The political economy of low carbon infrastructure in the UK
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1. Introduction

This chapter discusses the political economy of low carbon infrastructure, proposing an extended, systemic and inclusive definition of low carbon infrastructure, and understanding how value from it can be created and captured during processes of sustainable transition. Current trends in infrastructure governance, which are pushing the boundaries of who participates and how across multiple scales and levels, are discussed in terms of how they can enable the creation and capture of value from such an extended understanding. The chapter also makes important claims about how certain elements of low carbon infrastructure can be used to address core governance challenges.

The Paris Agreement to limit climate change to 2°C above pre-industrial levels, signed by over 195 countries in December 2015, could radically change the context for infrastructure governance, if countries act to follow through on their commitments. The UK already has in place a Climate Change Act with legally binding commitments to reduce national carbon emissions to meet five-yearly carbon budgets towards an overall 80% reduction by 2050. However, implementing measures to achieve these targets face questions of both economic viability and social acceptability. Infrastructure investment is particularly important in this context, as it has the potential to lock-in a country to high carbon or low carbon pathways (Stern, 2016). For example, securing the necessary investment for the maintenance, (smart) upgrade and development of infrastructure in the next few decades is a considerable challenge for infrastructure governance at multiple scales. Along with this so called investment gap, infrastructure governance in the UK is also facing a pressing need to lower carbon emissions specifically associated with infrastructure (HM Treasury, 2013), and to open up infrastructure governance to include more opportunities for people to take part in the decision making process, i.e. bridging what Coelho et al. (2014) term the institutional gap. The focus of the discussion in this chapter is on the potential for synergies between addressing these two challenges.

The economic importance of infrastructure investment has been highlighted by the UK Government, from 2010 onwards, with the creation of Infrastructure UK as a special unit within the Treasury and the production of annual National Infrastructure Plans, identifying a ‘pipeline’ of potential projects. The plans were aimed at enabling public funding, encouraging private investment and overcoming regulatory barriers in order to stimulate over £200 billion of infrastructure investment between 2010 and 2015 (HM Treasury, 2010). A further governance innovation was the creation of the National Infrastructure Commission in 2015 to inform the government on long-term strategic decision making for infrastructure investment. However, this approach has been criticised as being excessively top-down and lacking in local engagement (Hiteva and Watson, 2016), as well as prioritising economic rationales over social and environment goals (Foxon et al., 2015). This can be seen in government decisions in 2012 to support the HS2 high-speed rail link and in 2016 to support the building of a third runway at Heathrow Airport, which have been strongly opposed by local communities and environmental groups.
In this chapter, we explore changes in governance arrangements that could promote more inclusive infrastructure decision-making processes and enable greater consistency in aligning with the UK’s low carbon commitments under the Paris Agreement and the Climate Change Act. We argue that this requires attention to be paid to the range of social, environmental and economic values. Such values include: social justice, equality, security, preserving the environment, affordability and giving people more say in important government decisions (see Dietz, 2005). A broader range of values can be realised and captured through different types of investment, as well as by making different decisions about who can benefit from investments made. Building on previous work by the authors and others, and drawing on socio-technical transitions and business studies literatures, we argue that widening our understanding of business models could provide a useful framework for approaches to more systemic and inclusive value creation and capture (Foxon et al, 2015; Bocken et al, 2014; Bolton and Hannon, 2016).

The chapter discusses current trends in infrastructure governance which create opportunities and challenges for low carbon infrastructure in Section 2. A case for a systemic and inclusive definition of low carbon infrastructure is made in Section 3. Section 4 introduces the business model framework for thinking about infrastructure in terms of creating and capturing value. Section 5 details two case studies of low carbon infrastructure: of transnational municipal networks and local supply networks, which enable a systemic and inclusive value creation and capture. The chapter concludes with a reflection on the political economy of low carbon infrastructure and who benefits from low carbon infrastructure in Section 6.

