Kōtuitui: New Zealand Journal of Social Sciences Online

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/tnzk20

Reviewing the impacts of community energy initiatives in New Zealand

Ryan Roberts, Alan Brent & Jim Hinkley

To cite this article: Ryan Roberts, Alan Brent & Jim Hinkley (2021) Reviewing the impacts of community energy initiatives in New Zealand, Kōtuitui: New Zealand Journal of Social Sciences Online, 16:1, 45-60, DOI: 10.1080/1177083X.2021.1877161

To link to this article: https://doi.org/10.1080/1177083X.2021.1877161

© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group

View supplementary material

Published online: 12 Feb 2021.

Submit your article to this journal

Article views: 101

View related articles

View Crossmark data

Full Terms & Conditions of access and use can be found at
https://www.tandfonline.com/action/journalInformation?journalCode=tnzk20

KOTUITUI: NEW ZEALAND JOURNAL OF SOCIAL SCIENCES ONLINE
2021, VOL. 16, NO. 1, 45–60
https://doi.org/10.1080/1177083X.2021.1877161

Routledge
Taylor & Francis Group

REVIEW ARTICLE

OPEN ACCESS Check for updates

Reviewing the impacts of community energy initiatives in New Zealand

Ryan Roberts, Alan Brent and Jim Hinkley

Sustainable Energy Systems, School of Engineering and Computer Science, Victoria University of Wellington, Wellington, New Zealand

ABSTRACT

The New Zealand government has earmarked community energy as an investment mechanism that could assist the country in reaching its climate change goals, as well as lead to local benefits for its citizens. The objective of this paper is to identify what community energy initiatives are occurring in New Zealand, and the respective impacts that have arisen. A desk survey was undertaken, through an academic database and internet search to collect relevant resources and data. The country has a history of community energy initiatives; however, data on the impacts of community energy initiatives are scarce, at both a local and national level. The study also found diversity in the communities that are, or possibly could, benefit from community energy projects, each with differing motivations for participation. A national understanding of the successful impacts of community energy initiatives is needed, as well as more monitoring and analysis on the impacts of current projects. Ascertaining the true value of community energy is a complex task, but vital should development of these projects be pursued.

ARTICLE HISTORY
Received 19 October 2020
Accepted 5 January 2021

KEYWORDS
Community energy; impacts; New Zealand; sustainable energy transition

Introduction

The New Zealand Government has recognised climate change as a significant challenge and made aspirational climate change targets – 95% renewable energy by 2035 and a reduction in all greenhouse gas emissions to net-zero by 2050 (Transpower 2020). The investment required in the renewable energy sector will need to meet a clean electricity demand projected to grow 68% by 2050, from 42 TWh currently to 70 TWh (Transpower 2020). Community energy (CE) initiatives have been identified as a means to attract local investment and see the resulting benefits realised at a local level (MBIE 2019a). Such initiatives are playing a key role in the global energy transition and are prominent in Europe, with over 3700 projects identified (Caramizaru and Uihlein 2020). The impetus from these projects is often credited for leading innovation and maturation of renewable energy technologies in Denmark and Germany during periods when it was not commercially attractive (Morris and Jungjohann 2016).

CONTACT Ryan Roberts ryan.roberts@vuw.ac.nz
Supplemental data for this article can be accessed at https://doi.org/10.1080/1177083X.2021.1877161.
© 2021 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group
This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives License (http://creativecommons.org/licenses/by-nc-nd/4.0/), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited, and is not altered, transformed, or built upon in any way.

Community-scale renewable electricity generation was first recognised by the New Zealand Government as a matter of national significance in the National Policy Statement for Renewable Electricity Generation (NPSREG) in 2011 (MFE 2011). A discussion document developed in 2019 by the Ministry of Business, Innovation and Employment (MBIE) includes a section on community engagement in renewable energy and energy efficiency (MBIE 2019a). A definition of CE is given as 'energy activities (such as generation, demand-side management, storage, clean transport and energy efficiency) that are managed in an open and participative manner, and have local and collective benefits and outcomes' (MBIE 2019a). Evident throughout the discussion document is the lack of specific data on the impacts of CE initiatives at a project and country level. 'Potential' impacts are mentioned, based on overseas experiences and without much reference to magnitudes or significances. Details on the impacts of these projects are vital as, according to the MBIE, local and collective benefits are said to define them. Issues that have arisen due to the scarcity of data on impacts include:

- Different positions are taken on the benefits and risks of CE by local and national agencies.
- Lack of data to support the advocacy of CE by agencies and inform decisions on how to support replication.
- The potential benefits and risks of CE projects are not appropriately adjudicated (MBIE 2019a).

Further to these points, should local investment be leveraged to assist New Zealand in achieving climate change goals, all actors must understand the impacts that can emanate from community energy at a local and national scale.

Community energy impacts

Local and collective impacts, by the definition provided by the MBIE, are fundamental to CE, giving a need to explore what these impacts may be. Benefits include regional and economic sector creation, lower energy prices, more transparent decision-making and innovation in technologies and business models (IRENA 2018). A study undertaken by the European Commission (Caramizaru and Uihlein 2020) identified that CE can provide social benefits through energy ownership, energy education and social cohesion, as well as economically by shared profits reinvested into the community. These projects also support local energy systems by providing flexibility, alleviating network upgrades, and reducing transmission losses.

Berka and Creamer (2018) systematically reviewed the local impacts of community-owned renewable energy cited in peer-reviewed literature. The analysis found that certain impacts, such as socio-economic regeneration of the community, were linked to the project outcome or the end result of the project (e.g. is the project operating as planned). Other impacts, arguably less tangible, such as social capital, knowledge and skills development, and increased support for renewable energy, are largely linked to the project process or the method in which the project was carried out (e.g. high participation levels in the community). Further, pre-existing qualities within a community, as well as prerequisite activities in the project process or outcome, are identified in order for a specific impact to be realised.

