Impact of Brexit on the UK energy system – A statement from Durham Energy Institute
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The Durham Energy Institute (DEI) is making an urgent case for the UK Government to focus on energy priorities as part of the Brexit negotiations and decision-making process. The UK is already facing significant threats to the future security of the UK energy system which are likely to be enhanced by the uncertainties of the Brexit process.

This statement sets out some key issues the DEI would like policy makers to consider which have significant implications for UK Energy resilience and sustainability.

DEI forms part of Durham University. We nurture research on a wide-range of energy technologies including renewables generation (wind, solar, hydro, bio) and integration, smart grids, power systems and transmission networks, geo-energy, bio-fuels, and nuclear energy. Building on this expertise we emphasise a ‘Science and Society’ approach to energy which tackles the societal aspects of energy technology and explores the social, political and economic implications of technological developments (www.durham.ac.uk/dei/).

Summary of key points

The DEI is calling for a recognition that the UK is already facing significant threats to the future security of the UK energy system which are likely to be enhanced by the uncertainties of the Brexit process and we are calling for:

1. A consistent, long-term energy policy must be developed based on an open debate about whether the UK should aim to develop a more independent UK energy sector;
2. Increased investment in research and development for energy storage;
3. Increased emphasis on exploiting indigenous low-carbon energy sources, particularly heat and wind;
4. Incorporation of ambitious energy efficiency and energy demand reduction directives in to UK policy framework
5. A reset and push towards smart-grid development plans; and
6. Measures to safeguard collaborative developments in energy.

- The UK is increasingly reliant on external energy imports and non-UK players in the market. However Brexit has signalled a desire for greater sovereignty. What implications does this have for the UK energy sector? It is essential we have an open debate about how Brexit relates to energy and whether the UK should become more self-sufficient on energy.

- A long drawn-out Brexit process with little clarity on the direction of energy policy will have a significant impact on investments from the private sector which are so desperately needed if we are to ensure the UK energy system is resilient and fit for the future.

- Energy supply uncertainty is likely to be exacerbated by the decision to leave the EU. Whatever the final detail of the EU exit terms the UK will be more peripheral to EU energy markets which will mean higher prices and more unreliable supply. Also supply risks will increase around issues such as importing gas through subsea pipelines or electrical interconnectors linking UK to other EU countries.
The UK can no longer meet its own heat and power demands with indigenous supply. We are increasingly vulnerable to fluctuations in international supply of oil and gas and even the smallest change in energy imports could have a dramatic effect.

Properly exploring and investing in low-carbon indigenous energy sources such as heat networks and offshore wind will help us to meet our climate change and carbon reduction aims while also increasing our resilience in a post-Brexit world.

An increasing reliance on gas and renewables for electricity generation requires significant technological development and investment, particularly in the area of energy storage. An improved energy storage capacity will allow us to weather the increased uncertainties we face as a result of our greater reliance on energy imports and will enable us to increase the proportion of renewable generation in our energy mix.

Brexit presents an opportunity for us to ensure there is an increased UK policy emphasis on energy efficiency in buildings, industrial machines and electrical products. Significant reductions in energy demand have already been achieved through EU directives on energy efficiency. It is essential we continue and strengthen this commitment.

The Brexit process also seriously threatens to undermine efforts to develop a UK smart energy system. Research and technology developments in smart energy rely on stable partnership within the EU and the enhanced policy uncertainty triggered by the process is a further barrier to developing the smart system. This urgently needs to be addressed.

Achieving a resilient UK energy sector requires continued research and collaboration with European partners. It is therefore a priority to protect and support collaboration with EU partners on Research & Development and Demonstration projects and to identify ways to minimise the risks and barriers to collaborative working in the post-Brexit era.

**Full Statement:**

**Energy Resilience**

The Durham Energy Institute (DEI) is making an urgent case for the UK Government to focus on energy priorities as part of the Brexit process. On the 23 June 2016 the UK population decided to leave the EU. The long process towards identifying what a UK outside of the EU will look like has only just begun. There is still no clarity as to what structures or processes will be affected or the form of newly negotiated and implemented trade agreements, markets, legislation and regulations. However it is clear that we have entered a new period of enhanced uncertainty at a time when the UK energy system was already facing some major challenges and this could have significant implication for the resilience, sustainability and security of the UK energy system moving forward.

