Renewable and Sustainable Energy Reviews 211 (2025) 115307

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

The political economics of civic energy: A framework for comparative research

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ARTICLE INFO

Keywords:
Governance
Energy democracy
Energy communities
Transition pathways
Social innovation
Climate change

ABSTRACT

Deep civic engagement in energy transitions has been limited and unique to specific political economic contexts. This study develops a generic policy mix enabling civic energy, drawing on a systematic overview of barriers and policies for civic energy by country and region from 1980 to 2023. We show that when policy mixes support widespread diffusion of civic energy, they are likely to be "thick"; meaning that they align a wide range of corporate legal, market access, energy subsidy, localised planning and facilitation, access to finance, and capacity building policies - extending well beyond the domain of energy policy. Literature suggests that "thick" policy mixes emerge in contexts where there are narratives and conscious strategies for participation, political opportunities and resources mobilised towards enabling participation, with high degrees of fiscal and legislative decentralisation and policy coordination. In contrast, contexts characterised by low levels of civic energy are posited as having "thin" policy mixes, with limited opportunity for inclusive visioning or experimentation in multi-stakeholder platforms, limited decentralisation and policy coordination, resulting in marginalisation of civic arenas, conflicting framings and lack of high-level strategies for civic participation. We identify countries characterised by thick and thin policy mixes based on literature and identify research needed to confirm the existence of exclusive and inclusive governance and policy settings in relation to key indicators for both inclusivity and speed of transitions, allowing for better articulation of the value of inclusive innovation as a practical and beneficial approach to meeting emission reduction goals.

1. Introduction

Understanding the policies, governance and political contexts that can effectively produce demand-side climate solutions to influence production–consumption systems, technology choices, consumption, behaviour, and lifestyles, is a key area of research [1,2]. In the past 10 years, civic energy has entered the spotlight internationally as a promising arena for demand-side climate solutions, marking a shift from the centralised power plants owned and operated by large, specialised and centrally coordinated actors that have dominated since the mid-20th Century [3,4]. A form of social innovation [5–8], civic energy (CE) entails increased participation of community or social enterprise run by and for local citizens in the energy sector. This can take place in a wide range of forms, ranging from a small number of households in close proximity, hundreds of thousands of entities covering a larger area, or even crowdfunded investment in standalone renewable energy projects [9,10]. Civic energy initiatives may be locally or externally led, under collective, municipal or joint ownership with public or private entities, take on a variety of legal forms, and entail diverse innovations in energy practices, technologies and business models, planning, investment that can span across generation, storage, demand management, trading and supply, including on- and off-grid solutions [10,11]. Referred to as 'community energy' in the UK, 'energy communities' in Europe, or interchangeably using terms reflecting the specific organisational models emerging in different parts of the world, such as 'renewable energy co-operatives', 'community choice aggregation', 'village energy programmes' or 'community shared solar' - here we refer to all of these activities as 'civic energy' (CE) to denote its distinction from market and state activity as communitarian initiatives in which collectives of citizens - as opposed to individual consumers - are engaged in a clean energy initiative [12]. By combining locally specific social, economic and

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https://doi.org/10.1016/j.rser.2024.115307
Received 16 January 2024; Received in revised form 11 November 2024; Accepted 26 December 2024
Available online 2 January 2025

Abbreviations

CE - Civic Energy
DE - Distributed Energy
EU RED - European Union Renewable Energy Directive

infrastructure needs and public policy objectives around energy poverty, climate change and energy security, CE is thought to contribute towards the creation of the critical mass of support that is required to overcome stagnation in energy transitions, facilitating more rapid and effective reconfigurations of energy production, distribution and consumption [13–17].

There is evidence to suggest that deep CE engagement may be time consuming and expensive but can pay off both in terms of overcoming public opposition and by generating a wide range of local benefits. In rural areas of the developing world, community ownership, in-kind contributions and participatory planning and decision-making has been observed to be critical for successfully delivering access to affordable basic energy services [18,19]. CE is also central to the implementation of far reaching energy decarbonisation concepts and solutions emerging out of the global North, ranging from 'positive energy buildings and -districts' [20], and 'energy commons', where it is conceptualised as a platform for broader social transformation leading to "fundamentally different forms of thinking, actions, systems and structures", "solutions that challenge the very foundation of modern organisational and production systems", even facilitating living within planetary boundaries [21–25]. This is supported by evidence that depending on their design, CE projects can carry positive spillover effects, building local cohesion and capacity that results in a wide range of initiatives and empowers communities to collectively take control of locally pertinent social, environmental, and economic issues [18, 26–34]. To this end, ensuring that vulnerable groups can participate in CE is important, because it can prevent locking in potential injustices in new energy infrastructure and markets [35], can mitigate energy poverty, and deliver significant social benefits, and indirectly even address structural pre-existing inequalities [36–38]. From an instrumental perspective, a range of authors have suggested deep civic engagement in energy will be essential to foster the buy-in and land use change necessary to bring renewable energy to full scale [39]. For example, onshore wind development and its associated cost and emissions in Germany were found to be substantially influenced by public acceptance [40], with a broad range of studies demonstrating that civic energy has contributed instrumentally to social acceptance [41,42]. It seems likely that civic energy and domestic microgeneration have played an important role in supporting fledgling clean technology industries and creating political support coalitions necessary for maturation of new low carbon export industries, indirectly contributing to policy stability and the ratcheting up of domestic emission pricing mechanisms [43].

Literature from both the global North and South shows that CE does not develop on a level playing field with incumbent or commercial actors [44–51]. It faces substantial barriers related to organisational capacity, human resources, social cohesion, finance, land access, and technical resource potential that each play a role in constraining and enabling CE at project and organisational level, in turn shaped by wider political, material, regulatory and infrastructural constraints [51–55]. Policy settings and legacy institutional arrangements substantially shape their development and continued success [45,56], as well as the ability of both well-endowed and vulnerable communities to adopt and benefit from CE solutions [35–37,57,58]. Across the diversity of CE models, a key distinction is collectives operating as full-fledged market actors in provision of network-bound services in their own right, where they leverage markets to generate substantial revenue streams to underpin community development work and drive positive social outcomes, versus civic energy "playing in the playground", i.e. on the periphery or beyond the market, limited to small-scale initiatives and operating at the behest of, and largely dependent on, the state or utilities [12,26,59].

Furthermore, the role of CE in facilitating transitions both in the form of clean technology deployment, public support and political will seems highly context dependent and significant country variation can be observed in the mobilisation, success and wider diffusion of CE. Narratives, policies and practices around the role of citizen engagement in energy transitions vary widely across actor coalitions, countries and states, with local authorities and community organisations playing no role, minor roles, or undertaking a substantial proportion of new energy developments [49,52,60–62]. Given the importance of public policy in overcoming barriers and shaping the emergence, size and characteristics of CE, a number of studies have attempted to review the barriers and the policies enabling CE [50,53,56,63–66]. A large body of literature has observed policy gaps or enabling policies in specific country or regional contexts [14,51,67–71]. For example, widespread civic renewable energy played an important role in driving development of nursing markets for wind and solar technology in first mover countries such as Germany and Denmark. Since the introduction of the EU Clean Energy Package in 2018, members of the European Union - each with variability in the forms and extent of CE, have been directed to lay the legal and policy foundations to enable CE [62]. CE is also prevalent in several other countries, such as Nepal, Costa Rica and Croatia [4,52,72]. However, these examples seem an exception rather than a norm, with CE seemingly playing a much less prominent role in terms of overall deployment of renewable energy in UK, Chile, Uruguay, Australia, New Zealand as well as other countries in Eastern Europe, where incumbent utilities - both commercial and public - have been better positioned to drive clean energy technology development, diffusion and regulatory adaptation [52,63,73–75].

In addition to the geographic variation in the diffusion of CE, the role of CE also changes dynamically over time. For example, as technology markets have matured, several countries have begun dismantling key policies supporting CE with direct influence on the feasibility and take-up [76–80]. In others, historically unfavourable policy and regulatory contexts have been forced to adapt to new European Union laws in order to enable CE. Even within Europe, where CE has gained prominence and become institutionalised in European law, it remains to be seen whether CE was unique to early-stage technology markets or paved the way for a significant role for CE in future clean technology regimes.

We have yet to systematically explain how country-specific political economic contexts influence the shape and extent of diffusion of CE and understand its implications for the dynamics of energy transitions. Literature on growth, scaling or embedding of grassroots innovations as a means of overcoming and lock-in of unsustainable development trajectories has focussed on strategic behaviour of niche and grassroots actors as primary change agents [5], but paid less attention to the structural - and meso-level institutions that shape the political power and influence of different actor coalitions, setting 'the terms of niche development' [74,81–83]. These determine for instance whether there is access to the policy process, ability to mobilise resources and shape political discourse to influence policy and regulatory change outcomes [46,49,60]. To date, there has been little analysis of CE outside of Europe, and comparative and longitudinal studies on CE are currently limited, but existing comparative studies point to country-specific responses to critical junctures, broad (material-economic, actor-institutional, discursive) dimensions and variables ranging from resource potential, domestic industry interests, market composition and power as explanatory variables for country-level variation in CE [14,61, 73,84–88].

This study aims to set the stage for future systematic comparative research on the political economics of civic energy. It reviews what distinguishes governance contexts that have enabled versus constrained civic energy, asks how policy mixes have influenced the shape and extent of its development, and takes stock of the geographic distribution of policies enabling civic energy that have been documented in civic energy literature to date. In doing so, this study serves as a basis for country level civic energy policy assessments and empirical comparative research aiming to understand how structural changes in governance may open up opportunities for policy pathways conducive to demand-side climate solutions and accelerated climate action.

2. Understanding the effects of governance and policy contexts on civic energy

Alongside empirical studies on the governance of civic energy, there are several bodies of literature that provide a helpful starting point for understanding the role of civic engagement in distinct governance contexts: literature on socio-technical transitions [89–91], the political economics of energy transitions, and user-inclusive innovation, the latter focussing specifically on the preconditions and processes that generate innovations that are co-created by and to the benefit of vulnerable end-user communities [92–94]. Smith and Berkhout's seminal framework of ideal type transition contexts juxtaposes exclusive contexts dominated by market actors within the regime with more inclusive contexts that are driven by social actors beyond the regime [90]. Exclusive contexts are characterised by policy mixes that are primarily aimed at ensuring market access, co-financed or exclusively accessible to incumbents (henceforth referred to as 'thin policy mixes'), while inclusive contexts feature policy mixes that cater to both supply-side technology innovations and demand-side innovations, supporting experimentation, learning and involving a wide range of actors with different visions, competencies and assets - including niche actors from across civil society - to seed and diffuse a diversity of low carbon technologies and services (henceforth referred to as 'thick policy mixes') [14,95,96] (Table 1).

