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Government Technology Policy and Innovation: The Use of Expert Advice in the UK Smart Grids Policy Framework

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Abstract

The purpose of this paper is to offer insights into the process by which technical knowledge underpinning policy decisions is incorporated into policy design and development. This growing need requires enhanced absorptive capacity within government, the development of domain-specific institutional memory, and an increasingly cross-departmental approach to policy design. The involvement of private-sector firms--today's most important repositories of applied, practical knowledge--is therefore becoming critical to policy formation. This raises major issues in the design of the policy development process as policy makers seek to elicit and integrate expert advice; identify and manage potential conflicts arising from commercial interests; and maintain democratic accountability. The necessary organisational arrangements and structures must then recognise that the use of knowledge and evidence by policy makers is highly sensitive to the political context of the day and the commercial interests of firms.

Knowledge derived from all the sciences is essential to making public policy choices. This is often captured in the pursuit of 'evidence-based policy', which has become an increasingly used term in discussions of policy design. It has been argued, however, that this approach to understanding the use of science and expert advice is still limited and that a more fruitful metaphor for a research framework is 'evidence-influenced politics' (National Research Council, 2012). This recognises that evidence emerges in the actual processes of policy design when expert advice is collated, interpreted and converted for use. The notion of 'evidence-influenced politics' requires deep knowledge of such processes.

In this paper, recent decisions in a specific domain of energy policy are analysed using this approach. Concerns about decarbonising the energy sector and enhancing energy security have led to an increased interest in government policy making about upgrading the electric power system and altering the patterns of electricity production and consumption in a cost-effective fashion. In particular, these drivers, in line with the prospects offered by advances in communications, control, sensing, storage and power electronics technologies, have provided some jurisdictions with an impetus to promote the roll-out of a set of technologies commonly known as smart grids.

The paper contributes to the development of the concept 'evidence-influenced politics' by drawing on the insights from

two other bodies of literature. On the one hand, this paper reviews the issue of evidence use from a knowledge utilisation perspective with an emphasis on the role that politics play in public policy decisions. On the other, it adopts the sectoral systems of innovation (SI) approach (Malerba, 2002) to map and explore the role and interactions of the different actors that produce knowledge for public policy making in a specific sectoral and technological setting.

This paper offers preliminary findings from an empirical case-based study on the way in which the United Kingdom government has produced and used expert advice to inform the development of the country's smart grids policy framework. The core data collection method consists of 56 in-depth, semi-structured interviews with senior civil servants (19), industry executives (19), leading academics (8) and senior representatives from other organisations (10) involved in policy development. A large volume of unstructured data found in the grey literature, such as government reports, public consultations and industry documents supplements the data collection strategy. Data are analysed employing an inductive approach with the help of the software package NVivo 10.

The initial decisions related to modernising the electricity consumption infrastructure in the UK were largely politically driven. Such decisions overlooked critical technical and economic implications that have since emerged as policy implementation discussions take place. In addition, the necessary engineering knowledge was fragmented and scattered not only within one but across several industrial sectors. As a result of this challenging landscape, more sophisticated organisational arrangements to elicit and discuss expert advice have been created.

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1. Introduction

There is a consensual view that advances in science and technology will help us solve some of our most critical social and environmental problems (The Royal Society, 2010). Our ever-increasing reliance on science and technology, however, raises a number of important questions: Is scientific and technical knowledge used to inform public policy decisions that are supposed to mitigate or solve a problem? If so, to what extent do decision-makers incorporate scientific and engineering knowledge into policy design and development and how do they do so?

The decarbonisation of the electricity sector is an area that has attracted the recent attention of governments and regulators in developed economies. As a result, policy makers have devised major technology policy programmes and experiments with the purported aim of facilitating the transition to a low-carbon economy and society. This paper seeks to offer insights into the processes by which policy makers—along with other relevant actors—have incorporated technical and scientific knowledge underpinning some of these interventions.

2. Analytical Framework

It has been argued that our current understanding of when, why, how and whether science is used in public policy making is still limited (National Research Council, 2012). Three arguments buttress this statement. First, typologies such as that of Weiss (1979) or Renn (1995), which aim to explain how science is used in policy, are difficult to apply empirically. As Nutley et al. note (2007), knowledge use is 'a dynamic, complex and mediated process, which is shaped by formal and informal structures, by multiple actors and bodies of knowledge, and by the relationships and play of politics and power that run through the wider policy context' (Nutley et al., 2007, p. 111). Second, Caplan's (1979) 'Two-Communities' theory[1] does not provide a systematic explanation of use. Caplan's theoretical construct highlights the gap between policy makers and scientists resulting from differences in language, values, beliefs and incentives (Caplan, 1979). However, this construct does not help clarify how those factors interact, or the extent to which each of them can contribute

[1] Inspired by C.P. Snow's Rede Lecture 'The Two Cultures' (Snow, 1959).

to explaining the use of science in policy (Bogenschneider and Corbett, 2010; National Research Council, 2012). Third, the evidence-based policy and practice approach has provided few insights as to how science is used. This approach recommends that policy decisions should be made based on the best available scientific evidence (Nutley et al., 2000). Its emphasis is on evidence of 'what works', leaving ideology and values out of policy choices (Cabinet Office, 1999). Although this approach has arguably helped centre attention on the supply side (i.e. knowledge production), it has not offered solid propositions about the conditions that enable the use of science in public policy making. These arguments suggest that social science research has to address the issue of use in a different fashion.

In the light of these findings, the National Research Council has proposed a new framework for research on use. This framework explicitly takes away the emphasis from searching for improved conceptualisations of use; understanding the relative weight of the factors that influence it; and finding better ways to encourage it in public policy (National Research Council, 2012). Instead, it makes three recommendations as to how social science research can contribute to improving our understanding of whether, how and when knowledge is used in policy making. Two of those recommendations are directly relevant for this paper. First, it contends that knowledge is used and interpreted in the world of politics: policy making will never be a value-free enterprise. Indeed, the consensus in the political science literature should 'serve as a warning against idealised visions of pure data being applied in depoliticised arenas' (Henig, 2012, quoted by National Research Council, 2012, p. 37). As a result, science should be looked at through the lenses of policy argumentation. From this perspective, the policy argument uses science—along with many other practical considerations—as a form of evidence to encourage and justify a certain course of action.