2. Infrastructure governance dynamics in the EU and UK

Analysis of the political economy of infrastructure governance must be addressed within the context of the UK Government’s legally binding commitment to reduce national carbon emissions by 80% by 2050 (relative to 1990 levels). Progress towards this target is maintained through a system of five-yearly carbon budgets setting out intermediate targets, with the current budget taking us to 2032. Specific intermediate targets are a 50% reduction by 2025, and a 57% reduction by 2030. Although the UK had already achieved a 36% reduction by 2014, successive reductions will require more structural changes to be achieved (The Green Construction Board, 2013). The percentage contribution of infrastructure emissions to total national emissions is projected to increase in the future, posing a great challenge for UK infrastructure policy and indicating the urgent need to ensure consistency of infrastructure investments with carbon reductions (ibid.). The focus for UK carbon emissions reduction has so far concentrated on the energy sector, particularly measures to support large-scale low carbon electricity generation. However, in order to meet stringent medium to long-term carbon reduction targets, a more holistic view is needed of how a range of infrastructure investments, including for transport and other utilities, will contribute to locking in the UK to low carbon or high carbon pathways.

This creates clear challenges for infrastructure governance. Coelho et al. (2014) argue that there is an institutional gap, relating to the lack of: deliberation, available information and wider democratic input into infrastructure decision-making processes. They warn that the long-term effects of various governance factors may lead to poor infrastructure investment decisions in the UK. These include short-sightedness, lack of forward-looking strategy and local community opposition leading to political procrastination and delays. This is partly explained by a lack of adequate forums where politicians, experts, interest groups, and representatives of local communities may engage in structured, informed discussions about policy options for infrastructure investment. The institutional gap can be
attributed to lack of sufficient direct participation, as well as to limiting participation to one level only (i.e. local level during planning permission, or projects of national importance).

Applying this to the carbon challenge, we argue that instead of focusing purely on the investment gap in low carbon infrastructure governance, i.e. how to raise money for low carbon infrastructure investment and make it attractive to global investment companies, more attention is needed on addressing the institutional gap of low carbon infrastructure governance. This requires recognising that infrastructure decision-making should not be limited to states and businesses only, but should also be inclusive of other activities, processes and actors able to improve the governance process through strong deliberative and participatory approaches. This, however, would imply introducing significant changes to how infrastructure is governed. Although the recently established National Infrastructure Commission in the UK is intended to reduce the political risks and build consensus around large infrastructure investment over the medium and longer term, it so far reflects the values of the current governance approach. Its objectives are set in a top down manner, with a high degree of HM Treasury involvement, and its work only takes place at the national policy level, thus only partially bridging the institutional gap in infrastructure governance. It has been argued that this represents a ‘non-deliberative’ form of depoliticisation, complementing other marketised and technocratic forms, which reduce the capacity for the level of collective and deliberative engagement needed to achieve a low carbon transformation (Kuzemko, 2015).

Infrastructure has been governed within the boundaries of a tight politico-economic framework: where investment in infrastructure is usually enabled by a national level, top down approach of making decisions about what type of national infrastructure to build and where. In the UK, a governance innovation in the past decade has been the publication of a National Infrastructure Plan, listing investment priorities and projects. Thus distributions of power and wealth from infrastructure have tended to revolve around a primary group of actors, i.e. the state and private businesses involved in infrastructure finance, construction and supply chains. At the same time local authorities, users and citizens have taken a secondary role in contributing to the process through public engagement, consultations, planning permission processes and usage. Tight cost-benefit rationale usually dictates the expectation of the relationships and processes through which value can be created and captured.

For a long time, this has limited the environmental agenda of infrastructure to the role of an add-on or a purely technical solution, for example only in cases where it makes economic sense according to cost-benefit analyses or contributes to corporate social responsibility. Whilst environmental regulation has been successful with specific and well-bounded technological challenges, such as improving the environmental performance of fridges, its track record with complex and interdependent systems and infrastructure services, such as mobility, has been less effective. The impetus for the development of low carbon infrastructure offers an opportunity to develop a more comprehensive and inclusive approach to infrastructure governance. This could be achieved by conceptualising low carbon infrastructure as one facet of an interdependent and interconnected socio-technical system which spans different scales and levels. As such it offers more and different opportunities to bring together disparate and new actors in infrastructure governance, and to involve innovative processes and actors in creating and capturing value (cf. Hiteva et al., 2016).

