3rd International Conference
on Public Policy (ICPP3)
June 28-30, 2017 – Singapore

Panel T17cP20 Session 2
Energy Decentralization

Local Forms and Eco-social Functions: Community Energy Models in Canada and New Zealand

Julie MacArthur, School of Social Sciences, University of Auckland, New Zealand, j.macarthur@auckland.ac.nz

Christina Hoicka, Faculty of Environment, York University, Canada, cehoicka@yorku.ca

30 June 2017

Draft – please do not cite or quote without permission from authors

Abstract: The 2016 Paris Agreement prompted renewed attention to mechanisms for climate change mitigation. For energy researchers, community interventions spurred by public policies have long held promise for addressing the climate crisis. These include reducing opposition to new green infrastructure, providing new social mechanisms for learning, literacy, and facilitating economic development. Energy programs based in local community partnerships have been shown to be highly successful in engaging large segments of the population. 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 contributes to the empirical literature by examining the forms and functions of 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. Based in empirical examples selected for a range of models, and an interdisciplinary approach that employs political science, geography and engineering knowledges, this paper considers the questions: what models and functions of community energy have emerged in these jurisdictions and how has policy choice shaped these differences? Addressing these questions will generate new methods to better understand how to encourage and support community-based interventions as mechanisms for climate change mitigation.

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, global emissions continue to grow, with the 400 parts per million threshold surpassed in 2013 for the first time. As heat records continue to fall and sea-levels rise faster than expected, researcher attention has focused on the role of state and sub-state actors in both adaptation and mitigation activities. On 4 November 2016 the Paris Agreement came into force, prompting renewed public attention to climate policy action, but in June 2017 the newly elected President of the United States Donald Trump declared his country's intention to withdraw. This move spurred global condemnation, together with widespread acknowledgement that other nations, particularly in the EU and Asia, would and could lead more transformative policy shifts and that sub-state actors at local levels are increasingly committed to energy and infrastructural transformations. This latter movement has taken many forms over the past three decades, from 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 in the emergence of of local 'community energy' systems in diverse resource and political contexts.

For energy transition researchers, community interventions spurred by public policies have long held promise for addressing the climate crisis. These include reducing opposition to new green infrastructure, providing new social mechanisms for learning, literacy, and facilitating economic development (Haggett & Aitken, 2015; Walker, Hunter, Devine-Wright, Evans, & Fay, 2007).

Community energy, though conceptually contested, is defined here as *functions* that include the provision of energy supply, demand management, distribution and system management services by locally rooted actors, defined here as *forms*, such as co-operatives, non-profit societies, trusts or municipalities. Energy projects based in local community partnerships have been shown to be highly successful in engaging large segments of the population. However, empirical research continues to uncover many differences in the specific forms, functions and policy settings that relate to community initiatives across jurisdictions.

While local projects hold potential, 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' (Berka & Creamer, 2016; Seyfang, Jin, & Smith, 2013; Walker, 2011). The timing for this research is excellent, as the literature and profile of the 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. We have lacked empirical data and national maps of projects and activities up until very recently, when policymakers and energy networks such as REN21 began recognizing local energy innovations in generation, conservation, system management and education as a distinct arena of activity.

This paper contributes to the empirical literature by examining the forms and functions of community energy projects in Canada and New Zealand. These countries have the third and sixth highest greenhouse gas per capita emissions in the world, despite the technical and financial ability to make significant reductions (OECD, 2017b). They also contain within them distinct practices of 'community energy' in the form of indigenous 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 also market-liberal states who have, unevenly in Canada and more radically in New Zealand, undergone significant restructuring and privatization in the power sector. However, understanding the significance of these political economy factors to the impact of community energy forms is no small task, despite being an important one (Taylor Aiken, Middlemiss, Sallu, & Hauxwell-Baldwin, 2017). Prior to this research there were no national maps of the community energy sector in either jurisdiction, which we seek to remedy 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. Important questions have also been raised about the ability of community energy systems 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 has policy choice shaped these differences? What are their limits? We begin with a review of recent literature on the nature and functions of community energy, before moving to the empirical profile of the sector in Canada and New Zealand. We compare the findings from these two new datasets and then outline a program of future research in order to better understand the contribution of these actors to energy sector transitions and climate change action.

2 Literature Review: Conceptualizing Community Energy

Community is a nebulous term. Hagget and Aitken, for example, illustrate how communities are not just limited to those physically proximate, but can include communities of interest (Haggett & Aitken, 2015). The term has positive 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 (Amin, 2008; Iris Marion Young, 1986; Shragge, 1997). For example, where are the boundaries of community? Who's in or out? How do they operate? Critical scholarship has also pointed out the need to reject a naturalistic fallacy assuming that community is synonymous with good, fair or effective. If we are unclear on what they are, however, or using different definitions in each study it is next to impossible to identify how they might lead to particular outcomes with respect to behavioural change in the energy sector or elsewhere. This creates a need to clearly outline the specific features distinguishing both the forms and functions of the sector, which we turn to below.

We take as our starting point Walker and Devine-Wright's highly cited definition of community energy as an energy project run by and for the benefit of a local population (Walker & Devine-Wright, 2008). These social enterprises may take a range of legal forms: from the co-operative organizations to non-profit or for-profit associations and energy trusts, and in some jurisdictions (for example, Scotland and Denmark) the definition includes municipalities. The UK literature on community energy is by far the most prolific currently, so we have focused our attention on it, but turn later in this paper to potential issues of transferability. 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. Some projects can, of course, include elements of both, and these would represent an ideal-type community energy project, both participatory and financially beneficial. For those interested in aspects of participatory or engaged governance, the conceptual distinction between governing power and financial interest is an important one.

Due to the widespread trends of the densification of demand in communities and the decentralization of supply, communities are increasingly in a geographically proximate area to energy projects and are increasingly engaging with energy projects, whether community members are actively involved or passive recipients. Given that reliable energy is a permitting factor for economic and social development (Newman, Beatley, & Boyer, 2009; Owens, 1986), communities, including municipalities, have a fundamental interest in energy infrastructure. Prices for renewable energy technologies have been decreasing (IRENA, 2016; REN21, 2017) and the trend of replacing centralized generation (e.g., coal, nuclear, gas, oil, large hydro) with distributed generation technologies with lower power densities (i.e., Watts/m^2) means that an equivalent amount of land-based energy generation will require more structures over a larger land area (Owens, 1986; Smil, 2015). This increased area of interaction between land and power generation brings about an increase in visibility and community interaction with these technologies. Meanwhile, the densification of populations and buildings in communities and the densification of locational growth of energy, that will increasingly include local adoption of electric vehicles, can lead to congestion in traditional energy transmission/delivery systems, leading to difficulty in supplying energy demand in a specific location (e.g., Toronto Hydro, Hydro One, IESO, & Ontario Power Authority, 2014). Solutions to growth-related local congestion problems include local generation, conservation or more sensitive demand management to meet local energy requirements. The scale of available energy management technologies are becoming more local with smart-grids, smart-homes, smart-meters and micro-grids (Palensky & Kupzog, 2013). Furthermore, this densification of energy demand (e.g., buildings) improves the economics of district energy for heating or cooling (Environmental Commissioner of Ontario, 2012; Owens, 1986). Due to the expanding geography of supply and the increasing density of demand, the various functions of energy projects such as local demand management, distribution/system management and supply that coincide with communities require different forms of management, oversight, delivery, availability of labour, and the economics of procurement.

