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The potential impact of Brexit on Scotland's renewable electricity ambitions

Peter Zeniewski, University of Edinburgh

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Summary

Scotland's draft Energy Strategy contains an ambitious effort to reach a 50% share of renewables in 'all energy' by 2030. One of the main enablers of this transformation is to maximise Scotland's renewable power generation potential. The Scottish Government's goal is to generate 100% of gross electricity demand in Scotland from renewables by 2020, along with the complete decarbonisation of the electricity sector by 2027. This will require more than double the current installed capacity of renewable energy.

The UK's departure from the European Union looms large as an uncertain backdrop to Scotland's ambitious decarbonisation strategy. In this research report we consider the extent to which Brexit poses a risk to renewable electricity investment in the UK – and Scotland in particular. Our analysis reveals that, while the risk of a change in overall energy policy direction following Brexit is relatively small, the UK's future access to EU-based finance, R&D, and skilled labour in the renewable energy sector remains far from assured. There are some limited opportunities for the UK to benefit from Brexit, by enabling autonomy in pursuing bilateral low-carbon trade agreements and tailoring support for selected renewable energy technologies. However, the trade-off will be a loss of influence over the EU's policy-making institutions as the UK moves to rule-taking, observer status, as well as a risk of restricted access to the single EU energy market as a consequence of regulatory divergence, particularly around state aid rules.

The implications of Brexit for investment in the UK's renewable energy supply chain are uncertain, as much will depend on the broader terms of departure and the future relationship with the EU, which remain unclear. For Scotland, its primary exposure in the medium term lies with its substantial pipeline of on- and off-shore wind projects. The terms of Brexit may translate into reduced access to low-cost financing for these projects, the imposition of tariff and non-tariff barriers on low-carbon goods and services, reduced access to a skilled pool of labour, as well as more limited entitlements to European public funding for Research & Development. At the same time, however, there are positive signs that European utilities remain committed to developing the UK's domestic supply chain; we consider recent inward investment flows and record low auction prices for delivering offshore wind energy as encouraging signs of industry resilience.

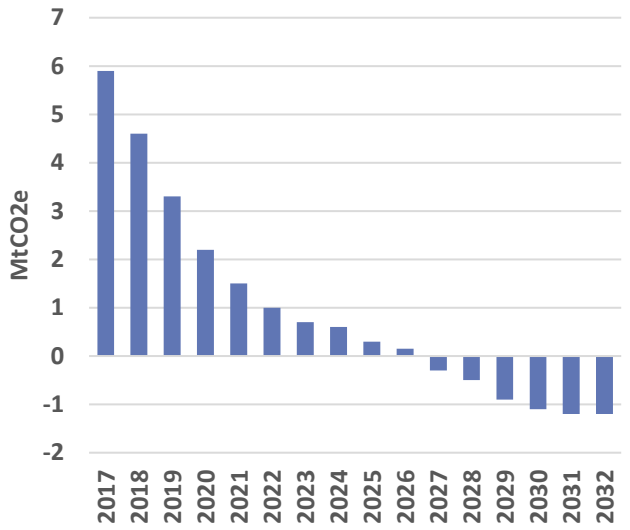
While the Scottish government has relatively few instruments at its disposal to address Brexit-related risks unilaterally, the report concludes by making some recommendations for actions which could mitigate the potentially adverse consequences of Brexit.

Introduction

1. Renewable power in Scotland

Over the past 15 years, Scottish renewable electricity output has quadrupled. According to the Office for National Statistics (ONS), the renewable energy sector in Scotland supported 50,000 FTE jobs in 2015 and generated almost £8 billion in turnover. Currently, the main driver of decarbonisation is the electricity sector, and the main contributor to this is wind power. Onshore wind activity generated £3 billion in turnover in 2015, taking a 14% share of total employment in the renewable energy sector. The draft Scottish Energy Strategy points to the need to accelerate heat and transport decarbonisation and to stimulate investment in less well-established low-carbon technologies such as carbon capture and storage (CCS), hydrogen or marine/tidal. However, as Figure 2 shows, the medium-term project pipeline is dominated by wind, with around 4 GW of onshore capacity already consented and a further 2.8GW in planning, as well as nearly another 4 GW of offshore wind awaiting construction. By contrast, just under 400 MW of wave and tidal projects are either in planning or already consented.

Figure 1: Scottish electricity emissions targets (draft Climate Change Plan)

