What Determines Municipal Renewable Energy Development? Insights From a Mixed-Methods Study of Municipalities in Alberta

by

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Abstract

This thesis contributes to energy social sciences, examining the potential of municipal renewable energy projects and employing a novel theoretical framework intersecting the theory of planned behaviour and transition theory. I site this work in Alberta, a province with a carbon intensive energy system and one in which advancing renewable energy is critical. One substantial challenge to renewable development in Alberta is a lack of community support, especially as the economy and culture of the province is closely tied to the oil and gas sector. Municipal projects can align with the dimensions of justice used to define community energy, a form of renewable development that respects local values and benefits nearby community, with demonstrated potential to reduce social barriers to renewable energy development. This thesis seeks to understand what municipal decision-makers perceive as the motivations, opportunities, and challenges to developing renewable energy projects. I utilise a mixed-methods approach to do so; a survey of municipal decision-makers across the province provides a broad understanding of what motivates renewable projects in a variety of contexts, demonstrates what types of municipalities are interested in developing renewable projects and why. I build on these findings with a case study of plans, projects, and policies in the city of Edmonton using document analysis and semi-structured interviews with administrative employees, elected council members, and energy experts to informs a more in-depth understanding of the complex decision-making informing these projects. Municipal energy projects are motivated by economic benefits and as carbon reduction initiatives. While acknowledging the cultural identity of fossil fuel support in the province, participants perceive support for renewable development both within and beyond municipal boundaries. Renewable projects are perceived to be challenged by capital limitations, low payback periods, and difficulty accessing external supports and financing. While

municipal energy projects were primarily discussed at the microgeneration scale, case study participants discussed the city taking a role as a community generator, but felt it was challenged by additional regulatory barriers and expertise challenges. Both survey and interview participants saw potential for partnerships with private firms, a collaboration with a hybrid of traits from the regime and niche dimensions of transition theory. These partnership approaches may be a key avenue for future municipal involvement in renewable energy, especially at the utility-scale. The findings of this study demonstrate there is substantial interest in developing municipal energy projects in Alberta, providing a key opportunity to introduce necessary renewable energy while also supporting local governments.

Preface

This thesis is an original work by Sonak Patel. All primary data collection, analysis, and management efforts received ethics approvals for the University of Alberta Research Ethics Board. The survey research discussed in Chapter 3 was approved under project name "Identifying the Opportunities and Barriers to Municipal Renewable Energy Generation", ID: Pro00086482. The semi-structured interviews discussed in Chapter 4 was approved under project name "What determines municipally-owned renewable energy development? Insights from a mixed methods study of municipalities in Alberta", ID: Pro00102224, amended under ID: Pro00102224_AME1.

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CHAPTER 1: INTRODUCTION

A transition to a low carbon energy system is a crucial component of Canada's climate action effort, necessary to mitigate the risk of climate change impacts. Nowhere is this more evident than the Province of Alberta, where approximately 90% of electricity generated is produced by fossil fuels (Canada Energy Regulator [CER], 2020). Introducing more renewably sourced power in Alberta is critical to reducing carbon emissions in the province, both those generated by existing energy services and through the electrification of services like transportation and heating that are predominantly powered by fossil fuels. Despite the timely need to introduce more renewable energy to meet carbon reduction targets, Alberta has seen a limited and slow uptake of renewable development. One challenge to the development of renewable energy is the lack of community, and therefore political, support. Energy conflicts in Canada are not uncommon; issues like pipeline development, fracking, and renewable energy development illicit significant public dialogues, debates, and even protests (Shaw et al., 2015). Community concern can affect the viability of renewable projects; several projects in Canada have been cancelled over public outcry (Jami & Walsh, 2014; Shaw et al., 2015). Public opposition can also influence the priorities of government. In 2019, Alberta elected a political party that campaigned on and enacted the removal of renewable subsidies and support programs, resulting in projections that Alberta will not meet the previous goal of having 30% of capacity on the grid be provided by renewable sources by 2030 (AESO, 2019; Stephenson, 2019).

Energy social science research has found potential for community-oriented energy projects to address the social and political barriers to renewable development, discussed further in the literature review. Among the types of communities that can develop these projects are local governments, or municipalities. Using a mixed-methods approach to assess the perception of

motivations, opportunities, and challenges among municipal decision-makers, this study seeks to understand the potential for municipal governments in Alberta to develop renewable energy projects.

Alberta Energy Context

Alberta is a highly carbon intensive jurisdiction, in no small part due to the prominent oil and gas extraction industry. The economic activity and employment created by this industry has also fostered a strong culture of fossil fuel support in Alberta, incorporating dimensions of ideology into energy discussions. The electricity system of the province is dominated by fossil fuel generators, with approximately 49% of electricity produced by natural gas generators and 43% being sourced from coal generators, the largest coal fleet in Canada (CER, 2020). As a result, electricity generation accounts for the second largest source of carbon emissions in the province, second only to oil and gas production (CER, 2020). Of the renewable sources powering the grid, the majority is produced by large-scale wind farms in the southern foothills of the province, followed by legacy hydroelectric dams. There is a small amount of solar generation complementing the renewable portfolio, comprising the majority of behind-the-meter, microgeneration projects (CER, 2020; Patel & Dowdell, 2018). While renewable projects are being developed, adoption is slow. Even as demand is anticipated to grow by 1% annually until 2039 and coal power is planned to be phased out by 2030, renewable energy is expected to remain relatively small portion of the generation portfolio (AESO, 2019).

Energy researchers describe similar energy systems in many jurisdictions in North America, where energy generation is highly centralised and fossil fuel based, a result of energy decision-making being guided by economic and engineering approaches (Andrews, 2008; Ashworth, 2012; Salter, 2015; van Hoesen & Letendre, 2010). Intersecting with the

technological lock-in of existing energy infrastructure in the province, the cultural identity of oil and gas formed by the historic and current economic value of the fossil fuel industry may cause contention with the environmentalist movement calling for climate action. Thus, Alberta presents a unique socio-technical landscape to situate energy transition research, yet a critical one for significant emissions reduction.

Literature Review

Community Energy

While the transition to a decarbonised energy sector is often treated as an engineering and economic challenge, social scientists have demonstrated the importance of understanding and building public support to enable renewable energy development (Klein & Coffey, 2016; Korjunen-Kuusipuro et al., 2017). From this intersection of social science and energy transition issues, the concept of community energy has received significant attention in both academic literature and implementation as a resource to encourage renewable development, as well as develop social capital and strengthen communities (Brummer, 2018, Klein & Coffey, 2016, Korjunen-Kuusipuro et al., 2017).

Community energy projects centre the values and goals of the nearby population. Definitions of the term vary among the authors who have explored the concept, including aspects such as local engagement, governance, location of energy consumption, ownership, and technologies employed (Brummer, 2018; Klein & Coffey, 2016). Across most definitions, two aspects remain consistent, which Walker and Devine-Wright (2008) refer to as procedural justice and distributive justice. Procedural justice is defined in the way the community is engaged and has an influential voice in the development and operation of the project. Energy projects that reflect the considerations and values of the community demonstrate procedural justice.

Distributive justice refers to the fairness of the distribution of impacts and benefits. Projects demonstrate distributive justice when the people that are the most impacted are the ones that receive the benefits of an energy project, often economic. Because energy project impacts are greatest in the local areas, demonstrating distributive justice means that the nearby community receive the benefits of the project (Walker & Devine-Wright, 2008). Community energy projects often involve renewable energy technologies, as these technologies are scalable to meet community demand and goals (Brummer, 2018, Szulecki, 2017).

Community energy can be summarily defined as a project initiated by a group of people united by common geography or interest, in which the benefits and costs of the project are born by those individuals (Klein & Coffey, 2016). Ambiguity about the definition of community has led to various institutions being assessed as possible developers (Brummer, 2018; Oteman et al., 2014). Though some authors define community energy through its exclusion of government agencies (Brummer, 2018), others demonstrate that municipal projects can express the features that define community energy (Klein & Coffey, 2016). Municipalities serve a relatively local area, meeting the definition of a community of geography (Musall & Kuik, 2011). Local governments employ a variety of community engagement techniques (e.g. surveys, open houses, workshops and charettes) and are obligated to allow any member of the public to speak on an issue before the municipal council. If this engagement is influential in the design, development, and operations of renewable projects, they can be considered to demonstrate procedural justice. Municipal renewable projects can provide benefits to the local government and community, such as funding programs and services for the local community or reducing the tax burden.

Klein and Coffey (2016) categorise different models of community energy based on a literature review of energy social science. Three of the models include municipal involvement;

municipalities can form public agencies to buy renewable energy for willing residents; an entity installs renewable generation using tax revenue; and a public utility owns, operates, and maintains a renewable energy system and sells the renewable energy to consumers. However, municipal energy efforts receive relatively less attention in community energy literature, presenting a research gap for a greater investigation into the potential for local governments to development renewable projects and assessment of how these projects align with the dimensions of community energy that this study seeks to fill.

Motivations for municipal energy development

The literature reviewed examines topics of municipal energy and climate action efforts, as well a wealth of community energy research. This literature demonstrates several motivations for municipalities to engage in renewable energy development.

Environmental Motivations

Krause (2013) cites four possible explanations for municipalities to engage in climate action; municipalities act out of altruism, despite economic consequences; climate action does not bring additional costs; climate action may lead to tangible local benefits; and climate action may produce political gains for local leaders. In a survey of 255 cities in the United States, Krause (2013) found that the most significant motivations for climate initiatives were creating an energy, and therefore cost, savings; the preferences of city officials; and requirements from the state, respectively. Through a factor loading analysis, Krause (2013) finds that the perception of financial benefits and mitigating climate change are motivations for emissions reduction efforts.

Aligning with global efforts to reduce greenhouse gas (GHG) emissions is a critical issue for municipal governments. Not only are municipalities places of significant GHG production, and therefore crucial places for mitigation, but municipalities are also of significant risk of

climate change impacts (Bassett & Shandas, 2010; Seabrook, 2010; Simpson, 2013). In Canada, municipalities have direct or indirect control of 44% of carbon emissions (EnviroEconomics, 2009). Additionally, Brummer (2018) finds that community energy projects foster a greater understanding and awareness of energy issues and climate change, addressing the psychological disconnect between energy consumers and the impacts of generation that occurs when consumers are physically distant from generators (Ashworth, 2012). Hoffman and High-Pippert (2205) discuss how connecting places of energy consumption and generation can result in more environmentally conscious behaviour, another method in which community energy projects can reduce GHG emissions. Community energy can also foster public support for renewable development (Ashworth, 2012; Brummer, 2018; Korjunen-Kuusipuro et al., 2017), which can be crucial in Alberta where energy discourses are divisive and contentious. As discussed by Krause (2013), environmental motivations can also intersect with political benefits, where elected officials and municipal administrations perceive a demand among members of their citizenry for climate action and pursue these projects for community approval.

However, renewable energy projects can have negative environmental impacts, which can discourage municipal-decision makers (Brummer, 2018). Issues that are frequently raised include disrupting natural ecosystems and wildlife corridors and harm to local wildlife, particularly wind turbines harming avian life. A complicating environmental consideration is spatial and temporal scale; climate change is a global threat that requires coordinated action across the planet. However, the environmental impact of energy infrastructure is mostly localised. At the municipal level, climate change can be perceived as an unknown, distant threat and therefore can be overshadowed by more immediate and visible threats (Schoenberger, 2013). Municipalities and their citizens may be reluctant to make a local sacrifice to be part of global climate action efforts.

Economic Motivations

Several papers note the importance of economic benefits motivating community energy development (Krause, 2013; St Denis & Parker, 2010). Community energy projects may reduce energy costs for communities, by offsetting power otherwise purchased from the grid (Galluzzo, 2005). Excess energy beyond local demand can also be sold back to the grid to generate revenue. Local projects can also create local employment for the community (Engelken et al., 2016, Galluzzo, 2005, Walker, 2008).

Highlighting the importance of distributive justice, Ashworth (2012) and Galluzzo (2005) discuss a multiplier effect of local benefits; as community energy projects provide revenue through lowering costs and the sale of energy to the community, local residents are more likely to spend this money in the community on local businesses.

Capturing economic benefit may be especially crucial for the municipalities; Heuton and Girard (2010) discusses a trend over the last two decades of decreases in transfers from provincial and federal governments to the municipal scale, while citizens advocate for lower taxes. Because of these challenges, municipalities are forced to be innovative with financing municipal services (Heuton & Girard, 2010). Municipalities may be incentivised to pursue renewable projects as a non-tax revenue source.

Social Motivations

The premise of community energy is related to the concept of energy democracy. Consistent with the themes of deliberative democracy, energy democracy describes the integration of people into the energy system they rely on instead on being passive consumers. Some researchers have defined this emerging role with the portmanteau “prosumer” (Korjunen-

Kuusipuro et al., 2017). This democratic process empowers communities with greater autonomy in the systems that are critical for their lives (Breen, 2009, Walker, 2008).

Some community energy authors discuss the ability of community energy projects to build social capital, which is defined as the social networks, shared norms, and values that link and unify a community (Brummer, 2018, Hoffman & High-Pippert, 2005; Klein & Coffey, 2016). The engagement that creates procedural justice allows community members to interact, share, and collaborate, developing relationships and social cooperation, which Hoffman & High-Pippert (2005) coins social gratification. Another social benefit of community energy projects is civic gratification, describing the satisfaction of fulfilling a desire or sense of duty to improve the welfare of their community (Hoffman & High-Pippert, 2005). In several of the case studies reviewed, community energy projects became symbols of pride for their communities, representing participation in the global effort to address climate change and benefit the local community (Brummer, 2018).

Resilience Motivations

Bradford (2012) and Gilmour and McNally (2010) discuss how North American municipalities have faced issues with energy security caused by reliance on power grids, to the detriment of local residents and businesses. Local generation can provide energy security by insulating communities from the impacts of grid level energy disasters, as well as reduce transmission costs and line congestion (Breen, 2009; Engelken et al., 2016). Albertan municipalities may be increasingly motivated to seek energy security by developing local renewable projects as a backup to the provincial grid that is threatened by the rising frequency and magnitude of climate change disasters (MacKay et al., 2020).

While these authors found technical benefits from community energy projects, Brummer (2018) finds that some communities question the feasibility of renewable technologies, which are relatively novel. Similarly, Busch and McCormick (2014) note that local expertise and enthusiasm for technology contribute to the intention to develop renewable projects.

Challenges to renewable development

The literature reviewed reveals several challenges for communities and municipalities engaging in renewable development. The perception of these challenges serve as barriers to developing the intention to pursue renewable development.

Economic Barriers

Economic challenges are the most discussed barrier in the literature reviewed. Community energy projects are a steep upfront expense that only payback after years (Hamin et al., 2014; Krause, 2013). This initial expense may be beyond the resources available to municipal governments, especially considering the financial challenges of municipalities in Alberta that have seen shrinking transfers from federal and provincial governments alongside increased downloading of services from the provincial to municipal tax base. At the same time, citizen advocates pressure leaders to shrink taxes and rely on user fees, forcing municipalities to be innovative and efficient with delivering key services (Heuton & Girard, 2010). Dedicating substantial capital to invest in renewable development can be challenged because local governments may feel as if GHG reduction is not within local jurisdiction and look to other governments to lead efforts like renewable energy development (Adler, 2005).

Additional economic barriers include the administrative costs of developing a project, including design, seeking approval to develop and connect projects to the grid, and engaging the community (Klein & Coffey, 2016; Walker, 2008). The complexity of renewable technologies

can bring the additional cost of contracting expert knowledge (Brummer, 2018). Brummer (2018) also discussed overly complex legal frameworks and grid connection costs as barriers which challenge communities and favour large corporate generators. While municipalities do have access to funding through resources like property taxes, user fees, and external grants, municipalities also have many responsibilities, both set in provincial legislation and through the expectations of their citizenry. These responsibilities compete with renewable development for budget and staff attention. Krause (2011) found that capacity, both in staff abilities and fiscal health, is the strongest predictor of climate action of the several theories she tested.

Community and Leadership Opposition

As community energy is intended to reflect the values, goals, and norms of the local community, Wolf et al. (2013) note that conflicting values in a community can challenge municipal energy development. One of the reasons for individuals to oppose renewable energy development is scepticism about the need for climate action (Hamin et al., 2014; Klein & Coffey, 2016). Finding community support for renewable development may be especially challenging in Alberta, a province with the lowest acceptance of the veracity of climate change in Canada (Lachapelle et al., 2012; Mildenberger et al., 2016).

While municipalities may see social benefits for energy development, the literature reviewed highlights political barriers to renewable development. Hamin et al. (2014) found that a lack of local leadership and support for renewable energy was the most frequently stated barrier in interviews with planners.

Theoretical Framework

Theory of Planned Behaviour

To guide the analysis of municipal energy intentions in Alberta, I employ the theory of planned behaviour to conceptualise the factors that are influencing the intention to pursue renewable development. The theory of planned behaviour has been employed by many researchers in social sciences to explain environmental actions, including recycling, composting, water conservation, sustainable agriculture, environmental purchasing, and energy use (Fielding, McDonald, & Louis, 2008; Kalafatis et al., 1999; Tikir & Lehmann, 2011). Armitage and Conner (1999) found that the theory of planned behaviour had strong internal and test-retest reliability, demonstrating the model as applied has had successful predictive validity.

The theory posits three factors that decision-makers consider when deciding whether to pursue a certain planned behaviour. The first is *attitude*, or the individual's positive or negative perception of the behaviour. The second is *subjective norms*, which is the respondent's assumption of social pressure or response to the behaviour. And the third are *perceived behavioural controls*, which is the respondent's perception of how difficult it would be to follow through on the behaviour. These three considerations form intention, or the amount of effort the individual is willing to put in to complete that behaviour (Busch & McCormick, 2014; Engelken et al., 2016)

Municipal Energy Case Studies

Researchers have applied the theory of planned behaviour to understand municipal renewable development; Engelken et al. (2016) applied the theory of planned behaviour to understand the motivations for mayors pursuing energy self-sufficiency in Germany. In their study, attitudes included environmental awareness; perceived value of renewable energy projects,

including revenue generation, job creation, independence from utility companies, and improvements to city image; and risks of rising energy prices and unstable energy supply. Subjective norms were determined by asking the mayors how they perceive voters and industry stakeholders feel about energy self-sufficiency. Perceived behavioural controls in the study includes inadequate financial resources, a lack of capacity and expertise among municipal employees, and political power to get the project approved. Engelken et al. (2016) concludes by identifying the need to understand the perspectives of other stakeholders in the development of municipal energy projects, including state policy makers, managers of utility companies, and citizens.

Similarly, Busch and McCormick (2014) examine the decision-making considerations of three mayors in Germany that have committed to reaching 100% renewable energy by 2030. Employing the theory of planned behaviour, Busch & McCormick (2014) highlight the individual motivations of mayors and key success factors of renewable energy. Busch & McCormick (2014) found that climate change was a driver for renewable support and is influenced by personal experiences with nature. Other attitudes that influenced these mayors included job creation, increasing the tax base, price security, and negative opinions of fossil fuels. When looking at subjective norms, all three mayors were positively motivated to develop renewable projects because they believed it would be well received and improve the local image. Busch and McCormick (2014) discuss the resources that alleviated the barriers to development, including social capital, supportive regional energy suppliers, and political support.

Though there are limitations to the theory, in particular overemphasising the agency of decision-makers over social and regulatory constraints, Engelken et al. (2016) and Busch and McCormick (2014) demonstrate the ability of the theory of planned behaviour to conceptualise,

visualise, and understand the factors influencing decision-making for municipal energy developments. However, municipal decision-making is a complex process, involving many actors and influencing factors. While Busch and McCormick (2014) and Engelken et al. (2016) use the theory of planned behaviour to conceptualise the decision-making of a single municipal actor, the application of the theory to understand collective municipal decision-making, as used in this study, is a novel effort. This study thus seeks to contribute to energy literature by examining the validity of the theory of planned behaviour to conceptualise municipal decision-making. As Engelken et al. (2016) discuss, understanding decision-making to pursue renewable development is crucial to developing support systems for municipally owned community energy.

Transition Theory

In addition to the theory of planned behaviour, transition theory is used to frame the phenomenon of municipal energy development within the landscape of energy transition of Alberta. Transition literature examines the non-linear process of societal change, examining the human and non-human aspects that contribute to transformation. Transition theories employ a multi-level perspective to understand socio-technical transition, theorising that transition occurs from the interplay of developments at three analytical levels; *niches*, which are the loci for innovations; *the socio-technical regime*, which are the dominant and established practices and the rules and institutions that enable that dominance; and the *exogenous landscape*, or features and actors beyond the scope of the system being analysed, but do still have an impact on the actors within the system (Geels, 2014; Geels et al., 2016).

Transition literature describes the process of transition, starting at the niche level, where innovations, or practices that differ strongly from the existing regime, emerge. These innovations can become widespread and eventually pick up momentum, though regime level actors oppose

change. Contributing to the spread on innovative practices, forces at the landscape level can destabilise the regime. Over time, the innovations can accelerate and become the new dominant regime, displacing the former system (Avelino & Rotmans, 2009; Geels, 2014).

In the context of energy transition in Alberta, the dominant regime is large scale, privately-owned, fossil fuel energy generation, supported by regulations and infrastructure that encourage market inertia. Included at the regime level is the provincial government, which regulates the energy system and enables the dominant actors to maintain the energy system inertia. In Alberta, the provincial government has demonstrated a strong alliance with the oil and gas sector but has also supported both community and large-scale renewable energy projects, suggesting an evolving and complex role for regime level actors responding to niche and landscape factors. Community energy projects represent innovations that differ from the dominant method of energy generation yet may present solutions to the failures of the existing regime, including the carbon intensity and lack of justice between places of generation and consumption. In taking a role in supporting these projects, municipalities are the niches where these innovations can emerge.

This study employs a novel theoretical approach through intersecting the theory of planned behaviour with transition theory. With the theory of planned behaviour focusing on individual perceptions of their opportunities and challenges to a planned behaviour, transition theory can situate these perceptions within the various dimensions of socio-technical transition, identifying what aspects internal and external to the municipality that are influencing decision-making.

Research Objectives

Given the need for renewable energy in Alberta to reduce carbon emissions and the potential for community energy projects to foster the necessary social support for renewable energy development, this research targets the timely and critical issue of enabling municipal energy projects. The literature reviewed demonstrates that community energy projects can create numerous local benefits, but also face substantial barriers to development. Municipalities can leverage their financial and capacity resources to develop projects that reduce carbon emissions and support the local community. Understanding what contributes and diminishes the motivation to develop renewable projects is key to creating opportunities to support these efforts. This research targets areas for future research identified in existing literature, including collecting perspectives from a range of elected and administrative municipal decision-makers (Breen, 2009; Engelken et al., 2016; Hamin et al., 2014).

The following research questions motivate this research:

1. What factors do municipal decision-makers consider as the motivations, opportunities, and barriers to pursuing renewable development?
2. How are these factors expressed in the types of projects municipalities are interested in developing?

Juxtaposing the novelty of this framework against the complexity of municipal decision-making, this research contributes to the growing body of energy transition literature by developing theoretical approaches to understanding community and municipal energy development. The following questions inform this research's contribution to energy social science literature:

1. How do municipal energy projects exhibit the dimensions of community energy?

2. How effectively do the theoretical frameworks of transition theory and the theory of planned behaviour conceptualise and understand municipal intention?

