# From tip to toes: Mapping community energy models in Canada and New Zealand

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*From Tip to Toes: Mapping Community Energy Models in Canada and New Zealand*

*Abstract:*

Community energy is associated with a wide range of benefits, for example, providing new social mechanisms for learning, facilitating economic development, and in engaging local populations in energy policy implementation. However, empirical research continues to uncover many differences in the specific forms, functions and policy settings that relate to community initiatives across jurisdictions. This paper examines community energy projects in Canada and New Zealand, two understudied countries with high per-capita greenhouse gas emissions, distinct practices of community energy, and Indigenous community participation. This comparison reveals a range of striking differences in what communities do and how community energy projects are structured. We use institutional theories to highlight the role of incumbent resources, actors, and political context to explain the variations of forms and functions of community energy. We provide a reconceptualization of community energy practice as a much broader in both energy activity and ownership structure than presented in much of the current literature. The distinct national practices of community energy found are explained predominantly by the policy settings: less privatization and more new renewable energy support in some Canadian provinces, with more uniform liberalization and legal support for trusts in New Zealand.
*Keywords*: Renewable energy policy, community energy, sustainability, local governance, New Zealand, Canada.

## 1 Introduction

Despite increasing global awareness of the significant impacts of climate change, greenhouse gas (GHG) emissions continue to increase, with the 400 parts per million threshold surpassed in 2013 for the first time. As heat records continue to fall, sea-levels rise, and national leadership on climate policy in countries like the US underwhelms, researcher focus is turning to the role of state and sub-state actors in both adaptation and mitigation activities. Non-traditional actors at local levels can be an appealing alternative route to policy change and increasingly committed to

leading necessary energy transformations. There is much to identify about appropriate institutional mechanisms that can realize benefits for both emissions reduction and reliable, accessible energy service provision. This movement has taken many forms over the past three decades, from International Council for Local Environmental Initiatives (ICLEI) to the C40 climate leadership group of megacities to the US based Climate Alliance of governors committed to climate policy action. Bottom up climate action has also increasingly manifested, amongst other activities, in the emergence of of local 'community energy' systems in diverse resource and political contexts.

Community interventions spurred by public policies have long held promise for addressing the climate crisis. These include reducing opposition to new green infrastructure, providing social mechanisms for learning, literacy, and facilitating local economic development (Walker *et al.*, 2007; Haggett and Aitken, 2015; van der Schoor and Scholtens, 2015). Some energy projects based in local community partnerships have been highly successful in engaging large segments of the population (Kennedy *et al.*, 2001; Berry, 2010; Hoicka, Parker and Andrey, 2014), but this benefit is by no means certain. As a result, researchers have begun to call for more systematic and comparative empirical research into the specific activities, forms and contributions of the umbrella term 'community energy' (Walker, 2011; Seyfang, Jin and Smith, 2013; Berka and Creamer, 2018a). Empirical research continues to uncover many differences in the specific forms, functions and policy settings that relate to community initiatives across and within jurisdictions.

This research is timely, as the literature and profile of the community renewable sector has developed significantly over the past two decades, from early emergence in Germany and Denmark to a wide range of other national contexts, including Canada and New Zealand (Musall and Kuik, 2011; Thomas Bauwens, 2016; MacArthur, 2018; McMurtry, 2018a). Prior to this there is also a long history of rural electrification and community energy ownership (Doiron, 2008; Yadoo and Cruikshank, 2010; Talosaga and Howell, 2012; J. MacArthur, 2016). The recent literature has tended to focus on the role of co-operative and social enterprise actors in power generation, with a particular focus on wind and solar installations. While relevant for $CO_2$ mitigation, this focus has obscured the full range of actual and potential initiatives, for example,

demand management, retail and other energy services, or distribution. Although there is recognition of local energy innovations in generation, conservation, system management and education as a distinct arena of activity by policy makers and energy networks such as REN21, we lack empirical data and national maps of projects and activities outside all but a few European jurisdictions.

This paper contributes to the empirical literature by examining the forms (ownership) and functions (activities) of community energy projects in Canada and New Zealand. These countries have the third and sixth highest per capita GHG emissions in the OECD (OECD, 2017b), despite the technical and financial ability to make significant reductions. They contain within them distinct practices of 'community energy' in the form of Indigenous[1] people's participation, community geothermal capacity and, in parts of Canada, strong public ownership, but both countries are understudied in the international literature on the subject. Both are market-liberal states who have, unevenly in Canada and more radically in New Zealand, undergone significant restructuring and privatization in the power sector since the 1990s (Cohen, 2001; Electricity Authority, 2011). As a reflection of these distinct practices and the literature, community energy, though conceptually contested, is defined here as *functions* that include the provision of energy supply, demand management, distribution and system management and retailer services by locally rooted actors, defined here as *forms,* such as co-operatives, non-profit societies, trusts or municipalities[2]. We provide a maximalist definition of activities and ownership structures, including the public sector: from tip to toes. Prior to this research there were no maximalist national maps of the community energy sector in either jurisdiction, which we seek to remedy here.

[1] A note on the terms "Indigenous" and "Aboriginal" as used in this paper is in order. In Canada, there has recently been a shift in terminology from "Aboriginal" to "Indigenous". This shift is seen in academic literature, government departments, and reports. In this paper, we use terminology used in the cited sources, some of which use the older term, but otherwise are consistent with the current terminology of "Indigenous". In New Zealand it is more common to refer simply to Māori, as New Zealand's Indigenous Polynesian peoples. However for purposes of comparison we use the generic term to refer to the first people's in both countries.

[2] In New Zealand, municipalities are referred to as local authorities, but for simplicity we use the term municipality for both jurisdictions here.

Policymakers and commentators often rely on assumed benefits, case-study information and definitions either much narrower or much broader than the comparable literature in other states (Walker, 2011; Berka and Creamer, 2018b; Hicks and Ison, 2018). Important questions have also been raised about the ability of community energy to provide services and engage with communities broadly, or if they are likely to concentrate on upper-middle class and particularly well resourced ones. This paper considers the questions: what models of community energy have emerged in Canada and New Zealand as of 2017? How have institutions and policy choices shaped these differences? What significance does this hold for the sector in other jurisdictions? We begin with a review of recent literature on the nature and functions of community energy, before providing empirical profiles of the sector in Canada and New Zealand which can be used for future in-depth case study and comparative research. We then compare the findings from these two new datasets and outline a program of future research to better understand the contribution of these actors to energy sector transitions and climate change action.

## 2 Background and Literature Review

### 2.1 Explaining Energy System Forms and Functions

Systemic features of the energy system have important impacts for the playing field for community actors. They mediate the nature and shape of community energy across national contexts. While earlier emphases on socio technical transitions literature located community energy practices within a multi-level framework of energy regimes, landscapes, and niche innovations, these approaches focused heavily on the importance of technical innovations and their relation to scaled social practices (Rotmans, Kemp and van Asselt, 2001; Geels, 2014; Smith *et al.*, 2016). Politics and political institutions, while they have certainly been addressed in this literature, have played a relatively understudied role (Kuzemko *et al.*, 2016). More recently, institutionalist theories that explain the character and development of national energy systems have filled this gap, providing comparative accounts of energy systems across national contexts (Kooij *et al.*, 2018). Niche innovation and technological changes are important drivers of community energy developments, while the institutional and political explanations integrate the insights long developed by political science and policy scholars about the importance of

institutional structure, veto actors, political cultures and ownership forms to the shape and function of energy systems (Kuzemko *et al.*, 2017; Lockwood *et al.*, 2017).

## 2.2 A Material - Institutionalist view of Energy Systems

The varied forms and functions of community energy are a product of path dependent political characteristics together with incumbent energy resources of a given society. Public policy choices are crucial for sectoral developments, but conditioned by ideas, actor interests and socio-political institutions (Hall, 1997). Kuzemko et al argue that it is not enough to argue that 'institutions' matter, because "different configurations of political institutions and energy resources will tend to influence types of governance choices made and, therefore also, the nature of changes that take place in energy systems" (Kuzemko *et al.*, 2016, p. 97). Recent work by Kooij et al on community and local energy innovation from a comparative and systemic perspective helps fill the gap in specifying key drivers. They identify three dimensions of structural influence on the development and shape of national community energy sectors: 1) *material-economic* (biophysical conditions, economic structure, energy market), 2) *actor-institutional* (governance traditions, access to policymaking, regulations) & and 3) *discursive* (openness to alternative ideas and practices) (Kooij *et al.*, 2018). Each 'leg' of their institutional framework provides a useful element for our analysis and reveals a number of unique features of the New Zealand and Canadian cases, and due to the stage of research in which we focus on identifying and comparing forms and functions, we focus most directly on 1) and 2).

