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Explaining inclusivity in energy transitions: Local and community energy in Aotearoa New Zealand

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ABSTRACT

International literature on citizen, local and community energy (LCE) has grown exponentially but has focussed on European and North American context. This paper contributes to understanding inclusivity in country-specific energy transition pathways, setting out an empirical analysis of grassroots energy innovation practices in a country that has to date followed an incumbent-led energy transition pathway – Aotearoa (New Zealand). A groundswell of emerging LCE initiatives face protracted feasibility stages and high failure rates, primarily due to lack of market access and risk exposure, and a lack of policy co-ordination and streamlining, with no popularised articulation of a collective energy transition strategy as such. Barring changes in discourse, regulation, and institutional arrangements, future LCE development is likely to be oriented primarily to accommodate utility-scale renewable energy through energy efficiency and demand side management. Within this unsupportive regime context however, we observe uniquely resourced forms of LCE, and identify strategies and policies for a more inclusive pathway. Our findings reveal the limits of grassroots agency and the dependence of wider diffusion of LCE on an enabling institutional context, suggesting there are understudied transition pathways in which opportunities for LCE are relatively constrained.

1. Introduction

'Grassroots energy innovation', 'citizen-', 'local -' and 'community energy' has received heightened attention from scholars and policy makers in recent years, yet a large proportion of this research has been carried out in European context. Grassroots energy innovation in socio-technical transitions literature has been loosely defined as (new forms of) collective engagement in sustainable energy solutions that takes place in civil society arenas and is tailored to local needs and values (Seyfang and Smith, 2007; Gupta et al., 2003; Smith et al., 2016). However, local and community energy (LCE) is studied across the social sciences where it variably denotes the engagement of local authorities and citizen collectives, both local and dispersed, in the provision of energy services, ranging from power generation, distribution, retail, storage and clean transport (Becker and Kunze, 2016; Walker and Devine-Wright, 2008; Hicks and Ison, 2018; Hoffman et al., 2013; Klein and Coffey, 2016; Koirala et al., 2018). Much of this interest has centred on its ability to harness capital investment by civil society actors that can speed up necessary deployment of clean technologies, drive end-user technology differentiation, and facilitate increased legitimacy, public and political support for low carbon energy policy by delivering a fairer distribution of costs and co-benefits of the transition to renewable energy (Jacobsson and Lauber, 2006; Seyfang

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et al., 2014; Smith and Stirling, 2018; Ornetzeder and Rohracher, 2013; Phimister and Roberts, 2012). Furthermore, it is thought to deliver benefits beyond energy decarbonisation, by (re-)introducing platforms for civic engagement in the public domain and cultural renegotiation towards sustainable lifestyles (Hoffman and High-Pippert, 2005; Smith, 2006; Seyfang, 2007; Seyfang and Smith, 2007; Smith and Sterling, 2018).

Despite the popularity and expectations around the transformative potential of LCE, an emerging number of empirical studies suggest that the presumed roles, impacts and outcomes of LCE in sustainability transitions are not given, nor are they universal. First, the socio-economic and environmental impacts posited to arise from LCE projects have been shown to depend on the motivation of leadership, the degree of wider community engagement, the business model design and other characteristics (Berka and Creamer, 2018; Devine-Wright, 2019). The large diversity of projects and organisations – in terms of pertinent local needs and motivation, social dynamics and levels of engagement, technology, scale, legal and ownership models, as well as their dependence and influence on state and private actors – precludes simple generalisations on their impact and contribution to system-wide change (Creamer et al., 2018, 2019; Rogers et al., 2012). This diversity is likely the reason for LCE's ambiguous role in relation to technology innovation; while there is evidence for a role in pre-commercial technological innovation (Smith et al., 2014; Nielsen, 2005; Szarka, 2007; de Vries et al., 2016; van der Waal et al., 2018), there is also abundant evidence that small new LCE organisations possess limited resources and ability to manage risks associated with pre-commercial technology, making these endeavours relatively dependent on a favourable policy environment (Bauwens et al., 2016; Berka et al., 2017; Bolinger, 2001; Harnmeijer, 2012; Gorrono-Albizu et al., 2019; Kelsey and Mickler, 2018; Kooij et al., 2018; Mitchell, 2010; Morris, 2013; MacArthur, 2016; Nolden, 2013; Oteman et al., 2014). Second, it has become clear that narratives around the role of the energy transition in realising far reaching social, technical and environmental transformations centred on citizen engagement appears to be playing out very differently across countries and states, with local authorities and community organisations playing no role, minor roles or undertaking a large proportion of new energy developments. An increasing number of publications now provide an overview of civic or community energy at country level, providing a rich empirical resource with which to engage with questions around the role of LCE in renewable energy transitions (Hoicka and MacArthur, 2018; Berka, 2018a; Braunholtz- Speight et al., 2018; Kelsey and Mickler, 2018; Wierling et al., 2018; Hewitt et al., 2019; Gorrono-Albizu et al., 2019; Heras-Saizarbitoria et al., 2018). Taken together, this evidence suggests that the substantial role of LCE in driving pre-commercial development of solar and wind technology in Denmark and Germany may have been unique and context-dependent, raising the question as to what are the preconditions for grassroots-driven low carbon transition pathways. To this end, the literature provides a number of clues, but remains far from conclusive.

Furthering our understanding of the context-specific roles of local and community energy in energy transitions will require a better understanding of the diverse forms of LCE in relation to impacts and the political opportunities derived from different governance and policy contexts. Given the diversity of LCE projects, we argue that this kind of analysis requires the development of LCE typologies and country level datasets to ensure the representative sampling of case studies, in addition to analysis of the governance context, all of which needs to be analysed and interpreted within the wider context of country-specific attributes of decarbonisation pathways.

This study explores the current and potential role of local and community energy in New Zealand's energy transition. It draws on research in grassroots energy innovation, community energy, energy policy and political economics, using concepts from strategic niche management, technological innovation systems and energy transition pathways to support arguments for how LCE may contribute to New Zealand's energy transition and shape dynamics of change going forward. With a longstanding reliance on hydropower for electricity generation, historically centralised energy governance and no concerted policy co-ordination to facilitate distributed energy activities to date, New Zealand provides an interesting contrast to the European context, which variably features centralised targets and support mechanisms for distributed renewable energy and for citizen energy specifically (REN, 2017a,b; Harker et al., 2016). In contrast to the UK, Netherlands, Denmark, or Germany, for example, the role of local authorities and community actors in meeting New Zealand's decarbonisation goals remains understudied, reflecting the lack of data, the limited development, and lack of discourse around LCE within public, policy and academic circles to date. New Zealand is also characterised by a large indigenous Māori population with strong claims to natural resources, representing a uniquely resourced and motivated form of community energy (MacArthur and Matthewman, 2018).

In what follows, we begin by setting out a conceptual framework to characterise grassroots energy niches and their context-specific role in energy transition pathways, drawing on literature to set out how widespread diffusion depends on country-specific windows of opportunity emerging from the wider techno-economic, institutional and discursive context (Section 2). Section 3 sets out research design and methodology, explaining how we conceptualise diversity across New Zealand LCE projects based on existing international typologies for local and community energy, followed by a description of how we have collected corresponding data and analyse the wider domestic context. Section 4 provides a descriptive overview of the current status, overall penetration and diversity of LCE initiatives in New Zealand, and explains LCE emergence in relation to New Zealand's energy governance context, asking to what extent elements of the socio-technical regime have presented prohibitive barriers and shaped opportunities for LCE development. Section 5 builds on our findings to identify potential windows of opportunity for LCE that may arise from internal and external pressures on the incumbent industrial regime, discusses the possibility of more inclusive pathways and the factors and policies likely to enable them. Our concluding section reflects on our contribution to the energy pathways and political economics of socio-technical transitions literature.

