UNIVERSITY OF CALGARY

Residential Solar PV Standard in Alberta

by

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Abstract

Alberta is one of Canada's most attractive jurisdictions for solar PV deployment because of the resource availability. Alberta's recent regulatory environment, which included attractive incentives that encouraged residential solar PV deployment and installation, resulted in tremendous growth in solar PV systems (1 MW in 2009 to 45 MW in 2017). This paper examines whether a residential solar PV standard in Alberta should be implemented, and what role a standard could play in increasing uptake and deployment of solar PV systems. The research includes an examination of minimum accreditation required for residential installations, the impact of having consistent regulatory approaches throughout the province, and what incentive policies could result in sustained residential solar PV development. Through reviewing policies and approaches used in other jurisdictions, this project aims to provide recommendations for a regulatory environment in Alberta which does not introduce additional barriers for consumers and installers and improves the industry's reputation.

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AMSP: Alberta Municipal Solar Program

CanSIA: Canadian Solar Industries Association

CEIP: Clean Energy Improvement Program

FIT: Feed-in Tariff

kW: Kilowatt

kWh: Kilowatt-hour

MCCAC: Municipal Climate Change Action Centre

MGA: Municipal Governance Act

MW: Megawatt

NABCEP: North American Board of Certified Energy Practitioners

NAIT: Northern Alberta Institute of Technology

PACE: Property assessed clean energy program

PV: Photovoltaic

RCSP: Residential and Commercial Solar Program

SAIT: Southern Alberta Institute of Technology

SESA: Solar Energy Society of Alberta

Chapter 1 - Introduction

Alberta's electricity grid relies heavily on coal for power generation. However, as part of the Government of Alberta's *Climate Leadership Plan*, the previous provincial (New Democratic Party) government (elected in 2015) committed Alberta to phasing-out coal-fired power generation in Alberta by 2030, and to having renewable energy contribute 30% of the power grid by 2030 (Government of Alberta, n.d.b). Due to this transition away from coal-fired power and this new commitment to renewable energy development, an emphasis was placed on integrating new forms of renewable energy into the Alberta grid.

Renewable power generation opportunities, such as solar photovoltaic (PV) systems, have become viable options which can fill the gap left by the transitioning away from coal-fired power. Renewable energy sources, such as solar PV systems, have recorded a large increase in deployment over the last decade, partially due to the falling costs of solar PV systems and components, and the incentives provided under the *Climate Leadership Plan*. For example, Alberta had approximately 50 solar PV systems installed in 2009 (Howell, 2018). By the end of 2017, this number had increased to more than 2,250 systems. This increase in solar PV systems also resulted in the total installed PV generating capacity in Alberta increasing from approximately 1 megawatt (MW) in 2009 to over 45 MW by the end of 2017. In comparison, installed capacity of solar PV grew approximately threefold in Canada, from approximately 4,000 MW to 12,000 MW, over the same period (Natural Resources Canada, 2018).

In addition to the emphasis placed on renewable energy in Alberta through provincial policies, Alberta is also one of Canada's most attractive jurisdictions for solar PV deployment from a resource availability perspective. It has the highest average annual equivalent of full sunlight hours of all provinces and territories, with 1,276 hours (the Canadian average is 1,126

hours) (Energy Hub, n.d.). Alberta also ranks above the Canadian average for cost per installed Watt of solar PV at $2.77 – $3.02.

Despite the attractiveness offered through public policies and low installation costs in Alberta, the residential solar industry's lack of maturity presents regulatory barriers through the lack of a consistent regulatory environment. Currently, the residential solar PV industry in Alberta is regulated by individual municipalities at one level and the provincial government on another. The Government of Alberta is the regulating and enforcing authority of codes and standards, with municipalities providing permitting and inspection services within their jurisdiction in accordance with provincial requirements (Municipal Climate Change Action Centre, 2017). For example, the Government of Alberta dictates the codes and standards required for master electricians and electrical codes in Alberta.

As a result, the permitting process and required procedure for new residential solar PV installations and inspections can differ depending on the municipality in Alberta. For example, some municipalities outline the requirements for residential solar PV in its bylaws whereas others deal with applications individually, some municipalities require development permits while others do not. This lack of a singular approach can result in inefficiencies and inconsistencies in the installation process, thereby increasing the installation costs rather than decreasing them over time. This report will provide recommendations for how a more consistent and uniform approval process and regulatory approach to the residential solar PV industry in Alberta could be implemented in order to reduce barriers, inefficiencies, and ultimately lower the cost of installations in the provinces.

My research questions is:

> What approach can the government of Alberta use to introduce and apply industry best practices and regulations to allow for consistency in the quality of residential solar installations, while ensuring transparency and ease of understanding for customers?

This capstone report will consist of four main sections: 1) A review of the residential solar industry in Alberta; 2) An analysis of approaches, policies, regulations and standards used in other jurisdictions; 3) A survey, including an interview questionnaire, circulated to individuals involved in the residential solar PV industry in Alberta; and 4) Recommendations for how Alberta may be able to adopt aspects of these in developing its own regulations and standards. The survey questionnaire asked respondents for their input on Alberta's solar PV industry, opportunities or existing barriers, and how a province-wide approach could function.

The topic of this report was chosen in January 2019, when many of the provincial government's policies and 2030 goals were clear. However, with the election of a new (United Conservative Party) provincial government, there exists uncertainty as to whether the policies and goals introduced by the previous government will be maintained. Even though some of the incentive policies have been suspended and the longevity and role of some programs and regulatory bodies (Energy Efficiency Alberta) are uncertain, this report focuses on several different aspects which can influence and promote the installation of solar PV. As a result, aspects of this report (incentive policies and subsidies) may not be as relevant if there is a significant change in policy direction, such as government policies, but other areas, such as certification and accreditation levels, may be less impacted.

1.1 Goals and objectives

Aspects of this report, such as accreditation policies, could be implemented without industry input or consideration and in ways which would introduce additional barriers and consequences for installers or consumers. For example, a mandated requirement for solar-specific training for installers or technicians could be implemented immediately but could be a barrier to entry for new installers and could result in an increase in installation costs. This approach could restrict installers that do not have the new certification from working in the industry, and could increase their operating costs, which may then be passed along to consumers.

Instead, the aim of this research is to provide recommendations for regulations and standards which will not introduce additional barriers for consumers and installers and bring consistency to the industry through a uniform approach throughout the province. The goal of this project, through the four sections, is to provide recommendations for a regulatory environment which is: safe, accessible, has the ability to improve the industry's reputation, is easy to follow, consistent, and does not introduce additional barriers for consumers and installers.

1.2 Interdisciplinary Nature

This capstone project will focus on three main areas: energy, the environment and policy development review. By looking at the residential solar PV industry in Alberta in comparison with other jurisdictions, I will be examining an energy industry, thereby fulfilling the energy requirement for the project. The renewable energy aspect of this project is correlated with the review of the residential solar PV industry in Alberta, thereby fulfilling the environmental requirement for this project, as the renewable energy installations will reduce overall environmental impact in terms of carbon dioxide emissions and other contaminants associated with coal and other fossil fuels. In addition to reviewing the residential solar PV industry, this

project will review existing policies, incentives and requirements throughout Alberta and other national and international jurisdictions. Finally, by reviewing approaches and policies used by other jurisdictions and providing recommendations for policy and industry development, I will be focusing on policy and how it can be designed to foster improved uptake of residential solar PV and lead to more efficient and effective projects overall.

1.3 Research Methodology

Research for this project took place in two parts: an analysis of residential solar PV policies, practices, and regulations; and a 12-question survey/interview questions of residential solar industry professionals and participants in Alberta. The feedback and information received from these two aspects of the research provided me with answers and direction, which ultimately led to the recommendations in Chapter 7 of this report.

The first form of research, the analysis and research of residential solar PV policies, practices and regulations, focused on jurisdictions with aspects of their applications which I thought could be implemented in Alberta and key takeaways or lessons-learned for the systems they implemented. Bylaws, incentive policies, subsidy programs, certification programs, and accreditation requirements were reviewed. Through this research, an analysis was conducted of various aspects of the residential solar PV industry in Canada (Alberta and Ontario), the United States (California and Texas), Japan, and Germany. This research can be found in Chapter 3.

The second form of research, a 12-question survey, was circulated to residential solar PV professionals in: government agencies, consultancies, research companies, installation companies, and consumers who have had solar PV panels installed on their homes. The questions focused on identifying gaps and barriers within Alberta's residential solar PV industry, the impact of regulatory and regime change, the aspects needed for the industry to continue its

growth, and the viability and potential role of a provincial regulating body. The goal of the survey was to collect information from a variety of people involved in the industry in order to better understand the role of a potential regulating body, and any further areas of research. The main findings of the responses can be found in Chapter 4: Survey Results, with the full list of survey questions available in Appendix C.

Chapter 2 - Current Practices

This chapter examines the current regulatory environment, installation process, and addresses the question of why residential solar PV systems are beneficial to Alberta. In this chapter the Alberta bylaws, applicable provincial and national regulations, and permitting processes are reviewed.

2.1 Current Regulatory Environment

2.1.1 Alberta Bylaws

A bylaw is a law made by a local authority in accordance with the powers conferred by or delegated to it. In Alberta, the delegating authority is the *Municipal Governance Act* (MGA) (Alberta Municipal Affairs, 2017). Section 7 of the MGA outlines general jurisdictions required to pass bylaws and also provides broad authority for each municipality to develop its own bylaws. The MGA regulates the parameters of bylaws and determines what restrictions or rules are enforced within each municipal jurisdiction. This results in each municipality being able to create its own permitting and inspection services as long as it abides by the provincial requirements under the corresponding provincial requirements (Municipal Climate Change Action Centre, 2017).

In Alberta, there are 352 municipalities, varying in population size from 10 to more than a million (City of Edmonton, 2018). This gives rise to the potential for a wide range of differing regulations and approaches to residential solar PV installations. In some smaller jurisdictions, such as Red Deer, residential solar PV applications are managed individually whereas in larger cities, such as Calgary and Edmonton, there are clear bylaws outlining requirements. This large variation and lack of consistency of regulations between jurisdictions can introduce uncertainty for customers, installers, and regulatory bodies, and may be a barrier to proceeding with a

project. Such an approach can also make it uneconomical for both consumers and installers that are seeking to get involved in the industry.