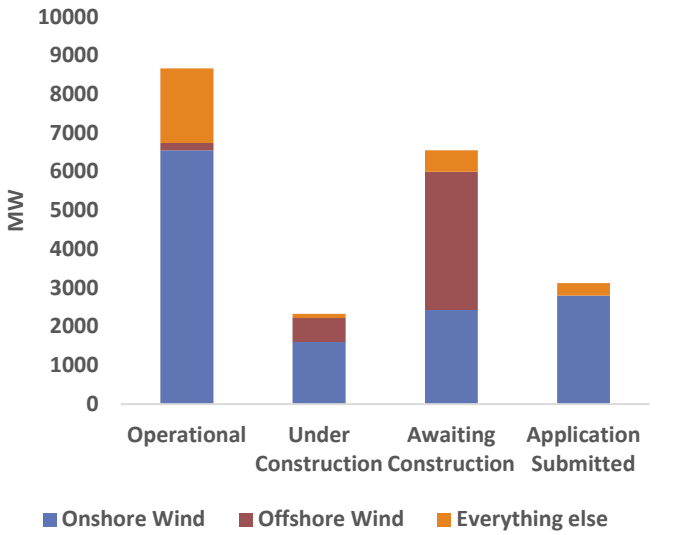


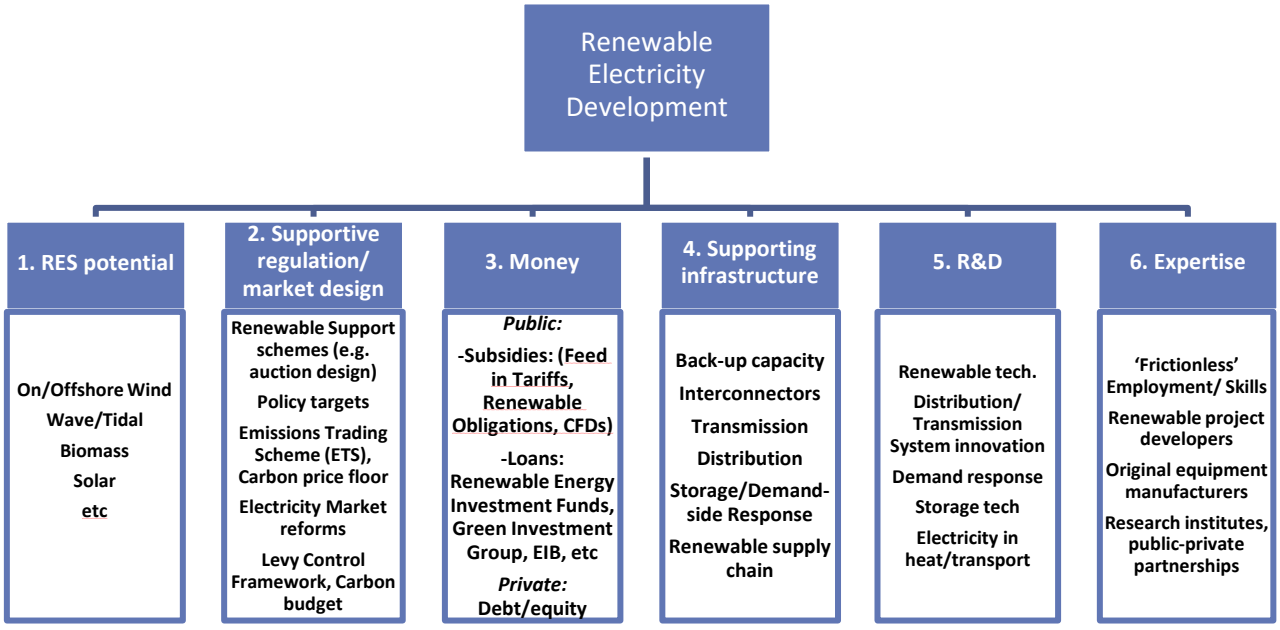
Despite all the headwinds facing the industry, with the early termination of Renewables Obligation support for onshore wind and its exclusion from Contract for Difference (CfD) auctions, projects continue to come forward. 1 GW worth of onshore wind projects in Scotland have been submitted for approval since the end of renewables obligation subsidies. 300 MW have been submitted since the 1 April 2017 'grace period' deadline, similar to the four-month period from April-July 2016. It is too early to tell but we are perhaps seeing the first signs of subsidy-free onshore wind investment in Scotland.

To continue to bring forward renewable electricity projects, Scotland and the rest of the UK need a good supporting architecture. This requires finance, expertise, regulation and market design, sufficient infrastructure and a commitment to foster research and development. Weaknesses in any one of these areas will challenge the integrity of the whole edifice.

To what extent do each of these pillars rely on EU membership? Happily, Brexit won't take away the UK's sunshine, or cause the wind to stop blowing, or the tides from coming in. But what about policy and regulatory risk? Or private and public money for project development and R&D? We explore some of these issues in the following sections.

Figure 2: Renewable electricity projects in Scotland (source: BEIS)





2.2 A supportive regulation and market design for renewables post-Brexit?

How much of the Scottish/UK/EU energy policy architecture is aligned? Even to begin untangling the various overlapping levels of energy governance and policy across multiple sectors and issues is a fiendishly complex undertaking, one which will not be attempted here. It is worth noting, however, that the Scottish Government has a limited set of competencies related to energy; most energy matters are reserved to the UK-wide Department for Business, Energy and Industrial Strategy (BEIS). In discussing potential policy impacts of Brexit, a UK-wide perspective should remain the default, although there are clearly areas where Scotland's policy priorities differ from the rest of the UK, and this will be highlighted in the subsequent analysis.

Holyrood's competencies extend into the promotion of renewables, community energy projects, efficiency and fuel poverty policies, and consenting for power generation and transmission investments. While deference and/or adaptation to EU policies are evident in some of these areas (e.g. Directive 2012/27/EU on energy efficiency, or Scottish Power/Scottish Hydro's respective derogation from unbundling rules), in the majority of cases the Scottish Government's policy documents consider the EU energy and climate policies to be a basis from which to build more ambitious targets, policies and support systems.

This is borne out by the Scottish Government's latest policy initiatives, the draft Climate Change Plan and the draft Energy Strategy, both of which consider EU membership to have been highly beneficial to the country's low-carbon ambitions. In the draft Climate Change Plan the Scottish Government has explicitly declared its support for EU climate policies and its preference for remaining within the single market, *even if* the UK as a whole opts to leave. The Scottish Government has also sought to minimise any disruption from Brexit on the UK's overall climate policy ambition. It is in this context that the draft Energy Strategy declares "the European internal energy market is vital to delivering affordable energy and to driving decarbonisation and investment in renewables. EU legally-binding renewable energy and energy efficiency targets have played a defining role in stimulating the huge growth in renewable energy in Scotland, which has seen significant inward investment flows."

The Conservative Government in Westminster appears a touch less enthusiastic about the benefits of EU membership in the area of energy. Despite the UK Parliament's recommendations that the country remain in the internal energy market, the UK Government's Industrial Strategy Green Paper makes no mention of the UK's participation in the single market, nor discusses any provisions for the UK's cooperation with EU institutional, financial or market actors in the area of energy following Brexit. The government's 'red lines' in its negotiating principles reject any role for the European Court of Justice, which effectively closes off the UK's membership not only in the single energy market, but also Euratom and the Emissions Trading Scheme.