2. Conceptualising context-specific roles of local and community in energy transition pathways

2.1. Characterising and delineating local and community energy

What distinguishes community energy from other energy initiatives and the attendant benefits is an ongoing debate, in part driven by normative theoretical contributions, and part driven by the diversity of the ways in which citizens engage with energy, and with state and private sector actors, across countries and regions. Grassroots niches are often explicitly or implicitly distinguished from other kinds of niches (commercial actors, or dispersed communities unified by a common interest) as having potentially transformative effects on sustainable development. Contrary to commercial niches, LCE niches are conceptualised as manifesting in social experiments in tandem with adoption and novel applications of pre-commercial clean technology innovations, ensuring social and environmental values are integrated in the innovation process (Dóci et al., 2015; Grin et al., 2010; Heiskanen et al., 2010; Hielscher et al., 2013; Hess, 2007; Ornetzeder and Rohracher, 2013; Seyfang et al., 2014; Seyfang and Smith, 2007; Smith, 2012; Smith and Stirling, 2018). LCE is often (implicitly or explicitly) conceptualised as a springboard to local collective action in domains well beyond energy, in part due to their ability to exploit local synergies across industries (Hoffman and High-Pippert, 2005; Haggett and Aitken, 2015; van der Waal et al., 2018). This explains its popularity with STI scholars, who conceptualise transformative change towards sustainable development in part through reflexive consensus building, cultural change and demand-side dynamics, rather than a change process purely driven by supply-side technology innovation (Markard and Truffer, 2008). Project revenues may be reinvested in a wide range of public goods to materialise in sustained local experiments in which local institutions, technology, built environment, culture and consumer behaviour are gradually and collectively reoriented as activities are evaluated, replicated and scaled up, effectively shortening the distance between production and consumption in, and enabling civic control over, key industries that are not meeting societal expectations.

A useful distinction places LCE in the value realm of mutuality and community trade, in which goods and services are allocated through continuing ties and subject to collectively defined social and cultural values, as opposed to operating vis-a-vis market and impersonal trade, where goods and services are impersonally and competitively exchanged subject to individual gains (Gudeman, 2009; Seyfang and Longhurst, 2015). Mutuality enables LCE to overcome the shortcomings of individualised behavioural approaches to environmental issues by tapping into a values-driven cultural renegotiation of sustainable lifestyles through person-to-person relationships (Smith, 2006; Seyfang, 2007; Seyfang and Smith, 2007). A number of authors have highlighted the important role that 'critical reflection' or political motivation plays as an arbiter between variants of community energy (Seyfang, 2009; Smith et al., 2013, 2016; Becker and Kunze, 2016). This approach distinguishes between practices and organisations within the energy sector that are mobilised as a social movement to challenge incumbent industries and practices versus use of the term as an apolitical, geographically prescribed bundle of activities. In its narrowest sense then, LCE is seen as strictly communitarian and mobilised by a mismatch between incumbent practices and local social needs and ideology.

From an empirical standpoint, the term 'community' is associated with widely different interpretations. The two common factors that were found to distinguish community energy from other projects across a broad range of stakeholders in the UK were 'open and participatory management processes' and positive 'local and collective outcomes' that extend beyond private economic gains to public social and environmental benefits (Hoffman et al., 2013; Walker and Cass, 2007; Walker and Devine-Wright, 2008). This provides a looser conceptualisation of community energy that is congruous with definitions emerging from US (Hoffman et al., 2013; Hoffman and High-Pippert, 2005; Klein and Coffey, 2016), Germany (Becker and Kunze, 2016) and Canada (Hoicka and MacArthur, 2018; MacArthur, 2016) and does not necessarily exclude publicly or even commercially-owned projects with an emphasis on citizen participation and local benefits. Across Europe and North-America, local authorities and commercial peer-to-peer projects have been variably shown to take on key leadership roles in consumer-facing energy projects, in addition to partnership and facilitating roles in local citizen-led energy projects, or in some cases, dilute theorized impacts of local and community engagement (Creamer et al., 2018; Fudge et al., 2012; Hall et al., 2015; Hoppe et al., 2015; Peters et al., 2010).

Setting out the dimensions by which projects laying claim to the term 'community energy' differ internationally, Hicks and Ison (2018) demonstrate the importance of using more broad and flexible definitions of community energy than previous scholarship in order to be able to assess the nature and potential value of diverse and context-specific forms of citizen engagement. This allows researchers to reflect on the empirical practice of the sector as it manifests itself in various forms in response to diverse socio-technical contexts, resources, and governance contexts (Geels, 2014; Hillman et al., 2018; Smith, 2007). They view sociopolitical context and actor motivations as factors that mobilise any given community energy initiative, with levels of wider community engagement, organisational management, technology and finance as mediating the community related impacts and outcomes of specific projects (Hicks and Ison, 2018).

2.2. Emergence and diffusion of local and community energy in different country contexts

Despite widespread use of the term 'grassroots energy innovation', the (historical or potential) contribution of grassroots niches in technological innovation is not well established (Ornetzeder and Rohracher, 2013). There is some evidence of self-organised civil society engagement in engineering, assembly, piloting and improvement of wind and solar technology at early stage of maturation ('nursing markets'), much of it taking place between 1970 and 2010, and much of it dependent on voluntary labour, educational institutions, and/or local government funding (Smith et al., 2014; Nielsen, 2005; Szarka, 2007). However, the vast majority of deployed local and community energy today can be classified as diffusion within bridging and mass-markets and followed after 2000 (Berka, 2018a; Braunholtz- Speight et al., 2018; Wierling et al., 2018; Hewitt et al., 2019; Gorrono-Albizu et al., 2019; Heras-

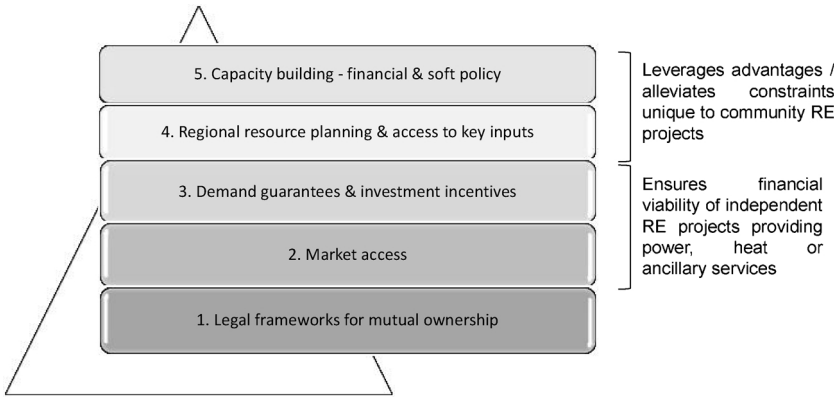

Fig. 1. Categories of policy instruments enabling community energy.

Saizarbitoria et al., 2018). It involves deployment of off-the-shelf technologies, or novel applications and combinations of off-the-shelf technologies with incremental design improvements, where the novelty lies more in new business models to facilitate changes in user practices and 'new meanings' of technology (Ornetzeder and Rohracher, 2013; de Vries et al., 2016).

The processes and conditions enabling the diffusion of grassroots innovations for sustainability from local experiments into more established 'proto-regimes' has been extensively theorised (Seyfang and Longhurst, 2015; Smith, 2007; Raven, 2012; Ornetzeder and Rohracher, 2013). Diffusion requires collective articulation of alternative energy futures, networking, recruitment of new actors and networking in advocacy coalitions, and knowledge exchange between projects (Seyfang and Longhurst, 2015). Country level overviews of LCE suggest that the wider diffusion of LCE has occurred primarily through replication of successful blueprint model projects in new locations or contexts and is dependent on favourable landscape and regime properties; and on enabling policy support frameworks, electricity market design, and narratives dominating energy governance in particular (Avelino and Wittmayer, 2016; Bauwens et al., 2016; Berka, 2018b; Bolinger, 2001; Hall et al., 2016; Hamilton, 2011; Gorrono-Albizu et al., 2019; Harnmeijer, 2016; Hess, 2014; Kelsey and Mickler, 2018; Kooij et al., 2018; Mitchell, 2010; Morris, 2013; MacArthur, 2016; Nolden, 2013; Oteman et al., 2014). Taken together, the evidence seems to suggest that with abundant political motivation, and social and environmental values, local and grassroots entities have more flexibility than incumbents to pursue less profitable low carbon technologies in early stages of maturation, but are also limited by human and capital resources (Walker, 2008; Tozer, 2013; Brummer, 2018; Ison, 2009; Hobson et al., 2016; Krupa, 2012; Reames, 2016; Harnmeijer, 2012; Bomberg and McEwen, 2012; Martin and Upham, 2016).

