BIEE 21-22nd September 2016

Governing for Innovation Without Disruption in Energy Systems.

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1. Introduction - the challenge of transformation of the energy system

The energy system in Britain, like others around the world, is undergoing fundamental and rapid change due to a wide range of different drivers, from technology through to social, environmental and businesses preferences and innovations (Mitchell 2016).

The drive to decarbonise electricity over the last 30-40 years has led to a significant rise in renewable generation, especially from wind and solar, and this has had significant impacts on how energy systems are operated and managed. As these technologies continue to expand as their costs come down, the value of flexibility elsewhere in the system will also grow fast. Existing forms of flexibility, such as natural gas-fired power plants, will become increasingly unavailable as carbon budgets get tighter. As a result, flexibility in demand for electricity, either through demand-side response or through forms of storage, is becoming increasingly important.[1]

Electrification may play an increasing role in transport and heat (DECC 2013b: 102-105), which may mean a significant increase in the demand for electricity, including peak demand. Wilson et al (2013) estimate that shifting even 30% of heat demand to electricity would mean daily electricity demand doubling if resistive heating is used, and increasing by 25% if heat pumps are used. Peak demand increases would be larger. While these developments , were they to happen, represent a huge technical and economic challenge, they also open up opportunities, since demands in electric vehicle charging and electrical heating are particularly well-suited to demand side management. In the absence of demand side flexibility, the costs of this transformation in terms of additional generating and network capacity will be enormous, again underscoring the value of that flexibility. However, it remains very unclear whether decarbonisation of heat and transport can (should or will) be achieved by this electricity route, or how far renewable gases may also be involved (Maclean et al 2016). These developments also point to the importance of demand reduction since the costs of system transformation will be lower the lower is total demand (Steward 2014).

A further dimension of transformation is that the rise of small-scale technologies (including many renewables), again (currently) especially in electricity generation. Britain is seeing a sharp rise in distributed generation (DG),[2] and the beginning of the reversal of the centralisation of the electricity system in the 20th century. Crucially, 21st century energy systems will be *decentralised*, with households, businesses, local government and other organisations taking back more control over energy production. It is also likely that we will see more heat being provided through local heat networks, rather than through burning gas delivered through a national network, especially in cities.

The emergence of a decentralised energy system, involving variable renewable power, more distributed generation, flexible demand including transport and heat, storage, interconnectors and interactions between electricity and renewable gas , will be made possible by the much deeper application of integrated ICTs across the system, in networks, meters, appliances, lighting, heating and cooling technologies, and in

[1] For more details see: http://www.sustainabilityfirst.org.uk/index.php/energy-demand-side/gb-electricity-demand

[2] i.e. generation attached to the lower voltage distribution networks

generation. These present the possibility of optimisation of energy and power flows at local levels, including the operation of virtual power plants composed of many different sources of generation, storage and demand response.

The changes that the energy system is now facing add up to a shift away from a supply-oriented, centralised system to a decentralised, smart, demand-focused system (Willis 2006). Some elements of this shift are already under way, with increases in renewables, the rise in DG, new business models for demand side response, and local authorities setting up energy companies. Interesting technical work is being done, for example in the Smart Grid Forum[3] and the IET's Future Power Systems Architecture initiative[4].

However, the most fundamental challenge in this transformation is not technical, but rather one of governance, and specifically inertia within governance (Mitchell 2014).[5] As we discuss further below, the current institutional framework for energy in Britain is not fit for the purpose of facilitating innovation and transformation. Transforming this framework is vital because of the risk that as technology races ahead infrastructure and regulations lag behind, thereby undermining (or even blocking) its use and potentially increasing the costs, undermine the security and threaten the low carbon transformation itself (Mitchell 2014).

This problem is now being increasingly recognised, and there is an active debate on the kinds of institutional changes that may be needed. For example, the House of Commons Energy and Climate Change Committee (ECCC) and the now-defunct Department for Energy and Climate Change (DECC) have raised the possibility of creating an independent system operator. Some distribution network operators (DNOs) are taking first steps towards becoming more active distribution system operators (DSOs). The recent reports from the National Infrastructure Commission (NIC) and the ECCC have highlighted the challenges and opportunities for creating a low carbon network infrastructure, and suggested that the challenges can only be met with an appropriate governance, regulatory and operational framework.

This paper provides a set of principles and options for a new institutional arrangement which, we consider, better manages the required transformation whilst at the same time trying to reduce energy system disruption. Our approach has been developed through a four-year project on Innovation, Governance and Affordability for a Sustainable Secure Economy (IGov) at the Energy Policy Group at the University of Exeter, funded by the Engineering and Physical Sciences Research Council. This Briefing Note only provides a headline summary of the institutions and their role, and a brief rationale for thinking. However, we have written a number of blogs, working papers and journal articles about the governance needs of the GB energy system in general, and its constituent parts. For further details on the approach and an earlier version of the proposed framework see Mitchell et al (2015). All of this information can be accessed via the IGov website.

2. Innovation without Disruption

Energy system disruption is often talked about in an innovation sense as positive. Solar photovoltaics, for example, is an example of a technology which is enabling new ownership and investment patterns, new

[3] http://uksmartgrid.org/
[4] http://www.theiet.org/sectors/energy/resources/fpsa-project.cfm?origin=reportdocs
[5] See IGov blog post *Overcoming inertia is the key to unlocking a sustainable energy future*, 12 January 2015, http://projects.exeter.ac.uk/igov/new-thinking-overcoming-inertia-is-the-key-to-unlocking-a-sustainable-energy-future/. Here governance is taken to mean policies, institutions, rules and incentives (i.e. the rules of the game).

means of system operation, new energy economics[6] which is having a major effect on conventional utility finances. The overall impact is one of greater decarbonisation, lower electricity costs and a greater connection between consumers and their energy use.

This paper however is discussing disruption from the perspective of the GB government – how to decarbonise the energy system without major disruptions to energy security or affordability. We argue that if the current GB governance framework continues as it is, and is not reformed then, at some point, major disruption will occur to the GB energy system. We argue that this disruption can be avoided if a new institutional framework is implemented in the near time, and if it is set up to be nimble and flexible so that it can re-set to meet new requirements easily.

A recent blog[7] series by Thomas Elmar Schuppe (see Part 1, Part 2 and Part 3) about the energiewende in Germany illuminates the complexity of energy transformation. As he shows, it is not just that decision-makers have to make the right governance decisions but the decision-makers have to be constantly vigilant about the unforeseen impacts of their policies – and then they must be prepared to make changes to counter those unforeseen effects. The governance system therefore has to be set up to enable these changes. He also shows that the German energy industry has been continuously forced to react and adapt their businesses to these policy changes and market impacts. Part 3 powerfully illuminates just what problems have arisen for companies (RWE, E.on, Vattenfall and EnBW (the big 4)) because they did not take the right strategic decisions at the right time.

Schuppe's series also illuminates the push and pull of policy. For example, a combination of events led to an increase in the use of lignite and hard coal in Germany from 2009, the opposite of what the energiewende intended. This then led to a determined policy push from the German government to get the energiewende back on track by resetting the policy base (Schuppe's Part 2). As a result of that policy resetting, and the potential forced early closure of coal plants , the fight between the 'old' and 'new' energy system in Germany has become focused on coal. Current German Government policy seems determined to shut coal plants within a certain time frame so that the mothballed gas plants become economic again but no-one should underestimate the policy determination required to follow this through, and even then, no doubt, this will lead to other unforeseen impacts which will require more policy resetting.

This is managed disruption: the transition of the German economy from one industrial base to another, with ups and downs, but, as yet, no fundamental crises. The governance process put in place has to inherently be able to deal with the push and pull of policies.