These geographic, demographic and technical trends are reflected in the community energy literature: the energy functions performed by community actors are shown to vary, from supplying power and heat, to distributing it and demand side management. The literature to date has largely focused on the role of community actors in power generation, and on small case studies but this is starting to change. 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 some 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 community 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 retrofits 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." (Berka & Creamer, 2016). It is likely, of course that the specific functions undertaken will depend largely on the policy settings and national energy contexts within which they develop. In their quantitative survey of the UK's community energy system in 2013 Seyfang, Jin and Smith examined the geographic distribution, growth over time and project activities. They expanded their data collection beyond generation activities and included energy conservation activities, an approach we follow in this paper.

While the technical and geographic features of energy projects will impact the structure of that project, the literature also suggests that how the project is structured—in terms of who participates and how they do so— is likely to matter for the impacts it has on local acceptance, energy education, affordability and emissions mitigation. One of the most important of these differences is the degree of participation or investment, as identified by Walker and Devine Wright, above. Another is the rising trend of local projects to be developed as partnerships with either public sector, conventional private sector or other community actors, all of which have in common an interest in a reliable energy supply for local economic development. In his analysis of Scottish community energy models, for example, Gubbins makes a distinction between community energy projects where benefits flow to a group of local private investors through a co-operative versus those going to a wider community through a community benefit trust or municipal organization (Gubbins, 2010). He argues that while co-operative models can include significant benefit to local individuals, the wider community has little to no say. However, they are not as likely to be reliant on public funds, and can help to encourage local support for new renewable energy initiatives if they are not forthcoming from other sectors. Partnerships with large private sector developers also raise challenges and benefits, as they help to ease financing and development experience hurdles, but can water down both the community participation and long term revenues from projects (J. L. MacArthur, 2016). As a result, analyses of community energy systems need to be attentive to the distinctions in organizational forms. This includes understanding the prevalence of broader community benefit models versus more individualized ones as well as the distinctions between local participation versus benefit raised earlier in this section.

After energy market restructuring, as well as a decade or more of experience with policies supporting community energy projects, there is now a growing number of community energy projects in Canada, New Zealand, and globally (REN21, 2016). Communities and governments are very much involved in the shift to a low-carbon economy yet we are not 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 (Berka & Creamer, 2016). With the proliferation of community energy internationally, researchers are documenting a wide range of divergent models and the need for better data collection (Berka & Creamer, 2016; Gubbins, 2010; Haggett & Aitken, 2015). Reviews of the sector are calling for more systematic cross-national comparative research on specific impacts, and reviews of the state of evidence for impacts (Berka & Creamer, 2016; Seyfang et al., 2013). Significant diversity in practice has emerged, as well as controversy over who participates and how the system interfaces with the broader energy sector. The community energy literature concentrates on the European experience and is still unclear the extent of gaps there are in the literature, for example, as it largely ignores indigenous forms of ownership.

This paper begins to address these gaps conceptually by beginning the collection of data on form and function of local energy projects in the two less-studied countries of Canada and New Zealand. This study will begin to answer the questions: what and where are these local energy projects? Who is becoming more involved in them? This study will contribute to the development of community energy maps and to understanding how community energy occurs in a geographic and regulatory heterogeneity (Canada).

Particular to Canada and New Zealand are Indigenous communities that are increasingly involved in renewable energy, in part due to the increased land-area required for renewable energy. 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 could be documented. Henderson (2013) describes the geography of renewable energy potential in Canada as one reason for the increasing participation of Aboriginal communities in community energy project development in Canada, although Krupa (2012) outlines the significant barriers to participation of aboriginal energy project ownership. 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 it is formally structured (Bargh, 2012, 2013). By contributing to understanding the emergent role of indigenous communities in energy planning and management, this research will contribute insights into the dimensions of distribution of benefits, inclusiveness and issues of justice.

A critical decision in the analysis is to include local energy plans and municipal plans and to include municipalities within the range of community involvement. This decision is due to their fundamental interest in reliable energy for economic development, increasing involvement or proximity to energy projects, and increasing involvement in local energy decisions through local plans. It is also recognition of the potentially problematic exclusion of state actors (even local ones) as central players in community energy futures, as either direct or facilitating participants. As Haggett and Aitken argue "…the role of the government should not be limited to distributing material or financial resources. We have also drawn attention to the issue of access to land. We suggest therefore that consideration be given to the identification and advertisement of potential community energy sites by local authorities. Support for the development of community renewables on publicly owned land, or a voluntary register of land-owners who are willing to lease their land to community renewables developments, would also serve to address this problem."(Haggett & Aitken, 2015) Municipal community energy may be structured to include community members only as passive recipients of an initiative. For these reasons, municipalities have been included as one form of ownership of projects in order to explore the nature of their role in community energy functions, rather than rendering them invisible by definitional fiat. Finally, some local energy projects are federally or provincially owned, and these categories have been collected in order to better contextualize their role in local energy projects/measure their share.

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, distribution systems, such as district energy, micro-grids and traditional distribution systems, energy generation as well as plans (e.g., community climate or energy plans). These categories are included below in Table 1. The range of ownership includes the categories of municipal and aboriginal ownership.

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

Functions (Physical Outputs)	Forms of Ownership (Governance)
• Supply • Demand • Distribution / System management (microgrids, district energy, traditional distribution) • Plans	• cooperative • community trust • community association • private company • charity • municipality • Indigenous/First Nations • Province • Federal • Partnership/Joint Venture

The sampling frame was informed by the identification of relevant policies, actors and reports. It includes lists and sources of local and community energy plans and projects in Canada. The identified sources of data include:

i. Keyword searches
ii. Regulatory 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
viii. Municipal plans

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 696 projects and 72 municipal plans in Canada and 84 projects and 22 municipal plans in New Zealand. These individual entries were then coded for the type of functions and forms outlined in Table 1 above, in order to establish the overall profile as well as identify correlations and trends between the activities and structures in each jurisdiction. From here we have generated the most comprehensive profiles of the range of community energy actors and activities in both countries to date[1]. The New Zealand data is connected to a related but as yet unpublished analysis of community energy systems in that country (Berka, MacArthur, & Gonnelli, n.d.). This approach allows for significant future work on the datasets involving a deep dig into projects of each form and function type in order to explain which, if any structural characteristics have significant 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 our ability to expand the comparative cases beyond these two developed settler-colonial countries and to other contexts.