Building on this literature, the starting premise of this work is that techno-economic, institutional, and discursive context creates or denies windows of opportunity for grassroots innovation to take hold and become more widely established (see also Kooij et al., 2018). Institutional preconditions and policies have contributed to 'shielding' (protect from mainstream selection pressures), 'nurturing' (support the development) and/or 'empowering' (enabling the widespread diffusion) of LCE in a variety of ways (Fig. 1). Fundamental grassroots niche protective policies with predominantly shielding functions are low risk market integration mechanisms enabling market access and ensuring the financial viability of projects within the prevailing market context (Fig. 1) (Nolden, 2013; Morris, 2013; Bauwens et al., 2016; Bolinger, 2001). While grassroots and commercial niches both benefit from these policies, several authors have suggested that the lack of established grassroots organisations, the democratic decision-making processes and social and environmental ambitions inherent to some LCE organisations generally makes them dependent on unique policy design features (Berka et al., 2017; Grashof, 2019; Hess, 2013). For example, lower risk tolerance due to reliance on single smaller projects with on average longer development timelines tends to make high risk market mechanisms, such as volatile electricity spot markets or renewable energy auctions, inaccessible to LCE (Berka et al., 2017; Grashof, 2019). In addition, LCE depend on a wider range of niche protective policies than commercial niches, ranging from suitable legal frameworks for mutual ownership and their eligibility for public policy provisions that influence access to key resources (land, assets and finance), to capacity building and soft policy, which facilitates the widespread diffusion of LCE projects (Berka, 2018b, Fig. 1). While market access and incentives have been strategically pursued by clean energy advocates (Smith and Raven, 2012), many of the other policies in Fig. 1 are in fact pre-existing legacies of historical (co-operative, commercial, decentralisation) law and regulation, or policies introduced as part of broader established rural development, third sector policy programmes. As such, it is through coherent integration of policy across these domains, many of which are peripheral to climate change policy processes, that public policy goals around decarbonisation have been successfully married with locally pertinent social and economic needs.

Transitions typology literature further suggests that widespread civic engagement is associated with 'substitution pathways' but not necessarily with other transition pathways (Geels and Schot, 2007; Geels, 2011, 2014). In contrast to 'substitution' pathways in which radical innovations are developed by new entrants, creating opportunities for politically motivated grassroots actors, such as the German or Danish energy transition to date, 'transformation' and 'reconfiguration' pathways are characterised as incumbent-led, providing fewer opportunities for civic engagement in driving innovation, technology differentiation and diffusion (Geels et al., 2016). Incumbent industries gradually absorb and reorient themselves towards clean technology, either through new alliances with niche innovations (reconfiguration), incremental reorientation of technology, technical capability, business strategy and operating procedures, or by acquisition of niche innovations (transformation), facilitated by limited and layered institutional change (Geels

Box 1
New Zealand's energy transition conceptualised as an energy transformation pathway.

Remote settlements and abundant hydropower have meant that New Zealand's leadership in renewable electricity generation predates the Kyoto Protocol (Martin, 1998; Krumdieck, 2009). With an isolated, relatively small and hydro-power dominated electricity market, seasonal supply shortages and excess supply of lake storage inflows translate into high price volatility (Bertram, 2006). From a generators perspective, the only way to manage this risk is through complex bilateral financial contracts with an existing gentailer, or through acquisition of hedge contracts - but the market for hedge contracts is thin and market share of independent generators has steadily declined since 2000 (Bertram, 2006, 2013; Wolak, 2009). As such, there is a lack of competition, with evidence of collusion and barriers to entry resulting from vertical integration between generators and retailers (Bertram, 2006; Bollard and Pickford, 1995; Ahdar, 2011; MBIE, 2018). In 2016, 85 % of power was sourced from renewable sources, with the remaining 15 % provided by natural gas and coal sources. Despite high renewable electricity penetration, the country is in the early stages of putting in place comprehensive climate change and energy policy to address a 24 % growth in gross greenhouse gas emissions since 1990 (Productivity Commission, 2018). Within the energy sector, emissions growth is attributed to substantial growth in road transport and a relatively energy inefficient housing stock (IEA - International Energy Agency, 2017). Energy policy discourse has focussed largely on supply-side market dynamics, and the dominant political paradigm has so far inhibited a co-ordinated policy strategy for distributed energy (Mitchell, 2010; Barry and Chapman, 2009). The state retains part ownership of major utilities but has not engaged proactively in energy policy and regulation, such that energy market structure and policy remain largely unchanged since the 1980′s. Incumbents have lead wind and geothermal development, which is largely connected to transmission networks, meaning that technical challenges associated with distributed generation elsewhere have been largely circumvented to date. With low rates of R&D expenditure and a factor-driven productive and export base, the overall picture is one in which state failure to support low carbon innovation since ratification of Kyoto is likely due to a broader inability of the state to shield and nurture domestic niche innovations documented elsewhere (Hazeldine, 2000; International Energy Agency, 2017; Kelsey, 2002; MPI, 2018; Nana, 2016; Porter, 2001; Kelsey, 2015; Rosenberg, 2016).

et al., 2016). Transformation pathways are understudied, but often associated with energy systems characterised by direct state interests in energy. There may be a lack of vested interests in conventional fossil fuels, so that both the state and civil society have had less prerogative to facilitate and lobby for clean technology diffusion by non-incumbents and LCE may not be politically motivated. This may reinforce a pre-existing hands-off public policy approach to low carbon innovation and domestic innovation of novel goods and services more generally, meaning that these countries are by and large 'technology takers' (Box 1).

While current literature goes some way to explaining country-specific variation in the emergence of LCE, it remains unclear whether hitherto exclusive 'transformation' pathways such as New Zealand's pathway can remain exclusive as attention shifts to complete substitution to renewable electricity and electrification of transport, facilitated by large gains in energy efficiency and ICT-mediated flexibility in demand (Markard, 2018; Grubler et al., 2018; Cruz et al., 2018). As a repercussion of the whole system effects of intermittent renewable generation and electrification of transport, this 'second phase' of the energy transition is likely to be necessarily oriented towards consumer facing technologies, behaviour and associated delivery models, suggesting that we will see an increased pressure for community and local involvement (Creamer et al., 2018; Hoicka and MacArthur, 2018; Wolsink, 2012; Avelino and Wittmayer, 2016; Newig et al., 2010). However, these consumer facing activities may or may not be associated with above-mentioned ideals of critical reflection, mutuality and community trade (Smith et al., 2016; Devine-Wright, 2019). It seems likely that the country-specific forms and extent of civic participation emerging from early stages of the energy transition, along with associated intermediaries and networks, will shape subsequent opportunities and forms of civic engagement. For example, extensive early stage civic engagement in solar, wind and biogas diffusion may leave Germany and Denmark with a more extensive base of distributed technologies, established community and consumer facing actors with energy expertise that can subsequently be engaged in consumer facing transport, storage, and demand-side management innovation programmes, compared to countries following exclusive energy transition pathways, where incumbent actors may be better positioned to move into this space, adopting niche ideas into mainstream contexts to address emerging regime pressures (Seyfang and Longhurst, 2015).

3. Research design and methodology

To assess the role of LCE in New Zealand's energy transition, we collated a comprehensive LCE dataset and implemented stakeholder interviews in each identified ownership category. Following on from Hicks and Ison (2018), we examine rather than assert the benefits of particular organisational forms, ownership structures or practices, by taking a full account of the existing range of activities and assessing respective participation and impacts. In order not to overlook potential avenues of citizen engagement in the energy sector, we include all citizen, local authority and commercially-owned activities aimed at citizen participation in the scope of this study but take care to characterise them in terms of local public benefits and other key dimensions known to vary across LCE initiatives. These dimensions are taken from the literature and introduced below:

1) The *dominant motivation for undertaking a project or activity*, ranging from normative drivers, which may be of environmental nature (decreasing community carbon footprint, increasing energy awareness, increasing local renewable electricity supply) or purely political nature (local ownership, local control), to instrumental drivers, which are often primarily socio-economic (generating material benefits for members, generating local income, strengthening the local economy, strengthening the

community sense of togetherness, lowering energy costs, increasing reliability of electricity supply).
2) The *level of engagement*, based on Arnstein's ladder of participation, ranging from manipulation and tokenism at the bottom through to partnership and finally citizen power at the top (Arnstein, 1969);
3) The *outcome of the activity*, who is the project or activity for, who benefits socially and economically (Hoffman et al., 2013), this element seeks to distinguish between projects that may benefit communities but are only minimally run by communities from those that might have high levels of engagement and a small beneficiary base;
4) The *legal status* of the organisation(s), whether a non-profit society, co-operative, trust, local authority or private company. These structures each have particular legal requirements that can have implications for membership, participation, decision making power, access to finance and eligibility for certain public policies, as well as distribution of profits that mean they operate in distinct ways;
5) The *functional activity*, ranging from power generation, distribution, retail and energy efficiency, in order to capture relationships between organizational form and energy activity, as well as examine the varied roles that local and community energy plays. While the design of LCE projects is in general highly context-specific (Seyfang et al., 2014; Smith et al., 2015), grid-tied electricity generation projects have globally been the most dominant, replicable, and scalable form of modern community energy, particularly in Europe and North America, resulting in relatively little research in other energy activities. However, these form only part of the activities of the community energy sector (Haggett and Aitken, 2015; Kooij et al., 2018; Seyfang et al., 2013). LCE spans from energy efficiency and transport initiatives, bulk purchase of domestic microgeneration technology, heat generation and supply projects, to electricity generation (for self-consumption or for grid-export), storage, distribution or supply.