3. Governing for Innovation

The IGov framework involves the creation of some new institutions, and changes in the nature of existing ones, such as a refocusing of the role of the energy regulator, Ofgem. A common concern about institutional change in the energy sector is that it is too frequent and sometimes is not worth the cost and disruption involved, with uncertainty causing delays in investment. We are aware of these arguments, but would emphasise two points. Firstly, what we are suggesting here does not constitute significant or disruptive change. It is actually a combination of what we already have and governance arrangements already in place

[6] http://projects.exeter.ac.uk/igov/new-thinking-is-the-centralised-utility-model-past-its-sell-by-date/

[7] http://projects.exeter.ac.uk/igov/new-thinking-managed-disruption-the-push-and-pull-of-policy-in-germany/

in other places, such as Denmark and New York State in the US. Moreover, by confronting the problems of the current framework, it is saving GB from greater disruption in the future.

Second, under conditions of technological change, the potential benefits of a more flexible, demand-focused and decentralised energy system over our current approach are enormous. For example, the National Infrastructure Committee recently estimated that a smart energy system involving more interconnection, storage and flexible demand would save consumers up to £8bn a year (NIC 2016). In this context, the cost of institutional change that will be needed to deliver such savings in practice – which are likely to be of the order of tens of millions pounds at most – are relatively minor.[8] This will require an investment in terms of the design of institutional change, but this investment will lead to quick returns in comparison with problems that governments will otherwise have to deal with in the form of an increasingly expensive and dysfunctional energy system.

Overall, it is essential that we find ways of transforming the energy system in ways that are affordable for consumers. It is also right that we seek to transform the system in ways that allow ordinary citizens to take back control of energy, to place them at the centre, instead of supply companies and regulators.

4. The existing institutional landscape

The British energy system is already undergoing a number of changes, many to do with decentralised technologies and the demand side, or those occurring at the distribution level from the bottom up. While some of these changes are being driven by aspects of the current governance framework , this is typically happening in a uncoordinated, volatile way – support to solar PV and associated network problems would be one example;[9] another would be the apparently unforeseen interaction between the Capacity Market and embedded benefits for DG, and what is an essentially dysfunctional response to that interaction.[10] In many other cases, current governance is actually blocking change, for example the virtual absence of a strategy on energy reduction, in stark contrast to Germany and Denmark.[11] Overall, current governance does not complement the technological, business and social changes underway, and change that is occurring is often happening in spite of, rather than because of, that governance. In this section, we assess the existing institutional landscape, and ways in which it is failing to fulfil certain key functions.

In the current institutional landscape, the ***Committee on Climate Change (CCC)*** provides advice to Government on the science (and state) of climate change, recommends carbon budgets, and produces analysis of ways to meet those budgets. The Committee, and more widely, the targets laid out in the Climate Change Act, are supposed to provide both long-term direction and independent expertise, through delegation of targets setting away from short-term politics (Kuzemko 2015). However, in practice, politics has not been removed from the setting of carbon budgets, or, more importantly, from the implementation of policy to meet those budgets (Lockwood 2013). The CCC has to walk a politically sensitive fine line between setting out GHG reduction needs, recording the extent to which various policies have worked in reducing the GHG emissions, and explaining how further reduction can be achieved on the one hand, while at the same time not explicitly making policy. The CCC is not meant to take a view between different

[8] See also IGov blog post *Restructuring GB's energy institutions – why it is worth the cost,* 18 April 2016, http://projects.exeter.ac.uk/igov/new-thinking-restructuring-gbs-energy-institutions/

[9] See, IGov blog post *Solar surprise, revisited*, 6 May 2016, http://projects.exeter.ac.uk/igov/new-thinking-solar-surprise-revisited/

[10] See IGov blog post *The embedded benefit saga*, 8 August 2016, http://projects.exeter.ac.uk/igov/new-thinking-the-embedded-benefit-saga/

[11] Kuzemko (2016) and IGov blog post *Germany's €17 billion energy efficiency strategy – where's ours?* 19 May 2016, http://projects.exeter.ac.uk/igov/new-thinking-germanys-e17bn-energy-efficiency-strategy-wheres-ours/

technological or social pathways; rather it is only meant to show the various ways in which carbon budgets can be met cost-effectively.

This arrangement constrains both the Committee and the nature of the debate, meaning that at the moment Britain lacks a formal home for transparent discussion about climate and energy policy and for reaching consensus on potential policies and decisions.[12] It is often argued that the near unanimous support in Parliament for the 2008 Climate Change Act means that its climate targets enjoy strong and wide support. However, there are good reasons for doubts on both of these dimensions (Carter 2010, Lockwood 2013), with the low salience of climate change in particular being a major problem. One response, which appears to be that taken in Britain currently, is to make decarbonisation policy on the basis of societal and political consent, i.e. adopting and maintaining policies unless and until they run up against strong opposition from particular constituencies, when they are abandoned.[13] While this approach may appear politically realistic, the danger is that it will run into limits on decarbonisation – not meeting the required CCC budgets - as the scale, nature and costs of decarbonisation policies intensify.

In addition, the Committee offers mainly high-level, broad advice on policy options. Its conclusions do not connect with the detail of institutions and regulation.[14] Perhaps reflecting this situation, the expert capacity of the Committee lies mainly with climate scientists and economists rather than with the details of energy policy.

In theory, the current arrangements then mean that the Government takes high level policy decisions. Here, there are two critical issues. One is whether the officials (previously in DECC, now in BEIS) advising political decision-makers have the expert capacity to develop policy well, given the exodus of expertise following privatisation. The incentive structure of the British civil service, rewarding generalists over specialists, is a problem here. In practice, the government has been quite heavily dependent on the energy industry, especially large incumbents, for both expertise via secondments and co-design processes,[15] and for data. Such arrangements clearly increase the risk of capture.

A second is that, in practice, policy making has over time become partially taken on by other bodies. This has happened through the institutional arrangements set up following privatisation, whereby the delivery of energy goods, services and some policy objectives was to be achieved through markets, or through regulation handled independently at arms-length from government. The argument was that the delegation of regulation and delivery through an 'independent' energy regulator (i.e. Ofgem) and thence to regulated industry actors beneficially 'de-politicised' energy (Kuzemko 2015). This also means there is no meaningful control of 'direction' of energy system change.

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[12] The House of Commons Energy and Climate Change Committee does provide a platform for debates on energy and climate policy, but is weak in formal institutional terms. More recently, the National Infrastructure Committee has been created, which also covers relevant aspects of energy transformation, which has more power. However, the NIC does not aim to generate a broad consensus.

[13] The most obvious example is support for on-shore wind.

[14] For example, energy industry codes are the detailed rule books for energy markets and networks, and need to be changed to reflect policy objectives, but at the moment there is direct link between CCC recommendations and code changes, and no requirement on code administrators or panels to ensure that they enable the meeting of the CCC recommendations (see Lockwood et al 2015). See also the IGov blog post *Putting the environment back into GB energy policy – stop being complacent about emission reduction*, 31 May 2016, http://projects.exeter.ac.uk/igov/new-thinking-putting-the-environment-back-in-gb-energy-policy-stop-being-complacent-about-emission-reduction/

[15] For example, the details of the Capacity Market were effectively co-designed through the 'Collaborative Development' process – see https://www.gov.uk/government/groups/electricity-market-reform-emr-collaborative-development

Ofgem was initially set up as an economic regulator responsible for overseeing market and network regulation, with the aim of ensuring that the energy system operated in a competitive and cost-effective way. However, over time is has taken on other social and environmental responsibilities through a whole series of changes to its remit and duties, and more recently through a Strategy and Policy Statement.[16] This drift in the remit of Ofgem has led to two consequences.

