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Nova Scotia Residential Solar

Market Outlook and Labour Force Study

Final Report
April 2019

Prepared for:

CanSIA

NOVA SCOTIA RESIDENTIAL SOLAR

MARKET OUTLOOK AND LABOUR FORCE STUDY

Final Report - April 2019

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ABOUT **DUNSKY**

Dunsky Energy Consulting, Canada's leading clean energy advisory, provides strategic analysis and counsel in the areas of energy efficiency, renewable energy and sustainable mobility. We assess opportunities (technical, economic and market), design strategies (programs, plans and policies) and evaluate performance for governments, utilities and others across North America.

Dunsky's team of 20+ experts is wholly dedicated to helping our clients build a sustainable energy future.

Governments ▪ Utilities ▪ **CLIENTELE*** ▪ Private firms ▪ Non-profits

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EXECUTIVE SUMMARY

After a number of years of moderate but steady growth, the Nova Scotia residential solar market has experienced a significant increase in uptake over the past year. Provincial support for residential solar through Efficiency Nova Scotia's (ENS) SolarHomes incentive program has sparked customer interest and awareness in solar photovoltaics (PV) and has supported the development a strong local solar industry.

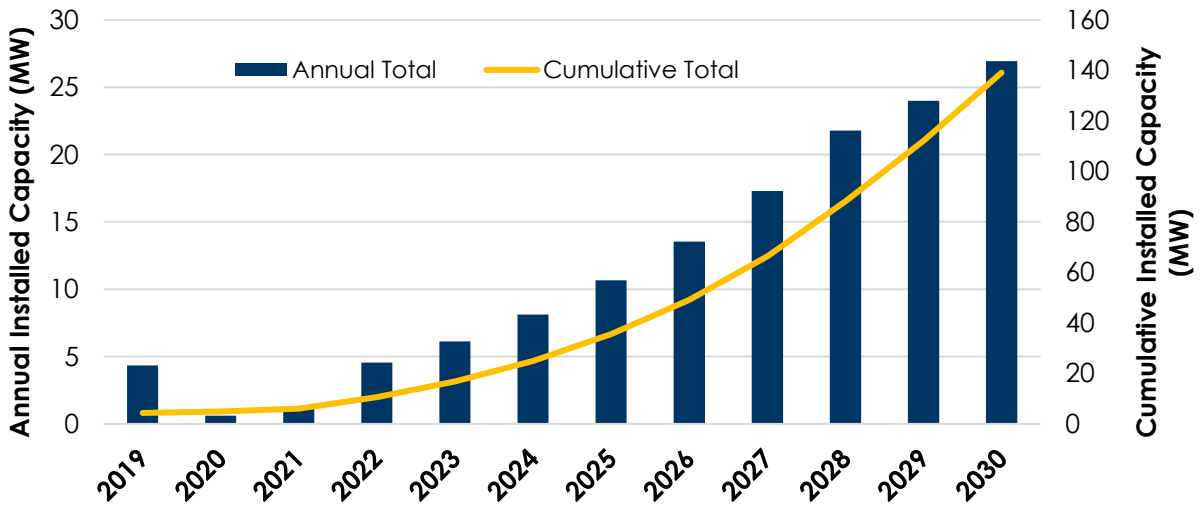
The scope of this study was to develop a market outlook and labour force study for the Nova Scotia residential solar market. Specifically, the report offers insights into forecasted residential solar deployment in Nova Scotia to 2030 under various market and policy scenarios. It also highlights estimated direct job creation associated with residential solar deployment as well as a high-level assessment of opportunities for indirect job creation along the solar supply-chain. Additionally, it identifies gaps in required skills, training and certification required to prepare the local labour force to meet the projected market demand. Finally, the report sheds light on the market potential of emerging technologies and the solar industry's readiness to engage in these areas, specifically battery storage and Electric Vehicle (EV) charger installation.

Findings from the study highlight the following key takeaways:

1 THERE IS SIGNIFICANT POTENTIAL FOR RESIDENTIAL SOLAR DEPLOYMENT IN NOVA SCOTIA OVER THE NEXT 10 YEARS

Under baseline conditions and assuming no future incentives beyond 2019, 140 MW (approximately 17,500 solar homes) are forecasted to be installed in Nova Scotia by 2030. By 2030, 150 GWh of renewable electricity are estimated to be generated from the forecasted deployment, representing 1.4% of Nova Scotia's total electricity consumption. The generated electricity is estimated to displace electricity from coal-fired power plants and results in 960,000 tCO2e of emission reductions over the assumed systems' lifetime of 30 years.

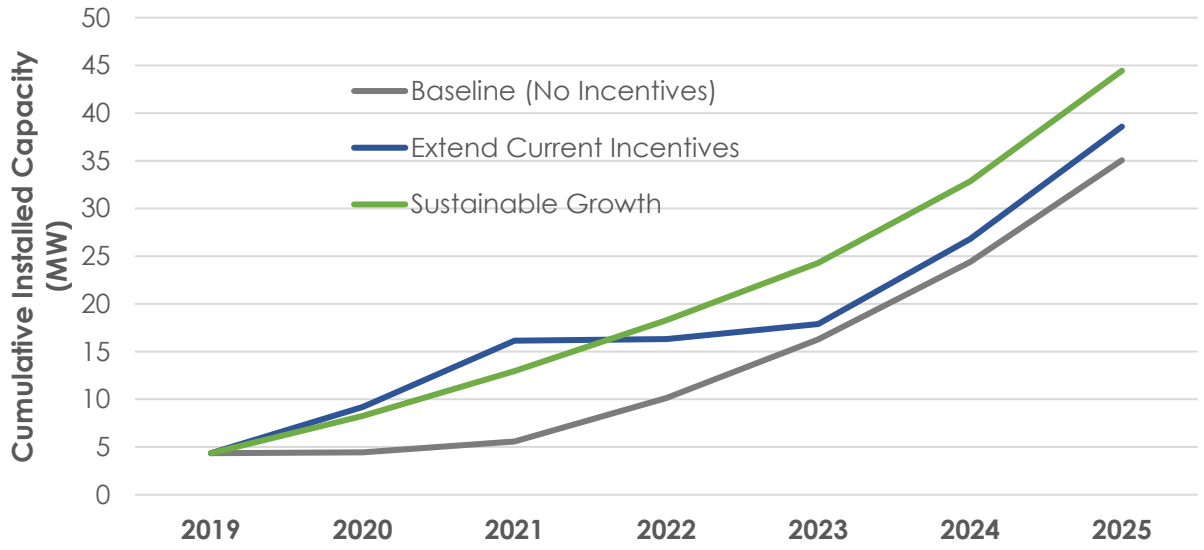
Figure ES 1: Projected Installed Residential Solar Capacity Under Baseline Scenario (No Incentives)