Structure of Thesis

This thesis contains four chapters. Chapter 1 introduces the study, including research objectives, relevance of this work, the context of the Alberta energy system, a review of academic research on municipal and community energy, and the theoretical frameworks guiding this work. Chapter 2 discusses a survey of municipal decision-makers in Alberta, presenting insights into what motivates municipalities to express the intention to develop renewable projects. Chapter 3 builds on these findings, using a case study of renewable projects and programs in the city of Edmonton to present an in-depth understanding of the decision-making behind renewable development in a city that is undertaking substantial renewable development efforts. Chapter 4 presents a synthesis of the findings of the two studies as well as opportunities for further research.

Positionality Statement

Reflexivity is a key consideration within interpretive and contextualising research methodologies. Reflexivity acknowledges that unique experiences and views of the researcher influence the research method and the identification and interpretation of findings. This statement shares my position throughout the research process and how it has influenced the data collection methods, responses, and analysis.

My interest in energy transition issues has largely been prompted by the need for climate action. As a young individual exposed to the growing threat of climate change for the majority of my life, I am distinctly aware of and immensely concerned about the impacts of a changing climate. I entered this program with the intention of learning more about sustainability issues and

solutions, especially to climate change. As such, my research focused on positioning municipal energy projects as an emissions reduction measure and may have influenced how survey respondents and interview participants responded to the phrasing and construction of the data collection elements, as well as how I interpreted and presented this data.

The way I interacted and was interacted with by interview participants can be influenced by aspects of my identity as a cisgender man and person of colour, affecting how comfortable both myself and interviewees felt during these discussions. Additionally, I often felt throughout my experience that I held a unique position as both an insider and an outsider. Prior to undertaking this graduate program, I studied urban and regional planning and was employed as a planner in a consulting firm in Edmonton. As such, I was very familiar with the municipal planning process, legal frameworks, and city of Edmonton policies. This background influenced the way I interacted with municipal employees and the details of municipal decision-making they were willing to share. For example, I discussed challenges in engaging certain demographics with some participants by sharing stories about my experiences doing community engagement as a consultant and asking them if they had similar experiences. I asked questions about specific policies and referenced industry-specific jargon, with may have invited participants to do the same, using terms and going into details they may not have shared with someone unfamiliar with municipal decision-making. At the same time, as a social scientist, I was often far less aware of the regulatory and technical considerations of energy development than some participants, sometimes requiring explanations about certain legalities and technologies. As participants may have felt more comfortable sharing details with me as an “insider” to municipal development practices, some may have been withholding of technical details to an “outsider” to renewable energy technologies.

While there strong rapport and moments of frank and open communication with survey respondents and interview participants, I was very grateful to everyone who was willing to dedicate their time and insight to this position. Exposure to a variety of views, considerations, and backgrounds has not only contributed to the research presented in this study, but also developed my own understanding, views, and perspectives.

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CHAPTER 2: INSIGHTS FROM A SURVEY OF MUNICIPAL DECISION-MAKERS IN ALBERTA, CANADA

Decarbonising Alberta's carbon intensive electricity system is crucial to climate action efforts, yet the rate of adoption is low, even with the substantial coal fleet planned to be decommissioned and replaced (AESO, 2019). Public support is critical for renewable energy adoption and development, with community energy presenting an opportunity to do so (Klein & Coffey, 2016; Korjunen-Kuusipuro et al., 2017). Municipalities have the opportunity to develop community energy projects, leveraging their resources and demonstrating the dimensions of procedural and distributive justice in order to introduce much needed renewable energy into the provincial portfolio. In Alberta, municipalities are regulated under the *Municipal Government Act* and include cities, towns, villages, and municipal districts, often called counties. Albertan municipalities are governed by an elected council and employ a municipal administration that includes planners and engineers to carry out delegated responsibilities, such as water and wastewater, maintaining and building transportation infrastructure, and providing transit, among many others.

This chapter employs a province-wide survey of municipal decision-makers to understand and conceptualise the perception of motivations, opportunities, and barriers to developing municipal renewable energy projects. I conduct a statistical analysis of the results to determine what municipal and respondent characteristics are related to the intention to develop renewable projects and what types of projects municipalities are interested in developing.

Methods

To capture the considerations that are influencing municipal decision-making, I surveyed municipal decision-makers, a sample that includes members of administration that have or would have a role in developing renewable projects and council members who are responsible for approving municipal actions. To administer this survey, I collaborated with the Alberta Urban Municipalities Association (AUMA) and the Rural Municipalities Association (RMA), province-wide associations that respectively represent, support, and advocate for the urban and rural municipalities in Alberta, as well as the Municipal Climate Change Action Centre (MCCAC), a collaboration of the AUMA, RMA, and the Government of Alberta to support climate action efforts of Albertan municipalities. The MCCAC provided a list of municipalities that they have worked with to develop renewable projects. I contacted these municipalities and asked them to participate in the survey. Both the AUMA and RMA shared the survey link in their September and October 2019 newsletters. I contacted every municipal administration in the province using a mailing list created and maintained by the Government of Alberta, asking the contact provided to forward the link to employees currently or potentially engaged in renewable energy discussions. I also reached out to all municipal councils, again using a mailing list maintained by the Government of Alberta, asking the contact to forward the survey link to current members of council.

While this administration process was necessary to capture the views of the target sample, this method also produced a number of statistical weaknesses. I cannot calculate the response rate, as I cannot be confident about the total number of individuals who saw the survey link in the newsletters. I also cannot confidently say the provincial mailing lists were reliable and up to date nor be assured the initial contacts forwarded the surveys to the relevant potential

participants. The complexity of this target population means I am unable to calculate its exact size, as I cannot know how many employees would be involved in renewable development across the hundreds of municipalities. Large municipalities may have dedicated employees to energy transition efforts, while smaller municipalities may rely on generalised employees to play a role in planning and development renewable projects. Instead, I turn to representation of municipalities to compare my sample to the population. The survey collected 101 complete responses from 74 municipalities, out of 338 municipalities in the province. Table 1 compares our sample response rate to the municipalities of Alberta. Our survey captured a higher proportion of respondents from cities, towns, and municipal districts, at the expense of being underrepresented by respondents representing villages and summer villages.

Table 1: Municipal types in Alberta represented in the sample

	Number of Responses	Percent of Sample	Number of Municipalities in Alberta	Percent of Municipalities in Alberta
City	13	13%	19	6%
Town	38	38%	106	31%
Village	18	18%	84	25%
Summer Village	4	4%	51	15%
Specialised Municipality	1	1%	6	2%
Municipal District	25	25%	63	19%
Improvement District	1	1%	8	2%
Special Areas	1	1%	1	0%

This method of survey administration also creates a concern about selection bias. Because the survey was labelled as a renewable energy study, the respondents may have been biased towards those that are interested in or passionate about renewable energy projects. In municipalities uninterested in renewable development, target decision-makers may feel

unknowledgeable or unwilling to discuss renewable energy, leading to a non-response bias. I did seek to reduce this source of error through the provision of a financial incentive to participation; respondents that completed the survey were eligible to enter a draw to win one of two $350 gift cards. However, the voluntary nature of this survey does pose a challenge to the validity of findings.

Findings

Respondents were asked whether they believed their municipality would be interested in developing a renewable project in the near future. Just under half the sample expressed the intention to develop these projects, 50 respondents (49.5%), while a further 31 respondents stated they were unsure.

Preferred Technologies

Of the respondents that indicated their municipality was interested in developing renewable projects in the near future (N=50), I asked what types of projects they are interested in developing (Table 2). I also asked why respondents were interested in each technology they expressed interested in. Almost all respondents were interested in a solar project (N=49), with the most cited reasons for solar being the reliability of a proven technology (N=31), expected public acceptance (N=27), and high natural feasibility (N=28). Thirty respondents expressed interest in developing biomass energy projects, motivated by perceived high natural feasibility (N=21) and expected greater public acceptance (N=12). Using the text entry option provided in the survey, several respondents noted that they were interested in biomass projects as able to meet two goals at the same time, or as one respondent called it to “hit two birds with one stone”; some biomass projects can use waste products for energy production, diverting waste that would otherwise be stored in a landfill. Twenty-four respondents expressed interest in developing geothermal

electricity, with the most selected reason for interest being greatest public acceptance (N=12), potentially because the subsurface nature of geothermal is similar to and can repurpose the labour and expertise of subsurface fossil fuel extraction. Fewer respondents expressed interest in wind (N=17) and hydro projects (N=7).

Table 2: Preferred renewable energy technologies and reasons for interest by municipal leaders in Alberta

	Solar	Wind	Biomass Electricity	Hydroelectricity	Geothermal Electricity
Interest in developing technology (N)	49	17	30	7	24
Reasons for Intention					
Minimal impact on the landscape	25	5	8	4	10
Reliable and proven technology	31	9	10	3	10
Cheap installation / operational costs	21	3	5	0	3
High potential / natural feasibility	28	6	21	5	7
Expected highest return on investment	17	5	10	1	5
Minimal impact to the environment	23	2	6	1	6
Expected greatest public acceptance	27	3	12	4	12
Other	4	1	5	0	3

Motivations

Respondents interested in renewable development were asked what factors were motivating them, presented in Table 3. The motivations considered the most significant were economic; capitalising on provincial or federal programs, often aimed at subsidising renewable development, and lowering costs by offsetting electricity that would otherwise need to be

purchased. Being perceived as innovative, ranked a significant motivation, is also considered an economic benefit, as it can attract new people and businesses to the municipality.

Reducing carbon emissions was considered less significant than several of the economic motivations, though 31 respondents considered it very or fairly significant. Fewer respondents considered achieving a specific carbon reduction target as significant, suggesting that municipalities may seek carbon reduction but do not have specific targets or carbon budgets to quantify these goals.

Table 3: Percent ranking of motivations to develop renewable energy projects by municipal leaders in Alberta

Motivation (%)	Very significant	Fairly significant	Somewhat significant	Barely significant	Insignificant	N
Capitalise on provincial or federal program	56	28	12	0	4	50
Lower costs	51	39	8	2	0	49
Being perceived as innovative	42	40	10	8	0	50
Generating revenue	38	22	24	8	8	50
Reduce municipal carbon footprint	36	26	20	12	6	50
Achieve a carbon reduction target	20	22	30	20	8	50
Create employment	16	34	32	8	10	50
Being energy self-reliant	12	44	28	12	4	50
Being inspired by projects in other municipalities	12	34	40	10	4	50

Opportunities and Barriers to Renewable Development

Respondents were asked about their opportunities and barriers to renewable development. Unlike the motivations in Table 3, all respondents were asked about opportunities and barriers regardless of whether they indicated intention to develop renewable projects. Opportunities were defined as factors or benefits of renewable development that are indirect to the operation of the project. Some opportunities overlap with motivations. Respondents were asked to rank these opportunities from most to least significant, presented in Table 4.

Similar to the motivations presented in Table 3, the presence of federal and provincial incentives was highly ranked as an opportunity. The second highest rated opportunity was the presence of community support for renewable power, related to the political considerations of municipal decision-making and challenging the hypothesis that renewable energy is ill-received in the province. The perception that renewable energy enhances image is a key contributor to intention, but is valued as an economic benefit, attracting new people and businesses, rather than a civic pride benefit, instilling pride in residents. As lowering costs was one of the highest motivations for renewable development, the perception that renewable energy is or soon will be cheaper than fossil fuel electricity was considered a moderately important opportunity.

Table 4: Percent of respondents ranking opportunities for renewable energy development

Ranking of importance of opportunity	Presence of federal and provincial incentives	Significant community support for renewable power	Adopting renewable electricity attracts people and business	Renewable electricity is or soon will be cheaper than fossil fuel electricity	Renewable electricity provides economic diversification	Adopting renewable electricity instils pride in residents
1 – Most important	38	21	13	14	6	3
2	21	18	24	19	11	5
3	15	19	20	18	13	13
4	13	10	22	12	15	27
5	6	10	16	9	31	28
6	6	15	4	20	23	20
7 – Least important	0	7	0	9	1	4

According to the theory of planned behaviour, the more difficult a respondent perceives developing renewable projects will be, the less likely they would be to pursue development. In this survey, barriers to renewable development were divided into economic, environmental/technical, and planning/political categories. Respondents were asked to rank the top three most impactful barriers within these categories.

The highest ranked economic barriers were the high initial costs of renewable investment and, related to that, the length of time before the municipality will recoup their costs. One of the factors that relates to the economic value of renewables is the cost of electricity; the cheaper electricity from the grid is, the less the value of renewable projects from offsetting this cost (Table 5). While capital costs and return on investment were considered the most substantial barriers, concerns about ongoing costs were considered less impactful.

Table 5: Perception of economic barriers to municipal renewable development

Economic Barriers	Most important barrier (N=97) (%)	Second most important barrier (N=96) (%)	Third most important barrier (N=90) (%)
Renewable electricity projects have capital costs that are too high	45	24	23
Renewable electricity projects have payback periods that are too long	25	40	22
The cost of electricity is cheap and therefore renewable projects will not generate enough revenue/savings	16	9	21
Renewable electricity projects have operational and maintenance costs that are too high	9	8	19
Renewable electricity planning, assessment, and/or engagement is too costly	4	19	14

When asked to rank the environmental/technical barriers to renewable development, the highest ranked barriers related to the technical performance of renewable technologies. Many considered renewable energy projects too risky or unreliable (N=78 considered renewable projects being too risky as one of the top three environmental/technical barriers), while over half of respondents (N=69) listed renewable energy technology not being feasible as a top three barrier to renewable development. Around half of respondents also believed that the electricity grid in Alberta not being able to accommodate a municipal renewable project was one of the biggest barriers to renewable development. Comparatively, few respondents listed environmental barriers such as impacts to local people and ecosystems as the most significant. However, this may be because of the technologies respondents prefer; environmental concerns are especially prescient in discussions around wind and hydroelectric dams, the two technologies respondents were least interested in. While solar, biomass, and geothermal were not necessarily preferred

because of their environmental performance (Table 2), the nature of these technologies may lead municipal decision-makers to have fewer concerns about the harm to local ecosystems.

Table 6: Percent ranking of environmental/technical barriers to renewable development

Environmental/Technical Barriers	Most significant barrier (N=86) (%)	Second most significant barrier (N=81) (%)	Third most significant barrier (N=70) (%)
Renewable electricity projects are too risky	30	19	29
Renewable electricity technology and infrastructure is not advanced enough to be feasible my municipality	24	31	14
The electricity grid in my municipality and/or province cannot support a municipal renewable project	21	16	13
Renewable projects diminish the natural vistas in my municipality	15	10	20
Renewable projects can adversely impact wildlife in my municipality	6	15	10
Renewable projects create noise and health disturbances	3	9	14

The final set of barriers participants were asked to address were planning and political challenges. The barriers ranked the most impactful intersect with economic challenges; respondents stated their municipal has other priorities that demand budget and staff attention. Additionally, because of the high capital cost and capacity requirements of renewable projects, municipalities are reliant on external supports for renewable development. This is reinforced in Table 3, where capitalising on provincial and federal programs is shown to be one of the strongest motivations for renewable development. However, over half of respondents believed the difficulty of accessing these supports was one of the most significant barriers for renewable development. Related to the importance of external support, several respondents considered a

lack of provincial support as one of the top three barriers to development. Comparatively, fewer respondents felt internal lack of support was a challenge, with community and council opposition being two of the lowest ranked barriers by the sample. Again, this may be impacted by the technologies respondents are interested in. Among the three technologies that Albertan decision-makers were most interested in, expected public acceptance was one of the most cited reasons for interest. Respondents either feel their community does not oppose the renewable projects they are interested in or they can design projects that will mitigate public concern.

Table 7: Percent ranking of planning and political barriers to renewable development

Planning and Political Barriers	Most significant barrier (N=98) (%)	Second most significant barrier (N=93) (%)	Third most significant barrier (N=82) (%)
My municipality has other priorities than renewable electricity generation	33	29	21
Provincial grants and loans are too competitive or unstable	25	28	17
The province will not support a municipal renewable electricity project	12	8	9
Developing renewable electricity generation is not a municipal responsibility	10	8	11
Municipal staff lack the technical capacity to plan for renewable electricity	8	12	20
The community will oppose renewable energy infrastructure	8	6	13
My municipality can reduce our carbon footprint without developing renewable electricity generation	2	5	6
The town or city council will oppose a renewable energy project	2	4	4

I asked respondents how their intention to develop renewable projects may be impacted by potential changes in the future, presented in Table 8. These responses can help understand how the respondents' intention may change in the future as their attitudes, subjective norms, and

perceived behavioural controls respond to changing conditions. The scenarios that were ranked most likely to increase intention both increased the economic value of renewable projects; the price of renewable technology falls and the price of electricity rising. Many respondents also felt municipal budget increasing and municipal debt decreasing would increase their intention to pursue renewable projects. These scenarios would free up resources for renewable investment. Around half of respondents felt scenarios that increased electricity demand, increases in municipal population and more adoption of electric vehicles, would somewhat or greatly increase their intention.

Forty-six respondents (46%) believed provincial emissions reduction targets would somewhat or greatly increase their intention to develop renewable projects, while 43 respondents (43%) felt the same about national climate action targets. However, comparatively fewer respondents believed that seeing the increased impacts of climate change would motivate them. As seen in the motivations for renewable development (Table 3), this finding reinforces that, while carbon reduction is a motivation, energy resilience does not appear to be one of the stronger motivations for renewable development.

Table 8: Percent of respondent's perceived impact of future scenarios impact on municipal intention to develop renewable energy projects

Scenarios	Greatly increase	Somewhat increase	Will not affect	Don't know/ unsure
The price of renewable electricity technologies decreases	51	40	4	4
The price of electricity rises	47	39	8	5
Municipal budget increases	30	37	21	12
Municipal debt decreases	19	37	35	9
Your municipality grows in population	8	45	43	4
Electric vehicles become more popular	16	36	45	4
A national carbon emission reduction target approaches	13	43	33	11
A provincial carbon emission reduction target approaches	16	45	28	11
Climate change impacts: Sea levels rise significantly	9	16	59	16
Climate change impacts: average temperatures rise	8	32	47	13
Climate change impacts: extreme events frequency rises	11	40	36	13

Correlation Analysis

To understand what considerations contribute to the intention to develop renewable projects, I employed a Spearman's Correlation analysis to test for significant relationships between the intention to develop renewable projects and potentially relevant considerations. The intention to development renewable projects was recoded into a binary variable, where individuals who stated they were interested in renewable development (N=50) were coded as 1 and respondents who stated they were not interested in renewable development (N=20) or were unsure about renewable development (N=31) were recoded as 0. The relationships that emerged as significant are presented in Table 9.

These results show that municipal size is correlated with intention to develop renewable projects; cities are strongly correlated with intention (0.41**), as is population (0.42**). The correlation analysis also shows a significant negative relationship between renewable development intention and both villages and summer villages, however, these relationships are very weak and can be considered negligible (-0.20*).

I asked respondents whether they believed their municipality was interested in taking on capital development; participants that responded yes were moderately correlated with renewable intention (-0.30**). I also asked respondents to state the economic sectors most present in their municipality. One economic sector emerges as significant; a self-reported technology and innovation sector is moderately correlated with the intention to develop renewable projects (0.31**), though this variable also displays a strong correlation with cities (0.47**).

As discussed in the literature reviewed, municipal projects require local leadership among decision-makers to encourage development. I tested for correlations between the views of the decision-maker and intention, as these individuals encourage their municipalities to act. The results show three significant results; the more important a respondent considered renewable development is moderately correlated with intention (0.36**); respondents that stated renewable energy in Alberta was adequate or overabundant were weakly negatively correlated with renewable intention (0.28**); and respondents that perceived climate change as a significant threat were moderately correlated with renewable intention (0.33**).

Finally, I generated a correlation analysis between the rankings of opportunities and barriers to development and the intention to develop renewable projects. The ranking of opportunities was recoded such that 1=least significant opportunity to 7=most significant opportunity. For the variables asking about the perceptions of barriers, respondents were only

asked to rank the top three barriers in each of category. If a barrier was left unranked, the dataset records a system missing value. To conduct analysis, I recoded the system missing variables to be an average of the possible ranking it could have received if the respondent was asked to rank all the variables. In the case of economic barriers, there were 5 possible options. Unranked variables could have ranked fourth or fifth on a respondent's list, therefore they were coded as 4.5. There were 6 possible options for environmental/technical barriers, thus system missing variables were recoded as 5. System missing variables for planning barriers were recoded as 5.5, as there were 8 choices in this category. Because barriers are ranked from most to least impactful, a positive relationship indicates that respondents who ranked a given barrier as less impactful are correlated with interest in renewable development.

Several significant relationships emerged from this analysis; respondents that highly ranked the importance of opportunity "Renewable electricity is cheaper than fossil fuel energy" were moderately correlated with intention to develop renewable energy. When looking at barriers, the more impactful respondents ranked the barriers of operating costs being too high, renewable energy infrastructure impacting vistas, their municipality having other priorities, and renewable energy not being a municipal responsibility, the less likely they were to express interest in renewable development. Some barrier variables actually demonstrated a negative relationship, meaning the more significant respondents ranked these barriers, the more likely they were to express support for renewable development. These included the barriers of the grid being unable to accommodate a renewable project, grants and loans being too difficult to access, and the province not supporting a renewable project, although, for this last variable, the strength of the relationship is very weak (-0.20*) and can be considered negligible.

Table 9: Correlations with intention to develop renewable projects

Variable	Correlation
Municipal Characteristics	
Population (1000s)	0.42**
Municipal Type – City	0.41**
Municipal Type – Village	-0.20*
Municipal Type – Summer Village	-0.20*
Economy - Technology and innovation	0.31**
Interest in making capital investment (1=yes, 0=all else)	0.30**
Respondent Characteristics	
Importance of renewable energy	0.36**
State of renewable energy in Alberta	0.28**
Climate concern	0.33**
Perception of Renewable Value	
Opportunities - Cheaper than fossil fuels	0.30*
Econ Barriers - Operating costs	0.20*
Env/Tech Barriers – Renewable energy affects vistas	0.33**
Env/Tech Barriers - Grid cannot accommodate	-0.21*
Plan Barriers - Grants and loans too competitive	-0.27**
Plan Barriers - Province will not support	-0.20*
Plan Barriers - Other priorities	0.20*
Plan Barriers – Renewable energy is not a local matter	0.21*

Logistic Modelling of Predictors of Intention

To identify a comprehensive list of variables that are related to intention, I sought to develop a model that could include all the variables from Tables 10 and 11. However, the small number of cases and extensive number of variables challenged my ability to develop a statistically sound model without issues of overfitting. Thus, I choose to divide the variables into

those that identify who is interested in developing renewable projects and variables that explain why these decision-makers are interested in renewable development.

Respondents likely to express intention

Using the results of the correlation analysis and findings from the literature review, I then developed a binary logistic model that identifies significant relationships between the factors that are contributing to the intention to develop renewable projects. In the first model, I tested for relationships between municipal and respondent characteristics and intention. This model determines which kinds of municipal decision-makers are more likely to express intention to develop renewable projects. Considering the factors that were discussed as significant in the literature review as well as those that emerged as significant in the correlation analysis and through pretesting regression models, the following independent variables were selected as to be included in this analysis:

- Geography: Respondents were grouped into three categories; North (N=20); above 55°N (north of Edmonton), Central (N=56); above 51°N (north of Calgary) and below 55°N, and South (N=24); below 51°N.
- Councillor: Respondents were coded as either 1 if they were a member of a municipal council (N=42) or 0 if they were an employee of a municipality (N=58)
- Self-assessed knowledge – Solar: Considering solar was the renewable technology that respondents were most interested in, I included self-assessed knowledge of solar power production (N=66) to determine whether respondents that are familiar with renewable technology are more interested in pursuing development.
- Climate Change Concern: I asked respondents about how they believe climate change will affect their municipalities, ranging from significant to no impact.

