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What do we know about overcoming barriers to siting energy infrastructure in local areas?

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By Prof Patrick Devine Wright[1], Dr Hannah Devine Wright[2], and Dr Richard Cowell[3]

[1] Department of Geography, University of Exeter
[2] Placewise Limited
[3] School of Geography and Planning, Cardiff University

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Any enquiries regarding this publication should be sent to either Hannah@placewise.org or the Department of Energy and Climate Change.

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Executive summary

This review examines the available evidence on installing energy infrastructure in local areas.

The Review summarises the evidence from a rigorous and systematic search of the available literature undertaken in Spring 2015, identifying the implications for practice and policy. The Review was conducted in response to an absence of a clear understanding and synthesis of the current evidence around the placement and public acceptance of energy infrastructure. This Review is for policy audiences and external stakeholders working in the policy area. It can be used as an introduction to the field and a source of evidence.

Implications for practice

There are some clear themes that emerge from the literature with implications for practice:

- Successful placement is associated with legitimacy and trust, which can be fostered by early dialogue and engagement (Dietz & Stern, 2008; Sciencewise, 2015; DECC, 2014f).
- Providing feedback to communities about how their input changed infrastructure proposals can increase trust and social acceptance (Aitken et al., 2014).
- Community renewable energy projects often attract more public support than commercial schemes, although that does not mean that they always obtain planning consent. 100% commercially owned schemes tend to be less popular with the public (e.g. Warren and McFadyen, 2006) and move more slowly through planning processes (Haggett et al., 2013).
- Coordination between different levels of policy (for instance between local and central government) can help communities to actively participate in community-led or shared ownership projects (Haggett et al., 2014).
- Community ownership, or provision for shared ownership, has the potential to become widely available for all infrastructure types (DECC, 2014e).
- There is little evidence that community benefits (such as shared ownership) make local publics more supportive of infrastructure development (Cass et al., 2010), but they can make them seem fairer to those living in the area.
- Spatial zoning strategies are useful to coordinate the concerns of major stakeholders but they do not eliminate public objection.
- Local communities may be more willing to accept projects if developers site and design them in ways that work with, rather than against, local identities and people's attachment to specific places (Devine-Wright & Howes, 2010).

Implications for policy

The literature points to the fact that siting nationally significant infrastructure in local areas is not just a local issue.

- All citizens are affected by infrastructure siting – as voters, taxpayers, members of interest groups or local residents – there is therefore potential benefit from giving them the opportunity to input into infrastructure planning and deployment.
- The evidence suggests that involving publics in national policy making is both possible and potentially beneficial, when carefully conducted (Pidgeon et al., 2014). This could help to address a national-local 'gap' in public attitudes (Batel & Devine-Wright, 2014)
- A national level debate, as has been undertaken in Germany, could explore how energy futures could be implemented in specific places in ways that take emotional attachments into account (Devine-Wright, 2009), do not sacrifice them for national or global interests (Ellis et al., 2007), and achieve distributional justice of impacts (Cowell et al., 2012).
- The authors suggest that policy is more likely to be successful if it acknowledges that energy infrastructure is a complex, interdependent system with many elements. These elements include various:
    - actors (e.g. national and local policy makers, companies, interest groups, citizens),
    - technologies of heat and power generation (e.g. wind farms) and
    - distribution (e.g. transmission networks)

    working across different:

    - scales (e.g. international, national, regional and local) and
    - contexts (e.g. urban and rural locations).
- This systemic approach is important as policy goals are more likely to be achieved if all elements (especially those that are problematic or under researched) are addressed, not just certain elements (e.g. only providing community benefit provision).
- Putting a systemic approach into practice (to encourage legitimacy and learning) would likely require a review of processes, practices, and actors involved in infrastructure siting.
- Supporting institutions that can play 'bridging' or capacity building roles between national and local levels for the development of sustainable energy systems (Hawkey et al., 2013) could be beneficial.
- In other European Countries municipalities are often much bigger players in infrastructure development, studying these could provide further insight for the UK.

Section 1: Introduction

Promoting more sustainable forms of energy – in terms of decarbonisation and sustainability, energy security and affordability – will require significant changes to infrastructure.

While government targets may set a high-level direction of travel, a key challenge in realising change is that infrastructures are embedded in places and environments. Such places are important for a variety of reasons, as part of the quality of people's lives and daily experience, and as the settings through which people connect to the wider environment. The installation of new energy infrastructure can reveal a wide range of people's concerns: about wider societal issues, about the impacts of projects on the environment and on communities, about the agendas that underpin these projects, and the ways in which decisions are made.

Such concerns provide the context for this research review. The overarching focus is on 'what works' to overcome barriers to installing new infrastructure in local areas?' The review is focused further by two questions:

- What works in relation to public engagement and acceptance of local infrastructure siting?
- What works in obtaining planning permission for new infrastructure in local areas?

The aim of the review is to produce an evidence summary from which useful lessons for future policy can be identified. In consultation with DECC and through a formal call for evidence, we identified potentially relevant evidence sources and conducted a rigorous and systematic search of literature (see appendix A). The rest of the report is structured as follows:

- Section 1 introduces the core assumptions the authors have made, and provides a brief overview of the field.
- Section 2 is a detailed review of the evidence on what works, categorised by intervention type.
- Section 3 concludes the paper by discussing the underlying assumptions in the literature, summarising gaps in knowledge and suggesting future research.
- Appendix A summarises the methodology used.

Core assumptions

There are multiple ways of understanding 'what works' for energy infrastructure siting. As well as obtaining planning permission without undue delay there is also the need to create decision-making procedures that are seen to distribute fairly the costs and benefits from infrastructure. Fostering public acceptance of energy infrastructures is another consideration for those involved in siting processes.

This review covers a diverse array of large-scale energy infrastructures. The available evidence varies in quantity by technology type, with larger numbers of studies conducted on more established or more controversial technologies. Although we generalise from specific technologies to infrastructures more generally it is important to recognise key differences between them, including technical configuration, scale, local impacts, levels of public familiarity, and whether there are already support or objection groups (for further information on the relevance of technology, please see 'Different forms of technology and 'what works'', in 'Section 3).

The public are not a single group of people and hold a wide variety of views about infrastructure and where it should be placed. We can make useful distinctions between:

- society as a whole,
- communities of interest (people who are linked through shared opinions); and
- communities of locality (people who are linked through living near each other).

Therefore in this paper we often talk not of the public as a single group, but of 'publics' – groups of people characterised by membership of different kinds of community and with different concerns as part of wider society. Although research on society as a whole tends to focus on general attitudes towards energy technologies, important insights can be gained when national-level studies focus on particular infrastructures and local case studies focus on national policies (Batel and Devine-Wright, 2014) (for further discussion of this, see 'Impacts of different ways of thinking about 'the public' or 'publics' on 'what works'', in Section 3).

People can form emotional attachments to particular places. This can lead to infrastructure siting being seen as a threat not only to a place but also to the identities of people who feel attached to that place. Often these emotional attachments are not taken into account by developers. This can have negative consequences for public engagement and public acceptance of infrastructure in their area (Devine-Wright, 2009).

Section 2: What do we know about overcoming barriers to siting energy infrastructure in local areas?

This section reviews the evidence of what we know about what works and the impacts of key categories of intervention.

Section Summary

The choice of where energy infrastructure is located has a significant effect on how different groups of people respond. Spatial planning exercises are a method of determining placement of infrastructure based on multiple concerns. They have the potential to be part of national discussions about possible energy futures, but this has not been well researched.

Spatial zoning strategies define areas that are more or less appropriate for certain kinds of development. They are useful for coordinating the concerns of major stakeholders involved in infrastructure development processes. However, even where infrastructure is targeted on spatial zones deemed more appropriate for development, this does not prevent public objection. A sense that decision-making processes are unfair is a significant cause of public opposition.

