



Original research article

Where is ‘the local’ in localization? Exploring socio-technical and spatial visions of energy system decarbonization in South Wales

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ABSTRACT

Energy system transition is essential to support global decarbonization, and will involve the increasing use of renewable energy and the socio-technical transformation of centralized, fossil fuel systems alongside changes to how supply and demand is met. Localization represents an emerging vision of how this transformation might occur, but any system transformation will be complex, thanks to the multi-level, polycentric modes of governance that are part of most dominant energy regimes globally and which may create collective action problems. Drawing on narrative policy analysis and using a novel anticipatory mapping method, we analyze data from expert interviews conducted in Wales, UK, to explore how emerging visions of localization are being used to make sense of these complexities and to help shape strategy in the present. We show how imagery of ‘clusters’ plays a key role in these visions as ways of constructing ‘the local’ to help coordinate action among key actors. At the same time, such ways of understanding locality raise additional challenges in the shape of collective action problems that require regionalization strategies to solve, alongside concrete national visions to coordinate priorities at local and regional level. This overflowing between spatial scales poses challenges of legitimacy for energy transition governance, not only in Wales and the UK but across national jurisdictions that have undertaken energy system privatization and liberalization.

1. Introduction

Widespread adoption of Net Zero targets for greenhouse gas (GHG) emissions and ‘climate emergency’ framings has contributed a renewed sense of urgency to climate change policy. In the UK, the Westminster Government’s advisory body the Climate Change Committee (hereafter CCC) [1] has called for strategic choices on pathways for decarbonizing power, heat and transport in the 2020s to set directions for the next 20–30 years. Determining what a renewable energy (RE)-based energy system might ‘look like’ is not just a technological problem. It is also a socio-technical and spatial one, which implies transformations of governance at different spatial scales. The socio-technical regimes on which energy production and distribution depend in the UK are the legacy of an energy system that is liberalized and privatized, and which has, like many other national jurisdictions, followed an evolutionary path towards polycentrism as a result [3], in which systems of governance are constituted from plural, spatially-ordered subsystems [4]. In

such systems, power as well as accountability are distributed away from central governments. A wholesale, system-scale transition towards decarbonized energy systems therefore raises questions about how the exercise of power can be coordinated between actors in such polycentric systems, and what consequences may flow from such exercise of power [5].

Recent literature on energy transitions has begun to recognize how tightly the spatial and socio-technical dimensions of energy system decarbonization are interlinked, and in particular, that visions of how to set pathways for decarbonization contain both socio-technical and spatial aspects. For example, it is generally expected that increasing RE production will require expanded ‘many-to-many’ generation alongside centralized ‘one-to-many’ generation [6]. This spatial transformation also requires a shift in socio-technical logic, in particular in how production and distribution are regulated and managed to provide system flexibility [7–9].

Socio-technical visions or imaginaries have often been seen within

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science and technology studies (STS) as a way of *performing* potential solutions here and now, enabling actors to coordinate power and resources in ways that may help bring these solutions about [10,11]. Researchers have noted how idealized visions of future decentralized 'local' energy systems based on 'smart' management of supply and demand have begun to play this role in relation to energy system decarbonization [12]. The spatial aspects of such visions may contribute significantly to this role [13]. For example, references to space can enhance visions' coordinating role. For example, in relating socio-technical niches (smart systems) to a particular spatial scale (the 'local'), the socio-technical elements of a project may receive additional normative legitimation through being linked to place-based development agendas [14].

In this paper, we contribute to debates in the literature on the spatial and sociotechnical aspects of visions of energy transition by addressing several research questions, with the first two of these recently being identified by Devine-Wright [15], drawing on previous research on spatial imaginaries. First, given that research has demonstrated that visions of energy transition often combine socio-technical and spatial imaginaries, to what extent are these shared or contested by actors in different sectors at different scales? Second, to what extent do narratives of socio-technical transformation use references to spatial scale (e.g. by invoking place-related identities) to justify particular transitions pathways? Our third research question concerns the connection between energy transition and governance, reflecting calls in recent reviews of sociotechnical energy research [16,17] for governance to be given a more central place. Once again, we connect this question to spatial as well as sociotechnical aspects of transition. We ask: how do the answers to our first two questions help understand how expert visions address coordination problems, and what implications might they therefore have for the governance and politics of energy transitions? For example, how do references to spatial imaginaries across different scales frame potential trade-offs between a felt need for urgency and democratic politics?

We use a case from Wales in the UK (the European Regional Development Fund-supported FLEXIS energy consortium) of how emerging narratives of energy transition are being woven around visions of change which are both socio-technical and spatial, and are dependent on often complex 'networks of expectations' [18] about transition. Working with data from a series of interviews with engineers, industry representatives and policy practitioners, we use an analytical approach based on narrative policy analysis to explore how emerging localization narratives perform two roles. First, they rhetorically couple expectations about localized actors and resources with expectations about trans-local actors [13]. Second, by doing so, they relationally construct particular local, regional and national places along with pathways to spatialized socio-technical transformations [19]. Localization is therefore about much more than 'the local'. We show how the relations these narratives weave between places and spaces at different scales may provide legitimacy for specific pathways both through reference to culturally shared meanings of places defined at different scales (e.g. drawing on ideas about the specific character of Welsh localities, regions and Wales as a whole) and by reference to specific coordination problems which are taken to be characteristic of the governance of energy system transition. We close by reflecting on some of the key issues exposed by our analysis of emerging narratives for energy policy within Wales, the UK and more widely in national jurisdictions characterized by an emphasis on polycentric governance.

2. Conceptual framework

In this section, we provide an outline of our analytical framework. This draws on literature which documents how imaginaries of energy system transition (such as localization) combine spatial and socio-technical elements. We focus on these elements as the *content* of emerging narratives of localization. At the same time, we draw on a

framework provided by narrative policy to clarify *formal* elements of visions of transition narratives. This enables us to show how emerging transition narratives are constructed with an internal logic that relates both socio-technical and spatial elements of energy systems to each other in attempting to identify and go beyond key systemic problems that energy system decarbonization must overcome.

2.1. Narratives and expectations

Narrative approaches to policy analysis examine how the framing of policy and strategy in governance takes narrative form, which helps achieve rhetorical effects through which power can be exercised [20]. Typically, such approaches distinguish formal aspects of narratives from their content, in order to trace patterns across different instances and show how problems, characters, plots and solutions are constructed [22] (see Table 1). Plots set out causal relationships in which 'villains' who represent obstacles to success are contrasted with 'heroes' who have the capacity to overcome them [22]. analysis of narrative form makes it possible to show how far narratives are shared or contested by different actors and across distinct contexts.

Content, as contrasted with form, may be analyzed using methods which look at shared contextual knowledge regarding those aspects of the world that narratives describe (such as socio-technical systems and spatial scales). These include background assumptions about the history of the narrative setting, but also expectations about possible and plausible future outcomes of change processes. The sociology of expectations has documented how narratives about future socio-technical transitions have for their content 'coherent sets of envisaged future states and developments' or networks of expectations [18,p. 1099]. These relate to different aspects of the setting for such narratives, that is one or more socio-technical systems. The sociology of expectations often classifies these distinct aspects in ways which reflect the multi-level perspective on socio-technical transitions (or MLP) [23]. The MLP identifies three analytically-distinct levels of such systems, which dynamically influence each other through often complex causal loops. These are the landscape, or the political, cultural, economic and biophysical world in which systems are embedded; regimes, as the institutional basis of systems which provide rules and practices for those actors who play particular roles in them; and niches, as 'spaces' where new socio-technical configurations may be nurtured that may reshape the dominant rules of the regime [24].

Expectations identify possible and/or desirable futures as responses to problems within socio-technical systems that are a legacy of previous historical developments. Although they often relate to niches, as Budde and Konrad [18] argue, expectations are often 'networked', and may thus relate to multiple transformations which may unfold at niche, regime or landscape levels. As expectations circulate among actors, if they are mutually-supporting and based on expertise held to be credible, they may coalesce together into socio-technical visions or imaginaries [25], narratives which map out a potential path from present to future. Imaginaries may then become 'black-boxed' [26], entering wider circulation within shared discourses as prerequisites for debates about which future trajectories are plausible and which are not [27].

So long as they possess credibility, plausibility and sufficient interpretative flexibility, imaginaries can serve as boundary objects [28] around which discourse coalitions may form [29]. Shared imaginaries help reduce the uncertainties that surround innovation processes by allowing 'mutual adaption and adoption of individual expectations among actors' [30,p. 298]. At the same time, sharing imaginaries does not imply complete consensus between actors regarding all the expectations gathered into them. Difference and even contradiction [31] can manifest between particular instantiations of imaginaries, based on variation within different actors' sets of expectations. Over time, such variation may expose tensions and divergences within the content of particular narratives that are similar in terms of their form [32].

Table 1
Narrative-based analytical framework applied to visions of energy system transition.