One is that Ofgem now, in practice, faces, and is expected to make, decisions on trade-offs between policy goals in how it enforces and interprets regulation; trade-offs that are essentially political. There are many grey areas in the relationship between the regulator and the government. Many decisions that should be in the policy sphere, ultimately decided on by the Secretary of State (SoS), have drifted by default into the regulatory sphere. For example, new technologies are opening up multiple pathways to meet Government climate policy goals. The choice of one rather than another technological pathway has important distributional implications for different sections of society (including the relevant industries and supply chains), its total costs and its speed of transformation. Technology pathways are heavily influenced by deployment support frameworks set by Government. But decisions on surrounding regulation within Ofgem's control – including those on the design of network charging, industry codes, balancing market design and incentives for distribution networks – also matter. Through its executive authority the regulator is now making a multiplicity of *de facto* policy choices which have impacts on a range of issues, including the relationship between transmission and distribution levels in electricity, centralisation vs. decentralisation of the energy system, the existence and availability of local markets and the involvement of customers. This situation has undermined the transparency and legitimacy of energy policy.

Moreover, because Ofgem has been slow to respond to its new duties, especially through the 2000s, there has been a degree of regulatory inertia. A commitment to the idea that intervention should be minimised that came with the free market paradigm at the time of privatisation and liberalisation has endured, which has slowed and hampered policy to support innovation in networks, for example (Lockwood 2016)

A second consequence of the drift in Ofgem's role is that it has become an over-large bureaucracy with reduced internal coherence and multiple responsibilities that it is not always well-equipped to handle. It has hundreds of staff, compared for example, with the 45 working Denmark's regulator which has a much clearer, narrower remit of economic regulation.[17] Its roles are constantly in flux – for example it has recently been decided to separate out the E-Serve environmental and social programmes delivery role into a new body,[18] but it is taking on greater powers in the area of code governance.

Overall, the context within which the regulator operates and makes decisions has changed dramatically since it was set up, and its role should be rethought. We think the answer is to scale back Ofgem back to be a minimal economic regulator and by re-assigning the social, environmental and security responsibilities elsewhere.

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[16] See IGov blog post *The odd couple – will a new Strategy and Policy Statement help sort out the relationship between government and Ofgem?*, 18 August 2014, http://projects.exeter.ac.uk/igov/new-thinking-the-odd-couple-will-a-new-strategy-and-policy-statement-help-sort-out-the-relationship-between-government-and-ofgem/; IGov submission to DECC consultation of Strategy and Policy Statement, October 2014, http://projects.exeter.ac.uk/igov/submission-to-decc-consultation-on-the-draft-strategy-and-policy-statement/

[17] See IGov blog post *Lessons from America: If only GEMA was more like a US Public Utility Commission*, 4 July 2014, http://projects.exeter.ac.uk/igov/lessons-from-america-if-only-the-gema-was-more-like-a-us-public-utility-commission/; Lockwood (2015a)

[18] See https://www.ofgem.gov.uk/system/files/docs/2016/03/simplification_plan_2016-17_0.pdf

A significant amount of *de facto* decision making in electricity has also been delegated to National Grid as the joint transmission and system operator which has, similar to Ofgem, seen a gradual expansion of its role in areas such as recommending targets for capacity auctions. This arrangement is problematic because there are too many conflicts of interest within NG at a time of fast changing and decentralising energy technologies, and because Ofgem has struggled to regulate system operation appropriately through commercial incentives (Strbac et al 2014).

There are further reasons for rethinking the role of the system operators, in both electricity and gas.[19] With essential technical expertise and knowledge of the details of the system, system operators are key actors for the delivery of the transformation of the energy system towards a low-carbon, more decentralized and more flexible future. However, at present system operation focuses almost entirely on the transmission level, whereas the major transformations are likely to come at the distribution level, nearer demand (see below). This imperative means abandoning the old separation between transmission and distribution in system operation, because in future a lot more of the balancing of the system through local generation, storage and demand management will be happening at the distribution level. This may be achieved through distribution service provider platforms (see below), but these need to be coordinated with the national SO. Until recently, the SO has had virtually no visibility of what is happening below the grid supply point.

At the same time, both transport and heat are likely to become at least partly integrated into the electricity system. The future of the electricity system is bound up with the future use of gas, and the gas network, and indeed gas system operation. At the same time, it is becoming clear that we will need more heat networks in the UK, and that these should be regulated. In Denmark, where district heating is widespread and involves combined heat and power, electric boilers, heat pumps and heat storage, heat and electricity are intimately intertwined. Especially during a transition, the evolution of electricity, heat, transport and gas should not only be thought about together, but also the operation of the systems should fit together.

Yet another area where decisions on the detailed rules of the energy system have been delegated, this time largely to industry itself, is industry codes. The current code governance system is overly complex and opaque, and not fit for the purpose of transformation, being prone to inertia, capture by incumbent interests, and not sufficiently connected with over-arching policy goals (Lockwood et al 2015).[20]

The delegation of policy making, regulation and delivery to different bodies has led over time to a highly fragmented and complex institutional system for energy (Figure 1 shows the actors and relationships just for electricity). These characteristics mean that the coordinated changes across different spheres of policy needed for a rapid and cost-effective transformation are extremely difficult. Policy making is nowhere near nimble enough to take account of rapidly changing technological developments and costs. Unintended consequences and unanticipated interactions between policies are commonplace. This state of affairs is widely recognised, with a number of calls for some form of system architect.[21]

The coordination problem is worsened by the lack of open and transparent access to data. With the growth of ICTs in networks and the roll out of smart meters and appliances, data will play a central role in the future

[19] See IGov blog post Not just independent but also integrated, 4 March 2016, http://projects.exeter.ac.uk/igov/new-thinking-not-just-independent-but-also-integrated/

[20] In October 2015, an IGov workshop was held on codes governance with key stakeholders; for further details and presentations see: http://projects.exeter.ac.uk/igov/category/events/igov-events/code-governance/, and IGov (2015) for a summary of the discussion.

[21] See IGov blog post *The belly of a (system) architect*, 27 May 2014, http://projects.exeter.ac.uk/igov/the-belly-of-a-system-architect/

energy system, and access to it will be a public good. Yet it currently does not flow sufficiently to guide effective investment strategies; for example, investors in storage do not know where their potential services to distribution network operators would best be located because of a lack of data. The current approach to data from smart meters is to privatise it through the creation of the Data Communications Company[22] which will make access to data conditional on payment. In its recent Energy markets investigation, the Competition and Markets Authority recommended that Ofgem create a secure domestic customer switching database that would be available to all suppliers, which is a step in the right direction, but still falls short of fully open and transparent data on energy services.

As discussed above, much of the forthcoming change in the energy system will come on the demand side, and at the local level, through new types of services. At present, there are no local energy markets in GB; no way for new actors to sell energy directly to local customers. Markets for services to distribution network operators (DNOs) such as storage and demand response are also very basic. There are multiple issues in the construction of such markets (Lockwood 2014). Incentives for DNOs to be more proactive in this area are still relatively weak.[23] There is some thinking going on about these issues in GB, for example in the Smart Grids Forum, but current institutions do not offer a clear way forward.

Finally, current policy sees consumers (and market actors their customers) very much in terms of traditional sectoral distinctions, i.e. domestic, commercial and industrial, rather than in terms of how able or willing they are to engage with the system, as is now happening in other countries.[24] A mass market approach to service still prevails in energy, in contrast with other sectors where service is now far more personalised. The idea that consumers could offer services to the system, for example via microgeneration or demand side response, and should receive value for those services, is still in its infancy, and very much at the margin of the system rather than at its heart.

