Decentralisation and inclusivity in the energy sector: preconditions, impacts and avenues for further research

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Abstract

This editorial for the Special Issue entitled 'Energy Decentralisation – Institutional Perspectives' in Renewable and Sustainable Energy Reviews contrasts and compares thirteen research and review articles submitted over the last year, each with a specific regional or thematic focus. The contributions examine decentralisation, its impacts and/or institutional preconditions in the United States, Sweden, UK, Denmark, South Africa, Germany, France, Japan, the Netherlands, Australia, and include three international thematic reviews. Embedding the findings from this work in the wider literature on decentralisation and inclusivity, we identify key findings and avenues for further research. Our review begins with an overview of how energy decentralisation is conceptualised in research and policy, identifying the logics used by proponents and opponents of inclusive decentralised energy across the literature. We review the ways in which structural institutional settings have influenced the prevalence of narratives furthered by stakeholders with different interests and worldviews, resulting in radically different policy decisions, support frameworks and incentive structures at regional or national scales. Building on these findings, our concluding discussion reflects on the factors that influence social consensus on, and effective implementation of, ambitious and inclusive energy policy. The focus of this Special Issue is even more relevant as governments around the world are forced to marry multiple crises in fiscal spending decisions; where significant economic support packages need to buffer the socio-economic impacts of COVID19 in the short to medium term, and simultaneously facilitate investment in infrastructure, technology and competencies that will enable the decarbonisation of the economy.

Key words

Energy transition, decentralisation, inclusivity, institutional analysis, energy policy, energy democracy

Word count: 5119

1. Institutions, decentralisation and inclusivity in the energy transition: an introduction to this Special Issue

The unbundling and liberalisation of energy markets over the past thirty years has come hand in hand with the clean-technology transition and opened new opportunities for engagement of new actors in the energy sector. Much of the policy reform and engagement with renewable energy and energy efficiency across government and civil society is mobilised by a growing concern over climate change and its recognition as a policy priority in international and domestic agendas. Sensors, ICT, distributed storage, demand response and electric vehicles continue to open further opportunities for engagement of new actors, disrupting traditional business and organisational models for electricity generation, distribution, and trade. By illustration, the International Energy Agency predicts that more than 71% of new electricity connections will be via off-grid or mini-grid solutions by 2030 [1]. The UN General Assembly has established a Global Action Plan for Decentralised Renewable Energy, placing energy decentralisation central to the pursuit of SDG7, "energy access to all" [2]. In the European Union, the Internal Market and Renewables Directives under the Clean Energy Package that were adopted by the European Parliament and the Council in 2019 set out arguably the most explicit and far-reaching policy objectives on facilitating the engagement of individual and collective consumers in the transition to renewable energy. It assigns consumers equal rights to participation in energy markets as traditional market players and bans disproportionate technical, administrative requirements, procedures and charges, promoting residential storage, stipulating "enabling frameworks" for collective energy initiatives ("citizens energy communities" and "renewable energy communities") [3]–[7]. The underlying assumption across these international policy strategies is that third-party involvement by civic and local government actors enables both accelerated investment in clean technology and new forms of engagement by traditionally passive consumers, as well as the distribution of associated co-benefits in the form of energy security, job creation, local economic and social benefits.

By all indications then, energy sectors worldwide are undergoing technological, institutional and social transformation, that will see a decentralisation of governance and practices far beyond the contexts in which they have historically been observed – remote areas and islands [6]. However, empirical evidence suggests there is large variation in the degree to which nations and regions are embracing such narratives, how these narratives are negotiated vis-à-vis traditionally dominant public policy objectives around cost-efficiency, economies of scale, and universal access to energy, to shape distributed energy agenda's, associated regulatory, policy and institutional reforms, and the diversity of practices on the ground. This is especially true outside of Europe, where the respective roles of state, market, community and third sector in ongoing energy transitions is less well documented and understood (see for example 6–10). There is also a lack of evidence on whether and in what contexts decentralized models are delivering on proclaimed benefits.

This Special Issue focusses on energy decentralisation; how it is conceptualised, how it is taking shape across various regions in the world, and its impacts, with a special focus on the institutional and policy context constraining and enabling it. It joins a growing literature that is shedding light on how institutional arrangements, energy sector composition and policy processes that influence agency and 'institutional space' for new and incumbent actors,

shaping the dynamics of discourse, policy and regulation, and ultimately shaping the forms, extent and impacts of third-party uptake and engagement in the energy transition [13]–[18]. In this Special Issue, we draw on a remarkable range of articles examining decentralisation, its impacts and/or institutional preconditions from the United States [19]–[21], Sweden [21], UK [22], Denmark [23], South Africa [24], Germany [25], France [22], [26], Japan [21], [27], the Netherlands [21], Australia [21], as well as broader regional reviews [6], [7], [28]. We distil some key findings from these studies and set out promising avenues for further research, embedding findings in the wider literature. Building on these findings, our concluding discussion reflects on the factors that influence social consensus on, and effective implementation of, ambitious and inclusive energy policy.

2. What is energy decentralisation, and what does it do?

The articles in this special issue demonstrate that the scope, agents and forms of decentralisation are country- and context-specific and that definitions are shaped by the empirical diversity on the ground. There is no one fixed definition of energy decentralisation (ED), and there is also ambiguity around associated terms ("citizen energy", "civic energy", "community energy", "energy communities", "prosumer", "prosumager") often seen as the embodiment of ED. Despite the widespread interest in the new roles of these civil society actors, private sector actors in Europe and North America dominate ownership of wind and solar PV assets [29], and incumbent actors can also dominate the energy decentralisation process and accelerate change through collaborative experimentation [22]. In this Special Issue, Judson et al. (21, p. 7) draw on Geel's et al. ideal type socio-technical transition pathways, each with a distinct role of incumbent and new entrants [30], to show that incumbents can introduce technical elements of decentralisation with limited community engagement or participation. In addition, other work has pointed out that private sector actors are often deeply entangled with initiatives led by civil society ("Third sector" actors) in the form of shared ownership, technology provision, as well as provision of a variety of (legal, financial, energy exchange and aggregation) services [31], [32]. Local governments sometimes assume prominent roles in ownership or development of DE [19], [33], sometimes facilitate DE led by civil society or "Third sector" actors [19], or in some contexts have very limited involvement [11], [24], [26].

Brinker and Satchwell [19] provide an overview of the variety of ways literature has characterised energy decentralisation, ranging from the physical deployment of modular technology viable at smaller scales, devolution of decision-making from centralized to local levels, to localised ownership, information and financial flows with correspondingly localised financial gains. Studies with a focus on emerging or developing country context similarly conceptualise energy decentralisation as a process of deployment of renewable technology at a variety of different scales in combination with mechanisms for participatory energy governance, but the emphasis on participation lies more on achieving energy access and poverty alleviation in parallel to decarbonization [24], [28]. Across the literature, energy decentralisation is understood as socio-technical process, where a combination of institutional, socio-political, economical, and technical factors shapes the diversity and inclusivity of clean technology projects. Energy decentralisation is referred to in three dimensions: first, as a shift in technological infrastructure, second, as a process that creates opportunities for new stakeholders within the market context, and third, as a normative goal in itself, associated to values such as citizenship, justice and democracy.

Building on “renewable energy community” and “citizen energy community” concepts set out by the European Union Clean Energy Package, Lowitzsch, Hoicka and van Tulder elaborate on a prototype governance model that can ensure that these concepts meet energy infrastructure needs (6, p.4). Underpinned by flexibility, interconnectivity, bi-directionality and complementarity, this governance model is based on collective control and administration of integrated renewable energy systems, demand flexibility and energy efficiency measures, storage and peer-to-peer trading (6, p.2). In a similar vein, Baucknecht, Funcke and Vogel [25] review the technological implications of decentralised energy infrastructure, distinguishing decentralised from centralised energy infrastructure in terms of four dimensions: connectivity to distribution versus transmission networks, proximity to demand, and location of actors engaged in flexibility and balancing of generation and demand. Following observations by other authors [18], [34], [35] they show that the degree of participation, a socio-political feature associated and expected from ED, depends on decentralisation of infrastructure. Ahl et al. [27] take this further, honing in on distributed ledger technology in terms of its potential to enable widespread distributed transactions and engagement by prosumers – but identify a variety of technological, economic, social, environmental and institutional barriers that would need to be overcome. Taken together, a high-level definition for energy decentralisation concurrent with all the contributions to this Special Issue reads: *a process by which decision-making and participation in the production, consumption, trade, planning and regulation of energy is to some extent distributed away from a central authority towards the final consumer*.

Several papers touch on value orientations, beliefs and alternative narratives of new energy actors as driving decentralised energy experiments and associated regulatory and policy conflicts on the periphery of energy markets [20], [26], [36]. Funcke & Ruppert-Winkel show that conceptualisations of ED differ across different stakeholder coalitions in Germany, and that conceptualisations of ED advocated by citizen energy coalitions centred on proximity to demand and decentralized flexibility are poorly represented at the federal level [36]. Actors advocating accelerated deployment of renewable energy do not necessarily support decentralisation if decarbonisation can be more rapidly be achieved through a centralized infrastructure [36]. Hess and Lee show how stakeholder conflicts over regulation that influences the risk and financial viability of community-based solar initiatives are fundamentally underpinned by an appeal on different values. Mirroring observations internationally [11], [37]–[39], cost-efficiency comes head to head with equal access to solar and resulting benefits in California (19 p. 5). In addition, equity is framed in different ways to serve incumbent and community interest groups (19 p. 4). This creates situations where associations of consumers might support central utilities over new community initiatives in order to avoid cost burdens to non-participants of community solar initiatives, rather than support equity in terms of equal access to such projects [20]. Similarly, Poupeau shows that although political actors within the French government promote ED through legislation, resistance persists, including among local actors and local authorities themselves [26]. Local authorities in France, especially in rural areas, appeal to principles of equality to justify the need for centralised management and a strong national regulatory framework, opposing decentralisation proposals that would place the burden of responsibility and resourcing on rural territories [26]. As such, there is a large gap between localist rhetoric and institutional reality [26]. Summarising separate but interrelated debates on ownership, co-benefits, scale and intermittency, **Table 1** recapitulates the logics used by proponents and opponents of decentralised energy across the literature. This illustrates how the prominence of different narratives furthered by stakeholders with different interests and worldviews can translate into radically different policy decisions, support frameworks and incentive structures at regional or national scales.