While the Brexit decision gives a clear message of a desire for greater sovereignty and control over our own UK structures, markets and legislation, it is still unclear what this means for the energy sector. Are we aiming for an independent UK energy sector? Do we want to reverse the trajectory we have been on for several decades of greater integration of energy markets internationally and a greater UK reliance on external energy sources and non-UK energy companies? Brexit presents an opportunity to stimulate an open debate on whether the UK should become more self-sufficient on energy and what implications this has for energy structures and energy policy.
UK policy towards the sector needs to recognise and address the risks and threats to secure energy supplies in a possible post-Brexit era. A secure energy supply requires: i) secure fuel sources, ii) adequate generation capacity, iii) well-developed infrastructure for frequency control, distribution and storage, and iv) a responsive demand-side. The UK is already facing challenges in all of the above areas, and energy supply uncertainty is likely to be exacerbated by the decision to leave the EU. We are therefore facing an increased risk of an energy crisis unless the Government actively addresses and mitigates these dangers.

The Changing UK Energy Landscape: An energy supply crisis looms

The UK can no longer meet its own heat and power demands with indigenous supply. In 2000 UK was self-sufficient in energy and as recently as 2004, the UK was a net exporter of energy, however by 2010, more than 25% of UK energy was imported\(^1\). Now our reliance on imports from Norway, interconnectors to western Europe and LNG shipped in from Qatar and now also the USA, has been increasing. It is currently unknown what type of deal will be agreed with the EU for trade relationships, however what we do know is that the UK is likely to have a weaker negotiating position for trading arrangements and be more peripheral to the markets. Not only will this mean higher prices for energy imports at a time when the pound is increasingly weak and our purchasing power has been reduced, but also an increase in the risks that the energy supply will not be available at times when EU members face difficulties meeting their own energy demands.

A global oil crisis is also on the horizon with the world currently relying on oil production from giant fields, many of which are in excess of 50 years old\(^2\). In short we are failing to find new oil at the same rate we are using it. As a consequence the world supply of light, easily accessible, oil is slowing down. Current low oil prices have all but killed off global exploration. In 2014 oil exploration companies added new reserves of 2.8 billion barrels, a 60 year low\(^3\) while in the same year 93 billion barrels was consumed\(^4\). Heavy oil, super heavy oil and tar sands abound (Canada, USA, Venezuela and elsewhere) and production of this could be increased but the environmental impact would be high and it would have significant implications for international climate change accords. From a global perspective, the situation for natural gas is much better but there is no true global market in gas, despite the growth in LNG shipping, and markets are largely regional and, for Europe, controlled by Russia.

We are currently highly reliant on Gas for electricity production, domestic heating and hot water. The increased consumption of gas has mirrored the decreasing use of solid fuels such as coal since the 1980s which has been shaped by its relatively lower carbon emission levels, the closure of UK coal industry\(^5\) and closure of coal-fired electricity plants. UK energy policy has signalled an intention to increase the UK’s reliance on gas for electric power as a lower carbon and more flexible means of generating electricity, that is able to respond much more effectively to changes in demand.

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3. HIS report (May 2016) conventional-discoveries-outside-north-america-continue-their-decl & Oil discoveries slump to 60-year low (8 May 2016) Financial Times [https://www.ft.com/content/1a6c6032-1521-11e6-9d98-00386a18e39d](https://www.ft.com/content/1a6c6032-1521-11e6-9d98-00386a18e39d)
more rapidly to changes in demand than conventional coal fired and nuclear generating plants can. Demand for gas is therefore expected to increase over the next 20 years\(^6\). For this to continue without interruptions of supply will require an increase in LNG capacity and storage, and development of stranded gas, tight gas and deployment of enhanced gas recovery in the North Sea. Although the UK Government has put a lot of emphasis on a UK shale gas revolution significant uncertainties remain over the extent of gas resources that would be accessible through fracking in the UK, and political conditions mitigate against extensive extraction on land.

If and when these crises do break the UK, working outside or on the periphery of EU energy markets, will likely be badly affected. The UK currently imports 5% of its gas through the interconnectors. The UK along with Germany and Italy also consumes more than half the EU's gas demand\(^8\). This means that we are increasingly vulnerable to fluctuations in supply and even the smallest change in energy imports could have a dramatic effect.

