



Smart grid knowledges and the state

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In this paper we call for a closer analysis of the role of the nation state in shaping the geographies of knowledge created through public–private infrastructure collaborations, focusing on the empirical case of smart grids. We draw on contributions from economic geographers and political scientists, identifying an empirical and analytical blind spot around how states shape knowledge production and mobility in regulated infrastructure economies. We argue that national state institutions have strong influence through their initial framing of what is relevant knowledge, and the geography of its applicability. The type of knowledge valued by the state institutions in our two case studies of public–private smart grid initiatives is that which can be rescaled to apply to national energy systems, by being stripped of its local context. In practice, however, many types of knowledge are produced through smart grid experiments, including tacit, context-specific knowledge. In this short paper we demonstrate the need to be attentive to both corporate and policy theories about types of knowledge and their mobilities, in order to better understand the geographies of smart grid and other regulated infrastructure knowledges.

KEYWORDS

knowledge mobilities, nation state, policy mobilities, private, public, smart grid experiments

1 | INTRODUCTION

The policy area of smart grids, wherein utility networks are modernised by new advances in digitisation, is one that has blurred boundaries between corporate and policy knowledge and objectives. In this fast-changing area of innovation, governments play central roles in shaping and funding large projects in collaboration with private sector energy utilities and other stakeholders. In this paper we seek to better understand the relationship between policy and corporate knowledges created through these public–private experiments by focusing on how governments frame and define knowledge. To do this we draw on theories of innovation and knowledge mobilities from economic geography and political science, and two smart grid case studies, in order to answer our core research question: how does the nation-state frame and define what is relevant knowledge in collaborative policy and technology experiments? The state can be defined in different ways and is a contested concept; here we define the state as “a set of institutions that possesses the means of legitimate coercion, exercised over a defined territory and its population. The state monopolizes rulemaking within its territory through the medium of an organized government” (Jones, 2001, p. 1463).

We explore these issues using primary empirical research from two smart electricity grid projects characterised by high levels of public–private collaboration: Smart Grid Smart City (SGSC) (Australia) and the Customer Led Network Revolution (CLNR) (UK). Within the energy sector the term “smart grid” includes any digital augmentation of the electricity grid, ranging from the use of sensors at electricity sub-stations to provide real-time information on load and voltage, to new

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digital technologies in households such as smart meters and in-home displays. Smart grid innovation has been driven by the emerging consensus in policy and industry discourse that the power system of the 20th century is ill-equipped to enable transitions to renewable, highly distributed systems of power generation that will also face challenging new forms of electricity demand, such as that created by the rise of electric vehicles.

The SGSC project was funded by the Australian federal government in 2009 through an AU\$100 million grant and a further \$390 million contributed by industry (directly and in-kind) in order to undertake “a commercial-scale [smart grid] trial deployment” (AEFI, 2014, p. 9). The SGSC consortium was led by the utility company EnergyAustralia (later renamed Ausgrid), along with several private and public sector project partners including IBM Australia and the City of Newcastle. In the UK, the Low Carbon Network Fund (LCNF) was established by the Office for Gas and Electricity Markets (Ofgem) in 2011 to provide a financial framework that would encourage network companies to pursue innovative projects in order to generate learning that could be applied to UK networks. The LCNF aimed to “replicate the incentives on unregulated companies to innovate” (Williams et al., 2016, p. 8). Active between 2011 and 2015, the CLNR project was the largest of the LCNF projects in the UK, and included trials of new tariffs, technologies, and types of customer engagement.

As the paper proceeds, we first provide an overview of relevant literature about the geographies of knowledge, drawing on theorisations about the state and corporate actors. Second, we briefly outline our methodology. Third, we analyse and discuss how our empirical cases help further develop our conceptualisation of the geographies of knowledge of regulated infrastructures, with a focus on the initial government act of framing and defining what is relevant knowledge. Fourth, we conclude the paper with a call to focus on how different types of knowledge produced and mobilised by collaborative initiatives are valued, as well as advocating a stronger focus on the nation state.