Amongst the factors that distinguish inclusive and exclusive governance contexts are discursive institutions such as norms, beliefs, and ideas and meso-level institutional arrangements and policy processes that are directly responsible for climate and energy governance [97–100] (Table 1). Legitimacy of civil society actors as change agents has often come about where stakeholders find mutual interest across instrumental and intrinsic narratives of community, with CE seen as instrumental for achieving broader policy goals [9,101,102], or to implement proposed solutions in context of local practices, relationships and infrastructure [103–110], delivering local control, economic benefits, or opportunities to renegotiate cultural and material aspects of consumption and engage in new ways with technology [111–114]. For others, the inclusion of new voices generates the diversity of ideas and solutions, some of which hold potential for commercialisation and broad diffusion, and merit targeted policies to stimulate, evaluate and selectively scale [115–119].

Furthermore, inclusive contexts are characterised by substantial vertical and horizontal co-ordination, where intermediary organisations embedded in local resources and networks connect fragmented actors to negotiate and articulate low carbon futures, identify common barriers and policy needs engaging in horizontal and vertical multi-level policy design and implementation, and serve as opportunity scouts and matchmakers to broker partnerships and coordinate projects, as well as investing or subsidising strategic initiatives directly [51,120–122] (Table 1). Evidence from across and within different country contexts suggests that local government leadership in these processes depends at least in part on the extent of political, administrative and fiscal decentralisation, how and to what extent climate and energy policy is devolved, as well as subnational capacity [123,124].

Finally, inclusive contexts feature policy processes and science, technology innovation systems that might enable initially small winning coalitions to influence narratives, marginalise opposing coalitions, and influence specific venues for policy decision making in order to broaden support for favourable reform policies [48,96,125–128] (Table 1). More generally, informed public debate and contestation over assumptions and interpretations can only arise if knowledge is widely available through relevant, contextualised, independently reported and diverse media, and there is a rich presence of public research organisations endowed with the freedom, incentives and resources to engage in applied, experimental and multistakeholder sustainability research and policy advice [111,129,130].

Taken together, this literature highlights how dominant discourse and institutional contexts are likely to influence whether there are political opportunities for advancing CE. However, there are several gaps in the literature. The majority of CE policy literature focuses on market-based instruments for renewable energy. To date this literature has not applied comprehensive approaches for analysing 'policy mixes' for sustainability transitions that would allow systematic comparative and

Table 1
Factors distinguishing inclusive and exclusive energy governance contexts based on literature.

	Inclusive	Exclusive
Material-economic	Pockets of local or municipal ownership endure through energy sector nationalisation and deregulation [131]	Legacy of centralised large-scale hydropower [14,63,132]
Discursive	Civil society seen as legitimate change agents; Solutions framing encompasses the social, end-user technological and institutional changes that are necessary for sustainable practices to materialise [8,95,111,133–135]	Solutions framing limited to supply-side technology innovation; Participatory approaches seen as messy, expensive and ineffective; Citizens framed as passive 'policy takers' with agency limited to consumer behaviour [63]. Policy criteria heavily oriented towards cost-efficiency over and above more obscure or indirect social and environmental impacts or innovation potential [60,88,136].
Actor-Institutional	Explicit inclusion of actors beyond regime incumbents in sector decarbonisation planning. Deliberate and targeted policy approaches to ensure participation of the wide range of stakeholders in both formal and informal policy processes [73,137]. Vertical co-ordination (across tiers of government) and horizontal co-ordination (across government departments, the private sector, and civil society) renders diverse networks of technologies, visions, barriers and practices visible [38,135], allows brokering of visions and scenarios for decarbonised systems, allow more coherence and connections across arenas, culminating in the articulation of the role of civil society in high-level formal policy strategy.	Few platforms for inclusive visioning and articulation of sectoral decarbonisation strategies [63,136]. Decisions made without engagement or consideration of needs of end-users [136,138]. Limited horizontal and vertical policy co-ordination, fragmented actors and initiatives; Low visibility of niche innovations [63]. Conflicting framings across stakeholder coalitions hinders necessary multi-stakeholder partnerships, restricts diffusion, and can lead to the rejection of feasible innovations or proven regulatory solutions due to prevailing norms and values [139,140]. Policy focus on large-scale infrastructural emissions abatement measures. Thin policy mixes and embedded narratives restrict stakeholder action towards narrow forms of participation and issues. Uneven influence in the policy process limits opportunity for civic actors to shape public resource allocation and policy mixes to their advantage, reinforcing policy inertia [2,141–144].

longitudinal assessment of the full range of policy domains that influence CE, and that incorporate policy instruments that are designed, implemented and enforced by a range of different governing entities, spanning different levels of government (see Ref. [145]). Furthermore, many of the characteristics inherent to inclusive governance contexts – such as fiscal and legislative decentralisation or inclusive science and innovation systems - are unique to high income countries with high levels of public support in product and process innovation and high R&D expenditures [146,147], raising a question as to whether inclusive governance and thick policy mixes are possible outside these contexts. It remains unclear whether distinct contexts are associated with specific forms or levels of civic engagement, whether this translates to specific patterns in distributional impacts, or is associated with specific types of innovation. Furthermore, it is unclear how and when policies for CE instigate "positive feedback effects", where they sow the seeds for successful pioneering CE projects to shape unique policy trajectories aimed at the ecosystem's continued growth and success [82]. For example, if successful, pioneering CE projects might take on additional functions and instigate the birth of new organisations to deploy diverse delivery models that can cater to different forms of civic engagement, contributing to sustained growth of civic capacity alongside both industry-wide accumulation of financial and technical capacity, learning and spill-over effects, as well as the accumulation of new policy capacities, narratives and expectations. Although not all documented historical speedy energy transitions are characterised by deep and broad civic engagement (e.g. see Ref. [148]), inclusive pathways have been argued to be essential to generate widespread benefits, foster the necessary political coalitions and policy stability for effective early-stage climate change and energy governance in context of modern democracies, suggesting that opportunities for accelerating energy transitions open up in inclusive contexts as a result of these positive feedback effects [82,149–153] [102]. Yet, others have pointed out that complex participatory processes may not necessarily generate sustainable outcomes [154] or intended benefits [155,156] and may even decelerate the speed of socio-technical change [157]. For example, early-stage community-based wind deployment in the UK was more costly, higher-risk, and more time-consuming than equivalent commercial deployment [158]; observations that are mirrored in the perceived risk that developers attach to citizen co-investment projects [159,160].

Comparative research is necessary to shed light on these issues and demonstrate clear empirically founded relationships between CE and politically viable pathways and speed of transitions. While single-context studies of a given region or country help us to understand the historical development, growth prospects, or the role of CE as part of the broader energy transition in a given region or country, comparative studies have the power to explain a wider range of variables that affect the diffusion and role of CE.

In what follows, this study hones in on CE policy, using policy mix analysis to develop a universal framework that can be used to analyse and compare CE policy, how this manifests (or not) in any given jurisdiction over time, and how this influences the uptake and shape of CE, as well as feedback effects and transition trajectories. The framework is an analytical construct that can help researchers seeking to critically evaluate the policy context for CE to manage and organise data. In addition, this study explores the relationships between barriers, and policy mixes on the one hand, and countries and regions on the other, as documented in current literature.

3. Methodology

Policy mix analysis is an approach that is widely used to delineate and assess the portfolio of policy instruments and the associated policy processes that influence a given impact domain or strategic objective [161–163]. Many studies focus on how relevant policy mixes intersect with systemic problems and barriers faced by relevant actors, assessing for interaction or alignment across policy instruments within the portfolio. Policy mix assessments variably involve analysis of archival and interview data to understand how policy strategies and instrument mixes intersect with systemic problems and barriers faced by relevant actors [162], although the approach has also been broadened to incorporate analysis of policy processes [161]. In this research we focus on the relationship between policy instrument mix, defined as the combination of policy instruments that serve to support civic energy [163], and policy outcomes, in terms of barriers and enablers to different forms of civic energy.

The first stage of research was to synthesise published resources to compile a generic policy mix for enabling widespread adoption of civic energy. Functional policies that circumscribe the barriers and success of CE initiatives are documented in a large number of studies across a wide range of relevant subject areas, such as engineering, social sciences, economics, decision sciences, and energy. To identify the necessary and sufficient policies to support widespread CE adoption, we employed a "bottom-up approach" to ascertain which policy instruments can be seen to impact on the success of CE initiatives across a variety of geographic contexts, ensuring that we delineate a general ("non-idiosyncratic") set of policy instruments [162]. The analytical scope used to gather and analyse data was based on existing conceptual frameworks and typologies of CE [10], with search delimiters designed to include the full diversity of local, collectively managed energy activities, characterised by early and frequent engagement using a broad range of methods (Table 2). Domestic micro-renewables were excluded from the scope of analysis unless they were part of collective electricity trading or virtual power plant initiatives. Technologies were limited to renewable, clean energy or associated ancillary technologies, at any scale. As such, the scope was not limited to specific ownership and delivery models, community roles, or legal and organisational structures.

We began by reviewing both empirical studies and reviews that specifically documented barriers, assessed existing policies, regulatory and policy barriers, and empirically derived policy gaps for CE across a wide variety of geographic contexts. This included identifying existing comparative studies [14,45,51,53,70,71,73,84,85,126,164,165], comprehensive reviews of barriers [28,166,167], and of CE policy [50,56,63–66]. In addition, we used a systematic literature search in Scopus to review existing empirical evidence, beginning with a broad scope title delimitation of relevant search terms (n = 1035) for publications published between 1980 and 2023, and then adaptively narrowing down the literature search using keyword and subject area delimitations by exploring the literature associated with each of the subject areas and keywords less likely to be associated with CE policies or barriers (e.g. Subject areas such as "Decision Sciences", or Key words such as "Game Theory", "Community Care", "Fossil fuel"). Subject area and keyword delimitations that did not contain any relevant articles were removed, resulting in a total of 503 documents which were screened for relevance

Table 2
Analytical scope of CE used to delimit the literature search, adapted from [10].