The actor-institutional setting and material-economic setting shape the composition of actors engaged in energy policy processes, the design of energy markets, corporate law, as well as energy and land use policy (Kooij *et al.*, 2018). The international literature on grass-roots community organisations illustrates that they do not typically exist on a level playing field with incumbent actors and that policy settings are crucial to their development (Peters, Fudge and Sinclair, 2010a; Miller, Richter and O'Leary, 2015; Burke and Stephens, 2017; Kuzemko *et al.*, 2017). They face a range of constraints that results in variable capacity to engage in and lead complex renewable energy projects and their ability to interface with broader socio-technical regimes (Kuzemko *et al.*, 2016). This is because powerful incumbent interests in nuclear and fossil fuels sectors can result in closed policy networks to new entrants. For community energy projects, institutional and

sectoral policy contexts shape the human, financial, physical and ideational resources available for project development (Hargreaves *et al.*, 2013; Smith *et al.*, 2016; Kooij *et al.*, 2018). As Kooij et al argue, 'without institutional space, [grassroots innovations] remain subjected to the dominant power-relations, and cannot exert much influence upon the energy system' (Kooij *et al.*, 2018, p. 52), so our understanding of these settings and the factors that shape them is key to explaining the divergent character of community energy in Canada and New Zealand.

Transformative energy sector change results from the interplay of actors and institutions (de Haan and Rotmans, 2018). In this paper we seek to develop an empirically rich account of the variety of actors and practices of community energy in these two countries – focusing not on the specific and the local, but on the system-wide array of legal forms and energy initiatives. Digging deeper into the actor-institutional dimension, we find that the conceptualization of community energy as part of the energy system is underdeveloped, and that a number of recent advances have been made which we utilize in this paper. Our mapping broad mapping approach allows us to then identify, using the institutional and material drivers above, and account of the differences we find based on not only the policy choices, but also the incumbent resources and industry actors. This empirically driven approach can also enable future research into the relationships and impacts of these differences for the ability of these countries to meet the energy challenges they face.

### 2.3 Forms of Community Energy

It is now commonplace to recognize how conceptually slippery the term community energy is and below we highlight the diversity of meanings as well as our maximalist approach outlined below (Walker, 2011; Seyfang *et al.*, 2013; Hicks and Ison, 2018). Community energy is developing in diverse, often poorly understood, organizational forms that differ from typical private sector organizations. Community itself is a nebulous term, and both political scientists and geographers are adding nuance to our understanding of how it manifests institutionally (Iris Marion Young, 1986; Shragge, 1997; Amin, 2008; Becker and Kunze, 2014; Smith *et al.*, 2016). The term community has positive rhetorical associations with harmony, locality, shared purpose and social networks, but political theorists have long been sceptical of the slipperiness of the concept in practical application. Hagget and Aitken (2015), for example, illustrate how

communities are not just limited to those physically proximate, but can include communities of interest. Critical scholarship has also pointed out the need to reject a naturalistic fallacy assuming that community is synonymous with good, fair or effective (Purcell and Brown, 2005; Albo, 2006). If we use different definitions in each study, or exclude whole areas or levels of innovative practice by definitional fiat (Avelino and Wittmayer, 2016), it is next to impossible to understand the empirical role of community actors in the energy sector. This creates a need to clearly outline the specific features distinguishing both the forms and functions of the sector, which we turn to below, and to ensure that our definitions are not based too heavily on one particular legal or geographic setting.

We take as our starting point Walker and Devine-Wright's (2008) highly cited definition of community energy as an energy project run by and for the benefit of a local population. Walker usefully highlights the variety of usages of 'community': as actor, scale, place, network, process and identity. He draws a distinction between community energy and its multiplicity of uses and theorized benefits and the more challenging practice of it, as we do below. Walker identifies 5 legal forms of community energy: 1) co-operatives, 2) charities and social enterprises, 3) local energy service companies 4) local government led projects and 5) non-local co-operative ownership. We were motivated by this empirically based UK typology to investigate the empirical practice outside Europe and see if there were additional forms or activities (Walker, 2011, pp. 777–778).

Another insight from these authors is the distinction made between *how* the community engages with a particular project, what they call the process dimension. Local actors may be deeply involved in the prioritization, initiation, planning and running of a new initiative, or they may be relatively passive recipients of an initiative that is taking place in in a geographically proximate area. On the other, the community level connection may be seen in terms of a financial stake or investment, what Walker and Devine-Wright call the benefit criteria. Projects can include elements of both, which represents an ideal-type community energy project, beneficial in both participatory and financial ways (Gubbins, 2010). For those interested in aspects of participatory or engaged governance, the conceptual distinction between governing power and financial interest is an important one. Avelino and Wittmayer (2016) have recently added complexity to

our understanding of process, insofar as CE initiatives are too often uncritically lumped in to an amorphous third sector characterization which lacks clarity on the distinctions between the level of organizational formality, orientation toward profit, and degree of citizen control. They also challenge the earlier work within transitions management and the multi-level perspective of equating regimes, landscapes and niches with particular actors, arguing that we need to keep open space for a range of distinct actors to be playing roles across levels, stages and spaces (Avelino *et al.*, 2017, pp. 628–629).

### 2.4 Functions of Community Energy

Community energy in theory and practice exhibits significant variation along two distinct lines: 1) physical energy localization (functions) and 2) organizational forms of 'community' (forms). While early studies largely focused on the role of community actors in power generation, and on small case studies (Loring, 2007; Lipp, 2008; Warren and McFadyen, 2010), this is starting to change. Recent community energy studies reflect these interactions between geographic, demographic and technical trends; energy functions performed by community actors are shown to vary, from supplying power and heat, to distributing it and engaging in demand side management activities. According to the most recent global renewables report by REN21 "the development of community renewable energy projects continued in 2016, but the pace of growth in countries is in decline. In a new trend, such projects have begun to expand into energy retailing (supply), storage and demand-side management." (REN Secretariat, 2017). Typical local projects include the installation of new renewable generation infrastructure in the form of wind turbines or solar panels, but also extend to the development of district heating and cooling, and energy retrofit projects. For Berka and Creamer "While there are increasingly also community based supply, storage and demand management projects in the UK, the majority of projects involve heat or electricity generation*"* (2018b). In their quantitative survey of the UK's community energy system in 2013, Seyfang et al. examined the geographic distribution, growth over time and project activities, expanding their data collection beyond generation activities and including energy conservation activities. Community Energy England (2017) also recognizes the broadening of practices, and includes electricity generation, energy efficiency/demand management, heat generation, transport and energy storage in their data collection. This expansion of data collection beyond generation is an approach we follow in this paper. It is

likely that the specific functions undertaken will depend largely on the policy settings and national energy contexts within which they develop.

The material-economic setting provides explanation for why communities are engaging with a wider range of functions and why this diversification of functions of community energy activities is expected to continue. Reliable energy is a permitting factor for economic and social development (Owens, 1986; Newman, Beatley and Boyer, 2009), and in a local context, gives communities an interest in energy systems. Costs for renewable energy technologies have been decreasing (IRENA, 2016; REN21, 2017). The trend of replacing or avoiding centralized generation (e.g., coal, nuclear, gas, oil, large hydro) with distributed generation technologies associated with lower power densities (i.e., Watts/$m^2$) means that an equivalent amount of land-based energy generation requires more structures over a larger land area (Owens, 1986; Smil, 2015). The scale of available energy management technologies is becoming more local and integrated with smart-grids, smart-homes, smart-meters and micro-grids (Palensky and Kupzog, 2013). Furthermore, the increasing density of populations in communities and associated locational growth of energy, including increasing adoption of electric vehicles, can lead to congestion in traditional energy transmission and delivery systems that requires increasingly localized methods of energy management. This increased density of energy demand (e.g., buildings) also improves the economics of district energy for heating or cooling (Owens, 1986; Environmental Commissioner of Ontario, 2012; Rezaie and Rosen, 2012); it can also lead to difficulty in meeting energy demand in a specific location (e.g., Toronto Hydro *et al.*, 2014). Solutions include local generation, conservation, or more sensitive demand management. The changing geography of generation and demand means that the functions of energy projects such as local demand management, distribution and that coincide with communities require different forms of management, oversight, delivery, availability of labour, and economics of procurement.

## 2.5 Community Energy in Canada and New Zealand

This study sets out to address the lack of awareness in policy and practitioner settings as to the scale and diversity of the community energy sector, particularly outside Europe. This gap is significant, because policy choice and material-economic conditions shape the forms and functions of the sector, making possible a wide range of both current and future models. In order

to inform these debates appropriately we need to know more about the activities, strengths, weaknesses and diversity of the sector. We are inspired to undertake this research to expand the range of energy projects, organizational forms and countries considered in order to increase transferability to other jurisdictions. Post-colonial settings such as Canada and New Zealand open up scope for analysis of a more diverse range of entrants, and also how community energy contributes in hydro-dominant electricity sectors. Accordingly, this study set out to contribute to our understanding of community energy by focusing on gathering data in two understudied countries, Canada and New Zealand, each having a significant Indigenous population that participates in the development of energy functions.

Following three decades of policy initiatives that have liberalised electricity markets from the 1990s, the technological developments for distributed power outlined above, and targeted support for community actors in recent years, a growing number of community energy projects in Canada, New Zealand, and globally have developed (REN21, 2016). Although communities and governments are involved in the shift to a low-carbon economy, we are not yet at a stage where we can measure the importance or impact of community energy or community as a mediating factor on energy until we collect more data (Akorede *et al.*, 2010; Peters, Fudge and Sinclair, 2010b; Berka and Creamer, 2018b). The community energy literature concentrates on the European experience and is still unclear the extent of gaps there are in the literature. For example, it largely ignores Indigenous forms of ownership and the distinct challenges, benefits and perspectives accompanying developments by those groups within broader postcolonial contexts.