A renewed focus on indigenous energy supply is essential if we are to weather these increasingly erratic fluctuations. UK renewables capacity has increased significantly with new records set in December 2016 for contribution of wind generation to UK electricity. Onshore wind is now cheaper than coal and offshore wind has demonstrated game-changing levelised cost of energy reduction over the last 3 years, a process which continues apace. Solar energy has also seen a rapid growth fuelled by recent significant reductions in the cost of PV technology. However the future of renewables is uncertain within current policy frameworks. The continued growth in renewable energy deployment and cost reduction are delivering UK energy sector resilience and helping the UK to realise its sustainability ambitions. However this also means increased variability of supply and therefore Capacity Markets rely on electricity from Europe to deal with the inherent fluctuations in both supply and demand. Further development in renewable energy must therefore be coupled with developments in energy storage technology and internal capacity as well as improved demand response mechanisms.

Energy priorities for the Brexit process

There are a number of ways in which UK energy policy could mitigate against this increased risk and uncertainty arising from Brexit, to ensure we have a resilient energy system.

1. **A consistent, cross-party, long-term energy policy must be developed.** It is now widely recognised by industry, HEI and public sectors that the biggest barrier to future investment and innovation is the lack of consistency in energy policy. Lack of policy consistency about subsidies, taxes and prices translates into uncertainty and in turn into lower investments and higher cost of capital\(^9\). DEI research on attitudes to investment in Renewables technology indicates that a key barrier to investment is uncertainty in

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\(^7\) International Energy Outlook 2016 [https://www.eia.gov/forecasts/ieo/nat_gas.cfm](https://www.eia.gov/forecasts/ieo/nat_gas.cfm)

\(^8\) Europe's declining gas demand trends and facts on European Gas consumption [https://www.e3g.org/docs/E3G_Trends_EU_Gas_Demand_June2015_Final_110615.pdf](https://www.e3g.org/docs/E3G_Trends_EU_Gas_Demand_June2015_Final_110615.pdf)

Government long-term planning\textsuperscript{10}. Ageing infrastructure combined with a reluctance to invest does not bode well for UK energy independence. The decision to Brexit has been strongly driven by a desire for greater sovereignty and it is essential that a debate is opened as to whether we also want this greater sovereignty to apply to UK Energy. Is achieving UK energy independence and greater self-sufficiency an objective for the UK? How can this be achieved through a clear, coherent and long-term energy policy?

Green agenda, Green Deal, Solar Feed in Tariffs, Onshore wind energy subsidies and plans for CCS are all examples of policies introduced and then removed within shortened timescale. The recent reduction in support for solar PV has seen installations hit a six-year low in the third quarter of 2016\textsuperscript{11}. The UK has made impressive strides towards cutting its carbon emissions from electricity production, which are now at their lowest level since 1960, and on increasing the penetration of renewable generation within the energy mix. However these advances are due to a long line of historical policies which have recently been undermined. The recent withdrawal of Government support for renewables, CCS and efficiency, and lack of clarity on support moving forward, means an uncertain future for secure, low carbon energy.

Exit from the EU can be seen as an opportunity to introduce ambitious country-level goals and ensure that they are consistently introduced over the long-term. However, it would be damaging to introduce ambitious energy policies and then withdraw them shortly afterwards. Consistency and long-term stability is key if industry buy-in and long term investment are to be realised. The recent Autumn statement did not give energy the focus it deserves and did little to reassure the industry to encourage the new investment that is now desperately needed. The long lead-time being taken to define the Brexit process and understanding its implications will increase this uncertainty significantly.

A coherent energy policy which incorporates sustainability, security and affordability must be introduced with a lifetime of several decades to ensure the investor confidence and support the required innovations in technology, needed in the UK. It is essential to ensure that the Energy Policy has credibility and is insulated from other policy adjustments by politicians, so that the set time period will not be tampered with and a clear future direction is secured.

2. Energy storage: increased investment in research and development.
Technology development has been advancing for various forms of energy storage. However, significant intervention at the state level is needed to reach the scale of storage required to make our energy system truly resilient and low-carbon. Energy storage on a localised level will enable us to increase distributed electricity generation, reduce demand pressure at the national level, reduce fluctuations in supply and lessen our reliance on emergency energy imports and fossil fuels.