This latter dimension will become increasingly important as available technology, new businesses models and change in social practices allows each consumer to be treated individually, ranging from those who are very active i.e. prosumers, through to those that are unable or unwilling to act. Consumers can be thought of on a continuum from 'empowered- engaged-essential'.[25] The current conception of engagement, which is largely about switching, does not capture this.[26]

[22] A wholly-owned subsidiary of Capita

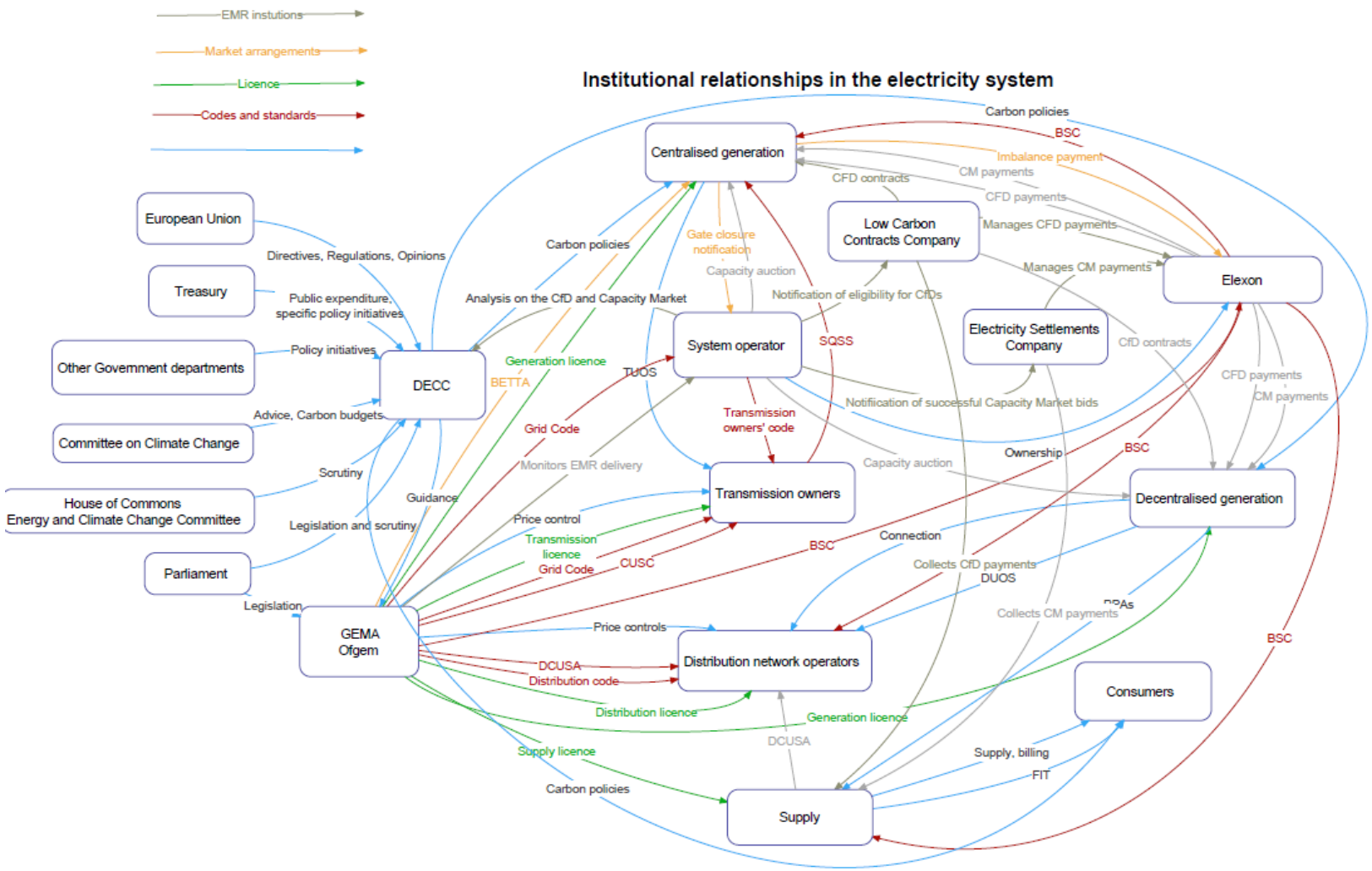
[23] See IGov blog post *Transformational regulation – comparing the NY REV and RIIO*, 11 August 2016, http://projects.exeter.ac.uk/igov/new-thinking-transformational-regulation-comparing-the-ny-rev-riio/

[24] For example in Australia –see CSIRO and ENA (2015)

[25] See IGov blog post *The changing role of consumers in the energy system*, 8 July 2016, http://projects.exeter.ac.uk/igov/new-thinking-the-changing-role-of-consumers-in-the-energy-system/.

[26] See IGov blog post *Switched off – is switching really a measure of consumer engagement?*, 12 November 2013, http://projects.exeter.ac.uk/igov/new-thinking-blog-switched-off-is-switching-really-a-measure-of-consumer-engagement/

Figure 1



Source: Woodman, 2015 https://blogs.exeter.ac.uk/energy/2014/11/12/mapping-the-power-in-the-electricity-system/

5. Principles for institutional reform

Above we argued that the governance of the British energy system is not fit for the purpose of facilitating rapid change to greater sustainability at the lowest cost, and needs institutional reform. In this section we lay out the basic principles for that reform, especially in terms of the functions that are required from a new institutional arrangement. In the following section, we then go on to propose a particular set of options that we believe meet these principles.

Before proceeding to specific principles, it is first useful to note two general aspects of our approach. The first is that our principles are shaped by political analysis, and in particular the influence of both interests and ideas in shaping how institutions work. Large incumbents in the energy sector deploy power resources, including lobbying, to influence policy design, and sometimes succeed in capturing the policy process. Ideas, especially ideas about the universal efficacy of markets, have also been very influential in energy policy, and remain so. We have tried to take these factors into account in the discussion of principles below.

We are also aware of the dangers, discussed above, of unintended consequences arising from institutional design, and of interactions between policies and institutions. Again, we have attempted to anticipate some of these issues, in part by thinking about institutional change in a holistic, system-wide way.

The still-strong commitment to markets in energy policy relates to our second general point. In what follows, we argue for institutional changes that do involve the coordination and direction of energy policy, and intervention in markets. However, it is important to emphasise that our proposals are not 'anti-market'; indeed they are aimed at making markets function more effectively for transformation, ensuring that they open up opportunities for new technologies, actors and business models. However, unlike a number of recent commentaries which argue for a number of 'first best' policies (e.g. Keay et al 2012, Helm 2012, Bird 2015), we recognise that institutional design must engage with markets as they are, rather than some unattainable ideal.[27] Moreover, even if one was to accept the ability of 'first best' policies, the time required for them to evolve to the necessary sophistication would be far too slow to meet the required emission reductions.

Taking these preliminary points into account, we propose the following principles for institutional reform for a sustainable, secure and affordable energy system, and these are further discussed below:

- Starting with, and centred on, the consumer
- Facilitating local markets
- Open and transparent access to data
- Greater co-ordination
- Long-term political stability
- Transparency and legitimacy in policy making

[27] For example, it is not particularly useful to simply reassert that what is needed is effective carbon pricing that reflects the social costs of climate change; it has long been clear that the political economy of carbon pricing is such that this cannot be delivered.

5.1 Starting with and centred on, the consumer

The first principle is that an agenda for institutional reform that aims to reorient the energy system towards the demand side above all has to place consumers at the centre, with changes to institutions following from this starting point. A number of other points follow from this basic principle.

First, in contrast to the current approach of poor quality, mass-market customer service, policy should create incentives for personalised service and interaction. The energy system should be run in such a way that it fulfils consumer wishes, rather than consumers having to fit into the wishes of companies and the regulator wishes, but which also provides a better service in terms of system operation cost.

Second, unlike the current categorisation of consumers by sector and size, consumers should be seen in terms of the degree of their engagement and of the vulnerability of their circumstances, where it is recognised that both of these will change as people move through the life-cycle and as the economy changes.