2.1.2 Provincial and National Regulations

In Alberta, the Government of Alberta, through legislation and agencies, is the regulating and enforcing authority of codes and standards, with municipalities providing permitting and inspection services within their jurisdiction in accordance with provincial requirements (Municipal Climate Change Action Centre, 2017). In addition to the municipal regulatory abilities outlined in subsection 2.1.1 of this report, several provincial Acts and Regulations, and national standards play a key role in the installation and implementation of renewable energy. Examples of such provincial Acts are the micro-generation regulation, the *Alberta Safety Codes Act*, and the *Electric Utilities Act*. Other provincial codes and standards, such as the *Alberta Building Code*, can be necessary and impact the installation process if additional structures or structural changes are required. National standards, such as the Canadian Electrical Code, ensure that a solar PV system has been safely installed.

The main provincial Act dictating and impacting residential solar installations is the Micro-Generation Regulation under the *Electric Utilities Act*. This Regulation aims to allow Albertans to meet their own electricity needs by generating electricity from renewable or alternative energy sources and earn credits for what they feed to the grid (Government of Alberta, n.d.a). The Act, which was implemented in 2008, is technically a form of incentive policy, known as “net metering”, as it allows for participants to earn credits or recognition for power delivered to the grid (Rural Municipalities of Alberta, 2008). As a result, participants under the Micro-Generation Regulation must be grid-connected. The Regulation differentiates

between two kinds of micro-generators: under 150 kilowatts (kW) (small micro-generators), and 150 kW to 5 MW (large micro-generators) (Micro-Generation Regulation, 2018).

The differentiation is due to different credit rates (Government of Alberta, 2019a). A small micro-generator system is credited (by financial reimbursement) for the electricity sent back to the grid on a monthly basis at their retail rate. This allows smaller solar PV systems, such as those used by many homeowners, to earn financial credits for what they send to the grid. As the rate is determined monthly, it provides less uncertainty than large micro-generator systems, which are credited for electricity sent back to the grid at the hourly wholesale market price. The maximum size of a large micro-generating unit, 5 MW, is more targeted towards larger generation than residential generation (Micro-Generation Regulation, 2018). Under the Regulation, homeowners are able to meet their energy needs and earn credits for extra generation but are limited to approximately the amount of power required to power their homes. For context, a 5-6 kW system in Alberta would be sufficient for residential homeowners in Alberta (Smith, 2017).

Despite the credits homeowners can receive for exporting power to the grid, homeowners are still required to pay: distribution charges, transmission charges, a local access fee, delivery charge, and balancing pool allocation (Utilities Consumer Advocate, n.d.). Much of the regulatory environment under the Micro-Generation Regulation is regulated by distribution companies and the Alberta Utilities Commission, an independent quasi-judicial agency of Alberta (Alberta Utilities Commission, n.d.).

As previously mentioned, the approach of having local jurisdictions set their bylaws can create challenges for consumers and installers as different regulatory requirements can exist in each situation. As hundreds of municipalities exist in Alberta, there can be variation in the

process but the installation process in Alberta would generally require: an electric permit, a development permit, a building permit, and a micro-generation project notice. Final inspection and approval by accredited authorities (usually City Inspectors) is also required to ensure compliance with regulations and Provincial Acts, as well as safe installations. For more information on the solar installation and permitting process, please see *2.3 Current Solar PV Installation Process*.

2.2 Alberta's Residential Solar PV Installation Process

2.2.1 Current Installation Process

The current process for the installation of a residential solar PV system by an installation company involves several steps. As this project focuses on the installation process for the majority of Albertans, the following process will focus on the installation steps required if a system were to be installed by an installation company. The steps may differ depending on which installation company is used, or if a homeowner installs it themselves. However, because of the required permitting, some aspects of this process will remain consistent regardless of whether the homeowner is installing a solar PV system on their own or not. Several of the permitting processes would still require installation by an installation company or by the required licensed professional.

The first step is an initial appraisal of a solar PV system on a specific property. This activity is required to estimate the cost and the overall feasibility of the installation. During this step, assuming a contractor has already been chosen, a high-level assessment of the property would be conducted, as well as an investigation of potential installation locations to determine overall feasibility. The second step is for a contractor to make a proposal to the homeowner. The homeowner would provide the contractor with a copy of the home's utility bill to demonstrate

the power usage. As a result, proposals feature estimated costs associated with the installation and return on investment, and available options for the installation. While the initial appraisal can occur over the phone, a formal proposal usually necessitates a site visit by the company (Kuby Renewable Energy Ltd., n.d.).

Before the third step occurs five permits and agreements may be required: a micro-generation project notice, an interconnection agreement (possibly), building permit, development permit, and electrical permit. Electric utility companies usually require homeowners seeking to make use of the Micro-generation regulation to sign an interconnection agreement (Solar Energy Society of Alberta, 2015). Once the electrical permit and inter-connection agreement are approved the third step of installation the solar PV system can occur. However, the system is not yet connected to the grid on installation.

The fourth and final step of the project is inspection and commissioning of the project. In Calgary, Edmonton and Red Deer, an inspection is required by a City Inspector to ensure the system has been safely installed. Once the inspection has been passed a bi-directional meter is installed to monitor power usage used and amount of electricity provided to the grid.

2.2.2 Permitting Process and Requirements

The need for some of these permits and agreements is based on the location of the installation. The five documents are: an electrical permit, a micro-generation project notice, a development permit, a building permit, and a grant application (Kuby Renewable Energy Ltd., n.d.). If an installation company is involved in the process, it will often apply for the electrical permit and the grant application. The electrical permit is a safety permit governed by the Canadian Electrical Code and can only be obtained by a Master Electrician (Howell, 2018). The electrical permit is used to notify the electrical authorities about what work is being completed

and at which location. A micro-generation notice allows homeowners with solar PV installed to earn credit for the energy being exported to the grid. It involves submitting plans and receiving approval from the Alberta Utilities Commission and local power provider (Government of Alberta, 2019a).

A development permit is used by municipalities to ensure changes to land use adhere to the rules and intentions of the local land use bylaws (Municipal Climate Change Action Centre, 2017). This is primarily done to ensure the land-use is aesthetically pleasing, fits with the neighborhood and does not interfere with or significantly impact the adjacent properties. This permit may be required, depending on the municipality. For example, development permits are not required for residential solar PV installations in Cochrane (Town of Cochrane, n.d.).

A building permit is required for any changes to a building's structure, such as changes to the roof reinforcement. The permit is used to ensure a building's structure has not been compromised, and solar PV systems have been properly attached to buildings and ground mounted attachments in according to building and fire safety codes. Finally, a grant application may be required if grants are available. An installation company would also apply for a grant application on a homeowner's behalf is required (Kuby Renewable Energy Ltd., n.d.). Additionally, in an attempt to reduce barriers and introduce consistency into the industry, several industry associations and organizations have developed and adopted their own best practices and code of ethics. Some of the organizations have also made recommendations for how province-wide or national solar standards can be achieved.

2.3 Why a Residential Solar Standard Is Needed in Alberta

Between April 2017 and November 2018, Alberta had more than 950 new commercial and residential solar installations (Bartko & Kraus, 2018). This increase in the number of

installations was part of a trend that saw 3,100 total installations and an increase in the solar PV industry of 500 per cent between 2015 and 2018. This growth occurred despite the lack of minimum accreditation level or a consistent regulatory approach for residential solar PV installations in Alberta, thereby illustrating the growth prospects for solar energy and PV in the province.

The current approach in Alberta provides a municipality with the flexibility to design and implement its own permitting approach and policies for residential solar installations that best suits its needs. The provincial regulatory environment in Alberta, through the Micro-Generation Regulation, also seeks to minimize risks and barriers, negative impacts, and potential gaming of the system, while ensuring a consistent approach. For example, in an attempt to thwart gaming of the Regulation, it was designed to allow installations which can provide power up to the size of the homeowner's annual consumption (Solar Energy Society of Alberta, 2015). However, the current approach also has negative consequences for the industry, consumers, and installers.

By allowing municipalities to set their own restrictions, permitting processes and inspection protocols, a large variation in approaches and standards can exist between jurisdictions. Under the bylaws of each city, the requirements for residential solar PV installation are similar, but have slight differences. The bylaws are where the most complex and intricate variations in the residential solar PV installation could appear. This could also result in the differing bylaws being the most challenging area of recommendation and modification.

For example, both the Edmonton and Calgary bylaws specify that a solar collector may be mounted on a roof a maximum of 0.5 meters from the surface of roof but differ in the distance a solar collector is allowed to project from the surface of a roof. This variation can create barriers to entry for residential customers and installers through the lack of a consistent approach. The

different regulatory requirements and processes within each municipality can act as an additional barrier for installation companies seeking to operate in multiple municipalities. For more information on bylaw requirements in Alberta, see subsection 3.1.

Additionally, a requirement in the installation process is for an electrical inspection conducted by a certified electrician to be conducted by the municipality prior to the connection of the system with the grid (Energy Efficiency Alberta, n.d.b). While this requirement provides assurance that the electrical aspects of the system were properly installed and are not a risk, it can create other challenges and inefficiencies. Primarily, a certified electrician is not required to be knowledgeable of solar PV best practices and ways to maximize a homeowner's investment. This can lead to poor solar installations which limit the effectiveness of the solar PV project and can be potentially damaging to the industry's reputation. Furthermore, these poor installations can occur without the homeowner, inspectors, or installers being aware.

By putting forward recommendations for the creation of a singular residential solar standard in Alberta, these differences in bylaws and associated barriers can be eliminated or reduced. This would result in a more consistent regulatory environment throughout Alberta and an opportunity for the development of province-wide accreditation for installers, which could bring with it the ability for installers to operate throughout Albertan municipalities and aid in the sharing of expertise and best practices. Furthermore, the streamlining of regulations and requirements could eliminate many of the inefficiencies created by the many different approaches and allow for more uniform and consistent updating.

Chapter 3 - Literature Review

This chapter of the report focuses on a review of bylaws in Alberta, incentive policies in use in other jurisdictions, qualification and accreditation policies, approval processes, and other overall jurisdictional approaches to residential solar installation. While there could be some similarities or differences between jurisdictions, success of replication can depend on a number of variables. The aim of this chapter, as mentioned in Chapter 1, is to examine which aspects could be implemented in Alberta, or key takeaways or lessons-learned for other implemented systems in other jurisdictions.

3.1 Bylaw Approaches

This report and its recommendations focus on policies and regulations which would be best equipped to encourage a safe, consistent and reputable process for further development of residential solar PV systems in Alberta. The potential 352 different permitting and regulatory environments in Alberta results in the possibility of there being 352 different residential solar PV bylaws existing in the province. In reality, as this section will demonstrate, not all municipalities have developed their own residential solar PV requirements. For example, not all rural and sparsely populated jurisdictions have their own requirements or processes for the installation of a residential solar PV system.