Sensitivity analysis highlights that market projections are influenced by local factors relating to system costs, electricity rates, system performance and system sizes which indicates a range in the forecasted increase in market demand from 96 MW to 187 MW. This corresponds to 104-202 GWh in annual renewable electricity generation by 2030 (1.0%-1.9% of Nova Scotia's electricity consumption).

To assess the impact of future incentives and phase-out strategies on uptake, we model five future incentive scenarios that may apply to Nova Scotia. As shown in Figure ES 2, the results highlight the significant impact of policy on the market's outlook in the short and long-term and confirm learnings inferred from other jurisdictions, where sudden removal of incentives (such as the shown *Extended Current Incentives* Scenario) has caused 2-3 years of near-zero demand, that can be severely damaging to local solar industries. More balanced gradual phase-out strategies (such as the proposed *Sustainable Growth Incentive Scenario*), where incentives are stepped down over a 3 to 5-year period, continue the market's growth trajectory and ensure natural hand-off from incented to non-incented regime. ENS's recent announcement of stepping down SolarHomes rebates from $1 per Watt to $0.85 per Watt as of April 2019 represents a similar gradual incentive ramp-down strategy, which will maintain market's sustainable growth both in the immediate-term and post-program. **If a sustainable incentive phase-out strategy is maintained and rebates are stepped down gradually over longer periods of time, we project that 44 MW of solar will be installed in the province by 2025 (corresponding to roughly 5,500 homes) and 178 MW by 2030 (corresponding to more than 22,000 solar homes).**

Figure ES 2: Forecasted Cumulative Uptake Under Modeled Incentive Scenarios



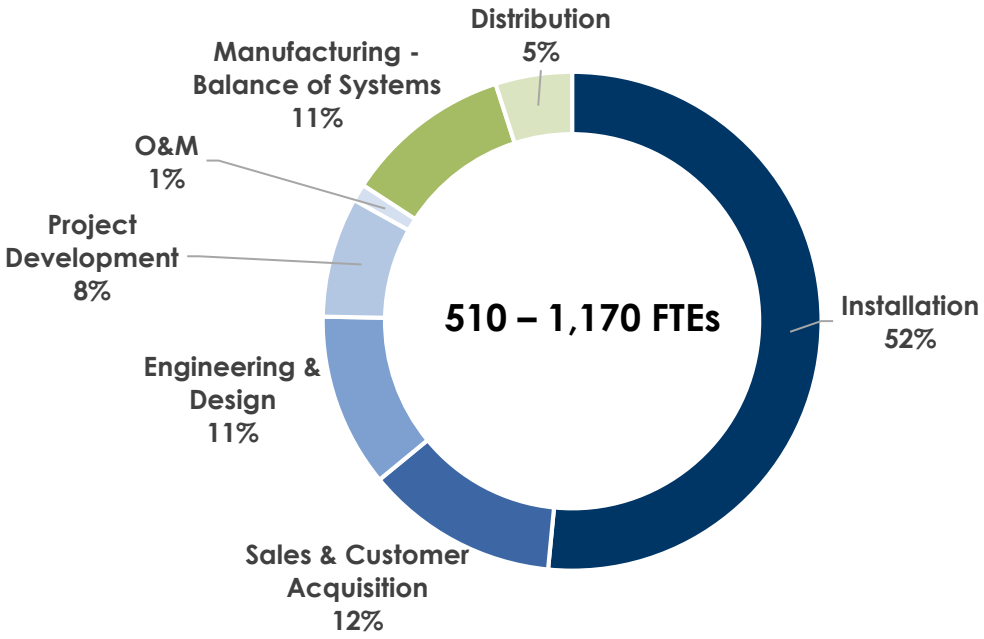
2 SUPPORTING THE SOLAR INDUSTRY OFFERS OPPORTUNITIES FOR LOCAL ECONOMIC DEVELOPMENT AND JOB CREATION

Nova Scotia's solar industry is growing, particularly in down-stream direct project-functions such as sales, engineering and design, project development and installation. The momentum gained from Efficiency Nova Scotia's SolarHomes program has resulted in significant growth in the local solar industry, with an estimated 51 active installers in Nova Scotia today. Input from stakeholders highlights that there are currently low barriers to entry for installation companies, and that the strong interest and support from the province and municipalities is likely to spur further growth.

Despite limited activities today, Nova Scotia has potential to unleash further job creation and economic development opportunities if additional components of the solar supply chain are addressed locally. Through a conducted Supply Chain Opportunity Assessment, Nova Scotia was found to be well-positioned to grow and foster a local solar distribution industry as well as a manufacturing of racking and other balance of system components required for the solar industry.