The degree of engagement of consumers is the new dimension, and so is important to emphasise. This goes far beyond the numbers who switch suppliers, which is at the centre of the current debate. Consumers will make or break the move to a smarter and sustainable system; many of the changes that are occurring are on the demand side, and as such are close to consumers. The energy system therefore needs to become more facilitative of what consumers want in respect to energy consumption, energy production and energy services, enabling those who want to be active players to become so, whilst protecting those that are unable, or unwilling to be active. Efforts to connect consumers with the possibilities for energy use, services and production are therefore essential, including 'conversations' about energy with consumers in some form.

The area of greatest interest is not energy per se, but rather energy services, both for the consumer and *from* the consumer to the system. The last of these is the newest and also the most important in future. Here there are three functions that a new system must deliver. Firstly, ensuring that consumers can get a fair value for services that they offer the system (most probably through some form of new markets). Companies and policy makers must start to view consumers as a source of system services, for which the customers are paid and which potentially negates the need for additional infrastructure capacity elsewhere. Secondly, precisely because these are new markets, there is a need to establish trust, credibility and legitimacy. Thirdly, where there are market failures, designing effective interventions to address these will be needed.[28]

5.2 Facilitating local markets

Currently, virtually the only markets we have in the sector are essentially national markets for energy. With technological change (including within ICT) and cost reductions, energy production will become increasing decentralised, allowing the possibility of truly local energy markets. At the same time, smarter electricity grids and meters open up the possibility of a whole new set of system

[28] For example, there are likely to be externalities in demand-side response markets (ENA 2014). Equally, it is well-known that demand for energy efficiency suffers from a number of problems, including a bias against capital spend, information costs and uncertainty amongst consumers about benefits.

service markets (including frequency, voltage, possibly reactive power, reserve), and a greater balancing of demand and supply at the local level.

If we want to see local markets for energy and energy services formed rapidly and successfully, then some form of coordination through local platforms and setting of market rules through regulation will be necessary. This process will also allow the coordination of local markets with national ones, and the linking of local and national system balancing.

5.3 Open and transparent access to data

On the demand side, the current energy system is all about static estimates, whereas the future energy system will be all about data, at least half hourly if not real time. Data will be central to the new markets and services. Making data acquisition costly and difficult will slow the development of these markets and services; making data openly accessible and free will accelerate their formation.

A related issue is need for the monitoring and analysis of data to ensure fair market operation, strictly subject to the legislation on data privacy. The need for such a function arises out of the principle of placing consumers at the centre (see above). Only if market data is available to the regulator, and the regulator has the capacity to analyse that data effectively, can consumers be assured that large incumbent actors are not exercising market power. The recent CMA inquiry has highlighted the inadequacy of GB market monitoring.

5.4 Coordination

A consumer-centric focus and the development of local markets are essential principles, but enabling and adapting to change efficiently also requires coordination of policy making at a higher level, to minimise unintended and problematic policy interactions and to take macro-decisions in areas such as the future of national networks. As is emphasised in debates on the concept of a system architect, this does not mean central planning or micro-management (IET 2014). But it does mean some form of institutional arrangement through which decisions about how different parts of the system, including markets, should fit together can be taken, and then implemented. At the moment, as discussed in Section 2 above, this function is missing. Since the energy system is also highly complex, technical expertise will be a crucial requirement for whichever institution leads this process.

5.5 Long-term political stability

A major driver of energy system transformation is the urgent need to decarbonise the economy. Yet climate change is a long-term problem whose major impacts will affect future generations, while many of the costs involved in decarbonisation are up-front,[29] making this a politically difficult task. Achieving a degree of long-term stability in the direction of policy is therefore crucial. As discussed

[29] Although these can be met in a variety of ways, and do not all have to be placed on current consumers of energy - see, for example, Lockwood, M. 'Paying for climate policy: the case for long-term public borrowing' *Juncture* (on-line) (26 September 2013), http://www.ippr.org/juncture/171/11321/paying-for-climate-policy-the-case-for-long-term-public-borrowing

above, our main means of achieving this stability currently is through the Committee on Climate Change, which is limited both in the degree to which it can lead a transparent discussion about climate and energy policy to achieve a deep societal consensus on the direction and speed of travel, and in the degree it can connect high level carbon budgets with details of policy and regulation.

The issue of societal (and therefore political) consensus is particularly important. Above, we argued that as we move into a phase of deeper and more far-reaching transformation of the energy system, the approach of policy-making by consent may not be sufficient to maintain momentum, and that a more pro-active approach to assessing and building consensus may be necessary. In countries with proportional representation and frequent coalition governments, including Denmark and some other continental European countries, such consensus tends to be generated with the political process itself. In the UK, with its first-past-the-post electoral system and single-party governments, the political process tends by contrast to produce policy instability (Lockwood et al 2016).[30] The question is therefore whether greater stability could be reached through an alternative process. Such a process would have to bring together representatives of all major societal groups, but also, to give it legitimacy and political effect, the leaders of political parties as well. These actors would then have to negotiate a way forward that arbitrated between their different positions, and with information on the costs and benefits of action.

5.6 Transparency and legitimacy in policy making

Finally, energy policy making has suffered in recent years from an erosion of transparency and legitimacy in policy making, in part through extensive delegation to a range of different quasi-public and private actors, with attendant risks and, importantly perceived risks, of incumbent capture. To restore these crucial qualities, there needs to be an institutional pathway from decisions taken in the political sphere to the details of policy making that is clear to the average citizen.

In summary, what is needed is a whole system approach to governance, based on legitimate direction from the top, optimisation of supply and demand from the bottom up, and then middle out facilitation through system and market institutions.

6. An option for institutional change

Above we argued for a set of principles for shaping institutional reform in the British energy sector. To further stimulate debate, and reflecting our more detailed thinking, in this section we also offer some more specific proposals for how such principles might be operationalised. These represent one option for institutional reform.

These proposals take the form of a specific set of institutional arrangements, as shown in Figure 2. Within this new framework we have set out changes to some existing institutions, as well as the creation of some new institutions. As noted above, in our view what we are proposing does not

[30] See IGov blog post, *First-past-the-post Politics is a Major Barrier in GB to a Legitimate, Long term Energy Policy Framework*, 2 April 2015, http://projects.exeter.ac.uk/igov/new-thinking-first-past-the-post-politics-is-a-major-barrier-in-gb-to-a-legitimate-long-term-energy-policy-framework/