Furthermore, due to the focus of this report being on a province-wide residential solar PV standard rather than an examination of Alberta's bylaws, this chapter of the report focuses instead on 'high-level' policies and necessary aspects to be considered when developing bylaws for residential solar PV systems. However, in order for a residential solar PV standard in Alberta to be successful and implemented province-wide, a consistent approach throughout Alberta residential municipalities will be needed.

As of January 1, 2019, Alberta's population was 4.35 million (Government of Alberta, 2019b). Alberta's population has been forecast to increase to 6.4 million by 2046, with three main cities estimated to have 80% of Alberta's total population, or 5.12 million people (Alberta Treasury Board and Finance, 2018). These three main cities are: Calgary, Edmonton, and Red Deer. In order for a residential solar standard and approach to be successful, recognition, buy-in and catering to these jurisdictions will be critical.

The current bylaws for the requirements for residential solar in Calgary and Edmonton outline similar parameters. Several requirements in each city's bylaws have similarities but feature different numbers, as Table 1 below demonstrates for roof mounted solar. For more information on each city's bylaws, please see Appendix A.

Table 1 - Calgary and Edmonton Bylaw Requirements for Residential Solar

CITY	BYLAW
Calgary	"A solar collector mounted on a roof with a pitch of 4:12, may project: a maximum of 0.5 metres from the surface of a roof, when the solar collected is located 5.0 metres or less from a side property line, measured directly due south from any point along the side property line; and in all other cases, maximum of 1.3 metres from the surface of a roof."
Edmonton	"A solar collected mounted on the roof of a building may project: a maximum of 0.5m from the surface of a roof, when located 2.0m or less from the wall of the building; in all other cases a maximum of 1.5 meters from the surface of a roof."

Source: (City of Calgary, 2019, p. 1); (City of Edmonton, 2019, p. 1).

In both of the city bylaw examples above, the similarities and differences are apparent. The City of Calgary's bylaw mentions the roof's pitch and property line whereas the City of Edmonton's bylaw mention only the distance to the wall of a building. However, both bylaws mention the maximum distance from the surface of roof that the solar mounting can be from the roof. The minor differences demonstrate that the bylaws could be potentially integrated with minor changes to each. For more on each city's residential solar bylaws, see Appendix A.

Interestingly, the third largest city in Alberta, Red Deer, currently does not have bylaw requirements outlining the restrictions related to the installation of residential solar. Instead, solar applications are accepted and reviewed on an individual basis by the Electric Light & Power department of the City of Red Deer (City of Red Deer, n.d.a). Although no bylaw restrictions are outlined, an informal application process exists in Red Deer. Applications for installation also still require the necessary permits (development, building, and electrical) and two safety code inspections in order to be fully approved (City of Red Deer, n.d.b).

In order for a residential solar standard to be successful, it will need to focus on the three most highly populated jurisdictions in Alberta: Edmonton, Calgary and Red Deer. While the cities of Calgary and Edmonton already have bylaws or processes outlining the residential solar requirements, similarities between them exist. Furthermore, Red Deer's lack of bylaws for the installation of residential solar PV also creates an opportunity for it to adopt new province-wide requirements for solar PV installation, or for it to adopt the bylaws from either Calgary or Edmonton to reduce the variation in Alberta.

3.2 Incentive Policies

Once a residential solar standard or minimum qualification level has been established in Alberta, a number of new incentive policies or subsidies could be implemented alongside to

facilitate the uptake of residential solar and capitalize on a streamlined approval and installation process. The already implemented province-wide residential solar PV standard would enable an easier approach to creating incentive policies and subsidies, because the province would have one singular approach to regulating and approving the installation process.

Previous research has shown carbon dioxide mitigation plans alone do not drive renewable energy development (Marques, Fuinhas, & Manso, 2010). Instead, incentive policies and subsidies have been found to be significant drivers of renewable energy use (Marques & Fuinhas, 2012). In Alberta, incentive policies or subsidies could be used to help the transition Alberta to natural gas and renewable energy sources and away from coal-fired electricity (Marques, Fuinhas, & Manso, 2010). While the focus of this paper is not to evaluate or compare available renewable energy incentive policies, several incentive policies and subsidies for residential solar PV, including those in Alberta, are discussed below. Each assessment focuses on the changes brought to residential solar PV by the policy or incentive, and the both positive and negative aspects of it. Examined below are rebate programs, property assessed clean energy programs, and feed-in tariffs. The incentive policies and subsidies outlined below need to be considered under a different criteria when evaluating their applicability in a new jurisdiction such as Alberta.

3.2.1 Alberta's Rebate Program

The Government of Alberta, under Energy Efficiency Alberta, previously offered the Residential and Commercial Solar Program (RCSP) for homeowners and businesses. The aim of the program was to lower the cost associated with solar PV, thereby increasing the affordability for homeowners and businesses (Garneau, 2018). When the program was first unveiled in 2017, it was estimated the RCSP would significantly increase the amount of solar PV installed in the

province. Initial estimates were that it would lead to 10,000 solar PV installations in Alberta by 2020 (Graney, 2017).

For the residential sector (defined under the program as 0-15 kW), the RCSP provided two incentives: a $0.90 per Watt incentive to residential systems, with the maximum payable incentive being the lesser of 35% of eligible system cost, or $10,000 towards the system (Energy Efficiency Alberta, 2017b). Other incentives were offered for commercial and non-profit or charity systems. Similar to other programs offered globally, in order to qualify for the RCSP rebate, the solar installation needed to be completed by an approved installer listed in either the SESA or CanSIA directory (Energy Efficiency Alberta, 2017a).

Over the two years the RCSP was offered, the province saw significant growth in the solar industry. Over the two years, more than $134 million was invested in solar projects across the province and solar installation costs also decreased by 35 per cent for residences and businesses (Energy Efficiency Alberta, 2019). The program helped reduce greenhouse gas emissions in the province by approximately 338 million tonnes (Energy Efficiency Alberta, 2019).

The RCSP, however, was not without criticism. Critics of the program stated that even though it will likely lead to increased renewable energy related employment and installations in the short term, it could lead to long-term problems as customers and businesses come to rely on the rebate to remain economical (Graney, 2017). Furthermore, after the recent change in provincial government, the program announced on May 22, 2019 it was no longer accepting applications (St-Onge, 2019).

Another incentive scheme offered in Alberta was the Alberta Municipal Solar Program (AMSP), which was offered by the Municipal Climate Change Action Centre. The AMSP

provided financial rebates to Alberta municipalities who installed grid-connected solar PV systems.

3.2.2 Other Rebate Programs

Many solar PV rebate programs exist globally. Similar to Alberta with respect to Canada, Florida has low electricity prices compared with other U.S. states, making solar PV potentially less attractive than other forms of energy generation. In 2017, the average price per watt of a solar PV system in Alberta for a residential solar application was between $2.00 and $3.00 CAD per watt (Smith, 2017). Similarly, the average cost of a solar panel system in Florida is $2.64 USD per watt (Richardson, 2019).

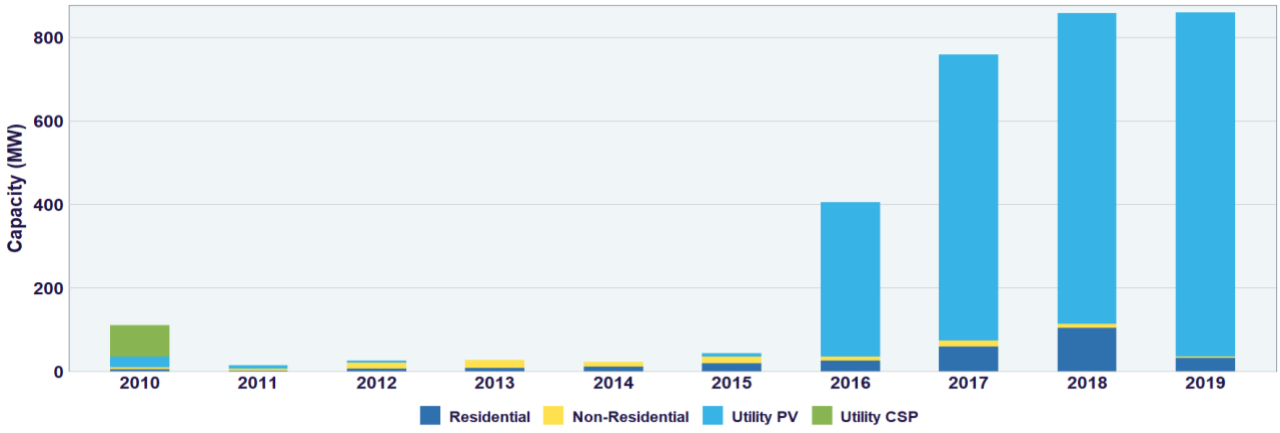
Florida enacted a solar rebate system, *The Solar Energy System Incentive Program*, in 2006. (Burkart & Arguea, 2012). The system aimed to incentivize both residential and commercial solar energy technology. Similar to the micro-generation regulation in Alberta, electric utilities are required to purchase excess generation from renewable sources (below 2 MW) in the form of offsets or to purchase it at a price equal to or greater than the cost of generation. Also, similar to Alberta, solar PV under the program in Florida was required to be installed by a licensed master electrician, solar contractor, or certified general contractor (OpenEI, 2015).

Florida's rebate system was originally based on a $4.00 per watt price, with differing rebate payouts for commercial and residential sites. The system's rebates were capped at $20,000 for 5kW and $100,000 for (25 kW). To provide some context, a 2 kW system would cost approximately $15,000 but received $8,000 from a state rebate and $4,500 from a federal tax rebate (thereby covering roughly 83% of the installation cost) (Turner, 2010).

A number of other incentive programs and funding opportunities were available for solar PV in Florida during the same period, including: the Florida Renewable Energy Technology Grants Program, the Florida Renewable Technologies Investment Corporate Tax Credit, and the Florida Renewable Energy Production Tax Credit (Roberson, 2017). The Solar Energy System Incentive Program expired in June 2010 (OpenEI, 2015). Since then, Florida has also introduced a number of new policies which have further increased the growth of residential solar, these are a net metering program (similar to Alberta), property tax exemption, and a sales tax exemption (Energy Sage, n.d.).