The development of CE has also received some criticism, particularly when policy does not fully grasp the context-specific social and economic environment. In cases where little state support is provided and market mechanisms are used, the ethics and inclusivity of these projects are often questioned (Catney et al. 2014; Taylor Aiken et al. 2017). Incorrect policy design can lead to substantial problems in community-driven projects in energy auctions (Tews 2018), as well as projects where communities only receive a portion of profits (Bristow et al. 2012; Wlokas et al. 2017). Designs of off-grid energy projects also need to grasp social dynamics if they are to ensure the sustainability of the initiative, with a holistic and transdisciplinary approach required (Brent and Rogers 2010).

The aim of this paper is to understand what CE initiatives are currently occurring in New Zealand and what the subsequent impacts are of these initiatives. The following section outlines the research questions, with Appendix A of the supplementary materials giving further details on the research process and resource collection. The third section provides background information that will contextualise the results discussed in the fourth section. A more detailed breakdown of CE initiatives and impacts found are given in Appendix B. The paper is then concluded, and further research points highlighted.

Research process and resource collection

Research questions

The overall objective of the research was to understand what community energy initiatives, and resultant impacts, are currently occurring within New Zealand. The following research questions were then compiled with parameters to refer to any results back to:

Research Question 1: What community energy initiatives are currently occurring in New Zealand?

There are a wide range of definitions of the term 'community energy'. The starting point was the official community energy definition given by the MBIE (2019a), mentioned in the Introduction section. This definition is quite broad and covers a range of initiatives (energy management, energy generation, energy storage and distribution). As such, the results are structured according to the different energy sectors, namely electricity distribution, electricity retail and energy generation. A separate section address the multifaceted role of local and regional councils, in both initiating and enabling CE projects.

Research Question 2: What are impacts that have arisen from CE initiatives at a local and national level?

The second research question aimed to explore the impacts emanating from CE projects, within each sector. Four categories of possible impacts were identified by the MBIE (2019a) and were used as a reference for the impacts found in this study. These categories, with some examples[1], are given as:

- Economic impacts: Investment into clean energy, regional economic development, energy prices, dividends for communities, and sector creation.
- Social impacts: Community cohesion, energy literacy. and behavioural changes.
- Environmental impacts: Avoided GHG emissions, environmental preservation, and air quality.

- Distribution network or security of supply impacts: Electricity load balancing, integration of new technologies onto networks, and electricity system losses.

It must be noted that the terms 'impacts', 'effects' and 'benefits' (relating to desirable impacts) are used interchangeably throughout the literature and also in this paper.

Research methodology and resource collection

The research review included an analysis of relevant peer-reviewed literature using academic databases. Further snowballing was also conducted, using references of the resources collected, to gather relevant information. Finally, a grey literature search was used to identify projects that may not be recorded within academic data sets. A more detailed breakdown of the research methodology and the resources collected are given in Appendix A of the supplementary documents.

Background information

Five major electricity suppliers make up 93% of electricity generation in New Zealand (Suomalainen and Sharp 2016). They are privately owned or have joint public and private ownership. These five major electricity generators also have their own retail companies (as a result they are often referred to as 'gentailers'). Transpower operates the country's transmission grid and distribution is performed by 29 companies, with a range of different ownership models. Local power boards historically had rights to generate, distribute and sell electricity. Electricity sector restructuring in the late 1990s led to many power boards transferring their electricity distribution or generation assets to community trusts.[2] Retailers in New Zealand provide the interface between general consumers and the electricity sector and purchase electricity from generators through the wholesale market and long-term contracts.

New Zealand is in a unique position in that approximately 80% of its electricity is sourced from renewable energy generation – predominantly hydropower (56%) and geothermal energy (18%) (Berka et al. 2020). Hydropower has a history dating back to the late nineteenth century. Large-scale efforts from the 1960s to 1980s were coordinated to stimulate economic growth (Suomalainen and Sharp 2016). Geothermal energy has also played a significant part in energy generation, particularly for Māori in the Central North Island who have used geothermal energy for social and economic purposes for centuries. Ownership of geothermal resources has been a contentious issue in the past, as developments have taken place without recognising the significance of the land and resources to Māori (Bargh 2012). The Te Ture Whenua Māori Act of 1993 now recognises that the land is of special significance to iwi and promotes the retention, protection and utilisation by Māori people (TPK 2018). New Zealand has excellent conditions for wind power, with capacity factors at some wind farm sites reaching 45-50% (IEA 2017). However, wind energy only supplies around 6% of the nation's electricity (approximately 690MW installed capacity). Solar energy is at a nascent stage, although it is beginning to play a greater role. Currently, solar may be a good fit for commercial businesses, households or mini-grid connections as utility-scale developments are beginning to reach cost parity with other, more established, technologies (MBIE 2019a).

Currently, 40% of total CO_2 emissions in New Zealand come from the use of fossil fuels in the transport, industrial process, and electricity generation sectors (MBIE 2019a). Investment in renewable electricity is not only vital for electricity sector goals, but the energy sector as a whole, as electrification is touted as the mechanism that will drive decarbonisation in process heat and transport.

Regional councils are mandated to adjudicate the effects of any new energy developments. Under the Resource Management Act (RMA), administrators ensure the protection of natural resources in a way that allows communities to improve their social, economic and cultural wellbeing (MFE 1997). National direction instruments have been developed under the RMA to give further detail in specific areas (e.g. the NPSREG). In doing so, councils must have regard for the country's climate change goals when making decisions on energy projects within their jurisdiction (MFE 2011). After a developer applies for consent to use natural resources, the council and the affected community discuss the impacts of the proposed project.