Although Canada is a resource-based country with community energy initiatives, the literature on the extent of community energy, particularly that which includes distribution, demand, and retail as well as generation is sparse. MacArthur has examined the range of renewable energy co-operatives (2016), assessed community energy policies across Canada (2017), and assessed the level of engagement in community energy initiatives (2016) while McMurtry (2018) and the People, Power, Profit project have investigated the involvement of 1) Co-operatives, 2) Aboriginal Ownership, 3) Community Investment Funds, 4) Non-Profit Organizations, and 5) MUSH (Municipalities, Universities, Schools, Hospitals) Sector in ownership of renewable

energy, while Lowan-Trudeau more recently outlines Indigenous energy projects (no date). Similarly, in New Zealand researchers have investigated the role of Māori energy project development (Bargh, 2012)(Bargh 2012), conducted a preliminary sector overview (MacArthur 2016), and studied the feasibility of small scale wind by policy actors (Parliamentary Commissioner for the Environment 2006) and local groups (Blueskin 2012) but there has been no published systemic mapping and analysis of CE as a sector[3].

Canada and New Zealand make for particularly important study sites for diverse community energy practices as Indigenous communities are increasingly involved in renewable energy, in part due to a combination of factors related to land control and sustainable development drivers. In Canada, there is increasing attention to lack of energy access in both remote Northern and Indigenous communities (e.g., Canada's First Ministers, 2016); the function of alleviating poverty or insecurity with energy in a remote region is another function where the relationship to form needs to be assessed. Henderson (2013) describes the geography of renewable energy potential in Canada as one reason for increasing participation of Aboriginal communities in community energy project development in Canada, although Krupa (2012) outlines significant barriers to participation of Aboriginal energy project ownership. Henderson (2013) promotes the development of community clean energy trusts that invest earnings into the community. However, whether this model has proliferated and benefited communities has not been examined or documented. Meanwhile, Rezaie and Dowlatabadi (2016) and Lowan-Trudeau (2017) document the meaning of renewable energy projects to Indigenous communities. Several studies have examined energy co-operatives in Canada (Tarhan, 2015; McMurtry and Lipp, 2018). In New Zealand, Māori communities have historically used geothermal resources for energy provision, and are increasingly playing a role in the community energy sector developing in the country. Similar to Canada, however, there are questions about how this participation and the benefits that arise from projects are distributed, and the contribution of community energy to local disaster resilience and recovery as well as and economic development (Bargh, 2012, 2013). By highlighting the activities and share of Indigenous community energy initiatives, this research

[3] The New Zealand data is connected to a related but as yet unpublished analysis of community energy projects and practices in that country (MacArthur, Berka and Gonnelli, no date).

will contribute insights into the dimensions of distribution of benefits, inclusiveness and issues of justice. It can also set the foundation for future case studies.

## 3 Method of Data Collection

As identified in the literature review, the frame for data collection on community energy in New Zealand and Canada includes a broader range of functions than generation; this analysis includes data collection on the physical functions of projects to include demand, such as energy efficiency retrofit programs and projects that influence energy use in local communities; distribution systems, such as district energy, micro-grids and traditional distribution systems; generation; retail, such as electricity trading or bulk purchasing for resale. These categories are included below in Table 1. The range of forms includes municipal and Indigenous ownership, co-operatives, trusts, associations and partnerships. We focus on operational projects, rather than those cancelled, stalled or in development.

**Table 1: Categories of Data Collection and Coding about Community Energy Projects**

| Functions (Physical Outputs) | Forms (Ownership) |
|---|---|
| Generation<br>Demand<br>Distribution (e.g., microgrids, district energy, traditional distribution)<br>Retail<br>~~Plans~~ | Co-operative<br>Community trust<br>Community association<br>Charity<br>Municipality<br>Indigenous Trusts & Co-operatives<br>Partnership/Joint Venture |

For both countries, the sampling frame was informed by the identification of relevant policies, actors and reports. The identified sources of data are:

i. Keyword searches (i.e., internet search engine)
ii. Regulatory, government and agency lists
iii. Cooperative registries
iv. Government programs
v. Projects awarded funding by government agencies
vi. Secondary datasets of projects and plans
vii. Renewable energy associations

The methods employed to understand the forms and functions of community energy in these two countries were qualitative, quantitative and comparative. We conducted a review of the relevant literature on the varied definitions and understandings of what constitutes community energy. Our analysis of the qualitative data sources listed above enabled us to identify 785 projects in Canada and 125 projects in New Zealand[4]. These individual entries were coded for the type of functions and forms outlined in Table 1, to establish the overall profile as well as identify correlations and trends between the activities and structures in each jurisdiction. We have generated the most comprehensive profiles of the range of community energy actors and activities in both countries to date[5]. This approach allows for future work on the datasets involving an impact and comparative analysis of each form and function type in order to explain which, if any structural characteristics have impacts on the kinds of benefits derived. For example, to what extent does it matter if a project is constituted as an energy trust, rather than a co-operative, or run as a project partnership with an Indigenous community versus a municipality. It also facilitates expansion of comparative cases beyond these two developed settler-colonial countries to other contexts. Although, in Canada where municipal ownership is more widespread some forms of municipal ownership may be more or less community oriented due to the issue of participation (McMurtry, 2018a). As this dataset is a broad profile of community energy sector in Canada, we have included all municipal cases for this stage of research, as has been done in other Canadian research projects, but a full analysis of municipal participation is outside the scope of this paper.

# 4 Results and Discussion

## 4.1 Community Energy in Canada and New Zealand

This section outlines the findings of the national profiles of community energy activities created for this project. It places these findings, briefly, in the material-economic and actor-institutional contexts within which they developed. Table 2 outlines key features of the energy sector in both

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[5] Given the range of newly emerging projects and plans and the difficulty of capturing information on stalled projects, maintaining and updating each dataset will be an ongoing task as the research continues. We consider the findings outlined below preliminary, but these are still the most comprehensive overviews of the local energy sector in both countries in 2017.

countries. Both rank in the top 10 GHG emitters per capita, with Canada third and New Zealand sixth globally. While each country has large renewable energy resources in traditional areas such as large hydropower, they have both been slower to develop small scale new and distributed renewables than their European counterparts (REN21, 2017). Politically, both countries are liberal democracies, governed by right and centre-right parties over most of the past decade, so there has been significant emphasis placed on market based policy tools and less command and control style regulation (Adkin, 2009; Pollitt, 2012). Energy sector restructuring, in the form of privatization and functional separation of distribution, generation and retailing activities has taken place in both countries, but far more radically and uniformly in New Zealand which does not have a federal political structure (Trebilcock and Hrab, 2005; Kelly, 2007). New Zealand is also unique insofar as it cannot rely on neighbours for its electricity grid reliability, since it is an island nation in the South Pacific. This places importance on the system managers to 'overbuild', but also means that the system is not exposed or constrained by requirements from other players in their market as Canada is with Federal Energy Regulatory Commission and North American Energy Regulatory Commission (Cohen, 2007; J. MacArthur, 2016).

**Table 2: Energy Sector Profile Canada and New Zealand**

| Category | Canada | New Zealand |
|---|---|---|
| Tonnes greenhouse gas emissions per capita | 20.5, #3 OECD 2014 (1) | 18, #6 OECD 2014 (1) |
| Main sources of energy | Natural Gas, Coal, Oil, Nuclear, Large Hydro, Renewable (2) | Natural Gas, Coal, Oil, Large Hydro, Renewable (2) |
| Sources of electricity | Natural Gas, Coal, Nuclear, Large Hydro, Other Renewable (3) | Large Hydro, Natural Gas, Geothermal, Wind (5) |
| Sector Sources of GHG emissions | 81% energy related (4) | 40 % energy related (48 % agriculture) (3) |
| Type of Electricity Market | Provinces range from publicly owned utility, to hybrid market, to market | Hybrid Market |
| Interconnections | Provincially/ internationally regulated and managed, tie-in with US states | Single national grid not connected to other countries |
| Change in GHG emissions 1990-2014 (excluding LULUCF) | + 19.5 % (1) | +23% (1) |

Sources: (1) (OECD 2015); (2) (New Zealand Ministry for the Environment 2017); (3) (Environment Canada 2017); (4) (MBIE 2016) ; (5) (Cohen 2001; Electricity Authority 2011)