- Population (1000s): Population was used as a scale measure of the size of the municipality. In Alberta, population is used to determine the type of municipality, allowing the measure to also reflect how urban a municipality is.
- Interest in Capital Development: Respondents were asked whether they believe their municipality would be willing to undertake a major capital investment. Positive responses were coded as 1 (N=49), whereas all other respondents were coded as 0 (N=51).
- Municipal Economy – Oil and Gas: Respondents were asked to identify significant economic sectors in their municipality. With increasing renewable adoption sometimes being labelled the "energy transition", I included the self-assessed presence of oil and gas industry (N=46) to test whether the communities that are supported by the fossil fuel industry are resistant to renewable energy development.

The model includes 97 cases and achieved a Nagelkerke R^2 value of 0.41. The rightmost column of Table 10 contains the Odds Ratio, a measure of association that describes how the likelihood of intention would change with a unit increase in the independent variable. For a binary independent variable, the Odds Ratio indicates how intention changes with the presence of this variable compared to without it.

Two variables emerged as significant in the model. Population has a positive relationship with intention; for every increase of 1,000 residents in the municipal population, the respondent is 6% more likely to express the intention to develop renewable project (Exp(B)=1.06), aligning with the strong correlation between cities and intention (Table 9). Respondents interested in capital development are almost three times as likely to express intention to develop renewable projects, an unsurprising relationship considering the steep initial investment required for

renewable development and demonstrating the importance of financial capacity for renewable development (Exp(B) = 2.98). The significance level of climate change concern is just above what can be considered significant from a statistical perspective but is still worth noting, especially since there is a significant correlation between climate change concern and intention.

Table 10: Binary regression model: Municipal and respondent characteristics and relationship with intention to develop renewable projects

	B	S.E.	Sig.	Exp(B)
Geography			0.13	
Geography (North)	-0.87	0.78	0.27	0.42
Geography (Central)	0.59	0.58	0.31	1.80
Council Member	0.34	0.55	0.54	1.40
Self-assessed renewable knowledge - Solar (PV)	0.49	0.54	0.36	1.64
Climate Change Concern	0.56	0.30	0.06	1.75
Population (1000s)	0.06	0.03	0.04	1.06
Interest in Capital Development	1.09	0.51	0.03	2.98
Municipal Economy - Significant oil and gas activity	-0.47	0.55	0.39	0.62
Constant	-3.19	1.22	0.01	0.04
N	97			
Nagelkerke R^2	0.41			

Factors contributing to perception of renewable value

In the next analysis, I tested the relationship between the ranking of opportunities and barriers and the intention to develop renewable projects. This analysis develops an understanding of why decision-makers are or are not interested in developing renewable projects. To cope with issues of overfitting, I developed several thematic scales combining variables measuring similar concepts. The variables that were included in a given scale are presented underneath that scale variables in Table 11. These variables were grouped according to the dimensions of change according to transition theory: niche opportunities, regime and landscape opportunities, niche

barriers, and regime and landscape barriers. The model included 93 cases and received a Nagelkerke R^2 score of 0.45.

In this model, two variables emerge as significant; respondents were less likely to express the intention to develop renewable projects if they felt renewable energy infrastructure affecting vistas was a substantial barrier to renewable development (Exp(B)=1.81). Though relatively few respondents considered this barrier one of the top three environmental/technical barriers (N=36), those that did appear to feel it is a dealbreaker issue, enough to significantly correlate with a lack of intention. The scale measuring external challenges from the regime level presented a negative relationship with the intention to develop renewable projects. Respondents who ranked these barriers as more impactful were more likely to be interested in renewable development. Explanations for these relationships are discussed in the following discussion section.

Table 11: Binary Regression Model 2: Predicting the factors influencing the perception of renewable energy value

Variables	B	S.E.	Sig.	Exp(B)
Niche Opportunities				
Opportunities Scale: Image Improvement	0.01	0.23	0.97	1.01
Opportunities: RE projects instill pride				
Opportunities: RE projects attract people and business				
Opportunities: There is community support for RE	0.01	0.27	0.96	1.01
Regime and Landscape Opportunities				
Opportunities Scale: Economic Performance	0.16	0.23	0.47	1.18
Opportunities: RE is/soon will be cheaper than fossil fuel				
Opportunities: RE provides economic diversification opportunities				
Opportunities: The presence of federal or provincial incentives	-0.37	0.27	0.18	0.69
Niche Barriers				
Economic Barrier Scale: Initial Cost	0.03	0.33	0.93	1.03
Economic Barriers: Planning costs are too high				
Economic Barriers: Capital costs are too high				
Economic Barriers: Operating costs are too high	0.31	0.40	0.44	1.36
Environmental/Technical Barriers: RE infrastructure diminishes vistas	0.60	0.21	0.01	1.81
Environmental/Technical Barriers Scale: Environmental Impact	0.22	0.19	0.24	1.24
Environmental/Technical Barriers: Noise and health concerns				
Environmental/Technical Barriers: Harm wildlife				
Environmental/Technical Barriers Scale: Risk	0.02	0.14	0.87	1.02
Environmental/Technical Barriers: RE technology not advanced enough to be feasible				
Environmental/Technical Barriers: RE projects are too risky				
Planning Barriers Scale: Limited Capacity	-0.08	0.24	0.75	0.93
Planning Barriers: Municipal staff lack the technical capacity to develop renewable projects				
Planning Barriers: The municipality has other priorities				
Planning Barriers: Have other ways to reduce carbon emissions	-0.30	0.29	0.30	0.74

Variables	B	S.E.	Sig.	Exp(B)
Planning Barriers: RE is not a municipal priority	-0.17	0.26	0.52	0.85
Planning Barriers Scale: Internal Opposition	-0.07	0.23	0.75	0.93
Planning Barriers: Community would oppose an RE project				
Planning Barriers: Council would oppose an RE project				
Regime and Landscape Barriers				
Economic Barrier Scale: Economic Value	-0.11	0.34	0.74	0.90
Economic Barriers: Electricity in Alberta is too cheap, so RE projects will not provide much value				
Economic Barriers: Payback period for RE projects are too long				
Environmental/Technical Barriers: Grid cannot support a municipal renewable electricity project	0.03	0.19	0.90	1.03
Planning Barriers Scale: External Challenges	-0.47	0.22	0.03	0.63
Planning Barriers: Grants and loans too difficult to access				
Planning Barriers: Province will not support municipal RE				
Constant	2.49	9.07	0.78	12.01
N	93			
Nagelkerke R^2	0.45			

Discussion

Using the theory of planned behaviour, findings were organised into the categories of attitude, subjective norms, and perceived behavioural controls. I then intersected these results with transition theory, allowing me to organise the findings into the dimensions of socio-technical transition; niches, regime, and landscape. Table 12 presents the findings of the survey categorised using a matrix of the two theoretical frameworks. Substantial themes that emerged in the analysis are discussed below.

Table 12: Survey findings of intention to develop renewable energy, organised by categories that intersect the theory of planned behaviour and transition theory

	Attitude	Subjective Norms	Perceived Behavioural Controls
Niche level factors	The perception of local economic value is the most important motivating factor, mostly from the belief renewable energy will lower costs	Most municipal decision-makers believe there is community support for renewable development	Municipalities are challenged by the steep initial cost of renewables and the long period until the project makes back its value
	Concern about the impact of renewable infrastructure on the view discourages development	Municipalities are not strongly motivated by other municipalities developing renewable projects	Municipalities have many responsibilities that are prioritised before renewable development
	Respondents choose technologies based on reliability and feasibility		Many respondents feel renewable technology is risky or not advanced enough
Regime level factors	Respondents are incentivised to develop renewable projects by provincial and federal supports	Respondents express concern about the province not supporting municipal renewable projects	Despite respondents being motivated by external grants and loans, many respondents feel these supports are too difficult to access
			While the current cheap electricity price diminishes the economic value of renewable projects, respondents expect the price to rise
			Some respondents believe the physical infrastructure of the grid is a challenge to renewable development
Landscape level factors	Municipalities are motivated to play a role in the global need for emissions reduction	Believing renewable development can foster an innovative image and attract new people and businesses	Intention is subject to changes in reliability and price of renewable technologies

The Importance of Economic Benefits

Aligning with the findings of Breen (2009), Krause (2013), and St. Denis and Parker (2010), the survey results reveal that the perception of economic value encourages renewable development. Respondents considered the ability of renewable projects to lower costs by offsetting the amount of energy that needs to be purchased as a significant motivation (Table 3). The correlation analysis demonstrates a significant positive relationship between respondents that considered renewable electricity to be cheaper or soon to be cheaper that fossil fuel energy and intention to develop renewable projects (Table 9). Reaffirming the importance of the perception of economic value, the two scenarios that were stated to have the greatest impact on increasing intention increased the economic value of a project; the price of renewable technology falls, reducing the initial cost of projects, and the price of electricity increase, which increases the value of offsetting energy purchased (Table 8). Scenarios that would increase the demand for electricity, both "Your municipality grows in population" and "Electric vehicles become more popular", were considered by several respondents likely increase their intention, as these changes also increase the value of having local generation to offset increased consumption. These influences are considered landscape level influences, as both immigration and electric vehicle feasibility, affordability, and cultural preference are all strongly influenced by factors beyond the Alberta energy system.

The perception of a positive reception to renewable projects was also considered a significant motivation for municipalities, consistent with the findings of Busch and McCormick (2014), Engelken et al. (2016), and Galluzzo (2005). Fostering an innovative image was one of the top three motivations for renewable development. However, while Hoffman and High-Pippert (2005) discuss the value of community energy projects as a way to build social capital

and foster civic pride, the rankings of the opportunities variables reveals that respondents mostly value image improvement for the economic benefits; believing renewable energy projects can attract new people and businesses, growing the municipal economy, was one of the highest ranked opportunities, while believing that renewable energy instils pride among the citizens was ranked the least important (Table 4).

Although lowering costs was the most significant motivation for renewable development, other economic benefits were less relevant to the sample of municipal decision-makers. Few respondents considered economic diversification created by renewable projects to be an important opportunity for renewable projects. The intent behind this question acknowledges that Albertan municipalities may be reliant on oil and gas revenue and economic activity, which is volatile to global price changes. While I suspected municipalities may be seeking other forms of revenue from alternative energy sources, this relationship does not appear in the data. Reaffirming this relationship, I also fail to see any significant correlation or relationship between the self-reported presence of the oil and gas industry in the municipal economy and the intention to develop renewable projects. However, this lack of relationship also challenges the hypothesis that oil and gas reliant communities are against renewable development due to economic reliance on or the culture of support for fossil fuel activities.

Renewable energy projects also have the potential to generate revenue through the sale of electricity or carbon credits, which several authors have found to be an additional economic motivation for communities (Engelken et al., 2019; Galluzzo, 2005; Walker, 2008). In this sample, respondents did not consider this as motivating as lowering costs (Table 3). This may suggest respondents are interested in developing small scale projects that are intended to offset local use rather than sell to the grid.

Concern about economic performance

While economic value was a strong contributor to intention, the cost of renewable energy projects is a substantial perceived behavioural control. The highest ranked economic barrier was the capital cost of renewable energy, a steep initial investment some communities may not have the resources to make. This relationship is reflected in the results of the correlation and regression analysis; respondents that stated they were interested in capital investment were significantly correlated with renewable intention (0.30**) and, in Model 1, these respondents almost 3 times more likely to express intention (Exp(B)=2.98). Reinforcing this finding, the scenarios that would increase municipal resources, municipal budget increasing and municipal debt decreasing, were among those considered most likely to increase intention (Table 8).

Associated with high capital costs, respondents also ranked long payback periods as a significant barrier. This barrier extends into the regime level, as the payback period is affected by the cheap price of electricity in Alberta. Long payback periods also pose a political barrier, as long-term investment may be undervalued by elected officials who may be more willing to support projects that return value within an election cycle. Compared to steep initial costs, operational and planning costs were considered less of a barrier.

While long payback periods were one of the highest ranked barriers to renewable development (Table 5), it also suggests opportunity in the near future. Sixty-six respondents stated the price of electricity rising would greatly or somewhat increase their intention to develop renewable projects, while only 6 respondents believed it would not have any effect on intention. Almost all respondents believed that price of electricity would rise in the next 25 years, with the most cited reasons being increased demand and increased carbon pricing. The correlation analysis demonstrates that respondents who feel renewable energy is or is soon to be cheaper

than fossil fuel sourced energy are more likely to express intention to develop renewable projects. As respondents increasingly believe that high electricity prices, particularly on carbon intensive generation, are increasing the economic value of renewable energy, municipalities are likely to be motivated to pursue development.

Limited Resources and Many Responsibilities

One of the most significant barriers to renewable development among the sample is dedicating limited resources to renewable energy over other priorities. The highest ranked political barrier was the statement "My municipality has other priorities than renewable electricity generation". A quarter of respondents stated that renewable energy not being a municipal responsibility was one of the top three barriers to renewable development. The challenge of investing in renewables with pressing local issues aligns with the findings of Schoenberger (2013), who discusses how the perception of climate change as an unknown distant threat often means more immediate and visible issues take priority in the municipal agenda.

External Support is Critical but Considered Lacking

The most cited reason for intent to develop renewable projects is to capitalise on federal or provincial supports. Additionally, the presence of federal and provincial incentives was the highest ranked opportunity. Intersecting with the previous theme of economic value, these supports often provide financial resources to address the barriers of high cost. In Alberta, institutions like the MCCAC have been successful in supporting renewable projects in municipalities. For many municipalities, securing funding from provincial and national sources is often critical for major projects, as these resources form a substantial portion of the municipal

budget. Supports can also come in the form of knowledge and expertise, potentially resolving the concerns of a lack of technical capacity (Table 7).

However, many respondents feel like these supports are too difficult to access. Believing provincial grants and loans are too competitive or unstable was the second highest ranked planning and political barrier, just above the barrier of the province not supporting a municipal renewable project. These variables are considered a regime level factor, as the provincial government regulates and supports the existing energy system. However, the province providing any form of support for these innovation projects challenges the theorised speculation that regime actors oppose innovative projects. The actions of the regime enablers can be seen as a response to landscape level pressure, as the demand for climate action may force the regime to pursue initiatives to introduce more renewable energy through local and utility-scale projects. While the province is supporting community projects, the Alberta energy system is continuing to introduce large scale natural gas and renewable projects, maintaining the characteristics of the dominant energy system, although with reduced emissions.

While the inaccessibility of external supports was ranked a substantial barrier to development, an interesting relationship emerges in the correlation and regression analysis. The ranking of the grants and loans variable was weakly and negatively correlated with intention to develop renewable projects, meaning that ranking this barrier as significant is correlated with the intention to develop renewable projects. In Model 2 (pg. 41), this variable was combined with the ranking of lack of support from the province to form the planning barrier scale for external opposition. This scale demonstrates a negative relationship between these barriers and intention; as respondents consider these barriers more impactful, they are actually more likely to be interested in renewable development. Because barriers were ranked against each other, this

surprising relationship could indicate that the perception of internal barriers is more impactful on intention; respondents that feel internal barriers are greater to external challenges are less likely to express the intention to pursue renewable development.

Municipal Decision-Makers Seek Reliability

While lowering costs was ranked as the highest motivation for municipalities, when it comes to choosing renewable technologies to invest in, reliability is the most valued characteristic for municipal-decision makers. Almost every respondent interested in renewable development is interested in solar development, with the most cited reason being the reliability and proven performance of solar projects. Reliability was also highly cited as a reason for support in biomass and geothermal projects, the other technologies that received significant interest among the sample. However, contrasting the importance of economic benefits as a motivation, respondents stated they were less interested in choosing technologies based on economic reasons, with the highest expected return on investment and cheap installation costs being among the least cited reasons to choose certain technologies. Instead, across the three most preferred technologies, along with reliability, respondents are more interested projects due to natural feasibility and expected greater public acceptance (Table 2). These responses suggest the sample decision-makers tend to be risk averse when choosing renewable technologies, favouring proven technologies, mitigating public concern, and projects that capitalise on adjacent resources over projects that can generate the most revenue.

When asked about the environmental/technical barriers to renewable development, over half of respondents considered renewable projects being too risky and not advanced or feasible for the municipality as one of the top three barriers. The ranking of these barriers, paired with the importance of reliability when choosing renewable technologies, demonstrate the risk-aversion

of decision-makers. Municipal decision-makers are under scrutiny for use of public dollars and seek reliability on renewable investments. However, transition theory suggests that knowledge sharing and the increased visibility of success stories can abate concerns about reliability, causing innovative projects to build momentum and diffuse. The aversion to renewable projects due to perceived lack of reliability may indicate early stages of transition and may diminish as more successful projects prove the value and effectiveness of renewable projects.

The Importance of Environmental Performance

Reducing the municipal carbon footprint was ranked the fourth most important motivation for renewable projects (Table 3, pg. 27), behind the economic motivations of capitalising on grants and supports, lowering costs, and being perceived as innovative. However, reaching a specific carbon reduction target was considered less important than the general motivation of lowering carbon emissions, suggesting that either municipalities do not have set carbon reduction targets or are not motivated to pursue renewable development to meet that target. The importance of the carbon reduction benefit is demonstrated in the correlation analysis. Respondents that express more concern about climate change impacting their municipality are moderately correlated with the intention to develop renewable projects (-0.33**, Table 9, pg. 36). While economic value was considered a more important motivation than climate action, the benefit of carbon reduction is still clearly considered an important reason to support renewable development. Emissions reduction is a landscape level feature, motivated in response to the global phenomenon of climate change.

However, seeing increased impacts of climate change were the scenarios least perceived to impact intention. This may suggest respondents consider renewable projects more of a climate mitigation measure to limit the consequences of climate change, rather than an adaptation

measure, protecting the municipality from the impacts of climate change. Supporting this perspective are the low rating of the motivation of energy self-reliance. While Breen (2009) discusses resilience to grid failures and natural disasters as a key motivation for community energy, this did not appear to be one of the stronger motivations among the sample. The importance of provincial and national carbon reduction targets is indicative of one of the most substantial challenges of climate action; individual municipalities may feel they have limited voice and effort in the global coordinated effort to reduce carbon emissions. Aligning with the efforts of other orders of government helps municipalities be ensured they are working alongside and on pace with other entities, speaking to the importance of coordination and leadership at the provincial and federal levels.

While renewable energy is often lauded as environmentally beneficial as a carbon reduction measure, it can also receive critique over local environmental impacts, including harm to local wildlife, especially avian mortality, and threats to nearby populations. However, these concerns appear less salient with the municipal decision-makers in the sample; concerns about renewable projects harming wildlife and creating noise and health disturbances were the lowest ranked environmental/technical barriers to renewable development (Table 6). This lack of concern may be because of the technologies the decision-makers are interested in. Small-scale solar, biomass, and geothermal projects may be considered to have a minimal impact on the environment, compared to large-scale wind and hydroelectricity.

Concern about Visual Impact Discourages Intention

The fourth highest ranked environmental/technical barrier for renewable development was concern that renewable energy would diminish natural vistas (Table 6). Both the correlation and regression analysis demonstrated a significant relationship between this variable and the

intention to develop renewable projects, where respondents who considered visual impacts a substantial barrier were less likely to express the intention to develop renewable projects. While relatively few respondents ranked visual impacts among the top three barriers to development, those that did found it enough of a detriment to sway them from renewable development. Municipalities may therefore be more willing to pursue smaller scale and less visually intrusive technologies, like rooftop solar and biomass generators.

The Importance of Community Support

Community support is a key pillar of community energy development, minimising the social barriers to renewable development. Wolf et al. (2013) discuss the challenge of municipal decision-makers being motivated to inaction by the values of their community; if the community is not supportive of renewable development, municipalities are unlikely to pursue development. Hamin et al. (2014) and Klein & Coffey (2016) find that climate change denial is a challenge to renewable development. In our sample, respondents also feel community support is key to municipal renewable development, as it is one of the most cited reasons for renewable technology preferences. However, respondents highly ranked the presence of significant community support as an opportunity and community opposition was not highly ranked as a barrier by many respondents (Tables 4 and 7). These results suggest that many municipal decision-makers believe they can design projects to mitigate opposition and build community support in their municipalities, which may pose a political incentive to develop renewable projects (Krause, 2013). This perception also speaks to the value of community energy as an opportunity to address the social and political barriers to renewable development.

Theoretical considerations

This paper applies a novel theoretical framework to municipal renewable development, using the theory of planned behaviour to understand intention to develop projects while situating these factors within the dimensions of socio-technical change described in transition theory. As Engelken et al. (2016) describe in their work, the theory of planned behaviour was used create a conceptualisation of the factors that are influencing decision-making, although the findings demonstrate that many themes extend and connect across boundaries, as opposed to clean and distinct realms. While the theory of planned behaviour can conceptualise the decision-making of individual actors, municipal decisions are the action of many stakeholders interacting with each other. Thus, the theory of planned behaviour is limited in its ability to predict the collective actions of an entity as complex as a municipality.

Transition theory suggests municipal renewable projects are in early stages of transition, with municipalities still evaluating renewable projects and some early adopters pursuing projects. The theory predicts that, as more projects are developed, knowledge is shared and other municipalities become inspired, picking up momentum and diffusing rapidly. However, transition theory predicts that the regime actors will oppose innovations for fear of being replaced as dominant actors. Yet, in the findings, niche municipalities actually rely on resources and supports from the regime, which incentivise existing and potential projects. These efforts may be due to pressure by a landscape level factor, international demand for climate action, however, more research is required to understand why the regime enabler encourages innovative projects. This survey also does not explore the role of private owners and developers of existing energy generators in Alberta in challenging or enabling municipal energy projects. A review of interactions between conventional energy owners, the provincial regulators and policy-makers,

and municipalities can further explore the value of transition theory to explain and predict the dynamics of municipal energy projects.

This research seeks to situate municipal projects within community energy literature. However, this connection may be challenged by the finding that economic value is the most motivation for municipal decision-makers. By centring the motivation of revenue, municipal corporations are in danger of having the same failings as private corporations, choosing economic goals over respecting community values and goals. While the benefits returning to the municipality meet the definition of distributive justice, municipal projects also need to meaningfully engage constituents in design and development. This survey did not ask about how communities can be engaged in development, instead assuming that citizenry will be deliberately engaged in design or will have a voice in public hearings. In the following chapter, I delve more deeply into how justice can and is demonstrated in municipal projects through a case study of renewable development in Edmonton.

Limitations

This study does contain several limitations to the effectiveness to the accuracy, reliability, and generalisation of the results. Because recipients were able to choose to participate, there is a selection bias that prevents the results from being generalizable to the target population. Because the survey was titled and presented as a renewable energy development survey, it may have attracted individuals passionate about renewable development instead of a more representative and broad perspective. The decision to target municipalities that have developed renewable projects, done through sending targeted emails to the municipalities listed in the MCCAC project database, was considered necessary to understand why they chose to pursue development, but also may have resulted in a sample that displays intention more than the target population, as

there is a correlation between having an existing project and the intention to pursue further development. Some of the weaknesses of this survey are a necessity of the methods used and complexity of the sample. These limitations can be mitigated through additional quantitative and qualitative work that builds on the findings.

Conclusion

The findings of the study identify the variables that contribute to the intention for municipal decision-makers to develop renewable projects. Model 1 shows that respondents who stated they were interested in capital development were more likely to express intention, demonstrating the importance of capital resources for renewable development. I also see that intention is related to population, where larger and more urban municipalities are more likely to express intention to develop renewable projects. There are several possible explanations for this relationship; larger municipalities have a larger tax base that may provide more capital resources for development, although this is balanced with additional responsibilities. Urban municipal residents may have a constituency more likely to express climate change concern, as I see a weak but significant correlation between respondent climate concern and the urbanism scale. Urban municipalities were also strongly correlated with self-reporting a significant technology and innovation sector, perhaps indicative of a perception of internal capacity and resources, similar to the findings of Busch and McCormick (2014).