Table 1 Logics used by proponent and opponents of inclusive decentralisation in the energy sector

	'Small is beautiful'	'Small is irrelevant'
Political	• Facilitates conducive legislative reforms and more rapid energy transitions [16], [40]–[43] • Creates inroads for "rights to energy" campaigns [44] • Reduced dependence on oil and uranium [26] • Increased transparency [19]	• Concern that the public might subsidise cost-inefficient development of assets [11]
Social	• Local energy users are more likely to be engaged in projects than in commercial or public projects [45], [46] • Contributes to social cohesion and community empowerment [47]. • Utilises local knowledge and enables control over aspects including technology scale, siting and orientation [45], [48]. • Contributes to a positive public perception and buy-in for renewable energy [49]. • Foregoes public risks of nuclear power [26] • Can facilitate access to energy and alleviate energy poverty [24], [26] • Distributed ledgers can enable values-embedded peer-to-peer trading and distributed benefits [50].	• Exacerbates socio-economic inequality where there is unequal access to finance, support and/or technology [51], [52]. • Requires high degree of prosumer outreach, engagement and training around the management of new niche technologies [51].
Economic	• DE contributes to rural development, local employment [24], [26], [53], [54] • Can reduce cost of energy for citizens [47], [55]. • Defers expensive upgrades and extensions of the transmission network [56]. • Can produce low cost heat [57]. • Advanced connectivity, big data and cloud computing could enable integrated co-ordination across distributed energy systems, reduce transaction costs and generate cost-efficiencies [27], [58]–[60]	• Requires higher transmission capacity and cost for a given power output as well as higher costs of reinforcement of the distribution network [61]. • Additional cost of system balancing and ancillary infrastructure [61]. • Higher subsidies required to finance remaining transmission infrastructure [62]. • Higher generation cost because DE projects do not achieve economies of scale in construction and operation [26], [63] • Higher administrative cost [64]. • Support incentives increase cost of electricity for consumers, decreasing purchasing power and indirectly generating job loss [63]. • Centralised nuclear sector as a strong job creator and/or export industry [26]

Environmental	• Engaging end-users results in energy awareness, absolute reductions in energy demand and demand GHG emissions [64]. • Ability to use waste heat raises system and GHG-efficiency [57]. • Energy-efficiencies could arise from integrated coordination and flexibility of energy systems enabled by distributed ledgers, connectivity, big data and cloud computing [27], [59]	• Larger-scale centralised nuclear/renewable energy deployment can be implemented more rapidly and more cost-effectively at greater scale to achieve higher GHG savings [26], [65].
Technical	• Scale and quality of energy generation is matched to load, preventing transmission losses [66]–[68]. • Creates 'islands of stability' and voltage stability [69]. • Increased reliability of electricity for community buildings in rural areas [70]. • Improved system efficiency if able to use waste heat locally [71].	• Distributed generation increases the per unit cost of transmission infrastructure [51]. • Installing must-take generators requires additional system balancing and ancillary technology, such as transmission and storage infrastructure, active network management, as well as additional centralised base-load and dispatchable peak load generators [26], [61].

To begin to understand and broker across these distinct points of view, it is useful to reflect on how they are shaped by different assumptions, knowledge, attitudes, and worldviews. On the one hand, this is a technical debate over what level of decentralisation incurs lowest economic cost to society – factoring in foregone costs in transmission expansion, investment in power management control, and economies of scale derived from large- scale storage, generation and demand side management consumers. In addition, these views are clearly shaped by different assumptions on what drives the energy transition, and the scope of factors one might include when assessing technology choices (**Table 2**). More fundamentally perhaps, these worldviews are characterised by a distinct risk appetite, trust in institutions and incumbents to deliver the energy transition, and the need for additional and accelerated investment in emissions abatement, stemming from higher prioritisation of action on climate change among proponents (**Table 2**). Table 2 summarises these points of view.

Table 2 Understanding how different assumptions, knowledge, attitudes, and worldviews shape distinct views on inclusive decentralised energy

	Proponents	**Opponents**
Theory of change	Emphasis on social, cultural-behavioural change and public buy-in	Emphasis on supply side technological change
Scope of analysis	Emphasis on potential advantages of functional integration heat/power generation, DSM, appliances, EV's at consumer level	Emphasis on costs of single technologies at consumer level
Criteria used to justify projects	Financial viability, social, local economic impacts / co-benefits, equal access, social justice	Least cost to overall economy (opportunity cost)
Trust in institutions and incumbents to deliver the energy transition	Low	High
Risk appetite	High	Low

3. How has institutional context influenced decentralisation?

Despite country and regional differences in market and regulatory landscape, scope, agents and forms of decentralisation, we see similar policy barriers, and fundamentally identical conflicts and underlying value orientations occurring across different localities. Key terrains for policy barriers and regulatory conflicts are distribution network charges [20], [27], [72], access to supply licenses (including legal responsibilities of suppliers) and wholesale markets [27], [32], [58], regulated power purchase prices or net metering [19]–[21], grid connection and balancing requirements [27], as well as standards and regulation for smart meter infrastructure that influence compatibility with distributed ledgers, access to smart meter data and privacy protection [27], [32]. However, conflicts also extend to procedural practices that influence transparency, access and ease of use, such as the complexity of credits from solar on prosumer bills, or the burden of regulatory requirements [20].

The contributions to this Special Issue shed light on the different ways by which the wider institutional context, and in particular the "the rules of the game" and historical ownership patterns and market composition, have influenced agency, political opportunity and openings for alternative narratives, experimentation, and associated policy and regulatory change. At the level of enabling policy and regulation, Warneryd et al.[21], Ahl et al.[27] and Judson et al.[22] all show that institutional change tends to catch-up with and acknowledge technological change and market trends, rather than initiate it. Warneryd, Håkansson and Karltorp review actors and networks, policy developments and associated narratives enabling microgrid projects in four regions where they identify a concentration of microgrid activity - USA, EU, Asia and Australia [21]. Key policy developments range from changes in utility revenue models, to ancillary service markets, seed-funding and market-based incentives, as well as comprehensive roadmaps for microgrid commercialisation, with a wide variety of county-level policy contexts and barriers observed [21]. A number of contributions to this Special Issue point to the need for flexible policies and regulations such as regulatory sandboxes to accommodate the wide variety of emerging actors and experiments [6], [7], [23], [26], [27]. Regulatory flexibility seems particularly relevant for microgrids, distributed ledger technologies, and associated peer to peer markets, with potentially far-reaching implications for consumers, end-user technology, network operators, and market regulation [6], [27]. Barriers across multiple dimensions are co-evolutionary [21], [27] so that overcoming them will require coherent policy strategies and mixes.

At a more fundamental level, structural institutional arrangements and policy processes are key to how much and what kind of energy decentralisation can be achieved. This includes the power sharing arrangements between national and subnational levels of government, and between state, private sector and civil society actors [19], but also the ways in which we organize stakeholder participation and create opportunity for engagement in collaborative innovation ecosystems [27], [73]. For example, in reviewing the positive impacts of solar home systems, Khan [28] shows that these impacts are conditioned by the lack of financing mechanisms and technical support that characterize the wider institutional context for many remote energy access projects in developing countries.

Brinker and Satchwell [19], Poupeau [26], and Sperling and Arler [23] build on previous work showing the variety of ways local government is engaging in the energy transition -

ranging from their involvement in horizontal and vertical multi-level policy design and implementation, to opportunity scouts and matchmaking, to investors, owners and operators [55], [64], [74]–[78]. Poupeau shows that a historically limited role of French local authorities in generation, transmission and supply limits their ability to engage proactively in narratives and regulatory change in support of decentralisation – instead they are selectively integrated as extensions of more powerful actor complexes [26]. In contrast, Denmark - which has retained pockets of local government utility ownership following the second world war [79], has seen a gradual and continued expansion of the local government roles in energy planning and low carbon experimentation [23], alongside a broad and longstanding programme of political, administrative and fiscal decentralisation [80], [81]. Sperling and Arler trace the dynamics of this process, and show that Danish local authorities are not exempt from a continuous struggle to balance short-term political agendas and resource constraints with long-term societal interests [23]. Setting out the challenges of local government action in a context of dynamic national politics, uncertain access to the resources, policy and regulatory instruments, they analyse how local leaders in two pioneering case studies successfully navigated those challenges to engage in new and voluntary areas of energy planning [23]. In Samsø, a locally owned nearshore wind farm proposal was met with scepticism on the project's cost and risk [23]. This was overcome by emphasizing attractive economic returns and linking the project to local green profile and identity (22. p.4). Both case studies show that trust and public-private networks and relationships can enable local politicians or actors with key skills, former experiences and long-time visions to mobilise each other and "explore all possible solutions, instead of focusing on obstacles" (22, p. 5). This study also shows clearly that windows of opportunity linked to external (national and European) finance or policy support mechanisms can tilt local narratives in favour of support of innovation projects [23].

Brinker and Satchwell show that municipal energy companies are less able to pursue decentralized energy activities in a competitive market environment, in absence of laws carving out a privileged position for municipal energy companies as monopolies or default providers [19]. This is because these laws afford them vertical integration, a captive customer base and regular predictable revenue streams that allows them - both from a financial and operational perspective - to pursue DE experiments, business models and marketing strategies that are not singularly focused on price competition (18, p.7). Compared to municipal energy companies in California and Germany, British and German retailers who "operate under competitive pressure and have neither a default customer base nor predictable revenues through network operation" find it more difficult to justify subsidizing DE (18, p.7). Their findings join a now wide range of studies observing that market mechanisms and policy instruments designed for the sole purpose of enhancing competition and cost-efficiency often overlook the risks unique to small scale or emerging energy actors and work to their disadvantage, essentially squeezing them out of the market [20], [23], [26], [39], [82]–[84]. Another example of this from this Special Issue is the case of South Africa's Renewable Energy Independent Power Procurement Policy Programme (REIPPP) [24]. The REIPPP is a centralised auction mechanism designed to cater to utility-scale projects that have to date largely been developed by multinationals [85]. Lawrence argues that these projects have proven to be difficult to tailor to local conditions, political cultures, social networks and needs, and are also less amenable to community oversight and control than smaller scale projects (23, p. 5). There may be a fundamental relationship between institutional design and competitive intensity in markets on the one hand, and the ability of market participants to consider indirect or non-monetary costs and benefits in their *modus operandi* on the other. Mediated through risk and financial viability, these factors influence who participates and why, and shape the extent of inclusivity and decentralised activity in the energy sector.

