

The Economic Consequences of Brexit: Energy

EPRG Working Paper 1702

Cambridge Working Paper in Economics 1706

Michael G. Pollitt

Abstract In this paper we raise a number of issues that are important for the UK to consider in the light of its decision to leave the European Union (EU). The first of these is the nature of the EU Single Market in Electricity and Gas and the UK's role within this. The second is the nature of UK energy policy in the light of Brexit, and the opportunities for changing this. And third, we consider some of the key issues to be addressed in a negotiating position with the EU.

Keywords Brexit, Energy Policy

JEL Classification L94

Contact m.pollitt@jbs.cam.ac.uk
Publication January 2017
Financial Support EPRG

The Economic Consequences of Brexit: Energy

Michael G. Pollitt¹
Energy Policy Research Group
Judge Business School
University of Cambridge

22 January 2017

The energy sector in the UK covers primary and refined liquid fuels, coal, natural gas and electricity supply. These sources of energy provide energy services for power, heating and transport. Petroleum products constitutes roughly 42% of all energy expenditure in the UK, with electricity and gas expenditure being roughly equal to this (41%), most of this latter expenditure is on electricity (25%).²

Energy is economically significant in total UK tax revenue with around 6% of all tax revenue being levied on the energy sector, mainly in the form of taxes on transport fuel sales.³

The UK has been a net energy exporter for much of the period of its membership of the European Union (from 1981 to 2003), however since 2003 its oil and gas production sharply declined and it has, once again, become a major importer of fossil fuels (with net energy imports of £13.9bn in 2015).⁴ It also imports a moderate amount of electricity (for 2015: around £950m out of final sales of £35.6bn, with net imports of £870m).⁵

¹ I am very grateful to Derek Morris and Cameron Hepburn of the *Oxford Review of Economic Policy* for encouraging me to write this paper as a contribution to a forthcoming special issue on 'The Economic Consequences of Brexit'. I acknowledge the debt I owe to my colleagues at EPRG for this paper and to the comments of John Rhys. I particularly acknowledge discussions with and comments from Kenneth Armstrong, David Reiner, David Newbery, Robert Ritz and Jorge Vinales. The paper draws heavily on the summary of the EPRG Workshop on "Implications of Brexit for UK and EU Energy and Climate Policy", held in Cambridge on 6 September 2016. A summary of the lessons arising from that workshop is available at: <http://www.eprg.group.cam.ac.uk/eprg-workshop-implications-of-brexit-for-uk-and-eu-energy-and-climate-policy-6-september-2016/>

The usual disclaimer applies and my views are solely my own and should not be taken to be shared with anyone with whom I am associated.

² See Market Value of Inland Consumption in DUKES 2016, p.32.

³ See HM Treasury (2016, p.58) for total tax receipts in 2015-16 of £628.6bn. DUKES (2106) shows total fuel duties + VAT + carbon price floor + climate change levy of £37.2bn in 2015, of which the tax raised on petroleum products is £32.5bn.

⁴ See DUKES 2016, Table G.7 (BOP basis).

⁵ See DUKES 2016, p.32.

The UK is heavily integrated into global oil and gas markets with substantial imports of pipeline gas from Norway.⁶ In contrast to many other strategic sectors the UK has relatively little dependence on the EU for either its exports or imports. This immediately suggests that even a ‘hard’ exit from the EU single market in energy will have little overall impact on energy trade and/or on prices.

In this paper we raise a number of issues that are important for the UK to consider in the light of its decision to leave the EU. The first of these is the nature of the EU Single Market in Electricity and Gas and the UK’s role within this. The second is the nature of UK energy policy in the light of Brexit, and the opportunities for changing this. And third, we consider some of the key issues to be addressed in a negotiating position with the EU.