Second, the framework for research on use calls for an increased utilisation of systems thinking. Such an approach serves as an analytical device to determine the elements that might be part of a system and how such elements interact with each other. This is particularly valuable in the context of policy decisions that may relate to other interventions, potentially resulting in indirect, delayed or unintended consequences. Systems thinking 'is an iterative learning process in which we replace a reductionist, narrow, short-run, static view of the world with a holistic, broad, long-term, dynamic view, reinventing our policies and institutions accordingly' (Sterman, 2006, p. 509). Systems thinking also allows this paper to enlarge the original scope proposed by the National Research Council: instead of targeting the analysis exclusively at the products resulting from academic research, a systems perspective enables this paper to explore how both *scientific* and *expert* knowledge are used in policy making. In other words, the analysis is now expanded to include all relevant actors that contribute to knowledge provision for policy making. This broad definition of knowledge encompasses, for instance, scientific papers at one end of the spectrum, and more tacit and proprietary knowledge acquired as a result of the commercial activities of firms at the other.

This paper adopts a particular systems thinking: the sectoral systems of innovation (SSI) framework (Malerba and Orsenigo, 1997; Malerba, 2002; Malerba, 2004) to examine the interactions of the different actors that produce knowledge for public policy making in a specific industrial and technological setting. The SSI framework, built upon theoretical constructs such as technological systems (Bijker et al., 1987; Carlsson and Stankiewicz, 1991) and national systems of innovation (Lundvall, 1992; Nelson, 1993), emphasises the importance of industrial sectors as a key level of analysis for innovative activities. The three building blocks of a sectoral system of innovation—knowledge base and technologies, actors and networks, and institutions[2]—are the determinants which explain variance in structure, behaviour, and knowledge creation, diffusion and application processes across sectors and jurisdictions.

The SSI framework offers a useful conceptual underpinning that can be used to study particular aspects of how a given sectoral system might work. While the SSI framework and its more generic form known as systems of innovation[3] have devoted much attention to analysing the systems' components, the issue of how such systems emerge and evolve has been partly neglected in the literature (Edquist, 2011; Malerba, 2002). This paper seeks to address this gap by examining public policy processes. It therefore presents an effort to direct the attention to the policy making process by answering the question of how a selected national government has used scientific and expert knowledge to inform its public policy decisions. Thus, this research contributes to opening up the 'black box' of policy

[2] In this paper the term 'institutions' refers to the rules of the game, which may be binding or non-binding, formal or informal as described by Edquist (1997).

[3] In its more generic form, a system of innovation (SI) characterises innovations as the result of interactive processes among the elements of the system, that is, the way in which organisations and institutions relate to one another (Lundvall, 1992; Nelson, 1993).

making processes (Chung, 2013) whereby the interplay between actors and institutions shapes not only the context in which innovators operate (Edquist, 2011) but also the organisational arrangements that enable or constrain the use of scientific and expert knowledge in public policy.

In this paper, the sectoral system under study is the electricity sector and the chosen national government is that of the United Kingdom. For more than sixty years, the infrastructure that delivers electricity to UK households and businesses has largely remained unchanged. However, concerns about decarbonising the electricity sector and enhancing energy security have led to an increased interest in government policy making in modernising the electricity distribution infrastructure and altering the patterns of electricity consumption in a cost-effective fashion. These drivers, in line with the prospects offered by advances in information and communications technologies, have provided the UK government with an impetus to promote the deployment of a set of new technologies with the goal of achieving specific environmental and societal goals. This impetus is reflected in a public policy intervention hereafter referred to as smart metering.[4]

Smart metering is an infrastructure programme that involves the roll-out of residential 'smart' electricity and gas meters.[5] The emphasis of this intervention is therefore on the consumption component of the electric power system. Energy retailers, operating in a competitive market, are in charge of rolling out about 53 million smart meters by 2019. Two reasons justify the choice of the United Kingdom in relation to this policy area. Firstly, the country's residential smart metering programme is considered to be one of the most complex changeover engineering programmes in the energy industry in the past four decades (DECC, 2011), coming at an estimated cost of £11 billion to energy consumers. The complexity of the programme therefore encourages investigation of the availability, accessibility and quality of expert knowledge required to design such an undertaking. Secondly, the UK has not been amongst the first jurisdictions intervening in this space: California, Italy, the Netherlands, Northern Ireland, Ontario (Canada), Sweden and Victoria (Australia) have previously launched relatively similar initiatives. Thus, there is a question

[4] An updated version of this paper will incorporate findings from a complementary policy area focusing on the distribution component of the electricity sector: smart grids.

[5] This research concerns decisions linked to the electricity sector. However, gas meters are also mentioned throughout the study.

regarding the extent to which lessons from international experience might have contributed to informing the UK's smart metering programme. These two reasons make the United Kingdom a compelling case to be examined in the light of the proposed analytical framework.

The empirical setting in which this research takes place is therefore heavily influenced by engineering science: it is one where emerging technologies with different readiness levels—and uncertain benefits—need to be integrated with existing technologies, and tested and deployed at scale. It is in this context that the UK government and its relevant bodies are meant to produce, collate, interpret and utilise scientific and expert knowledge to inform their decision-making processes.

3. Methodology

The research design consists of a case study approach. This methodological technique allows the contextualising of complex real-life events or phenomena that have occurred over a period of time (Walsham, 1995; Gerring, 2007). Based on the grounds that the use of scientific and expert knowledge is the result of complex and mediated processes (Nutley et al., 2007), this technique is suitable to explore how such processes have unfolded in relation to the development of smart metering policy. The unit of analysis is the United Kingdom's electricity sector, with a narrow focus on its domestic consumption element.

