Local Engagement and Success of Small-Scale Renewable Energy Projects in Remote Areas: Insights from Ramea's Wind Energy Projects

by

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Abstract

Access to clean, affordable, and sustainable energy remains a significant challenge in off-grid areas across the world. As the energy transition progresses, relevant stakeholders in the energy sector have acknowledged the potential of small-scale renewable energy (SSRE) in addressing this challenge. However, studies have demonstrated situations where the development and uptake of some SSRE schemes fail to realize their intended purposes, especially due to ineffective local engagement by project proponents, and partly to capacity gaps of beneficiaries. Leveraging the cases of two wind energy demonstration projects in the Town of Ramea, Newfoundland and Labrador (NL), this thesis investigates how the projects' proponents engaged the community in the activities of the projects. It also explores the strengths, weaknesses, opportunities, and threats (SWOT) of the projects, intending to unearth key factors that can impact the successes or failures of test projects. By using document reviews, site observation, and in-depth interviews with the various stakeholders of the projects, the study established that there was an early, genuine, and multi-faceted engagement with the local community. The community's premium wind resources, coupled with both local and external interest in wind energy development, present key opportunities for the energy transition in the Town. Despite contributing to a reduction in the use of diesel, creation of employment, and the development of wind-hydrogen-diesel integration control technology, one of the projects has been discontinued due to technical challenges with part of the project's equipment. Competing energy priorities, rate uniformity in NL, and large-sized diesel engines in Ramea significantly challenged the optimum integration of wind energy in the island's electricity grid and limited the benefits the community enjoys from the projects. I conclude that effective local engagement may not be enough to ensure the success of SSRE projects in off-grid areas, recognizing that the proponents' internal organizational issues and the broader energy ecosystem affect the success of demonstration projects as well.

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List of Abbreviations

°C	Degrees centigrade
ACOA	Atlantic Canada Opportunities Agency
BOOT	Build, Own, Operate, and Transfer
CANMET	Canada Centre for Mineral and Energy Technology
CBC	Canadian Broadcasting Company
CE	Community Engagement
CO_2	Carbon dioxide
EIA	Energy Information Agency
EMS	Energy Management System
FPS	Frontier Power Systems
IIS	Island Interconnected System
IRENA	International Renewable Energy Agency
KII	Key Informant Interviews
kW	Kilowatts
MS Word	Microsoft Word
MW	Megawatts
NIMBY	Not-In-My-Backyard
NL Hydro	Newfoundland and Labrador Hydro
NL	Newfoundland and Labrador

NRCan	Natural Resources Canada
NZ	Net Zero
PV	Photovoltaic
R&D	Research and Development
RA	Research Assistant
RE	Renewable Energy
RE Co-ops	Renewable Energy Co-operatives
SDGs	Sustainable Development Goals
SE	Sustainable Energy
SSRE	Small-Scale Renewable Energy
SWOT	Strengths, Weaknesses, Opportunities, and Threats
SZA	Step-Zero Analysis
US	United States
WDICS	Wind- Diesel- Integrated Control Systems
WDP	Wind-Diesel Project
WEPs	Wind Energy Projects
WHDP	Wind-Hydrogen-Diesel Project

Chapter 1: Introduction

1.1 Background of the Study

Small-scale renewable energy (SSRE)[1] has gained considerable recognition across the globe for contributing to the areas of (a) reducing greenhouse gas emissions, (b) promoting access to clean and sustainable energy, especially in remote areas, and (c) improving local control over energy resources and encouraging community-based solutions for eliminating fossil fuels (see Akella et al., 2009; Akikur et al., 2013; Vezzoli et al., 2018). As a result, there is growing and widespread support for the development and utilization of these projects both in research and practice (Givelt et al., 2018).

The literature on SSRE is still growing. However, some scholars have criticized it for narrowly focusing on issues of technology, finance, and policy (Colombo et al., 2017; Escobar et al., 2012). This narrow focus has unintentionally left out other important issues like how to effectively engage the beneficiary community—a geographical location where or for whom an energy project is developed—in the development and management of SSRE systems. However, it has contributed to addressing some of the major issues in the development and utilization of these projects. Evidence across developed nations indicates that the foregoing issues are being addressed with technological advancements (e.g., hybrid energy systems (see Mohammed et al., 2014)), favorable renewable energy policy (e.g., net metering (see Navigant, 2014), power-purchase agreements (see The World Bank, 2021), carbon taxes (see The World Bank, 2020), etc.), and increasing funding arrangements across governments, charities, and research institutes (see Akikur et al., 2013; Lestari et al., 2018). The foregoing suggests that issues of technology, policy, and finance are far advanced and

[1] Small-Scale Renewable Energy (SSRE) is often used to describe energy generated from renewable sources (e.g. solar, wind, biomass, etc.) that characteristically have "small installed capacities" (see Byrne et al., 2007; Vezzoli et al., 2018), usually 10MW or below (Terrapon-Pfaff et al., 2014).

not the only factors that contribute to sustainable access to energy in off-grid areas, especially in the developed world. Issues surrounding effective community engagement are increasingly gaining more importance (see Brown et al., 2020; Kooij et al., 2018), given the surging interests in community energy[2] globally.

There are numerous cases (Feron et al., 2017; Lestari et al., 2018; Rodon et al., 2021) in practice across the world where the development and/or uptake of SSRE systems in remote/off-grid communities[3] fail to achieve their intended purposes. In such instances, SSRE projects are abandoned and/or rejected by project owners or are simply left unutilized by beneficiary communities (Bidwell, 2016). In terms of key causes, recent studies have partly blamed knowledge and capacity gaps on the part of the community and ineffective local engagement on the part of project owners (see Bidwell, 2016; Brennan & Rensburg, 2016).

Community energy is gaining more interest in Canada, as many off-grid/remote communities are championing the development and utilization of these systems for various reasons, including the reduction of dependence on diesel generations and promoting more affordable and sustainable energy in their jurisdictions (see Miller et al., 2019). For instance, Karanasios & Parker (2018) observe that as of 2016, there existed about 71 renewable energy projects in remote indigenous communities in the country across Yukon, North West Territories (NWT), Ontario, British Columbia (BC), Quebec, and Newfoundland and Labrador (NL). Concerns of local energy sovereignty particularly drive the increasing

[2] Community energy is used to refer to any SSRE system that is owned by a community or that which is developed while giving precedence to the beneficiary community (see Miller et al., 2019).

[3] An off-grid community is "any permanent community of at least 10 dwellings not connected to the North American grid nor the piped natural gas network" (Natural Resources Canada, 2011, 3). The term is used interchangeably with remote communities/ areas in this thesis.

adoption of community energy in most of these remote Indigenous communities (see Rodon et al., 2021).

In some instances, due to inadequate local capacity—i.e., the ability of a community to address its issues or manage its affairs successfully (see Kamstra, 2017)—on the part of off-grid communities, the development of these SSRE systems is undertaken for the community by stakeholders (including public utilities, private enterprises, research institutes, NGOs, etc.) outside the community. In such cases, community engagement and/or acceptance are crucial to the projects' success (see Mercer et al., 2018).

1.2 The Newfoundland and Labrador (NL) context

The development of SSRE systems has not received much attention in NL, compared to other parts of Canada, largely because of a heavy provincial focus on large-scale hydro projects (Mercer et al., 2018). Although the situation has made the province a haven of excess renewable energy generated from hydro, some remote/off-grid communities are still dependent on "unclean sources"—i.e., diesel generation— to serve their energy needs (Mercer et al., 2018). In total, there are currently 27 off-grid communities in NL, with 21 of them (including 6 in the island region and 15 in Labrador) exclusively depending on diesel generations owned and operated by NL Hydro (Mercer et al., 2020 b). This topic will be further discussed in Chapter 3.

It is contended that operating these isolated diesel generating systems is expensive. However, experts have advised stakeholders that they are still more cost-effective and feasible than connecting these communities to the grid (Government of Newfoundland and Labrador, 2015). That notwithstanding, off-grid communities in NL are faced with many issues concerning energy security and sustainability. That is, their main source of energy largely contributes to carbon emissions, and is relatively not affordable for residents when compared with the rest of the province who are connected to the Island Interconnected System (IIS)[4], especially during the cold winter months when the demand for electricity is relatively higher (see Mercer et al., 2020 a). As well, some of these communities located in Labrador are exposed to the risks of fuel spills and leaks, heat insecurities, and environmental degradation (see Mercer et al., 2020 b).

In an attempt to gradually phase out dependence on diesel generating systems in off-grid communities of the Island region, a wind-diesel demonstration project was sanctioned in Ramea[5] (see section 3.5.1 for details) by a private energy developer— Frontier Power Systems Inc. (FPS) in 2004. FPS worked with Nalcor Inc., a crown corporation responsible for managing the province's energy resources, to test how wind energy could be used to displace the use of diesel in generating electricity in the community. And in 2007, Newfoundland and Labrador Hydro (NL Hydro), a subsidiary of Nalcor Inc., established another hybrid energy project, i.e., the wind-hydrogen-diesel (WHD) demonstration to experiment with the use of wind and hydrogen to produce and store renewable energy that can be utilized to further reduce the reliance on diesel plants in generating electricity (Nalcor Energy, 2020; Rowland and Gaede, 2019).

In this case, the Town of Ramea is a beneficiary of the initiatives championed by organizations outside the community— i.e., FPS and NL Hydro. The community's role and involvement in the maintenance and operation of the facilities are not well known to the relevant bodies of literature. Ramea's only involvement in the projects thus far has been recorded in two main instances: (1) their participation in a stakeholder consultation process

[4] The Island Interconnected System is described by NL Hydro (2018, 6) as "the interconnected portion of the electrical system of the island".

[5] Ramea is a small archipelago community located off the southwest coast on the Island of Newfoundland. It is one of the communities on the Island of Newfoundland that is not connected to the IIS (Explore NL, 2010).

conducted by NL Hydro at the early stages of the projects' development and (2) their provision of hired labor during the installation of the project's infrastructure (Nalcor Energy, 2010). Using an approach informed by elements of step-zero analysis and SWOT (strengths, weaknesses, opportunities, threats) analysis, the study explores the various forms and the extent to which the Town of Ramea has been engaged in the projects before their implementation and seeks to broadly understand factors contributing to the current state of the project.

1.3 Relevance of the Research

The timing of this study could not be more crucial given the increasing Federal Government's support for renewable energy and carbon reduction strategies (Natural Resources Canada, 2021) as well as the growing concerns lingering around the future and sustainability of the Ramea wind energy projects (WEPs) as community stakeholders are expressing anxiety over the functionality of some of the installed wind turbines amid increasing electricity rates (CBC News, 2018). Again, Ramea's contribution towards the success of this project is not well known but is vital to understanding how remote or off-grid communities are engaged or can be engaged effectively to ensure the success of SSRE systems. Just as interest is currently growing in understanding innovative ways of designing SSRE projects that are participatory and capable of bolstering community acceptance and ownership (Huybrechts et al., 2018), furthering SSRE development in NL requires finding answers to the questions of "how", "when" and "to what extent" local communities are/can be engaged to ensure the success of these projects.

As a small community with a decreasing population[6] that has a national significance regarding wind energy development in Canada due to the presence of the novel wind energy

[6] Like most of the rural communities in NL, the Town of Ramea has been experiencing a decreasing population since the 1970s. It had a population of around 1,120 in the 1970s. This reduced to 526

projects, Ramea presents a compelling case for broadening our understanding of effective ways of engaging off-grid communities in SSRE developments. Also, the case will help unearth valuable insights regarding the general strengths, weaknesses, opportunities, and threats of the projects. This offers an opportunity for a broad understanding of the wind energy projects' success and challenges that can be used to inform the future of SSRE developments, particularly WEPs in NL.

1.4 Research Objectives

The main purpose of the study is to understand the role of local engagement in the success of small-scale renewable energy projects in remote communities, using the Town of Ramea as a case study. Specifically, the study will:

(a) examine the general strengths, weaknesses, opportunities, and threats of Ramea's novel research and development wind energy projects.

(b) ascertain the various ways that the community of Ramea has been or are being engaged in the development, operation, and maintenance of the projects; and

(c) provide insights on how these demonstration projects can be optimized for the development and persistence of small-scale renewable energy projects in other remote communities, in the province of Newfoundland and Labrador and beyond.

1.5 Outline of Thesis

This thesis is organized into 5 chapters. Following this introductory Chapter 1, which has provided a broad overview of the study and what it seeks to achieve, is Chapter 2, a literature review that gives the theoretical justification of the study. Throughout Chapter 2, the literature on rural development, local engagement, sustainable energy, and small-scale

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persons in 2011, and 447 in 2016, representing an average declining rate of 3% per annum over the two census periods (Statistics Canada, 2016).

renewable energy development is examined to highlight the research gaps the study hopes to address and to establish the conceptual and theoretical underpinning of the study. Chapter 3 contextualizes the study and describes the methodology and methods employed. The chapter outlines the geographical and contextual scope of the study. In terms of context, the chapter provides a general overview of energy development in NL, focusing on SSRE developments in off-grid communities and the Ramea wind projects. And in the latter part of Chapter 3, the general study approach, data collection, and analysis methods used are explained. Chapter 4 presents the results of the data gathered and discusses the findings. And Chapter 5 is the conclusion of the report, providing summaries of the results and discussions, and drawing lessons and implications therefrom.

Chapter 2: Literature Review

2.1 Introduction

In this chapter, I present the conceptual underpinning of the thesis, providing highlights from the literature on the concepts of rural development, renewable energy, small-scale renewable energy, sustainable energy, and community engagement. The synergies between and among these concepts and their recent foci in the literature are established. In the concluding section, I provide a summary of the literature on the various issues examined and draw some lessons, justifying the relevance of the thesis.

2.2. Rural Development

Despite its relative popularity, the term “rural” has no specific definition, and its uses vary across countries (Tadele, 2020). However, it is often associated with areas characterized by farmlands, forests, mountain villages, mining, coastal communities, etc. (Ramisch, 2012). Rural is often defined in contrast to “urban”, referencing the number of people residing in an area (i.e., lower population densities) and the type of economic activities undertaken (e.g., extractive industries) therein (Atkinson, 2020; Kim et al., 2005). With this viewpoint, Statistics Canada(2001, p. 1) defines rural as “the population living in towns and municipalities outside the commuting zone of larger urban centers with populations of 10,000 or more”.

Even so, the gradual shift in jobs (e.g., factories, mines, ports, petty commerce, tourism, etc.) in areas regarded as rural (see Atkinson, 2020; Kim et al., 2005) makes it difficult to distinguish between rural and urban areas using population thresholds and economic activities (Ramisch, 2012). The concept of rurality differs across jurisdictions (Ramisch, 2012; Tadele, 2020)—i.e., rural areas in Asia are characteristically different from those in Africa and North America for example. Still, Ramisch (2012) finds that rural areas generally have four main characterizing features, including “1. the abundance of resources, 2. isolation, 3. the abundance of labor, and 4. the importance of social factors [i.e., the exhibition of relatively strong ties to community and community aspirations]” (Ramisch, 2012, p. 335).

Rurality is sometimes used to refer to remote or “off-grid” areas in the energy literature (Mercer et al., 2020; Karanasios & Parker, 2018; Wyse & Hoicka, 2018), especially in geographical areas that are isolated or disconnected from mainstream infrastructure (Government of Canada, 2011). Although these terms are largely similar, off-grid—i.e., isolated or remote areas and communities not connected to the main electricity distribution system—is preferably used in the energy literature, because it can be argued that ‘all off-grid areas are rural, but not all rural areas are off-grid.’ For example, in Canada, “any permanent community of at least 10 dwellings not connected to the North American grid nor the piped natural gas network” (Government of Canada, 2011, p. 3) is considered an off-grid community. The majority of these areas are remote and Indigenous communities (see Government of Canada, 2011; Karanasios & Parker, 2018; Wyse & Hoicka, 2018).

The concept of rural development has undergone several changes over time. It was first based on advancing agriculture-based economies but is now more focused on ‘sustainable livelihood approaches’—which focus on developing the continually shifting source of livelihoods in rural areas (see Ramisch, 2012). They are typically concerned with “economic and social efforts intended to increase growth and expansion in areas outside cities and improve the living conditions of the people living there” (Atkinson, 2020, p. 1). In recent times, rural development has been subsumed under sustainable development thinking, manifested in the 17 Sustainable Development Goals (SDGs) of the United Nations. Goals 1 (no poverty), 2 (zero hunger), 7 (affordable and clean energy), 9 (industry, innovation, and infrastructure), 10 (reduced inequalities), 11 (sustainable cities and communities), and 13 (climate action) are particularly relevant to the development and sustainability of rural and remote areas (see United Nations, 2016).

Researchers now contend that there is an intimate relationship between sustainable development and sustainable energy (see “Sustainable Energy” section below), as energy is the largest industrial sector that feeds into almost every other sector nowadays (Dincer, 2000; Vezzoli et al., 2018). It is argued that achieving sustainable development (and not just the SDGs) is intrinsically linked to ensuring that everyone everywhere has access to sustainable energy (Vezzoli et al., 2018).

2.3 Renewable Energy

Renewable energy (RE) is understood as energy generated from fuel sources that regenerate and replenish upon usage (Hasselriis & Mahoney, 2013, p. 1561). According to Natural Resources Canada, “RE is obtained from natural processes that replenish at the same or faster rate they are utilized” (Natural Resources Canada, 2020). Across the literature on renewable energy, the five most widely utilized renewable energy resources around the world today are biomass, solar, hydro, wind, and geothermal (see Hasselriis & Mahoney, 2013, 1561; Vezzoli et al., 2018).

RE has gained prominence since the early fights against climate change began and have since received sustained attention and support across governments, academia, industry, and international development organizations (Alibašić, 2018; Marais et al., 2018; Prasad et al., 2019). Transitioning to renewable energy (RE)—i.e., transforming the global energy sector from a fossil-fuel-based one to a zero-carbon[7] one using RE (see International

[7] Net-zero means having an atmosphere where the level of GHGs does not increase from year to year. It means essentially stopping CO2 and/or countering carbon emissions with carbon capture (sequestration) techniques as strategies to reverse the impacts of climate change by 2050. Two major approaches are being pursued to attain net-zero: 1. use of renewables coupled with energy efficiency, and 2. technologies that absorb greenhouse gasses. It is achieved by balancing emission with absorption; i.e. removing the same amount of

Renewable Energy Agency, 2020)—is seen as one of the most important approaches to effectively reduce carbon emissions and promote sustainable development across the world today (Brown et al., 2020; Dincer, 2000; Lund et al., 2014).

As of 2020, RE constitutes about 28 percent of the global energy mix (International Energy Agency, 2020), and 16.3 percent of the total energy produced in Canada (Natural Resources Canada, 2020). With climate science suggesting that to reverse the impacts of climate change, global temperature rise must be limited to 1.5°C or less above the pre-industrial era (International Renewable Energy Agency, 2020), several countries around the world are setting and pursuing targets to reach net-zero carbon economies by mid-century (see Energy & Climate Intelligence Unit, 2018). The majority of the current strategies across most of these countries are centered on increasing the share of electricity produced from RE, coupled with energy efficiency; this is noted to be the safest and most effective approach to attaining Net- Zero (Energy & Climate Intelligence Unit, 2018; International Renewable Energy Agency (IRENA), 2020).

In terms of capacity, RE production is broadly categorized into large-scale and small-scale projects. Both large-scale and small-scale RE are difficult to define and have no widely accepted definitions in the literature. However, this research adopts the definition of large-scale or utility-level RE given by the US Department of Energy. That is, “renewable energy facilities larger than 10 megawatts” (U.S Department of Energy, 2013, p. 1). This definition suggests that any RE facility smaller than 10 megawatts can be regarded as small-scale. This is expanded in the “Small-Scale Renewable Energy” section below.

greenhouse gasses emitted (see Energy & Climate Intelligence Unit, 2018; International Renewable Energy Agency, 2020).

Large-scale renewable energy projects are, however, not ‘popular’ in the sustainable energy literature. Although their potential to accelerate the achievement of broad energy goals—i.e., attaining net-zero—are duly recognized, sustainable energy advocates find that they generally neglect the lives of locals, as they result in huge disturbances to the environment and the core fabrics of the local communities in which they are sited (see Wyse & Hoicka, 2018). On the other hand, small-scale renewable energy (see next section) continues to receive increasing attention and is regarded as a suitable alternative for attaining sustainable energy (Vezzoli et al., 2018).

In Canada’s renewable energy mix, hydro energy is the mainstay of the electricity sector, accounting for about 60 percent of the total electricity produced in the country as of 2018. The majority of these hydro projects are large-scale centralized projects; out of a total of 563 hydro projects in 2018, only 45 of them had capacities below 1 MW while the remaining 518 had at least 1 MW[8] (Natural Resources Canada, 2020). Among the other renewable energy resources in Canada, wind and solar are the fastest-growing (Natural Resources Canada, 2013). At the end of 2020, Canada had a total wind energy generation capacity of 13,588 MW, ranking ninth in the world. The country also ranked 22nd in the world in solar energy with a total generation capacity of about 3,000 MW (Canada Renewable Energy Association, 2021). According to the Canada Energy Regulator (2018), Saskatchewan has the highest solar energy generation potential while Newfoundland has the least, with Manitoba and Alberta ranked in second and third places respectively. However, Ontario, which is ranked fouth in terms of solar generation potential, is leading in solar energy generation capacity with over 98 percent of the country’s generation capacity. Just like solar energy, Alberta and Saskatchewan have the highest wind energy generation

[8] No specific data was found for the number of small-scale projects (i.e., hydro projects with a capacity less than 10MW) as adapted in this thesis.

potential with Ontario having the highest concentration of projects (Canada Energy Regulator, 2018). The potential of wind energy development in NL is amongst the strongest in North America (Mercer et al., 2017), and as of 2010, it was projected as being capable of meeting 20 percent of Canada's energy needs (Chris Barrington-leigh & Ouliaris, 2015).

Despite the availability of electricity produced from hydro across Canada, which has allowed the country to claim it is a global leader in clean energy production (see Natural Resources Canada, 2013), many off-grid communities across the country are said to be in energy poverty and contribute significantly to carbon emissions (Karanasios & Parker, 2018; Wyse & Hoicka, 2018). These communities, predominantly rural and Indigenous, rely on diesel-generated electricity, which is noted to be expensive, insecure, and emissions-intensive (Government of Canada, 2011; Karanasios & Parker, 2018). Due to the foregoing issues associated with diesel electricity generation and the lessons from local oppositions to some renewable energy developments, particularly wind farms (see "Community Engagement and Small-Scale Renewable Energy Schemes" section below), there has been increasing focus on developing community energy.

Community energy is tricky to define and hence has no specific definition in the literature, as argued by Wyse & Hoicka (2018). However, in the ideal sense, Walker & Devine-Wright note that it is "any energy project that is run by and for the collective benefit of a local community" (Walker & Devine-Wright, 2008; p. 498). Other scholars equate community energy to that which promotes varying degrees of "community engagement" in the development and operation of any energy project. That notwithstanding, Wyse & Hoicka (2018) consider community energy to be any form of energy that promotes the following three conditions: 1. community participation, 2. community control and or ownership, and 3. community capacity (i.e., empowering a local community through building their capacity to enable them to participate in the development and management of energy projects). Community energy advancement revolves around decentralized energy systems to specifically promote community involvement in SE projects, and more broadly, advance local sustainability agendas (Karanasios & Parker, 2018; Walker & Devine-Wright, 2008; Wyse & Hoicka, 2018).