What people think about energy infrastructures is not just determined by how close they live to the infrastructure but also by what they think about different energy technologies and how they feel about the places where those energy technologies are located. Where developers or policy-makers assume that publics are essentially NIMBYist (Not-In-My-Back-Yard) in their attitudes towards infrastructure development, this encourages approaches to public engagement that people involved are likely to find tokenistic, instrumental, and therefore problematic.

Research consistently emphasises that **public engagement** can improve the quality and legitimacy of energy infrastructure decision-making. Research consistently calls for public engagement at the early stages of development decisions, with this being especially important where technologies are less familiar. However, if engagement opportunities are limited or insincere, this can deepen public mistrust of developers and make public objections more likely. The use by developers of locally-based people as liaison officers can help enable information to flow between project proponents and communities and increase trust.

Evidence shows that publics evaluate **community-owned projects** more positively than conventional commercial schemes. Community energy projects enable greater public engagement and control over siting and design and channel more benefits to local citizens. However, some community energy projects are evaluated less positively than others – public acceptance is not guaranteed. To address this, attention needs to be given to the particular models of ownership being promoted by community energy projects – which vary greatly due to the ambiguity and flexibility of the term ‘community’ (Walker et al., 2007) – and how they allocate control and the flow of benefits.

Energy projects developed and/or owned by communities can proceed more quickly through planning but getting planning consent remains a challenge, regardless of the balance of local support to opposition. There are few places where there is a lot of capacity and strong desire to promote community renewable projects; this suggests that there is a need to build capacity, and to develop shared or joint ownership in commercially led projects.

The provision of **community benefits** started with on-shore wind projects and is now more widely practised. There is little evidence that providing community benefits changes the attitudes of local publics or alters the outcomes of planning processes. If handled badly, community benefits can increase conflict and mistrust. This can be reduced if benefits are introduced in a timely and transparent manner. In general people support the principle of community benefits. For example, DECC's public attitudes tracking survey (DECC, 2015) found that 78% of respondents felt that a community ought to experience some direct benefit from infrastructure siting; the level has remained between 81% and 78% for the past 4 years. Even if community benefits do not make people more positive toward a project they can be important for achieving distributional justice, a way to compensate people for accepting the impacts of nationally significant infrastructure. Research indicates that for the majority of the British public, it is important that particular locales are not disproportionately affected by infrastructure siting, and that such decisions should be made in an inclusive and democratic way (Parkhill et al, 2013, p29).

Disputes about the national need for infrastructure and how that is determined underlie many apparent problems of 'local acceptance' for energy infrastructure in 'local planning'. Evidence, both from Germany and the UK, shows that publics can be involved in debates about national energy policy making, and that it is beneficial when conducted carefully using deliberative methods of public participation. From this we can infer that institutions will site more successfully if they connect national policy and local engagement. This will produce beneficial learning across connections between project and policy, and reduce the likelihood of 'national-local gaps' (Batel and Devine-Wright, 2014).

1.1 Effective spatial planning

Decision-making procedures for energy infrastructures are sometimes detached from the conventional planning system

In assessing 'what works in obtaining planning permission for new infrastructure in local areas', it is important to recognise that much energy-related infrastructure goes through quite specialised decision-making procedures, which are detached or semi-detached from the conventional planning system:

- large-scale energy infrastructure (electricity generating stations over 50MW, major grid lines) is determined by central government, through the special regime for Nationally Significant Infrastructure Projects
- statutory undertakers in the energy sphere have a whole host of powers to undertake actions that operate, maintain and extend networks (be it through low voltage wires or pipelines) without conventional planning consent
- very small infrastructures such as micro-renewables do not need consent at all: they are permitted development.

This is important for four reasons:

i. It is only necessary to obtain planning permission for certain categories of infrastructure – but this covers a large amount of infrastructure and facilities that have a high potential for controversy (e.g. wind farms or field-scale solar farms up to 50MW, fracking wells).

ii. Decision-making for Nationally Significant Infrastructure Projects and wires and pipelines do make provision for public engagement or landowner objections, but because they are designed to make sure that strategic energy goals like decarbonisation, system integration and energy security are met, they limit the scope for opposition that would affect delivery (see, for example, DECC 2011c, DECC 2013e).

iii. Institutional arrangements for decision-making affect where measures to enhance public engagement and public acceptance 'fit'.

iv. The institutional arrangements for decision-making shape the distribution of research –most investigation of public acceptance of local infrastructure siting has focused on those technologies that require planning permission (e.g. renewable projects up to 50MW), where local objections have greatest potential to influence decisions, and thereby delay or derail projects. Much less research addresses projects going through central consenting processes, and very little addresses infrastructure like pipes and low voltage electricity wires.

Of course, potential changes to these decision-making arrangements – e.g. to bring developments into the local planning system or take them out of it – are themselves an important form of intervention, and one which can affect the relative impact of importance of public acceptance in receiving approval for local infrastructure siting. For example there is a proposal to take all on-shore wind farm permissions, including those over 50MW, out of the Nationally Significant Infrastructure Projects process and pass them to local authorities (Shankleman 2014). The effects of such moves could be significant but are rarely researched.

Siting matters

A key message from the existing research is that siting matters to how the public responds. Public attitudes and the likelihood of resistance are affected by how a project is perceived to impact upon existing landscapes and visual amenity (Wolsink, 2000), ways of life (Pasqualetti, 2011) and place attachments (Devine-Wright, 2009). There is a sizeable technical literature that describes how energy infrastructure might be designed or placed in the landscape to minimise visual effects (for a review see Pasqualetti et al., 2002). GIS-based mapping and visualisation tools have been used to show how the supply of different renewables changes across time and place (Blaschke et al., 2013), where the areas of greatest renewable energy potential are located (Palmas al., 2014) and where there is community capacity to accommodate new developments (Martinkus et al., 2014). One result of these mapping and visualisation tools has been to show the (often) limited spatial scope for developing renewables that are free from environmental constraints (Palmas al., 2014) – a typical example is the tendency for high wind resource areas to also be uplands that are valued for their landscape qualities. However, the usefulness of mapping and visualisation tools in actual decision-making contexts is rarely tested. Research tends to be dominated by assessments of technical and economic potential for energy development (Cowell, 2010*)* and, although the scope for public input is acknowledged (Blaschke et al., 2013), it is rarely demonstrated.

Proximity is not a simple indicator of public attitudes

Various governments have deployed 'separation distances' to govern how close wind turbines can be to the nearest dwellings, or other environmental standards. DECC commissioned research into the phenomenon of sound pollution from wind farms in Spring 2015. Haggett

(2012) examined the social experience of noise from wind farms and concluded that whether sound is experienced as intrusive noise reflected people's wider attitudes to wind energy projects. Sound, like landscape impacts, may be more acceptable to people if they feel that they have been properly involved in development decisions. Jones and Eiser (2010) used a survey to investigate the attitudes of Sheffield residents to nearby and distant, onshore and offshore wind energy developments. They concluded that while participants favoured offshore developments, their attitudes to nearby onshore projects were not solely determined by how close they were, but also by their concerns about the visual impact of the turbines on the landscape.

Spatial zoning aids development but does not prevent public objection

Planning bodies have used spatial zones to specify areas that may be more or less suitable for renewable energy development, especially for wind energy. Research in the UK has concluded that government-directed 'strategic search areas' for large wind energy development in Wales has supported more extensive wind farm development and stimulated developer interest. However, it has not prevented significant public objections to wind and associated grid projects or speeded up development (Power and Cowell, 2012). In Scotland, advisory constraints mapping from Scottish Natural Heritage has helped some wind farms avoid more sensitive areas, but it has not always been complied with by developers (see Smart et al., 2014*)*.

Spatial zoning for energy may restrict opportunities

It is important to be clear about what spatial zoning does and does not achieve. Spatial zoning is useful for 'screening out' from energy infrastructure development the most environmentally sensitive areas and sites most likely to result in conflict (Martinkus et al.,2014; Thygesen and Agarwal, 2014). Spatial zoning for renewable energy may assist in coordinating development with grid connection corridors: Zichella and Hladik (2013) argue this has been achieved to good effect in Texas. They also argue that guiding energy generation to areas of spare grid capacity may remove the need for new infrastructure. They suggest using spatial planning to aid coordination between renewable energy development and available grid capacity. However, such zoning and mapping exercises rarely capture the complexity of environmental impacts (Christie al., 2014), landscape character (Antonson, 2009), place attachments and identities felt by local publics. As a result, wind energy projects that 'fit' within designated development zones can still be highly contentious.