The proposed case study employs two data collection methods: face-to-face interviews and unstructured data from documentary sources.[6] The core data collection method draws on in-depth, semi-structured interviews. In contrast to policy evaluation studies, some of which tend to look back several decades, or indeed to studies exploring policy change over long periods of time (Sabatier, 2007), a central feature of this case study is its emphasis on policy formation in near 'real-time'. The emphasis on the initial processes and interactions leading to the formulation of smart metering policy has been a compelling reason to seek access to policy makers, academics, private-sector representatives and other actors interested in influencing and shaping those processes. Indeed, the near real-time aspect of this research

[6] Both the interview data and the data from electronic secondary sources have been organised and categorised using the software package NVivo 10.

permits tapping into the various actors' experience, knowledge, perceptions and reflections about the use of scientific and expert knowledge in policy formation.

The identification of the relevant actors in the UK smart metering (and smart grids) landscape relied on two complementary techniques: snowballing sampling and document analysis. Snowballing sampling was used to compile the names of all relevant civil servants within government. It was initiated through high level contacts at the UK's Council for Science and Technology and the Policy Fellows programme run by the Cambridge University Centre for Science and Policy. These contacts provided an initial list with key names working on smart metering within the UK government. The first interviews with these civil servants served not only to obtain further names of officials affiliated to other government departments, but also names of other individuals working within non-departmental public bodies. With the help of this technique, a list of 35 names was produced.

Document analysis, in turn, supplemented the snowballing sampling. This technique was employed to identify industry leaders, academics and other relevant individuals working on smart metering. Documents such as industry reports, lists of participants in industry events, industry presentations, public consultations and regulatory decisions were scrutinised. As a result, two lists were compiled: one with 25 academics and another with over 150 representatives from firms and not-for-profit organisations with a stake in this space. In total, a personalised 'cold' e-mail inviting the recipient for a one-hour, face-to-face interview was sent out to 160 candidates out of over 210 people identified for the purposes of this research.

In the end, a total of 65 people (equivalent to a response rate of about 40%) from the UK smart metering (and smart grids) landscape agreed to participate in this research. The interview programme was broken down into three phases. Twenty-one senior civil servants were interviewed during the first phase; eight senior academics during the second phase; and thirty-six industry executives and representatives from not-for-profit organisations during the third and last phase. It is worth emphasising that this paper presents initial findings of the first phase of this research. Table 1 provides a condensed view of the participants' affiliations and job titles interviewed during that initial phase.

Public Body	Type of Public Body	Number of Interviewees
Committee on Energy and Climate Change	House of Commons, UK Parliament	1
Council for Science and Technology	Advisory non-departmental body	1
Department for Business, Innovation and Skills	Government department	2
Department for Energy and Climate Change	Government department	5
Engineering and Physical Sciences Research Council	Research Council	1
HM Treasury	Government department	2
National Audit Office	Audit of central government	1
Office for Gas and Electricity Markets	Regulator	3
Office for Low Emission Vehicles	Cross-departmental body	1
Office of Communications	Regulator	2
Technology Strategy Board	Non-departmental public body	1
UK Trade and Investment	Government department	1
Total		**21**
By Job Title		
Director		4
Head of		6
Lead		2
Senior Adviser		3
Senior Policy Analyst		4
Other		2
Total		**21**

Table 1. Interviewees from public bodies within the UK government.

The second and complementary data collection method for this case study relies on assembling a large volume of unstructured data. The unstructured data were gathered from a wide range of documentary sources, including: academic literature, working papers, books, policy and regulatory documents, government consultations and white papers, position papers, corporate presentations, websites and technical documents. In addition to helping delve into the historical elements of this case study, these secondary data sources have also provided an opportunity to triangulate and verify a number of claims, dates and facts, thereby allowing for more robust findings.

4. A Summary of the UK Smart Metering Policy Process

The discussions over domestic smart metering in the United Kingdom have spanned 13 years. The earliest document on the topic can be traced back to April 2000 when the trade association BEAMA[7] commissioned a report on the benefits of advanced utility metering (Owen and Ward, 2006).[8] However, it was not until 2006 that the idea of smart metering began to crystallise, both in Britain and Europe. In February, Ofgem launched its first major public consultation on the topic (Ofgem, 2006a). In March, HM Treasury made available £5 million to help co-fund[9] with retailers the Energy Demand Research Project (EDRP), trialling the use of residential smart meters and feedback devices (HM Treasury, 2006). In April, the

[7] BEAMA, the British Electrotechnical and Allied Manufacturers' Association, is one of the largest trade associations in the UK.

[8] See Owen and Ward (2006) for a succinct historical account of smart metering between 2000 and 2006.

[9] The original amount allocated to these trials was to be augmented to £9.75 million by the government a few months later.

European Commission introduced its Directive 2006/32/EC, encouraging Member States to provide 'electronic' meters and 'intelligent' metering systems (European Parliament and the Council of the European Union, 2006). The importance of EDRP was emphasised in two subsequent government white papers, 'The Energy Challenge', and 'Meeting the Energy Challenge'. In the latter, the government set out its ambition to see a roll-out of domestic smart meters subject to the results of this project (DTI, 2007). EDRP was launched in June 2007, with Ofgem managing the trials until their completion at the end of 2010.

On 28 October 2008, less than one year into EDRP, the Minister of State for both DECC and DEFRA[10] announced the government's intention to mandate a nation-wide roll-out of gas and electricity smart meters (House of Lords, 2008). This statement was followed by a new public consultation led by DECC in May 2009 (DECC, 2009a). Finally, on 2 December 2009, DECC communicated its decision to mandate the roll-out of both gas and electricity smart meters to all British households and small businesses by 2020 (Ofgem, 2009). The smart metering programme was to be divided into three phases: scoping study, detailed design, and implement design (Ofgem, 2009).

