# IDENTIFYING RURAL RESIDENTS' VIEWS ABOUT INTEGRATING SOLAR FARMS INTO RURAL LANDSCAPES OF NOVA SCOTIA

by

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Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq.
We are all Treaty people.

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## ABSTRACT

Solar farms are increasingly being built in Canada as part of the national transition to renewable energy. Because they require large areas of land typically in more rural areas, solar farms can have landscape impacts concerning rural residents. In turn, this type of energy development has caused community pushback in some provinces of Canada. To better understand why resident resistance to solar farms occurs, this paper identifies rural residents' views about integrating solar farms into rural landscapes of Nova Scotia, a province where community pushback has occurred, and solar farm development is increasing. Employing Q methodology, 18 rural residents of Berwick (n = 9), Mahone Bay (n = 6), and New Ross (n = 3) expressed their views by ranking 40 statements related to landscape impacts of solar farms. Subsequent semi-structured interviews revealed feelings toward rural landscape change and knowledge of solar farms. Exploratory factor analysis revealed two distinct views: (1) solar farms should either be integrated and embraced in; or (2) isolated and hidden from rural landscapes where people live, work, and/or recreate daily. Strong consensus around mitigating harm to local natural environments was also identified. Interview results indicate that the identified views represent two different types of expectations for how solar farms impact existing landscape uses and emotional connections. These insights build upon wider energy social science research and can inform land use policy and public engagement efforts seeking to advance sustainable solar farm development in Nova Scotia.

# CHAPTER 1: INTRODUCTION

## 1.1 Background

Large-scale solar energy facilities, often called solar farms, are increasingly being built in Canada and other parts of the world as part of the global transition to renewable energy systems. Solar farms—also termed solar parks, solar gardens, or utility solar—are typically ground-mounted solar array systems that span across relatively large areas of land (see Figure 1) and supply electricity to a public power grid (Nilson and Stedman, 2022). Because of their large land requirement, solar farms can change the way landscapes look, feel, and function to the people who live around them. In various cases around the world, such change has led to land use conflicts and public opposition to solar farm development (Bedi, 2019; O'Neil, 2021; Uebelhor et al., 2021; Nilson and Stedman, 2022; Stock, 2022). While place- and project-specific opposition has occurred in many parts of North America, national survey research in Canada has found that public support for both solar energy (Sherren et al., 2019) and large-scale solar infrastructure development (Donald et al., 2022) is high. This discrepancy between support for renewable energy development in general and support for specific renewable energy projects is recognized by social science energy scholars as the 'social gap' (Bell et al., 2013; Batel and Devine-Wright, 2015; Nilson and Stedman, 2022). Many times, local opposition to solar farm development arises when citizens believe that it will negatively impact the environmental, economic, and/or cultural components of the local landscape (Hunold and Leitner, 2011; Mulvaney, 2017; Silva and Sareen, 2021; Moore et al., 2022).

*Figure 1: Community Solar Garden in Berwick, Nova Scotia. Image source: Town of Berwick, 2024a (https://www.berwick.ca/solar-garden.html). Photography by Adrian Johnstone (see Appendix A for copyright release).*

To recognize that solar farms are not isolated technological systems, but rather a subsystem embedded in landscapes with existing values, some scholars have proposed that development of such infrastructure should aim to be *landscape inclusive* (Oudes, 2022; Oudes et al., 2022). That is, the design and planning for solar farms should incorporate existing environmental, economic, and/or social landscape objectives (Oudes, 2022). In turn, solar farm developments become an integrated component of the wider landscapes in which they are sited. Moreover, as Oudes (2022) argues, landscape-inclusive solar farms allow socially valued landscape uses to be maintained or enhanced, rather than compromised. Social acceptance of solar farm projects is an integral part of their success because, without it, the progress of these projects can be delayed or even stopped altogether (Roddis et al., 2020), having wider implications for climate change mitigation. Further, as some scholars argue, implementing energy projects without properly accounting for their potential negative social, environmental, and economic impacts ultimately leads to a renewable energy transition that is not truly just and sustainable (Stremke, 2015; Walker and Baxter, 2017).

To understand if and how solar farm development can be landscape inclusive, and in turn, more sustainable, social science research can investigate resident perspectives on landscape impacts, and opportunities associated with solar development. The need for such investigation is the impetus for this thesis research. Specifically, this research identifies rural residents' views about integrating solar farms into rural landscapes of Nova Scotia, Canada, a place where solar farm development is becoming more prevalent.

## 1.2 Solar Farm Development in Nova Scotia

In 2021, construction—and in some cases operation—of large-scale solar facilities called 'community solar gardens' commenced in Nova Scotia. One of the solar gardens is located in Amherst and is owned by the private utility company, Nova Scotia Power (Nova Scotia Power, 2022). Three other solar gardens, located in Antigonish, Berwick, and Mahone Bay, are managed by Alternative Resource Energy Authority (AREA), a municipally owned company (AREA, 2022).[1] By allowing Nova Scotians to buy shares for the solar gardens and in turn earn credits on their power bills, all four projects aim to make solar power more accessible to renters, business owners, and homeowners who do not have the financial ability or proper site conditions to install their own solar infrastructure (Nova Scotia, 2021).

In 2022, resident opposition to some of the solar gardens arose in the province due to concerns about the infrastructure's impact on local property owners and ecosystems (CBC, 2022; Smith, 2022). Specifically, residents of Antigonish and Mahone Bay raised concerns about forest clearing and water runoff that occurred during construction of the solar gardens in the two towns (CBC, 2022; Smith, 2022). Moreover, private property expropriation to accommodate transmission line construction contributed to resident opposition in Mahone Bay (Smith, 2022). These cases of resident opposition indicate that residents care about the land use and landscape implications of solar farm development in the province. Moreover, when speaking to the media, concerned residents expressed that they are not opposed to renewable energy or solar farm development itself (i.e., *in general*), but rather how it impacts the *land*, or more broadly, the local

[1] The general locations of the four solar farms in Nova Scotia are marked in Figure 2 in Chapter 3.

landscape (CBC, 2022; Smith, 2022). Therefore, there seems to be public desire for solar farm development to happen in the province, as long as it does not negatively affect valued landscape attributes.

Understanding Nova Scotians' expectations for landscape change caused by renewable energy development is important as renewable energy development increases across the province to meet the Government of Nova Scotia's ambitious greenhouse gas emission reduction targets. The Environmental Goals and Climate Change Reduction Act, a piece of provincial legislation, has mandated for (1) greenhouse gas emissions to be reduced by 53% below 2005 levels by 2030; and (2) achieve net-zero greenhouse gas emissions by 2050 (*Environmental Goals and Climate Change Reduction Act, 2021*). Large-scale solar infrastructure development, specifically, is expected to be a significant part of the transition to renewable energy in the province. According to the Nova Scotia Department of Natural Resources and Renewable's '2023 Clean Power Action Plan', power generated from large-scale solar is expected to comprise 5% of the province's energy mix by 2030. Specifically, this amount of new large-scale solar is expected to generate over 300 megawatts of solar power (NSDNRR, 2023). The expansion of large-scale solar in the province will be largely facilitated by the Province's recently implemented Commercial Net-Metering (NSDNRR, 2022) and Community Solar (NSDNRR, 2024) programs. In tandem with transitioning the electricity grid to renewable energy to meet legislative mandates, solar farm development contributes to a wider landscape transition in Nova Scotia attributed to increased siting of large-scale renewable energy infrastructure. Expansion of renewable energy infrastructure will change not only the way landscapes look, but also the way they function as current land uses are altered or displaced to accommodate infrastructure siting.

## 1.3 Research Purpose and Questions

Overall, the purpose of this research is to identify rural residents' views about integrating solar farms in rural landscapes in the province of Nova Scotia. This thesis answers the following two research questions:

1. What type of views do rural Nova Scotians share regarding how solar farms should be integrated into rural landscapes of Nova Scotia?

2. What type of underlying values and perceptions of solar farms and landscape change influence the identified shared views?

### 1.4 Methodological Approach

This research employed the Q methodology to identify shared views among rural residents of Nova Scotia regarding how solar farms *should* (or should not) be integrated into rural landscapes in the province.[2] Briefly, the Q methodology is a mixed methods approach to studying human subjectivity and shared viewpoints (Brown, 1994). Residents of three rural communities were recruited to participate in a card sorting exercise and semi-structured interview. Quantitative data gathered from the card sorting exercise—called a Q-sort—along with qualitative data from the interviews informed an explorative factor analysis. Such analysis allowed shared views among rural Nova Scotians to be identified. The interview data also provided context and rationale for the views, based on participants' personal opinions, understandings, and experiences.

The first research question is answered by the results of the exploratory factor analysis. That is, factors identified by such analysis are regarded as *shared views*. Moreover, areas of consensus and disagreement between the views were identified via the factor analysis. The second research question is answered by analysis of the interview data, which provide deeper insight into how participants' feelings, opinions, and experiences shape the views. In other words, the views are *conceptualized* by the factor analysis, and *contextualized* by analysis of the interview data.

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[2]Larger-scale energy plants, including solar farms, are typically sited in more rural areas due to their land availability and relatively low population densities. For this reason, rural citizens and landscapes are the focus of this research.

## 1.5 Positionality Statement

This research explores how people perceive rural landscapes and changes to them in Nova Scotia. Therefore, it is important to mention that I have lived in a rural community in Nova Scotia for most of my life, causing me to have my own intimate, preconceived perception of rural life and values in the province. My emotional attachment to Nova Scotia, and particularly its rural places, is a prominent reason why I have chosen to focus on rural place change for both my undergraduate and graduate thesis research projects. To ensure the results of this research are reflective of the participants' subjectivity, rather than my own, I aimed to practice reflexivity throughout the entire research process through journal writing. While I attempted to mitigate the influence of my own feelings toward and opinions of landscape change and solar farm development in Nova Scotia, subjectivity is impossible to erase.

Also, in the spirit of self-reflexivity, it is important to acknowledge how my connection to research participants was likely influenced by my identity as a white, Canadian, English-speaking woman. In many ways, my nationality and first language afforded me the ability to relate to and connect with rural Nova Scotians——many of whom are white and English-speaking—during recruitment and interviews. Being a woman also influenced my decision to do the interviews in public places, like libraries and community centres, rather than private homes. Ultimately, it is important recognize how my positionality not only the influenced my motivations for doing this research, but also the research design, and both likely shaped the research findings presented in this thesis.

## 1.6 Thesis Overview

This thesis is presented as a monograph comprising six chapters: (1) Introduction; (2) Literature Review; (3) Study Area and Methodology; (4) Results; (5) Discussion; and (6) Conclusion. More specifically, Chapter 2 assesses and summarizes social science literature regarding public reactions to large-scale solar development to identify research gaps. Chapter 3 provides an overview of Nova Scotia's rural landscapes, an explanation of the type of area that is regarded as a 'rural Nova Scotia landscape' in this thesis, and a description of how the research was designed and implemented according to the Q methodology. While there is no overarching theory that informed the design of this research, per se, two conceptual frameworks were employed during some parts of the research process; these are explained in the Q methodology section of Chapter 3. Chapter 4 presents the two factors/views that were identified via factor analysis, along with interview themes that contextualize and help explain the views. Chapter 5 discusses how the views align with findings of previous research, as well as existing theories. Insights for future research and limitations are also discussed in Chapter 5. Chapter 6 concludes with a summary of the research findings, and a brief discussion of their potential contributions to academia, as well as planning and design of future solar farm developments.

# CHAPTER 2: LITERATURE REVIEW

## 2.1 Overview

The purpose of this literature review is to situate the thesis within the greater body of relevant literature. The concern of this thesis, in the broadest sense, is how people respond to landscape change caused by renewable energy development. Thus, this thesis falls within the intersection of two realms of literature: (1) landscape values literature; and (2) social acceptance of renewable energy landscapes. Arguably, the latter must be understood within the context of the former. Based on such an assumption, this literature review is comprised of two major parts. Serving as a theoretical foundation, the first section examines notable research regarding models and theories for landscape values. Then, becoming narrower in scope, the second section discusses research regarding social acceptance of renewable energy landscapes (i.e., landscapes with large-scale renewable energy facilities), with a focus on research regarding public responses to solar energy landscapes (i.e., landscapes with large-scale solar energy facilities). Lastly, the research gap that this thesis can fill is discussed.

## 2.2 Landscape Values Research

For centuries, the concept of landscape has been employed in both academic and non-academic contexts to conceptualize and categorize environments, typically of regional scale (Soini, 2001; Tress and Tress, 2001). While landscape is a central concept of interest in many disciplines concerned with the environment, such as environmental aesthetics (Andrews, 1989; Carlson, 2009) and archeology (Kluiving, 2012), it has been acknowledged by many scholars as a concept grounded in geography (Terkenli, 2001; Stephenson, 2008). While what constitutes a landscape has been contested, it is generally regarded as an assemblage of cultural (i.e., human) and natural (i.e., non-human) features and processes over a relatively large area of land (Terkenli, 2001; Stephenson, 2008). As Stephenson (2008) notes, some landscapes are nationally or even internationally recognized for their significant natural and/or built features. Maintaining the integrity of such landscapes is perceived to be of universal value, which is the underlying impetus for national and international 'landscape conservation' organizations and land designations, such as the UNESCO World Heritage Convention and its World Heritage Sites (UNESCO, 2011).

To help researchers, planners, and policy makers make sense of landscapes and the ways in which they are valued by people, numerous conceptual frameworks have been conceived. In the early 2000s, a few notable contributions to 'landscape theory' were made, namely by Soini, (2001), Terkenli (2001), and Tress and Tress (2001). While these articles each build upon landscape value theory in different ways, they all seem to agree that landscape research is highly diverse (Soini, 2001; Terkenli, 2001; Tress and Tress, 2001). Because of their diversity and complexity, Terkenli (2001) emphasizes that landscapes can be more thoroughly understood via quantitative and qualitative research approaches. In an attempt to unify landscape research occurring across disciplines, Terkenli (2001) offers a conceptual framework which divides landscape 'aspects' into three categories: visual aspects (forms), cognitive aspects (meanings), and experiential aspects (functions). Similar to Terkenli (2001), Tress and Tress (2001) suggest that landscape research across disciplines requires not only foundational conceptual frameworks, but also clear definitions of concepts, including for landscape itself. They argue that without such guidelines, landscape research in different disciplines will miss opportunities to recognize the ways in which they interconnect, as well as advance a unified understanding of how natural and cultural landscape components converge and have influence on each other.

Drawing upon these earlier conceptual discussions regarding landscape dynamics, Stephenson (2008) developed a Cultural Values Model, which can be operationalized in landscape research concerned for landscape components that can be *culturally valued*. To create this model, Stephenson (2008) employed a grounded approach involving analysis of qualitative data gathered from community case studies in New Zealand. Based on her findings, Stephenson (2008) suggests that three components of landscape can be culturally valued: forms, practices (and processes), and relationships. Forms refer to the material attributes of a landscape; practices refer to human and natural (non-human) activities or processes that occur on a landscape; and relationships refer to the latent cultural and emotional bonds people develop with landscapes, such as sense of place. Notably, Stephenson (2008) argues that human relationships with a landscape tend to strengthen as one spends more time in it, gaining a deeper sense and understanding of its forms, processes, and history. Moreover, Stephenson (2008) suggests that the temporal dimension of landscape dynamics allows two different types of landscape values to manifest: surface values and embedded values. The former refers to components of landscape that can be immediately observed, such as its physical forms and practices, while the latter refers to components that often take time and experience to form and value, such as relationships and historic events. Stephenson's (2008) Cultural Values Model for landscape is much like Terkenli's (2001) 'landscape aspects', as both conceptual frameworks recognize the interplay between cognitive (intangible) and physical dimensions of landscape.

In more recent years, landscape values have been examined in various social and geographical contexts, and with various methods. With the advancement of digital technology, researchers have been able to utilize innovative techniques for examining landscape values. For instance, a study by Chen et al. (2018) used images posted on the social media site Instagram to investigate how landscape change caused by hydroelectric dam development (or removal) can influence landscape users' place-based values, such as community attachment and sense of home. Another example of innovative technology being used to identify landscape preferences is a study by Yuan et al. (2023), which used virtual reality simulations of different landscape types to determine participants' preferred landscape attributes. By asking their participants open-ended research questions, Yuan et al. (2023) learned that the emotions evoked and senses experienced by landscape elements influence the degree to which an entire landscape is preferred over other landscape types. For instance, it was found that the sounds of crashing waves evoked feelings of relaxation in tropical beach landscapes, making this the most preferred landscape type in the study (Yuan et al., 2023).

The use of sound and other senses is quite rare in landscape research, but visual sensory experiences evoked by landscapes have also been found in other studies to significantly contribute to landscape values and preferences. For example, in a study by Liu et al. (2023) regarding tourists' perceptions of forests in Taiwan, they found that the vibrant colours that appear on tree leaves as they undergo senescence is generally highly valued by this type of landscape user. Interestingly, Liu et al. (2023) found that aesthetic characteristics of forest landscapes were important to tourists, which aligns with the previously discussed conceptual frameworks suggesting that tangible elements of landscape are often most obvious and potentially valued by landscape users who have experienced the landscape for a shorter amount of time. Although sensory-focused research is only a subset of landscape values research, it contributes to the general understanding that landscapes are valued by people for a multitude of reasons.

In sum, theoretical research within the last two decades has effectively provided frameworks for understanding and examining the ways in which landscapes are valued by people. Some empirical research has also investigated the effect of sensory landscape characteristics on landscape perceptions. As Stephenson (2008) suggests, time and direct experience with landscapes influences how well their tangible and intangible components are understood, and in turn valued. Further, this realm of research emphasizes that the complexity and dynamism of landscapes can mean that values attributed to them are difficult to discern. However, conceptual models serve as tools for examining values in various landscape contexts.

## 2.3 Social Acceptance of Renewable Energy Landscapes

Large-scale renewable energy facilities, such as wind farms and solar farms, are becoming more abundant across landscapes around the world. To recognize the role of that landscape plays for the design of these facilities, Stremke (2015) recommends that they be referred to as (renewable) energy landscapes. This term will be used herein to describe landscapes in which large-scale renewable energy facilities are sited. While renewable energy landscapes have increased in number, so too have cases of community-scale public pushback in various parts of the world (Hunold and Leitner, 2011; Devine-Wright, 2015; Mulvaney, 2017; Moore et al., 2022). In turn, formation of these 'new' landscapes over recent decades has become a phenomenon of interest for social scientists (Devine-Wright, 2005; Mulvaney, 2017; Moore et al., 2022). Various studies have been conducted to understand community opposition and examine ways to make renewable energy landscapes more publicly accepted.

With regards to public acceptance, Wüstenhagen et al. (2007) suggest that there are three dimensions of acceptance for renewable energy adoption: socio-political acceptance, community acceptance, and market acceptance. Together, these dimensions comprise 'social acceptance'. (Wüstenhagen et al., 2007). This broader concept of social acceptance is commonly operationalized by energy social scientists (Devine-Wright and Wiersma, 2020; Roddis et al., 2020). Thus, the wider body of research examining public acceptance of renewable energy is generally known within the discipline of energy social science as ‘social acceptance literature’.