Based on a jurisdictional scan of employment studies from other jurisdictions and survey of local Nova Scotia installers, **we estimate that the forecasted residential solar deployment in Nova Scotia will support up to 1,170 local jobs by 2030; expressed in Full-Time Equivalent (FTE)[1], with 84% (430 - 980 FTEs) being direct jobs in installation, sales, engineering and other project related functions and 16% (80 – 190 FTEs) being indirect jobs in upstream activities related to distribution and manufacturing of balance of system components**. Future program support will be critical in the short-term to capture these job creation estimates; particularly continuing the gradual rebate step-down strategy will ensure continuous growth of the industry in Nova Scotia. On the other hand, periods of flat-line demand that could be caused by sudden drops in Incentive level could break the momentum the industry has gained and result in reduced employment.

Figure ES 3: Distribution of Jobs Supported Through Residential Solar Deployment in Nova Scotia by Function



A survey of industry members highlights that Nova Scotia's existing labour force has the necessary skills to address market needs, however limited experience in solar installation and solar-specific engineering functions was pointed as short-term challenge. Although local, national and online channels for training programs were identified, several installers, through both the survey and stakeholder engagement, reported limited access to adequate courses as a major challenge. This indicates that need for developing local, accessible and well-advertised training program, which will be critical for the industry's success and continued growth. For example, establishing a "one-stop-shop" for solar-specific training for engineers, installers and other general labourers in the industry would help mitigate concerns about labour force's lack of experience and ensure the industry is ready to meet the forecasted market demand.

[1] We use Full-Time Equivalents (FTEs) to measure jobs; which is defined as one full-time position (i.e. 40 hours per week) for a period of one year. While FTEs are defined as one full-time position for a period of one year, in reality, this may be a mix of part-time and full-time positions that when combined make up the FTE metric and applied results.

3 EMERGING POTENTIAL AND OPPORTUNITIES FOR THE SOLAR INDUSTRY TO ENGAGE IN NEW SERVICE AREAS

The solar industry is well positioned to meet future market demand for emerging technologies; namely battery storage and electric vehicles charging infrastructure installation.

Under current conditions, limited opportunities exist for large-scale deployment of residential battery storage, with only 15 – 35% of new residential solar installations estimated to be storage-paired by 2035. The solar industry is well-positioned to tackle the market demand for storage, which is expected to create 10 – 30 additional FTEs by 2030. Under alternative rates or solar compensation structures, which may increase the value proposition of storage-paired solar, market demand and corresponding economic impacts are expected to increase significantly.

Engaging in services relating to sales and installations of EV home charging stations could result in interesting business opportunities for industry, through additional revenue streams from new services as well as expanding lead generation channels for solar business. Based on NSPI's forecasted EV adoption in Nova Scotia, we estimate that 20 – 70 FTEs could be supported in EV home charger installation services by 2030.

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INTRODUCTION

CONTEXT

Although less developed than other jurisdictions across North America, Nova Scotia's solar market has seen significant growth in the past few years and possesses all the key ingredients for further growth in the future. Provincial support for residential solar photovoltaics (PV) through the SolarHomes incentive program has sparked significant market uptake and awareness and has supported the development a strong local solar industry. This support is primarily driven by the significant role that solar can play in achieving Nova Scotia's transition to a clean and renewable electricity mix. Additionally, increasing electricity rates and significant cost reductions are resulting in a growing interest among Nova Scotia homeowners in solar PV systems.

Dunsky Energy Consulting was mandated by the Canadian Solar Industries Association (CanSIA) to develop a market outlook and labour force study for the Nova Scotia residential solar market. The scope of the study covers grid-connected distributed solar PV deployment in the residential sector. The objectives of the study are to:

- Forecast the deployment of residential solar in Nova Scotia to 2030
- Estimate the direct job creation associated with residential solar deployment
- Perform a high-level assessment of opportunities for indirect job creation along the solar supply-chain
- Identify gaps in required skills, training and certification to prepare the labour force to meet market demand
- Understand the potential and readiness of the solar industry to engage in emerging technologies; namely battery storage and Electric Vehicle (EV) charger installation

METHODOLOGY

The study used the following approach:

- Use of Dunsky's Solar Adoption Model (SAM) to forecast the market potential for residential solar in Nova Scotia.
    - *Compile data on key market characteristics and inputs, including building stock, electricity consumption, electricity prices, PV system costs, solar insolation, etc.*
    - *Using historical inputs, calibrate SAM to the Nova Scotia market by benchmarking model to historical adoption in the province between 2007 and 2018*
    - *Use calibrated model to project future market demand for residential solar under a baseline business-as-usual scenario*
    - *Conducted scenario and sensitivity analysis to identify impact of key market, technology and policy uncertainties on market demand*
- Conducted a jurisdictional scan of solar supply chain and employment studies to obtain a metric for direct and indirect job creation associated with residential solar deployment
- Stakeholder engagement, expert interviews and an online survey to probe for areas of engagement across the supply chain, current employment levels, skills and training gaps, economic development opportunities, and other ancillary inputs

A more detailed description of the methodology is presented in Appendix A, and key inputs and assumptions used in the study are presented in Appendix B.

STRUCTURE OF REPORT

This report is structured as follows:

RESIDENTIAL SOLAR MARKET OUTLOOK: Presents forecasted demand under market and technology uncertainty as well as different policy options.

SOLAR LABOUR FORCE: Highlights the current status of the solar supply chain in Nova Scotia, solar job creation outlook, potential opportunities in indirect functions as well as considerations for workforce skills and training.

EMERGING TECHNOLOGIES: Evaluates opportunities for the solar industry to engage in business activities related to battery storage and electric vehicle charging.