2.4 Small-Scale Renewable Energy

The term ‘small-scale renewable energy’ (SSRE) is widely used but lacks a universally accepted definition. It is, however, often used to refer to energy generated from renewable energy sources with ‘small’ installed capacities and produced in a decentralized way in communities, not in centralized facilities run by utility companies (Byrne et al., 2007). The installed capacity that is considered small-scale depends on several factors, including the type of energy resource and the context/ jurisdiction. For instance, and in the case of solar energy, the United States Energy Information Agency (US EIA, 2017) categorizes solar photovoltaic (PV) panels with installed capacities of less than 1 megawatt (MW) or 1,000 kilowatts (kW) as small-scale. In a study of China, Byrne et al. (2007) considered any renewable energy scheme with installed capacities of less than 2 kW as small-scale. Also, in a review of the impacts and sustainability of SSRE projects in developing countries, Terrapon-pfaff et al.(2014) categorize projects with a capacity of 100 kW or below as SSRE. And as highlighted in section 2.3 above, the US Department of Energy (2013) generally categorizes projects with capacities below 10 MW or 10,000 kW as SSRE. For this study, SSRE is used to describe all projects that utilize renewable energy resources with capacities below 10 MW.

A key assumption in the sustainable energy literature is that SSRE technologies meet the technical, economic, and environmental criteria in most cases, although this might be contestable in some contexts (Iddrisu & Bhattacharyya, 2015; Vezzoli et al., 2018). In particular, SSRE is gaining prominence in the current discourse on promoting access to sustainable energy in off-grid/remote communities across the globe, largely because they inherently contain the key features of sustainable energy—i.e., clean, affordable, and reliable (Vezzoli et al., 2018).

Despite the widespread claim that they can address energy issues in off-grid communities, there are instances where SSRE projects are either not accepted or not utilized by beneficiary communities, largely due to the community's lack of knowledge and/or capacity to both utilize and manage these projects, resulting from inadequate local engagement by project developers or proponents (Bidwell, 2016; Madriz-vargas et al., 2018). For instance, Ikejemba et al.(2017) found that 26 of 29 SSRE projects across Sub-Saharan Africa either failed or were inadequately maintained or sabotaged, with reasons causing the failure ranging from problematic cooperation among stakeholders to low public acceptance and inclusion to improper project planning and implementation.

This partly explains the increasing attention of energy scholars to understanding innovative ways of designing SSRE projects that are participatory and capable of bolstering community acceptance and ownership (Huybrechts et al., 2018). Consequently, SSRE systems in which community members take the lead or center role in the design, implementation, and management are garnering increasing support in the energy literature (Akinyele & Rayudu, 2016; Brown et al., 2020; Kooij et al., 2018).

2.5 Sustainable Energy

Any form of energy that "meets the needs of the present without compromising the needs of the future generations is typically regarded as sustainable" (Hasselriss & Mahoney, 2010, p. 1561). Sustainable energy (SE) subsumes all "energy sources that are not expected to be depleted in a time frame relevant to the human race" (Lund, 2014, 11). Broadly, van Staden (2018) defines sustainable energy as "energy in the production and utilization of electricity, heating, and cooling, which has no or little adverse impacts on human health, environment, and ecological systems” (van Staden, 2018, p. 25).

SE does not only refer to the adoption of renewable energy, as narrowly assumed by some scholars (Hasselriis & Mahoney, 2013, p. 1561); it goes beyond that. Alibašić (2018) contends that SE consists of three main components: “1. energy conservation, 2. production of renewable energy, and 3. practicing efficient management of energy” (Alibašić, 2018, p. 11). A similar view is held by Prasad et al. (2019) and Van Staden (2018), who argue that SE is not only limited to the use of renewable energy but also intrinsically includes energy conservation (i.e., reducing energy wastage and practicing energy savings) and efficiency activities and/or technologies. Characteristically, SE is reliable, available, and affordable for all (Frame et al., 2011; van Staden, 2018) at all times across the world.

SE is primarily derived from the concept of sustainable development, which calls for developmental interventions that advance the economic and social well-being of society while protecting the environment (Vezzoli et al., 2018). The literature on SE incorporates ‘technical’ and ‘institutional’ dimensions to the traditional economic, social, and environmental dimensions of sustainable development thinking (see Frame et al., 2011; Iddrisu & Bhattacharyya, 2015).

For this study, sustainable energy is used to refer to renewable energy (specifically SSRE) that maximizes energy efficiency and is reliable and accessible to all persons at all times. Despite its heavy focus on the literature, the understanding of sustainable energy adopted herein is largely highlighted in Goal 7 of the United Nations’ Sustainable Development Goals (SDGs), the main reference point in the recent political and development discourse on sustainable energy, which proposes to “ensure universal access to affordable, reliable and sustainable modern energy by 2030" (United Nations, 2016; Vezzoli et al., 2018).

2.6 Community Engagement

Community engagement (CE) combines the concepts of community[9] and engagement. CE is broadly concerned about "ways of working" (Smith et al., 2014, p. 8). A commonly cited definition is the U.S. Centers for Disease Control and Prevention (CDC)'s 1997 definition: "the process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people" (Centers for Disease Control and Prevention, 2011, p. 3). Thus, it is a cooperative process of working with people to address their well-being (Smith et al., 2014). The concept of CE gained popularity and is now mainstreamed in almost every aspect of life following its first recognition (in the literature) in the field of public health during the latter part of the 20th century (Centers for Disease Control and Prevention, 2011; M. A. Walker, 2011). CE has recently been recognized as an inalienable practice in natural resources development and governance (Ojha et al., 2016), as it helps "establish partnerships and coalitions that help in mobilizing resources and influence systems, change relationships, and provide a media for changing policies, programs and practices" (Centers for Disease Control and Prevention, 2011, p. 3).CE forms and processes differ across communities and projects. Thus, the context of a project or initiative largely determines the participants or stakeholders to engage (Smith et al., 2014). For instance, community-based initiatives that are led and controlled by a local community (see Haugh, 2007) may engage different stakeholders within or outside the local community to (a) instill

[9] Although the concept of community is very difficult to define, it is generally used to describe a group of people identified as a unit, and who interact with and support each other, often as a result of their geographic proximity, shared attributes, and a sense of belonging (see Centers for Disease Control and Prevention, 2011; Cobigo et al., 2016).

a sense of ownership, (b) ensure a fair distribution of benefits, and/or (c) establish partnerships for the implementation and management of the initiative (Colvin et al., 2016; Ojha et al., 2016; Smith et al., 2014). On the other hand, when projects or initiatives are championed by institutions outside the local community, CE may take forms where the project proponents institute ways to involve the community throughout the stages of the project (e.g., devolution of control) to work collaboratively to achieve the project goals (Smith et al., 2014). In another vein, when an initiative is developed or undertaken by both a local community and an external organization (a partnership)—e.g., research projects between public universities and local communities—CE may result in the formation of collaborative governance structures to achieve project goals (Colvin et al., 2016; Ochocka et al., 2010; Smith et al., 2014).

CE is an unending process and offers numerous benefits to the actors involved (Colvin et al., 2016). It is often undertaken to achieve three main objectives: 1. to garner community acceptance and prevent any conflicts that might arise as a result of the project, 2. to establish long-term relationships between project actors, and 3. to empower the community to influence decision-making and to implement the desired change that the project seeks (Colvin et al., 2016; M. A. Walker, 2011). Some of the many reasons CE is gaining recognition in the project development and implementation literature are that it:

(a) allows individuals and the community to advocate for their needs (Walker, 2011);
(b) gives project proponents the opportunity to gather advice and guidance from a community's experience and expertise (Walker, 2011); and
(c) empowers communities to undertake decision-making and to own and accept developmental interventions (Colvin et al., 2016).

Although there are no clear-cut established processes for successful CE, the literature identifies certain desirable practices that contribute to an effective process. In terms of individual processes, an effective CE process begins with defining and/or understanding the community and establishing a relationship with the community (Walker, 2011). For projects that are sanctioned by proponents outside the local community, the process should, at the early stages, empower the community and create a conducive space for their participation in decision-making—i.e., throughout the planning, development, implementation, and maintenance phases of a project (Colvin et al., 2016). On the other hand, the process may begin by empowering local actors to initiate their projects and then engage external actors to help implement them (Colvin et al., 2016; Smith et al., 2014). In trying to understand how to effectively engage communities in the development of energy projects, Jami and Walsh propose a framework to conducting community engagement, which suggests (1) identifying the stakeholders and undertaking stakeholder assessments and then (2) engaging them throughout the key phases of the project development using effective public participation models (see Jami & Walsh, 2014).

Several different terms have been used in some contexts in the literature to describe the processes of CE. The following terms are used as a means to gauge CE: local/public engagement (see Pellizzone et al., 2015), participation (see Bidwell, 2016; Jami & Walsh, 2014), and involvement. Although these terms are not the same in meaning, they are used as a reference point to assess how local communities or groups, in any democratic society, are being collaborated with, for any development intervention that impacts them.

2.7 Community Engagement and Small-Scale Renewable Energy Schemes

Just like in natural resource governance (see Colvin et al., 2016), as highlighted above, CE is increasingly gaining recognition as a key component in the successful development and governance of SSRE schemes (Howard, 2015). This is partly because there are several instances in practice across the literature where the development and/or uptake of SSRE failed to achieve their intended purposes as a result of no/inadequate community engagement, which in most cases led to either the beneficiary community not utilizing the services of SSRE schemes or the project proponents abandoning it entirely (Bidwell, 2016; Brennan & Rensburg, 2016). This largely influenced the resurgence of interest in and advocacy for CE in SSRE to foster community acceptance and the sustainable governance of SSRE (Barrios-O'neill & Schuitema, 2016; Bidwell, 2016; Colvin et al., 2016).

Renewable energy development in local communities, particularly remote areas, seems to be a paradox, where the society supports and opposes such initiatives at the same time (see Colvin et al., 2016; Hall, 2014; Hindmarsh & Matthews, 2008; Pellizzone et al., 2017). For example, Hall (2014) recognizes that there exists in Australia significant support for the development and uptake of renewable energy projects while contending that there is also growing resistance to the development of such projects in some local communities. WEPs are noted to experience the most opposition (Christidis et al., 2017; Hall, 2014). Hall (2014), Hindmarsh & Matthews (2008), Vezzoli et al. (2018), and Weis (2008) identified several factors that breed this resistance to wind farms' development from community stakeholders: the noise produced from projects sited within the community, conflicts resulting from improper local engagement, disruptions to local tourism and hospitality businesses, and negative impacts on birds and bats among other factors. Christidis et al. (2017) group the source of these oppositions into three broad areas: aesthetics, implementation (which includes lack of community engagement), and health risk perceptions. The famous blanket term "NIMBYism " (not in my backyard) is used to conceptualize this oxymoron of general societal support for renewable energy and local opposition to some specific renewable energy developments (see Devine-Wright, 2009).

CE in SSRE is particularly popular for WEPs (see Colvin et al., 2016; Firestone et al., 2018), and is seen as a medium for obtaining the "social license to operate" (see Hall, 2014, p. 220). Numerous studies have justified the practice of CE in SSRE and its prospects in contributing to the attainment of energy targets and reversing the impacts of climate change (Klain et al., 2017; Marais et al., 2018; Parks & Theobald, 2013). In the context of wind energy development, Colvin et al. (2016) contend that CE is undertaken to obtain social acceptance and avoid conflict. Hence, CE is seen as an effective strategy to address oppositions likely to hinder the development of SSRE and to obtain the three main objectives highlighted in the preceding “Community Engagement” section.

Pro-community renewable energy developments have gained prominence in Canada since the beginning of the 21st century and have largely been influenced by the interest of Indigenous governments in climate change mitigation and advocacy for their participation in energy projects within their traditional jurisdictions (Karanasios & Parker, 2018). Between 1980 and 2016, a total of 71 community renewable energy projects were developed across remote Indigenous communities in Canada, with the majority located in the Northwest Territories, Ontario, British Columbia, Nunavut, and the Yukon (Karanasios & Parker, 2018). As highlighted in Section 2.3 above, the issues associated with diesel generation and the desire to phase out the reliance on those systems (Government of Canada, 2011; Wyse & Hoicka, 2018), coupled with local development and sustainability goals of off-grid communities in Canada, have shifted interests to community-focused energy in these communities (see Hoicka & MacArthur, 2018; Karanasios & Parker, 2018; Wyse & Hoicka, 2018).

2.8 Step-Zero Analysis

Step-zero analysis (SZA) is “a form of inquiry used to examine governance tools or development approaches to understand the underlying factors hindering their implementation” (Lowery et al., 2019). It is particularly concerned with the pre-implementation phase of any development intervention (Chuenpagdee et al., 2013). Its analysis is focused on understanding the existing conditions, drivers, and processes before the inception of a development initiative (Barragan-Paladines & Chuenpagdee, 2017; Chuenpagdee et al., 2013). The approach contends that the conditions and actions that precede any development have a significant impact on what happens afterward (Chuenpagdee & Jentoft, 2007).

SZA was first used in the fisheries governance sector, particularly in marine protected areas (see Barragan-Paladines & Chuenpagdee, 2017; Chuenpagdee et al., 2013). For example, Olson (2011) used the approach to examine the steps, processes, and interactions between and among fishery stakeholders in the Bay of Islands area in Newfoundland that preceded a discussion around the voluntary closure of a snow crab fishery in 2010. However, its applicability has been extended to other resource government and local economic development spheres. For instance, Lowery et al. (2019) adapted the theory to analyze asset mapping initiatives in rural Newfoundland and Labrador (NL).

Typically, in conducting SZA, the focus is largely on finding answers to the "how and by whom types of questions; i.e., who got the idea in the first place, who initiated the process, and in what way," etc. (Chuenpagdee & Jentoft, 2007, p. 659). Consequently, the practice tends to examine stakeholders' perceptions through interviews and/or focus group discussions in addition to document and media reviews (Lowery et al., 2019).

2.9 SWOT Analysis

SWOT is an acronym for strengths, weaknesses, opportunities, and threats. SWOT analysis is a strategic planning tool that is usually employed by decision-makers to evaluate both the internal and external enabling and hindering factors that impact an organization's activities (Cayir et al., 2018; Phadermrod et al., 2019; Sammut-bonnici & Galea, 2017). It is a brainstorming exercise to aid high-level decision-making (Phadermrod et al., 2019). Thus, the goal for conducting a SWOT analysis is to ascertain sound bases for designing appropriate strategies that maximize strengths and opportunities while minimizing weaknesses and threats (Cayir et al., 2018).

SWOT analysis is widely used and praised for its simplicity; however, it is criticized for being overly subjective (Phadermrod et al., 2019). There is no clear-cut approach to conducting a SWOT analysis. However, the process entails a careful identification, organizing, and assessment of the strengths, weaknesses, opportunities, and threats of an organization or the issue being considered (Cayir et al., 2018; Phadermrod et al., 2019; Yuan, 2013). It is mostly approached in two broad ways: (1) identifying and outlining the internal factors (i.e., strengths and weaknesses) and external factors (i.e., opportunities and threats); and (2) designing strategies by using the identified strengths to maximize the opportunities and using both (i.e., strengths and opportunities) to minimize or overcome weaknesses and threats (Cayir et al., 2018).

Although SWOT analysis is popular in business management, it has been used in almost every sector of decision-making (see Ming et al., 2014; Phadermrod et al., 2019; Yuan, 2013). Its scope transcends an individual organization’s environment; it is sometimes used to assess broad developmental interventions—projects, programs, etc.—that impact larger populations and jurisdictions (see Cayir et al., 2018; Yuan, 2013). For example, Ming et al. (2014) used the tool to assess the effectiveness of carbon capture technologies in reducing carbon emissions in China. Also, Cayir et al. (2018) used the approach to evaluate energy planning strategy and priorities in Turkey.

In this study, elements of SWOT analysis support the approach to broadly understanding all the factors impacting or capable of impacting the success and persistence of the Ramea wind energy projects. Thus, the technique is not used to inform planning decisions nor develop strategies to address any issues found, but mainly to identify and examine the projects' strengths, weaknesses, opportunities, and threats to form lessons for future developments and research.

2.10 Summary and Relevance for Study

Although rural areas typically continue to lose population in Canada (Christopher Barrington-leigh & Ouliaris, 2017) and across the world, largely to emigration, they continue to play key roles in the overall socio-economic development of broader society, including both rural and urban areas (Atkinson, 2020; Lisiak et al., 2017). Their resilience to the issues of climate change and declining populations are of utmost importance to both local and higher-level governments. And the relevant literature recognizes the importance of ensuring access to affordable, reliable, and clean energy (generally termed as sustainable energy) in these off-grid areas (Karanasios & Parker, 2018; Vezzoli et al., 2018).

Energy researchers are praising the potential of SSRE that is community-focused or community-led. SSRE is not only seen as an effective approach to reducing carbon emissions, but the ideal form of energy capable of promoting the realization of local sustainability goals in off-grid areas, if the community is engaged in the entire process of development, implementation, and maintenance of such initiatives (Jami & Walsh, 2014; Karanasios & Parker, 2018; Wyse & Hoicka, 2018).

Efforts to wean off the dependence on diesel generation in off-grid communities in NL led to the sanctioning of 2 research and development wind projects in the community of Ramea, one of the off-grid, rural communities in the province. The projects are small-scale, per the description in section 2.4 above — i.e., the first project has a total capacity of 390 kW, and the second 300 kW— and are championed by two different organizations outside the community, with Ramea being a beneficiary. My review on how the local community of

Ramea was engaged in the project did not find adequate information in the literature in that regard. Hence, I seek to address this knowledge gap by subtly using SZA to ascertain and report on the various ways and forms the community has been or is being engaged by the project leaders in the affairs of the projects. Again, the available literature reveals that the Ramea projects are unique in the context of renewable energy development in off-grid communities in Canada and across the globe, offering a great and interesting case to learn about their (the projects') strengths, weaknesses, opportunities, and threats. Highlighting the key enabling and militating factors to the development and operation of the Ramea projects will broaden the literature in this regard. And as research and development initiatives, with the overarching goal of testing and ascertaining effective ways of providing SE and reducing diesel usage in off-grid areas, this research will help broaden the current literature by highlighting some of the key lessons from the Ramea case, which can contribute to cataloging "best practices" to achieving future SE goals in off-grid areas in NL and beyond.

Chapter 3. Study Context, Methodology, and Methods

3.1 Introduction

This chapter describes both the geographical and contextual scope of the study. It provides broad highlights of the nature of renewable energy development in Newfoundland and Labrador (NL), focusing specifically on the Ramea wind energy project in the context of small-scale renewable energy developments in off-grid communities. The chapter also gives a detailed account of the methodology adopted for the study, the data collection and analysis methods employed, and reports on the other related activities undertaken to complete the research (including preliminary research conversations with key informants, ethics, and pandemic approvals, among others.).

3.2 Newfoundland and Labrador in Perspective

NL is the easternmost province of Canada and the easternmost jurisdiction of North America other than Greenland (Newfoundland and Labrador Tourism, 2021)—see Map 1 below. It is the newest province in Canada after joining Confederation in 1949 (Government of Newfoundland and Labrador, 2018).

Map 1. Newfoundland and Labrador

Source: Encyclopedia Britannica, 2004

The province shares boundaries with Quebec, New Brunswick, Prince Edward Islands, and Nova Scotia to its west and southwest (Encyclopaedia Britannica, 2004). The physical environment of NL is made up of an amalgamation of two different geographical components: the island of Newfoundland and the Labrador mainland, which are separated by the Strait of Belle Isle (Bell and Liverman,1997; Newfoundland and Labrador Tourism, 2021). In terms of size, NL has a total land area of 405,720 square kilometers. According to the Newfoundland and Labrador Statistics Agency (NLSA), the population of NL was estimated at 520,438 persons as of the first quarter of 2021 (Newfoundland and Labrador Statistics Agency, 2021). Although the Labrador region has 72.5 percent of the land area of the province, it contains only 5.3 percent of the population (Newfoundland and Labrador Heritage, 2013).

3.3 Highlights of Renewable Energy Resources Development

The province has a rich environment of abundant and diverse natural resources, including energy resources. NL boasts of vast oil, wind, and hydro resources, among others (Government of Newfoundland and Labrador, 2021). According to the Canada Energy Regulator (2021), NL's oil production was at 243.7 thousand barrels a day, constituting 5 percent of Canada's overall production, in 2018. The province is the largest producer of crude oil in Eastern Canada and ranks third in the whole of the country behind Alberta and Saskatchewan respectively (Canada Energy Regulator, 2021). Regarding wind resources, NL is amongst the jurisdictions with the strongest potential for wind energy production in North America (Mercer et al., 2017). A spatial analysis of the renewable energy landscape in Canada revealed that NL has the potential to produce about 530 terawatt-hours (TWh) per year from wind energy, capable of meeting about 20 percent of Canada's energy demands in 2010 (Chris Barrington-leigh & Ouliaris, 2015).

In 2007, Nalcor Energy, a wholly-owned crown corporation under the Government of Newfoundland and Labrador was created to champion the development of the province's energy resources (Government of Newfoundland and Labrador, 2015). To date, NL is a leading jurisdiction in Canada for the development and export of electricity generated from hydro; it is currently ranked third, generating about 10 percent of the hydroelectricity produced in the country in 2018, behind Quebec at 50 percent and British Columbia at 17 percent (Canada Energy Regulator, 2021; The Canadian Encyclopedia, 2020).

Although NL is a haven for renewable energy resources in Canada, electricity generation is skewed towards hydro, leaving other resources largely undeveloped (Canada Energy Regulator, 2021: Mercer et al., 2017). A recent analysis of the renewable energy landscape of NL revealed that about 94.3 percent of electricity was generated from renewable sources, with hydro consisting of 93.9 percent and the remaining 0.4 percent constituting wind and biomass (Canada Energy Regulator, 2021).

3.4 An Overview of the Electricity Sector in Newfoundland and Labrador

The energy ecosystem in NL is mostly "clean" [10] as about 90 percent of the energy portfolio is produced from renewable sources (Mercer et al., 2018). The province generates its energy from different but complementary generating systems including "9 hydro, one oil-fired thermal plant, 4 gas turbines, and 25 isolated diesel-generating and distribution systems" (NL Hydro, 2020). And the majority, about 80 percent of the total energy generated from these generation systems, is from hydroelectricity (NL Hydro, 2020).

Although NL is a forerunner in the development of renewable energy in Canada (Mercer et al., 2018), several areas in the province are still relying on "unclean" sources—primarily diesel generations—to serve their energy needs. These areas are known as *off-grid* (or remote) communities, which according to Natural Resources Canada includes "any permanent community of at least 10 dwellings not connected to the North American grid nor the piped natural gas network" (Natural Resources Canada, 2011, p. 3). Currently, there are 27 off-grid/remote areas in NL, mainly coastal communities that are not connected to the IIS (Mercer, 2020 b). The electricity needs of 21 of these communities—6 in the island region (including Ramea, Grey River, Francois, McCallum, St Brendan's, and Little Bay Islands), and 15 in the Labrador region—are exclusively served by diesel generation plants that are owned and operated by NL Hydro (Government of Newfoundland and Labrador, 2015, p. 41; NL Hydro, 2014).