A common conclusion drawn from this Special Issue is that there is a need to acknowledge that regime actors have privileged positions that they use to actively and passively shape the form and extent of decentralisation takes place, who participates and who benefits [22], [24], [26]. For example, Art. 22 in the EU Renewable Energy Directive II stipulates that "unjustified regulatory and administrative barriers are removed"[6]. Acknowledging these dynamics is likely the first step to new forms of engagement, policy and legal entrepreneurship with an eye to ensuring balanced and fair participation by emerging actors on the periphery of the market. Inclusive institutional frameworks can entail hybrid regimes, comprising of both centralisation and decentralisation features depending on the field of activity (25, p.8) but might also involve the formal recognition and protection of rights of emergent civil society actors in law [7]. Set against the European Union proposal to support Renewable Energy Communities (REC) in the 2019 RED II Directive, Heldeweg and Saintier suggest the creation of a new legal category for REC entities, namely "civil engineering networks", distinguished by collaborative and sharing relationships and the pursuit of social or community interests (29, p. 4). Their analysis compares and contrasts institutionalised social patterns of behaviour and manifestations of energy justice across three different institutional contexts (public, private, and civil society) [7]. They argue that this proposed legal innovation will help to align REC legal entities to the legal demands in the space in which they operate, and acknowledge the changing relationship between the state, market and society [7].

The work in this special issue also sheds light on the factors that influence incumbent strategies towards DE, or that can tilt the balance of power and shape the outcomes of incumbent resistance [20]–[22], [24], [26], [36]. Resistance is exercised at the policymaking level through lobbying and regulatory capture or in practice by a lack of diligence in implementing rules enabling decentralisation. Hess and Lee show how differences in state-level institutional context and state-level policy and regulation can shape incumbent political strategies towards DE and ultimately shape geographically dominant models for decentralisation [20]. Comparing California and New York, they show that regulations limiting ownership of distributed generation assets by utilities in New York ultimately generated political opportunity for more favourable offtake prices for distributed generation there, resulting in wider uptake of community shares in local solar installations [20].

Several studies in this Special Issue show how market institutional arrangements can shape incumbent inertia in DE, which in turn influences the extent of momentum for grassroots collective action. For example, Hess and Lee show how in absence of deregulation of retail markets in California, California saw extensive social mobilization for 'community choice' models, where the local government is given the authority to negotiate purchase of electricity on behalf of its constituents [20]. This did not happen in New York where retail markets were deregulated, resulting in a broader diversity of actors in the retail market [20].

Lawrence analyses the “tardy” transition to DE in the context of a parastatal energy regime, setting out a decentralised and renewable energy future for South Africa that can simultaneously address a number of critical socio-economic and environmental issues facing the country [24]. Adopting a historical process-tracing approach, he pinpoints the legal foundations that influence leverage by ESKOM - the country’s electricity public utility and Africa’s largest electricity producer - over South Africa’s government [24]. Lawrence shows how this has resulted in the failure to set out an institutional framework that can generate investor confidence and attract private sector participation in renewable electricity generation (23, p. 4). In the South African context – as in Australian, UK, and French contexts set out in this Special Issue [22], [26] - policy support for renewable energy emerges in the form of incremental institutional layering, where new measures are added onto and conflict with the existing institutional framework (23, p. 6). Lawrence suggests that South Africa’s coal-centred lock-in and inertia is unlikely to be overcome until fiscal crisis concurs with an intra-regime schism [24].

4. Policy implications & avenues for further research

There are several key messages we can take away from the findings discussed above. We see that deregulation is necessary but not sufficient for inclusive participation in the energy transition. In several cases, such as in South Africa and the USA, we see the absence of deregulation as generating inertia on renewable energy deployment and resulting in social and political mobilization that can result in new forms of civic or local engagement. At the same time, we see that competitive intensity (often in combination with a variety of regulatory barriers) can drive out new and emerging actors and business models from the marketplace. As such, the wider institutional context and policy mix has a substantial impact on local capacities to innovate, influencing access to finance directly, but also influencing risk and financial viability in more subtle ways. Latent ideas and expertise can be invoked by political leadership introducing and legitimising an alternative narrative. Project success relies heavily on clear identification of local benefits and de-risking by (inter)national policy support mechanisms and funds, as well as dedicated spaces for experimentation, in which lighter regulatory frameworks enable demonstration. Wider diffusion is further enabled by propitious and coherent policy mixes that variably require policy entrepreneurship and legislative change.

The contributions to this special issue demonstrate that there is a gap between discourses and measures promoting energy decentralisation and reality on the ground. While a number of key pieces of legislation now officially recognise and promote decentralisation, on the ground we observe conflicting regulations and actor resistance that hampers its development. It is therefore important to systematically evaluate impacts and assess enabling institutional and policy contexts in order to identify barriers and diffuse best practices for the development of ED. This will be important in the European Union going forwards, where member states are in process of putting in place national legislation to implement the European Union’s cornerstone package for promoting citizen involvement in the energy transition. Examining the future implementation of the EU Clean Energy Package, and in particular how member states embed the concept of ‘Renewable Energy Communities’ in their domestic institutional contexts, and extent to which these entities will be afforded favourable conditions and incentives, will be of significant importance for European studies on ED. This is a formidable challenge as highlighted by Lowitzsch, Hoicka &

van Tulder [6] and Heldeweg and Saintier [7], the latter recommending a replicable legal environment model for RE communities. Systematic documentation of practices, impacts, barriers and policy gaps is even more important for other regions where high level policy strategies for ED are not in place, where ED activities and barriers are poorly documented, and where it has been suggested that, due to a variety of material-economic, actor-institutional and discursive factors, energy transitions may take on fundamentally different change dynamics [11], [22], [86]. While much of the energy justice literature has focussed on conceptualising energy justice, systematic empirical analyses of equity impacts are necessary to provide clarity on desirable pathways for inclusion. This might include empirical studies of the socio-economic characteristics of participants across different forms of ED, as well as economy-wide distribution analyses of direct and indirect costs and benefits. Finally, more systematic country comparative studies across European and non-European regions will also help to verify some of the structural institutional barriers that shape inclusive versus exclusive ED pathways.

Most of the contributions to this Special Issue focused on electricity, yet energy decentralisation covers a wider field of study and that leaves space for research in other fields, such as heat. Although electricity is promoted by IEA as 'the energy of the future' (2018) it represents a minor share of the total global energy consumption. As Judson, Fitch-Roy, Pownall et al. argue, heat represents more than half of global energy consumption [22], [87]. This will be important to be able to develop a cross-sectorial integration and take a holistic approach to ED. Another underexplored aspect of energy decentralisation is what forms of ED can promote energy conservation (*sobriété* in French, sometimes also called '*negawatt*') in a context of competing market trends around home convenience, comfort and time saving [88].

Local energy markets are still in formative phase and merit further study as they develop. As Brinker and Satchwell emphasise, while opening the market to local entrants with a traditional business model based on the volume of electricity sold will bring new actors into the market, potentially distributing social benefits more widely, it will not question our general energy model [19]. The latter will most likely require the use of digital tools in order to share information as well as physical and financial flows, especially in smart grids for peer-2-peer markets, virtual power plant creation or vehicle-to-grid technologies [19]. Ahl, Yarime, Goto et al. show that distributed ledger technology is a likely a key tool in these markets to ensure flexibility, security and building trust between participants, in particular prosumers [27]. More empirical studies around the globe are necessary to assess the real potential of digitalization.

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Decentralisation and inclusivity in the energy sector: preconditions, impacts and avenues for further research

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Abstract

This editorial for the Special Issue entitled 'Energy Decentralisation – Institutional Perspectives' in Renewable and Sustainable Energy Reviews contrasts and compares thirteen research and review articles submitted over the last year, each with a specific regional or thematic focus. The contributions examine decentralisation, its impacts and/or institutional preconditions in the United States, Sweden, UK, Denmark, South Africa, Germany, France, Japan, the Netherlands, Australia, and include three international thematic reviews. Embedding the findings from this work in the wider literature on decentralisation and inclusivity, we identify key findings and avenues for further research. Our review begins with an overview of how energy decentralisation is conceptualised in research and policy, identifying the logics used by proponents and opponents across the literature. We review the ways in which structural institutional settings have influenced the prevalence of narratives furthered by stakeholders with different interests and worldviews, resulting in radically different policy decisions, support frameworks and incentive structures at regional or national scales. Building on these findings, our concluding discussion reflects on the factors that influence social consensus on, and effective implementation of, ambitious and inclusive energy policy. The focus of this Special Issue has become yet more relevant as governments around the world are forced to marry multiple crises in fiscal spending decisions; where significant economic support packages need to buffer the socio-economic impacts of COVID19 in the short to medium term, and simultaneously facilitate investment in infrastructure, technology and competencies that will enable the decarbonisation of the economy.

Key words

Energy transition, decentralisation, inclusivity, institutional analysis, energy policy, energy democracy

Word count: 5119

1. Institutions, decentralisation and inclusivity in the energy transition: an introduction to this Special Issue

The unbundling and liberalisation of energy markets over the past thirty years has come hand in hand with the clean-technology transition and opened new opportunities for engagement of new actors in the energy sector. Much of the policy reform and engagement with renewable energy and energy efficiency across government and civil society is mobilised by a growing concern over climate change and its recognition as a policy priority in international and domestic agendas. Sensors, ICT, distributed storage, demand response and electric vehicles continue to open further opportunities for engagement of new actors, disrupting traditional business and organisational models for electricity generation, distribution, and trade. By illustration, the International Energy Agency predicts that more than 71% of new electricity connections will be via off-grid or mini-grid solutions by 2030 [1]. The UN General Assembly has established a Global Action Plan for Decentralised Renewable Energy, placing energy decentralisation central to the pursuit of SDG7, "energy access to all" [2]. In the European Union, the Internal Market and Renewables Directives under the Clean Energy Package that were adopted by the European Parliament and the Council in 2019 set out arguably the most explicit and far-reaching policy objectives on facilitating the engagement of individual and collective consumers in the transition to renewable energy. It assigns consumers equal rights to participation in energy markets as traditional market players and bans disproportionate technical, administrative requirements, procedures and charges, promoting residential storage, stipulating "enabling frameworks" for collective energy initiatives ("citizens energy communities" and "renewable energy communities") [3]–[7]. The underlying assumption across these international policy strategies is that third-party involvement by civic and local government actors enables both accelerated investment in clean technology and new forms of engagement by traditionally passive consumers, as well as the distribution of associated co-benefits in the form of energy security, job creation, local economic and social benefits.

By all indications then, energy sectors worldwide are undergoing technological, institutional and social transformation, that will see a decentralisation of governance and practices far beyond the contexts in which they have historically been observed – remote areas and islands [6]. However, empirical evidence suggests there is large variation in the degree to which nations and regions are embracing such narratives, how these narratives are negotiated vis-à-vis traditionally dominant public policy objectives around cost-efficiency, economies of scale, and universal access to energy, to shape distributed energy agenda's, associated regulatory, policy and institutional reforms, and the diversity of practices on the ground. This is especially true outside of Europe, where the respective roles of state, market, community and third sector in ongoing energy transitions is not well documented and understood (see for example 6–10). There is also a lack of evidence on whether and in what contexts decentralised models are delivering on proclaimed benefits.