Results and discussion

Community energy in New Zealand

Two pieces of academic literature detail the state of CE in New Zealand. The first by Hoicka and MacArthur (2018) maps the CE practices in Canada and New Zealand. Using the commonly cited definition provided by Walker and Devine-Wright (2008) (and consists with the definition used in this paper), the study identifies operational projects in the two countries, categorising them by project type (generation, retail, distribution, efficiency or a combination of functions) as well as form (municipal, indigenous-linked, trust, cooperative, community association, joint venture). A similar study by Berka et al. (2020) found 198 initiatives in New Zealand, including projects that were suspended, operational, under construction or at feasibility stage. It is evident there is a range of different CE activities currently in New Zealand, spanning many forms and functions, and based on windows of opportunity set by policy. Figure 1 illustrates this diversity and shows a history of CE initiatives in New Zealand, as well as a recognition and willingness to support the sector. The literature resources therefore adequately answer the paper's first research question, namely what CE initiatives are occurring in New Zealand, but fall short of answering the second. Examining the impacts is, in fact, noted as crucial to the development of CE and is suggested as future research areas (Berka et al. 2020).

Electricity distribution

This study found 26 community or council trusts that owned the local distribution network. Lines companies then operate the network on the trust's behalf. Annual dividends or profits of the lines company are passed on to the trust, who in turn pass it back to their respective electricity consumers (referred to as beneficiaries) in one form or another. An investigation was done into the benefits flowing to communities from these community-owned trusts (results given in Table 1 of Appendix B). Websites of respective trusts and lines companies were used to gather information on the impacts.

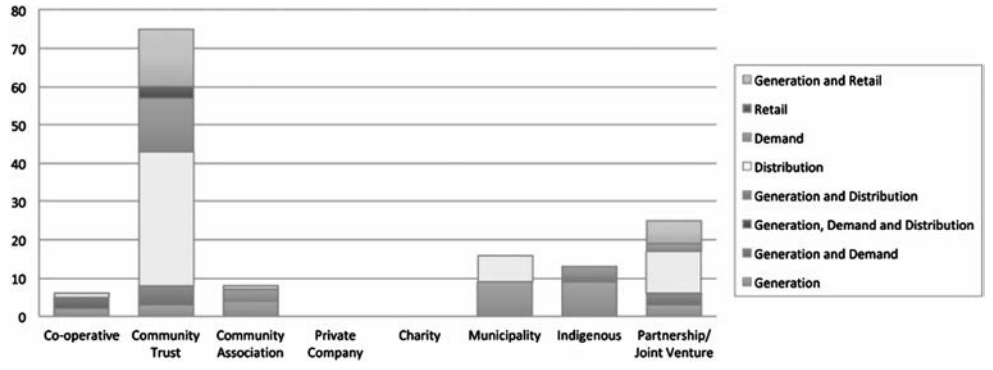

Figure 1. Community energy initiatives in New Zealand by type and organisation (Hoicka and MacArthur 2018).

A report on discounts and distributions from the MBIE was then used for missing information (MBIE 2019b).

Many of these trusts emphasise that reducing electricity costs as much as possible is their way of giving back to the community. This is in line with other findings stating lines companies' main goal is to provide cost efficiency and functioning of the grid with secondary community benefits (Berka et al. 2020). This motive could be true for 12 of the 26 distributors that are exempt from price-path quality regulation, but perhaps less so for the remainder. The Commerce Commission regulates and monitors the performance of all distributors, yet some are exempt from regulation due to their small size and community ownership. This shows a level of confidence in the ownership model that the distribution company will perform efficiently and will be held accountable by the community.

From the sources used it is difficult to calculate the total economic benefits given annually. It is evident, however, that large sums of money are distributed to citizens (over NZ$ 10 million per year by larger community-owned trusts) through various means. There is heterogeneity in the manner in which these benefits are distributed, as well as how these trusts engage with their community. This can range from simply distributing profits annually to dedicated staff actively involving citizens and creating community investment strategies; for example (ECT 2019; WEL Energy Trust 2019).

The most common type of distribution to citizens given by these community-owned trusts are dividends (also referred to as discounts, rebates or distributions) received at the end of the year. Often this amount is linked to the profits of the trust for that year and the amount of electricity consumed. Therefore, high consumption customers receive greater discounts. Further, the discount is awarded to the owner of the house and not the resident. Citizens who may not be able to afford to buy a house, and can only rent, are not entitled to this discount even though they will contribute through their electricity bill payments.

Community grants are another common mechanism used by trusts. Established community organisations are generally recipients for these grants to fund an initiative. Community trusts act as a source of funding rather than actively investigating the needs of the community and directly benefitting. However, a certain level of competition is embedded

within accessing these grants where more resourced or experienced candidates may have an advantage. The selection criteria for chosen grants is often geared toward reducing the risk of the funds being mismanaged or initiatives being unsuccessful.

Many grants have a distinct energy theme. University scholarships are most often awarded to students in the field of sustainable electricity, often coupled with work experience at the utility. Grants are awarded to various energy-related projects such as wide support, advertising and co-funding of the state-led Healthy Homes programme (discussed further in Section 'Regional and district councils'). Entrust, an electricity distribution-linked community trust, have developed an Energy Solutions Programme. This includes the installation of 130 solar PV systems with battery packs and a 1MW / 1.7 MWh smart grid project at Kawakawa Bay, intended to stabilise electricity supply to local residents (Vector 2018a). The solar PV systems and battery packs are being installed on schools, community centres and homes, and are said to reduce electricity bills by 18%. They further increase awareness of new technologies to students and are helping the utility plan for a future where distributed generation and batteries are more widespread (Vector 2018b). These initiatives are evidence that the community-owned electricity distributional model – especially for specific companies with energy themed community benefits – is supporting both the uptake of clean energy technologies, as well as the integration by lines companies of these technologies onto the grid. These technical benefits could fall under the network supply impact category mentioned in Section 'Research questions'.