Form	Setting	Character	Plot	Solution
Content	Contextual knowledge, key assumptions, expectations about change	Contextual knowledge, key assumptions regarding causal agency, expectations about change	Contextual knowledge, key assumptions about causal processes, expectations about change	Contextual normative knowledge, key assumptions about values, expectations about change
Examples of socio-technical and spatial content relevant to narratives of energy system transition	<ul style="list-style-type: none"> socio-technical aspects of energy systems: landscape, regimes, niche Spatial aspects (e.g. scale and interrelationship of different regimes, role of place in system) 	<ul style="list-style-type: none"> position of actors in socio-technical networks (e.g. governance responsibilities) spatial aspects of agency (e.g. jurisdiction) 	<ul style="list-style-type: none"> anticipated interactions between levels of socio-technical system mediated by key actors spatial structure of change processes, relevance of place at different scales 	<ul style="list-style-type: none"> Socio-technically and spatially reconfigured regimes

2.2. Imaginaries: socio-technical and spatial

Socio-technical imaginaries or narratives of energy system transition are also spatial narratives. Recent developments in the geography of sustainability transitions (including energy transitions) have examined “spatial contexts actively and substantially shape transition processes” [33,p 373] and how the networks of expectations on which imaginaries are based produce or reproduce relationships between places and spaces at different scales [34]. This focus has accompanied a period when ‘the spatial arrangements of political and governance processes are themselves in flux’ [35,p. 1140]. Imaginaries of transition play a role in creating new governance relationships within and between the local, regional, national and transnational scales, meaning that a traditional emphasis within transitions scholarship mainly on the national scale has been seen as misplaced [32,36]. In policy studies, particular importance has been accorded to the role of subnational policy actors in shaping transitions within the polycentric governance systems created through privatization and liberalization [35]. Research on the spatial aspects of socio-technical energy imaginaries has shown how imaginaries create ‘transition spaces’ through which institutions and territories are co-constructed and networked together [13], and how transitions play out in ways which are not confined to pre-defined spatial scales (like local, regional or national) but overflow such categories [38]. Narratives of socio-technical change help construct places (with specific histories and affective resonances, like “unspoilt Wales”), idealized spaces (the rural, the urban), and spatial transformations (like decentralization) through which system changes are prefigured more concretely [19].

The socio-technical and spatial content of imaginaries influences how readily they are able to support coalition building, as links between the two help contribute credibility for them [39]. In particular, invoking ideas of places and idealized spaces (such as ‘the industrial legacy of south Wales’) can help provide normative authority and legitimacy for specific socio-technical narratives [14], such as ‘industrial decarbonization as a path to growth’. An example of how narratives of energy system transition have been analyzed by focusing mainly on the socio-technical and spatial aspects of their content and its legitimating role, is recent research on the *localization* of energy systems [12,40].

Localization represents an attempt to give concrete content to more abstract narratives of decentralization, which frame transition chiefly at the national scale (e.g. the UK electricity grid) and link it to specific energy regimes (e.g. electricity production and consumption). Narratives of localization begin from the bottom up, anchoring energy transitions within spatial units like neighbourhoods, cities or islands. In terms of socio-technical expectations, such spaces share three features which help define them as niches within a system, relatively isolated from a dominant regime [12]: (1) they must be based around the management of supply-demand balance at a small scale; (2) they must integrate multiple energy vectors; and (3) they must make extensive use of information and communication technology (ICT), including automation for network monitoring and management. In terms of spatial expectations, the meaning of ‘local’ may feature the high degree of

interpretative flexibility often associated with successful sociotechnical visions. ‘Local’ might refer to the proximity of users to a source, the proximity of a number of users on a network to a particular substation, or sometimes a shared interest among a more broadly territorially-defined group in particular impacts of changes in energy production [42 p. 3]. The ‘places’ around which localization is narrated may thus signify anything from a single building with its own energy production assets to a whole town.

Walker et al. [40] show how three visions for energy system localization niches (smart local energy systems or SLES) construct themselves spatially by linking concepts of place with spatial categories such as neighbourhoods, cities and islands. In doing so, they create distinct configurations of ‘the local’ with the aim of constructing credible project narratives to recruit policy and innovation actors into project coalitions. This work of construction has three aspects. Through *emplacement*, localness is constructed either as a techno-economic quality which relates to resource access and defines ‘the local’ as an abstract ‘site’, or as related to ‘physical and social-psychological qualities’ which are experienced by those who inhabit or move through places. Through *place framing*, ‘local’ projects are then scaled in relation to other scales, such as the regional and national, and represented as reshaping places in particular ways. Finally, through *placemaking*, boundaries are drawn around localities based on the impacts of projects or resource proximity, with how downstream consequences for how risks or benefits are distributed between particular populations. What is local is not therefore simply given. It is constructed from the bottom up at, and also in relation to, a variety of territorial scales.

Tracking the content and effects of localization narratives in this way documents how socio-technical and spatial aspects of narratives of transition can assist coalition building. Where narrative policy analysis can take this kind of analysis further is in mapping how formal elements (settings, actors, plots, solutions) are shared across instances of narratives or imaginaries and what *anticipatory* work these elements do, exercising power by constraining what alternative narratives of transition (or non-transition) are prevented from being articulated or gaining traction. Reciprocally, linking spatial and socio-technical aspects of narrative content can help understand more richly the specificities of the formal elements and their interrelationship. Through comparative work, commonalities between key elements of settings, such as definitions of problems that are seen as potentially solvable through socio-technical transitions, are particularly important, given that these define priorities and may therefore restrict the space of potential plots and solutions and with them potential futures.

3. Methodology

In 2016–17, we carried out twenty semi-structured interviews with engineering researchers, industry project partners and key policy stakeholders associated with the FLEXIS project in Wales. FLEXIS undertook to bring together innovation-oriented engineering researchers within three Welsh universities with industry actors and policy

practitioners from local councils and Welsh Government to develop place-based technological niches in post-industrial and rural Wales. Analysis of this data demonstrated that future visions of a decarbonized energy system for Wales took on various forms dependent on ideas about place (the industrial cities and towns of south Wales, ‘unspoilt’ rural Wales, and the peri-urban settlements of the south Wales Valleys) [AUTHOR PAPER]. These diverse visions represented place-dependent ways of narrating a spatial transformation from centralized fossil-fuel dependent systems to more decentralized ones. A key theme evident across these interviews was that of *localization*. Interviewees stressed that the energy transition would depend on bottom-up processes of niche experimentation and scaling-up attentive to the attributes of specific places, but that localization in this sense would also require coordination across broader spatial scales through appropriate governance. Questions thus arose about how emerging narratives of energy transition might deal with this issue, which future pathways they might open up, and which they might close off.

A further twenty semi-structured interviews, on average around 70 min in length, were conducted between November 2021 and early March 2022 with FLEXIS researchers, project partners, or key stakeholders. Seven of these participants had participated in the earlier round of interviews. Due to COVID protocols in place at the time, interviews were conducted primarily via Zoom. Changes in FLEXIS staffing in the intervening period, together with the forming of new project partnerships, necessitated identifying new interviewees, including officials from the Welsh Government’s decarbonization and energy division, project officers from distribution network operators, local government officers and project consultants were all included in this sample (see Table 1 below).

To bring into sharper focus within the interviews connections between socio-technical futures and spatial imaginaries, we included a mapping task within the interviews. With the assistance of a design agency, we prepared multi-layered maps of the Welsh energy system and other aspects of its spatial context, using publicly available data on the location of generation assets, energy transmission/distribution networks, and other notable features such as protected habitat areas with a range of designations (including national parks, sites of special scientific interest, and so on). Physical maps and multi-layered PDF versions (see Fig. 1) were produced and used in face-to-face and online interviews respectively. Interviewees were invited to annotate the physical or digital maps themselves to indicate how they anticipated significant changes would be made to the energy system.

Data were analyzed using a conceptual framework adapted from narrative policy analysis, as discussed above, to guide initial coding. To outline the *setting* (see next section), we drew on the 2016–17 interviews and key governance literature to assist with coding. We drew on our outline of the setting to help develop an analysis of villains, heroes, plots and solutions. In terms of narrative content, coding focused on how narratives about energy transition describe socio-technical change with reference to places, idealized spaces and spatial transformation [19]. Following an initial reading, the coding tree was elaborated and revised, adding new top-level codes. A final reading refined the lower-level coding. In this way, we treated expert interview data not as a way of accessing specialist knowledge but instead as ‘a theoretically rich conceptualization of (implicit) stores of knowledge, conceptions of the world and routines’ [41,p. 48]. Pseudonymous identifiers (e.g. E1, E10 – see Table 2 above) are used alongside quotations from data throughout the presentation and discussion of data below.