> In its 2005 planning guidance, the Welsh Government introduced 'strategic search areas' (SSAs) in which there was a presumption in favour of large-scale wind energy. These were drawn up by mapping existing major landscape and other environmental constraints and landscape analysis. However the zoning exercise did not eliminate environmental concerns arising from projects within the SSAs (such as on peat). Communities remained concerned that values they attached to landscapes within these areas – notably for tourism – were neglected (Cowell, 2007, 2010).

Zoning also risks unnecessarily restricting development opportunities; a common refrain of the energy industry itself. In France, Nadai (2012*)* showed how creative actions *within* protected areas could result in siting solutions that balanced wind energy development with bird protection. Similarly, Palmas, Siewart & von Haaren (2014) comment on the way that 'exclusion zones' are treated as undifferentiated spaces, even though areas within them may be more or less able to accommodate some renewable energy development.

Combining spatial zoning with community and/or financial benefits fosters public acceptance

Research in the UK and elsewhere shows that spatial zoning is only effective in shaping local government and public reactions to infrastructure projects when it is combined with other factors. In France, local areas can be designated as potential wind power development zones. When a project is proposed in these zones it triggers the payment of community benefits (Nadai, 2007). In Germany, local planning designates zones for wind farms but it is community ownership of the projects rather than zoning that leads to more positive public reactions (Szarka, 2007). The effect of different ownership models and community benefits is discussed below.

Research has shown that distance from infrastructure is a weak indicator of whether people feel positive or negative about projects (with those closest and most exposed to potential impacts being most negative) (e.g. Jones and Eiser, 2010). Indeed, it is often the reverse, with positive or negative attitudes about the rightness of the infrastructure in a particular location affecting whether visual or sound effects are seen as problematic, regardless of how close they are (Firestone, Bates & Knapp, 2015; Haggett 2012). Because of this, there are limits to how far zoning exercises can identify fully acceptable locations.

Similar findings come from research that examines public engagement with 'landscape capacity' for on-shore wind (Jones et al, 2011). This shows that general attitudes to energy and beliefs about the distributive fairness of the impacts of energy development, affect the amount of development people feel can be accommodated. Consequently it is difficult to work out the capacity of a landscape to accommodate a technology, based on visual or other environmental impact criteria, because for the public, attitudes to sites and siting cannot be separated easily from attitudes to technologies and places.

Spatial zoning, place attachment and local identity impact on social acceptance

Strategic spatial zoning can be more useful in coordinating major stakeholders (energy generation developers and grid network companies, development interests and statutory environmental bodies) than in wholly pre-empting issues of local social acceptability (Cowell, 2010). This may explain why spatial zoning is seen as more effective by planners in marine environments (Jay, 2012) as it has been presumed by stakeholders that siting energy infrastructure (e.g. wind farms) at sea, distant from private properties and therefore 'NIMBY' concerns, will be less controversial and more efficient (Walker et al., 2010). However, although public acceptability might be less of an issue with offshore wind energy (e.g. Firth of Forth) without a fully inclusive approach to stakeholder engagement there is evidence that this does not prevent objection from key stakeholders (such as fishermen) (O'Keeffe & Haggett, 2012).

Whether spatial zoning interventions lead to public acceptance also depends on the wider arrangements for infrastructure decision-making. Research shows that zoning exercises created and imposed 'top-down', by regional or national government, without local buy-in, can become a focus for opposition and often fail to achieve the targeted level of development (Wolsink, 1996; Moragues-Faus and Ortiz-Miranda, 2010; Cowell, 2010). One solution, therefore, might be to allow greater local government and public input into such spatial mapping or zoning exercises. Since the National Planning Policy Framework (Communities and Local Government, 2011), this is now encouraged in England. However, bottom-up approaches beg a wider question - should local publics and councils be allowed to define the limits to growth of different kinds of energy generation? Evidence from Sweden (Bergek, 2010) shows that some communities may define very few areas as acceptable for renewable energy development (such as on-shore wind). To address this, Barry and Ellis (2010) suggest that local communities should be allowed to identify the carbon-reduction strategies that work best for them, rather than being required to accept specific technologies.

The ‘optimum’ balance or procedures for national-local relations has not received much research attention. Cowell (2007) found that more people became engaged in the Welsh Government’s spatial strategy for on-shore wind than its various ‘higher-level’ target-setting strategies. This suggests that public engagement is higher when spatial representations of possible energy futures are provided and consideration is given to the availability of acceptable sites (Cowell, 2010). Prompting deliberation and learning about energy futures is another important dimension of ‘what works’ in infrastructure decision-making, and spatial planning strategies seem better at stimulating this.

Key message – work with, not against, local identities and place attachments

The key message for spatial planning interventions is that developers might achieve greater local social acceptability for projects if they site and design them in ways which work with, rather than against, local identities and place attachments (Devine-Wright & Howes, 2010). However, achieving the detailed investigation required to understand places will depend as much on effective public engagement as strategic spatial planning.

1.2 Methods of public engagement that work well

Rowe and Frewer (2000) distinguish three types of public engagement:

- **Communication** involves one-way information flow from the ‘sponsor’ (in UK infrastructure siting, this is typically a private company) to the public, for example using leaflets and web based materials.
- **Consultation** involves two-way information flow between ‘sponsor’ and publics, but the information flows back without any substantive dialogue between the parties (e.g. using phone lines or questionnaires).
- **Participation** involves a two-way exchange of information with the possibility of opinion change in both parties.

Three predominant rationales for undertaking public participation have been identified: normative, substantive and instrumental (Sterling, 2006).

- The **normative** rationale is the view that involving members of the public is the right thing to do, for example in a democracy it can be thought right and proper to seek citizens’ views before making decisions on their behalf.
- The **substantive** rationale means that public participation is undertaken because it is believed to improve the quality of decision-making.
- An **instrumental** rationale means that public participation is undertaken because it is believed to increase the likelihood of achieving a pre-determined goal, for example to promote greater social acceptance, or achieving regulatory compliance (Howard, 2015).

One of the most comprehensive reviews conducted on the role and value of public participation in the environmental domain was funded by the US National Research Council (Dietz and Stern, 2008). The review concluded that public participation does improve decision-making along the dimensions of quality, legitimacy and capacity, and that these criteria are positively correlated: processes that enhance decision-quality tend to improve legitimacy and enhance capacity.

Public engagement through processes of communication and consultation has become conventional in UK infrastructure siting over the two past decades and incorporated into

planning regulations (e.g. 2008 Planning Act), moving away from what had been criticised as a 'Decide-Announce-Defend' approach characterised by minimal information provision prior to planning submissions (Walker, 2009). Alongside this, public participation has become an increasingly common feature of many sectors of policy and decision-making, with the Aarhus convention introducing a legal commitment upon national governments to enable public access to environmental information, participation in environmental decision-making, and access to justice on environmental matters (United Nations, 2014). Despite this, the scope for genuine public participation in decision-making over infrastructure siting (i.e. not just rhetoric) is a matter of considerable debate in the academic literature (e.g. Hindmarsh and Matthews, 2008), on the basis that the different actors involved (e.g. national governments, local residents, private companies, environmental groups) hold different agendas and levels of influence over decision-making. As some groups have more power than others, and there are vested interests in the outcome of these decisions, the capacity for all affected communities to influence decisions may be undermined.