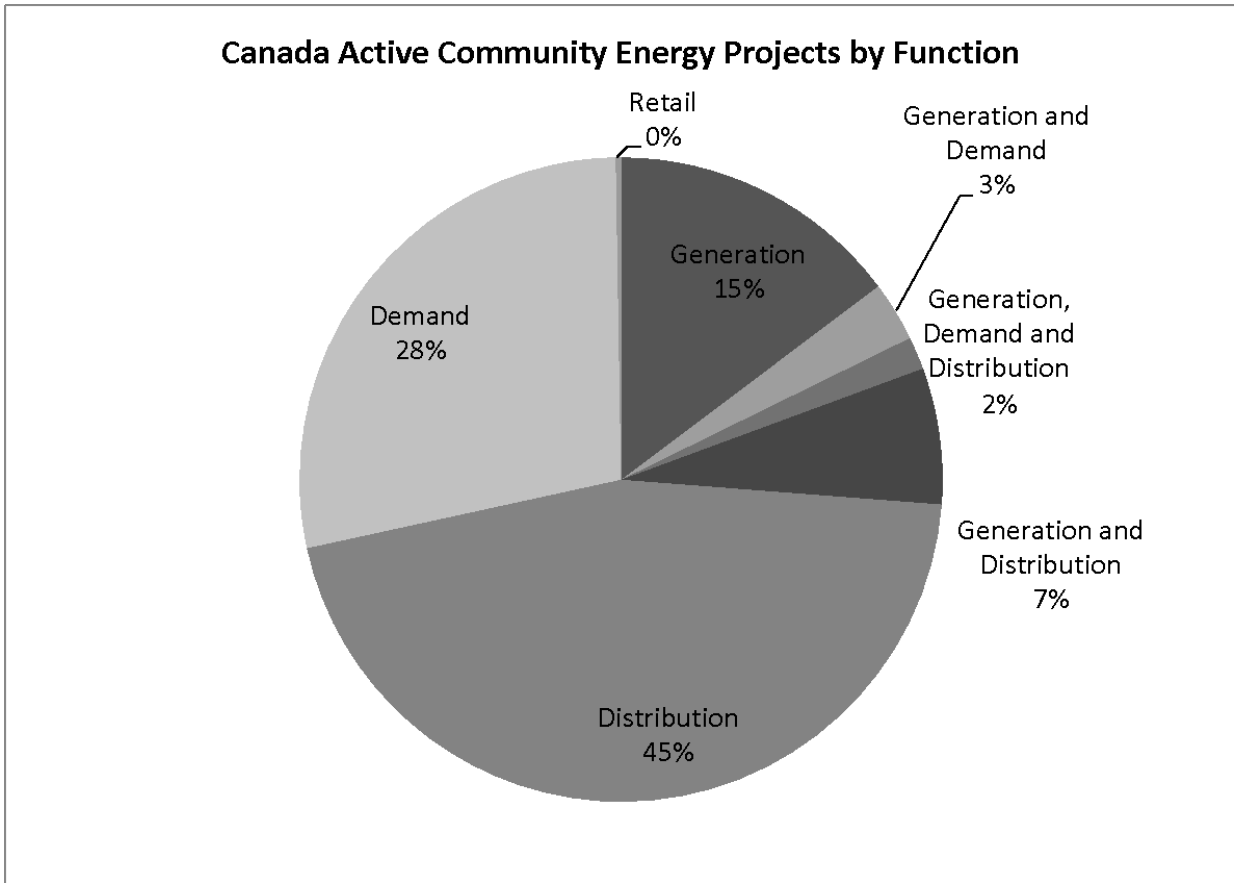


**Figure 1: Active Community Energy Projects in Canada by Function**

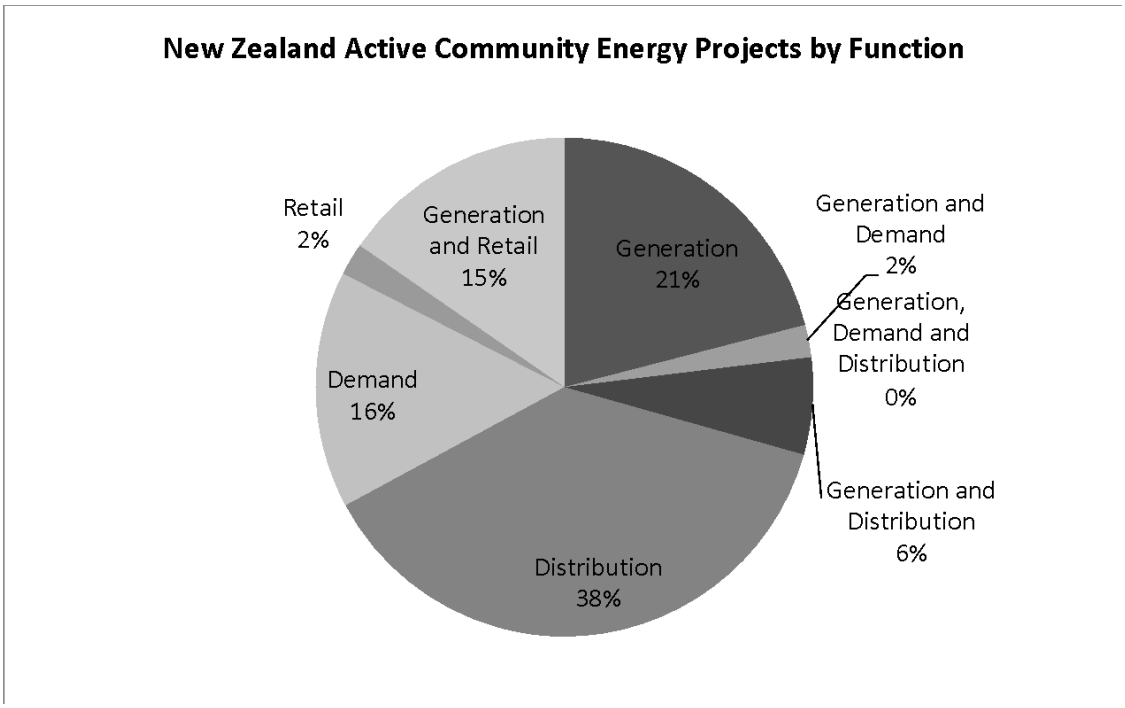


**Figure 2: Active Community Energy Projects in New Zealand by Function**

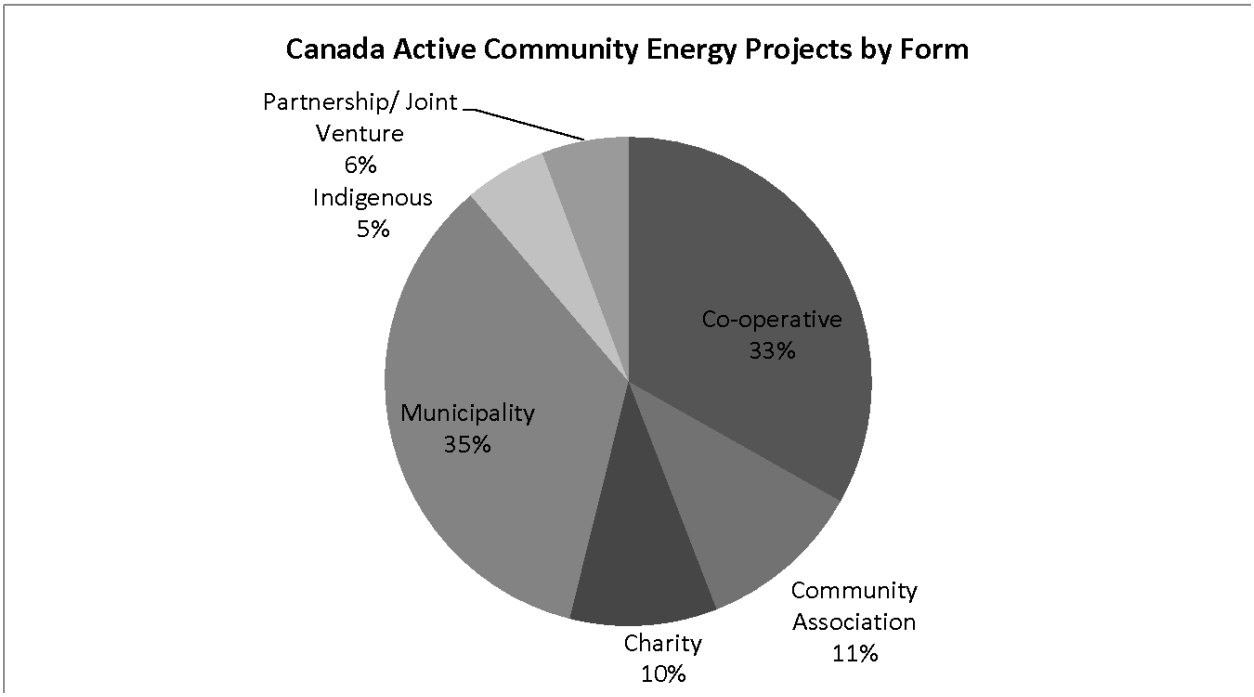


**Figure 3: Active Community Energy Projects in Canada by Form**

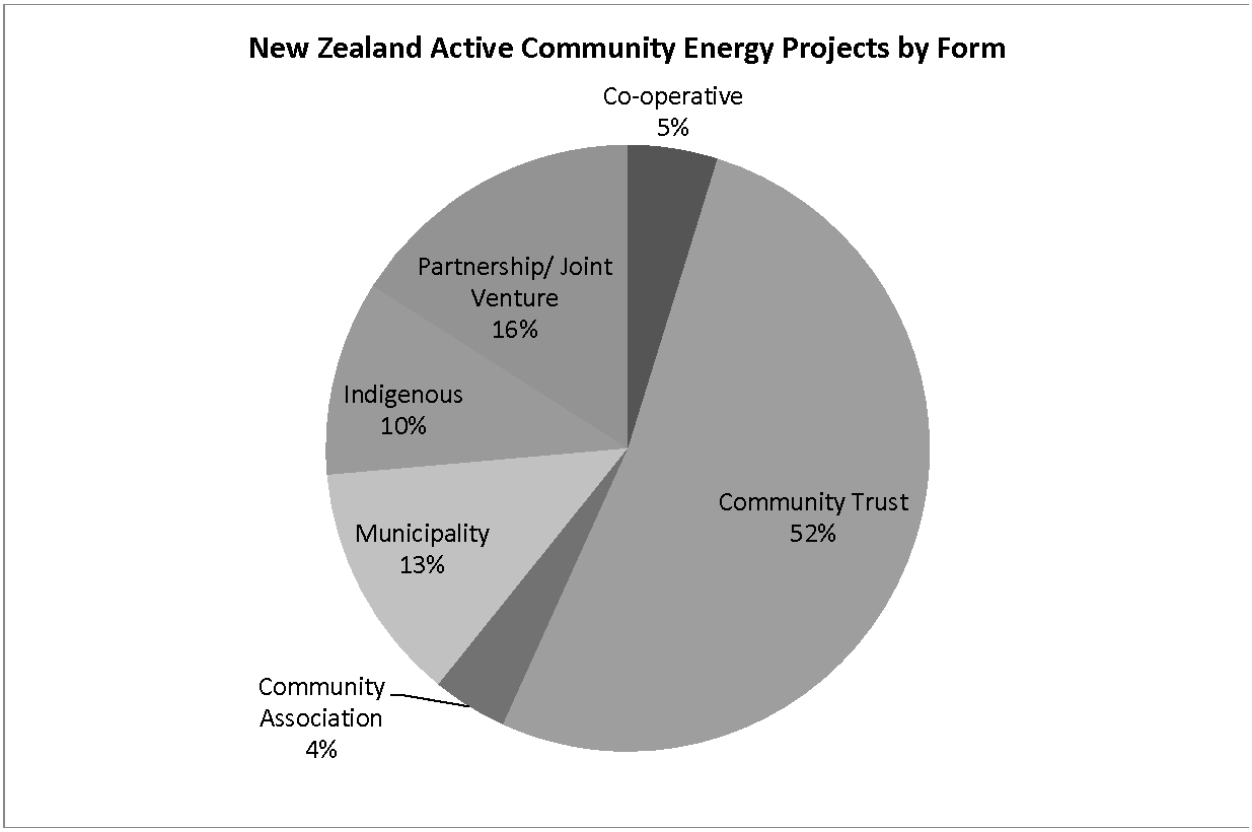


**Figure 4: Active Community Energy Projects in New Zealand by Form**

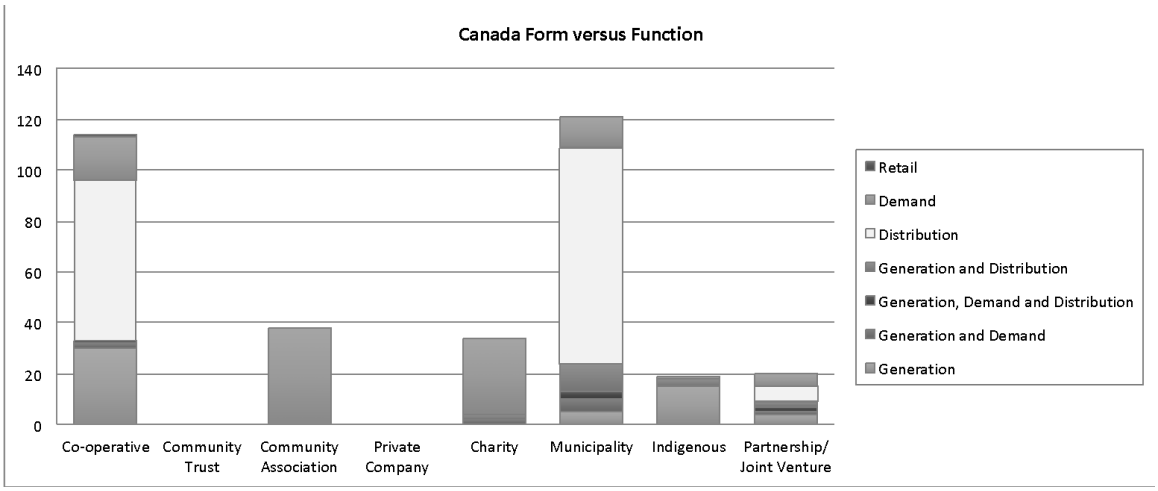


**Figure 5: Form Versus Function in Canada**

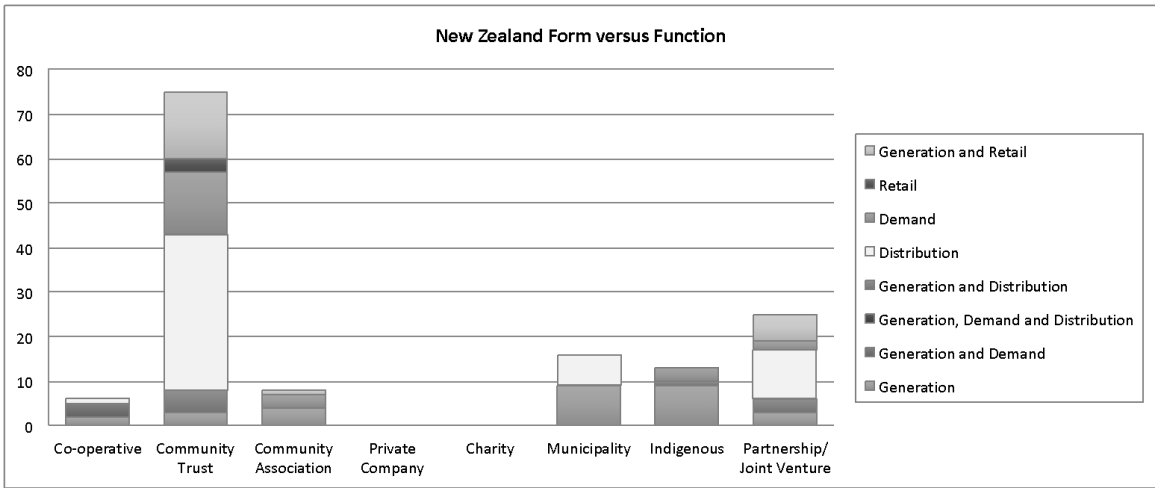


**Figure 6: Form Versus Function New Zealand**

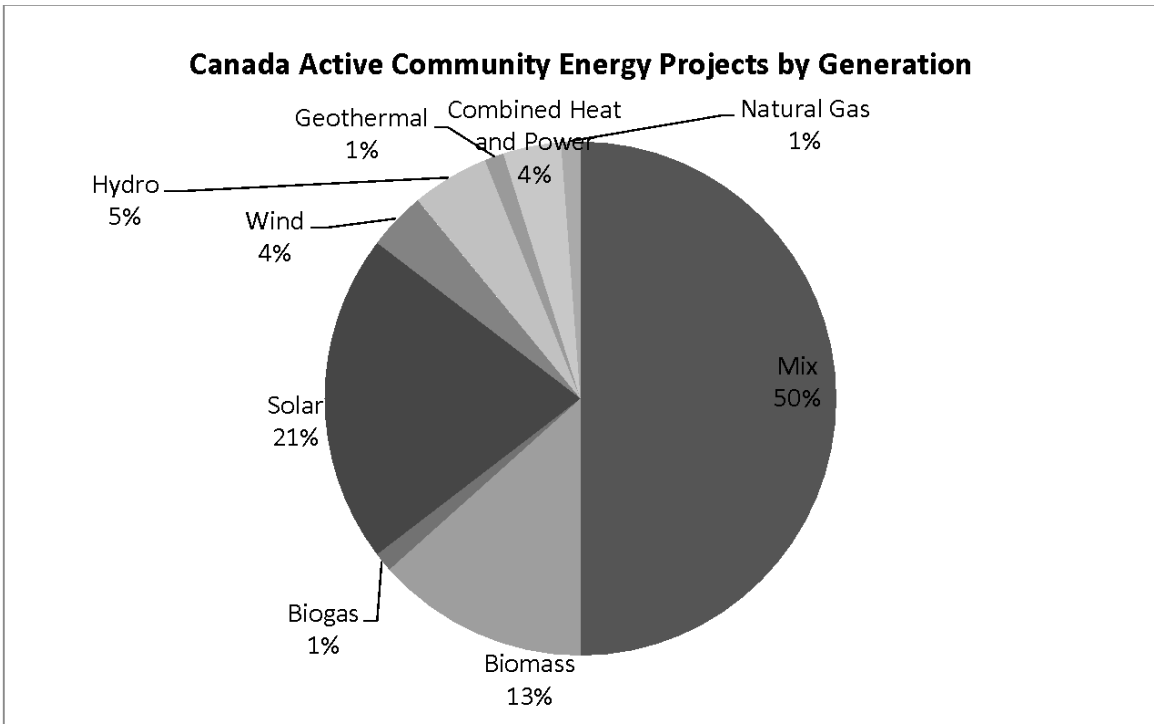


**Figure 7: Canada Active Community Energy Projects by Generation**

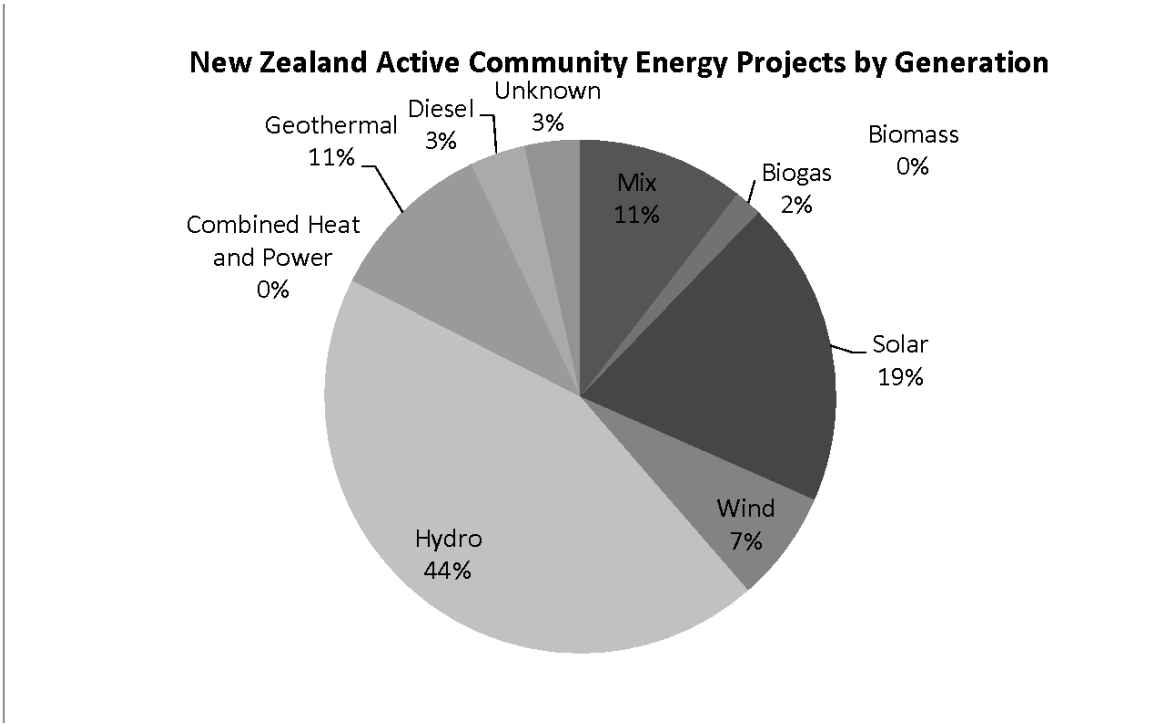


**Figure 8: New Zealand Active Community Energy Projects by Generation**

## 4.2 Canada Context

Canada is made up of 10 provinces and three territories and has a population of over 35 million people (Statistics Canada, 2016b). Since 1990, Canada's GHG emissions have increased by nearly 20 % (Table 2). 81% of these are energy related (Environment and Climate Change Canada, 2017) and Canadians are among the highest GHG emitters per capita in the world (OECD, 2017b). Despite being a large country, most of the Canadian population resides in a concentrated area along the southern border (Brouard, McMurtry and Vieta, 2015). Oil and gas and transportation sectors are responsible for 26% and 24% of emissions respectively, with electricity in third place with 11% (Environment and Climate Change Canada, 2017). Nationally, 64% of installed electricity generation capacity in Canada is renewable (hydro, wind, solar), the remainder a mix of coal, natural gas, diesel (in remote communities) and nuclear (Statistics Canada, 2016a). This overall profile masks significant differentiation between each province and territory in terms of the fuel sources developed, policy settings and governance structure in the power sector (Valentine, 2010; National Energy Board, 2011; J. MacArthur, 2016; McMurtry, 2018b). Furthermore, the provinces regulate and manage electricity and energy use in Canada, and large centralized energy projects often limit local involvement in energy decisions. For example, Ontario's significant reliance on nuclear power (more than 60% of electricity produced, Independent Electricity System Operator, 2017) results in a physical limitation on the amount of energy, whether community forms or otherwise, that can be produced and used. We return to this briefly below, but in Canada, as with other federal states like Australia, Germany and the U.S.A, national level statistics provide only a starting point for understanding the sector.