The rebate program and other incentive programs have led to sizeable growth in residential solar capacity in Florida. As Figure 1 shows, residential solar installation in Florida saw significant growth from 2010 to 2018 (note the data was released in Q1 2019 and therefore does not incorporate all of 2019). Furthermore, estimated small scale residential generation in Florida year-to-date through April 2019 is 149,000 MWh, compared with 89,000 MWh year-to-date through April 2018, thereby leading to another year of consecutive growth (United States Energy Information Administration, 2019).

Figure 1 - Florida Annual Solar Installations



Source: (Solar Energy Industries Association, 2019)

3.2.3 Alberta's Property Assessed Program

Another mechanism used to facilitate the uptake of renewable energy is a property assessed clean energy program (PACE) program. For residential solar PV installations (known as R-PACE), R-PACE programs allow homeowners to finance energy efficiency and renewable energy projects, such as the installation of solar PV, for approximately 20 years through tax liens on their property (The Bond Buyer, 2017). It addresses two main barriers hindering investment in renewable energy and energy efficiency: lack of upfront capital, and lack of transferability of the investment (Bond & Scott, 2018). With R-PACE programs, homeowners are no longer required to provide upfront capital and investment companies can now invest in residential energy efficiency and green initiatives.

In Alberta, one such program which could be offered is the Clean Energy Improvement Program (CEIP). This program was Energy Efficiency Alberta's approach to a R-PACE Program. While not an incentive program specifically, it is a financing program that aims to make it easier for property owners to overcome the barrier of accessing affordable financing for renewable energy upgrades (Energy Efficiency Alberta, n.d.a). Similar to other R-PACE programs, the CEIP is designed to lower up-front costs associated with clean energy or energy efficiency upgrades through loans issued by municipalities to citizens interested in making property upgrades.

In Alberta, the CEIP would allow interested homeowners to enter into an agreement with a municipality, with the repayment of the loan occurring over the years through a municipal tax (Kauffman, 2019). While the CEIP was being launched as a pilot project in Edmonton in fall 2019, uncertainty remains with whether the newly elected provincial government will support the program and offer it province-wide.

3.2.4 Other Property Assessed Programs

A number of R-PACE programs exist in the United States as well, with approximately 33 states plus Washington, D.C. having active PACE-enabled legislation, and 20 states offering PACE programs (Khanal, 2019). Furthermore, since 2008 in the United States, over $4 billion has been invested in more than 150,000 projects in 36 states (Bond & Scott, 2018). The first PACE program was implemented in California, which first enabled municipalities to levy contractual assessments to finance certain clean energy installations in 2008 with the enacting of California Assembly Bill 811 (Ranchod, Yung, & Hart, 2018). Between 2010 and 2015, California's PACE program, combined with incentive and subsidy programs and the falling cost of installation, contributed to more than 400,000 residential PV installations in the state (Deason & Murphy, Assessing the PACE of California residential solar deployment: Impacts of Property Assessed Clean Energy programs on residential solar photovoltaic deployment in California, 2010-2015, 2018a).

Additionally, a study conducted by the Lawrence Berkley National Laboratory found that cities in California which adopted a PACE program saw an increase in deployment between 7 and 12% between 2010 and 2015 (Berkeley Lab, 2018). Large cities (defined as cities with a population above 65,000) experienced the largest growth in deployment, approximately 12% over the 5 years (Deason & Murphy, Assessing the Property Assessed Clean Energy of California residential solar deployment, 2018b). Growth across all California cities measured was closer to 7%.

However, PACE programs are not without risks of potential negative consequences. One primary concern is that PACE programs and PACE loans potentially increase the risk of default on residential mortgages (Khanal, 2019). The reality of whether they do remains to be seen, as

recent studies have found the number of defaults increased in overall numbers but fell as an overall percentage of total homes enrolled in PACE programs (Western Riverside Council of Governments, 2017). Potentially due to this increased risk, PACE programs for residential properties are only offered in three states in the U.S. (California, Florida and Missouri).

Another potential negative consequence is the rate of return for the property purchaser. If the cumulative value of energy savings, and repayment period and interest rate do not provide a positive rate of return, the value of the property can decline to reflect the PACE loan (Khanal, 2019). Interestingly, a review of PACE programs in California found that, even though PACE programs increased the adoption rate of residential solar PV by 108% over the state average, PACE loans at the time were not the best financing option available. However, the review only covered two years before the programs were terminated, and therefore long-term viability of growth is unknown (Kirkpatrick & Bennear, 2014).

Recent regulatory changes could also lead to changes in growth rates. Renew Financial, an American PACE program financier, released a report in 2018 where it reported a 42 percent decrease volume in California residential PACE volume for the first half of 2018 (DeVries, 2018). The reduction in volume was said to be attributable to the California Assembly Bill 1284, which established parameters and standards necessary for homeowners to qualify for PACE programs. For example, under Bill 1284, a property owner does not qualify for the PACE program in California if he or she has been party to bankruptcy proceedings in the previous seven years, or has more than one late payment on a mortgage in the previous 12 months (Merchant, 2018).

3.3.5 Feed-in Tariff

Feed-in tariffs are a popular incentive for stimulating the development of renewable electricity, and improving investment security. A feed-in tariff (FIT) is a guaranteed price that a producer of renewable energy can expect to receive, and the price is set so that the producer can expect a profit on the power they are generating (Jelley, 2017). FIT schemes have been a popular mechanism worldwide for the development of renewable energy but can have a high implementation cost to either the jurisdiction's budget or for the clients of the electricity utilities (Marques & Fuinhas, 2012). They are also simple to implement administratively as, similarly to bidding systems, the level of subsidies (and thereby the level of public spending) can be controlled (Menanteau, Finon, & Marie-Laure Lamy, 2003). Although not offered in Alberta, a number of jurisdictions globally have or have used FIT schemes to facilitate the development of renewable electricity, such as Ontario, Germany and Japan.

Figure 2 - Ontario's Renewable Energy Standard Offer Program

Type of Renewable	Base Price (per kilowatt hour)	On-Peak Premium (per kilowatt hour)
Wind	$0.11	Not eligible
Biomass	$0.11	$0.0352
Biofuel	$0.11	$0.0352
Biogas	$0.11	$0.0352
Landfill gas	$0.11	$0.0352
Small hydro	$0.11	$0.0352
Solar photovoltaic (PV)	$0.42	Not eligible
Solar thermal	$0.11	Not eligible

Source: (Reeds, 2014)

In Ontario, the government of Ontario offered North America's first FIT with the announcement of its Renewable Energy Standard Offer Program in March 2006 (Reeds, 2014). The program was designed as a pricing regime for small renewable electricity projects, such as residential solar, with the intention of providing incentives for renewable energy production

(Mabee, Mannion, & Carptener, 2011). The program locked producers into a 20-year contract with the Ontario Power Authority at varying rates. Solar PV and other forms of renewable energy with the capacity of less than 10 MW qualified for the program. Also offered as was the microFIT program for projects 10 kW and smaller. As Figure 2 demonstrates, under the FIT scheme, solar PV earned $0.42 CDN per kilowatt-hour (kWh), significantly more than the other forms of renewable energy covered under the scheme (Reeds, 2014).

In 2009, the government of Ontario introduced the *Green Energy Act.* Included under the act, was a microFIT program. Under the microFIT program, it was estimated that between 2009 and 2019 over 20,000 microFIT projects were connected to the grid, 99 per cent of which were solar PV projects (Ontario Ministry of Energy, Northern Development and Mines , 2019). By 2011, the Ontario Power Authority estimated that the renewable electricity sector created 13,000 jobs and had 3000 MW under contract (Mabee, Mannion, & Carptener, 2011).

However, Ontario's FIT program was not without controversy and mistakes. While the multi-decade contracts signed under the program did spur investment in renewable energy, they provided rates as high as 40-times the fair market value of electricity in Ontario (Hill, 2017). In its 2015 annual report, the Auditor General of Ontario estimated that the guaranteed price of renewable contracts would cost Ontario consumers approximately $9.2 billion over the 20-year contract terms (Office of the Auditor General of Ontario, 2015). In July 2018, the government of Ontario announced it would cancel or wind down 758 renewable energy contracts, many of which were FIT contracts (Apestéguy-Reux, 2018). Ontario's Minister of Energy, Northern Development and Mines estimated it would save Ontario taxpayers from $790 million in savings. The move was done in an effort to reduce electricity bills in the province (Canadian Press, 2018).

Other jurisdictions which adopted a FIT scheme include Germany and Japan. Germany adopted a FIT scheme in 2000, followed by Japan in November 2009. Japan further modified its FIT scheme in 2012, resulting in a huge increase in solar PV capacity over the next few years.

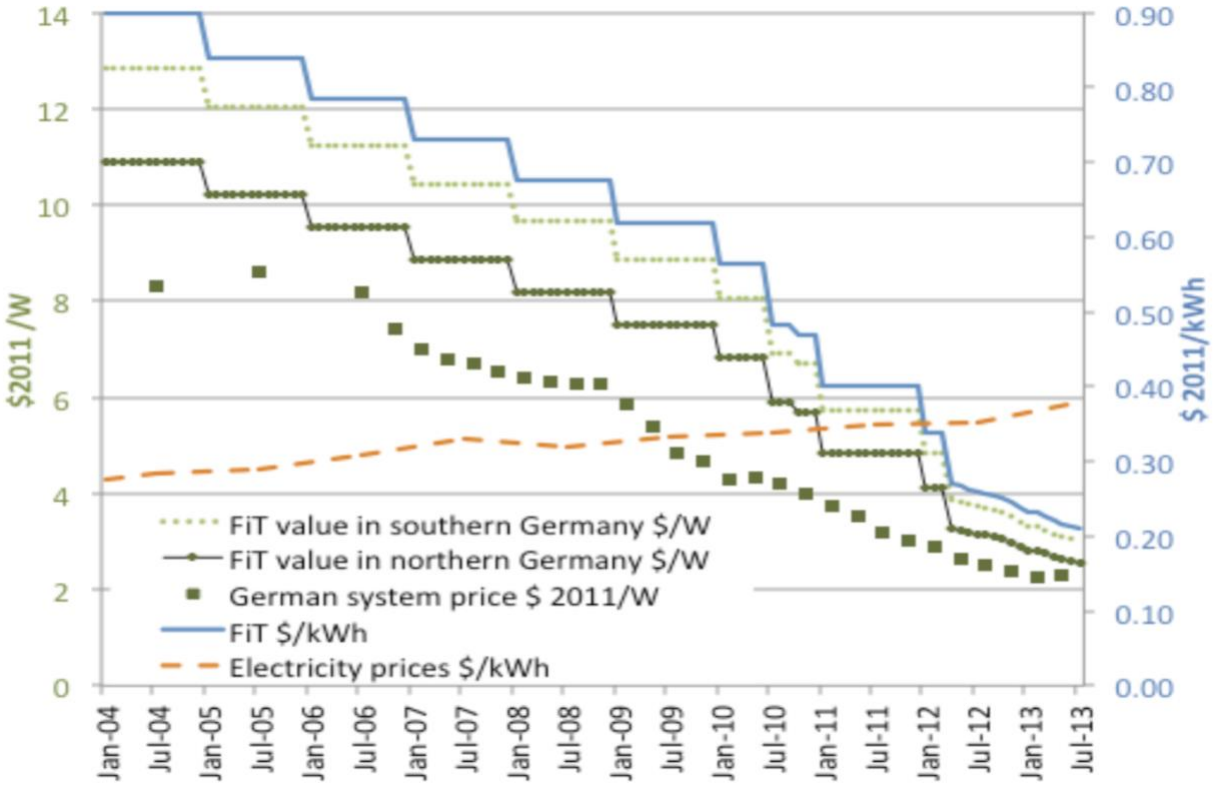
Both Japan's and Germany's FIT schemes resulted in a huge increase in solar PV installations, largely due to the incentives offered. Germany's FIT scheme was so successful in attracting investment in solar PV (both residential and commercial), the installed capacity in Germany grew from 32 MW in 1999 to 17,320 MW in 2010 (Huenteler, Schmidt, & Kanie, 2012). In Japan, the solar PV was estimated to be approximately 40 GW, a 10-fold increase from before the 2012 modifications to its FIT scheme (Komiyama & Fujii, 2019).