3.1. Themes

In this section, we provide analysis of narratives identified within interview data to help answer our research questions. We show the extent to which expectations about emerging transition pathways are shared by interviewees, and where differences emerge. We show how specific constructions of ‘the local’ are used by interviewees to identify a

specific localization narrative (‘clustering’)¹ as central to credible energy decarbonization pathways. We also show that tensions within this narrative push interviewees to expand the spatial imaginaries they rely on, out to regional and national (whole of Wales) levels. Chief among these tensions are particular coordination problems faced by energy system governance. The conceptual framework we employ enables us to show how the narrative logic of localization, while seen as essential to move forward, is not self sufficient in itself, and necessarily expands into two further narratives – one of regionalization, and one of national visions that relate energy system decarbonization to other policy questions.

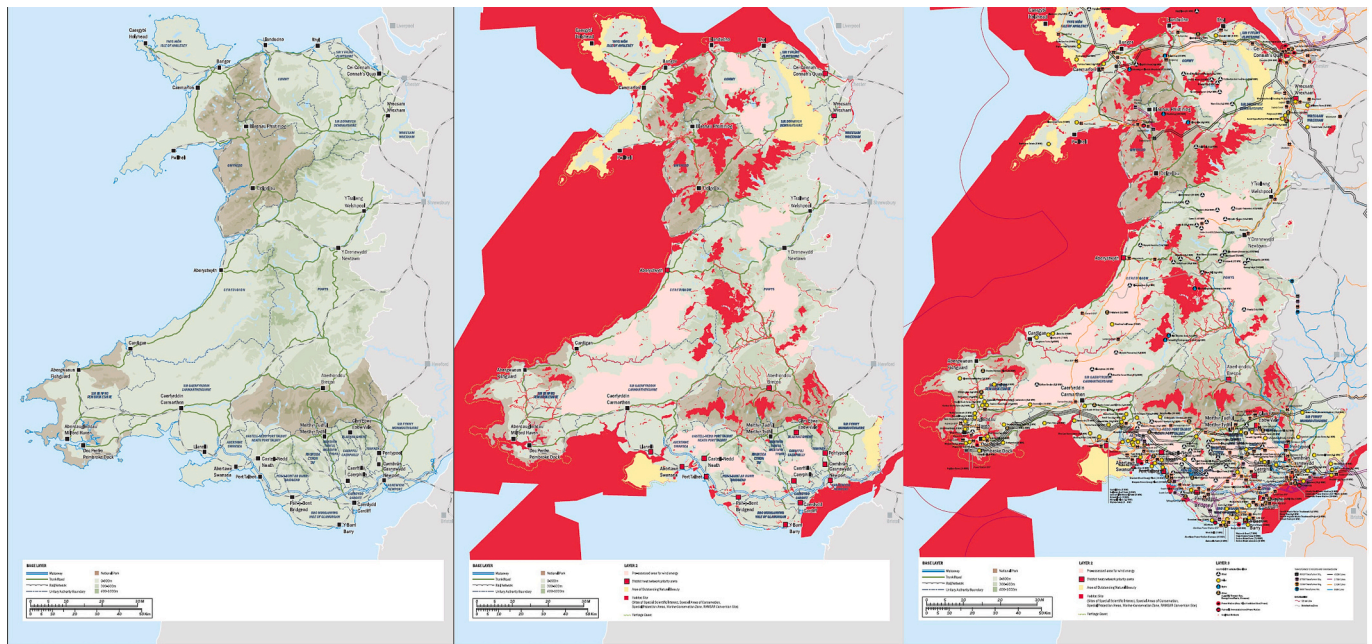
3.1.1. Mapping the setting

Before exploring in detail the narratives (form and content) which emerge from the interviews, we provide key elements of UK and Welsh context, weaving in elements of how interviewees present a setting for their narratives, including challenges they see the energy transition as needing to solve. Some interviewees explicitly state that visions of energy transition need to play a ‘coordinating role, setting ambitions’ (E4) within the polycentric regime of UK energy system governance that is the product of the Thatcher and Major governments’ privatization and liberalization programmes in the 1980s and 1990s. These measures and governance arrangements were taken as models for liberalization in countries from northern Europe to Australia, Chile, Argentina and Uganda. In the UK, responsibility for energy system governance is split between the UK and devolved (Northern Ireland, Scotland and Wales) administrations, energy producers, utility companies that sell electricity and gas, transmission network operators (TNOs), regional distribution network operators (DNOs), and arms-length regulatory bodies, such as the Office of Gas and Electricity Markets or Ofgem. Decarbonizing the UK energy system therefore poses significant problems of coordination for governance actors [9,p. 137]. These problems are intensified by the tendency of neoliberal governance to create competition between economic actors [42], including regional and local authorities (LAs), for public funding and inward investment.

A role for regional bodies in addressing coordination problems within such polycentric systems of governance was increasingly recognized in the UK in the period preceding the UK Government’s Localism Act 2011 [43]. ‘City Region’ organizations were established, initially as agents of economic regeneration [44] but later as entities with responsibility for housing and energy too, creating coalitions of local authorities (LAs) with close social, economic and geographical ties ‘to fund, finance and deliver infrastructure, and to formulate and implement new initiatives in policy areas such as skills and business support’ [45]. Their economic governance role is particularly relevant in relation to socio-technical transitions. City Regions have in various countries been seen as optimizing coordination between LAs in applying for grand challenge funding [43] from governments. Funding packages in the UK have been agreed as ‘City Deals’ between city region consortia and the UK Government, together with the Welsh and Scottish governments for regions within Wales or Scotland. In Wales, deals have been secured in recent years for the cities of Swansea and Cardiff and their surrounding regions, which together comprise the whole of south Wales, paralleled by north and mid-Wales Growth Deals, which support regional bodies for these areas.

This growing role for ‘mid-tier’ organizations with spatial jurisdiction over regions which may overflow historical designations represents (in terms of the MLP) landscape elements of the UK and Welsh energy systems. Two other such background elements discussed by interviewees are, first, the policy need to couple the public value of decarbonization with other dimensions of public value such as

¹ ‘Clustering’ has as its referent *clusters* in the sense of a socio-technical assemblage related to, but broader in scope than, the socio-technical concept of ‘industrial clusters’ as discussed recently by DevineO’Wright [15].



Layer 1: physical & political features

Layer 2: protected habitat areas, search areas for RE siting

Layer 3: generation, transmission & distribution infrastructure

Fig. 1. Multi-layered Welsh Energy System map used in interviews.

Table 2
Interview participants overview.

Designation	Organization	Gender	Position
Expert 1	FLEXIS	M	Principal Investigator
Expert 2	SME	M	Consultant
Expert 3	FLEXIS	M	Principal Investigator
Expert 4	Wales and West Utilities (WWU) (DNO)	M	Project officer
Expert 5	WWU	M	Project officer
Expert 6	WWU	F	Project officer
Expert 7	FLEXIS	M	Principal Investigator
Expert 8	FLEXIS	M	Senior Researcher
Expert 9	Local Authority	M	Energy Strategy Officer
Expert 10	FLEXIS	M	Principal Investigator
Expert 11	FLEXIS	M	Principal Investigator
Expert 12	FLEXIS	M	Principal Investigator
Expert 13	Local Authority	M	Sustainable Development Officer
Expert 14	Welsh Government (WG)	M	Director
Expert 15	FLEXIS	M	Principal Investigator
Expert 16	FLEXIS	M	Senior Researcher
Expert 17	WG/climate change and energy efficiency	F	Deputy Director
Expert 18	WG/Innovation and energy	F	Senior Manager
Expert 19	Third sector	M	Consultant
Expert 20	WG/decarbonisation and energy	F	Director

addressing historic patterns of deprivation within Wales, and second, specific problems of coordination between innovation actors that exist within Wales.

Legal duties to pursue decarbonization goals are written into the UK Government’s Climate Change Act 2008 and the Environment (Wales) Act 2016 passed by the Welsh Government itself. These require from UK and Welsh Government significant year-on-year cuts in carbon emissions and strategies for achieving these. The devolved administration in Cardiff faces challenges similar to those facing other less-affluent regions across Europe, including old and energy-inefficient housing stock, and a reliance for economic output on hard-to-decarbonize polluting

industry and farming. Decarbonization is seen as potentially bringing economic costs, but also opportunities which governments wish to capture to revitalize deprived regions, without which ‘those communities will completely get left behind’ (E1) as transition accelerates. To inform the development of strategies to bring together decarbonization and economic regeneration, Welsh Government commissioned several reports during the 2010s, including the *Re-energising Wales* report from the independent Institute for Welsh Affairs [46], work commissioned from consultants on prospects for expanding RE in Wales and on the potential role of hydrogen in the Welsh energy system [47,48]. Buckland-Jones and Stevens [49] point out that decarbonization might help address long-standing economic and health inequalities within Wales between cities and rural areas. Retrofitting housing to improve thermal comfort and additional employment opportunities associated with RE supply chains should be combined with the pursuit of comparative advantage in hydrogen and marine energy, and a large increase in the community ownership of energy assets [50].