This raises the question: what changes in infrastructure governance could enable the institutional gap to be (at least partially) bridged? This requires attention to be paid to multiple actors and interests involved. We argue that a lack of participation opportunities at multiple levels and scales in infrastructure debates limits opportunities to introduce a wider range of values into mainstream infrastructure governance. Greater participation in decision-making processes can enable new forms of value creation and capture. In Section 5, we discuss two case studies, transnational municipal
networks and local supply networks, which illustrate how the conditions for innovative and wider value creation and capture are enabled through network activities at the sub and supra national level.

Infrastructure services and assets have the potential to bring about change, accelerate transformation, embed forces of inclusion, and create spaces for diverse and democratic innovation for sustainability. As Stern (2016) argues, reorienting infrastructure investment towards low carbon options is a key aspect of realising a sustainable low carbon transition. However, current governance approaches to assessing the desirability and viability of infrastructure projects tend to focus on economic values, with limited attention to social and environmental values, while low carbon infrastructure is mainly discussed in technological terms. Thus, the potential scope and direction for innovation for low carbon infrastructure will also be limited, and could exclude those innovative actors, technologies and processes, mentioned below, which are not well captured by economic values.

UK infrastructure governance is also the product of policy and actions going beyond the UK’s national borders, and is defined by linkages to a number of European and international institutions and programmes. The OECD has argued that that there needs to be a more integrated approach to sustainability governance. For example, to achieve sustainability, the management of environmental and green systems needs to become part and parcel of infrastructure governance (OECD, 2002). However, this remains problematic (Morphet, 2016). The EU started to develop an integrated approach in the Lisbon Treaty 2007 with the principle of policy integration focusing on territory and place and away from sectors, following a somewhat failed attempt to integrate sustainable development principles into EU policy making through the Cardiff Process (Jordan and Schout, 2006). So far, within the EU, soft policy mechanisms involving capacity and networking building through programmes like Intelligent Energy Europe and direct investment in infrastructure assets, through the European Bank for Reconstruction and Development and the European Investment Bank, have been more successful at integrating environmental and green systems into infrastructure governance. EU environmental values have also significantly shaped infrastructure policy at multiple scales, especially member states and cities/city-regions, through environmental targets, tariffs, standards and measures. However, with the UK having voted in 2016 to (Br)exit the EU (though with the detailed nature of any future relationship still unclear), this raises questions about the extent to which EU-driven pressures will continue to influence UK infrastructure governance.

Cross-cutting issues like climate change, resilience and security can contribute to the inclusion of a wider group of actors who get involved in decision-making and implementation. However, such integrative approaches tend to be ad hoc and opportunity based, limited to specific geographic locations and scales, and have so far failed to translate into national policy. Urban and regional scales of infrastructure governance are seeing an increase in formal and informal actions and interventions aimed at environmental performance, ranging from whole towns, like the Transition Towns movement, to individual interventions like urban guerrilla gardens and green roofs. For Bulkeley et al (2014), low carbon infrastructure governance is defined by experimentation, through the development of demonstration technologies, projects and area-based schemes. Often, in such cases, value from infrastructure is created and captured through an alignment of dominant institutions, techniques and artefacts with a ‘low-carbon’ rationale or narrative. More importantly, this means that increasingly the processes and actors involved in infrastructure governance include a range of ‘non-traditional’ values, actors, interactions and relationships.

Whether cast as a rebalancing of economic settings (cf. Martin et al., 2016), or linked more closely to participatory democracy, devolution has played a big role in infrastructure governance in recent years. Defined as “the relative transfer of power and responsibility from the nation state downward to other
units of government and governance” (Jones et al., 2005), devolution away from national government can feature increased powers for regions, as in the case of Scotland in the UK, for cities, such as Greater Manchester, or for other actors such as local authorities. Such movements of powers can adjust centres of decision-making, shifting priorities and interests in procuring and delivering infrastructure, and with them the delivery of value through infrastructure and the opportunities to capture that value.