Participating Actors	● Individuals active collectively with a focus on local needs and requirements ● Any mix of local and non-local individuals, organisations, government and business, but excluding projects featuring non-local engagement only
Engagement	● Early and frequent engagement using a broad range of methods
Energy Activities	Any, ranging from: ● energy efficiency and transport initiatives ● bulk purchase of domestic microgeneration technology ● heat generation and supply projects ● electricity generation (for self-consumption or for grid-export) ● storage, distribution, or supply, including microgrids, embedded networks ('solar sharing'), local energy trading (peer-to-peer), virtual power plants and load-shifting projects
Technologies	Renewable, clean energy or associated ancillary technologies

on the basis of titles and abstracts. Studies bearing no relationship with the CE models of interest (for instance, referring to 'community', 'power' or 'heat' in other ways, such as "European Community" or 'community power' in terms of capacity to influence), duplicate articles, articles by the same authors based on the same datasets, and articles that we could not access (these were typically conference papers dated before 2000) were removed from the pool of literature. Studies representing hypothetical simulations, technical feasibility studies and optimisation studies were removed unless they focussed specifically on policy aspects. This left 192 potentially relevant studies containing information on barriers or policies. Further relevant literature was tracked by selectively identifying relevant literature cited in these articles.

For each study, thematic analysis was used to document empirical observations describing barriers to CE and policies positively or negatively influencing CE, with all information entered into a spreadsheet alongside notes on forms of CE to which barriers and policies applied (see Research Data for this article). Studies bearing no information on barriers or policies were removed. Following review and thematic analysis, the analysis incorporated policy and barriers data for a total of 160 independent empirical studies, with energy source or technology investigated, year of publication, geographic scope of study, and rural versus urban context documented for each country context analysed. It was not possible to analyse ownership and delivery models by country because this was not specified in most articles.

Throughout the thematic analysis, policy instruments and barrier categories were renamed and rescoped as new evidence emerged to arrive at mutually distinct and consistent groupings. Policy instruments were classified according to whether they were economic (market-based incentives), regulatory (involving use of rules, regulations, or standards), and soft policy (policy instruments that provide information, facilitate cooperation and learning, and create networks, with the aim of stimulating idea generation, demonstrating projects and knowledge exchange), following policy instrument typologies used by Refs. [161,168]. Throughout the analysis we sought patterns across the literature in terms of how policy influences CE, how policy relates to specific barriers, as well as how addressing different barriers and policy categories relate to governance context and prospects for widespread diffusion of CE. Policy instruments were subsequently grouped into broad functional categories on the basis of their functional purpose. Including multi-country studies, this analysis draws on 232 separate country observations, and, including review articles, draws on 172 literature sources in total (see Research Data for this Article). Finally, data on the frequency of studies documenting specific barriers and policies by country and region was amalgamated and visualised to explore the extent to which different barriers and policies may be associated with specific regions and countries.

3.1. Limitations

In reviewing barriers and policy gaps, we have taken care to encompass all forms of CE (Table 2). However, our literature search largely omits studies with no explicit mention of the words 'civic' or its synonyms, potentially omitting relevant literature focussing on specific energy concepts, such as smart grids or microgrids, energy access or energy poverty. By being based on existing academic and grey literature on barriers and policies, our findings omit undocumented barriers and regulations specific to emerging models of CE. In addition, our results reflect the practices, barriers and policies that have been observed and documented in English in grey and academic literature, as such there is likely a discrepancy between this data and the practices, barriers and types of CE present on the ground internationally (see also Capellan-Perez, 2022 [52]). This means that while our findings represent current literature, barriers and policy instruments from across countries and regions of the world, empirical comparative research will be necessary to validate our findings in different country contexts. The following provides a descriptive overview of the documents included in the analysis, their geographic focus and publication year.

3.2. Literature sampled: descriptive results

The literature pool reviewed mirrored literature pools in other published systematic reviews with a focus on civic energy in terms of journals, geography and publication year, with few studies published until 2000, and rapid growth in literature since 2012 [50,64,169,170]. Mirroring the characteristics of other published systematic reviews on CE [50], geographic scope of the literature was dominated by European (56 %) and North American (20 %) context, with a small proportion of articles focussing on other regions, and a small proportion focussing on emerging or developing country context (Fig. 1, Table 3). This is likely to reflect both the relative presence of CE in these regions and country contexts, as well as the extent to which barriers and policies for CE have been analysed and documented.

The following provides a summary of the barriers and corresponding policy instruments identified.

4. A policy mix framework for civic energy

Taken together we identified seven distinct functional policy categories to support widespread CE adoption, each corresponding to specific barriers to CE identified in the literature, and each consisting of a set of policy instruments, whether local, state and/or federal or supranational. Foundational policies ensuring the viability of independent energy projects providing power, heat or ancillary services support renewable energy projects irrespective of ownership and organisation (A, Fig. 2). Once foundational policies are in place, structural policies enabling place-based social innovation (B, Fig. 2) open up opportunities for innovation that is social in its means and that contribute to achieving energy decarbonisation alongside social goals [8]. A final policy category (C) serves to set precedent, seed capability and legitimacy for civic energy (Fig. 2). Whereas foundational policies focus on enabling energy markets and infrastructure, Category B and C policies are related to building supportive broader ecosystems for civic energy and extend to legal systems, subnational governance and social systems; they serve to leverage the advantages and alleviate the constraints unique to civic energy, influencing access to key resources (land, assets and finance) and provisions for capacity building.

Below we review each functional policy category in turn, using examples from the literature to illustrate how each provides increasing opportunities for widespread CE deployment, enabling the mobilisation of legal, financial, physical and human resources that facilitates project development and replication, and from there a broad and potentially transformative sector. We discuss the variety of policy instruments that exist, aligning policy instruments to specific barriers to CE that have been documented, for each high-level policy functional purposes (A-C) in turn below.

4.1. Ensuring the viability of independent energy initiatives

First and foremost, to enable viable civic energy projects, community organisations need to have access to, and be able to operate and compete in, energy and transport markets. To support this, jurisdictions have put in place legislation and policy to enable access to electricity networks, demand response and balancing markets for independent power producers as well as key enabling services such as aggregators (Table 4), and to secure the financial viability of distributed energy and community transport initiatives (Table 5). Where these provisions do not exist, exist in weak form, or are designed to exclude community initiatives, community initiatives have not been viable, irrespective of whether higher level (category B and C) policy instruments are in place, suggesting these policies form a necessary policy foundation for market-based CE [75,171–174]. We distinguish between two policy categories here.

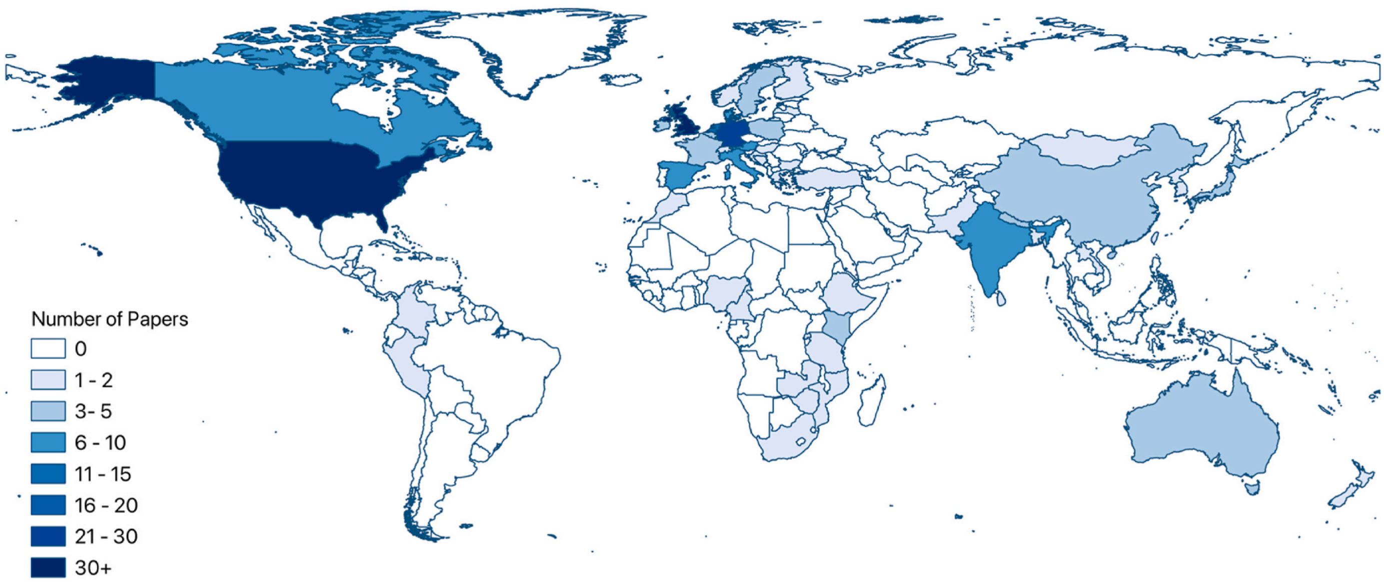

Fig. 1. Geographical distribution of empirical literature analysed (including multi -country studies).

Table 3
Regions represented in empirical literature reviewed (including multi-country studies).

Continent	Region	Number of times analysed across 160 documents reviewed	% of total
Americas	North America	46	20
	Caribbean	0	0
	Central America	0	0
	South America	3	1
Europe	Northern Europe	53	23
	Eastern Europe	5	2
	Southern Europe	20	9
	Western Europe	51	22
Africa	Northern Africa	1	0
	Eastern Africa	9	4
	Middle Africa	1	0
	West Africa	2	1
	Southern Africa	1	0
Asia	West Asia	1	0
	Central Asia	0	0
	South Asia	15	6
	Southeast Asia	4	2
	East Asia	14	6
Oceania	Micronesia	2	1
	Melanesia	1	0
	Polynesia	2	1
	Australia and New Zealand	7	3

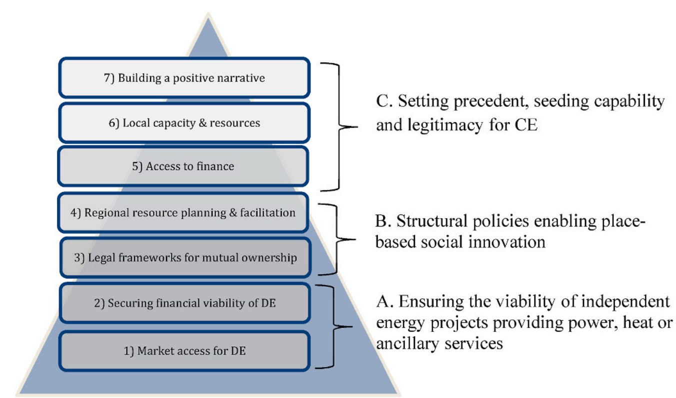

Fig. 2. Policy mix enabling civic energy (CE), showing policy categories (1–7) and high-level policy functional purpose (A–C). DE denotes 'distributed energy'.