A general consensus in the social acceptance literature is that support for renewable energy often varies at different scales (e.g., national vs regional vs local) (Wolsink, 2007; Chappell et al., 2021; Nilson and Stedman, 2022). While public support for renewable energy has been found to be high at a national level in various countries (Sherren et al., 2019; Pew Research Center, 2020), it has also been found to be low at a local level in areas where renewable energy facilities have been actually proposed and/or constructed (Roddis et al., 2020; O’Neil, 2021; Nilson and Stedman, 2022; Stock, 2022). This discrepancy between support for renewable energy ‘in general’ and support for renewable energy projects in specific local contexts is regarded as the ‘social gap’ in social acceptance literature (Bell et al., 2013; Batel and Devine-Wright, 2015; Nilson and Stedman, 2022). To understand why such a gap exists, various studies, particularly in the social sciences, have investigated factors that influence local acceptance of renewable energy projects.

As research about local opposition to renewable energy projects started to increase throughout the latter part of the twentieth century, many scholars considered community resistance to nearby projects to be a nothing more than expression of the NIMBY (Not in My Back Yard) phenomenon, also termed ‘NIMBY syndrome’ (Dear, 1992) or ‘NIMBYism’ (Devine-Wright, 2009). Dear (1992) describes NIMBYism as “the protectionist attitudes of and oppositional tactics adopted by community groups facing an unwelcome development in their neighborhood” (p. 288). The NIMBY argument used to explain local opposition to renewable energy projects has been critiqued by human geographers, such as Devine-Wright (2009). For example, Devine-Wright (2009) and Devine-Wright and Howes (2010) argue that local opposition to siting proposals for renewable energy infrastructure, particularly within the context of wind turbines, occurs when residents’ emotional bonds to their place of residence are disrupted by such infrastructure. The specific place-based emotions Devine-Wright (2009) refers to are sense of place, place identity, and place attachment. Wolsink (2007) also suggests that calling public opposition toward renewable energy siting decisions as NIMBYism oversimplifies residents’ motives for opposing projects or mistakes it for mere selfishness. Furthermore, Wolsink (2007) cautions that the 'U-shaped curve' observed in graphs depicting how level of public support for renewable energy waxes and wanes over stages of renewable energy development (i.e., no proposal, proposal, and construction) ought not to be considered as merely NIMBYism in action. Rather, a decrease in public support for renewable energy projects as they are proposed and planned can exemplify a moment of public criticism driven by perceived environmental impacts and procedural fairness (Wolsink, 2007). Often, if the perceived negative impacts do not materialize during the construction phase of a project, then public support can be regained (Wolsink, 2007).

The way in which support for renewable energy development is influenced by landscape preferences and values has also been explored (Plieninger et al., 2018; Devine-Wright and Wiersma, 2020; Salak et al., 2021). For instance, in a participatory mapping and narrative analysis study by Plieninger et al. (2018) regarding landscape development preferences in the Faroe Islands, it was found that many residents desire renewable energy development, and thus, would like it to become more abundant on the islands. Interestingly, however, they found that many resident participants (48.5%) shared the narrative that renewable energy is necessary, but not at the cost of nature conservation. Moreover, citizen perceptions of how well renewable energy infrastructure 'fits' with different landscape types has been investigated by Devine-Wright and Wiersma (2020), as well as Salak et al., 2021. In general, both studies found that participants least preferred renewable energy development in landscapes perceived as 'natural' and relatively free of modern, technological features.

In the Canadian context, much social acceptance research has been conducted to understand factors that can influence public opinions toward renewable energy development at various scales. At a national scale, Sherren et al. (2019) conducted a survey to analyze whether exposure to renewable energy, political views, environmental values, and sectoral employment are predictors of support for energy technologies, notably both renewable and non-renewable. In their analysis, they found that wind and solar energy were both the most supported types of energy among respondents (Sherren et al., 2019). They also found that exposure to any kind of energy infrastructure generally increased support for renewable energy infrastructure (Sherren et al., 2019). The scale of project ownership and benefits (e.g., community vs private companies) has also been studied in Canada as factors that can influence public acceptance of renewable energy projects. For instance, in a study by Chappell et al. (2021) regarding wind energy development in Atlantic Canada, it was found that many participants supported wind energy projects that accrue local energy supply and profits; however, they also found that a good predictor of willingness to host wind energy facilities in view of homes of participants was support for the idea of developing wind energy to be generated as an export commodity.

Notably, much of the social acceptance research in Canada pertinent to community opposition has occurred within the context of Ontario, as this is where renewable energy development, specifically wind energy, has been highly contested and politicized at local scales (Baxter et al., 2013). Much of the public opposition to renewable energy in Ontario has been attributed to the province's Green Energy Act, which essentially removed the mandate for public consultation during the decision-making process for siting renewable energy infrastructure (Baxter et al., 2013; Walker et al., 2014; Walker and Baxter, 2017). Predictors of public opposition toward renewable energy—again, specifically wind energy— identified in these studies include perceived health impacts, procedural justice of siting processes, economic benefits, and visual aesthetic variables (Walker et al., 2014; Walker and Baxter, 2017).

### 2.4 Social Acceptance of Solar Energy Landscapes

In recent years, large-scale solar (LSS) development has gained increasing attention in academia, thus leading to an increased number of studies regarding how people respond to it. Such an increase is unsurprising given the fact that solar energy has increased significantly in many countries over the last few years (IEA, 2022). Studies examining public attitudes toward LSS projects have been conducted in various countries, including the United States (Hunold and Leitner, 2011; Carlisle et al., 2014; Carlisle et al., 2016; Mulvaney, 2017; O'Neil, 2021; Uebelhor et al., 2021; Moore et al., 2022; Nilson and Stedman, 2022), India (Bedi, 2019; Stock, 2022), Morocco (Hanger et al., 2016), the United Kingdom (Roddis et al., 2020), Portugal (Silva and Sareen, 2021), and the Netherlands (Van den Berg and Tempels, 2022). These studies comprise a growing body of literature. Notably, public acceptance of solar energy landscapes has been studied in Canada; however, to my knowledge, only at a national scale by Donald et al. (2022), rather than in specific community contexts where solar farms are present.

Most often, LSS is the term used in the literature to refer to a site with a solar farm. Thus, LSS is used throughout the rest of this literature review. While the term is appropriate for this review, it is arguably inappropriate for landscape-oriented research, such as this thesis. Rather, 'solar energy landscape', as described by Oudes (2022), regards a solar farm as a component of a larger landscape system. That is, solar energy landscape accounts for the greater landscape impacts of solar farms, rather than focusing merely on the impacts of their site-level technical/built components. The term LSS can also be problematic as it typically refers to both 'community-scale' and 'utility-scale' solar farms. Nilson and Stedman (2022) argue that referring to all relatively large installments of solar infrastructure as LSS without indicating their actual size and scale causes the nuance of public perceptions of LSS to be disregarded. Nonetheless, since LSS is the most widely used term in energy social science literature, it will be used here when describing previous studies.

The LSS projects being examined in this review are divided into two categories: concentrated solar power (CSP) and photovoltaic (PV). While most of the studies discussed focus on large-scale PV systems, some focus on CSP systems, particularly in desert environments (Hunold and Leitner, 2011; Hanger et al., 2016; Mulvaney, 2017). Further, the types of LSS examined can be sub-categorized as utility-scale or community-scale (Carlisle et al., 2014; Carlisle et al., 2016; Mulvaney, 2017; Uebelhor et al., 2021; Nilson and Stedman, 2022). Another relatively unexplored type of LSS discussed in the literature is 'multi-functional solar landscapes' (Van den Berg and Tempels, 2022).

Various theoretical frameworks and methodologies, largely grounded in the social sciences, have been employed for studies examining public attitudes toward LSS. These include energy and social justice (Bedi, 2019; Stock, 2022), sense of place and place attachment (Carlisle et al., 2014), fairness and procedural justice (Hanger et al., 2016), social representations (Nilson and Stedman, 2022), community acceptance (Roddis et al., 2020), and community benefits (Van den Berg and Tempels, 2022). Other lenses through which data in these studies have been analysed include environmental ethics (Hunold and Leitner, 2011) and land use planning (Mulvaney, 2017). Notably, these frameworks are all similar in that they help conceptualize subjective perspectives of solar projects. Also, these frameworks help contextualize place- and culture-specific social structures and values that influence who is impacted by these projects, and in what way.

Like theoretical frameworks, various methods have been used to examine and understand public attitudes toward LSS, including quantitative, qualitative, and mixed methods. To collect qualitative data, many of the studies use non-random sampling techniques (e.g., snowball sampling), such as Mulvaney (2017) and Moore et al. (2022). While these studies focus on recruiting participants who are regarded as 'experts' or professionals associated with or impacted by LSS, findings from these participants nonetheless provide insights into or context for public attitudes towards these projects. Interviewing professionals and/or activists to gain context for public attitudes towards LSS was also a part of the studies by Bedi (2019), Hunold and Leitner (2011), Stock (2022), and Van den Berg and Tempels (2022), implying that analysing perspectives from multiple actors is relatively common practice in this field of research. Some studies, however, only conducted interviews with residents who are directly impacted by LSS, providing more insight into public attitudes toward this technology (O'Neil, 2021; Uebelhor et al., 2021).

While qualitative methods provide nuance, quantitative methods can provide insights about LSS at a population level. Studies by Carlisle et al. (2014, 2016) and Hanger et al. (2016) employed surveys and quantitative data analysis to examine how different independent variables affect public acceptance of LSS. The main independent variables examined by Carlisle et al. (2014) and Carlisle et al. (2016) were place attachment and proximity of different land uses to solar farms, respectively. To understand different drivers of public acceptance of LSS, Hanger et al. (2016) investigated whether trust in LSS developers and investors is associated with public acceptance of these projects. Other independent variables were examined by studies that used mixed methods. For example, Nilson and Stedman (2022) assessed whether the scale (i.e., community- scale vs utility-scale) of LSS projects influences public acceptance of these projects. Various types of statistical analyses have been used to interpret relationships between variables associated with acceptance of LSS, including factor analysis (Carlisle et al., 2014; Carlisle et al., 2016), variance analysis or ANOVA (Nilson and Stedman, 2022), and regression analysis (Hanger et al., 2016).

In the studies that examine factors that spur negative public attitudes towards LSS projects, various drivers of opposition have been identified. A prominent finding in many of these studies is that public opposition is more likely when LSS projects pose risk to wildlife habitat (Hunold and Leitner, 2011; Carlisle et al., 2016; Mulvaney, 2017; Roddis et al., 2020). Another common concern that has been identified in a few of the studies is that LSS can negatively impact culture and sense of place in rural areas. For example, in their study on stakeholder dynamics involved in solar siting decisions on agricultural land in the United States, Moore et al. (2022) discovered that some residents in agricultural communities are concerned that LSS on agricultural land will hinder local heritage and sense of place. Mulvaney (2017) also found that negative cultural impacts from LSS in Indigenous communities in the American Southwest can cause negative attitudes toward projects in that area. Public concerns about negative impacts to amenity values, specifically ‘rural landscape character’, have also been identified in parts of Portugal (Silva and Sareen, 2021). Moreover, results from some studies indicate that public opposition can occur when solar projects inhibit economic activities that are valued by locals, such as agriculture (Mulvaney, 2017; Moore et al., 2022) and rural tourism (Silva and Sareen, 2021). Other economic impacts have also been found to initiate public opposition. For example, Stock (2022) found that public support for solar farms in India decreased as citizens realized that many of the jobs provided by the solar developments were temporary, and thus, did not significantly contribute to the local economy. Although some studies, such as Stock (2022), attribute public opposition to the economic impacts of LSS, most studies in this body of research attribute such opposition to the impact this technology has on landscapes and their respective values.

Interestingly, some studies have found that LSS is perceived by citizens in certain places as more environmentally, economically, and/or culturally beneficial than harmful. When solar developments appear to provide these benefits, they are generally supported by the public. In a study by Hanger et al. (2016) regarding community acceptance of CSP in Morocco, most respondents (92%) indicated that they highly support nearby CSP projects because the projects are widely believed to have either positive or benign environmental impacts. Furthermore, Moore et al (2022) and Uebelhor et al. (2021) found that LSS is appreciated in some areas of the United States where siting LSS on agricultural land is perceived as an effective way to diversify and stabilize farmers’ incomes. Regarding cultural benefits, Van den Berg and Tempels (2022) observed that solar parks in the Netherlands with multiple functions, such as recreational amenities, can increase the degree to which some people support these projects; however, this was not found to be the case for all their study participants. Another common finding is that citizens are generally more supportive of LSS if it is built on brownfield sites, such as landfills (O'Neil, 2021; Nilson and Stedman, 2022). The spatial scale of the solar infrastructure and proximity to other land use types have also been identified by Nilson and Stedman (2022) and Carlisle et al. (2016), respectively, as factors that influence public support.

Within the last year, public preferences for landscape change caused by LSS have been explored by Codemo et al. (2023) and Bessette et al. (2024), though in different geographic contexts. The study by Codemo et al. (2023) employed the Q methodology involving an image-based Q-sample to understand citizen preferences for solar development in Arcos de la Frontera, Spain. Using this methodology, four viewpoints were identified, which are unified by an appreciation for solar infrastructure in residential and commercial areas rather than more rural, scenic landscapes. Bessette et al. (2024) also examined resident preferences for LSS development, though in the United States. Through conducting interviews, Bessette et al. (2024) found that residents generally care about how LSS development impacts the aesthetics of landscapes. In some of the examined case studies, design elements, such as fences and integrated pollinator habitat, causing a solar farm to 'fit' better into the local landscape, were appreciated by residents (Bessette et al., 2024). Both of these studies demonstrate that landscape-technology fit is an important factor in social acceptance of LSS.

With regards to research on public acceptance of LSS in Canada, Donald et al. (2022) found that Canadians generally support this technology. Interestingly, 69% of their participants indicated having high support for LSS and 26% were somewhat supportive, which was higher than the levels of support indicated for both large-scale wind farms and hydro plants (Donald et al., 2022). However, they note that the exceptionally high level of public support for LSS may indicate theorized rather than realized ideas of LSS held by much of the public given that this technology is only starting to emerge in Canada, whereas wind and hydro have been established in many parts of the country of a longer amount of time (Donald et al., 2022). Thus, there remains a need to understand how people perceive this technology in parts of the country where it is actually starting to develop, especially at local scales.

Societal considerations for LSS have largely been examined by social scientists, which is to be expected. However, it is also worth mentioning the ways in which such considerations are being acknowledged and incorporated in landscape architecture research. Such research evaluates how different societal values can be included and represented in the landscape design for LSS sites, specifically involving ground-mounted photovoltaic panels and termed 'multifunctional solar power plants' (Oudes et al., 2022). While discussing the nuances of research pertinent to landscape design for LSS sites is beyond the scope of work considered in this review, it is worth mentioning research by Oudes et al. (2022), which presents a comprehensive analysis of multifunctional solar plants in the Netherlands and discusses how their design can be shaped by societal values and expectations. To help categorize the different landscape designs that can exist for sites with these plants, Oudes et al. (2022) propose a 'typology of solar energy landscapes' comprised of four dimensions: energy, economic, nature, and landscape. Together, these dimensions result in three types of multifunctional solar plants: mixed-production, nature-inclusive, and landscape-inclusive (Oudes et al., 2022). This typology is worth mentioning as it represents the nexus between landscapes, LSS, and societal values, and delineates the set of possible design options drawn on in establishing the methods of this study.

## 2.5 Research Gaps

While it is evident that the field of research concerned for social impacts of LSS has been growing, especially within the last five years, there remains much opportunity to investigate public attitudes towards and expectations for LSS in various relatively understudied geographic contexts. For example, in the case of North America, this type of research has been much more prominent in the US than in Canada. As previously discussed, the reason why LSS is opposed in one place can be the very reason it is supported in in another (e.g., changing economic activity in agricultural communities). While some social acceptance research pertinent to LSS has been done by Donald et al. (2022), they focused on generalizing levels of public acceptance for this technology across Canada rather than investigating the nuance of public opinions and expectations that exist among citizens, at a national or local scale. The lack of nuanced understanding offered by the results of their national survey is something Donald et al. (2022) note as a limitation of their study. Thus, public preferences for landscape change due to LSS has yet to be investigated in Canada. Performing studies in more parts of the world can help and understand nuances of public attitudes towards LSS.

Two additional realms of enquiry that have yet to be deeply explored in this field of research are (1) public attitudes towards LSS facilities that are multifunctional and form synergies with other land uses valued by locals (e.g., recreation, nature conservation, agriculture, etc.); and (2) comparative analysis of public attitudes in places where LSS is present versus where it is not. To help fill some of these research gaps, this thesis research will identify views shared among rural residents regarding the integration of LSS (solar farms) in rural landscapes of Nova Scotia.

By exploring subjective views, I hope that this work will provide a nuanced understanding of citizen perspectives of solar energy landscapes not offered by national surveys. Additionally, the results of this thesis may offer proactive, rather than reactive, insights for solar farm planning across landscapes in Nova Scotia, as solar farm development is not yet widespread in the province. Moreover, an aim of this thesis research is to learn what people *want* to happen when solar development occurs in rural landscapes, rather than merely focusing on what they do not want, or on the possibility of it not happening in these landscapes at all. This approach regards solar farms as having the potential to have a positive landscape impact, rather than a negative one, as long as their planning and design accounts for residents' landscape preferences to some extent.

# CHAPTER 3: STUDY AREA & METHODOLOGY

## 3.1 Overview

The research for this thesis investigates the views of rural Nova Scotians about integrating solar farms into rural landscapes of Nova Scotia. When the idea for this thesis was first developed in 2022, solar farm development and community reactions to it were only beginning to emerge in Nova Scotia, making the province an interesting case to study citizen expectations and preferences for such development. As emphasised earlier, solar farm development was ramping up not only provincially during this time, but also nationally in Canada, and internationally as solar power development was becoming more economically feasible across the globe. The rise of solar farm development at various geographic scales and the lack of social science research focused on this type of renewable energy development — compared to that for other types of larger-scale renewable energy, such as wind farms and hydropower plants—suggested a salient time for exploratory research on the topic. Thus, the research methodology used for thesis is largely exploratory, using an approach called the Q methodology.

This chapter comprises two major sections. The first section will provide a background on Nova Scotia rural landscapes and solar farm development in the province more broadly. The second section will describe the Q methodology and how it was employed for this research. Overall, this chapter provides a comprehensive understanding of the research context and design.

## 3.2 Study Area: Nova Scotia

The area of study for this research is Nova Scotia, an eastern province of Canada. Nova Scotia is regarded as one of Canada's four Atlantic provinces due to its adjacency to the Atlantic Ocean. Moreover, the province, shown in Figure 2, is comprised of two distinct regions: Cape Breton Island, forming the most eastern part of the province, and the peninsula of Nova Scotia or 'mainland Nova Scotia' (although it has many small islands). Cape Breton and the Nova Scotia peninsula collectively have a land mass of 52,824.71 $km^2$ (Statistics Canada, 2021). Despite having a relatively small landmass compared to Canada's other provinces and territories, Nova

Scotia has a diverse range of natural landscapes, including coastal drumlins, Acadian forests, and Appalachian uplands (Nova Scotia Department of Environment and Labour, 2002).