This Special Issue focusses on energy decentralisation; how it is conceptualised, how it is taking shape across various regions in the world, and its impacts, with a special focus on the institutional and policy context constraining and enabling it. It joins a growing literature that is shedding light on how institutional arrangements, energy sector composition and policy processes that influence agency and 'institutional space' for new and incumbent actors,

shaping the dynamics of discourse, policy and regulation, and ultimately shaping the forms, extent and impacts of third-party uptake and engagement in the energy transition [13]–[18]. In this Special Issue, we draw on a remarkable range of articles examining decentralisation, its impacts and/or institutional preconditions from the United States [19]–[21], Sweden [21], UK [22], Denmark [23], South Africa [24], Germany [25], France [22], [26], Japan [21], [27], the Netherlands [21], Australia [21], as well as broader regional reviews [6], [7], [28]. We distil some key findings from these studies and set out promising avenues for further research, embedding findings in the wider literature. Building on these findings, our concluding discussion reflects on the factors that influence social consensus on, and effective implementation of, ambitious and inclusive energy policy.

2. Energy decentralisation: narratives, logics and underlying worldviews

The articles in this Special Issue demonstrate that the scope, agents and forms of decentralisation are country- and context-specific and that definitions are shaped by the empirical diversity on the ground. There is no one fixed definition of energy decentralisation (ED), and there is also ambiguity around associated terms ("citizen energy", "civic energy", "community energy", "energy communities", "prosumer", "prosumager") often seen as the embodiment of ED. Despite the widespread interest in the new roles of these civil society actors, private sector actors in Europe and North America dominate ownership of wind and solar PV assets [29], and incumbent actors can also dominate the energy decentralisation process and accelerate change through collaborative experimentation [22]. In this Special Issue, Judson et al. (21, p. 7) draw on Geel's et al. ideal type socio-technical transition pathways, each with a distinct role of incumbent and new entrants [30], to show that incumbents can introduce technical elements of decentralisation with limited community engagement or participation. In addition, other work has pointed out that private sector actors are often deeply entangled with initiatives led by civil society ("Third sector" actors) in the form of shared ownership, technology provision, as well as provision of a variety of legal, financial, energy exchange and aggregation services [31], [32]. Local governments sometimes assume prominent roles in ownership or development of ED [19], [33], sometimes facilitate ED led by civil society or "Third sector" actors [19], or in some contexts have very limited involvement [11], [24], [26].

Brinker and Satchwell [19] provide an overview of the variety of ways literature has characterised energy decentralisation, ranging from the physical deployment of modular technology viable at smaller scales, devolution of decision-making from centralized to local levels, to localised ownership, information and financial flows with correspondingly localised financial gains. Studies with a focus on emerging or developing country context similarly conceptualise energy decentralisation as a process of deployment of renewable technology at a variety of different scales in combination with mechanisms for participatory energy governance, but the emphasis on participation lies more on achieving energy access and poverty alleviation in parallel to decarbonization [24], [28]. Across the literature, energy decentralisation is understood as a socio-technical process, where a combination of institutional, socio-political, economical, and technical factors shapes the diversity and inclusivity of clean technology projects. Energy decentralisation is referred to in three dimensions: first, as a shift in technological infrastructure, second, as a process that creates opportunities for new stakeholders within the market context, and third, as a normative goal in itself, associated to values such as citizenship, justice and democracy.

Building on "renewable energy community" and "citizen energy community" concepts in the European Union Clean Energy Package, Lowitzsch, Hoicka and van Tulder set out a prototype governance model that can ensure that these concepts meet energy infrastructure needs (6, p.4). Underpinned by flexibility, interconnectivity, bi-directionality and complementarity, this governance model is based on collective control and administration of integrated renewable energy systems, demand flexibility and energy efficiency measures, storage and peer-to-peer trading (6, p.2). In a similar vein, Baucknecht, Funcke and Vogel [25] review the technological implications of decentralised energy infrastructure, distinguishing decentralised from centralised energy infrastructure in terms of four dimensions: connectivity to distribution versus transmission networks, proximity to demand, and location of actors engaged in flexibility and balancing of generation and demand. Following observations by other authors [18], [34], [35] they show that the degree of participation, a socio-political feature associated and expected from ED, depends on decentralisation of infrastructure. Ahl et al. [27] take this further, honing in on distributed ledger technology in terms of its potential to enable widespread distributed transactions and engagement by prosumers – but identify a variety of technological, economic, social, environmental and institutional barriers that would need to be overcome. Taken together, a high-level definition for energy decentralisation concurrent with all the contributions to this Special Issue reads: *a process by which decision-making and participation in the production, consumption, trade, planning and regulation of energy is to some extent distributed away from a central authority towards the final consumer*.

Several papers touch on value orientations, beliefs and alternative narratives of new energy actors as driving decentralised energy experiments and associated regulatory and policy conflicts on the periphery of energy markets [20], [26], [36]. Funcke & Ruppert-Winkel show that conceptualisations of ED differ across different stakeholder coalitions in Germany, and that conceptualisations of ED advocated by citizen energy coalitions centred on proximity to demand and decentralised flexibility are poorly represented at the federal level [36]. Actors advocating accelerated deployment of renewable energy do not necessarily support decentralisation if decarbonisation can be more rapidly achieved with centralized infrastructure [36]. Hess and Lee show how stakeholder conflicts over regulation that influences the risk and financial viability of community-based solar initiatives are fundamentally underpinned by an appeal on different values. Mirroring observations internationally [11], [37]–[39], cost-efficiency comes head to head with equal access to solar and resulting benefits in California (19 p. 5). In addition, equity is framed in different ways to serve incumbent and community interest groups (19 p. 4). This creates situations where associations of consumers might support central utilities over new community initiatives in order to avoid cost burdens to non-participants of community solar initiatives, rather than support equity in terms of equal access to such projects [20]. Similarly, Poupeau shows that although political actors within the French government promote ED through legislation, resistance persists, including among local actors and local authorities themselves [26]. Local authorities in France, especially in rural areas, appeal to principles of equality to justify the need for centralised management and a strong national regulatory framework, opposing decentralisation proposals that would place the burden of responsibility and resourcing on rural territories [26]. As such, there is a large gap between localist rhetoric and institutional reality [26]. Drawing on submissions to this Special Issue and the wider literature,**Table 1** recapitulates the logics used by proponents and opponents of decentralised energy across the literature, summarising separate but interrelated debates on ownership, co-benefits, scale and intermittency. This illustrates how the prominence of different narratives furthered by stakeholders with different interests and worldviews can translate into radically different policy decisions, support frameworks and incentive structures at regional or national scales.

Table 1 Logics used by proponent and opponents of inclusive decentralisation in the energy sector

	'Small is beautiful'	**'Small is irrelevant'**
Political	• Facilitates conducive legislative reforms and more rapid energy transitions [16], [40]–[43] • Creates inroads for "rights to energy" campaigns [44] • Reduced dependence on oil and uranium [26] • Increased transparency [19]	• Concern that the public might subsidise cost-inefficient development of assets [11]
Social	• Local energy users are more likely to be engaged in projects than in commercial or public projects [45], [46] • Contributes to social cohesion and community empowerment [47]. • Utilises local knowledge and enables control over aspects including technology scale, siting and orientation [45], [48]. • Contributes to a positive public perception and buy-in for renewable energy [49]. • Foregoes public risks of nuclear power [26] • Can facilitate access to energy and alleviate energy poverty [24], [26] • Distributed ledgers can enable values-embedded peer-to-peer trading and distributed benefits [50].	• Exacerbates socio-economic inequality where there is unequal access to finance, support and/or technology [51], [52]. • Requires high degree of prosumer outreach, engagement and training around the management of new niche technologies [51].
Economic	• ED contributes to rural development, local employment [24], [26], [53], [54] • Can reduce cost of energy for citizens [47], [55]. • Defers expensive upgrades and extensions of the transmission network [56]. • Can produce low cost heat [57]. • Advanced connectivity, big data and cloud computing could enable integrated co-ordination across distributed energy systems, reduce transaction costs and generate cost-efficiencies [27], [58]–[60]	• Requires higher transmission capacity and cost for a given power output as well as higher costs of reinforcement of the distribution network [61]. • Additional cost of system balancing and ancillary infrastructure [61]. • Higher subsidies required to finance remaining transmission infrastructure [62]. • Higher generation cost because DE projects do not achieve economies of scale in construction and operation [26], [63] • Higher administrative cost [64]. • Support incentives increase cost of electricity for consumers, decreasing purchasing power and indirectly generating job loss [63]. • Centralised nuclear sector as a strong job creator and/or export industry [26]

Environmental	• Engaging end-users results in energy awareness, absolute reductions in energy demand and demand GHG emissions [64]. • Ability to use waste heat raises system and GHG-efficiency [57]. • Energy-efficiencies could arise from integrated coordination and flexibility of energy systems enabled by distributed ledgers, connectivity, big data and cloud computing [27], [59]	• Larger-scale centralised nuclear/renewable energy deployment can be implemented more rapidly and more cost-effectively at greater scale to achieve higher GHG savings [26], [65].
Technical	• Scale and quality of energy generation is matched to load, preventing transmission losses [66]–[68]. • Creates 'islands of stability' and voltage stability [69]. • Increased reliability of electricity for community buildings in rural areas [70]. • Improved system efficiency if able to use waste heat locally [71].	• Distributed generation increases the per unit cost of transmission infrastructure [51]. • Installing must-take generators requires additional system balancing and ancillary technology, such as transmission and storage infrastructure, active network management, as well as additional centralised base-load and dispatchable peak load generators [26], [61].

To begin to understand and broker across these distinct points of view, it is useful to reflect inductively on how they are shaped by different assumptions, knowledge, attitudes, and worldviews. On the one hand, this is a technical debate over what level of decentralisation incurs lowest economic cost to society – factoring in foregone costs in transmission expansion, investment in power management control, and economies of scale derived from large- scale storage, generation and demand side management consumers. In addition, these views are clearly shaped by different assumptions on what drives the energy transition, and the scope of factors one might include when assessing technology choices (**Table 2**). More fundamentally perhaps, these worldviews are characterised by a distinct risk appetite, trust in institutions and incumbents to deliver the energy transition, and the need for additional and accelerated investment in emissions abatement, stemming from higher prioritisation of action on climate change among proponents (**Table 2**). Table 2 summarises these points of view.

