
- 94 retired teacher dennis lynn ([REV0020](#))
- 95 RSPB ([REV0133](#))
- 96 Scottish Renewables ([REV0078](#))
- 97 ScottishPower ([REV0116](#))
- 98 Siemens plc ([REV0095](#))
- 99 Smart Energy GB ([REV0084](#))
- 100 Smart Generation Limited ([REV0069](#))
- 101 SNC-Lavalin ([REV0127](#))
- 102 Solarmass Ltd ([REV0075](#))
- 103 SSE ([REV0108](#))
- 104 Stag Energy Development Co. Ltd ([REV0056](#))
- 105 Steven Hall ([REV0015](#))
- 106 Swanbarton Limited ([REV0067](#))
- 107 Tempus Energy Technology ([REV0100](#))
- 108 The Anaerobic Digestion and Bioresources Association (ADBA) ([REV0103](#))

- 109 The Royal Academy of Engineering ([REV0124](#))
- 110 Tokamak Energy Ltd ([REV0079](#))
- 111 Tony Hughes ([REV0021](#))
- 112 UK Energy Storage Hub Oxford ([REV0059](#))
- 113 UK Hydrogen and Fuel Cell Association ([REV0074](#))
- 114 UK Power Networks ([REV0113](#))
- 115 Unipart Rail ([REV0046](#))
- 116 United Kingdom Atomic Energy Authority ([REV0085](#))
- 117 Vincenzo Messina ([REV0004](#))
- 118 Western power distribution ([REV0047](#))

Leaving the EU: implications for UK climate policy inquiry HC 553

The following written evidence was received and can be viewed on the [inquiry publications page](#) of the Committee's website.

EUC numbers are generated by the evidence processing system and so may not be complete.

- 1 AECB ([EUC0056](#))
- 2 AES UK & Ireland ([EUC0020](#))
- 3 Aldersgate Group ([EUC0048](#))
- 4 Ashden sustainable solutions, better lives ([EUC0025](#))
- 5 BASF ([EUC0041](#))
- 6 British Ceramic Confederation ([EUC0013](#))
- 7 Carbon Capture and Storage Association ([EUC0017](#))
- 8 CF Fertilisers UK Limited ([EUC0051](#))
- 9 Citizens Advice ([EUC0030](#))
- 10 Client Earth ([EUC0045](#))
- 11 Construction Products Association ([EUC0042](#))
- 12 CPL Industries ([EUC0028](#))
- 13 Dr Katherine Watts ([EUC0004](#))
- 14 E.ON ([EUC0038](#))
- 15 E3G ([EUC0037](#))
- 16 EDF Energy ([EUC0021](#))
- 17 EEF ([EUC0047](#))
- 18 Energy Intensive Users Group ([EUC0031](#))
- 19 Energy UK ([EUC0049](#))
- 20 ENGIE ([EUC0046](#))
- 21 Environmental Change Institute, University of Oxford ([EUC0002](#))
- 22 European Federation of Energy Traders (EFET) ([EUC0029](#))
- 23 Gemserv ([EUC0018](#))
- 24 Geological Society ([EUC0044](#))
- 25 Grantham Research Institute at the London School of Economics ([EUC0032](#))
- 26 Greenpeace ([EUC0052](#))
- 27 International Emissions Trading Association (IETA) ([EUC0003](#))
- 28 Kingspan Insulation Limited ([EUC0010](#))
- 29 Lendlease ([EUC0053](#))
- 30 Max Fordham LLP ([EUC0007](#))
- 31 Mineral Products Association ([EUC0022](#))
- 32 Mineral Wool Manufacturers' Association (MIMA) ([EUC0027](#))
- 33 NFU ([EUC0006](#))
- 34 Oil & Gas UK ([EUC0033](#))

- 35 Orchard Partners London Ltd ([EUC0040](#))
- 36 Outokumpu Stainless Ltd ([EUC0009](#))
- 37 Overseas Development Institute ([EUC0023](#))
- 38 Professor David Campbell ([EUC0058](#))
- 39 Prospect (Trade Union) ([EUC0034](#))
- 40 Renewable Energy Systems Ltd (RES) ([EUC0026](#))
- 41 Ricardo Energy & Environment ([EUC0019](#))
- 42 RSPB ([EUC0008](#))
- 43 RWE UK ([EUC0024](#))
- 44 Scottish Carbon Capture and Storage ([EUC0050](#))
- 45 ScottishPower ([EUC0035](#))
- 46 Shell International Petroleum Co Ltd ([EUC0015](#))
- 47 techUK ([EUC0043](#))
- 48 The Royal Society ([EUC0005](#))
- 49 The Scientific Alliance ([EUC0001](#))
- 50 The Scotch Whisky Association ([EUC0014](#))
- 51 The UK Health Alliance on Climate Change ([EUC0012](#))
- 52 Tyndall Manchester, University of Manchester ([EUC0036](#))
- 53 UK Environmental Law Association ([EUC0016](#))
- 54 UK Petroleum Industry Association ([EUC0011](#))
- 55 UK Power Reserve ([EUC0054](#))
- 56 University of East Anglia ([EUC0039](#))
- 57 Vattenfall UK ([EUC0055](#))