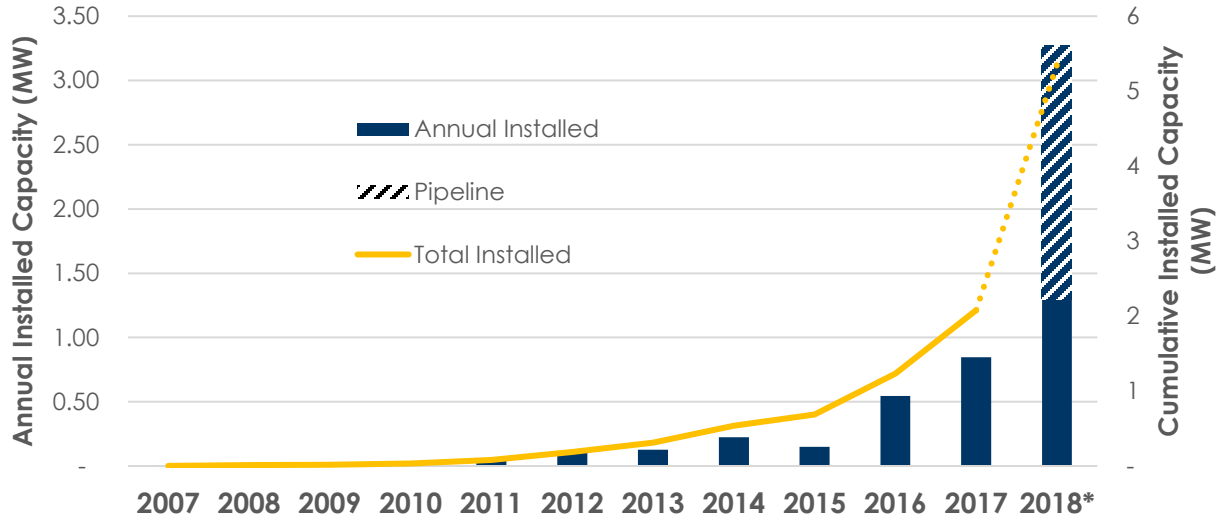
CONCLUSION: Summarized findings and presents key takeaways from the study.

RESIDENTIAL SOLAR MARKET OUTLOOK

MARKET OVERVIEW

As shown in Figure 1, the Nova Scotia residential solar market had a steady growth from 2011 up to 2015. In recent years, the market entered an expansion phase characterized by a rapid growth. **By end of 2018, 530 systems totalling 3.4 MW were installed with an additional 200 systems corresponding to 2 MW estimated to be in the pipeline awaiting installation, resulting in a total of 730 systems (5.4 MW of capacity).** This growth can be largely attributed to four key factors, highlighted below.

Figure 1. Installed Residential PV capacity in Nova Scotia from 2007 to 2018[2,3]



MARKET DRIVERS

Net-Metering: A key enabler of residential solar PV in the Nova Scotia has been the Enhanced Net Metering policy, which allows households and businesses to sell back excess electricity generated by their renewable energy systems to the utility. Under Enhanced Net Metering, systems are intended to offset self-consumption and are sized to produce electricity less than or equivalent to the annual consumption of a customer's buildings. In the early years of net metering, the uptake of solar PV systems in Nova Scotia was relatively limited, with only an estimated 130 systems installed between 2007 to 2015.

Efficiency Nova Scotia (ENS) SolarHomes: In August 2018, ENS launched the SolarHomes Program, which offered Nova Scotia residents a rebate of $1 per Watt for installed solar PV system, up to a maximum of $10,000 or 40% of eligible system costs[4]. As a result, the average subsidized cost of solar fell to $1.6 per Watt for program participants. The program has a target of supporting 2,000 residential solar installations over a four-year period (2018-2022). In its first four months (December 2018), the program had received

[2] Nova Scotia Power (2018). Submission to UARB Regulation 3.6 – 2018 Net Metering Report

[3] 2007 to 2017 data represents residential solar installations reported by NSPI based on interconnection date, whereas 2018 represents 1.3 MW of reported installed capacity by NSPI interconnection data and 1.9 MW assumed to be in the pipeline and estimated to be interconnected early 2019 based on application data from SolarHomes.

[4] As of April 1st, 2019, ENS has announced that rebate levels will be reduced to $0.85/Watt up to a maximum of $8,500 or 35% of eligible costs.

more than 350 applications for a combined 3 MW of installed capacity[5], more than doubling the cumulative residential solar capacity in the province to 5.5 MW by end of 2018. In addition to improving the business case and accelerating the adoption of solar PV in the province, the program has supported the development of a strong local solar industry, with an estimated 51 active solar installers in Nova Scotia today[6]. Additionally, the program has increased local awareness of solar PV and is likely to have a long-term market transformation impact.

Specialized Solar Financing: In addition to the solar rebate program, Nova Scotia is also home to one of Canada's first Property Assessed Clean Energy (PACE) financing programs targeted specifically towards solar technologies; the Solar City Program. The Solar City Program is administered by the Halifax Regional Municipality and offers complete financing to eligible property owners across the municipality that wish to install a solar energy system. While the financing is tied to the property, the repayment is not done through the property tax bill, unlike most PACE programs. Financing is fixed at an interest rate of 4.75% over a ten-year term and participants can choose among several repayment options. Between the fall of 2016 and the end of 2017, almost half of all installed solar capacity in Halifax was financed through the Solar City Program[7]. There was a notable increase in program participation after the launch of the SolarHomes Program in late 2018. A number of other municipalities across the province have launched similar financing programs including the Districts of Lunenburg, Digby, Barrington and Colchester as well as the Town of Bridgewater. Additionally, private lenders are starting to offer affordable financing solutions to homes and businesses in the province, either through specialized financing products like Credit Union Atlantic's (CUA) GoGreen program as well as more traditional offerings such as Home Equity Lines of Credit (HELOC) offered by several mortgage lenders.

Solar PV and Electricity Pricing Trends: Reductions in PV system costs and increasing electricity rates resulted in slight market growth in 2016 and 2017, reaching a cumulative 330 systems and 2.1 MW of installed capacity by 2017. During that period, system costs reported in Nova Scotia were among the lowest in Canada, with an average unsubsidized cost of $2.8/Watt-DC between 2013 and 2017[8]. Similarly, electricity rates in Nova Scotia increased by an average of 2.6% annually during the same period.