In the past decade politically Canada has changed the national governing party from Liberal, to Conservative, and in 2015, Liberal again. These changes in government brought about policy swings relating to climate change policy,that impact the energy sector. One notable area has been on the national level commitments to the global climate policy regime. A Liberal government first signed and ratified the Kyoto Protocol, although with insufficient action, prior to a very public backtracking on climate change commitments starting in 2006 and withdrawal by the Conservative government in 2011. With the new Liberal government, Canada's most recent policy statement, the "Pan-Canadian Framework on Clean Growth and Climate Change: Canada's Plan to Address Climate Change and Grow the Economy" (Canada's First Ministers,

2016) confirms Canada's commitment to the Paris Agreement. The framework makes federal government commitments to support renewable energy and clean technology projects, and presents a patchwork of provincial frameworks and commitments.

Electoral swings have also occurred at the provincial level, where constitutional power for regulating resources and electricity rests. These changes have resulted in both electricity sector restructuring policies and community energy policy support in some provinces and territories (MacArthur, 2017; MacArthur, 2016). This was, in part, driven by the wavering commitments to climate change mitigation at the national level between 1997 and 2015. The provincial commitments outlined in the Pan-Canadian Framework include a cap and trade system (Ontario) and a carbon tax (British Columbia), and various policies to promote renewable energy, electric vehicles, and clean technology development (Canada's First Ministers 2016). Nearly every Canadian province or territory has developed policies to stimulate new renewable energy developments, either through feed-in tariffs, or request for proposals. This is important to facilitate the entry of new technologies and actors, but community actors are rarely able to compete on lowest-cost or on speed of project development, so the uptake of community projects has been uneven (MacArthur, 2017). Some jurisdictions, most notably Ontario, Nova Scotia and New Brunswick have developed targeted support for local actors in the form of either grid set-asides or feed-in-tariffs with community adders (additional payment of 1 to 1.5 cents per kwH) between 2009 and the present. Other provinces have set up competitive grant funding for local projects (British Columbia), or requirements that independent (private) projects need to have 50% First Nations ownership (Yukon). These policies are far from stable, however, they are continuously being amended, scaled back and reversed as a result of subsequent electoral shifts (MacArthur 2017).