Similarly to Ontario's FIT scheme, Japan and Germany significantly increased their installed capacity of solar PV and other renewables, but at a high financial cost. The FIT scheme in Japan was aimed primarily at non-residential sectors, but in 2012 still offered a rate of ¥42/kWh paid for 10 years for residential PV installations (Muhammad-Sukki, et al., 2014). This is the equivalent of $0.51 CDN/kWh, similar to the level of financial incentive offered in Ontario (XE Currency Converter, 2019b). However, in 2018, the Japanese government announced it would bring down the prices promised to solar producers in the past under the FIT, in order to reduce the economic burden on the major power companies buying energy from them (Takeuchi, 2018). In 2018, FIT levels for residential solar PV in Japan are now: ¥24-26/kWh, depending on the region, an almost 50% cut from original level offered (Willuhn, 2019). The number of corporate bankruptcies in Japanese PV power firms also increased in 2018 for the fifth straight year, by 8% over 2017 (a record high for Japan).

In comparison, Germany's FIT level for residential solar can vary widely, as Figure 3 demonstrates. In 2016, price levels for residential solar could be as high as €0.52/kWh, with the

level for new installations at €0.13/kWh (Gahran, 2016). This is equivalent to approximately $0.19 CDN/kWh, demonstrating significantly less financial incentive for solar PV development than Japan or Ontario (XE Currency Converter, 2019a). As demonstrated by the varying levels of FIT available, there have been many changes to the level since its introduction, with the main change being a reduction in price per kilowatt-hour.

Figure 3 - German Feed-In Tariff Value



Source: (Seel, Barbose, & Wiser, 2014)

While the original FIT level price spurred solar PV growth at a level Germany's power grids and energy markets could not accommodate, there were a number of other consequences. Primarily, the attractive cost for residential solar PV installation introduced by the FIT level was being subsidized by residential utility consumers. Additionally, other negative impacts were measured, such as a decrease in research and development spending because money was being

reallocated to new production, manufacturing was moved to low-wage jurisdictions. (Huenteler, Schmidt, & Kanie, 2012).

The FIT schemes in Ontario, Japan and Germany were successful at deploying renewable energy, specifically solar. However, in all three jurisdictions, this was done at significant cost to taxpayers or power generating companies. Furthermore, each system featured large changes in the pricing being offered, thereby creating an environment of uncertainty for consumers.

3.3 Qualification and Accreditation Requirements

3.3.1 Professional Requirements

A number of qualification and accreditation policies for the installation of residential solar PV exist globally. In Alberta, the required accreditation and qualification also depends on the step of installation. For example, in order to obtain an electrical permit in Alberta you are required to be a 'master electrician'. Other jurisdictions, such as specific states in the United States, require installers to be a member of the North American Board of Certified Energy Practitioners (NABCEP) Certified PV Installer. This variation in qualification and accreditation requirements creates an environment which could potentially inhibit or discourage the movement of solar PV professionals as new accreditation or training may be required in a different jurisdiction.

Currently in Alberta, no specific solar related qualifications are required to install or inspect residential solar PV. However, as outlined in subsection 2.3 of this report, certain installation steps and permitting processes require specific professional designations. The two professional designations which may be required for the installation of residential solar are: professional engineer, and master electrician. A professional engineer may be required to submit and approve documents under a building permit, depending on the level of structural changes

required for the installation. Additionally, some municipalities require a structural engineer to field inspect installations if a building permit was used (Municipal Climate Change Action Centre, 2017). A master electrician is required to apply for an electrical permit (Safety Codes Council, n.d.c). Additionally, under previous provincial incentive programs, a certified installer listed on either the SESA or CanSIA directory was required in order to qualify.

Alberta electricians receive the "master electrician" certification from the Safety Codes Council through application once all necessary qualifications have been met. The Safety Codes Council, which regulates master electrician designations, was established by the Government of Alberta in 1993 under the Alberta *Safety Codes Act* and is responsible under the Alberta Minister of Municipal Affairs (Safety Codes Council, n.d.a). In order to maintain their certification in Alberta, master electricians are required to renew their certification annually (Safety Codes Council, n.d.d). In order to renew their certification, they must prove they have met any outstanding requirements, such as code update training. Currently, in order for Master Electricians to renew their certification in 2020, they must have taken a course from a list of approved institutions and regulating bodies (such as the Northern Alberta Institute of Technology and the Electrical Contractors Association of Alberta) on the 2018 Canadian Electrical Code (Safety Codes Council, n.d.b).

The lack of specific solar training requirements could be due to the lack of recognized or required training for professionals in the industry, as several institutions in Alberta offer a variety of solar training. For example, the Southern Alberta Institute of Technology (SAIT) and the Northern Alberta Institute of Technology (NAIT) both offer solar PV installation courses for electricians. As being a master electrician does not guarantee knowledge about solar PV best

practices, courses like these or similar ones, could be required for the residential solar installers, electricians, and inspectors under a residential solar standard in Alberta.

Similar to requiring a master electrician designation for solar PV installation in Alberta, in Ontario wiring and connection of a solar PV array must be done by an electrical contractor licensed by the Electrical Contractor Registration Agency of the Electrical Safety Authority in Ontario (Ontario Solar Installers, 2018). Any individual hired to do electrical work in the province must be a Licensed Electrical Contractor (Ontario Electrical Safety Authority, n.d.). In order for an individual to become an electrical contractor in Ontario, they must be a master electrician or employ at least one designated master electrician at all times (Electrical Safety Authority, 2019). Furthermore, any electrical installation related to solar PV in Ontario requires an inspection to ensure it complies with the Ontario Electrical Safety Code (Electrical Safety Authority, 2014).

In the U.S., NABCEP certification is commonly required for residential solar installation. States such as Maine, Minnesota, and Wisconsin require a solar PV system to be installed by a NABCEP-certified professional in order to be eligible for state incentive programs (Solar Energy International, n.d.). Other states, such as California, Delaware, and Massachusetts, specifically recommend NABCEP-certified professionals, whereas Utah requires NABCEP certification as a prerequisite for state solar contractor licenses. For my information on NABCEP certification, see Appendix B.

3.3.2 Industry and Organizational Requirements

Several industry associations and organizations in Alberta and Canada have implemented their own best-practices and codes of conduct for installers. With the lack of an overarching regulatory body to enforce proper installation techniques, offer any substantial consequences for

rule breaking, and to provide customers with appropriate information, these industry organizations have introduced their own approaches. These industry organizations attempt to introduce a degree of consistency and professionalism into the solar industry, but can lack the means or power to adequately enforce it as they are not a regulating body.

As a result, there is little consequence for poor installations, and in certain situations, little knowledge that sub-standard installations have taken place. This can limit the overall usefulness and effectiveness of the PV panels, which can reflect poorly on the residential solar industry. The only current consequence for a poor installation or poor practices by a professional is being removed from an organization's list of approved installers and negative publicity. While the removal from an organization's list can impact a business over time, no body or regulation prevents that person or company from continuing to operate. Without specific negative consequences as a result of non-compliance or poor practice, enforcing the best-practices and codes are difficult.

One industry organization that has created its own directory of approved installers is the Solar Energy Society of Alberta (SESA). SESA provides a number of resources for industry professionals and consumers. Its main objectives are to provide public and members with renewable energy related information, to be an independent public resource of information, and to sponsor educational programs (Solar Energy Society of Alberta, 2018). These include information for installers, a code of conduct for installers, and educational resources for consumers.

Another organization similar to SESA, but at a national level, is the Canadian Solar Industries Association (CanSIA). CanSIA is a national trade association that represents the solar energy industry throughout Canada (CanSIA, About us, n.d.). Similar to SESA, CanSIA offers

resources for consumers, qualified installers, and opportunities for installers to join CanSIA's network. While these organizations introduce some transparency into the industry, neither CanSIA nor SESA are regulating bodies and therefore cannot dictate necessary qualifications required, or penalties for violating regulations.

CanSIA has some characteristics similar to a regulating body in the industry because it works: "closely with our members and a number of government representatives at all levels to break down barriers and open up opportunities for all sectors of the solar industry" (Canadian Solar Industries Association, n.d., p. 1). However, despite working with government representatives, CanSIA is not a regulating body that can enforce a solar standard. CanSIA's webpage for Alberta solar resources also does not make reference to SESA, thereby demonstrating the overlap and potential uncertainty among consumers and installers in the industry. Each organization also maintains its own list of approved installers, but there is no guarantee an installer would be on both CanSIA's and SESA's lists. This demonstrates a lack of consistency and an area of potential confusion for consumers. Even though both CanSIA and SESA aim to bring consistency and transparency to the industry, the duplication and lack of consistency within the regulating bodies in Alberta and Canada reduces the consistency and harmony in the residential solar industry. For more information on CanSIA and SESA, see Appendix B.

The organizational standards used by organizations and industry associations can help guide the behaviour and eventual province-wide policies. With many residential solar companies already abiding by these standards, the impact of implementing similar standards province-wide would be less than implementing new standards. This could allow for a less disruptive and more economically impactful implementation of a province-wide standard.