Leaving the EU: implications for UK energy policy inquiry HC 554

The following written evidence was received and can be viewed on the [inquiry publications page](#) of the Committee's website.

EUE numbers are generated by the evidence processing system and so may not be complete.

- 1 ADBA ([EUE0053](#))
- 2 AES UK & Ireland ([EUE0065](#))
- 3 Aldersgate Group ([EUE0050](#))
- 4 Aluminium Federation ([EUE0019](#))
- 5 AMDEA ([EUE0004](#))
- 6 Baxi ([EUE0010](#))
- 7 BEAMA ([EUE0021](#))
- 8 Biofuelwatch ([EUE0058](#))
- 9 British Ceramic Confederation ([EUE0042](#))
- 10 BRUFMA ([EUE0045](#))
- 11 Carbon Capture and Storage Association ([EUE0064](#))
- 12 Carbon Connect ([EUE0005](#))
- 13 Centre for Energy, Petroleum and Mineral Law and Policy ([EUE0044](#))
- 14 Chartered Institution of Building Services Engineers ([EUE0040](#))
- 15 Chatham House ([EUE0016](#))
- 16 Citizens Advice ([EUE0032](#))
- 17 Confederation of British Metalforming ([EUE0047](#))
- 18 Construction Products Association ([EUE0069](#))
- 19 CPL Industries ([EUE0057](#))
- 20 DONG Energy ([EUE0051](#))
- 21 Dr Feroze Duggan ([EUE0009](#))
- 22 E.ON UK ([EUE0073](#))
- 23 E3G ([EUE0011](#))
- 24 Ecotricity ([EUE0071](#))
- 25 EDF Energy ([EUE0033](#))
- 26 EEF, the Manufacturers Organisation and UK Steel ([EUE0062](#))
- 27 ELEXON Limited ([EUE0014](#))
- 28 Energy and Utilities Alliance ([EUE0039](#))
- 29 Energy Institute ([EUE0063](#))
- 30 Energy Intensive Users Group ([EUE0036](#))
- 31 Energy Networks Association ([EUE0041](#))
- 32 Energy Policy Group, University of Exeter ([EUE0048](#))
- 33 ENGIE ([EUE0043](#))
- 34 European Federation of Energy Traders (EFET) ([EUE0056](#))

- 35 Gemserv ([EUE0025](#))
- 36 Greenpeace UK ([EUE0070](#))
- 37 Institution Of Mechanical Engineers ([EUE0068](#))
- 38 InterGen ([EUE0049](#))
- 39 International Air Transport Association (IATA) ([EUE0037](#))
- 40 Kingspan Insulation Ltd ([EUE0046](#))
- 41 Low Carbon ([EUE0038](#))
- 42 Major Energy Users Council ([EUE0023](#))
- 43 MIMA (Mineral Wool Insulation Manufacturers' Association) ([EUE0022](#))
- 44 Mineral Products Association ([EUE0027](#))
- 45 Ms Susan Hedley ([EUE0020](#))
- 46 National Farmers' Union ([EUE0013](#))
- 47 National Grid ([EUE0079](#))
- 48 Oil & Gas UK ([EUE0075](#))
- 49 Renewable Energy Systems Ltd (RES) ([EUE0059](#))
- 50 RenewableUK ([EUE0055](#))
- 51 Ricardo Energy & Environment ([EUE0035](#))
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- 53 RSPB ([EUE0076](#))
- 54 School of Law, University of Reading ([EUE0024](#))
- 55 Scottish Centre for Carbon Storage ([EUE0078](#))
- 56 Scottish Renewables ([EUE0052](#))
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- 63 The Renewable Energy Association (REA) ([EUE0066](#))
- 64 The Scotch Whisky Association ([EUE0017](#))
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- 67 UKOnshore oil and gas (UKOOG) ([EUE0072](#))
- 68 University of Sussex ([EUE0034](#))
- 69 Valero Energy Ltd ([EUE0030](#))
- 70 Vattenfall ([EUE0074](#))
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- 72 Wedge Group Galvanizing Ltd ([EUE0015](#))

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The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

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