There are many reasons why municipal involvement in various forms and functions of energy is more prevalent in Canada. Clearly, policy choices have played a crucial role. For example, in Ontario, Canada's most populous province, municipalities have owned the majority of local electricity distribution companies for over a century (Ontario Distribution Sector Review Panel, 2012). There is increasing awareness that through their impact on land-use and bylaws, municipalities have direct and indirect influence on GHG emissions from energy use of

transportation and buildings (Environmental Commissioner of Ontario, 2012). Many provinces now require municipalities to conserve energy and reduce GHG emissions (QUEST, 2016). There is increasing recognition of the important relationships between energy and economic development in communities (QUEST, 2016). Ontario municipalities also have the tools to utilize local improvement charges, "charges that recover the costs of capital improvements made on public or privately owned land from property owners who will benefit from the improvement" (Ministry of Municipal Affairs and Housing, 2015), to finance energy retrofits on private properties (Ministry of Municipal Affairs and Housing, 2012).

Demographic and technological changes have also driven community energy growth. For example, the electrification of transportation, one of the largest and growing sectors of GHG emissions, that will increase the density of electricity demand in communities, requiring electric vehicle owners, local distribution companies, and municipalities to alter their relationship to the local use of electricity. The densification of communities (Ontario, 2005), decentralization of energy (Ontario, 2009), the introduction of a range of community energy programs (Gliedt and Parker, 2014), various social enterprise strategies (Brouard, McMurtry and Vieta, 2015), and low-carbon technologies (Canada's First Ministers, 2016), and the push for heat recovery and local energy management such as district heat (e.g., Environmental Commissioner of Ontario, 2012) are all occurring across Canada (QUEST, 2017). Energy retrofits for demand management are labour intensive, creating local economic development benefits. In a federal program that focused on GHG reductions in residential buildings, the highest uptake of energy retrofit programs in Canada without grants was due to the credibility of a community partnership between a university, local utility, municipality and a community based organization (Kennedy *et al.*, 2001; Parker and Rowlands, 2007).