In summary, it is clear that community ownership of most of the distribution sector is a model that is greatly benefitting local citizens and is fostering a shift to cleaner energy sources. The impacts reported were predominantly economic in nature (for example quantity of distributions or grants given). These may intend to, and most likely do, have social impacts, but they are not always reported in this way. Apart from a collation of the dividends by the MBIE (2019b), there is no analysis on how community-owned trusts are making an impact through their ownership form. The country has a 20-year history of community organisations developing partnerships and operating efficiently run businesses in the electricity sector.

Electricity retail

This study found two community-owned energy companies in the retail sector. Pioneer Energy is owned by two trusts, Buller Electricity Power Trust (see Appendix A Table 1) and the Central Lakes Trust. Through customer dividends and grants, the trusts distribute profits to communities much like community-owned trusts in the electricity distribution sector.

Peer-to-peer trading also fits within the provided definition of CE. This fairly new technology allows consumers, who choose to install solar systems, to decide who to sell any excess electricity to and, in some instances, at what price. This service also has the potential to provide technical, load balancing impacts. However, no data on this was found in the literature reviewed. Four peer-to-peer trading companies were found and, although there are a lot of stated financial benefits, such as potential profits from sellers and savings from buyers, none were published. Peer-to-peer trading may be in a nascent stage but large gentailers, such as Trust Power, are also offering a similar service.

Energy generation

Different co-ownership models, in the form of CE, exist from past sector reform (predominantly involving legacy hydropower plants) and emerging renewable energy initiatives driven by community groups. The electricity sector reform in the 1990s saw some generation assets moved to community-owned trusts. These companies operate, and distribute dividends to beneficiaries, in a similar manner to the trusts discussed in the electricity distribution sector. The impacts of these trusts are given in Appendix B. CE generation developments in more recent times have struggled to get off the ground, and this section will focus on the three most prolific emerging CE technologies.

Wind energy

New Zealand has world-class wind resources and has the prospect to create a thriving industry, yet New Zealand has only one successful community wind energy project (Berka et al. 2020). Barry and Chapman (2009) state that a trend toward large-scale wind developments, and the small number of investors, is limiting the wind energy industry potential and the rate at which renewable energy targets are met. The study surveyed over 1600 rural landowners in areas earmarked for their good wind resources in the North Island. The first conclusion from the analysis showed an increase in acceptance of small-scale wind projects (defined as a maximum of 3 wind turbines 100 kW or larger in capacity) as opposed to larger projects. These results are similar to those of Schaefer et al. (2012), who interviewed landowners in the South Island, using 5 turbines as the defined size of a small-scale wind project.

Opposition groups to wind energy in New Zealand have identified the scale and obtrusiveness of these developments as a concern (Barry and Chapman 2009). As mentioned previously in the third section, a robust engagement process is undertaken through the Resource Management Act (RMA) in order to grant consent for wind energy projects. Any decision can be appealed by any relevant party and taken to the Environmental Court. Apprehensions by local communities for large wind farms can cause significant overruns. In contrast, three small-scale wind projects at the time of the study were able to obtain consent within 6 months. An increase in willingness for farmers to invest in small-scale wind projects as opposed to large-scale projects is also shown, particularly if government support was involved (Barry and Chapman 2009). These results show increasing citizen support for renewable energy (when done in a particular manner) and are directly linked to the social impact category of Section 'Research questions'.

Schaefer et al. (2012) test the levels of acceptance of relevant actors for a small-scale wind project feed-in-tariffs (FITs) – a support mechanism that has been successful worldwide in growing community generation projects. These actors included rural landowners in Otago, as well as wind energy stakeholders in New Zealand and Germany. Strong levels of support were recorded by most rural landowners, with 75% of the respondents having a positive response. They believed that a FIT could promote locally owned projects and could bring in a stable income stream to supplement their variable income patterns. This overshadowed the risk that a FIT could increase overall electricity prices. Opposition to FIT was primarily due to the mechanism being anti-competitive and 'would lead to unacceptable electricity prices'. This is similar to the criticism received from a minority group of farmers.

The various challenges and ways to support CE generation developments seem to be the focus of the two studies (Barry and Chapman 2009; Schaefer et al. 2012). Current market regulations are claimed to stifle the entry of new wind developers and more supportive policy is suggested. Some of the hurdles and evidence of the difficulties cited include:

- the disproportionately high costs or small-scale wind projects (Barry and Chapman 2009),
- competition on the wholesale market with more established energy sources – often retailer linked and government subsidised (Schaefer et al. 2012)
- unattractive market conditions stalling the construction of 2500MW of installed wind capacity already being given consent (NZWEA 2020).

It is difficult to divorce supportive policy and its outcomes as they both influence each other in a reinforcing loop. Unattractive policy regimes throttle the pipeline of CE projects, which in turn provide little data to lobby for a more supportive environment. Without evidence, the comments from stakeholders about the effects of a FIT (both for and against) on the electricity price of the system are ideological, especially as no FIT programme for New Zealand has been designed. Moreover, different stakeholders may have different perspectives on what impacts CE will have. More data on the diversity and magnitude of CE project impacts will assist relevant actors (investors, policy makers, landowners etc.) to make more informed decisions or take certain positions.

The studies by Barry and Chapman (2009) and Schaefer et al. (2012) bring up further discussions on CE impacts. First, these landowners were in the agricultural sector – responsible for almost half the country's CO_2 emissions and feeding the nation. Getting this demographic's support and participation in leading more environmentally friendly lifestyles is vital for the country to reach its climate change goals. The second is the generally supportive attitude of these landowners and a willingness to invest if government assistance is involved. These results also show political impacts from CE (falling outside the categories used above) as these projects can influence policy, as well as assist the government in achieving climate change targets through local action and investment.