*Figure 2: Map of Nova Scotia with points indicating the study area and solar farm locations (as of 2024) within the province.*

In terms of population, Nova Scotia has been growing steadily over the last decade (Statistics Canada, 2021). Notably, at the end of 2021, the province reached the milestone of one million residents (Government of Nova Scotia, 2021). However, unlike many of Canada's provinces, but typical for Atlantic Canada, much of Nova Scotia's population lives rurally. According to the Government of Nova Scotia (2022), 41.1% of the province's population lived rurally in 2021, compared with 17.8% Canada-wide (Statistics Canada, 2022a). Due to declines in many traditional industries, such as coal mining and pulp and paper production, rural development has been a prominent concern politically, economically, and socially in the province for much of its recent history (OneNS, 2014; Gibson et al., 2015; Foster et al., 2021).

### 3.2.1 Defining Rural Nova Scotia

The state of rural Nova Scotia is important to contextualize here because, as explained earlier, this research is concerned about solar farm development in the province's rural landscapes. Therefore, what constitutes a 'rural area', and a 'rural landscape' is important to clarify for one to properly understand the topic of this research. First, it must be recognized that rurality is, of course, a relative concept which has evolved over time (Cromartie and Bucholtz, 2008; Hawley et al., 2017). Population size and density, development and land use type, and proximity to amenities are all metrics commonly used to determine whether a region should be delineated as rural or urban (Cromartie and Bucholtz, 2008). Plessis et al. (2002), working on behalf of Statistics Canada, acknowledges the complexity of defining 'rural', recommending that analysts determine a definition of rural that best suits the research questions they seek to answer. However, to serve as a benchmark, the 'rural and small town' definition is also offered, which regards rural *populations* as "the population living in towns and municipalities outside the commuting zone of larger urban centres (i.e., outside the commuting zone of centres with population of 10,000 or more)" (du Plessis et al., 2002, pg. 1). More recently, rural *areas* have been defined by Statistics Canada as "all territory lying outside population centres" (Statistics Canada, 2022b, para. 1). Importantly, Statistic Canada's (2022b) concept of 'population centres' refers to areas with a population of at least 1,000 and a population density of 400 persons or more per square kilometre, making it more inclusive than the concept of 'larger urban centres' by du Plessis et al. (2002).

Definitions offered by census bureaus, such as Statistics Canada, can serve as useful guidelines for assigning characteristics to geographic areas (e.g., rural vs urban). However, it is important to recognize that such definitions are operationalized to understand *population* characteristics rather than *landscape* characteristics. Moreover, census definitions are derived from and for the application of positivist approaches, while this thesis is concerned with constructivism. That is, what is understood as component of reality—in this case, a rural landscape—is subjective. The Statistics Canada (2022b) definition of a rural area ignores degrees of rurality, and if followed, many villages and small towns in Nova Scotia, which are designated 'small population centres' according to the 2021 Canada Census (Statistics Canada, 2022c), cannot be categorized as rural areas. By contrast, this thesis recognizes villages and small towns as culturally understood components of Nova Scotia's rural landscapes. For example, the Town of Berwick is—based on the Statistics Canada (2022b) definition—a small population centre, and not a designated rural area. However, it can be easily argued that Berwick is culturally recognized as a relatively rural place situated within a well-known rural landscape in the province: the Annapolis Valley. For instance, on the homepage of the Town's website, Berwick is described as a rural town with "farms, vineyards, and forests … making for an idyllic rural setting" (Town of Berwick, 2024b., par. 1). Therefore, smaller towns are recognized here as components of Nova Scotia's network of rural landscapes, consistent with their endogenous identity.

While this thesis prioritizes a constructivist perspective of rural landscapes—that is, how landscapes are understood through personal experience and knowledge—it is important to also define what is likely *not* perceived as rural in Nova Scotia. In other words, what is 'urban'? To do this, the definition of 'rural' employed by Statistics Canada (2024) is operationalized for this thesis. This definition states that rural "refers to areas outside of Census Metropolitan Areas (CRAs) and Census Agglomerations (CAs)" (par. 2). In Nova Scotia, Halifax—the province's capital—is a CMA, while Kentville, Truro, New Glasgow, and the Cape Breton Regional Municipality are CAs (Storring, 2023). All territory outside of the province's CMA and CAs are, therefore, regarded here as 'rural Nova Scotia'. Whether or not such territory is a true 'rural landscape' can be contested based on one's subjective scheme for differentiating landscape types. However, to ensure clarity in this thesis, all territory beyond Halifax and the province's four CAs are regarded as types of rural landscapes in Nova Scotia.

Rural Nova Scotia is comprised of a mosaic of different rural communities and landscapes. Being almost completely surrounded by ocean, the province has numerous small fishing villages that support not only a prominent fishing industry (Government of Nova Scotia, 2016), but also tourism (Foster and Main, 2020). Mining of minerals, such as coal, limestone, gypsum, and gold (Nova Scotia Department of Natural Resources and Renewables, 2021), and forestry are also natural resource sectors that depend on the province's rural landscapes. Various types of agriculture also occur in the province, particularly in its northern regions (Devanney, 2010). Major crops grown in the province include corn, apples, and blueberries (Statistics Canada, 2017), and many livestock commodities are also produces. In the province's more southern rural landscapes, particularly within Lunenburg County, balsam fir farming for the Christmas tree industry is prominent; so much so that Lunenburg County is regarded as the 'Christmas tree capital of the world' (Government of Nova Scotia, 2024). In the 2021 State of Rural Canada Report, Foster et al. (2021) explain that natural resource extraction and agriculture, tourism, and real estate for vacation rentals are all important sectors in the province that depend upon the natural capital offered by its coastal and inland rural landscapes. Thus, it can be argued that these landscapes play an important role in the prosperity of Nova Scotia's greater economy.

### 3.2.2 Study Communities

To hear opinions about solar farms and their landscape impacts from various types of rural residents in the province, three communities were selected for this research: Berwick, Mahone Bay, and New Ross. An overview map of the study areas is presented in Figure 2. The rationale behind community selection is discussed in a following section titled 'P-Set Selection'. In the following three subsections, overviews of the communities are provided with the hope of putting the scope of this research into context.

#### 3.2.2.1 Berwick

Incorporated in 1923, Berwick is a town centrally located in the Annapolis Valley region of Nova Scotia (Town of Berwick, 2024c). According to the Town of Berwick, Berwick has a population of 2,506, and has experienced an increase in population and development over recent years (Town of Berwick, 2024c). While it has been growing, Berwick is relatively small compared to other towns in the province, such as Kentville and Truro, with populations greater than 10,000 people (Statistics Canada, 2022c). Also, being only 4.31 $km^2$, Berwick is relatively small in terms of its geographic size (Statistics Canada, 2023a).

The Town of Berwick prides itself in being known as the 'Apple Capital of Nova Scotia' due to its prominent apple orchard industry (Town of Berwick, 2024b). Apple farming contributes to the identity of not only Berwick as a place, but to the identity of the greater Annapolis Valley as a cherished rural landscape in the province. In addition to the economic benefits derived from apple farming, the blossoms of apple trees (see Figure 3) in the area are appreciated aesthetically by many, making them an important draw for rural tourism in the region during the spring (Tourism Nova Scotia, 2024a). Farming is a significant part of the economy of Berwick and the greater Annapolis Valley, which is recognized as one of the main agricultural regions of Atlantic Canada due to its fertile soil (Tourism Nova Scotia, 2024b). The landscape of Berwick, specifically, is also comprised of vineyards, forests, and residential and smaller-scale commercial development.

*Figure 3: Blooming apple trees in the peripheral area of Berwick.*

For its residents, Berwick has various amenities, such as a library, town hall, fitness centre, grocery store, and numerous small businesses of its main street (see Figure 4). Residents can also take public transit in and out of the town, as Berwick is part of the Kings Transit busing network linking communities in the Annapolis Valley (Kings Transit Authority, 2024). Lastly, Berwick has its own electric utility called the Berwick Electric Commission (Town of Berwick, 2024d). Hydro, wind, and solar are all components of the Commission's energy mix. To date, about 60% of the Town's electricity is generated by renewable sources (Town of Berwick, 2024e). Some of these sources are located directly in Berwick, such as the Town's community solar garden, pictured in Figure 5. In sum, while Berwick can be identified as a rural town, it seemingly embraces modern development that makes life more affordable and efficient for residents, as well as supporting environmental sustainability.

*Figure 4: The view of Berwick's main street from outside of the Town's public library.*

*Figure 5: A view of Berwick's Community Solar Garden from the nearby highway (Highway 101).*

3.2.2.2 Mahone Bay

Mahone Bay is a coastal town situated in the South Shore region of Nova Scotia. In 2021, the population of the town was recorded as 1,036 (Statistics Canada, 2023b), making it, like Berwick, a relatively small town in the province. Mahone Bay is also relatively small in terms of geographic area, as it is only 3.12 km$^2$ (Statistics Canada, 2023b).

Provincially, the Town of Mahone Bay is recognized as a significant heritage town where local art and an idyllic coastal landscape can be appreciated (Tourism Nova Scotia, 2024c). Local heritage is an important part of the Town's identity, which is evidenced by the various heritage buildings found throughout its landscape. Some of these buildings, such as the Mahone Bay Town Hall, were constructed before the Town was incorporated in 1919 (Town of Mahone Bay, 2020a). Three buildings that are particularly valued in the landscape for their heritage significance and aesthetic value are the three churches (shown in Figure 6), visible from the Town's eastern entrance (Tourism Nova Scotia, 2024c). The oldest of the three, St. James'

Anglican Church, is a well-known feature of Mahone Bay's landscape (Town of Mahone Bay, 2020b). The preservation of heritage features combined with the coastal environment in Mahone Bay makes it a significant tourism site in Nova Scotia (Tourism Nova Scotia, 2024c). The degree to which to local landscape aesthetic is appreciated by the Town as a draw for visitors is demonstrated by its slogan: *We love the beauty around us and we welcome you to share it* (shown in Figure 7). Annual events in the town, such as the Mahone Bay Scarecrow Festival, celebrate small town life, and as such, also serve as draws for rural tourism.

*Figure 6: The famous three churches of Mahone Bay.*


*Figure 7: The Town of Mahone Bay's slogan presented on a welcome sign at one of the town entrances.*

Like many other towns in Nova Scotia, Mahone Bay has various amenities for its residents, such as a community centre, grocery store, bank, school, and numerous smaller businesses along its main street (see Figure 8). Moreover, the Town has its own electric utility called the Mahone Bay Electric Utility (Town of Mahone Bay, 2024c). Renewable energy, including wind and solar, are both part of the energy mix for the Town. To facilitate its transition to renewable energy, Mahone Bay, along with Berwick and Antigonish, formed an energy development company called AREA, which allows the three towns to collaborate on renewable energy projects. Currently, a 23.5MW, ten-turbine wind power plant, and three solar farms (one in each of the towns) are facilities owned by AREA that supply electricity to the towns (AREA, 2024). These components of Mahone Bay indicate efforts to simultaneously preserve old and develop new infrastructure in its landscape.

*Figure 8: Restaurants and other businesses along the main street of Mahone Bay.*

3.2.2.3 New Ross

New Ross is a relatively small inland rural community located between the Annapolis and South Shore regions of Nova Scotia. According to the New Ross Regional Development (2024a) website, the community of New Ross has a population of 1,393 people. Throughout the community's natural landscape, forests, lakes, and rivers are abundant. Like in many rural areas, the natural landscape of New Ross is a major component of its economy. For instance, Christmas tree farming and forestry are both prominent economic activities in the community and can be seen in various parts of the community's landscape (see Figures 9 and 10). Forestry, specifically, has been an important source of local employment for over a century, making it a significant part of the community's heritage (New Ross Regional Development Society, 2024b). Along with forestry, agricultural heritage is important to the community, which is demonstrated by its Ross Farm Museum. Barrel making, woodworking, and other traditional skills are demonstrated and taught to visitors of the museum, making it a popular destination for rural tourism in Nova Scotia (Ross Farm, n.d.).


*Figure 9: A Christmas tree farm visible from the core area of New Ross.*

In addition to its cultural and working landscapes, New Ross has various amenities to support its local residents. A hardware store, elementary school, family resource centre, and gas station can all be found along the main street of the community (see Figure 11). There are also a few notable sites that are considered a part of the wider peripheral area of New Ross. Firstly, just over 400 hectares of land in New Ross belongs to the Sipekne'katik First Nation, a district of the wider Mi'kmaq Nation spanning across Atlantic Canada (Sipekne'katik First Nation, 2023). Secondly, there is a wind power facility called the South Canoe Wind Farm located northeast of New Ross. Due to their proximity, the wind turbines can be seen from parts of New Ross, making the facility a part of the community's wider visual landscape (see Figure 10). Aside from the wind farm, the landscape of New Ross has seemingly experienced little development over recent years.

*Figure 10: A view of the wider landscape of New Ross. An active woodlot and windfarm can be seen in the background.*


*Figure 11: The main street of New Ross.*

### 3.3 Q methodology

The overarching research approach used for this thesis is the Q methodology. This methodology, often referred to as 'the science of subjectivity' (Brown, 1994; Ramlo, 2020), was first conceptualized by the late British physicist and psychologist, William Stephenson, in the 1930s (Stephenson, 1935). Since then, the Q methodology has been further theorized by Stephenson's former student, Steven R. Brown (1980, 1994) and employed by social scientists in various fields and disciplines, such as health care (Miguel et al., 2023) and environmental management (Dencer-Brown et al., 2022). Q-research is widely regarded as the scientific study of human subjectivity as it offers a systematic approach to measuring individual subjectivity and identifying shared 'ways of thinking' (i.e., perspectives, views, etc.) within a group of interest (Brown, 1994; Stephenson, 2018). Specifically, the methodology involves a forced-choice procedure, called a Q-sort, in which people rank—based on level of agreement or disagreement with their point of view—a series of opinion statements or images regarding a given subject matter (Stephenson, 2018). Thus, through this sorting procedure, latent subjectivity becomes observable (Stephenson, 1977). Individual Q-sorts gathered from a set of study participants, called a 'P-set', are compared via correlation and factor analysis, revealing a set of shared views regarding the concept or phenomenon in question. Often in Q-studies, qualitative data are also gathered via interviews that can occur during or immediately after a Q-sorting session (Wolf, 2014). Because the Q methodology generally involves the collection of both quantitative data (Q-sort data) and qualitative data (interview data) to gain qualitative insights (factors or 'shared views'), it is widely regarded as a mixed methods research approach (Ramlo, 2016a).

The type of insights that can be derived from a Q-study is the main reason why I chose the Q methodology to identify views among rural Nova Scotians regarding the integration of solar farms into rural landscapes. The remaining sections of this chapter will describe the steps of the Q methodology in more detail, and how they were carried out for this research. Specifically, the methods used to setup the study (concourse development, Q-sample selection, and 'P-set' recruitment), collect data (Q-sort and interviews), and perform analysis on those data (correlation and factor analysis) will be discussed. An overview of the research process is shown in Figure 12.

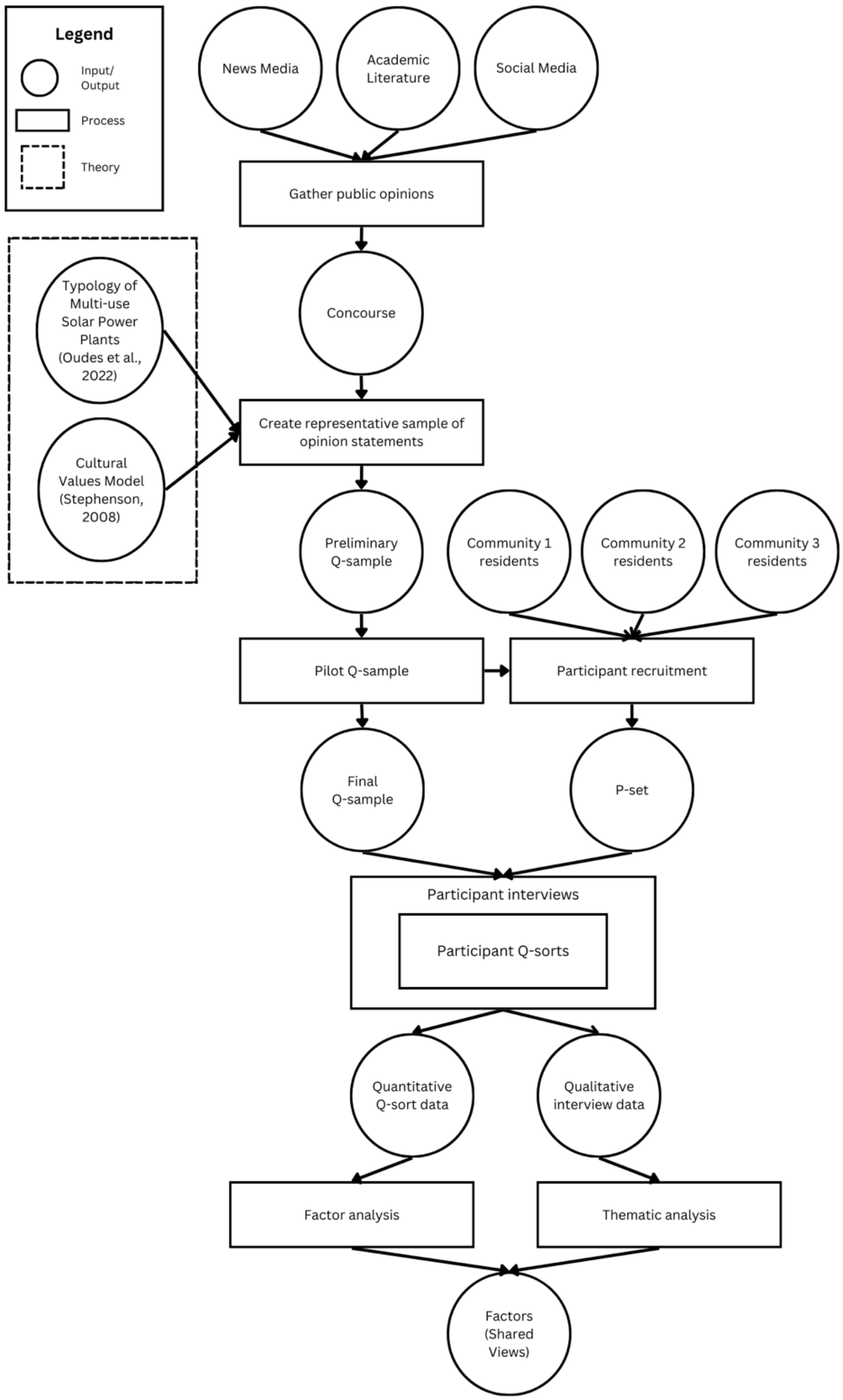


*Figure 12: Overview of how the Q methodology was employed for this research.*

### 3.3.1 Concourse Development

The first step of any Q study is to identify the communication ‘concourse’ that exists around the concept or phenomenon being questioned in the study. According to Stephenson (1986), a concourse is the “universe of [subjective] statements” associated with “any situation or context” (p. 44). That is, a concourse represents all the ways in which a situation or context is talked about in everyday conversations based upon held values, perceptions, and beliefs, rather than merely learned objective information (Stephenson, 1986). Moreover, as Stephenson (1986) emphasizes, a (statement-based) concourse is understood by empirical knowledge about how people really talk about concepts and phenomena.