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[10] Clean energy is a term without an explicit definition that is often used synonymously with renewable energy. It primarily describes energy sources whose production and utilization do not emit greenhouse gas or other pollutants (see Chariot Energy, 2020). The North Carolina Sustainable Energy Association (NCSEA) identifies three components of clean energy: 1. energy sourced from renewables, 2. energy sources that do not emit greenhouse gases, and 3. energy systems that save energy through energy efficiency programs (NCSEA, 2021

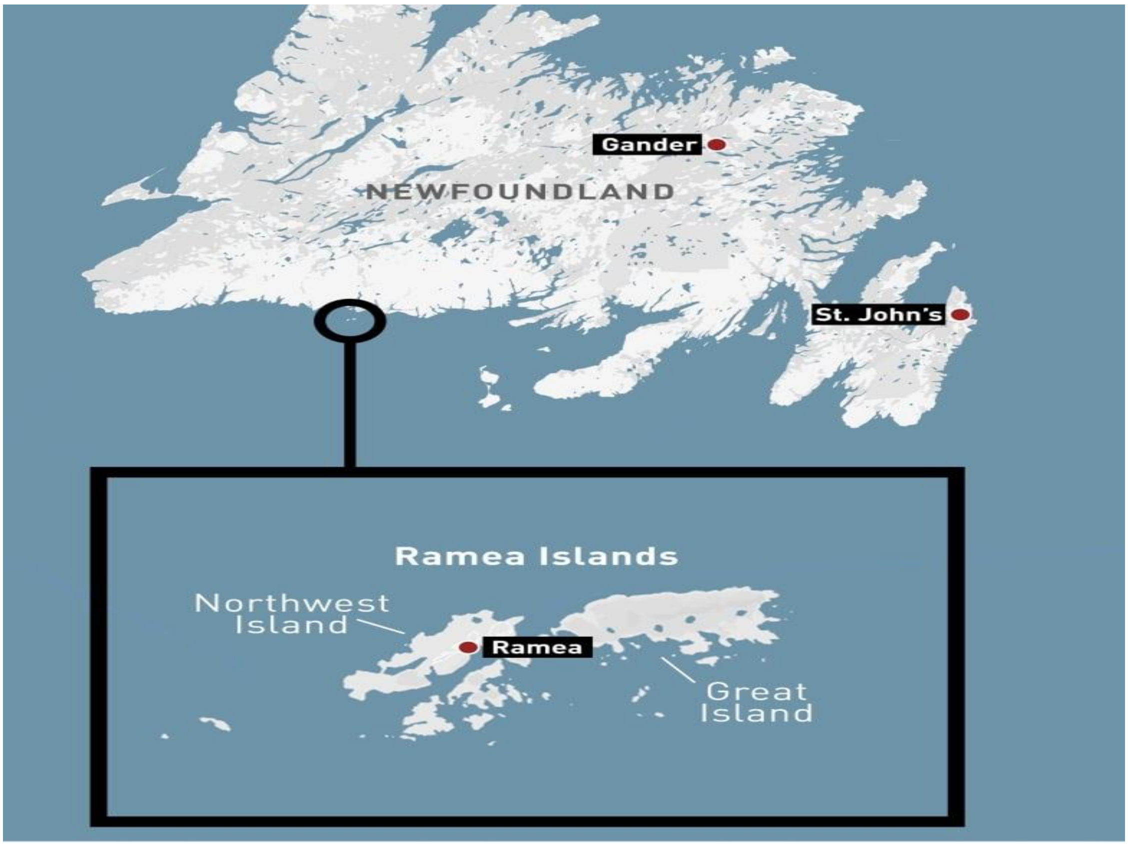
3.5 Small-Scale Renewable Energy Development in NL: Ramea Wind Energy Projects in Perspective

SSRE developments in NL have not received much attention despite the huge potential available in terms of the abundant renewable energy resources (Mercer et al., 2017). However, SSRE's relevance in ensuring access to sustainable energy in off-grid remote areas cannot be overemphasized (see Vezzoli et al., 2018). There is a recognized need for SSRE development in off-grid communities in NL as diesel generating systems are not desirable alternatives for both energy producers and consumers. In addition to carbon emissions, the cost of operating these isolated diesel generating systems is expensive for energy producers. Also, it is not cost-effective for energy producers and/or distributors to connect these areas to the main grid (see Government of Newfoundland and Labrador, 2015).

At the community level, off-grid communities are faced with several issues of energy security and sustainability. A study by Mercer et al. (2020 b) in some remote communities in Labrador revealed that apart from valuing the socio-economic contributions of diesel-generation systems, there are concerns of oil-spills risks and environmental degradation among residents. Again, issues of heat insecurity and the fact that energy systems are controlled by external factors are major concerns, the study found. The Ramea WEPs remain key reference points regarding SSRE developments in NL.

3.5.1 The Ramea community

The Ramea islands (see Map 2) are a small archipelago located off the southwest coast of the Island of Newfoundland (Explore NL, 2010). The archipelago consists of 5 major islands, namely "Northwest Island, Great Island (or Big Island), Middle Island, Harbour Island, and Southwest Island" (Explore NL, 2010). However, people—a settler population—only inhabit the northwest island(Town of Ramea, 2020). Accessibility to the community is only by ferry from Burgeo on the main Island of Newfoundland, which is about 20km away from the ocean (Global Islands, 2020).



Map 2. Ramea in the Context of Newfoundland and Labrador

Source: CBC News, 2020

As a coastal town, the fishery has been the mainstay and the driver of the community's local economy since its incorporation in 1951 (Global Islands, 2020; Town of Ramea, 2020). However, the infamous cod moratorium in 1992 adversely impacted the local economy as it led to the closure of the town's only fish processing plant, which was a major employer for the community of about 1,120 residents in the 1970s (Global Islands, 2020). Since then, the community has struggled to maintain its population numbers, which keep declining. According to Statistics Canada, the Town's population declined by more than half to 526 in 2011 and even further to 447 in 2016 (Statistics Canada, 2016; Town of Ramea, 2020).

Ramea is one of 6 off-grid communities on the Island of Newfoundland and among the total of 21 in the entire province, that are not connected to the IIS as mentioned earlier Not long ago, the town depended exclusively on an isolated diesel generation system for their electricity needs and relied on furnace oil and wood to heat their homes, especially during the winters (Iqbal, 2009). However, the development of a wind energy project in the early 2000s (changed the community's energy narrative (NL Hydro, 2007).

3.5.2 The Ramea Wind Energy Projects and Justification of Study

In recent years, unlike most other off-grid communities in NL, Ramea has gained some popularity in the energy discourse both provincially and federally. In 2004, FPS[11] with support from the federal and provincial governments, piloted a wind-diesel research project in Ramea as part of steps to reduce and gradually phase out the reliance on diesel generation using small-scale wind technologies (Frontier Power Systems, 2003). The project saw NL Hydro enter into a power purchase agreement with FPS who installed, own, and manages six 65-Kilowatt (kW) wind turbines on the Ramea islands (Frontier Power Systems, 2003). Under the agreement, NL Hydro buys, and integrated electric power produced from the six wind turbines into their existing diesel system, aiming to displace some of the energy produced from the diesel plants, especially during peak demand periods in winter (Frontier Power Systems, 2003; Jones, 2008; Nalcor Energy, 2010). Towards the end of the pilot exercise, it was projected that about 10 percent of the total electricity used by customers on the islands was produced from wind turbines (Frontier Power Systems, 2021), displacing unclean energy that would otherwise have been produced from only the diesel generation system.

[11] Frontier Power Systems (FPS) is a private energy developing company who are specialised in the designing, installation, and management of renewable energy solutions for remote areas. The company is based in Georgetown, Prince Edward Islands (Frontier Power Systems, 2021).

In addition to the wind-diesel system, another demonstration project was installed to incorporate wind and hydrogen energy generation and storage (Global Islands, 2020; Iqbal, 2009). The Ramea hybrid wind-hydrogen-diesel (WHDP) research and development initiative, sanctioned in 2007, was developed to integrate energy solutions from wind, hydrogen, and diesel to generate environmentally friendly energy that can be used in remote/off-grid communities or isolated distribution systems (Iqbal, 2009). The facility leveraged the successes of the first wind-diesel pilot project commissioned by Frontier Power Systems in 2004 (NL Hydro, 2003).

The Ramea WEPs are considered crucial to clean energy development in remote communities in Newfoundland and across Canada, and as such are popular in the climate change and sustainable energy development discourses both at the provincial and federal government levels.

The Ramea projects are typical examples of a situation where a community is a mere beneficiary of development interventions championed by organizations outside the community. The community's role and involvement in the maintenance and operation of the facilities are not fully known yet. Ramea's only involvement in the projects thus far is recorded in two main instances: 1) their participation in a stakeholder consultation process conducted by NL Hydro at the early stages of the projects' development, and 2) their provision of hired labor during the installation of the projects' infrastructure (Nalcor Energy, 2010). That is, the maintenance and operation of the facility are overseen by NL Hydro staff originally not from Ramea (NL Hydro, 2007b; Nalcor Energy, 2010).

The timing of this study could not be more crucial given that there are currently concerns lingering around the future and sustainability of the project as community stakeholders are expressing anxiety over the non-functioning of some of the installed wind turbines amid increasing electricity rates (CBC News, 2018). Again, the Ramea community’s involvement in the WEPs is largely unknown, yet it is crucial in understanding how off-grid communities contribute to the provision of and access to sustainable energy when engaged in the development, operation, and maintenance of projects championed by organizations outside the community. The growing support for pro-community energy (Hoicka & MacArthur, 2018; St. Denis & Parker, 2009; G. Walker & Devine-Wright, 2008; Wyse & Hoicka, 2018), both in the literature and practice, and increasing access to sustainable energy in off-grid communities further justify the relevance of this study. As a research initiative, the Ramea WHDP project presents a unique opportunity for secondary stakeholders (referring to academia, etc.) to understand all the nuances of the project to better inform future research and development initiatives.

3.6 Methodology and Research Design

The study mainly adopted a qualitative case study approach (see Baxter & Jack, 2008) as a methodology in achieving the objectives set forth. A research methodology, according to Buckley and Chiang (1976, cited in Jamshed 2014, p. 87) is “the strategy used by the researcher to map out an approach to attaining a research objective”. The qualitative research approach employs a set of methods for (a) collecting linguistic data, and (b) establishing “meanings” from the data gathered (see Dey, 2005; Elliott & Timulak, 2005). This research specifically was an interpretive case study (see Bhattacherjee, 2012, pp. 93–102), relying on a single case, where qualitative data was gathered and used to answer the research questions (Dey, 2005).

The relevance of this research approach is duly acknowledged in the literature (see Bhattacherjee, 2012; Campbell et al., 2018; Dey, 2005; Elliott & Timulak, 2005). Qualitative research, as posited by Campbell et al. (2018), is used “to help … in the understanding of some social process or experience” (Campbell et al., 2018, p. 2), and this case how the locals of Ramea were engaged in the development of the Ramea WEPs projects.

Characteristically, this study adopts a grounded theory method (Noble & Mitchell, 2016), as the interest is mainly on gaining new knowledge from the case study, using a variety of data collection methods (Section 3.7). Hence, in the analysis and discussion of findings, caution is taken to avoid over generalization, recognizing that although the findings could be used as a starting point to understand comparable contexts, they might be peculiar to this case study. The next section describes the processes of instrument development, sampling, and data collection—the three key components employed for designing this research as noted by Bhattacherjee (2012, p. 35).

3.7 Data Collection

The nature of the research questions necessitated the use of primary data that was collected from two main sources: interviews and document reviews. Interviews were the main source of gathering the data (qualitative data) due to their potential to unearth in-depth perspectives from study participants. These methods are expounded in the following sub-sections.

3.7.1 Document Reviews

A document review (see Bowen, 2009) was conducted before the interviews. The purposes for undertaking the document review were (a) for “triangulation” reasons (see Olsen, 2004), and most importantly (b) to help in designing the interview instrument by asking the right questions during interviews. The intent was to ascertain all the publicly available information relevant to the research and avoid asking interview participants questions whose answers can be found through published documents and/or articles.

For the document review process, different kinds of documents were gathered and examined to elicit some project-relevant information; these included NL Hydro’s reports, website posts, workshop/seminar presentation materials, media/news articles, and other related documents that are accessible online. The exercise provided insights into the project's background, stakeholders/partners involved with the development and operation, and the current state of the project.

3.7.2 Key Informant Interviews (KII)

Before the interviews, I completed preliminary research conversations with 5 individuals, identified as 'key informants' herein, to help in identifying prospective research participants and the best approaches to engage them to achieve the objectives of the study. These key informants were professional contacts of the researcher and members of the supervisory committee. They included 3 energy researchers who had completed or are currently undertaking research related to energy development in remote areas in NL as well as 1 professor and 1 graduate student originally from Ramea.

Before the conversations, an email invite was sent to 6 individuals, and 5 of them responded affirmatively. During each of these sessions, we discussed the objectives of the study, the research questions, the proposed methods of data collection, prospective participants, and the appropriate approaches for engaging participants. The following key lessons were learned:

1. *Undertaking more community-based interviews:* The plan initially was to only conduct interviews with all (or some of) the key stakeholders of the Ramea projects (i.e., NL Hydro, Government of NL, professor(s) at the Engineering Faculty of Memorial University, Frontier Power Systems, Atlantic Canada Opportunities Agency, Canada Centre for Mineral and Energy Technology (CANMET) Energy Technology Centre of Natural Resources Canada, and community leaders of Ramea). However, some key informants expressed that it would be appropriate to

skew more of the interviews towards the general population of Ramea due to the nature of the research questions.

2. *Embarking on face-to-face interviews*: Also, I initially intended to conduct all interviews virtually or over the phone (using both video and audio calls). Notwithstanding the flexibility this offers, especially during this present COVID-19 pandemic situation, there were concerns raised about the possibility of not being able to gather quality data from the community using this approach due to: (a) absence of a pre-existing researcher–participant relationship and (b) possibility of network problems with cellular connections. I, therefore, decided to pursue face-to-face interviews for all community interviews and maintain the remote interviews for other stakeholders outside the community.

3. *Use of a research assistant (RA):* It was anticipated that conducting face-to-face interviews with the remote community might be difficult for both the researcher and the participants due to the possibility of "accent barriers". Not being able to understand each other's accents could affect communication during interviews and subsequently affect the quality of responses obtained from the field. Hence, we sought the services of an RA from the community to assist with interpretation during the interviews. This also ensured a natural connection for interviewee recruitment, rather than having to rely on "cold call" invitations.

3.7.3 Interviews

The main source of data was one-on-one interviews, comprising face-to-face and virtual interviews. Although this method of collecting primary data has its flaws, it nevertheless was used because of its numerous advantages, including its potential of "unearthing rich and in-depth knowledge of individuals' perceptions, understandings, and experiences on the phenomenon under focus" (Coughlan, 2009, p. 309). Interviews are the most common method used in collecting data in qualitative research (Coughlan, 2009; Elliott & Timulak, 2005; Gill et al., 2008). They are broadly categorized into three forms: unstructured, semi-structured, and structured (see Coughlan, 2009). Of these forms, unstructured and semi-structured forms are widely used (Elliott & Timulak, 2005). This study employed the semi-structured format where an open-ended interview guide was prepared (see Appendix 2) and used for both face-to-face and virtual interviews. The semi-structured format was chosen because it does not restrict the researcher to asking only the questions on the interview guide. That is, it affords the researcher some flexibility to probe and ask relevant questions, when necessary, in the course of interviews. In this case, the format helped in capturing in-depth information regarding the views and experiences of the research participants to aid in answering the research questions. Before using the instrument on the field, it was discussed in a pre-research conversation with key informants.

In the course of preparing for the fieldwork, a research assistant who is originally from Ramea was hired by the supervisor to assist with the interviews. The RA was needed to address a possible communication barrier that could have adversely impacted the interviews and the data quality as highlighted in the KII section above. An audio tape-recorder was also secured to record the interview sessions. As a standard practice in collecting data using interviews, we needed to tape-record the interview sessions to capture all responses of research participants. The recorded files were copied onto my personal computer, renamed (using alphanumeric as a way of ensuring the confidentiality of the research participants), and later transcribed for analysis.

One week was earmarked for completing the face-to-face interviews. The first day was used for traveling to the field from Corner Brook, and the second for “surveying” the community and introducing the purpose of our visit and the research to the community’s leadership. On this second day, the researcher and the RA visited the two sites of the wind turbines—the first six 65 kW turbines that were installed initially and the additional three 100 kW turbines that were added later—and the site of NL Hydro's diesel generation plant. Figures 1 and 2 below show the wind turbines, as was captured by the researcher during the field visit. We also visited other landmarks in the community, including the Man O' War hill—the highest point of the island where one can have a clear and broad view of the whole community and the islands—the St. Boniface school, the museum, the Ramea Voluntary Fire Department, and the fish processing plant, among others. While visiting these places, we made some observations and interacted with some of the community members.

Figure 1. A picture of the six 65 kW Ramea wind turbines

Source: Field visit, April 2021.

Figure 2. A picture of the three 100 kW Ramea wind turbines

Source: Field visit, April 2021.

The rest of the days were used to conduct interviews with the community members; who were sampled purposively, using the snowball sampling technique (see Bhattacherjee, 2012). Research participants were identified with the help of key informants and the RA. The principal investigator planned to conduct 20 interviews—15 community interviews and 5 virtual interviews. However, this goal was not met because many potential interviewees contacted declined to participate in the study.

A total of 8 in-depth interviews were completed in person and virtually between April and July 2021. Five (5) interviews were completed in-person at the community, involving present and retired public servants and individuals from the general population who were directly engaged in some capacity by the developers of the projects. In addition to the face-to-face interviews, 3 interviews were completed virtually with individuals from the proponent organizations and a funding agency. On average, interviews lasted for about half an hour; the longest was 45 minutes, and the shortest was 20 minutes.

Table 1 below provides some general information about the study respondents. On the other hand, Table 2 details the 13 prospective participants who were contacted but declined to participate in the study. Unfortunately, I am unable to provide the exact reasons why individuals decided not to participate because it would not be appropriate to ask for such information. Even so, the low of number responses was somewhat expected, given that data collection started in April, a period when there was a spike in COVID-19 cases in NL. During this period, understandably, individuals tried as much as possible to avoid face-to-face interaction with others, although the primary researcher observed all the protocols outlined for conducting in-person research during the pandemic (and offered the possibility of virtual or telephone interviews).

Table 1: Information on Interview Respondents (n = 8)

Community interview (n = 5)	Interviewee Number	Virtual Interviews (n = 3)	Interviewee Number
Local public servant	1	Manager, public energy corporation	6
Local public servant	2	Executive Director, private energy developing company	7
Retired local public servant	3	Manager, funding agency (Atlantic Canada Focus)	8
Journeyman electrician	4		
Bird enthusiast	5		

Source: Author’s Construct, September 2021

Table 2: Information on Potential Interviewees Who Declined

Potential Interviewee	Number
Energy researcher, public university	1
Federal energy research center	1
Public servants	2
Employee, proponent organization	1
Volunteer, community-based organization	1
Community members	7

Source: Author’s Construct, September 2021.

3.8 Data Analysis

The data analysis stage was characterized by a systematic process of transcribing, organizing, editing, coding, and making deductions from the data gathered from the field (Karen & Bronwynne, 2016; Vaismoradi et al., 2016). Specifically, the thematic analysis technique (see Vaismoradi et al., 2016; Vaismoradi et al., 2013) was employed to analyze the data gathered from both interviews and document reviews. Thematic analysis is commonly used to describe the "method of identifying, analyzing and reporting patterns [or themes] within data" (see Vaismoradi et al., 2013, p. 400). First, all recordings were transferred onto the personal computer of the researcher and renamed alphanumerically. For instance, the recordings for interviews with the community members were named CI1, CI2, CI3, and so on. And those conducted virtually were named VI1, VI2, VI3, etc. The recordings were transcribed manually with the help of a media player (that was used to play the recordings) and MS Word (used to type the content of the recordings), all on the personal computer of the researcher.

The coding (Dey, 2005) of the data process was done manually, employing the thematic analysis technique, as highlighted afore. Transcripts were read and examined individually to understand and note key concepts elicited from the interviews. Then, using themes generated from both the transcripts and the interview guide, some specific responses of interviewees were categorized into specific codes (see Bhattacherjee, 2012), which formed the basis on which deductions were made. For instance, "forms of community engagement", "strengths and opportunities", and "weaknesses and threats" were themes generated from the interview guide. and "details of the Ramea projects" and "lessons for future WEPs" were themes derived from the interview guides and document reviews.

3.9 Ethics and Pandemic Approvals

Before the start of the interviews, this research underwent both ethics and adherence to public health guidelines reviews to ensure the exercise was conducted ethically and within public health recommendations during the present global COVID-19 pandemic.

The proposal for this study was submitted for review to the Grenfell Campus Research Ethics Board and was approved and found to comply with Memorial University's ethics policy (see Appendix 1). The requests to undertake fieldwork as well as to conduct face-to-face interactions amid the current health crisis were sought from the Grenfell Campus Environmental Health and Safety unit (see Appendices 5 and 6). As part of the process, health and safety plans were drawn up to ensure that the fieldwork and face-to-face interviews were conducted within public health recommendations and did not expose the researchers and/or participants to undue COVID-19 risks.

Chapter 4. Results and Discussion

4.1 Overview

The Town of Ramea and the Ramea WEPs have a national significance in Canada, in the context of earlier efforts in the development of renewable energy in the country's remote and off-grid communities. "Ramea was chosen as the site of Canada's first wind-diesel demonstration project" (Frontier Power Systems, 2021), an initiative developed as part of steps to transition from the reliance on diesel to renewable energy alternatives to produce electricity in off-grid communities (Frontier Power Systems, 2003 a). In addition to this project, another research project in Ramea was later sanctioned by a different proponent, leveraging on the successes of the former, to experiment with ways of storing wind energy in the form of hydrogen, which can be used later to generate electricity when needed (NL Hydro, 2007; Rowland and Gaede, 2019). Therefore, there are two WEPs in Ramea owned by two separate entities that are working together to test how best wind energy can be generated, stored, and used to gradually phase out the use of diesel to generate electricity in off-grid communities, especially in Newfoundland and Labrador (NL).

In this chapter, I first provide a detailed description of the two projects by looking at the rationale for their implementation, how they operate, their current state, etc. I move on to explore how the proponents of these projects engaged the Town of Ramea throughout the life cycle of the projects. I proceed therefrom to highlight the key strengths and opportunities of the projects and conclude by examining the weaknesses and threats for the projects as well. To achieve this, I largely use data from the documents reviews to complete the early sections of this chapter, and data from the interviews to complete the latter sections. The sub-sections under each of the sections are themes that emerged from the qualitative analysis process.

4.2 Introduction to the Ramea Diesel System

The diesel generating system was the sole provider of energy to Ramea before the introduction of the Ramea wind-diesel project (WDP) and the Ramea wind-hydrogen-diesel project (WHDP). It remains the main source of power for the community, which the various stakeholders are working to change. From the interviews, it was learned that the system consists of 3 diesel engines, each with a capacity of 925 kW, which were installed in the early 1990s. These engines are noted to be too large for the relatively smaller load in Ramea.

According to interviewee 6 from one of the proponents of the WEPs, the engines were installed during a period the community needed a large load to support its population and the big fish plant that was operating. The interviewee noted that after the cod moratorium in the province, the community was heavily affected when the fish plant was shut down. Since then, the population of the town keeps declining, and so does the load requirement. Consequently, as revealed from the interviews, the diesel engines are currently operated at their lowest capacity levels, implying that the Town does not need additional sources of energy. Although the capacity of the diesel system is enough to serve the energy needs of Ramea, the desire to replace diesel with cleaner alternatives, not only in the community but NL in general, led to the sanctioning of the WEPs.

4.3 Introduction to Ramea's Wind-Diesel Project: "Canada's First Wind-Diesel Demonstration Project"

The first wind-diesel test project (WDP) in Ramea and Canada was championed in 2004 by Frontier Power Systems (FPS)—a privately owned firm located in Georgetown, Prince Edward Island, Canada, which deals in the designing, building, and installation of renewable energy systems in remote areas (Frontier Power Systems, 2021). The proponent partnered with Natural Resources Canada (NRCan) and Atlantic Test Site Inc. (Now Wind

Energy Institute of Canada) and also worked closely with NL Hydro in the execution of the project (Frontier Power Systems, 2003 a). In terms of its capacity, the project consists of six 65-kilowatt (kW) wind turbines with a total capacity of 390 Kilowatt (kW). FPS owns the system and led its design, funding, installation, and operation. (Frontier Power Systems, 2003). This project was designed as a "medium penetration wind-diesel application" (Frontier Power Systems, 2003 a, p. 3), implying that the diesel engines would continue to run as a primary source of power to the community, with the energy produced from the wind turbines only displacing some amounts of diesel from being used (Frontier Power Systems, 2003 a).