Under Section 35 of the 1982 Canadian Constitution Act, Aboriginal people in Canada are made up of First Nations, Métis, and Inuit people and have their rights enshrined in Canadian law (Krupa, 2012). The Aboriginal population, as measured by participation in a Census, is estimated 1,7 million people, or 4.9% of the Canadian population and since 2006, has grown at four times the rate of non-Aboriginal population (Statistics Canada, 2017). Krupa (2012) reports that there are 633 First Nations communities. Although Canadians are such high GHG emitters on average,

there is growing attention to the lack of energy and levels of fuel poverty in remote and Aboriginal communities (Canada's First Ministers, 2016). A 2011[6] federal report identified 292 Canadian remote communities (communities without electricity grid access) with a total population of approximately 194,281 people (Government of Canada, 2011). This was reduced from 380 remote communities in 1986. Of these 292 communities, "170 sites are identified as Aboriginal communities (First Nations, Innu, Inuit or Métis) with approximately 126,861 people living in these sites. The remaining 122 communities are cities, villages or commercial outposts that are predominately non-Aboriginals or under non-Aboriginal governments, with approximately 67,420 people living in them." These communities mostly rely on diesel fuel for electricity generation[7] (Government of Canada, 2011). Diesel fuel is delivered to these communities, that are difficult to access at various points of the year, by air, water, and winter roads (Advance Energy Centre (AEC), 2015). Replacing diesel fuel in these communities would reduce the negative impacts of high delivery costs and of the increasing and fluctuating costs of the fuel itself that discourage local economic development (Advance Energy Centre (AEC), 2015). There is increasing involvement of Aboriginal communities in the production of clean power generation for local economic benefits (Henderson, 2013; Lumos Clean Energy Advisors, 2017). An Indigenous renewable energy database measures a strong emergence of Indigenous participation in energy in Canada (Lowan-Trudeau, no date). The database estimates that there are approximately 300 Indigenous clean energy projects in 194 communities across Canada, although many are feasibility studies or in early stages of development. Most of these projects are in the provinces of British Columbia (153) and Ontario (79). Most Indigenous projects that focus on renewable energy are driven by a desire for community economic development and a reduction in reliance on diesel in remote communities (Hunter-Loubert, 2016). Although there appears to be a large number of renewable energy projects developed by Indigenous communities in Canada (Lowan-Trudeau, no date; McDiarmid, 2017), despite tax exemptions for on-reserve income generation, Krupa (2012) outlines significant barriers specific to Aboriginal people in Canada in developing these projects. These barriers are intimately tied to historical

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[7] A 2011 report using 2006 Census data from Statistics Canada estimated that 257 of Canada's 292 off-grid remote communities were reliant on diesel fuel, impacting nearly 200,000 Canadian, Inuit, Innu, Metis and First Nation people (Government of Canada 2011).

mistreatment and denial of rights by settler governments, and include lack of legitimacy due to unresolved treaty issues, capacity to manage and develop projects and access to capital.

### 4.3 New Zealand Context

New Zealand is a remote South Pacific nation of 4.5 million people spread primarily over two large islands, connected by one high voltage cable across the Cook Straight. It is a leader in renewable electricity generation with more than 80% coming from hydro, geothermal wind, solar and biomass sources in 2015, and a policy target of 90% renewable electricity generation by 2025 (MBIE, 2016). Under the Paris Agreement, New Zealand has set a target of 11 per cent GHG emission reductions to 1990 by 2030. The emissions profile and energy sector are distinct from Canada in a number of ways. First, the electricity grid is stand-alone, and so is not able to draw power from neighboring states; as a result domestic sources must be able to cover all domestic demand with extra capacity built in for any unforeseen issues such as major plant outages or significant demand spikes (OECD, 2015, 2017a). Another unique feature of the New Zealand context is that while the energy sector is a significant source of GHG emissions for the country, at 40.5 %, nearly half of the country's emissions come from methane produced by agriculture (New Zealand Ministry for the Environment, 2017). The significance of this is that the energy sector often gets overlooked in discussions of the country's overall climate targets, with the assumption that because electricity is renewably generated on the whole, significant policy action is not needed. This is problematic, however, because overall GHGs are 24% higher than 1990, with part of this due to transport emissions from fossil fuel combustion increasing 74% since 1990. New Zealand homes also continue to be cold and energy inefficient by international standards (Byrd and Matthewman, 2012; New Zealand Ministry for the Environment, 2017). As the International Energy Agency has recently pointed out in its review of New Zealand's energy sector, the country has an enviably high share of renewable generation and strong potential for a shift to vehicle electrification and new technologies, but lacks the strong policy support for deep decarbonization (International Energy Agency, 2017).

New Zealand's primary policy instrument to combat emissions is its Emissions Trading Scheme (ETS). Action on climate change in New Zealand has, even in the government's own words,

been to focus on 'fast following' versus ambitious leadership. The ETS, uniquely, covers a range of gasses but the price of units has varied widely, from NZD $16 to NZD $2, and emitters can purchase cheap and sometimes fraudulent overseas units. Research on the ETS from a wide range of sources shows it is insufficient to meet even the relatively weak Paris target, despite multiple reviews and re-calibrations (Royal Society of New Zealand, 2016; Kerr *et al.*, 2017; OECD, 2017a). Furthermore, agriculture, which makes up half of New Zealand's emissions, is not included.

In the past decade a number of policy actors have shown an interest in the role of smaller scale and local actors to improve the range of sources and utilization of more sustainable energy practices in New Zealand (Parliamentary Commissioner for the Environment, 2006; Barry and Chapman, 2009; Stephenson *et al.*, 2010; Schaefer, Lloyd and Stephenson, 2012). A change in government from the Labour party to National party in 2008 ushered in a number of policy recalibrations, however, including a backtracking from government intervention in power markets, support for direct subsidies and a strong emissions pricing system[8]. Political swings to the right also deepened the policy focus on creating competitive electricity markets, begun in a radical restructuring process in the 1990s. This process has included state asset sales, functional separation of electricity functions and creation of power pools to determine prices (Hall, 1999; Beder, 2003; Electricity Authority, 2011). Unlike Canada, New Zealand is a unitary state, so sub-national policy variations at the regional level do not exist. Local governments have planning authority under the *Resource Management Act 1991*, but this does not extend to regulating the electricity sector in any significant way.

One significant piece of context for the community energy sector in New Zealand relates to the relationship between the Indigenous Māori population and the state. Māori make up approximately 15% of the current population of the country. Under one of New Zealand's founding constitutional documents the *Treaty of Waitangi/ Tiriti o Waitangi* (1840) the country

[8] In October 2017, a centre left coalition of Labour, New Zealand First and the Green Party won power, so significant energy and climate policy changes are likely to come, including more ambitious carbon reduction goals, and a new climate commission.

was formed as a partnership between Māori and European settlers with the former retaining significant rights over land and resources. As with Canada, serious violations of early agreements were committed by the settler states, including land theft, economic displacement and extrajudicial killings. Many of these injustices are only now starting to be addressed, through settlement processes with specific groups. These developments form an important context for the community energy sector as the Te Ture Whenua Māori Act 1993 (or Māori Land Act 1993) strengthened and reconfirmed the collective communal rights of Māori over land, as well as the framework to set up a range of land trusts for the benefit of local community, or parts of it. As we see in the data of community ownership models below, Māori Iwi (roughly translated as 'tribe') trusts form a significant ownership share of the overall community sector (11%). The relationship and duties of the trustees to the Indigenous community members varies based on the specific trust form. A variety of legal structures exist, depending whether the trust is set up to manage the resource, or owns the resource rights, or whether the beneficiary is a tribe, or familial lineage. The complexities of these forms are outside the scope of this article, but others have addressed them and we plan to in more detail in future work now that the initial scoping study has been completed (MacArthur and Matthewman, no date; Tutua-Nathan, 1992; Coombes, Johnson and Howitt, 2012; Forster, 2017; MacArthur, Berka and Gonnelli, 2018; Ministry of Justice, 2018).

New Zealanders on the whole are some of the highest users of trusts per capita in the world (Law Commission of New Zealand, 2012). They are simple to set up, flexible, and enjoy preferential tax status, whereas in many European states, co-operatives, community benefit societies or municipalities are the more numerous community energy forms. The degree of community participation and control in trusts in New Zealand varies based on the trust's founding document (the 'deed'), so a direct relationship between the form (trust) and function or local benefit is difficult to draw without further research. Many consumer energy trusts in New Zealand were established from local lines companies and power boards into investment entities. Of the 28 distribution networks across New Zealand 65 % are owned by community electricity trusts, with full local government ownership in four and mixed trust and municipal ownership in a further three cases (Energy Trusts of New Zealand, 2015). Figure 5 illustrates the significant role that distribution functions play in the community energy sector in New Zealand. According to Energy

Trusts New Zealand, consumer energy trusts have investments of nearly $ 6 billion New Zealand dollars (NZD) in 2017 (Energy Trusts of New Zealand, 2015).

The figures in section 4.4. outline the results of the New Zealand community energy sector profile. Drawing from our dataset, we find significant activity in the distribution sector, a strong contribution of Māori communities in geothermal generation and newer, less successful moves to develop wind and solar projects.

## 4.4 Comparison of Results

The purpose of this research was to address the lack of comprehensive community energy maps in both Canada and New Zealand and to set the foundation to understand the implications of these differences for future energy transitions. In both countries, community energy project data is not held in one location, requiring the identification of diverse sources. This data collection is still in early stages and can now be enhanced with more details for further research. One important finding is that harmonizing data comparison across heterogeneity of forms, countries, provinces, territories, municipalities and regions is a challenging endeavour, one which can never really be complete. There are many moving parts and continual developments at the project, policy and the technology levels. However, while focusing on well established datasets or practices may be appealing for certainty and clarity, our broad comparison allows for a much richer picture of the scope and scale of activities taking place outside of the usual jurisdictions and energy activities studied.