2 | DIVERSE KNOWLEDGE MOBILITIES

Here we draw together overlapping bodies of theory about knowledge: one developed from the study of corporations within the sub-discipline of economic geography, and one based on studies of policy processes, and located within political science and more recently human geography. These two areas of scholarship are both highly relevant, because of the public–private nature of smart grid projects, creating both governmental and corporate knowledge mobilities. In this section of the paper we briefly consider how these literatures conceive of knowledge and its mobilities, and identify some important limitations at their intersection, which our case studies of smart grid public–private collaborations have drawn attention to. While much common ground has been developed between these two areas of scholarship in recent years, in particular with the advent of the concept of policy mobilities, we concentrate here on better understanding the role of the state in defining the type of knowledge that is deemed relevant and comes to be valued within public–private experiments and research collaborations.

2.1 | Traditional conceptualisations of corporations and the state

The focus of economic geography scholars has been on the types of knowledge produced by corporations. The main distinction has been between two interconnected knowledge types: relatively immobile tacit knowledge and highly mobile codified knowledge (Dicken, 2015). While the analytic detail of this literature has developed considerably (Asheim & Isaksen, 2002; Bathelt et al., 2004), the focus of economic geography scholarship on *types of knowledge* provides an important contrast to studies of the state within political science. The focus in economic geography has been much less about the politics of knowledge creation and transfer, and more about the form of knowledge – its classification. Relational notions of space (Amin & Cohendet, 2005), learning (Ibert, 2007), and knowledge mobilities have been developed that tease out the different geographies of these types of knowledge. For example, Bathelt et al. (2004) identify distinct geographies of tacit and codified knowledge produced and consumed by corporations, observing that there is a tendency for codified knowledge to be globally mobile, through global “pipelines.” Economic geographers such as Amin and Cohendet (2014) have added to this a more nuanced and less structural account of knowledge mobilities, for example in their book *Architectures of knowledge*, where they dispute a simple codified or tacit classification, explaining how in their view knowledge is heterogeneous in nature, and has several different manifestations, including: individual and collective, specialised and general, possessed and practised, as well as codified and tacit. In terms of thinking about the spaces and mobilities of these knowledge types, they similarly foreground heterogeneity:

We define spaces of knowledge as organized spaces of varying length, shape, and duration, in which knowing, depending on circumstances, can involve all manner of spatial mobilizations, including placements of task

teams in neutral spaces, face-to-face encounters, global networks held together by travel and virtual communications, flows of ideas and information through the supply chain, and transcorporate thought experiments and symbolic rituals. (Amin & Cohendet, 2014, p. 12)

Faulconbridge's (2013) analysis of global green building design also celebrates the diversity of knowledge types and their mobilities, and develops an account of the production of hybridity rather than mimicry in green building design, attentive to difference in places and outcomes; as does Weller (2007) in her research on the global fashion industry, examining the "viscosity" and complexities of fashion knowledge:

The spatialities of these different forms of knowledge cannot be understood using a binary tacit-codified classification. Instead I adopt a descriptive framework in which modes of fashion knowledge are characterised by their viscosity, an abstract quality that reflects their relative complexity. (Weller, 2007, p. 41)

These accounts of corporate knowledge mobilities are typically grounded in intensive studies of firms and actors within particular sectors – such as fashion and architecture – and offer valuable insights into the heterogeneity of knowledge flows in those economies. However, these theorisations originate from analyses of far less regulated industries than energy – our empirical focus. We claim that the role of the state in knowledge production in regulated sectors like energy, where innovation is often state-funded, must be better understood. To inform us in this endeavour, we now turn to scholarship on policy transfer and policy mobilities.

Political science scholarship on policy transfer and diffusion is a longstanding area of scholarship, first emerging in the 1960s. The focus has been on the bilateral transfer of knowledge and policy across geopolitical boundaries, between state institutions (Dolowitz & Marsh, 1996, 2000). A key area of emphasis of political science approaches has been on why these transfers occur, including exploring the political motivations for transfer. Within this, positive and negative lesson-drawing from case studies and the emulation of perceived successes and avoidance of failures are central to the analysis of policy transfer (Stone, 2004). Policy learning visits to other cities and countries alongside international policy networking have been identified as principal mechanisms enabling these state-state transfers and the subsequent diffusion of the most successful practices and policies (González, 2011).