Despite the Westminster Government's overtures toward a 'hard' Brexit in energy, a rollback in the UK's national low-carbon energy policies is unlikely; both Scotland and the UK's support instruments and its market rules are institutionally embedded in a national policy framework that is likely to endure after Brexit. UK-wide public interventions to support the renewable energy eco-system, such as the Capacity Market, Contracts for Difference, the Carbon Budget, and the Levy Control Framework are all underpinned by the UK Climate Change Act 2008 and the electricity market reform delivered by the Energy Act 2013. The UK is bound by these acts and its provisions, many of which are independent from, or go beyond, EU requirements: the fifth carbon budget commits the UK to a 36% emissions reduction by 2020 and 57% by 2030, relative to 1990 levels. This goes beyond the EU-wide target of 20% by 2020 and 40% by 2030. As set out in Westminster's new Clean Growth Strategy, "leaving the EU will not affect our statutory commitments under our own domestic Climate Change Act and indeed our domestic binding emissions reduction targets are more ambitious than those set by EU legislation."

However, the UK is also bound to the provisions of the EU's *acquis communautaire*, the accumulated body of EU law and obligations since 1958. In the energy chapter (15), this spans well over two hundred Regulations, Directives, Decisions, Conventions and Treaties setting out common rules and obligations for EU member states. These range from competition policies and state aid rules to provisions for developing the internal energy market, promoting renewable energy sources, improving energy efficiency, as well as safeguarding nuclear materials. This legal corpus is the sum of decades of continuous cooperation, negotiation, and incremental improvements in the way Europe produces, buys, sells, transports and consumes energy. To this, an environmental acquis (Chapter 27) contains an equally long list covering areas such as waste management, water and air quality, biodiversity, industrial pollution control, and chemical regulations.

Currently, the UK is deliberating a 'Great Repeal Bill' which will transpose the entirety of EU legislation – by some estimates over 80,000 items – into the UK's statute book, in order to prevent legal disruption and uncertainty following Brexit. But this is a highly complex undertaking, throwing up a number of hurdles, from broader questions around the authority of the European Court of Justice in enforcing the provisions of various EU acts to the minutiae of article-specific provisions, delegations, obligations, derogations, and exemptions. For the electricity sector, for example, EU law obliges the UK to uphold non-discriminatory and transparent provisions in the design of subsidy schemes; maintain vertical unbundling of generation and transmission; comply with network codes concerning cross-border capacity allocation; and submit transparency data and information on market functioning. The EU's competencies around compliance in these areas (ranging from powers to launch infringement proceedings, to various roles in certification, monitoring and verification procedures) will need to be unpicked and transferred to UK bodies, many of which do not currently exist.

On the other hand, there are numerous instances where the UK has acted in favour of open, competitive energy markets and climate-friendly policies despite the absence of any EU legislation compelling it to do so. For example, the UK was the first country to include interconnectors in its capacity market. The steady erosion of coal from the electricity mix is a result not just of the EU's Industrial Emissions Directive but also the UK's unilateral carbon price floor. The UK Government's desire to phase out coal in power entirely by 2025, or to ban petrol and diesel cars and vans by 2040, are national pledges that are additional to the common EU efforts to reduce carbon emissions. Scotland is arguably ahead of the rest of the UK in some of these efforts; the last coal-fired station, Longannet, closed in mid-2016, while the Scottish National Party-led government has recently declared an ambition to phase out new petrol and diesel vehicles by 2032. Even before the UK's proposed phase out, Scotland's draft Climate Change Plan envisioned a concrete target of a 32% reduction in transport emissions within the next fifteen years. Regarding the EU's Emissions Trading Scheme, which is a cap and trade EU-wide system for buying and selling carbon emission allowances, around 40% of Scotland's territorial emissions rely on this trading mechanism. The draft Climate Change Plan states that the ETS cap "delivers a 43% reduction on 2005 EU emissions levels by 2030 and we will argue for a share of that cap in line with meeting Scotland's domestic ambitions."

UK access to the single energy market is the key uncertainty

Thus, in many ways there is already strategic alignment between the EU and Scotland and the UK on most aspects of energy policy; in fact the key variance is in the level of ambition in supporting renewable energy, rather than a fundamental divide over its desirability. Ultimately, there is no particular interest on either side to diverge from the principles, policies, investments and relationships that are currently in place. Regardless of the UK's eventual inclusion or not in the EU's single

energy market, therefore, there is a common interest in the continued regulatory alignment of low-carbon energy policy and the continued trade in low-carbon goods and services (even despite question marks over the UK's future membership in the Emissions Trading Scheme and bodies such as Euratom).

A Chatham House report explores the various models for cooperation with the EU that the UK could adopt following Brexit; these range from a reversion to World Trade Organization (WTO) rules to more specific "Canada", "Norway" or "Swiss"-style arrangements, in addition to various institutional options, such as membership in the Energy Community. Some have signalled that even if the UK had to operate outside the single energy market, there would be no real cause for alarm - non-members like Norway are well integrated into the EU's energy sphere both physically and in regulatory terms. Moreover, some advantages would accrue to the UK in the process: potentially unencumbered by the EU's state aid and competition rules, there would be more freedom to selectively support sectors or technologies that could give the UK a competitive advantage in Europe. With agricultural emissions not currently explicitly addressed by the EU's Common Agricultural Policy, the UK could potentially tie future nationally-determined subsidies to environmental performance. Similarly, the EU has controversially imposed high tariffs on Chinese solar panels as an anti-subsidy and anti-dumping measure, which the UK would potentially be free to remove in order to attract low-cost solar equipment. Some have argued that the UK could impose a border tax on the carbon content of electricity imported from the EU, to level the playing field between domestic generators paying a carbon price floor and EU-based electricity suppliers which do not.

There are, of course, trade-offs if the UK decides to pursue unilateral opportunities in opposition to the provisions of the single energy market. For example, withdrawing from the EU's state aid rules may end up costing the UK access to the European Union's single market or expose it totariffs, whilst endangering its existing cross-border energy trade, to say nothing about its involvement in future cooperation agreements. Indeed, the UK's participation in the single energy market provides a wide range of benefits, such as tariff free access to the goods and services required by the renewable energy supply chain; access to EU public funding and European Investment Bank (EIB) loans; participation in the EU's emissions trading scheme; ability to shape the rules governing cross-border electricity trading; relatively frictionless access to a large pool of skilled labour - the absence of which, according to a recent survey, is already proving to be a bottleneck to the UK's renewable energy industry.