There is consensus that a lack of early and genuine public engagement leads to conflicts

Literature reviewed for this report showed a high level of consensus over the substantive value of public participation in infrastructure siting. This conclusion was found in both UK and international research, and across technology sectors, including wind energy (Aitken et al., 2014), nuclear power (Richardson et al, 2013), electricity power lines (Cotton and Devine-Wright, 2013), CCS (Customer Insight Group 2011; Brunsting et al, 2011) and shale gas (TNSBMRB, 2014). One of the reasons why this finding is so consistent is that analyses of conflicts over infrastructure siting consistently reveal the significance of procedural injustice as a key factor explaining public objections to technologies such as wind power, large-scale solar and grid powerlines (e.g. Gross, 2007; Zoellner et al., 2008). For example, Devine-Wright (2013) found that procedural justice (measured in a survey using items such as *"Decision making about the powerline has involved opportunities for local people to have a say")* was the most significant factor in explaining local objections to a proposed high voltage powerline in South West England. That said, public concerns over procedural and distributive justice (about how fair a process was, and how fair they consider the distribution of benefits) do not inevitably lead to siting conflicts. This was apparent in a tidal energy case in Northern Ireland that was characterized by little local involvement or financial benefit provision, yet high levels of public support. This was explained by the fact the communities affected by the project held low expectations of involvement in planning decisions, and received symbolic benefits from a project that was seen to boost the distinctiveness of the area, enhancing local identities and place attachments (Devine-Wright, 2011a).

Research consistently suggests that public engagement may be more effective if commenced at an 'early stage' of infrastructure siting (or 'upstream', Wilsden and Willis, 2004; Chilvers and Burgess, 2008), since late engagement occurs after key decisions have been taken on details such as routing, under or over grounding of power lines, scale of wind farm etc. This is particularly important for less familiar or emergent technologies such as hydrogen (Flynn et al, 2011) and shale gas (TNSBMRB, 2014) to enable the incorporation of public values and responses into technology development pathways (including design). For example:

'We want to be engaged in decision-making processes at an early stage, rather than being consulted at the last minute, when decisions have already been taken and agendas have already been set' (quoted in Wolsink, 2011, p.84).

There is evidence that engagement should continue across the lifetime of infrastructure projects (from pre-planning to decommissioning) and that feedback on how proposals have been modified arising from a dialogue with affected communities can serve to enhance trust between parties and increase social acceptance of proposals (Aitken et al., 2014).

For engagement activities to be perceived as genuine, trust is essential. Where developers are not trusted by local residents, publics may be sceptical that engagement activities are genuine, and be less willing to volunteer to participate.

Trust is an additional factor that influences the outcomes of public engagement

Another consistent feature of social science research on conflicts over infrastructure siting (alongside procedural injustice) is that lack of trust in developers is associated with objections to siting proposals (e.g. Devine-Wright, 2013; Midden and Huijts, 2009). Some have proposed that the impact of lack of trust is particularly strong when the technology is less familiar (e.g. hydrogen, Flynn et al., 2011; carbon capture and storage, Huijts et al, 2012).

Disengagement or active protest may follow if publics doubt that their opinions are genuinely listened to, or that their input will lead to tangible changes to infrastructure proposals. It is therefore problematic that several studies have revealed how members of the public do not expect local residents to have a high degree of influence upon decision making for the siting of high voltage power lines, in comparison to industry (e.g. National Grid) or policy actors (Devine-Wright et al., 2010; Batel and Devine-Wright, 2014). Although public engagement is mandatory for power line siting under the terms of the 2008 Planning Act, these perceptions of a lack of public influence over planning decisions reveal concerns that such engagement is tokenist in nature. It has also been shown that a strong national policy position in favour of a technology or energy source (e.g. shale gas) can lead to citizens having doubts about the fairness of local planning procedures and the possibilities for local residents' objections to have any impact upon consent decisions (TNSBMRB, 2014; Upham and Shackley, 2006).

There are benefits to employing locally based intermediaries

One set of practices that 'works' in infrastructure siting is when private developers from outside of a community of locality, use locally based intermediaries (e.g. community liaison officers) to enable information flows in both directions (Customer Insight Team, 2011). For example, in one study, the use of intermediaries in two contrasting UK offshore wind energy cases was compared (one with high conflict, the other with low) (Devine-Wright, 2012). It was concluded that arranging for a local primary school teacher to speak to local residents and schoolchildren about climate change, the specific technology (offshore wind) and the local project proposal led to greater awareness of an infrastructure project and its outcomes, wider social acceptance, and increased trust in the developer.

How developers think about publics (e.g. as NIMBYs) shapes public engagement

The literature also discusses why, despite the evidence, genuine public participation may often not occur with infrastructure siting. Several studies have investigated how policy makers and developers think about publics generally, and in particular the local residents who are directly affected by infrastructure projects. Much of this literature focuses upon the 'NIMBY' (Not In My Back Yard) label, which implies that objectors lack rationality, objectivity and public mindedness (Walker et al., 2011; Barnett et al, 2012; Cotton and Devine-Wright, 2011; Burningham et al., 2014). This label has been strongly critiqued by social scientists as not being a fair, accurate or helpful description of objectors (e.g. Burningham, 2000; Devine-Wright, 2005a; Ellis et al., 2007).

Research suggests that when informed by preconceptions that locals are 'NIMBY', public engagement is driven by instrumental rationales, with a predominant focus upon one-way communication of information (to address presumed information deficits), and the avoidance of certain engagement methods (e.g. public meetings), since they afford objectors the opportunity to gather en masse and protest against technology proposals (Barnett et al., 2012). Regarding

the public as 'NIMBYs' leads developers to emphasise the provision of financial incentives (to address presumed selfishness and lack of public mindedness), attempt to site technologies distant from human settlements (e.g. offshore wind energy), and hold a preference against early timing of engagement, to prevent the raising of unnecessary levels of concern amongst publics (Walker et al., 2011; Cotton and Devine-Wright, 2011). By contrast, academics' support for the substantive benefits of public participation is often founded upon a more positive conception of the abilities and capacities of publics, for example when characterised as 'local experts' or 'place protectors' (Devine-Wright, 2009) with the overall conclusion that genuine public participation is less likely to occur when publics are conceived as NIMBYs.

There are Interaction effects between engagement and benefit provision

Recent research has shown how public engagement and benefit provision (i.e. procedural and distributional justice) are related in cases of infrastructure siting. A Dutch study with a quasi-experimental design showed that the provision of a 'community incentive' led to higher levels of social acceptance when the developer had consulted on the incentive with the local community (TerWel et al., 2014). A Scottish study showed that how decisions were taken over the ways that community benefits were spent could lead to conflict amongst local residents (Aiken, 2010). These findings show the systemic nature of infrastructure siting – specific aspects (e.g. benefits provision) are not viewed in isolation by publics, but in relation to other relevant aspects of those proposals (e.g. whether procedures of decision-making are seen as fair). The implication of this finding is that a piecemeal approach to a single aspect of 'what works' is unlikely to lead to successful outcomes or desired policy goals.

1.3 The impact of different models of project ownership

Diverse models of project ownership exist

An important factor shaping public acceptance of energy infrastructure is the model of ownership. In the UK there are many different types of ownership models (Brophy and Pollitt, 2013), from the more usual, commercial schemes developed by private companies through to schemes in which local communities are in charge of the development and own the final product. Between these 'poles', there are a lot of other models: joint ventures between community organisations and private companies; community ownership as shareholders or managers; taking dividends or using profits for collective social purposes (Strachan et al, 2015). The 'community' that owns a community energy project might be a community of place, a collection of shareholders from a wider geographical area, or a particular sector (e.g. local farmers).

Community led and owned energy projects have higher levels of public acceptance than conventional commercial schemes

'Community renewables' are renewable energy generation projects in which local communities have a significant role in developing the project and receive most or all of the financial benefits. Community renewables can have wider benefits: shares of profits may be invested in other, local sustainable energy initiatives; technology type and size may be considered more locally appropriate, and scheme development may foster skills and capacities that can be applied to future development (Slee 2015; Van der Horst, 2008). There is good evidence to suggest that community renewables projects have a higher level of local public acceptance than conventional commercial schemes (Devine-Wright, 2005b; Rogers et al., 2008; Cowell et al., 2007; Warren and McFadyen, 2010). Similar results have been found in Denmark and Germany, where higher market penetration of wind energy has been attributed to sustained public support, founded partly on models of development that have higher levels of local, citizen ownership than the UK (Walker, 2008).