Table 2 Understanding how different assumptions, knowledge, attitudes, and worldviews shape distinct views on inclusive decentralised energy

	Proponents	**Opponents**
Theory of change	Emphasis on social, cultural-behavioural change and public buy-in	Emphasis on supply side technological change
Scope of analysis	Emphasis on potential advantages of functional integration heat/power generation, DSM, appliances, EV's at consumer level	Emphasis on costs of single technologies at consumer level
Criteria used to justify projects	Financial viability, social, local economic impacts / co-benefits, equal access, social justice	Least cost to overall economy (opportunity cost)
Trust in institutions and incumbents to deliver the energy transition	Low	High
Risk appetite	High	Low

3. How has institutional context influenced decentralisation?

Despite country and regional differences in market and regulatory landscape, scope, agents and forms of decentralisation, we see similar policy barriers, and fundamentally identical conflicts and underlying value orientations occurring across different localities. Key terrains for policy barriers and regulatory conflicts are distribution network charges [20], [27], [72], access to supply licenses (including legal responsibilities of suppliers) and wholesale markets [27], [32], [58], regulated power purchase prices or net metering [19]–[21], grid connection and balancing requirements [27], as well as standards and regulation for smart meter infrastructure that influence compatibility with distributed ledgers, access to smart meter data and privacy protection [27], [32]. However, conflicts also extend to procedural practices that influence transparency, access and ease of use, such as the complexity of credits from solar on prosumer bills, or the burden of regulatory requirements [20].

The contributions to this Special Issue shed light on the different ways by which the wider institutional context, and in particular the " rules of the game" and historical ownership patterns and market composition, have influenced agency, political opportunity and openings for alternative narratives, experimentation, and associated policy and regulatory change. At the level of enabling policy and regulation, Warneryd et al.[21], Ahl et al.[27] and Judson et al.[22] all show that institutional change tends to catch-up with and acknowledge technological change and market trends, rather than initiate it. Warneryd, Håkansson and Karltorp review actors and networks, policy developments and associated narratives enabling microgrid projects in four regions where they identify a concentration of microgrid activity - USA, EU, Asia and Australia [21]. Key policy developments range from changes in utility revenue models, to ancillary service markets, seed-funding and market-based incentives, as well as comprehensive roadmaps for microgrid commercialisation, with a wide variety of county-level policy contexts and barriers observed [21]. A number of contributions to this Special Issue point to the need for flexible policies and regulations such as regulatory sandboxes to accommodate the wide variety of emerging actors and experiments [6], [7], [23], [26], [27]. Regulatory flexibility seems particularly relevant for microgrids, distributed ledger technologies, and associated peer to peer markets, with potentially far-reaching implications for consumers, end-user technology, network operators, and market regulation [6], [27]. Barriers across multiple dimensions are co-evolutionary [21], [27] so that overcoming them will require coherent policy strategies and mixes.

At a more fundamental level, structural institutional arrangements and policy processes are key to how much and what kind of energy decentralisation can be achieved. This includes the power sharing arrangements between national and subnational levels of government, and between state, private sector and civil society actors [19], but also the ways in which we organize stakeholder participation and create opportunity for engagement in collaborative innovation ecosystems [27], [73]. For example, in reviewing the positive impacts of solar home systems, Khan [28] shows that these impacts are conditioned by the lack of financing mechanisms and technical support that characterize the wider institutional context for many remote energy access projects in developing countries.

Brinker and Satchwell [19], Poupeau [26], and Sperling and Arler [23] build on previous work showing the variety of ways local government is engaging in the energy transition - ranging from their involvement in horizontal and vertical multi-level policy design and implementation, to opportunity scouts and matchmaking, to investors, owners and operators [55], [64], [74]–[78]. Poupeau shows that a historically limited role of French local authorities in generation, transmission and supply limits their ability to engage proactively in narratives and regulatory change in support of decentralisation – instead they are selectively integrated as extensions of more powerful actor complexes [26]. In contrast, Denmark - which has retained pockets of local government utility ownership following the second world war [79], has seen a gradual and continued expansion of the local government roles in energy planning and low carbon experimentation [23], alongside a broad and longstanding programme of political, administrative and fiscal decentralisation [80], [81]. Sperling and Arler trace the dynamics of this process, and show that Danish local authorities are not exempt from a continuous struggle to balance short-term political agendas and resource constraints with long-term societal interests [23]. Setting out the challenges of local government action in a context of dynamic national politics, uncertain access to the resources, policy and regulatory instruments, they analyse how local leaders in two pioneering case studies successfully navigated those challenges to engage in new and voluntary areas of energy planning [23]. In Samsø, a locally owned nearshore wind farm proposal was met with scepticism on the project's cost and risk [23]. This was overcome by emphasizing attractive economic returns and linking the project to local green profile and identity (22. p.4). Both case studies show that trust and public-private networks and relationships can enable local politicians or actors with key skills, former experiences and long-time visions to mobilise each other and "explore all possible solutions, instead of focusing on obstacles" (22, p. 5). This study also shows clearly that windows of opportunity linked to external (national and European) finance or policy support mechanisms can tilt local narratives in favour of support of innovation projects [23].

Brinker and Satchwell show that municipal energy companies are less able to pursue decentralised energy activities in a competitive market environment, in absence of laws carving out a privileged position for municipal energy companies as monopolies or default providers [19]. This is because these laws afford them vertical integration, a captive customer base and regular predictable revenue streams that allows them - both from a financial and operational perspective - to pursue ED experiments, business models and marketing strategies that are not singularly focused on price competition (18, p.7). Compared to municipal energy companies in California and Germany, British and German retailers who "operate under competitive pressure and have neither a default customer base nor predictable revenues through network operation" find it more difficult to justify subsidizing ED (18, p.7). Their findings join a now wide range of studies observing that market mechanisms and policy instruments designed for the sole purpose of enhancing competition and cost-efficiency often overlook the risks unique to small scale or emerging energy actors and work to their disadvantage, essentially squeezing them out of the market [20], [23], [26], [39], [82]–[85]. Another example of this from this Special Issue is the case of South Africa's Renewable Energy Independent Power Procurement Policy Programme (REIPPP) [24]. The REIPPP is a centralised auction mechanism designed to cater to utility-scale projects that have to date largely been developed by multinationals [86]. Lawrence argues that these projects have proven to be difficult to tailor to local conditions, political cultures, social networks and needs, and are also less amenable to community oversight and control than smaller scale projects (23, p. 5). There may be a fundamental relationship between institutional design and competitive intensity in markets on the one hand, and the ability of market participants to consider indirect or non-monetary costs and benefits in their *modus operandi* on the other.

Mediated through risk and financial viability, these factors influence who participates and why, and shape the extent of inclusivity and decentralised activity in the energy sector.

A common conclusion drawn from this Special Issue is that there is a need to acknowledge that regime actors have privileged positions that they use to actively and passively shape the form and extent of decentralisation takes place, who participates and who benefits [22], [24], [26]. For example, Art. 22 in the EU Renewable Energy Directive II stipulates that "unjustified regulatory and administrative barriers are removed"[6]. Acknowledging these dynamics is likely the first step to new forms of engagement, policy and legal entrepreneurship with an eye to ensuring balanced and fair participation by emerging actors on the periphery of the market. Inclusive institutional frameworks can entail hybrid regimes, comprising of both centralisation and decentralisation features depending on the field of activity (25, p.8) but might also involve the formal recognition and protection of rights of emergent civil society actors in law [7]. Set against the European Union proposal to support Renewable Energy Communities (REC) in the 2019 RED II Directive, Heldeweg and Saintier suggest the creation of a new legal category for REC entities, namely "civil engineering networks", distinguished by collaborative and sharing relationships and the pursuit of social or community interests (29, p. 4). Their analysis compares and contrasts institutionalised social patterns of behaviour and manifestations of energy justice across three different institutional contexts (public, private, and civil society) [7]. They argue that this proposed legal innovation will help to align REC legal entities to the legal demands in the space in which they operate, and acknowledge the changing relationship between the state, market and society [7].

The work in this Special Issue also sheds light on the factors that influence incumbent strategies towards ED, or that can tilt the balance of power and shape the outcomes of incumbent resistance [20]–[22], [24], [26], [36]. Resistance is exercised at the policymaking level through lobbying and regulatory capture or in practice by a lack of diligence in implementing rules enabling decentralisation. Hess and Lee show how differences in state-level institutional context and state-level policy and regulation can shape incumbent political strategies towards ED and ultimately shape geographically dominant models for decentralisation [20]. Comparing California and New York, they show that regulations limiting ownership of distributed generation assets by utilities in New York ultimately generated political opportunity for more favourable offtake prices for distributed generation there, resulting in wider uptake of community shares in local solar installations [20].

Several studies in this Special Issue show how market institutional arrangements can shape incumbent inertia in ED, which in turn influences the extent of momentum for grassroots collective action. For example, Hess and Lee show how in absence of deregulation of retail markets in California, it saw extensive social mobilization for 'community choice' models, where the local government is given the authority to negotiate purchase of electricity on behalf of its constituents [20]. This did not happen in New York where retail markets were deregulated, resulting in a broader diversity of actors in the retail market [20]. Lawrence analyses the "tardy" transition to ED in the context of a parastatal energy regime, setting out a decentralised and renewable energy future for South Africa that can simultaneously address a number of critical socio-economic and environmental issues facing the country [24]. Adopting a historical process-tracing approach, he pinpoints the legal foundations that influence leverage by ESKOM - the country's electricity public utility and Africa's largest electricity producer - over South Africa's government [24]. Lawrence shows how this has resulted in the failure to set out an institutional framework that can generate investor confidence and attract private sector participation in renewable electricity generation (23, p. 4). In the South African context – as in Australian, UK, and French contexts set out in this Special Issue [22], [26] - policy support for renewable energy emerges in the form of incremental institutional layering, where new measures are added onto and conflict with the existing institutional framework (23, p. 6). Lawrence suggests that South Africa's coal-centred lock-in and inertia is unlikely to be overcome until fiscal crisis concurs with an intra-regime schism [24].

4. Policy implications & avenues for further research

There are several key messages we can take away from the findings discussed above. We see that deregulation is necessary but not sufficient for inclusive participation in the energy transition. In several cases, such as in South Africa and the USA, we see the absence of deregulation as generating inertia on renewable energy deployment and resulting in social and political mobilization that can result in new forms of civic or local engagement. At the same time, we see that competitive intensity (often in combination with a variety of regulatory barriers) can drive out new and emerging actors and business models from the marketplace. As such, the wider institutional context and policy mix has a substantial impact on local capacities to innovate, influencing access to finance directly, but also influence risk and financial viability in more subtle ways. Latent ideas and expertise can be invoked by political leadership introducing and legitimising an alternative narrative. Project success relies heavily on clear identification of local benefits and de-risking by (inter)national policy support mechanisms and funds, as well as dedicated spaces for experimentation, in which lighter regulatory frameworks enable demonstration. Wider diffusion is further enabled by propitious and coherent policy mixes that variably require policy entrepreneurship and legislative change.