However, the extension of infrastructure governance across and between scales, levels and issue areas, has introduced more complexity and created challenges related to competing jurisdictions, scales and priorities, as well as gaps and fragmentation in responses and approaches (Hiteva and Watson, 2016). For example, what may be achieved through one project may be detrimental to others (Morphet, 2016), while environmental targets such as lowering carbon emissions can simply be moved from one end of the supply chain to another, and even exported.

3. Low carbon infrastructure and governance

Public infrastructure investment has traditionally been driven by the contribution it makes to economic growth and meeting growing demand using, as mentioned above, a cost-benefit analysis as a guiding rationale in decision-making (c.f Abiad et al., 2014; Andres et al., 2014; Moloney & McKeogh, 2015). Various approaches have been proposed for incorporating environmental values into infrastructure investment decision making, including ecological modernisation, the discussion of biodiversity, eco-system services, resilience, introduction of eco-innovations and more recently, social innovations in infrastructure governance, with varying success. These new approaches remain, however, mostly on the periphery, at an arm’s length from the core economic values driving decision-making at the national and regional levels, with the NIC’s National Infrastructure Assessment is a case in point. The concept of green infrastructure, see (Tzoulas et al 2007), is now being incorporated into UK planning practice guidelines for local planning authorities. This concept argues for the upgrading of urban green spaces to promote both ecosystem and human health, including mitigation of climate change (ibid). Adopted carbon reduction measures tend to revolve around technological and system efficacy, such as energy management, especially in manufacturing and transport, and the use of the natural environment through landscape management, tree planting in rural areas and green roofs (Morphet, 2016).

We argue for the adoption of a systemic and inclusive definition of low carbon infrastructure, which includes technical solutions such as increased efficiency, but which also includes the wider systemic features associated with green infrastructure. The primary objective of low carbon infrastructure is lowering carbon emissions; this can be addressed through 1) cost saving and resource efficiency, 2) lowering the demand for carbon associated with construction, operation and maintenance, and 3) taking into consideration trade-offs between the competing priorities, assets and services within a systemic approach. The Infrastructure Carbon Review (2013) advocated for reducing carbon at any point in the delivery process and through upgrading, adapting and modernising existing infrastructure, as early in the value chain as possible. Approaches to reach low-carbon ambitions in infrastructure include the use of green infrastructure (Gil et al., 2007), technologies and non-technical artefacts, such as open book supply chain arrangements (Hiteva et al, 2016), and any spaces, processes and actors that can contribute to the overall lowering of infrastructure related emissions (Kennedy & Corfee-Morlot, 2013). An important aspect of the definition of low carbon infrastructure is the integration between all these elements, and the cumulative and networked effect of the ways infrastructure works together. However, such integration requires the existence of institutions capable of working
across multiple sectors, especially at the national scale, where institutional mandates are more rigidly defined. For example, Watson and Rai (2013) found that opportunities to use renewable energy in the water sector were stifled by failure to resolve competing policy priorities between the water regulator (Ofwat) and climate change regulation. The establishment of the cross-sector institution UK Regulators Network (UKRN) is yet to tackle such missed opportunities in a systemic way, although it is working for removing barriers for cross-sector investment. This indicates that the institutional gap for infrastructure at the top might be even wider within the context of low carbon infrastructure.

A systemic understanding of low carbon infrastructure thus recognises the importance of interdependence within individual infrastructure systems as well as between separate systems or sectors. This is a substantially broader concept than just dependence on the immediate inputs that infrastructure requires to function. This expanded understanding of low carbon infrastructure spans carbon emissions associated with the operation and use of infrastructure, as well as carbon arising from the production and manufacture of materials, transport of people and materials, design and on-site activities, and its disposal and storage. So, value from low carbon infrastructure can thus be achieved through the introduction of carbon reducing and conservation technologies and processes, from cradle to grave, rather than just temporary shifting of carbon emissions from one territory to another, for example by importing or exporting embodied carbon. An inclusive understanding of low carbon infrastructure refers to the inclusion of a more diverse set of actors, processes, technologies, knowledge and values, as well as ways of participating in governing low carbon infrastructure. For example, informal and semi-formal activities like knowledge and resource sharing in local energy cooperatives can enable the development of low carbon housing infrastructure and public spaces, such as green roofs on community centres, schools and libraries. However, value created through informal and semi-formal activities can be hard to capture in a standard cost benefit analysis, as the benefits of this type of social innovation are not easily monetised.