Community renewables projects are seen as less exploitative than private schemes, and generate a greater 'subjective' sense of ownership as well as formal ownership among local publics. The popularity of the community windfarm on the Isle of Gigha, Scotland, christened locally 'the three dancing ladies', is a good example (Warren and McFadyen, 2010).

> Only one study has directly compared public acceptance of company and community-owned energy projects. Warren and McFadyen (2010) compared the responses of people living in two parts of Scotland – one where commercial wind farms were common (Kintyre) and another with a community owned wind farm (Gigha). The study found that participants were much more in favour of wind power generally in Gigha by comparison to Kintyre. It also found that community ownership was associated with higher levels of public support than company-led development. For Gigha respondents, 45% said that they would be more supportive of a new windfarm if it was community owned, and none expressed a negative attitude. For Kintyre respondents, 65% said that their support for a new wind farm would decrease if owned by a commercial company.

Community ownership does not guarantee local acceptance or planning consent

However, the relationship between community ownership, local acceptance and positive planning outcomes is rarely straightforward. Firstly, projects and contexts vary:

- greater localisation of the flows of financial benefits (distributive justice) is a commonly perceived benefit of community renewable energy projects, but some projects localise benefit flows more than others, and the distribution of benefits between groups can be contentious (Walker and Devine-Wright, 2008);
- greater public engagement and control over siting and design (procedural justice) is seen as an advantage of community renewables but some community project developers are more effective than others in engaging local publics (see Howard, 2015);
- and some communities are more cohesive than others.

Secondly, achieving majority local public support does not automatically translate into swift planning consent. Sometimes it does: the Bro Dyfi Community Renewables turbine achieved a positive planning result, despite being just outside a National Park (Cowell et al., 2007). Haggett et al. (2013) found that community energy projects pass more quickly through planning processes than commercial projects with community involvement, and both are quicker than wholly commercial schemes. But swift, positive outcomes are not guaranteed: the Awel Aman Tawe windfarm in the Swansea Valley went through successive applications and appeals over ten years, despite majority support in the local community. Protracted timescales can arise for community renewables for several reasons:

- negotiating environmental regulations and providing impact information is more burdensome for community schemes, which are often organised by volunteers with limited resources (Seyfang et al., 2013);
- planning decisions give little specific weight to whether schemes are going to be owned by community bodies (Slee, 2015; Strachan et al., 2015);
- financial resources can be limited, leaving projects dependent on government-funded grant/loan schemes (Walker, 2008).

Arguably, the biggest 'limit' to the positive potential of community renewable lies in the very scope for such schemes. Community-led, community owned renewable energy projects remain a minor feature of UK energy infrastructure, requiring:

- places to have existing, active organisations (such as transitions towns, or social enterprises);
- a shared and immediate sense of dissatisfaction with the *status quo* (as on islands otherwise dependent on diesel generators);
- skilled and committed individuals;
- adequate access to land (Strachan et al., 2015).

These conditions are not found everywhere and the pace of replication (e.g. by learning) is likely to be slow. The weak organisation of the community renewable sector, and its limited influence on core energy policy agendas, has also been a factor (Bomberg and McEwen, 2012; Strachan et al., 2015).

Shared ownership models

Community ownership could be increased by adopting models in which communities took less direct responsibility for development e.g. owning a portion of a conventional commercial schemes (DECC, 2014e*),* or local authority leadership, or through schemes where ownership is secured by share-ownership, perhaps obtained from a wider spatial area. This is mandatory in Denmark, where 20% of the equity in a commercial wind farm must be released for community ownership. These are 'thinner' definitions of community ownership but nevertheless may be more applicable to more places, larger projects and larger numbers of energy infrastructure projects (Strachan et al., 2015). However – other than the widely reported positive example of Fintry, where the community owns one fifteenth share of the profits in a fifteen-turbine commercial wind farm (Cowell et al., 2012), and supported the developer's overall ambitions in the planning process – there is little research available to how these models affect public acceptance. Given UK government intentions for shared ownership to become conventional in renewable energy projects (DECC, 2014e), research is required to investigate whether and how alternative ownership models influence what works in actual cases of infrastructure siting.

Community ownership and large-scale infrastructure siting

Rarely is consideration given to alternative models of ownership for massive, capital-intensive or linear energy infrastructure (e.g. nuclear power, grid networks). That said, use of a share issue for part or whole ownership of the infrastructure can serve to create a novel community of interest around the project, as has been the case with a Danish example of cooperative energy – the Middlegrunden offshore wind farm in Copenhagen (Haggett, 2008). It is also interesting to note that in Germany, there are moves to retake energy infrastructure back into public ownership (e.g. Hamburg and Berlin city grid networks, Moss, 2014).

1.4 The impact of community benefit provision

The prevalence and value of community benefits has increased since the 1990s

An important development accompanying the expansion of energy infrastructure in the UK since the mid-1990s has been the growing use of 'community benefits'. This can be defined as the provision by the developer of a project of some form of positive provision (in addition to jobs and incomes) for the area and people affected by the infrastructure development. The typical community benefit provision in the year 2000 was the payment of an annual fund by the

developer of a wind farm to the parish in which it was located, equivalent to £1,000 per megawatt of installed capacity.

Since 2000 community benefits have expanded in scale, become more diverse in form, been applied to more energy sectors, and attracted government interest (Cowell et al., 2007, 2012; Cass et al., 2010; DECC, 2014e). Community benefit payments are now routine for on-shore wind projects, and some schemes now offer more than £5,000/MW/annum, meaning that for very large wind farms (such as Pen-y-Cymoedd in south Wales), annual payments exceed £1million. In-kind benefit provision sometimes replaces monetary payments: one example is the Lincs offshore wind project, where developers funded visitor facilities at Gibraltar Point National Nature Reserve (Devine-Wright, 2012); another is the quite widespread channelling of a proportion of benefit funds into local sustainable energy projects (Bristow et al., 2012). A more recent trend is the interest in providing low tariff electricity to communities living near energy projects (see box below). Community benefit packages have become a feature of new nuclear generation projects, waste repositories, offshore renewables (also through the re-allocation of royalties from the Coastal Communities Fund of the Crown Estate), fracking wells, and have been raised in conjunction with linear infrastructure like electricity grid lines (RGI, 2011). Governments have sought to give more legitimacy, consistency and encouragement to community benefits.

> Good Energy announced a 'local electricity tariff' available to households living within 2km of an onshore wind farm in Delabole, Cornwall. Switching to this tariff was claimed to potentially save eligible households £110 per annum derived from a 20% discount on the company's standard electricity tariffs, plus the potential to receive an annual 'windfall' dependent upon the annual output of the wind farm. This development is only possible where the owners of generating plant also act as suppliers selling power direct to customers, which is often complicated to achieve in the UK's electricity markets.

(sourced from 'goodenergy.co.uk' on March 2015)

What is not clear from this activity is whether community benefits 'work' for infrastructure siting and public acceptance. It is unclear partly because research has not caught up with practice (and research grounded in practice is especially limited) but it is also unclear because 'what works' with community benefits has multiple dimensions.

There is a complex relationship between community benefits and social acceptance

It is generally thought that community benefits 'work' by improving the local social acceptability of projects. There is an intuitive sense to this in that concern about distributive unfairness is a common dimension of public opposition to new energy infrastructure – that costs are imposed on communities while people elsewhere enjoy the benefits. However, there is limited and contradictory evidence that the provision of community benefits promotes local social acceptability, improves trust in developers (Cass et al., 2010; Gallagher et al., 2008), or speeds up the delivery of infrastructure development. In some places, especially the more economically disadvantaged, jobs and income provision through infrastructure construction and operation have provided sufficient benefit to ensure local support (Cowell et al., 2012). In other places, community benefits have been used to support local social infrastructure over a number of years and this has resulted in a more positive attitude to energy infrastructures, for example, the community council of Carno, mid-Wales earns benefits from three on-shore wind farms (Bristow et al., 2012). However, it is hard to establish how far (how often, or where) the provision of community benefits has really changed public views. Decision-making processes for the largest

infrastructures, as noted in 2.1 above, often entail issuing consents for projects that are in line with national policy even without widespread local acceptance. No matter what a community thinks about community benefits, communities often have no right of veto over infrastructure decision and community benefits are not currently a formal part of planning decisions.