There are many ways that a Q-researcher can attempt to understand a concourse in its entirety. In practice, it is virtually impossible for one to identify *all* the statement possibilities for a concourse, but it is important that a comprehensive *understanding* is gathered of the most common possibilities. Focus group interviews, literature reviews, and analysis of media content are three frequently used methods for ‘populating’ a concourse (McKeown and Thomas, 1988). For this research, the latter two methods were used for gathering opinion statements pertaining to the impacts of solar farms on landscapes. Specifically, three categories for these sources were used: social science literature regarding large-scale solar (LSS); news media content covering public responses to solar farms in Canada; and social media content related to solar farm development in Nova Scotia. Importantly, to be considered a component of the concourse for this study, a verbatim opinion or description of an opinion found from these sources needed to be related to landscape change caused by solar farm development.

First, I gathered opinion statements during my literature review to identify components of the concourse that exist beyond Canada. For context, this process occurred between November 2022 and January 2023; therefore, literature published after this period was not considered. To extract potential opinion statements, I reviewed result summaries and verbatim quotes found in papers involving citizen interviews. Notably, opinions regarding multifunctional solar farms, which are relatively uncommon in Canada, were gathered during the literature review. In the Netherlands, for instance, multifunctional solar farms are relatively common (Oudes et al., 2022), and interesting opinions about them are presented as interview quotes by van den Berg et al. (2022). Due to a lack of literature from Canada, statements indicative of public opinion in

Canada could not be extracted during the literature review process. Nonetheless, the literature review, overall, helped enhance the comprehensiveness of the concourse.

Next, I gathered opinion statements from Canadian news media content. Only news media from Canada was reviewed to capture the more local discourse. Also, only news articles published prior to April 2023 were examined, as this is when this stage of concourse development had concluded. News articles were retrieved using the Eureka and ProQuest Historic Newspapers databases and downloaded as PDFs. To extract opinion statements, the articles were manually coded in NVivo12. Most articles served as a source of both primary and secondary opinion data. The latter was the in the main article, while the former was in the comment section following the online articles. All news articles were analysed with caution, as their authors typically presented a paraphrased version of the opinions shared with them during interviews. However, comment sections of online articles presented authentic opinions held by readers, which could be directly coded as opinion statements. Both types of data provided opinions about landscape change caused by solar farm development in Canada.

Lastly, I examined public discourse on social media to extract opinion statements. Social media posts and their corresponding comments on Facebook and Twitter, specifically, were reviewed. To find relevant posts, the terms “Nova Scotia” and “community solar garden” or “solar farm” were entered into the Facebook search field. All posts that appeared were examined for opinions about the impact of solar farm development on landscapes. The comments added to the posts were also analyzed to extract relevant statements of opinion. This stage of concourse development allowed opinions that are unique to Nova Scotia to be accounted for. It is important to note, however, that there was relatively little discourse about solar farm development in Nova Scotia found on social media, presumably because such development was relatively new in the province at this time.

### 3.3.2 Q-Sample Selection

The second stage of the Q methodology involves selecting a Q-sample, which is a sample of statements or images representing the Q-study's larger concourse. Such statements—or images— serve as material to be considered and arranged by study participants as Q-sorts. For this Q-study, I decided that the Q-sample needed to be designed in a way that not only represents the *identified* discourse around landscape impacts of solar farms, but also allows participants to provide opinions on different landscape impacts and design options that may be possible in Nova Scotia. For instance, although there are no multifunctional solar farms in Nova Scotia, they could, in theory, be developed in the province in the future. Moreover, participants may have learned about multifunctional solar farms in other places through news content or communication with others. Therefore, the Q-sample needs to provide the opportunity for all participants, no matter their knowledge of solar farms, to be able to express their full view as a Q-sort. Based on these goals, I decided that the opinion statements comprising the Q-sample should be deductively *designed* using theory and informed by the concourse, rather than a *selected* sample of verbatim opinion statements comprising the concourse. To assemble statements for the Q-sample, a procedure by Paige and Morin (2016) was followed, involving: (1) choosing a preliminary Q-sample using a deductive or inductive approach; (2) evaluating the sample with experts; (3) piloting the sample; and (4) refining and editing the sample based on feedback received during stages 2 and 3.

As per Paige and Morin's (2016) procedure, a preliminary Q-sample was designed first. To do this, I used a deductive approach, involving two conceptual frameworks. The first framework is the Cultural Values Model by Stephenson (2008), which can be operationalized to understand values that exist in a landscape. This framework was chosen as it recognizes both the physical and cognitive components of landscapes. Specifically, the Model separates landscape components into three categories: forms, practices (including processes), and relationships. Examples of landscape forms include vegetation and human-made structures; examples of practices include ecological processes and human activities; and examples of relationships include sense of place and aesthetic appreciation (Stephenson, 2008). According to Stephenson (2008), all such components can be culturally valued, and these values change across time and space. The concourse for this study illustrates that opinions exist regarding the impacts of solar farms on landscape forms (e.g., forest cover), practices (e.g., agriculture), and relationships (e.g., rural character). Thus, the framework by Stephenson (2008) was useful for designing statements that reflect landscape values that can be impacted by solar farm development.

The second framework that I used to design a preliminary Q-sort is the Typology of Solar Power Plants by Oudes et al. (2022). According to this framework, there are four types of solar farms or 'SPPs': (1) monofunctional; (2) mixed production; (3) nature inclusive; and (4) landscape inclusive. Monofunctional prioritizes electricity generation; mixed production combines solar infrastructure with other land uses to maximize the site's economic opportunity (e.g., agrivoltaics); nature inclusive incorporates vegetation or other natural features to concurrently achieve nature-based goals (e.g., biodiversity conservation); and landscape inclusive enhances physical landscape features and/or landscape user experiences (e.g., walking trails) (Oudes et al., 2022). This framework was employed for Q-sample selection as it recognizes the different *possibilities* for solar farm design in a landscape, even if they are uncommon in this region. Opinion statements for each type of solar farm landscape design were added to the Q-sample so that participants to express their own opinions about the full range of possibilities and landscape impacts.

In sum, the two conceptual frameworks informed the type of content to be included in the sample of opinion statements. Two other decisions were made regarding the wording of the statements. First, the overarching prompt applied to the beginning of each statement was "Solar farms in rural Nova Scotia". Second, each statement written on a card to be sorted was phrased as an event that "should" or "should not" happen. An example of the former is "should be available for community access", and an example of the latter is "should not impede wildlife movement". The polarity of a statement (whether it is positive [should] or negative [should not]) was chosen based upon how such a situation is discussed in the concourse. For instance, impeding wildlife movement is generally perceived as a negative impact of solar farms; therefore, the statement card regarding wildlife movement began with "should not". In total, 41 opinion statements comprised the preliminary Q-sample.

Next, the preliminary Q-sample was piloted. Due to time restrictions, the expert review phase of Paige and Morin's (2016) procedure was skipped. However, my thesis research committee was asked to provide feedback on the first round of statements, serving as a type of expert review. Based upon committee feedback, several statements were reworded, and one was removed. To pilot the adjusted 40-statement Q-sample, I recruited two residents of rural Nova Scotia. This process did not require institutional research ethics board (REB) approval, as the pilot Q-sorts were excluded from the final analysis. For the pilot sessions, I gave the participants a brief description of the study and instructions on how to complete a Q-sort (see Appendix A). At this stage, a Q-sort board with a ranking grid was not yet made, so the participants were instructed to sort the statements on a table. While there was not a formal grid to guide sorting, the participants were asked to rank statements along a continuum of categories from least agree (-4) to most agree (+4). The centre category was neutral (0). Feedback regarding the clarity of each statement and comprehensiveness of the Q-sample was provided by the pilot participants, resulting in further edits to the statements. Once my committee and I felt that the Q-sample was sufficiently reviewed, the final 40-statement Q-sample was submitted for REB approval and printed on paper cards which were subsequently laminated to be used for the formal Q-sort sessions.

### 3.3.3 P-set Recruitment

The Q methodology involves unique expectations with regard to participant recruitment. To understand them, it is first important to understand the statistical theory for Q-methodological studies are the inverse of that for R-methodological studies (Brown, 1980). For R-studies, a representative sample of participants is selected from a greater *population of people*, and a relatively small number of variable-to-variable correlation tests are run to make generalizations about said population. In Q-studies, however, people serve as the variables. In other words, Q-studies involve people-to-people correlation tests, which allow the researcher to make generalizations about a greater *population of opinions* around a topic (i.e., the concourse). The representative sample of importance for a Q-study is the Q-sample. To reach data saturation in a Q-study, only a relatively small sample of participants is needed (Brown, 1980). In Q-terms, the sample of respondents chosen for a Q-study is called a ‘P-set’ (Brown, 1980).

For this study, a P-set was recruited during the spring, summer, and early fall of 2023. Before recruitment began, REB approval (file #2023-6658) was obtained from Dalhousie University. An overarching goal for participant recruitment was to recruit a relatively diverse group of Nova Scotians who reside in rural areas (see section 3.1.1 for the operationalized definition of rural area in Nova Scotia), as P-set diversity is recommended to ensure a Q-study is robust (Brown, 1980). The first way of doing this was recruiting residents that were presumed to have different types and levels of experience with solar farms based on where they lived in the province. As mentioned earlier in this chapter, Berwick, Mahone Bay, and New Ross were the chosen communities from which participants were recruited. A community solar garden was in Berwick during this time, but community reactions to it were not documented in the news; therefore, this community served as a case of 'neutral community experience'. In contrast, community opposition to a solar garden had been documented by local news for Mahone Bay, making this community a case of 'negative community experience'. Lastly, New Ross did not have a solar farm, so it served as a case of 'no community experience'

Participants were recruited from the three communities using purposive, snowball sampling. This recruitment method involved recruiting an initial group of eligible residents, and then asking them to help recruit others who either: (1) tend to have different views than themselves; and/or (2) are a different age, gender, or occupation than themselves. I recruited an initial group of participants through on-the-street conversations in the communities, and digitally through email and social media. I also posted a recruitment poster (see Appendix B) on community bulletins, both physical and online, asking eligible residents to volunteer to participate. Lastly, I reached out to personal contacts in the three communities who were able to connect me with eligible residents. The recruitment process ended in October 2023.

### 3.3.4 Q-sorting and Interviews

For this study, all participants completed a Q-sort and semi-structured interview in person. The Berwick Library, Mahone Bay Centre, and New Ross Family Resource Centre all served as sites to meet with participants. To ensure participants could complete their Q-sorts and answer questions in confidence, I met with them in a private room. At the beginning of each session, I provided a brief overview of the study and instructions for completing the Q-sort. Then, I asked participants to sign a copy of the research consent form (see Appendix C), representing consent to not only engage in the session, but also have it recorded. All participants were sent a copy of the consent form via email prior to the session, except for one participant who did not have an email address. After formally consenting to participate, participants completed the Q-sort exercise using the opinion statement cards and ranking grid presented on a poster board. The format of the ranking grid is shown in Figure 13.

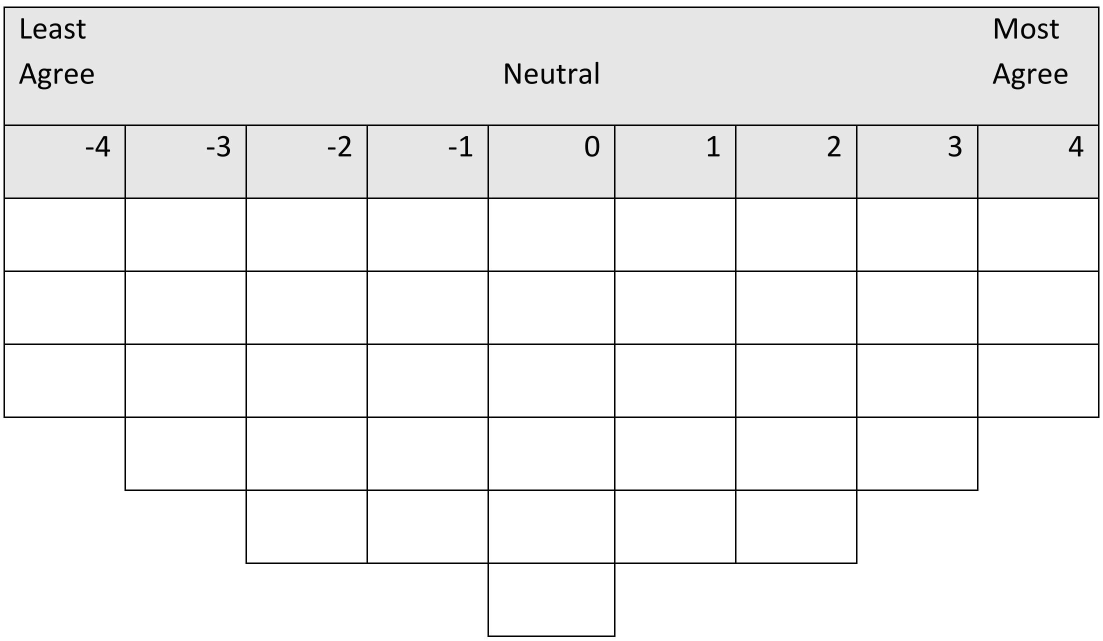


*Figure 13: Q-sort grid for ranking statements of the Q-sample*

As participants were completing their Q-sort, I encouraged them to ask questions and/or bring up any topics that they wanted to discuss before the interview. Based on a list of guiding questions (see Figure 14), interviews were conducted *after* Q-sort completion. The purpose of the interviews was to gain understanding about participants' level of experience with solar farms and feelings about rural landscape change at local and provincial scales, as well as allow participants to provide context and rationale for their Q-sort. Importantly, participants were able to make changes to their Q-sort during their interview. Often, Q-sort changes were made if a participant learned something about solar farms from the researcher and/or gained clarity on their opinion(s). The aim of ensuring most of the conversation happened after Q-sorting was to mitigate my influence on sorting decisions. The sessions were between 30-60 minutes long; with the average time being about 45 minutes, as this was the time negotiated in the consent form.

1. Did you know about large-scale solar before completing this activity?
   - *If yes*: What is your experience with large-scale solar?
   - *If no*: What do you think about large-scale solar after completing this activity?
2. Is landscape change occurring in your community?
   - *If yes*: How do you feel about this change?
   - *If no*: How do you feel about this lack of change?
3. Do you think landscape change is happening in rural Nova Scotia more broadly?
   - If yes: How do you feel about this change?
   - If no: How do you feel about this lack of change?
4. Why did you place [type of statements] in the 'most agree' part of the sorting grid?
   - *Follow up*: What is your experience with [landscape components/options that are most preferred]?
5. Why did you place [type of statements] in the 'least agree' part of the sorting grid?
   - *Follow up*: What is your experience with [landscape components/options that are least preferred]?
6. Why did you place [type of statements] in the 'neutral' part of the sorting grid?
   - *Follow up*: What is your experience with [landscape components/options that the participant feels neutral about]?
7. Do you have any questions for me?

*Figure 14: Interview guide*

### 3.3.5 Factor Analysis

The final stage of Q methodology is completing a factor analysis. Such analysis can be performed in various ways, but it always results in a distinguished set of *factors*. In the case of Q-research, factors represent shared 'ways of thinking' or *viewpoints* around a topic. Fundamentally, factor analyses for Q-studies function as a method of analyzing the quantitative data derived from Q-sorts (Brown, 1980). Notably, Stephenson (1977) emphasized that factors in

Q-studies serve as "subjective operants" (p. 7). That is, they represent subjective views in an observable and communicable format.

In the context of this research, a factor analysis was performed using quantitative Q-sort data and qualitative interview data to identify shared views regarding solar farms in Nova Scotia's rural landscapes. Several procedural and analytical steps were taken to 'extract' a final set of factors (i.e., shared views). It is important to clarify that the 'factor analysis' for this study was informed by not only statistical outcomes generated from the Q-sort data, but also themes found in the interview data. Post-sort interviews are used to contextualize participants' Q-sorts (Brown, 1980; Wolf, 2016). Moreover, insights from interviews informed the abductive reasoning used during factor determination, which is encouraged for Q-studies (Ramlo, 2016b; Wolf and Peace, 2018). Abductive reasoning involves using various lines of evidence to determine an (abductive) inference (Halas, 2015). The inference that is determined serves as a 'well-informed guess' based on all available evidence. As such, an abductive inference is not necessarily a 'guaranteed truth' but rather a strong hypothesis (Halas, 2015). In the case of my factor analysis, broad themes in the interview data (i.e., findings from along with statistical data from the Q-sorts provided an indication of the *number* of distinct factors (views) that *likely* exist. Presumably, an error in factor selection is the result of my interpretation of the data, rather than the data themselves (as long as data collection was appropriately conducted). In addition to informing the final number of chosen factors, the interview and Q-sort datasets were both used to understand the characteristics of the factors.

For the statistical component of the factor analysis, I used release 2.35 of the PQMethod computer software, maintained by Schmolck (2014a). To derive factors using the software, I followed the general flow and procedure for analysis, outlined in the PQMethod Manual by Schmolck (2014b). The first step of this procedure was data entry, which involved entering all the opinion statements (i.e., the Q-sample) and the individual Q-sorts into the software. Then, the data were analyzed using an exploratory lens to hypothesize how many *significant* factors exist. The first stage of data exploration was assessing the factor significance based on the eigenvalue criterion. According to McKeown and Thomas (2013), the eigenvalue criterion implies that "factors with eigenvalues greater than 1.00 are considered significant; those with eigenvalues of lesser magnitude are considered too weak to merit serious attention" (p. 9). Based on the table of eigenvalues, Factors 1-4 had values greater than 1.00. However, Factors 5 and 6 had relatively high values (~0.7). Next, a series of varimax rotations were performed for various factor scenarios, based on which factors had relatively high eigenvalues. The results of the varimax rotations were examined based on the degree to which participants were loaded onto each factor (i.e., factor loading values). Statistically significant loadings were indicated by a 'flag'. Ultimately, the factor scenario in which all participants were flagged to a factor was chosen.

To justify the chosen factor scenario, its factor arrays, factor scores, and the interview data were consulted simultaneously. A factor array is a composite Q-sort for each factor; that is, a representative Q-sort. Each statement of the Q-sample is 'scored', giving it a position within the factor array. Using this information, the factors were characterized based upon differences in their most salient statements (i.e., statements that are ranked higher and lower).