However, this scholarship has been criticised for its narrow focus on state actors and employees, with arguments for more fluid and decentralised conceptualisations of knowledge mobilities, taking into account the role of corporations and other non-state actors. Emerging from this debate is a new area of scholarship that has brought together ideas about policy and corporate knowledge. This field of research, termed "policy mobilities," is part of the relatively recent mobilities turn that theorises contemporary life as generative of movement in all manner of ways (Hannam et al., 2006; Sheller and Urry, 2006; Urry, 2007). A key feature of the world theorised as mobile are relays of knowledge, ideas, practices, and norms between nodes in a topological rather than territorial geography. The significance of this is that it positions knowledge as predisposed to mobility – if it is recognised and valued, it will move. In this, economic geography conceptualisations of globally mobile knowledge are drawn on. Indeed, the concept of policy mobilities has been developed in an effort to better interpret and understand empirical observations about the movement of "fast policy" – the globalisation of policy ideas and programmes which is judged to be increasing in scope, scale, and speed (McCann, 2011; Peck, 2011; Ward, 2006). Learning from international case studies is identified as typical of contemporary policy learning processes (Bulkeley et al., 2016; McGuirk et al., 2014).

Corporate organisations such as multinational companies and consultants are identified as key actors by policy mobility scholars (McCann, 2011; McCann & Ward, 2012; Prince, 2012), especially in highly technical areas of new policy development such as utilities (Larner & Laurie, 2010) and energy (Lovell, 2017a, 2017b). Whereas in many ways this observation resonates with our smart grid cases, with private sector corporations taking the lead within the CLNR and SGSC consortiums, our findings also suggest that a focus on non-state actors may result in a lack of attention to the role of the state in knowledge creation processes. In particular, our findings point to ways in which policy mobilities scholarship can be further developed through greater attention to the state. While policy mobility scholars have researched many empirical cases where local government is a key actor, especially within cities and urban areas (McCann, 2008, 2011; Temenos & McCann, 2012), there have been far fewer cases wherein the nation state is the primary empirical focus (for notable exceptions see Clifford & Morphet, 2015; Geddie, 2015), and we suggest that there is still some work to do to better understand the often multi-scalar ways in which states and corporations work together in practice to co-produce knowledge. This is particularly the case within heavily regulated infrastructure sectors such as energy, where we suggest the nation state

continues to have a significant influence. Our empirical case studies below explore how the role of the state manifests within public–private experimental collaborations, and specifically the crucial role of the state in carefully defining at the outset what is relevant knowledge, and the ongoing effects of this framing.

3 | METHODOLOGY

For this analysis we have undertaken a number of strands of primary empirical research, which have varied according to the characteristics of the smart grid project under study. The purpose of our analysis was to better understand the framing and definition of what is relevant smart grid knowledge. We were able to achieve this by examining both projects over their lifetime, and by paying close attention to the processes of knowledge production and consumption by state and private sector project participants.

3.1 | Smart Grid Smart City

Our study of the SGSC project involved discursive analysis of all published SGSC reports, including analysis of their citations. A second strand of empirical research centred on an online database called the Information Clearing House (ICH), developed by the lead SGSC organisation Ausgrid in the period 2013–2016, in order to share SGSC reports and data. The ICH required user registration, and Ausgrid shared with us the anonymised registrations dataset, which provided basic information on the number of registrations and their geographical location (Australian/international). An online survey of all registered users of the ICH was then circulated by Ausgrid on our behalf in late 2016, comprising 12 questions. Fifty-one online surveys were completed, a response rate of 5%. Follow-up phone interviews were completed with survey respondents in early 2017: a total of 17 interviews (33% of survey population). A third strand of research was nine broader in-person interviews with key SGSC team members, from government and the private sector.

3.2 | Customer Led Network Revolution

Our study of CLNR was two-fold. First, it was based on extensive participant observation of project meetings, events, and note taking over a three-year period between 2011 and 2014, as one of the authors was a member of the CLNR project team. Second, we drew on data created by CLNR’s project management office relating to the geographic location of users of the project’s online “Project Library” – an online resource somewhat similar to the SGSC ICH. The CLNR Project Library comprises research activity summaries, reports, and data sets, with project findings also published in a number of other channels (Bulkeley et al., 2016; Powells et al., 2014). The details and location of all organisations requesting access to the project data sets over a two-year period between July 2014 and July 2016 were documented by CLNR, and we used these data to analyse the mobility and geographies of some of the key knowledge assets created through the project.