Stakeholders of the project sought to leverage the success of wind energy technology around the globe to produce clean energy, addressing the environmental concerns associated with the use of diesel for electricity generation (Frontier Power Systems, 2003 a). Being the first wind-diesel demonstration project in Canada, the project was the "first to use the Wind-Diesel- Integrated Control Systems (WDICS) technology that was developed by Canada's Wind Testing and Development Program at the Atlantic Wind Test Site" (Frontier Power Systems, 2003a, p. 4).

As part of the project's design and operation arrangements, FPS entered into a power purchase agreement with NL Hydro. The agreement allowed the company to produce and sell the power to NL Hydro, which is in charge of providing reliable power to the Ramea community and other similar off-grid communities in the province (Frontier Power Systems, 2003 a). NL Hydro integrates the power purchased from the company's wind turbines directly into the Ramea electricity grid, which relies on three 925-kW diesel generators to produce electricity for the Town (Nalcor Energy, 2010).

Since its inception, this pioneering project has contributed to meeting about 15 percent of Ramea's energy needs with clean and sustainable energy. Each year, it successfully displaces around 375 tonnes of emissions from diesel (Frontier Power Systems, 2021). To build on the successes of this project, NL Hydro commissioned another project in Ramea, seeking to further displace more diesel generation in the community and other off-grid communities in the province (NL Hydro, 2007) as described in the next section.

4.4 Introduction to Ramea's Wind-Hydrogen-Diesel Project: "A Novel Hybrid System in the World"

The second wind-diesel test project in Ramea was a wind-hydrogen-diesel (WHDP) project. It was a five-year research and development initiative championed by NL Hydro in partnership with Natural Resources Canada (NRCan), the Government of Newfoundland and Labrador (GNL), and the Atlantic Canada Opportunities Agency (ACOA) as a step toward eradicating the use of diesel generation by increasing wind generation and storage on the existing Ramea's grid (NL Hydro, 2007). NL Hydro also worked with the Engineering Department of the Memorial University of Newfoundland and the Sustainable Power Research group of the University of New Brunswick (NNL Hydro, 2007). Partners of the project provided either technical or financial contributions to NL Hydro. For instance, ACOA provided funding and NRCan provided the hydrogen generating equipment (NL Hydro, 2007; Windpower Monthly, 2007).

The project is unique as it employed an innovative technology that had not been used anywhere else in the world at the time (NL Hydro, 2007; Windpower Monthly, 2007). As a typical hybrid project (see Mohammed et al., 2014), it was designed to combine three different components—wind, hydrogen, and diesel—to produce and store enough wind energy to offset more diesel from the Town's electricity grid. Its uniqueness lay in its design to store excess energy produced from the wind in the form of hydrogen that would be used to generate electricity during periods of high energy demands and low winds (NL Hydro, 2007).

The project was scheduled to begin operation in the Fall of 2007 and run until 2011 (NL Hydro, 2007). However, interviewee 6 noted that the project started in 2008 and ran until 2011 due to delays and technical challenges with some project equipment respectively. These issues, as noted by the interviewee, resulted in the shut-down of the hydrogen component of the project.

According to the same interviewee, the proponent organization designed Phase II of the project that sought to address the technical challenges of the hydrogen component with better technology, as part of efforts to get the system back working. However, due to other broader energy-related issues faced by the organization, that phase of the project was never implemented. The interviewee intimated that although there is nothing wrong with the additional wind turbines that were installed to support the hydrogen part, they are rarely being used because the energy produced therefrom is not needed on the Ramea grid. Hence, the research project has since been discontinued.

4.5 Details of the Ramea Wind Projects: Rationale, Technical Descriptions, and Operational Details

The issues associated with the reliance on diesel for generating electricity are well known and duly established (see Government of Canada, 2011; Karanasios & Parker, 2018). As a result, almost all energy-generating or providing stakeholders in NL are keen on identifying ways to reduce and eventually eliminate the usage of diesel to produce electricity (Frontier Power Systems, 2021; NL Hydro, 2007). And, just like most hybrid projects (see Karanasios & Parker, 2018), the primary objectives of both the Ramea WDP and the Ramea WHDP were to ascertain ways to gradually phase out the reliance on diesel for electricity generation in off-grid communities, in NL in this case (Frontier Power Systems, 2003a; NL Hydro, 2007). However, each of these projects had some specific objectives that they sought as described in the sub-sections following.

4.5.1 The Rationale of the Ramea Wind-Diesel Project

Frontier Power Systems set three basic objectives for the WDP. All these objectives focused on ascertaining the technical feasibility of the technology to be tested, with little to no interest in cost-effectiveness (Frontier Power Systems, 2003). The firm sought to:

> -"demonstrate, at low risk to the utility, that wind power is technically viable for use with diesel generators in isolated communities",
>
> -"establish a reference project that can be used to study wind-diesel operational issues and to evaluate advanced technologies as they become available", and
>
> -"provide project developers with the practical experience to enable the replication of similar projects with an improved economy" (Frontier Power Systems, 2003a, p. 2).

4.5.2 Technical and Operational Details of the Wind-Diesel Project

The infrastructure of the WDP includes six 65-kW wind turbines, comprising a 390-kW-capacity wind plant, as well as distribution lines and transformers. These pieces of equipment were installed and are being operated by FPS (Frontier Power Systems, 2003a).

The project is operated using the "Wind-Diesel-Integrated Control Systems" (WDICS)[12] technology (Frontier Power Systems, 2003a). The project's 390-kW capacity wind plant is connected to NL Hydro's electricity grid for the community. By using weather information, the WDICS technology conditions "the wind turbines to operate when the winds blow at a speed between 5 m/s to 22 m/s—the operation range of the turbines"

[12]The Wind-Diesel-Integrated Control System is designed to integrate wind turbines with diesel generators commonly used in isolated communities. The technology was developed by Canada's Wind Testing and Development Program at the erstwhile Atlantic Wind Test Site, now known as the Wind Energy Institute of Canada (Frontier Power Systems, 2003).

(Frontier Power Systems, 2003a, p. 2). Energy generated is fed directly into Ramea's electricity grid (Frontier Power Systems, 2003a).

4.5.3 Rationale of the Ramea Wind-Hydrogen-Diesel Project

The proponent organization invested in the Ramea WHDP purposefully to expand on its expertise in renewable energy alternatives and their integration into the organization's existing generation systems (NL Hydro, 2007). The main objective for embarking on this WHDP demonstration project was to test and obtain cost-effective ways of using the province's abundant wind resources to gradually transition from reliance on diesel (Rowland and Gaede, 2019). Taking advantage of the existing wind farm in Ramea and the relationship with Frontier Power Systems (NL Hydro, 2007), the project's proponent added more wind generating equipment and developed and incorporated the hydrogen component to generate and store enough wind energy to meet the energy needs of the community all year successfully and cost-effectively round (NL Hydro, 2007; Rowland and Gaede, 2019). Commenting on the rationale for embarking on this project, respondent 6 explained:

> [Our organization] has 20-ish remote communities that use 'diesel generation' as the main source of power generation. So, we are trying to find ways to use wind energy and some sort of energy storage to offset our diesel use… In Ramea, there was a small wind farm put in place in [2003] by a company called Frontier Power Systems… We looked at that and thought it was a potential, but we did not feel there was enough penetration [of RE on the system], and we were still relying so much on diesel. So, we decided to look at ways to offset the diesel even more. And the only way to do that is to have some kind of energy storage system.

In addition to finding a sustainable and cost-effective way of providing clean energy to its off-grid communities, it was also anticipated that the project would make NL Hydro a global leader in using state-of-the-art technologies in addressing energy challenges in off-grid remote areas. During the launching of the project in 2007, NL Hydro's leadership indicated that "upon being successful, the project would place NL Hydro as a leader in the electricity industry of Canada and North America regarding its ability to design and implement innovative renewable energy systems to serve off-grid areas" (NL Hydro, 2007). This recognition meant that the technology was a potential revenue-generating opportunity for NL Hydro in the long term. In one of my interviews in Ramea, respondent 3 recalled that NL Hydro mentioned during one of their meetings with the community that they were looking to sell the technology to others once it was proven successful.

Although the hydrogen component of the project is shut down, NL Hydro was successful in designing the control system technology that allowed all the different components of the project to work harmoniously together. Again, respondent 3 opined, "NL Hydro developed the control system that is working just fine. The system is managing the energy output in Ramea. And it tells the wind turbines when to turn on, and when to turn off'.

4.5.4 Technical and Operational Details of the Wind-Hydrogen-Diesel Project

The hybrid WHDP combined three different energy-generating systems—wind, hydrogen, and diesel—to function as one system. Its infrastructure is comprised of the various assets that support the operation of each of these components and the entire system. However, since it was built onto the existing diesel and wind-diesel projects, the project only installed the needed equipment to enable the operation and integration of the hydrogen component. The proponent organization procured the hydrogen electrolyzer, hydrogen storage tank, and additional three 100-kW wind turbines. The hydrogen generating unit—an internal combustion engine—was provided to the proponent by Natural Resources Canada to start the project (NL Hydro, 2007). In addition, the proponent procured some commercially available pieces of equipment and used them to design a control system technology— an energy management system (EMS)— that would be used to harmonize the operation and successful integration of the three different components of the project. Hence, the EMS and WDICS technologies would work complimentarily to ensure a smooth harmonization of the WDP and the WHDP.

These pieces of equipment were combined to generate more wind energy, store the excess wind energy in the form of hydrogen, and produce electricity from the stored hydrogen during periods of low winds and higher energy demands. Specifically, the three 100-kW turbines installed by the project added a 300-kW capacity of wind energy to the Frontier Power Systems' existing 390 kW capacity, increasing the total wind capacity to 690 kW, which would be adequate to meet the majority of the power needs of the community, which averages between 350 KW to 610 KW per day (Iqbal, 2009). At that capacity, "the wind plants would be able to provide about 70 percent of wind penetration [i.e., around 70 percent of Ramea's electricity would come from wind]" (NL Hydro, 2007, 6). The hydrogen electrolyzer was configured to use electricity generated from the wind turbines to split water into hydrogen and oxygen, and the hydrogen was compressed and stored in the hydrogen storage tanks for later use (NL Hydro, 2007). Finally, the hydrogen combustion engine was used to burn the hydrogen to produce electricity during periods of high energy demand and when the wind is not blowing strong enough to run the wind turbines (NL Hydro, 2007).

The proponent organization developed the EMS that allowed the wind turbines, hydrogen generators, and diesel engines to communicate with one another. The technology operates using real-time information on the energy demands of the Town, together with the available weather conditions. It primarily controls when the wind turbines, hydrogen generator, or diesel engines should be on or off. This is described in the extract below from interviewee 6:

> The plan was really to develop a control system that would make all that equipment talk to each other. So, the intent was to buy commercially available equipment and use our expertise to develop a control system that will make the equipment talk to the diesel generator... So basically, by taking the weather conditions and system

> conditions of the town, we would say at this hour of the day, the wind is blowing, so let's turn on our digital engine back and use our wind generation. And when the conditions change and the winds are not blowing, we would then turn on the hydrogen internal combustion engine generator.

4.6 The Current State of the Ramea Wind Projects

Currently, the Ramea WHDP is not operating. It has been shut down due to technical challenges, and the proponent organization is in the process of decommissioning the project's assets from the site, as revealed by the interviews. According to interviewee 6, the organization faced all sorts of issues with the hydrogen internal combustion engine that was used to run the project. It was said that the organization had spent a lot of resources, trying to fix it, but could not get it to work as needed. So, the company had secured funding and decided to change that faulty hydrogen engine with hydrogen fuel cells in a planned Phase II of the project in 2012. However, they could not proceed with that because of other challenges, which diverted the attention of the organization from the research project to concentrate on their primary mandate of providing clean and reliable power to the entire province.

The company had to deal with issues on the main grid (which serves the majority of the province), including 'Dark NL' that was "characterized by intermittent power outages that left tens of thousands of individuals in darkness in the middle of winter" (see CBC News, 2014). As expected, interviewee 6 noted that the company had to put resources into addressing those province-wide issues to ensure the reliability of the grid. It was indicated that Ramea did not have any issues with its grid and the generation at the demonstration site was not required to serve the needs of the community. As such, the company had to shift its focus away from the Ramea project and concentrate on bigger and more pressing challenges. It was also revealed during the interview with respondent 6:

> Our company had all kinds of issues—entire jurisdictional problems... So, the company's resources were put towards issues that will ensure the reliability of the grid. And the Ramea project was a research and development project, and the generation down there was not required to meet the load of the community—the diesel engine was meeting all the load of the community.

The WDP, however, is still operating to date. And the proponent organization is currently looking to upgrade the project (Frontier Power Systems, 2021; The Guardian, 2021). As highlighted earlier, this project currently meets about 15 percent of the Town's load, displacing an equal amount of diesel that would have been used to serve the community's needs every year (Frontier Power Systems, 2021). The proponent organization is proposing 'Ramea 2', an initiative that will increase the capacity of the wind energy they produce to be able to offset about 50 percent of the diesel used in the community yearly (The Guardian, 2021).

4.7 Community Engagement for the Ramea Wind Projects

The importance and relevance of community engagement in development initiatives have been duly recognized (see Colvin et al., 2016; Ojha et al., 2016). From the interviews, it is clear that the proponents purposefully worked collaboratively with the community to achieve the following: (1) to obtain the community's acceptance, (2) to empower the community, and (3) to establish a lasting relationship with the community—the three main goals of community engagement as identified by Colvin et al. (2016) and Walker (2011).

Commenting on the importance of community engagement, interviewee 6 stressed, "We tried to keep the community involved and engaged, and it seemed to work. For me, it is very critical because they could have caused us a lot of problems if they wanted to". Respondent 7 from the other proponent organization posited, "I believe that the projects are unlikely to work reliably unless someone locally really cares that they worked". These excerpts from the interviews reveal how the project owners attached importance to the community's involvement and the extent to which that could impact the successes of the projects. Essentially, and just like many other WEPs, the project owners sought to obtain "the social license to operate" (see Hall, 2014, p. 220), which guarantees "social acceptance" and avoids any conflict (Colvin et al., 2016) in the course of the implementation of the project in the community.

The study revealed that Ramea as a community was and is still being engaged in several different forms and varying degrees by the proponents of the WEPs throughout the different phases. I learned that community consultation, community dialogues, information sharing, responding to community concerns, employment of some community members, community education, community training, and community support were all forms in which the town was engaged. Soon, the community might be engaged as part-owners of the Ramea 2 project when it is implemented. These engagement forms conform to Jami & Walsh's (2014) framework for conducting effective community engagement. Jami & Walsh argue that an effective community engagement (a) identifies and assesses stakeholders, and (b) uses appropriate public participation models to engage the stakeholders in the key phases of the project. All these diverse strategies employed by the projects' proponents in engaging the community are elements of effective public participation and are among the core features of a successful community engagement approach (see Centers for Disease Control and Prevention, 2011; Colvin et al., 2016).

4.7.1 Continuous Community Consultation and Dialogue

As highlighted in the preceding section, community consultation and dialogue were revealed as key practices employed by the projects' proponents to engage the community. During our interaction with interviewee 3 from the Town, it was said, "everything was a very collaborative process; that's the way I see it". The same participant recounted, regarding the first lot of wind turbines, "the President of Frontier Power [Systems] approached the community, wanting to set-up small wind farm on the island as a demonstration to develop and fine-tune wind generation, and inject it into the diesel system".

When asked how the community was engaged in the projects' activities interviewee 1from the community noted, "it was the consultation and the continuous dialogue between all parties. Like, there was nothing done that was not discussed with the council". Regarding the hydrogen integration project, interviewee 2 from the Town recalled:

> The personnel from Newfoundland Hydro who run the power and the gentleman who owns the other system came in the beginning and met with the town council. [They] had public meetings as well at the community center to reveal the project. [And] gave details to everyone in town and everyone who wanted to attend. And asked for the go-ahead from the town before any of this was put in place. So, they consulted with everybody.

These extracts above confirm that there was a continuous consultation and dialogue between and among the projects' leaders and the community. The town council, in particular, was informed or involved in almost every activity undertaken regarding the projects. Respondent 6 indicated, "we sent out newsletters to the community, regular mail out and news updates on the state of the project and the next project activities. We kept them engaged as much as we could". The town was not only being kept informed but their inputs and suggestions were also welcomed and incorporated during the initial phases of installing the wind farms. "We were continually being informed as to what was happening and asked our opinion on different things like placement of the turbines—where they could set them up and things like that", interviewee 3 reiterated. However, the extent to which the project proponents sought the inputs of the community in the project designing and planning phases was not revealed.

4.7.2 Community Training: A Form of Community Engagement

As noted earlier, one of the goals of community engagement is to empower the community to contribute towards a project's success (Colvin et al., 2016; Walker, 2011). The study ascertained that one of the proponent organizations undertook some measures to train and empower the Town of Ramea to contribute to the operation and maintenance of some aspects of the WHDP. As a remote community that is not easily accessible, the proponent, therefore, recognized and provided hydrogen safety training and hydrogen detection equipment to the Ramea Volunteer Fire Department to build their capacity to detect and address any issues that might arise from the project site, as they are in the community and closer to the project. From the perspective of the proponent organization, interviewee 6 noted:

> We did some training—we brought someone to take the Voluntary Fire Department of Ramea through a hydrogen safety training course. Because if there was a fire or any sort of emergency at our diesel facility, the Ramea Voluntary Fire Department would be the ones to respond. So, we provided them with some training on hydrogen and how to deal with it safely. We provided them with equipment that they would need—thermal illusion cameras and other types of equipment that would be available to be used to detect fire or smoke.

"Having a successful relationship with the community is important. Having them supportive of what is happening, keeping them engaged and aware, so that there are no surprises for them", respondent 6 added. This quote underscores the significance of building and maintaining a successful relationship with the community towards realizing the project's goals. Appreciating this, the proponent organization established some form of working relationship with the community leadership and the volunteer fire department to keep them informed and involved in the project's activities to facilitate their continual support. For instance, regarding how the community leadership was involved, interviewee 6 noted:

> We tried our best to keep the town involved as much as we could. The mayor of Ramea would be involved and he would be our point of contact if we knew something was happening or something was going to happen.

The exact ways in which stakeholders and groups were involved by the proponents were not established. However, the general community was engaged through mailings, newsletters, and other forms of information sharing. Respondent 6 indicated, “we sent out newsletters to the community, regular mail out and news updates on the state of the project and the next project activities”.

4.7.3 Community Education Efforts

Another form in which the Town of Ramea was engaged in the wind projects, as revealed from the study, was educational programs. It was learned that one of the proponent organizations organized educational programs as part of efforts to sensitize the community and to address their concerns regarding the project and its related activities. “We had a public meeting at the Lions Club Community Centre with NL Hydro where they talked about what they were up to and other stuff”, noted interviewee 1 from the community. Respondent 4 corroborated, “at the early stages, we had a community meeting and anybody who was interested was welcomed. And they answered all questions after that”.

Before incorporating the hydrogen component into the existing WHDP, the proponent organization educated the community on hydrogen and how it will be handled safely in the course of the project. This was done to address all misconceptions about hydrogen and assure the safety of the community. Interviewee 6 remarked:

> When you think of hydrogen, from what I know, it scares people—people think of it being explosive—it can easily start a fire and all that stuff. So, we did our best to educate the town on what hydrogen is all about, and how it would be stored safely.

4.7.4 Responding to the Concerns of the Community

Another form in which Ramea was engaged was through reporting issues the community had with the project to the developers. This contributed to influencing the activities of the proponents and supported them to act in the best interest of the community. Regarding an experience one of the proponent organizations had with some aspects of the project, respondent 6 recalled:

> We had a problem with one of the wind turbines—we changed the brakes, and anytime the wind turbine turned in the wind, it made a really loud screeching sound. And you could hear it all across the island. So, the community was upset about that, and we had to bring someone back in to fix it right away. So, if we decided now it doesn't have any technical problems, it's just the loud noise, and it will cost us money to fix it, we were going to lose all our community support.

4.7.5 Employment for the Community

Some of the community members were employed by both proponent organizations throughout different phases of the projects—from the environmental impact assessment stage to the installation of project equipment to the current operational phase of the project. Apart from the "one-time" employment period, where some of the community members were contracted to help in the installation of the project's equipment (NL Hydro, 2007), others have been involved in diverse capacities from part-time to full-time roles. Interviewee 4 mentioned that they were engaged as an operator, who worked for some time before retiring. When asked about their connection to the Ramea WEPs, they noted that "I worked as an operator at the Ramea diesel plant, [and] when this project [the WDP] started, I was involved to do some work that I understood".

During a bird interaction and mortality study that was conducted on the early wind turbines in 2005 and 2006 (as part of the environmental impact assessment requirement of the project to ascertain the impact of the turbines on birds that frequent the island—see NL Hydro, 2007b), Frontier Power Systems engaged a community member in the exercise. The study required an observer who would monitor and report findings of bird mortalities at the project's site for two years (Frontier Power Systems, 2003 b). Respondent 5recounted:

> I am interested in birds and when they needed someone to be visiting the project site to look for birds that were killed by the windmills and report to them, they hired me. They could have hired someone outside the community to come and do that, but they felt I was qualified to do that because I research birds a lot. And they paid me well too, but I did not find any dead birds around the windmills to report to them.

Also, we were informed that one of the proponent organizations currently has a full-time employee in the community. This can be inferred from the following extract from interviewee 6: "The employer [our organization] has in the community—his job is to make sure the power stays on for the community, not necessarily keep the wind turbines on. If he keeps the diesel on and the power stays on, then he is successful". All these engagements provided a source of income for those employed and contributed to the development of the town indirectly.

4.8 Strengths and Opportunities for the Ramea Wind projects

The Ramea projects have had numerous strengths and opportunities, ranging from the town's admirable wind resources to its geographical location to its welcoming community. Some of these were recognized by the stakeholders even before the life of the projects. For instance, the proponent for the WDP argued that it was because of "the availability of premium wind resources in Ramea, its relative accessibility, and the interest of the community in renewable energy" among other reasons that influenced their decision to choose the community for the project (Frontier Power Systems, 2003a, p. 4).

The sub-sections that follow expound on the foregoing and other strengths and opportunities of the projects as learned from this study.

4.8.1 Commendable Community Support: No Experience with NIMBYism

The presence of 'community support' of the town for the projects, as learned from the interviews, can be considered the projects' biggest strength. This is despite the literature on renewable energy development recognizing that WEPs have received the greatest resistance from local communities; it has always been perceived as one of the major threats to and weaknesses of wind energy developments by project proponents (see Christidis et al., 2017; Hall, 2014). Although the Ramea projects were not community-led, and the community was instead being involved in varied forms, they embraced the projects and were very supportive. Interviewee 7 noted, "the project [WHDP] was not a community-led project, but the community was involved. [We] approached the community on [our] plans to establish the project, and they were very supportive".

The Ramea projects have contributed to justifying a key strength for the development of renewable energy in NL: the absence of local-community opposition to WEPs development, and the availability of considerable interest in and support for renewable energy developments in remote areas. Recounting on NL Hydro's experience with the Ramea projects and other WEPs at St. Lawrence and Fermeuse (which are relatively bigger at 27 MW each—see Pennecon, 2021; Elemental Energy, 2020), interviewee 6 acknowledged the positive attitude of the communities towards the projects, stating, "we are very lucky in NL: there is little to no community backlash to renewable energy development. In a lot of places, they have what we call NIMBYism. We have not experienced it to date in Newfoundland". Perhaps the increasing awareness of communities on the benefits of SSRE projects, as learned from Ramea's case, partly explains this attitude. Our interactions with the community showed a strong resolve from the town in supporting the projects and seeing them achieve their goals. Interviewee 4 who was also engaged in the operation of one of the projects recounts the welcoming nature of the town towards the project, affirming, “the community was made aware of it. And they were all for it”. Interviewee 1 stressed, “the town is, from the beginning, more than willing to do what we can to see the projects succeed”. From the interviews, the community support from the Town can also be seen as a great opportunity for similar projects in the future. Interviewee 3 from the Town reiterated, “we will certainly be 100 percent behind Frontier Power Systems and/or NL Hydro if they want to make the system work properly”.