A systemic approach to low carbon infrastructure can 1) capture the activities and institutional linkages that exist across scales and across sectors (both formal and informal); 2) widen the scope for synergies to emerge and competing priorities to be resolved; and 3) offer a wider consideration of how low carbon infrastructure can be developed and maintained. A systemic approach to low carbon infrastructure can also create a normative ordering between multiple actors, processes and outcomes, increasing the number and variety of institutions and actors involved in infrastructure governance, as well as introducing rules for their interaction beyond the scope of regulated assets and individual sectors.

4. Value creation and capture lens: business models for low carbon infrastructure

In order to incorporate these wider notions of value creation and capture into infrastructure decision-making, a framework is needed that addresses these concepts. In traditional cost-benefit analyses, all social and environmental values are reduced to monetary values, for example, by asking what people are willing to pay to preserve a particular environmental feature. However, this approach has been criticised as these areas of concern are subject to well-known cognitive framing issues (Pollak, 1998), and understanding of effects holds particular difficulties within infrastructure systems (Hall et al., 2016; Vickerman, 2007). Moreover, the business model framework speaks to both the infrastructure investment gap and the institutional gap, by focusing i) on how new processes by which value is created and captured are brought together (i.e. who participates in infrastructure governance and how), and ii) on balancing between divergent social, economic and environmental values. We argue
that low carbon infrastructure changes what is considered valuable and by whom, and how divergent actors can participate in value-related activities in infrastructure.

Thus, we draw on the concept of a business model, from business studies literatures, and extend this to incorporate values associated with low carbon infrastructure (Hannon et al., 2013; Foxon et al., 2015). In the business literature, the concept of a business model is used to characterise how a business creates value and delivers this value to its customers, although usually focussing on economic value. However, we argue that this can be extended to apply to other types of organisation and a wider range of values, in order to highlight factors that are neglected in standard economic cost-benefit analyses.

An organisation’s business model characterises the ways in which it creates and captures value (Teece, 2010), and it can be considered as a simplified representation of what a firm does and the ways it generates income from its activities (Magretta, 2002; Baden-fuller & Morgan, 2010). Centred on actors’ activities and agency, business models, and their interactions around infrastructure provision and operation, can trace the interests and activities working to influence infrastructure purpose, form and performance (in terms of social as well as economic attributes). Value creation in infrastructure includes all processes, activities, technologies, artefacts, actors and knowledge that produce a useful outcome, output or service for the end users or any of the participants in the low carbon infrastructure system. Value can be created intentionally or as a side effect, and/or as an unintended consequence of other processes or objectives. Value capture can be partial or whole, and is usually the result of a unique position, activity, role or arrangement, relationship or constellation within a business model. An example of ‘traditional’ value created from low carbon infrastructure could include more efficient processes, which lead to less energy use or lower carbon emissions. An example of ‘inclusive’ value created from low carbon infrastructure can be the greater involvement of end users in influencing the design of energy systems, i.e. users as producers as well as consumers of energy. To a large extent, the value that can be created and captured from low carbon infrastructure will depend on what are the expected outcomes and outputs, for example infrastructure with lower associated carbon emissions or infrastructure that will enable low carbon living. The latter will involve deeper and more ambitious infrastructure solutions as well as more fundamental changes to the way low carbon infrastructure is governed.

After a period of time wherein the prevailing approach to managing established infrastructure sectors has been national level monopolies, more instances of multi-organisation sectors are emerging, e.g. through privatisation and restructuring in the UK. Recent developments of the business model framework have acknowledged the importance of resources and actors outside of the focal organisation’s boundaries and have begun to consider the business model as a system concept (Zott & Amit, 2011), positioning the business model as the co-ordinating centre of activities for the organisation’s position within a value chain or network (Osterwalder et al., 2005; Massa & Tucci, 2013). This system approach emphasises its applicability both to monopoly and multi-organisation sectors and highlights its usefulness in tracing value flows, control over decision-making and opportunities for change across different infrastructure sectors.