Community benefit provision can undermine social acceptance

Although there is little evidence that community benefits cause local publ public opposition, in circumstances where conflict has already emerged then community benefit provisions can have exacerbating effects. Community benefits can be seen as 'bribes'; devices to 'buy' support or to silence objectors (Cass et al., 2010), which reduces social acceptance (Walker et al., 2014), causes mistrust in developers and in the UK, increases anxiety about the purchasing of planning permission (Cowell et al., 2011). Academics point out that benefits can be divisive (Cass et al., 2010), when there are disputes over who should be eligible to benefit (Aitken, 2010), and difficulties in working out – in line with discussions in Section 1 – who is 'the community' that should benefit (Bristow et al., 2012). In the case analysed by Aitken (2010), it was felt that parties that had opposed the windfarm should not be eligible to receive community benefit funds. Disputes can also arise between those who prefer to see benefits concentrated on the communities nearest to the infrastructure and those who prefer to see some of the benefits allocated to a wider constituency, and thereby targeted on wider social needs (Cowell et al., 2011). In terms of distributive fairness, some communities are very aware that the payments per MW of energy they might receive as community benefits from a commercial developer is a small fraction (typically less than 10%) of what they might receive per megawatt from renewable energy generating facilities that are community-owned (Warren and McFadyen, 2010). When expected economic benefits do not materialise there is the possibility that 'conditional supporters' of energy projects may turn into active opponents (Hitzeroth and Megerie, 2013).

Research does suggest that, procedurally, community benefits can be provided in ways that reduce the likelihood of conflict. Where developers discuss community benefits at an early stage rather than as the planning decision approaches, it is less likely to cause mistrust. For example, in the case of the Gwynt y Mor offshore wind farm in North Wales, two years passed between the developer's announcement of the submission for planning consent (November 2005) and announcement of details of the community benefits package (November 2007). At that stage, opposition to the project was well established, many local residents mistrusted the developer and the benefit offer was seen as a 'bribe to silence opposition' (Cass et al., 2010). Some developers, conversely, suggest that it is difficult to be specific about the level of community benefits available while project scale or funding remains uncertain (e.g. where potentially costly grid connection issues remain unresolved) (Cass et al., 2010).

Community benefits may lack transparency, either at a project level (because it is not clear what level of benefits has been achieved, for whom and why), or across projects (making it difficult for communities faced with infrastructure to learn what has been achieved elsewhere (Cowell et al., 2011). Steps taken by DECC (2014e) to follow Scotland in creating a register of community benefits may be helpful here (see also Hitzeroth and Megerie, 2013). Community benefits may be more positively received where communities feel they have been effectively engaged in decision-making (TerWel et al., 2014). Experimental research by Zaal et al. (2014) has shown that publics could be more accepting of compensation payments in conjunction with risky facilities if they feel that the benefits and costs are morally equivalent to each other (e.g. not where financial payments are provided to accept projects that threaten human life).

Research identifies two trends in community benefit provision that may reduce the potential for conflict. One is that as the amount of community benefit increases, so it becomes possible to satisfy more people, both those very immediate to the infrastructure and wider groups. The second is that as communities become more familiar with community benefit funds over time,

perhaps from a succession of energy infrastructure projects, they will become more flexible in how and where they would be prepared to see the monies allocated: Carno, mid-Wales, is a good example (Bristow et al., 2012); so too is Argyll and Bute (see below).

> After responding in an ad hoc way to a succession of windfarms, Argyll and Bute Council adopted a more strategic and consistent approach to community benefits. This voluntary approach set down recommended minimum sums per MW that it would expect to see from developers and encouraged developers to split the funds as follows: 60% to the immediate local community through a local trust fund or equivalent, and, 40% to the wider Argyll and Bute Community through supporting the work of the Argyll, Lomond and the Islands Energy Agency (Alienergy). Alienergy has channelled these revenues into energy efficiency improvements across the whole county. (For a review, see Cowell et al., 2012)

Community benefits can increase community's perception that a project is fair

This returns us to wider questions of 'what works'. As shown above, there is some evidence that the provision of community benefits (a) makes infrastructure projects more acceptable to people and (b) thereby changes the dynamics or outcomes of local planning processes. However, this instrumental role in project delivery is not the only function of community benefits. Such benefits can also serve justice, in that they compensate publics for the loss of environmental value caused by the construction and presence of new energy infrastructure (Cowell et al., 2012). Indeed, research suggests that this is often how key stakeholders think about community benefits (Cowell et al., 2011). It can also be seen as serving wider distributive fairness; allowing publics living with or affected by energy infrastructure to share in the benefits that it creates. There is a link here with developers' preference for seeing community benefits as a demonstration of corporate social responsibility to the host community. This rationale may be particularly important for technologies like on-shore wind that provide relatively few jobs to the rural locations in which they are situated (Munday et al., 2011).

These wider ethical roles might all be seen as helping infrastructure development processes to work better for local publics. One might hope that they foster more positive public attitudes to infrastructure development (and more research might tease out how far this is true); but they can also serve purposes of justice whether or not attitudes are changed.

1.5 How the national energy narrative might affect 'what works'

Every infrastructure project involves a 'need case' to be presented by the developer to impacted communities that sets out *why* such infrastructure is required. Typically, the need case is justified by citing national policies (e.g. on energy or climate change) or global environmental benefits (e.g. reduced greenhouse gas emissions). When there is a lack of consensus across society about the legitimacy of certain policies, or about the value of such infrastructure provision for the nation as a whole, this 'need case' can be challenged, often by a combination of communities of locality and communities of interest (e.g. cases of new nuclear, more recently in the case of shale gas).

The consequence is a debate about why local places should be 'sacrificed' for national or global benefits that are themselves disputed (e.g. Ellis et al., 2007; Groves et al., 2013). This has led to some academics diagnosing a disconnection between national target setting and local infrastructure siting, and calling for better ways to connect local siting and national policy to ensure that the gap is more effectively bridged (Devine-Wright, 2011c; Batel and Devine-Wright, 2014).

The Energiewende as an example of a national energy narrative

An often-cited example is Germany's 'Energiewende' (or 'energy transition'), where a national energy narrative has been constructed about the transition away from nuclear and fossil fuel energies towards renewable energy and energy efficiency. Of significance is the fact that the national energy transition involves significant citizen input, for example in the form of citizen share purchase in new wind farms (Moss, 2014) and mechanisms for involving publics in the planning of new power lines.

Steinbach (2013) noted that implementing early participation at various consultations phases was very successful in the establishment of the first grid development plan (as well as transparency in information provision and determination of the need case for new powerlines).The process had two stages:

1. an 'upstream' consultation on national energy futures (e.g. future energy mixes) to determine 10 year grid upgrade plans;
2. consultation on starting and end points of particular new lines.

The German case offers a contrast to the processes that led to the 2008 Planning Act and the creation of the National Policy Statements (NPSs) that inform and regulate infrastructure siting in the UK (see section 2.1). Although the energy NPS required under the Planning Act 2008 were subject to wide public consultation, including national events in different parts of the country and Parliamentary scrutiny (DECC, 2010), it did not result in an inclusive narrative. Researchers have been critical that this new consenting system serves mainly to confine the scope for discussion on need and wider environmental objections (Lee et al., 2015), and allows private developers considerable scope to define the national interest (Groves et al., 2013).