4.1.1. *Market access*

A range of regulatory instruments are widely observed to influence prospects for independent power generation and storage technologies to physically connect to networks and access markets, ensure demand for distributed electricity and bridge access to power and ancillary markets via utilities [50,65,175], as well as participate in local transport markets beyond bespoke contracts [171] (Table 4). Grid connection policies ranging from grid connection guarantees or competitive mechanisms, and network-specific technical requirements imposed on systems above a certain size influence the feasibility and cost of grid connection [71, 176–179]. Power purchase guarantees [180–182], and supplier obligations for energy savings and renewable electricity [56,71,173,182] determine whether and to what extent energy savings or electricity offtake is remunerated. Additionally, the availability of advanced metering infrastructure and associated regulation ensuring access to consumer meter data (to multiple or third parties) has also been influential in determining whether peer-to-peer service providers, aggregators, and community-based implementing organisations have access to necessary consumption, grid-export, diagnostic and status data, and the means to manage energy flows [63,71,183,184]. Finally, in unbundled electricity sectors explicit product definitions and stacking rules are necessary to allow shared investment in multi-use community scale battery systems such that they can serve different stakeholders simultaneously, providing grid support, peak demand reduction and local reliability enhancement [185]. Collectively, these regulations ensure both the physical infrastructure and market mechanisms underpinning market access.

4.1.2. *Securing financial viability*

A number of policies ranging from regulated pricing and charges to market-based investment incentives ensure the financial viability of renewable electricity, heat, energy efficiency or transport projects (Table 5). In the transport domain, community transport tends to respond to market and government failures, for example providing special needs transport in rural areas, and is dependent on continued state funding [171]. Across Europe and North America, a range of economic instruments including regulated buy-back rates above wholesale price, net metering, Feed-In-Tariffs or Renewable Obligation markets, have allowed standalone heat and power to become financially viable

Table 4
Policy instruments ensuring market access for independent energy and transport projects (E = economic instrument, R = regulation, S = soft policy).

Specific Barriers	Policy Instrument	E	R	S
Projects not operationally viable [14,31,66,136,173,174,185–188]	Clear grid connection procedures [13,53,71,126]; Grid connection guarantees or competitive access [13,31,50,176–178,188]		x	
	Supplier mandates or obligations [17,51,56,64,65,70,71,164,173,182,187,189]		x	
	Power purchase guarantees [31,45,180–182,190]		x	
	Priority dispatch [14,45,64,172]		x	
	Appropriate grid connection costs; Grid upgrade and congestion management costs distributed [50,53,66,126]		x	
	Advanced metering infrastructure and third party access to consumer meter data [63,71,84,183,184,191–193]; Data management and billing systems [20,160]		x	
	Product definitions and stacking rules to support multiple use applications for energy storage [185]		x	

Table 5
Policy instruments ensuring the financial viability of independent energy and transport projects (E = economic instrument, R = regulation, S = soft policy).

Specific Barriers	Policy Instrument	E	R	S
Projects not financially viable in market context due to high technology cost, high risk and cost of finance, high transaction costs [14,45,62,63,71,79,102,136,138,164,165,185,188,202–212]	R&D grants [34,178,185,213]	x		
	Investment subsidies/capital grants, energy bonuses [34,50,59,126,166,185,209,211,214–218]	x		
	Low interest public loans and loan guarantees [45,50,53,70,202,211]	x		
	Regulated buy-back rates above wholesale price (Feed-in-tariffs) and subsidies for Renewable Heat [14,45,59,64,66,70,71,73,79,87,126,164,166,190,204,210,219–225]	x		
	Premiums [45,50,51,53,77]	x		
	Tax credits/exemptions [45,65,71,126,190,202,211,226,227]	x		
	Community net metering, net metering or billing [31,50,52,56,65,71,192,205,227]	x		
	Tradeable credit or certificate mechanisms [17,50,53,71,77,172]	x		
	Auction systems (parallel to wholesale auctions) [53,69,71,126,164,165,172,203,210,228]	x		
	Incentives for small-scale DSR & ancillary services (dynamic pricing, local generator network credits, network charge reductions or exemptions) [20,71,175,185,186,188,191,198,229–232]	x		
	(−) Fees for energy export, system services or electricity sales [71,185]	x		
	(−) Tax on generation or capacity [71]	x		
	(−) Subsidies for diesel technologies [122]	x		

and bankable even where the levelised cost was higher than the price of purchasing heat from fossil fuel alternatives or power from the electricity grid [31,51,56,70,71,194]. Across the world, these policy instruments have often been weakened or removed over time as the cost of technology has come down, or in response to high demand and mounting policy costs [31,59,68,76–80,164,179,195]. These mechanisms have variably been replaced with auction mechanisms, which may or may not have explicit provisions for small-scale or community projects [69,159,196,197]. Also emerging are microgrid tariffs and advanced pricing and charging mechanisms that can reflect the time and location-specific value of electricity in specific network context, encompassing transmission losses, network and environmental values, as well as network costs, such as 'time-of-use FiT's', reduced network charges or 'local generator network credits' to remunerate generation close to load [160,175,179,198]. Empirical data on network values and costs of different types of CE are only just emerging, but the broader deployment of these instruments will have significant bearing on scalability of emerging forms of CE focussing on local supply and distribution [199–201].

4.2. Structural policies enabling place-based social innovation

Once foundational policy provisions for viable energy and transport projects are in place, the opportunity to develop these projects must be made accessible to local community organisations and other forms of social enterprise. There are two types of policy categories that are necessary for this to occur, shown in Fig. 2 as Category B, 'Structural policies enabling place-based social innovation'.

4.2.1. Legal frameworks for social enterprise

To realise their mission, raise capital, manage projects and carry out their activities to the satisfaction of community members or shareholders, CE organisations rely on regulatory frameworks for collective ownership and provisions within relevant laws and policies to allow for the establishment of suitable tradeable entities. Beyond organisational legal provisions, these legal entities need to be integrated into relevant energy market regulations for them to engage in the energy sector, allowing for example access to relevant markets, necessary licences, and existing policy support (Table 6). In short, the instruments in this policy category serve as the legal and policy foundation enabling social enterprise to operate in the energy sector, with significant bearing on the form, size and nature of civic energy projects that are possible in any given context.

A first set of instruments focuses on removing restrictions for social enterprise. CE organisations have variably been restricted in their rights to sell electricity directly to their members, barring them from operating as energy suppliers [233], or access to existing policy support mechanisms, priority processes for grid connection or licensing [66,234]. Similarly, consumer collectives are widely prohibited from buying and selling power by legal classifications and associated retail regulation [121,176,188,229,230]. In the USA, the development of community choice aggregation schemes enabling communities to procure renewable wholesale electricity is dependent on legislation granting local authorities the authority to procure electrical power for constituents [56,235,236]. Although crowdsourced or subscription models of cooperative energy are not immune to fraud [237], there are numerous examples worldwide of instances where consumer collectives fail due to complex administrative requirements put in place to protect investors and regulate investment funds by discouraging fraudulent behaviour, or to discourage uncompetitive behaviour, but which may poorly suit the collective ownership context [188,204,238–240]. This points to a need for tailored regulations to specific risks, effective complaint and exemption mechanisms, as well as financial literacy and member engagement.

A second set of policy instruments in this category sets out legal provisions for communitarian energy action, creating political

Table 6
Legal frameworks for social enterprise (E = economic instrument, R = regulation, S = soft policy).

Specific Barriers	Policy Instrument	E	R	S
Restrictions for social enterprise accessing wholesale, supply, retail markets, selling electricity directly to members, obtaining supply licences or access to existing policy support [20,27,28,31,45,52,53,66,71,121,132,165,172,176,186,188,192,199,204,205,230,231,233,234,238,250,253,254]	Corporate legal frameworks that provide suitable tradeable entities through which community organisations can raise capital, manage projects and carry out their activities to the satisfaction of their members or shareholders [45,53,66,165,210]		x	
	Market legislation allowing local authorities to procure electrical power on behalf of their residents (community choice aggregation) [56,102]		x	
	Market legislation allowing for bundled generation, distribution and retail within a single CE organisation [221,255]		x	
	Market legislation allowing direct supply and exchange surplus energy with others through peer-to-peer mechanisms [20,58,62,71,229,231,253,256]		x	
	Market legislation allowing access to balancing markets by independent aggregators [20,71,191]		x	
Lack of growth in CE or DE [136,138,188,257]; public opposition against DE [258]	Mandatory CE programmes [160]		x	
	Guidance on shared ownership, mandatory shared ownership [14,45,51,66,70,75,77,190,246,247,258]; social procurement or community benefit requirements [124,246,249,258,259]		x	X
Corporate initiatives camouflaged as CE [160,186,234]	Clear legal definition of CE; Eligibility rules for CE [12,20,52,58,62,66,71,84,160,165,186,192,225,234,244,260]		x	
	Non-profit regulation for monopoly services [14,172,241,242]		x	
Arbitrary or counter effective restrictions on size, proximity, or eligibility of CE [20,58,62,71,210,234,244]	Flexible non-prescriptive legal definitions and eligibility rules for CE [244]		x	

opportunities for civic and public ownership and protecting CE from co-optation and mission drift (Table 6). This manifests for example in non-profit regulation for monopoly services [241,242], state-level legal mandates for community energy [160] and legal specifications for what constitutes CE embedded in law [66,84,160]. These instruments have served to create protective spaces for CE experimentation, with important lessons as to the implications of broad versus narrow legal specifications for CE. For example, broad legal definitions for CE in Greece, Ontario and Minnesota have led to overrepresentation of commercial and institutional investors [160,234,243]. In the case of Minnesota's utility-led community shared solar scheme, equity provisions in the form of set-asides and tiered compensation rates were subsequently put in place in order to ensure access for low-to moderate income households, affordable housing and public interest groups. At the same time, narrow legal specifications for CE can also impose arbitrary restrictions on the size, proximity or eligibility of CE. For example, country specific size or eligibility specifications of 'community shared solar', 'renewable energy communities' and 'citizen energy communities' in USA and Europe have influenced project size, ability to capitalise on complementary demand and generation profiles, in turn influencing profitability and rate of uptake [20,160,244]. Taken together this literature suggests that a key challenge for legal specifications for civic energy is to balance specificity of requirements that ensure mission alignment and credibility versus allowing larger economically attractive projects and flexibility to support the diverse forms of CE to respond to locally specific needs and context.