Geothermal energy

Information was found on four iwi-owned trusts involved in geothermal energy, and details on the relevant impacts are given in Table 2 of Appendix B. The shortcomings in searching for impacts of these iwi-owned trusts using the internet and academic paper research were immediately noted. These trusts often did not have websites or did not fully publish details online. A different methodology would most likely be needed to fully grasp the scope of the impacts. The available information shows that distributions from iwi trusts to community members are made, with a focus on children (through education grants) and elderly citizens (annual stipends). This is somewhat different from the range of sponsorships and discounts to homeowners seen in distribution-linked community trusts.

Iwi-owned trusts tend to go into partnership with corporate entities in order to establish CE projects. Partnerships with the private sector can raise certain challenges and benefits to projects. For example, financing and development hurdles can be more

easily overcome with private sector participation. However, this may come at the cost of a certain level of community participation and long-term community-directed revenue from projects (Hoicka and MacArthur 2018).

Innovation is also a common theme in both the operations, as well as the industries accessing the geothermal energy developments. The Ngāta Tūwharetoa Settlement Trust owns the world's largest geothermal process heat operation at Kawerau (Tuwharetoa mai Kawerau ki te Tai 2018). The Tuaropaki Trust owned geothermal fields has seen substantial innovations, such as Miraka (a Māori-owned dairy processing company), which developed the first-ever geothermal milk drying facility, as well as a climate-controlled greenhouse using geothermal heat to grow vegetables (Blair 2018). These ventures, therefore, have technical aspects that go far beyond the potential technical impacts identified in Section 'Research questions'.

These iwi-owned trusts have diversified their assets and ventures, making the impacts not directly linked to the geothermal developments. However, the ownership and operation of geothermal resources has led to reinvestment by the relevant iwi-owned trusts into other sectors of the community. This is a distinction from the community trusts in the electricity distribution industry where only a few were looking to diversify their assets and not necessarily within the community. This has an impact on the economic multiplier of dividends by these projects. The diversification of industries by these trusts makes it difficult to fully grasp the full scale of impact these iwi-owned geothermal enterprises have, especially as a responsibility to social and environmental development underpin many of the ventures. For example, the Tuoropaki Trust has branched into industries including horticulture and nutraceuticals, hydrogen energy, and organic waste processing. The trust also has a certification that all staff are paid a sufficient wage (Tuaropaki Trust 2020).

Bargh (2012) provides reasoning for the struggle in ascertaining the full benefit of these projects. Māori geothermal enterprises operate in a complex manner and are 'charted by ethical coordinates' that stem from Māori values. The four fundamental coordinates identified are mana (authority), utu (balance), kaitiakitanga (guardianship) and whakapapa (genealogy). More detail is given in Figure 2. This research found strong evidence of these principles on the iwi-owned trust websites.

Similar views are shared by MacArthur and Matthewman (2018). Te Ao Māori (a holistic, world view) is the fundament from which Māori renewable energy developments are derived, revealing that cultural impacts may be emanating from CE projects. Further, iwi have a strong interest in the energy transition as they are aware of the impacts climate change can have on their land and resources, as well as the view that fuel poverty will impact Māori harder than other New Zealand citizens due to their current socio-economic disadvantage (MacArthur and Matthewman 2018).

Distributed generation and mini-grids

Distributed generation refers to electricity generation systems connected (a) directly to the distribution network or (b) to an electricity consumer installation that is connected to the distributed network, into which the generation system is capable of injecting electricity (EA 2015). Almost 30,000 distributed generation systems have been reported as of June 2020 (more than 1500 MW) (EMI 2020). This study chose to focus on systems larger than 10 kW, not receiving streamlined application processes similar to those under

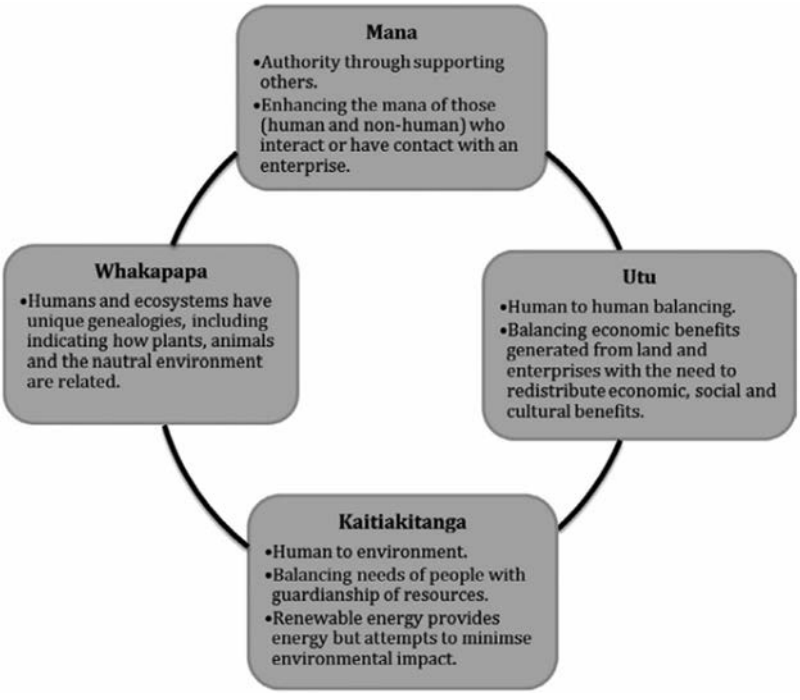

Figure 2. Ethical Coordinates of Māori Enterprises (Bargh 2012).