The contributions to this Special Issue demonstrate that there is a gap between discourses and measures promoting energy decentralisation and the reality on the ground. While a number of key pieces of legislation now officially recognise and promote decentralisation, on the ground we observe conflicting regulations and actor resistance that hampers its development. It is therefore important to systematically evaluate impacts and assess enabling institutional and policy contexts in order to identify barriers and diffuse best practices for the development of ED. This will be important in the European Union going forwards, where member states are in process of putting in place national legislation to implement the European Union's cornerstone package for promoting citizen involvement in the energy transition. Examining the future implementation of the EU Clean Energy Package, and in particular how member states embed the concept of 'Renewable Energy Communities' in their domestic institutional contexts, and extent to which these entities will be afforded favourable conditions and incentives, will be of significant importance for European studies on ED. This is a formidable challenge as highlighted by Lowitzsch, Hoicka & van Tulder [6] and Heldeweg and Saintier [7], the latter recommending a replicable legal environment model for RE communities. Systematic documentation of practices, impacts, barriers and policy gaps is even more important for other regions where high level policy strategies for ED are not in place, where ED activities and barriers are poorly documented, and where it has been suggested that, due to a variety of material-economic, actor-institutional and discursive factors, energy transitions may take on fundamentally different change dynamics [11], [22], [87]. While much of the energy justice literature has focussed on conceptualising energy justice, systematic empirical analyses of equity impacts are necessary to provide clarity on desirable pathways for inclusion. This might include empirical studies of the socio-economic characteristics of participants across different forms of ED, as well as economy-wide distribution analyses of direct and indirect costs and benefits. Finally, more systematic country comparative studies across European and non-European regions will also help to verify some of the structural institutional barriers that shape inclusive versus exclusive ED pathways.

Most of the contributions to this Special Issue focused on electricity, yet energy decentralisation covers a wider field of study and that leaves space for research in other fields, such as heat. Although electricity is promoted by IEA as 'the energy of the future' (2018) it represents a minor share of the total global energy consumption. As Judson, Fitch-Roy, Pownall et al. argue, heat represents more than half of global energy consumption [22], [88]. This will be important to be able to develop a cross-sectorial integration and take a holistic approach to ED. Another underexplored aspect of energy decentralisation is what forms of ED can promote energy conservation (*sobriété* in French, sometimes also called '*negawatt*') in a context of competing market trends around home convenience, comfort and time saving [89].

Local energy markets are still in formative phase and merit further study as they develop. As Brinker and Satchwell emphasise, while opening the market to local entrants with a traditional business model based on the volume of electricity sold will bring new actors into the market, potentially distributing social benefits more widely, it will not question our general energy model [19]. The latter will most likely require the use of digital tools in order to share information as well as physical and financial flows, especially in smart grids for peer-2-peer markets, virtual power plant creation or vehicle-to-grid technologies [19]. Ahl, Yarime, Goto et al. show that distributed ledger technology is a likely a key tool in these markets to ensure flexibility, security and building trust between participants, in particular prosumers [27]. More empirical studies around the globe are necessary to assess the real potential of digitalisation.

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Decentralisation and inclusivity in the energy sector: preconditions, impacts and avenues for further research

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Abstract

This editorial for the Special Issue entitled 'Energy Decentralisation – Institutional Perspectives' in Renewable and Sustainable Energy Reviews contrasts and compares thirteen research and review articles submitted over the last year, each with a specific regional or thematic focus. The contributions examine decentralisation, its impacts and/or institutional preconditions in the United States, Sweden, UK, Denmark, South Africa, Germany, France, Japan, the Netherlands, Australia, and include three international thematic reviews. Embedding the findings from this work in the wider literature on decentralisation and inclusivity, we identify key findings and avenues for further research. Our review begins with an overview of how energy decentralisation is conceptualised in research and policy, identifying the logics used by proponents and opponents across the literature. We review the ways in which structural institutional settings have influenced the prevalence of narratives furthered by stakeholders with different interests and worldviews, resulting in radically different policy decisions, support frameworks and incentive structures at regional or national scales. Building on these findings, our concluding discussion reflects on the factors that influence social consensus on, and effective implementation of, ambitious and inclusive energy policy. The focus of this Special Issue has become yet more relevant as governments around the world are forced to marry multiple crises in fiscal spending decisions; where significant economic support packages need to buffer the socio-economic impacts of COVID19 in the short to medium term, and simultaneously facilitate investment in infrastructure, technology and competencies that will enable the decarbonisation of the economy.

Key words

Energy transition, decentralisation, inclusivity, institutional analysis, energy policy, energy democracy

Word count: 5119

1. Institutions, decentralisation and inclusivity in the energy transition: an introduction to this Special Issue

The unbundling and liberalisation of energy markets over the past thirty years has come hand in hand with the clean-technology transition and opened new opportunities for engagement of new actors in the energy sector. Much of the policy reform and engagement with renewable energy and energy efficiency across government and civil society is mobilised by a growing concern over climate change and its recognition as a policy priority in international and domestic agendas. Sensors, ICT, distributed storage, demand response and electric vehicles continue to open further opportunities for engagement of new actors, disrupting traditional business and organisational models for electricity generation, distribution, and trade. By illustration, the International Energy Agency predicts that more than 71% of new electricity connections will be via off-grid or mini-grid solutions by 2030 [1]. The UN General Assembly has established a Global Action Plan for Decentralised Renewable Energy, placing energy decentralisation central to the pursuit of SDG7, "energy access to all" [2]. In the European Union, the Internal Market and Renewables Directives under the Clean Energy Package that were adopted by the European Parliament and the Council in 2019 set out arguably the most explicit and far-reaching policy objectives on facilitating the engagement of individual and collective consumers in the transition to renewable energy. It assigns consumers equal rights to participation in energy markets as traditional market players and bans disproportionate technical, administrative requirements, procedures and charges, promoting residential storage, stipulating "enabling frameworks" for collective energy initiatives ("citizens energy communities" and "renewable energy communities") [3]–[7]. The underlying assumption across these international policy strategies is that third-party involvement by civic and local government actors enables both accelerated investment in clean technology and new forms of engagement by traditionally passive consumers, as well as the distribution of associated co-benefits in the form of energy security, job creation, local economic and social benefits.

By all indications then, energy sectors worldwide are undergoing technological, institutional and social transformation, that will see a decentralisation of governance and practices far beyond the contexts in which they have historically been observed – remote areas and islands [6]. However, empirical evidence suggests there is large variation in the degree to which nations and regions are embracing such narratives, how these narratives are negotiated vis-à-vis traditionally dominant public policy objectives around cost-efficiency, economies of scale, and universal access to energy, to shape distributed energy agenda's, associated regulatory, policy and institutional reforms, and the diversity of practices on the ground. This is especially true outside of Europe, where the respective roles of state, market, community and third sector in ongoing energy transitions is not well documented and understood (see for example 6–10). There is also a lack of evidence on whether and in what contexts decentralised models are delivering on proclaimed benefits.

This Special Issue focusses on energy decentralisation; how it is conceptualised, how it is taking shape across various regions in the world, and its impacts, with a special focus on the institutional and policy context constraining and enabling it. It joins a growing literature that is shedding light on how institutional arrangements, energy sector composition and policy processes that influence agency and 'institutional space' for new and incumbent actors,

shaping the dynamics of discourse, policy and regulation, and ultimately shaping the forms, extent and impacts of third-party uptake and engagement in the energy transition [13]–[18]. In this Special Issue, we draw on a remarkable range of articles examining decentralisation, its impacts and/or institutional preconditions from the United States [19]–[21], Sweden [21], UK [22], Denmark [23], South Africa [24], Germany [25], France [22], [26], Japan [21], [27], the Netherlands [21], Australia [21], as well as broader regional reviews [6], [7], [28]. We distil some key findings from these studies and set out promising avenues for further research, embedding findings in the wider literature. Building on these findings, our concluding discussion reflects on the factors that influence social consensus on, and effective implementation of, ambitious and inclusive energy policy.

2. Energy decentralisation: narratives, logics and underlying worldviews

The articles in this Special Issue demonstrate that the scope, agents and forms of decentralisation are country- and context-specific and that definitions are shaped by the empirical diversity on the ground. There is no one fixed definition of energy decentralisation (ED), and there is also ambiguity around associated terms ("citizen energy", "civic energy", "community energy", "energy communities", "prosumer", "prosumager") often seen as the embodiment of ED. Despite the widespread interest in the new roles of these civil society actors, private sector actors in Europe and North America dominate ownership of wind and solar PV assets [29], and incumbent actors can also dominate the energy decentralisation process and accelerate change through collaborative experimentation [22]. In this Special Issue, Judson et al. (21, p. 7) draw on Geel's et al. ideal type socio-technical transition pathways, each with a distinct role of incumbent and new entrants [30], to show that incumbents can introduce technical elements of decentralisation with limited community engagement or participation. In addition, other work has pointed out that private sector actors are often deeply entangled with initiatives led by civil society ("Third sector" actors) in the form of shared ownership, technology provision, as well as provision of a variety of legal, financial, energy exchange and aggregation services [31], [32]. Local governments sometimes assume prominent roles in ownership or development of ED [19], [33], sometimes facilitate ED led by civil society or "Third sector" actors [19], or in some contexts have very limited involvement [11], [24], [26].

Brinker and Satchwell [19] provide an overview of the variety of ways literature has characterised energy decentralisation, ranging from the physical deployment of modular technology viable at smaller scales, devolution of decision-making from centralized to local levels, to localised ownership, information and financial flows with correspondingly localised financial gains. Studies with a focus on emerging or developing country context similarly conceptualise energy decentralisation as a process of deployment of renewable technology at a variety of different scales in combination with mechanisms for participatory energy governance, but the emphasis on participation lies more on achieving energy access and poverty alleviation in parallel to decarbonization [24], [28]. Across the literature, energy decentralisation is understood as a socio-technical process, where a combination of institutional, socio-political, economical, and technical factors shapes the diversity and inclusivity of clean technology projects. Energy decentralisation is referred to in three dimensions: first, as a shift in technological infrastructure, second, as a process that creates opportunities for new stakeholders within the market context, and third, as a normative goal in itself, associated to values such as citizenship, justice and democracy.