National level public engagement with energy infrastructure and policies

Examples in the UK of national level participatory energy engagement are few and recent, including DECC's Big Energy Shift and ScienceWise public dialogues. However, whilst these have engaged publics with national policy-making, and sometimes used deliberative methods, they differ from an Energiewende process in being of limited scope (e.g. taking a focus on a particular technology sector or specific communities of locality - shale gas, TNSBMRB, 2014) and scale of deployment (households and communities, for more information see Rathouse and Devine-Wright, 2010).

The 2050 calculator and related engagement activities represent an attempt to engage with publics on energy system change, but to date it has not been undertaken as part of a widespread and planned campaign of national engagement over diverse energy futures. The UKERC funded research project conducted by the University of Cardiff (Pidgeon et al., 2014) offers an example of an in-depth, deliberative public engagement activity at a more systemic or national energy system level. This project drew on the 2050 calculator to scope public acceptability of diverse energy future pathways encompassing both supply and demand. Whilst infrastructure siting was not the main focus of the research, the findings have relevance to this report for revealing shared values that were observed to underlie the acceptability of system change, specifically 'autonomy', 'fairness' and 'social justice', which suggest that publics expect national infrastructure policy making to reflect similar aspects of procedural and distributional fairness that have been found in relation to specific local cases of infrastructure siting. Similarly, Ek and Persson (2014) report on an economic valuation study, conducted in Sweden, which showed that the general public were more likely to support higher subsidies for wind energy where local people were involved in decision-making processes and have some ownership of schemes.

In terms of what works, evidence suggests that involving publics in national policy making is both possible and beneficial, when carefully conducted using deliberative methods of public

participation. However, we do not yet have evidence on whether such national level deliberations, in turn, enhance the legitimacy and acceptability of local infrastructure siting.

Section 3: Discussion, gaps and research suggestions

This section examines four core assumptions that affect 'what works':

i) definitions, ii) technologies, iii) publics; and iv) places, followed by gaps in the literature and suggestions for further research.

2.1 Discussion

Definitions of 'What works'

For much of the last fifteen years 'what works' has been defined – in the UK and elsewhere – predominantly in terms of delivery. That is, decision-making works if infrastructure is given planning consent within predictable time frames. 'Delay' is a key part of 'what does not work' (Hyder Consulting, 2013). This is based, in part, by the need to meet binding targets for greenhouse gas emission reduction and renewable energy expansion (see, for example, Gibson and Howsham, 2010) deemed to require an enormous amount of infrastructure investment. Key changes to decision-making systems have centred on creating policies that 'work' because they are believed to help realise these desired qualities of effectiveness, efficiency and predictability.

However, there are other ways of thinking about 'what works' beyond efficient or rapid infrastructure delivery. There is evidence that British people believe that decisions on energy infrastructure should include people affected in a fair and democratic way (Parkhill et al., 2012), and societies may also be interested in achieving *procedural* and *distributive* justice. Procedural justice is when decision-making procedures are fair; they allow publics and organised actors adequate opportunity to engage in decisions that affect them. Distributive justice is when the distribution of costs and benefits between places and social groups arising from infrastructure siting and construction is seen as fair (Cowell et al., 2012). While facilitating infrastructure delivery may reflect inter-generational justice (because future generations should inherit a liveable climate and more sustainable system of energy provision), these other dimensions of justice within present generations are also important. Researchers also identify a wider democratic role for project-based participatory processes in allowing public reflection on substantive issues that define 'national needs' for infrastructure (Groves et al., 2013).

This is important because different conceptions of 'what works' – delivery, procedural justice, distributive justice – are not always necessarily mutually compatible. There can be mutual reinforcement – e.g. between measures which enhance procedural justice and increase the likelihood of positive planning decisions – but also tensions, such as between fostering deeper public engagement and accelerating decisions. However, even where improving procedural or distributive justice does not 'work' in obtaining planning permission for infrastructure or fostering public acceptance of infrastructure projects, each dimension is still of value in its own right and constitutes a quality of decision-making processes that 'work'.

Different forms of technology and 'what works'

As stated in the introduction, this review encompasses a diverse array of large-scale energy infrastructures, from wind farms, to high voltage power lines to nuclear power stations to carbon capture and storage. The evidence base varies in quantity by technology type, with larger numbers of studies conducted on more established or more controversial technologies, for example onshore wind energy and nuclear power in comparison to more recent or less controversial technology types. The implications of technology type for 'what works' is significant. Although we generalise from specific technologies to infrastructures more generally in this report, it is nonetheless important to recognise key differences between them, such as:

- technical configuration (e.g. linear versus site-specific footprints, for example high voltage power lines versus a wind farm);
- scale (e.g. nuclear power stations tend to be larger than renewable energy installations);
- local impacts, spanning issues of health (e.g. emissions from biomass combustion), environment (e.g. visual impacts of wind turbines on landscapes) and economy (e.g. employment from nuclear power);
- levels of public familiarity (e.g. higher for nuclear power, lower for carbon capture and storage);
- already mobilised social movements (e.g. against nuclear, onshore wind or the fracking of shale gas).

These differences are also manifest in surveys of general public attitudes towards energy infrastructures, with consistent findings from DECC's Public Attitude Tracker and other sources that renewable energy sources are more positively perceived in comparison to both nuclear power and fossil-fuel energy. While these general attitudes do not in themselves determine local responses, including objections, to infrastructure siting they nevertheless play a role in shaping these responses (e.g. Jones and Eiser, 2009).

Impacts of different ways of thinking about 'the public' or 'publics' on 'what works'

As also discussed in the introduction, social scientists emphasise the problems that arise when presuming a homogeneous 'public' in relation to infrastructure siting. They highlight the diverse ways that groups and individuals engage with energy technologies (e.g. Walker, 1995). Researchers often refer to 'publics' instead of 'the public' (e.g. Barnett et al., 2012) and distinguish between society as a whole, communities of locality (i.e. local residents) and communities of interest (i.e. individuals sharing an attitude or preference, but not living close by). Specific individuals can be members of both types of community at the same time and both are relevant to understanding what can work in engaging communities in the development of new energy infrastructures, since:

a) communities of locality can link together to form a larger network of supporters or opponents in order to achieve their goals (e.g. 'Somerset Alliance Against Pylons', fighting the Hinkley Point C power line proposals);
b) communities of interest at the national level can link with and seek to influence communities of locality, as well as to lobby policy makers in central Government (e.g. 'National Opposition to Wind Farms'; 'Frack Off').

There are also differences in research design and methods. Societal opinions or attitudes are typically captured using nationally representative questionnaire surveys (e.g. Batel and Devine-Wright, 2014) or focus groups conducted in diverse regions of the UK (e.g. Pidgeon et al.,

2014). Research into communities of locality, by contrast, typically focus on residents living closest to the proposed site of an infrastructure project, using qualitative (e.g. focus groups, Ellis et al., 2007) or quantitative (e.g. surveys, Jones and Eiser, 2010) methods, and sometimes both (e.g. Devine-Wright and Howes, 2010). Importantly, research at the national level tends to focus on general attitudes or opinions towards energy sources or technologies, whilst research at the local level tends to focus on specific attitudes or opinions towards a given project proposal. It is the 'gap' between general attitudes captured at the national level and specific attitudes captured at the local level that is often claimed to be a 'problem' underlying 'NIMBY' responses to infrastructure siting (Aitken, 2010). However, there is no reason why national studies cannot focus on particular examples of infrastructure siting or local studies cannot focus on national energy policies or general attitudes (Batel and Devine-Wright, 2014).

Impacts of different ways of thinking about localities for 'what works'

Locations of infrastructure projects have been thought about in diverse and contrasting ways as 'sites', 'backyards' and 'places' (Devine-Wright, 2011d), each with important consequences for how public engagement is practiced. Research has shown that developers and planners typically see infrastructure locations as 'sites' that are characterised by generic features such as topography, resource availability, proximity to dwellings etc. Such locations may also be seen as 'backyards', linked to 'NIMBY' presumptions about objectors' self-interested and emotional concerns (e.g. reduced property values). Finally, locations can be viewed and talked about in symbolic, personal and emotional ways (i.e. as 'places') that emphasises their unique character. The employment of these different labels is one of the reasons why opposing sides in conflicts over energy infrastructures find it difficult to reach common ground (Drenthen, 2010).