A new public consultation, which served as the basis for the scoping study, was published in July 2010 (DECC and Ofgem, 2010). DECC's and Ofgem's response was released in March 2011, in which they set out the key decisions underpinning the smart metering programme. First, they confirmed that the roll-out would be led by the energy suppliers in the context of a competitive market, commencing in 2014 and being completed by 2019.[11] Second, they determined that the government would require a set of minimum functional specifications, including the provision of an in-home display. Third, they resolved to procure a new, licensed Data and Communications Company (DCC) to centrally manage the programme's IT infrastructure. Lastly, DECC decided to take over from Ofgem the responsibility for managing the implementation of the programme (DECC and Ofgem, 2011).

The second phase of the programme (detailed design) began in April 2011 with the establishment of seven working groups. Since August 2011, DECC has published 15 further

[10] Lord Hunt of Kings Heath was Minister of State in both the Department for Environment, Food and Rural Affairs (DEFRA) and the Department for Energy and Climate Change (DECC).

[11] On 10 May 2013 DECC announced that the deployment will be delayed for one year, starting in autumn 2015 and being completed in 2020 (DECC, 2013).

consultations. It also presented its final Impact Assessment (IA) in April 2012, preceded by two others the year before. In its final IA document, DECC estimated the overall cost of the programme to be £10.9 billion with potential benefits of £15.7 billion. The latest set of major decisions made by DECC was announced in September 2013. The department made public the list of preferred bidders for the services that will be procured as part of the programme's data and communications requirements.

5. Results: The Use of Expert Knowledge in UK Smart Metering Policy

5.1. The Politics of Smart Metering and the Initial Search for Evidence

To be properly examined, the policy process has to be grounded in the wider political context of the day. In this sense, it is useful to recall the role that former Prime Minister Tony Blair[12] played in bringing climate change onto the UK's political agenda. Blair's aim was initially set out in the 1997 Labour Party manifesto (Labour Party, 1997). The subsequent energy reviews all pointed to climate change as one of the country's most pressing challenges (see for instance Cabinet Office (2002) and DTI (2006; 2007)). Moreover, Blair declared on several occasions that climate change was the most serious threat facing mankind (House of Commons, 2005). Blair affirmed that it was thanks to the UK's presidency of the G8[13] in 2005 that the issue of climate change was finally put high on the agenda at an international level (Blair, 2007). The UK, eventually, became the first country to set legally binding carbon reduction targets (GOV.UK, 2013). This wider picture of the political importance of climate change in the UK sets the scene for understanding the genesis of smart metering.

Although the idea of smart metering began to gain traction in government documents published from 2006 onwards, there is an important element that helps explain the emphasis on energy efficiency in the public policy discourse. DTI's 2003 white paper 'Our Energy Future. Creating a low carbon economy' offered no support for new nuclear plant (DTI, 2003). This was a politically sensitive issue that had been put on one side until after the general election of 2005. As a result, both DTI and DEFRA started looking for alternatives

[12] Tony Blair was Prime Minister from 2 May 1997 to 27 June 2007. Gordon Brown was Tony Blair's successor until the Labour party was defeated in the May 2010 general election.

[13] The eight most industrialised nations in the world.

that would address some of the needs prompted by the intended curtailment of nuclear power generation. It was at this point that smart metering was identified as a potential solution that could help reduce electricity demand due to the foreseen reduction in electricity supply. Thus, in its 2004 Energy Efficiency document, DEFRA committed to reviewing the metering arrangements with civil servants from DTI and Ofgem (DEFRA, 2004).

As government support continued to build around the pursuit of energy efficiency measures, in 2005 HM Treasury affirmed that the UK had started negotiations with the European Union regarding Directive 2006/32/EC. More importantly, however, it stressed the importance of undertaking further work to understand the potential of consumer feedback to generate reductions in energy consumption: 'there is *little available data* [emphasis added] on the impact of such schemes in the UK, and the review highlights the need… to evaluate further the potential of different forms of enhanced feedback to consumer feedback [*sic*]' (HM Treasury et al., 2005, p. 9). This statement recognised that the government did not have the necessary evidence to allow it to make an informed decision on whether smart metering should be implemented.

In March 2006, the think tank Sustainability First published a report[14] on domestic electricity smart metering, which included references to international experience in this area (Owen and Ward, 2006). The report suggested that, subject to further work, the cost-benefit analysis (CBA) of smart metering in the UK was likely to be positive, as was the case in 'many other countries' (Owen and Ward, 2006, p. 8). It concluded that undertaking a large trial would be useful to further inform regulatory interventions. This report coincided with the announcement by HM Treasury, also in March 2006, of the allocation public money to co-fund the EDRP.

While at that time DTI's officials were relatively passive in relation to smart metering, DEFRA's civil servants had taken the lead on energy efficiency initiatives within the government. DEFRA commissioned a review of the literature on the effectiveness of

[14] This work was sponsored by five energy retailers (British Gas, EDF, E.ON, npower and SSE), a British meter manufacturer (Ampy),[14] an IT solutions supplier (IBM), a consumer association (EnergyWatch) and a charity (Energy Saving Trust), signalling an increasing interest in smart metering from industry. One author is former Group Head of Public Affairs for National Grid and the other a former non-executive member of Ofgem's board.

feedback on energy consumption from an Oxford researcher (see Darby (2006)). This review concluded that direct feedback mechanisms from various different schemes around the world had shown energy savings of between 5% and 15%. DEFRA's position at that stage was to provide better consumer feedback, rather than engage in a mass roll-out of smart meters. DEFRA then developed a proposal[15] in 2007 which was about deploying in-home displays clipping on to existing electro-mechanical meters to provide real-time consumption information (DTI, 2007). However, DEFRA's proposal was strongly criticised by industry and ultimately DTI decided to overturn this idea.