Building on "renewable energy community" and "citizen energy community" concepts in the European Union Clean Energy Package, Lowitzsch, Hoicka and van Tulder set out a prototype governance model that can ensure that these concepts meet energy infrastructure needs (6, p.4). Underpinned by flexibility, interconnectivity, bi-directionality and complementarity, this governance model is based on collective control and administration of integrated renewable energy systems, demand flexibility and energy efficiency measures, storage and peer-to-peer trading (6, p.2). In a similar vein, Bauknecht, Funcke and Vogel [25] review the technological implications of decentralised energy infrastructure, distinguishing decentralised from centralised energy infrastructure in terms of four dimensions: connectivity to distribution versus transmission networks, proximity to demand, and location of actors engaged in flexibility and balancing of generation and demand. Following observations by other authors [18], [34], [35] they show that the degree of participation, a socio-political feature associated and expected from ED, depends on decentralisation of infrastructure. Ahl et al. [27] take this further, honing in on distributed ledger technology in terms of its potential to enable widespread distributed transactions and engagement by prosumers – but identify a variety of technological, economic, social, environmental and institutional barriers that would need to be overcome. Taken together, a high-level definition for energy decentralisation concurrent with all the contributions to this Special Issue reads: *a process by which decision-making and participation in the production, consumption, trade, planning and regulation of energy is to some extent distributed away from a central authority towards the final consumer*.

Several papers touch on value orientations, beliefs and alternative narratives of new energy actors as driving decentralised energy experiments and associated regulatory and policy conflicts on the periphery of energy markets [20], [26], [36]. Funcke & Ruppert-Winkel show that conceptualisations of ED differ across different stakeholder coalitions in Germany, and that conceptualisations of ED advocated by citizen energy coalitions centred on proximity to demand and decentralised flexibility are poorly represented at the federal level [36]. Actors advocating accelerated deployment of renewable energy do not necessarily support decentralisation if decarbonisation can be more rapidly achieved with centralized infrastructure [36]. Hess and Lee show how stakeholder conflicts over regulation that influences the risk and financial viability of community-based solar initiatives are fundamentally underpinned by an appeal on different values. Mirroring observations internationally [11], [37]–[39], cost-efficiency comes head to head with equal access to solar and resulting benefits in California (19 p. 5). In addition, equity is framed in different ways to serve incumbent and community interest groups (19 p. 4). This creates situations where associations of consumers might support central utilities over new community initiatives in order to avoid cost burdens to non-participants of community solar initiatives, rather than support equity in terms of equal access to such projects [20]. Similarly, Poupeau shows that although political actors within the French government promote ED through legislation, resistance persists, including among local actors and local authorities themselves [26]. Local authorities in France, especially in rural areas, appeal to principles of equality to justify the need for centralised management and a strong national regulatory framework, opposing decentralisation proposals that would place the burden of responsibility and resourcing on rural territories [26]. As such, there is a large gap between localist rhetoric and institutional reality [26]. Drawing on submissions to this Special Issue and the wider literature,**Table 1** recapitulates the logics used by proponents and opponents of decentralised energy across the literature, summarising separate but interrelated debates on ownership, co-benefits, scale and intermittency. This illustrates how the prominence of different narratives furthered by stakeholders with different interests and worldviews can translate into radically different policy decisions, support frameworks and incentive structures at regional or national scales.

Table 1 Logics used by proponent and opponents of inclusive decentralisation in the energy sector

	'Small is beautiful'	'Small is irrelevant'
Political	• Facilitates conducive legislative reforms and more rapid energy transitions [16], [40]–[43] • Creates inroads for "rights to energy" campaigns [44] • Reduced dependence on oil and uranium [26] • Increased transparency [19]	• Concern that the public might subsidise cost-inefficient development of assets [11]
Social	• Local energy users are more likely to be engaged in projects than in commercial or public projects [45], [46] • Contributes to social cohesion and community empowerment [47]. • Utilises local knowledge and enables control over aspects including technology scale, siting and orientation [45], [48]. • Contributes to a positive public perception and buy-in for renewable energy [49]. • Foregoes public risks of nuclear power [26] • Can facilitate access to energy and alleviate energy poverty [24], [26] • Distributed ledgers can enable values-embedded peer-to-peer trading and distributed benefits [50].	• Exacerbates socio-economic inequality where there is unequal access to finance, support and/or technology [51], [52]. • Requires high degree of prosumer outreach, engagement and training around the management of new niche technologies [51].
Economic	• ED contributes to rural development, local employment [24], [26], [53], [54] • Can reduce cost of energy for citizens [47], [55]. • Defers expensive upgrades and extensions of the transmission network [56]. • Can produce low cost heat [57]. • Advanced connectivity, big data and cloud computing could enable integrated co-ordination across distributed energy systems, reduce transaction costs and generate cost-efficiencies [27], [58]–[60]	• Requires higher transmission capacity and cost for a given power output as well as higher costs of reinforcement of the distribution network [61]. • Additional cost of system balancing and ancillary infrastructure [61]. • Higher subsidies required to finance remaining transmission infrastructure [62]. • Higher generation cost because DE projects do not achieve economies of scale in construction and operation [26], [63] • Higher administrative cost [64]. • Support incentives increase cost of electricity for consumers, decreasing purchasing power and indirectly generating job loss [63]. • Centralised nuclear sector as a strong job creator and/or export industry [26]

Environmental	• Engaging end-users results in energy awareness, absolute reductions in energy demand and demand GHG emissions [64]. • Ability to use waste heat raises system and GHG-efficiency [57]. • Energy-efficiencies could arise from integrated coordination and flexibility of energy systems enabled by distributed ledgers, connectivity, big data and cloud computing [27], [59]	• Larger-scale centralised nuclear/renewable energy deployment can be implemented more rapidly and more cost-effectively at greater scale to achieve higher GHG savings [26], [65].
Technical	• Scale and quality of energy generation is matched to load, preventing transmission losses [66]–[68]. • Creates 'islands of stability' and voltage stability [69]. • Increased reliability of electricity for community buildings in rural areas [70]. • Improved system efficiency if able to use waste heat locally [71].	• Distributed generation increases the per unit cost of transmission infrastructure [51]. • Installing must-take generators requires additional system balancing and ancillary technology, such as transmission and storage infrastructure, active network management, as well as additional centralised base-load and dispatchable peak load generators [26], [61].

To begin to understand and broker across these distinct points of view, it is useful to reflect inductively on how they are shaped by different assumptions, knowledge, attitudes, and worldviews. On the one hand, this is a technical debate over what level of decentralisation incurs lowest economic cost to society – factoring in foregone costs in transmission expansion, investment in power management control, and economies of scale derived from large- scale storage, generation and demand side management consumers. In addition, these views are clearly shaped by different assumptions on what drives the energy transition, and the scope of factors one might include when assessing technology choices (**Table 2**). More fundamentally perhaps, these worldviews are characterised by a distinct risk appetite, trust in institutions and incumbents to deliver the energy transition, and the need for additional and accelerated investment in emissions abatement, stemming from higher prioritisation of action on climate change among proponents (**Table 2**). Table 2 summarises these points of view.

Table 2 Understanding how different assumptions, knowledge, attitudes, and worldviews shape distinct views on inclusive decentralised energy

	Proponents	**Opponents**
Theory of change	Emphasis on social, cultural-behavioural change and public buy-in	Emphasis on supply side technological change
Scope of analysis	Emphasis on potential advantages of functional integration heat/power generation, DSM, appliances, EV's at consumer level	Emphasis on costs of single technologies at consumer level
Criteria used to justify projects	Financial viability, social, local economic impacts / co-benefits, equal access, social justice	Least cost to overall economy (opportunity cost)
Trust in institutions and incumbents to deliver the energy transition	Low	High
Risk appetite	High	Low

3. How has institutional context influenced decentralisation?

Despite country and regional differences in market and regulatory landscape, scope, agents and forms of decentralisation, we see similar policy barriers, and fundamentally identical conflicts and underlying value orientations occurring across different localities. Key terrains for policy barriers and regulatory conflicts are distribution network charges [20], [27], [72], access to supply licenses (including legal responsibilities of suppliers) and wholesale markets [27], [32], [58], regulated power purchase prices or net metering [19]–[21], grid connection and balancing requirements [27], as well as standards and regulation for smart meter infrastructure that influence compatibility with distributed ledgers, access to smart meter data and privacy protection [27], [32]. However, conflicts also extend to procedural practices that influence transparency, access and ease of use, such as the complexity of credits from solar on prosumer bills, or the burden of regulatory requirements [20].

The contributions to this Special Issue shed light on the different ways by which the wider institutional context, and in particular the " rules of the game" and historical ownership patterns and market composition, have influenced agency, political opportunity and openings for alternative narratives, experimentation, and associated policy and regulatory change. At the level of enabling policy and regulation, Warneryd et al.[21], Ahl et al.[27] and Judson et al.[22] all show that institutional change tends to catch-up with and acknowledge technological change and market trends, rather than initiate it. Warneryd, Håkansson and Karltorp review actors and networks, policy developments and associated narratives enabling microgrid projects in four regions where they identify a concentration of microgrid activity - USA, EU, Asia and Australia [21]. Key policy developments range from changes in utility revenue models, to ancillary service markets, seed-funding and market-based incentives, as well as comprehensive roadmaps for microgrid commercialisation, with a wide variety of county-level policy contexts and barriers observed [21]. A number of contributions to this Special Issue point to the need for flexible policies and regulations such as regulatory sandboxes to accommodate the wide variety of emerging actors and experiments [6], [7], [23], [26], [27]. Regulatory flexibility seems particularly relevant for microgrids, distributed ledger technologies, and associated peer to peer markets, with potentially far-reaching implications for consumers, end-user technology, network operators, and market regulation [6], [27]. Barriers across multiple dimensions are co-evolutionary [21], [27] so that overcoming them will require coherent policy strategies and mixes.

At a more fundamental level, structural institutional arrangements and policy processes are key to how much and what kind of energy decentralisation can be achieved. This includes the power sharing arrangements between national and subnational levels of government, and between state, private sector and civil society actors [19], but also the ways in which we organize stakeholder participation and create opportunity for engagement in collaborative innovation ecosystems [27], [73]. For example, in reviewing the positive impacts of solar home systems, Khan [28] shows that these impacts are conditioned by the lack of financing mechanisms and technical support that characterize the wider institutional context for many remote energy access projects in developing countries.