To amalgamate data on current and past LCE projects, projects and organisations were identified through relevant governmental and non-governmental organisations; Electricity Authority 2015 data on existing power generation plants, the Energy Trusts of New Zealand, the Energy Efficiency and Conservation Authority (EECA) through its funding and awards projects, and Community Energy Networks. Projects were also sourced through the New Zealand chapter of international organisations, such as Transition Towns New Zealand, local authority websites, and Cooperative Business New Zealand, which currently represents over 50 New Zealand co-operatives operating across a vast spectrum of industries (Table 1). This process generated a list of projects or distinct activities by organisation that potentially met our selection criteria, which were subsequently verified for inclusion through web-based search of organisation websites, project profiles on conference proceedings and national and local newspapers, and using the New Zealand companies register, based on the selection criteria set out in Table 2.

Web-based information was used in as far as possible to populate data fields on ownership structure (distinguishing between owner name, operator name and community organisation name to accommodate joint ventures), type of organisation (cooperatives, unincorporated community groups, iwi organisations, municipally owned entities, consumer trusts, charitable trusts, companies and partnerships/ joint ventures), primary activity of the community organisation (e.g. distribution, community development, generation, generation-retail, retail, local energy action, energy efficiency, public service, harbour management, lobbying/advocacy, local heritage, irrigation), project activity (e.g. distribution, retail, generation, energy efficiency, off-grid generation, remote battery management), year of organisation establishment, technology, plant capacity (MW), with additional notes on ownership and community benefits and participation. Other data fields included in the dataset were geographical location, project starting and operational date and current project status (suspended, investigating, under construction, operational), allowing us to explore possible historical links with national policies or programmes. While the dataset provides a representative overview of community energy in New Zealand, it inevitably contains omissions and errors, in particular with respect to older, unsuccessful or unsupported off-grid projects, and also excludes historical municipally owned projects no longer under local ownership.

Within each category we contacted a wide range of individuals leading LCE activities for interview, in some cases snowballing to follow up interviews with relevant staff. Interviewees targeted project managers and energy policy officers in local councils, chief executives and community outreach personnel in iwi trusts, chief executives in distribution line companies and board members of corresponding consumer trusts, directors of start-ups and community energy organisations. Interviews were semi-structured and directed at four key areas: 1) Projects and organisation: organisational mission, legal structure, projects and activities, business models, partners, and community participation, 2) Barriers and opportunities: projects and collaborations considered but not

Table 1
Key data sources and search terms.

Source	Notes
New Zealand AND (community OR civic OR citizen OR local) AND (energy OR wind OR solar OR hydro OR geothermal OR energy efficiency)	Online websearch
New Zealand AND energy co-operative OR Māori OR iwi energy OR energy trust	
Electricity Authority Generators 2015	Identified LCE projects through verifying ownership and project objectives via companies register and organisation websites
Energy Efficiency and Conservation Authority New Zealand (EECA)	Search on EECA website and publications for 'community', 'Māori', co-operative, or 'trust' or other local descriptor in name.
Community Energy Network, New Zealand	Search on CEN website for member organizations
Co-operative Business New Zealand	Online – search within website for member organizations with energy activities
Local council name + energy	www.localcouncils.govt.nz and online websearch

Table 2
Selection criteria.

Attribute	Details
Energy sector activity	Power generation, distribution, retailing, energy efficiency and energy related transport activities
Local and community ownership	Co-operative structure, municipal ownership, trust ownership, Māori, non-profit structure, partnership structures with private organization
OR	Multiple households or individuals in a geographical location are involved in project design, management, or owners or users of technology
Community participation	
New Zealand	Projects and activities in New Zealand

pursued, or tried and failed, organisational responses and problems surmounted, factors shaping new opportunities, organisational strategy and objectives vis-a-vis key barriers and opportunities for LCE 3) Networks: the degree of collaboration, networking and knowledge exchange with similar initiatives and within the energy sector more broadly, 4) Policies: regulatory, institutional or policy challenges, how regulation and market institutions shape the opportunities that are available to the organisation. Although not all individuals approached agreed to interviews, we were able to ensure that our interviews covered the full range activities and ownership structure (for example, ensuring that we covered community activities in wind, solar, solar-battery, geothermal and energy efficiency).

For further understanding of the governance context, we have drawn on status reports and interviews with representatives from the Electricity Authority, Energy Efficiency and Conservation Authority, Energy Trusts of New Zealand, Ministry of Business, Innovation and Employment and Ministry for the Environment. These interviews were directed at identifying embedded narratives around the role of local and community energy actors in the energy transition, networks and knowledge sharing spanning from the community energy sector to government, and any relevant policy action towards facilitating LCE. This process resulted in a total of 35 semi-structured interviews held during the course of November 2015 – August 2018.

We conduct this research as Pakehā, or non-Indigenous New Zealanders, which presents particular research challenges with respect to our ability to obtain information about some of those projects, as well as our ability to convey significant issues of cultural importance of Māori. Where possible we attempt to foreground the work of Māori scholars studying in this research field, but LCE in New Zealand is in a nascent period of development.

4. Local and community energy as a function of the energy regime context

A total of 198 initiatives that met our definition of local and community energy were identified. They comprise renewable (co-) generation projects (43 %), energy efficiency initiatives (35 %), and consumer trust owned distribution networks (14 %), with the remainder a variety of peer-to-peer, microgrid, co-operative generation-retail or remote battery management projects (7.5 %), the majority of which are at early feasibility or pilot stage. Of the 198 initiatives, 17 are suspended projects, 20 are at feasibility stage, and 161 are operational or under construction. Operational generation projects represent approximately 502 MW of local or community owned generation capacity (5.4 % of total installed capacity in 2017). One third of generation projects are hydro projects, while solar, geothermal and wind projects make up 24 %, 18 % and 18 % of projects respectively. However, measured by the share of installed capacity, geothermal plants are by far the most dominant generation technology. Local and community energy actors are not confined to one particular energy activity; power generation and energy efficiency are the focus areas for actor diversification (Fig. 2). Energy efficiency initiatives are widely distributed across the organisational profiles, and interviews suggest that state

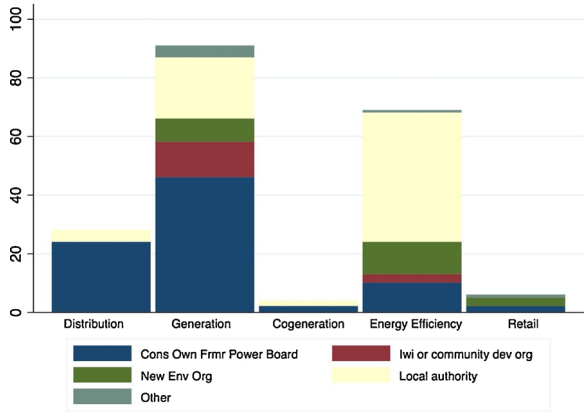

Fig. 2. Number of local and community energy projects by activity and organisation profile.

Table 3
Characterisation of local and community energy profiles in New Zealand.