I also seek to understand what factors influence municipal development. Within the attitude dimension, municipal decision-makers are most incentivised by the perception of economic value, emerging mostly from lowering costs and attracting new people and businesses. Climate change concern was also a significant motivation, but less so than economic benefits. However, when choosing renewable projects to pursue, decision-makers are more likely to

choose based on mitigating risk than maximising returns. Model 2 demonstrates that, while few respondents expressed concern about visual impacts of renewable projects, those that did were less likely to express interest in renewable projects.

Within the subjective norms dimension, respondents do not perceive challenges from community opposition to renewable projects. However, decision-makers also see the importance in choosing technologies that are well received by the public. These findings together suggest municipal decision-makers feel they can create projects that are well-received by the community, demonstrating the value of community energy as a tool to develop renewable projects in Alberta.

Several respondents stated they would be more likely to develop renewable projects if there were approaching provincial or national emissions reduction targets, perhaps to ensure local efforts are in collaboration with other entities in Alberta and across Canada. However, belief that the province would not support a municipal energy project was the ranked the third most important planning barrier. This lack of support from the province that regulates the energy system in Alberta may discourage municipalities from developing renewable projects, especially when considering the importance of external supports.

Among the perceived behavioural controls, high capital costs, long payback periods, and other municipal priorities are economic barriers to renewable development. Coupled with these challenges, many respondents felt external supports and grants were too difficult to access. This regime level barrier poses a substantial challenge, as capitalising on external supports and funding was one of the highest rated motivations and opportunities for development. However, while the lack of external support might be assumed to dissuade renewable intention, Model 2 challenges this perception. The more significant respondents consider external planning barriers, the more likely they were to express interest in renewable development. Based on the correlation

analysis, the higher respondents ranked barriers at the niche level, the less likely they were express intent to develop renewable projects. On the other hand, respondents that were interested in renewable projects were correlated with high rankings of external barriers. This may suggest that internal capacity and motivation forms intention over external motivations. Another possible interpretation is that only motivated decision-makers have investigated accessing external supports, while unmotivated decision-makers are unaware of the process and challenges of accessing these resources. These results suggest that addressing and minimising internal barriers are the crucial ways to develop intention in municipalities. Detracting from intention, respondents noted challenges from developing renewable projects with limited resources and many responsibilities, which often are considered higher priority than renewable projects. This suggests the value of external support earmarked for renewable development, which addresses issues of limited resources while prioritising renewable generation. The survey also shows that higher electricity prices can incent development, suggesting an important role for carbon pricing to encourage municipal energy projects. High concern about the risk of renewable technologies again emphasises the importance of the perception of reliability. Also at the regime level, respondents expressed concern about integrating municipal energy projects with the energy grid, developed around centralised power production instead of distributed generation.

This paper presents a conceptualisation of the motivations, opportunities, and barriers that influence the intention to develop municipal renewable projects in Alberta. In order to garner greater interest in renewable development, proponents should focus on communicating economic value and climate action importance, while highlighting the reliability and feasibility of renewable technology. External programs should seek to address high capital costs and earmark funding for renewable projects, as municipalities may have other priorities for their capital

budget. While this quantitative analysis provides a general understanding of the primary decision-making factors of municipal actors from a variety of municipalities across the province, in the following chapter, I seek to build on these findings with an in-depth case study of renewable decision-making in Edmonton, Alberta.

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CHAPTER 3: A CASE STUDY OF RENEWABLE ENERGY PROJECTS AND POLICIES IN THE CITY OF EDMONTON

Located in heart of Alberta, Edmonton, the capital city of the province, is situated in a unique socio-technical energy landscape. While the significant oil and gas industry has created a culture of support for fossil fuel extraction in Alberta, the city of Edmonton's municipal government is pursuing an ambitious energy transition strategy, with actions to reduce energy demand, use energy more efficiently, and support renewable development. While Edmonton is a carbon intensive city (Riebe, 2019), the municipal government has made commitments to carbon reduction in line with limiting global warming to 1.5°C globally and is undertaking substantial efforts to reduce energy demand, use energy more efficiently, and support renewable development. The city has developed a variety of renewable energy projects and has recently updated their Community Energy Transition Strategy to guide actions in the near future, though these efforts have not been without challenge. This case study builds on the findings of the survey, developing an in-depth understanding of what factors are motivating the city, a municipality on the forefront of renewable energy development, to pursue renewable energy projects and how these considerations are reflected in the projects being developed.

The City of Edmonton Context

Edmonton's population in the latest census (2016) was 932,546, second in the province and sixth in the county (Statistics Canada, 2017). Relative to other municipalities in Canada, Edmonton is a carbon intensive city. A city of Edmonton report from 2019 states Edmonton emits 20 tonnes of carbon dioxide per person each year, significantly higher than the city of Vancouver, which emits 3 tonnes of carbon dioxide per person per year (Riebe, 2019). The report attributes Edmonton's carbon intensity to a variety of causes, including a colder climate,

industrial emissions, and fewer people that walk, bike, or take transit (Riebe, 2019). Acknowledging the need for carbon emissions reduction, in 2018, the municipal government signed the Edmonton Declaration, a commitment to target emissions reduction required to limit average global warming to 1.5°C. To meet these targets, the city is employing several carbon reduction efforts, including renewable energy development. Two select projects are discussed below:

Blatchford

The city of Edmonton is taking on a developer role to create a carbon-neutral neighbourhood built around sustainability principles, on former municipal airport lands, referred to as Blatchford. Several energy efforts are included as part of the Blatchford redevelopment, including a neighbourhood district energy heating system that uses solar, geothermal, and other sustainable sources (Blatchford Renewable Energy, n.d.a). The city has created and owns Blatchford Renewable Utility, a utility corporation that operates in the neighbourhood (Blatchford Renewable Utility, n.d.b). Blatchford's Energy Centre One houses the district energy system for the neighbourhood and is powered by rooftop solar photovoltaics (PV) (Blatchford Renewable Energy, n.d.a).

E.L. Smith Solar Farm

Another renewable project that is discussed by interview participants is the E.L. Smith Solar Farm, a 12 MW project adjacent to the E.L Smith Water Treatment Facility (EPCOR, n.d.). The 51 acre solar farm offsets the power consumed by the treatment plant, while a battery electricity system can store excess power (EPCOR, n.d.). The E.L. Smith solar farm is owned by EPCOR, an arms length utility solely owned by the city of Edmonton. While the city council approved the rezoning to allow the project to continue, the E.L. Smith Solar Farm did receive

critique and oppose over concerns about impacts to the local ecosystem and recreation, as the project is located in the North Saskatchewan River Valley, a urban park system in Edmonton.

To reduce their emissions consistent with their climate action targets, the city needs to take a proactive approach to renewable development, integrating energy projects into the planning framework guiding sustainable development. However, the Blatchford and E.L. Smith Solar Farm projects demonstrate that, while municipal energy efforts may be aspirational, they face substantial challenges, both internally from community concern, knowledge limitations, and financial constraints, and externally, from regulatory barriers and resistance from incumbent energy actors. In this case study, I again employ the theory of planned behaviour and transition theory to conceptualise and understand the perception of motivations, opportunities, and barriers to renewable development in Edmonton, developing a better understanding of how renewable projects emerge and can be best supported.

The city of Edmonton was chosen for the case study as an exemplary example of a municipality pursuing renewable projects in a variety of projects and formats. To understand what determines municipal renewable development, I seek to understand the decision-making in a municipality on the forefront of renewable energy development in Alberta.

Methods

Case Study Methodology

Case studies are a frequently used tool in qualitative research studies (Noor, 2008; Yazan, 2015). While case studies are sometimes critiqued due to a lack of scientific rigor and lack of generalisability, Noor (2008) demonstrates the value of case studies as a tool to understand complex real-life activities in greater depth. Yin (2002) defines a case as a “contemporary phenomenon within its real life context, especially when the boundaries between a phenomenon

and context are not clear and the researcher has little control over the phenomenon and context", while Stake (1998) defines a case study as a "study of the particularity and complexity of a single case, coming to understand its activity within important circumstances". As seen in the quantitative chapter, the context of a municipality is a critical to the presence of the intention to develop renewable projects. Case studies can answer how or why questions about a phenomenon, such as: why is the city of Edmonton developing renewable projects (Yazan, 2015; Yin, 2002). The use of a case study allows for a more in-depth analysis of the complex decision-making informing municipal energy projects as a multi-perspectival analysis, where researchers consider not just the voice and perspective of the actors but also the vies of groups of actors and their interactions (Tellis, 1997). The development of my case study methodology follows the process described by Merriam (1998), where a literature review informed the construction of a theoretical framework and development of research questions. Stake (1995) and Merriam (1998) identify three sources of data in qualitative case study research, of which I utilise two: document review and interviews. The use of two data sources allows for triangulation, maximising the validity of the inquiry (Yin, 2002).

A substantial point of division in case study methodological literature are views on data validation and reliability. Yin's guidelines for case study research highlights the importance of validity and reliability and recommends researchers incorporate these considerations into study design (Yazan, 2015). This approach reflects a positivist approach, where research methods attempt to capture an accurate knowledge of the case (Yazan, 2015). Stake (1995) and Merriam (1998), in contrast, discuss the inability to apply concepts of reliability and validity into case study design, as, under a constructivist epistemology, there are multiple versions of knowledge, as knowledge is constructed in the intersection of the "knower" and the "known" (Yazan, 2015).

I align this research with constructivist epistemology and thus employ data validation tools discussed by Stake (1995) and Merriam (1998); data source triangulation, through the use of both interviews and document analysis; theoretical triangulation, through the use of both the theory of planned behaviour and transition theory to explain the phenomenon of municipal energy projects; and disclosure of my own position in the positionality statement (pg.16)(Yazan, 2015).

Research Approach

To understand the decision-making behind the municipal renewable energy programs, I employ a document analysis of the energy transition plans and policies produced by the city of Edmonton. I build on this analysis with semi-structured interviews with municipal decision-makers and energy industry experts held from September 2020 to April 2021. This approach allows me to not only analyse the approved roles for renewable development by the city but also develop an in-depth assessment of the motivations, opportunities, and challenges perceived by the individuals that developed, administered, and approved the strategy, as well as understand the actions the city considered but chose not to pursue.

The document analysis was done by searching for plans and policies on the city of Edmonton's website under the Energy Transition Strategy page. Several documents were reviewed, with five being considered for detailed analysis, described in *Table 13: Plans and policies included in document analysis*. These documents were coded using an analysis guide developed considering the theoretical frameworks described above.

Table 13: Plans and policies included in document analysis

Document	Year Published	Purpose
Edmonton's Community Energy Transition Strategy & Action Plan 2021 (CETS 2021)	2021	This document is an update to the former community energy transition strategy and action plan, as per the requirement to review and update the plan every 5 years. This document is intended to be the path forward for a low carbon city and is the city's climate change mitigation plan.
Energy Transition Strategy (CETS 2015)	2015	The Community Energy Transition Strategy is a risk management strategy designed to make Edmonton an energy sustainable city. The document contains a diagnosis of energy and climate challenges and opportunities and twelve strategic courses of action
Community Energy Transition Strategy 2019 Implementation Progress Report (CETSU 2019)	2020	This report details implementation progress on the community energy transition strategy in 2019
Community Energy Transition Strategy 2018 Update (CETSU 2018)	2019	This report details implementation progress on the community energy transition strategy in 2018
Greenhouse Gas Management Plan 2019-2030 Civic Operations (GHGMP)	2019	This document creates a strategy and action plan to reduce the GHG emissions of the city's operations

The document analysis is supplemented with semi-structured interviews with relevant decision-makers at the city of Edmonton municipal government. Interview participants were purposively sampled through a professional connection with an employee at the city of Edmonton, who reached out to me after hearing about my research. I delivered a presentation to the Edmonton's Environmental Strategies Team, introducing this study and preliminary findings, and invited individuals who were working on the energy transition strategy to participate in an interview. At the end of each interview, I asked the participant for recommendations about other individuals to reach out to, snowballing sampling from this initial participant list. I also asked

each participant if they could recommend a potential participant with an opposing viewpoint to their own, included to avoid concerns about only gathering perspectives from individuals that shared similar perspectives. I also reached out to every current member of council using contact information from Edmonton's website.

Several respondents recommended speaking to individuals who are not part municipal decision-makers. I thus expanded my scope to include energy experts who can provide insight and expertise on the issue of municipal renewable energy development. I reached out to the Alberta Urban Municipalities Association (AUMA), the Rural Municipalities Association (RMA), and the Municipal Climate Change Action Centre (MCCAC) using contacts in an earlier study. I reached out to organisations and individuals that researched or advocated for community or municipal energy development, including participants recommended through snowball sampling and others I was familiar with from their work. The participants from municipal associations and those engaged in energy development efforts are collectively referred to as energy experts in this study. Again, I asked each participant for recommendations for other possible interviewees, including those who may have a differing perspective on municipal energy.

The participants included in this study are described in *Table 14: Interview participants*. Certain roles and organisations are left ambiguous for the purposes of maintaining the anonymity of participants. Participants 15 and 16 were interviewed together, as were participants 17 and 18. All interviews were approximately an hour long and guided by an interview guide included in Appendix E: Interview Guide.

Table 14: Interview participants

Participant	Organisation	Role
1	City of Edmonton	Environmental Strategies Team
2	City of Edmonton	Environmental Strategies Team
3	City of Edmonton	Environmental Strategies Team
4	City of Edmonton	Environmental Strategies Team
5	City of Edmonton	Environmental Strategies Team
6	City of Edmonton	Environmental Strategies Team
7	City of Edmonton	Environmental Strategies Team
8	City of Edmonton	Council Member
9	City of Edmonton	Blatchford Team
10	City of Edmonton	Energy Transition and Climate Resilience Committee Member
11	City of Edmonton	Council Member
12	Green Energy Futures	Energy Transition Expert
13	Alberta Urban Municipalities Association	Municipal Energy Expert
14	Municipal Climate Change Action Centre	Municipal Energy Expert
15	Community Energy Organisation	Community Energy Expert
16	Community Energy Organisation	Community Energy Expert
17	EPCOR	E.L. Smith Solar Farm Project Team
18	EPCOR	EPCOR Operations

The interviews were transcribed and anonymized according to the preferences of the participant. The transcriptions were sent to the participant to allow them to review their statements and the identifying information that will be removed, as well as provide the participant the ability to revise, clarify, or redact information from the transcript. The anonymized transcriptions were analysed using a guide created considering the theoretical frameworks employed and informed by both themes discovered in the document analysis and those that emerged in through coding the interviews. Interviews were ceased once no new names emerged from snowball sampling.

Findings

The documents and interview data provide insight into the decision-making influences that inform the city's direction. This data is analysed below, structured using the dimensions of the theory of planned behaviour; intention, the willingness to pursue renewable development; attitudes, the perception of benefits and negatives that would emerge from renewable development; and, perceived behavioural controls; the perception of barriers that would challenge the city's efforts.

Intention to Develop Renewable Projects

Across both the documents reviewed and the interview participants, the city of Edmonton demonstrates a clear intention to pursue energy transition efforts. The latest update to the Community Energy Transition Strategy (CETS 2021) introduces four pathways of the energy transition with the goal of reaching a GHG reduction of 50% below 2005 emissions. The first of these pathways is referred to as *Renewable and Resilient Energy Transition*. Among the goals of this pathway are having Edmonton be supplied by carbon neutral energy by 2040, with 10% of electricity used being produced locally by 2030. Several actions are described as part of this effort, including "increasing local renewable installations and decarbonising of the grid" (City of Edmonton, 2021, pg. 17).

Acting in an ownership/developer role, the CETS 2021 sets the directive to install solar PV on 12 buildings in 2021 on select properties (City of Edmonton, 2021). The GHGMP describes microgeneration solar PV projects that have been installed in the past 4 years (City of Edmonton, 2019b) expanding on the directive given in the CETS 2015 to study the feasibility of installing renewable technology on city infrastructure over 2015, 2016, and 2017 (City of Edmonton, 2015).

In the CETS 2021, the action “The City leads by example by installing renewable energy systems on municipal buildings as outlined in an updated Civic Operations GHG Management Plan” is considered *high impact*, meaning it replaces carbon intensive energy and is scalable, and has *moderate funding requirements ($1,000,000 - $20,000,000)*. Federal/provincial funding is considered *desired* to scale and accelerate this action but is not considered needed (City of Edmonton, 2021).

The documents reviewed focused on solar PV as the technology best suited for municipal development. In the GHGMP, local solar installations are divided into two categories: small scale, with the example of a 20 kW system on a fire hall given, and; large scale, with the example given of a 650 kW system on a bus garage (City of Edmonton, 2019b). Several participants (N=6) also highlighted solar PV as the best option for local projects. P9 touts solar as a technology that has been proven over decades, lessening the perception of risk. Five participants discussed the potential of solar as Edmonton receives significant amounts of sunlight, while P3 and P10 also discussed the opportunity from abundant space for solar PV installations. P3 shared the following quote:

> *“I definitely see that there's a lot of opportunity for the city to be a generator, effectively, of electricity in the renewable field, at least in the solar area, given that we have so much rooftop potential”*

P3 and P9 also described district energy systems as “a great way to integrate renewables, especially into new buildings or new developments” (P9). The precedent for integrating renewable technologies with district energy projects is demonstrated in the Blatchford Project, where the city has taken an ownership role by establishing a municipal corporation to act as a utility for the neighbourhood.

The renewable projects the city has developed and has planned in the documents reviewed fall into the category of microgeneration, defined as renewable projects intended to offset electricity consumption at the location of the project. These projects have a capacity limit equivalent to local consumption, to a maximum of 5 MW. P2 expressed the city's further intention to support microgeneration projects with the statement "we have a goal to put solar systems in most of our buildings so they can generate their own energy". P1 discussed enabling microgeneration on new municipal properties with a city policy that mandates 1% of capital costs be used to develop on-site renewable energy projects to offset the consumption on the property. In order to reach the emissions reduction target set in the CETS 2021, the accelerated microgeneration solar PV program would introduce a total of 20 MW of solar generation on city properties (City of Edmonton, 2020a).

Community Generation Role

While the documents reviewed and participants interviewed agreed that the city should be developing microgeneration projects, developing energy projects for other consumers was a more contentious role discussed by some participants. Energy experts P13 and P14 saw potential for municipalities to play a role in larger scale energy projects. P13 stated:

> *So to me, behind the meter small scale that's already enabled, I don't think there's any restrictions there. And to me, the most valuable piece is getting the efficiencies once you get into more utility scale or small scale utility ranges. So as we get into the five to 25 MW or 25 to 100 MW. That's where I think there's really untapped potential. And I do think there's value for municipalities to get into that space. Incumbent generators are not there.*

P14 discussed the potential for a community generation role for municipalities but did describe it as “a fairly new and unknown space”. P1 also saw community generation as a potential opportunity for the city, stating:

> *Maybe what we have to be doing is putting the solar on our roof to support the community around us in a community generation model rather than just supplying our buildings. So as I was saying, like, we're working within the existing models, we're trying just to do microgen[eration] for the most part for our civic operations, I suspect to meet our climate goals, we're going to have to look at community generation. And we already do look at it in some aspects for our bigger projects, right? Like for Blatchford, and things like that, like that's a totally different ballgame where the city of Edmonton is a utility provider.”*

However, P8, a member of council, believed the city should not take an ownership role, citing concerns about the expertise of the city in this area and the lack of a proven business model to sustain development. These challenges are discussed further below as perceived behavioural controls.

> *I don't think the city of Edmonton should necessarily be the ones who own [renewable generation], in part, because I don't think we have the expertise. We have some phenomenal people in the city of Edmonton and people who I think could handle that. But it's better to look at a group like EPCOR, which is I mean, technically part of the city, but not, right? So I'd rather look at entities like that, that have that expertise and talent on staff and have shown a track record related to those type of things. And truly have, I think, the business model, and foundation meant to help that advance into the future. So I would be concerned*

> *if we were doing it ourselves, even if we were tapping into that expertise but trying to maintain ownership on the city perspective. So I'd rather look for those partners, P3 [public-private partnerships] or not, look for the regulatory changes that we need to make to make it easy to do things. That's my gut reaction, I think, well, it's not even my gut reaction, it has been what I've been thinking about for some time. Now, as we've looked at things, I think it's truly better to use our experts, and set clear goals and targets as a city to say "Here's what we need to accomplish. Now, let's find the partners to help us get there."*

P9 also agreed that the municipal administration lacks expertise in energy development, saying "[renewable energy is] part of our business, but it's not our core business". When discussing the Blatchford project, P9 believes the city should not own the utility in perpetuity but needed to take an ownership role at the start of the project to pilot the concept and demonstrate its potential. P12 agreed that the city is not the most efficient entity to run a project like Blatchford but stated municipal ownership was likely a necessity for the project to begin. Citing co-owned district energy projects in Vancouver as a replicable model, P9 believed that a public-private ownership model is a possible future for the Blatchford utility.

P3 and P6 also believed there are opportunities for a public-private partnerships for renewable, with P6 stating that partnerships can resolve issues of a lack of funding. P6 agreed with P8 that the city should look to partner with entities that already know how to set up large scale energy production to resolve expertise limitations at the city. P13 believes that incumbent generators are interested in innovation and may be willing to partner with municipalities in the near future. P14 discussed a solar project being pursued in Innisfail has a community benefit agreement (CBA) with the municipality. While the municipality does not have an ownership

stake in the project, the CBA confers benefits to the local government and community. P14 believes that partnerships enabled by community benefit agreements “will continue to be common until there's, I think, an easier path for municipalities to be involved in direct ownership”.

Some participants (N=4) discussed potential for EPCOR, a city-owned entity, to take on a generator role, adding to the energy retailer business EPCOR operates. However, participants representing EPCOR, P17 and P18, explained that EPCOR is not in the generation business and do not anticipate generation becoming a main part of their operations. They went on to add that EPCOR was a niche opportunity to develop renewable energy to enhance and support the adjacent water treatment plan.

Because the community generation role is not detailed in approved plans and policies, the intention to pursue a community generation role is not present, suggesting the perception of barriers overshadows the expected benefits.

The Importance of Council Leadership

Energy experts P13, P15, and P16 discuss the importance of a “visionary champion” (P13) to push energy transition efforts, while administration needs to be able to sustain and execute the projects. P14 discussed experiences they have had where a proposed renewable project was halted by a resistant council. In Edmonton, many participants (N=5) feel they have strong and consistent leadership and support from council to pursue renewable energy solutions. P9 discussed the importance of consistent support across multiple councils for the Blatchford project, which underwent significant public scrutiny. Four of the participants from the city describe the importance of council prioritising energy transition to get support from other parts of the municipal administration. P5 made the following statement to that effect: “I usually

preface anything that I need with council approved the greenhouse gas management plan. So (laughing), get on the bus or under the bus".