PROJECTED BASELINE MARKET DEMAND

To model the range of future demand scenarios, we start by first projecting market demand for residential solar in Nova Scotia under business-as-usual conditions. Under this scenario, we use key inputs and assumptions in line with observed market trends (key inputs can be found in Appendix B). Additionally, we assume that current $1/W incentive from the SolarHomes program will remain available up to the end of 2019 and that no further incentives are provided afterwards[9].

[5] Efficiency Nova Scotia (2018). SolarHomes Update. Nova Scotia Solar Summit.

[6] Based on list of approved solar installers in the Efficiency Nova Scotia Trade Network on April 5th 2019. Available Online : www.efficiencyns.ca/trade-network/directory/search/?st=residential&bt=contractor-or-service-provider&c=solar-equipment&p=solar-pv

[7] Halifax Solar City – Program Update & Extension (2018). Halifax Environment and Sustainability Standing Committee. Available online: www.halifax.ca/sites/default/files/documents/city-hall/regional-council/181204rc1421.pdf

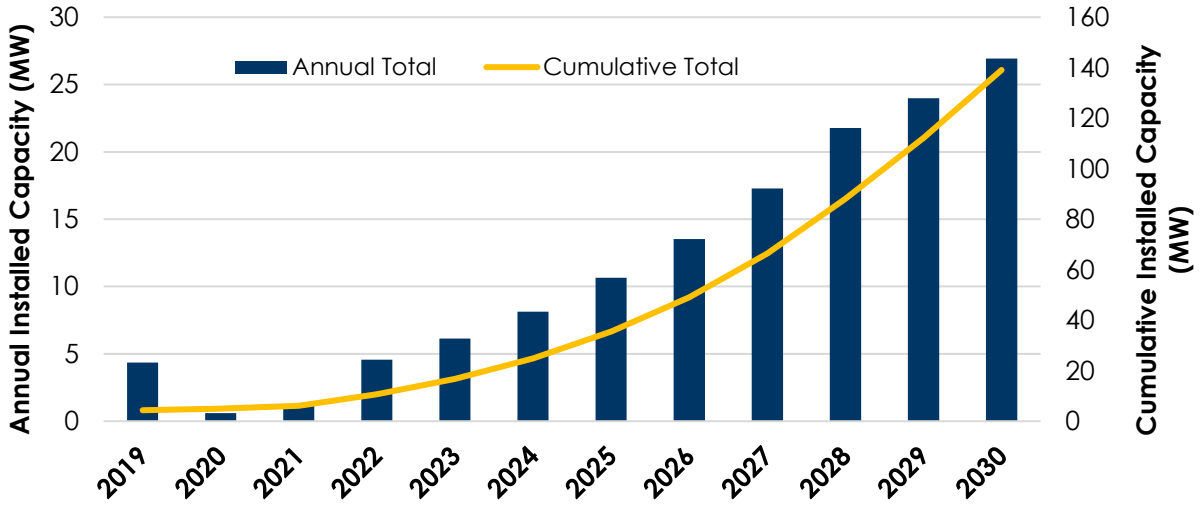
[8] Solar Nova Scotia (2017). Prices and Productivity of Solar Electricity in Nova Scotia. Available online: www.solarns.ca/sites/solarns.ca/files/2018-10/NS_Solar_Price_report_2018.pdf

[9] Since SolarHomes has committed to four years of programming, the modeled 1-year incentive scenario is unlikely, and only used for the sake of establishing a baseline for comparing the impact of other incentive levels.

SolarHomes has committed to four years of programming, therefore the modeled 1-year incentive scenario is a theoretical one used for the sake of establishing a baseline for comparing the impact of future rebates. Additionally, Efficiency Nova Scotia (ENS) recently announced that rebates available through SolarHomes will be stepped down from $1/Watt to $0.85/Watt as of April 1st, 2019 along with a reduction in maximum rebate coverage (the lesser of $8,500 or 35% of eligible costs), however this program update is not captured in this study.

As shown in Figure 2, in 2019, continued SolarHomes incentives are expected to result in approximately 540 new solar installations. If incentives are to be completely removed in 2019, as assumed in this scenario, the market is forecasted to experience a sharp and immediate drop in demand in 2020 and 2021. By 2022, natural market demand for solar will pick up as a result of improving solar economics and a steady market growth is observed. Cumulatively, **under baseline scenario conditions, an estimated 17,500 systems, representing 140 MW of capacity, are projected to be installed by 2030.**

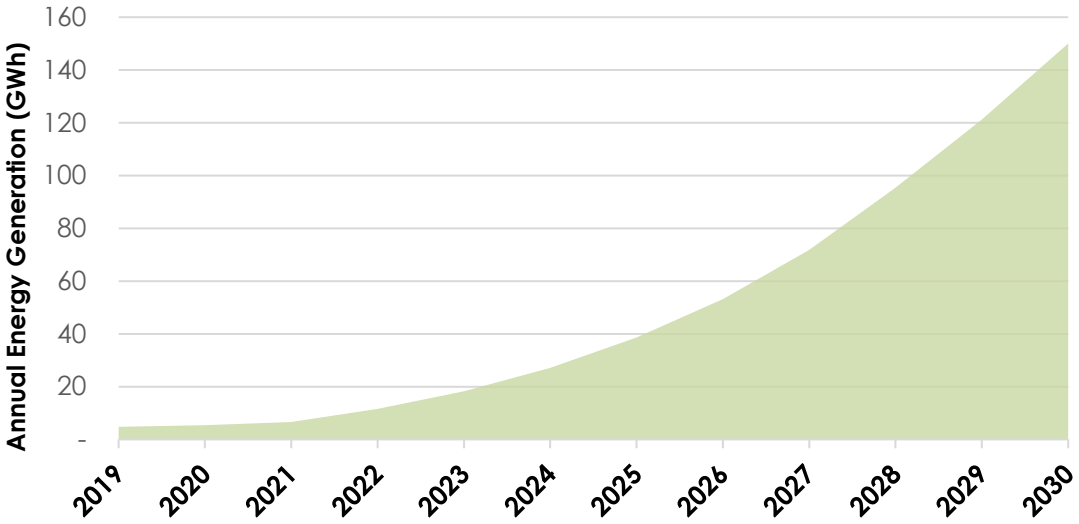
Figure 2: Projected Installed Residential Solar Capacity Under Baseline Scenario (No Incentives)



The installed capacity will result in an estimated 150 GWh in annual renewable electricity generation by 2030, which will correspond to approximately 1.4% of Nova Scotia's annual electricity consumption during the same timeframe (assuming total energy requirements by 2030 are 10,650 GWh). The generated renewable energy displaces electricity from coal-fired power plants and results in 960,000 tCO2e of emission reductions over the systems' lifetime[10].