Profile	Legal status	Activities	Motivation	Level of engagement	Outcomes
Iwi trusts	Settlement trusts	Generation	Normative (Self-sufficiency, self-empowerment); Instrumental (Employment, community development)	Consent, Voting rights, Partnership	Education and employment for Iwi beneficiaries
	Charitable Trust	Energy efficiency, Generation	Instrumental (Health, employment, community development) Normative (Self-sufficiency, self-empowerment);	Iwi control, consultation	Local community improved services, education; employment for local Māori.
Consumer trusts and co-operatives in distribution	(Charitable) Trusts	Distribution; Generation	Instrumental (member material benefit, lower cost of energy, community development)	Voting rights	Accountability and fair pricing for electricity consumers
	Co-operative	Distribution	Instrumental (member material benefit, lower cost of energy)	Voting rights	Accountability and fair pricing for electricity consumers
New environmental organisations	Charitable trusts	Generation; Energy efficiency	Normative (environmental stewardship, local ownership)	Citizen control	Decarbonisation, local benefits, community resilience, energy democracy, warm homes
	Co-operatives	Generation, Retail	Normative (environmental stewardship, local ownership)	Citizen control	Decarbonisation, local benefits, community resilience, energy democracy
Local authorities	N/A	Energy efficiency, Generation	Instrumental (Local energy supply resilience)	Informing, consultation	Warm homes, energy security
	N/A	Distribution; Generation	Instrumental (constituent material benefit, lower cost of energy)	Informing, consultation	Accountability and fair pricing for electricity consumers
Peer-to-peer	Limited companies	Generation, Retail	Normative (choice, environmental stewardship); Instrumental (lower cost of energy)	Partnership (participation)	Consumer control; lower electricity prices; decarbonisation (reducing peak energy demand)

funded energy efficiency subsidy programmes ('Healthy Homes'[1]) and regional development funds have variably been a lifeline for a wide variety of LCE organisations. In some cases these activities have catalysed microgeneration projects on community facilities, and affordable housing projects.

The dataset and interviews reveal an active, geographically dispersed and diverse set of projects and activities within which we can distinguish five dominant profiles. Although there is diversity within the five profiles identified, each of these LCE profiles associates in distinct ways with respect to legal status, activity, motivation, form of participation or engagement, and outcomes (Table 3).

(i) The majority of LCE initiatives are *consumer-owned former power boards in the form of consumer trusts and co-operatives,* or charities that have divested but are derived from them (42 %, 83). Local power boards functioned as integrated energy service companies until the 1990′s when they were corporatised, and distribution, retail and generation assets were separated. These locally elected power boards, having corporatised and variably transferred assets to consumer held trusts or local authorities (and in one instance, a co-operative) were given a choice as to which assets to sell (retail and generation, or distribution). Consumer trusts have primarily retained ownership of power distribution assets, but in at least three cases have retained control over generation and supply assets.[2] However, 41.5 % of locally owned distribution network operators remain involved in power generation, and distribution network operators represent the leading form of locally owned generation (see 'Consumer-owned Former Power Board or derivative', Fig. 2). A substantial proportion of this generation capacity is existing hydro-power predating the Kyoto era.

They are to varying degrees becoming more involved in off-grid solar battery deployment, solar PV school projects, EV infrastructure development, funding home insulation, and demand-side management innovation, including two virtual power plants for disaster resilience, and two peer-to-peer projects. Smaller remote operators facing declining or volatile electricity demand in sparsely populated areas in particular are actively involved in consumer focussed demand side flexibility programmes or rural area power solutions, whereas other CEO's stated that these activities fell well outside of their legislated mandate. Although operators are clearly engaging in novel activities in the form of pilot projects, their current scope of activity falls short of a central co-ordination role around facilitating widespread distributed generation, storage and ancillary services that we see distribution network operators assuming internationally (Frame et al., 2018). In select cases, they invest directly in local industry. Interviews suggest that all the activities in this category are predominantly motivated by a desire to cut costs, and maintain a robust and functioning grid for residents, while bringing additional secondary socio-economic benefits.

(i) *Local authority initiatives* make up 36 % (71) of projects. Although council climate change strategies extend to district scale power generation and supply, there are few power generation projects. Public entities are eligible for low electricity rates, which has historically made self-consumption projects financially unviable, and existing operational solar rooftop schemes have not delivered the projected returns. Local authorities have relatively little legislative authority to put in place support mechanisms LCE and or legal authority to raise finance beyond planning consent. As a result, most councils have focused on energy awareness and energy efficiency projects.

Larger city councils have dedicated staff facilitating external low carbon behavioural change projects, working with tenants, landlords, home owners, providing free assessments or home energy audit kits and financial support for insulation measures. In Auckland and Wellington, local authorities work in innovation projects with distribution network operators by providing educational components or part-financing technology in residential and school peak-shaving solar battery projects respectively. Smaller councils focus their activities on reducing internal footprints and producing guidance on adoption of best-practices. Many EE projects were initially developed as part of a country-wide state funded programme,[3] but are being continued through partnership funding or rates-funded through council long term plans. A number of spin-off initiatives lead by local boards suggest local authorities have recently started taking on intermediary roles, working with local boards to embed energy efficiency projects into longer term local community platforms and strategies. Finally, in areas historically featuring municipal power boards, local authorities still retain arms- length ownership of distribution network companies.

(i) Just 11 % (22) of initiatives are carried out by *new environmental organisations,* distinguished as charitable non-profit entities and co-operatives, involved primarily in energy efficiency, residential and standalone solar PV for private residences, public utilities and schools. In contrast to Europe and North American country contexts, New Zealand has seen just three community wind projects in this category, two of them unsuccessful. In the last five years, these organisations have started exploring integrated

[1] The Warm Up New Zealand: Healthy Homes initiative ('Healthy Homes') was established in 2013 by the government of New Zealand to assist in weatherproofing homes, particularly for low income families. It followed on from the previous government's Warm Up New Zealand: Heat Smart initiative (2009-2013). Funding is provided to address the cold and damp nature of many homes in the country through provision of insulation, curtains, and upgrading of heat sources. Services are not generally provided directly by the government, but by private and community organizations (EECA, 2018).

[2] These are Pioneer Energy, a remnant of the Otago Central Electric Power Board, owned by Central Lakes Trust, and Natural Gas Corporation, a remnant of the Hutt Valley Energy Board, partially owned by the Hutt Mana Energy Trust, and King Country Energy, a remnant of King Country Electric Power Board, partially owned by King Country Electric Power Trust.

[3] EcoDesign Advisor Programme.

solar PV and retail, peer-to-peer projects and climate resilient housing. However, outside of energy efficiency, projects in this category are largely limited to projects in planning.

(ii) 7.6 % (15) of projects are owned by Māori *indigenous organisations*. These are indigenous settlement trusts and charitable community development organisations, owned by particular Iwi (tribes), hapu (sub-tribe) or runanga (sub-tribe clan), involved in grid-tied geothermal generation, geothermal heat and steam supply for local industry, two off-grid microgrids and a number of microgeneration projects powering marae (communal buildings used for ceremonies and social purposes) (Fig. 2). These are joined by iwi-lead energy efficiency initiatives, sometimes carried out as part of Māori and Pacifica-focussed energy poverty and social service operations.

All three off-grid projects demonstrate high degrees of community involvement in project design and implementation, and are politically motivated by a desire for self-sufficiency, supporting socio-economic development on ancestrally owned land, and sustainable use of Māori natural resources. Both integrated microgrids are at feasibility stage supported by grant funded projects in partnership with universities. They are also embedded in longer term community development strategies aimed at generating local socio-economic opportunities, reversing historical economic decline and restoring Māori way of life.

Māori owned geothermal enterprises by contrast are large corporately run enterprises, where community involvement is limited to voting and further community engagement has followed gradually from establishment of successful geothermal operations. The majority are joint ventures with established utilities and iwi trusts that have re-acquired land, cash and/or geothermal assets through New Zealand's Treaty of Waitangi settlements process. The development of iwi owned geothermal was enabled through a convergence of state-led geothermal mapping and exploration, followed by Treaty settlements, and subsequent land access rights to many areas covering the geothermal fields (Bargh, 2012, 2010; MacArthur and Matthewman, 2018; MBIE, 2016; NZGA, 2016). One interviewee explained: "Centuries of use of the geothermal is one of the sort of treasures of the area. So, that was targeted through the [Treaty settlements] negotiating process to say, look we want the statutory acknowledgement over geothermal and that was achieved. That in itself doesn't have any direct commercial outcomes, but it does mean that any interested parties utilising geothermal have to talk to us. It's a requirement, and the council have to listen to what we say…[Furthermore] the fiscal envelope that was achieved in the Treaty settlement created some financial horsepower to create the opportunity to then go and leverage that to purchase the geothermal business".