The marginal opportunities for the UK to set its own tech-specific rules or introduce its own set of standards/regulations would be greatly offset by the loss of the UK's voice in European energy policy, as it would essentially move from a rule maker to a rule taker. Outside the single energy market, the UK could theoretically remain a member of important independent European bodies such as the European Network for Transmission System Operators for Gas and Electricity (ENTSO-E and ENSTO-G). But it would lose its membership privileges in the Agency for the Cooperation of Energy Regulators (ACER) – Europe's agency for energy regulators, which is becoming increasingly important in deciding on the rules of the game for energy flows across Europe. Similarly, the loss of rights in the European Council, Commission, and Parliament will mean the UK loses its ability to shape the direction of EU energy policy. This is not just a loss for the UK, but also for the EU27, given the UK's pioneering role in liberalising energy markets, lobbying for a continent-wide emissions trading scheme.

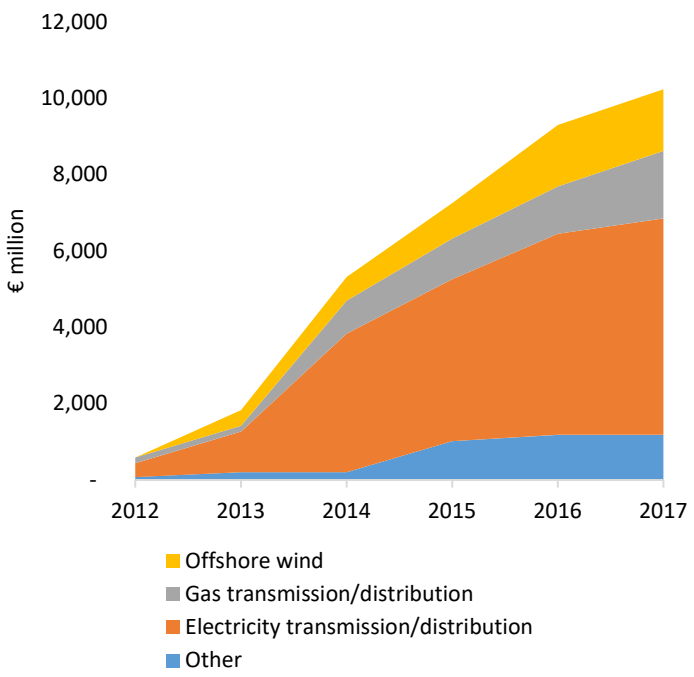
There are many other uncertainties that will impact on the overall landscape for electricity investments which will only be resolved once the UK's access to the single energy market - and its associated adherence to the European Court of Justice (ECJ) – is known. This will emerge in both national as well as regional contexts. For example, the Irish single electricity market project (I-SEM) relies on a slew of EU-level common electricity market rules, mainly the provisions of the Third Energy Package but also the EU's new 'Winter Package'. This legislation provides for further integration of the Irish-Northern Irish market areas; any risk of tariff imposition following Brexit would severely impact on the security and affordability of electricity in both markets, but particularly the smaller, more isolated market of Northern Ireland. In the case of Scotland, its receipt of EU funding for innovation is a key driver of low-carbon projects, a focus of the next section.

2.3 Is it all about the money?

Renewable projects are just one part of a much wider set of investment requirements in UK energy infrastructure over the coming years. Estimates are that the UK will require £275 billion of new energy infrastructure by 2021 to replace existing plant and upgrade the network, or around £55 billion per annum. Overall, foreign direct investment, much of which comes from other EU countries, provides about 40% of all financing for UK energy infrastructure.

One of the largest sources of external public funding for the UK's energy transition is the European Investment Bank (EIB). The UK is one of the primary recipients of EIB loans, having been provided nearly €40 billion since 2013. In theory the UK can continue to access certain types of EIB loans after Brexit, but it would be excluded from the Fund for Strategic Investment and other initiatives, like Project Bonds. For those who are optimistic about UK access to EIB funding after Brexit, it is worth noting that only around 10% of the EIB's lending goes to non-EU member states. By contrast, as a member the UK has to date received 14% of *total* EIB lending. This would mean the UK would have to fill a funding gap by other, potentially costlier means, which would raise the overall cost of capital in the market. Given that the energy sector is particularly capital intensive and going through a period of investment in new infrastructure, an increase in financing costs could have a significant impact on overall consumer bills. This will be further explored in an upcoming independent review for the government on energy prices.

Figure 3: EIB loans to UK energy infrastructure projects



In the case of Scotland, its energy sector is a recipient of European bank loans, grant funding and other forms of financial support for innovation, research and development of clean energy technologies. As noted by a Scottish Government document on Scotland's place in Europe, the EIB has awarded funding to Scottish marine pilot projects such as MeyGen phase 1B and the Sound of Islay (€37.4m), as well as a £525m loan to support the construction of the Beatrice offshore wind farm in Outer Moray Firth – the largest EIB loan for an offshore wind project. Horizon 2020 funding of €10m has also been awarded to Scotrenewables Tidal Power for its Floating Tidal Energy Commercialisation (FloTEC) project. European Structural and Investment Funds are also a source of co-financing for Scotland's Low Carbon Infrastructure Transition Programme (LCITP), providing match funding for investments in low-carbon infrastructure programmes and sustainability initiatives over the period from 2014-2020. The LCITP has directly awarded more than £43m to such projects. EU Cohesion funds supplied match funding for the European Marine Energy Centre (EMEC) in northern Scotland, of around £7million. While funds already committed are unlikely to be affected by Brexit, future funding is far less clear. New sources on the horizon, such as the ETS Innovation Fund, may be out of reach post-Brexit.

2.4 The EU's role in UK clean energy Research and Development

The development projects above have also variously benefitted from EU R&D funding, either directly or indirectly. From 2014 to mid-2017, the EU's Horizon 2020 support scheme has awarded UK research institutions the status of 'lead coordinators' in €380m worth of grants related to energy and climate innovation. The UK is a partner in Europe-wide research projects worth an additional €600m. Overall, at least one UK research organisation is either a coordinator or a partner in about 60% of all Horizon 2020 funding made available for energy and climate research.