10 kW. Only around 1000 distributed generation systems above 10 kW are operational in New Zealand to date. Single ownership systems by households or private companies were excluded.

Aside from the efforts of electricity distribution-linked community trusts, other community organisations can also play a role in this field. Energise Ōtaki is one such organisation that implements various solar projects on public buildings and schools, with funding from various sources, such as community trusts. Details of the benefits of these projects are published, in a case study format, on the organisation's website (Energise Ōtaki 2020b). One project involving a solar array at a college, in partnership with the college alumni association, provided NZ$ 11 000 in revenue that was used for scholarships (Energise Ōtaki 2020a). A second solar project, funded by the Wellington Community Trust, is planned for the council wastewater treatment plant and second college. This project will reduce the municipality's emissions by 17 tons a year, return up to NZ$ 30 000 annually to the Wellington Community Trust for the next 25 years that can be reinvested into energy projects (Energise Ōtaki 2020a).

A scarcity of mini-grid (or smart-grid) community benefits was found in peer-reviewed literature, even though there is mention of projects. Two micro-grid projects, with Māori socio-economic development and self-sufficiency aims, were said to be at a feasibility stage and involved substantial community involvement during project development (Berka et al. 2020). In line with the technical impacts noted in Section 'Research questions', a smart grid is also planned at Kawakawa Bay, intending to improve network supply needed to run pumps at the local wastewater facility (Vector 2018a).

Regional and district councils

The complex roles of councils cut across generation, distribution, and demand management. This study found 78 projects or plans stemming from 49 councils, generally detailing emissions targets and proposed projects (see Table 3 in Appendix A). There was, however, little correlation between a council having a plan and a council implementing a project. Often councils had detailed plans, but no projects implemented or vice versa. LED street lighting retrofits, heat pumps for swimming pools, electric vehicles, and energy management programmes were the most common examples of in-house council projects. Only 23 of the 78 councils had projects where information could be found. Heterogeneity in implementation models of energy projects was noted among the 78 councils in New Zealand from dedicated in-house units, ownership of corporate entities, partnerships with national and local entities, as well as funding community organisations to implement work on their behalf.

Another role the council can play is the creation of enabling environments and support mechanisms from which constituents can develop CE projects. Councils need to give consideration to national climate change goals as well as develop objectives, policies and methods for CE developments (MFE 2011). Berka et al. (2020, 179) believe it is

> the ability of state and local authorities to coordinate and streamline niche protective policies, and the position and influence of incumbents and regime players in shaping these policies (and the associated narratives that serve to consolidate them), to a large extent determine the 'windows of opportunity' for local and CE.

Support and guidance from national entities had a greater association with CE projects coming to fruition. From 2009 to 2013 the national government, through the Energy Efficiency and Conservation Authority (EECA) ran the Warm Up New Zealand: Heat Smart programme. A second iteration is being continued under the banner of the Healthy Homes programme. These programmes offered support, in the form of grants and advice, to low-income households for weatherproofing their homes. Councils were seen to offer derivations of this support, often supported by the EECA, and were the most common type of CE project listed in this section. The council support included topping up EECA grants to a certain limit, offering free advisory support and providing loans that can be paid back through rates. Regarding in-house council projects, an EECA grant was also seen to assist with council energy management programmes and energy efficiency initiatives.

The impacts of council energy projects are not widely published. If so, it is often anecdotally on a council website or other sources (local media house, environmental association etc.). Of the impacts recorded, most related to monetary savings and CO_2 emission reductions. Two noteworthy projects provide deeper insight into the effects of CE projects not yet discussed. The first is the Civic Office building in Christchurch being designed to be a net-zero carbon public building, with a range of energy efficiency and renewable energy technologies. The stated impacts included improved employee productivity and satisfaction, as well as strengthened relations with community (Energy Cities 2010). CE projects are said to strengthen social relationships between members within the community, and, ultimately, the community itself (Berka et al. 2020). The impacts stated in the Christchurch case study are similar to those of social capital generation; however, they are at a council or regional level. Additionally, the strengthened bond is manifesting within the employees of the

council as well as the citizens for whom the council works. The second is that energy, monetary or emission savings may not be direct motivation for projects. Hawke's Bay Regional Council's Sustainable Homes Programme is directed at improving air quality in the region, by funding suitable insulation and heating products. Outdoor air quality in the region has improved by 54% over the last seven years and the programme aims to end when the area meets national air quality standards set by the government (Hawke's Bay Regional Council 2019). Health benefits may be the desired outcome of CE projects and be the area that is most impacted, much like the Warm Up New Zealand programmes (Grimes et al. 2012). A link can also be drawn to the mini-grid projects discussed earlier, where CE initiatives may enable other desired results, such as the provision of basic services (wastewater treatment and household electrification), as well as self-sufficiency. These varying motivations all have implications on the desired impacts of a CE project.

Conclusion

A history of CE in New Zealand and evidence of impacts flowing to communities were found. However, the full scope of impacts emanating from these initiatives is not fully monitored and is not openly shared through readily accessible literature sources. The data that have been published are often anecdotal in nature and project specific. There is very little standardisation or collation, and the impacts are mainly focussed on direct economic benefits. No tangible impacts at a national level are given and are rather discussed in a theoretical manner.