The EU Single Market in Electricity and Gas

While primary commodity markets are primarily Atlantic basin based (gas) or global (oil and coal), electricity and gas supply markets are regional and significantly integrated with Europe. The UK has been at the forefront of efforts to create a genuine European-wide single market for electricity and gas.⁷ This has involved three levels of market extension and deregulation: the creation of wide area wholesale electricity and gas markets; non-discriminatory rules for access to transmission wires and pipelines; and the extension of retail competition and full deregulation of ownership. The progress made via successive EU Directives (1996, 2003 and 2009) has been impressive in opening up the market in electricity and gas across Europe.⁸

By 2015, around 85% of electricity in the EU could be said to part of the same wholesale market, with the potential for a single market price to emerge in the absence of transmission constraints.⁹ Progress in gas has been somewhat slower but has been notable in reducing the number of occasions when gas price flows across transmission links did not reflect the direction indicated by the relative price differences (i.e. from low to high price areas). Across the EU there has been a substantial merger wave with the emergence of EDF, RWE, E.On, Iberdrola, Vattenfall and Enel as pan-European utilities.¹⁰ In this merger wave UK electricity companies have been largely bought up and incorporated into other European countries’ former incumbents. These companies have also become significant retailers of gas in the UK.

Much of this progress has been inspired by the model of liberalisation pioneered in the UK (and Norway), where unbundling of wholesale, retail and network elements has allowed competition in wholesale and retail, in the presence of successful independent regulation of network companies.¹¹

⁶ See DUKES 2016, Table G.5.

⁷ See Jamasb and Pollitt (2005).

⁸ See Pollitt (2009) and Pollitt (2016).

⁹ See Pototschnig (2015).

¹⁰ See Jamasb and Pollitt (2005).

¹¹ See Bergman et al. (1999).

More recently there has been a concerted move to standardise much of the regulation surrounding the electricity and gas sectors. Pan-European organisations including, ACER, ENTSO-E and ENTSO-G have emerged. ACER is the Association for the Cooperation of European Energy Regulators and has a key role in disputes between national regulators.¹² ENTSO-E and ENTSO-G¹³ are the associations of electricity and gas system operators. They are responsible for facilitating and co-ordinating non-discriminatory access to their relative transmission systems. ACER is currently overseeing a process of standardising network codes across EU member states with a view to making it easier to negotiate many of the detailed network use and connection arrangements that are overseen by national regulators.¹⁴

While the single market in electricity and gas is an impressive achievement of the European Union in terms of the degree of standardisation and common access that has now been achieved, the size of the measured benefits remain small and difficult to quantify.¹⁵ At the EU level, the gains from market integration remain below 5% of costs (at best) at the EU level as a whole.¹⁶ This is partly because internationally determined wholesale fossil fuel prices combined with limited interconnection capacity have meant that the size of the gains from trading and the ability to realise gains remains modest for the large countries including the UK. Both electricity and gas demand remain stable or have been falling in many EU countries since the early 2000s, limiting the gains from trade.¹⁷

In the light of this it is difficult to see how UK will lose much at least in terms of energy, even from a hard Brexit. Of course, it is possible that a small limitation on net imports of electricity from France and the Netherlands will raise prices in the UK more than proportionally. However imports are only 6% of electricity supply. Limitations on the substantial re-exports of gas (arriving in the UK by ship or pipeline) to the EU, would lower prices in the UK.¹⁸ Though, increased co-ordination costs between the UK and EU countries, might delay new interconnector investment and limit future capacity growth relative to what it might otherwise have been. This suggests the costs of limitations on trading, especially of renewable electricity, might be rising over time. Similarly, there may be some (limited) gains from further integrating existing European markets, that the UK will lose out on if it leaves the EU.¹⁹

It is worth pointing out that the EU electricity market provides two helpful models of participation by non-EU countries.

¹² See <http://www.acer.europa.eu/en/Pages/default.aspx>

¹³ See ENTSO-E: <https://www.entsoe.eu/Pages/default.aspx> and ENTSO-G: <http://www.entsog.eu>

¹⁴ See Dale (2016).

¹⁵ See Pollitt (2012a).

¹⁶ See discussion in Pollitt (2012a).

¹⁷ See Sioshansi (2016).

¹⁸ The UK has net exports to the EU of 117,000 GWh of natural gas in 2015 (see DUKES Table G5).

¹⁹ See Newbery et al. (2016).

Norway is fully integrated into the EU electricity market by its membership of NordPool (which it shares with several Nordic EU member states) and by virtue of its participation in the European Free Trade Association (EFTA). Norway is a full member of the single energy market (and ENTSO-E). It participates fully in all of the stakeholder committees overseeing the network codes negotiation processes. Norwegian energy traders can trade electricity across the EU.