Reviewing the treatment of business models and innovation, Massa & Tucci (2013) distinguish between business model design for new activities, without a previous business model associated with them, and business model reconfiguration, where an existing business model is adjusted, and they highlight the destabilising possibilities of business model change. This destabilisation can extend to changing the content of what is considered valuable and the range of activities that are conducted to generate value. In particular, there are emerging movements around business models for sustainability (c.f. Wüstenhagan and Boehnke, 2006; Bocken et al., 2014; Foxon et al., 2015), and for
increasing social welfare beyond that represented in money flows (c.f. Anderson & Kupp, 2008; Massa & Tucci, 2013). Business models as focus points for agency in disrupting the way activities are carried out and the generation and capture of value, represents a useful concept for considering the potential of achieving low-carbon versions of infrastructure systems.

Control and negotiation over business models in infrastructure sectors can be important arenas for the politics of low carbon infrastructure. One powerful example of this is evident in recent work by the UK gas and electricity regulator, Ofgem, which has been investigating non-traditional business models (NTBMs) and has sought ways to enable their entry into the energy market (Ofgem, 2015). Ofgem (2015) considers NTBMs to be a tool for increasing the consumer voice and supporting more flexible and local energy initiatives. Building upon Foxon et al.’s (2015) work using business models to consider low carbon investment in infrastructure, the discussion of the examples below considers the politics of low-carbon developments in infrastructure by examining shifts in value creation and value capture as part of governance changes.

5. Enablers of value creation and capture in low carbon infrastructure

This section details two case studies of low carbon infrastructure: transnational municipal networks and local supply networks that illustrate how low carbon infrastructure values can be created and captured.

5.1 Transnational municipal networks

Our first case study highlights the potential of transnational municipal networks to support investment in low carbon infrastructure, increase participation in infrastructure governance, in terms of value and people, and to offer integrated ways of governing low carbon infrastructure - thereby overcoming the institutional gap. Transnational municipal networks for energy, like Energie-Cités and the Covenant of Mayors (CoM), align with the objectives of low carbon infrastructure and play a significant role in its governance. Bulkeley et al (2014) illustrate the linkages between energy actions at the municipal level and urban infrastructure networks within the establishment and stabilisation of a low carbon regime in London. This allowed for new forms of energy generation and use to take place and at the same time, creating political space and visibility for a low-carbon logic.

Since the late 1980s, the EU has been promoting networks as new modes of governance at the local, regional and transnational scales and encouraged the development of transnational municipal networks, such as Energie-Cités and Intelligent Energy Europe. They are networks connecting municipalities with a common objective/sets of interests, constructed of nodes (actors) and linkages (information flows) between these nodes (Keiner and Kim, 2007). Their aim is to reduce carbon dioxide emissions through energy efficiency improvements, by assisting city-regional level efficiency policy, and supporting regional and local renewable energy services. They enable information flow and learning between members, and develop and disseminate ‘good’ practice among their constituents (Kern and Bulkeley, 2009) for the reduction of greenhouse gas emissions; and aim to enhance local social and technical capacities for addressing climate change, by promoting the exchange of experience and transfer of know-how among its member cities, and represent the interests of their constituents at national, supranational and international levels. A transnational municipal project (MODEL) introduced the role of energy managers and sustainable energy action plans within municipalities and developed the first version of the EU methodology for municipal planning. This is being used by all municipal signatories to the CoM for the development of their municipal sustainable energy action plans (SEAPs).
The Covenant of Mayors (CoM) initiative was launched in January 2008 after the introduction of the second European action plan for energy efficiency and it includes over 6000 signatory cities, towns or regions that have voluntarily committed themselves to reduce their greenhouse gas emissions by at least 20% by the year 2020. Covenant signatories commit to adopting an integrated approach to climate change mitigation and adaptation. They are required to develop Sustainable Energy and Climate Action Plans with the aims of cutting CO2 emissions by at least 40% by 2030 and increasing resilience to climate change within the first two years of adhesion. The introduction of municipal energy managers played a substantial part not only in the developing of the technical capabilities for the low carbon infrastructure governance, through the development of base line assessments and SEAPs but also for nurturing political will within local authorities for low carbon infrastructure, and for creating important linkages between the latter and the energy efficiency and conservation agenda.