HM Treasury has guaranteed to underwrite the payment of Horizon2020 awards made before the UK's exit in March 2019. Future participation as a non-EU member is also possible. In fact, Norway is the ninth largest recipient of H2020 funding in climate and energy science (~€100m). However, by contrast the UK is currently the second largest recipient in this area,

leading projects worth four times this amount. The level of access to H2020 funding post-Brexit, therefore, is expected to decline significantly.

Figure 4: UK Energy R&D national expenditure (excl. EU)

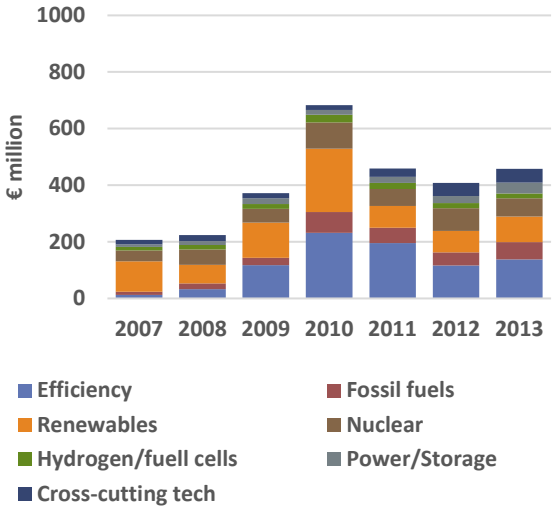
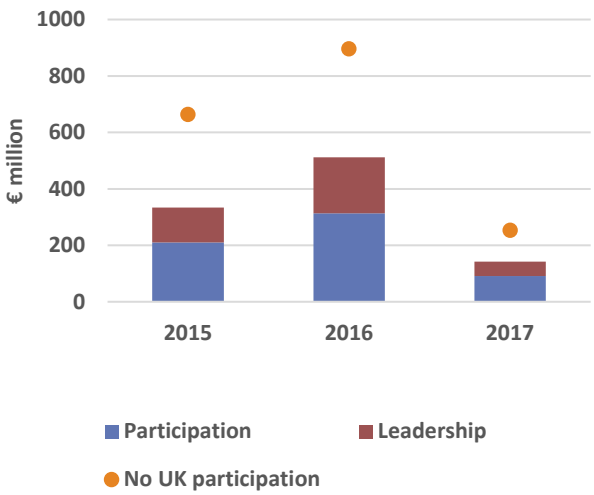
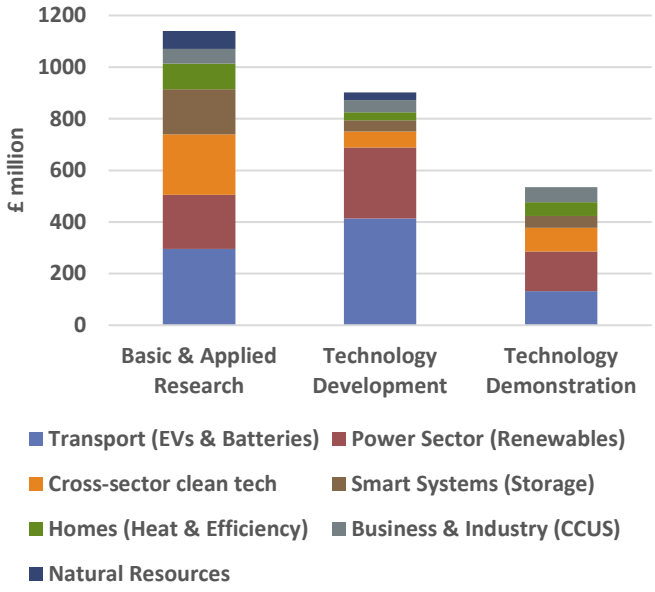


Figure 5: UK participation in Horizon 2020 energy & climate projects



How does this compare with the UK's national R&D budget in the area of energy? The IEA's figures on public energy Research & Development and demonstration, which includes only federal government and state-owned company budgets, estimates UK investment in low-carbon tech peaked in 2010 before falling to a level around €450m in 2013, the last year for which data is available (figure 4).

Figure 6: UK Clean Growth Strategy spending commitments, 2015-2021

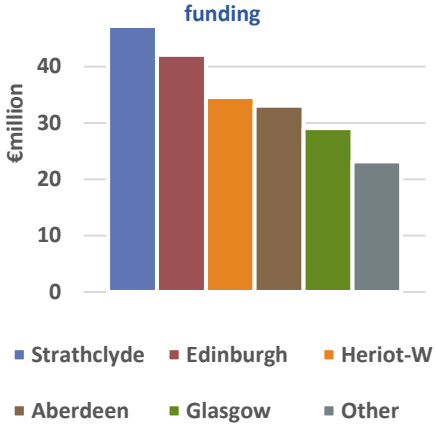


The UK's Industrial Strategy and the new Clean Growth Strategy recognise some of the funding gaps and challenges for energy innovation. A top up to the overall R&D pot of £4.7 billion by 2020-21 has been announced in the Industrial Strategy. On energy innovation in particular, the new Clean Growth Strategy details the UK government's spending commitments on low-carbon innovation, allocating around £2.5 billion over the period 2015-2021, nearly 60% of which will go toward low carbon transport and power sector technologies. Indeed, the bulk of initial funding has been reserved for ultra-low carbon vehicles, in particular battery technologies: the 'Faraday Challenge' will invest £246 million in battery technology over the next four years. There are signs that the UK may be moving toward a supply-side, selective industrial policy akin to selecting technology 'winners.' This sits uneasily with the EU's general state aid guidelines as well as those specific to energy.

Overall, the European Union's framework for R&D funding for energy and climate research is not just about the absolute amount of money received, but also the network-building, partnerships and cooperation across European institutions that underpin these projects. This generates social, cultural and political capital that gives the UK and its partners in Europe a global competitive advantage. Several Scottish universities have publically voiced these sentiments: figure 7 gives an indication of the value of their partnerships in Horizon2020 energy R&D since 2014.