In a similar vein, guidelines or mandates for shared ownership or community benefits in the USA, Australia and the UK have widely mobilised community-private partnerships either as an instrument to deploy renewable energy at scale or as part of broader preventative community health or social development programmes [160,187,190,245–249]. For communities, partnerships with developers or utilities can represent a low-risk pathway to renewable energy ownership in unfavourable market contexts in which they may be ill equipped to overcome challenges on their own, or where there is a lack of capacity or desire to lead on all aspects of CE projects [79,245,249,250]. Tishman (2017) demonstrates that partnerships with large place-based public and non-profit institutions such as housing authorities or medical centres present unique opportunities for CE because they are mission aligned and generate long term local demand for products and services [249]. Where willing to relinquish control and autonomy, shared ownership can generate local revenue streams, and indirectly enable community-led projects and capacity development [77,182,251,252].

4.2.2. Localised planning and facilitation

CE is more likely to be prevalent where climate and energy policy and planning are devolved to subnational authorities but embedded and streamlined with national level targets and strategies. In this context, there are several important economic, regulatory and soft policy instruments relating to strategic spatial energy planning, land access and planning barriers, as well as local leadership and facilitation (Table 7). The policies in this category range from integrated energy and urban planning, regional or local targets for renewable energy development, developing and disseminating regionalised development zones or pre-feasibility studies to relevant organisations, or making public land available for (community) renewable energy development, as well as formally or informally including local ownership criteria in planning decision making processes [45,51,70,187,261,262]. In many countries, land use planning is devolved to regional authorities and characterised by some form of public engagement that has been thought to give locally owned projects an advantage over commercial projects [70]. However, there is wide variation in the extent of local land rights, ownership and control. In some cases, landless community organisations have struggled to negotiate access to suitable sites for development [187]. Depending on the extent of local control over land procurement, community and Indigenous ownership of land with geothermal, biomass, solar or wind potential can create opportunities for CE [63,263–265], as opposed to commercial or state-directed development and conflict [88,136]. There is also wide variation in how effectively energy and spatial planning processes intersect and provide opportunities for genuine community engagement in the development of desirable strategies that can meet both local or regional development and energy system optimisation objectives [56,124,266–272].

4.3. Kickstarting civic projects by setting precedent, seeding capability and legitimacy

CE projects grow out of existing social networks where there is trust, shared visions and community capacity. Without this, CE projects fail to mobilise, and/or tend to be led or appropriated top-down by state, NGO or private actors, and often experience considerable challenges in generating the engagement, ownership and self-governance necessary for projects to succeed [136,261,275,283–288]. Important capacities are existing social ties, engaged residents, grassroots financial resources, technical, legal and financial expertise, leadership, and time, but also include political alignment, leverage and access to resources and information within both the wider community and in relevant external

Table 7
Localised planning and facilitation (E = economic instrument, R = regulation, S = soft policy).

Specific Barriers	Policy Instrument	E	R	S
Non-uniform disproportionate treatment, retroactive changes; delays and costs associated with planning permission [45,53,70,79,210,221]	Simple preferential/rapid planning procedures for small-scale projects [53,71,172]		x	
	Municipal bylaws, regulations and guidelines (such as green building standards, solar access criteria, municipal building code guidelines for EV development) [38,214–216,273]		x	
	Explicit criteria for local benefits or preference for community-led development in planning consent [187,224]		x	
Lack of local expertise, resources, champions/facilitators, comprehensive action plans, and consensus on best-practice, contextual knowledge or data [17,27,63,70,138,192,211,216,221,224,274–278]	Training of municipal staff and building inspectors in RE technologies and building performance [216,273]			x
	Certification, benchmark, and labelling system tailored to local context [215]			x
	Regional energy demand and supply mapping and planning, regional RE or CE targets [17,39,50,59,65,167,190,214,217,267]			x
	State or municipal investment incentives [31,51,65,105,202,214,216,279]	x		
	Project leadership, direct investment, in kind support, or social procurement by local authorities or other anchor institutions [38,71,249,256,280]	x		
	Local authority mediated site pre-feasibility mapping and RE planning zones [45,51,70]			x
	Local authority mediated promotion and non-financial support for CE [31,167,214,221,224,273]			x
	Strong local or regional multi-actor networks [14,102,121,167,217,221,249,262,281]			x
Struggle to acquire local sites for development [45,62,63,138,165,187,188,202,221]	Legal frameworks and programmes facilitating access to indigenous, public or private land or right to rent roofs [31,63,165,187,262,282]		x	x

networks [28,42,85,227,281,289–294].

In contexts with a rich tradition of civic (or co-operative) enterprise and strong community organisations, ensuring the viability of independent energy projects and enabling place-based social innovation has been sufficient to enable the adoption and diffusion of CE. For example, a rich literature documents established organisations, support and advocacy networks and financing mechanisms for CE in German, Danish, French or Dutch context, where the CE sector implements its own initiatives to overcome structural barriers and build further capacity [85,121,295–298]. Unsurprisingly, in contexts where there is a lack of historical precedent for civic enterprise, and a lack of established organisations, support networks and financing mechanisms, it becomes necessary for the state to seed capability, set precedent and legitimise collective action, extending to the formation of community organisations [2,18,44,51,85,287,299–301] (Table 8). There is strong evidence that failing to do this results in the exclusion of marginalised communities [36,105,202,243,294]. This suggests that to make CE accessible to all communities - including low-income communities and communities

Table 8
Policies that serve to build capacity (E = economic instrument, R = regulation, S = soft policy).

Specific Barriers	Policy Instrument	E	R	S
Long development timelines, high failure rates, over or undersizing [31,62,63,110,158,234,288,301,303]	National/regional handholding of projects by intermediaries [18,44,66,70,199,202,224,277,288]			x
	Expert support for needs assessment and project viability appraisal [51,165,306]			x
	Participatory community energy planning, planning and resourcing operation, maintenance and use of end products post-installation [18,44,257,268,284,286–288,304,307]			x
	Aligning CE projects with support for additional productive uses of energy to sustain loads, ability to pay and revenues [18,44,287,288,304]	x		x
Lack of capacity and expertise [28,62,79,107,122,138,158,160,165–167,188,191,192,204,206,212,222,224,226,250,254,275,277,283,288,294,300,302,308]	‘How to’ guidance, skills development training [105,211,214,219,221,224,249,294,302,306–309]			x
	Guidance on viable blueprints and measures [56,66,202,208,215]			x
	Match-making projects with technical, legal, financial expertise; partnerships [107,199,214,215,249,250,281,306,308]			x
Lack of networking, knowledge sharing and meaning making [14,53,63]	Strong multilevel networks, networking & knowledge sharing programmes [14,34,53,87,102,205,208,216,221,249,273,310,311]			x

where there is little precedent for collective action - additional policies that set precedent, seed capability and legitimacy are necessary. We distinguish three policy categories here, outlined in Fig. 2 as Category C, ‘Setting precedent, seeding capability and legitimacy’. These policies are variably embedded in broader policy agendas around community development, rural development and income diversification, cultural landscape protection, ‘Third Sector’ approaches to social policy, as well as regional or national climate, renewable energy or energy poverty strategies.

4.3.1. *Capacity building*

In some contexts, we see dedicated state or aid-funded handholding organisations or intermediaries established to build community capacity, for example by disseminating essential technical, financial, legal, project management guidance, facilitating knowledge exchange, training and subcontracting of services [18,44,50,66,199,288,301,302] (Table 8). These functions are particularly important where there is a lack of historical precedent for civic enterprise alongside little recent engagement of local government in utility ownership and energy planning, as in documented cases in the UK, Australia, New Zealand, and most of the documented cases in the Global South. In all but one case study within the literature on CE in the global South (see Thiba, Kenya [44]), community-led projects are rare, and intermediaries play a far more prominent role in CE, where they acquire funding, build and install renewable energy systems for subsequent handover to CE organisations [18,44,288,301]. At the same time, community-based off-grid projects present a set of unique challenges around balancing supply and demand, managing maintenance and operation and sustained revenue streams [288,301,303,304], and arguably require higher levels of local capacity than on-grid projects in order to succeed. The barriers and factors for success documented in this literature demonstrate that the more a given context is shaped by structural socio-economic deprivation, perceptions of oppression and mistrust, and cultural differences, the more important it becomes to embed CE programmes in the local community, for instance by employing locals to lead and implement, finding ways for CE projects to support and be sustained by local income generation activities, and integrating local knowledge, language, practices, and beliefs [18,32,44,105,288,301]. Doing this effectively requires careful relationship building, tailored solutions sensitive to social context, flexibility in terms of funding programmes, and long-term project horizons that extend to providing operations and maintenance support [32,105,110,284,304,305].

4.3.2. Access to finance

New community organisations often struggle to seed finance feasibility studies [46,70,312]. Even with a viable business proposal, community organisations that lack assets and credit history have struggled to access commercial finance, particularly where there is lack of precedent and a distrust of CE projects [6,28,45,173,182,299]. In this context, a range of economic instruments enabling access to finance have been utilised by central, state and local governments, ranging from (revolving) seed capital loans or grants, fixed premiums for electricity generated from community or small to medium-scale projects, and tax privileged investment structures for social enterprise [29,50,66,79,288] (Table 9). Although co-operative or crowd-financing has provided a useful additional pathway to raising capital, co-operative projects - like other forms of civic enterprise, including municipal and cooperative utilities, have remained dependent on subsidised loans or bank-financed debt, which has implications for risk exposure, ownership, scale and design, and revenue streams [70,160,312,313].

4.3.3. Building legitimacy and a positive narrative

A number of cases suggest that CE sectors in the early stages of development are mired by a lack of consensus and awareness of the benefits of CE, and/or its legitimacy as an effective approach to energy sector decarbonisation, and/or a distrust of local authority or community-led projects and perceptions of community organisations as lacking the necessary skills and expertise [2,49,63,102,240]. This may add to lack of legitimacy in nascent sectors characterised by lack of consumer protection, product and service standards [160,319]. A number of African countries experience this issue in the extreme; where centrally planned co-operative programmes have historically been used as vehicles for political appropriation and control, the resulting reputational damage can serve as a powerful deterrent to grassroots energy action [302]. A number of cases show that lack of legitimacy translates into lack of willingness by third parties, such as developers, lenders, local authorities and service providers to accommodate projects [159,314]. Explicit government targets, strategies and guidelines for CE aimed at lenders, local government and commercial developers, as well as promotion of case studies and positive impacts have served to acknowledge and endorse CE as legitimate actors in the development of distributed energy solutions [66,314] (Table 10).

Taken together, the broad set of policies set out here present the range of options from which distinct policy mixes emerge in any given country context or jurisdiction; they may be comprehensively implemented and aligned across elements and categories to comprehensively address barriers and enable a diverse range of CE (a 'thick' policy mix) or they may be partially present or largely absent ('thin' policy mix).