More importantly, the establishment of energy managers and the creation of SEAPs helped participating municipalities move from individual energy efficiency and renewable projects towards an integrated, cross-sector approach to low carbon infrastructure. This has prompted them to examine interdependencies and alternative ways and consider which public and private actors, such as local community groups and local energy agencies, can help in lowering low carbon emissions of infrastructure. Energy managers, auditors and centralised coordinators of initiatives like the CoM facilitate not only the creation of value but are also essential enablers of its capture at the local level and urban scale, through the creation and monitoring of SEAPs.

Transnational municipal networks enable value creation and capture from low carbon infrastructure by acting as centres for coordination of low carbon governance activities for municipalities, cities and regions. In many cases, transnational municipal networks were also instrumental for the alignment of local infrastructure needs for energy saving and conservation, with the low carbon objective. These activities are instrumental for increasing interest in low carbon infrastructure investment by public and private bodies, and community groups, and reducing associated risks with such projects. This diversity of actors and values that they bring with them also increases participation in infrastructure governance. For example, community energy projects have thrived in cities who are active members of transnational municipal networks, with the support of energy managers, and available data and tools like SEAPs, giving opportunity for citizens and users to participate directly in governing low carbon infrastructure by doing.

5.2 Local supply networks

Our second case study highlights the connection between the potential for enabling carbon reductions through expansion of local electricity supply and smart grid networks in the UK and the institutional gap relating to the development of local supply and smart grids. As noted, UK low carbon policy has so far largely focussed on incentivising large-scale centralised low carbon electricity options, including offshore wind and new nuclear power stations. However, work on low carbon transition pathways has highlighted the potential for other pathways with more focus on local distributed generation and energy efficiency measures (Foxon, 2013; RTP Engine Room, 2015). This would require greater engagement by end users in the supply and management of their energy use, which, in turn, could create new opportunities for energy saving and change in energy practices. Greater municipal involvement in smart grid investment and distributed generation options could also contribute to local economic development; create revenues that could be recycled to deliver social benefits; and reduce carbon emissions through faster and cheaper connection of renewable generation (Hall and Foxon, 2014).
However, an institutional gap remains relating to the involvement of householders and municipal authorities in local low carbon infrastructure decision making, and the potential for the development of new business models for creating and capturing these types of values (Foxon et al., 2015). Regional distribution networks are managed as a regulated asset base within the UK’s privatised electricity system. This means that, until recently there has been very little incentive for distribution network operators (DNOs) to invest in innovative approaches, seen as higher risk. The new RIIO (Revenue = Incentives + Innovation + Outputs) regulatory framework, introduced from 2016, does enable some investments towards smart grid solutions. However, DNO representatives still admit a challenge in developing new business models and contractual relationships in a system that was designed to support building and connection of a relatively small number of large-scale centralised electricity generation plants, rather than a large number of local distributed generators. Similarly, the potential for new forms of value proposition and value capture associated with new local electricity supply models, such as energy service companies, is difficult to realise under the current institutional frameworks (Hall and Roelich, 2016). It has been argued that a more flexible low carbon electricity system thus requires a radical overhaul of current institutional frameworks (Mitchell, 2016).

What we want to stress here is that the implementation of institutional changes to enable more local creation and capture of value in electricity networks will also require improvement in governance process to enable greater engagement by a wider range of actors. Electricity systems have generally been analysed and understood in a somewhat technocratic way, led by experts of a techno-economic nature. However, the scale of systems changes needed to realise a low carbon transition necessitates greater public involvement and participation. At the moment, this is largely restricted to supporting or opposing particular energy developments, such as local wind farms or new nuclear power stations. Given the scale of change needed, and the range of different potential low carbon pathways, we would argue that more participative and deliberative forms of engagement are needed to assess the desirability of different options and pathways. This level of engagement could stimulate changes in national institutional frameworks, greater municipal involvement in local electricity supply, and new business models in which end users could participate. This, in turn, could help to close the institutional gap that we have highlighted.