[10] Emission reductions were calculated using 2017 reported electricity emission intensity (656.5 tCO2-eq/GWh) and an assumed annual decline at average of 5% as per Nova Scotia's compliance CO_2 emission caps. System lifetime is assumed to be 30 years and an annual degradation factor of 0.5% is assumed for installed solar systems.

Figure 3: Annual Electricity Generation from Residential Solar Deployment under Baseline Scenario (No Incentives)



SENSITIVITY TO MARKET AND TECHNOLOGY FACTORS

KEY MARKET AND TECHNOLOGY FACTORS

The projected demand for residential solar is sensitive to a range of market and technology factors. Four key factors were identified, and a sensitivity analysis was conducted to show the impact of each factor on market demand. The four factors are:

- **Electricity Rates:** Nova Scotia has one of the highest electricity rates in Canada[11] with residential customers paying $0.156/kWh in 2018/19. Although, Nova Scotia Power (NSP) projects an annual rate escalation of 2.7% between 2020 and 2040 [12] [13],there remains some uncertainty around future price escalation, which may actually be higher or lower than projected.

- **System Cost Reductions:** Significant cost reductions have been observed in solar PV hardware and non-hardware (soft) costs[14] over the past decades. System costs reported by Efficiency Nova Scotia highlight average costs of $2.51 per Watt for 2018/19[5], which is significantly lower than other major markets across Canada[15] and the U.S.[16] Although further cost reductions are expected over the next decade, there is uncertainty around their level and trajectory for both hardware and soft costs.

- **System Output:** Solar system output is dependent on regional characteristics (solar insolation, weather, etc.), local installation characteristics (roof orientation, pitch, shading, etc.) and system characteristics (module and inverter efficiency, etc.). An average of 1,087 kWh per kW installed (roughly 12.5% capacity factor) has been reported for existing installations in Nova Scotia[8], on par

[11] Hydro Quebec (2018). Comparison of Electricity Prices in Major North American Cities. Available online: www.hydroquebec.com/data/documents-donnees/pdf/comparison-electricity-prices.pdf
[12] Nova Scotia Power (2014), 2014 Integrated Resource Plan NS Power Final Report
[13] Nova Scotia Power is in the middle of a Rate Stability Plan to maintain average residential rate increases at 1.7% between 2017 and 2019
[14] Soft costs include permitting, financing, and installing solar, as well as other non-hardware expenses that solar companies incur to acquire new customers, pay suppliers, and cover their bottom line.
[15] Energy Hub (2019). Cost of Solar Power in Canada 2019. Available online: www.energyhub.org/cost-solar-power-canada
[16] Energy Sage (2019). How much do solar panels cost in the U.S. in 2019?. Available online: www.news.energysage.com/how-much-does-the-average-solar-panel-installation-cost-in-the-u-s

with the Canadian average. Improvements in solar PV technologies or changes to the quality of installed systems (i.e. more homes with better solar characteristics adopt systems) could increase or decrease the observed average system output.

- **System Sizes:** System sizes can be constrained by several factors including available roof space or net-metering regulations, which are designed to ensure customers size their solar installations to meet their annual energy need and not over-generate. A general trend of increasing system sizes has been observed over the past few years in Nova Scotia, particularly under SolarHomes, however it is unclear whether this trend will continue. On one hand, the larger system sizes may be a by-product of the incentives offered through SolarHomes or larger households making up most of the current adoption. Conversely, with the increased electrification of heating and transportation (Electric Vehicles), households may tend to install larger systems to accommodate the increased load. Therefore, considering existing residential solar interconnections, both before and after the launch of SolarHomes, we assume an average residential installation of 8 kW, and model a potential increase and decrease in systems sizes of 20% relative to the average (6.4 – 9.6 kW)

In addition to these factors, a number of additional ones; including availability of financing programs, changes to solar compensation mechanisms (i.e. net-metering) and changes to electricity rate structures, can have significant impacts on solar uptake and are discussed in the Other Considerations Section.

IMPACT OF KEY FACTORS ON MARKET DEMAND

Assumptions for the range of inputs used to assess the sensitivity for each factor are summarized in the table below with detailed assumption in Appendix B.

Table 1: Summary of Assumptions used for Sensitivity Analysis

	Decline in Variable	Baseline	Increase in Variable
System Costs Reductions	2% Average Annual Decline	3% Average Annual Decline	4% Average Annual Decline
Electricity Rates	1.7% Annual Increase	2.7% Annual Increase	3.7% Annual Increase
System Output	11.5 % Capacity Factor (1,000 kWh/kW)	12.5 % Capacity Factor (1,095 kWh/kW)	13.5 % Capacity Factor (1,180 kWh/kW)
System Size	6.4 kW	8 kW	9.6 kW

Table 2 below highlights the impact of each factor in isolation relative to the baseline scenario in the short, medium and long terms.