4 | THE SMART GRID CASE STUDIES

In this core empirical section of the paper we first examine findings from our case studies that fit with policy mobilities and economic geography conceptualisations of highly mobile, global knowledge. We then proceed to examine in detail the national scale framing of knowledge by the state, and the effects of this.

4.1 | Evidence of highly mobile global knowledge and the role of non-state actors

First, ambitions to create globally mobile forms of policy knowledge were present in both our case studies, in particular at the outset, and especially with regard to SGSC. SGSC was positioned by the Australian government as being able to generate highly transferable knowledge, relevant to other places. For example, one of the seven original objectives for SGSC – as listed in the Australian government’s SGSC Pre-deployment Report – was to “Develop an innovative solution that can serve as a global reference case” (DEWHA, 2009, p. 16).

More specifically in relation to the SCSC ICH, there were at the outset clear international ambitions, for example in linking the ICH to other similar databases elsewhere, such as “the possibility of connecting the Smart Grid, Smart City data to the US Clearinghouse database” (DEWHA, 2009, p. 16), and also in explaining how:

The intent is that [ICH] registered users will be able to download and use the Smart Grid, Smart City data and research to further their own knowledge and research and in so doing *contribute to the global knowledge base of smart grids and associated technologies*. (AEFI, 2014, p. 22, emphasis added)

This initial international framing of knowledge bears out to some extent in the data that emerged from the project library usage. While the CLNR project library data was mostly accessed by UK organisations (72% of all users of the library) – in keeping with its stronger national focus (explained below) – there was nevertheless some international reach, with more than a quarter of all organisations (28%) being located outside the UK. SGSC data on the registration of users of the ICH database revealed a slightly higher traction internationally, with 41% of the registered users based outside of Australia and 59% within Australia.

In terms of the key actors involved, we also found evidence of private sector organisations playing a key role in knowledge mobilities, again in keeping with ideas from policy mobilities and economic geography scholarship. Much of the knowledge transfer identified through our research was via professional collaborative (public–private) networks. For instance, a senior smart grids academic, based in Australia, described the way in which such public–private networks facilitated the international mobilisation of SGSC findings and data:

I've directed a lot of people towards it [SGSC ICH], particularly my old colleagues at [UK university] and people who were at that university and have moved on to other places. So there's a fairly large research group in computer science ... who are working on smart grid technology, and the diaspora from that group have gone elsewhere, mainly within Europe but actually all over the place ... We work on similar flavoured things so it makes sense to share these sorts of things around. (Interview, academic researcher, January 2017)

An important factor highlighted by this interviewee are the professional networks that provide contextual detail, anecdotes, and specificities, and thereby facilitate the transfer of a plurality of kinds of knowledge – data sets and models as well as good practice and lessons learned. In the case of the CLNR, the transferability of knowledge among private sector organisations was also evident, for example:

The understanding upon which the project is conducted is that what we learn, what we experience, what we do, are not just kept in house for our own company to benefit. Those are actually shared with other distribution companies and energy supply companies ... they'll be able to pick those up and use them too. (Durham University, 2012)

So, while the focus of policy mobilities scholarship on global “fast policy” represents a welcome opening up of long-standing political science research beyond the state, and our research findings concur to some extent with this, we also found that when knowledge creation is collaborative between the state and private sector, and when regulated industries are involved, the state and its territorial boundaries remain important. We now turn to these research findings.

4.2 | Evidence of nation-state influence on smart grid knowledge production and consumption

Despite the international positioning and traction of SGSC and CLNR described above, in practice the main geographical focus of attention of both projects was on the national scale. The nation state was a central actor in defining the types of desirable knowledge flows, which in our two cases were heavily defined by the strong national regulatory and governance structures of the electricity systems. For instance, in the UK a large proportion of recent research into smart grids and meters has been funded either directly or indirectly by national government bodies, including Ofgem – the gas and electricity market regulator (Frame et al., 2016). Moreover, this research has been explicitly tied to national policy challenges: a core criteria for the evidence being produced through the LCNF is that it must be nationally applicable. This is explicitly written into the economic case for the CLNR project, and as a result the claims made by research teams reporting on the findings have had to be highly attentive to the national scale. For example, the CLNR project newsletter of 2014 states:

We purposely selected a range of rural and urban locations for our network technology trials to ensure our findings can be applied more across the UK. ... learning we gain from these trials will be applicable to 80% of GB networks. (CLNR, 2014, p. 4)