This unwavering support from the community is rooted in their interests in paying lower power rates and getting rid of the “expensive” and “dirty” diesel for good. Interviewee 2 from the community envisioned, “what I would like to see is that at some point in time, we could rely totally on wind energy which would give us a cheaper rate of electricity”. Respondent 4, who was directly engaged in the operation of the WDP, was convinced both projects would provide clean energy and reduce electricity rates, saying, “we would use clean energy and it will reduce power rates in this community and other remote communities”. , “If they use wind and hydrogen to generate power, the rates should be lower and there would be a lot less pollution”, interviewee 2 anticipated. However, these projects have a downside, for which some of the community members expressed their concern—they do not contribute directly to a reduction in the electricity rates the community pays in the short term due to the rate uniformity policy in NL as discussed in Section 4.9.6 below. That being said, the proposed Ramea 2 project offers a key opportunity to provide cheaper power rates to the Town than the current system should it be successfully implemented.

Regarding the interest of communities in the development of renewable energy projects, the study found a significant amount of interest in community-led initiatives across NL, as some communities have expressed interest in developing wind farms and other small-scale renewable energy projects. Respondent 6 recalled in our interview, “we have had many communities [including both off-grid and on-grid towns] approach [our organization] about building wind farms in their communities"—noting that remote communities, in particular, are leading this course, largely because of the revenue the town would get from selling the power, the jobs that come along with such projects, and the reductions in diesel usage, among others. This is evidenced by the growing number of renewable energy projects in Labrador. There is a hybrid demonstration project led by the local Nunatsiavut Government and the town of Nain—the Nain Remote Microgrid project—that is using wind generation and lithium battery storage to reduce the town's diesel generation (Natural Resources Canada, 2021; Canadian Insider, 2021). There is also the Mary's Harbour Renewables project, a small-scale renewable energy project led by a community-based company—the St. Mary's River Energy Limited —that is combining hydro-generation with solar and battery storage to offset diesel generation (CBC News, 2016; Natural Resources Canada, 2019). Although some on-grid municipalities are also interested in developing WEPs in their communities through the net metering program in NL (see NL Hydro, 2021), they are however limited by the over-supplied nature of electricity on the grid. This is further explained in Sub-Section 4.9.4.

4.8.2 A Proven System Control Technology

The EMS technology that was developed to harmonize and control the various components and operation of the system respectively has been a huge success and a great achievement of the hydrogen integrated component. As highlighted in the operational details sub-section of the WHDP, the project required the proponent to develop an oversight control technology that would ensure successful communication between and among the wind turbines, hydrogen generators, and diesel engines. It was revealed by the interviews that the proponent organization succeeded in doing this. Interviewee 1 from the community posited:

> The one good thing that came out of this was NL Hydro developed the technology to be able to do this stuff. They got the system set up to run smoothly, and we have got a good steady supply of electricity in Ramea—we seldom have any issues… Their technology has proven to work…. And they can send it somewhere else.

Interviewee 3 corroborated, “I think the technology could be used anywhere… As far as I know, it is fine-tuned because the power gets injected directly into the island’s grid”. As indicated earlier in this report the technology was designed with a secondary goal to place it on the market once proven successful. This implies that the utility can use this technology in any of the off-grid communities in NL and can also sell it to other jurisdictions interested in using the technology. This study has, however, not ascertained from the proponent organization the current state of the technology or how it has been used in other places.

4.8.3 Wind Resources

The wind resource in Ramea remains the projects’ main strength and opportunity. It was the fundamental attracting factor for the projects because WEPs cannot be established in areas without adequate wind resources to support their operation. In their justification for choosing Ramea as the site for the first-ever wind-diesel demonstration project in Canada, Frontier Power Systems argued, among other reasons, that “the community had a premium wind resource that had the potential to increase the amount of wind energy generated” (Frontier Power Systems, 2003a, p. 4). The community is found to have one of the highest wind resource regions in Canada (Iqbal, 2009). This is not just peculiar to only Ramea; NL, in general, is noted to have one of the best wind resources in North America (Mercer et al., 2017).

Apart from summertime when the wind is a bit inconsistent, it is windy in Ramea for most of the year. We had a first-hand experience of it staying in the community for about a week during the data collection period. Interviewee 1intimated, “some people may not believe that there are times in Ramea when there is no wind, but there are times in the summertime”. Another community member, interviewee 5, indicated, “I would say about 90 percent of the time you have the wind in Ramea”. Although there are no specific studies done or available data on the wind speeds in Ramea, it is generally noted to be windy largely due to its location on the southwest coast. A study by Khan and Iqbal (2020) that maps the wind energy resource in NL reveals that the coastal regions in the province have higher wind speeds than the other regions.

4.8.4 Creation of Jobs and Revenue

The creation of jobs, both one-time and permanent employment for some community members as a form of community engagement, has been a recognizable strength of the projects. The seasonal and full-time jobs created can be argued as the singular most direct economic benefit to the town of Ramea. From the interviews and document reviews, it was understood that the town of Ramea had no equity nor revenue-sharing agreements with either of the proponents. Although the community’s financial and general economic gains from the projects were relatively minimal, this was somewhat understandable since they were not those championing the initiatives.

4.8.5 Reduction in Carbon Emissions

The greatest concern for the use of diesel for energy generation is its emission of carbon, which is often considered “dirty” and the main contributor to climate change (Government of Canada, 2011; Karanasios & Parker, 2018). As a result, the reduction in diesel emissions has been the major reason for the transition to renewable energy and the development of the Ramea WEPs (Frontier Power Systems, 2021; NL Hydro, 2007).

As mentioned afore, the WHDP is no longer operating, and I could not establish in this research the amount of diesel that was displaced during its period of operation—one of the limitations of this study. However, the initial WDP still runs and has chalked up some success in reducing carbon emissions through the displacement of some diesel. As highlighted in Section 4.3 above, about 15 percent of Ramea's energy needs are met with clean energy generated from the wind project. The project displaces around 375 tonnes of emissions from diesel every year (Frontier Power Systems, 2021). There is a greater opportunity in reducing more carbon emissions when Frontier Power Systems succeeds in implementing its proposal for Ramea 2.

4.8.6 Ramea 2: A step to Completely Shut Down Diesel Generation

Though still under consideration, the Ramea 2 proposal is arguably one of the greatest opportunities to transition Ramea from a largely diesel-dependent community to a more renewable-driven one. According to the developer, they are currently sourcing funds for the project and will start its development in Fall 2021 and complete it by Spring 2022. The project will contribute steps toward attaining a future where diesel generation will be completely taken offline as a source of energy in Ramea. Speaking with the proponent organization, I discovered that the Ramea 2 project will replace the existing six 65-kW wind turbines installed in 2004 with 100-kW turbines and will acquire the three 100-kW turbines owned by NL Hydro. In addition, a battery storage system will be installed to store the excess energy generated from the turbines, essentially addressing the storage challenges faced by the WHDP. With that infrastructure, the developer envisions generating enough wind energy to offset about 50 percent of diesel generation, displacing around 500,000 liters of diesel yearly (The Guardian, 2021).

In the current system where wind energy is used to offset diesel, for most of the year (i.e., when the load of the town is low and the diesel engines are operating below efficiency levels), the energy from the wind, particularly the three 100-kW turbines, is not optimized as they are usually turned off. The Ramea 2 proposal seeks to completely shut down the diesel plants during these down periods by incorporating the battery storage system. The storage will allow the new system to optimize the generation from the three turbines installed by the proponent of the WHDP and take the diesel system offline, which will be expensive to run during such periods. This, according to interviewee 7 from the proponent organization, “will be the first project in Canada that will do that”. A similar development was demonstrated successfully in an off-grid community in Alaska, USA (Frontier Power Systems, 2021).

Apart from offsetting up to half the current diesel usage, the Ramea 2 proposal looks to further empower and engage the community in the direct operation and maintenance of the projects by making them part-owners. “Once we get the financing for the project, we will work with the community directly to give them an equity share in the project”, noted respondent 7. The proposal will approximate a Build, Own, Operate, and Transfer (BOOT) financing and service delivery model (see Kanakoudis et al., 2007), granting equity ownership to the town of Ramea. Speaking on how the project will be financed and how the proponent organization looks to engage the town as part-owners, respondent 7 disclosed:

> So, in this project, we are going to the community [to tell them] we want to make you equity holders in this project. Even though you have no equity, we are getting some financial support for this project from the federal government, and essentially that federal government contribution is going to be transferred as equity to the community.

4.8.7 Crown Lands

This emerging theme is more related to the general development of renewable energy projects in the entire province and not specific to the Ramea wind projects. Although the Ramea projects are not explicitly sitting on crown lands, this was noted from the interviews as one of the opportunities for wind energy developments in NL.

The availability of a large expanse of crown lands is a great opportunity for the development of renewable energy as there would be essentially no issues with land-use conflicts, one of the key sources of opposition to renewable energy resources development (Colvin et al., 2016). “NL is blessed with an enormous amount of crown lands—we could put up more wind turbines in many places if we needed the energy, but we don’t”, stated interviewee 6 from one of the proponent organizations.

4.9 Weaknesses and Threats for the Ramea Wind project

The Ramea wind projects, particularly the WHD project, have had to deal with some weaknesses and threats since their sanctioning, some of which have partly contributed to the shutting down of some aspects of the project. As expounded in the following sub-sections, most of the downsides of the projects were external forces and were generally unavoidable. Others emanated from within the project and were somewhat avoidable. That notwithstanding, these shortcomings have provided important lessons for the development of similar projects in the future.

4.9.1 Intermittent Breakdown of Hydrogen Combustion Engine

As mentioned earlier, the main weakness of the Ramea WHDP was the internal combustion engine. It was revealed by the interviews that this piece of equipment had technical issues which caused it to break down almost every time throughout the life of the project. My interview with respondent 6 from the proponent organization disclosed that the Organization invested significant amounts of time and money to fix the equipment but were unsuccessful. The interviewee noted:

> That piece of equipment [the hydrogen internal combustion engine] … caused us all kinds of problems, and we had to spend a lot of money and time to try to get it to work, [but] we never got it to work at the consistency and reliability that we wanted.

As a result, the project was shut down temporally for the organization to identify and plan a more effective alternative to this piece of equipment. This led to Phase II of the project where the company developed a proposal and secured funding to replace the combustion engine with fuel cells in the year 2012. However, as briefly highlighted in Section 4.6, this phase of the project was never implemented due to the Dark NL crisis and other province-wide energy-related issues that required the full attention of the proponent organization. This subsequently led to a complete discontinuation of the project.

4.9.2 Not Community-Led or -Owned

For a community to achieve the full bundle of benefits (social, economic, and environmental) associated with the development and operation of renewable energy projects, they should be leading or co-leading the development of such projects (see Berka & Creamer, 2018; Rezaei & Dowlatabadi, 2016). Community-led initiatives have the potential to deliver economic, social, and environmental benefits to the local community that owns and controls them (Haugh, 2007). When a community owns and governs an enterprise, it can meet its local needs, build its capacity towards self-reliance and generate social capital (Haugh, 2007; Murphy et al., 2020). In the case of Ramea, the community was engaged largely because they were beneficiaries of the project, and they missed out on some of the crucial benefits of WEPs, including one of their primary goals of rate reduction (i.e., pay less or the same amount customers on the main grid pay) and the revenue that comes along with owning, producing, and selling power, among others. This is one of the reasons for the growing number of community-led energy initiatives in many Indigenous remote communities in Canada (see Karanasios & Parker, 2018).

During the interview with respondent 6, it was learned that "if the community owns the wind farm, they can sell the electricity to NL Hydro and get the revenue from that energy." The respondent further explained, citing the case of one of the other renewable energy projects in Labrador, that if the Nunatsiavut Government, for example, decides to sell their energy to NL Hydro, they will sign a power purchase agreement (PPA) with NL Hydro. The PPA will allow the Nunatsiavut Government to be able to sell the energy generated at a certain agreed price, which will be less than the cost NL Hydro currently incurs in running the diesel, and reasonable enough to generate revenue to the Nunatsiavut Government from generating and selling the energy to NL Hydro.

In trying to understand if the community is considering investing in the ownership of the three 100-kW wind turbines that were installed by NL Hydro to support the hydrogen component and are currently not operating, they showed wariness, citing the town's financial constraints as a key hindrance. Interviewee 1, a council member, explained:

> If we had the dollars, and that's something we don't have as a small community, we could own a part of the system and sell the electricity and the community would have made money from doing that, which would help to run the town. But right now, we don't have the dollars to invest in things like that.

That notwithstanding, the community has expressed their interest in owning the wind turbines should the proponent organization wish to turn it over to them. Interviewee 3 briefed:

> We have already told NL Hydro that we were willing to accept ownership of the turbines… If they had turned over the turbines to the town, the town would have turned it over to Frontier Power to operate and maintain. It would not have cost the town anything.

Maybe the proponent organization is looking to make some returns from that investment, especially since the proponent of the Ramea 2 project is hoping to purchase them. In any case, the excerpts above show the level of interest of the community and their determination in seeing the wind turbines continue to operate and succeed.

4.9.3 Limited Community Engagement

Closely linked to the fact that the WEPs were not owned or led by the community (as described in the preceding section) is the limited level of involvement of Ramea in the project. Despite the continuous community consultation and dialogue, training of a community-based organization in hydrogen safety measures, responding to community needs, and employing some community members, there were instances the community could not be involved with the projects. Notably, the community was not directly involved in the maintenance of the projects, although that would have required technical expertise on the part of the community, which they lacked. However, it was practically difficult for the town to be involved in that regard, even if they had the necessary capacity.

As explained earlier, the main reason for the shutting down of the Ramea WHDP was an intermittent breakdown of the hydrogen generating equipment. It was mentioned by an interviewee from the proponent organization that the company always had to send their operation staff based in central Newfoundland down to Ramea to fix a problem whenever there was one, and that was always costly. When asked whether the organization ever thought of training and or building the capacity of the Ramea locals as technicians to oversee the maintenance of the equipment since they were closer to it, I was made to understand that the unionized nature of the staff of the proponent organization presented a challenge in that regard. However, the proponent could contract a local company to do that if one existed. It was explained by respondent 6, “that would not be possible, because the staff is unionized. If someone set up a company in the community, [our organization] could contract them—that is possible”. This presented an opportunity for the Town to further engage themselves in the projects, but it was missed.

4.9.4 Diesel Engine Size

The “large-sized” diesel engines in Ramea present a hindrance to the successful optimization of wind energy in the Ramea electricity grid. Since the three 925-kW diesel engines (which remain the primary source of energy for the town) are running below their recommended capacity levels, for most of the year, it is more expensive to run as they require more fuel per unit of electricity generated to operate at that level, the study found. This phenomenon, caused by the community’s small load coupled with the unreliability of wind energy is a disincentive for the displacement of more diesel generation with wind energy. Respondent 6 explained:

> The load of Ramea, for the majority of the year, outside of the coldest winter months from April until November, is like 300 or 400 kilowatts. So, we have got large diesel engines that can only run at a minimum of 725 kW. A lot of the time in the summer and the warmest days, we have to run our diesel engine at a lower operating range than is suggested by manufacturers. So, we are outside of efficiency curves, and we are using more diesel than we should generate just because we are running them so low. So, we are operating like 80% lower than we should operate. Since in Ramea we are using our wind power to offset our diesel use, in the summer months, when our diesel engines are running at the minimum that we can run, say 275, if the town load is 300 kW, there is only room for 25 kW of wind in the system.

To optimize the wind energy generation in Ramea, it was suggested from the interviews that the system needs smaller diesel engines to allow for more wind energy penetration. I observed from the community, and also learned from the interviews that there are a lot of times when the wind blows but the turbines do not turn because there is no load to support them. Interviewee 6 stated:

> We do not need those big units. Ramea needs a smaller unit to run most of the time. In the winter, then you can use your bigger units. In December, January, February, the load is up around a megawatt—to 1000 kW or a little bit more. So, in those times you do need your bigger units. But for a lot of the year, you do not.

The above extract has shown how a past development, which was very relevant at the time but has outlived its usefulness is currently one of the major threats to transitioning to renewable energy in Ramea. However, this study could not establish how the appropriate authorities or stakeholders are doing to address the issue.

4.9.5 Competing Energy Priorities

There are a lot of expectations concerning wind energy development in NL, especially with the presence of “world-class” wind energy resources (Mercer et al., 2017), the abundance of crown lands, and limited local opposition to its development. NL should be a leader in wind energy development given its enviable resources. Due to several reasons, including the ones highlighted in the preceding sub-section, we can crudely conclude that wind energy is desired and needed but the existing system presents some challenges for its incorporation on the grid, not only in Ramea but in NL in general. But at least in Ramea and other off-grid communities (i.e., Fermeuse and St. Lawrence), wind can displace “dirty” energy, whereas it can not do that in the main grid because it is powered almost exclusively by hydroelectricity.

In the case of the entire province, Mercer et al. (2017) identify the many barriers limiting the development of wind energy in NL, concluding that “wind energy is not an issue for [the] government [of NL]”. Respondent 6 posited, “We could put up more wind turbines in many places if we needed the energy, but we do not”. Respondent 6 further explained:

> The issue is we do not have the load to support wind power. We got enough hydro generation on the island to do the majority of the year, except for the coldest days. And because wind cannot be relied on to be on when you need it, it does not make sense to install it.

This quote further corroborates the findings of Mercer et al. (2017) that the focus on large-scale hydro projects (especially the Muskrat Falls project) by the provincial government hinders the development of other renewable energy projects like wind energy in NL.

4.9.6 Rate Uniformity in NL

One of the major interests of Ramea as a community in the projects was to see a reduction in their electricity rates. As interviewee 1 from the community hoped, “what I would like to see is that at some point in time we could rely totally on wind energy, which would give us a cheaper rate of electricity”. Currently, customers on the Island Interconnected System and the isolated diesel communities are paying 12.20 cents per kilowatt-hour and those on the Labrador Interconnected System pay 3.5 cents per kilowatt-hour (NL Hydro, 2021). However, rates for off-grid communities are sometimes higher than the main grid, notably in winter. “In wintertime, we pay about double the rate after 1000 kilowatts a month. But normally in the summertime, we pay the same rate as everybody else in the province”, respondent 2 noted.

This has been one of the weaknesses of the Ramea WEPs, as the interviews suggested. A community member expressed his displeasure, saying, “when I asked NL Hydro about Ramea getting a reduction in our rates, they told me the project was not going to contribute to that in the foreseeable future”. Despite the presence of the projects in the community, which technically reduces the cost of electricity generation in the town compared with other off-grid communities that rely on only diesel generation, they all still pay the same rates. In speaking with respondent 6, it was explained:

> One of the downsides of Ramea is that all our remote communities in NL pay the same cost for electricity. So, by putting wind turbines in Ramea, you may be decreasing the cost of generation in Ramea, but the customers in Ramea do not benefit from that. Because the electricity is spread across the system. So, if you live in Ramea or other rural communities, you pay the same rate for your electricity. If we lowered the cost in one community, that lowered cost goes everywhere, so there is no benefit to the rates of the people of Ramea by having wind turbines there.

From the excerpt above, it is understood that in the off-grid communities of NL, the electricity is generated in and supplied from separate grids by one organization—the Public

Utility Company. However, any operations costs or savings are spread across the system, making all off-grid communities pay the same rates. In a situation where the generation and supply of electricity in an off-grid community is undertaken by the community or a different organization other than the Public Utility, then the rates might vary. In which case, customers in such a community might pay lower electricity rates as compared to other remote communities. Ramea 2presents a classical example of how this can happen.

4.9.7 Remote Location

Although the WEPs would not have been initiated in the first place if Ramea was on the main grid, the fact that Ramea is a remote community is a weakness that hindered the operations of the projects. When compared to other remote areas in NL, the Town is relatively easy to access. However, I learned from the interviews that it was time-consuming for the operations staff of the proponent organization, who are based in Central Newfoundland, to reach or send equipment and spare parts to the community. This caused a lot of delays in repairing and replacing faulty parts of the project equipment. Respondent 6 indicated, "it is not easy to get there; it's not easy to get equipment there". While sharing their experience with me, the same respondent stated, "I have been in Ramea a lot of times where we needed a piece of equipment and have to wait at least two days before we can get it".

Also, the Town's ease of accessibility compared to other off-grid communities keeps it a lower priority for the government and other stakeholders. In NL, other remote areas are harder to reach than Ramea. The cost of running diesel in those communities is far more justifiable than in the case of Ramea. This, together with the "expensive research and development" (a theme further explored in the next sub-section) partly contributed to the discontinuation of the hydrogen component of the project. Although Ramea might be considered a lower priority compared to other off-grid communities in NL, it remains a typical remote area. Hence, connecting it to the main grid is not cost-effective.

4.9.8 Expensive Research and Development

A key contributing factor to the shutdown of the Ramea WHDP was the fact that it was expensive and not economically justifiable to the project proponents at some point in time. I learned that because the project was unique, most of the pieces of equipment used were in their early development stages and were expensive to procure. A respondent from a funding agency, interviewee 8, noted that it was due to the expensive nature of some of the project's equipment that partly contributed to its current state. For instance, they recalled that "the fuel cells were really expensive … like millions to fuel cells versus hydrogen generators", which was the reason for choosing the hydrogen internal combustion engine that was donated by NRCan. Unfortunately, as discussed above, this piece of equipment failed to function as intended and was the main contributing factor to the shutdown of the project.

Also, there are many competing energy issues in the province, and the proponent organization must always concentrate on "more pressing needs" as the only public company charged with the primary responsibility of providing clean, reliable, and affordable energy to the entire province.

Due to this, the organization has focused more on its primary mandate, with less concentration on research and development activities, especially during crises like Dark NL. Interviewee 6 explained:

> Our company had all kinds of issues—entire jurisdictional problems... So, the company's resources were put towards issues that will ensure the reliability of the grid. And the Ramea project was a research and development project, and the generation down there was not required to meet the load of the community- the diesel engine was meeting all the load of the community.

Reiterating the quote above, I learned from the interviews that the success of demonstration projects largely depends on the availability of more financial resources and commitment from whoever is leading such projects. I conclude that the expensive nature of research and development projects amidst competing energy issues presented a key hindrance and was one of the main reasons for the discontinuation of the Ramea WHDP Project.

4.10 Conclusion

All through this chapter, I have described the Ramea WEPs, highlighting the rationale behind their sanctioning and providing a brief technical and operational overview. The projects are research and development initiatives developed and owned by two different organizations—i.e., a private energy developer and a public utility company. As demonstration projects, the Ramea WEPs aimed to, through either exclusively using wind or using wind and hydrogen generation and storage, offset diesel in generating electricity in an off-grid community. The first project, the wind-diesel project (WDP), is still operating and contributes to the displacement of hundreds of tonnes of diesel every year. However, due to some technical and organizational challenges, the second project, the wind-hydrogen-diesel project (WHDP), is currently shut down and the proponent is in the process of decommissioning the project's assets from the site.

Interviews with some community members in Ramea and other key stakeholders of the projects showed that the community was engaged in varied forms in the designing (i.e., site selection), installation, and operation of the projects. Community consultation, training of a community-based organization, and employment of some community members in the activities of the projects were among the ways the proponents of the projects engaged the Town.

Also, I established herein some key opportunities for the Ramea WEPs: the availability of enviable community support in Ramea, the Town's location in a world-class wind resource region, and the availability of vast crown lands. These are also opportunities for the future development and operation of similar projects, not only in the Town but NL in general. The Ramea projects have contributed to a reduction in carbon emissions, the creation of jobs and revenue for the community, and the development of a successful system control technology to harmoniously integrate the operation of wind, hydrogen, and diesel systems that can be used to support the operation of similar projects.