Specific cities within the United States, such as the cities of Austin, Texas, and Madison, Wisconsin, have adopted their own approaches to solar contractor licensing and certification requirements (Solar Energy International, n.d.). For example, in Austin, homeowners can earn a $2,500 rebate if they complete a solar education course administered by Austin Energy and install a qualifying solar PV system with a participating contractor (Austin Energy, 2019a). Austin Energy is a public utility which, as of 2014, had 23% of its energy mix being provided by renewable energy (Austin Energy, n.d.).

For residential solar PV installations, Austin Energy maintains requirements similar to other jurisdictions throughout the United States while introducing its own specific requirements. The specific requirements are in addition to the state regulations for installing solar PV, such as a state electrical contractor license being required for any company in the business of: "installing, erecting, repairing and altering electrical systems, or apparatus used for electrical light, heat, power or signaling" (Interstate Renewable Energy Council, n.d., p. 1). Solar contractors in Austin must abide by state requirements and the city's code of conduct and ethical requirements, and the city's solar incentive program contractor handbook. Under these documents are outlined the requirements for solar PV installation. For example, systems design to be reviewed and endorsed by a NABCEP PV installation professional (Austin Energy, 2019b).

Through the education course and list of participating contractors, Austin Energy can increase the level of consistency in the industry through specific installers requirements, and consumer knowledge through the course. The setting of specific requirements for solar installers also allows Austin Energy to function as a regulatory body with the ability to set industry requirements and incentive policies and determine who is eligible to work in the industry.

3.4 Permitting and Approval Process

Prior research on the ways to increase the efficiency and streamline the permitting process has been done by the Municipal Climate Change Action Centre (MCCAC), a joint initiative between the Government of Alberta, the Alberta Urban Municipalities Association, and Rural Municipalities of Alberta (Municipal Climate Change Action Centre, n.d.a). In April 2017, it released *Best Practices for Permits, Taxes and Solar Access*. In it, it made several recommendations to streamline, through specific exemptions and requirements, the development permits, building permits and electrical permits in Alberta. Table 2 below summarizes MCCAC's recommendations for permitting in Alberta.

However, it is important to note that, by removing some of the permitting requirements as the MCCAC suggests, municipalities would have greater flexibility to specific different restrictions. For example, by removing the development permit, the municipality's land use zones, such as residential, commercial or industrial zones, would play a larger role in regulating residential solar PV installation. While this approach could reduce the barriers and expedite the installation process, it could result in new barriers of installation through differentiation of land-use zone requirements municipalities.

Table 2 - MCCAC Best Practice Approach for Permitting

Permit Type	Permit Exemption	Permit Requirement
Development Permit	A broad permit exemption for installers from needing to obtain a development permit for solar PV (as long as installation complies with permitted practices in bylaws). This exemption would apply to all types of land (commercial, industrial, residential) and generating capacities.	None – no permit would be required for most installations. Installations of residential solar PV could be installed without permits, as long as it complies with bylaw requirements and land-use zone requirements. The land-use zones could outline in detail the requirements for installation locations, projection in setbacks, and height restrictions.
Building Permit	A best practice would be exempting installers from requiring a building permit for less onerous or complex installations. For example, parallel roof mounted residential solar PV installations would be exempt. Under this scenario, municipalities would need to define what constitutes a complex installation.	When required, an application for a building permit would be submitted or certified by a professional engineer, include a simplified structural drawing, and if needed, calculations showing it meets the Alberta Building Code and Fire Safety Code. Additionally, when required, building and electrical inspections should be scheduled for the same window of time to reduce delays.
Electrical Permit	No specific exemptions listed. Simplified diagram drawings could be allowed.	An electrical permit is required for all solar PV system installations in Alberta to assure safe installation and operation of the system.

Source: (Municipal Climate Change Action Centre, 2017)

Chapter 4 – Survey Questionnaire

As previously mentioned in Chapter 1, a survey was circulated to a variety of people involved in Alberta's residential solar PV industry. The goal of the survey was to collect information from a variety of roles in the industry, and to examine potential areas of research for the project. The survey questions were created to collect as much information on as many potential strengths and weaknesses of Alberta's residential solar PV industry, the impacts of policy change, and the potential role of a residential solar PV standard in Alberta. Furthermore, the questions were informed by the literature review and looked to address potential gaps and characteristics of Alberta's industry. Given the variety of roles surveyed and the different areas of involvement in the industry, the survey attempted to be applicable to anyone in the industry, including installers and homeowners.

This wide variety of roles and involvement in the residential solar PV industry surveyed led to a variation in the types of responses received. Respondents included professionals in renewable energy consulting, government agencies, installation companies, homeowners, Alberta academic institutions and industry organizations. In total, approximately 24 people were contacted, and the survey template was used for 10 individuals. Less structured interviews or surveys were held with approximately 5 people throughout the solar industry in Alberta. Below is the breakdown of questions asked, and summaries of the answers collected. In addition to the 11 questions below, one question was asked at the beginning of the survey for respondents to outline their experience in the industry. The full list of survey questions included in Appendix C, and a Table 3 in Appendix D provides a summary of the responses collected.

4.1 Survey Results

4.1.1 Alberta's Residential Solar PV Strengths & Weaknesses

Three questions in the survey focused on Alberta solar industry's strengths and weaknesses:

1. What are Alberta's biggest strengths and weaknesses for residential solar installation?
2. What are the largest barriers or obstacles to Alberta's residential solar industry?
3. In your view, do the positives or incentives of the residential solar industry in Alberta outweigh the barriers or negative aspects?

The survey responses received for the main strengths of Alberta's residential solar PV standard centered on the fact that the Province was 'better than most' in terms of availability of solar energy, the entrepreneurial spirit, a well-educated workforce, and the regulatory and permitting process. The weaknesses centered on the low prices of traditional energy sources, consumer misunderstandings and lack of solar education, and little enforcement and guiding mechanisms for the industry. Interestingly, more information around weaknesses were received than strengths. When asked whether the positive aspects or incentives of the residential solar PV industry in Alberta outweigh the barriers or negative aspects, the responses were primarily positive. However, most positive responses to this question specifically mentioned incentive programs as part of the reason for the positive response. Since several of the survey respondents benefit from incentive program, either by working as installers or by having solar PV systems on their own homes, the identification of the incentive programs as positive is not surprising. Summary of the main strengths of Alberta's residential solar PV industry:

- A more efficient permitting system than some other provinces.
- Very good solar resource in Alberta.

- Strong entrepreneurial spirit and regulatory environment in the province.
- Alberta has the engineering expertise (well-educated workforce), capital, available talent, and energy industry knowhow to become a huge player in the renewable energy space.
- Prior to recent changes, Alberta also had a better standard for interconnections and the incentives.

Summary of the main weaknesses received for the residential solar PV industry in Alberta were:

- Low power prices for traditional fossil fuel sources, and too much discussion focusing on either/or, rather than looking at a balanced mix of generation.
- Large up-front costs and the uncertainty around the longevity and consistency of incentive policies. Current provincial government does not seem supportive. Furthermore, the fluctuation in consumer spending when incentives are anticipated, or closing is not encouraging for installers.
- Consumer misunderstandings and lack of education. Specifically: payback periods, solar PV technology, insurance and fire protection, and residential valuation improvements.
- Poorly designed systems and a lack of strong tools for the residential solar PV industry to self-manage and address problematic behaviors, and no designated associations or agencies responsible for governing solar installers. The risk the solar industry develops faster than the regulatory and quality management.

4.1.2 Opportunities for Growth in Residential Solar PV

In addition to the previous two questions which focused on the strengths and weaknesses of the industry, two questions focused on opportunities and gaps in the industry:

4. What are the major gaps (such as incentives, regulations, or approaches) that are lacking or missing from Alberta's residential solar industry?

5. What is needed in Alberta for residential solar installations to continue to grow at the same or a faster pace?

Even though a number of responses were received for gaps and opportunities in the residential solar PV industry in Alberta, the responses focused on three areas of opportunity. The three areas were: consistent incentive programs, a consistent and up-to-date regulatory environment, and a self-sustaining residential solar PV industry. Similarly, when ask what is needed to sustain residential solar installations at the same growth rate in Alberta, consistent policies and incentives were a common theme. Other answers included: having the industry position itself as innovation (rather than climate change) opportunity, developing a high-quality reputation among homeowners, and higher energy prices.

Summary of Gaps and Opportunities:

- Consistent regulations and incentives.
- A PACE scheme or PACE bonds (in addition to consistent incentives) could help facilitate the development of residential solar PV.
- Updating of the micro-generation regulation to ensure a decent rate of return for supplying excess generation to the grid.
- Self-sustaining aspects of the residential solar PV industry would provide less opportunities for government and policy impacts.

4.1.3 Impact of Changing Provincial Governments

Due to the recency of the provincial government change and uncertainty around policies and goals, two questions on policy and government change were included in the survey:

6. What impact does the current regulatory approach and policy system have on the residential solar industry? If any, in what way are they negative or positive?

7. What impact do changing governments, like the recent change in Alberta, have on the overall solar industry? What, if anything, could be done to help minimize the changes and associated risks?

Summary of impacts due to a changing provincial government:

- Likely dampening effect on solar power investments (change of Ontario government).
- Some installers removing or limiting exposure to Alberta. They were reliant on the 30% incentive available under the MCCAC.
- Regulatory environment is well established and should not be heavily impacted.

4.1.4 Comparison with Other Jurisdictions and Industries

Two questions also focused on the respondents' experiences with renewable energy policies in jurisdictions and their experience in other energy industries:

8. Do you have experience with the residential solar industry in other jurisdictions? If so, how does Alberta compare?
9. Given your experience, how does the residential solar industry and regulatory environment compare with other renewable energy technologies or energy efficiency initiatives? (Ex: cost of implementation, regulations, incentives, barriers, etc.)

For question (8), the majority of respondents only had experience with the industry in Alberta. The few respondents with outside experience had experience with British Columbia, Saskatchewan and Manitoba's residential solar industry. These respondents mentioned Alberta was more efficient with permitting and offered better incentive policies. Interestingly, one respondent mentioned the industry in Alberta is not as mature or advanced as other jurisdictions. For the second question, many respondents weren't experienced enough to comment on how the residential solar PV industry compares with other energy technologies. Two respondents stated

energy efficiency initiatives are usually the easiest attained and lowest cost forms of energy reduction, potentially making it easier to attain the previous government's 2030 goals.