5. Barriers and policies in different geographic and governance contexts

The amalgamated thematic data on barriers and policies by country from the 160 documents analysed is presented in Tables 11–19, with raw data provided in the Research Data for this article. Within the literature pool, holistic studies covering all policy categories were rare. While literature in some country contexts is rich and likely to be representative of the barriers and policies present, the data demonstrates foremost that there is a paucity of studies and comprehensive overviews of CE models, barriers and policy settings in country contexts outside of Europe, North America, Australia, and New Zealand. There are many regions across the world in which CE remains undocumented, encompassing North and Middle Africa, West and Central Asia, and Melanesia (Fig. 1). CE in Southern, West Africa, Eastern Europe, South and South-East Asia, Latin America and Micro- and Polynesia is only documented in the form of a

Table 9
Policies that enable access to finance (E = economic instrument, R = regulation, S = soft policy).

Specific Barriers	Policy Instrument	E	R	S
CE organisations struggle to finance feasibility/resource consent [46,63,70,224,314]	Low risk public loan or grant programmes for seed funding of early project phases [27,45,50,164,165,190,224,273,294,304,308]	x		
Difficulties engaging with existing funding mechanisms [208,212,240,276,277,300]	Ensure existing innovation, development or decarbonisation funds including carbon markets are consistent with CE [38,214,240]			x
Inability of CE organisations or members to finance large upfront capital cost due to lack of access to commercial debt and/or poverty [18,28,45,63,79,138,164–166,173,182,187,188,192,207,211,219,254,283,299,314,315]	Low risk public loan programmes for capital funding [18,34,56,64,164,187,211]	x		
	CE grants [18,29,50,56,66,187,199,244,316]	x		
	Community energy tariffs or premiums [316,317]	x		
	Special provisions for CE in renewable energy auctions such as: separate provisions for small to medium scale projects, local shareholder requirements or local value creation, reduced security payments [69,71,77,204,228,259,260,318]	x		
	Tax privileges for social enterprise or community energy [31,45,50,71,227,308]	x		

Table 10
Policies that build legitimacy and positive narrative (E = economic instrument, R = regulation, S = soft policy).

Specific Barriers	Policy Instrument	E	R	S
Distrust in external parties or renewable energy technology [105,138,211,240,259,284]; Benefits of CE not widely known and accepted across government, industry and wider public; mistrust in professional capabilities or state autonomy of CE organisations [2,28,49,63,102,202,208,212,240,250,276,300,302,320]	Integrated civic/distributed energy strategy with clear objectives and measures, backed by relevant agencies, extending to objectives around process of policy development, implementation and learning [62,64,101,199,321]			x
	National or local targets or set asides for CE [46,64,71,128,160,190,199,219,291]			x
	Data collection, impact evaluation [62,77,199,215,249,316,321,322]			x
	Promotion of tangible programme information, case studies (video, regional workshops etc.), benefits and sector promotion, energy literacy programmes [34,66,105,211,215,314,323]			x
Lack of experience or willingness to accommodate CE by third parties (Utilities, Health & Safety, Insurance, etc.) [45,62,71,102,158,188,314]	Guidance and training on CE targeting utilities, local government, landowners and/or lenders [18,66,224,314].			x

Table 11
Proportion of studies (0–1) referring to barriers to CE by functional category, by country and region. Countries with a paucity of studies/data have been excluded.

Continents	Regions	Country	Market Access	Securing Financial viability	Legal frameworks for collective ownership	Localised planning and facilitation	Capacity	Access to Finance	Legitimacy & Positive narrative
Africa	Eastern Africa	Ethiopia	1.0	1.0	0.0	1.0	1.0	0.0	1.0
		Kenya	0.0	0.0	0.0	0.0	0.7	0.3	1.0
	West Africa	Nigeria	0.0	0.5	0.5	0.5	1.0	0.5	0.5
Americas	North America	Canada	0.0	0.2	0.1	0.1	0.3	0.2	0.2
		USA	0.2	0.2	0.1	0.2	0.2	0.3	0.3
Asia	South Asia	India	0.0	0.2	0.0	0.3	0.8	0.7	0.7
		Nepal	0.0	0.0	0.0	0.0	0.5	0.5	0.5
	Southeast Asia	Singapore	0.5	0.0	0.5	0.0	0.0	0.0	0.0
	East Asia	China	0.3	0.3	0.0	0.5	0.3	0.0	0.3
		Japan	0.0	0.3	0.0	0.0	0.3	0.0	0.3
		South Korea	0.0	0.5	0.0	0.5	0.5	0.0	0.0
Europe	Northern Europe	Denmark	0.0	0.2	0.2	0.2	0.0	0.0	0.0
		Sweden	0.0	1.0	1.0	0.0	1.0	0.0	1.0
		United Kingdom	0.1	0.3	0.1	0.3	0.4	0.5	0.3
	Western Europe	Austria	0.0	0.4	0.2	0.0	0.2	0.0	0.2
		France	0.0	0.5	0.0	0.0	1.0	0.5	0.0
		Germany	0.1	0.2	0.2	0.1	0.1	0.1	0.2
		Netherlands	0.1	0.1	0.5	0.0	0.3	0.1	0.0
	Southern Europe	Italy	0.0	0.0	0.3	0.0	0.3	0.0	0.3
		Spain	0.4	1.0	0.6	0.2	0.2	0.4	0.0
Oceania	Australia and New Zealand	Australia	0.4	0.4	0.2	0.6	0.6	0.4	0.6
		New Zealand	0.5	0.5	0.0	0.5	0.5	1.0	1.0

Table 12
Civic energy strategy – number of references to presence of strategy instruments across the literature pool by country and region.

Regions	Country	Integrated Civic/ Distributed Energy Strategy	National or local targets or set asides for CE
North America	Canada	0	1
	USA	0	1
Northern Europe	Denmark	0	2
	Sweden	0	0
	United Kingdom	3	4
Western Europe	Austria	0	0
	Germany	0	0
	Netherlands	0	0
	Italy	0	0
	Spain	0	0
East Africa	Kenya	0	0
West Africa	Nigeria	0	0
South Asia	India	0	0
	Nepal	0	0
East Asia	China	0	0
	Japan	0	0
	South Korea	0	0
Australia and New Zealand	Australia	0	0
	New Zealand	0	0

small number of case studies documenting individual projects or policy programmes. This makes it difficult to discern whether this reflects a lack of CE and/or data and analysis in these country contexts. Nevertheless, there are a number of high-level observations we can draw from the patterns in the data.

The data demonstrates that a number of countries such as Canada, USA, Denmark, UK, Germany, and the Netherlands, have deployed policies at one point in time in at least one jurisdiction across every policy functional category, with policy instruments extending from market access (Category A) to localised planning and facilitation (Category B), and policies that set precedent, seed capability and legitimacy (Category C), indicating thicker policy mixes. Based on current literature, countries across Asia and Africa, as well as countries such as Austria, Italy, Spain, Australia and New Zealand are characterised by thinner policy mixes, either oriented exclusively towards economic instruments to ensure the financial viability of independent distributed energy without consideration of the unique constraints or attributes of civic energy (Category A policies), or by sporadic and lone standing financial support programmes for civic energy (Category C policies) (see Tables 13–19).

Policy focus within the literature varied by country and region. Policy mixes across South Asia and Africa appear largely focussed on capacity building and setting precedent (Category C) more so than market integration (Category A), but there are also exceptions. India, Nepal, Sri Lanka, China and Kenya have implemented broader CE policy programmes variably encompassing lenient power purchase agreements or guarantees, investment subsidies and regulated buy-back rates (Category A), in addition to regulatory concessions for small-scale renewable energy projects, regional targets and local authority mediated promotion and non-financial support, simple preferential planning consent procedures (Category B), CE grants and loans, installation of new regional intermediaries, and engagement with multilevel networks across financial services and technology manufacturers and suppliers (Category C) (see Tables 13–19) [18,44,316,319].

5.1. How do policy mixes shape country-specific types of CE and barriers observed?

The geographic distribution of policy mixes reflects both the dominance of different types of CE in different parts of the world, as well as country-specific barriers observed, in a number of ways (Table 11). The literature suggests that a range of policy contexts - from New Zealand, Australia, Spain, Cameroon, Nigeria, Ethiopia and Mozambique - have been relatively hostile to civic energy, resulting in long project timelines, high rates of failure and limited overall deployment [63,73,74,88,257]. In many of these contexts, such as the UK throughout the period 1970–2000 [86,173,203], Australia [9,324,325]; New Zealand [63,326,327], Chile [328] and some states in the USA [28,65,177,329], Category A policies have been absent, weak or inaccessible to small-medium scale projects. This has resulted in less widespread deployment, but also in CE taking on forms that circumvent the market, such as energy efficiency, self-consumption or direct supply projects designed to maximise generation to load and reduce dependency on conventional electricity supply, or alternatively, large-scale shared ownership projects in which commercial partners handle power purchase contracts as well as

Table 13
Market Access – number of references to presence of market access instruments across the literature pool by country and region.

Regions	Country	Grid connection procedures, guarantees or competitive access	Supplier Mandates/ Obligations	Power purchase guarantees	Priority dispatch	Appropriate Grid connection costs: Grid upgrade costs distributed	Advanced metering infrastructure & third-party access to consumer meter data; Data management and billing systems	Product definitions and stacking rules to support multiple use applications for energy storage
North America	Canada	1	1	0	0	0	0	0
	USA	2	4	1	0	1	3	0
Northern Europe	Denmark	1	2	1	0	0	1	0
	Sweden	0	0	1	0	0	0	0
	United Kingdom	1	1	0	0	0	0	0
Western Europe	Austria	0	0	0	0	0	0	0
	Germany	0	2	0	1	0	0	0
	Netherlands	1	0	1	0	0	0	0
	Italy	0	0	0	0	0	0	0
	Spain	0	0	0	0	1	0	1
East Africa	Kenya	0	0	0	0	0	0	0
West Africa	Nigeria	0	0	0	0	0	0	0
South Asia	India	0	0	0	0	0	0	0
	Nepal	0	0	0	0	0	0	0
East Asia	China	1	0	0	0	0	0	0
	Japan	0	0	0	0	0	0	0
	South Korea	0	0	0	0	0	0	0
Australia and New Zealand	Australia	1	1	0	0	1	0	0
	New Zealand	0	0	0	0	0	1	0

planning, construction, maintenance and operation of the plant [52,172,187,245]. In these less favourable policy and regulatory contexts, there has also been a recent emergence of CE projects in the form of solar 'behind-the-meter', embedded networks or real-time virtual local energy trading on the local distribution network, often purposefully designed to work around grid constraints or the absence of favourable offtake prices [9,188,199]. However, there no indication as of yet of widespread deployment of these projects, perhaps because they are typically financially and contractually complex, and depend on both data infrastructure and the presence of favourable grid connection policies, network charges and compensation for flexibility services that reflect the time and location-specific value of electricity [175,176,188,193,229,230,330].