The second issue – problems of coordination between innovation actors within Wales – was often seen by interviewees as connected to the relative historical absence within Wales of ‘mid-tier’ intermediary organizations. In 2005, the Welsh Government abolished the Welsh Development Agency (WDA), which had a role in coordinating private, public and academic actors in bringing innovation to bear on just these kinds of linked problems: ‘if you wanted to do something involved a big capital project you’d just go and see WDA’ (E11). Weaker ties have historically existed between Welsh firms and academic institutions. Some argued that abolishing the WDA then ‘rendered Wales a much more state-centric system in which institutional diversity and intellectual pluralism were significantly reduced’ [51, p. 576]. In this context, Welsh Government’s use of ERDF funds to support FLEXIS from 2015 represents one example of an attempt to support mid-tier organizations that create stronger contacts between academia and industry, and which link to the city region and similar settlements in north Wales, and mid-Wales, along with the Swansea Bay City Deal and Cardiff Capital Region. Further, these regional growth-focused institutions and their partner local authorities are ascribed duties under the Welsh Government’s *Future Wales 2040* strategic planning framework for ‘co-ordinating

strategic action' [52,p. 97] across environmental quality, improvement of ecosystem services, energy provision and economic strategy under the umbrella priority of decarbonization. Within this overall framework an increase of 'local ownership' of RE generating assets, totalling 1GW by 2030, is seen as an important contribution to maximizing the value of decarbonization to Welsh communities. Local ownership of energy projects was defined expansively as any project 'owned by one or more individuals or organizations wholly owned and based in Wales, or organizations whose principal headquarters are located in Wales' [53,p. 2], while community ownership was nested within this broader category, requiring ownership by a 'social enterprise whose assets and profits are committed to the delivery of social and/or environmental objectives' (p. 3).

Alongside these policy elements, another key element of the setting for narratives which emerged from the interviews is socio-technical: the legacy of earlier waves of development of renewable energy generation. A key part of the Welsh Government's energy strategy in the early 2000s focused on onshore wind power generation as a way of speedily decarbonizing energy production, by identifying 'strategic search areas', mainly in rural areas, in which developing wind power would be prioritized. This approach created two problems. First, wind power expansion was resisted by campaign groups as threatening despoliation of place through encroaching on distinctive 'unspoilt' Welsh landscapes, and for the way it evoked a long history of value extraction in which chiefly English actors benefited from Welsh resources [54]. Public resistance to previous waves of wind power development [54] was seen as representing a failure to consider how RE projects might impact a range of public values. Second, the rapid expansion of wind power highlighted capacity constraints across the Welsh power grid, as noted by Western Power Distribution, the DNO responsible for south Wales' power grid: 'the greater volumes of DG [distributed generation] being connected' have meant that 'DG output in some areas is limited by the capability of transmission network components' [55,p. 4]. This problem has also been identified in relation to rapid expansion of RE generation in Scotland and elsewhere in Europe [56]: 'an ever growing sort of renewable base, our grid currently wasn't designed with that in mind' (E9). One way of tackling these infrastructural problems would be to reinforce power grids to upgrade capacity to cope with more large DG installations. However, this solution was often framed by interviewees as bringing high costs ('horrendously expensive', E9).

Visions of transition were therefore often seen as needing to be responsive to all these challenges at once: problems of coordination, infrastructural problems, and the difficulties of realizing different public values through energy decarbonization. Further, it was generally agreed among interviewees that the dominance of Net Zero as a way of framing action on GHGs meant that the situation was now different to when 'before a climate emergency was declared' (E17), as 'speed is really, really important' (E11). However, 'to move forward at the speed required' is made more difficult because 'the governance across the various organizations is disjointed' (E13). There was a sense that 'some of the kind of solutions that might have been appropriate in 2015 are no longer viable' (E4) and the situation now demanded 'greater integration between government actors' (E14), including UK government, Welsh Government, local authorities, and mid-tier organizations. A particular issue for Wales was that the 'last 5%, 10% [of carbon emissions] are really tough' (E2) to address, given that they arise from sources in productive sectors seen as difficult-to-decarbonize, such as agriculture and fossil fuel-dependent industries located in specific areas of south and north Wales on which the nation is economically reliant.

3.1.2. Localization as plot, 'clustering' as solution

Against this backdrop, visions of *localization* from interview data as ways of narrating a transition towards a decarbonized energy system in Wales. In the 2016–17 round of interviews, interviewees framed the coming transition from a centralized fossil-fuel based system to a more decentralized RE based one in terms of spatial imaginaries that used

Welsh place exemplars (rural Powys, the peri-urban communities of the south Wales Valleys and industrial towns like Port Talbot) to fill out idealized spatial imaginaries of rural, peri-urban and urban places. This enabled them to describe how the development of decarbonization demonstrator projects (socio-technical niches) would need to be responsive to the differences between these distinct spatial contexts. At the same time, how the development of such niches might be coordinated as part of regional or Wales-level energy strategies was left unaddressed. In the round of interviews we report on here, the focus expanded from a focus on a localized account of place as the lens through which decarbonization might be imagined, to encompass broader spatial imaginaries as well as the local, reflecting a growing awareness of the coordination problems associated with transition. 'The local', as we shall see, forms only the first level of these, and localization only one vision or narrative which emerges within the interviews. This is because localization is a story which provides a solution ('clustering') that overcomes two key villains from within the narrative setting, while failing to deal with another.

3.1.2.1. Identifying villains of localization narratives. Localization may be called the plot of the first narrative we examine, articulated against the setting discussed previously. Within this plot, a significant role is played by two villains which are features of the setting itself, i.e. the Welsh electricity and to a lesser extent, gas grids, and also public resistance to DG siting.

The Welsh energy grids (and especially the electricity network) pose capacity and connectivity problems that were universally seen by interviewees as presenting huge obstacles for decarbonization: 'we're investing massively in generation, but not in the flexibility that you absolutely have to have in order to have a secure system' (E20); the next step 'will be dealing with the challenges of [increasing distributed] generation and a flexible energy system' (E18). One interviewee described how 'we in Wales' had 'painted ourselves into a corner' (E15) by focusing on a large increase in onshore wind power generation while failing to develop adequate grid infrastructure.

Through the mapping task, interviewees identified specific system pressures with roots in the electricity regime and landscape level of the system which they saw as exerting pressures on the historical evolution of the power grid in Wales, which one engineering saw as 'redundant in a way now' (E12). They identified from the map how the Welsh electricity grid is split into northern and southern networks, each featuring high-rated distribution networks radiating along a transmission line that connects urban settlements and larger power stations (nuclear in the north, gas in the south). The evolution of infrastructure was seen as a legacy of 19th and 20th century industrialization, where 'what happened with industry and population built up because of the energy source that was readily available.' (E7). With an eye on the future, the structure of these elements of the current electricity regime was seen as posing specific obstacles. Many rural areas in mid-Wales were identified as representing areas with abundant renewable resource but as only having relatively scarce and mostly low-rated grid connections: 'you can't take it [RE] anywhere, you can't distribute it' (E12).

Additional pressure was seen as originating with public perspectives on RE within Wales. As noted earlier, previous waves of wind power development were accompanied by public resistance that focused on certain meanings associated with wind turbines (such as visual intrusion and the unjust extraction of resources). As well as tackling grid issues, strategies for decarbonization were seen as needing to 'take on the idea of [...] visual intrusion' and consider questions about how energy infrastructure may be taken as a 'visual symbol' of particular positive public values (E15). In particular, new infrastructure was seen as providing the basis for a narrative that would connect different spatial contexts and places by symbolizing a common commitment across rural and urban contexts to reducing GHG emissions as DG infrastructure became ubiquitous across affluent and less-affluent areas alike.

3.1.2.2. *Local authorities as heroes of localization narratives.* In describing how the influence of these villains might be overcome, interviewees imagined localization through the use of images of *clusters*, and to a lesser extent, of *cells*. In spelling out what localization trajectories towards clustering might look like, interviewees tended to position LAs as key facilitating actors. Clustering implies particular socio-technical configurations (energy production, storage, networks, provision of heating and power for electrified transport) that are linked in specific ways to shared historical meanings related to place. These meanings relate to the identification of opportunities that are dependent on local conditions. On the one hand, these depend on techno-economic criteria like density of demand for heating, and the presence of businesses who might invest in energy production and storage. LAs were therefore seen as ideally placed to identify locations with favourable profiles thanks to their access to relevant data, making decarbonization more responsive to variations in social and geographical context [E5]. Flexibility services could be provided by building new artificial intelligence-enabled balancing of demand and supply into the system at smaller scales: ‘smartness in managing the systems’ (E16). On the other hand, opportunities are also seen as being connected to places with histories of deprivation and vulnerability connected to Welsh histories of industrialization and deindustrialization, such as in more rural and peri-urban communities. Infrastructure may be seen as potentially helping to address the vulnerabilities of more isolated communities in ways that help precipitate a new wave of socio-economic development: ‘instead of having a big infrastructure that connects the entire country you might have just small cells just connecting those small towns or locations’ (E8).