We are heading towards an increasingly electric future e.g. the electrification of transport, and a significant increase in electrical battery storage will be required to meet the increased demand from EVs, households appliances etc. Increased storage capacity is also essential if


\textsuperscript{11} Solar Media Ltd data UK solar hits near 6 year low as q3 deployment falls to reach 100mw (Solar Power Portal) http://www.solarpowerportal.co.uk/blogs/uk_solar_hits_near_6_year_low_as_q3_deployment_falls_to_reach_100mw
we are to continue increasing the proportion of renewable, distributed generation within the UK system. More storage facilities for LNG within the UK will also be required to cope with the increased reliance on LNG imports that we are facing and to mitigate against disruptions to supply resulting from political and social turmoil.

Interventions are required to support the development of a range of enhanced storage solutions to meet the range of energy storage needs (battery storage, hydrogen storage, compressed air storage, reservoir storage, salt storage, thermal storage, gas storage); and to build the energy storage infrastructure required locally and nationally. It is innovative energy storage that have the greatest potentials for transforming our energy system. This could be achieved through direct investment in R&D, subsidies or by indirect market mechanisms such as requiring energy suppliers to implement a certain level of storage and tax breaks for companies who introduce storage. However, it is essential, whichever policy interventions are chosen, that they are consistently applied over an extended period.

3. **Emphasis on exploiting indigenous low-carbon energy sources, particularly heat and wind.**

45% of all UK energy requirements goes towards heating and the vast majority of this is provided by gas and oil. In 2015, fossil-fuelled boilers generated 88% of domestic space and water heating\(^\text{12}\). This demand for heat could be met in part by developing renewable heat systems to offset the use of conventional fuels for electrical energy generation. By investing in innovative heat solutions the UK could significantly increase its resilience by reducing its reliance on external energy sources and lowering its carbon consumption, helping to meet the countries climate commitments.

Heat networks and sources (including geothermal\(^\text{13}\), industrial waste heat, heat from abandoned mines, solar thermal, heat from sewage etc) have the potential to be a significant part of the future energy mix in the UK: carbon-neutral, home-sourced, sustainable and reliable sources of heat which can help UK become more self-sufficient and resilient with respect to energy. These are proven technologies that have great potential for implementation in the UK.

Current UK Government initiatives to encourage development in the UK of this sector have not gone far enough. There are examples from other countries, such as Denmark and the Netherlands, which the UK could and should learn from. The one area of notable success for the UK is the deployment of wind power on the national grid. This can now contribute up to 20% of the generating capacity needed to meet electricity demand on high wind days. The UK currently has more installed offshore wind capacity (>5GW) than any other country in the world. A statistic that we should take national pride in, but which is rarely reported in media communications. The UK’s future growth plan for offshore wind is ambitious with the forthcoming development of the Round 3 sites. DONG Energy’s development of the first phase of the Hornsea Round 3 site will see the world’s first GW scale wind farm deployed in UK waters within the next few years. This transformative ambition needs to be incentivised in other areas of the UK’s indigenous potential low-carbon energy sources, if the country is to meet its future carbon reduction targets.


\(^{13}\) DEI has helped to develop BritGeothermal: a UK-based consortium established as a focus for deep geothermal energy research both in the UK and globally. http://www.britgeothermal.org/
Other indigenous low-carbon energy sources that are currently un/under-used in the UK and should be exploited to increase our energy security include tidal energy (rivers, lagoons, undersea), and residual gas (comparatively low carbon compared to other fossil fuel sources).

4. **Incorporate ambitious energy efficiency and energy demand reduction directives into UK policy framework.**

A clear concern arising from Brexit is the danger that we will lose the impetus of EU directives on energy efficiency. Current targets for a 20 per cent improvement in energy efficiency and mechanisms to increase energy efficiency in products are key examples. These initiatives have been credited with the significant reductions in electricity demand we have seen over the past 10 years. The EU has also been important in encouraging UK legislation and action to improve energy efficiency in buildings. For instance through the Energy Performance of Buildings Directive 2010 and Energy Efficiency Directive 2012 ambitions for all new buildings to be nearly zero energy by end of 2020 and obligations on companies to carry out energy audits. Improving energy efficiency of our buildings in the UK would lead to a reduction in energy demand, as well as a reduction in fuel poverty. This is made even more urgent by projections which see domestic sector energy demand set to increase the most over the next 20 years. Energy efficiency is therefore key to ensuring UK energy security and resilience.