Attitudes

Environmental Benefits

Inspiring all the actions of Edmonton's energy transition is the goal of emissions reduction. Several of the documents reviewed open by discussing the risks of a changing climate and the need for climate resilience, with the CETS 2021 describing threats from more extreme weather events, adverse health effects, and loss of productivity and services (City of Edmonton, 2021). All participants (N=16) felt the city of Edmonton has a responsibility to reduce their carbon emissions. Because the city's GHG accounting includes emissions produced by the carbon intense grid that power city operations, offsetting this energy with local power was considered an opportunity to reduce emissions produced by city. Six participants believed that renewable energy is necessary to meet the city's carbon reduction goals set in the Edmonton Declaration. P10 also discusses the failure to address climate change now will exacerbate impacts in the future, exemplifying this threat with the statement:

> *just look at the number of forest fires in the last five years. Look at the amount of flooding we've seen all over the province. We are dealing with the climate impacts already. They're just going to get more and more compounded and worse if we don't start to mitigate it*

Quantifying this risk as an economic impact, the CETS 2021 predicts climate change will result in a loss of $3.2 billion annually to Edmonton's GDP by 2050 (City of Edmonton, 2021). The GHGMP introduces the concept of social cost of carbon, an economic value of emissions reduction that accounts for costs of climate change impacts often not considered in

conventional municipal economics that can quantify the benefit of the emissions reduction measures proposed (City of Edmonton, 2019b). Similarly, P8 also discussed the environmental benefits of climate action through economic costs, discussing a $1.8 billion flood mitigation effort needed to deal with the impacts of climate change. In their own words, “nothing will be more expensive than inaction on this file”.

The installation of 20 MW of solar PV is expected to reduce GHG emissions by 10,000 tonnes beyond the business-as-usual scenario, offsetting 6% of the city’s emissions (City of Edmonton, 2019b). The emissions reduction from city solar installations is less than building retrofits, electric bus adoption, and green electricity purchasing. Many participants also highlighted the small contribution of city microgeneration projects to reduce carbon emissions, citing the need to also employ demand reduction and energy efficiency actions alongside renewable development. Due to limitations in what the city can generate through the proposed development, the city is also procuring renewable energy through a Power Purchase Agreement (PPA) that will develop a renewable generator in the province. This action would account for the majority of emissions reduction in the GHGMP, critical to the issue of climate action (City of Edmonton, 2019b).

Because civic operations account for less that 5% of the emissions produced in Edmonton, many participants (N=11) also discussed the need to enable and support renewable projects developed by residents and businesses in municipal boundaries through reducing administrative barriers in municipal bylaw and requirements, providing financial incentives, and encouraging action. Both the documents reviewed and the interview data demonstrate the city perceives a relatively low, but positive benefit of local, municipally owned solar PV

microgeneration projects as a climate change abatement measure, relatively to other climate action and renewable energy plans and programs.

Economic Performance

While climate action benefits were often the first discussed motivation, economic benefits were also considered crucial for developing renewable projects. The CETS 2021 describes climate action as a new era of economic growth, with international commitments under the Paris Agreement providing trillions in investment and demand for clean energy technologies (City of Edmonton, 2021). The document describes energy transition as an opportunity for Edmonton to capitalise on this new industry, growing and diversifying the economy. Capitalising on these economic advantages is a key motivation for the energy transition strategy, with *prosperous* being a one of the strategic principles of the current strategy.

Microgeneration projects can generate revenue through reducing energy costs. P1 highlighted this value as unusual among municipal projects, stating "renewable energy and energy efficiency are some of the few investments that a municipality can make that are actually revenue generating". P13 and P14 described renewable energy generation as a potential revenue stream that can fund other priorities and felt it may be valuable for Albertan municipalities seeking revenue with a shrinking tax base. According to P3, the economic benefits of renewable energy can contribute to the city's recovery from the impacts of the COVID-19 pandemic. P10 went so far as to say that if municipal buildings are not renewably powered, they waste taxpayer money, stating:

> *Public buildings are for the public, like, why aren't we building them to a standard where we all want to be proud of them, as well as have them durable for the long term? For me, it's actually ridiculous that any public building right*

> *now be built conventionally, when we know we're going to be off of carbon by, hopefully 20 years; the lifecycle of a mechanical system in a building is 40 years. So if we're not building buildings to be carbon neutral, and to be highly run by renewable energy, we're wasting taxpayers money, because we're going to be ripping out things in 20 years when we are no longer able to use any carbon whatsoever.*

Providing economic value was often considered one of the key motivations for the city to take an ownership role. P3 believes that "at the end of the day, these projects would not proceed if they were not cost effective", while P6 stated "[economic value] would probably be the biggest corporate angle I would think of". Both council members interviewed described the positive business case the project demonstrates as a deciding factor in council's decision to approve the E.L. Smith Solar Farm. P13 also highlighted the importance of economic returns for Albertan municipalities, especially with the current economic climate:

> *So it all depends on economics, in my view, Maslow's hierarchy of needs, when your tax base is threatened, environmental engagement and renewables and a focus in that area, if it doesn't result in a direct economic benefit, I think municipalities are going to revert away from it.*

I asked the participants from the city how they felt the revenue generated by these projects could be used. Five participants discussed the potential of using this revenue to establish a revolving fund mechanism, where the savings generated by each project are used to fund further installations, expanding the city-owned renewable portfolio.

However, while the perception of the economic benefits of renewable projects is positive, both the documents reviewed and many of the participants discuss the challenges of the

relatively weak economic performance of renewable projects. In the GHGMP, small solar PV has a payback period of 30 years with an installation cost of $3/W, while large solar PV has a payback of 19 years with an installation cost of $2.3/W (City of Edmonton, 2019b). These are respectively the two longest payback periods of the energy transition measures considered. Small solar PV also presents the lowest rate of return at 4%, while large solar PV performs slightly better with a rate of return of 6% (City of Edmonton, 2019b) Several (N=6) participants also used payback period to describe renewable energy, primarily considering the economic return to be long term; “even if there is a premium for green technology, it pays for itself in the long run” (P4); “there’s benefit in the long term economically” (P11) and; P5, P9, P10, and P12 expressed similar views about the long-term but present economic benefit of renewable development. However, P1 and P7 believed the city has the ability to take a long-term economic perspective on these projects. P9 justified the city’s investment into renewable projects as the municipal government is better able to take an approach that balances economic returns with environmental and social benefits compared to a private company.

Contributing to the weak economic performance of renewable projects is the low cost of electricity in Alberta. Four city participants discuss how renewable projects do not have a high return because the electricity they offset is relatively cheap. As P6 says: “it’s a much longer payback period to set up a renewable project in Alberta than it would be elsewhere”. P9 discussed the challenge of low prices for the Blatchford utility, which is mandated to charge market rates in Edmonton. With energy prices being low, the utility is unlikely to make revenue for a long time (P9).

P1 believes the price of electricity is a temporary barrier: “I personally don’t think that we’re going to have cheap electricity forever”. Conversely, P6 does not anticipate the price of

electricity changing much and instead feels the economics of renewable energy is reliant on the price of generation falling. P13 discusses the third potential price change, pricing decreasing due contracted growth or decline in energy demand in Alberta, which poses a risk in reducing the economic performance of municipal renewable projects.

Relating to the importance of the price of energy, P7 and P11 believe that carbon pricing has a big impact on the economics of renewable projects, with P5 going so far to say that the economics of renewable projects rely on the survival of the carbon tax. P7 feels the existing carbon price set by the federal government was too low to encourage renewable energy development. P13 agreed, believing plans for the carbon tax rising to $170 dollars could incent development. The city lacks the ability to set carbon pricing themselves and are therefore reliant on other orders of government to set these regulations. This reliance posed a challenge in 2019, when a change in provincial government resulted in the repeal of the provincial carbon tax. As a result, Alberta is now subject to a carbon price set by the federal government. At the time of most participant interviews, the federal carbon pricing scheme was being challenged by the Government of Alberta in the Supreme Court of Canada. P4 discussed the challenge that the uncertainty of future carbon presented, stating that the court challenges being resolved would provide more price certainty and reduce risk. P1 and P13 also discussed the risk of external carbon pricing being removed, with P1 calling the presence of federal carbon pricing “always questionable”.

The datasets suggest that economic benefits are critical to the intention to support renewable projects, however, they are perceived as a relatively weak economic performance.

Indirect Economic Benefits

The documents reviewed also discuss a benefit for the ownership role in supporting local employment; the CETS 2021 highlights the benefit of supporting "regional employment through local renewable energy and storage systems" (City of Edmonton, 2021, pg. 18) and states that energy transition "will see the Edmonton Metropolitan Region attract and incubate 50 next generation energy companies by 2030 with diverse ownership" (City of Edmonton, 2021, pg. 17). P2 discussed the potential for city developed renewable projects to development the local labour force, echoed by the CETS 2021 stating that renewable and resilient energy transition "will build on our current strengths and innovation to develop the next generation of energy jobs, small business opportunities and products the global market is beginning to demand" (City of Edmonton, 2021, pg. 17). P4 discussed the value of developing the renewable industry in Edmonton, which they believe lowers the costs for others in Edmonton to develop renewable projects, supporting further renewable development.

Several participants believed developing the renewable energy industry could help transition the energy economy of the city from conventional, fossil fuel sources to include alternative energy sources. P4 believed that developing renewable energy can maintain the legacy of Edmonton as an energy economy but make it more diversified and resilient, saying; "[renewable energy projects] just makes us more stable economically". P11 believes that developing renewable energy expertise and technology in Edmonton could be exportable and "could be very much part of our future economy".

The CETS 2015 discusses the value of locally owned renewable projects to insulate Edmonton to rising energy prices for fossil fuels, driven by rising population and economic development increasing demand and the supply of fossil fuel resources dwindling (City of

Edmonton, 2015). The CETS 2015 considers the energy constraints from 2015 to 2035 a moderate risk with possible likelihood, while energy risks beyond 2035 are considered high risk with major consequences and a possible likelihood of occurring (City of Edmonton, 2015).

Resilience

Among the threats of climate change discussed in the documents reviewed are impacts to the city's energy supply. Both the CETS 2021 and 2015 tout energy transition as an opportunity to be more resilient to disturbances that could affect its energy supply, protecting Edmontonians from major energy risks (City of Edmonton, 2015; City of Edmonton, 2021). In the CETS 2015, the risk of disruptions to energy supply due to climate change is considered a low to moderate risk (City of Edmonton, 2015).

I asked the participants whether they felt city owned renewable projects provided any benefits or challenges from a resilience perspective. Participants were divided on whether resilience was a substantial benefit or not. P3, who had experience working on resilience plans in Edmonton, discusses the case for resilience benefits: "there is actually a bit of liability relying on grid electricity". Threats of relying on the grid include a natural disaster taking out the powerlines supplying the city, causing human and economic damage. According to P3, "local generation would minimize the impact of such as event occurring" so that "we're not as susceptible to a single event causing us an extreme problem". Four of the city participants agree that local generation provides some resilience to power grid impacts, while P10 calls it the biggest reason to develop local renewable capacity. P11 believed that the city likely cannot be self-sufficient with local sources but agreed that any resilience is a positive. P16 and P17 described resilience as a substantial motivation for the E.L. Smith Solar Farm, as the local energy would allow the adjacent water treatment plant to remain operational in the event of a blackout.

However, P11 believed this was one of the weaker motivations for the project. P13 also believes resilience is one of the weaker motivations to develop local renewable projects as Edmonton is well-connected to the power grid and is not vulnerable to impacts from grid failures. P15 and P16 agree, stating that energy security in Alberta is good, as the energy system is overbuilt and oversupplied P14, also a municipal energy expert, stated that developing resilience has come up as a motivation in communities they have worked with, but it is not as strong of a motivation as other factors.

Social Impacts

Some participants viewed municipal renewable energy projects from a social value perspective. P1 discussed municipally-owned renewable projects through a equity and justice lens; the city developing renewable energy allows the residents of Edmonton to support renewable energy through their taxes, even if they do not have the outright capital to develop renewable energy themselves. P1 believes municipal renewable energy projects help citizens meet their private climate action goals, supporting the residents who lack the resources to meet those goals themselves. P2 believed community energy projects bring benefits of energy democracy and autonomy. In their own words, community energy provides “a bit more democratic process on those things that could impact them and that they could also benefit from”.

P3 and P4 both believed that the public engagement done as municipal plans are developed and executed is an opportunity to teach citizens about renewable energy opportunities. P4 believes that these municipal projects are an opportunity to encourage and convince citizens to take on their own renewable projects.

Subjective Norms

The theory of planned behaviour suggests that an actor's perception of how other entities will perceive their behaviour will influence their intention to proceed. Both the documents reviewed and interview participants show that municipal decision-makers believe renewable projects are well-received, encouraging municipal development efforts.

Citizen Perception

The response of the citizenry to municipal efforts are of key importance. Citizens can disrupt unwelcome municipal action by challenging it to council and electing officials who reflect their views. In this case study, many participants (N=8) from the city believed that Edmontonians are positively receiving the renewable energy initiatives the city is pursuing. P1 believes that the existing renewable projects in the city are well-received, stating: "the feedback that we get through Change for Climate on the work that we're doing is good from what I understand. So, no concerns there". Some participants (N=4) cited a survey done in 2020, which found high support for climate action efforts. This survey is also referenced in the CETS 2021, presenting the results; nearly 75% of Edmontonians are concerned about climate change and believe the city needs to act priority (City of Edmonton, 2021). P4 provides context for the survey, discussing how, even during a global pandemic and struggling economy, Edmontonians consider the climate action to be a high priority. The CETS 2021 also discusses a citizen panel that recommended carbon emission reduction (City of Edmonton, 2021).

P10 believes that city-owned projects are not only supported but can even provide Edmontonians a sense of ownership and pride by investing into renewable infrastructure, stating:

> *If people can see it, actually, that's a huge benefit. If people see solar on top of buildings, if people see windmills or wind turbines around there. They can*

> *equate "Hey, that's where my power coming from." I think there's also maybe a sense of ownership if people knew the city of Edmonton is creating power from its own kind of District systems or microgeneration on its own buildings like, "hey, that's, that's part of the city's infrastructure, that's an investment my tax dollars have made", so we can start to talk about a narrative of the investment. And further to that the return on investment of doing those.*

While many participants (N=8) believed that Edmontonians were supportive of renewable development, they emphasised that the design and messaging of renewable projects was critical to the reception. P1 acknowledged the importance of respecting what is visually acceptable to the public, specifically citing concerns with developing renewable infrastructure on heritage buildings. P3, despite saying the city has received "tremendous amounts of positive feedback on even undertaking such an initiative [energy transition]", believes that the renewable projects do need to be designed in collaboration with citizens to identify areas and designs that are acceptable to the community. This philosophy is demonstrated in the development of the E.L. Smith Solar farm; P17 and P18 discussed the importance of having public acceptance for the project, stating the social license was as important as the business case. P8, when discussing the feedback they received about the project, did not receive any opposition to the idea of renewable energy but did here concerns about impacts on the local ecosystem and community.

P1, P2, and P6 all believed that solar PV projects were well-received, contributing to the reasons the city is focusing on developing solar PV projects. While P6 stating they believed solar PV was considered "cutting-edge" and even "sexy", P2 surprisingly took an opposing stance, believing that solar PV is supported by the community due to a perception of reliability; "solar is

very well received, it's one of those things that have had years and years to prove itself that it works.".

Reasons for Opposition

Despite believing that most Edmontonians were in support for developing renewable projects, participants did discuss why they felt some citizens are in opposition to the city pursuing renewable development. P2 and P6 both acknowledged that there are a minority of Edmontonians that do not acknowledge climate change and were therefore unsupportive of climate action. P6 stated that the public likes to focus on small and concrete issues they can easily wrap their head around instead a complex and widespread issue like climate change. In their own words, "[some citizens] can't see the forest for the trees" (P6). When asked about whether rising climate change impacts will encourage more municipal renewable development in Alberta, P13 believed that climate change impacts are disconnected from renewable energy and Albertans will likely not see renewable energy as a solution to environmental threats in the short to medium term. P4 similarly felt that many Edmontonians will not be encouraged to pursue renewable energy over increased climate change impacts due to their adaptability but expresses concern over those that lack the resources to mitigate climate change impacts.

Some participants felt like the culture of fossil fuel support in Alberta resulted in a lack of public support for renewable energy development, echoing concerns in the CETS 2021 (City of Edmonton, 2021). P4 describes this loyalty to the oil and gas industry, discussing how the fossil fuel industry made Alberta a wealthy province and people may be worried Alberta is moving away from that industry and the associated prosperity. P6 elaborates that some people will oppose renewable energy because their livelihoods are tied up in fossil fuel extraction, which they perceive as at odds with renewable energy. P10 believes that the fossil fuel industry itself

fosters resistance to energy transition, while P12 adds that some politicians supportive of the fossil fuel industry discourage renewable efforts. As P6 encapsulates the cultural relevance of fossil fuel with the statement: “they’ve come to believe that not using those fuels anymore is an abandonment of our way of life, which is silly”. The CETS 2021 also discusses this cultural resistance, stating that “a part of our economy and identity are tied to the fossil fuel industry” (City of Edmonton, 2021, pg. 17) resulting in opposition to efforts to diversify the energy industry. “There will be enthusiasm from the next wave of energy entrepreneurs, and there will be others who are experiencing various “stages of grief” (ie. denial, anger, etc.).” (City of Edmonton, 2021, pg. 17).

Perhaps in an attempt to leverage this energy industry culture as an opportunity, the city sometimes presents renewable energy as the evolution of the energy industry rather than an abandonment of the energy sector. In the CETS 2021, energy transition is portrayed as being able to usher in a new era of economic growth and capitalises on the experience of Edmonton and Alberta as energy innovators (City of Edmonton, 2021). P7 discussed how they feel energy conversation has changed recently from an antagonistic relationship between fossil fuels and renewable energy towards energy co-existence and believes the city needs to signal support for renewable energy but acknowledge that there are still opportunities for oil and gas. Similarly, P11 believed people are not opposed to renewable energy but dislike being told they cannot use conventional energy sources. P14 agreed with the CETS 2021, discussing how municipal governments can deliver a narrative of the co-existence of renewable energy and fossil fuels through pitching renewable energy as a continuation of existing energy communities. While they acknowledged that fossil fuel cultural support can be a barrier, P12 discussed their experience working with coal communities across Canada that acknowledge the energy transition and the

lack of future for fossil fuel industries. P12 expressed their surprise but support that these communities are welcoming renewable technologies as an opportunity to diversify. When discussing opposition to municipal government investment into renewable energy, P10 suggests that citizens should be reminded that the fossil fuel industry also required public investment when it was developing.

Participants also described public opposition to the cost of municipal renewable energy investment. P3 believes there is a group of Edmontonians that are supportive of climate action but concerned about cost and the city "spending like drunken sailors". P13 stated that renewable energy will be challenged if there is a perceived premium on renewable technology, even if it does not reflect reality, especially in a period of economic struggle: "when people can't put food on the tables, it's- there's anger, there's anger when people invest in that stuff". P1 agrees, stating: "it's just not the time that people want to hear about city investing in certain things." P3 believes that a business case for renewable investment can foster support among those concerned about financial impacts. P13 agrees, stating: "it's tough to challenge positive economics". P14 believes highlighting positive economics could also minimize anti-renewable sentiment from fossil fuel proponents who support the oil and gas industry for the economic benefits it generates.

Some participants discussed opposition to the E.L. Smith Solar Farm over concerns to the local ecosystem, as the project locates in the much beloved river valley park system. P17 and P18 referred to this concern as a conflict of environmental values between emissions reduction and environmental conservation, forcing individuals to consider the trade-off between these impacts. Most participants did not discuss environmental opposition to renewable projects, suggesting these concerns are perceived as unique to the E.L. Smith Solar Farm, potentially

because of the location of the project in a greenspace or the size of the system. Microgeneration projects may not be considered to foster the same types of ecosystem concerns.

Motivating Action

Both the documents reviewed and several of the participants discuss the importance of demonstrating leadership and inspiring action. Because civic operations only account for 2.7% of emissions in Edmonton (City of Edmonton, 2020b), supporting renewable development in the community can result in a far greater emissions reduction than developing microgeneration projects alone. The city anticipates its efforts can encourage others by demonstrating what is possible; “leading the implementation of low carbon initiatives shows that they can be replicated by other Edmonton businesses and organisations” (CETSU, City of Edmonton, 2019a, pg. 11). P6 describes the importance of local and visible energy projects to encouraging others, stating: “people notice those technologies [city renewable energy projects] and are fascinated by them” and added “it captivates them. And it makes them realise it’s feasible”. P1 claimed that “the work we’re doing is 100% about leading by example” and P4 adding that the city’s ownership role is “demonstrating to the community, both commercial and residential, how this is done”. P10 demonstrated this role in practice, discussing a conversation they had with a business leader who was motivated to develop renewable projects because the city has been supportive of renewable development:

> *Even this morning, I was at a meeting on emission-free building strategy. The first thing I see people from the development and even the home construction or the construction industry said in that meeting, "well, as long as the city takes leadership on this we'll follow" and it's like, there you have it, right? Everyone is waiting for someone else to show the leadership. So it's almost obvious to me*

that the city or some level of government must establish the leadership or set the bar and demonstrate it's all possible

Two participants even felt that city efforts could even support renewable development in other municipalities. In Alberta. P11 suggested that city efforts could derisk municipal renewable projects, encouraging these municipalities to develop renewable projects of their own by demonstrating that they can be successful. P14 discussed the ability for municipalities to motivate each other through competition:

Municipalities have a pretty strong competitive nature with one another. That's something we hear a lot as well, with the town of Raymond project, which you might be familiar with. You know, one of the reasons that they often talk about when they're being interviewed is that they saw the neighboring community of Cardston do a solar project and felt this kind of, you know, friendly competition, that they wanted to do something as well. So, I think that plays into it more than maybe we realize in some cases

Attracting New Investment

Perceiving global resistance to the Alberta oil sands as a carbon intensive and environmentally degradative industry, the CETS 2015 suggests that energy transition efforts in Edmonton can develop an environmentally friendly image that counters the carbon intensive reputation of the province and is “marketable” to new firms and industries (City of Edmonton, 2015). P4 agreed, stating that, with the perception of Alberta’s energy system as dirty, diversifying the energy economy can be a marketable tool. With the addition of renewable infrastructure, P4 believed that Edmonton would be “maybe more appealing to a wider range of investors around the world”, growing Edmonton’s economy.

Perceived Behavioural Controls

Capital Challenges

The most substantial barriers discussed by the participants was the capital cost of renewable projects, a challenge discussed by several participants (N=6). The GHGMP prices the proposed installation of 20 MW of solar PV at $46 million in additional funding above the business-as-usual case (City of Edmonton, 2019b). In P6's words, "the upfront costs are so high that … we can't get past the first hurdle". P3 adds that this barrier has been aggrandized by the COVID-19 pandemic and economic challenges the city is facing, echoed by P10 and P13. P1 discussed how they felt that current economic situation limited the city's approach, stating:

> *Right now, we don't have that- we're in a financially restrained time right now. And so being able to look at longer term paybacks, and it's something that the city can do and does do quite happily for these types of things, but we just don't even have the capital right now to be doing that type of work.*

P4 also characterises economic challenges as political challenges, as the city must demonstrate a responsible use of taxpayer money to citizens, intersecting economic barriers with subjective norms. Participants discussed the challenges of allocating funds to renewable energy when there are other priorities on the agenda, with P2 saying "there's always the challenge of limited resources, where do we put them?". P7 presents this constraint as a mutually exclusive choice: "Are you building this road? Or are you putting the solar panels on this building?".

Among the efforts competing with renewable energy for resources are other emissions reduction efforts. Several participants felt these efforts were complementary not competitive, highlighting the need for the city to take all available options for carbon emissions. P3 summed

up the debate with the following statement, though they did elaborate that efficiency actions should occur first.

> *it's an open debate, I guess, you know, what is better? Dealing with the energy consumption side or dealing with the energy production side? I kind of don't wade into the debate anymore because in my world of 1.5 [reducing carbon emission to limit average global warming to 1.5°C], it's both. So, it's more of a question of when.*

Answering the "question of when", P11 stated that demand reduction and efficiency are the areas where the city will get the "best bang for the buck" and "so that has to be the first priority". P11 went on to say that there is no point building solar panels on an inefficient building. P8, also a councillor, agreed, stating that, although the city will likely need to develop microgeneration projects, the city should focus on the actions that have the best payback and environmental return first.