In addition to qualitatively assessing the nature of the factor arrays, themes in the interview data were drawn upon. Using a relatively informal thematic coding approach, themes were manually identified within verbatim transcripts of the interviews and my field notes. Many of these conceptual clusters began as insights induced during or reflecting upon the field work and captured during mu journaling process. Then, broad themes found within the qualitative data were compared to the themes identified in the factor arrays. Based on this comparative analysis, the chosen factor scenario could be justified. To understand values and perceptions of solar farms and landscape change that seem to influence the two views (i.e., answer to research question 2), the interview data were further analyzed using factor-based deductive coding. That is, participants' interview responses were categorized as belonging to View 1 or View 2 based on whether the participant loaded onto Factor 1 or Factor 2, respectively. Then, themes derived from the interview responses were associated with the two views.

# CHAPTER 4: RESULTS

## 4.1 Overview

In total, I recruited 18 Nova Scotians to serve as the P-set. Nine were residents of Berwick, six were residents of Mahone Bay, and three were residents of New Ross. The P-set covers a relatively diverse range of genders, ages, and occupations, as shown in Table 1. Half of the participants identify as female and the other half as male. More than half of the participants are over the age of 50, and only a third of the participants identified as a retiree.

A Q-sort and interview session was completed by each participant. All data from these sessions were accounted for in the factor analysis, which ultimately resulted in a two-factor scenario. In this results section, when I am discussing the statistical results, I will refer to these as factors. As I transition into the qualitative analysis, these factors will be discussed as two distinct ‘views’. Characteristics of the factors/views can be succinctly understood through the way in which statements are ranked (from -4 [least agree] to +4 [most agree]) in their corresponding factor arrays (i.e., representative Q-sorts), shown in Table 2. Based on themes found in the two factor arrays, as well as themes found in the interview data, View 1 and View 2 are titled ‘Embrace and Integrate’ and ‘Hide and Isolate’, respectively. Importantly, these views are associated with the place of solar in ‘everyday landscapes’ of rural areas; that is, the landscapes in which people live, work, and recreate frequently, rather than areas infrequently visited and used by people (e.g., uninhabited nature areas). This distinction was made based upon themes identified in the participants’ interview and Q-sort responses. Moreover, 19 distinguishing statements (i.e., statements that distinguish the views) and 14 consensus statements (i.e., statements that unify the views) were identified from the factor analysis (see Table 2). Ten participant Q-sorts are loaded to Factor 1 and eight are loaded to Factor 2. All Q-sort loadings are shown in Table 3. The following sections of this chapter will discuss points of consensus between the two views, as well as the unique characteristics of each view. Moreover, themes in participant Q-sort and interview responses will be described to further contextualize the two views.[3]

Table 1: P-set demographic information

| Variable | Count (n = 18) |
|---|---|
| ***Gender*** | |
| *Male* | 9 |
| *Female* | 9 |
| ***Age Range*** | |
| *20-29* | 1 |
| *30-39* | 1 |
| *40-49* | 2 |
| *50-59* | 6 |
| *60-69* | 5 |
| *70-79* | 3 |
| ***Occupation*** | |
| *Information Technology Professional* | 2 |
| *Elected Official* | 1 |
| *Farmer* | 1 |
| *Artisan/Artist* | 2 |
| *Pharmacist* | 1 |
| *Cook* | 1 |
| *Natural Resource Clerk* | 1 |
| *Library Clerk* | 1 |
| *Homemaker* | 1 |
| *Teacher* | 1 |
| *Retiree* | 6 |

[3] As participant responses are discussed in this chapter, qualitative quantifiers such as *few*, *some*, *many*, and *most*, are used to describe themes in the Q-sort and interview data. This form of 'verbal counting' is typical in qualitative research (Sandelowski, 2001). For clarity, when discussing themes among all participants, *few* means less than 5; *some* means 5-8; *many* means 9-15; and *most* means greater than 15. When responses are linked to factor/view themes, *few* and *some* generally mean less than 50%, *many* means at least 50%; and *most* means more than 50%.

*Table 2: Factor array for each of the factors/views*

| **Statement Number** | **Statement ("Solar farms in rural Nova Scotia…")** | **Grid Position for that factor (-4 [Least Agree] to 4 [Most Agree]):** **Factor 1:** | **Factor 2:** |
|---|---|---|---|
| 1* | Should not require forest area to be cut | 3 | 3 |
| 2 | Should include space for native plants or wildflowers | 3 | 1 |
| 3 | **Should not be seen from houses or cottages** | -4 | 1 |
| 4 | **Should integrate livestock (e.g., sheep or rabbits)** | 1 | -4 |
| 5 | **Should be designed to attracted visitors from outside the community** | 0 | -4 |
| 6 | **Should not be permitted to decrease the natural beauty of the landscape** | -1 | 3 |
| 7 | **Should prioritize panel coverage** | 1 | -1 |
| 8 | **Should not be permitted to decrease the rural character** | -2 | 2 |
| 9* | Should be placed on grassland or pasture | -2 | -3 |
| 10 | **Should be removed after the lifespan of the panels** | -3 | 2 |
| 11 | Should make no sound audible to neighbors | 0 | 1 |
| 12* | Should be securely fenced | -1 | 0 |
| 13 | Should be oriented to avoid glare for neighbors | 2 | 0 |
| 14 | Should be built on existing forest clearcuts | -1 | 1 |
| 15* | Should not degrade wildlife habitat | 3 | 4 |

| **Statement Number** | **Statement ("Solar farms in rural Nova Scotia…")** | **Grid Position for that factor (-4 [Least Agree] to 4 [Most Agree]):** **Factor 1:** | **Factor 2:** |
|---|---|---|---|
| 16 | Should not require wetlands to be infilled | 4 | 3 |
| 17* | Should include space for fruit trees to be grown | 0 | -1 |
| 18 | **Should be physically accessible to communities** | 1 | -2 |
| 19 | Should be interplanted with Christmas trees | -2 | -2 |
| 20 | **Should be interplanted with food crops** | 2 | 0 |
| 21* | Should not displace residential development | -2 | 0 |
| 22 | **Should be built along roadways** | 2 | -3 |
| 23* | Should be placed over gravel | -2 | -1 |
| 24 | **Should not be placed in areas of heritage significance** | 0 | 3 |
| 25 | Should not impede wildlife movement | 4 | 2 |
| 26* | Should be built on lakes | -4 | -4 |
| 27 | **Should include recreational features, like walking trails** | 1 | -2 |
| 28 | **Should be built on parking lots** | 2 | -3 |
| 29 | **Should not be built in areas with cultural artifacts** | 0 | 2 |
| 30 | **Should not hinder people's emotional connection to the landscape** | -3 | 2 |
| 31* | Should not impede natural waterways | 4 | 4 |
| 32* | Should be built in areas with wind turbines | 0 | -1 |
| 33* | Should not impede hunting | -4 | -3 |

| Statement Number | Statement ("Solar farms in rural Nova Scotia…") | Grid Position for that factor (-4 [Least Agree] to 4 [Most Agree]): Factor 1: | Factor 2: |
|---|---|---|---|
| 34* | Should be built on contaminated sites (e.g., old landfills) | 3 | 1 |
| 35* | Should not emit heat | -1 | -2 |
| 36 | **Should not displace agriculture** | 1 | 4 |
| 37* | Should not displace commercial development | -1 | -1 |
| 38 | **Should be placed near cities where the power is most needed and in not rural areas** | -3 | 0 |
| 39 | **Should not change the "feel" of an area** | -3 | 0 |
| 40 | **Should be showcased as symbols of climate responsibility** | 2 | -2 |

*Note:* Distinguishing statements that differentiate Factor 1 from Factor 2 are bolded. Consensus statements, representing consensus between the two factors, are indicated with an asterisk (*). These statements are statistically significant at $p < .01$.

*Table 3: Factor loading by participant Q-sort with an * indicating a defining sort.*

| | Loadings | |
|---|---|---|
| **Q-Sort** | **Factor 1** | **Factor 2** |
| *New Ross Resident 1* | 0.6699* | 0.1528 |
| *New Ross Resident 2* | 0.4223* | 0.3039 |
| *New Ross Resident 3* | 0.0786 | 0.6603* |
| *Berwick Resident 1* | 0.6173* | 0.3237 |
| *Berwick Resident 2* | 0.6071* | 0.2805 |
| *Berwick Resident 3* | 0.4721* | 0.3865 |
| *Berwick Resident 4* | 0.1382 | 0.7390* |
| *Berwick Resident 5* | 0.2436 | 0.4327* |
| *Berwick Resident 6* | 0.5470 | 0.6452* |
| *Berwick Resident 7* | 0.7389* | 0.0556 |
| *Berwick Resident 8* | 0.7389* | 0.0556 |
| *Berwick Resident 9* | 0.5548* | -0.1004 |
| *Mahone Bay Resident 1* | 0.5926* | 0.2700 |
| *Mahone Bay Resident 2* | 0.2586 | 0.4748* |
| *Mahone Bay Resident 3* | 0.0718 | 0.5316* |
| *Mahone Bay Resident 4* | 0.1458 | 0.7909* |
| *Mahone Bay Resident 5* | -0.0723 | 0.8446* |
| *Mahone Bay Resident 6* | 0.8768* | -0.0315 |

4.2 Consensus: Solar farm development should not harm the local natural environment

A major theme identified both in the consensus statements (i.e., statements representing consensus between the two factors/views) and interview responses is concern about solar farm development having a direct impact on the local natural environment. With regard to the Q-sort data, all participants placed statements indicating that solar farms should not harm the natural environment on the ‘agree’ portion of their Q-sorts (i.e., within columns greater than 0). Notably, in the factor array for each factor, the statement “should not impede natural waterways” is located at the +4 position, indicating the highest level of agreement. Other statements within the +3 and +4 positions of the two factor arrays are "should not require forest area to be cut"; "should not degrade wildlife habitat"; and "should not require wetlands to be infilled". These shared opinions are contextualized by the interview responses.

Firstly, many participants explained during their interview that the global environmental benefits of renewable energy development do not supersede the environmental harm such development can cause at local scales. Within the context of Nova Scotia, many participants thought that too much environmental degradation has already happened in the province, so environmental conservation and preservation should be prioritized. This point was demonstrated by Berwick Resident 2 when they said:

> Yeah, I mean, my main concern is we're already… I mean… degradation is already happening quite quickly. So, there's a need for things like solar and wind, but [when] I think about the amount of energy generated from a solar farm, versus the land requirement, I want to make sure that that land is somewhere that's not going to disrupt existing ecosystems, especially wetlands. Especially forests. Just because we need as much forested cover as we can get, in my opinion.

Ecosystems that many participants considered to be 'ecologically significant', such as old growth forests and wetlands, were often brought up as examples of sites that warrant the most protection from not only solar farms, but all forms of development. In addition, protection of forest cover in general was regarded by many as especially important during solar farm development. Again, within the context of Nova Scotia, preservation of forests was often described as a major priority due to a perceived lack of mature and old-growth forest cover in the province. Further, almost all participants believed that a solar farm should be sited where tree removal is unnecessary or very limited during construction. For example, Berwick Resident 1 said: "Definitely [don't] want extra trees cut. We need our trees." Also, Berwick Resident 4 explained:

> I don't think you need to be cutting down trees to put up solar gardens. Um. I don't think you need to be cutting down trees for anything really other than maybe lumber (laughs), but, um, 'cause it's a, kind of something we do need. Um, yeah. That's a big impact on the environment and on the land. And in and of itself, it has a big carbon footprint to, to destroy the, well not destroy so much, but, but to remove the forest.

One exception is New Ross Resident 3, who felt that a certain level of landscape 'sacrifice' is inevitable as solar farm development continues. Specifically, with respect to solar farm siting, they said: “It’s gotta go somewhere. Gunna have to cut trees down. Gunna have to give up some farmland, or, ah, put it on gravel, you’re gunna have to... it’s gotta go somewhere” (New Ross Resident 3).

Wildlife movement was also described by many as a landscape process that should not be impeded by solar farms, or other forms of renewable energy for that matter. Often, protection of wildlife corridors was described as an important way to conserve biodiversity, which many perceived to be declining. A few participants who were especially well-informed on biology discussed the importance of biodiversity to people. For example, one of these participants explained: “Yeah, you know, and anything with wildlife and anything like that, we have to really, really, really, really protect it because if we don't have biodiversity, we're done.”

Some participants shared past development ‘mistakes’ that they witnessed in Nova Scotia, which caused environmental impacts that they thought were avoidable with more careful planning. In relation to environmental impacts caused by wind energy development, New Ross Resident 2 explained: “When it comes to the natural waterways and the wildlife, and if we, if we destroy the natural corridor for the moose, which we did with some of the wind turbines. Again, moose showing up in the downtown New Ross, common!” Berwick Resident 6 also shared an example of past development mistakes that should be learned from when they said:

> I think we’re destroying the world, and I think we’ve gone… into things without thinking of those consequences. We’ve done it in the past. But, my big example is when they built the causeway between Windsor and, and the Valley to replace the bridge. Um. It was sold as being, you know, the next best thing to sliced bread. And it turned out to be an ecological disaster. And so, I want them to, I want us to learn from our mistakes. And if we’re going to go ahead with something like a solar farm, um, really try to do it with as little impact as for the Earth as possible.

Notably, some participants found it difficult to agree as much as they wanted with certain statements regarding environmental impacts because of the structure of the Q-sort grid. Berwick Resident 6 articulated this challenge when they said:

> I think that’s what it is. Like I know it matters to me. I just haven’t thought in terms of ok ‘what matters to me more?’ That wildlife habitat is not degraded or wetlands not be infilled. Like, like to me, like all these things need to be [thought of].

In sum, local environmental protection during solar farm development in Nova Scotia was a concern shared among participants. Much of this concern seems to stem from the perception that too much environmental degradation has already occurred in the province, so planning for future development should mitigate the impacts on local environments as much as possible. Overall, the global environmental benefits of solar farm development via greenhouse gas emission mitigation were not regarded as more important than local environmental conservation and preservation.

## 4.3 View 1: Embrace and Integrate

After both the factor analysis and thematic analysis of interview data, it was found that Factor 1, hereafter called 'View 1', believes that solar farms should be *embraced and integrated* within everyday landscapes of rural areas. Ten participants comprise this view (i.e., their Q-sorts are loaded onto this factor/view and qualitatively contributed to defining this view). Specifically, this view corresponds with the Q-sorts of six Berwick residents, two Mahone Bay residents, and two New Ross residents. The title given to this view is partly based on two themes identified in the distinguishing statements.

The first theme is that View 1 cares less than View 2 about solar farms impacting *relationship values* (which include aesthetic and place attachment appreciations) tied to rural landscapes. For example, statements related to landscape aesthetics are on the 'least agree' portion of the factor array for this view. Such statements—followed by their grid position in parentheses—include 'should not be seen from houses/cottages' (-4); and 'should not be permitted to decrease the natural beauty of the landscape' (-1). Statements indicative of impacts to place attachment and sense of place are also least agreed with, including 'should not hinder people's emotional connection to the landscape' (-3); 'should not change the "feel" of an area' (-3); 'should not be permitted to decrease the rural character' (-2).

The second theme in the distinguishing statements that View 1 is interested in integrating solar farms with other landscape uses, allowing them to be in areas used by and/or noticeable to people on a relatively daily basis. For instance, statements related to multifunctional solar farms are on the 'agree' side of the factor array for this view. Such statements include 'should be built on parking lots' (+2); 'should be integrated with food crops' (+2); 'should integrate livestock (e.g., sheep or rabbits)' (+1); and 'should include recreational features, like walking trails' (+1). This view also agrees with statements indicating that solar farms should be visible in everyday landscapes. These statements include 'should be showcased as symbols of climate responsibility' (+2); and 'should be built along roadways' (+2).

The factor array results provide an idea of the kinds of things that matter most, and do not matter very much, to View 1. However, it is the interview results that provide further context and *explanations* for this view. Such results also informed the title given to this view. In the following subsections, themes in the interview transcripts from participants who correspond with this view, statistically, are presented and described as overarching explanations for the view.

### 4.3.1 Renewable energy development should be shown and celebrated

Many of the participants corresponding with View 1 explained that they either do not mind or enjoy seeing larger-scale renewable energy infrastructure in everyday landscapes. Appreciation was expressed for being able to see not only larger-scale solar developments, but also wind turbines. For example, when asked if they like the look of solar panels, Berwick Resident 8 responded: "I like the look of them. … Oh, I think they're beautiful. Same as wind turbines. I think … they look like renewable energy to me (laughs)." Also, a few participants exemplifying this view explained that renewable energy development visually symbolizes progress in terms of transitioning away from fossil fuel use. This idea was expressed by Mahone Bay Resident 6 when they said:

> The way I look at it is you look at that and it's not producing any greenhouse gases, like, a turbine or solar panel. Whereas you see a car drive down the road, well it's producing greenhouse gases and if you have oil heat in your house, you're producing the greenhouse gases. So uh, you've got to get over what it looks like and get on to what we need. So that's my take on those folks. … And then the emotional connection to the landscape. Like again, people have to change. You can't stick with these old, you know, it's our place, it should be forever. It's just like nothing's forever and nothing will be if you, if we don't approve. So to have these emotional connections… I can see like a beautiful waterfall, and you dam it off or something like that, that wouldn't be good, but uh, but as far as like the

> landscape, like the view of the harbour or whatever, if it was solar panels in the background or the foreground, it's sign of progress and that, uh, we're trying to do something to make a difference. And that should be celebrated and not shunned, in my opinion.

While many participants associated with View 1 expressed being happy to see renewable energy sources in the landscape, they generally did not think that such infrastructure should be physically accessible to the public without supervision due to concerns about safety and vandalism. Thus, being able to see the infrastructure from a distance, but not being able to directly access it, was often described as an ideal scenario. Mahone Bay Resident 3 summarized this shared idea when they explained:

> Yeah, well… I feel… that people should be aware that [solar farms] exist. Uh… now, I'm not sure that you really want a bunch of teenagers playing volleyball … on the solar panels. So, I might say let's have it so that you can see them from a distance, but that they are secured off from people that might sabotage them or misuse them in ways. So, I think we have to do it. … But at the same time, I don't want to feel ashamed that we've got them either. We should feel proud that we've got solar panels, really. You know.

In addition to conveying appreciation for the sight of renewable energy generation in Nova Scotia's landscapes generally, many participants comprising View 1 expressed pride for renewable energy development in their local landscape. It was explained by some that having renewable energy nearby symbolizes to non-locals that their community is progressive, forward-thinking, and 'green'. Moreover, participants who expressed this thought also mentioned that local renewable energy can potentially attract new residents to the community. Notably, this sense of local pride for being a progressive rural community was especially prominent among residents of Berwick. This sense of local pride was expressed by Berwick Resident 8 when they shared an encounter with people from outside the community who had heard that Berwick is an environmentally progressive place:

> …we were out for a walk out by the beach and up through the woods on this little road and met someone who actually lives in Dartmouth, and um, also has connections down in this little community. So, was there for the weekend or something and they were like 'oh yes, I hear Berwick is a really…'. So, this is someone in Guysborough County from HRM who heard about Berwick and how Berwick is doing things for renewable energy and stuff like that. And that it's known, she knew it as a place that has Frenchies and Wheatons [popular local

> stores], but also a place that has renewable energy and seems to be doing a lot for the environment. So, that's important to me, to know that.