Brinker and Satchwell [19], Poupeau [26], and Sperling and Arler [23] build on previous work showing the variety of ways local government is engaging in the energy transition - ranging from their involvement in horizontal and vertical multi-level policy design and implementation, to opportunity scouts and matchmaking, to investors, owners and operators [55], [64], [74]–[78]. Poupeau shows that a historically limited role of French local authorities in generation, transmission and supply limits their ability to engage proactively in narratives and regulatory change in support of decentralisation – instead they are selectively integrated as extensions of more powerful actor complexes [26]. In contrast, Denmark - which has retained pockets of local government utility ownership following the second world war [79], has seen a gradual and continued expansion of the local government roles in energy planning and low carbon experimentation [23], alongside a broad and longstanding programme of political, administrative and fiscal decentralisation [80], [81]. Sperling and Arler trace the dynamics of this process, and show that Danish local authorities are not exempt from a continuous struggle to balance short-term political agendas and resource constraints with long-term societal interests [23]. Setting out the challenges of local government action in a context of dynamic national politics, uncertain access to the resources, policy and regulatory instruments, they analyse how local leaders in two pioneering case studies successfully navigated those challenges to engage in new and voluntary areas of energy planning [23]. In Samsø, a locally owned nearshore wind farm proposal was met with scepticism on the project's cost and risk [23]. This was overcome by emphasizing attractive economic returns and linking the project to local green profile and identity (22. p.4). Both case studies show that trust and public-private networks and relationships can enable local politicians or actors with key skills, former experiences and long-time visions to mobilise each other and "explore all possible solutions, instead of focusing on obstacles" (22, p. 5). This study also shows clearly that windows of opportunity linked to external (national and European) finance or policy support mechanisms can tilt local narratives in favour of support of innovation projects [23].

Brinker and Satchwell show that municipal energy companies are less able to pursue decentralised energy activities in a competitive market environment, in absence of laws carving out a privileged position for municipal energy companies as monopolies or default providers [19]. This is because these laws afford them vertical integration, a captive customer base and regular predictable revenue streams that allows them - both from a financial and operational perspective - to pursue ED experiments, business models and marketing strategies that are not singularly focused on price competition (18, p.7). Compared to municipal energy companies in California and Germany, British and German retailers who "operate under competitive pressure and have neither a default customer base nor predictable revenues through network operation" find it more difficult to justify subsidizing ED (18, p.7). Their findings join a now wide range of studies observing that market mechanisms and policy instruments designed for the sole purpose of enhancing competition and cost-efficiency often overlook the risks unique to small scale or emerging energy actors and work to their disadvantage, essentially squeezing them out of the market [20], [23], [26], [39], [82]–[85]. Another example of this from this Special Issue is the case of South Africa's Renewable Energy Independent Power Procurement Policy Programme (REIPPP) [24]. The REIPPP is a centralised auction mechanism designed to cater to utility-scale projects that have to date largely been developed by multinationals [86]. Lawrence argues that these projects have proven to be difficult to tailor to local conditions, political cultures, social networks and needs, and are also less amenable to community oversight and control than smaller scale projects (23, p. 5). There may be a fundamental relationship between institutional design and competitive intensity in markets on the one hand, and the ability of market participants to consider indirect or non-monetary costs and benefits in their *modus operandi* on the other.

Mediated through risk and financial viability, these factors influence who participates and why, and shape the extent of inclusivity and decentralised activity in the energy sector.

A common conclusion drawn from this Special Issue is that there is a need to acknowledge that regime actors have privileged positions that they use to actively and passively shape the form and extent of decentralisation takes place, who participates and who benefits [22], [24], [26]. For example, Art. 22 in the EU Renewable Energy Directive II stipulates that "unjustified regulatory and administrative barriers are removed"[6]. Acknowledging these dynamics is likely the first step to new forms of engagement, policy and legal entrepreneurship with an eye to ensuring balanced and fair participation by emerging actors on the periphery of the market. Inclusive institutional frameworks can entail hybrid regimes, comprising of both centralisation and decentralisation features depending on the field of activity (25, p.8) but might also involve the formal recognition and protection of rights of emergent civil society actors in law [7]. Set against the European Union proposal to support Renewable Energy Communities (REC) in the 2019 RED II Directive, Heldeweg and Saintier suggest the creation of a new legal category for REC entities, namely "civil engineering networks", distinguished by collaborative and sharing relationships and the pursuit of social or community interests (29, p. 4). Their analysis compares and contrasts institutionalised social patterns of behaviour and manifestations of energy justice across three different institutional contexts (public, private, and civil society) [7]. They argue that this proposed legal innovation will help to align REC legal entities to the legal demands in the space in which they operate, and acknowledge the changing relationship between the state, market and society [7].

The work in this Special Issue also sheds light on the factors that influence incumbent strategies towards ED, or that can tilt the balance of power and shape the outcomes of incumbent resistance [20]–[22], [24], [26], [36]. Resistance is exercised at the policymaking level through lobbying and regulatory capture or in practice by a lack of diligence in implementing rules enabling decentralisation. Hess and Lee show how differences in state-level institutional context and state-level policy and regulation can shape incumbent political strategies towards ED and ultimately shape geographically dominant models for decentralisation [20]. Comparing California and New York, they show that regulations limiting ownership of distributed generation assets by utilities in New York ultimately generated political opportunity for more favourable offtake prices for distributed generation there, resulting in wider uptake of community shares in local solar installations [20].

Several studies in this Special Issue show how market institutional arrangements can shape incumbent inertia in ED, which in turn influences the extent of momentum for grassroots collective action. For example, Hess and Lee show how in absence of deregulation of retail markets in California, it saw extensive social mobilization for 'community choice' models, where the local government is given the authority to negotiate purchase of electricity on behalf of its constituents [20]. This did not happen in New York where retail markets were deregulated, resulting in a broader diversity of actors in the retail market [20]. Lawrence analyses the "tardy" transition to ED in the context of a parastatal energy regime, setting out a decentralised and renewable energy future for South Africa that can simultaneously address a number of critical socio-economic and environmental issues facing the country [24]. Adopting a historical process-tracing approach, he pinpoints the legal foundations that influence leverage by ESKOM - the country's electricity public utility and Africa's largest electricity producer - over South Africa’s government [24]. Lawrence shows how this has resulted in the failure to set out an institutional framework that can generate investor confidence and attract private sector participation in renewable electricity generation (23, p. 4). In the South African context – as in Australian, UK, and French contexts set out in this Special Issue [22], [26] - policy support for renewable energy emerges in the form of incremental institutional layering, where new measures are added onto and conflict with the existing institutional framework (23, p. 6). Lawrence suggests that South Africa’s coal-centred lock-in and inertia is unlikely to be overcome until fiscal crisis concurs with an intra-regime schism [24].

4. Policy implications & avenues for further research

There are several key messages we can take away from the findings discussed above. We see that deregulation is necessary but not sufficient for inclusive participation in the energy transition. In several cases, such as in South Africa and the USA, we see the absence of deregulation as generating inertia on renewable energy deployment and resulting in social and political mobilization that can result in new forms of civic or local engagement. At the same time, we see that competitive intensity (often in combination with a variety of regulatory barriers) can drive out new and emerging actors and business models from the marketplace. As such, the wider institutional context and policy mix has a substantial impact on local capacities to innovate, influencing access to finance directly, but also influence risk and financial viability in more subtle ways. Latent ideas and expertise can be invoked by political leadership introducing and legitimising an alternative narrative. Project success relies heavily on clear identification of local benefits and de-risking by (inter)national policy support mechanisms and funds, as well as dedicated spaces for experimentation, in which lighter regulatory frameworks enable demonstration. Wider diffusion is further enabled by propitious and coherent policy mixes that variably require policy entrepreneurship and legislative change.

The contributions to this Special Issue demonstrate that there is a gap between discourses and measures promoting energy decentralisation and the reality on the ground. While a number of key pieces of legislation now officially recognise and promote decentralisation, on the ground we observe conflicting regulations and actor resistance that hampers its development. It is therefore important to systematically evaluate impacts and assess enabling institutional and policy contexts in order to identify barriers and diffuse best practices for the development of ED. This will be important in the European Union going forwards, where member states are in process of putting in place national legislation to implement the European Union’s cornerstone package for promoting citizen involvement in the energy transition. Examining the future implementation of the EU Clean Energy Package, and in particular how member states embed the concept of ‘Renewable Energy Communities’ in their domestic institutional contexts, and extent to which these entities will be afforded favourable conditions and incentives, will be of significant importance for European studies on ED. This is a formidable challenge as highlighted by Lowitzsch, Hoicka & van Tulder [6] and Heldeweg and Saintier [7], the latter recommending a replicable legal environment model for RE communities. Systematic documentation of practices, impacts, barriers and policy gaps is even more important for other regions where high level policy strategies for ED are not in place, where ED activities and barriers are poorly documented, and where it has been suggested that, due to a variety of material-economic, actor-institutional and discursive factors, energy transitions may take on fundamentally different change dynamics [11], [22], [87]. While much of the energy justice literature has focussed on conceptualising energy justice, systematic empirical analyses of equity impacts are necessary to provide clarity on desirable pathways for inclusion. This might include empirical studies of the socio-economic characteristics of participants across different forms of ED, as well as economy-wide distribution analyses of direct and indirect costs and benefits. Finally, more systematic country comparative studies across European and non-European regions will also help to verify some of the structural institutional barriers that shape inclusive versus exclusive ED pathways.

Most of the contributions to this Special Issue focused on electricity, yet energy decentralisation covers a wider field of study and that leaves space for research in other fields, such as heat. Although electricity is promoted by IEA as 'the energy of the future' (2018) it represents a minor share of the total global energy consumption. As Judson, Fitch-Roy, Pownall et al. argue, heat represents more than half of global energy consumption [22], [88]. This will be important to be able to develop a cross-sectorial integration and take a holistic approach to ED. Another underexplored aspect of energy decentralisation is what forms of ED can promote energy conservation (*sobriété* in French, sometimes also called '*negawatt*') in a context of competing market trends around home convenience, comfort and time saving [89].

Local energy markets are still in formative phase and merit further study as they develop. As Brinker and Satchwell emphasise, while opening the market to local entrants with a traditional business model based on the volume of electricity sold will bring new actors into the market, potentially distributing social benefits more widely, it will not question our general energy model [19]. The latter will most likely require the use of digital tools in order to share information as well as physical and financial flows, especially in smart grids for peer-2-peer markets, virtual power plant creation or vehicle-to-grid technologies [19]. Ahl, Yarime, Goto et al. show that distributed ledger technology is a likely a key tool in these markets to ensure flexibility, security and building trust between participants, in particular prosumers [27]. More empirical studies around the globe are necessary to assess the real potential of digitalisation.

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Highlights

- The trend towards decentralised governance and practice in the energy sector is not universal
- The scope, agents and forms of energy decentralisation are country- and context-specific
- Conflicting logics underpin disputes over policy and regulation and are widely observed
- Energy decentralisation is facilitated by regulatory flexibility, power sharing across levels of government, inclusive policy processes and relief from competitive intensity in energy markets
- Institutional arrangements and regulation influences the extent and shape of opposition from incumbents