Accessing External Supports

Because of their capital limitations, municipalities often need to rely on external grants and supports to finance capital investments. The GHGMP discusses the importance of external funding to encourage development by improving the business case of these projects. P13 believes that many municipalities will not engage in climate action unless there is financial support to incent them (GHGMP, 2019b).

However, both the documents reviewed and the interviews, municipal decision-makers discuss substantial challenges to accessing external supports. The GHGMP discusses the Alberta Municipal Solar Program, administered by the MCCAC, as a source of funding. This program offers between $0.55 per watt to $0.90 per watt depending on the capacity of the system, helping

cover up to 25% of eligible expenses. Despite describing the value of this incentive, the GHGMP describes funding as available on a "first come, first serve" basis and therefore the city cannot rely on consistently receiving this funding across the multimillion-dollar portfolio of projects (City of Edmonton, 2019b). While the GHGMP suggests the city attempt to take advantage of grants whenever possible, the lack of certainty in receiving these funds does limit the degree to which external funding is perceived to alleviate funding challenges (City of Edmonton, 2019b).

P1 also discussed the challenge of funding being is allocated on a project-by-project basis, requiring the city to complete several applications to procure funding for the many buildings in the city's portfolio. In their perspective, external funding was too arduous to address the capital barriers of the city:

> *One of the biggest limitations is that grants are currently administered is just- it's almost more work than it's worth to actually go through the process of accessing these types of things*

P1 also identifies a challenge in the monitoring and reporting that is often a requirement of external funding. P6 believes that the funding available is inadequate to support city projects: "most renewable energy projects would be more expensive than current funding would accommodate. So, there isn't enough funding". P9 discussed efforts to acquire funding by the Blatchford Project team, which has so far been unsuccessful.

P13 added that, while the former NDP government established programs that catalysed municipal energy projects, the current government is not encouraging nor dissuading it. However, P13 believes the role of government is not to prop up industry and the industry now needs to prove that these projects are self-sustaining.

Interruptions to Municipal Services

Installing renewable infrastructure on municipal properties also comes with the challenge of interrupting the operations of the building during the construction period, which may require a long period of downtime, restructuring the service delivery, and increased operational impact (GHGMP Summary Document, City of Edmonton, 2018), creating both additional soft costs to renewable installation from the restructuring of operations and potential community outcry to the interruption of municipal services.

Risk

Several participants (N=5) discuss how municipalities tend to be averse to engage in what may be perceived as a risky investment. P12 discussed the Blatchford Project, where they felt the city gravitated to a low-risk approach and therefore likely spent more than what was necessary. P9 and P13 believe that municipalities do not think of fostering innovation as their role. Conversely, P10 believes that municipalities should be leading edge of innovation, embracing technologies that have demonstrated success. P7 expressed a moderate approach, believing the city has the ability to dabble in emerging technologies, but ultimately needs to be practical and cost effective in their actions. P3 tied technical risks with subjective norm concerns, expressing concern about the city taking on a project that is too cutting edge and overselling the benefits to the community. P3 discussed how project failures and budget overruns can not only sour the public to a specific renewable project but to all other renewable projects in the future.

Regulatory Barriers

P5 and P14 discuss Section 95 of the *Electricity Utilities Act* (EUA), which prohibits municipalities or a subsidiary of a municipality from holding any interest in a generation unit, with some exceptions, including microgeneration projects. Through small scale generation

regulation, municipalities can participate in developing renewable projects through community benefit agreements, which confers social, environmental, or economic benefits to the municipality, or with a community benefits statement, which describes the community benefits the municipality receives through the ownership of a renewable project. Small scale community projects must have a capacity less than the hosting capacity at their interconnection point to the grid. P14 believes there may be potential to amend Section 95 of the EUA and highlights the opportunity for community benefit agreements to allow municipalities to be involved in utility scale renewable development.

However, P4 believes that regulatory barriers for municipalities are not yet a challenge because the city is choosing to pursue projects that fall in the microgeneration category, stating:

> *"[The city] probably got a few years of runway to really execute some installations and expansions and awareness and maybe some P3s. There's lots of room to run right now".*

P15 and P16 believed that microgeneration is simpler from a permitting and implementation perspective, saying microgeneration is "a good way to get a quicker win" while "taking that next step to being a generator, rather than offsetting your use is really, really dependent on the community" (P16). At the utility scale, P15 and P16 identified issues around interconnection, longer project timelines, and maintenance issues. Similarly, P14 discussed the challenges of overregulation, calling the regulatory process for generators a "tremendously rigorous process" for small-scale renewable projects.

P13 discussed a challenge with the distribution network in Alberta, who they believe are not interested in innovation or system change because the infrastructure may struggle to support distributed energy and because the distributors are guaranteed a return on investment. P13 also

potentially saw a challenge in opposition from transmission companies “who have 100 year histories, significant political sway, significant investment. And it's really, those are very large behemoths to try to challenge.”

Complexity

Engaging with developing renewable energy requires substantial knowledge to navigate the complexity of developing renewable technology and seeking funding, particularly at the community generation scale. P13 discusses how the municipalities on the forefront of renewable development have departments dedicated to climate action, while other municipalities may have a single person working on climate action or no dedicated resources. P13 felt that many municipalities are looking to support renewable energy but lack the capacity to engage and so “they’re looking for an easy solution”. P15 and P16 also discuss this issue, stating that even if municipalities have the funding, developing renewable energy at the utility scale is complicated and requires time, effort, knowledge, and construction and project management skills. When asked about EPCOR’s intention to move into a generator role, P17 and P18 responded that the firm would need significant back and mid office support to add generation to their operations.

Discussion

The documents reviewed and the interview participants provide key insight into the decision-making informing the city’s approach to developing renewable energy. The city has demonstrated the intention to pursue microgeneration projects on city properties. While developing community generation projects was considered, the challenges to this role has led to the city not pursuing this role. Each participant had unique considerations of the opportunities and barriers for renewable development. Common themes and shared perceptions, as well as areas of contention, are conceptualised into their respective roles in forming the intention to

pursue renewable development using the theory of planned behaviour in Figure 1. I also explore these factors using transition theory, situating each consideration in the theorised dimensions of sociotechnical change.

Considering the four motivations Krause (2013) suggest for municipalities to engage in climate action, developing city-owned renewable projects can be considered to be motivated by tangible local benefits, as local renewable projects provide economic benefits, create energy resiliency, and foster civic pride. Considering the perception of community support for climate action, all three actions are also motivated by political gains for local leaders.

Contrasting with results from the municipal survey in Alberta (Chapter 2), Edmonton decision-makers appears to be primarily motivated to develop renewable projects to reduce carbon emissions and mitigate the impacts of climate change, a landscape level factor, as climate change is a global phenomenon yet one that will have drastic impacts on the local level. The documents reviewed and participants interviewed highlighted the threats of climate change, reflecting the literature reviewed that discusses the risk of climate change impacts (Bassett & Shandas, 2010; Seabrook, 2010; Simpson, 2013). This motivation is demonstrated through the several efforts the city is undertaking to develop renewable projects beyond developing projects on municipal infrastructure. Microgeneration projects on municipal infrastructure is anticipated to make a significant, but relatively minor impact on municipal emissions. Accounting for the limitations in what the city can produce locally, the municipality is also purchasing renewable energy from generators in Alberta, accounting for the majority of the emissions reduction necessary to meet climate action goals. Additionally, the city is also seeking to reduce community emissions produced by the residents and businesses in Edmonton, a much more substantial source of emissions than civic operations. In addition to inspiring and informing

action using municipal energy projects, the city is reviewing administrative barriers, funding municipal projects, and creating networks that can support municipal development. Unlike developing microgeneration projects, these actions do not provide additional benefits, demonstrating the importance of climate action to the city. Krause (2013) describes these emissions reduction roles as motivated by altruism, as they create economic consequences.

While emissions reduction appeared to be the most significant motivation for renewable development, the economic benefits of renewable projects were also considered a key motivation, with P3 even claiming that projects would not proceed if they did not have a viable business case. This finding aligns with those of Krause (2013) and St. Denis and Parker, (2010) who demonstrate that economic benefits are substantial and often the primary motivation for municipal climate action. Participants and documents reviewed discuss the potential for economic benefits to also garner public support for renewable projects, particularly among those that are unconcerned about climate change. While the city discusses the economic benefits of developing renewable projects, documents and participants did acknowledge that these efforts have a longer payback period than other climate action initiatives and that the economic performance was tied to carbon pricing, which some participants (N=4) felt was unreliable. Economic benefits are niche level motivation but are intersected with the regime level, as incumbent generators set the price of electricity in the province.

Interestingly, both the documents reviewed and councillor P8 chose to present the threat of climate change in economic terms, estimating the costs of climate change impacts and using concepts such as the social cost of carbon. Quantifying the costs of carbon emissions could reflect the nature of the municipal corporation as a government in a capitalist system, where decisions must have a business justification, or indicate that decision-makers are seeking to

express the impacts of climate change in many different ways to convey the need for climate action to Edmontonians with differing values and considerations is not clear. However, the datasets demonstrate there is a perceived intersection of economic and environmental motivations, suggesting costs and revenue are a shared language across the two considerations.

The niche level motivation of social benefits from energy autonomy and enhanced energy literacy were also often discussed but were rarely the first mentioned, suggesting social benefits are considered secondary motivations. Using city projects to develop resilience was one of the most contentious motivations; while some felt that local energy could protect the city from grid level interruptions, others felt the city was not very vulnerable to energy supply disruptions. As energy security is created through the dominant energy actors and the enabling infrastructure and regulations, resilience to grid scale impacts in a regime level consideration.

Within the realm of subjective norms, at the niche level, municipal decision-makers perceive strong support for developing renewable projects, due to concern for the impacts of climate change and need for the city to act demonstrated by the public in a variety of engagement effort. In the motivations discussed by Krause (2013), this perception of public support could indicate a political motivation for renewable energy as a climate action effort. Some participants discussed the potential for municipal energy projects to foster pride in the community, what Hoffman and High-Pippert (2005) refer to as civic gratification. Many participants (N=7) did acknowledge that renewable projects do need to be developed to respect the values and views of the public, demonstrated in the contention to the E.L. Smith Solar Farm. At the landscape level, the city believes that municipal energy projects can counter the carbon intensive reputation of the province and attract new businesses and residents. This motivation of image improvement was similarly apparent in the findings of Busch and McCormick (2014).

The capital cost of renewable energy projects was considered the most significant perceived behavioural control, reflecting the findings of Hamin et al. (2014) and Krause (2013). While this barrier exists at the niche level, it intersects with regime level, as the provincial government that regulates the energy system is also the source of many funding programs considered inaccessible, as well as the landscape level, as funding can also emerge from the federal government.

Focusing on the community generation scale, a number of additional barriers emerged. These included the knowledge limitations to engaging in the complexity of the energy sector, which was perceived to require technical and regulatory expertise. P8, a member of council, cites these limitations as the reason the city should not take an ownership role, instead relying on partnering with entities that have renewable energy expertise to create successful projects. Expertise limitations were also described as the main barrier for EPCOR taking a greater generator role. P13 discussed their insight on municipal renewable energy efforts across the province; in their view, municipalities want to support renewable energy but seek a relatively simple way to do so, emphasising the challenge of complexity. These findings are consistent with Krause (2011), who describes capacity challenges, both in expertise and budgets, are the strongest predictors for the lack of climate action.

At the regime level, several participants highlighted regulatory barriers to owning municipal projects beyond the microgeneration. Section 95 of the *Electric Utilities Act* prevents municipalities from having an ownership stake in an electricity generator with some exceptions, as explained by several participants. While community benefit agreements and community benefit states can allow municipal involvement, benefit, and even ownership in small scale

generation, these development types are relatively novel and not discussed by the documents reviewed or the municipal decision-makers.

Because of the additional barriers to community generation scale of project, the city has not demonstrated the intention to pursue these types of projects. Instead, several participants felt that the city should be focusing on microgeneration projects, which were to be considered to have fewer regulatory barriers. Municipal involvement in the utility-scale may be a possibility in the future, particularly in partnership roles.

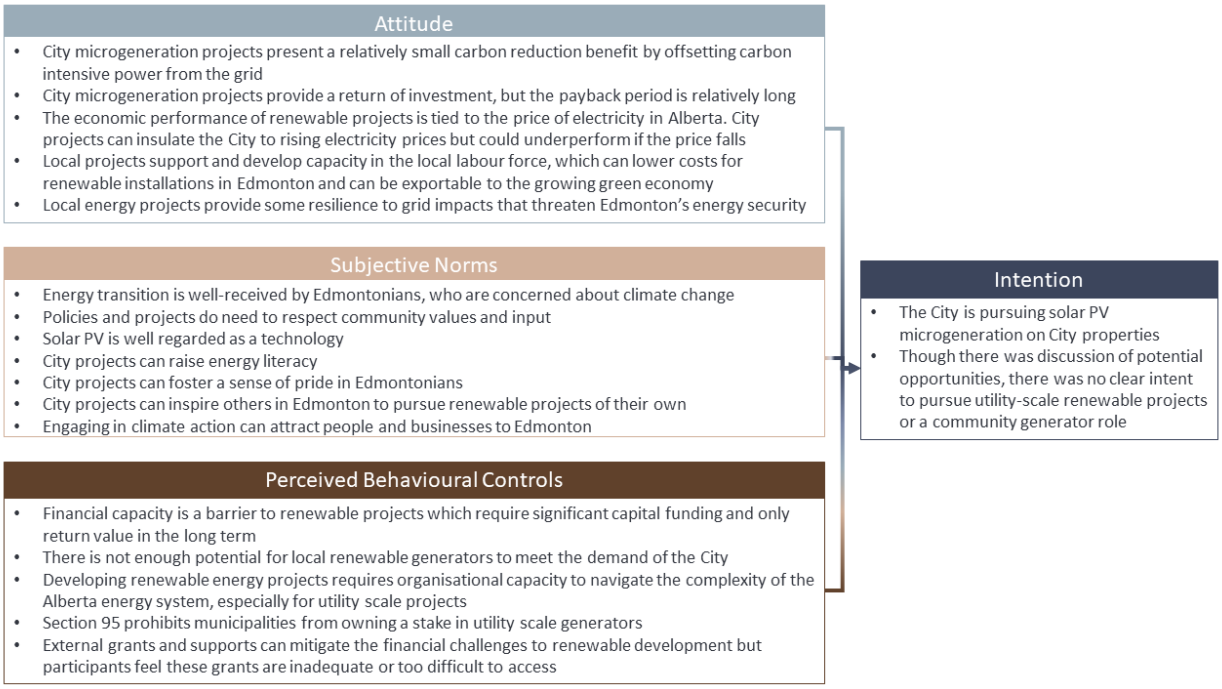

Figure 1: Factors contributing to the intention for Edmonton decision-makers to pursue renewable development

Themes of Community Energy

The documents reviewed and the participants' responses were assessed to understand how they expressed the dimensions of community energy. Projects discussed are reminiscent of community energy models defined by Klein and Coffey (2016); microgeneration projects are funded by tax revenue and the Blatchford project and hypothetical community generation

projects are public utilities that own and operate renewable infrastructure. Many participants (N=13) and documents reviewed strongly believed that community engagement was important, even for a topic as technically and legally complex as renewable energy development. The city employed several efforts to engage the Edmonton community in the design of the energy transition strategy include surveys, open houses, and citizens and stakeholder committees. The participants discussed the importance of incorporating citizens' perspectives into the policies and projects being pursued, determining acceptable projects and project design. As P3 states, "we [the city] work so hard at making sure that the public is kind of involved with those developments, so that they can provide that guidance so that we know where we're in lockstep with our residents".

P2 discussed the importance of communicating energy transition efforts with those most vulnerable and likely to be impacted by climate change, who can have time, technology, and financial constraints to participating in engagement. Highlighting the importance of justice and equity in energy transitions, P2 discussed ways the city is engaging with vulnerable populations through partnerships with existing community organisations and suggested an opportunity to assemble a diverse working group compensated by honorarium to guide the city's energy transition efforts.

Municipally-owned projects provide a return to the city; if this revenue serves to benefit the citizens, the ownership role demonstrate distributive justices. Participants identified opportunities for city project revenue to be used for a revolving fund (N=5) or to account for this reduction in operating costs, freeing up budget for the city to use in other areas or to reduce the tax burden (N=3). This latter option demonstrates distributive justice, providing benefits to Edmontonians. If the renewable projects developed by the revolving fund eventually provide

greater value for the city, the ownership role can benefit the local community over a long term. However, in P11's perspective, the city needs to be upfront about communicating the benefits of municipally-owned projects to citizens and cannot double count the revenue generated from renewable development as both a cost savings measure and a revenue generation measure.

While the city's efforts to develop renewable energy meet the characteristics of community energy, the efforts of the city to procure renewable energy through the PPA will fund a privately-owned renewable project outside of Edmonton, failing to demonstrate distributive justice. The impacts of this project will remain local to the area of construction, while the climate benefits are claimed by the city of Edmonton and financial benefits will go to a private firm. Considering this action accounts for the majority of emissions reduction by the city, the role of community energy and co-benefits to the local community that it provides, are relatively low in the city's overall energy transition strategy.

Themes of Transition Theory

As a niche in the socio-technical energy system, the city of Edmonton is proposed to be the source of innovative projects in transition theory. The theory also proposes the regime level actors will oppose innovations. However, the decision-making described in the documents reviewed and through the interviews reveals that the actions of the niche and regime level actors are more complicated than theorised. Projects developed by the city on municipal infrastructure can be considered innovations; small-scale, decentralised, and publicly owned projects differ from the energy generation that dominates the energy system in Alberta. However, the city is also procuring energy through the PPA which supports the development of a generator with regime characteristics; large-scale, centralised, and privately-owned, albeit renewably powered.

At the regime level, the provincial government and regulatory agencies do challenge renewable projects with legal and regulatory barriers, as theorised by Avelino and Rotmans (2009) and Geels (2014). However, the findings show that regime level actors also support innovation projects. The province provides funding for municipal projects, especially true under the former provincial government that established several renewable support programs. Though these supports were considered difficult to access, this funding still enables municipal energy projects, as discussed by the energy expert participants.

At the community generation scale, some participants (N=4) also saw potential for partnership approaches between the private generator industry and municipalities to develop renewable projects. These types of projects suggest the potential of hybrid level projects, formed by partnerships between entities at the niche and regime levels. These hybrid projects demonstrate a mix of niche level and regime level characteristics: part private, part community ownership; benefiting local communities and providing profit to corporations; and, intended to produce more than locally required yet potentially integrative of local considerations. While only a few examples of this type of project exist currently in Alberta, such as a solar farm operating under a CBA with a neighbouring municipality discussed by P14, some participants (N=4) see this as a likely way forward for the Alberta energy system. However, partnerships with profit motivated entities could challenge the dimensions of community energy in municipal projects, if project developers fail to adequate collect and consider local values and opinions, hybrid projects run the risk of failing to address sources of community opposition.

Intersecting transition theory with the theory of planned behaviour, we see many of the motivations for energy transition actions are at the niche level: local economic benefits, social value creation, and strong support within the niche. Perceived behavioural controls exist at both

the niche level, such as financial and expertise limitations, and at the regime level, such as regulatory barriers and insufficient funding. However, the presence and strength of the landscape level factor of emissions reduction can encourage niche level actors to support regime projects, while regime actors can be pressured to support niche level projects. The importance of landscape level forces and the potential emergence of hybrid projects is an addition to the theorised process of sociotechnical change that can and one that demands further research to understand its potential emergence and role both in Alberta and other jurisdictions in the process of energy transition.

Conclusion

In the heart of the fossil fuel intensive energy system of Alberta, the city of Edmonton has demonstrated the intention to pursue renewable development in both policy and action. In this case study, I seek to understand the factors that are influencing the intention to develop renewable energy projects through a document review of energy transition plans and policies and through semi-structured interviews with municipal employees and elected officials, supported by energy experts. The city has and is pursuing microgeneration projects on municipal properties. The strongest motivation for development was the desire for GHG emissions reduction, seeking to capture economic benefits, and the strong internal and external reception to renewable projects, despite a cultural identity of fossil fuel support. However, Edmonton is challenged by the capital investments required for renewable projects and difficultly accessing external grants and funding. Several participants discussed projects beyond the microgeneration, acting as a community generator. However, the additional regulatory and expertise barriers to this role have discouraged the city from pursuing these projects. However, some participants saw potential in

municipal partnerships with private firms, suggesting an opportunity for the city to be involved in utility-scale generation.

The municipal energy projects being developed by the city align with the community energy principles, demonstrating procedural justice through extensive community engagement and distributive justice through benefits to the local community.

Limitations

While this study provides insight into the considerations of city decision-makers, there are limitations challenging the accuracy and generalisability of these results. The interview participants were purposively sampled to include those engaged in energy decisions. This created a sample supportive of climate action and renewable energy development. Participants were relatively consistent in their comments, often echoing similar lines of thought also expressed in the documents reviewed, many which have been developed by some of the participants. The results may not be an accurate representation of the views of the administration and council as a whole. To combat this sample bias, I asked all respondents to recommend an individual with opposing views to themselves, though this prompt was rarely answered.

As the energy experts highlighted, the motivations to pursue renewable development can vary substantially between decision-makers and municipalities, challenging the ability of the findings of this study to be generalised to other municipalities in Alberta. These discrepancies are explored further when comparing the results of this case study with the Alberta municipal survey, discussed in the previous chapter. The following chapter synthesises the findings of the survey and those of this case study, exploring how the decision-making of the city of Edmonton compares to the other municipalities in Alberta.

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Chapter 4: Synthesis of Results and Opportunities for Future Research

Both the survey of Alberta municipal decision-makers and the case study of renewable projects in Edmonton seek to answer the key question of what determines municipal energy projects. The survey provides a general understanding of the renewable energy decision-making across the province, demonstrating why some municipalities are interested in renewable development and others are not. The city of Edmonton case study focuses on developing an in-depth and nuanced understanding of the actions and motivations behind renewable actions in a single municipality. This chapter synthesises the findings of the two studies in relation to each other, summarises findings, and discusses opportunities for future research.

Intention to Pursue Renewable Development

One significant correlation found in the survey data is between population and intention to develop renewable projects, suggesting that larger and more urban municipalities are more likely to develop renewable projects. The city of Edmonton holds this relationship true, demonstrating strong intention to pursue renewable development. In expressing the intention to pursue renewable development, the city aligns half of survey respondents. Edmonton's intention to pursue renewable development aligns with just under half of the municipal decision-makers surveyed, who expressed interest in developing renewable projects in the near future.

Both survey respondents and interview participants identified solar PV as the preferred renewable technology for their municipal energy projects, with both datasets highlighting benefits in reliability, public acceptance, and natural feasibility as the reasons for this preference. The regression analysis of the survey data shows that concern about visual intrusions correlate with a lack of renewable development intention, suggesting that technologies like solar PV that have a minimal visual impact, particularly when building integrated, are preferred to

technologies like wind turbines, that create a substantial visual intrusion. While the survey did not explicitly ask respondents what scale of projects were interested in developing, the case study reveals that the city's intention is to develop microgeneration projects, or small-scale renewable infrastructure on buildings intended to offset the consumption of power on-site.

Some interview participants did discuss the potential for the city to take an ownership role in community generation, with the city producing renewable energy to power residents of the city. This role was largely discussed as a hypothetical future direction and is not currently a mandate in city plans. This community generation role was more contentious than microgeneration projects, which received universal support. Several participants were unsure about the city taking an ownership role beyond microgeneration, highlighting regulatory and expertise limitations.