In sum, many of the participants comprising View 1 expressed excitement and pride in renewable energy development, both provincially and locally. Moreover, many thought that both solar and wind farms should be visible in everyday rural landscapes, as this infrastructure exemplifies that progress is being made in terms of reducing greenhouse gas emissions. Notably, however, most of these participants explained that solar farms can only be physically accessible to the public if there is security supervision and/or the viewing trails are not directly near the solar infrastructure to prevent people and/or the solar infrastructure being harmed.

#### 4.3.2 Not mitigating climate change is a greater threat to landscape beauty than *solar farm*s

Another theme found in the responses from participants comprising View 1 is a concern that not mitigating climate change via renewable energy development will cause more harm to the natural beauty of landscapes than solar farms. Specifically, several of these participants explained that not mitigating climate change via renewable energy will lead to more extreme weather events, which can destroy the natural beauty of rural landscapes. For example, Berwick Resident 9 said:

> You know, when you look at some of these [statements] and they say, 'should not be permitted to decrease the natural beauty of the landscape.' So what's global warming going to do to that? See, so here we are talking about ways to reduce carbon and in turn reduce global warming and in turn, you know, protect these areas. So, you know, a question like that or statement like that is kind of like, well if we don't, what are we going to have?

Berwick Resident 9 elaborated on this point later in their interview when they explained:

> I kind of look at it [through] the lens of what if we don't do something? You know. So when it says 'should I be permitted to decrease rural character'? Well, yeah, well, I kind of agree with that. But on the other hand, you got to look at the flip side of the coin. Right? What's the regional character gonna look like once a huge wildfire goes through or maybe we can't produce food because of ecological changes. You know? … So, the need to quote Spock [a character from Star Trek]: the needs of the many outweigh the needs of the one.

Similarly, when asked about the Q-sample statement regarding natural beauty, Berwick Resident 7 said: "…if we don't do anything about renewables, we're not gonna have natural beauty. So, I mean, it's a very extreme view. … I don't mind looking at panels (laughs) if it means that we're gonna change, you know, the way we get our energy."

Also, some of the participants comprising View 1 explained that landscapes are already changing due to climate change, so we should prioritize mitigating greenhouse gas emissions. For example, New Ross Resident 1 said:

> I think the idea to get off of power by coal and be better for the environment, you gotta be, you know, … this year, friggin' monsoon rains. My driveway washed out three times this year! … Lots of…we're seeing change, but nothing that we've, well that we've done. Well, we did it through the years of neglect and years of what we've been doing. And you don't think this is going to stop, overnight? It won't stop overnight. It's gunna be bad for a while before it gets better.

Mahone Bay Resident 1 also expressed concern about landscape change from climate change when they said:

> I think, like, these ones where it was like the look and feel of rural character and anything that's sort of like people's emotional connection to the landscape. Like I think it's fair to say, the landscape's changing regardless. … And if we don't do something about it, it won't matter how pretty you think it is or how emotionally you're connected to … the place that you're in. Um. So, it's like, I think solar panels can be part of the area. So, I think, I think progress has to happen and solar panels need to happen.

Later in their interview, Mahone Bay Resident 1 further explained that mitigating climate change should take priority over aesthetic concerns related to solar farms when they said: "I'm not super concerned about, like, neighbors and communities. Like, I think we're at critical mass. Like major change has to happen." The same sense of urgency to prioritize climate change mitigation over emotional and visual impacts of solar farms was conveyed by Berwick Resident 2 when they explained:

> Some of it, I guess (laughs), just stuff that I know is important to people, I guess it's just a bias of mine. Like emotional connection to landscape, that is important. Um, or, you know … you don't want to decrease the natural beauty. And I do

> understand that those are important. But, at the same time, we do need renewable energy at this point. And… I guess just personally, those kind of take a backseat. So it's not that I disagree with them, but, compared to the other priorities we have here, they just kind of fall in the middle."

Notably, although many participants who make up View 1 felt that impacts to natural beauty and emotional landscape connections caused by solar farms are not of great concern, they generally appreciated the preservation of such landscape components. Overall, these participants emphasized that climate change will have more of a negative impact on the natural beauty of and emotional connections to rural landscapes. Thus, climate change mitigation efforts, such as solar farm development, is the best way to maintain these landscape relationships.

#### 4.3.3 Integrating multiple land uses could maximize site benefits

The third theme identified in responses from participants comprising View 1 is support for multifunctional solar farms (i.e., where land uses other than solar energy generation are incorporated into the site). Interestingly, all three types of multifunctional solar farms (i.e., mixed production, nature inclusive, and landscape inclusive) were supported to some extent by two or more of the participants exemplifying View 1. Especially, design options that integrate solar farms with food crops, flower meadows, and parking lots were especially supported by these participants.

Firstly, with regard to integration with food crops, most participants comprising View 1 conveyed interest in this concept. A couple of participants, specifically, supported this type of multifunctional solar farm due to their perception that the two land uses could easily coexist and perhaps provide co-benefits. This idea was shared by Mahone Bay Resident 6 when as they explained: "I can see that [they're] really enhancing each other because, well, solar panels provide shade and uh, you know, that sort of thing; [those] can coexist, in my mind." Some participants were unsure if a solar farm could be integrated with agriculture; however, they were very interested in the idea of it happening. For instance, when discussing the possibility of agrivoltaics, New Ross Resident 1 mentioned:

> 'Cause you … wonder if they can make it work together, would it be using, uh, land twice, you know what I mean? … But, anyway, I think that's a [good thing].

> I feel like if you can make it so that it cannot interfere with the growth underneath of it, you can use it on farmland.

Moreover, some participants contributing to View 1 felt that a solar farm site should almost always include one or more other land uses to derive the most benefits. Berwick Resident 2 expressed this idea when they said: “So [instead] of just solar panels, grow something. There’s lots of crops you can grow in, around solar panels, right? Um, or at least grow things for things like $CO_2$ capture, that kind of stuff, right?”

Based on the same appreciation for maximizing site benefits, nature inclusive solar farm options were also generally supported by participants comprising View 1. Specifically, many of these participants liked the idea of incorporating native plants and wildflowers into a solar farm site to increase biodiversity and support local wildlife. For example, Berwick Resident 7 explained:

> I do think that maybe we should be more imaginative in terms of what else can we do, um, like a dual function or something like that. … Like, growing fruit trees or wildflowers, you know the same sort of… but something like that where it’s like, because maybe it’s protection for, for birds. I don’t know, ground nesting birds (laughs).

Interestingly, most of the participants who expressed support for mixed production and/or nature inclusive solar farms were explicit about only appreciating smaller scale operations. This point was emphasized by Mahone Bay Resident 6 when they explained:

> I like the ones where you could integrate like uh, some agriculture and … like small, not beef-farming, but more, I guess, sustainable farming like rabbits and that sort of thing. … And not commercial. I looked at that more like, uh, independent farmers and that sort of thing. If somebody had a farm close by and they wanted to say, okay, I've got 20 acres down there, but you're gonna have to share it with the sheep. And uh, you know, as long as it's not commercial, you know, industrial food processing.

When asked why they dislike the idea of incorporating large-scale agriculture with solar farms, the same participant responded:

> … Because the small-time farmer is supporting his own local economy thing and the big scale guys are just there for mass profit. That's all it's about. And they

> don't have the right attitude, uh, to be good stewards of, you know, taking care of the planet. They're there to make profit. Whereas the small-scale guy realizes that he's got to make sure everything is kind of in sync. And if he can fit solar or a wind turbine on his property, that would be great. But I don't think you'd ever see the big guys wanting to do that without wanting money.

Berwick Resident 7 also conveyed a preference for smaller-scale activities. For them, the statement suggesting that Christmas tree farming should be integrated with solar farms is less agreeable than statements regarding other forms of mixed production sites. When asked why they feel that way, they responded: "… because it's commercial, right? And this was more, like, actual wildflowers that, you know, for pollination and then, um, what was it? The fruit trees… for food security, you know. That, like in the area that would be better than I think something like that." Furthermore, when asked why they thought it is acceptable for solar farms to displace commercial development, they explained: "Um. (Sighs). Well … I always see like gas stations being developed or more big box land or whatever. I'd rather have a solar farm there (laughs) than another gas station, so." When asked a similar question during their interview, Berwick Resident 2 shared a similar opinion when they said:

> It just depends on what that commercial development is. I did struggle with those. I wasn't sure to put them at like three or even two. But, again, it depends on what that commercial development is. If it's a big box store that's just going to displace a huge amount of space, um, that doesn't seem like a good use. If it was, again, like a mixed-use kind of situation, the smaller businesses, that wouldn't bother me as much. But I see a lot of that commercial development, again, being (sighs) large-scale, large corporations. That's kind of the development I've seen.

Lastly, a few of the participants contributing to View 1 were supportive of integrating solar farms with parking lots. Like the mixed production and nature inclusive options, it was explained that parking lots can provide co-benefits to solar farms. For instance, when Berwick Resident 9 was asked how they felt about incorporating solar infrastructure with parking lots, they responded:

> I think that's a great idea. … It does two things, because all that asphalt gets very hot. So if we can shield that from getting hot using solar panels, and granted they

> will get warm as well, but, you're getting more value out of that than just a parking lot.

Likewise, New Ross Resident 1 conveyed their support for the idea when they said:

> It makes sense if you put the cars underneath the solar panels. … It's not a bad idea. If you got a parking lot anyways … most of those places are close to the people, so then you wouldn't have very far to transmit the energy. 'Cause it will lose juice going from here to there.

Interestingly, with regard to landscape inclusive solar farm options, many participants were uncertain about incorporating features for recreation, like walking trails, due to safety concerns. However, a couple participants explained that incorporating trails into a solar farm site could help enhance community approval of local solar farm development. For example, when asked about adding trails to a solar farm site, Berwick Resident 7 responded:

> That would be great because then, I think, what would happen [is] you would get more people being interested in it, or this one… recreation. Like walking trails and stuff. Then you could, maybe if it's a nursing sort of environment [for wildlife], maybe you don't want walking trails. But, to think of something, you know, like… it might be cool for kids to learn that there's a lot of frogs coming out or a lot of turtles coming out of that area. Or, you know, stuff like that.

Overall, multifunctional solar farm options were well-liked by participants who exemplify View 1. Important conditions, however, is that the added uses can provide co-benefits and/or help remediate global problems such as food insecurity and biodiversity loss via agrivoltaics and plant meadows, respectively. Lastly, integrating non-commercial land uses with solar farms was preferred among these participants.

### 4.4 View 2: Hide and Isolate

In contrast with View 1, Factor 2, hereafter called 'View 2', believes that solar farms should be *hidden and isolated* from everyday landscapes of rural areas. Like for View 1, unique characteristics of View 2 were identified based on themes in the distinguishing statements and factor array for the view. Essentially, the two themes for View 2 are the reverse of that for View 1 (see Table 2 for the grid placements of each statement). That is, impacts to relationship values tied to the landscape are of greater concern for this view, and statements indicative of integrated (i.e., multifunctional and/or visible in everyday landscapes) solar farm options are less preferred. Another interesting yet distinct characteristic of View 2 that is worth noting is a strong concern about the displacement of agriculture. While View 1 agrees slightly (+1) with the statement 'should not displace agriculture', View 2 agrees with this statement strongly (+4). Thus, the statement is included as a distinguishing statement in the factor analysis results. Like for View 1, context and explanations for View 2 were revealed as themes in the interview transcripts from participants comprising the view. These interview themes— contextualizing and corresponding with themes in the factor array—are discussed in the following subsections.

### 4.4.1 Solar farms should be hidden away from everyday rural landscapes

The first theme in responses from participants who make up View 2 is a perception that solar farms hinder the aesthetic of rural landscapes; thus, they should be hidden away from areas where people can see them regularly. For many of these participants, solar farms are perceived as a type of modern development that visually detracts from the valued charming, quaint, and/or historic aesthetic of rural landscapes. For example, when discussing their perception of solar infrastructure in rural towns that are cherished for their 'historic character', Mahone Bay Resident 2 explained:

> …you look at them roof wise, especially on historic properties, homes, and anything that's modern-looking or changes, that you're kind of off put by it. But, the more I do look at it, I mean it's a needed… So, yeah. I don't mind them, and I think in the future you won't just have, it will just look like shingles, and you know, not the traditional big panels that everybody sees.

Interestingly, a few participants comprising View 2 thought that rural towns that are valued as heritage areas should not have any visual modern features, let alone solar infrastructure, to maintain their traditional, historic aesthetic. Mahone Bay Resident 4 demonstrated this opinion when they said:

> But I think, you know, significant heritage areas need to be protected from not just solar panels, but a lot of modern stuff. … You know. They preserve that or…

> Quebec City. I mean, you don't see modern stuff [there]. You go there for that feel of the heritage

Some participants explained that preserving the overall heritage look of rural towns is important for not only attracting residents who value a quiet, rural lifestyle, but also for tourism. A couple of participants described rural landscapes in Nova Scotia that are especially popular tourism destinations, and how renewable energy in general can be perceived as a hindrance to their appreciated aesthetics. For example, Mahone Bay Resident 4 said:

> Yeah, so it comes back again to aesthetics and visual. … Like if you're in the Annapolis Valley, people love going there, you know, because of the farms and seeing the orchards and stuff. And if you have all these visible solar farms around, it kind of takes away from it. But you can still put them in the valley, just put them out of sight.

Furthermore, as New Ross Resident 3 was considering the statement about impact to emotional landscape connections, they explained:

> Should not hinder people's emotional connection to the landscape? [Pause]. Um, to landscape. Well yeah, I mean, I get it, [like] in the valley, the Blomidon Bluffs. They didn't want the turbines. This is the scenery; this is the money shot; this... that's their, you know. When you're coming down the 101, you know, you get the view over there, and the pictures are all of the Grand-Pré...

A few participants shared the opinion that solar farms should be kept 'out of sight', as well as the thought that there are many sites available in Nova Scotia that allow solar farms to be 'hidden away' in the landscape. For instance, with regard to solar farm siting, New Ross Resident 3 said: "…you can create, you know, there's so many places where you can tuck it in where you just, you don't get to see very much… you know. It doesn't take much to get out of sight, out of mind." These participants also often discussed the need for borders around solar farms to ensure they cannot be seen by people. However, some participants thought that some types of borders, such as tree borders, are insufficient for completely hiding a solar farm. Mahone Bay Resident 4 exemplified this point when they said: "…just planting individual trees isn't going to do it. So, it's probably easier to find slopes that aren't seen from the road that, don't impact neighbors. I mean, there's lots of [them], there really are."

Also, many participants comprising View 2 were explicit about simply not liking the look of solar panels. For example, Mahone Bay Resident 5 said that solar panels are “ugly” and a “visible blight on the landscape”. Further, Berwick Resident 5 explained that they had a relatively large solar system on their own property, but they did not like seeing so many solar panels in their yard. Mahone Bay Resident 4 also described a personal experience at their previous residence in the northeastern United States that caused them to dislike having solar infrastructure visible from their house:

> You know, we had these people who lived on the next mountain from us, and they had their solar pa- they had their sun trackers and those babies just shined like bright lights right at us. I mean [at night] we’d sit out, you know, in the beautiful, open mountains … and I had this light shining [in the night] and in the afternoon.

While many of these participants expressed not liking the look of solar infrastructure, they did not explicitly state that solar farms should not be in rural areas at all. An important condition, however, for having them in rural areas, is making sure they cannot be seen on a regular basis. Interestingly, many of these participants feel that it is acceptable for larger-scale solar installations to be visible in more urban, commercial areas because they ‘fit the look’ of those places. For example, with regard to solar infrastructure, Mahone Bay Resident 2 suggested to “intermix it in with the commercial development” and “put it on the roofs of the buildings” because “[t]hey’re already cut down. They’re ugly.” Moreover, they explained that “cities are already built up”, so larger-scale solar is more visually appropriate in “that setting than a rural setting”. Similarly, Mahone Bay Resident 4 expressed that it is more acceptable for larger-scale solar to be visible in Bayers Lake, a prominent urban/commercial area in Nova Scotia, than in rural areas when they said:

> So I think, um, if we had rules and regulations, I think, for placing solar farms, they would have to need certain criteria that they're not visible, impacting neighbors or visible from the highway. Like down here that says should be built along the roadways, absolutely not. Because you're driving by, not like if you’re in Bayers Lake, who cares. But if you’re talking about the rural environment, no.

Overall, participants who comprise View 2 expressed dislike for being able to see solar farms in rural landscapes. Particularly, everyday landscapes in rural areas are perceived as inappropriate sites for solar farms. Moreover, these participants generally believe that if a solar farm is sited in an everyday rural landscape, design strategies, such as borders and building on slopes, should be used to ensure they are hidden away. A statement made by Berwick Resident 5 as they were describing the Community Solar Garden in Berwick summarizes this point: “I do like that it’s not in a part, that it’s out, like you can see it from the highway, but it’s not like, you don’t see it every time you’re… just generally living in town… you’re not seeing it every day.”

#### 4.4.2 Integrating with other land uses with solar farms is nonsensical

The second theme identified in the responses of ‘View 2 participants’ is confusion about integrating other land uses into a solar farm site. Such confusion was generally related to two things: (1) uncertainty about whether other land uses hinder the effectiveness and efficiency of a solar farm, and vice versa, and (2) the perception that solar farms can only function as an industrial site. Thus, many participants associated with View 2 generally thought that larger-scale solar power generation is incompatible with other land uses.

Firstly, with regard to incorporating other land uses on a solar farm site, some of these participants raised concern about putting solar panels on sites with food crops. For instance, while pondering the statement regarding integration with food crops, New Ross Resident 3 said:

> (Sighs) Should have food crops… I don’t know about some of this stuff… hmm. Interplanting. I think wind- solar, a solar farm would be a solar farm. Not integrated. I mean if it’s beneficial, fine, but it doesn’t… then you take up more space. That’s the drawback. It would be concentrated in one space.

New Ross Resident 3 further elaborated on their concern about incorporating farming activities with solar farms when they said:

> Well, I just don’t think, like, animals and solar panels, you know, ah, you could get into trouble with it. … But not in … crops and stuff. I’d just like to see … to me… it should be just a concentrated effort. And fenced in and kept sterile.

Mahone Bay Resident 5 also conveyed uncertainty about incorporating agriculture with solar farms when they explained: “I don't understand that. Like, yes, fruit trees, yay. But I don't know that that's really a fit with solar panels.”

In contrast to some of the participants representing View 1, some participants representing View 2 made clear that a solar farm is only an industrial site and should be treated and referred to as such. Thus, for these participants, ‘farm’ and ‘garden’ are inappropriate terms to associate with a solar farm. For instance, Mahone Bay Resident 5 said

> So, our particular solar garden was placed in a prime area, prime real estate, coming into our bay. So people across the bay can look and see this big industrial site, not a garden. It's an industrial site. … which is, I think, part of the issue around our solar, um, solar factory I'd rather call it than a solar garden. Has sort of a green washing kind of term, calling it a solar garden. (Laughs).