Switzerland, by contrast, is equally fully physically integrated into the EU electricity market but has had its full participation in the market blocked, most recently hindered by EU sanctions following the failure of the Swiss Referendum on freedom of movement in 2014.²⁰ Although there are relatively large mutual trading benefits from being part of the EU single market, the Union has refused to proceed with the integration process. These negotiations had been underway since 2007 and the reason for the delay had been the refusal of the Swiss to submit to dispute arbitration by the EU. This suggests that energy integration benefits are likely to be sacrificed by the EU in the absence of the UK not agreeing to free movement of labour post-Brexit.

UK Energy Policy in the light of Brexit

As in many countries, energy policy has three major goals in the UK: energy security, low prices and meeting environmental targets. How will Brexit affect the cost of simultaneously achieving all three of these goals?

We have already said that it is difficult to see how Brexit significantly affects energy costs due to lost trading benefits, thus price efficiency effects are not the main issue. This is distinct from negative exchange rate effects (i.e. a fall in the value of the pound), which are not an energy specific impact, but negatively effect the whole economy.

Energy security may be negatively affected if Ireland, France, Belgium and the Netherlands are less willing to operate their electricity and gas interconnectors with the UK strictly in line with price differentials. This causes the UK system to become more risky (prone to extreme shortages) than before. National actions to reduce risk, such as investing in more energy storage or back up capacity, do raise system cost.

Environmental targets are currently set at the EU level for renewable energy and for carbon emissions from sectors covered by the EU Emissions Trading System (EU ETS). Basic economics would suggest that the least cost achievement of the UK government's decarbonisation targets make it is obviously sensible to remain a member of the EU ETS, which includes electricity production but not gas supply. However the UK's renewables target (agreed in 2009) for 2020, set at 15% of gross final consumption of energy, remains an expensive ambition. The Paris Agreement

²⁰ See James Shotter and Christian Oliver, 'Swiss vote on migrant quotas sparks EU membership threat', *Financial Times*, 11 February 2014. The referendum had asked the following Yes/No question: *Do you accept the federal popular initiative "against mass immigration"?*, which 'Yes' won. This was seen as unilateral withdrawal from the bilateral treaty with the EU on Freedom of Movement which had been in force since 2002.

contemplates the possibility for countries to ‘link’ their mitigation systems to allow for efficiency gains even in the absence of a common cap set by a common instrument (such as the EU ETS). The UK could explore efficiency gains through this avenue, such via sharing joint renewables targets with Ireland or Nordic countries.

As early as 2007, leaked internal government analysis suggested that a 2020 target of 9% was reasonable.²¹ Instead the government went with a much more ambitious renewables target. This resulted in (or allowed the justification of) extremely poorly managed policies that saw the cost of renewables support soar. By mid 2015, the UK was expected to exceed its Levy Control Framework that governs subsidies to renewables and energy efficiency by more than £1.5bn per annum in 2020-21.²² Among the most economically illiterate of the renewables support policies introduced was a massively generous subsidy to domestic PV from 2010-12, which was among the most generous in the world when it was introduced. This sparked an unexpected gold-rush among households who could afford the £5,000-£10,000 upfront cost of installation. This resulted in around 270,000 installations of solar in around between 1 April 2011 and 31 March 2012.²³ The policy was uncapped when it was introduced and is currently costing around £1bn per year.²⁴

Other EU-inspired energy policies (massively gold-plated by the UK) have also proved disastrously expensive. The most egregious of these is the government’s smart meter roll out policy. This is an £11bn and rising programme aimed at installing 30 million smart electricity meters AND 23 million smart gas meters in households and small businesses by 2020.²⁵ Smart meters are capable of two-way communication with the grid, enabling real time pricing, accurate billing and easy switching between suppliers, improved energy use monitoring and potentially the exploitation of flexibility in energy use to manage both energy demand and power quality. The inspiration for this policy is currently in the 2012 Energy Efficiency Directive²⁶, which mandates that 80% of new electricity meters should be smart by 2020, should the overall assessment be positive. The UK has made widely criticised technology choices for the way the smart meters will be configured and the data will be managed, as well as ignored the obvious facts that smart gas meters are largely unnecessary (and not required by the 2012 Directive) and smart electricity meters are best rolled out in response to customer demand for them. It also, rashly, mandated that 100% of households should be given smart meters when the optimal number to install is

²¹ <http://image.guardian.co.uk/sys-files/Guardian/documents/2007/08/13/RenewablesTargetDocument.pdf>

²² NAO (2016, p.4).