When it comes to opportunities for development, survey respondents and interview participants both saw potential for partnership approaches. Over half of respondents surveyed see potential for the public-private partnership approaches to finance renewable projects, aligning with several participants interviewed who felt that partnering with private firms could resolve gaps in the city's financing and expertise. The presence of these projects demonstrates an interesting space for renewable projects within transition theory. Though the theory suggests that niches will be the loci for innovative projects that will be opposed by the dominant regime of incumbent energy generators and regulators. However, under the pressure of climate change mitigation, an exogenous landscape factor, actors at the niche and regime level can partner to create a hybrid level project, exhibiting shared traits between the innovations of municipal projects and the incumbent private energy generation projects: local benefits are provided through municipal agreements, though private firms continue to own and profit from utility-scale

renewable projects. The presence of these partnership driven hybrid projects was perceived by some interview participants to be a potential opportunity for the future of Alberta's energy system.

Attitudes motivating renewable development

The survey of Albertan municipalities demonstrates that capturing economic value was considered the most significant motivation for developing renewable projects, perceived to occur primarily through reducing cost of purchasing electricity and fostering an innovative image that attracts new residents and businesses. However, in the case study of Edmonton, the city's intention is primarily motivated by the need for climate action; climate change risks are foregrounded in the documents reviewed and often the first motivation for the participants discussing the benefits of the ownership role. Several participants felt that renewable energy development was considered necessary to meet the carbon reduction targets set by the city. Environmental motivations are most clearly demonstrated in the city's perceived need to take on purchasing and enabler roles, which are major emissions reduction efforts but provide no direct economic benefits to the municipality. Thus, I find the first discrepancy between the findings of the survey and those of the case study. In the survey analysis, reducing the municipal carbon footprint was ranked a less significant motivation than capturing economic benefits, while trying to reach a specific carbon target was considered ranked even less significant. However, the climate change concern demonstrated by the participants does align with a significant correlation between personal concern about climate change and renewable intention.

Though the two studies show a difference in primary motivations, an interest concept that emerged from the case study are the ways that climate concern and economic motivations intersect; the documents reviewed and participants interviewed use concepts such as social cost

of carbon and economic damages due to climate change impacts to present the need for climate change. This need to quantify environmental motivations may speak to the importance of economic decision-making for municipal corporations.

While economic benefits were the most significant motivation in the survey and a critical motivation in the case study, both survey and case study data show that municipal decision-makers perceive challenges to the economic value of renewables created by the relatively low price of electricity in Alberta. Because the cost of the electricity offset by ownership projects is low, the payback created by these projects is high. Survey respondents ranked the low price of electricity and related long payback period as significant economic barriers. However, while survey participants overwhelmingly believed that the price of electricity will rise in the near future, interview participants were more divided on the direction of electricity prices, citing concern about the longevity of carbon pricing and the growth of demand in the province. One possible reason for this discrepancy is the time period of data collection. Despite being conducted only one year apart, interviews occurred during the COVID 19 pandemic, resulting in interview participants potentially being more concerned about recovery from related pandemic related economic challenges. Therefore, the responses of the participants may be more indicative of the current perception of economic value of renewable ownership in Alberta.

Resilience was another common theme in the studies and, within both datasets, was one of the most contentious motivations. While some participants discussed the value of local energy to mitigate the threats of energy supply interruptions, including one participant who felt it was the most important reason for the city to develop renewable projects, others were not as motivated by resilience. Some participants felt energy disruptions were not a significant risk, with Edmonton being well connected to the provincial grid. The survey results show that energy

self-reliance was considered one of the least significant motivations for renewable development, suggest it is a lesser motivation to economic and environmental goals. Several interviewees also felt that increasing climate change impacts were unlikely to encourage renewable development, citing a psychological disconnect between renewable energy and mitigating the impacts of the changing climate and concerns about high adaptability to climate impacts reducing motivations for mitigation. This lack of relationship between renewable energy development and reducing climate change impacts is also reflected in the survey data, where respondents considered rising climate change impacts less motivating than economic opportunities and capacity raising measures.

Subjective Norms

Interview participants at the city felt strong community support for climate action and renewable energy development. This perception was backed by substantial amounts of community engagement that not only encouraged but informed the energy transition strategy. This relationship speaks to the value of community energy; in a province of divisive renewable energy conversations, energy projects built with community input and local benefits can address the social and political barriers to renewable development. Several of the participants interviewed discuss the importance of integrating community feedback and priorities into policy and project design, what community energy literature defines as procedural justice, as a critical tool to mitigate community opposition. Interview participants also saw opportunities for community engagement to foster energy literacy. Some participants not only perceived community support, but even felt city owned renewable energy projects were points of pride in the community. Many respondents highlighted a critical benefit of city ownership to inspire others in the city to take up renewable projects of their own by demonstrating the potential for

renewable projects to be successful in Edmonton. This finding suggests municipal decision-makers believe municipal efforts can actually be on the vanguard of larger wave of community energy projects.

While noting the majority of Edmontonians are supportive of renewable efforts, participants did highlight sources of opposition. Among these include climate science denial, which nullifies the climate action motivations for renewable development, anger that renewable projects oppose the fossil fuel industries, a substantial source of economic activity in Alberta, and concern about effective use of taxpayer dollars, especially in the COVID recovery period. Though some participants felt there was greater appetite for municipal climate action efforts in Edmonton, the survey results show that few municipal decision-makers across Alberta actually ranked community opposition as a barrier to renewable development and many in fact feel community support is an opportunity. Whether this means that respondents feel the community supports renewable project or, like city participants, believe they can develop projects that mitigate concerns is unclear from the data. While I hypothesised that the support for oil and gas in the province would foster an anti-renewable stance in the province, which was not demonstrated in the data. This finding aligns with some of the threads discussed in the interviews, where participants felt that energy discussions have evolved to position renewable energy as the evolution of the Alberta energy industry and as possible to co-exist alongside conventional energy systems.

Both datasets also speak to the value of municipal projects being well-received beyond the municipality. The case study in Edmonton speaks about negative views of the oil and gas industry in Alberta and the potential for renewable energy to challenge that perception and attract new residents and businesses. Similarly, the survey shows that attracting new people to

Edmonton is perceived as one of the most significant opportunities for development, ranking above fostering pride in the existing community. Marketability is thus an economic motivation, growing the municipal economy and tax base.

Perceived Behavioural Controls

The survey and interview shared key findings about the perceived behavioural controls. Both datasets demonstrate the challenges from the capital funding required for renewable investment, especially considering renewable projects compete with other priorities for this funding. Coupling capital challenges, both datasets agree that external grants and loans are inadequate or too difficult to access, a substantial challenge considering the ability of external supports to catalyse renewable development demonstrated in the survey data. The interview data also confirms a surprising relationship in the survey data; the regression model shows that respondents who feel external challenges are a more substantial barrier than internal limitations are more likely to pursue renewable projects. At the city, respondents similarly cited several external forces as challenges, including challenges accessing grants, regulatory barriers, and a lack of support from the province particularly, yet remained determined to pursue renewable development.

While the perception of technological risk was considered a significant barrier in renewable development, embracing novel technology was another contentious theme in the interview data. Several participants felt that the city was risk averse in technology and not interested in piloting novel projects. Others disagreed, seeing the city's role as being able to inspire support by demonstrating the potential of renewable technology and should be, if not on the bleeding edge, then on the leading edge of technology. Projects like E.L. Smith Solar Farm and the Blatchford Energy utility demonstrate a "braver" perspective on renewable projects,

employing relatively novel technologies in Alberta. Interestingly, both projects are also not directly owned by the city and are instead owned by corporation with which the city is the sole stakeholder, indicative of the legal entities required for the ownership role. The variances in the participants' views on the city's aversion to technological risk suggests an interesting dynamic in municipal development, where certain decision-makers may push the envelope of what should be considered feasible while others hesitate to invest in these technologies. The survey results seem to demonstrate, ultimately, the perception of reliability is needed for intention and approval.

Another point of difference between the datasets is the magnitude of the barrier of knowledge limitations. Within the survey data, the economic barrier of the cost of planning renewable projects and the planning barrier of a lack of capacity from municipal staff were two of the lowest ranking challenges in their respective categories. In the case study, several city staff felt that expertise limitations were a more substantial barrier, with a council member even saying that a lack of capacity was the reason the city should not take an ownership role. A possible reason for this discrepancy is the scale of projects being considered. Several participants felt microgeneration was a simpler process, while community generation was considered to have more regulatory and technical complexity. Similarly, regulatory and administrative barriers were primarily discussed in interviews as a barrier to utility-scale generation, with Section 95 of the EUA and resistance from transmission grid providers being considered challenges. The survey did not collect information about regulatory barriers.

Opportunities for Future Research

Though this research presents an understanding of the decision-making motivation municipal energy projects, many opportunities for future research remain in the field. This research can identify the feasibility of specific opportunities, take a more detailed analysis of

specific relationships and themes presenting in this thesis and investigate the consistencies between the findings in Alberta to those across in other key jurisdictions.

As several participants and respondents alike discuss, municipalities are encouraged, inspired, and informed by other municipal energy projects. Here lies a crucial opportunity for researchers and academics; in researching the municipal energy projects in Canada, we not only build a better understanding of the phenomenon but can encourage and catalyse further development. One critical opportunity that can be pursued by academics, industry researchers, or the municipal associations of Alberta is an inventory of municipal projects, detailing key information like project size and cost, but also details such as installers, payback period, sources of funding, and others. This inventory can encourage municipal development by demonstrating not only what is possible but also some of the mechanisms avail to pursue these projects.

Dataset inquires

Both quantitative and qualitative datasets host a significant source of information, with the potential to answer several research questions not posed in this study. These questions include:

What informs preferences to different types of technologies?

The survey dataset collected information about preferred renewable technologies, not only the sources of energy (solar, wind, biomass, hydroelectricity, and geothermal), but also much more granular project types (solar on public building vs solar farm on vacant land, large wind farm in rural land vs horizontal axis wind turbines in urban land). Investigating these responses can present a more in-depth analysis of the preferred technologies in Alberta and why. Municipal characteristic variables such as geography, municipal type, and economic sector presence, which were largely insignificant in the statistical analysis conducted to assess

intention, may have more predictive validity to understand preferred energy types. Additionally, as the qualitative data demonstrates, the personal characteristics of the participants influences what they feel is possible in Edmonton. Technologies such as run of river hydro, district energy, and geothermal were all discussed as possible, influenced by personal characteristics like risk tolerance and knowledge of renewable technologies. The survey data can be further probed to understand what personal traits (climate change concern, role in the municipality, knowledge of renewable technologies) may influence what kinds of projects municipalities are interested in.

Preferred technologies may also demonstrate a relationship with motivations, opportunities, and challenges. Perhaps respondents that think renewable energy projects are attractive and desired are more likely to choose wind turbines as a highly visible technology? Respondents especially concerned about environmental impacts may choose rooftop solar as a relatively non-impactful development type. Relevant findings of these inquiries can support renewable generators and proponents target energy project opportunities to likely municipalities.

How are municipal decision-makers interested in financing renewable projects?

Municipal decision-makers were also asked about tools and financing options for renewable development, including partnerships and financing tools. Inquiries into what factors predict the willingness to use different financing options can help foster a greater understanding of the mechanics with which decision-makers are interested in pursuing development. Perhaps smaller municipalities are more interested in partnerships with private companies while larger municipalities are more interested in debt financing? Perhaps council members were interested in external grants, while municipal employees see value in tax increment financing? These questions again support renewable developers and proponents better understand how to shape and target opportunities to likely municipalities.

Further Data Collection and Analysis

Several opportunities for further investigations into municipal energy efforts can help build the literature base for this critical opportunity. Among these is attempting to replace these results in other jurisdictions; several of the key considerations in this study were informed by factors unique to the province, such as the support for the fossil fuel structure and the accessibility of provincial fundings. Research in other energy systems can investigate not only if the motivations, opportunities, and challenges vary in other jurisdictions, but also what roles municipal energy projects play in these energy landscapes.

An unexpected finding of this study is the possibility of hybrid scale projects, exhibiting traits of regime and innovation dimensions of transition theory. With hybridity being a theme not discussed in the transition theory literature reviewed yet discussed as relevant in the future of the Alberta energy system, more research into the emergence of these projects is necessary to build our understanding of the evolution of energy systems. Interviews with private firms can add to understanding how these projects emerge, while case studies into projects where a municipality is the beneficiary of a CBA can frame this research. This research can answer key questions about why these projects can emerge, how they are structured, and whether they can maintain a long-term presence in the Alberta energy system.

This research targeted two major groups of municipal decision-makers; members of council and municipal administration. However, there is another influential group: citizens. Future research can fill this gap, collecting and analysing detailed information using tools such as public surveys and citizen panels into whether the municipal citizens are in support or opposition to municipal investment into renewable projects. This research can be compared with the datasets discussed in this paper to determine if municipal decision-makers are aware of true

public sentiment to renewable development. This information can also support municipalities by informing decision-makers of public views and opinions, which can be incorporated into energy plans and policies.

Renewable energy is a timely and critical issue, providing a substantial opportunity to reduce the carbon intensity of the province. Community energy has been demonstrated to be a powerful tool to enable renewable development and may be especially salient in Alberta, a province where conventional energy systems have been critical for the wealth of the province. Community energy projects can preserve this legacy of a province supported by energy industries while acknowledging the weaknesses of the existing energy system in the carbon intensity of fossil fuel energy sources and the injustice of large, centralised generators, powering distant communities, profiting private corporations, and impacting local communities. Municipal governments are often overlooked in community energy research, sometimes intentionally as a government entity. However, as this research shows, municipal energy projects can demonstrate the procedural and distributive justice that is often used to define community energy.

The findings of these studies suggest a path forward for municipal energy development; certainly in microgeneration projects, where municipalities have demonstrated the intention to offset their own corporate emissions with on-site renewable energy, and; potentially in other roles, where some participants feel there are opportunities to become involved at the utility-scale, taking a role in community generation and potentially as a purchaser of renewable energy from private and even other community generators. While challenges to development remain, this study demonstrates that municipal energy projects can play a critical role in energy transition.

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Appendix A: Survey Information Sheet and Consent Statement

INFORMATION LETTER and CONSENT STATEMENT

Study Title: Identifying the Opportunities and Barriers to Municipal Renewable Energy Generation

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Background

- Our Research Team is currently surveying all the municipalities in Alberta and eventually Canada to understand whether they are interested in developing renewable electricity generation in their municipality. We are speaking with municipal policy-makers and decision-makers, including planners, municipal employees, councillors, and mayors. We have contacted you because we believe you can provide some insight into renewable electricity projects in your municipality.
- This research is funded by the Canada First Research Excellence Fund through the Future Energy Systems Research Initiative. This project will result in a number of papers, thesis projects, and presentations.

Purpose

- This study is trying to identify the demand, opportunities, and barriers regarding renewable electricity projects in Canadian municipalities. We want to understand whether municipalities are considering renewable electricity generation, what factors are influencing that perception, and how this demand changes in different municipalities
- This research will help us and researchers understand where there is demand for specific technologies and will help legislators, developers, and decision-makers create smart and effective policies about renewable electricity that benefit the country and the province, as well as enhance and support the local community and municipality.
- Our research is supported by the Rural Municipalities Association, Municipal Climate Change Action Centre, and the Federation of Canadian Municipalities and will be used to develop resources for municipalities interested in community energy.

Study Procedures

- The Research Team is using a survey of municipal employees and decision-makers to try and understand how they feel about renewable electricity. We are asking them to speak about their experiences with renewable electricity projects and their feelings about renewable electricity.
- This survey is estimated to take 20 to 30 minutes to complete.
- If you choose to complete the survey, your responses will be anonymized and added to all other responses. These will then be analysed using quantitative software to look for patterns and trends.

Benefits

- Our study will help developers and politicians make better decisions about renewable electricity. It can help them develop the right kind of renewable strategy for their community.
- Additionally, participation in this study provides an opportunity for you to be entered into a draw to win a $350 gift card. After completing the survey, you will have an opportunity to enter your email address in a draw. Your email will not be associated with the responses you give.
- There may not be any benefits for participating in this research.
- There are no costs to being in this study.

Risk

- Your email and personal information will not be stored, so we will not be able to associate responses with a specific respondent. While we will ask for your position, this information will be aggregated with similar responses. There is no risk to participating in this survey.

Voluntary Participation

- You are under no obligation to participate in this study and your participation is completely voluntary. You can also skip any specific question you do not feel comfortable answering. If you decide you do not want to participate and have already started, you can close the survey and any response you have provided will be deleted. Because the data is anonymized, after completing and submitting the survey, we cannot withdraw your response, as we cannot link your identity to your responses.

Confidentiality & Anonymity

- Your response will be made available to the Research Team members, but only after it has been anonymized. No one, not even the Research Team or the Principal Investigator, will be able to see your responses attached to your name.
- The anonymized data will be encrypted and stored on secure servers. Only the Research Team will be able to access the data. This data will be encrypted. According to University of Alberta policies, the anonymized responses will be stored for 5 years before being destroyed. Other researchers may use this data in future research projects, but if they do, they will get approval for the Research Ethics Board.

Further Information

- If you have any questions or concerns about this study or this survey, please contact Sonak Patel at sonak@ualberta.ca
- The plan for this study has been reviewed by a Research Ethics Board at the University of Alberta. If you have questions about your rights or how research should be conducted, you can call (780) 492-2615. This office is independent of the researchers.

Consent Statement

By proceeding with the survey, you indicate that you have read and understand the above information and that you agree to participate in the research study described above.

Appendix B: Survey Contact Sheet

To whom it may concern,

We are contacting you to ask if you are willing to participate in a survey regarding renewable energy development in your municipality. If you are willing to participate in this survey, we will be asking you questions about existing renewable projects, your inclination for renewable energy development, and some of the opportunities and barriers you may be facing. Your responses will help us develop a better understanding of the demand for renewable energy at the municipal scale. Our research is supported by the Alberta Urban Municipal Association, Rural Municipalities of Alberta, Municipal Climate Change Action Centre, and the Federation of Canadian Municipalities and will be used to develop resources for municipalities interested in community energy.

You will have an opportunity to win a gift card valued $350 dollars if you participate in this survey. The odds of winning this survey will depend on the number of responses we get, but the approximate odds are about 1/350.

Please be ensured that your responses will be completely confidential. We will ask for your position in the municipality and the name of your municipality, but this information will be aggregated in any publications and presentations. The individual responses will only be seen by the research team.

This survey will be done online and your responses will be recorded digitally. Please take the time to read all the questions and answer them as best as possible. The survey will take about 25 minutes to complete.

Please find a link to the survey here: *INSERT LINK*

Thank you again for your time and participation. If you have any questions regarding this survey, please consult the attached information sheet or contact Sonak Patel at sonak@ualberta.ca.

Sincerely,

Measuring the Costs and Benefits of Renewable Energy Transitions Research Team

Appendix C: Municipal Survey

ABOUT YOU

In this section, we will ask you to think about your personal experience, knowledge and understanding of renewable electricity. We will ask more questions about your municipality in other sections of the questionnaire.

QUESTION 1: Please provide the name of your municipality
OPEN ANSWER
Text response

QUESTION 2: Which of the following describes your position within the municipality?
CHOOSE 1

- Elected official (Mayor or councillor)
- Municipal administration
- Other (Please describe): _____
  4 = elected official, 5 = municipal administration, 6 = other

QUESTION 3: Do you have any experience planning or making decisions about renewable electricity? *PICK ONE*

- Yes. If so, please describe it here: _____
- No
  1=yes, 2=no

QUESTION 4: Would you consider yourself knowledgeable in any of the following renewable technologies? *CHOOSE ALL THAT APPLY*

- Solar photovoltaic (PV)
- Wind
- Biomass
- Hydroelectricity
- Geothermal electricity generation
- Wave
- Tidal
- None of the above
  0=no, 1=yes

QUESTION 5: How important is renewable electricity development to you? *PICK ONE*

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not at all important
  1=extremely important, 2=very important, 3=moderately important, 4=slightly important, 5=not at all important

QUESTION 6: How would you describe the current level of renewable electricity infrastructure in Alberta? *PICK ONE*

- Lacking; more renewable electricity projects need to be developed
- Adequate: there are enough renewable electricity projects that have been developed
- Overabundant: there are too many renewable electricity projects
- Don't know / unsure

1=lacking, 2=adequate, 3=overabundant, system missing=don't know

QUESTION 7: How do you feel climate change will impact your municipality? *PICK ONE*

- Climate change will have significant and irreversible impacts on my municipality
- Climate change likely will have minor but not significant impacts on my municipality
- I am uncertain whether or not climate change will have any impacts on my municipality
- Climate change is likely not real or is highly exaggerated and will not have any impact on my municipality.

1=significant, 2=minor, 3=uncertain, 4=not real

ABOUT YOUR MUNICIPALITY

In this section, we will ask you questions about the characteristics of your municipality.

QUESTION 8: Which of the following do you believe describes your municipality? For more information about these definitions, please hover your cursor over the responses or click on the following link: *CHECK ALL THAT APPLY*

- Cities
- Towns
- Villages
- Summer villages
- Specialized Municipalities
- Municipal Districts (As called a County)
- Hamlet
- Improvement District
- Metis Settlement
- First Nations Reserve
- Special Areas

0=no, 1=yes

To appear as text boxes when hovering above the responses

- Cities: Cities have populations over 10,000 people and have been granted city status
- Towns: Towns have populations between 1,000 and 10,000 people or above if a town has not been granted city status
- Villages: Villages have a population between 300 and 1,000.
- Summer Villages: Have populations between 300 and 1,000 but are required to hold elections in summer.
- Specialized Municipalities: Specialised municipalities allow urban and rural communities to coexist in a single municipal government
- Municipal Districts: Municipal districts are a government form in rural areas

- Hamlet: An unincorporated community within a MD or specialised municipality may be considered a hamlet if it has more than 5 structures, a generally recognised boundary and name, and contains some land for non-residential use.
- Improvement Districts: Within an improvement district, the Province of Alberta assumes all functions of local government.
- Metis Settlements: Settlements established under the Metis Settlement Act
- First Nations Reserve: Reserves are lands specified for use by Canada's Indigenous people
- Special Areas: Special Area refers to a rural area in southeast Alberta established by the Special Areas Act

QUESTION 9: Do you believe any of the following describe your municipality? *PICK ONE*

- Retirement Community
- Bedroom Community
- Seasonal Community
- Off-Grid Community
- None of the above

0=no, 1=yes

The following two questions will ask you about your infrastructure investment preferences. These questions are not specifically about renewable electricity.

QUESTION 10: Is your municipality interested in making major capital investments at this time? *PICK 1*

- Yes
- No
- Don't know / unsure

1=yes, 2=no, 3=don't know

QUESTION 11: What type of infrastructure investments are a priority in your municipality? *RANK TOP 3, RANDOMIZE RESPONSES*

- Upgrading or building roads, streetscapes, highways, and bridges
- Transit infrastructure and facilities
- Water and wastewater servicing
- Waste collection and processing
- Municipal or community buildings
- Developing recreation or parkland
- Electricity generation
- Electricity transmission or distribution
- Maintaining existing infrastructure
- Other (Please describe): _____

1=highest priority, 2=second highest priority, 3=third highest priority, system missing=unranked

QUESTION 12: Do you believe any of the following describes your municipality's economy? *CHECK ALL THE APPLY, RANDOMIZE RESPONSES*

- Significant agricultural sector
- Significant forestry sector
- Significant manufacturing sector
- Significant oil and gas sector
- Significant mining sector
- Significant tourism sector
- Significant technology and innovation sector
- Sector(s) not provided above, but is significant in my municipality. Please describe:

  _____

  0=no, 1=yes

YOUR MUNICIPALITY AND RENEWABLE ELECTRICITY

In this section, we will ask about the general level of knowledge, experience, and motivation for renewable electricity in your municipality as well as any existing or proposed renewable projects.