View 2 participants also differ from View 1 participants as many of the former did not like the idea of incorporating solar farms with parking lots. For example, Berwick Resident 4 said: “Well, parking lots seem to already have a use: for parking. (Laughs).”

In sum, many of the participants who make up View 2 believed that incorporating other land uses with solar farms is nonsensical. Reasons provided for this belief are that larger-scale solar energy systems are incompatible with other land uses and solar farms are more efficient if they operate as an isolated, industrial site. In turn, solar farms should only serve as a site for power generation, according to these participants.

# CHAPTER 5: DISCUSSION

## 5.1 The Identified Views and Key Lessons

From this study, it was discovered that two views seem to exist among rural Nova Scotians regarding the integration of solar farms into rural landscapes of the province. The first view is that solar farms should be *embraced and integrated* within everyday rural landscapes. In contrast, the second view is that solar farms should be *hidden and isolated* from those landscapes. Based on the study findings, two key lessons have been learned. The first lesson is that rural Nova Scotians generally care about *local environmental impacts* of solar farms in a similar way. That is, based on the two identified views, rural Nova Scotians seem to care a lot about how solar farm development impacts components of the natural environment, such as waterways and wildlife habitat. The second key lesson is that the impacts of solar farms on human landscape components (e.g., relationships) are cared about and appreciated in two different ways among rural Nova Scotians. That is, solar farms should either be integrated with human landscape components (View 1) or isolated from them to maintain valued landscape aesthetics and emotional connections to them as much as possible (View 2). This discussion will expand upon these lessons by connecting them to findings, theories, and debates presented in existing literature.

Before discussing the key lessons further, it is worth highlighting that the two identified views do not seem to be site-specific. That is, participants from all three communities contributed to each view. According to Ramlo (2023), this type of finding is expected for Q-studies, as "the viewpoints that emerge from them [typically] supersede social and physical categories of the P-set" (p. 1720), such as age and place of residence. People's demographic characteristics, such as age and gender, likely have influence on the type of experiences they have in the world, and in turn, their subjectivity. Therefore, recruiting a relatively diverse group of participants is important for a Q-study. However, the demographic characteristics and geography of participants do not seem to significantly shape the two identified views, which is be expected, according to Ramlo (2023).

#### 5.1.1 Lesson 1: Impacts to Natural Landscape Components are Cared about Similarly

While the views identified by this research are specific to the rural Nova Scotia context, they relate, in interesting ways, to findings from previous research in other parts of the world. Firstly, public concern for protecting local habitats from renewable energy development, as shared by both views in this study, is well-documented in energy social science literature. Mulvaney (2017) describes this phenomenon within the context of deserts in the American Southwest. As development of utility-scale solar farms became more prevalent in desert environments, local environmental groups expressed concern about the impact this infrastructure has on wildlife habitats and movement. As Mulvaney (2017) explains, this type of conflict between greener energy development and local environmental preservation has resulted in a 'Green Civil War' in the American Southwest. Survey results found by Carlisle et al. (2016) also indicate strong public concern regarding the impacts of renewable energy facilities on local habitats and wildlife. To understand how proximity to other land uses affects public acceptance of solar farms, they asked residents of southern California to select their preferred buffer distance around solar farms depending on how land near them is used. Notably, survey respondents generally preferred the largest buffer distance for solar farms next to a wildlife migration route or breeding ground (Carlisle et al., 2016).

Public concern about forest clearing—which has been controversial in Nova Scotia—to make way for solar farms has also been identified by other studies. For example, interview research in the Netherlands by van den Berg and Tempels (2022) found that some citizens of a community with a multifunctional solar farm were in opposition to its development because it resulted in forest clearing. Research by Plieninger et al. (2018) regarding development preferences on the Faroe Islands found that residents supported renewable energy development, but not at the cost of nature conservation.

Another point of consensus between the two views is that solar farms should not be built on lakes. Public concern about solar farms on bodies of water—commonly termed 'floating photovoltaics'— has been identified in other studies as well. In a study examining social acceptance of floating photovoltaics (PV) on Oostvoornse lake in the Netherlands, Bax et al. (2022) found that local stakeholders were concerned about how the PV systems would impact valued recreational activities in and around the lake. However, they also identified during interviews that many stakeholders felt that impacts to recreation could be tolerable, as the floating PV system was proposed as having a relatively small spatial scale and lifespan on the lake (Bax et al., 2022). In the case of Nova Scotia, no floating PV systems have been installed or proposed, so participants were unsure what the actual impact on recreation would look like. Another similarity to the findings of Bax et al. (2022) is that people were unsure what kind of impacts floating PV can have on a lake ecology. Research on the ecological impacts of floating PV has begun in recent years (e.g., Pimentel Da Silva and Branco, 2018). However, it seems that in some places, including Nova Scotia, the results of such research have not been effectively shared with the public.

Of course, solar farms are not the only form of larger-scale renewable energy infrastructure that have spurred public debate about the environmental *costs* of constructing and operating more sources of renewable energy across landscapes. Wind turbines and hydroelectric dams are both notorious for being met with community opposition due to their impacts on bird and fish populations, respectively (Hirsh and Sovacool, 2013; Keilty et al., 2016). Interestingly, in the context of this research, many participants brought up the environmental impacts of wind turbines in Nova Scotia. Specifically, wind turbines were often described as an example of how renewable energy development can have trade-offs for local wildlife and ecosystems while benefiting global climate change mitigation. It is unsurprising that wind turbines were used by many participants as a point of reference when discussing the local environmental impacts of renewable energy plants, given that wind power plants are currently more prevalent in Nova Scotia than solar farms. In sum, based on findings in social science energy literature at large, as well as results from this research, public concern for local environmental impacts caused by renewable energy development has been a prevalent and well-known issue for some time. This research suggests that local environmental degradation from solar farm development is very much a *shared concern* among rural Nova Scotians.

### 5.1.2 Lesson 2: Impacts to Human Landscape Components are Cared about Differently

As previously stated, while the two views identified in this research are united by their belief that components of local natural environments should not be harmed or degraded to accommodate solar farm development, they diverge in their beliefs about how such development should impact people's relationship to and use of Nova Scotia's rural landscapes. Notably, the two views, when viewed holistically, relate to the concepts of 'landscape-technology fit', 'climax thinking', and 'land sharing vs. land sparing' presented in the literature. The ways in which the two views correspond with such concepts and theory are summarized in Table 4. These linkages prompt useful questions to address with the public during discussions of renewable energy landscape transitions.

*Table 4: Summary of how the two views correspond with concepts of landscape-technology-fit, climax thinking, and land sharing vs. sparing. The applied questions are value-based questions to take into conversations with the public about solar farm developments.*

| **View 1:**<br>**Embrace & Integrate** | **View 2:**<br>**Hide & Isolate** | **Applied question** |
|---|---|---|
| Landscape-technology fit | Landscape-technology misfit | Does it match or disrupt how we think about this place? |
| Non-equilibrium thinking | Climax thinking | Should our landscapes be static or adapt to new needs? |
| Land sharing | Land sparing | Should we optimize efficiency or plan for wider benefits? |

In relation to the first concept of landscape-technology fit, the two identified views demonstrate two conflicting perspectives about how well solar farms 'fit' into rural landscapes. Specifically, View 1 generally believes that solar farms can be integrated into everyday rural landscapes (i.e., they 'fit' with the existing aesthetic and land uses of rural landscapes). View 2 has the reverse perspective. Whether or not renewable energy infrastructure fits with existing landscapes—or places—has been explored in energy social science literature through the conceptual lens of landscape-technology fit. Considered a deviation of 'place-technology fit', landscape-technology fit refers to the subjective evaluation of how well a given technology—typically renewable energy infrastructure—fits into a given landscape (Salak et al., 2021). In the early 2000s, Devine-Wright (2005) explored the importance of this concept in relation to community acceptance of wind farms. Based on findings from his research in the United Kingdom, he argues that the more that renewable energy infrastructure is perceived by residents as a ‘fit’ with the identity and aesthetic of a place, the more likely it will be accepted by communities.

More recent research has explored what kind of places and landscapes are generally perceived to fit with renewable energy infrastructure (Devine-Wright and Wiersma, 2020; Salak et al., 2021). Interestingly, the results of such research very much align with View 2 from this research. That is, more rural landscapes appreciated for their natural beauty are perceived as less of a fit for renewable energy infrastructure than more urban, utilitarian landscapes. Notably, Devine-Wright (2020) only examined this concept in relation to offshore wind turbines in the English Channel, while Salak et al. (2021) examined it in relation to various types of renewable energy infrastructure, including roof- and ground-mounted photovoltaic infrastructure, in Switzerland. One of the major findings from the survey research by Salak et al. (2021) is that exposure to (experience with) different landscape types and renewable energy infrastructure influenced the meanings attributed to them, and in turn, landscape-technology fit perspectives. Based on this finding from Salak et al. (2021), exposure to renewable energy infrastructure matters when examining citizens’ perspectives of how well it fits into landscapes. It is also worth noting that, in a Canada-wide survey, Sherren et al. (2019) found that exposure to solar infrastructure was associated with support for solar; however, they did not differentiate between residential and large-scale solar.

As findings from these previous studies indicate, the potential influence of *exposure* is important to consider in the context of the results of this research, since most participants had little to no exposure to solar farms before completing their Q-sort and interview. As Stephenson (2008) explains, time and direct experience with landscape components influences how well they are understood and subsequently valued by landscape users (e.g., residents). Therefore, it can be assumed that participants’ responses may have been different if they had previous experience with solar farms to refer to when answering interview questions and making comparisons during the Q-sort activity. Specifically, participants would have made decisions based upon what they *know* to be true based on personal experience, rather than what they *assume* to be true based on their limited knowledge of solar farms.

The second concept that may help explain the divergence between the two views is climax thinking. Theorized by Sherren (2021), climax thinking refers to idealized stasis or equilibrium in lived landscapes. According to Sherren (2021), a 'climax thinker' is a person who believes that current landscapes have reached their ideal 'climax stage', and if a landscape is 'disturbed' by human or natural forces, efforts should be taken to ensure it reverts to its perceived climax state. Climax thinking allows landscapes that were created to serve previous societal needs to persist, sometimes beyond their utility, making it difficult for these landscapes to serve current and future needs. Based on my results, it seems that participants comprising View 2 generally demonstrate climax thinking. In contrast, participants comprising View 1 generally believe that landscapes are ever-changing, and ought to be this way in order to meet the needs of future generations, consistent with 'non-equilibrium thinking' (Sherren, 2021). The fact that landscapes have been continuously changing throughout human history to accommodate evolving societal needs (i.e., accessibility, urbanization, and globalization) has been raised by Antrop (2005). However, Antrop (2005) also recognizes that societies often attach meanings and symbols to existing and past landscapes, making changes to them difficult for some to accept. In turn, past landscape features, while no longer useful, are preserved into the future as a symbol of identity. According to View 2, preservation of past features should be prioritized. Specifically, View 2 strongly values emotional connections to landscapes in which past features have been kept, and feels that rural landscapes—especially those with widely-recognized heritage value—should be preserved. Characteristic of climax thinking, View 2 prioritizes landscape stasis. Moreover, according to View 2, modern features, such as solar farms, should be hidden and isolated from everyday rural landscapes. In contrast, participants comprising View 1 largely felt that solar farms symbolize important societal progress, and in turn, this energy infrastructure should be embraced and integrated within everyday rural landscapes. Characteristic of non-equilibrium thinking, View 1 recognizes that human-initiated change to landscapes can be necessary to accommodate the changing needs of society.

Lastly, the third concept of 'land sharing vs. land sparing' is reflected in the two views. Green et al. (2005) first proposed the land sharing vs. land sparing framework, hereafter referred to as ‘sharing vs. sparing’. Essentially, this framework assesses trade-offs to integrating ecological benefits into land production systems (with some cost to the efficiency of those systems) vs. allocating smaller areas of land to intense, higher-yield production systems so larger areas of land can be dedicated to nature preservation. Debate regarding the benefits and trade-offs of sharing vs. sparing production systems has been prevalent for much of the last three decades, especially with regard to agriculture (Fischer et al., 2008; Fischer et al., 2013). In more recent years, quantifying the benefits of synergizing solar farms with other land uses has become an emerging area of research (Nordberg et al., 2021). However, the way such benefits are perceived by the public has received little attention.

To begin filling this knowledge gap, van den Berg and Tempels (2022) examined whether incorporating community benefits into multifunctional solar farms contributed to public support for solar farm development. Through interviews with citizens living near multifunctional solar farms, they found that in some cases, public good compensation strategies, such as incorporating walking trails or planting native species, enhanced support for solar farms. In other cases, however, such forms of compensation caused greater dislike of solar farms, usually because incorporating other uses for the community was regarded as pointless, and a disingenuous attempt by developers to foster community appreciation. This finding by van den Berg and Tempels (2022) parallels the two views identified by this research. That is, View 1 agrees with synergizing other land uses with solar farms, while View 2 prioritizes energy generation. Further, participants comprising View 1 generally believed that solar farms can have co-benefits with other land uses, such as agriculture. In contrast, participants comprising View 2 generally thought that a solar farm would hinder other land uses, and vice versa. In relation to the typology of solar energy landscapes by Oudes et al. (2022), it seems that View 1 represents a preference for multifunctional solar farms, while View 2 prefers for them to be monofunctional. However, both views express concern about public access to solar farms, indicating that solar farms with integrated features for recreation may not be publicly accepted in Nova Scotia. Nonetheless, based on these themes, the two views can be regarded as an expression of the larger sharing vs. sparing debate.

Importantly, the two identified views cannot be solely explained by any one of these concepts on their own, but these questions of fit, landscape stability, and design underlie them both. Rather, the views may represent how these concepts relate to one another, as well as indicate how these concepts can be expressed in wider views regarding the integration of solar farms into landscapes. Perhaps, these concepts are related in that they deal with different perspectives around maintaining the status quo of rural landscapes. From one perspective, adding a new landscape component, such as a solar farm, is regarded as a way to potentially enhance landscape aesthetics, emotional connections, and uses. That is, the new landscape component can have cascading landscape benefits. In turn, the disruption to the status quo caused by the new landscape component is accepted and even celebrated. However, from another perspective, the addition of a new landscape component is regarded as a threat to landscape aesthetics, emotional connections, and uses. In other words, such a change only leads to landscape losses. As a result, the new landscape feature is only accepted if it is hidden away and isolated from other landscape uses. This act of hiding and isolating provides a sense of maintaining the status quo. Interestingly, these two perspectives may be shaped by similar aspirations for rural areas, such as conserving biodiversity, enhancing landscape aesthetics, and creating more economic opportunities. However, the ways in which these aspirations can be realized by new landscape components are thought of differently. In sum, these perspectives, which align with the views identified in this research, may contribute to landscape-technology fit, climax thinking, and land sharing vs. sparing opinions.

Lastly, it must be emphasized that the archetypal views identified in this study are generalizations about *how* rural Nova Scotians' think about integrating solar farms into rural landscapes. As Ramlo (2024) discusses, the factors that result from Q-studies are *substantive generalizations*. That is, they indicate the *type* of views that exist within a population of interest, rather than the prevalence of such views within said population. Therefore, Q-studies can indeed offer population-level insights, despite involving a 'small-N'. In sum, the two identified views not only contribute to wider conversations being had among energy social scientists, but also provide new insight into how rural Nova Scotians think about integrating solar farms into rural landscapes of Nova Scotia. Additionally, the theoretical underpinnings of the views can be made practical through reflective questions (presented in Table 4) that can be used as prompts for public discussion, engagement, and/or co-design planning.

## 5.2 Insights for Future Research and Limitations

In various ways, the results of this research can provide impetus for future research not only in Nova Scotia, but also in other parts of the world. Firstly, it would be interesting to use quantitative methods to investigate how prevalent each view is within the wider population of Nova Scotia. Before doing this, however, it might be worth examining whether more urban citizens in this region have different views through the implementation of another Q-study. That way, it can be assured that future survey-based research in the province accounts for all the possible views that can exist among citizens. Moreover, it is often assumed that rural and urban dwellers have different views regarding land use and renewable energy development (Nilson and Stedman, 2023). Thus, it would be beneficial to identify through more Q-research whether this assumption is correct in the context of Nova Scotia, or whatever jurisdiction it might be expanded to. Surveys can include questions like those presented in Table 4 or present the distinguishing statements from this Q-study for Likert assessment, as done by Parkins and Sherren (2021).

Furthermore, it would be interesting to explore through future and/or longitudinal research in Nova Scotia whether increased exposure to solar farms leads to different views among rural citizens. Of course, this Q-study captures views at a time when exposure to solar farms is relatively low in the province. As exposure increases, people may become more aware of the actual landscape impacts of solar farm development, and in turn, they may develop different concerns and/or appreciations for this form of larger-scale renewable energy. As Wolsink (2007) explains, local acceptance of renewable energy projects tends to change over the course of project development. Specifically, acceptance is generally high before a project is proposed as people are hopeful for or generically supportive of the technology. Then, during a proposal phase of a specific project, acceptance tends to drop considerably as residents make assumptions about what *could happen* based in their local context based on their previous knowledge of and experiences with renewable energy. Finally, after the construction phase, acceptance typically reverts to a high level as project impacts are no longer merely perceived but are actualized. As landscape impacts of solar farms become more observable in Nova Scotia, the type of views that exist among citizens may change.

In addition to examining whether these views change across time, it would be useful to investigate whether they change across space, to inform more generic advice around development. To do this, Q-studies could be conducted in other parts of the world with the same Q-sample. However, it is worth acknowledging the limitations of the Q-sample used for this study in that it was largely informed by discourses in Canadian news media. Therefore, pilot work should be conducted with Q-sample first to ensure it is sufficiently refined for the geographic context it is used within.

Lastly, when considering opportunities for future research, the limitations of this study must be acknowledged. As previously explained, the findings of this study are only applicable to the context of rural Nova Scotia. Moreover, a significant limitation is that this Q-study is that many of the participants were only vaguely aware of the *actual* landscape impacts of solar farms. Therefore, many felt that they could not fully express an opinion on certain matters presented in the Q-sample. It is very likely that as Nova Scotians, not only in rural areas but in general, become more exposed to solar farms, their opinions about them will change. Specifically, opinions about the sensory impacts (i.e., reflected glare, emitted heat, and sound) will likely change as people learn whether these impacts manifest. Nonetheless, the two views identified and explained by this research exemplify two distinct 'ways of thinking' among rural Nova Scotians with regard to adding solar farms to rural landscapes in the province. These insights could benefit short-term planning and design of solar farms during the early stage of their development in the province.

# CHAPTER 6: CONCLUSION

Development of large-scale solar facilities, often called solar farms, is expected to continue into the future as many countries transition from fossil fuel energy systems to renewable energy systems. With this technological transition comes a transition of everyday landscapes (Oudes, 2022). That is, energy infrastructure is being increasingly developed in landscapes where people live, work, and recreate regularly. Learning how to incorporate this infrastructure with socially valued landscape components, tangible and intangible, is important for ensuring a sustainable energy transition (Stremke, 2015). There remains much opportunity to do this proactively in places where large-scale renewables, such as solar farms, are not yet prevalent.