Aside from difficulties in finding a common language, ways of thinking about localities are important for 'what works' because individuals form emotional attachments to particular places, which also become significant for their identity (Altman and Low, 1992; Proshansky et al., 1983). Actual or proposed changes to these locations can cause distress (Fullilove, 2013). However, since developers tend to view infrastructure locations as 'sites', these subjective, emotional bonds are often overlooked or ignored (Devine-Wright, 2011; Cass and Walker, 2009). Reflecting the importance of the perceived 'fit' between place and technology (Devine-Wright, 2009), research has shown that when new proposals match with the existing character of a place this leads to greater acceptance (Venables et al., 2014). When infrastructures are 'industrial' and located in a 'natural' landscape or place (Devine-Wright and Howes, 2010) this leads to greater opposition. For these reasons, it is important that engagement activities attempt to understand how the place and technology are seen by stakeholders as this will help to understand why support and opposition positions exist (McLachlan, 2009). Developers might achieve greater local social acceptability for projects if they site and design them in ways that work with, rather than against, local identities and place attachments (Devine-Wright & Howes, 2010).

2.2 Gaps and suggestions for future research

Gaps in evidence and quality of research

The research base is unbalanced in a number of respects:

- it is biased towards greater coverage of infrastructures that are considered controversial (notably on-shore wind);
- there is a tendency to focus on specific interventions with narrowly defined goals, rather than looking at systems as a whole;
- it is dominated by single case study work, or technical methodological development in which the effects on actual decision-making are not tested.

Because of these weaknesses in the evidence base, it is risky to recommend specific interventions or changes, since the effects are significantly shaped by contextual conditions or the institutional setting. The knowledge base for action would be improved if the following gaps in research were addressed: problem framing, focus and methodology.

i. Gaps in problem framing

- The issue of effective infrastructure siting needs to be viewed as part of a wider system, in which what happens at different levels and across different projects can be mutually effecting.
- The issue of 'what works' needs to more explicitly embrace multiple dimensions – instrumental effectiveness as well as procedural and substantive fairness
- In practice, different interventions can coincide (e.g. changing provisions for community benefits coincide with localisation of decisions for on-shore wind and centralising of decisions for offshore wind), and this needs to be reflected in research, to understand how publics relate to combinations of measures.
- Research needs to be alert to wider 'spillover effects', both positive (does engaging with the development of energy generation foster increased propensity to save energy?) and more problematic (do adverse experiences of project-specific engagement foster other oppositional activities?)
- Research needs to more clearly differentiate between (i) effects on social attitudes and (ii) effects on planning process dynamics and outcomes, but also how they might be related. This could be applied to more systematically examine the effects of community benefit provision and community ownership on infrastructure planning processes.

ii. Gaps in focus

- Rather than asking 'local people' about 'local projects', research needs to examine what publics living near prospective infrastructure projects feel about broader decision-making arrangements, and what the wider public feels about specific infrastructures.
- There is a need to test whether findings gathered from concentrations of research on particular technologies (notably on-shore wind) also apply to other, under-researched technologies (e.g. solar PV, shale gas).
- Research needs to examine the effects of different formats for community benefits on public attitudes, including those subject to recent policy innovations such as shared ownership (DECC 2014e). Outside of Scotland, to investigate whether community energy projects move more quickly through the planning process, followed by commercial projects which have community investment, and whether both are quicker and more likely to be successful than wholly commercially owned projects.
- There is scope for research to address the potential for shared ownership applied to massive energy infrastructures (e.g. transmission networks, nuclear power stations), not just to renewable energy projects.
- As well as the copious research on project-specific public engagement, there is a clear gap in the literature that could be addressed by assessment of the impact of 'upstream'

deliberative methods of community engagement (e.g. citizens panels, pre-application discussions), and how the two affect each other. Examples of evolving engagement processes across these levels in Germany's 'Energiewende' could be identified and evaluated. Whether national level deliberations, in turn, enhance the legitimacy and acceptability of local infrastructure siting is largely untested.

- Potentially, researchers could investigate how the dearth in sub-national actors concerned with energy infrastructure may optimally be filled in order to facilitate a sustainable energy transition, including a comparative international review of the role of local and regional intermediaries (e.g. municipalities, energy agencies, networks).
- Research into possible interventions around (i) actions to increase public trust and decrease perceptions of procedural injustice, (ii) ways to provide 'trusted information' about energy infrastructures to affected communities.
- To investigate how spatial zoning could incorporate participatory modes of public engagement and take account of place attachments and local identities.

iii. Gaps in methodology

- More systematic cross-case analyses, including mapping effects of sets of interventions across sets of technologies
- More research into how certain models or interventions (a mode of providing community benefits, GIS or visualisation tools in spatial planning) work in the field, 'in action'.

Appendix A: Methodology

In collaboration with DECC we conducted a Rapid Evidence Assessment of the subject area in the following stages:

i. Established scope of the literature search
    - Energy infrastructure - to include generation, transmission and geological storage
    - UK focus - include only best practice non-UK research
    - Medium scale - local, community level
    - Timeframe – 2005 onwards

ii. Defined the key search terms
    - Infrastructure, energy, electricity
    - Engagement, participation, consultation
    - Planning, decision-making
    - Public

iii. Identified literature sources
    - published and unpublished DECC documents
    - academic publications using three databases:
    - Sciencedirect
    - Google Scholar
    - Gov.UK

iv. Conducted call for evidence from topic experts
    - Prof. Nick Pidgeon (Cardiff University)
    - Dr. Claire Haggett (University of Edinburgh)
    - Dr. Christopher Jones (Sheffield University)
    - Dr. Charles Warren (University of St. Andrews)
    - Dr. Stephen Jay (University of Liverpool)

v. Identified publications authored by or familiar to the academic experts who authored the report
    - Prof. Patrick Devine-Wright (University of Exeter)

- Dr. Richard Cowell (Cardiff University)
- Dr. Hannah Devine-Wright (Placewise Ltd)

vi. Conducted literature search – see Table 1

Table 1: Result of literature search

Source	Search term(s)	Number of articles identified	Number of articles selected
Gov.UK	Energy	28	28
Gov.UK	Research and analysis	248	11
Sub-total		**276**	**39**
Google scholar	Engagement and electricity	13	1
	Participation and electricity	155	1
	Consultation and electricity	24	0
	Energy and engagement	73	6
	Engagement and wind	29	5
	Energy and participation	140	2
	Infrastructure and engagement	18	1
	Infrastructure and participation	72	2
	Infrastructure and decision-making	73	0
	Energy, planning and decision	39	1
Sub-total		**636**	**19**
Sciencedirect	Electricity and engagement	52	3
	Electricity and participation	210	1non-UK
	Electricity and consultation	22	2 non-UK
	Energy and engagement	276	5
	Energy and participation	941	12
	Infrastructure and engagement	147	10
	Infrastructure and participation	357	1

	Infrastructure and consultation	79	1
	Infrastructure and public in energy	257	39
	Infrastructure and planning in energy	11471	49
Sub-total		**1897**	**123**
Academic experts		21	19
Sub-total		**21**	**19**
Totals		**2851**	**190**

vii. Established criteria for inclusion/exclusion in evidence database based on

a) relevance

- as defined by scope of the literature search
- empirical rather than exclusively theoretical
- applied rather than purely academic interest
- actual rather than hypothetical or anticipated research
- contains research element, rather than statement of policy or procedures

b) Quality and appropriateness of research

- Clear aim(s)
- Adequate description of method

viii. Created an Excel database and entered publications

- Initial stage – full reference, reviewer, abstract/summary, source, status, priority (include/exclude with reason)
- Second stage – if 'include' then complete review entered into the database

Appendix B: References

A database of literature sources is available in the excel file provided alongside this document. References used in this paper are supplied below:

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