The impact categories used in this study did not capture all of the impacts noted from the CE sector – cultural, technical and political impacts were also identified. Further, greater granularity is also needed in these areas in order to determine the success of CE projects. For example, economic impacts may be highly desirable for CE wind projects, but it may refer to a lowest possible electricity price, or to diversified income streams for local communities. Stakeholders within the sector have differing views on the impacts of CE, both at a project and country level, with some placing more importance on certain impacts than others. Energy has a complex role in society and often these projects are a means to an end. For example, better citizen health and living conditions or reversing past colonial injustices. The work from Bargh (2012) goes some way in providing a high-level framework for understanding what makes a successful CE project for the Māori culture and impacts noted elsewhere can be seen within these four 'coordinates'. But these coordinates may not be understood, or agreed upon, by the rest of New Zealand, making consenting, or even supporting, these projects difficult to justify. A national understanding of what CE projects are, or should be, accomplishing would be beneficial to colour the sector's identity, as well as provide further support if its development is desired. National government influence was seen to play a large role in the growth of CE. Sector reform led to community trusts in the electricity distribution industry, treaty settlements led to Māori geothermal enterprises and the efforts of a nationally run home insulation programme were multiplied through councils and other community organisations.

The existing initiatives found show that there is potential for CE to grow in New Zealand, from which more can be expanded upon. Various parts of society can realise

the benefits of community energy, such as indigenous iwi communities, low-income households, and potentially an agricultural sector that is the largest contributor to climate change emissions in the country. The diverse range of CE impacts found in this study could be supported and directed to the demographics or sectors that are most in need of positive change.

Future research

The multidimensional nature of CE impacts elevates the importance of ascertaining the outcomes of these projects for both citizens, as well as New Zealand as a whole. A framework highlighting what makes a successful CE project in New Zealand is sorely lacking. Input and acceptance of such a framework would need widespread discussion and acceptance.

Investigation needs to be done into how community trusts in the electricity distribution industry act as agents of social change, or, in fact, if they should be tasked with this responsibility, secondary to providing cheap electricity supply. The relationship between (a) the trust's right of choice, (b) the efficient spending of dividends, and (c) the impacts needed within the community (and perhaps country at large) could be unpacked further by scholars.

Pilot projects have been earmarked as a means to identify risks and barriers for CE initiatives and potentially set up an impact monitoring and evaluation strategy (MBIE 2019a). These efforts could be supplemented by coordinating information from current projects, providing real-world data on how these benefits materialise. Modelling could be used with collated data to estimate the effects on a larger, national scale.

There are a variety of ways the impacts of current projects are realised within communities, perhaps shaped on the founding principles of the community or the business model in operation. Data collection on these impacts is needed as well as possible multiplier effects of different operational models and methods of distribution.

Finally, enabling support measures to grow CE were discussed throughout the paper, predominantly based on international experience. Understanding the challenges posed in starting CE projects, as well as how impacts manifest, can guide the design of supportive policies and mechanisms, relevant to New Zealand context, to see the development of these projects in the future.

Notes

1. The list of examples given are not intended to be exhaustive or comprehensive, but rather provide clarity on the types of CE impacts that may be found within each category.
2. An unforeseen effect of these reforms saw emerging retailers facing great difficulty entering the market of a specific region if they did not have a relationship with a generator. Therefore, in 2010, distributors were allowed to re-enter the retail sector under certain conditions if the distribution company operated within its jurisdiction.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

The Victoria University of Wellington Scholarship Programme supported this work.

ORCID

Ryan Roberts http://orcid.org/0000-0003-0343-1503
Alan Brent http://orcid.org/0000-0003-3769-4512
Jim Hinkley http://orcid.org/0000-0002-4069-7362

References

Bargh M. 2012. Rethinking and re-shaping indigenous economies: Māori geothermal energy enterprises. Journal of Enterprising Communities. 6(3):271–283. DOI:10.1108/17506201211258423.

Barry M, Chapman R. 2009. Distributed small-scale wind in New Zealand: Advantages, barriers and policy support instruments. Energy Policy. 37(9):3358–3369. DOI:10.1016/j.enpol.2009.01.006.

Berka AL, Creamer E. 2018. Taking stock of the local impacts of community owned renewable energy: a review and research agenda. Renewable and Sustainable Energy Reviews. 82 (November 2017):3400–3419. DOI:10.1016/j.rser.2017.10.050.

Berka AL, MacArthur JL, Gonnelli C. 2020. Explaining inclusivity in energy transitions: local and community energy in Aotearoa New Zealand. Environmental Innovation and Societal Transitions. 34(August 2018):165–182. DOI:10.1016/j.eist.2020.01.006.

Blair A. 2018. Geothermal fuels prosperity: how geothermal projects in New Zealand are catalyzing significant socio-economic benefits for Māori. 25th Congreso Anual 2018, La Asociación Geotérmica MexicanaAt: Morelia, Michoacán, Mexico.

Brent AC, Rogers DE. 2010. Renewable rural electrification: sustainability assessment of mini-hybrid off-grid technological systems in the African context. Renewable Energy. 35(1):257–265. DOI:10.1016/j.renene.2009.03.028.

Bristow G, Cowell R, Munday M. 2012. Windfalls for whom? The evolving notion of "community" in community benefit provisions from wind farms. Geoforum. 43(6):1108–1120. DOI:10.1016/j.geoforum.2012.06.015.

Caramizaru A, Uihlein A. 2020. Energy communities: an overview of energy and social innovation. EUR 30083 EN. Luxembourg: Publications Office of the European Union. doi:10.2760/180576, JRC119433.

Catney P, MacGregor S, Royston S. 2014. Big society, little justice? Community renewable energy and the politics of localism. Local Environment: The International Journal of Justice and Sustainability. 19(7):715–730. DOI:10.1080/13549839.2013.792044.

EA. 2015. Connection of distributed generation (greater than 10 kW) to a local network. https://www.ea.govt.nz/dmsdocument/24761-guidelines-for-connection-of-dg-greater-than-10kw.

ECT. 2019. He Tau Whakatutuki: annual report 2019. https://trusttairawhiti.nz/assets/Documents/Annual-Reports/ECT-2019-Annual-Report-for-web.pdf.