²³ See <https://www.gov.uk/government/statistics/solar-photovoltaics-deployment%20>

²⁴ Ofgem (2015).

²⁵ For the latest government impact assessment see: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/567167/OFFSEN_2016_smart_meters_cost-benefit-update_Part_I_FINAL_VERSION.PDF

²⁶ Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, but also in the 2009 internal electricity market directive: Directive 2009/72/EC.

significantly less than this (as recognised by the 2012 Directive). The result of the prolonged period of debate around smart meters has been escalating expense that will make the UK's smart meters among the most expensive ever installed globally.²⁷

The electricity system is changing under the increase of renewable generation. Renewable generation is not well suited to existing wide area markets where prices have been determined by the cost of marginal fossil fuel plants. Renewables involve large upfront capital costs and low marginal running costs. This is why they have largely been supported by fixed feed-in-tariffs or premium payments from associated green certificate revenue. Thus, increasingly, new investment on the decarbonising electricity system is not determined by the need for new capacity to meet demand or replacement needs but by government ambition to push up the renewable electricity supply (RES) share in gross final energy consumption. The brief period where the government could (largely) leave new electricity system investment to the market (from 1990 to the mid-2000s) would seem to have been an aberration.²⁸

The deregulated wholesale market model for guiding investment lay behind the push for stricter unbundling rules between stages of production in the electricity system. Leaving the EU may be a good moment to re-consider how investment can be decentralised in an RES based system. One suggestion would be a return to vertically integrated (at least from a financial point of view) generation and retailing where non-integrated retailers would be squeezed out of the market, because of their inability to fund long term investments.²⁹ Energy only markets would cease to be the route to market for stand-alone generators, but such markets would once again assume their historic role as power pools which allow basically 100% integrated incumbents to trade electricity at the margin. This was the origin of power pools that became Independent System Operators (ISOs) in the United States.³⁰ One variant of this would be to allow certain investments to be financed, under long-term contract, by the whole of the customer base, such as nuclear power plants where the off-take contracts would be divided in line with shares of MWh sales in the retail market.³¹ This was something that was contemplated with the UK's Electricity Market Reform where the collective of suppliers might be the counterparty to the nuclear contract with EDF to supply power from the new nuclear power plant at Hinkley Point C.³² EU membership currently limits the ability of the UK government to approve or underwrite long-term contracts between certain parties, where these contracts conflict with EU rules.³³

²⁷ See Haney et al. (2011) and Alex Henney, *Smart Metering Chaos and Waste*, at <https://rogerhelmermep.wordpress.com/2015/01/08/smart-metering-chaos-and-waste/>

²⁸ As was suggested in Helm (2004).

²⁹ See Keisling (2009).

³⁰ See Pollitt (2012b) on the history of ISOs in the United States.

³¹ Keisling (2009) suggests something similar in a related context, which she calls a 'competitive joint venture'.

³² See DECC (2010).

³³ For instance, the Hinkley C contract required EU State Aid approval. See: http://europa.eu/rapid/press-release_IP-14-1093_en.htm

The need to think again about strict unbundling has already been under consideration by the Commission in their proposed in their latest package energy measures announced on 30 November 2016.³⁴ This envisages a much more active role for the Distribution System Operator (DSO) in a world of increasingly distributed energy resources (for demand side response and for generation). This suggests a decline of wide area markets and a more active role for local markets to match supply and demand at the required power quality at different nodes within the distribution system. Unbundling is further challenged by the need to promote decarbonisation of transport systems and heating. These will require a mix of government and private sector action, possibly with an active role for local authorities in energy sales and production. Local scale suggests that current unbundling rules may too unwieldy to meet the energy challenges of the future.³⁵

What seems to be needed is more large-scale local experimentation (e.g. city level) with solutions that might include combinations of technology push and pull at the local level (e.g. banning diesel vehicles and promoting electric vehicles). This sort of experimentation is what the UK has led the world on with its Low Carbon Networks Fund (now Network Innovation Competition).³⁶ It is likely to suggest different mixes of private and public, spot and contract markets in different places across the UK. This sort of local experimentation is very difficult under the letter of the EU law, and not well suited to central direction from the European Commission.