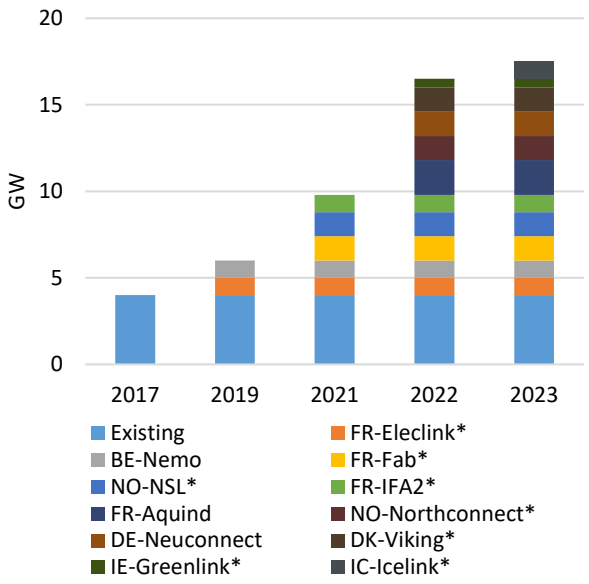
2.5 Staying connected with Europe

Figure7: Scottish universities as project partners in Horizon2020 energy & climate funding



EU EIB, Regional & Development Funds, and Horizon 2020 are not the only source of finance for low-carbon initiatives in the UK. The EU also has a funding framework in place for so-called 'Projects of Common Interest', or PCIs. Projects accorded this status qualify for financial assistance from the Connecting Europe Facility (CEF), a €5.4b fund for use between 2014-2020. Thus far, six UK electricity interconnector projects have been awarded around €70m in funding from the CEF over the past three years to support pre-planning feasibility studies and development costs. Two of these projects, NorthConnect and Icelink, would connect Scotland's electricity grid with valuable balancing resources, in the form of Norwegian hydro and Icelandic geothermal energy. The 1.4 GW Norway-Scotland interconnector project, NorthConnect, was awarded up to €10.5m from CEF in February 2017. The second prospective interconnector, IceLink, hasn't received European funding, but its status as a Project of Common Interest makes it eligible for future CEF grants – at least while Britain formally remains a member of the EU.

Figure 8: UK interconnector project pipeline



*PCI projects with CEF funding

Cumulatively, interconnector projects in the pipeline will increase cross-border capacity four-fold over the next 5-6 years. As shown in Figure 8, there are 11 projects with a combined capacity of nearly 14 GW, at an estimated investment cost of £11 billion. These will link the UK to many previously unconnected neighbours, including Belgium, Norway, Denmark, Germany, and Iceland. Ofgem, National Grid and other UK bodies have commissioned several studies on the impact of interconnectors on UK consumer welfare and found that in most cases they provide benefit in the form of lowering wholesale prices, optimising power flows, enabling renewable integration, enhancing system management capabilities as well as security of supply.

These benefits rely, in part, on the UK's participation in EU-wide common rules on market coupling, which allows more efficient allocation of interconnector capacity between countries. The benefit to the UK from harmonised rules for trading electricity through market coupling was estimated by National Grid to be about £90m a year with current levels of interconnection, and up to £1bn per year if capacity doubles by 2020. Vivid Economics has considered how much the UK might stand to lose if some of the UK's planned interconnectors did not go ahead, estimating the impact up to £200m per annum as a result of the loss of liquidity, market coupling, ancillary services, higher capacity market prices, and higher wholesale power prices.

The business case for further electricity interconnection with the rest of Europe also requires clarity on the future regulatory model. Under current arrangements, Ofgem has put in place a 'cap and floor' model that reconciles the EU's

'regulated' model for interconnector investment with the UK's preference for a 'merchant'-based approach. Under this model, qualifying interconnector projects are guaranteed a minimum return (the "floor"), in exchange for setting a maximum return (the "cap") beyond which the revenues from the project are shared with British consumers.

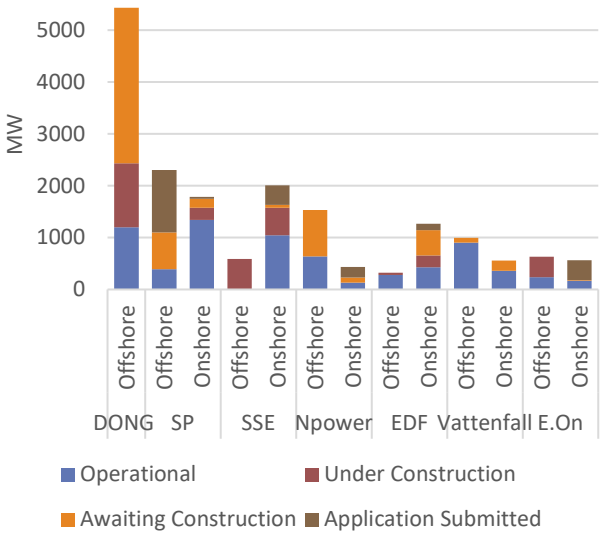
Should the UK exit the EU single energy market, the rules governing cross-border transmission capacity and investment would no longer apply, while operational practices enshrined by the EU network codes would no longer have direct effect. On the one hand, the UK would be free to develop interconnectors on a merchant basis, without having to worry about obtaining exemptions from EU rules about regulated returns on monopoly infrastructure. But the trade-off would come in the form of a lack of rule harmonisation between the UK regulator and its counterpart on the other side; indeed, there is already some uncertainty over whether one piece of infrastructure can be operated under two different regulatory models (the 'hybrid' cap and floor on the UK side and a 'regulated' approach on the partner side). Moreover, the future terms of use around interconnectors as the intraday and balancing markets evolve and are further integrated would be largely out of the UK's hands, so it could only observe from the side lines the eventual EU framework adopted in areas such as ancillary service valuation, implicit allocations and so on.

Further uncertainties are around the devaluation of Sterling and possible tariffs on electricity, depending on whether the UK has to revert to WTO rules, which will be considered in the next section.