Exclusive iwi ownership of geothermal fields is limited. The Kawarau geothermal fields (Bay of Plenty), which were developed through a settlement with the Crown obtained in 2005, is the only project 100 % owned by Iwi through the Ngati Tuwharetoa (BoP) Settlement Trust (NTST). In the case of NTST, 1500 registered beneficiaries of the geothermal activities are entitled to a range of trust-administered benefits, from scholarships to study geothermal engineering (and other fields) at university, to living subsidies for those over 65. All registered adult beneficiaries are eligible to vote for seven trustees, two of whom (selected by the trustees) then go on to sit on the board of the asset companies. The trust owns two limited liability companies, Ngāti Tūwharetoa Electricity Limited and Ngāti Tūwharetoa Geothermal Assets Limited who return dividends to the trust and has 11 employees. The trust is working with a newly hired local community engagement officer to understand the needs of the trust beneficiaries, create "identity and pride in the land and potentially some jobs in the area", without trying "to become everything for their people" and "stepping into the breach of the Crown" (Community Energy Practitioner). This concern highlights one echoed in the international literature on community energy, where these actors allow for the state to retreat from basic service provision, and impose these responsibilities on to community actors.

(i) Six commercial enterprises have embarked on peer-to-peer pilots on the distribution network or on secondary embedded networks, or microgrid projects. With the exception of one established retailer power sharing scheme, these are all start-ups with explicit social objectives. They are driven by a desire to consume locally produced power and local supply resilience, have more control over and more social and monetary reward for generated solar power, in some cases through delivery of low cost electricity to low-income households suffering energy hardship, as well as contributing to decarbonisation; participation in these projects is sometimes driven by a contempt of utilities. Peer-to-peer projects are variably run in collaboration with schools, churches or housing companies to host solar PV, community organisations to facilitate community outreach and participation, and solar developers to handle the assets. There are currently four operational peer-to-peer pilots enabling power sharing, gifting and demand response, demonstrating potential to match local consumption with local generation in real time and reduce peak loads.

Remaining initiatives (2 %) are local heritage organisations with an interest in maintaining historic hydro-electric assets, or advocacy groups with an interest in supplying members with low cost power.

All LCE initiatives identified except local authority initiatives and distribution networks are driven by normative objectives, mobilising the same counter-narratives that drive community energy in Europe and North America; energy democracy, community development and resilience, decarbonisation (Table 3). Interestingly, these notions overlap with Māori conceptualisations of sustainable development that underpin iwi energy initiatives, underpinned by kaitiakitanga (collective guardianship of natural resources) and tino ragatiratanga (self-determination). All of the individuals leading these projects were inspired by exposure to indigenous, local and community energy case studies overseas. However, contrary to Europe and parts of North America, these counternarratives exist locally, and have largely not been popularised, or adopted in industry or policy domains. This is part because there is little precedent for successful LCE projects in these categories and no evidence base for local benefits that can be popularised and used to justify and resource community-based energy initiatives.

There are strong indications that there has also been active and strategic resistance to grassroots narratives within both the

electricity industry and key organisations in energy governance, on the basis of technical and economic arguments, often emphasizing the unique setting provided by New Zealand's high renewable energy penetration, seasonal hydro-power supply, and energy demand patterns. This has manifested for example in organised industry opposition to solar PV, and a failed attempt by the Green Party to regulate buy-back rates and grid connection for small-scale distributed generation in 2015. The prevailing narrative is centred on economies of scale and the cost-effectiveness of emissions savings, but perhaps more fundamentally by a deep-rooted laissez-faire policy culture, in which LCE actors are not seen as legitimate parties to take on complex capital-intensive projects, and the diversity of motivations and needs of communities is seen to preclude the possibility of unified government policy. This narrative is firmly embedded in the institutional arrangements governing energy policy processes, where the regulating body has a narrow mandate that does not extend beyond pricing and energy security, yet takes on key energy policy responsibilities, including the design of electricity codes and regulation pertaining to consumer participation in the energy market. Policy discourse has so far centred on removing administrative and legal barriers to the spot market, grid connection legislation, and changes in regulation and infrastructure required to enable household consumers to choose dynamically between peer retailers, commercial retailers, and self-generation, which will further facilitate peer-to-peer projects. In depth engagement with policy design at Ministry level is inhibited by a lack of expertise and fragmentation of responsibilities across Ministry for the Environment, Ministry of Business, Innovation and Employment, and the Energy Efficiency and Conservation Authority. None of the interviews with these parties suggested there was networking or knowledge of existing community energy activities or barriers. As such, there has been no articulation of alternative narratives that would support the introduction of market access regulation, demand guarantees and investment incentives, capacity building or decentralised planning and resourcing that has facilitated widespread uptake of LCE internationally.

There are various ways in which this has clearly influenced LCE activities materially, as well as shaped the nature and diversity of local and community energy activities in New Zealand. The overriding view emerging from both local authorities and new community energy practitioners was that systemic constraints beyond their control precluded simple grid-tied generation, with little willingness of key parties to accommodate community projects: "It became obvious as soon as we started looking into it, that the advantage for, say a home owner, consuming about 8000 kW hours a year, spending about 2000 dollars, is minimal. They might save 300 dollars or 400 dollars with solar, and yet they are being sold by the companies just trying to sell them solar panels, something like five, six kilowatts. And they can't use it…it just dribbles onto the grid with pretty much no benefit to them. So it's just not worth it in that context" (Community energy practitioner). "We put in a few small systems on houses, but we can see straight away it's just minor stuff. It's not going to influence the country, it's not going to help any resilience, it's not going to help… It always ends up being about the bigger picture. When [our distribution network operator set up a retail company], we talked to them, and they couldn't buy in power, not at all. They can't cope with it in their accounting systems. So that was never going to be an option for them, buying back excess generation. They were too busy doing what they were doing and they couldn't do anything more for us. And then we talked about an embedded network, where you've got one ICP meter feeding a group [..] and at that stage, they said, they can't handle that" (Community energy practitioner).

The majority of standalone generation projects by local energy co-operatives and charities are currently inactive or 'in limbo', reflecting the difficulties of developing viable grid-tied distributed generation projects within the current energy governance landscape. Small-scale generators are required to sell power directly on the wholesale market for which one needs access to a hedge contract, or arrange sale through complex financial instruments via bilateral arrangements with existing generator-retailers. To do this, LCE organisations have necessarily had to seek partnerships with established utilities, who have little incentive to collaborate on these initiatives, and have found themselves in a weak bargaining position when negotiating terms of finance, risk distribution and return. Examples include the Wellington Wind Group, a co-operative whose efforts were suspended after Meridian decided not to sell a turbine to the community, and the Sustainability Trust, whose co-operative solar PV projects on church and council rooftops stalled as a result of its power trading and council partners unwilling to proceed in the face of compliance costs with the Terrorism Act, and health and safety liabilities associated with a long-term rooftop lease. This demonstrates how the absence of consensus and consistent messaging on the role and benefits of community across government and industry has translated into a lack of regulatory streamlining and willingness of key stakeholders such as councils and generator-retailers to accommodate community energy projects where it is seen to conflict with health and safety, customer due diligence regulations (stemming from Anti-Money Laundering Act), district and regional plans, or local support under resource consent. For example, the lack of specific and transparent provisions in the 'National Policy Statement on Renewable Electricity Generation' has led to non-uniform and political treatment of renewable energy across local authorities. Unlike most other countries, including the UK and Australia, small scale wind and solar is not universally made exempt of resource consent, environmental impact assessment, posing administrative hurdles that are disproportionate in relation to risks posed. There are currently efforts ongoing to facilitate clearer integration of emissions mitigation requirements in the planning permission process, but it remains to be seen as to whether this will give local authorities the resources they need to engage in brokering and facilitating LCE beyond energy efficiency. Furthermore, community energy start-ups operate unsupported to date; energy efficiency and electric vehicle infrastructure are the only areas that receive programmatic support, in addition to one-off MBIE, council grants, university projects and technology innovation competitions. There is often a lack of local capacity and resources to identify viable projects and bring them to implementation, including land, seed finance, capital finance, and, in some cases, relevant legal, technical and financial expertise.