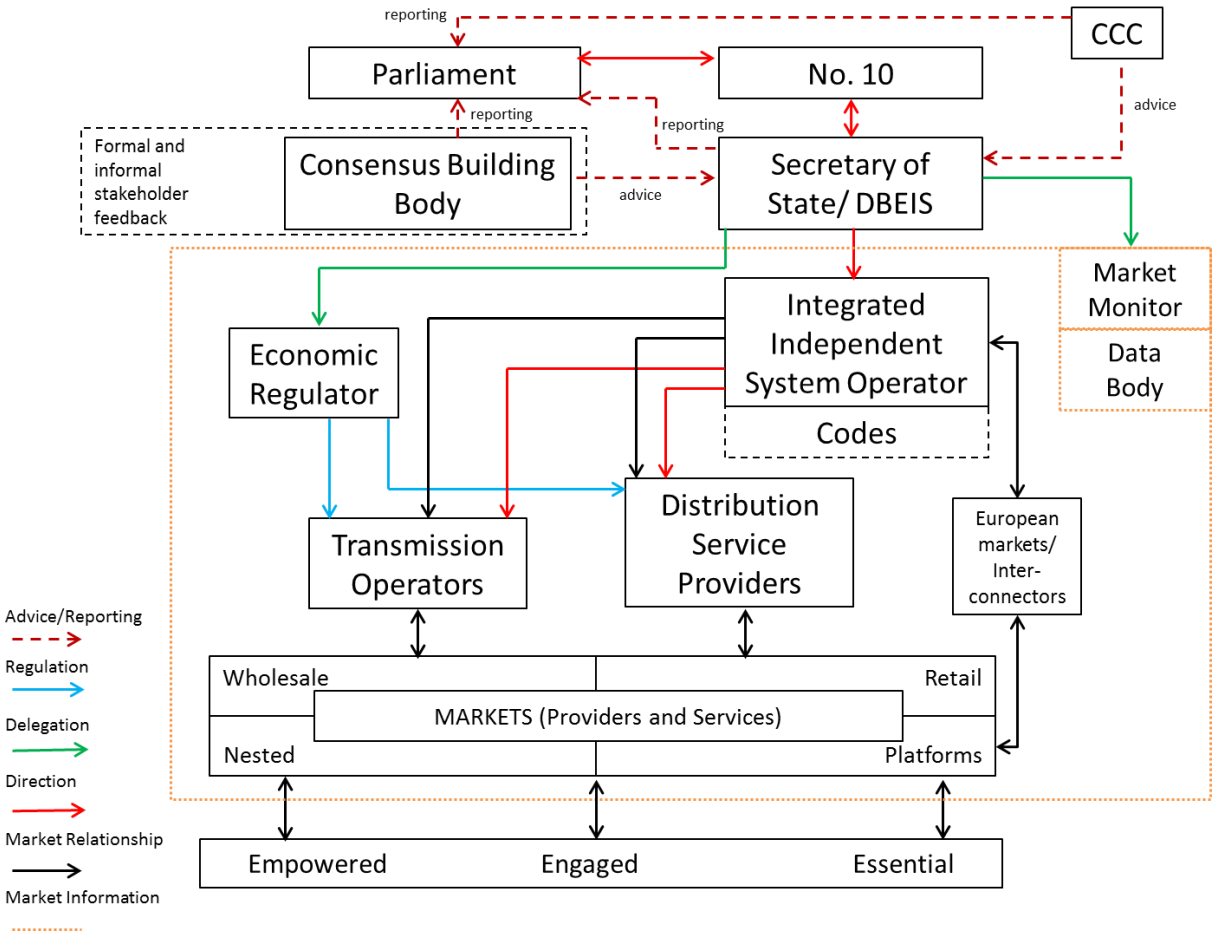
constitute significant or disruptive change; rather, it is a combination of what we already have and governance arrangements already in place in some other places, including Denmark and New York State in the US. The nature and role of each body, and the relationships between them, are described below.

6.1 Consumers

Above we argued that a new governance framework should start with and be centred on consumers. To build and offer legitimacy, credibility and trust we support the introduction of a Social Licence for all energy institutions and actors. We expect consumers to be able to capture a fair part of the value of any services they can offer to the system via the DSP markets (see below). Moreover, we support 'conversations' about energy with customers. Funds have to be available for this and should be bid for by those which wish to undertake the conversations. We propose that Citizen's Advice would have control over those funds which could be bid for by local authorities, small communities or companies. We also think DSPs (see below) should be enabling 'outreach', and this would be incentivised via their performance based regulation (PBR)s.

Figure 2

IGov institutional framework



6.2 Distribution Service Providers (DSPs)

A new governance framework must also facilitate the creation of local markets for energy services of all kinds, and including all potential actors, for example including community groups, cooperatives, local authorities etc. as well as companies. We propose that distribution network operators (DNOs) are transformed into 'active' Distribution Service Providers (DSPs), sitting at the heart of the future energy system.

DSPs effectively provide platforms for local markets and network services. They are distinct from, and go beyond, the distribution system operator (DSO) concept, in which DNOs take over some of the roles of the national system operator (e.g. related to system services such as on frequency and voltage control, possibly reactive power, reserve, handling constraint etc.) but which does not include energy services .[31] DSPs can be set up in numerous ways and a final choice still needs to be worked out. For example, the DSP can be a combined operator and wires company; it could be separate. The IISO could be an institution which combines the TO and DO – a true system operator which we conceptually support.

However, the DSP concept [as a way to link system operation, customer services, local markets and achieve government energy policy cost effectively, including encouraging energy efficiency across the system] seems to us to be potentially transformational.

The transformation of DNOs into DSPs will require change in the basis of regulation, away from anticipated demand and the asset value and towards a model where a larger proportion of their revenue is related to performance based outputs[32] and the extent to which they facilitate market transactions. This shift has started with the move from RPI-X to RIIO but does not go far enough.[33] The potential model for DSPs is the Reforming the Energy Vision initiative in New York state (NY REV).[34] This sees the move to DSPs taking about a decade, at which point they are envisaged as being the 'heart' of the electricity system with new values (or payments) available to new entrants for providing new services (both system and energy) to customers. We envisage DSPs as a means to operate the distribution area in the most energy efficient and cost effective way, including as the facilitator of market platforms, including a pool for energy and services, and as a way to complement government policies, such as renewable energy deployment and improving energy efficiency across the energy system.

Crucially, DSPs would provide a platform for 'nested' or local markets within distribution areas to enable companies, other actors and consumers to connect in new ways. Ultimately markets offer

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[31] The IGov project hosted a workshop on DSPs and the related distribution system operator (DSO) concept in May 2016. Presentations can be viewed at: http://projects.exeter.ac.uk/igov/category/events/igov-events/dsp-roundtable/

[32] See IGov blog post *Progressive regulation – what future for Ofgem?*, 26 October 2015, http://projects.exeter.ac.uk/igov/new-thinking-progressive-regulation-what-future-for-ofgem/

[33] See IGov blog post *Transformational regulation – comparing the NY REV and RIIO*, 11 August 2016, http://projects.exeter.ac.uk/igov/new-thinking-transformational-regulation-comparing-the-ny-rev-riio/

[34] See IGov blog post ***What, and how, the New York utilities are expected to transform to over the next decade – the New York REV's Ratemaking May 2016 Order*, 13 June 2016,** http://projects.exeter.ac.uk/igov/us-regulatory-reform-ny-utility-transformation/

new ways to buy and sell energy and services within the system in a more facilitative way than is currently the case, bringing value to both the system and consumers. 'Nested' or local markets within the distribution areas would have the choice to either sell into the DSP pool (for either supply or demand products) or directly into the national wholesale market. Customers – of different types – would buy and sell into any of those markets they chose to. Larger producers and customers may continue as they are buying and selling via the wholesale market. IGov would argue that new entrants, technologies, social preferences and so on are opening up new services and wishes and values in markets should be available for them.

The boundary between the IISO (discussed below) and DSP is complex. We support the principle that the system is optimised from the bottom-up via the DSPs. This is because customers and demand are inherently local, and a DSP is the way to maximise the capture of the demand side and to run a system optimally between supply and demand, including particular issues of system operation around specific places in the network or at specific times. In this way, the system is driven from the bottom-up. However, at some point the IISO may have to intervene to manage the system more efficiently. This is an area of institutional governance which needs more discussion.

Overall, IGov argues that a move to a DSP system seems to be the most logical way to both direct the energy system to meet Government goals whilst at the same time encouraging markets.

6.3 Independent Integrated System Operator (IISO)

Another key principle for institutional reform was the need for greater coordination in system design and delivery. Below we lay out a proposal for the design element; here we focus on delivery through an independent integrated system operator (IISO).

Because of the greater interactions in the future energy system between gas, heat and electricity (and increasingly, transport), and between the different levels of the gas and electricity networks (i.e. transmission and distribution), we propose the creation of an ***integrated*** system operator that works across all these areas. This reflects the fact that energy is a whole system: making changes in one place, will lead to changes in another part of the system and it therefore has to be integrated in order to run the system effectively.

In addition, greater co-ordination will be required between transmission and distribution, as discussed above. At the moment, the SO only really deals with transmission. We argue for a SO which takes an operator view across T and D. A SO which is linked to a TO, as is the case with National grid, will not be trusted by the DNOs.