On the other hand, the fact that the projects are not community-led, owned, or co-owned is a key weakness, as it limited the ability of the Town to enjoy the 'full bundle' of benefits associated with community ownership and operation of SSRE projects. Additionally, from the interviews, I note that the large-sized diesel engines that were installed in the 1990s somewhat hindered the optimal penetration of wind energy and the displacement of more diesel in Ramea. Issues like rate uniformity and the expensive nature of R&D were found as threats to the operation and realization of the benefits of the wind projects. Overall, I examined the current state of the projects, as well as the key strengths, weaknesses, opportunities, and threats as highlighted herein, and have drawn some key lessons and their implications on related policies and further research in Chapter 5.

Chapter 5. Summaries, Implications, and Conclusions

5.1 Chapter Outline

Throughout this thesis, I sought to, as an overarching objective, understand the influence of local engagement towards the success of SSRE schemes in remote areas. By using the Town of Ramea and the Ramea WEPs as a case for the study, I have established in the previous chapters how the community was or is being engaged by the projects' proponents throughout the various stages of the projects. Also, I have identified some key strengths, weaknesses, opportunities, and threats of the projects, and provided insights for the future developments and sustainability of similar projects in NL and beyond.

Herein, I highlight the broad summaries of my findings in my attempt to achieve the objectives of this study. Also, I have drawn some key lessons learned from the study and made some observations regarding the implications of this research for future policy and research.

5.2 General Summaries

This section summarizes the major findings of the study as detailed in Chapter 4. In the following Sub-Sections, I briefly give highlights about the Ramea projects and how the community was engaged therein. Also, I recognize the strengths and opportunities and identify the key weaknesses and threats of the projects as revealed from the analysis.

5.2.1 Ramea and the Ramea Wind Energy Projects

Ramea, a community located in the heart of a region with world-class wind energy resources, is a popular tourist destination in Newfoundland with national significance regarding wind energy development. There are two unique small-scale renewable energy projects in the community: the wind-diesel project and the wind-hydrogen-diesel project. These are both demonstration projects, with a common overarching goal of testing and establishing proven ways to displace the use of diesel for electricity generation in the off-grid communities of NL. The initial project was the first of its kind in Canada to test the use of wind energy to displace diesel for electricity generation. The second project combined wind energy and hydrogen generation and storage to ascertain ways to displace even more diesel in Ramea. Before the sanctioning of these projects, like the other off-grid communities in NL, Ramea solely relied on diesel generation operated by NL Hydro for electricity (Frontier Power Systems, 2021; NL Hydro, 2007).

These projects do not belong to the community. The first project belongs to a private wind energy developer, who championed its development in 2004 and has since been operating it. The energy produced from the project's six 65-kW wind turbines is directly incorporated into Ramea's existing diesel-powered electricity generating system, offsetting the use of diesel in the process. Since its sanctioning, the project successfully contributes to providing about 15 percent of the Town's electricity needs with renewable energy, displacing equal amounts of diesel usage every year. The second project—the wind-hydrogen-diesel demonstration—was championed by NL Hydro in 2007 to optimize the existing wind energy in the community by experimenting with the use of hydrogen to store excess wind energy for future use. The hydrogen stored was to be burnt in an internal combustion engine to generate electricity when needed. However, due to technical issues, coupled with other external challenges (issues not directly related to the project) faced by the proponents, the project was shut down and is currently not operating.

I have also found that the private developer is proposing a project entitled "Ramea 2" to displace more diesel—i.e., up to 50 percent of the current amounts of diesel used to generate electricity in the Town. The company seeks to retrofit the six initial wind turbines installed for the first wind-diesel project with 100-kW capacity turbines. In addition, the developer looks to acquire the three 100-kW wind turbines installed by NL Hydro in 2007 to increase its wind generating capacity. By incorporating battery storage and other ancillary equipment, the company hopes to, for the first time in Canada, shut down and take the diesel generators offline in Ramea during certain periods of the year.

5.2.2 Community Engagement in the Ramea Projects

The study established that the Town of Ramea was engaged in several forms throughout some of the stages of the projects. I found the following forms of engagement: (a) the project proponents kept the community informed of their activities regarding the projects; (b) the community was consulted and their inputs were incorporated into the design of the projects during the initial stages; (c) some community members were employed during both the installation of the projects' equipment and their operation; (d) the capacity of local institutions were enhanced by the proponents of the projects to further bolster their participation in the operation of the projects (i.e., the Volunteer Fire Department of Ramea was trained on hydrogen safety and was equipped to be able to address hydrogen-related incidents when they happen), and (e) the developers of the projects addressed the concerns of the community on time.

From a step-zero perspective, steps, processes, and interactions between various stakeholders that precede the implementation of a development initiative influence its success or condition in the future (Christidis et al., 2017). As such, the varied forms of engagement strategies employed by the proponents during the projects' pre-implementation phases provide a benchmark that can be referenced to gauge the influence of community engagement on the success or otherwise of SSRE.

Like most renewable energy projects, the developers engaged the community mainly to establish a cordial working relationship with the community and to obtain social acceptance for the projects (see Colvin et al., 2016). The proponents somewhat succeeded, judging from the reception and support from the community towards the projects. However, part of the community critiqued the projects for not contributing to the reduction of electricity rates on the island.

5.2.3 Strengths and Opportunities for the Ramea Wind Energy Projects

I uncovered numerous strengths and opportunities for the Ramea wind projects. Some of these are peculiar to the Town of Ramea and contributed to attracting the projects to the area. Others resulted, either directly or indirectly, from the existence of the projects. The strengths of the projects include strong community support towards the projects; reduction in carbon emissions; creation of jobs and revenue; and the development of a successful wind-hydrogen-diesel integration control technology.

Also, the existence of premium wind energy resources; the availability of a vast expanse of crown lands; and the continuous interest of the private energy developer in developing the community’s energy resources, which lead to the proposed Ramea 2 project, were some of the opportunities for the Ramea WEPs. The availability of a vast expanse of land as identified herein is not peculiar to only Ramea, but it was found as a key opportunity for the general development of SSRE in NL.

5.2.4 Weaknesses and Threats to the Ramea Wind Energy Projects

In general, the weakness and threats of the Ramea wind energy projects can largely be grouped into governance and technical challenges. The main downsides of the wind projects were found to be: the fact that the Town of Ramea had no form of ownership or control over the projects, limiting the Town from enjoying most of the benefits associated with community ownership and governance of wind projects; the uniformity of electricity rates in NL (i.e. no local reduction in the electricity rates customers pay resulting from the projects); remote location of the community, which caused delays in carrying out some of the projects' related activities (e.g., the transportation of operations staff and project equipment); competing for energy priorities (i.e., the oversupply of hydroelectricity is limiting the development of wind energy not only in Ramea but across NL); large-sized diesel engines that are restricting the maximum utilization of wind energy on the Ramea's grid; and the expensive nature of research and development projects.

Particularly, it was revealed by the interviews that the closure of the WHDP was largely due to technical issues with the internal combustion engine that was used to generate electricity from hydrogen. By reflecting on these, I have identified some useful lessons that can be used to inform future projects and help improve the successful management of similar projects in other jurisdictions.

5.3 Lessons for Future Wind Energy Developments

This study has suggested that there may be an inextricable relationship between community engagement and the general success of renewable energy projects in off-grid areas. At the same time, it has also revealed that successfully undertaking community engagement, and more specifically obtaining local acceptance and support, may not be sufficient to ensure the success of renewable energy projects in these areas. I have appreciated from the interviews that using the right equipment and technology is intrinsically crucial and contributes immensely to the success of demonstration projects. Also, this study revealed that obtaining these pieces of equipment or technology for R&D can be an expensive undertaking capable of adversely impacting the success of such projects.

This section explores the foregoing subtleties and the implications of other striking revelations from the study in the following sub-sections. To achieve this, I examine and draw out key insights from the community engagement experience of Ramea and the SWOT analysis of the WEP. Lessons are especially on the implications of the project equipment, diesel equipment sizing, community engagement, and cost justification to the development and management of SSRE in remote areas. Also, I looked briefly into how a proponent organization can influence the success of demonstration projects using the Ramea situation.

5.3.1 Proper Equipment Type

The experience of the Ramea WHDP shows that equipment type contributes largely to the success or failure of any demonstration project. As explained in the preceding chapter, the main reason for the shut-down of the hydrogen component of the project was the faulty hydrogen combustion engine. Possibly, the outcome would have been different if the right equipment was used. As explained by respondent 6:

> When we started that project in 2007, the Genset [internal combustion engine] and fuel cells were still new technology—nobody knew what the better technology was … If the project had started 4 or 5 years later, we would have gone with fuel cells; just because it's better technology, it's more efficient, and it's more reliable.

The extract above justifies the importance of getting the appropriate technology right from the beginning. That is particularly important because it will not only facilitate attaining the objectives of the project but also help in preventing additional costs associated with using inappropriate equipment and reduce risks associated with the use of unproven technology

However, as also indicated in the quote, it is practically impossible to know in advance what the better technology is at the early stages of demonstration projects. This is because these technologies are usually new and largely not tested. That is until a particular technology is tried and tested, it will be difficult for proponents to know if it will work better than another, especially in the case of novel projects like Ramea's case.

The high risk associated with new technology and demonstration projects makes them relatively expensive, requiring more financial commitments to succeed. As revealed from the interviews, plans for Phase II of the Ramea WHDP were far advanced to replace the hydrogen combustion engine with fuel cells, but it was never implemented due to the diversion of resources to tackling primary energy concerns and the heavy concentration on the Muskrat Falls project by the proponent organization, as posited by Mercer et al. (2017). Perhaps if the proponent organization were able to purchase the fuel cells and had implemented the planned Phase II of WHDP, the project would have realized its goals. In any case, the Ramea situation partly supports the claim that R&D projects need significant financial commitment and assistance on the part of proponents to succeed (Costello, 2016).

5.3.2 Diesel Equipment sizing, and Energy Storage

Greater consideration should be given to the sizing of existing diesel engines operating in any off-grid community. A key characteristic of most renewable energy projects in off-grid communities is that they seek to displace the use of diesel-powered generators to produce energy (see Akinyele & Rayudu, 2016; Government of Canada, 2011; Karanasios & Parker, 2018). Knowing the size of these diesel generators is imperative as it has a direct implication on the successful implementation of the renewable energy project. As seen in the Ramea case, the bigger-sized diesel engines hindered the optimization of wind power. The unreliability of wind power somewhat compelled the proponent organization to keep the large diesel engines running, even at a very high cost, especially during periods of low electricity demands.

Although, the narrative would have been different if the energy storage component had worked. That would have enabled the developers to store excess wind power enough to reliably meet the load of the community and could have even led to the shutting of the large diesel engines during times of low energy demands. In any case, the lesson is that, in the planning and designing phases of renewable energy projects in off-grid communities, emphasis should be given to their reliability in meeting the community's load economically. Also, proponents of similar projects should be cautious when using research and development initiatives to meet the needs of a community, especially when those technologies have not been proven. The existing diesel plants are usually able to provide reliable power (see Akinyele & Rayudu, 2016), although they are costly and unsustainable. Hence, any alternative that seeks to displace that should be able to, at least, function similarly if not better. Perhaps the "just transition" framework, which argues in favor of bringing together the various dimensions of climate, environmental, and energy justice issues to design solutions to effectively transition to a net-zero carbon society (Mccauley & Heffron, 2018), can play a crucial role in ensuring this. Maybe the Ramea 2 project will offer more insights into this when implemented successfully. Therefore, it will be easier to implement displacing renewable energy in diesel-powered communities with smaller engines rather than a few large ones.

5.3.3 Community Engagement

A somewhat interesting observation from the community engagement processes and outcomes experienced with the Ramea projects is the absence of NIMBYism (see Devine-Wright, 2009). The exhibition of unwavering support and no backlash from local communities regarding the development and operation of WEPs is a huge potential and opportunity for the future developments of similar projects in other off-grid communities in NL, assuming that the absence of NIMBYism is more of a provincial trait rather than being unique to Ramea. This implies that wind energy developers in NL may face little to no local opposition to the development and operation of WEPs being experienced across many jurisdictions (see Hall, 2014; Klain et al., 2017).

The Ramea case has underscored the importance of undertaking early, genuine, and multi-faceted local engagement for the development of SSRE projects, the main focus of step-zero analysis (Barragan-Paladines & Chuenpagdee, 2017; Chuenpagdee et al., 2013). Although the community had no equity ownership in any of the WEP, they nonetheless demonstrated their unflinching support and interests in ensuring the success of the projects. The Town's enviable attitude can largely be traced back to how they were engaged by the proponents of the projects. This, therefore, suggests that wind energy developers, especially those from outside the project community[13], should recognize all the relevant local organizations and institutions throughout the life cycle of their projects and endeavor to engage the community as possible.

Community engagement is an unending process that intends to benefit both the project proponent and the community (see Colvin et al., 2016). The proposed Ramea 2 project which seeks to make the Town of Ramea an equity shareholder pre-empts how imperative it is for project proponents to continuously identify innovative ways of engaging local communities in projects of interest to them. The proposal would not only position the community well to enjoy more benefits from the project but would also contribute to a subsequent building of local capacity in the "wind energy business". For the Town to be able to fully participate or engage in the operation and maintenance of the projects, they must develop the needed capacity in that regard. This implies that the community will be adequately prepared to directly get involved in the project, and can also take up some opportunities that were missed in the WHDP as highlighted in Sub-Section 4.9.3.

[13] The project community herein refers to a remote or off-grid community in which a renewable energy project is or has been developed.

5.3.4 Cost Justification: Priority to More Remote Indigenous Locations

I also recognized that, among the 21 off-grid communities that exclusively rely on diesel for electricity generation in NL, some communities are more remote and hard to reach than others. As highlighted in Sub-Section 4.8.6, Ramea is relatively easy to access as compared to most of the province's off-grid communities. Access to some off-grid communities is only via a twice-weekly helicopter and weekly ferry during summer and fall, and snowmobile during winter (Mercer et al., 2020 b). Many of these off-grid areas are Indigenous communities located in the Labrador region of the province (Mercer et al., 2020 a). The cost of running diesel generation in those hard-to-reach locations is relatively expensive. Interviewee 6 revealed:

> The cost to get diesel to Ramea is not that expensive compared to other off-grid communities on the island. If you go up north, you are flying diesel in helicopters... So, the justification for projects in those places would probably be better than Ramea.

Therefore, a lot of attention is directed towards Indigenous off-grid communities, especially given the current interest of Indigenous Governments to cost-effectively reduce reliance on diesel generation. So, NL Hydro is currently partnering with the Nunatsiavut Government, the Town of Nain, and St. Mary's Harbour in Labrador to develop renewable energy alternatives in some communities.

This observation partly supports the arguments of energy researchers in favor of community-led SSRE initiatives in off-grid areas. The fact that some local off-grid communities are beginning to lead the developments of SSRE in NL also suggests that this might be the way of future initiatives, as utilities seem to be taking a step back from direct involvement in SSRE developments that have no direct impact on their primary mandates (Costello, 2016). The increasing availability of funds from the Federal Government[14] to

[14] The Clean Energy for Rural and Remote communities Programme is a 6-year initiative of the Federal Government that started in 2018. The Programme aims to support projects that focus on reducing diesel fuel

promote clean energy developments in remote areas presents a great incentive for off-grid communities and local organizations to take the lead roles in the energy transition in these areas.

5.3.5 Who is Effective in Leading Demonstration Projects: Public Utilities or Private Developers?

The fact that the Ramea projects are owned by two different organizations—a public utility company and a private energy developer—presents a rare opportunity to compare "who" should be championing research and development (R&D) initiatives in the small-scale renewable energy sector: public utilities or private developers. In the US, there is a growing disinterest among utilities in R&D and their investment therein is generally declining, due to various reasons (Costello, 2016). However, the fear of losing monopoly status to "a new technology" is generally the main reason (Costello, 2016).

The core mandate for energy utility companies is to provide access to reliable and affordable energy to their customers. So, their activities are generally centered around achieving this. Although R&D can be seen as part of attaining this core mandate, utilities' involvement in this is often limited, recognizing the expensive nature of the exercise and the competing energy interests, as revealed herein. I found that the cost of some pieces of equipment and technology used for demonstration projects is usually very expensive, due to being in the early phases of development. A participant from a funding agency noted that the cost of fuel cells was really expensive around the year 2007 when the WHD project started. This was the main reason why the proponent organization had to rely on the internal combustion engine that was given to them free-of-charge by NRCan to start the project. To corroborate this, a respondent from one of the proponent organizations asserted, "because a

use and the transition to clean energy in rural and remote communities in the country (Natural Resources Canada, 2018).

lot of the stuff is very early in its development, it is not cheap”. Again, as highlighted in Chapter 4, the proponent organization had to prioritize addressing issues within their core mandate while running the demonstration, and this led to the diversion of the company’s resources from the research project to providing reliable energy to their customers. This necessary risk aversion is the main reason that utilities tend to be consumers of innovation rather than producers (Costello, 2016).

I, therefore, recognize that the expensive nature of R&D and the fact that utilities are ‘bigger’ public entities with many priorities due to the many customers they service partly impedes demonstration projects. A smaller private company can easily focus more on something and might be relatively successful at leading and managing SSRE demonstration projects. However, the study found that irrespective of who is undertaking R&D, they need unflinching support from utilities in the form of working partnerships and power purchase agreements to succeed. Respondent 8 from the funding agency posited, “the fact that you have a major utility behind it is good, but the fact that you have a major utility doing it is not so good”. This is further understood in the response of interviewee 7 who stated, “utilities are very conservative—relies much on established technology”. This is quite understandable because unestablished technologies have higher risks and might be challenging for utilities to rely on in the course of delivering their core mandate to customers. It was further noted by interviewee 8 that “the small department that is often allocated to do R&D in utilities is usually overloaded and does not have the resources to consider new ideas. [Hence], they tend to rely on something commercially available”.

“You need the support and commitment from your company or whoever is doing it”. This statement, made by respondent 6 from one of the proponent organizations, sums up the key factors needed for R&D to be successful. A small to medium-scale firm that deals solely in the business of developing and operating these systems tend to be able to offer these moreso than utilities. It was suggested by interviewee 8; “[it] is better to have a small- to medium-sized enterprise developing the system and doing all the main work”. Private energy developers tend to be more committed and focused on making R&D work because that is their business, and they bear the risks of losing profits and wasting investment if they fail to deliver. Respondent 7 stated, “a company like ours is more focused and more driven on what the outcomes will be”. I, therefore, conclude that demonstration projects may be more likely to succeed if championed by private energy developers than public utilities. However, irrespective of the one leading the research and development projects, utilities play a fundamental role in their success.

5.4 Policy and Research Implications

In this section, I identify some policy and research recommendations for future research and policy development regarding SSRE schemes. These recommendations are informed by the insights drawn from the Ramea case. Also, the current trends in both renewable energy policy and research (Karanasios & Parker, 2018; Mercer et al., 2020; Murphy et al., 2020; Vezzoli et al., 2018) have influenced some of the recommendations suggested herein. The following sub-sections detail these policy and research recommendations.

5.4.1 Research Implications and Recommendations

With the growing advocacy and interest in community energy[15] in the recent literature (see Madriz-Vargas et al., 2018; Süsser et al., 2017; Walker & Devine-Wright, 2008), the Ramea 2 project, when successfully implemented, would offer an empirical case to examine how a private developer might successfully involve a local community more directly in the energy business. Also, it would offer first-hand insights into how local off-

[15] Community Energy refers to “the direct participation, ownership, and sharing of the mutual benefits from renewable energy project by or for a local community” (Toronto Renewable Energy Co-operative, 2016, p. 2).

grid communities, usually with limited capacities in terms of technical expertise and financial resources, would prepare themselves to be able to participate fully in the implementation and maintenance of the project as well as the governance of the benefits to be derived from their participation therein. The proposed Ramea 2 project will provide a very insightful experience on how wind power can be used to successfully shut down and take diesel plants offline in a primary diesel-dependent remote community. Although this has been proven on a micro-level in Alaska, USA, it has not been done in Canada yet, and it is still unclear how this can be done successfully.

Also, as the energy transition proceeds, researchers should begin to show interest in "what happens after diesel engines are successfully taken offline in off-grid communities", either permanently or for a certain period. This will not only offer key insights from empirical cases on how diesel engines can be successfully shut down and replaced with clean energy but also provide key lessons for the persistence of SSRE projects.

Closely linked to the above is the understanding of off-grid communities' capacity levels in running SSRE projects when developers hand them over. This is particularly relevant for projects in which the community leads or has equity in the development and management of SSRE projects. For instance, the proposed Ramea 2 project, which would be implemented under the BOOT model, would require the developer to transfer the ownership, operation, and management of the project to the Town of Ramea at some point in the lifespan of the project. It will be interesting to understand in advance how Ramea or other off-grid communities will or could organize themselves to successfully do this.

Future research is needed to find solutions to the technical and governance challenges of the Ramea projects highlighted herein. Also, research should begin to explore how lessons and key prospects emanating from demonstration projects are advanced. As highlighted earlier, one of the weaknesses of this study is that it did not ascertain from the proponent organization how the control technology that was successfully developed to synchronize the smooth harmonization of the 3 different components of the WHDP is currently being used. Knowing this, for instance, and generally how other lessons learned from demonstration projects are being used will offer useful insights in informing future policy and research.

5.4.2 Policy Implications and Recommendations

To contribute to the development and successful maintenance of SSRE schemes, especially WEPs, I suggest the following policy recommendations to local communities, energy developers, funding agencies, and other stakeholders.

- *Capacity Building in the SSRE Management "Business"*: With the growing recognition for community-led SSRE development and management, local community councils and community organizations in off-grid areas should consider building their capacity in the renewable energy business. As experienced from the Ramea case, off-grid communities and their organizations are relatively better-off when they are adequately prepared to lead or fully engage in the development and persistence of renewable energy, given that the energy transition is continuing unabated. A "well-prepared" off-grid community will be in a better state to explore and exploit opportunities regarding their energy and general sustainability development. Perhaps off-grid communities could begin exploring ways of starting and running community-based enterprises, which offer great potential to revitalize local communities through delivering social, environmental, and economic benefits (see Haugh, 2007).
- *Access to Capacity Building Funds for Off-Grid Areas*: As highlighted in this study, capacity building at the local community level is especially crucial for the

persistence of community-led initiatives. However, local governments might be challenged in pursuing this given their small and limited budgets, as revealed from Ramea. To cushion these areas in furthering renewable energy development, the availability and easy access to special grants for building local institutions' capacity will go a long way to propel the development and sustainability of SSRE in off-grid areas.

- *Explore the Prospects of Renewable Energy Co-operatives (RE Co-ops)*: A key characteristic in the renewable energy landscape in Canada is the growing number of RE co-ops in local communities. Although there is currently no RE co-op in NL (see NL Federation of Cooperatives, 2017; Toronto Renewable Energy Co-operative, 2016), their benefits and contribution to the overall development and sustainability of RE are widely acknowledged across Canada (see Toronto Renewable Energy Co-operative, 2016). Hence, to promote the development of renewable energy in NL, stakeholders should consider setting up a RE co-op to facilitate the process.
- *Retrofitting of Diesel Systems*: I have justified in this study that the large-sized diesel engines largely contributed to the limited penetration of wind energy in the Ramea's isolated grid. To successfully displace the use of diesel engines in off-grid communities, this study suggests that proponents should consider retrofitting bigger-sized diesel engines (in cases where they exist) to smaller ones at the very early stages of the development of SSRE projects. This implies that developers might have to include the installation of smaller diesel engines as part of an SSRE project's assets. Although this might be somewhat conflicting with the overall goal of displacing the use of diesel engines in the long run, it, however, would facilitate the process in the short run. Also, old diesel engines that are still in good shape could be sold to generate revenue which could be reinvested into the new system. Again, the

just transition thinking (Mccauley & Heffron, 2018) may be relevant in pursuing this recommendation.