A key example of what cluster development as a socio-technical and spatial transformation anchored around place might look like is provided by one local government interviewee. They refer to the village of South Cornelly near Bridgend, a fairly affluent settlement with a relatively isolated electricity grid. Providing localized electricity and infrastructure for peer-to-peer energy trading within the village is intended to

derive an income for people within the village and we can actually decarbonize the village and get heat pumps, electric vehicles, etcetera, in there without horrendously expensive grid reinforcement.

(E9)

Another benefit of cluster development is therefore seen as avoiding costs associated with electricity grid extension or reinforcement to enable the exploitation of sources of renewable energy currently remote from the constrained Welsh grid. Clustering generation and storage via ‘smart’ networking infrastructure is therefore seen as presaging a decisive move away from previous trajectories of system development, creating a link with socio-economic benefits that positions clusters as potentially making energy system decarbonization more publicly acceptable: ‘there is more money in developing a project which combines generation and flexibility or just provides flexibility in some way’ (E19).

LAs are seen as possessing capabilities which will be central to developing clusters of this kind. In particular, they are seen as repositories of contextual knowledge, able to help identify opportunities for cluster development which attach to categories of place with specific attributes. Clusters represent idealized socio-technical niches [15] that may then provide impetus for bottom-up processes of scaling up and replication: ‘I see [clusters] as anchor developments that you could then build out from’ (E20). Links between socio-technical and spatial imaginaries play out in still more complex ways, however, in how clustering is described. Differences are drawn between how clusters may be realized in different categories of Welsh places that concretize specific spatial contexts (urban, peri-urban and rural) and represent different infrastructural and social needs: ‘Cardiff and the high-rise blocks, and the vast open spaces of Carmarthenshire and Ceredigion; they’re quite clearly going to be completely different solutions’ (E20). Cities and

larger towns are distinguished from more ‘unspoilt’ rural areas, and from the mixed rural and lower density peri-urban settlements of the south Wales valleys [56], which represent a specific place category unique to Wales, post-industrial areas with widespread coal mining heritage and settlements often relatively isolated and often at elevated altitudes. We summarize here some ways in which different expectations attach to these distinct categories of place.

Urban locations are associated with Welsh histories of industrialization, with clusters seen as symbolizing a continuation of some central aspects of national Welsh identity [57]: ‘clustering is gonna happen around predominantly existing towns and sources of either energy production or industrial emissions’ (E5). Opportunities there may include the possibility of extracting ‘significant quantities of hydrogen from steelworks-arising gases’ (E15) or waste heat from industrial processes, and alongside densified power and/or heat demand. Public buildings, business parks, university campuses and housing estates in locations such as Milford Haven, Port Talbot, Cardiff and Newport are expected to be potential demand anchors for power and for vectors like hydrogen for heat and heavy transport, especially LA vehicle fleets: ‘there’s wind and solar assets going up quite close to [motorway junction], so we [...] then use that green hydrogen primarily for heavy vehicles - our refuse fleet, our highways fleet’ (E9).

A number of experts shared expectations regarding the role urban clusters would play in helping to shape strategic decision making on the longer-term role of hydrogen in decarbonizing energy. Several interviewees from FLEXIS and Welsh Government described how such locations represent opportunities for ‘focusing on green hydrogen’ (E14) produced via electrolysis, allowing renewable electricity from anticipated offshore wind power development to reach land. High density of demand for hydrogen is expected in such locations, whether due to large and hard-to-decarbonize industrial facilities or ‘multiple off-takers’ such as ‘domestic and commercial’ users, representing ‘individually very small amounts but a large number of off taking points.’ (E15). Even if Wales were to lose more of its existing industrial base, clustering in such locations is expected to benefit from grid infrastructure formerly used to service large industrial facilities, which would provide ‘an enormous reserve of infrastructure capability’ (E12).

Peri-urban settlements within the south Wales Valleys are seen as offering less numerous but important opportunities for cluster development in the shape of small-scale industrial manufacturing businesses and value chains of which they form part, insofar as they are often co-located on council owned industrial parks. Collaboration between a variety of businesses is seen as essential to realizing these opportunities, with an example of such a development in Torfaen Council’s jurisdiction described by a Welsh Government interviewee. This represented a ‘consortium’ set up by a Valleys council, involving Welsh universities, DNOs and businesses co-located on an industrial estate to set up an ‘energy trading platform’ (E14). Other ‘low hanging fruit’ (E11) opportunities are afforded by larger businesses, including supermarkets, which run distribution centers in peri-urban locations that consume relatively large amounts of energy and which could anchor clusters.

Where rural communities are concerned, the kinds of opportunities afforded by existing patterns of resource and demand are different and perhaps rarer. Agriculture, generally represented like heavy industry as a hard-to-decarbonize sector, also affords specific opportunities for developing clusters. Farms as sources of energy from solar and bio-methane, but also as able to use battery or fuel cell-powered farm vehicles as ‘static stores’ for electricity at those times of year when not in use (E11), and as able to make use of solar and wind resource to produce ‘something like hydrogen and potentially ammonia for fertilizers [...] also as a fuel’ (E8). Again, LAs are expected to play a central role in identifying and helping develop such opportunities in collaboration with farmers.

Similarly, they are expected to be able to help identify exactly how constraints on electricity and gas grid connectivity create specific vulnerabilities for rural communities. Such vulnerabilities create incentives

for LAs to work with academic and private sector partners in developing DG-based solutions for heating and transport. Rural mid-Wales communities in particular are poorly served by existing gas infrastructure, making households dependent on expensive propane or oil heating, though are seen as being potentially rich in wind or solar resource. This need may make them ‘ripe for hydrogen island’ clusters (E14) for heating and transport. Given grid constraints some experts expect ‘it is not going to be economically justifiable’ (E16) to extend gas or reinforce power grids to serve such communities. Rural areas offer opportunities for clustering ‘much more about electrification of heat’ (E20), based on ‘local renewable sources’ (E16) and battery or power-to-gas storage. Locally produced biogas, ammonia or hydrogen might enable these communities to serve as clusters in which could be developed ‘hydrogen refuelling’ based on gas production ‘at or close to the forecourt’ (E15) to link together renewable energy generation, heating and new public transport services to better serve communities that currently have poor external public transport connections (Table 3).

Spatial imaginaries of rural, urban and peri-urban places are therefore closely interwoven with socio-technical imaginaries, and indeed make it possible to narrate different versions of localization for different place categories. Isolated villages and small towns in rural Powys or Gwynedd, often with limited connection to the gas grid; the industrialized cities of south Wales, and the peri-urban communities of the Valleys, where small business and industrial parks are distributed amid residential areas that follow the track of distributor roads along valley bottoms. Such places are used as archetypes to help justify particular socio-technical visions, by associating specific transition opportunities with each place category (sometimes with individual places used as examples, such as South Cornelly or Torfaen). Interviewees emplace [40] socio-technical configurations in places that are imagined as possessing certain techno-economic characteristics, but also as having particular place histories (e.g. as vulnerable, isolated, and/or unspoilt).

Table 3
Socio-technical structure of clusters for different spatial contexts.

Spatial category	Socio-technical elements of cluster development
Peri-urban (Welsh Valleys, e.g. Torfaen)	<ul style="list-style-type: none"> • Demand density offered by small industrial parks and supermarkets/retail distribution centres • Smaller scale shared generation, battery or hydrogen storage, peer-to-peer energy trading. • Collaboration between LAs, smaller businesses and universities to identify and create potential niches. • Farms as energy sources (solar, biomethane) and potential centres for small scale ammonia and hydrogen production
Rural (Carmarthenshire, Ceredigion, Powys, Vale of Glamorgan)	<ul style="list-style-type: none"> • Rural vulnerabilities (poor transport links, isolation from gas grids and higher-rated power grid) create incentives for ammonia/hydrogen production for storage, transport fuel, heating • Collaboration between LAs, universities and Welsh Government rural development programmes • Hydrogen from waste industrial gases • Repurposing existing distribution infrastructure to drive DG development • Residential areas, businesses, universities, public buildings create demand density for heat networks, power production, larger scale hydrogen-based energy storage development
Urban (Cardiff, Newport, Swansea)	<ul style="list-style-type: none"> • Collaboration between medium/large/multinational business, LAs and universities to identify and create potential niches.

Opportunities for clustering are associated with types of attribute.

The role of LAs as *heroes* of localization narratives lies in their capacity to draw on systematized local knowledge and thus to identify places that possess such characteristics and so identify opportunities for clustering. In addition, this capacity is seen as enabling them to help promote a *just* energy transition. As accountable ‘guarantor[s] of public values’ [58,p. 445], LA’s can link localized decarbonization to other priorities like economic regeneration and social justice. Further, clustering is seen as not only making energy infrastructure more tangible in everyday life by ‘bringing renewables closer to our communities’, but also allowing LAs to promote a narrative in which urban, rural and peri-urban communities are all involved in linked but socio-technically diverse spatial transformations of Welsh landscapes, ‘embracing the fact that we accept this challenge as a populace’ (E15). A significant benefit of cluster-based DG development is therefore expected to be ‘the buy-in that it gets you to decarbonization’ (E19). Clustering is therefore linked to a political framing of decarbonization, evoking a sense of ‘being in it together’ (E19) often associated with Welsh mining and quarrying communities’ past experience of industrialization, while at the same time also having positive environmental and public health connotations, thus differentiating the coming energy transition from the fossil-fuel-powered process of industrialization.