4 Preliminary Results: Community Energy in Canada and New Zealand

This section outlines the core findings of the national profiles of community energy activities created for this project. It places these findings, briefly, in the national energy policy contexts within which they developed. We illustrate how both Canada and New Zealand face significant energy sector challenges. Table two outlines some of the key features of the sector in both countries. They are both in the top 10 greenhouse gas emitters per capita, with Canada at number three and New Zealand at number six globally. While each country has large renewable energy resources in traditional areas such as large hydropower, they have 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, but far more radically and uniformly in New Zealand which does not have a federal political structure (Kelly, 2011). New Zealand is also unique insofar as it cannot rely on neighbours for its electricity grid reliability, since it is an isolated island in the South Pacific. This places an extra weight on the system managers to ‘overbuild’, but on the other hand also means that the system is not exposed or constrained by requirements from other players in their market as Canada is with FERC and NERC (Cohen, 2007; J. L. MacArthur, 2016).

Table 2: Energy Sector Profile Canada and New Zealand

Category	Canada	New Zealand
Tonnes greenhouse gas	20.5, #3 globally 2014 (1)	18, #6 globally 2014 (1)

[1] 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.

emissions per capita		
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) (Organization for Economic Co-operation and Development, 2017)
(2) http://www.oecd.org/env/climate-change-mitigation-9789264238787-en.htm
(3) http://www.mfe.govt.nz/climate-change/reporting-greenhouse-gas-emissions/nzs-greenhouse-gas-inventory
(4) (Environment Canada, 2017)
(5) Energy in New Zealand 2016, MBIE, http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/publications/energy-in-new-zealand

4.1 Canada Context and Preliminary Results

Canada is made up of 10 provinces and three territories. Since 1990, Canada's greenhouse gas emissions have increased by nearly 20 per cent (Table 2). 81 per cent of these are energy related (Environment Canada, 2017) and Canadians are among the highest greenhouse gas emitters per capita in the world (Organization for Economic Co-operation and Development, 2017). Oil and gas and transportation sectors are responsible for 26% and 24% of emissions respectively, with electricity in third place with 11% (Environment Canada, 2017). Nationally, 64% of installed electricity generation capacity in Canada comes from renewable (hydro, wind, solar) sources, with the remainder coming from a mix of coal, natural gas, diesel (in remote communities) and nuclear (Statistics Canada, 2016). 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. 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.

Despite being a large country, most of the Canadian population resides in a concentrated area along the southern border (Brouard, McMurtry, & Vieta, 2015). Although Canadians are such high greenhouse gas emitters on average, there is growing attention to the lack of energy and fuel poverty in remote and Indigenous communities (Canada's First Ministers, 2016). Communities are responsible for 60% of energy use in Canada (QUEST, 2017a) and 44% of greenhouse gas emissions (Environmental Commissioner of Ontario, 2012).

In the past decade politically Canada has had changes in Federal government party from Liberal, to Conservative, and in 2016, back to Liberal again. These changes in government brought about significant policy swings relating to the energy sector. One particularly 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 with lack of action, prior to a very public backtracking on climate change commitments and withdrawal by the Conservative government in 2011. With the new Liberal government in place, 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 starting point in committing to the Paris Agreement. The framework makes federal government commitments to support renewable energy and clean technology projects, and presents the various provincial frameworks and commitments as well.

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 supports in some provinces and territories (J. MacArthur, 2017; J. L. 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. MacArthur (2017) outlines that there are supportive policies in place for community energy in nearly every Canadian province. Ontario, Nova Scotia and New Brunswick also developed targeted supports for community renewable energy projects in the form of either grid set-asides or feed-in-tariffs with community adders between 2009 and the present, but with many of these policies being amended, scaled back and reversed as a result of electoral shifts.

There are many reasons why municipal and community involvement in various forms and functions of community energy is increasing. The densification of communities (Ontario, 2005), decentralization of energy (Ontario, 2009), the introduction of a range of community energy programs (Gliedt & Parker, 2014), various social enterprise strategies (Brouard et al., 2015), increased creation of community energy plans (QUEST, 2017a) 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, 2017b). Furthermore, there is increasing awareness that through their impact on land-use and bylaws, municipalities have direct and indirect influence on greenhouse gas emissions from energy use of transportation and buildings (Environmental Commissioner of Ontario, 2012). There is also increasing recognition in Canada of the important relationships between energy and economic development in communities (QUEST, 2016). There is also increasing involvement of Aboriginal communities in the production of clean power generation for local economic benefits (Henderson, 2013) and Aboriginal community energy plans (Indigenous and Northern Affairs Canada, 2016). Community energy plans typically involve measuring baseline energy use in the community and ways to reduce energy use and greenhouse gas emissions across the built environment (QUEST, 2016), and identify the need for actions such as energy retrofits. Energy retrofits for demand management are labour intensive, creating local economic development benefits. The highest uptake of energy retrofit programs in Canada without grants was due to credibility of a community partnership between a university, local utility, municipality and a community based organization (Kennedy, Parker, Scott, & Rowlands, 2001; Parker & Rowlands, 2007). The Government of Canada, British Columbia, Quebec, Ontario and other provinces are providing policy drivers and funding to support electrification of transportation (Canada's First Ministers, 2016). This 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 systematic data collection and the study of community energy in Canada can contribute to a broader understanding of community energy by examining for variation in models of technology, governance, and impact across provinces and territories, and across small (spread out) rural, large (dense) urban and Aboriginal communities. Given the potential for overlapping of policies at three levels of government (municipal, provincial/territorial, federal), we can examine the impacts of cumulative/overlapping policies. Furthermore, due to the geographical variation and the contrast between communities, we can examine the differences in community uptake of eligible communities where supportive policies exist.