This suggests that the UK can play the role of a ‘California’ within Europe in promoting experimentation, the use of new technology and seeking to innovatively address energy policy issues, often in the face of challenges/much slower progress at the European level (i.e. somewhat like California relative to the federal level in the US). The key is that such an approach actually does promote productivity growth rather than productivity regress, and is not captured by industrial policy interests. The UK needs an efficient energy sector in terms of the use of resources. The good news is that its RES sources of supply – in particular wind - are relatively abundant in the UK³⁷.

It is important to reiterate the link between low carbon energy policy and the UK’s overall decarbonisation strategy.³⁸ A radical market based approach to decarbonisation, which focussed on widening the scope and tightness of carbon pricing would allow a reduction in reliance on specific mechanisms for promoting renewables in electricity and/or subject them to better external audit. While individual policies to promote renewables in electricity might still be required they could be more easily evaluated as to their whole economy efficacy if they competed directly

³⁴ See European Commission, Clean Energy for All Europeans – unlocking Europe's growth potential, Press Release, 30 November, 2016
http://europa.eu/rapid/press-release_IP-16-4009_en.htm

³⁵ See Pollitt and Anaya (2016) for a discussion of three potential futures.

³⁶ See Ofgem, Network Innovation, <https://www.ofgem.gov.uk/network-regulation-riio-model/network-innovation>

³⁷ See Jamasb et al. (2008).

³⁸ See Cameron Hepburn’s paper in the forthcoming *Oxford Review of Economic Policy* special issue on ‘The Economic Consequences of Brexit’.

with policies to decarbonise the heat and transport sectors. Equally, should Brexit lead to lessening of the UK's commitment to decarbonisation, this could have a significant impact in reducing the imperative to achieve a low carbon transition in the electricity sector. This seems unlikely given that the UK has actually been a leading champion of tough climate targets within the EU and has ratified the Paris agreement on Climate Change in its own right, as well as via the EU, following the Brexit vote.³⁹

The UK's negotiating position on energy

The UK's basic negotiating position on energy should be that costless trading of energy goods and services should continue. This is because the trade is mutually beneficial and there is an immediate loss to both sides from interrupting trade.

However what matters in wide area electricity and gas supply is that there are common rules across borders. It seems difficult to imagine how this can be the case without participation in the single energy market. The UK would wish to participate in the governance and regulatory structures set up and approved by the EU. The Norwegian and Swiss examples are important. Both are members of the ENTSO-E and ENTSO-G, but not members of ACER. Switzerland is having further rule harmonisation frozen and the right of its companies to participate in EU energy markets restricted. The UK is in a better position than Switzerland in terms of its full current harmonisation, but UK and EU rules could rapidly diverge if there is no common dispute resolution or if the EU's rules change.

The EU is clearly in charge on all issues relating to energy trading and hence it is impossible to see how individual member states such as Ireland, France, Belgium and the Netherlands can sign treaties with the UK to preserve market access. This is case even though it might in their mutual interest to sign a 'Common Energy Security Treaty' with neighbouring states to share reserve electricity and gas capacity via wholesale market integration. Reverting to World Trade Organization (WTO) rules is not going to help as energy is poorly defined as a good/service and not current subject to common tariff/non-tariff barrier rules.⁴⁰ This is partly because energy that is delivered across networks is a service as well as a good.

The UK could seek to include substantial energy elements in external trade deals with Canada and the US, particularly around access to LNG exports, which might drive down the price of gas in the UK relative to the rest of Europe. This is a long shot, but

³⁹ See Arthur Neslen, Boris Johnson Ratifies Paris Climate Agreement, *Guardian*, 17 November 2016.