It was against this background that the EDRP, managed by Ofgem, kicked off in July 2007. Civil servants from Ofgem, BERR (DECC from October 2008) and DEFRA were sitting on EDRP's project board. The private sector representatives on the EDRP were EDF Energy, E.ON, Scottish Power and SSE.[16] The results of these large scale trials were to be reported in August 2010 and were meant to inform policy development in this area.[17] Nevertheless, in October 2008—about 22 months prior to the conclusion of EDRP and notwithstanding the public rhetoric about the importance of large-scale trials—the Minister of State for DEFRA and DECC[18] announced, in the House of Lords, the government's intention to mandate a universal roll-out of residential smart meters. This statement made clear the existing fault line between the politicians and the civil servants: while the latter were working on building an evidence base, the former determined the policy direction that the UK would adhere to, regardless of the results of the trials.

In November 2008, the Energy Bill 2008[19] was given Royal Assent, conferring powers on the Secretary of State to mandate a smart metering roll-out. In early 2009, the Telegraph claimed that Lord Truscott, who had been Parliamentary Under-Secretary for Energy at DTI between 2006 and 2007, was a paid consultant to Landis+Gyr, one of the largest meter manufacturers worldwide (Winnett and Rayner, 2009). Lord Truscott had been heavily

[15] Largely driven by David Miliband.

[16] Three energy retailers invited academic partners to join the EDRP. EDF was associated with one researcher from SPRU; E.ON with two academics from De Montfort University; and SSE with two researchers from the University of Reading.

[17] They were actually delivered in June 2011.

[18] Lord Hunt of Kings Heath became Minister of State in both DEFRA and DECC.

[19] Of 26 November 2008.

involved in driving smart metering policy and had lobbied the responsible BERR Energy Minister Malcolm Wicks—and other civil servants—to amend the bill so that it included the UK commitment to a national roll-out. The House of Lords' Privileges Committee concluded that the Labour peer had indeed tried to exercise parliamentary influence in return for a financial inducement.[20]

Finally, in December 2009 the UK government announced its decision to mandate the roll-out of smart meters in every British home by 2020, with the full support of the energy retailers, IT companies and consumer associations. The decision was also justified by the introduction of a new European directive, Directive 2009/72/EC, which mandated the implementation of intelligent metering systems to at least 80% of consumers subject to a positive cost benefit analysis (European Parliament and the Council of the European Union, 2009). Thus, DECC and Ofgem were unable to base their policy on the results of the EDRP, which had been identified as an essential step to gather further evidence of how such a scheme might work in the UK.

The change of government in May 2010 did not pose a threat to the programme. The newly-elected Prime Minister, David Cameron, had an ambition to detoxify the brand of the Conservative party—often associated with acrimonious attitudes towards polices aimed at improving the environment. Visiting DECC a few days after being sworn in, Cameron declared that he wanted the coalition to be 'the greenest government ever' (DECC, 2010). Thus, the smart metering programme was given the green light and both DECC and Ofgem carried on with the work leading to the publication of the Prospectus in July 2010. If anything, the programme became a priority for the government: not only was DECC going to take over from Ofgem the responsibility for managing its detailed design and implementation, but the programme was also to be highlighted in the National Infrastructure Plan 2010 (HM Treasury and Infrastructure UK, 2010); and it was subsequently included as one of the top forty major infrastructure projects in refreshed versions of that document.

One widespread view amongst civil servants working on the programme is that DECC's policies are determined by the active consumer view of the world. Smart metering is indeed

[20] He was subsequently suspended from Parliament for six months until November 2009 (BBC, 2009). The last suspension in the House of Lords dates back to the 17th century.

a case in point: this programme has been framed as a consumer initiative, one which requires active consumers to monitor their electricity and gas, and take action to reduce consumption. Policies framed in such a way fit better with the political narrative about fighting climate change. In addition, politicians prefer to leave their mark with visible, consumer-oriented policies, which may have a lasting impact in the voters' memory. In the civil servants' eyes, ministers see smart metering and in-home displays as 'the sort of bag of goodies that will give benefits to consumers'. As another official commented: 'there are things that are sexy at the time; these areas involving climate change ICT are all sexy'. By promoting these types of initiative, ministers aim to be perceived by the electorate—and their own peers—as major players in the government.

This view serves to better illustrate the genesis of the smart metering programme: it has a strong foundation rooted in the ministers' own political ambitions and agendas. This would also help explain why there has been ample support for the programme across the entire political spectrum, as emphasised by a senior official: 'there is no difference in the essential interest of politicians in information and communications technologies (ICT). They all want to do all the things the previous lot had been doing and more'. In Britain, more generally, decisions to implement policies involving ICT tend to be made very quickly and well ahead of an evidence base being gathered, as noted by senior civil servants who have worked with ministers of all parties.

5.2. The Economic Case for Smart Metering

HM Treasury's Green Book is the reference document in government that summarises guidance and best practice to civil servants in relation to the delivery of public services. In particular, it states that 'comprehensive but proportionate assessment' must be carried out for all new policies, programmes and projects. It recommends that monetary values are attributed to the impacts of any new initiative and that a cost-benefit analysis is performed to account for the wider social costs and benefits (HM Treasury, 2013). From the Treasury's point of view, a positive assessment is a key piece of evidence that informs policy formation; it is therefore a fundamental prerequisite for any policy or programme to gain approval from the Treasury's spending teams.

Following HM Treasury's guidelines, the smart metering intervention has been subject to various CBAs and impact assessments (IAs). Ofgem carried out the first public sector CBA which yielded negative results for a supplier-led roll-out (Ofgem, 2006b). Mott MacDonald was then commissioned by BERR to undertake a comprehensive economic assessment of different roll-out models. In April 2007 they concluded that 'the provision of feedback through advanced metering solutions… is not favoured in terms of overall NPVs [*net present values*]', with 'the assumptions, methodology and spreadsheet model… [*having been*] extensively scrutinised by BERR, DEFRA and HM Treasury economists' (Mott MacDonald, 2007, pp. 88 and 93).