4.2 Canada Preliminary Results

Table 3: Number of Community Energy Projects and Plans in Canada

	n	Active
Projects	696	288
Plans	72	

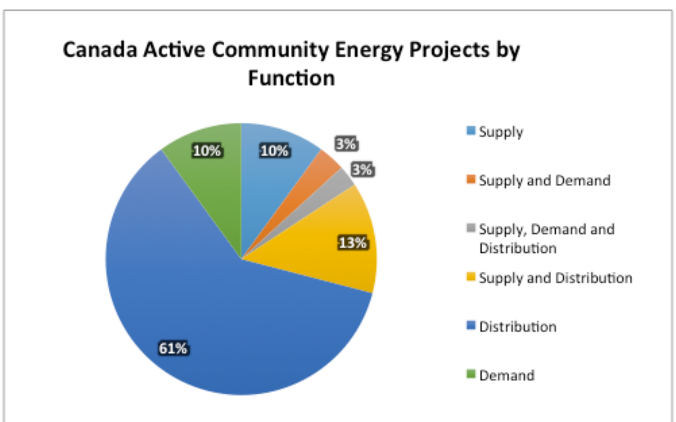

Figure 1: Active Community Energy Projects in Canada by Function

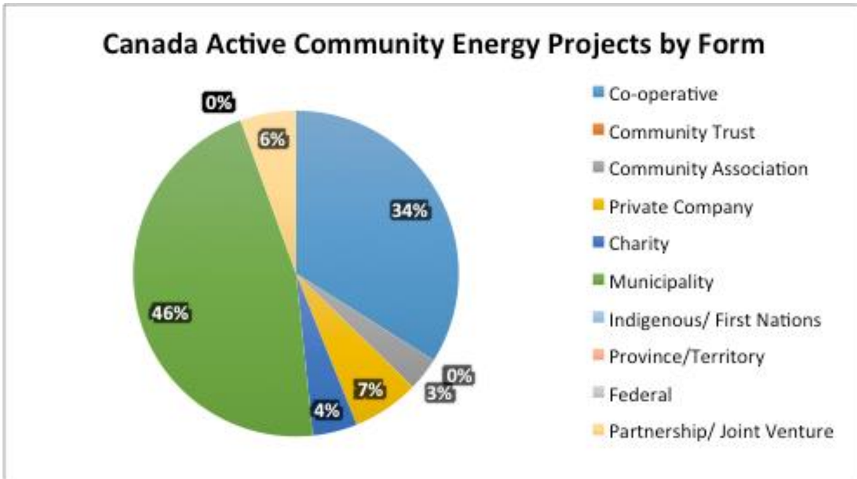

Figure 2: Active Community Energy Projects in Canada by Form

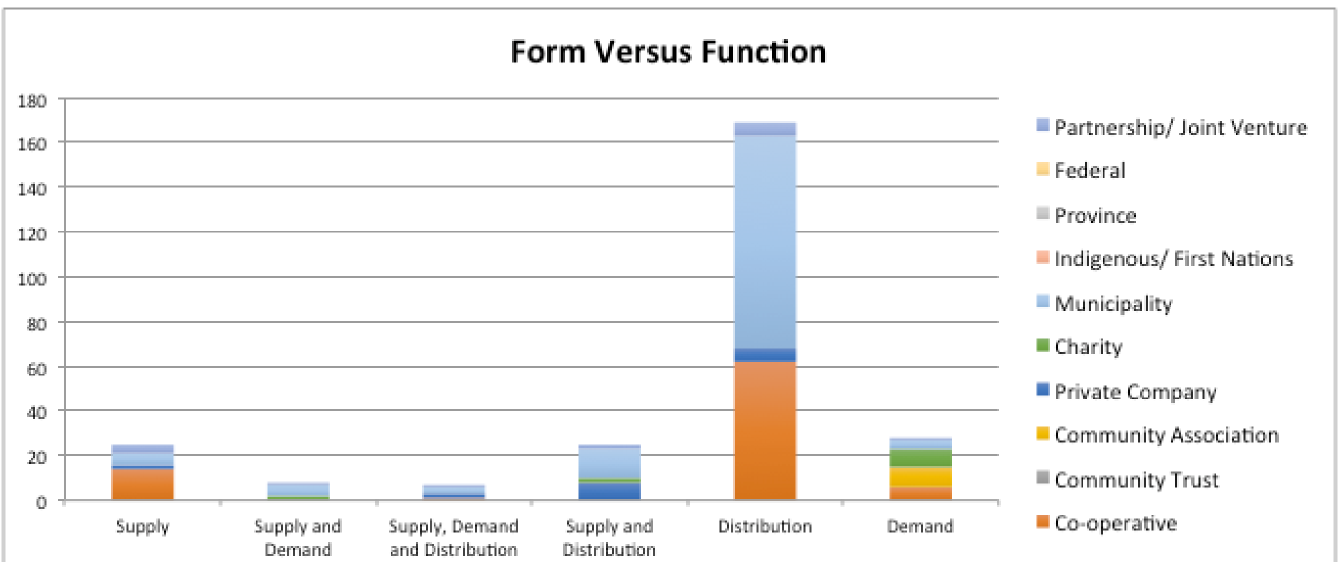

Figure 3: Form Versus Function in Canada

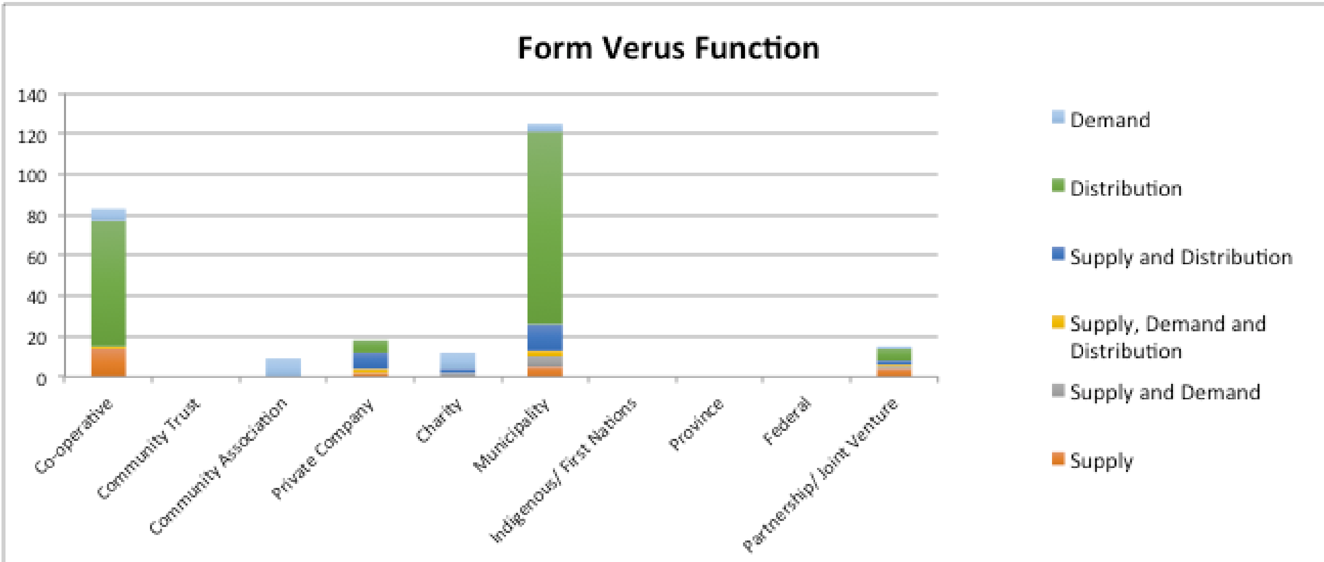

Figure 4: Function versus Form in Canada

4.3 New Zealand Context and Preliminary Results

New Zealand is a small South Pacific island nation of 4.5 million people. 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. Under the Paris Agreement, New Zealand has set a target of 11 per cent reductions to 1990 by 2030. The emissions profile and energy sector are distinct from Canada in a number of ways. First, as mentioned above, 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 greenhouse gas emissions for the country, at 40.5 %, nearly half of the country's emissions come from methane produced by agriculture. 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 (New Zealand Ministry for the Environment, 2017). Furthermore, emissions from fossil fuel combustion for transport have increased a significant 74% since 1990, and New Zealand homes continue to be cold and energy inefficient by international standards (Byrd & Matthewman, 2012; New Zealand Ministry for the Environment, 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 (Kerr et al., 2017; OECD, 2017a; Royal Society of New Zealand, 2016). Furthermore, agriculture, which makes up half of New Zealand's emissions, is not included (Pollitt, 2012).

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 (Barry & Chapman, 2009; Parliamentary Commissioner for the Environment, 2006; Schaefer, Lloyd, & Stephenson, 2012; Stephenson et al., 2010). 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. 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 (Beder, 2003; Electricity Authority, 2011; Hall, 1999). 