5.5 Limitations of the Study

Just like any other research activity undertaken during the global COVID-19 pandemic, this study was adversely affected. The “community-engaged” nature of this research necessitated the collection of primary data through interviews and personal observations. The health crisis partly contributed to delays in executing project tasks and deadlines as more time was committed to obtaining additional permissions to conduct field research during this period. Also, conducting field research during the pandemic brought along additional financial costs. However, this was not borne directly by the researcher, thanks to my supervisor’s assistance in this regard.

Although we were able to obtain all the permissions to undertake the fieldwork, the general response rate from the community members was low, resulting in the completion of fewer interviews than planned. During the weeklong stay in the community, we were able to complete only 5 interviews out of the 15 planned interviews. With the 3 non-community interviews conducted remotely, 8 interviews took place out of the 21 potential interviewees originally contacted.

The panic associated with the health situation possibly contributed to the low interest shown by the community members to participate by interacting with someone from outside the community despite the researcher observing all the necessary public health recommendations. That notwithstanding, we were able to obtain useful and in-depth information and insights from speaking with the few individuals and community leaders who were directly involved or informed regarding the issues of the community’s development.

In retrospect, it might have been informative to also ask interviewees, particularly from the community, about their perceptions of hydrogen energy, and to ask project proponents about the current state of the energy management technology that was successfully designed, such as whether it was commercialized or not. Even though these were outside the scope of the research questions, they nevertheless would have provided a more detailed analysis.

5.6 General Conclusion

Remote communities that are not connected to the main electrical grid are usually disadvantaged regarding their access to clean, affordable, and sustainable energy. These communities typically rely heavily on diesel-powered engines that are often expensive to run, produce carbon emissions, and are not sustainable. Attempts to gradually transition these communities from this undesirable form of energy have identified a huge potential in small-scale renewable energy projects to facilitate the process. As a result, there is an increasing number of demonstration projects across the world, experimenting on the use of these technologies to provide access to sustainable energy. However, some of these projects in other jurisdictions have failed to achieve their intended purposes due to several reasons, including inadequate community engagement in the process. Accordingly, there is a growing literature in support of community energy that bolsters a deep involvement of the local community in the development and governance of the benefits of renewable energy projects.

Leveraging the existing WEPs in an off-grid community in NL, this study set out to (a) examine the general strengths, weaknesses, opportunities, and threats of the projects; (b) ascertain the various ways Ramea as a community has been engaged or is being engaged in the development, operation, and maintenance of the project; and (c) provide insights on how the demonstration project can be optimized for the development and maintenance of similar projects in other remote communities in NL and beyond. By embarking on the site observation and conducting in-depth interviews with the various stakeholders of the projects and document reviews, the study found that Ramea has been engaged in several different ways, both directly and indirectly, by the project proponents. The availability of premium wind energy resources as a result of the geographical location of the town of Ramea, coupled with the commendable local community interest and support for renewable energy projects, provides great potential and opportunity for the Ramea WEP and future renewable energy projects in the community.

I have also learned that the projects contributed to a reduction in carbon emissions, provision of jobs and revenue, and the development of proven control technology for the smooth integration of wind, hydrogen, and diesel systems in a remote location. Conversely, I ascertained that because the projects were not community-owned and due to the uniformity of electricity rates in NL, the direct involvement of Ramea in the operations and sharing of benefits from the projects was limited. Also, the competing energy interests, the large-sized diesel engines, and technical issues with project equipment, in addition to the expensive nature of R&D, largely contributed to the shut down of the wind-hydrogen-diesel demonstration in the community.

I, therefore, conclude that an effective local engagement is a crucial requirement but may not be enough for small-scale renewable energy projects to succeed. Getting the right type and size of equipment to produce and store enough renewable energy that ensures the availability of a reliable source of power is equally critical for the success of off-grid energy solutions. Finally, demonstration projects require strong commitment, greater attention, and a high degree of risk-taking from developers to achieve their intended objectives, suggesting that private developers may have a better chance of succeeding than public utilities.

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APPENDICES

Appendix 1: Research Ethics Approval Email Confirmation

GRENFELL CAMPUS | MEMORIAL UNIVERSITY
Research Ethics Board
University Drive, Corner Brook, NL Canada A2H 5G4
Tel: 709-639-2399 Fax: (709) 637-2885 http://www.grenfell.mun.ca/research-ethics-boar

April 16, 2021

Reference number: **20211430**

Dear Abdul-Rasheed Ature,

Thank you for your update on the personal associated with Local engagement and success of small-scale renewable energy projects in remote areas. The Grenfell Campus Research Ethics Board (GC-REB) has reviewed your update and finds it acceptable.

Your approval for this project expires on the same date as previously communicated to you. To remain in compliance with Article 6.14 (Continuing Research Ethics Review) of the Tri-Council Policy Statement on Ethics in Human Research (TCPS2), should your project continue past that date, you are required to renew your ethics approval before that time. As well, please note that any changes to the proposed study will need to be cleared by the GC-REB first.

The Board wishes you success with your research.

Best wishes,

John Bodner, Ph.D., Chair

IMPORTANT REMINDERS – PLEASE READ:

Important Notice regarding COVID-19: As the situation changes and develops with COVD-19, it is up to the PI to ensure that the research team remains in compliance with Memorial's current status on in-person data collection. You can follow information on the current status of policy here: https://www.mun.ca/research/.

GRENFELL CAMPUS, MEMORIAL UNIVERSITY
20 University Drive, Corner Brook, NL, Canada, A2H 5G4
Tel: 709 637 6200 Fax: 709 639 8125
www.grenfell.mun.ca

FIND YOUR CORNER

Appendix 2: Interview Guide

General Note to self/ Instruction for RA
-This is a semi-structured interview, and each interview session is expected to last between 30 minutes and an hour in duration.

Objectives
-acquire in-depth commentary on interview topics from interviewees
    -tape-record sessions with an audio recording device
    -probe by following prompts and asking for examples/scenarios to illustrate key responses
-Not keep interviewees more than an hour

Pre-Interview Checklist:
☐ thank the interviewee for their time and participation.
☐ if they have a time constraint, solicit their help in getting through all questions.
☐ provide a copy of the consent form; allow them to ask questions (introduce RA appropriately before obtaining consent).
☐ have them sign the consent form (in the case of remote interviews, an electronic or audio-recorded consent is okay)
☐ clarify that, for any question, it is fine to say that they have already answered it
☐ start audio-recording the interview.

Interview Topics:
1. Tell me about yourself and your connection to the Ramea wind-diesel demonstration project
____
____
____
____

2. Tell me about the Ramea wind-diesel project (prompt to discuss both initial development and expansion)
The initial development in 2004
____
____
____
The upgraded development in
2011____
____
____

3. What are the strengths, weaknesses, opportunities, and threats for the project (prompt for each of the four)

Strengths

Weaknesses

Opportunities

Threats

4. How was the community engaged in the process? (prompt for what was done, could have been done, what is now done, what should be done)
What was done?

What could have been done?

What is done now?

What should be done?

5. How is the project a "demonstration" project for other communities? (how could it do better, what else could other communities learn)
How could it do
better?

What else could other communities learn?

Appendix 3: Informed Consent Form

I invite you to participate in a research study entitled "Local engagement and success of small-scale renewable energy projects in remote areas: Insights from Ramea's wind-hydrogen-diesel project"

Researcher
Abdul-Rasheed Ature, Graduate Student (MA Environmental Policy), Environmental Policy Institute, Grenfell Campus, MUN. Email: araature@grenfell.mun.ca. Phone: (709) 632-6564.

Supervisor
Dr. Garrett Richards, Assistant Professor, Environmental Policy Institute, Grenfell Campus, MUN. Email: grichards@grenfell.mun.ca. Phone: (709) 639-6534.

Research Assistant
Skylar Skinner, Graduate Student (MA Environmental Policy), Environmental Policy Institute, Grenfell Campus, MUN sws782@grenfell.mun.ca

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Introduction
This form provides details about this research and what your participation will involve. It also describes your right to withdraw from the study at any time. You should understand the risks and benefits before making an informed decision to participate.

Purpose of study
The study seeks to examine the role of local engagement in the success of small-scale renewable energy projects in remote communities, using the Ramea wind-hydrogen-diesel project as an example.

What you will do in this study
If you wish to participate in this study, you will participate in an interview with the researcher. Potential topics include:

- the Ramea wind-diesel project in general, and your connection to it (if any)
- strengths, weaknesses, threats, and opportunities for the project
- community engagement around the project
- what other communities could learn from the project being a "demonstration project"

Length of time
Your participation is a one-time event that is expected to last between 30 minutes and one hour.

Withdrawal from the study
Your participation in the study is entirely voluntary and you have the right to withdraw at any point during the interview without any consequences. You may choose not to answer individual questions for any reason. You may also withdraw or change your comments within one month of the interview; afterward, your comments may already be too integrated into the project to be removed.

Possible benefits
There are no immediate direct benefits to you if you agree to participate in the study. However, your participation could indirectly contribute to an improvement in how local remote communities are engaged in the development and management of energy projects.

Possible risks
Participation in this study will not expose you to any known significant risks.

Confidentiality and storage of data
The interview will be conducted in a location of your choosing (and maybe by phone or virtual). It will be audio-recorded. Any Research Assistant present during interviews will be required to protect the confidentiality of your responses. The recording can be shared with you on request. All data files will be stored on the researcher's devices or password protected. Raw data will only be accessed by the researcher and supervisory committee. It will be kept for five years and then deleted.

Anonymity
You are assured that any quotes or paraphrases of your comments used in the thesis report or any publication will not identify you by name or include any identifying information.

Sharing of results with participants
The final thesis report and/or any publication made from this study can be shared with you upon request.

Questions
You are welcome to ask questions at any time during your participation in this research. If you would like more information, please contact the researcher or supervisor identified at the top of this form.

The proposal for this research has been reviewed by the Grenfell Campus-Research Ethics Board and found to comply with Memorial University's ethics policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the GC-REB through the Grenfell Research Office (GCREB@grenfell.mun.ca) or by calling (709) 639-2399.

Consent
Your signature on this form means that:

- You have read the information about the research.
- You understand what the study is about and what you will be doing.
- You understand that you are free to withdraw from the study at any time, without having to give a reason, and that doing so will not affect you now or in the future.
- You consent to participate in the study and contribute your comments as data.

If you sign this form, you do not give up your legal rights and do not release the researchers from their professional responsibilities.

______________________________ ______________________________
Signature of participant Date

Researcher's signature
I have explained this study to the best of my ability. I invited questions and gave answers. I believe that the participant fully understands what is involved in being in the study, any potential risks of the study and that he or she has freely chosen to be in the study.

______________________________ ______________________________
Signature of researcher Date

Research Assistant's Signature
I understand that I will serve as an interpreter between the researcher and the participant and will ensure confidentiality of all responses I am privy to during interviews.

______________________________ ______________________________
Signature of Research Assistant Date

Appendix 4: Interview Recruitment Invitation

Subject: Invitation to participate in a research study.

Introductory text

Dear [potential participant's name],

My name is Rasheed Ature, a graduate student at the Environmental Policy Institute at Grenfell Campus, Memorial University of Newfoundland. As part of my master's program, I am working on my thesis entitled, "Local engagement and success of small-scale renewable energy projects in remote areas: Insights from Ramea" under the supervision of Dr. Garrett Richards. The purpose of the study is to examine the role of local engagement in the success of small-scale renewable energy projects in remote communities, using the Ramea wind-hydrogen-diesel project as a case.

We are looking for participants who have some sort of connection to the project. And so, we are currently reaching out to all stakeholders who were identified (by publicly available information) as partners to the project or were involved in some form or capacity during the planning, development, operation, and/ or maintenance of the project. And I am contacting you [because you were identified as a stakeholder or works with/ for the stakeholder of the project]. If this applies to you, I would like to formally invite you to a short interview on your experiences and/ or views about the Ramea project.

The interviews will be conducted remotely over the phone or video call and will take about 30 minutes or more but less than an hour long. Your participation is entirely voluntary and your responses (should you wish to participate) will be confidential. If you are interested in participating (or have any questions or concerns) please contact me (via araature@grenfell.mun.ca; 709-6326564). You may also direct questions and concerns to the Grenfell Campus Research Ethics Board (gcethics@grenfell.mun.ca). I will provide you with additional details and a consent form before confirming your participation if you wish to participate.

Thank you!

Follow-Up Text for Positive Responses

Hello [interested person's first name],

Thank you for expressing to participate in this study. I have attached a consent form, containing detailed information about the study and how you will be participating. Also included is an outline of the questions that will be covered during the interview session. Although the actual consent will be taken at the beginning of the interview, you can review it and let me know if you have some questions or concerns now.
If you are okay with everything, I would proceed to schedule 30 mins to 1-hour call (either audio or video) on a date and time that works well for you. My availability is [describe availability in the near future].
Please let me know what date, time, and call medium (audio or video) that would be most convenient for you.

Thanks again!

Appendix 5: Face to Face Interactions with Research Participants Request

Face-to-Face Interactions with Research Participants Request Form

Grenfell Campus

COVID-19 Framework

PLEASE COMPLETE ELECTRONICALLY AND SAVE AS A MS-WORD FILE.

This request form and COVID-19 Health and Safety Plan should be completed with reference to the *Framework for a Phased Approach to Returning to On-Campus Research Spaces, Fieldwork and Face-to-Face Interactions with Research Participants* (SEE LINK HERE).

It is recognized that this request is unusually detailed. It is critical, however, that face-to-face interactions with research participants resume in a manner that ensures that our faculty, staff, students, research participants, as well as members of the broader communities in which we live and interact, are not exposed to COVID-19 risks as a result of Memorial's research programs.

Careful completion of this request form and activity-specific Health and Safety Plan by the principal investigator (PI) is important in regard to resuming face-to-face interactions with research participants in a timely manner. It is critical to also comply with building-specific Health and Safety Plans that are in place for the buildings that will be accessed in preparing for the research activity. The building-specific Health and Safety Plans that pertain to the requested activities are available from the PI's Dean.

Your careful completion of this request form and COVID-19 Health and Safety Plan is important in regard to resuming face-to-face interactions with research participants in a timely manner. Also, please include a copy of any existing health and safety plans that are used by your research group for normal research operations. Incomplete requests or COVID-19 Health and Safety plans will delay consideration and approval of requests.

Name, academic unit, email address and telephone number for the principal investigator: Abdul-Rasheed Ature, Graduate Student (MA Environmental Policy), Environmental Policy Institute, Grenfell Campus, MUN. Email: araature@grenfell.mun.ca. Phone: (709) 632-6564.
Names, email addresses and telephone numbers for each research team member to be authorized to engage in the face-to-face interactions with research participants: **Supervisor:** Dr. Garrett Richards, Assistant Professor, Environmental Policy Institute, Grenfell Campus, MUN. Email: grichards@grenfell.mun.ca. Phone: (709) 639-6534 **Research Assistant:** Skylar Skinner, Graduate Student (MA Environmental Policy), Environmental Policy Institute, Grenfell Campus, MUN. Email: sws782@grenfell.mun.ca.
Location of the requested research involving face-to-face interactions with research participants: The Town of Ramea (where the RA is originally from). We will be conducting face-to-face interviews with some members of the community.
Description of the requested researching involving face-to-face interactions with research participants (maximum 300 words and indicate sources of funding): The research entitled, "local engagement and success of small-scale renewable energy in remote areas" is conducted as my master's thesis. It seeks to understand how local engagement in off-gird communities in remote areas influences the success or otherwise of small-scale renewable energy projects, using the Ramea wind-hydrogen-diesel (WHD) project as a case. The Ramea WHD is a research and development project which combines energy generations from wind and diesel systems together with hydrogen storage to produce clean electricity. It was developed by Nalcor Energy in the community as part of efforts to phase out electricity generation from diesel plants in Newfoundland and Labrador. This study sets out to achieve the following objectives: -examine the general strengths, weaknesses, opportunities, and threats of the novel research and development WHD project. -ascertain the various ways Ramea as a community has been engaged or are being engaged in the development, operation, and maintenance of the project. And -provide insights on how this demonstration project can be optimized for the development and maintenance of small-scale renewable energy projects in other remote communities in the province of Newfoundland and Labrador and beyond.

The face-to-face interaction component of the study is a primary data collection exercise involving in-person interviews by any of the research team members with participants from the Town of Ramea. Participants will be drawn across the general population of the community using a snowball technique of purposive sampling method. And during the conversations with each of the research participants, the session will be recorded (upon seeking and obtaining consent from participants). This research has no "targeted funding" but the supervisor has discretionary funding to cover some of the costs.
Description of any equity, diversity and inclusion considerations associated with the request: There are no equity, diversity, and inclusion considerations associated with the study.
Duration and frequency of the face-to-face interactions with research participants (indicate specific dates and times): The exercise is expected to last between 4 to 7 days. And the site visit will be embarked ideally sometime in April 2021, upon obtaining all the needed approvals. Interviews with participants will be a one-time event, and each interaction is expected to last between 30 minutes and 1 hour.
Description of other activities that will be ongoing at the location of the proposed research involving face-to-face interactions with research participants (address interactions with other activities in responses to the subsequent questions): Apart from the usual daily activities undertaken by residents in the community, there are no other known special activities that will be ongoing at the study location. And in this situation, interviews will not be conducted in areas where it will be difficult to limit interaction with others or avoid third parties' interferences; but in areas that will be convenient and accessible to both the researcher and the participant in each case without any form of disturbance.
Explain how travel to and from your fieldwork site(s) can be conducted in compliance with current federal, provincial and University travel advisories and restrictions, and the attached Health and Safety Plan. Include necessary measures for physical distancing during all travel. Describe the health insurance arrangements that are in place to cover each member of the research team for COVID-19 related matters: -Travel to the town will be done with a personal vehicle of one of the research team members (from Corner Brook to Burgeo) and ferry (Burgeo to Ramea) as the community cannot be accessed by vehicle after Burgeo. -In the vehicle and ferry, physical distancing will be maintained throughout the journey. -Face masks will be worn whenever necessary (both in the vehicle and the ferry).
Describe your plan for provision of food and gasoline where travel is involved:

-The research team members will pack enough food and snacks for the journey. -The vehicle will be fueled at pay at the pump station, therefore no physical contact with others. Paper towels will be used to cover palms before grabbing the pump and fueling the vehicle and hand sanitizer will be used to sanitize hands afterward. The same will be done when entering payments at the point of sale.
Outline efforts made to minimize number of personnel needed: **-** Only two members of the research team will be undertaking this exercise. And they will observe all COVID-19 protocols throughout the exercise.
Outline measures that will be taken to ensure no research team member or research participant has COVID-19 symptoms before commencing face-to-face interactions with research participants: Before the commencement of the face-to-face interactions in the community, we will conduct a self-assessment each day using the self-assessment tools and resources provided at the NL government's website below: https://www.gov.nl.ca/covid-19/covid-19-symptoms-treatment/ https://www.811healthline.ca/covid-19-self-assessment/. And if any member of the research team exhibits any of the symptoms of COVID-19, he will not be allowed to partake in the fieldwork. And will be required to self-isolate immediately at their place of accommodation, as we contact the office of the Chief Medical Officer for further directions.
In accordance with the attached Health and Safety Plan, outline how working conditions and use of equipment during the face-to-face interactions with research participants will allow observance of physical distancing: During interviews, the interviewers will always wear a face mask and will conduct interviews with participants only while maintaining at least 2 meters/ 6 feet distance apart per the COVID-19 physical distancing guidelines. Again, all interviews will be tape-recorded with an audio recording device, which will be placed in a convenient place where it will be possible to secure a clear recording of the sessions.
In accordance with the attached Health and Safety Plan, identify any critical Personal Protective Equipment (PPE) required in carrying out the face-to-face interactions with research participants. Confirm whether this is available. Indicate how the face-to-face interactions with research participants will be conducted while wearing PPE: Face masks, sanitizers, and paper towels will be obtained for the field exercise. These items will be used in the following manner: -Face masks will be worn throughout all sessions by the research team members. And for each interview, the interviewer and the interviewee will be seated 2 meters or 6 feet apart. -Sanitizers: Before and after each interview session, chairs, surfaces, or any other items touched will be disinfected using sanitizers and paper towels.

Should a member of the research team develop COVID-19 symptoms while travelling or engaged in the face-to-face interactions with research participants, describe your response plan. Describe how self-isolation will be assured under such circumstances: If a member of the research team exhibits any symptoms of COVID-19, he will be required to immediately halt field activities and self-isolate at his accommodation in Ramea per the COVID-19 guidelines. And the appropriate authorities will be contacted and assisted with contact tracing and any other relevant information to contain the spread.
Are there high-risk groups involved in the research in any way (whether directly or indirectly, e.g. during research travel, as participants or members of research teams or otherwise)? If yes, describe plans for how these risks will be eliminated or mitigated: The research does not involve any high risks groups.
Does this research requires approval by an ethics board? If yes, please provide an update on the status of the ethics board approval to resume or undertake the research. Please note that research may not proceed or resume until all approvals, including ethics board approval, have been received and linked or uploaded in ROMEO. This research has been reviewed and approved by the Grenfell Campus Research Ethics Board. If you have ethical concerns about the research, you may contact the Chairperson of the GC-REB through the Grenfell Research Office (GCREB@grenfell.mun.ca) or by calling (709) 639-2399.
Indigenous Research includes any research on Indigenous land (under title or upon which an Indigenous group has asserted rights), and/or that uses Indigeneity as a way to recruit participants, gather data or input, or interpret data and information. In also refers to primary research and secondary use of data. Does your request seek to undertake or resume Indigenous Research? If yes, please confirm that you have received appropriate permissions and consent to conduct or resume your research or provide an update on the status of your actions to secure the permission and consent. Note: for questions, advice, or support related to Indigenous research, please contact Indigenousresearch@mun.ca. -This study does not involve any form of indigenous research.
Other resources required (e.g. Technical Services, Animal Care Services, CREAIT, Library, Information and Telecommunications Services, Departmental or Faculty resources or staff, etc.): -No other resources are required
List all equipment and supplies from Memorial which will be used during the face-to-face interactions with research participants: -No equipment or supplies from Memorial will be used during this exercise.

List all equipment and supplies which will be obtained locally where face-to-face interactions with research participants occurs off-campus: None
Will equipment or supplies used on site be shared by research team members or research participants? If yes, in accordance with the attached Health and Safety Plan, indicate the cleaning and disinfection measures will be undertaken for shared or re-used equipment and supplies: -No
Discuss why the face-to-face interactions with research participants must be undertaken at this time (maximum 150 words): Conducting the face-to-face interaction at this time is influenced by two reasons. The first reason is the anticipation of an unavoidable difficulty in obtaining the desired interview outcomes with remote interviews. The reason is that there is currently no rapport between the research team and Ramea, as the researchers have not had an opportunity to establish a pre-existing relationship with the community before this study. And so, there is the tendency of not being able to convince prospective participants unto the study when interviews are to be conducted over the phone. The second reason is the goal of the PI to finish his MA by August, which is now dependent on the completion of this thesis in time. And hence it might not be possible if this exercise is postponed to another time; when everything gets back to normal.
Discuss the negative impact on research or scholarly activity program if the face-to-face interactions with research participants is not approved (maximum 150 words): - There will be a likely lower response rate and lower-quality responses should this request not be approved.
Discuss your contingency plan in the event the face-to-face interactions with research participants must subsequently be suspended (e.g., due to renewed government restrictions or illness amongst team members): -Will have to resort to remote interviews. Although, this might adversely affect the achievement of project objectives and/ or the completion of the project in time.
Have you have received and reviewed a copy of the building-specific Health and Safety Plan(s) for the building(s) that you need to access in relation to the research involving face-to-face interactions with research participants. No. No specific building will be used for this study.