One year later, BERR published a new economic assessment which had been undertaken internally. This exercise also showed negative results for a range of mandatory roll-out options (BERR, 2008). However, after signposting the intention to mandate a nation-wide roll-out in October 2008, DECC published yet another assessment in May 2009, which yielded positive results for the first time (DECC, 2009b). Following the decision to mandate the roll-out in December 2009, and once DECC had established the particular roll-out model to be followed, all subsequent cost-benefit analyses[21] returned a positive result around £5 billion.

Coming at a cost of almost £11 billion, which will be passed on to consumers through their energy bills, the economic case for the programme has received close scrutiny. In particular, Alex Henney[22] produced a critique of the various government assessments pointing out the change of £9 billion in NPV benefits between the Mott MacDonald assessment and the final one from DECC (Henney, 2012; Anderson and Henney, 2012). In this criticism, he has vehemently disputed the unreliability of DECC's costs and benefits, the reduction of optimism bias factors, the choice of the discount rate, and the capital costs of the programme compared to other initiatives of similar size.

Notwithstanding the debate on the assumptions, civil servants offer important explanations of how the CBAs fit into policy formation and how these exercises actually get conducted in practice. Civil servants perceive economics as the discipline closest to policy, given that every decision in government is mediated through cost-benefit analysis. The rationale is

[21] The latest CBA combines domestic and small and medium non-domestic sectors with a NPV of £6.6 billion.

[22] Alex Henney was chairman of the London Electricity Consultative Council and a board member of the London Electricity Board. He was one of the first proponents of the privatisation of the British electricity industry. He has published two books on the history of British electricity reforms.

simple: if a decision is deemed to be expensive, the government should not be spending money on it. Thus, when a new policy area is under discussion, there is a sense within the civil service that policy analysts will inevitably 'embark frantically on a CBA' to verify whether the intervention is economically viable or not.

Policy analysts then need to start searching for the costs associated with that intervention. For them, this quest, in theory, does not represent a major hurdle. In complex infrastructure projects, where different technologies are being assessed, civil servants typically employ two methods to access costs: they either hire the consultants used by the private sector who sell the same figures to government afterwards, or initiate requests for information processes targeted at industry. For the most part, civil servants are confident of getting the costs right, although reasonable doubt could be cast on whether they possess the necessary expertise to examine critically the information provided by third parties.

The real problem for the analysts, however, is how to quantify the benefits of a policy intervention. Some of the benefits in the smart metering programme are intangible and therefore hard to estimate. In addition, there is a widespread view amongst civil servants about the uncertainty of some benefits in the longer term, in particular how consumers are likely to respond to feedback on their energy consumption. Thus, CBAs are usually seen, by the civil service, as pieces of evidence over which there will inevitably be *a lot of* negotiation around the purported benefits.

If there is indeed at least some degree of negotiation over a programme's benefits, this might help explain the response given by civil servants after being asked why they needed to carry out a new assessment after the one commissioned from Mott MacDonald: 'it gave the wrong answer', was the reply. While it is true that CBAs can be refined over time, the impact assessments of the smart metering programme appear to have served as an ex-post rationalisation of decision making by ministers rather than a robust input for policy formation: '[…we were] doing what ministers want to do, which is massage the whole story and do as positive a case as possible', reflected a civil servant working on the smart metering programme. Consequently, these impact assessments could be regarded more as political documents than technical documents. As another civil servant explained: 'if there is political will to do something, then the evidence gets sort of squeezed and squashed'.

5.3. DECC's Organisational Set-Up

This paper has argued so far that the use of evidence leading to the smart metering mandate was superseded by political will. Although evidence from EDRP and some international reviews had begun to be collected and analysed by the civil service, the potential energy savings from smart metering—one of the programme's main objectives—were still a matter of debate in and out of government. However, the coalition's commitment to rolling out smart meters meant that DECC had to move from a policy formation phase to a delivery one, which included a major design component as well as the actual programme implementation. Therefore, several key decisions have had to be made by DECC, implying the need to collate further evidence and elicit new expert knowledge in a range of technical domains.

Initially, DECC's core comprised the former DTI (and then BERR) energy team. DEFRA's climate change team—much smaller than the former DTI energy team—complemented DECC's structure. Smart Meters Policy was then taken out from the original energy team and assigned to the climate change team. Smart Meters Policy was finally placed under the Fuel Poverty & Smart Meters team, sitting under DECC's International Climate Change and Energy Efficiency Directorate. Leaving Smart Meters Policy within this Directorate meant that this area would be dealt with as an energy demand issue: all interventions aimed at energy supply fell under the Energy Markets and Infrastructure Directorate. This revealed both a conceptual and organisational split between energy demand and supply, instead of treating the two as interdependent issues.

When the smart metering programme was transferred from Ofgem to DECC in March 2011, so were the contracts of about 45 civil servants who were working on the programme's delivery at the regulator. This was to become DECC's Smart Metering Delivery team, sitting under Fuel Poverty & Smart Meters. In this organisational structure, Smart Meters Policy is the team responsible for recommending critical decisions on the programme to ministers. However, it is argued that one particular organisational arrangement has been instrumental in providing expert technical advice for the delivery phase of the programme: the Science and Innovation team lead by DECC's Chief Scientific Adviser, appointed in October 2009. The CSA's main role consists of providing 'a source of independent challenge… to ensure that policy decisions are informed by the best science and engineering advice' (House of

Lords, 2012, p. 5). DECC's CSA is a Director General level job, reporting directly to the department's Permanent Secretary and having wide-ranging access to the department's business.

It is important to note that, at the time of its creation, the department's in-house engineering resources were severely constrained. Most engineers within DECC worked in the oil and gas licensing area, which had been the department's traditional area of activity, inherited from BERR and DTI. Moreover, during the Science and Engineering Assurance Review carried out by the Government Office for Science (Government Office for Science, 2012), the group leading it discovered that the ratio of senior level economists to senior engineers in DECC was 100 to 1. Thus, new policy domains such as smart metering and renewables had no dedicated engineering expertise.