Industry is one of our major users of Electricity with industrial electric motors accounting for more than 60% of all electrical energy consumption in the UK. So there is clearly much room for improvement in this area. European Commission Regulation 640/2009 and directive 2005/32/EC – based on the IEC standard 600034-30 – established a framework for the setting of eco-design requirements for energy-using products. The more efficient use of energy in these machines and in industry will contribute substantially to reducing overall consumption and greenhouse gas emissions.

It is essential that new policy instruments are considered at the national and international levels to maintain or increase these ambitions for energy efficiency. The Brexit process provides policy makers with the opportunity to identify areas in which the UK could become more ambitious than current EU directives, however there is also the danger that pressure from energy industry and construction sectors to reduce regulation and increase competitiveness, may severely curtail the UK’s ambitions in this area.

5. **A reset of and push towards smart-grid development plans**

The aim of smart grid development is to enable efficient delivery of sustainable, economic and secure energy supplies to consumers and is therefore a crucial component for building the resilience of our energy system. The roll-out of smart meters provide a good foundation for smart grid development, although the initial investments of smart meters have not been as effective as they may have been due to indecision at the policy level. To exploit the full potential, the next step must be on making full use of smart meters and ensuring they enable more flexible user interaction within the energy system. Recent research and development on energy systems and smart energy, such as H2020 SmarterEMC2 project (where UK

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University and Industry play key roles) as well as the new UK Research Funding Council's investment in the National Centre for Energy Systems Integration (CESI), promise significant improvement and are testing a range of innovative technologies.

Research in this area will enable us to reassess early assumptions about what smart grids might offer, the means by which load and supply may be managed more effectively, how to motivate consumers to modify behaviours and therefore demand to make power systems more efficient, and how to exploit meter data and measurement data to make better decisions at both market and operational levels. More research is needed on the interaction between demand and supply and the implementation of ICT infrastructure and systems to control demand. This would require a full range of research and development activities including home electronics, advanced metering infrastructure, intelligent data mining, ICT, and new energy market design.

In abandoning its membership to the EU, the UK might isolate itself from various European Research & Development funding streams such as H2020 LCE and LEP funding, and also lose the opportunity of sharing best practice from smart grid deployment trials. During 2014-2020 alone, the EU allocated £1.6bn of funding to incentivise the development of smart grid technologies and their integration with energy storage. With Brexit, UK Universities and Industry are in danger of losing this opportunity. Even with the Government's compensation promise, the majority of collaboration chances will be lost, as they rely on long-term sustainable partnerships with EU partners. An even more serious issue is that the initial investment in smart metering will not be as effective as it should be, because their advanced functionality is based on running demand response programs. This is an area in which the UK largely relies on the EU to stimulate the appliance industry through common EU Standards.

Questions also remain about the legislative integration of different parts of the UK, and uncertainty over investment in grid-reinforcement for distributed generation is a major obstacle in the development of a balanced low-carbon system. Longer term, consistent policy is again a key ingredient for ensuring that appropriate future investments are secured.

6. **Measures to safeguard collaborative research.**

Collaborative Research & Development and demonstration projects through EU partnerships in the energy sector have been pivotal for the UK over many years. This needs to be protected. The UK is only second to Germany in benefiting from EU funding in research and innovation. Mitigating the risks brought about by Brexit in this respect isn’t just about replacing EU funding for research, development and demonstration projects with funding from UK Government, EU membership also acts to reduce barriers and risk for scientists, engineers and entrepreneurs whilst also acting to drive ideas through to full commercial deployment. It is essential that mechanisms are put in place that allow UK research institutions and industry to continue to engage in collaborative pan-European research programmes and projects.

It is essential that the UK maintains its position as a research centre of excellence for energy systems development post-Brexit and that systems are put in place to encourage the innovations needed to make the UK energy system secure and sustainable into the future.

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19 Electricity Networks & Storage (EN&S) Summary Report, Technology Innovation Needs Assessment (TINA), Low Carbon Innovation Coordination Group
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