Note:

Approved face-to-face interactions with research participants are restricted to only those that have been recommended to Environmental Health and Safety (EHS) by the Dean and only upon receipt of a letter from EHS following review of the COVID-19 Health and Safety Plan for the activity. In undertaking the requested research, the researchers are agreeing to comply with relevant building-specific Health and Safety Plan and the activity-specific Health and Safety Plan. The Dean will advise of any conditions attached to an approval. In the case of requests related to activities by researchers at the Grenfell Campus or the Marine Institute, the approval of the respective campus Vice-President (or their delegate) and the Vice-President (Research) is required. **All ethics approvals and documented consent (for Indigenous Research) must be in place and linked and uploaded to ROMEO before research can proceed or resume**.

Face-to-Face Interactions with Research Participants

COVID-19 Health and Safety Plan
Grenfell Campus

Using the table below, please provide a Health and Safety Plan that details the activities to be undertaken, and identifies potential hazards, applicable engineering, administrative and personal protective equipment (PPE) controls required to undertake face-to-face interactions with research participants during the COVID-19 pandemic. These controls must be followed in addition to all NL Occupational Health and Safety requirements, relevant Memorial University Policies and Procedures, other COVID-19 requirements (e.g. confirmation of COVID-19 awareness training, COVID-19 screening procedures) that may be introduced by Memorial's Environmental Health and Safety unit, and other health and safety plans and procedures that would be applicable to your face-to-face interactions with research participants under normal circumstances.

Please review the activities and controls noted in the table below, and add/delete/modify the activities and control descriptions so that they are comprehensive and relevant to your request. If assistance is required in preparing the COVID-19 Health and Safety Plan, please contact health.safety@mun.ca.

In preparing your Health and Safety Plan for fieldwork please note the following:

- Everyone has a part to play in reducing the spread of COVID-19.
- This COVID-19 Health and Safety Plan must be shared with all researchers involved in the research activity.
- Researchers who have symptoms associated with COVID-19 must not engage in the requested research activities. Symptoms include fever (or signs of a fever such as chills, sweats, muscle aches, and lightheadedness), cough, headache, sore throat, painful swallowing, runny nose, unexplained loss of appetite, diarrhea, and loss of sense of smell or taste.
- Researchers must practice high personal hygiene by regularly washing hands with soap and water, when available, or using approved hand sanitizer when hand washing is not possible. Wash hands often and for at least 20 seconds at a time.
- Physical distancing must be maintained when entering, exiting and working within on-campus spaces, during transportation to and from the off-campus sites, and during completion of the research involving face-to-face interactions with research participants. Maintain a physical distance of 2m (6ft) from other people in order to stop, slow down or contain the spread of COVID-19.
- Health monitoring protocols, as directed by the Environmental, Health and Safety unit, must be implemented.

- A detailed log must be kept for the use and cleaning of vehicles, research spaces, equipment and other materials that may be used by multiple individuals.
- Researchers must minimize the transfer of commonly used equipment among them and research participants during the course of the research.
- Enhanced cleaning protocols for COVID-19 must be followed. Surfaces must be cleaned with 70% alcohol or other suitable disinfectant before and after use. Users must wipe down any contact points with approved disinfectant or sanitation wipes once they have finished using equipment.
- Materials that can't be cleaned must be quarantined for 72 hours between usage.
- Fieldwork sites must be configured to accommodate physical distancing and reduce the density of occupation. Enhanced cleaning protocols for COVID-19 must remain in place for these sites.
- All waste materials generated during the course of research must be properly disposed of.
- Where access to common or centralized research resources is required, a process for advance scheduling and coordination among different users must be implemented.
- Every effort must be made to conduct office work (i.e. computer work, writing, etc.) associated with the fieldwork at home as recommended by the Provincial Public Health Guidelines.
- Physical distancing and enhanced cleaning protocols for COVID-19 must also be implemented when working in an office environment is unavoidable. It is important to limit the number of people working in a space in accordance with the Provincial Public Health Guidelines. Every effort must be made to minimize office occupancy to reduce possible risk associated with COVID-19.
- In single offices with one occupant, physical distancing must be maintained if another person enters the office.
- In shared offices with multiple occupants, the configuration of the office must be such that physical distancing can be maintained when occupation of the space increases to more than one individual.
- In circumstances where physical distancing is not possible between individuals occupying office space, appropriate PPE should be used, in case where PPE is not available, occupation must be staggered to avoid personal contact.
- A mechanism of communication, such as the MUN safe app, must be in place so that the principle investigator remains in regular contact with any students and/or staff working alone or members of the research group that are engaged in fieldwork.
- The principal investigator must have a plan and process in place for the students and staff to check each day and report on risks encountered, and mitigation strategies employed.
- On a daily basis while research activities are ongoing, there must be a procedure to make an assessment of risks which must be used as the basis for a decision to continue activities.

Hazard Assessment			
Activity	**Potential Hazard**	**PPE/Admin Controls**	**Engineering Controls**
Entering and exiting offices and on- and off-campus research spaces for research involving face-to-face interactions with research participants	Biological virus COVID-19 exposure and circulation	-Any member of the research team will always wear face masks when accessing buildings. And -Will always check in with security to access any building or facility for this research.	-All members of the research team will always maintain 2 meters or 6 feet physical distancing protocols when using buildings and offices.
Travel to/from off-campus research sites	Biological virus COVID-19 exposure and circulation	-Members of the research team will pack enough food and snacks for the journey. -Travel to the town will be done with a personal vehicle of one of the research team members (i.e., from Corner Brook to Burgeo) and ferry (Burgeo to Ramea) as the community cannot be accessed by vehicle after Burgeo. -The vehicle will be fueled at any of the pay at the pump stations along the highway to Burgeo (i.e., Corner Brook, Stephenville, Burgeo). And there will not be any physical contact with others in the process. Paper towels will be used to cover palms before grabbing the pump to fuel the vehicle, and hand sanitizer will be used to sanitize hands afterward. The same will be done when effecting payments at the point of sale.	- All members of the research team traveling will always wear face masks whenever necessary (both in the vehicle and ferry). -Physical distancing will be observed while traveling in the vehicle and ferry.

Working at off-campus research site	Biological virus COVID-19 exposure and circulation	-Before the start of any data collection each day, the members of the research team will conduct a COVID-19 self-assessment provided by the Government of NL at https://covidassessment.nlchi.nl.ca/ to be sure they are safe and also prevent the spread. -Face masks will be worn throughout all sessions. And for each interview, any member of the research team and the research participant will be seated 2 meters or 6 feet apart. -Sanitizers: Before and after each interview session, chairs, surfaces, or any other items touched will be disinfected using sanitizers and paper towels. -The research team members will stay in constant contact with the appropriate authorities to be updated on the COVD-19 situation in the province and to have timely information regarding its impacts on the field activities. -The team will use any other tool and resource available to prevent exposure to the virus and to also help contain its spread.	- Interviewees will be allowed to choose the location for the interviews, which will likely be a public space in Ramea. -Physical distances of 2 meters or 6 feet will always be maintained when conducting face-to-face interviews -Face masks will always be worn by the research team - Participants will not be forced to wear a mask (although they will be expected to keep a 2m distance) - The COVID alert App will be installed on the mobile devices of the research team members on the field to further assist in detecting exposures to the virus.

Accommodation in the field	Biological virus COVID-19 exposure and circulation	-Reservation will be made at a local hotel or accommodation facility in Ramea for the PI. -The RA is originally from Ramea and will be staying at his home.	-Any member of the research team staying at the hotel, will observe the physical distancing arrangements of the hotel. -Face mask will be worn at all-time necessary.
Exploring the field	Biological virus COVID-19 exposure and circulation	- Face mask will be worn when accessing any public space or building.	-Observe physical distancing when outside.

Appendix 6: Fieldwork Request Form

Fieldwork Request Form

Level 4 Activity Level

COVID-19 Framework

PLEASE COMPLETE ELECTRONICALLY AND SAVE AS A PDF FILE.

This request form and COVID-19 Health and Safety Plan should be completed with reference to the *Framework for a Phased Approach to Returning to On-Campus Research Spaces, Fieldwork and Face-to-Face Interactions with Research Participants* (SEE LINK HERE).

It is recognized that this request is unusually detailed. It is critical, however, that fieldwork resumes in a manner that ensures that our faculty, staff and students, as well as members of the broader communities in which we live and interact, are not exposed to COVID-19 risks as a result of Memorial's research programs.

Please note that at Framework Level 4 (High Risk), fieldwork must not include overnight stays, interactions with individuals outside of the members of the research team named in the request, or travel in shared vehicles. Your careful completion of this request form and COVID-19 Health and Safety Plan is important in regard to resuming fieldwork in a timely manner. Also, please include a copy of any existing health and safety plans that are used by your research group for normal research operations. Incomplete requests or COVID-19 Health and Safety plans, or requests that extend beyond the scope of Framework Level 4 will delay consideration and approval of requests.

Name, email address and telephone number for the principal investigator: Name: Abdul-Rasheed Ature Email: araature@grenfell.mun.ca. Phone: (709) 632-6564.

Names, email addresses and telephone numbers for each research team member to be authorized to engage in the fieldwork: **Supervisor:** Dr. Garrett Richards Email: grichards@grenfell.mun.ca. Phone: (709) 639-6534 **Research Assistant:** Skylar Skinner Email: sws782@grenfell.mun.ca.
Location of the requested fieldwork: The Town of Ramea (where the RA is originally from). We will be conducting face-to-face interviews with some members of the community
Description of the requested fieldwork to be undertaken (maximum 300 words and indicate sources of funding): The research entitled, "local engagement and success of small-scale renewable energy in remote areas" is conducted as my master's thesis. It seeks to understand how local engagement in off-gird communities in remote areas influences the success or otherwise of small-scale renewable energy projects, using the Ramea wind-hydrogen-diesel (WHD) project as a case. The Ramea WHD is a research and development project which combines energy generations from wind and diesel systems together with hydrogen storage to produce clean electricity. It was developed by Nalcor Energy in the community as part of efforts to phase out electricity generation from diesel plants in Newfoundland and Labrador. This study sets out to achieve the following objectives: -examine the general strengths, weaknesses, opportunities, and threats of the novel research and development WHD project. -ascertain the various ways Ramea as a community has been engaged or are being engaged in the development, operation, and maintenance of the project. And -provide insights on how this demonstration project can be optimized for the development and maintenance of small-scale renewable energy projects in other remote communities in the province of Newfoundland and Labrador and beyond. The face-to-face interaction component of the study is a primary data collection exercise involving in-person interviews by any of the research team members with participants from the Town of Ramea. Participants will be drawn across the general population of the community using a snowball technique of purposive sampling method. And during the conversations with each of the research participants, the session will be recorded (upon seeking and obtaining consent from participants). This research has no "targeted funding" but the supervisor has discretionary funding to cover some of the costs.
Description of any equity, diversity and inclusion considerations associated with the request: There are no equity, diversity, and inclusion considerations associated with the project and this request.

Duration and frequency of the fieldwork program (indicate specific dates and times): The exercise is expected to last between 5 to 7 days. And the site visit will be embarked upon ideally sometime in April 2021, upon obtaining all the needed approvals. Interviews with participants will be a one-time event, and each interaction is expected to last between 30 minutes and 1 hour.
Description of other activities that will be ongoing at the location of the proposed fieldwork (address interactions with other activities in responses to the subsequent questions): Apart from the usual daily activities undertaken by residents in the community, there are no other known special activities that will be ongoing at the study location. And in this situation, interviews will not be conducted in areas where it will be difficult to limit interaction with others or avoid third parties' interferences; but in areas that will be convenient and accessible to both the researcher and the participant in each case without any form of disturbance.
Explain how travel to and from your fieldwork site(s) can be conducted in compliance with current federal, provincial and University travel advisories and restrictions, and the attached Health and Safety Plan. At Level 4, fieldwork must not include overnight stays and researchers must travel in single occupancy vehicles. Include necessary measures for physical distancing during all travel: -Travel to the town will be done with a personal vehicle of one of the research team members (from Corner Brook to Burgeo) and ferry (Burgeo to Ramea) as the community cannot be accessed by vehicle after Burgeo. -In the vehicle and ferry, physical distancing will be maintained throughout the journey. -Face masks will be worn whenever necessary (both in the vehicle and the ferry).
Describe your plan for provision of food and gasoline in the field (note that interactions with individuals outside of your research team are not permitted at Level 4): -The research team members will pack enough food and snacks for the journey. -The vehicle will be fueled at pay at the pump station, therefore no physical contact with others. Paper towels will be used to cover palms before grabbing the pump and fueling the vehicle and hand sanitizer will be used to sanitize hands afterward. The same will be done when entering payments at the point of sale.
Outline efforts made to minimize number of field personnel needed: **-**Only two members of the research team will be undertaking this exercise. And they will observe all COVID-19 protocols throughout the exercise.

Outline measures that will be taken to ensure no research team has COVID-19 symptoms before commencing fieldwork: Before the commencement of the face-to-face interactions in the community, we will conduct a self-assessment each day using the self-assessment tools and resources provided at the NL government's website below: https://www.gov.nl.ca/covid-19/covid-19-symptoms-treatment/ https://www.811healthline.ca/covid-19-self-assessment/. And if any member of the research team exhibits any of the symptoms of COVID-19, he will not be allowed to partake in the fieldwork. And will be required to self-isolate immediately at their place of accommodation, as we contact the office of the Chief Medical Officer for further directions.
If you are conducting fieldwork alone, explain how you will comply with Memorial's Working Alone policy (see http://www.mun.ca/health_safety/OHSMS/S-014_Working_Alone.pdf): In a situation where any member of the research team will be conducting the exercise alone in the field, he will be required to maintain constant contact with the supervisor to keep him updated on his activities and progress. Again, the MUN safe App will be installed on the research team member's mobile device where he will have access to all resources and tools needed to ensure his safety while working in the community.
In accordance with the attached Health and Safety Plan, outline how working conditions and use of equipment at the fieldwork site will allow observance of physical distancing: Interview settings will be organized to maintain a distance of 6 feet apart between interviewers and interviewees. And interviewers will always wear a face mask.
In accordance with the attached Health and Safety Plan, identify any critical Personal Protective Equipment (PPE) required in carrying out the fieldwork. Confirm whether this is available to the researchers. Indicate how fieldwork will be conducted while wearing PPE: Face masks, sanitizers, and paper towels will be obtained for the field exercise. These items will be used in the following manner: -Face masks will be worn throughout all sessions by the research team members. And for each interview, the interviewer and the interviewee will be seated 2 meters or 6 feet apart. -Sanitizers: Before and after each interview session, chairs, surfaces, or any other items touched will be disinfected using sanitizers and paper towels.
Should a member of the research team develop COVID-19 symptoms while travelling or engaged in the fieldwork, describe your response plan. Describe how self-isolation will be assured under such circumstances: If a member of the research team exhibits any symptoms of COVID-19, he will be required to immediately halt field activities and self-isolate at his accommodation in Ramea per the COVID-19 guidelines. And the appropriate authorities will be contacted and assisted with contact tracing and any other relevant information to contain the spread.
Are there high-risk groups involved in the research in any way (whether directly or indirectly, e.g. during research travel, as participants or members of research teams or otherwise)? If yes, describe plans for how these risks will be eliminated or mitigated:

No high-risk groups are associated with this research and request.
Other resources required (e.g. Technical Services, Animal Care Services, CREAIT, Library, Information and Telecommunications Services, Departmental or Faculty resources or staff, etc.): Not Applicable.
List all equipment and supplies from Memorial which will be used during fieldwork: None
List all equipment and supplies which will be obtained locally at the fieldwork locations: No equipment or any supplies to support the research activities will be bought on the field.
Will equipment or supplies used on site be shared by field team members? If yes, in accordance with the attached Health and Safety Plan, indicate the cleaning and disinfection measures will be undertaken for shared or re-used equipment and supplies: No
Discuss why this fieldwork must be undertaken at this time and meets the relevant criteria for Framework Level 4 activity (maximum 150 words): Conducting the face-to-face interaction at this time is influenced by two reasons. The first reason is the anticipation of an unavoidable difficulty in obtaining the desired interview outcomes with remote interviews. The reason is that there is currently no rapport between the research team and Ramea, as the researchers have not had an opportunity to establish a pre-existing relationship with the community before this study. And so, there is the tendency of not being able to convince prospective participants unto the study when interviews are to be conducted over the phone. The second reason is the goal of the PI to finish his MA by August, which is now dependent on the completion of this thesis in time. And hence it might not be possible if this exercise is postponed to another time; when everything gets back to normal.
Discuss the negative impact on research or scholarly activity program if the fieldwork is not approved under Framework Level 4 (maximum 150 words): - There will be a likely lower response rate and lower-quality responses should this request not be approved.
Discuss your contingency plan in the event the fieldwork must subsequently be suspended (e.g., due to renewed government restrictions or illness amongst team members): Will have to resort to remote interviews. Although, this might adversely affect the achievement of project objectives and/ or the completion of the project in time.

Note:

Approved fieldwork is restricted to only the fieldwork that has been approved in writing by the Vice-President (Research) and only upon receipt of the approval letter and upon meeting any conditions set out in the approval letter. In the case of requests related to fieldwork by researchers at the Grenfell Campus or the Marine Institute, the approval of the respective campus Vice-President (or their delegate) and the Vice-President (Research) is required.

Fieldwork

COVID-19 Health and Safety Plan

Framework Level 4

Using the table below, please provide a Health and Safety Plan that details the activities to be undertaken, and identifies potential hazards, applicable engineering, administrative and personal protective equipment (PPE) controls required to undertake fieldwork during the COVID-19 pandemic. These controls must be followed in addition to all NL Occupational Health and Safety requirements, relevant Memorial University Policies and Procedures, other COVID-19 requirements (e.g. confirmation of COVID-19 awareness training, COVID-19 screening procedures) that may be introduced by Memorial's Environmental Health and Safety unit, and other health and safety plans and procedures that would be applicable to your fieldwork under normal circumstances.

Please review the activities and controls noted in the table below, and add/delete/modify the activities and control descriptions so that they are comprehensive and relevant to your request. If assistance is required in preparing the COVID-19 Health and Safety Plan, please contact health.safety@mun.ca.

In preparing your Health and Safety Plan for fieldwork please note the following:

- Everyone has a part to play in reducing the spread of COVID-19.
- This COVID-19 Health and Safety Plan must be shared with all researchers involved in the research activity.
- Researchers who have symptoms associated with COVID-19 must not engage in on-campus activities. Symptoms include fever (or signs of a fever such as chills, sweats, muscle aches, and lightheadedness), cough, headache, sore throat, painful swallowing, runny nose, unexplained loss of appetite, diarrhea, and loss of sense of smell or taste.
- Researchers must practice high personal hygiene by regularly washing hands with soap and water, when available, or using approved hand sanitizer when hand washing is not possible. Wash hands often and for at least 20 seconds at a time.

- Physical distancing must be maintained when entering, exiting and working within on-campus spaces, during transportation to and from the fieldwork site, and during completion of the fieldwork. Maintain a physical distance of 2m (6ft) from other people in order to stop, slow down or contain the spread of COVID-19.
- Health monitoring protocols, as directed by the Environmental, Health and Safety unit, must be implemented.
- A detailed log must be kept for the use and cleaning of vehicles, research spaces, equipment and other materials that may be used by multiple individuals.
- Researchers must minimize the transfer of commonly used equipment between them during the course of their fieldwork.
- Enhanced cleaning protocols for COVID-19 must be followed. Surfaces must be cleaned with 70% alcohol or other suitable disinfectant before and after use. Users must wipe down any contact points with approved disinfectant or sanitation wipes once they have finished using equipment.
- Materials that can't be cleaned must be quarantined for 72 hours between usage.
- Fieldwork sites must be configured to accommodate physical distancing and reduce the density of occupation. Enhanced cleaning protocols for COVID-19 must remain in place for these sites.
- All waste materials generated during the course of research must be properly disposed of.
- Where access to common or centralized research resources is required, a process for advance scheduling and coordination among different users must be implemented.
- Every effort must be made to conduct office work (i.e. computer work, writing, etc.) associated with the fieldwork at home as recommended by the Provincial Public Health Guidelines.
- Physical distancing and enhanced cleaning protocols for COVID-19 must also be implemented when working in an office environment is unavoidable. It is important to limit the number of people working in a space in accordance with the Provincial Public Health Guidelines. Every effort must be made to minimize office occupancy to reduce possible risk associated with COVID-19.
- In single offices with one occupant, physical distancing must be maintained if another person enters the office.
- In shared offices with multiple occupants, the configuration of the office must be such that physical distancing can be maintained when occupation of the space increases to more than one individual.
- In circumstances where physical distancing is not possible between individuals occupying office space, appropriate PPE should be used, in case where PPE is not available, occupation must be staggered to avoid personal contact.
- A mechanism of communication, such as the MUN safe app, must be in place so that the principle investigator remains in regular contact with any students and/or staff working alone or members of the research group that are engaged in fieldwork.
- The principal investigator must have a plan and process in place for the students and staff to check each day and report on risks encountered, and mitigation strategies employed.
- On a daily basis while research activities are ongoing, there must be a procedure to make an assessment of risks which must be used as the basis for a decision to continue activities.

Hazard Assessment			
Activity	**Potential Hazard**	**PPE/Admin Controls**	**Engineering Controls**
Entering and exiting buildings, offices, and on- and off-campus research spaces in preparation for fieldwork	Biological virus COVID-19 exposure and circulation	-Any member of the research team will always wear face masks when accessing buildings. And -Will always check in with security to access any building or facility for this research.	-All members of the research team will always maintain 2 meters or 6 feet physical distancing protocols when using buildings and offices.
Travel to/from fieldwork site	Biological virus COVID-19 exposure and circulation	-Members of the research team will pack enough food and snacks for the journey. -Travel to the town will be done with a personal vehicle of one of the research team members (i.e., from Corner Brook to Burgeo) and ferry (Burgeo to Ramea) as the community cannot be accessed by vehicle after Burgeo. -The vehicle will be fueled at any of the pay at the pump stations along the highway to Burgeo (i.e., Corner Brook, Stephenville, Burgeo). And there will not be any physical contact with others in the process. Paper towels will be used to cover palms before grabbing the pump to fuel the vehicle, and hand sanitizer will be used to sanitize hands afterward. The same will be done when effecting payments at the point of sale.	- All members of the research team traveling will always wear face masks whenever necessary (both in the vehicle and ferry). -Physical distancing will be observed while traveling in the vehicle and ferry.

Working at the fieldwork site	Biological virus COVID-19 exposure and circulation	-Before the start of any data collection each day, the members of the research team will conduct a COVID-19 self-assessment provided by the Government of NL at https://covidassessment.nlchi.nl.ca/ to be sure they are safe and also prevent the spread. -Face masks will be worn throughout all sessions. And for each interview, any member of the research team and the research participant will be seated 2 meters or 6 feet apart. -Sanitizers: Before and after each interview session, chairs, surfaces, or any other items touched will be disinfected using sanitizers and paper towels. -The research team members will stay in constant contact with the appropriate authorities to be updated on the COVD-19 situation in the province and to have timely information regarding its impacts on the field activities. -The team will use any other tool and resource available to prevent exposure to the virus and to also help contain its spread.	- Interviewees will be allowed to choose the location for the interviews, which will likely be a public space in Ramea. -Physical distances of 2 meters or 6 feet will always be maintained when conducting face-to-face interviews -Face masks will always be worn by the research team - Participants will not be forced to wear a mask (although they will be expected to keep a 2m distance) - The COVID alert App will be installed on the mobile devices of the research team members on the field to further assist in detecting exposures to the virus.
Accommodation in the field	Biological virus COVID-19 exposure and circulation	--Reservation will be made at a local hotel or accommodation facility in Ramea for the PI. -The RA is originally from Ramea and will be staying at his home.	-Any member of the research team staying at the hotel, will observe physical distancing arrangements of the hotel.

			-Face mask will be worn at all-time necessary.
Exploring the field	Biological virus COVID-19 exposure and circulation	- Face mask will be worn when accessing any public space or building.	-Observe physical distancing when outside.