**Table 3: Number of Community Energy Projects in Canada**

| Category | n | Active/Complete |
|---|---|---|
| Project | 785 | 367 |

**Table 4: Number of Community Energy Projects in New Zealand**

| Category | n | Active |
|---|---|---|
| Project | 144 | 126 |

The data collected is shown in Tables 3 and 4, and in Figures 1 through 8. Our summary of findings is as follows. The data illustrates that community level actors are undertaking a wide range of activities in both countries. We also see varied organizational forms in both. Distribution is the most frequent function of community energy projects in Canada, whereas in New Zealand, generation is the dominant form, with trust distribution a close second. This is despite the significant role that energy consumer distribution trusts play in the country and likely due to the significant number of large partnerships between the Māori actors and formerly public (now partially private) power companies. The most frequent forms of ownership in Canada are municipal (45%) and co-operative (33%).

While there is a push towards the market development of clean technology and innovation across Canada (Canada's First Ministers, 2016), the findings show that most distribution companies are often owned by municipalities or cooperatives, particularly in Ontario, few are owned by private companies. As the purpose of this initial assessment was to conduct an initial identification of community energy, we have not analysed the extent to which municipalities involve members along the process function, although the data allows for this future analysis. In New Zealand, trusts comprise 45% of community energy projects, and are the most common form of community energy with partnerships also playing a very important role. The latter confirms the experience in many countries where local actors are working together with a range of others, sometimes public, sometimes private on a new project.
In Canada, a mix of energy sources is dominant in the supply category, whereas in New Zealand the singular sources of hydro and geothermal as the dominant. Currently, there is a larger share of Indigenous trusts (iwi & iwi trusts) in New Zealand than Indigenous owned projects in Canada.

## 4.5 Discussion

Our main line of inquiry is about how diverse forms of ownership and functions of community energy are, and whether these cases suggest unique practices or models. We found a variety of community energy functions in both Canada and New Zealand, limited to wind or solar power generation as much of the existing literature focuses on. The results also show that how form and

function are deeply tied to the policy settings, particularly around the ways that municipalities are involved.

The finding that much distribution in Canada is owned by municipalities and cooperatives, while distribution is often owned by community trusts in New Zealand, as well as the other range of ownership differences brings us back to the significance of public policy and political context on community energy development. The energy sector restructuring initiated in the 1990s in New Zealand required the privatization and unbundling of the sector across the country (Ministry of Economic Development, no date; OECD, 2017a). Canada's federal structure, on the other hand, provided for a very uneven process of liberalization and privatization, so much so that today Nova Scotia has an integrated but private utility with significant coal generation and British Columbia's utility is largely hydro-powered and publically owned. The New Zealand government has been slow to incentivize wind and solar generation as many Canadian jurisdictions have done through power purchase agreements and feed-in tariffs, which explains in part why Canada often has a mix of energy sources compared to the dominance of hydro and geothermal energy in New Zealand (Buhrs and Christoff, 2006; Kelly, 2011).

There are several reasons why there is a larger share of Indigenous trusts (iwi & iwi trusts) in New Zealand than Indigenous owned projects in Canada. First, one facilitating factor the effects of the settlements process over the past two decades and the legal changes facilitating the business activities of Māori through the trust form. High levels of geothermal project ownership by Māori actors is also a significant difference from Canada, and is unique in the world. One project, 75% owned by the Tuaropaki Trust, is a 110MW geothermal station. These projects are large, and can generate significant revenues for the community groups involved. Māori communities are increasingly involved in new project development, from Te Kura Whare, by Ngāi Tūhoe in Taneatua, New Zealand's only net zero building, to microhydro installations near Rotorua. Canadian developments are also gaining steam, as reported by the Indigenous Renewable Energy Database (Lowan-Trudeau, no date) and Lumos Clean Energy Advisors (2017), there are several hundred Indigenous projects currently in planning stages, so their share of the sector is likely to increase significantly in coming years.

## 4.6 Identifying Future Research Areas

These results form an initial step in mapping out the various forms and functions of community energy in both countries. As outlined in the literature review, there are pressing questions to be answered about the definitions, impacts and benefits of community energy in the diverse contexts within which we find it operating. This initial sampling frame and dataset can be used to answer vital questions about the ultimate contribution of CE to climate mitigation. For example, it can be a starting point to collect available data on project impacts which could also include the size, capacity factor of project, number of participants/residents reached, as well as information and indicators on the community itself. Furthermore, data can be collected on the identified and measured social, economic, environmental or other identified impacts of these projects, or the extent to which different actors play a legitimizing role by creating or inhibiting trust in an energy related activity. Future research needs to examine the process dimension of municipal involvement in energy in Canada. It should also consider the systematic measurement benefits for distinct project forms and activities identified, as emphasized by Berka and Creamer (2018).

This comparison between Canada and New Zealand reveals a range of striking differences explained by distinct policy settings but also brings up several important follow-up questions. The lack of municipal involvement in New Zealand compared to very high municipal involvement in community energy in Canada is a key difference; further study to describe and unpack the impacts of these differences can give us information about the significance and eco-social impacts of municipal involvement. Another is that a mix of sources for supply is predominant in Canada, while single sources, such as hydro and geothermal, are dominant in New Zealand. One hypothesis requiring further examination is that Canada's higher level of municipal involvement accounts for this difference. Tracking how community energy evolves in both places will offer us information on heavy municipal involvement (Canada) versus minimal municipal involvement (New Zealand). For example, are there impacts on demand side, reliability, or enhance prospects for the establishment of locally managed energy such as district energy or micro-grids?

Ownership differences are also striking between the two countries. New Zealand community projects demonstrate a high share of partnerships, potentially due to the less prevalent role of

municipal energy ownership. It would be worthwhile to examine the governance and benefits structure of these partnerships and how they compare to models of municipal ownership in Canada. The findings also show that Canadians favour the use co-operatives for community ownership, while New Zealanders favour the use of trusts. The co-operative sectors in both countries are strong, so the cause cannot be attributed to lack of co-operatives per se, though a lack of energy co-operative models specifically in New Zealand may account for differences, along with lack of targeted policy support for community energy. A future research question can investigate whether these trusts and cooperatives are similar in the two countries in terms of how they are set-up for governance, distribution of benefits, and the actors participating in them. Furthermore, Kooij et al's (2017) discourse element outlined in the framework section (and omitted due to space and time constraints) suggests future qualitative research needs to unpack how and why revealed differences in CE systems are a result of ideas, norms and discourse coalitions delineating the possible in a given country.

In terms of Indigenous community energy, New Zealand Māori may be further along the experience curve in developing community energy projects (Bargh, 2012; MacArthur, 2018). Despite Canada's favouring of co-operatives, Henderson (2013) encourages a community clean-energy trust model for Aboriginal communities in Canada; some communities have adopted this model, although not enough projects have been completed to confirm whether this model is easy to implement or may become dominant. Detailed analysis of the activities that led to this level of development this will offer fruitful lessons for Canada and other postcolonial settings. Research by Indigenous scholars and work attentive to distinct practices, methodologies and worldviews would also be extremely valuable.

## 5 Conclusion and Policy Implications

The energy transitions challenge set out at the start of this paper is a daunting one. Canada and New Zealand are wealthy, technologically advanced, politically stable and have significant renewable resources. Layered upon these challenges are pressing socio-political challenges, where problems of uneven economic development, inequality and fuel poverty loom large.

Community energy models may potentially aid in bridging these challenges, by involving and engaging a broader set of actors in the design, development and benefits of energy transitions.

This study set out to address the lack of awareness in policy and practitioner settings as to the scale and diversity of the community energy sector, particularly outside Europe by focusing on gathering data in two understudied countries, Canada and New Zealand, each having a significant Indigenous population that participates in the development of energy functions. This gap is significant, because while historical policy choices have shaped the forms and functions of the sector, sometimes unintentionally, a wide range of future models are possible. Post-colonial settings such as Canada and New Zealand open up scope for analysis of a more diverse range of entrants, and also how community energy contributes in hydro-dominant electricity sectors.

Much of the diversity in community energy practice can be likely be explained by the distinct policy settings in each jurisdiction studied here: less privatization and more new renewable support in some Canadian provinces, with more uniform liberalization and legal support for trusts in New Zealand, but this historical insight can only take us so far in addressing energy transition dilemmas. The identification and initial analysis of the range of community energy projects in Canada and New Zealand makes a contribution to the literature by opening up future space to examine issues of settler-Indigenous relations, local public ownership, and land rights impacts on community energy. There may be opportunities for transferability of findings about community energy between Indigenous communities.

The systematic data collection and the study of community energy in these countries presented in the paper has provided a broader understanding of community energy by examining for variation in models of technology and governance across provinces and territories, and across small (spread out) rural, large (dense) urban and Indigenous communities. This is the first step towards identifying the impacts of these models. Energy services are increasingly place based and communities will likely need to play a larger role in future projects, from car charging stations to local heating or cooling systems. While the rise of individualized prosumers and micro-grids are widely discussed today in energy policy circles and beyond, the institutional and political underpinnings of transitions remain vague and underdeveloped at present. This analysis renders

visible the scale of activities taking place by communities from the northern tip of Canada to the southern toes of New Zealand's Stewart Island. How and where these activities take place, and what they *displace*, in these countries and beyond are vital future questions for unpacking the contribution of community energy to energy transitions.

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