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 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 New Zealand's founding constitutional document the *Treaty of Waitangi/ Tiriti o Waitangi* (1840) the country 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 group. 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. The relationship and duties of the trustees to the indigenous community members varies based on the specific trust form set up under the Land Court.. As we see in the data of community ownership models below, Māori Iwi (roughly translated as 'tribe') trusts form a significant share of the overall sector (11%).

Even outside the Māori population, New Zealanders are some of the highest users of trusts per capita in the world. This is because 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. However, the degree of community involvement 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. The New Zealand trust forms most likely to overlap with the international understanding of 'community energy' based on local participation and benefit would be the consumer trusts, community trusts, or Māori trusts. Many trusts in New Zealand were established from local lines companies and power boards into investment entities representing local consumers. As a result, the majority (65 %) of the 28 distribution networks across New Zealand are owned by community electricity trusts, with full local government ownership in four (Aurora Energy, Electricity Invercargill and Orion) and mixed trust and municipal ownership in a further three (Alpine Energy, Electricity Ashburton and Vector) cases (Commerce Commission New Zealand, n.d., 2013). Figure 5 below illustrates the significant role that community distribution functions play in the CE sector. In the case of Auckland, Entrust (formerly AECT) arose out of the consumer owned Auckland Electric Power board utility, established in 1992. According to Energy Trusts New Zealand, consumer energy trusts have investments of more than $ 5 billion New Zealand dollars (NZD) in 2015 (Energy Trusts of New Zealand, 2015).

The tables below outline the results of the New Zealand CE 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 New Zealand Preliminary Results