4.1.5 Viability of a Solar Standard and Body

The final two questions of the survey focused on the viability of a single regulating body for residential solar industry in Alberta:

10. Would a central hub for residential solar, with recommended regulations and approaches, best practices, approved installers, and minimized regulatory involvement and review positively impact Alberta's residential solar industry?
11. Would a single regulating body that approves installations and installers help or hinder the industry?

As with the other questions, answered and feedback varied greatly based on people's background in the industry. For the first question, the answers were cautiously optimistic about the potential roles a single regulating body could play. Many of the answers provided were positive, depending on how the body was implemented. Most of the feedback received for this question focused on how a regulating body could be implemented without negatively impacting the industry, such as: not adding a bureaucratic or administrative burden to installation process, distancing it from the provincial government, and addressing intermittency and reliability issues. Several surveyed installers were hesitant towards the idea of a regulating body, whereas others in a regulatory role were optimistic around its potential role and positive impact.

For the second question, most of the responses believed some form of minimum requirement for solar installations could be a positive addition to the industry and add consistency throughout the process. Notably, the responses which provided feedback on a regulating body which approves individual solar PV installations all stated it would likely

become a bureaucratic process which would limit the industry. Instead of a body which approves all installations, respondents recommended a minimum certification or requirement be met for aspects of the installation and inspection. Furthermore, because of the variety of roles surveyed, feedback collected from this question focused on the potential roles and areas in which a regulating body could function based on the respondents' experience. For example, individuals with installation experience focused on the role a regulating body or a standard could play in installations.

Chapter 5 - Conclusion and Recommendations

The goals and objectives of this report, as outlined in Chapter 1, were: to provide recommendations for a regulatory environment which is safe, accessible, increases the industry's reputation, is easy to follow, consistent and does not introduce additional barriers for consumers and installers. This chapter provides recommendations and suggestions on how bylaws in Alberta could be approached and structured, which incentives could result in sustainable growth of residential solar PV systems in Alberta, and potential areas of accreditation and professional qualifications.

5.1 Best Practices – Bylaw Approaches

As mentioned in Chapter 2, the potential 352 regulatory environments in the province can act as a barrier for installation companies and consumers by creating an ambiguous regulatory environment. The streamlining of municipal bylaws for residential solar PV could decrease the barriers and number of regulatory environments applicable to residential solar PV installation companies. It could also help in educating consumers by simplifying the process, requirements, and knowledge required.

As a 80% of Alberta's population is expected to be in concentrated in three cities in 2046, these three cities (Calgary, Red Deer, and Edmonton) should be the main developers and focus of any bylaw streamlining or developments (Alberta Treasury Board and Finance, 2018). By developing a consistent approach to bylaws in these three cities, a residential solar standard would apply to 80% of the province.

5.2 Best Practices – Incentive Policies

Commonality among the responses collected from the surveys conducted was the need for a consistent regulatory environment in order for growth in residential solar in Alberta to

continue. This consistent regulatory environment was mentioned for both regulations and incentives. Furthermore, several studies also linked "political factors", including incentive policies, as among the most critical aspects of renewable energy development (see as examples (Aguirre & Ibikunle, 2014), (Marques, Fuinhas, & Manso, 2010)).

Feed-in tariffs have been successful in growing renewable energies, but with varied results. One study observed feed-in tariffs have a positive effect for solar, but at the expense of a negative effect on wind technology (Marques & Fuinhas, 2012). Another study found feed-in tariffs and investment incentives have a significant and positive effect for all renewable energy sources (Zhao, Tang, & Wang, 2013). However, it is important to note the true impact of a feed-in tariff would be dependent on the amount offered by the tariff.

In order to maintain a consistent regulatory environment, the rebate program and potential PACE program could be maintained. As Florida demonstrated, its rebate program which was later followed by several other policies resulted in growth even after the rebate program ended. This demonstrates how a rebate program, when compared with other incentive policies, can provide more consistent policy and incentives.

Survey feedback from installers in indicated several companies were operating in Alberta because of the 30% rebate provided by MCCAC under the Alberta Municipal Solar Program and associated growth (Municipal Climate Change Action Centre, n.d.b). Furthermore, the industry and consumer dependence seen with the feed-in tariffs in Ontario, Germany and Japan demonstrated unrealistic economic rates these projects depended on in order for them to be economic. An R-PACE program, as demonstrated in California, can also help homeowners' access solar PV when it would otherwise be inaccessible, and lead to growth in larger cities.

5.3 Best Practices – Qualification and Accreditation Policies

The actual process and people required in the installation of a residential solar PV system can vary based on a homeowners' needs. However, as outlined in Chapter 3, several professional designations are currently required in the installation of residential solar PV. One of these designations, a master electrician, is required regardless of whether an installation is done by the homeowner or a contractor company is used.

For master electricians to retain their certificate, they are required to take the necessary courses on code updates. The code update courses offered are available at several Alberta institutions and are required every several years.

One possible avenue to introduce a level of consistency in the residential solar PV industry is to require a variety of solar PV training options for electricians or inspectors. Some options could include the training and courses already offered by NAIT and SAIT, or NABCEP certification. These courses offered in Alberta could focus on correct installation techniques and aspects to look for. Furthermore, these solar PV courses could be required periodically, similar to the code updating, in order to maintain and advance the industry standard.

Another possible avenue would be requiring a course for homeowners similar to the one used in Austin, Texas in order for them to be qualify for rebates or pass an inspection. Austin's course, which covers topics such as: solar access and equipment, panel sizing, and comparing proposals, could introduce a level of consistency and knowledge with homeowners throughout the Alberta. However, in order to implement such a course for homeowners, a single regulatory environment or residential bylaws could be required. Combined with solar installation course requirements for electricians or inspectors, the two could significantly help in introducing a level of basic requirements and knowledge across Alberta.

5.4 Conclusion and Summary of Recommendations

This report examined the ways in which a residential solar PV standard could be implemented in Alberta. As part of a residential solar PV standard, uniform and consistent bylaws throughout the province could make it easier for installations to occur, and increase consumer understanding. With much of Alberta's population forecasted to be concentrated in three cities (Edmonton, Calgary, Red Deer), the most successful approach depends on being adopted by those cities, and therefore requires meeting their needs.

With the implementation of consistent residential bylaws for the installation in Alberta, a qualification or accreditation requirement, and incentive policies or subsidies could be easier to implement. As two roles (master electrician, inspector) are consistent despite any difference in implementation process, requirements could be made for these roles to require solar PV training. This solar training requirement could be approached similarly to the electrical code in Alberta, and require updating every 4 years. With a few main accreditation and training organizations existing throughout North America, such as NABCEP, these could be recognized under the require training. Furthermore, the training requirements, educational material, list of installers could be maintained through a government or government agency (such as Energy Efficiency Alberta) website. As residential solar PV installations could still occur without government incentives, a government or arm's-length website would at least provide transparency and consistency through a single website.

One additional way for Alberta to raise the consistency of the residential solar PV industry while providing educational opportunities for consumers is through a mandatory online course, similar to the rebate requirements in Austin. The free course would help educate consumers on panel sizing, what questions to ask installers, and how to compare installer

proposals. Together, the requirement of training and course requirement for homeowners, could raise the consistency and reputation of the industry. In order to reduce the barriers and costs put on solar PV industry professionals by implementing a required level of certification or accreditation, the most common accreditations could be accepted.

Along with the implementation of bylaws, training requirements, and educational opportunities, incentive policies could be explored. As demonstrated in chapter 3, feed-in tariffs can have unintended consequences for renewable energy deployment and can result in the industry being dependent on the rate offered to be economical. Furthermore, policy consistency has been found to be driver of renewable energy deployment and was mentioned throughout the surveys. As a result, reoffering the rebate for residential consumers and advancing with the PACE program could help in advancing renewable energy deployment in Alberta.

Chapter 6 – Limitations and Future Research

Throughout my research, several limitations and areas of future research became apparent. An outline and explanation of the main limitations and areas of future research are listed below.

Limitations:

- Survey responses: Despite attempting to collect as much feedback as possible from individuals with experience in the residential solar PV industry through the surveys, the limited sample size could impact my recommendations. In total 10 responses were collected.
- Political Uncertainty: The uncertainty around regulations, policies and industry outlook once the new provincial government was elected made it difficult to position this report to remain relevant if policy changes do occur.
- Bylaw changes: The City of Calgary is currently in the midst of possibly changing its bylaws for solar installations. This added uncertainty to the regulations and their longevity.

Areas of Future Research:

- Bylaw development: As mentioned in Chapter 3, forecasts by the Government of Alberta see Calgary, Red Deer and Edmonton being home to the majority of Albertans by 2045. The specific development or recommendations for a singular bylaw approach in all three jurisdictions would increase the regulatory consistency in Alberta and decrease the amount bylaws installers and consumers would need to be familiar with.
- Accreditation Development: As survey results demonstrated, a minimum level of accreditation could be pursued in Alberta. An area of research would be the development of this specific level of accreditation.

- Incentive Policies: A review of incentive policies and subsidies were examined in Chapter 3, but primarily focused on how successful they were on encourage sustainable growth in residential solar PV. A specific review of the economics of incentive programs and policies and how they could be implemented in Alberta could allow for further deployment of residential solar.
- Incentive Policies: The primary focus of this report is Alberta's residential solar PV industry. Another area of potential research would be on federal incentive policies and subsidies, and what could be implemented or offered to encourage renewables growth.
- Capacity Market: With the recent announcement of Alberta entering a capacity market, the potential changes this introduces to the residential solar PV industry could be explored.

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Appendix A - Bylaws

Calgary Bylaws

Please note that as of August 2019, the City of Calgary's bylaws for solar PV installation are under review with possible changes being considered. Below are the current bylaws, and the proposed changes can be found here: https://www.calgary.ca/PDA/pd/Documents/solar-power/web-solar-collector-bylaw-changes-summary.pdf.

Solar Collectors

343.1 **(1)** A ***solar collector*** may only be located on the wall or roof of a ***building***.

(2) A ***solar collector*** mounted on a roof with a pitch of less than 4:12, may project:

(a) a maximum of 0.5 metres from the surface of a roof, when the ***solar collector*** is located 5.0 metres or less from a ***side property line*** , measured directly due south from any point along the ***side property line*** ; and

(b) in all other cases, maximum of 1.3 metres from the surface of a roof.

(3) A ***solar collector*** mounted on a roof with a pitch of 4:12 or greater, may project a maximum of 1.3 metres from the surface of a roof.

(4) A ***solar collector*** mounted on a roof must not extend beyond the outermost edge of the roof.