Table 2: Sensitivity Analysis Results

	Impact on Installed Capacity Relative to Baseline (%)		
	Short Term 2020	Medium Term 2025	Long Term 2030
System Cost Reductions	-13% 7%	-22% 14%	-25% 17%
Electricity Rates	-12% 12%	-17% 16%	-16% 15%
System Output	-24% 23%	-13% 12%	-9% 9%
System Size	-20% 20%	-20% 20%	-20% 20%

All factors have the expected directional impact and a similar magnitude of impact on market demand, and highlight the following takeaways:

- **System Costs Reductions:** System costs significantly impact the economics of solar adoption and have an increasing impact on market demand over time. Favourable system costs declines could result in a 17% increase in installed capacity over the baseline projection by 2030, whereas higher than projected costs reduce projected demand by as much as 25% as compared to the baseline.

- **Electricity Rates:** Higher than projected increases in electricity rates will improve the business case for solar PV, which would result in as much as a 15% increase in market demand and installed capacity by 2030. Conversely, if electricity rates increase more slowly than expected, the market would be reduced by as much as 16% by 2030.

- **System Output:** An increase in system output corresponds to higher bill savings for customers who adopt and overall increased market demand. However, the factor seems to have a declining impact over time as solar economics improve naturally (as a result of increasing electricity rates and PV cost reductions), reducing the importance of the system's technical performance.

- **System Sizes:** Changes in average installed system sizes does not have a direct impact on adoption, as systems within the narrow range examined (6.4 – 9.6 kW) are assumed to have the same costs per installed watt. However, changes in system sizes have a direct corresponding impact on installed capacity as a result of customers installing smaller or larger systems.

RANGE OF UNCERTAINTY

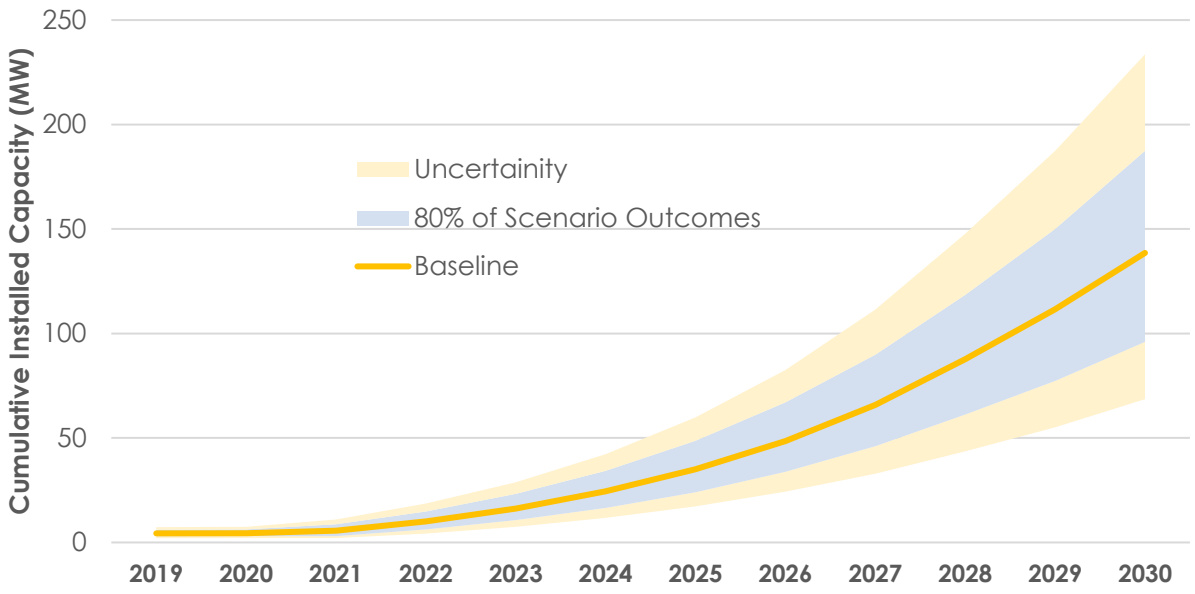
Several of the factors highlighted above are linked and often change concurrently. For example, PV technology advancements may result in increased system output and reduction in costs, which drives customers towards the adoption of larger systems.

Considering all possible permutations of the four factors under investigation (81 unique scenarios), Figure 4 shows the upper and lower bound of uncertainty in cumulative market demand for residential solar. This approach results in a wide range of uncertainty, with the upper and lower bounds being the extreme optimistic and pessimistic scenarios respectively. To narrow the range of forecast, the distribution of projections within the scenario space is used and the 10th and 90th percentile were set as the bounds of the range. 80% of the scenario outcomes were found to fall within 40% of the range, thus narrowing the bounds of uncertainty in projections[17].

Under the most favourable conditions, forecasted market demand increases by 35% to 187 MW (versus 140 MW under baseline), whereas under the most constraining conditions cumulative market demand by 2030 drops by 30% to 96 MW. This corresponds to 104-202 GWh in annual renewable electricity generation by 2030 (1.0% - 1.9% of Nova Scotia's electricity consumption). Over the systems' lifetime, this corresponds to 664 – 1,300 ktC02-eq of emission reductions[10].

[17] This approach assumes that the range of modeled scenarios represents all possible outcomes and that all scenarios have equal weighting; with the frequency of occurrence of each outcomes representing its probability.

Figure 4: Range of Projections for Residential Solar Deployment in Nova Scotia



IMPACT OF INCENTIVE PROGRAMS

Policy has a significant impact on solar demand, as highlighted earlier by the notable increase in solar installations in 2018 after the launch of the SolarHomes program. In this section, we assess the impact that incentives can have in determining the trajectory of Nova Scotia's residential solar PV market in the coming years.

Many jurisdictions across the U.S. including (most notably California and New York) have successfully used incentive programs to drive significant market uptake of distributed solar and demonstrate best practices for program design and delivery. Their experiences have shown that successful programs should aim to accomplish two key objectives:

- **Establish appropriate incentive levels** that accelerate market uptake, as an investment that builds local solar PV industry capacity.
- **Consider how and when to best ramp down the incentives** in such a manner that does not threaten demand for solar PV installs, thereby undermining the industry that the investments sought to build.