Table 4: Number of Community Energy Projects and Plans in New Zealand

	n	Active
Project	84	75
Plan	22	

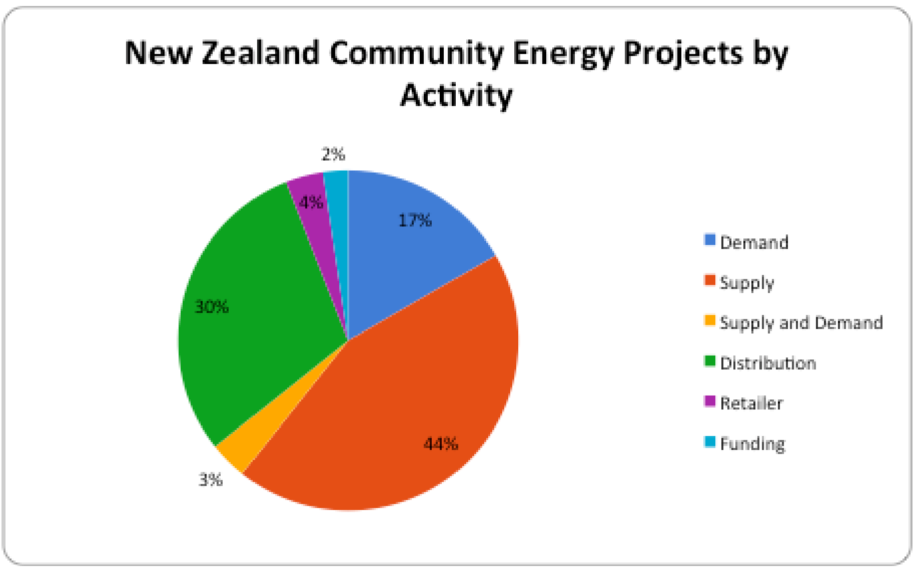

Figure 5: Active Community Energy Projects in New Zealand by Function

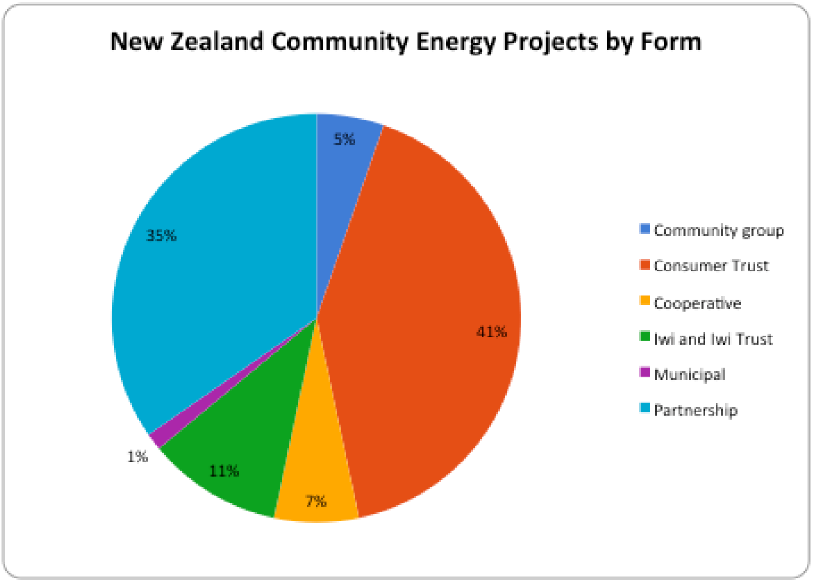

Figure 6: Active Community Energy Projects in New Zealand by Form

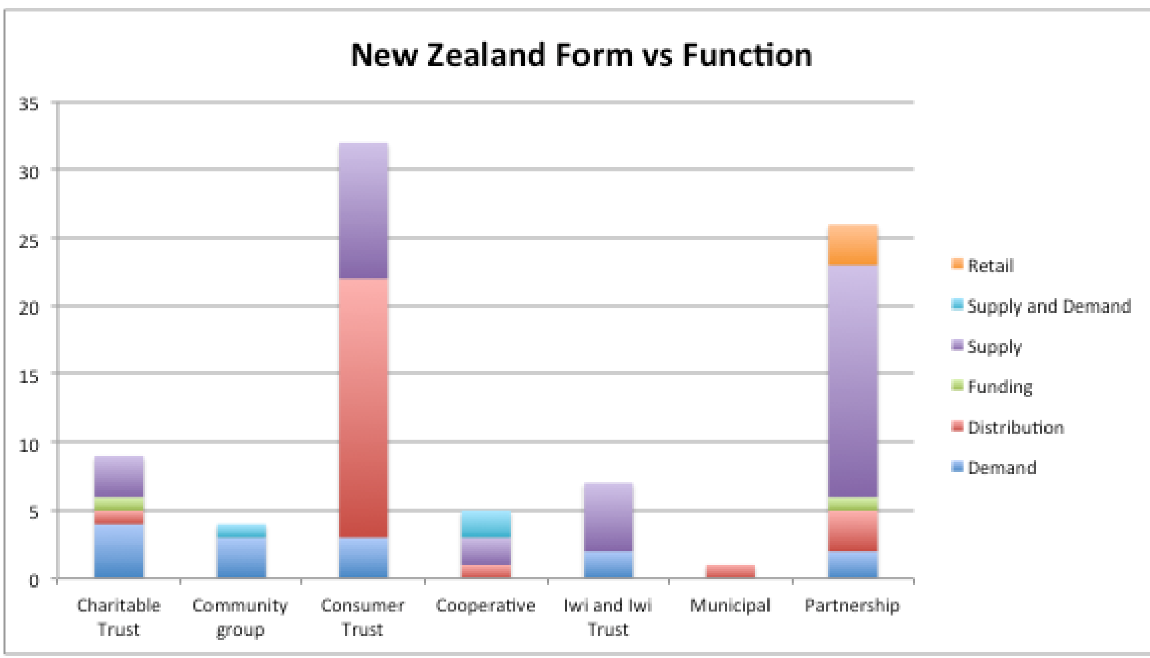

Figure 7: Form Versus Function New Zealand

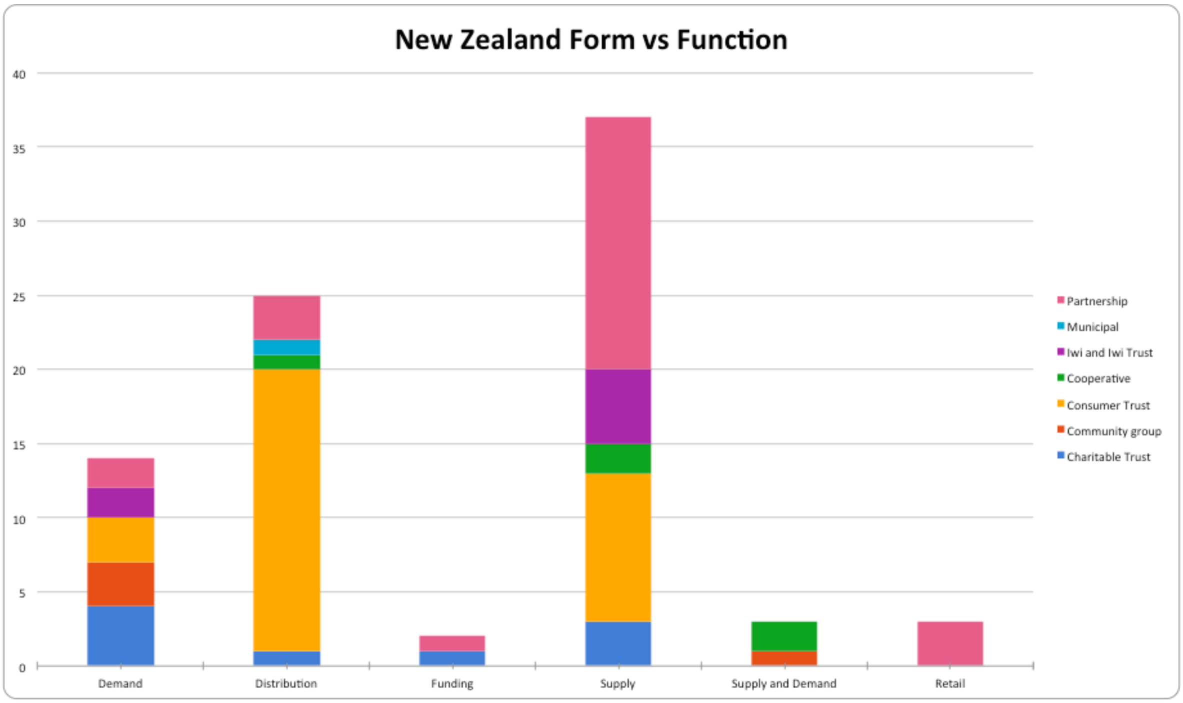

Figure 8: Form Versus Function New Zealand

4.5 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 requires further verification for completeness. One important finding is that harmonizing data comparison across heterogeneity of two countries, provinces, territories, municipalities and regions is a process. However, not attempting this broad level comparison leads us to construct models of community energy practices that are either unrepresentative of the potential activities or lacking in transferability of impacts.

The data collected is shown in Tables 3 and 4, and in Figures 1 through 8. Our summary of findings is as follows. At 72 completed, community energy plans are relatively common in Canada, while our analysis in New Zealand shows that local energy planning plays a much smaller role. The most frequent forms of ownership in Canada are municipal (45%) and co-operative (33%). In New Zealand, at 45% of community energy projects, trusts 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. We found that there is a larger share of Indigenous trusts (iwi & iwi Trusts) in New Zealand than Indigenous owned projects in Canada, likely due to 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 as far as we know. One project, 75% owned by the Tuaropaki Trust, is a 110MW geothermal station. These projects are not small, and generate significant revenues for the community groups involved. In Canada, there are many Indigenous projects currently in planning stages, so their share of the sector is likely to change significantly in coming years.