My aim with this thesis research was to learn what kinds of things people want to happen regarding solar development in rural landscapes, rather than merely focusing on what they do not want, or on the possibility of it not happening in these landscapes at all. With a focus on rural Nova Scotia, I identified citizen views of integrating solar farms into rural landscapes. Rural Nova Scotia makes an interesting case for investigation as it is in the early stages of solar farm development—in the form of community solar gardens—and local opposition to it. Development of large-scale solar facilities is expected to increase over the coming years in the province due to recently implemented Commercial Net-Metering and Community Solar programs (NSDNRR, 2022). Thus, it is useful time to proactively understand the nature of rural residents' views.

To identify rural Nova Scotians' views, I employed the Q methodology. A total of 18 residents from the communities of Berwick, Mahone Bay, and New Ross were recruited as participants. Through sessions comprised of Q-sorting and semi-structured interviews, quantitative and qualitative data were gathered, which were subsequently examined via an exploratory factor analysis. From this analysis, two distinct views were revealed. Analysis of interview data also contextualized the views by indicating how they are influenced by underlying values and perceptions of solar farms and landscape change.

In brief, the first view (View 1) believes that solar farms should be *embraced and integrated* within everyday landscapes (i.e., where people live, work, and recreate regularly) of rural areas, while the second view (View 2) believes that they should be *hidden and isolated*. Specifically, View 1 appreciates—or at least does not mind—the sight of solar farms in rural landscapes, as well as believes that solar farms should be multifunctional (i.e., include other land uses). Interview responses from participants comprising View 1 indicate that this view is influenced by (1) a belief that large-scale renewable development symbolizes progress and is something to be proud of; (2) an assumption that climate change presents higher risk to the natural beauty of landscapes than renewable energy infrastructure; and (3) an assumption that multifunctional solar farms will maximize site benefits. In contrast, View 2 dislikes the sight of renewable energy facilities in everyday landscapes, and believes that solar farms should prioritize energy generation and not include other uses. Responses from participants comprising this view suggest that it is influenced by (1) a strong appreciation for traditional rural landscapes free of modern features; and (2) a belief that integrating other land uses with solar farms is nonsensical. Also, many participants comprising View 2 felt that if a solar farm needs to be within an everyday landscape, it should be *hidden away* using design strategies, such as adding a privacy fence or buffer.

While the two views differ in distinct ways, they strongly agree that solar farm development should not come at a cost of nature conservation and preservation. Impacts to wildlife movement and habitats, waterways, and forests are all regarded as the most important concern for both views. Moreover, they both do not agree that solar farms (i.e., floating PV) should be built over lakes; however, based on the interview responses, this opinion seems to be based on a lack of knowledge about how PV impacts lake ecology. Thus, the results of this study indicate that rural Nova Scotians care greatly about how solar farms impact the natural environment where it is sited.

Through connecting the results of this research to discussions and findings in relevant literature, I discovered that the two identified views seem to parallel the existing theories of landscape-technology fit (Devine-Wright, 2005; Salak et al., 2021) and climax thinking (Sherren, 2021), and concept of land sharing vs. land sparing (Green et al., 2005). Finding these connections stimulated the development of three value-based questions, which can guide public engagement initiatives for future solar farm developments. In doing so, these questions can allow theory to be applied in practice for the advancement of landscape-inclusive solar farm projects.

In terms of their utility, the two identified views provide insight into two general ‘ways of thinking’ among rural Nova Scotians regarding the integration of solar farms into rural landscapes of Nova Scotia. While the views indicate points of disagreement that could lead to conflict between and within communities, they also indicate a strong area of consensus, which can facilitate common ground as public discussion and engagement is carried out for future projects. Moreover, this research provides insight into Nova Scotians’ knowledge of and expectations for solar farm development, which can inform future research and planning practice in the province. Lastly, the materials created for the Q-study can be used for longitudinal research in Nova Scotia, as well as research in other Canadian or international contexts as long as adjustments are made to the Q-sample to account for place-specific landscape values and design options. Such research can help ensure the energy transition continues in a way that is mindful of social values and, in turn, is truly sustainable.

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# APPENDIX A – LETTER OF COPYRIGHT RELEASE

August 13, 2024

Graduate Thesis
6299 South St, Halifax, NS B3H 4R2

I am preparing my Master of Environmental Studies thesis for submission to the Faculty of Graduate Studies at Dalhousie University, Halifax, Nova Scotia, Canada. I am seeking your permission to include your picture of the Berwick Community Solar Garden posted on the Town of Berwick's website.

**Dalhousie graduate theses are collected and stored online by Dalhousie University and Library and Archives of Canada. I am seeking your permission for the material described above to be stored online in Dalhousie University's institutional repository and in Library and Archives of Canada (LAC)'s Theses Canada Collection.**

Full publication details and a copy of this permission letter will be included in the thesis.

Yours sincerely,

Emily Key

Permission is granted for:

a) the inclusion of the material described above in your thesis.

b) **for the material described above to be included in the copy of your thesis that is sent to the Library and Archives of Canada inclusion in Theses Canada.**

c) **For the material described above to be included in the copy of your thesis that is sent to Dalhousie University's institutional repository.**

Name: _Title: _ [redacted]

Signature: _Date: _

# APPENDIX B – Q-SORT INSTRUCTIONS

**Q-sort instructions**

Before beginning, I would like to provide a short description of this study. The purpose of this study is to identify what kind of landscape conditions rural citizens in Nova Scotia prefer for solar farm development, as well as understand why they have those preferences.

Solar farms, or community solar gardens, are different from the solar panels we put on rooftops. Solar farms are generally made up of rows of solar panels that are mounted to the ground. These panels generate electricity using sunlight, which is then fed into a public power grid. Because these facilities supply electricity for numerous buildings in a community or city, they usually take up relatively large land. The amount of land that solar farms can take up varies from project to project. Because they take up land, they can change the way local landscapes look, feel, and function.

**At this point I show a picture of a solar farm.*
We are interested in understanding what people would like to see for solar farm development in rural

Nova Scotia, in terms of how it changes landscapes.

As I mentioned earlier, if you have any questions about the purpose of this study, please feel free to let me know at any time.

There are two steps to the interview, first a statement-sorting activity and then I'll ask you some things to help me understand your perspectives a bit better. Completing this first activity involves several steps, which I will explain now.

First, I will hand you a stack of cards that have different statements written on them. Please take your time to read all the statements over once. Then, sort the cards into three piles: one with statements describing conditions for large-scale solar that you agree with; one with statements describing conditions for large-scale solar that you do not agree with; and one with statements that you are unsure about. After this stage of sorting is complete, please arrange the cards on the grid outlined on the whiteboard in front of you according to your level of agreement with the statements written on them. It is generally easiest to work from the outside, the strongest opinions, in toward the more neutral ones.

Please feel free to move the statements around until you are comfortable with how they are all ranked against each other.

# APPENDIX B – RECRUITMENT POSTERS

## Participants needed!

Are you a resident of Berwick?

Are you over the age of 18?

If you answered **yes** to these questions, then you're **eligible to participate in a study about citizen preferences for large-scale solar projects in rural Nova Scotia.**

All participants recieve a $20 Irving gift card!

### What we're investigating:

Large-scale solar projects (also called solar farms or community solar gardens) are increasing in many parts of Canada, including Nova Scotia. Because these projects take up large areas of land, they can change the way landscapes look and function in communities. We are interested in learning what rural residents of Nova Scotia want landscape change to look like as large-scale solar projects become more abundant across the province.

### What you'll be asked to do:

You will be asked to meet with Emily at a private meeting space in either Berwick Town Hall or the public library to complete a 30-45 minute card sorting exercise and interview about your preferences for landscape change caused by large-scale solar projects.

**For more information, please contact the lead researcher, Emily Snair, at emily.snair@dal.ca**

**Research Ethics file #2023-6658**

Leaders in Energy Sustainability

DALHOUSIE UNIVERSITY

# Participants needed!

Are you a resident of New Ross?

Are you over the age of 18?

If you answered **yes** to these questions, then you're **eligible to participate in a study about citizen preferences for large-scale solar projects in rural Nova Scotia.**

All participants recieve a $20 Irving gift card!

## What we're investigating:

Large-scale solar projects (also called solar farms or community solar gardens) are increasing in many parts of Canada, including Nova Scotia. Because these projects take up large areas of land, they can change the way landscapes look and function in communities. We are interested in learning what rural residents of Nova Scotia want landscape change to look like as large-scale solar projects become more abundant across the province.

## What you'll be asked to do:

You will be asked to meet with Emily at the Forties Community Centre or Family Resource Centre to complete a 30-45 minute card sorting exercise and interview about your preferences for landscape change caused by large-scale solar projects.

**For more information, please contact the lead researcher, Emily Snair, at emily.snair@dal.ca**

**Research Ethics file #2023-6658**

Leaders in Energy Sustainability

DALHOUSIE UNIVERSITY

# Participants needed!

Are you a resident of Mahone Bay?
Are you over the age of 18?

If you answered **yes** to these questions, then you're **eligible to participate in a study about citizen preferences for large-scale solar projects in rural Nova Scotia.**

All participants recieve a $20 Irving gift card!

**What we're investigating:**

Large-scale solar projects (also called solar farms or community solar gardens) are increasing in many parts of Canada, including Nova Scotia. Because these projects take up large areas of land, they can change the way landscapes look and function in communities. We are interested in learning what rural residents of Nova Scotia want landscape change to look like as large-scale solar projects become more abundant across the province.

**What you'll be asked to do:**

You will be asked to meet at the Mahone Bay Centre to complete a 30-45 minute card sorting exercise and interview about your preferences for landscape change caused by large-scale solar projects.

**For more information, please contact the lead researcher, Emily Snair, at emily.snair@dal.ca**

**Research Ethics file #2023-6658**

Leaders in Energy Sustainability

DALHOUSIE UNIVERSITY

# APPENDIX C – CONSENT FORM

**CONSENT FORM**

DALHOUSIE UNIVERSITY

**Project title:** *Identifying and Understanding Citizen Preferences for Large-Scale Solar Energy Landscapes in Rural Nova Scotia*

**Lead researcher:** Emily Snair (she/her), Master of Environmental Studies Candidate, Emily.snair@dal.ca

**Supervisor:** Dr. Kate Sherren (she/her), Professor in the School for Resource and Environmental Studies, Kate.sherren@dal.ca

**Funding provided by:** Leaders in Energy Sustainability (funded by the Canadian Natural Science and Engineering Research Council); Dalhousie University's Faculty of Management; and the Canadian Social Science and Humanities Research Council.

**Introduction**

As a resident of [name of community], I would like to invite you to take part in a research project based on your experiences in this community and preferences for how its landscape, and landscapes in rural NS more generally, change over time.

As a participant in this research, you will be requested to share your perspectives and opinions during a card sorting exercise and interview, the duration of which will not exceed 45 minutes. There are no foreseeable risks which could result from your participation in this research. In signing this consent form, you agree to being audio recorded unless you ask Emily to opt out of this when she asks at the outset. Only optional personal information, including age, gender, and occupation, will be recorded as part of this interview and no participant will be identified directly in the interview transcript and final thesis. Only the lead researcher (Emily) and faculty supervisor will have access to the information provided as a result of your participation, and all materials will be securely stored.

This interview will take place at [name of local community centre]. To manage the potential health risks posed by COVID-19, masks and sanitizer will be made available to use.
If you feel uncomfortable answering any of the questions asked during card sorting exercise

and/or interview, you may choose to skip them and/or leave the interview at any time. You are free to withdraw from this study at any point prior to the deadline for withdrawal (March 1, 2024) without penalty or repercussion. Any information provided to that point will be destroyed should you choose to withdraw. The data collected from you will be used to inform Emily's graduate thesis project. A link to the completed thesis in Dalhousie's library archive will be shared via email upon its completion in August 2024 if you provide your email address. Additionally, results of the study can be found at: https://dalspace.library.dal.ca/handle/10222/11163 upon completion of the final thesis.

You should discuss any questions you have about this study with Emily. Please ask as many questions as you like. If you have questions later, please contact Emily (Emily.snair@dal.ca).

**Purpose and Outline of the Research Study**

Development of large-scale solar projects (also called solar farms, solar parks, or community solar gardens) is increasing in many Canadian provinces, including Nova Scotia, as part of Canada's effort to transition to renewable energy. Large-scale solar—which typically looks like rows of solar panels mounted to the ground—can take up large areas of land. As a result, these projects can change the way landscapes in communities look and/or function. Moreover, these projects tend to occur in rural areas where there is enough sunlight and land for the solar infrastructure to be set up. In Nova Scotia, community solar garden projects are already occurring in Amherst, Antigonish, Berwick, and Mahone Bay.

Through this research, we are interested in understanding what rural citizens in Nova Scotia would like to see as large-scale solar projects are installed in rural regions of the province. Particularly, we are more interested in identifying citizen preferences for landscape change that occurs as large-scale solar facilities are built rather than whether or not large-scale solar should be built at all.

**Who Can Take Part in the Research Study**

Residents of Berwick, Mahone Bay, and New Ross are eligible to participate in this research. In addition to being a resident of one of these three communities, you must be over the age of 18 to participate in this research.

**What You Will Be Asked to Do**

If you decide to participate in this research, you will be asked to meet once with Emily at a local community centre to participate in a card sorting exercise and interview, which should take no longer than 45 minutes. At the end of the meeting, I will ask you to let me know the gender you identify as, as well as your age and occupation, if you are comfortable doing so. Please note that this optional demographic information is only collected to ensure diversity of representation was achieved in the study; your demographic information will not be linked to your responses. Then, I will ask you to sort a pile of cards which have different options for landscape change caused by large-scale solar written on them. You will rank the options from "most agree" to "least agree" based on your personal opinion. To sort the cards, you will be asked to place them on a poster with a ranking pattern outlined on it (see image below). After sorting the cards, you will also participate in an interview about any experiences with solar or other landscape changes in your region, as well as about why you have certain preferences for large-scale solar development. During our meeting, I hope to use a voice recorder to record our conversation.

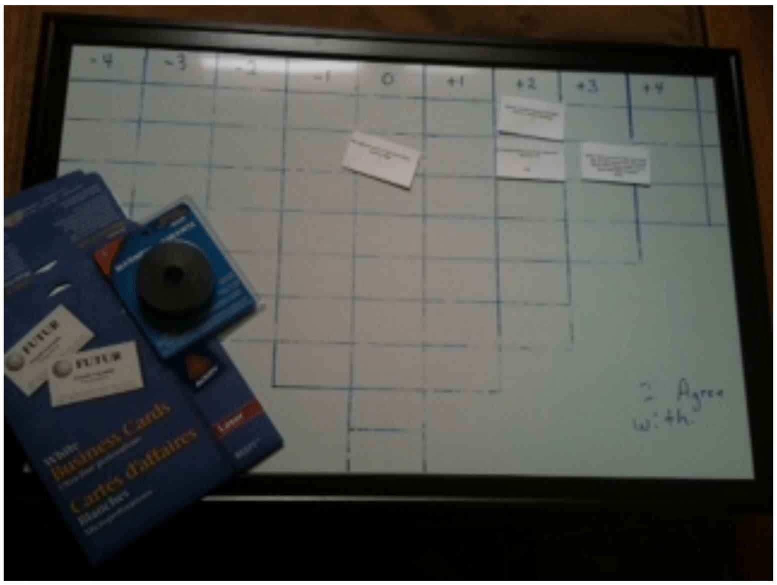


Image of the ranking pattern used sort the cards.
(Image retrieved from https://i0.wp.com/qmethod.org/wp-content/uploads/2016/01/qboard.jpg?ssl=1)

Lastly, a few months after meeting with Emily, you will be given the option to review the transcript of your responses. This task, which should take no longer than one hour, ensures that only information you are comfortable sharing is being included in the analysis. Any information that you feel does not properly reflect your thoughts and opinions will be excluded from the analysis.

**Possible Benefits, Risks and Discomforts**

Benefits: Participating in this study might not benefit you directly, but the findings from this research have the potential to inform future land use policy, solar farm design, and planning that aims to implement sustainable development of large-scale solar projects in rural Nova

Scotia.

Risks: Participating in this research presents minimal risk to you. In the final thesis, no information presented will be linked to your identity in order to maintain your anonymity.

**Compensation / Reimbursement**

To thank you for your time, we will give you an Irving gift card worth $20 when you participate in the study. If you do not feel comfortable completing the card sorting exercise and/or interview, but showed up to a meeting with Emily, then you will still receive the gift card to compensate you for your time.

**How your information will be protected:**

Privacy: Your participation in this research will be known only to the lead researcher (Emily Snair) and her faculty supervisor (Dr. Kate Sherren). Additionally, your meeting with Emily will take place in a private room in the community centre to ensure no one, aside from Emily, hears you provide responses. Also, the recording of your responses will only be accessible to Emily and Dr. Sherren.

Confidentiality: The information you provide to us will be kept confidential. In the final thesis paper and any subsequent research articles and reports, information that is indicative of your identity will not be disclosed. When interview transcripts are analyzed and the research results are written, participants will be identified in the following format: [Community name] and [Resident number]. For example, labels such as "Berwick Resident 1", "Mahone Bay Resident 2", and "New Ross Resident 3" will be associated with interview responses. All voice recordings collected, and interview transcripts written for this research will be stored in an encrypted file on the lead researcher's password protected computer. Only the lead researcher and her faculty supervisor will have access to these files. We will use a participant number (not your name) in our written and computer records so that the research information we have about you contains no names. All your identifying information (such as your name and contact information) will be securely stored separately from your research information. All paper records will be kept secure in a locked filing cabinet located in the researcher's office."

Data retention: After the research analysis is completed, data (i.e., consent forms and information obtained from the card sorting exercise and interview) will be retained for three years. The data will be stripped of personal identifiers and stored on a flash drive, which will be kept in a locked location for three years Discuss plans for the data after data collection and analysis are complete. After the three-year period, the data will be destroyed so that it is no longer retrievable.

**If You Decide to Stop Participating**

You are free to leave the study at any time. If you decide to stop participating during the study, you can decide whether you want any of the information that you have provided up to that point to be removed or if you will allow us to use that information. After participating in the study, you will have until March 1, 2024, to decide if you want us to remove your data. After that time, it will become impossible for us to remove it because it will already be analyzed.

**How to Obtain Results**

You can obtain the research results after March 1, 2024, by including your contact information at the end of the signature page. Emily can send you a summary of the research results using the email address you provide.

**Questions**

We are happy to talk with you about any questions or concerns you may have about your participation in this research study. Please contact Emily at Emily.snair@dal.ca or Dr. Kate Sherren at kate.sherren@dal.ca at any time with questions, comments, or concerns about the research study.

If you have any ethical concerns about your participation in this research, you may also contact Research Ethics, Dalhousie University at (902) 494-3423, or email: ethics@dal.ca (and reference REB file # 2023-6658)."