<https://www.theguardian.com/environment/2016/nov/17/uk-boris-johnson-ratifies-paris-climate-agreement>

⁴⁰ See Thomas Cottier, Garba Malumfashi, Sofya Matteotti-Berkutova, Olga Nartova, Joëlle De Sépibus and Sadeq Z. Bigdeli, Energy in WTO law and policy, World Trade Organization, May 2010

https://www.wto.org/english/res_e/publications_e/wtr10_forum_e/wtr10_7may10_e.pdf

potentially highly beneficial to the UK. Being out of the single market in gas might make the US more willing to support their old defence ally in the this way.⁴¹

The EU restricts the UK's ability to impose differential energy taxation on EU imports on the basis of carbon content. This has resulted in the UK's carbon price floor giving rise to the possibility of substantial electricity leakage and providing a tax arbitrage incentive to build more interconnectors between the UK⁴². This situation could be corrected by a suitable border tax adjustment, based continental European system marginal fuel analysis. This would allow a potentially even tougher carbon pricing/traded carbon quantity restriction target in UK for the electricity sector in the future. However, border adjustments would have to be carefully designed in such a way that is compliant with applicable WTO rules and, potentially, rules arising from free trade agreements applicable in the UK. That could be the case by reference to climate change agreements, among others.

Four smaller, but significant, issues can be identified.

The first point to consider is the Single Electricity Market⁴³ in the island of Ireland, which is a joint venture between the UK and Irish governments. Ireland's electricity market is increasingly heavily integrated into that of Great Britain and needs access to the whole UK market to stabilise its system that has high wind penetration (and as a source of export revenue). The EU will be under pressure to come to an arrangement with the UK, which does not substantially disadvantage Ireland.

Secondly, the UK has a shortage of highly skilled labour and has benefited from the single European labour market to provide the engineers that it lacks.⁴⁴ However the detailed figures suggest, if anything, this may be less of a problem in the energy sector than many other sectors.⁴⁵ Access to skilled talent may be an issue if there are general restrictions on net migration following Brexit (though there are relevant skills in many other countries globally).

Thirdly, energy is a part of the EU research budget.⁴⁶ UK based research organisations disproportionately benefit from funding from the EU for energy related projects. Withdrawal from European funding will impact the UK research base, unless

⁴¹ There are some energy aspects to trade deals even when the trading parties are geographically a long way apart.

⁴² The carbon price floor is currently frozen at £18/ tonne CO₂. For a gas-fired (CCGT) power plant generating 1 MWh with 0.36 tonnes of emissions, this is a £6.48 / MWh penalty for UK generated power on a market price of around £55 / MWh. For a coal fired power plant the UK penalty (at 0.9 tonnes / MWh) is a substantial £16.20 / MWh versus an identical plant in the rest of the EU. A substantial fall in the value of sterling does go some way to offset the effect of this (but only to the extent that costs are not driven by international commodity prices).

⁴³ See <https://www.semcommittee.com/sem>

⁴⁴ See Royal Academy of Engineering (2016).

⁴⁵ Migration Advisory Committee Secretariat (2010).

⁴⁶ See The Royal Society (2015).

it is replaced with similar levels of funding and opportunities for foreign collaboration. Any R+D money that is repatriated could be used to supplement current levels of UK research funding more productively, e.g. via linking to collaborations with top US universities, rather than middle-ranking EU ones.

Finally, access to European capital for the energy sector has been significant. It would seem sensible to adopt a negotiating position which said that there should be matching market access for UK based firms trying to invest in the rest of Europe. EDF are major investors in the next generation of nuclear power plants in the UK and the UK benefits from EU based ownership of large parts of its existing energy system. Of course, it is not clear why EU firms would be reluctant to invest post-Brexit (in the long run). Should they choose not to, there would seem to be huge international appetite for utility investment in the UK.

Conclusions

The EU energy system is highly integrated and the UK has fully participated in and, indeed, led the way in promoting this integration. This suggests that it is unlikely to be contentious as to what an economically sensible end-point of negotiations might look like.

However the energy sector in the UK is less exposed than many other sectors to EU (rather than global) energy market trends. This is likely to put energy low down the priority list for any UK government, given much more pressing issues in other sectors.

If this is the case, an agreement on energy post-Brexit could be agreed early but be held back to the end (to be added back in) when the more contentious issues are settled.

It is important to point out that there are opportunities presented by leaving the EU in energy. These include rationalising the subsidy regime, reconsidering the smart meter rollout, redesigning the wholesale market for a high RES future, relaxing unbundling rules and promoting further integration with Ireland, Norway and North America. It is therefore possible that the UK will be freed up to lead the way globally on a new round of electricity market reforms, in a way that might not have been possible under continued membership of the EU. However the UK needs to be careful that leaving the EU introduces more not less cost effective/cost beneficial energy policy, given its historic capacity for adding unnecessary cost to well-intentioned EU driven policies.