The data also shows that community level actors are undertaking a wide range of activities in both countries. These include power generation and supply, system management, distribution, retailing and planning. We also see varied organizational forms in both. Distribution is the largest function of community energy projects in Canada, whereas in New Zealand, supply is the dominant form, with distribution a close second. This is despite the significant role that energy consumer distribution trusts play in the sector and likely due to the significant number of large partnerships between the Maori actors and formerly public (now mostly private) power companies. In Canada, a mix of energy sources is dominant in the supply category, whereas in New Zealand has hydro and geothermal as the dominant. 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.

While there is a push towards the market development of clean technology and innovation across Canada (Canada et al., 2016), the findings show that most distribution companies are owned by the province, municipalities or cooperatives, few are owned by private companies. This finding brings us back to the significance of public policy and political context on CE development. The energy sector restructuring initiated in the 1990s in New Zealand required the privatization and unbundling of the sector across the country. 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.

4.5.1 Summary and Next steps

The energy transitions challenge set out at the start of this paper is a daunting one. The global community is struggling, and largely failing, to avoid catastrophic global warming and key developed large emitters are stalling or withdrawing policy supports for cleaner energy systems. Canada and New Zealand are wealthy, technologically advanced, politically stable and have significant renewable resources. However, for a range of reasons, transport emissions continue to rise, emissions per capita are among the highest in the world and overall emissions have increased in the double digits from 1990 in both countries. Layered upon these challenges are also the pressing socio-political challenges at play today, where problems of uneven economic development, inequality and fuel poverty loom large. Community energy models may potential aid in bridging these challenges, by involving and engaging a broader set of actors in the design, development and the benefits of energy transitions. Once seen as niche, many countries, agencies, and actors are turning their attention to bottom-up groups and the role of local 'prosumers'. Of course, as we've discussed in this paper, community energy is a slippery concept, both in its organizational form and in its function in the energy sector. We need to understand far more than we do about this sector across national settings.

Much 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 supports 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. This comparative analysis of form and function of community energy in Canada and New Zealand brings up several important follow-up questions. First, Canadians favour the use of co-operatives for community ownership, while New Zealanders favour the use of trusts. A future research question might investigate whether these trusts and cooperatives are similar in the two countries in terms of how they are used and the actors participating in them.

Another key difference 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 it is the high level of public (municipal) involvement in Canada that accounts for this difference. Furthermore, as outlined in the literature review, there are pressing questions to be answered about the 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 for this further research. For example, to collect available data on project impact which could also include 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.

There is a lack of awareness in policy and practitioner settings as to the scale and diversity of the community energy sector, particularly outside Europe, but this has started to change in the past decade. 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. In order to inform these debates appropriately we need to know far more about the strengths, weaknesses and diversity of the sector. We were inspired to undertake this research because while co-operative wind turbines are widely discussed in the community energy literature, they are not necessarily the activity that is either most useful for achieving the range of goals communities might seek, or the most widespread. Energy services are increasingly place based and communities will likely need to play a larger role in future projects, from car charging stations to energy planning and local heating or cooling systems. But understanding how and where these activities take place, and what they displace are vital for unpacking the contribution of community energy to addressing the energy challenges we face.

5 References

Adkin, L. (2009). *Environmental conflict and democracy in Canada*. Vancouver: UBC Press.

Amin, A. (2008). *Community, economic creativity, and organization*. London: Oxford University Press.

Bargh, M. (2012). Rethinking and re- shaping indigenous economies: Māori geothermal energy enterprises. *Journal of Enterprising Communities: People and Places in the Global Economy*, *6*(3), 271–283. http://doi.org/10.1108/17506201211258423

Bargh, M. (2013). A Blue Economy for Aotearoa New Zealand? *Environment, Development and Sustainability*, 1–12. http://doi.org/10.1007/s10668-013-9487-4

Barry, M., & Chapman, R. (2009). Distributed small-scale wind in New Zealand: Advantages, barriers and policy support instruments. *Energy Policy*, *37*, 3358–3369.

Beder, S. (2003). *Power play: the fight to control the world's electricity*. New York: The New Press.

Berka, A. L., & Creamer, E. (2016). Taking stock of the local impacts of community renewable energy: a review and research agenda. *Preprint*.

Berka, A. L., MacArthur, J. L., & Gonnelli, C. (n.d.). Power, projects and policies: The role of community energy in New Zealand.

Brouard, F., Mcmurtry, J. J., & Vieta, M. (2015). Social Enterprise Models in Canada - Ontario. *Canadian Journal of Nonprofit and Social Economy Research*, *6*(1), 63–82.

Byrd, H., & Matthewman, S. (2012). Warm up New Zealand: Heat smart - a critical overview, *27*(2), 54.

Canada's First Ministers. (2016). *Pan-Canadian Framework on Clean Growth and Climate Change: Canada's Plan to Address Climate Change and Grow the Economy*.

Canada, Ontario, Prince Edward Island, British Columbia, Alberta, Nova Scotia, … Northwest Territories. (2016). *PAN-CANADIAN FRAMEWORK on Clean Growth and Climate Change*.

Cohen, M. G. (2007). Imperialist regulation: U.S. Electricity market designs and their problems for Canada and Mexico. In R. Grinspun, Y. Shamsie, & M. Barlow (Eds.), *Whose Canada? Continental Integration, Fortress North America and the Corporate Agenda*. Montreal: McGill-Queens Press.

Commerce Commission New Zealand. (n.d.). Electricity and the Commerce Commission's Role. Retrieved from http://www.comcom.govt.nz/regulated-industries/electricity/electricity-role/

Commerce Commission New Zealand. (2013). *Electricity distributors' performance from 2008 to 2011*. Commerce Commission New Zealand.

Electricity Authority. (2011). *Electricity in New Zealand*. Wellington: Electricity Authority.

Energy Trusts of New Zealand. (2015). Welcome to the Energy Trusts of New Zealand Inc. Retrieved August 11, 2015, from http://etnz.org.nz

Environment Canada. (2017). *National Inventory Report 1990-2015: Greenhouse Gas Sources and Sinks in Canada*.

Environmental Commissioner of Ontario. (2012). *Building Momentum: Provincial Policies for Municipal Energy and Carbon Reductions* (Annual Energy Convervation Progress Report - 2012 (Volume One) No. ISSN 1923-2268). Environmental Commissioner of Ontario.

Gliedt, T., & Parker, P. (2014). Green community entrepreneurship 2.0 Collective response or individual adaptation strategy to funding cuts in Canada (2006-2012). *International Journal of Social Economics*, *41*(7), 609–625. http://doi.org/10.1108/IJSE-05-2013-0125

Gubbins, N. (2010). *The role of community energy schemes in supporting community resilience*. *Joseph Rowntree Foundation briefing paper: Community Assets*.