2.5.1 A focus on the UK's renewable energy supply chain

The European Union's support for renewable technologies and electricity infrastructure are no substitute for private capital, which ultimately makes up the most significant share of investment in the UK's renewable energy sector. It is therefore worth exploring the profile and possible exposure to Brexit of the major utilities active in the UK renewable electricity sector.

Figure 9: Largest wind project developers in the UK



Six out of the seven largest renewable electricity developers in the UK are ultimately European utilities - Denmark's DONG, Spain's Iberdrola (which owns Scottish Power), Germany's Npower (owned by RWE Innogy) and E.On, France's EDF and Sweden's Vattenfall. A quarter of all renewable electricity supply (RES) projects in the UK (i.e. those that are either operational, under construction, awaiting construction, or consented) are owned by these 6 European utilities. In fact, SSE and Centrica are the only two firms in the 'big six' that are British, but only the former is active in the renewable energy space.

These utilities are above all focussed on developing wind power in the UK, which covers 96% of their total RES portfolio. They are the key enablers of future investment in offshore wind, particularly in Scotland where there is a project pipeline of 6 GW out to 2030. The draft Scottish Energy Strategy recognises that "there is huge optimism for further development of offshore wind in Scotland. Scottish waters remain open for business and the pipeline of development continues to grow." These projects are not only driven by larger utilities. Several tasks related to development, operation and maintenance are subcontracted to smaller companies. According to RenewableUK's supply chain database, there are around 1,400 small and medium-sized enterprises servicing the wind and marine renewable sector in the UK. Around 20% of these firms are located in Scotland, giving an indication of its relative importance in the national supply chain.

As the terms and conditions of Brexit become clear, multinational European utilities leading large-scale renewable projects will have to consider any possible divergences between UK and EU standards, rules on procurement, licensing of power trading operations, VAT changes, and so on. Many of these utilities issued stark warnings against a UK departure from the European Union, but have since claimed that Brexit is unlikely to significantly affect their business developments. Companies such as Iberdrola, Siemens, Vattenfall, and DONG have all variously sought to reassure shareholders that the

regulatory risks of Brexit are manageable, that currency devaluation has been hedged, and that investments planned before the 2016 referendum are likely to continue, if not enjoy further expansion.

In the absence of any certainty about a future UK/EU trading relationship, this general emphasis on 'business as usual' belies a far more fundamental choice about whether to locate supply chains inside or outside the UK. There are some encouraging signs in this regard, as the past few years has seen a trend towards greater shares of local content in the offshore wind industry. A Crown Estate study carried out in 2014 found that about 43% of total project costs were spent in the UK; a recent update to this report has now put the figure closer to 50%. Domestic strengths include substation and array cable fabrication, as well as operation & maintenance activities. Capital expenditure on offshore wind projects, on the other hand, is relatively low, with 97% of the turbines (representing around a third of total capital costs) imported from abroad. But there is significant investment anticipated in the sector. Examples of recent multi-million pound investments include DONG's decision to build a tower assembly facility at Campbeltown and to further develop its capabilities in the Humber, as well as Siemens' construction of a £310m wind turbine assembly and rotor blade factory in Hull. This, along with the record low CfD contracts awarded in September 2017 to two offshore wind projects (one in Moray East, a joint venture between Spain's EDRF and France's Engie), indicate that European utilities active in the UK consider the supply chain to be resilient and the supply/demand fundamentals underpinning their investment decisions (with tightening margins anticipated) to be robust, even in the face of numerous Brexit-related uncertainties.

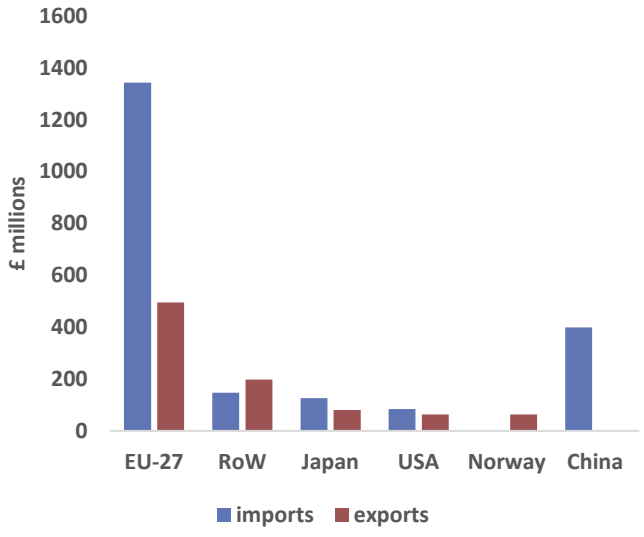
Another way of reading the current situation is that utilities have adopted a strategy of frontloading capital investment while the UK remains a member of the EU, thereby laying the foundations for a robust domestic manufacturing industry that can insulate itself from exposure to potentially higher future trade costs. In doing so, moreover, these companies would be better positioned to export from the UK, taking advantage or at least hedging currency risks if Sterling is further subjected to devaluation or volatility over the course of Brexit. There are also exporting opportunities if a domestic manufacturing base is developed; as DONG mentions in its written response to the UK Parliamentary Inquiry on leaving the EU, "we have a number of UK suppliers from component manufacturers to specialist wind service companies that are starting to grow and export their goods and services to other markets, including European markets."

2.6 The UK's renewable energy trade balance

DONG's statement raises the question of what risks might arise in the renewable supply chain from a reversion to WTO rules after Brexit. This has been the subject of some interesting analysis at LSE Grantham Institute, which notes, firstly, that a deficit to the tune of about £1.2b exists in the UK's trade balance in low-carbon goods (such as solar, wind, hydro, clean vehicles, heating, insulation & energy saving technologies). The EU is the UK's most important import market (see figure 9). Thus, whether or not there is local content in the industry, even UK-based firms would potentially be exposed to tariff or non-tariff barriers on much-needed imports. This could increase manufacturing or installation costs as well as administrative requirements, which could lead to investment delays or projects unable to come in on a budget that would allow them to recoup costs through the CfD awards.