Due to the lack of policy guidance and discourse as to what type of innovation is desireable and acceptable, LCE actors are largely left to their own devices in terms of conceptualising New Zealands energy future, understanding the focal areas and change processes of the energy transition, and the role and benefits of LCE therein. While we find local collaboration between iwi, distribution networks, and local authorities, there are very limited resources for networking and advocacy for local and community energy practitioners at national level, with no (self)-recognition of local and community energy as a distinct sector as such, and no

articulation of what the sector needs to prosper and contribute to the energy transition.

Interviews suggested that the deficiency in government leadership and lack of precedent has translated into a lack of public support and awareness of the benefits and opportunities provided by LCE, with nearly all community organisations reporting instances of local opposition (sometimes violent), health and safety concerns, or concerns around the effectiveness of the technology. For example, the Blueskin Charitable Trust has been developing New Zealand's first community led wind farm since 2006. After a seven year feasibility and planning process, resource consent was denied in 2016 on the premise of local opposition to the project and an appeal rejected in the Environment court in 2017 amidst death threats for project leaders. According to one interviewee lack of resourcing, regulatory challenges, and the complacency or invisibility of community energy in New Zealand were key issues for the project: "…. there aren't any other organisations that are strong enough that are in the community space who are building assets or want to build assets. They've all faltered and fallen at various hurdles or are treading water at the moment. I can't think of any who have got the point where we've got to or have passed it, and I think many have expressed a desire to do this but haven't done it yet for very understandable reasons." (Community energy practitioner).

Despite their proximity to consumers, their consumer ownership and their central co-ordination function, distribution network operators demonstrate a limited and variable ability and willingness to lead or facilitate LCE innovation projects. This is shaped by the political opportunity and resources available to them in terms of the material assets and operational challenges they face, consumer appetite for deeper forms of engagement, their ability to shape narratives around distributed generation, as well as access to smart meter data. The appropriate role and performance of distribution network companies in New Zealand has been a subject of public and political debate since reforms in the 1990's. Public policy discourse has been dominated by monopoly price concerns that uniquely resulted in the sale of retail arms - and with it, their customer base. Their legal authority to engage in generation was capped in 1998, only to be subsequently loosened in 2007. Interviews suggested that historical regulatory constraints, and narrow discourse around the role of distribution network operators, as well as organisational culture limits the extent to which they engage in consumer-facing innovation projects. For example, we identified a discongruence between the decisions of distribution network operators to innovate or invest or attract local investment outside of energy and to attract regional investment in order to guarantee the long-term viability of their distribution business, vis-a-vis the notions of appropriate conduct by the regulator: "..you'll see that many community-owned or trust-owned distributors will also tend to see themselves as an actor to enable regional economy growth policy. They might make investment decisions or run their business in ways that are not efficient for the business just because they view themselves as a tool to promote economic growth and I have questioned whether that is the best policy [..]. I think there is an example of a distributor investing in a failing [..] company. So [..] you're having consumers of distribution line services subsidising a local [..] company to keep jobs. That's not necessarily the best market design and policy setting from the economic point of view" (Staff member, Electricity Authority).

Historical separation of distribution and retail has had implications for the co-ordination of smart meter roll out and data ownership, where about half of distribution trusts have sold meters and meter data to retailers, and the regulator now aims to ease access to consumer data and produce network opportunity maps to open up opportunities for distributed generation and storage to third parties. Several interviewees suggested that policymakers did not understand the nature of their operational challenges, and in some cases implied that while there are ample opportunities for innovation, they are cautious to engage in activities beyond distribution and load management in fear of further regulatory reversals. A number of interviewees expressed concern that network operators don't have the necessary incentives, data and know-how to identify and promote non-network solutions and engage with community actors, and are afraid of the operational impacts that would reveal an ageing and underperforming network infrastructure. This is underscored by network operators lobbying for defensive network charges for solar power, or in several cases their limited engagement in peer-to-peer projects on their own networks.

However, we also observe considerable variation in perceived responsibilities and role of network operators in enabling consumer or community engagement with energy. In the past three years, several network operators have ventured into off grid solutions, two local lines companies have formally contracted with peer-to-peer start-ups, and networks have further embarked on two remotely controlled battery pilots and time-of-use trials. One rural operator, for instance, is strategically offering solar- battery - diesel generator packages for customers on uneconomic or unreliable lines, but also has ambitions for larger co-operative microgrid systems to overcome network constraints and replace diesel back-up generators. We find limited active engagement of parent organisations (local consumer trusts or local authorities) in the initiation or implementation of these initiatives, suggesting consumer or municipally owned lines companies are largely not leveraging their relationships with local consumers to co-create end-user innovation projects. This is reflective of a very limited engagement of consumer trusts or local authorities and representing consumers in operational or investment decisions of their respective network companies, with limited sense of ownership. This can also be seen in earmarking of revenues: revenues from distribution operators are currently largely channelled to consumers in the form of rebates, discounted power, or rates rebates, rather than being pooled and earmarked for low carbon innovation projects with community benefit.

While the regime context outlined here is clearly hostile to LCE, the data shows that there are clearly pockets of LCE activity that are enabled by unique local and institutional contexts, are attempting to circumvent market access barriers, or cater more strategically to emerging needs of incumbents for ancillary, capacity and demand response services. For example, frustrated by the lack of viable prospects for sizeable grid-tied generation projects, at least three grassroots new environmental initiatives are at the early stages of developing co-operatively owned solar PV/ battery installations that combine retail to members with wholesale market trade. These projects plan to retail renewable electricity generated by co-operative members, following similar models in the UK, Netherlands and Sweden. Partnerships with established energy actors provide another distinct opportunity for LCE within the New Zealand context. The majority of the planned or operational grid-tied generation projects we identified are joint ventures, allowing

access to the wholesale and hedge contracts market. Taken together, peer-to-peer and shared ownership projects are likely the most promising avenues for mainstreaming LCE in that they can overcome some key market access and capacity and resourcing barriers, as well as alleviate key industry concerns, for example around local opposition to wind, network level costs of distributed generation, network resilience, and demand side reduction. These dynamics are illustrative of 'fit-and-conform' niche-scaling processes, where future acceptable development in LCE in New Zealand is likely to be largely oriented towards network optimization and supply resilience, and accommodating utility-scale renewable energy through demand side management.

5. Prospects for an alternative local and community energy transition pathway

Current projections on the directions that climate mitigation governance will take suggests that there is renewed focus on heat, efficiency and transport; slow but steady growth in both electric vehicle uptake and residential solar PV, with additional need for demand side flexibility to accommodate new generation capacity for wind power (International Energy Agency, 2017; REN21, 2017a;b). However, there is a growing recognition that the targets and policies currently in place are insufficient to meet Paris commitments (Table 4), and the country faces a number of socio-economic and socio-technical challenges that may provide the necessary political momentum for a coordinated national energy strategy with a more prominent role for distributed, local and community energy. The government has in the past failed to achieve its Kyoto climate mitigation commitments through what are perceived by the public to represent legitimate domestic mitigation efforts (Rocha et al., 2015; Simmons and Young, 2016; Chapman, 2008), and there is large latent civic interest in engaging in decarbonisation. The energy sector faces an increased risk of erratic hydro-power resources due to a changing climate, and an emergence of competitive solar and storage technologies (Electricity Authority, 2018). In addition, the New Zealand government has recently set a policy target of 100 % of power generation from renewables by 2035 (MBIE, 2017, 2018), with social justice in climate change policy and community energy reappearing on the policy agenda for the first time since 2007 (NZTU, 2017). Future energy scenarios have suggested as much as an additional 61 G W of solar power may be required, with battery storage playing an increasingly important role (Transpower, 2018; MBIE, 2019). With income distribution and poverty statistics worsening since 2010 (Ball and Creedy, 2016; OECD, 2016), the percentage of low-income households not heating their homes has continued to increase since 1996 (Statistics New Zealand, 2017). This is attributed to rising electricity prices, poor building standards and poor regulation of rental properties, with disproportionate impacts on Māori and Pasifika communities (Howden-Chapman et al., 2012). Although regional development is now firmly on the government's agenda, core public funding models remain heavily skewed towards growing urban centers and are largely failing to maintain necessary infrastructure and investment in New Zealand's regions (Nana, 2016).