Energy justice has been framed in recent years in terms of three aspects: distributive (sharing out of benefits and risks), procedural (allowing those affected to have effective voice in what happens) and recognition (paying attention to how those affected understand their own situation and the implications for it of transition) [e.g. [59]]. Narratives of localization based on clustering framed justice concerns primarily in terms of distributive justice, but again saw a key role for LAs in exploring how benefits of DG development may be realized for host communities. As noted previously, opposition to RE development in rural mid-Wales often reflected a view that the development of RE hasn’t ‘brought value to Welsh communities’ (E2). ‘Bringing value’ tended to be framed in localization narratives as a matter of finding new ways to ‘formaliz[e] community benefits’ [60,p. 1116] in ways that are, on the one hand, generic across projects (such as community benefit funds) and on the other are responsive to local conditions, such as building hydroponic and aquaculture infrastructure linked to cluster developments (E18) to provide employment and locally-sourced food.

Placing importance on the role of LAs in determining what might be of benefit locally in ways that are responsive to local needs also points to a role for communities. This role is limited, which is underlined by the relatively minor importance interviewees from different backgrounds accord to community-owned energy assets in decarbonization, stressing that this is unlikely to be ‘transformative’ for many communities (E19). The commitment [53] from Welsh Government to increase local and community ownership (these being defined differently, as mentioned previously) was seen as problematic. One FLEXIS expert argued that the relationship between community benefit, community ownership and local ownership, as defined by Welsh Government [53] ‘is a mess’ (E10) and in need of clarification, given that they could see no necessary link between local ownership, which can include companies simply with headquarters in Wales, and localized benefit within specific communities.

3.1.3. From localization to regionalization

Clustering is thus framed as a solution to the challenges presented by localization as a socio-technical and spatial narrative. At the same time, it also presents challenges that, we now suggest, interviewees do not believe it can itself solve. Another socio-technical and spatial narrative is interwoven with localization, which emerges as a potential solution to these challenges – that of *regionalization*. Localization narratives do not address the coordination problems which, as we discussed previously, arise within polycentric systems of governance that exist in liberalized and privatized energy systems like the UK’s and many other countries from northern Europe to Australia, Chile, Argentina and Uganda.

Localization narratives which focus on clustering have their own villain: collective action problems which undermine LAs' capacity to lead on developing clusters. Existing incentive and market mechanisms to drive energy infrastructure investment require markets in production capacity. However, such markets do not currently exist for some potential solutions, such as low carbon heating, thanks to a lack of UK-level regulation and other issues [61] - 'there is no mature kind of heat market in the UK at the moment' (E16).

In consequence, most interviewees envisioned localization as dependent on developing new mechanisms at UK and Wales level for regulating technology and for driving and allocating investment. These were seen as necessary to create favourable conditions for innovation, but also to enable those championing particular socio-technical solutions to take advantage of these conditions. Interviewees tended to represent the proper position of governments as generally falling short of directing investment into particular solutions, but at the same time, going beyond the 'guiding' role they have typically adopted under liberalization and privatization. National and devolved governments were expected to shape the innovation environment more strategically, assisting coordination for localized projects via grand challenge-type funding schemes. For their part, LAs are expected, in line with the *Future Wales* document, to communicate to Welsh Government strategic visions for localized energy plans that are responsive to the diverse spatial contexts (rural, peri-urban, urban) for which they have responsibility, enabling funding calls for innovation in particular technology areas to align with 'the challenges that they're seeing' (E18).

Further, interviewees from LAs emphasized that the heroic role accorded to councils in stories of localization was problematic. In the UK, unlike in Europe for example, municipalities lack both the power and technical capacity to invest themselves in local energy infrastructure [62]. As a result, LAs often rely on motivated individual 'champions' with interests in or skills related to RE projects [63], which can be precarious thanks to institutional obstacles within LAs, such as procurement procedures: 'You do things despite the system not because of the system, and that can't be right' (E9) [cf. [64]].

Given these challenges, the bottom-up dynamic of localization based on LAs' identification of place-based opportunities may create collective action problems. Current government funding models and assistance to build capacity within LAs lead to often intense competition between LAs who may be developing similar cluster projects (E14), resulting in protracted yet often unsuccessful bids for funding: '[w]e went through a process of a competition for 12 over 15 months in total' (E9). As well as inefficient, these problems of 'disjointed' governance are seen as making it harder 'to move forward at the speed required' [E13]. It is for these reasons that *regionalization* of cluster development is therefore represented by many interviewees from different backgrounds as necessary to support localization. Regional cooperation facilitated by governance actors who operate across LA boundaries is often seen as a way of dealing with tensions within polycentric systems of governance [28]. Existing regional organizations are often seen as important facilitating actors for energy transition given their existing resources and concentrations of expertise [30, p. 300]. Interviewees positioned the city and growth deal organizations in Wales, with responsibility for 'catalyzing' economic growth in their areas, as 'naturally' having this role. Just as localization narratives construct places through specifically Welsh imaginings of urban, rural and peri-urban contexts, what 'the regional' means is configured through spatial imaginaries. These rely on pre-existing constructions of historical, cultural, economic and geographical commonalities that are seen as reflected in the four regional 'growth deals'. These are represented, first, by the city region of Swansea, including areas historically and socio-economically linked to it, such as Pembrokeshire and the Valleys around Carmarthen and Swansea. Second, there is the city region of Cardiff, including both Newport and the Valleys north of these cities. Third, there are the agricultural communities of Powys, Gwynedd and Ceredigion. Fourth, there is the city of Bangor in Gwynedd and communities across Conwy and Denbighshire

with strong economic and cultural links on one side to predominantly Welsh-speaking rural communities and on the other to the cities of the English north west.

Simultaneously, expectations about regionalization tended to depict it as going beyond supporting a bottom-up process; it is expected to confer on innovation a spatial logic that will exert downward pressure to shape how individual clusters are developed. Welsh Government respondents anticipated regional bodies' primary role as being to 'support the authorities in each region to do local energy planning work' (E20), enabling practitioners working in LAs to share knowledge and expertise. In line with the *Future Wales* planning framework, they are also expected to formulate regional strategies for decarbonizing power, heat and transport, and integrate into these plans LAs' own planning. Regional planning is expected to reciprocally influence what is seen as possible and desirable locally. For example, forming partnerships with private industry to deliver individual projects was often seen as necessitating larger bids at expanded spatial scales for UK and Welsh Government grand challenge funding to provide adequate incentives for companies to engage, meaning it was necessary 'to start thinking less about doing this locally, and more about how to do this regionally.' (E9).

These roles for regional organizations thus modulate the contribution of LAs. Clusters may depend on LAs identifying particular combinations of place-based conditions which provide opportunities for development. In addition, different combinations of technologies are expected to need to be pursued in varying spatial contexts simultaneously. Clusters are thus expected to create deviation within emerging power, heating and transport regimes in different spatial contexts [64]. Regional-level planning was seen as potentially helping to identify opportunities earlier and in ways which enable support for similar proposals to be coordinated: 'have a demonstrator of biomass, another ammonia, another of hydrogen, and then broadcast it and disseminate it as much as possible' (E8). What counts as 'local' was therefore expected to shift in some cases as clusters developed, with actors needing to be 'a little bit more open to the geographic spatial extent of the cluster' (E9), potentially re-drawing lines to expand the reach of individual projects [cf. [40], p. 9].

For example, regionalization narratives construct regional contexts within the reach of the various growth deal organizations, around particular socio-technical and spatial affordances. Working with the maps with which we provided them, several FLEXIS engineers and policy practitioners independently discussed such an example. Rural railway lines running across the mid-Wales region from England to the south west Wales region which 'will probably never be electrified' (E18) were seen as providing key opportunities for seeding localized cluster demonstrators relatively rapidly. Rural contexts, as noted previously, are seen as posing specific difficulties for decarbonization, but also as providing opportunities (often through their specific vulnerabilities). Developing hydrogen-fuelled trains for these networks was expected to enable the development of clusters in communities along the length of the rail lines, based around DG, hydrogen electrolysis and storage. Further, the railway then becomes 'a distributary mechanism for hydrogen' (E14), with the clusters it supports also providing fuel for road freight and rail transport, expanding to 'five, six, seven maybe 10 maximum nodes throughout Wales' (E15).

Again, certain shared meanings, based on the concepts of Welsh regions as places reflected in the growth deals, are positioned at the center of regionalization narratives. The growth deal bodies thus emerge as heroes of regionalization narratives, able to play a coordinating governance role across the jurisdictions of the LAs that are their members, but also collaborating to (as in the case of the railway lines) help coordinate projects which cross regional boundaries. Further, by helping to overcome the problems posed by 'disjointed' governance, they are expected to accelerate decarbonization [65].