Haggett, C., & Aitken, M. (2015). Grassroots Energy Innovations: the Role of Community Ownership

and Investment. *Current Sustainable/Renewable Energy Reports*, *2*(3), 98–104. http://doi.org/10.1007/s40518-015-0035-8
Hall, D. (1999). *Electricity restructuring, privatisation and liberalisation: some international experiences*. London: Public Services International.
Henderson, C. (2013). *Aboriginal Power: Clean Energy and the Future of Canada's First Peoples*. Rainforest Editions.
Indigenous and Northern Affairs Canada. (2016). ARCHIVED - ecoENERGY for Aboriginal and Northern Communities Program. Retrieved December 21, 2016, from http://www.aadnc-aandc.gc.ca/eng/1100100034258/1100100034259
IRENA. (2016). *The Power To Change: Solar and Wind Cost Reduction Potential to 2025*. Bonn, Germany.
Iris Marion Young. (1986). The Ideal of Community and the Politics of Difference on JSTOR. *Social Theory and Practice*, *12*(1), 1–26.
Kelly, G. (2011). History and potential of renewable energy development in New Zealand. *Renewable and Sustainable Energy Reviews*, *15*(5), 2501–2509.
Kennedy, R. D., Parker, P., Scott, D., & Rowlands, I. (2001). Social marketing of the residential energy efficiency project: effective community implementation of a national program. *Environments*, *28*, 57–74.
Kerr, S., Leining, C., Silver, J., Brown, P., Brunel, N., Cortes-Acosta, S., … Young, P. (2017). *An Effective ETS: Clear Price Signals to Guide Low-Emissions Investment*. Wellington, New Zealand.
MacArthur, J. (2017). Trade, Tarsands and Treaties: The Political Economy Context of Community Energy in Canada. *Sustainability*, *9*(3), 464. http://doi.org/10.3390/su9030464
MacArthur, J. L. (2016). *Empowering Electricity: Co-operatives, Sustainability, and Power Sector Reform in Canada*. Vancouver, BC: University of British Columbia Press.
New Zealand Ministry for the Environment. (2017). New Zealand's Greenhouse Gas Inventory 1990–2015. Retrieved August 13, 2015, from hhttp://www.mfe.govt.nz/climate-change/reporting-greenhouse-gas-emissions/nzs-greenhouse-gas-inventory
Newman, P., Beatley, T., & Boyer, H. (2009). *Resilient cities responding to peak oil and climate change*. Washington, DC: Island Press.
OECD. (2015). Climate Change Mitigation - Policies and Progress - en. http://doi.org/http://dx.doi.org/10.1787/9789264238787-en
OECD. (2017a). *Energy Policies of OECD Countries: New Zealand 2017*. Paris.
OECD. (2017b). No Title. http://doi.org/10.1787/93d10cf7-en
Ontario. Places to Grow Act, S.O. 2005, CHAPTER 13 (2005).
Ontario. Green Energy and Green Economy Act, S.O. 2009, Ch. 12 (2009).
Organization for Economic Co-operation and Development. (2017). *Greenhouse gas emissions*.
Owens, S. (1986). *Energy, Planning and Urban Form*. Pion Limited.
Palensky, P., & Kupzog, F. (2013). Smart Grids. *Annual Review of Environment and Resources*, *38*, 201–226. http://doi.org/10.1146/annurev-environ-031312-102947
Parker, P., & Rowlands, I. (2007). City Partners Maintain Climate Change Action Despite National Cuts: Residential Energy Efficiency Programme Valued at Local Level. *Local Environment*, *12*, 505–517.
Parliamentary Commissioner for the Environment. (2006). *Get smart, think small: Local energy systems for New Zealand*. Wellington: Parliamentary Commissioner for the Environment.
Pollitt, M. G. (2012). The role of policy in energy transitions: Lessons from the energy liberalisation

era. *Energy Policy*, *50*, 128–137. http://doi.org/10.1016/j.enpol.2012.03.004
QUEST. (2016). *Community Energy Planning In Ontario: A Competitive Advantage For Your Community*.
QUEST. (2017a). *Our Impact: Advancing Smart Energy Communities in 2016*.
QUEST. (2017b). Smart Energy Atlas of Canada.
REN21. (2016). *Global Status Report*. Paris: Renewable Energy Policy Network.
REN21. (2017). *Renewables Global Futures Report: Great debates towards 100% renewable energy*.
REN Secretariat. (2017). *Executive Summary: Renewables Global Status Report*. Paris.
Royal Society of New Zealand. (2016). *Transition to a low-carbon economy in New Zealand*. Wellington, New Zealand.
Schaefer, M. S., Lloyd, B., & Stephenson, J. R. (2012). The suitability of a feed-in tariff for wind energy in New Zealand—A study based on stakeholders' perspectives. *Energy Policy*, *43*, 80–91.
Seyfang, G., Jin, J., & Smith, A. (2013). A thousand flowers blooming? An examination of community energy in the UK. *Energy Policy*, *61*, 977–989. http://doi.org/10.1016/j.enpol.2013.06.030
Shragge, E. (1997). Community Economic Development: In Search of Empowerment and Alternatives. Montreal: Black Rose Books.
Smil, V. (2015). Chapter 7 Making Sense of Power Densities. In *Power Density:A Key to Understanding Energy Sources and Uses* (pp. 190–220). MIT Press.
Statistics Canada. (2016). CANSIM Database Table 127-0009, Installed Capacity by Ownership and Source. (Statistics Canada, Ed.). Government of Canada.
Stephenson, J., Barton, B., Carrington, G., Gnoth, D., Lawson, R., & Thorsnes, P. (2010). Energy cultures: A framework for understanding energy behaviours. *Energy Policy*, *38*(10), 6120–6129.
Taylor Aiken, G., Middlemiss, L., Sallu, S., & Hauxwell-Baldwin, R. (2017). Researching climate change and community in neoliberal contexts: an emerging critical approach. *Wiley Interdisciplinary Reviews: Climate Change*, e463. http://doi.org/10.1002/wcc.463
Toronto Hydro, Hydro One, IESO, & Ontario Power Authority. (2014). *Central Toronto Integrated Regional Resource Plan (IRRP) Introduction to the Engagement and IRRP Overview*.
Walker, G. (2011). The role for "community" in carbon governance. *Wiley Interdisciplinary Reviews: Climate Change*, *2*(5), 777–782. http://doi.org/10.1002/wcc.137
Walker, G., & Devine-Wright, P. (2008). Community renewable energy: What should it mean? *Energy Policy*, *36*(2), 497–500.
Walker, G., Hunter, S., Devine-Wright, P., Evans, B., & Fay, H. (2007). Harnessing Community Energies: Explaining and Evaluating Community-Based Localism in Renewable Energy Policy in the UK. *Global Environmental Politics*, *7*(2), 64–82.