EMI. 2020. Installed distributed generation trends. www.emi.ea.govt.nz. https://www.emi.ea.govt.nz/Retail/Reports/GUEHMT?DateFrom=20130901&DateTo=20200630&Capacity=All_Total&FuelType=All_Total&Show=Capacity&_rsdr=ALL&_si=v%7C3.

Energise Ōtaki. 2020a. energise.otaki.net.nz. https://energise.otaki.net.nz/content/otaki-college-pv-solar-array-for-scholarships/.

Energise Ōtaki. 2020b. index @ energise.otaki.net.nz. https://energise.otaki.net.nz/.

Energy Cities. 2010. Renewable energy civic building in Christchurch. https://energy-cities.eu/wp-content/uploads/2018/11/christchurch_582_en.pdf.

Grimes, et al. 2012. Cost benefit analysis of the warm up New Zealand: heat smart programme Ministry of Economic Development. June. 26. http://www.healthyhousing.org.nz/wp-content/uploads/2012/05/NZIF_CBA_report-Final-Revised-0612.pdf.

Hawke's Bay Regional Council. 2019. Heatsmart and sustainable homes financial assistance programmes', (July). https://www.hbrc.govt.nz/assets/Document-Library/Fact-Sheets/Sustainable-Homes-Information-Sheet.pdf.
Hoicka CE, MacArthur JL. 2018. From tip to toes: Mapping community energy models in Canada and New Zealand. Energy Policy. 121(November 2017):162–174. DOI:10.1016/j.enpol.2018.06.002.
IEA. 2017. Energy Policies of IEA Countires – New Zealand 2017, 1–235. https://www.iea.org/publications/freepublications/publication/EnergyPoliciesofIEACountriesNewZealand2017.pdf.
IRENA Coalition for Action. 2018. Community energy: broadening the ownership of renewables, 8. https://coalition.irena.org/-/media/Files/IRENA/Coalition-for-Action/Publication/Coalition-for-Action_Community-Energy_2018.pdf.
MacArthur J, Matthewman S. 2018. Populist resistance and alternative transitions: indigenous ownership of energy infrastructure in Aotearoa New Zealand. Energy Research and Social Science. 43(May):16–24. DOI:10.1016/j.erss.2018.05.009.
MBIE. 2019a. Discussion document accelerating renewable energy and energy efficiency. https://www.mbie.govt.nz/dmsdocument/10349-discussion-document-accelerating-renewable-energy-and-energy-efficiency.
MBIE. 2019b. Line company discount and energy trust distribution analysis 2019.
MFE. 1997. Resource Management Act 1991. Environmental and Resource Management Law (July).
MFE. 2011. National Policy Statement for Renewable Electricity Generation 2011', (April), 1–8. www.mfe.govt.nz/publications/rma/nps-renewable-electricity-generation-2011/index.html.
Morris C, Jungjohann A. 2016. Energy democracy: Germany's Energiewende to renewables. Palgrave Macmillan.
NZWEA. 2020. consented-wind-farms @ www.windenergy.org.nz. [accessed 2020 May 5] http://www.windenergy.org.nz/consented-wind-farms.
Schaefer MS, Lloyd B, Stephenson JR. 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. DOI:10.1016/j.enpol.2011.12.032.
Suomalainen K, Sharp B. 2016. Electricity sector transformation in New Zealand: A sustainability assessment approach. Journal of Renewable and Sustainable Energy. 8(3):8. DOI:10.1063/1.4950943.
Taylor Aiken G., Middlemiss L, Sallu S, Hauxwell–Baldwin, R. 2017. Researching climate change and community in neoliberal contexts: an emerging critical approach. Interdisciplinary Reviews: Climate Change. 8(4). DOI:10.1002/wcc.463.
Tews K. 2018. The crash of a policy pilot to legally define community energy. Evidence from the German auction scheme. Sustainability (Switzerland). 10(10). DOI:10.3390/su10103397.
TPK. 2018. 'Te Ture Whenua Maori Act 1993', (October). http://legislation.govt.nz/act/public/1993/0004/latest/DLM290546.html.
Transpower. 2020. Whakamana i te Mauri Hiko: empowering our energy future. https://www.transpower.co.nz/sites/default/files/publications/resources/TPWhakamanaiTeMauriHiko.pdf.
Tuaropaki Trust. 2020. Tuaropaki Trust. www.tuaropaki.com. http://www.tuaropaki.com/owner-services/.
Tuwharetoa mai Kawerau ki te Tai. 2018. Ngati Tuwharetoa Geothermal Assets Ltd Updates. https://nzgeothermal.org.nz/app/uploads/2019/07/NTGA-Industry-Updates-NZGW-2018-1.pdf.
Vector. 2018a. Report to entrust the energy solutions programme financial year 2017/18. https://www.entrustnz.co.nz/media/68037/entrust-energy-solutions-annual-report-2018.pdf.
Vector. 2018b. Dozens of Auckland schools connected to the Future of Energy. www.vector.co.nz. https://www.vector.co.nz/articles/dozens-of-auckland-schools-connected-to-the-future.
Walker G, Devine-Wright P. 2008. Community renewable energy: what should it mean? Energy Policy. 36(2):497–500. DOI:10.1016/j.enpol.2007.10.019.
WEL Energy Trust. 2019. Annual Report 2019. https://www.welenergytrust.co.nz/wp-content/uploads/2016/09/Wel-Annual-Report-2019-FINAL.pdf.
Wlokas HL, Westoby P, Soal S. 2017. Learning from the literature on community development for the implementation of community renewables in South Africa. Journal of Energy in Southern Africa. 28(1):35–44. DOI:10.17159/2413-3051/2017/v28i1a1592.