At this point, however, a potential tension emerges within the regionalization narrative, relating to distributive and procedural justice. One of the contributions LAs are expected to make is through their

capacity to draw on local knowledge of the vulnerabilities and needs of specific communities. This, as we saw, is seen as supporting their role as ‘guardians’ of multiple public values. The coordinating function often ascribed to regional organizations like the growth deal bodies within polycentric systems, however, has been associated with a similar guardianship role over multiple public values [66]. A central problem, however, is that such organizations tend to foreground economic goals like growth and competitiveness at the expense of other values like social justice [67]. Further, whether such organizations increase accountability for the governance of socio-technical transitions (and more widely) has been questioned, particularly given the implications for procedural justice of moving key planning decisions to a regional level beyond LA planning departments [67].

3.1.4. From regionalization to national visions

Regionalization is seen as providing spatialized solutions to collective action problems, by facilitating coordination between LAs and removing their need to compete for additional resources. Nonetheless, coordinating development across and between regional institutions, particularly ones organized around economic priorities, raises questions about accountability, prioritization, and justice issues which pertain to the three dimensions of energy justice [58]. The localization narratives we have documented sometimes draw on cultural meanings attached to place in identifying potential opportunities for cluster development. Regionalization on the other hand tends to abstract away from the bottom-up dynamics of cluster development, while also promising to coordinate cluster development in the name of urgency. The question of how different public values (including decarbonization) can be realized alongside each other is a central question for LAs, with their local accountability. It arises again, however, with regionalization, where democratic accountability becomes a more significant problem against the priority of accelerating decarbonization.

The narrative plots of localization and regionalization thus create new villains that problematize their own solutions. That this is the case with regionalization is recognized by some interviewees, who weave an additional level of socio-technical and spatial narrative: national visions for a decarbonized energy system. This narrative plot depicts clustering and regionalization as needing to reflect priorities balanced at national level as part of a coherent strategic vision for a just energy transition that ‘can reconcile renewable energy expansion with environmental protection, rural diversification and economic development’ [68, p. 1248].

As researchers have shown, relationships between national imaginaries and more localized ones can create productive synergies [69]. Welsh Government policy documents have consistently linked the energy transition to broader visions of ‘a wealthier, more resilient and sustainable future for Wales’ [70, p. 6]. The Wales in question here is one constructed against the backdrop of long-standing spatialized narratives. A key example is the storyline established through European Union development policy, which allocated funding from the European Structural Fund to the ‘Objective One’ area of ‘West Wales and the Valleys’ (which in fact includes the whole of Wales excepting the rural county of Powys, the urban areas of south east Wales, and the more prosperous rural counties of the Vale of Glamorgan and Monmouthshire) [71]. Wales is defined through this lens as one of the more deprived regions of Europe, imagined as needing to spread development and share prosperity from its more developed regions.

From interview data, three divergent solutions to the problem of how to balance public values through the energy transition can be traced. These three visions represent three ways to challenge the long-standing national vision of a ‘deprived Wales’, drawing on localization and regionalization narratives to depict the energy transition as a spatial transformation as well as a socio-technical one [19]. At the same time, no pattern emerges from our data which might help explain how and why experts from specific backgrounds subscribe to each of these visions.

The first emphasizes *sufficiency* as a ‘value of values’ that can help

align priorities, ‘to at least meet our own needs now [...] but actually to what level then should we contribute towards the [UK] or the global picture I think is a further discussion,’ (E20). This is associated with a significant shift within energy governance, making the Welsh system ‘distinct’ ‘organizationally and technically’ (E10) from the English system, perhaps requiring ‘an energy equivalent of Dwr Cymru’ (E12), the non-profit body which regulates Wales’ drinking and wastewater services. The implications of this possibility for devolution are significant, as it would see a significant shift in the system of polycentric governance through which the UK energy system is currently regulated towards a vision of something like energy independence for Wales. A key element of this vision was ‘keeping the benefit of decarbonization within Wales’, recognizing that previous public resistance to RE depended on perceptions of unfairness related to resource exploitation from across the English border. Clustering and regional collaboration are seen as key mechanisms for achieving prosperity through resource independence, seeking to address public perceptions of historical unfairness. In this vision, rural, peri-urban and urban places share the burdens of RE development, in ways that reflect the differences between these spatial contexts identified by interviewees and discussed in previous sections.

The second vision prioritized creating a new skills and employment base located within existing urban centers of employment, with the goal of supplying products required internationally for wind, solar and hydrogen infrastructure supply chains, ‘enabling technologies for renewables’ (E1). Working once again with the energy system maps to identify sites, some interviewees suggested that maximization of energy production to drive industrial growth involving both clusters and more centralized concentrations of RE (‘we want to exploit everything that is available in our country’ [E3]) might then go alongside significant investment in high grade manufacturing, such as ‘building wind turbines [...] and the hydrogen sector which is an export business and is at the cutting edge of the tech’ (E19). Welsh ports in the north and south become key places in this vision, with rural clusters becoming ‘exporters’ of energy to these centers, creating a narrative of *reindustrialization*.

The third vision focused on using cluster development to expand energy production and lower-technology manufacturing into areas of the country historically not associated with it. Clusters here become a way of working with the grain of grid constraints to create economic opportunities in rural Wales and the Valleys, anchored around green hydrogen production: ‘these transformative uses of hydrogen could benefit those communities, those regional economies, and also give them access to, wider markets’ (E14). Like reindustrialization, this vision of *regeneration* focused on looking outwards from Wales to forming active trading relationships with the rest of the UK and globally, ‘becoming exporters of [hydrogen and ammonia to England and some other places in Europe] (E8), ‘supplying our own industrial base’ but also supporting ‘the economies in, in the West Midlands [of England] and places like that’ (E11). While discussing the energy system map, one interviewee described this future as one in which Wales becomes not ‘a mini-Saudi or a mini-Libya’ focused on maximizing RE production in order to export it, but something more like ‘a mini-Scandinavian country’ (E12), increasingly energy self-sufficient but also exporting energy vectors in which it has comparative advantage thanks to the development of rural and urban DG clusters.

Each vision aims, in different ways, to keep the benefits of decarbonization within Wales, constructing new regional relationships between the former ‘Objective One’ areas and more prosperous ones in order to guide the energy transition in ways that are responsive to multiple priorities. However, each vision rests on expectations that Wales is ‘going to be more industrialized’ (E8). The ways in which rural landscape values that reflect ideals of an ‘unspoilt Wales’ may help create synergies or tensions between national visions and localized projects tied to specific places within in Wales are open to question. The three national visions which are articulated in the interviews represent attempts at solutions, ways of overcoming the villain of multiple

priorities. Nonetheless, they open up the same challenge faced by previous waves of RE development: whether ‘large-scale industrial development’ ‘actually adds value to Wales or detracts from it’ (E20).

4. Discussion

We have seen that among the narratives articulated by experts from diverse research, industry and policy backgrounds, many *formal* elements of energy system decarbonization narratives (including setting, heroes and villains, plot elements and solutions), were widely shared. This was the case, in particular, where these narratives focused on local and regional scales. Similarly, many elements of the linked socio-technical and spatial imaginaries that provided the *content* of these narratives were also shared, although different interviewees tended to emphasize the importance of e.g. specific socio-technical configurations or spatial contexts in the development of clusters. Significant divergence was apparent, however, when experts made reference to the national scale, with three distinct and contrasting narratives emerging.

Key socio-technical elements of narrative settings were particularly widely shared. These included understandings of longstanding capacity and connectivity problems affecting the Welsh power and gas grids, histories of public perspectives on RE technologies in Wales, concepts of how the Welsh and UK energy systems are governed, and finally, ideas about how legacies of deindustrialization and rural poverty play out in particular Welsh place contexts. These were reflected in how the localization narratives we have documented combine socio-technical and spatial imaginaries to construct plotlines that move towards *clustering* as a solution, one which is expected to overcome both grid capacity issues and public resistance.

The widely shared localization narrative demonstrates how spatial elements of transition narratives help to shape how transition processes are conceived of [33] and also how they help to justify particular narratives. For example, one key justification for the concept of clusters is how they are expected to help address how many communities with place characteristics that may create opportunities for DG development are relatively cut off from high-rated power distribution networks. These opportunities do not just reflect the availability of key resources (such as wind, water or solar energy), framing locations as ‘sites’ [38]. They also reflect the socio-economic and physical characteristics of them as places, defining opportunity in relation to some culturally shared meanings that reflect aspects of inhabitants’ experiences (for example ideas about vulnerability attached to Valleys communities that have undergone deindustrialization). Clustering represents a narrative that responds to such characteristics while not requiring expensive grid extension.