The IISO would also be ***independent*** in that it would be separated out from the transmission operator, which would involve moving SO functions out of National Grid, where they currently sit. The IISO would take responsibility for long-term planning of networks, taking into account generation investments but also the evolution of storage and demand side response, and delivering the long-term strategy made at higher levels about the future of the gas network and heat networks. In these sense it would play the role of 'system architect' discussed by others, but with a wider framework set ultimately by the carbon budgets and the long term strategy set through a high-level energy and climate policy body (see below). Crucially, in undertaking this system operator role it

would have technical capacity and expertise that currently does not exist either in Ofgem or in BEIS. The IISO would also take on the roles currently played by the SO in electricity, including half-hourly scheduling, frequency management, reserve management and ancillary services, although these would be increasingly shared with the DSPs acting at the local level (see above). The transmission operators would retain the roles of owning, building and maintaining the transmission networks, and handling connections.

Because of the conflict of interest involved in co-locating transmission network ownership and system operation in a commercial company, the difficulties in setting commercial incentives for an ISO, and because its role is closely related to the delivery of policy, the IISO would be state-owned. The IISO will ultimately have responsibility for overseeing the delivery of energy system transformation to ensure policy goals for decarbonisation and system security are met, and for the energy system aspects of affordability. The IISO is directed by the government to ensure that it both acts to facilitate the carbon budgets set by the Committee on Climate Change.

The IISO would also house new arrangements for the governance of industry codes. Here, the key recommendation is that the current principle whereby industry itself effectively writes codes should end, and the initiative should pass to a dedicated codes management body that sits under the IISO. Codes should be changed to fit with the IISO decisions, as and when needed, although there will need to be clear and transparent links to relevant policies. To reduce complexity and duplication, code administration should come together within one body.

6.4 Data Body and Market Monitor

Open and transparent access to data, along with analysis of that data to ensure fair competition, was also identified above as key principles for a future energy governance architecture. We propose that a Data Body is created which treats data as a public good; it collects and provides access to available data within the system to ensure that the goals for energy policy are met.[35] However, the privacy of data on individuals would have to be protected under relevant legislation, with appropriate anonymization and data security provisions.

The recent CMA inquiry has highlighted the inadequacy of GB market monitoring,[36] so we also propose the creation of a new Market Monitor with oversight of all the institutions and markets in the energy system, operating independently of the economic regulator and other institutions. This body would monitor and report what is happening within markets openly and transparently. The Market Monitor and the Data Body will need to work closely together and are given remits directly from government.

[35] The DataHub for electricity in Denmark could provide a model for such a body.
[36] For IGov submissions to and reviews of the CMA energy investigation see http://projects.exeter.ac.uk/igov/?s=CMA+

6.5 Economic Regulator

IGov argues that the economic regulator should revert to its original role of being purely an economic regulator, with responsibility for regulating transmission operators and DSPs delegated from government. The wider responsibilities that it currently has in respect to social concerns and sustainability should be passed to other bodies in the system, and it should no longer be making policy decisions by default.

The economic regulator's environmental duties should effectively be passed to the state-owned IISO, which has responsibility for system security and transformation to a sustainable energy system to meet the CCC and [what we have called] the Consensus Building Body recommendations. Because the IISO would have more technical capacity than the economic regulator, it should be more able to drive technical discussions with the TO and DSPs. We argue that the economic regulator is the wrong institution to take responsibility for social concerns (primarily affordability and fuel poverty) with respect to the energy system.

The SoS would have hierarchy over both the economic regulator, and the IISO. However, the economic regulator and the IISO are on the same level of hierarchy – this is a resetting of institutional importance from where economics / competition / the market has hierarchy to one where the latter and a strategic framework to meet the CCC recommendations are on an equal footing. This is because IGov argues that we need more strategic direction in relation to meeting Government goals. Once that strategic framework is established, then markets can work.

6.6 Consensus Building Body

Above, we argued that a new basis for long term political stability to underpin sustainable energy policy may be needed as the scale and up-front costs of transformation to a more sustainable energy and transport system increase over the next decade. This is particularly a challenge for countries like Britain where the electoral and political system, does not by itself easily create consensus, and raises the question of whether a new process, outside the formal political process but connecting to political parties and ultimately feeding into government decision making, should be considered. This would be distinct from the current approach of delegation to technical committee (e.g. the Committee on Climate Change, the National Infrastructure Commission), as while it would involve the collection and analysis of technical data, it would integrate such activities together with a more political, consensus-building function.

There are few precedents for such an approach. Royal Commissions played an adjudicating role and took evidence and viewpoints from a wide range of actors, but are now defunct. In France, there were attempts to organise debates on climate policy involving a range of constituencies, although these failed largely because they did not connect with mainstream politics.[37]

We have not finally decided how institutional arrangements should be set up to meet this need – although we have called it a consensus building body. It seems to us that the basic function of the consensus building body would be to meet the current gap within GB policy-making of a way to agree a stable political consensus on how the UK can decarbonise, setting the long-term direction for

[37] https://en.wikipedia.org/wiki/Grenelle_Environnement

energy and transport policy in light of carbon budgets set by the CCC. It would provide an intellectual coordination of GB energy governance, including enabling a 'national conversation', involving all major political parties and social and economic constituencies, supported by expert input on technologies, behaviour change, costs etc. This would include gathering formal and informal feedback from all stakeholders operating with the energy system, including consumers and their protection. The body would also continuously monitor and review the progress of policies in the energy, buildings and transport sectors and report these back to government, industry and wider stakeholders. On the basis of this process, it would make recommendations to the government of the day on long-term strategy for meeting sustainable energy policy goals.

References

Bird J (2015) *Let's get it right: suggested framework for improving government low carbon interventions.* Report, Sustainability First, London

Carter, N., 2010. Vote Blue, go Blue: have conservatives forgotten about the environment? In: Paper presented at the Political Studies Association 2010 Conference, http://www.psa.ac.uk/journals/pdf/5/2010/130_1187.pdf

CSIRO and Energy Networks Association (2015) *Electricity Network Transformation Roadmap: Interim Program Report*, http://www.ena.asn.au/sites/default/files/roadmap_interim_report_final.pdf

Energy Networks Association (ENA) (2014) *Demand Side Response shared services framework Concept Paper*, Electricity Demand Side Response Working Group, ENA, London

Helm, D. (2012) *The Carbon Crunch: How we're getting climate change wrong – and how to fix it*, Yale University Press

IGov (2015) *Codes governance and reform discussion paper*, http://projects.exeter.ac.uk/igov/wp-content/uploads/2015/11/Energy-Codes-Discussion-Note-Nov-2015-updated.pdf

Institute of Engineering and Technology (IET) (2014) *Britain's power system,: the case for a system architect* Briefing paper, IET: London, http://www.theiet.org/factfiles/energy/brit-power-page.cfm

Keay, M., Rhys, J. and Robinson, D. (2012) *Decarbonization of the electricity industry – is there still a place for markets?* Working Paper 9, Oxford Institute for Energy Studies, University of Oxford.