Bibliography

Bergman, L., Doyle, C., Newbery, D., Regibeau, P. and von der Fehr, N. and Pollitt, M. (1999) *Monitoring European deregulation: vol.2: A European market for electricity?* London: Centre for Economic Policy Research.

Dale, L. (2016), *The IEM Integration Process*, presentation to EPRG Workshop on 'Implications of Brexit for UK and EU Energy and Climate Policy', 6 September 2016.

Department of Energy and Climate Change (2010), *Electricity Market Reform Consultation Document*, December, London: TSO.

Department of Energy and Climate Change (2016), *Digest of UK Energy Statistics 2016* [DUKES], London: TSO.

Brophy Haney, A., Jamasb, T. and Pollitt, M.G. (2011), 'Smart metering: technology, economics and international experience', In: Jamasb, T. and Pollitt, M.G. (eds.) *The future of electricity demand: customers, citizens and loads*. Cambridge: Cambridge University Press, pp.161-184.

Helm, D., (2004), *Energy, the State, and the Market: British Energy Policy since 1979*, 2nd Edition, Oxford: Oxford University Press.

HM Treasury (2016), *Autumn Statement 2016*, London: HM Treasury.

Jamasb, T. and Pollitt, M. (2005) 'Electricity market reform in the European Union: review of progress toward liberalization and integration', *The Energy Journal*, 26(Special Issue): 11-41.

Jamasb, T., Nuttall, W.J., Pollitt, M.G. and Maratou, A. (2008), 'Technologies for a low-carbon electricity system: an assessment of the UK's issues and options', In Grubb, M., Jamasb, T. and Pollitt, M.G. (eds.): *Delivering a low carbon electricity system*. Cambridge: Cambridge University Press, pp.64-99

Keisling, L.L. (2009), *Deregulation, Innovation and Market Liberalization*, Oxford: Routledge.

Migration Advisory Committee Secretariat (2010), *Which sectors and occupations use more immigrant labour and what characterises them? A quantitative analysis*, Working Paper, November 2010.

NAO (2016), *Controlling the consumer-funded costs of energy policies: The Levy Control Framework*, Report by the Comptroller and Auditor General, London: National Audit Office.

Newbery, D.M., Strbac, G. and Viehoff, I. (2016), 'The benefits of integrating European electricity markets', *Energy Policy*, Vol. 94: 253-263.

Ofgem (2015), *Feed-in Tariff Annual Report 2014-15*, London: Ofgem.

Pollitt, M. and Anaya, K., (2016), 'Can current electricity markets cope with high shares of renewables? A comparison of approaches in Germany, the UK and the State of New York', *The Energy Journal*, Volume 37, Bollino-Madlener Special Issue: 69-88.

Pollitt, M.G. (2009), 'Electricity Liberalisation in the European Union: A Progress Report', EPRG Working Paper, No. 0929.

Pollitt, M. (2012a), 'The Role of Policy in Energy Transitions: Lessons from the Energy Liberalisation Era', *Energy Policy*, 50, November: 128-137.

Pollitt, M. (2012b), "Lessons from the History of Independent System Operators in the Energy Sector." *Energy Policy* 47 (August): 32–48.

Pollitt, M.G. (2016), *An Evaluation of EU Energy and Climate Policy*, presentation to The Single Market at 25 Conference, 30 January 2016.

Pototschnig, A. (2015), *Overcoming the Obstacles to the Completion of European Energy Market*, presentation to European Court of Auditors, 5 May 2015.

Royal Academy of Engineering (2016), *Engineering A Future Outside the EU – securing the best outcome for the UK*, London: Royal Academy of Engineering.

The Royal Society (2015), *UK Research and the European Union: The Role of EU in funding UK Research*, London: The Royal Society.

Sioshansi, F.P. (2016), 'What is the Future of the Electric Power Sector?', In Sioshansi, F.P. (ed.), *Future of Utilities - Utilities of the Future: How Technological Innovations in Distributed Energy Resources Will Reshape the Electric Power Sector*, London: Academic Press, pp.3-24.