Ultimately, decentralised forms of infrastructure governance (through greater involvement of a wider range of actors including end users, households, municipal authorities, local community groups and energy agencies), illustrated in the transnational municipal networks and local supply networks, place value on integrated and interdependent decision-making processes and outcomes. This in turn allows for new business models to flourish and for new forms of value creation and capture from low carbon infrastructure to emerge. Flexible and open governance forms operating across the whole value chain of infrastructure can build up the ‘inclusive’ value of low carbon infrastructure, leading to deeper and more ambitious infrastructure solutions.

6. Reflections on the political economy of low carbon infrastructure

This chapter has argued that developing a systemic and inclusive understanding of low carbon infrastructure can help bridge the so-called institutional gap in infrastructure governance, by bringing in a wider range of value creating and capturing actors and processes. Two case studies were provided in order to illustrate that it is possible to do so, and well as showing how it can be achieved. We suggest that the investment and institutional gaps facing infrastructure development in the UK should be addressed together, increasing public engagement with and participation in infrastructure.
Both of the cases discussed here feature governance changes that have altered infrastructure development because of the changing roles of organisations and processes already concerned with low-carbon infrastructure and social inclusion that increases their presence in infrastructure decision-making. These are not examples of existing infrastructure actors, like the National Infrastructure Commission, expanding their focus to embrace environmental and social issues but of new actors, for whom the low carbon agenda is a core value central to their business model, entering into infrastructure governance. The integrated approach illustrated by CoM signatories has a potential to bring about opportunities for more local, albeit smaller scale investment in low carbon infrastructure; and with it more direct participation and by wider groups of people. Such an integrated approach to low carbon infrastructure can bring together a wider set of values and provide a means for balancing between them within their specific context. Taking a step further, it can be claimed that wider forms of engagement could increase the number of people involved in decision-making and the ways in which they could benefit from infrastructure. This challenges existing infrastructure governance arrangements at the national level, which represent a piecemeal approach to addressing climate change and building resilience, sector by sector, project by project, and within dichotomies of public and private, social and economic values. An integrated approach to low carbon infrastructure also challenges assumptions about who can create value in infrastructure development and use, and from where, thereby opening up spaces for participation by local users, as well as EU institutions and networks far away. The same applies to the wider groups of beneficiaries, such as EU municipalities, who are able to capture value and learn from local, small-scale projects at a distance.

However, a more integrated approach would represent a challenge to the way that key infrastructure actors, like national economic and environmental regulators, and centralised institutions like the NIC, currently operate. In particular, an integrated approach to low carbon infrastructure would challenge the treatment of the investment and institutional gap of infrastructure governance as separate issues, and the prioritisation of the former over the latter. The cost of their separate treatment is that a top down, technocratic process focused on investment reproduces the gaps between public and private values, and reinforces the role of business and national government as dominant decision makers in low carbon infrastructure (i.e. deciding what to build, where and why). We argue that a growing institutional gap threatens the investment environment for low carbon and infrastructure in general. With the threat of economic backlash and the potential removal of EU driven targets for renewables and environmental protection post Brexit, the imperative for developing an integrated and inclusive understanding of low carbon infrastructure is ever more pressing. It is not clear to what extent these governance innovations at sub and supra national level can currently either supplement or influence national level infrastructure decision-making, which remains the dominant governance level.

As infrastructure sectors start to become spaces for the interaction of many actors and to incorporate the voices of many interests beyond established, techno-economic expertise, the business model lens can be useful for considering these many points of agency and activity. The web of intersecting interests in value creation and capture in infrastructure provision and operation can be more difficult to understand than centralised policy approaches and agency-centred business models can be used to trace activity and interests. However, devising ways to incorporate and respond to these many interests and understanding of infrastructure systems could also provide a key step in enabling low-carbon infrastructure, and the practices that surround it, to flourish for the future.
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