Existing literature suggests that thick policy mixes in Canada, USA, Denmark, UK, Germany, and the Netherlands have provided unique opportunities for community-based, end-user innovations [31,121,310] and in some cases, for redistribution and shifts in dominant ownership patterns [43,295,331]. Although empirical literature on exclusive governance contexts characterised by thin policy mixes is scarcer, it suggests policy instruments to support place-based innovation or kick start civic projects exist incidentally to serve pre-existing arenas and are implemented in isolation and in an ad-hoc manner rather than following from consensus-based long-term sector decarbonisation strategies [63,88,172]. This literature points to limited entrepreneurial activity targeting demand-side innovations involving social and institutional change, generating largely passive engagement by households and community organisations and little direct civic engagement in shaping regime rules or in the diffusion of technology, widely divergent narratives on the meaningful role of CE, alongside barriers ranging from the lack of resources to regulatory barriers [63,73,257,275,283] (Table 11). Innovation is largely limited to technological improvements generating resource efficiency gains and adoption of market-competitive low carbon technologies by incumbents but can also feature diffusion of disruptive regime-destabilising technologies such as peer-to-peer trading platforms through acquisition or alliances between new entrants and incumbent industry [49,240].

Even where Category A policies exist and are aligned with the interests of a commercial renewable energy industry, CE projects differ from commercial projects in several key respects making their success dependent on specific policy design features and on a wider range of niche protective policies. In their early stages of development, grassroots niches feature a number of unique characteristics - ranging from their small size, lack of credit history, reliance on single sites, and democratic decision-making processes - that result in low risk tolerance and long project development timelines [45,69,70,86,187,223,332–334]. For instance, the use of support mechanisms that force technologies at different levels of maturity to compete, that do not remove short-term power price or imbalance risks, or that require large sunk investment and hedging across multiple projects, have driven out small-scale or community-based projects in a variety of country contexts [69,78,173,203,204,335,336].

While there are likely to be undocumented CE initiatives across the Global South, current literature suggests that overall, CE in the Global South is poorly institutionalised in mainstream energy markets and infrastructure and is dominated by initiatives operating beyond the energy market, where energy access is the primary goal. Demonstrative of the significant energy access challenges still facing large parts of the Global South, the overwhelming focus of CE literature from the global South has been on documenting barriers and programmes enabling decentralised energy solutions in rural off-grid settings, characterised by large state-led renewable energy programmes, or small to medium-scope aid-funded renewable energy programmes (Table 11). Because structural market and infrastructure and financial barriers have a smaller role to play in top-down, off-grid and grant-funded projects, the focus of this literature is on barriers and policies related to capacity for effective engagement, sustained operation and maintenance, such as technology standards, technology supply ecosystems, resourcing and skills for operation and repair, supporting income diversification and productive non-lighting uses of energy to sustain load, system revenues and long term sustainability of installations [18,44,287,288] (see Tables 13–19). Literature on community-led or grid-connected CE projects in the global south is scant, with only two case studies identified [18,44]. Nevertheless, as is the case in the Global North, successful country programmes documented in Kenya, Nepal and Sri Lanka, are characterised by multiple policy interventions in parallel, involving Category A policies that ensure the viability of independent energy initiatives (such as Kenya's market regulation for decentralised energy, tax credits; or Sri Lanka's regulatory exemptions for electricity generation and supply), as well as

Table 14
Securing Financial Viability – number of references made to presence of instruments securing financial viability across the literature pool by country and region.

Regions	Country	R&D Grants	Investment Subsidies, capital grants, energy bonuses	Low interest public loans, loan guarantees	Regulated buy-back rates above wholesale price; Subsidies for Renewable Heat	Premiums	Tax credits exemptions	Community Net metering, Net Metering or billing	Renewable Energy mandates and tradeable credit or certificate mechanisms	Auction systems	Incentives for small-scale DSR ancillary services	Fees for energy export, system services or electricity sale	Tax on generation or capacity
North America	Canada	0	0	0	3	0	2	1	1	2	0	0	0
	USA	1	6	3	2	0	7	5	2	0	1	0	0
Northern Europe	Denmark	0	0	0	3	2	3	1	3	1	1	1	2
	Sweden	0	1	0	0	0	1	0	1	1	1	0	0
	United Kingdom	0	3	1	6	1	0	0	0	1	1	0	0
Western Europe	Austria	0	1	0	0	0	1	0	0	0	2	0	0
	Germany	1	3	2	6	1	3	0	0	1	1	1	0
	Netherlands	0	4	1	3	1	2	2	0	0	0	0	0
	Italy	0	0	0	1	0	0	1	0	0	0	0	0
	Spain	0	0	0	0	1	0	1	0	0	0	0	1
East Africa	Kenya	0	0	0	0	0	0	0	0	0	1	0	0
West Africa	Nigeria	0	0	0	0	0	0	0	0	0	0	0	0
South Asia	India	0	3	2	0	0	1	0	0	0	0	0	0
	Nepal	0	0	0	0	0	0	0	0	0	0	0	0
East Asia	China	0	0	0	2	0	0	0	0	0	0	0	0
	Japan	0	1	0	3	1	0	0	0	0	0	0	0
	South Korea	1	2	0	2	0	0	0	0	0	0	0	0
Australia and New Zealand	Australia	0	1	0	2	0	0	0	1	0	1	0	0
	New Zealand	0	0	0	0	0	0	0	0	0	0	0	0

Table 15
Legal Frameworks for Collective Ownership - number of references made to presence of instruments across the literature pool by country and region.

Regions	Country	Suitable corporate legal frameworks	Market legislation allowing local authorities to procure electrical power on behalf of residents	Market legislation allowing for bundled generation, distribution and retail within a single CE organisation	Market legislation allowing direct P2P electricity supply and exchange	Market legislation allowing access to balancing markets	Mandatory CE programmes	Guidance or mandatory shared ownership, social procurement or comm benefit requirements	Clear nonprescriptive legal definition of CE; Eligibility rules	Non-profit regulation for monopoly services
North America	Canada	0	0	0	1	0	0	2	0	0
	USA	0	3	0	1	0	2	2	2	0
Northern Europe	Denmark	0	0	0	1	1	0	3	1	2
	Sweden	0	0	0	0	0	0	0	0	0
	United Kingdom	1	0	0	0	1	0	2	1	0
Western Europe	Austria	1	0	0	2	1	0	0	1	0
	Germany	1	0	0	1	1	0	0	1	0
	Netherlands	0	0	0	0	0	0	0	0	0
	Italy	0	0	0	1	0	0	0	2	0
	Spain	0	0	0	0	1	0	1	0	0
East Africa	Kenya	0	0	0	0	0	0	0	0	0
West Africa	Nigeria	0	0	0	0	0	0	0	0	0
South Asia	India	0	0	0	1	0	0	0	0	0
	Nepal	0	0	0	0	0	0	0	0	0
East Asia	China	0	0	0	0	0	0	0	0	0
	Japan	0	0	0	0	0	0	0	0	0
	South Korea	0	0	0	0	0	0	0	0	0
Australia and New Zealand	Australia	0	0	0	0	0	0	1	0	0
	New Zealand	0	0	0	0	0	0	0	0	0

Table 16
Localised Planning and Facilitation - number of references made to presence of instruments across the literature pool by country and region.

Regions	Country	Simple preferential planning procedures for small scale RE	Municipal bylaws, regulations and guidelines	Training of municipal staff and building inspectors in RE technologies & building performance	Tailored certification, benchmark & labelling systems	Regional energy demand and supply mapping and planning, regional targets	State or municipal investment incentives	Direct investment or project leadership or kind support by local authorities or local anchor institutions	Local authority mediates site pre-feasibility mapping and RE zoning	Local authority mediated promotion and non-financial support of CE	Strong local regional multi actor networks	Legal framework and programmes for access to public or private land or right to rent roofs
North America	Canada	0	2	0	0	2	1	0	0	1	1	1
	USA	0	2	1	0	5	7	3	1	0	7	0
Northern Europe	Denmark	1	0	0	0	3	0	1	2	0	0	0
	Sweden	0	0	0	0	1	0	0	0	0	0	0
	United Kingdom	1	0	0	0	0	0	0	0	2	2	0
Western Europe	Austria	0	1	0	1	1	0	1	1	0	1	0
	Germany	0	0	0	0	3	3	2	1	1	1	1
	Netherlands	0	0	0	0	3	4	2	0	1	1	1
	Italy	0	0	0	0	1	0	0	0	0	0	0
	Spain	0	0	0	0	1	0	1	0	0	0	0
East Africa	Kenya	0	0	0	0	0	0	0	0	0	1	0
West Africa	Nigeria	0	0	0	0	0	0	0	0	0	0	0
South Asia	India	0	0	0	0	0	0	0	0	0	0	0
	Nepal	1	0	0	0	0	0	0	0	0	1	1
East Asia	China	0	0	0	0	1	0	0	0	1	0	0
	Japan	0	1	0	0	2	1	1	0	0	1	0
	South Korea	0	1	0	0	2	2	0	1	2	2	1
Australia and New Zealand	Australia	0	0	0	0	0	1	0	0	0	1	0
	New Zealand	0	0	0	0	0	0	0	0	0	0	1

Table 17
Capacity Building - number of references made to presence of instruments across the literature pool by country and region.

Regions	Country	National/regional handholding of projects by intermediaries	Needs assessment & Project viability appraisal	Planning and resourcing O&M, use of end products post-installation	How to guidance, skills development training	Advisory services, Guidance on viable blueprints and measures	Matchmaking projects with technical legal financial expertise and partnerships	Strong multilevel networks networking and knowledge sharing programmes
North America	Canada	1	0	0	2	0	0	0
	USA	3	2	0	10	3	8	5
Northern Europe	Denmark	0	1	0	0	1	0	0
	Sweden	0	0	0	0	0	0	1
	United Kingdom	6	2	0	2	3	3	3
Western Europe	Austria	0	0	0	0	1	1	0
	Germany	1	0	0	0	0	1	0
	Netherlands	1	0	0	0	0	0	3
	Italy	0	0	0	0	0	1	0
	Spain	0	0	0	0	1	0	1
East Africa	Kenya	0	0	0	0	0	0	0
West Africa	Nigeria	0	1	1	1	0	0	0
South Asia	India	3	2	4	4	0	3	0
	Nepal	2	2	2	2	1	1	0
East Asia	China	1	0	0	0	0	1	0
	Japan	0	0	1	0	0	0	2
	South Korea	0	0	0	1	0	1	1
Australia and New Zealand	Australia	1	0	0	1	0	0	1
	New Zealand	0	0	0	0	0	0	0

Table 18
Access to Finance - number of references made to presence of instruments enabling access to finance across the literature pool by country and region.