(5) A ***solar collector*** that is mounted on a wall:

(a) must be located a minimum of 2.4 metres above ***grade***; and

(b) may project a maximum of:

(i) 1.5 metres from the surface of that wall, when the wall is facing a ***rear property line*** and;

(ii) in all other cases, 0.6 metres from the surface of that wall.

68P2008

Source: (City of Calgary, 2019)

Edmonton Residential Bylaw

Bylaw 17934
April 10, 2017

50.7 Solar Collectors

1. Unless otherwise specified in this Bylaw, Solar Collectors shall comply with the following:

a. in a Zone where the maximum permitted Height is 12.0 m or less:

i. a Solar Collector mounted on the roof of a building may project:

A. a maximum of 0.5 m from the surface of a roof, when located 2.0 m or less from the wall of the building;

B. in all other cases, a maximum of 1.5 m from the surface of a roof;

ii. notwithstanding subsection 50.7(1)(a)(i), a Solar Collector shall not extend more than 1.5 m above the maximum permitted Height of the Zone or Overlay;

iii. a Solar Collector mounted on a roof must not extend beyond the eave or outermost edge of the roof;

iv. notwithstanding Section 44, a Solar Collector mounted to the wall of a building may project a maximum of:

A. 0.6 m into an interior Side Setback, provided a minimum of 0.6 m is maintained between the property line and the Solar Collector; and

B. 1.5 m into all other Setbacks, provided a minimum of 0.6 m is maintained between the property line and the Solar Collector;

v. notwithstanding Section 44, where a Solar Collector is mounted to the wall of a building and projects into an interior Side Setback, the total length shall not exceed one third of the length of the wall it is mounted to; and

vi. where a Solar Collector is mounted to the wall of a building or forms a structural component of a wall, monolithic and monochromatic walls with low aesthetic appeal shall be avoided.

b. in a Zone where the maximum permitted Height is greater than 12.0 m:

i. a Solar Collector mounted on the roof of a building:

A. may project a maximum of 1.5 m from the surface of a roof;

B. must not extend beyond the eave or outermost edge of the roof;

ii. notwithstanding Section 44, a Solar Collector mounted to the wall of a building may project a maximum of 1.5 m into all required Setbacks, provided a minimum of 0.6 m is maintained between the property line and the Solar Collector; and

iii. Section 44(2)(b) shall not apply to a Solar Collector mounted to the wall of a building.

Source: (City of Edmonton, 2019)

Appendix B – Solar Qualifications

North American Board of Certified Energy Practitioners (NABCEP):

Solar contractor licensing in the United States (U.S.) began in the 1980s alongside incentive programs for solar water heating (Solar Energy International, n.d.). Due to the lack of maturity of the industry, two main approaches exist throughout the country. The first being the use of a nationally recognized standard, and the second being regulations adopted by local governments.

The North American Board of Certified Energy Practitioners (NABCEP), established in 2003, is an internationally recognized, independent and voluntary certification program that refers to a variety of different kinds of solar thermal and photovoltaic installations. It's aim is "to support, and work with, the renewable energy and energy efficiency industry professionals, and stakeholders to develop and implement quality credentialing and certification programs for practitioners" (North American Board of Certified Energy Practitioners , n.d., p. 1). It was developed by subject matter experts with a U.S.-based focus for industry professionals and solar-thermal system installers (North American Board of Certified Energy Practitioners, n.d.b). Despite the U.S. focus, NABCEP has also received *ANSI/ISO/IEC 17024: General Requirements for Bodies Operating Certification Systems of Persons* accreditation. This accreditation, which has been approved by 85 countries, demonstrates that certificate receivers operate in a consistent, comparable and reliable manner (North American Board of Certified Energy Practitioners, 2019).

NABCEP certification requires applicants to: attain at least one year of installation experience, document all installations and training, pass an exam, sign a code of ethics, and take continuing education courses for re-certification every three years. Despite the emphasis placed

on NABCEP certification, it is voluntarily and not required in all states. Nonetheless, the certification has not only been recognized by U.S. states but has also been required in order to attain incentives or rebates.

Solar Energy Society of Alberta (SESA)

The Solar Energy Society of Alberta (SESA) was formed in 1991 as a non-profit educational organization with the goal of "advancing the awareness, understanding, and use of solar energy as well as other renewable energy and conservation technologies" (Solar Energy Society of Alberta, n.d., p. 1). It holds seminars, provides workshops and classes, exhibits and public demonstrations and provides a solar technology demonstration trailer for public events in Alberta.

As an education organization, SESA provides consumers and installers with a variety of resources, such as available grants and incentives, directory of approved installers, performance data, installation information and guides, and local industry information. However, as purely an educational organization, it is not a certified or accredited body for the maintenance or upholding of industry standards. This results in an inability for it to enforce regulated standards or certification for installers in Alberta.

Appendix C – Survey Questions

1. What is your involvement and experience in Alberta's solar industry? (Ex: residential installation, regulation, etc.)

2. Do you have experience with the residential solar industry in other jurisdictions? If so, how does Alberta compare?

3. What are Alberta's biggest strengths and weaknesses for residential solar installation?

4. What are the largest barriers or obstacles to Alberta's residential solar industry?

5. What are the major gaps (such as incentives, regulations, or approaches) that are lacking or missing from Alberta's residential solar industry?

6. What impact does the current regulatory approach and policy system have on the residential solar industry? If any, in what way are they negative or positive?

7. What impact do changing governments, like the recent change in Alberta, have on the overall solar industry? What, if anything, could be done to help minimize the changes and associated risks?

8. Given your experience, how does the residential solar industry and regulatory environment compare with other renewable energy technologies or energy efficiency initiatives? (Ex: cost of implementation, regulations, incentives, barriers, etc.)

9. What is needed in Alberta for residential solar installations to continue to grow at the same or a faster pace?

10. In your view, do the positives or incentives of the residential solar industry in Alberta outweigh the barriers or negative aspects?

11. Would a central hub for residential solar, with recommended regulations and approaches, best practices, approved installers, and minimized regulatory involvement and review positively impact Alberta's residential solar industry?

12. Would a single regulating body that approves installations and installers help or hinder the industry?

Appendix D – Summarized Survey Results

Question Focus	Survey Questions	Main Feedback
Strengths of Alberta's residential solar PV industry	1. What are Alberta's biggest strengths and weaknesses for residential solar installation? 2. What are the largest barriers or obstacles to Alberta's residential solar industry? 3. In your view, do the positives or incentives of the residential solar industry in Alberta outweigh the barriers or negative aspects?	• A more efficient permitting system than some other provinces. • Very good solar resource in Alberta. • Strong entrepreneurial spirit and regulatory environment in the province. • Alberta has the engineering expertise (well-educated workforce), capital, available talent, and energy industry knowhow to become a huge player in the renewable energy space. • Prior to recent changes, Alberta also had a better standard for interconnections and the incentives.
Negatives of Alberta's residential solar PV industry		• Low power prices for traditional fossil fuel sources, and too much discussion focusing on either/or, rather than looking at a balanced mix of generation. • Large up-front costs and the uncertainty around the longevity and consistency of incentive policies. Current provincial government does not seem supportive. Furthermore, the fluctuation in consumer spending when incentives are anticipated, or closing is not encouraging for installers. • Consumer misunderstandings and lack of education. Specifically: payback periods, solar PV technology, insurance and fire protection, and residential valuation improvements. • Poorly designed systems and a lack of strong tools for the residential solar PV industry to self-manage and address problematic behaviors, and no designated associations or agencies responsible for governing solar installers. The risk the solar industry develops faster than the regulatory and quality management.
Opportunities for growth in residential solar PV	4. What are the major gaps (such as incentives, regulations, or approaches) that are lacking or	• Consistent regulations and incentives. • A PACE scheme or PACE bonds (in addition to consistent incentives) could help facilitate the development of residential solar PV.

	missing from Alberta's residential solar industry? 5. What is needed in Alberta for residential solar installations to continue to grow at the same or a faster pace?	• Updating of the micro-generation regulation to ensure a decent rate of return for supplying excess generation to the grid. • Self-sustaining aspects of the residential solar PV industry would provide less opportunities for government and policy impacts.
Impact of changing provincial governments	6. What impact does the current regulatory approach and policy system have on the residential solar industry? If any, in what way are they negative or positive? 7. What impact do changing governments, like the recent change in Alberta, have on the overall solar industry? What, if anything, could be done to help minimize the changes and associated risks?	• Likely dampening effect on solar power investments (change of Ontario government). • Some installers removing or limiting exposure to Alberta. They were reliant on the 30% incentive available under the MCCAC. • Regulatory environment is well established and should not be heavily impacted. • A boom & bust economy is inefficient – especially if it is artificially created. • Consumers wait for incentives to be announced (impacting businesses) and then "gold rush" to buy solar because nobody knows when the funding will run out.
Comparison with other jurisdictions and industries	8. Do you have experience with the residential solar industry in other jurisdictions? If so, how does Alberta compare?	• Alberta is much more efficient in terms of permitting compared to Manitoba and Saskatchewan. • Alberta's appears to be at an intermediate level compared with other Canadian jurisdictions. • Alberta has better standard for interconnectedness and incentives, such as the 30% offered to municipalities. • Solar is high-tech and sexy but for most existing homes built to low energy standards the best use of making the home more efficient provides a much better use of scarce resources.
	9. Given your experience, how does the residential solar industry and regulatory environment compare with	• Energy efficiency programs are less expensive than PV and more of a "low-hanging fruit" because of it. • Some energy efficiency retrofits can be easier than solar PV installation but others can be more difficult and costly.

	other renewable energy technologies or energy efficiency initiatives? (Ex: cost of implementation, regulations, incentives, barriers, etc.)	
	10. Would a central hub for residential solar, with recommended regulations and approaches, best practices, approved installers, and minimized regulatory involvement and review positively impact Alberta's residential solar industry? 11. Would a single regulating body that approves installations and installers help or hinder the industry?	• This sounds like it could be somewhat helpful, but I would be very careful adding a bureaucratic/administrative burden • If it's done right, probably. • I can't see a centralized government agency that approves installations and installers as anything but a bureaucratic nightmare that slows down the industry. • Getting all of the permitting under one body would create challenges, but province-wide consistency would be a huge help. • Yes, Yes but who it reports to or is ultimately responsible may require regulations and may be a long-term solution. • It could hinder industry, if individual installations need to be approved. • In theory this will have a positive effect on the market. However, it is very difficult to implement because regulations come from multiple jurisdictional authorities.

Source: (McGoey, 2019)