Renewable electricity projects are defined as any project that generates electricity from a source that is replenishing within the human timescale. This includes sources like solar, wind, and biomass. Some common examines of renewable electricity projects include solar panels on rooftops, wind turbines, and hydroelectric generators.

QUESTION 13: To the best of your knowledge, does your municipality own or co-own a renewable electricity project in development or completed? *PICK ONE*

- Yes: PATH 1
- No: PATH 2
- Don't know: PATH 2

  1=yes, 2=no, 3=don't know

PATH 1:

QUESTION 13.1: What kinds of renewable electricity project does your municipality own or co-own? *PROVIDE THE NUMBER OF PROJECTS BESIDE THE RENEWABLE SOURCE*

- Solar electricity Generators
- Wind electricity Generators
- Biomass electricity Generators
- Hydroelectricity Generators
- Tidal electricity Generator
- Wave electricity Generator
- Geothermal electricity Generators
- Other (Please Describe): _____

The next three questions will ask you about the renewable electricity projects owned or co-owned by your municipality. If you have multiple projects, please describe the most recent one.

QUESTION 14: Please describe your most recent renewable electricity project below. If you can, please include the technology and any co-owners: *OPEN ANSWER*

Text

QUESTION 15: When was this project approved? *ENTER YEAR*
Text

QUESTION 16: What, in your opinion, were the motivations behind developing the project and how important were these motivations? *CHOOSE THE SIGNIFICANCE FOR EACH MOTIVATION AND RANK THE MOST SIGNIFICANT MOTIVATIONS*

Motivations	Very Significant	Fairly Significant	Somewhat Significant	Barely Significant	Insignificant
Lowering costs by minimising electricity purchased from the grid					
Generating revenue through the sale of electricity or environmental attributes (e.g. emission offsets)					
Generating employment					
Reducing my municipality's carbon footprint					
Trying to achieve a specific carbon emission reduction target					
Becoming energy self-reliant					
Taking advantage of provincial and/or federal funding or support					
Seeing successful renewable projects in other municipalities					
Being perceived as an innovative municipality					
Other: _____ Please describe and provide significance of the motivation					

1=extremely important, 2=very important, 3=moderately important, 4=slightly important, 5=not at all important

RANK: 1=highest, 10=lowest, system missing=unranked

PATH 1 END, SKIP TO "IS THERE DEMAND FOR MUNICIPAL RENEWABLE ENERGY?"

PATH 2:
QUESTION 17: If no, to the best of your knowledge, was a renewable electricity project ever proposed or intended in your municipality? *PICK ONE*

- Yes PATH 3
- No PATH 2 END, SKIP TO "IS THERE DEMAND FOR MUNICIPAL RENEWABLE ELECTRICITY?"

1=yes, 2=no, 3=don't know

PATH 3:
The next two questions will ask about intended but failed renewable projects. If there are multiple projects that meet this criteria, please consider only the most recent one.

QUESTION 18: To the best of your knowledge, where in the planning process did this project stall? *PICK ONE*

- Initial planning and workshopping
- Initial feasibility and assessment studies
- Public consultation
- At council
- While tendering for developers and construction companies
- In operation
- Other (Please describe): _____

1=planning, 2=feasibility, 3=consultation, 4=at council, 5=tendering, 6=In operation, 7=other, 8=don't know

QUESTION 19: Which of the following barriers was the most significant in halting this renewable project? *RANK TOP 3*

- The project was found to be financially infeasible
- The project encountered significant regulatory barriers in the development phase
- The environmental assessment process uncovered significant environmental concerns
- The community opposed the project due to the cost
- The community opposed the project for reasons other than the cost (natural impacts, visual impacts, etc.)
- A private sector partner left the project
- A provincial or national grant or loan was not won or was cancelled
- City or town council opposed the project
- The project experienced a technical failure in operation
- The project starting losing money in operation
- There was a change in city or town council, causing priorities to shift
- There was a change in provincial or national governments, threatening the funding or economic feasibility of a project

- Other: Please describe _____
  1=highest, 2=second highest, 3=third highest, system missing=unranked

PATH 3 END

MOTIVATIONS FOR DEVELOPING RENEWABLE ELECTRICITY

In this section, we will ask about the motivations for developing renewable electricity in your municipality. Please leave aside your own views and preferences and consider the general view within your community regarding renewable electricity.

QUESTION 20: Is your municipality interested in developing municipally-owned renewable electricity? *PICK ONE*

- Yes PATH 4
- No SKIP TO OPPORTUNITIES FOR RENEWABLE ELECTRICITY DEVELOPMENT
- Don't know/unsure *SKIP TO OPPORTUNITIES FOR RENEWABLE ELECTRICITY DEVELOPMENT*
  1=yes, 2=no, 3=don't know

PATH 4:
QUESTION 21: In your opinion, how important are the following motivations when considering developing a renewable electricity project? *LIKERT SCALE AND RANK THE TOP THREE*

Motivations	Very Significant	Fairly Significant	Somewhat Significant	Barely Significant	Insignificant
Lowering cost by minimising electricity purchased from the grid					
Generating revenue from the sale of electricity or environmental attributes (e.g. emission offsets)					
Generating employment					
Reducing my municipality's carbon footprint					
Trying to achieve a specific carbon emissions reduction target					

Becoming energy self-reliant					
Taking advantage of provincial or federal funding or support					
Seeing successful renewable projects in other municipalities					
Being perceived as an innovative municipality					
Other: _____ Please describe and provide importance					

1=very significant, 2=fairly significant, 3=somewhat significant, 7=barely significant, 20=insignificant, RANK from 1=highest to 3, system missing=unranked

QUESTION 22: What types of renewable electricity technology would your municipality be interested in as a potential renewable electricity project? For more information about these technologies, please consult the following document: *CHOOSE ALL THAT APPLY*

- Solar
  - Rooftop solar or solar walls on public buildings
  - Rooftop solar or solar walls on private buildings, either leased or co-owned
  - Solar canopies on parking lots
  - Solar farms on undeveloped land
  - Floating solar panels on lakes, lagoons, and water reservoirs
- Wind
  - Horizontal axis wind turbines in urban areas (rooftop or undeveloped land)
  - Vertical axis wind turbines in urban areas (rooftop or undeveloped land)
  - A small wind farm on rural land (less than 5 turbines)
  - A large wind farm on rural land (over 5 turbines)
  - A small offshore wind farm (less than 5 turbines)
  - A large offshore wind farm (over 5 turbines)
- Biomass
  - A biomass facility using agricultural or forestry waste material
  - A biomass facility using purpose-grown crops for energy
  - A biogas facility using landfill gas
  - A waste to energy project using municipal solid waste
- Hydroelectricity
  - A hydroelectric dam
  - A hydroelectric run-of-river project
- Tidal energy facility
  - A tidal barrage generator
  - A tidal lagoon generator

    - A tidal stream generator
- Wave generation facility
- Geothermal generation facility
- None of the above: SKIP TO "WHAT ARE THE OPPORTUNITIES FOR RENEWABLE ELECTRICITY DEVELOPMENT?"
- Other (Please describe)
  0=no, 1=yes

For more information about these technologies, please consult the following attachment: https://docs.google.com/document/d/1imezoWd8nvPzmGBGNjAD8yGIhSfcaKGDB1BfTWV_cSA/edit?usp=s

QUESTION 23: *For each renewable technology chosen above:* What is it about *energy type* that is most appealing to your municipality? *RANK TOP 3*

- Minimal impact on the landscape
- Reliable and proven technology
- Cheap installation/operation cost
- Proven natural capacity near or in your municipality (*vary by type)*
    - High wind speeds
    - High solar radiation
    - Presence of adjacent forests, farms, or usable municipal waste (for biomass generation)
    - Presence of rivers with run-of-river or dam potential
    - Significant tidal variation
    - High subsurface temperatures at low depths
    - Strong and consistent wave regime
- Expected highest return on investment
- Minimal impact on the wildlife, avian life, and/or the natural environment
- Expected greater public acceptability
- Other: please describe
  Rank

PATH 5 END

OPPORTUNITIES FOR DEVELOPING RENEWABLE ELECTRICITY

This section will ask you to identify what you consider to be opportunities for developing renewable electricity in your municipality.

QUESTION 24: When making decisions about renewable electricity, what do you consider the greatest opportunities for your municipality? *RANK*

- Adopting renewable electricity instils pride in residents
- Adopting renewable electricity creates a positive image that attracts people and business
- Renewable electricity is or, in the near future, will be cheaper than fossil fuel electricity
  PATH 6
- Presence of federal and provincial incentives
- Renewable electricity provides economic diversification opportunities
- Significant community support for renewable power

- Other (please describe)
  1=highest to 3, system missing=unranked

QUESTION 25: When financing renewable projects, please rank your top three preferred methods of financing: : *RANK TOP 3*

- Co-financing with a private company through a P3 agreement
- Co-financing with the provincial or federal government
- Co-financing with another municipality or several municipalities
- Taking on greater debt
- Raising property tax
- Using tax increment financing or a community revitalization levy
- Using development charges or offsite levies
- Issuing bonds
- Other (Please describe): _____
  1=highest to 3, system missing=unranked

QUESTION 26: In your opinion, in the next 25 years, how likely is it that the price of electricity will rise? *NUMERICAL SCALE*

0	1	2	3	4	5	6	7	8	9	10
Unlikely					Somewhat likely					Very likely

QUESTION 27: Which of the following do you think are the most important factors influencing the price of electricity? *RANK TOP 3*

- Global supply of fossil fuels becomes depleted
- Carbon pricing is increased
- Demand for electricity rises
- Existing generators reach the end of their lifespan
- The province develops utility-scale generators or infrastructure using public funds
- Carbon pricing is reduced
- Energy efficiency improves
- More electricity trade with other provinces or the US
- More utility-scale renewable projects are developed
- Other: _____
  1=highest to 3, system missing=unranked

PATH 6 END

BARRIERS TO RENEWABLE ELECTRICITY DEVELOPMENT

This section will ask you to identify the greatest barriers to the development of renewable electricity projects in your municipality.

QUESTION 28: When making decisions about renewable electricity, which of the following economic factors do you consider to be the greatest barriers for your municipality? *RANK THE TOP 3*

- Renewable electricity planning, assessment, and/or engagement is too costly
- Renewable electricity projects have capital costs that are too high
- Renewable electricity projects have operational and maintenance costs that are too high
- Renewable electricity projects have payback periods that are too long
- The cost of electricity is cheap and therefore renewable projects will not generate enough revenue/savings

  1=highest to 3, system missing=unranked

QUESTION 29: When making decisions about renewable electricity, which of the following environmental or technical factors do you consider to be the greatest barriers for your municipality? *RANK THE TOP 3*

- Renewable projects diminish the natural vistas in my municipality PATH 7
- Renewable projects create noise and health disturbances
- Renewable projects can adversely impact wildlife in my municipality
- Renewable electricity technology and infrastructure is not advanced enough to be feasible in my municipality
- The electricity grid in my municipality and/or province cannot support a municipal renewable electricity project
- Renewable electricity projects are too risky

  1=highest to 3, system missing=unranked

QUESTION 30: When making decisions about renewable electricity, which of the following political or planning factors would you consider to be the greatest barriers for your municipality? *RANK THE TOP 3*

- Municipal staff lack the technical capacity to plan for renewable electricity
- Provincial grants and loans are too competitive or unstable PATH 8
- My municipality can reduce our carbon footprint without developing renewable electricity infrastructure
- The province will not support a renewable electricity project
- My municipality has other priorities than renewable electricity generation PATH 9
- Developing renewable electricity generation is not a municipal responsibility
- The community will oppose renewable electricity infrastructure
- The town or city council will oppose renewable electricity projects

  1=highest to 3, system missing=unranked

QUESTION 31: Are there any other barriers not mentioned above that are significant in your municipality? *OPEN ANSWER*

PATH 7:
QUESTION 32: Do you believe the visual impact of renewable electricity projects will: *CHOOSE ALL THAT APPLY AND RANK*

- Reduce tourism to the municipality
- Reduce property values in the municipality
- Reduce the number of residents immigrating to your municipality
- Reduce the commercial and industrial investment in your municipality
- Reduce the cultural or heritage value of the land
- None of the above

PATH 7 END
PATH 8
QUESTION 33: In your opinion, what is the likelihood of provincial or federal support for renewable electricity decreasing over the next 5 years? *NUMERICAL SCALE*

0	1	2	3	4	5	6	7	8	9	10
Unlikely					Somewhat likely					Very likely

PATH 9
QUESTION 34: How will your renewable electricity priorities change as the following factors change? *SCALE*

Change	Greatly increase our interest in developing renewable energy generation	Somewhat increases our interest in renewable energy generation	Will not affect our interest in renewable energy generation	Don't know/unsure
Price of electricity rise				
Municipal budget increases				
Municipal debt decreases				
Your municipality grows in population				
A national carbon emission reduction target approaches				
A provincial carbon emission reduction target approaches				
Electric vehicles become more popular				

Climate change impacts: Sea levels rise significantly				
Climate change impacts: average temperatures rise				
Climate change impacts: extreme events frequency rises				
The price of renewable electricity technologies decrease				
Other: please describe and rank				

1=greatly increase, 2=somewhat increase, 3=will not affect, 4=don't know

PATH 9 END

QUESTION 35: Do you have any other comments regarding municipally-owned renewable projects or this survey? *OPEN ANSWER*

QUESTION 36: Is there anyone else who you believe could provide insightful responses to the questions in this survey? If so, can you provide us with their contact information? *OPEN ANSWER*

QUESTION 37: Would you be willing to participate in follow-up interviews or discussions? *PICK ONE*

- Yes
- No

If yes, please provide an email or phone number we can reach you at: _____

Please be assured this information will be stored separately from your response, so we will never be able to associate your name with your responses. We will also only be using your contact information to contact you about follow-up interviews and for no other purpose. This information will not be released to the public or other organizations.

QUESTION 38: Would you like to be entered in our prize draw for a $350 gift card? *PICK ONE*

- Yes
- No SKIP TO NEXT QUESTION

Please provide an email where we can reach you, if you win the sweepstake: _____
Please be assured this information will be stored separately from your response, so we will never be able to associate your name with your responses. We will also only be using your contact information to contact you about sending you the gift card. This information will not be released to the public or other organizations.

Appendix D: Interview Information Sheet

INFORMATION LETTER and CONSENT STATEMENT

Study Title: What determines municipally-owned renewable energy development? Insights from a mixed-method study of municipalities in Alberta (Pro#00102224)

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Background

- Alberta is a carbon-intensive province and developing renewable energy can play a significant role in reducing the province's greenhouse gas emissions, contributing to national targets and mitigating climate change
- Albertan municipalities that develop renewable energy projects can receive many benefits, such as a non-tax form of revenue, more energy conscious decision-making, local employment, reduce vulnerability to grid failures, social networks, and municipal pride.
- Municipal renewable energy projects can also be considered a type of community energy, a energy development type that places greater emphasis of democratic decision-making and the fairness of who is harmed and who benefits from an energy system.
- This study is being conducted as part of the Principal Investigator's graduate degree.

Purpose

- This study is trying to identify the motivations, opportunities, and barriers to municipalities developing renewable electricity projects. We want to understand whether municipalities are considering developing renewable projects and what factors are influencing that intention.
- This research will help us understand what local governments consider the biggest motivations and barriers to developing renewable projects and will help legislators, developers, and decision-makers create smart and effective policies to capitalize on opportunities and remove barriers.

Study Procedures

- The study includes an analysis of a survey of municipal decision-makers from fall of 2019.
- The findings of the survey will be complemented by an in-depth analysis of renewable development in Edmonton, Alberta. This analysis will be done by examining plans and policies that have been approved and through interviews with municipal employees, individuals working for industry and support institutions, experts in the field of community energy, community organisations that have developed renewable projects, and elected officials.
- Interviews will be approximately 1 hour in length and will be recorded and transcribed.
- Any identifying information about employees will be removed when the findings are presented or published.

Benefits

- Our study will help developers, local decision-makers, and provincial and federal governments better understand opportunities and challenges to renewable development. This can result in more supportive provincial and federal policies, provide more direction to local governments that want to develop projects, and help developers work alongside municipalities to develop cooperative projects.
- The City of Edmonton will receive an in-depth analysis of the perceived benefits and challenges to renewable development, assisting in the potential development of an energy project
- There may not be any benefits for participating in this research.
- There are no costs to being in this study.

Risk

- Interviewees can skip any questions or topics they do not want to speak about and can end the interview at any time
- Interview response will be anonymized in any public data presentation or publication.
- Interviewees will have the opportunity to review a transcript of their interview to redact or clarify any statements.

Voluntary Participation

- You are under no obligation to participate in this study and your participation is completely voluntary. You can also skip any specific question or topic you do not want to speak to. You will receive no negative impacts from not participating in this study.

Confidentiality & Anonymity

- The audio recording and transcription will only be made available to the principal investigator and supervisor. After the transcription is approved, any identifying information will be removed from the transcription.
- If you would like your direct quotes to be attributed to yourself, please indicate so below.
- The anonymized data will be encrypted and stored on secure computers and servers. According to University of Alberta policies, the anonymized responses will be stored for 5 years before being destroyed. Other researchers may use this data in future research projects, but if they do, they will get approval from the Research Ethics Board.

Further Information

- This study is funded by the Social Sciences and Humanities Research Council and the Future Energy System Research Initiative.
- If you have any questions or concerns about this study or this survey, please contact Sonak Patel at sonak@ualberta.ca
- The plan for this study has been reviewed by a Research Ethics Board at the University of Alberta. If you have questions about your rights or how research should be conducted, you can call (780) 492-2615. This office is independent of the researchers.

Consent Statement
Please circle your answers.

Do you consent in participating in a discussion about municipal energy development in Edmonton?

Yes No

Have you received, read, and understand the attached Information Sheet?

Yes No

Do you understand the benefits and risks of taking part in this research?

Yes No

Do you understand that you may skip any questions or leave the interview at any time? You do not need to say why.

Yes No

Do you understand that this interview will be recorded and transcribed? Do you understand that only the principal researcher and supervisor will have access to unedited transcript?

Yes No

Would you like your direct quotes to be attributed to you? If you select no, the quotes will be anonymized?

Yes No

Do you consent to us using the data you provide for this study?

Yes No

By signing on the below line, you consent that you have read and understand the above information and that you agree to participate in the research study described above.

Signature: _____

Date: _____

Appendix E: Interview Guide

Introduction:

Hello, how are you?

Thank you very much for agreeing to this interview. Is it okay if I start recording now?

I sent over an information sheet with some details about this study, did you have a chance to review it? Do you have any questions or would you like me to go over anything? Have you signed the consent statement?

Okay, so I will be asking a few questions. If there is anything you are uncomfortable with, just let me know and we can skip. You can also end the interview at any time, if you want. The interview will be recorded and transcribed. I'll send you the transcription and you can redact any information you don't want to be considered part of the study. Do you have questions before we begin?

About the respondent:

Can you tell me a little bit about yourself and what you do in the City of Edmonton?

- How long have you been at your position?
- What attracted you to this position?

Do you have any experience planning renewable energy projects?

Intention:

Do you believe the City of Edmonton should be developing renewable projects?

- *If yes or it depends/maybe:* What kinds of projects do you think the City should be developing?
    - What technologies/sources do you think we should be developing?
    - What ownership structures/partnerships do you think have potential for renewable projects?
        - P3s? Intermunicipal partnerships?
        - Financing tools? *E.g.* bonds, tax increment financing, etc.

If yes to above. How do you think renewable development could be integrated into policy? For example, do you think renewable targets and goals should included in the upcoming City Plan or changes to the Land Use Bylaw?

Attitudes:

Do you think municipally-owned renewable projects could provide benefits to the City of Edmonton? What do you think these benefits may be?

If the respondent says the City should not be developing projects, ask this question before the above question. What do you think are risks or negative impacts of developing a renewable project?

Benefits and Harms Follow-Up Questions (If these topics come up in the discussion during the above questions, ask then, otherwise follow-up after)

- Environmental:
    - How do you think climate change will affect Canada? How about Edmonton?
    - What role do you think municipal governments have in the global effort to reduce greenhouse gas emissions?
    - *Ask if the respondent says local governments have a role in climate action.* Do you think that developing renewable projects is a good opportunity for the City of Edmonton to reduce greenhouse gas emissions?
    - Do you think Edmontonians' behaviour would change if the City develops renewable energy projects?
    - *If they mention an impact on urban form or energy self-sufficiency.* Do you think developing renewable projects could result to more sustainable planning?
- Economic:
    - Do you believe investing in renewable development is a good economic decision for the City of Edmonton?
    - Do you think renewable development will have adverse economic impacts?
- Technical:
    - Do you think local renewable power can resolve problems with energy security, like blackouts or spikes or drops in price?
    - Do you have any concerns with renewable technology that discourage you from wanting to develop a renewable project?
- Social:
    - Do you think a local renewable project is something Edmontonians would be proud of?
    - Do you think renewable projects could enhance Edmonton's image to residents and/or businesses?
- Other
    - Is there another reason we haven't talked about yet that would encourage you to develop a renewable project?

What do you think is the most important reason to develop a renewable project? [List motivations from earlier question]

Subjective Norms:

How do you think Edmontonians would react if The City of Edmonton was to propose a renewable project? Why?

- What kinds of things do you think would make the public more receptive to a local renewable project? *e.g.* technology/source, location, earmarked revenue, funding, etc.
- Why do you think people might oppose a renewable project?

How do you think the City Council would react if you were to propose a renewable project to council?

How do you think other departments in the city administration would feel about developing a renewable project? Do you think it would receive much support or opposition?

How do you think businesses/industry in Edmonton would react if The City of Edmonton was to propose a renewable project? Why?

How do you think the provincial government would react if The City of Edmonton was to propose a renewable project? Why?

Perceived Behavioural Controls

Do you think it would be difficult for Edmonton to develop renewable energy projects?

What do you think are the biggest challenges to developing a renewable project?

What do you think are the biggest opportunities or things/intuitions that would support the City of Edmonton if we were to develop a renewable energy project?

Transition Theory

Do you think there are challenges to municipal energy projects because of the existing energy market?

Do you think energy corporations are supportive to municipal energy development?

Do you think the provincial government is supportive of municipal energy development?

Do you think other municipalities are interested in developing renewable energy projects? Have you seen or heard of any other municipal energy projects?

Community Energy and Justice:

How important do you think it is to get citizen input into renewable project design?

How do you think the City should go about engaging the public about a specific renewable project?

How do you think the revenue generated by a renewable project should be used?

- Do you think the revenue should be used for programs or services for the community immediately around the project?

How do you think municipal renewable projects could be designed to be fair to the local community?

- What do you think fairness means when talking about a municipal renewable project?

Snowball Sampling

Is there someone else who you feel I should be talking to about renewable development?

Can you think of someone with a different opinion about renewable development that I should speak with?

Thank you very for your time. Do you have any other comments you want to be included in this interview?

For this interview, I will begin transcribing our discussion. Once that is done, which should not take longer than a month, I'll send that to you. Please review the transcript and if you have any issues or statements you would like removed, please indicate so and I will strike it. Once that transcript is good with you, I will remove your name and identifying information to begin the analysis. Does that sound good to you? Do you have any questions or concerns?

If you have any further questions, comments, or issues, please do not hesitate to contact me. Thank you again for your time.