How much would project developers in the UK have to pay for low-carbon equipment if the UK reverts to WTO rules after Brexit? The EU does not currently impose tariffs on the trade of electrical energy or mineral fuels on any major trading partner. However, imported goods and equipment required for the wind farm supply chain may be exposed to potential tariffs. For example, the EU's rate of duty on steam turbines for electricity generation as well as 'wind powered generation sets' is currently 2.7%, with the rate on electric conductor cables up to 3.7%. Other electrical equipment varies between 0-4%, while a common customs tariff on raw materials such as copper or steel can command tariff rates up to 5%, depending on the specific product.

Figure 10: UK trade balance in low-carbon goods (source: LSE, UN Comtrade)



These tariff levels may drive up supply chain costs but they are not necessarily insurmountable hurdles (in contrast to, say, processed cocoa products, which command tariffs as high as 60%). Moreover, the WTO is currently attempting to eliminate tariffs for a broad set of 'environmental goods', and is now in the process of negotiating the specific items – such as wind turbines – for inclusion in this list.

Although the UK does depend on imported goods to develop its renewable assets, its key exports strength is in low-carbon services – such as banking & finance, project management, legal and regulatory advice, business consulting, software and IT procurement. After Brexit, the UK could look to market its expertise in value-added low-carbon services to non-European countries and regions. Indeed, this strategy would anticipate some of the broader shifts in low-carbon investment occurring globally, as the EU's share of investment in renewable energy has been declining since 2010, according to Bloomberg New Energy Finance (see figure 11). While European renewables will continue to grow, developments in east Asia will become increasingly significant as it is widely expected to become the global leader in both renewable investment and electricity demand growth by the early 2020s (figure 12). The UK Committee on Climate Change estimates that global trade in a selection of low-carbon goods and services could increase from around £150 billion in 2015 to £1.0–£1.8 trillion in 2030, and to £2.8–£5.1 trillion in 2050. This is a huge opportunity for early adopters of low-carbon technology.

Figure 11: Global shares of RES investment (source: BNEF)

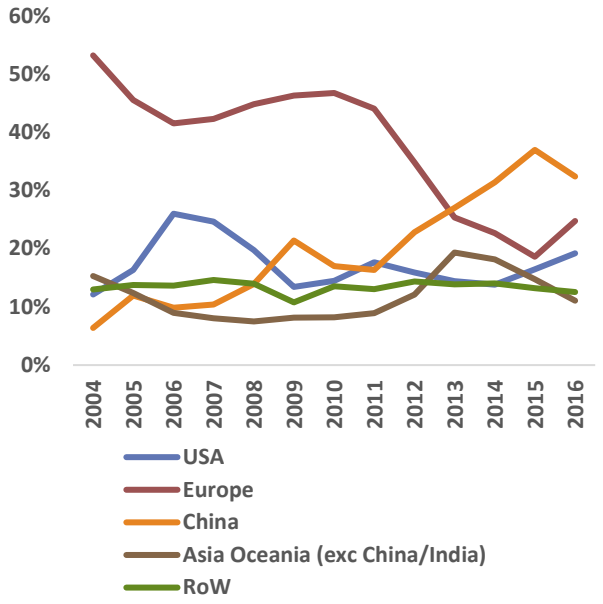
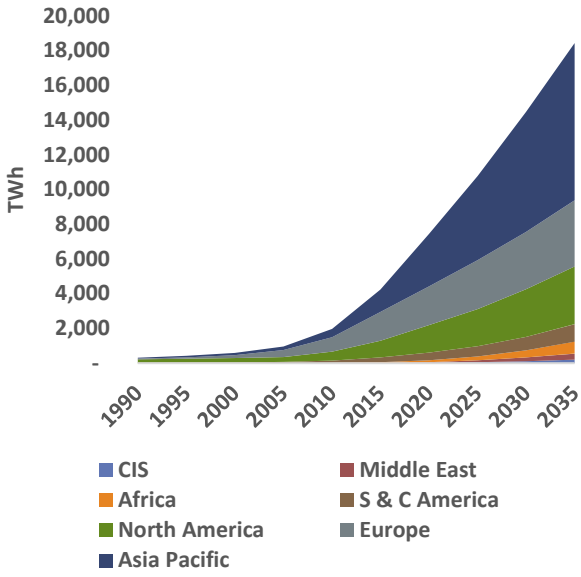


Figure 12: Renewable electricity production forecast (source: BP)



Conclusions and Recommendations

- Scotland's ambitions to be at the forefront of the low-carbon transition will be tested over the course of the UK's departure from the European Union. The primary uncertainty is whether the UK as a whole will be able to maintain access to the EU's single energy market, and to what extent it will continue to abide by its rules and participate in its regulatory and policy-making institutions.
- While the risk of a post-Brexit rollback in the UK's overall climate policy is relatively minimal, the negotiations with the EU may serve to highlight the differences between Scottish and English renewable energy ambitions and the respective governments' preferences for maintaining access to European energy resources, skills and funding to further decarbonisation goals.
- Scotland is host to a number of European utilities who are particularly active in the on- and off-shore wind sectors, and has attracted significant investments in low-carbon technologies that have benefited from various forms of

EU funding and regulatory support. Following Brexit, it would be advisable for the Scottish government to consider ways to encourage continued investment in domestic offshore wind supply chains, particularly pushing for Original Equipment Manufacturers (OEMs) to set up manufacturing hubs in areas where offshore wind development is anticipated. The government could also encourage the potential export of low-carbon equipment and expertise, while leveraging talent from the oil and gas industry to develop world-class renewable supply chains.

- Scotland has a number of links to European research institutions and EU financial support for R&D. It is therefore advisable that the Scottish Government is active in ensuring that all relevant renewable energy-related projects are included in HM Treasury's guarantee to underwrite EU funding in this area. Setting up a 'risk register' for renewable energy projects, initiatives and funding sources that rely on EU membership would be a useful resource for this purpose. Concurrently, the government could consider exploring opportunities for research partnerships outside of the EU.