Regions	Country	Low risk public loan or grant programmes for seed funding of early project phases	Existing innovation, development or decarbonisation funds consistent with CE	Low risk public loan programmes for capital funding	CE grants	Community energy tariffs or premiums	Special provisions for CE in renewable energy tenders, auctions or procurement programmes	Tax privileges for social enterprise
North America	Canada	1	0	3	3	3	1	0
	USA	1	1	4	4	0	0	1
Northern Europe	Denmark	1	0	0	0	0	2	0
	Sweden	0	0	0	0	0	0	0
	United Kingdom	4	0	2	8	0	0	1
Western Europe	Austria	0	0	0	0	0	0	0
	Germany	1	0	0	0	0	4	0
	Netherlands	1	0	0	1	0	0	1
	Italy	0	0	0	0	0	0	0
	Spain	0	0	0	0	1	0	0
East Africa	Kenya	0	0	1	0	0	0	1
West Africa	Nigeria	0	0	0	0	0	0	0
South Asia	India	0	0	1	4	0	0	0
	Nepal	0	0	1	1	0	0	0
East Asia	China	0	0	0	2	1	0	0
	Japan	1	1	0	0	0	0	0
	South Korea	1	1	0	0	0	0	0
Australia and New Zealand	Australia	0	0	0	1	0	0	0
	New Zealand	0	1	0	1	0	0	0

Category B and Category C policies (see Tables 13–19).

5.2. How does governance shape observed policy mixes?

The literature analysed points to several ways in which thick or thin policy mixes reflect country-specific differences in governance, in terms of material-economic, discursive and actor-institutional context.

Category A market access and financial viability policies have widely followed energy sector unbundling and privatisation reforms that have taken place in the 80's to 90's around the world and are characteristic of renewable energy support policies in many countries across the world [195,337], yet there are exceptions to this rule (see for example [63]). Energy sectors that were historically or are currently nationalised as a result of large-scale domestic hydropower or fossil fuel resources, such as those in South Africa, to Chile, UK, Sweden, New Zealand as well as provinces or states in Canada and Australia, do not lend themselves comprehensive Category A policies or to broadscale diffusion of CE, compared to countries like Germany and Denmark that have maintained more diverse forms of ownership. Although little is known about recent Chinese community solar programmes and the policies enabling them - the Chinese context may present an interesting anomaly. Documented CE projects in China are fully funded and implemented by state controlled local distribution companies with ownership and revenue management transferred to village unions [316,338].

Although the development of overarching policy strategies is thought to allow the identification of policy gaps and facilitate

Table 19
Legitimacy & Positive narrative - number of references made to presence of instruments across the literature pool by country and region.

Regions	Country	Data collection, impact evaluation	Case studies, benefits and sector promotion	Guidance of CE for local government landowners and lenders
North America	Canada	0	0	0
	USA	1	5	0
Northern Europe	Denmark	1	0	0
	Sweden	0	0	0
	United Kingdom	5	3	2
Western Europe	Austria	2	1	0
	Germany	0	0	0
	Netherlands	1	0	0
	Italy	0	0	0
	Spain	0	1	1
East Africa	Kenya	0	0	0
West Africa	Nigeria	0	0	0
South Asia	India	0	1	0
	Nepal	0	0	1
East Asia	China	1	0	0
	Japan	0	0	0
	South Korea	1	0	0
Australia and New Zealand	Australia	0	0	0
	New Zealand	0	0	0

coordination and coherence across policies [161,339] (Quitzow, 2015; Rogge & Reichart, 2016), the empirical literature on CE suggests that overarching CE strategies remains rare in practice (Table 12). CE strategy in some countries (Ireland, Denmark) has been integrated into sector wide climate or energy strategy, whereas standalone non-statutory CE or local energy strategies have featured in England, Scotland and Australia. The European RED serves as an overarching strategy to some extent but is limited to foundational legal frameworks for enabling market access, legal frameworks for collective ownership and data collection practices for CE [62]. This suggests that to support CE, there is ample opportunity to better coordinate strategy across relevant ministries and implementation agencies responsible for policy categories A, B and C in the policy mix identified (Fig. 2) to ensure alignment and coherence across policy domains.

6. Conclusions

Drawing on a systematic overview of barriers and policies for civic energy by country and region from 1980 to 2023, we set out a generic policy mix enabling civic energy, showing how different policy categories address existing barriers to specific types of CE projects on the ground, with each category consisting of a set of policy instruments (whether local, state and/or federal, or supranational). This generic policy mix comprises seven categories of policies (market access, financial viability, mutual ownership, regional resource planning and facilitation, access to finance, local capacity and positive narrative building) that collectively ensure project viability, enable place-based social innovation, and support capacity for and legitimacy of CE.

Our analysis suggests that the extent to which inclusive policy mixes have been implemented will influence the types of civic projects that are viable as well as the extent of uptake. We show that when policy mixes support widespread diffusion of civic energy, they are likely to be "thick"; meaning that they align a wide range of corporate legal, market access, energy subsidy, localised planning and facilitation, access to finance, and capacity building policies - extending well beyond the domain of energy policy. Specifically, in order to engage in medium to large scale renewable energy projects with potential to support local socio-economic development, CE projects must have market access and access to policy support mechanisms that make projects viable, with legal frameworks and market regulation designed to encompass social enterprise. Based on the evidence reviewed, it is likely that policies enabling both viable independent energy projects and structural policies enabling place-based innovation are necessary to support widespread engagement of CE. For widespread adoption of CE in contexts where there is a lack of historical precedent for civic enterprise, and a lack of established organisations, support networks and financing mechanisms, including in marginalised communities, it becomes necessary to take active measures to seed capability, set precedent and legitimise collective action. Validating these findings requires empirical research that aligns policy mix evolution with country level datasets on the size and shape of CE.

The generic policy mix presented here provides an analytical construct for researchers, advocates and policy analysts seeking to understand how CE can be encouraged, to critically evaluate and improve policy for CE in their jurisdiction. Current academic literature on barriers and policies documented internationally - as far as it provides a snapshot of barriers and policies on the ground - indicates that large parts of Africa, Oceania and Asia are characterised by thin policy mixes, with thicker policy mixes documented across North and Western Europe, North America. CE in the Global South remains poorly institutionalised in mainstream energy markets and infrastructure and is dominated by initiatives operating beyond the energy market. While these are a broad sweeping generalisations based on incomplete data, which do not do justice to the significant variation in governance and policy across provincial or state jurisdictions, nor the large scale and highly successful CE programmes in Nepal, Sri Lanka, China as well as CE in Kenya which have involved concerted deployment of policy instruments to ensure market access, financial viability, effective market regulation, access to finance and local capacity, the findings indicate at the very least that there is ample room in many jurisdictions to extend policy priorities more broadly across the functional categories. For example, policy entrepreneurs may seek to co-ordinate better across relevant ministries and agencies, and deploy regulatory experiments currently limited to flexibility on peer-to-peer trading, and local network tariffs under purview of electricity regulators ("regulatory sandbox") [176,340] more broadly to address regulatory barriers and policy gaps across the policy mix.

The policy mix framework set out here allows for systematic comparative research on CE in energy transitions at an aggregate national or state level. Such comparative research is necessary if we are to demonstrate clear empirically founded relationships between CE on the one hand, and politically viable pathways and speed of transitions on the other. Current theory and literature suggest that inclusive contexts associated with 'thick' policy mixes support diverse multi-stakeholder and civic arenas and generate broad winning coalitions in support of technological diffusion. In contrast, exclusive contexts are posited as manifesting in thin policy mixes with substantial policy gaps, inconsistent policies and/or lack of credible policies, narrow winning coalitions, policy instability and incremental diffusion, as well as technology and infrastructural development that is far removed or at odds with local communities. However, in order to build a robust basis that can demonstrate the value of inclusive innovation as a practical and beneficial approach to meeting emission reduction goals, future studies are needed to confirm the existence of exclusive and inclusive governance and policy settings in these country contexts, in relation to key indicators for both inclusivity and speed of transitions. Utilising emerging country-level datasets on CE, we can compare variably inclusive energy transitions across different political economies and pinpoint the preconditions for inclusive low carbon innovation, enabling translation of knowledge and findings across contexts.

Setting the stage for comparative research, this study reviews existing theory and evidence on the range of actor-institutional, material-economic and discursive factors underpinning country contexts distinguished by thin versus thick policy mixes. Literature suggests that "thick" policy mixes emerge in contexts where there are narratives and conscious strategies for participation, political opportunities and resources mobilised towards enabling participation, with high degrees of fiscal and legislative decentralisation and policy coordination. In contrast, contexts characterised by low levels of civic energy are posited as having "thin" policy mixes, with limited opportunity for inclusive visioning or experimentation in multi-stakeholder platforms, limited decentralisation and policy coordination, resulting in marginalisation of civic arenas, conflicting framings and lack of high-level strategies for civic participation. Studies comparing the policy mix over time across countries in relation to the diversity and penetration of CE will allow us to identify the specific institutional arrangements and political contexts that produce more or less inclusive policy mixes and that result in positive socio-political, fiscal and administrative feedback effects, and effective policy pathways. This might involve identifying key inflection points for institutional change that have set the stage for positive feedback effects, mapping them against key indicators for both inclusivity (such as CE as a proportion of total renewable energy capacity or investment) and speed of transitions (such as energy CO2 emissions, carbon intensity, or investment over time) as well as mapping them against distinct material-economic and actor-institutional contexts.

CRediT authorship contribution statement

Anna L. Berka: Conceptualization, Data curation, Methodology, Formal analysis, Writing, Visualization, Project administration. **Christina E. Hoicka:** Paper structure and strategy, Review & Editing. **Karl Sperling:** Review & Editing.

Research Data for this article

Berka, Anna (2024), "Civic Energy International Overview of Barriers and Policies", Mendeley Data, V2, doi: 10.17632/5xndc8ymty.2.

Declaration of competing interest

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

Acknowledgements

Thanks to Volker Hoffman, Jeffrey York, Gail Whiteman, Yan Yifei and Karen Hytten for feedback on an early version of this article. This study would not have been possible without the work of civic energy researchers worldwide.

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