At the time of the creation of DECC, most of the technical advice required in these new policy areas came from external consultants—and it was widely assumed at DECC that this ought to be the best way of fulfilling internal knowledge gaps. During the fiscal year 2009-10, DECC's expenditure on consultants was 40% of its total staff costs (NAO, 2010). However, with the austerity measures promoted by the coalition government, the departmental budget for outsourcing expertise was reduced. In parallel, some policy areas had struggled to get fundamental analytical work right, leading the department to face big business risk issues as flagged by the CSA. These problems eventually led to the creation of the Head of Engineering, a position which was filled in August 2012.[23] DECC's simplified organisational set-up is shown in Figure 1.

[23] A year after the creation of the Head of Engineering position, the central Engineering team contains 40 engineers as of August 2013.

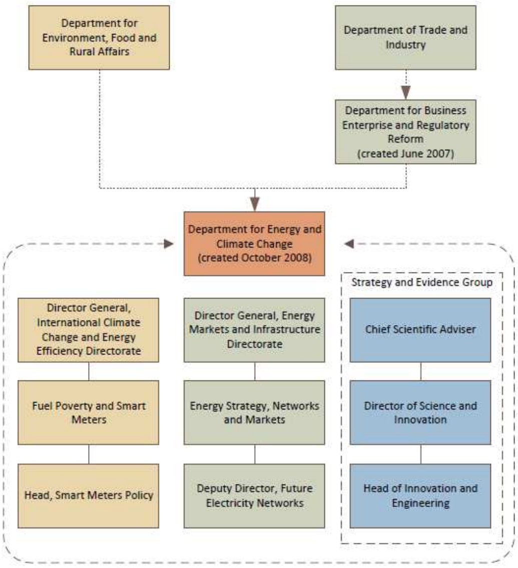

Figure 1. DECC's Organisational Set-Up.

The work of the Engineering team initially focused on resolving two problems. First, they found wrong underlying technical assumptions in various policy areas, which had to be rectified in order to lower the risk exposure faced by the department. Often, the models underpinning some decisions had been created by consultants, whose knowledge had never been challenged internally. Second, procurement exercises were run by different policy teams that did not talk to each other, meaning that opportunities for purchasing more intelligently were being lost.

The smart metering programme was no exception to these problems. Thus, the Engineering team has been able to provide on-demand technical expertise to the programme in areas such as communications networks, security and demand-side response. Furthermore, it has helped run the procurement process of the Data and Communications Company, a critical step in the delivery of the programme. In addition, the Head of Engineering sits on the Smart Metering Programme Board. This has enabled him to raise awareness about the programme's technical risks as well as helping link the programme with other related policy areas within DECC, some of which fall under the Energy Markets and Infrastructure Directorate.

Reflecting on the role of the Engineering team, officials noted that civil servants in charge of providing science and engineering advice within government tend not to be delivery focused: 'you can't come back and say: you know? It takes two years and two million pounds to answer this question'. Indeed, the commercial pressures of the business world would not allow such a passive stance. For this reason, the Engineering team has brought in technical experts with hands-on commercial experience: their aim is to find the middle ground enabling faster yet robust answers.

This pragmatic approach to resolving difficult technical questions has gained notoriety with ministers and civil servants alike and is arguably better aligned with the short timescales associated with the clock of political decision-making. With the Engineering team well established and an internal reputation earned, ministers have also learned to try to align their public statements with the existing technical evidence. In the most extreme case, ministers had been told that certain ideas are simply unfeasible given that they would break the laws of physics. Therefore, ministers are now more prone to seek engineering advice in order to minimise the possibility of failing to deliver their public commitments.

The creation of a central Engineering team within DECC has also enabled the establishment of new communication channels with the engineering community outside of government. Instead of following the traditional stakeholder management routes such as consultations, the professional networks to which members of the Engineering team belong have been extremely valuable in sounding industry representatives out. These networks, purely based on trust and past collaboration, provided an early warning to the Engineering team that a House of Commons' Select Committee wanted to question independent experts about the programme's risks. The Engineering team was then able to arrange a meeting between the Smart Metering Delivery team and members of the Energy and Climate Change Committee outside of the formal proceedings of a Select Committee hearing. In the end, this meeting was beneficial for both the civil servants leading the programme and the politicians overseeing it, resulting in the welcomed decision of delaying the programme one year.

All in all, the strengthening of the department's central technical expertise, along with its statutory role guaranteeing its independence vis-à-vis ministers, have been essential in helping the smart metering programme make more informed decisions. Moreover, the work undertaken by the CSA and his team has led to the creation of a departmental evidence strategy. If implemented, this strategy would mean that every Senior Responsible Officer (SRO) would be accountable not only for signing his or her programme off but also for the corresponding evidence plan. SROs would then be acknowledging missing evidence in their programme as well as stating the corresponding actions envisaged to mitigate the evidence gap. The CSA's team has had a positive impact on the smart metering programme, including the development of an evidence strategy. This demonstrates the importance of the organisational set-up in enabling the use of evidence and expert advice in government policy making.

6. Discussion

This paper has sought to offer insights into the processes by which technical knowledge has been incorporated into smart metering policy design and development. Knowledge derived from all the sciences is essential to making public policy choices. This is often captured in the pursuit of evidence-based policy, a term which has been used increasingly in both academic and practitioner discussions of policy design (Labour Party, 1997; Nutley et al., 2000; Bogenschneider and Corbett, 2010). This term represents an idealised, value-free notion of the world of policy making. However, the empirical analysis of smart metering policy formation in the UK has revealed a different picture. On the one hand, the initial search for policy ideas has shown the extent to which politics have influenced decision-making within government in relation to smart metering. On the other hand, the phase of policy design and implementation has uncovered how one specific organisational arrangement within DECC has facilitated the provision of expert advice in the context of a large technology programme.