Kuzemko, C. (2015) 'Energy depoliticisation in the UK: Destroying political capacity. *The British Journal of Politics and International Relations, 18, 1, pp 107-124*

Kuzemko, C. (2016) *Governing for demand management innovations in Germany* Working Paper 1601, IGov/Energy Policy Group, University of Exeter, http://projects.exeter.ac.uk/igov/wp-content/uploads/2016/02/CK-Governing-for-Demand-Mangement-Innovations1.pdf

Lockwood, M. (2013) 'The political sustainability of climate policy: the case of the UK Climate Change Act' *Global Environmental Change* 23, 5, pp 1339-1348

Lockwood, M. (2014) *Energy networks and distributed energy resources in Great Britain* Working Paper 1406, Gov/Energy Policy Group, University of Exeter, http://projects.exeter.ac.uk/igov/working-paper-energy-networks-and-distributed-energy-resources-in-great-britain/

Lockwood, M. (2015a) *The Danish system of electricity policy-making and regulation* Working Paper 1504, IGov/Energy Policy Group, University of Exeter, http://projects.exeter.ac.uk/igov/wp-content/uploads/2015/06/ML-Danish-model-of-regulation1.pdf

Lockwood, M., Mitchell, C., Hoggett, R. and Kuzemko, C. (2015) *Innovation and energy industry codes in Great Britain* Working Paper 1505, IGov/Energy Policy Group, University of Exeter, http://projects.exeter.ac.uk/igov/wp-content/uploads/2015/12/ML-Innovation-energy-industry-codes-in-GB1.pdf

Lockwood, M., Kuzemko, C., Mitchell, C. and Hoggett, R. 'Historical institutionalism and the politics of sustainable energy transitions: A research agenda' *Environmental and Planning C*, published on-line, (July 2016) http://epc.sagepub.com/content/early/2016/07/22/0263774X16660561.full.pdf+html

Lockwood, M. (2016) 'Creating protective space for innovation in electricity distribution networks in Great Britain: The politics of institutional change' *Environmental Innovation and Societal Transformation,* 18, 1, pp. 111-127

Maclean, K., Sansom, R., Watson, T. and Gross, R. (2016) *Managing heat system decarbonisation: comparing the impacts and costs of transitions in heat infrastructure* Centre for Energy Policy and Technology, Imperial College, London.

Mitchell, C. (2014) *Change and inertia in the UK energy system – getting our institutions and governance right* Working Paper 1402, Energy Policy Group, University of Exeter

Mitchell, C. (2016) 'Momentum is increasing towards a flexible electricity system based on renewables' Nature Energy 1, Article no. 15030, Published online 1 February 2016, http://www.nature.com/articles/nenergy201530?WT.mc_id=TWT_NEnergy

Mitchell, C., Woodman, B., Kuzemko, C. and Hoggett, R. (2015) Public Value Energy Governance, Working Paper 1502, IGov/Energy Policy Group, University of Exeter, http://projects.exeter.ac.uk/igov/wp-content/uploads/2015/03/Public-value-energy-governance.pdf

National Infrastructure Commission (NIC) (2016) *Smart Power* NIC, London, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505218/IC_Energy_Report_web.pdf

Pudjianto, D., Djapic, P., Auinedi, M., Kim Gan, C., Strbac, G., Huang, S. and Infield, D. (2013) 'Smart control for minimizing distribution network reinforcement cost due to electrification' *Energy Policy* 52, pp 76-84

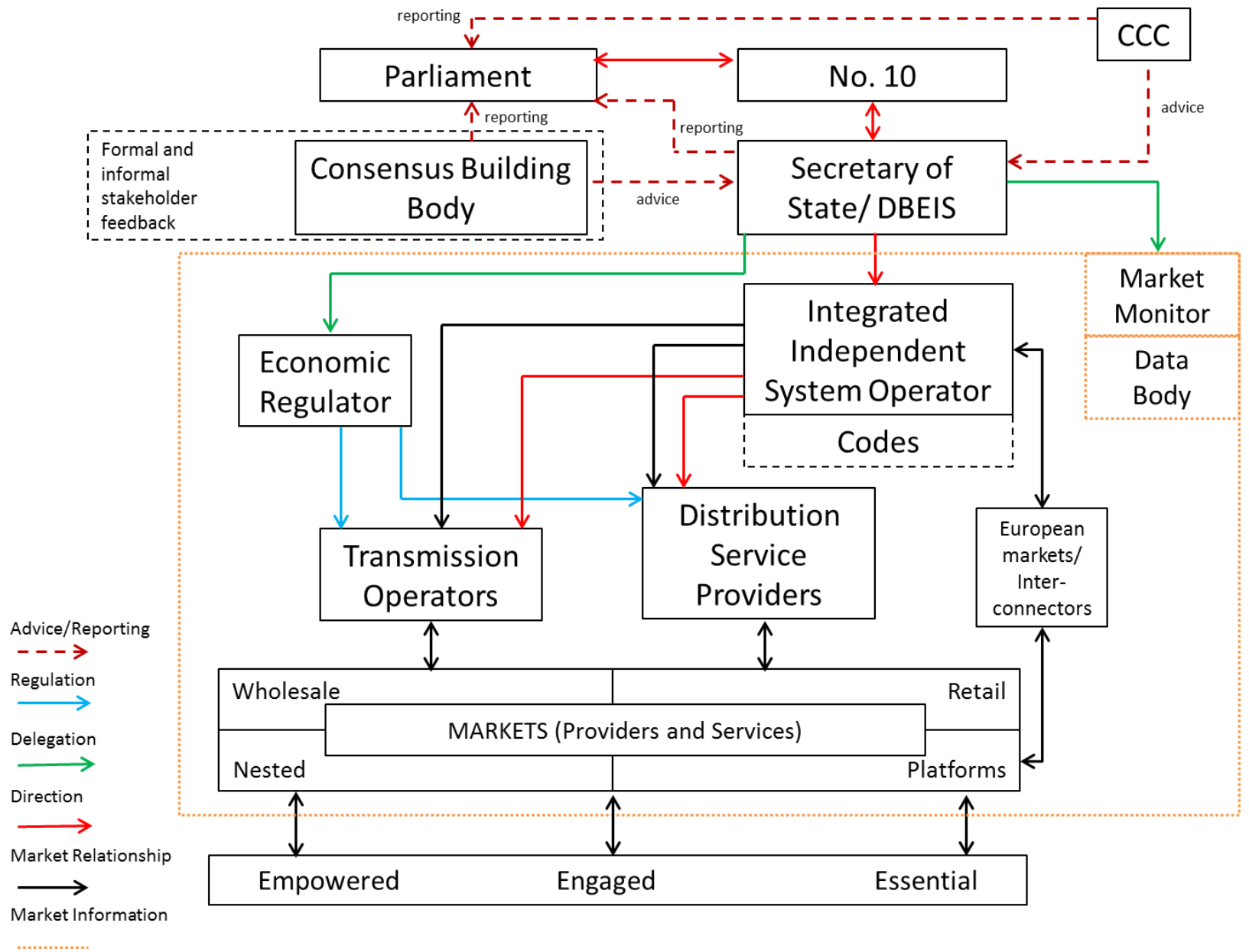
Steward, T. (2014) *Demand and decarbonisation in 2050: Themes from scenarios* Working Paper 1401, IGov/Energy Policy Group, University of Exeter

Strbac, G., Gan, C. K., Aunedi, M., Stanojevic, V., Djapic, P., Dejvises, J., Mancarella, P., Hawkes, A., Pudjianto, D. Le Vine, S., Polak, J. Openshaw, D., Burns, S., West, P., Brogden, D., Creighton, A., and Claxton, A. (2010) *Benefits of Advanced Smart Metering for Demand Response based Control of Distribution Networks* London: Energy Networks Association, Available at: http://www.energynetworks.org/modx/assets/files/electricity/futures/smart_meters/Smart_Metering_Benerfits_Summary_ENASEDGImperial_100409.pdf

Strbac, G., Pollitt, M., Kostantinidis, C. V., Moreno, R., Newbery, D. and Green, R. (2014) 'Electricity transmission arrangements in Great Britain: Time for a change?' *Energy Policy*73, pp.298-311

Willis, R. (2006) *Grid 2.0: The next generation* Green Alliance, London

Wilson. I. A. G., Rennie, A. J. R., Ding, Y., Eames, P. C., Hall, P. J., and Kelly, N. J. (2013) 'Historical daily gas and electrical flows through Great Britain's transmission networks and the decarbonisation of domestic heat' *Energy Policy* 61, pp. 301-305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