Another justification for clusters as a vision of localized energy systems is how the interpretative flexibility the concept affords (given that clusters can include a variety of socio-technical configurations selected from a ‘moving landscape’ (E13) of options) may help address the spatialized diversity of needs across divisions between specific Welsh places that are seen as exemplifying idealized imaginaries of urban, peri-urban and rural. Finally, they are seen as potentially helping mitigate future distributive injustices between urban and peri-urban/rural contexts within Wales that risk mirroring the historical center-periphery relationship between Wales and England. If less developed areas (within the Objective One definition of ‘West Wales and the Valleys’) become suppliers of energy to urban centers, then the historical relationship some Welsh publics perceive between Wales as resource base and England as consumer risks being re-inscribed across Wales. The concept of clusters, as way of understanding what a decentralized energy system might look like, provides a way of anticipating this distributive injustice, given that the logic of clustering implies that new energy production, distribution and storage infrastructure will be required across Wales, and not just either within rural settings or for that matter within industrial clusters [15].

At the same time, the polycentric governance context in which these narratives are woven includes additional subnational scales that can

significantly influence what happens at national [32,34] and local scales. The spaces of energy transition [13] constructed through the three levels of narrative we have analyzed are ones which connect together not just spaces but places (Welsh localities, regions and visions of a nation’s energy future) at local, regional and national scales. Localization, regionalization and national visions interconnect and overflow [38], given that localizing narratives require regionalizing narratives to stabilize them, and that regionalizing narratives in turn require national visions to stabilize them [cf. [69]].

By analyzing the form and content of narratives, we have shown how tensions emerge within the narratives of localization and regionalization. The importance accorded to LAs in localization as agents of transformation through their contribution to cluster siting also destabilizes this narrative. Collective action problems created by resource competition require regional actors – the growth deal bodies – to coordinate transformation. At the same time, however, the ways in which these bodies are expected to play a role in shaping transformation within and across the regional contexts constructed around them have implications for democratic politics. The legacies of deindustrialization across cities and the Valleys, and of rural poverty, mean that the accountability of LAs for promoting a range of public priorities (including social justice and environmental quality) alongside decarbonization is a key consideration. Interviewees acknowledged this in pointing to the strength of feeling that characterized previous public responses to RE siting in rural locations, citing shared meanings relating to people’s attachment to ‘unspoilt’ Welsh landscapes.

The *Future Wales* planning framework translates an idealized spatial imaginary of local, regional and national into the Welsh context. A flow of information upwards from LAs is imagined as informing regional and thereby national planning. Our analysis of interviews suggests, however, that the flow of action within Wales’ polycentric governance system is also seen as necessarily flowing downward from the regions, as regional actors take on planning responsibilities in the name of normative priorities like efficiency and urgency that will constrain LAs’ scope of action and also potentially place limits on community participation in local planning decisions. This raises questions around the energy transition relating to procedural and recognition justice that mirror research findings that point to how regional governance may lack accountability and emphasize, by placing stress on the need for growth, only a limited set of priorities [67,68]. In response to our third research question, we therefore see that our Welsh study identifies key issues around urgency and accountability that transition narratives face at regional and national levels, but cannot easily resolve.

When energy decarbonization overflows the regional level, these issues can be seen emerging once again as interviewees from the same and different backgrounds diverge from each other in constructing three examples of national visions. These seek explicitly to balance the multiple public priorities that regional growth bodies are entrusted with. At this level, however, tensions re-emerge between the need for socio-technical and spatial transformation, and public perspectives on meanings of place in Wales. Each of the three narratives features a different balance of priorities to help coordinate action at lower spatial levels, but also implies significant socio-technical and spatial transformations of a kind that threaten to re-invoke earlier debates within the nation about the relationship between industrial patterns of development and ‘unspoilt Wales’. A key legitimization for the concept of clustering was, as we saw, in the promise of distributive justice in the form of ‘burden sharing’ between cities, Valleys and countryside. Across the national visions we have documented, however, the question of how acceptable such a vision of distributive justice might be among Welsh publics remains open, and how a strategic balance can be struck between urgency and accountability.

5. Conclusion

Socio-technical transitions, like the energy transition, are challenges

to incumbent regimes, and as a result also have extensive societal impacts, many of which may be difficult to anticipate. Questions therefore arise about how actors involved in transitions rely on certain imaginaries and assumptions in framing potential strategies they might follow in the present. Narrative policy analysis can provide a means of understanding these framings, even where narratives are still emerging. It provides ways of investigating how actors frame the settings of transitions, and how in response to these settings they construct narrative plots in which 'heroic' actors overcome obstacles and challenges to provide solutions. These formal aspects of narratives interact with their specific content in ways which rule in some potential pathways forward and rule out others, also granting agency to some actors and not to others (such as publics). We combined this analytical approach with expert interviews that featured anticipatory mapping tasks to answer three questions. First, to what extent are socio-technical and spatial aspects of transition narratives shared or contested by expert actors? Second, to what extent do these transition narratives employ spatial imaginaries (related, for example, to shared cultural meanings attached to place) to justify particular pathways? Third, can we use answers to these first two questions to help understand the implications of expert narratives for the governance and politics of energy transitions? By employing a narrative policy analysis-based approach, we offer a novel way of relating socio-technical and spatial elements of transition narratives that shows how both kinds of elements interact in shaping the internal logics of these narratives.

Overall, in the Welsh and UK context, we have seen that narratives which are linked to larger spatial scales are employed to ease tensions within ones at smaller scales [cf. [69]]. Localization narratives shaped a perspective shared widely among expert interviewees upon how to solve problems in the existing UK and Welsh energy systems. The spatial and socio-technical concept of clusters was constructed in relation to spatially-heterogeneous contexts (urban, peri-urban and rural places defined in relation to Welsh social history and shared ideas about Welsh landscapes) as such a solution. To stabilize this concept, experts invoke the agency of local authorities, and their assumed capacity to identify opportunities or affordances for cluster development. This capacity is based on their access to data on resources, but also to data on the social and physical characteristics of particular places. Nonetheless, the localization narrative is itself unstable. Competition between LAs for resources, which reflects how funding is allocated for energy transition projects within the UK, creates collective action problems. Experts therefore rely on a regionalization narrative to help stabilize visions of localization. This is however in turn subject to internal tensions, given that regional actors such as the growth deal bodies have to balance a range of public values, while not themselves being subject to democratic oversight. Consequently, national visions that explicitly connect together distinct values (social justice, decarbonization, economic regeneration, environmental quality) are introduced. The formal structure of these is loose, however, and there is divergence among experts on what narrative plot and solution is the most plausible and desirable.

Each level of narrative relies on different ways on spatial imaginaries, both to construct what counts as local, regional and national, and also to justify the pathways and solutions they set out. Shared meanings attaching to Welsh industrial and post-industrial cities, the Valleys, and unspoilt rural Wales and the special social vulnerabilities which characterize each, in an era of deindustrialization, are used to justify clustering. The growth deal-based concept of Welsh regions as places, reflecting a need to respond in coordinated fashion to such vulnerabilities, is employed in constructing regionalization narratives. Finally, histories of spatial transformations such as deindustrialization and the spatial divisions enshrined by Objective One funding are reflected in the three different visions of a Welsh future of sufficiency, reindustrialization or regeneration.

The implications of these narratives for energy transition governance and for concerns about energy justice [72] are significant within the context we have studied. However, the UK was an early adopter of

energy system privatization and liberalization, and has an established history of polycentrism in energy system governance that is relevant to the evolution of governance in other countries that followed the UK's example, from northern Europe to Australia, Chile, Argentina and Uganda. Consequently these implications have relevance far beyond Wales and the UK. Coordination problems are a general issue for polycentric systems of governance. As we have seen, such issues are identified by experts in the shape of collective action problems at the level of localization. To articulate a solution to such problems at the regional level, experts refer to the institutional capacity of growth deal bodies to coordinate action between their member LAs. To what extent, however, does this remove from LAs, which have democratic accountability for their guardianship of public values, key planning functions? What implications does this have both for democratic oversight of an energy transition increasingly framed as urgent, and for the importance of the shared meanings attaching to place that are central to localization narratives? A key rhetorical role for national visions is to help determine what a proper balance between distinct public values might 'look like'. Yet the three visions we have documented all have significant implications for shared ideas about place which, interviewees note, have played a significant role in previous public responses within Wales to energy system change. A limitation of our research emerges here, given that we did not have time within this project to investigate potential links between the institutional backgrounds of interviewees and their perspectives on the credibility and desirability of specific national visions. Investigating these links therefore represents a potential avenue for further research.

It has been argued that visions of localization have no inherent link to community empowerment [73] and thereby do not necessarily support the procedural and recognition aspects of energy justice. Our study underlines that, given the historical evolution of systems of polycentric governance, such links cannot be expected to materialize on their own. Seeking public perspectives on particular siting decisions or even on helping to define how public priorities in particular places should inform place-based energy strategies [74] is arguably not sufficient. The larger problem for Wales, the UK and indeed internationally concerns how public perspectives can have effective impacts upon the kinds of strategic coordination required by the kinds of regional and national narratives we have documented, and how framings of energy transition as requiring urgency above all will interact with this problem.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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