The initial search for policy ideas seems to have been influenced by the ever-increasing importance of climate change in the country's political discourse. The ministers' ambitions to become catalysts of change in a traditionally conservative sector found echoes in the energy retailers, the IT companies and consumer organisations—and were also influenced by European directives. The large-scale pilot to which the government committed in order to test their ideas had little influence on the early decision to mandate the rollout of this technology. In fact, the empirical data obtained from in-depth interviews with civil servants show that evidence is never technical from a minister's perspective. Policy argumentation for an intervention, from a minister's point of view, is therefore reduced to figures showing the potential of an idea in terms of economic growth, job creation and money savings. This is perhaps an indirect result of the economic austerity measures implemented since the coalition government took office in May 2010.

In 2006, when smart metering entered the government's agenda, DEFRA had a specific interest in better understanding how customer feedback interfaces could help reduce energy demand. The hope of DEFRA's policy team was that such mechanisms were the key to realising environmental benefits. This concern led one civil servant to retrieve a PhD conference paper from 2000 on the topic. The author of that paper, who had since left that line of inquiry, was then invited to conduct a refreshed version of it in the form of a literature review. The resulting piece is probably the only product of academic research that has had an impact on the smart metering policy process. The findings of this piece of secondary research—which was not peer-reviewed—were used in the various government impact assessments and led to the decision to require in-home displays along with smart meters in every UK household. To civil servants, the importance of both EDRP and the academic work commissioned did not turn upon getting accurate answers to all the open questions raised by the potential rollout. Instead, they served to confirm the sense of direction originally envisaged by politicians.

The decision to deploy smart meters brought about a host of new challenges in terms of getting access to technical knowledge—very likely on a scale that had not been anticipated in 2006. The complexity of the programme required inputs from a broad set of disciplines, including power systems, computer science, telecommunications, security engineering, IT processes and integration, and consumer behaviour. However, Ofgem, originally conceived as an economic regulator, soon faced the fact that it did not have the necessary competencies to manage the smart metering programme. Similarly, when the programme was transferred to DECC, the government department in charge of setting energy policy realised that it had inherited an organisational structure that was extremely limited in terms of engineering knowledge. Indeed, the privatisation of the UK's electricity industry had resulted in the inadvertent fragmentation of knowledge and the dismantling of the advisory system that used to inform technical decisions.

DECC addressed these knowledge gaps by relying almost exclusively upon industry knowledge. Since 2010, the department has issued a long list of consultations about the different aspects of the programme; it has also organised several expert working groups to design key aspects of the proposed technical solution. At the same time, the Smart Metering Delivery team had to be expanded, mostly via contractors, to cope with the programme's growing scale and complexity. This all meant that the sources of knowledge for DECC were, for the most part, external to the department. Without an adequate mechanism of checks and balances against vested interests, the programme's risk exposure was being left uncontrolled: critical decisions had to be scrutinised internally.

In response to this need, an Engineering team reporting to DECC's Chief Scientific Adviser was set up to challenge technical assumptions and provide ad-hoc knowledge to the programme—and indeed to the entire department. Three specific features of this organisational arrangement have been essential to achieve these goals. Firstly, it has statutory authority to operate independently from both the department's political decision-makers and the Smart Meters Delivery team. Thus, it has been able to shield the programme from the contractors' own interests and their often ill-advised technical recommendations. Secondly, it has served as a bridge between different directorates and programmes within DECC. By having an overarching view of the department's business, the Engineering team has been able to address coordination problems. This has provided the department with an opportunity to develop a systems-oriented approach to policies by identifying interdependencies among previously unconnected interventions. Thirdly, by bringing in individuals with commercial expertise, the Engineering team has adopted a pragmatic approach to resolve complex technical issues. Such an approach has enabled the team to focus on delivery, hence completing critical aspects of the programme on schedule, including the government-procured Data and Communications Company.

This paper has sought to focus into the initial stages of the policy making process. By doing so, it has offered the insight that, at the highest level of decision-making, politicians have a monopoly on ideas for policy interventions. In this sense, this paper provides empirical evidence supporting the suggested metaphor of 'evidence-influenced politics' (National Research Council, 2012). Furthermore, instead of choosing from the menu of available policy-making models, this research has opted to focus on one organisational arrangement that has been instrumental in enabling the use of expert advice in public policy. The initial findings presented in this paper contribute to sustain the idea that organisational arrangements do matter (National Research Council, 2012; Nutley et al., 2002). An improved understanding of different organisational arrangements is therefore essential if the connections between the sciences and public policy is to be strengthened. Finally, this research has also shown that in the context of this sectoral analysis, Caplan's 'Two-Communities Theory' (Caplan, 1979) is a model that does not longer hold: firms are today's most important repositories of applied, practical knowledge. As such, governments are more susceptible of tapping into their expertise in order to assist the policy development process. This, in turn, raises major challenges in the design of organisational arrangements that seek to integrate expert advice. These must be able to identify and manage potential conflicts arising from commercial interests while at the same time maintaining democratic accountability.

7. Further Research

This paper has presented only part of the findings of a larger study comprising a bigger sample of actors. An updated version of this paper will establish the links between smart metering and smart grids in the UK. In addition, it will analyse further the role played by other public bodies in relation to these policy areas, offering a detailed view of the various existing efforts towards collating and integrating expert advice in government. Finally, it will examine the role of private-sector firms and academics in the policy development process, placing special emphasis on the emergence of new organisational arrangements to elicit knowledge and discuss expert advice.

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Acronyms

BEAMA	British Electrotechnical and Allied Manufacturers' Association
BERR	Business, Enterprise and Regulatory Reform
CBA	Cost-Benefit Analysis
CSA	Chief Scientific Adviser
CSP	Communications Service Provider
DCC	Data and Communications Company
DECC	Department of Energy and Climate Change
DEFRA	Department for Environment, Food and Rural Affairs
DSP	Data Service Provider
DTI	Department for Trade and Industry
EDRP	Energy Demand Research Project
IA	Impact Assessment
ICT	Information and Communication Technologies
IT	Information Technologies
NPV	Net Present Value
Ofgem	Office for Gas and Electricity Markets
SRO	Senior Responsible Officer
SSI	Sectoral Systems of Innovation