In theory, there are a number of ways in which support for LCE can be tailored to these issues and contribute to low emission scenarios (Table 5). LCE could provide additional renewable electricity capacity through community-owned or shared ownership in geothermal, wind and solar assets. It could provide short-term flexibility, peak-load reduction and ancillary services, by using distributed generation, battery storage, vehicle to grid technology, residential devices, and high specification inverters in combination with peer-to-peer trading or automated load response carried out through transactive markets. Small scale biomass CHP could provide alternatives to coal and gas boilers (Table 5) (Stevenson et al., 2018). In the current institutional context, selected consumer trust-owned distribution network operators with development arms and iwi organisations may be in a position to develop additional generation capacity, with both incumbents and commercial intermediaries leading on residential or community-scale demand response and self-consumption (particularly in schools and retail, where there is high day-time load). Given the barriers to LCE outlined above it is unlikely that we will see substantial development by either local authorities or newly established environmental organisations beyond energy efficiency initiatives - barring considerable changes in discourse, regulation and policy.

A wide range of policy recommendations follow from this work. LCE growth would benefit from collective visioning and articulation of the key features and benefits of an inclusive energy transition, and a systematic effort towards brokering that vision with key relevant authorities, through a national network for advocacy and knowledge exchange, potentially working towards a national strategy backed by all relevant agencies. That national strategy would need to cater for a variety of ownership and delivery models that can facilitate participation of community organisations and end-users with range of time, human and capital resources. Systematic resourcing, evaluation and promotion of a variety of trail blazer projects with diverse objectives would help to articulate a role and build a positive narrative on the benefits of LCE projects – these will range from social license, energy supply resilience, local social or economic benefits, energy hardship, energy decarbonization to piloting novel technology applications. These trailblazer projects could simultaneously inform the trialing and development of market incentive systems to remunerate distributed energy resources for the range of ancillary, capacity, demand response services they can deliver to the network. Looking forward, the wider diffusion of projects would likely require facilitation of a commercial power purchase market to provide an alternative for independent electricity generators to the wholesale market, and a project handholding, matchmaking, and seed finance facility. There is also a need for guidance on shared ownership, and public programmes to facilitate access to land. Given that there is currently no strategic policy alignment across these various policy domains, there is ample scope for better policy co-ordination and streamlining to facilitate LCE.

6. Conclusions

In this paper we have provided an overview of existing profiles, activities, and constraints, to explore how identified organisational profiles might further contribute to driving New Zealand's energy transition. We find a rich diversity of local and community initiatives driven by a variety of normative and instrumental motivations. Established local ownership that exists as a function of the

Table 4
Climate change and energy policy, targets ad policy instruments in place in New Zealand in 2019.

	Emissions	Energy efficiency	Renewable electricity and heat	Transport
Target	10 % methane reduction by 2030 / 24–47 % by 2050 Reduce all other GHG emissions to net zero by 2050	Sector wide 1.3 % p/a energy intensity improvement	100 % RE by 2035; 9.5 PJ p/a from woody biomass or direct use geothermal additional to that used in 2005	Doubling EV's p/yr to reach 64,000 EV's by 2021
Policy instruments	Emissions Trading Scheme	Warmer Kiwi Homes partial subsidy insulation; EECA Business Programme; TechDemo	Transpower Demand Response programme; Warmer Kiwi Homes partial subsidy on heat pumps.	Low Emission Vehicles Contestable Fund; Road User Charges exemption; Vehicle Purchase Feebate Scheme (2021).

Table 5
Opportunities for local and community energy to contribute to New Zealand's low emission scenarios.

MBIE, BEC, Vivid 2050 low emission scenarios	Opportunities for local & community energy
Reduced peak seasonal lighting & heating loads	EE and self-consumption
20-50 TWh additional generation	Local / shared ownership in geothermal (8 TW h) & wind (12–30 TW h); solar (1–61 TW h).
ST flexibility and ancillary services	Hydro-power (2–10 TW h), demand response
Renewable dispatchable alternatives to gas	Small-scale biomass CHP
Electrification of transport	EV + DG, ride sharing

historical legacy of deregulation is largely instrumentally motivated and apolitical, whereas emerging LCE initiatives are normative and politically motivated as a response to incumbent practices. Despite a groundswell of the same critical narratives driving LCE in Europe and North America, we observe protracted feasibility stages and high failure rates in a largely unsupportive regime context, with limited evidence that niches are growing or diffusing either through replication, scaling, or translation into new contexts. Interviews suggests that this is primarily due to lack of market access and risk exposure, but also a lack of policy co-ordination and streamlining, with lack of precedent reinforcing regime narratives and a lack of recognition of less tangible social-economic and environmental benefits. Taken together, there is not much evidence to suggest that grassroots actors, iwi, local authorities and, to some extent distribution network operators, have been seen as legitimate change agents in shaping the energy transition thus far. To a large extent, this is because there is no popularised articulation of a collective energy transition strategy. We find no evidence of a co-ordinated government strategy to engage with LCE organisations or to set up an institutional environment in which local authorities, community organisations and energy industry actors co-create low carbon energy projects with clear co-benefits for communities.

Our findings reveal the limits of grassroots agency and the dependence of wider diffusion of LCE on an enabling institutional context. The New Zealand case demonstrates how context-specific structural barriers shape the extent to which resources and opportunities can be mobilised for niche development activities and grassroots narratives popularised. Clearly, the extent and effect of grassroots agency in facilitating inclusive market and policy contexts to enable widespread diffusion depends on selection pressures and prohibitive versus enabling interactions with incumbent actors. To some extent, the drive and motivation for LCE in New Zealand is limited by the fact that incumbents are achieving progress in the transition to renewable electricity. However, niche-regime interactions are also framed and orchestrated by the institutional arrangements, policy processes, regulations and narratives embedded in the regime, in this case to the exclusion of actors pursuing (social innovation, local development) logics beyond cost-efficient emissions savings. These findings concur with a number of studies (Hess, 2013; Chilvers and Longhurst, 2016; Kooij et al., 2018) showing that the ability of state and local authorities to co-ordinate and streamline niche protective policies and the position and influence of incumbents and regime players in shaping these policies (and the associated narratives that serve to consolidate them) to a large extent determine the 'windows of opportunity' for LCE. These primary order preconditions shape the concrete opportunities for LCE experiments on the ground, through mobilisation of latent trust, social capital and alternative conceptualisations of sustainable production and consumption that is contained within citizen collectives. These primary order preconditions also influence the legitimacy and resources available for the formation of networks and intermediaries for knowledge sharing, learning and replication of LCE, the dynamics of which have been extensively studied by STI scholars. In short, the wider institutional context and resulting policy mix unique to different regional or country contexts has been instrumental in shaping prevailing forms and diversity of LCE and also determined the extent to which LCE has been replicated and adapted to different contexts to become mainstream rather than peripheral to conventional renewable energy development.

Even within this context however, the findings also point to uniquely resourced forms of LCE, where state support for energy efficiency are a springboard to other forms of energy innovation, and Māori are capitalising on renewable energy opportunities as a means of asserting their identity and facilitating thriving communities on ancestrally owned land. Elsewhere, such niches have over time built capacity and expertise that enabled the scaling, replication and translation to different contexts, albeit in the context of conducive policy support frameworks. As such, perhaps more so than its OECD counterparts Germany or Denmark, for which civic energy became a core part of renewable energy and climate change policy strategies as early as the 1970's, New Zealand now sits at a crucial juncture historically. It may need to fundamentally revise its public policy approach to energy if it is to meet its climate change mitigation targets alongside other social and economic benefits.

The findings presented here highlight that there are understudied transition pathways in which opportunities for LCE are relatively constrained. Select cases of new alliances between incumbents and niche innovations in peer-to-peer projects are suggestive of 'fit and conform' niche regime dynamics and suggest that transformation pathways are likely to remain relatively exclusive even with the emergence of decentralised storage and demand response, with little opportunity for LCE practices characterised by critical reflection, mutuality and community trade. The distinct nature of local and community energy in New Zealand, especially in contrast to feed-in-tariff driven electricity export models that dominate community energy in Western Europe, demonstrates the complexity of organisational governance arrangements and the wide scope of activities germane to building a low carbon society and economy. While there is likely much to learn from the practices of community and local energy elsewhere, the material and cultural settings in New Zealand highlight transition pathways and forms of civic engagement that may prove significant as this sector continues to develop globally, with increased shares of renewable energy in the mix but perhaps underdeveloped diversity in actors or social license for new infrastructural investments. The New Zealand case represents a unique form of grassroots energy innovation that, by virtue of its socio-political and material-economic context, is of relevance to civic energy researchers internationally.

Declaration of Competing Interest

None.

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