There are strong parallels here also with SGSC:

The trial was largely focused on the greater Newcastle and Sydney CBD areas ... The selection of appropriate geographic locations for the trial was considered critical to producing reliable data that could be accurately extrapolated to assess the viability of a large-scale smart grid roll-out in Australia. The greater Newcastle area ... characteristics ... result in representative geography, climate, socioeconomic and demographic factors, ... [that] closely reflect the ... attributes of a typical Australian city. (AEFI, 2014, p. 10, emphasis added)

These national scale imperatives are driven by the state institutions, and reflect the political economy of UK and Australian energy systems, wherein energy utilities operate as licensed monopolies rather than as unregulated corporate organisations. A key government decision maker involved in establishing SGSC explains the reasons for a national focus in the energy sector as follows:

Electricity network regulation is an inherently domestic issue ... obviously, it's electrons going through copper wires and that's the same everywhere – and much of the technology is the same – but the regulatory ownership arrangements and the history of those and the political economy of those varies dramatically from country to country. Regulatory philosophy varies ... (Interview, Australian Federal Government, June 2015)

Thus critical project aims for both CLNR and SGSC were that they would provide “value for money” for all bill payers in the respective national markets, not just those in the trial areas. A focus on the nation state highlights how there is a bias towards the generation of dis-embedded, nationalised policy knowledge that is mobile, rather than knowledge that stays with and serves the local trial areas and contexts of its production. Such an approach fits with policy mobilities' research which has focused on highly mobile knowledge that is codified, so that it can be mobilised. But with an important caveat, which is that in regulated economies, where the state has strong influence, those national geographies of regulation shape the resulting knowledge geographies. Our research suggests though that the codification that happens in these nationally regulated industries does not totally strip the trial outcomes of all context, but rather tends to re-scale knowledge from local to national.

We are not presenting a simple binary analysis in which the codified knowledge – reports, models, and other assets – are mobile, and tacit knowledge locally constrained. If we drill down into our data, a more nuanced situation is revealed. In particular, the ways in which smart grid knowledge from SGSC and CLNR was valued was contingent on the context of its production, meaning that it was accessed most by policy and corporate actors who thought it could tell them something about their own context. Other than from the UK, the CLNR project library was most often accessed by users in the USA (4.7% of all users), and EU nations which together accounted for 3.75% of users, followed by India, Australia, and Japan. This suggests that learning from CLNR flowed mostly to places where there was a fit between the national contexts of knowledge production (the territorial geography of power system regulation, market conditions, and culture) and the contexts in which the knowledge was being sought. Therefore, despite the rise of the global mobilities literature, our findings align more closely with Stone's analysis of state-centred policy transfer, about which she claims that “transfer is more likely to occur when lessons are ‘proximate’; that is, transferred from a jurisdiction that is geographically, ideologically or culturally proximate” (Stone, 2004, p. 552). In this sense, re-scaling the knowledge created by smart grid projects to the national scale – an objective prioritised by the state in both our cases – enabled others in “proximate” national contexts to find value in the project.

5 | SUMMARY AND CONCLUSIONS

The public–private nature of smart grid projects and the highly regulated economies in which they are embedded create governmental and corporate knowledge mobilities which cannot be adequately understood by traditional concepts of state-based policy transfer within political science, nor by economic geography ideas about codified knowledge that is stripped of all context in order to be rendered globally mobile. Policy mobilities scholarship has sought to bring together these two areas of scholarship and has made valuable progress. However, there has been too little attention to the role of national state institutions. In effect, theories of knowledge focused on the state have waned in popularity as a result of the “mobilities turn.” We suggest that the role national and territorial geographies play, particularly within regulated infrastructure economies, has been under-estimated. In this short paper we have shown the analytic need to be attentive to both corporate and policy theories about types of knowledge and their mobilities. There is a need to better understand how the diverse

types of knowledge produced and mobilised by collaborative (public–private) initiatives are prioritised and valued. We are not suggesting a return to state-to-state policy transfer studies but we are, however, highlighting the persistent structuring effects of political and territorial geographies, especially at the national scale. In particular, we have shown how the state can play a pivotal role in the initial framing of what is relevant knowledge from policy and technology experiments, prioritising territorial forms of knowledge.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding authors on reasonable request.

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