To ensure that incentive programs achieve both their short-term market acceleration and long-term market transformation objectives, programs can be designed to ramp-down incentive levels gradually and transition the market to a non-incented regime as naturally as possible. In other words, incentive programs should avoid creating boom-and-bust cycles that can actually have a long-term negative impact on the local industry.

To highlight potential strategies for continued support of solar in Nova Scotia and the corresponding impacts, the following scenarios for future incentive programs were explored:

- **Baseline Market (Incentive end in 2019):** Program maintains incentive level of $1 per Watt for 2019 and program is discontinued starting 2020.
- **Extend Current Incentives:** Program through 2021 at current incentive levels of $1 per Watt (not considering any program quotas or limits)
- **Steep Ramp-Down:** Incentives are ramped down steadily over a 3-year period. Current incentive levels are maintained for 2020 and ramped down to $0.50 per Watt in 2021 and discontinued starting 2022.
- **Maintain Current Flat Market:** Incentives ramped down annually with an aim to maintain the annual market activity as it was in 2018, resulting in around 500 installations per year.
- **Support Sustainable Growth:** Incentives ramped down somewhat more slowly and over a longer time period, in order to maintain sustainable growth in installations of 10%-20% per year.

Table 3 shows incentive levels that were used to represent each of these scenarios, while Table 4 and Figure 5 highlight forecasted adoption under each scenario. The results are shown with a particular focus on the 2019 to 2025 timeframe to highlight the impact of the incentive scenarios on market uptake in the short-term.

Table 3: Modeled Incentive Scenarios

	Incentive Level ($/W)							Estimated Total Incentive Costs
Incentive Scenario	2019	2020	2021	2022	2023	2024	2025	2019-2025
Baseline (No Incentives)	$ 1.00	-	-	-	-	-	-	$4.4 M
Extend Current Incentives	$ 1.00	$ 1.00	$ 1.00	-	-	-	-	$16 M
Steep Ramp-Down	$ 1.00	$ 0.50	-	-	-	-	-	$4.8 M
Maintain Current Market Activity	$0.90	$0.80	$0.60	$0.35	$0.05	-	-	$10 M
Support Sustainable Growth	$1.00	$0.90	$0.75	$0.55	$0.30	$0.10	-	$17 M

Table 4: Forecasted Annual Uptake Under Modeled Incentive Scenarios

	Annual Installed Capacity (MW)							Cumulative Installed Capacity (MW)
Incentive Scenario	2019	2020	2021	2022	2023	2024	2025	2019 - 2025
Baseline (No Incentives)	4.4	0.6	1.1	4.6	6.1	8.1	10.7	35 MW
Extend Current Incentives	4.4	4.9	6.9	0.2	1.5	8.9	11.8	39 MW
Steep Ramp-Down	4.4	0.8	0.7	4.8	6.4	8.5	11.2	37 MW
Maintain Current Market Activity	3.7	3.7	3.9	4.3	4.7	9.1	13.0	42 MW
Support Sustainable Growth	4.4	3.9	4.7	5.3	6.0	8.6	11.6	44 MW

Lowest Highest

Based on the scenario analysis, we arrive at three overarching conclusions:

1. **Removing incentives immediately would eliminate demand for solar PV in the NS market for the next 2-3 years, which could very likely harm the local industry:** Under the *No Incentives* and *Steep Ramp-down* Scenarios, the market exhibits nearly the same behaviour, with 4.4 MW of new capacity forecasted to be installed in 2019, followed by a flat-line demand for two years due to the abrupt drop in incentives in 2020. Even under the $0.5/Watt incentive offered under the aggressive ramp-down scenario, the market reacts negatively to the sudden drop in incentive and almost no uptake is observed in 2020 and 2021.

2. **Keeping current incentives for a few more years then removing them would still likely causes 2-3-year period of near zero demand in the market (starting in 2021), and again this could severely damage the local industry:** The *Extend Current Incentives* scenario, which continues the $1/W incentive until 2021, maintains market growth during that timeframe, resulting in an additional 16 MW of capacity (approximately 2,000 homes) by 2021. However, similar to the effect observed under the *No Incentives* and *Steep Ramp-Down* scenarios, the sudden incentive removal results in nearly no demand between 2021 and 2023.

3. **Gradually reducing current incentives over a 3-5 year period can play a key role in maintaining solar PV demand in each year and thereby better support the health of the local solar PV industry:** Under the two incentive scenarios where incentives are ramped down gradually over time, *Maintain Current Market* and *Support Sustainable Growth*, the market has a positive trajectory to 2021. In addition neither scenario results in a "demand-shadow" when incentives are removed, as opposed to the 3 other scenarios investigated, and both maintain market growth after the incentives are phased-out in 2023/2024.

The results confirm the learnings inferred from other jurisdictions, where sudden removal of incentives has caused zero demand periods that can be severely damaging to local solar industries and can undermine the market transformation investments made through previous incentive programs. **ENS's recent announcement of stepping down SolarHomes rebates from $1 per Watt to $0.85 per Watt as of April 2019 represents a commitment to follow a careful incentive ramp-down strategy, which intends to both accelerate market adoption of solar in the short-term and help maintain market's sustainable growth both in the immediate-term and post-program.**

If this approach is maintained and incentives are stepped down gradually over longer periods of time, **we project that 44 MW of solar will be installed in the province by 2025, corresponding to roughly 5,500 solar homes.** This sustainable incentive phase-out approach will also result in a long-term market transformation effect, ultimately **increasing uptake of solar by as much as 28% by 2030 to 178 MW (relative to 139 MW in the baseline scenario), as highlighted in Table 5, and more than 22,000 solar homes in Nova Scotia by 2030.**

Figure 5: Forecasted Cumulative Uptake Under Modeled Incentive Scenarios

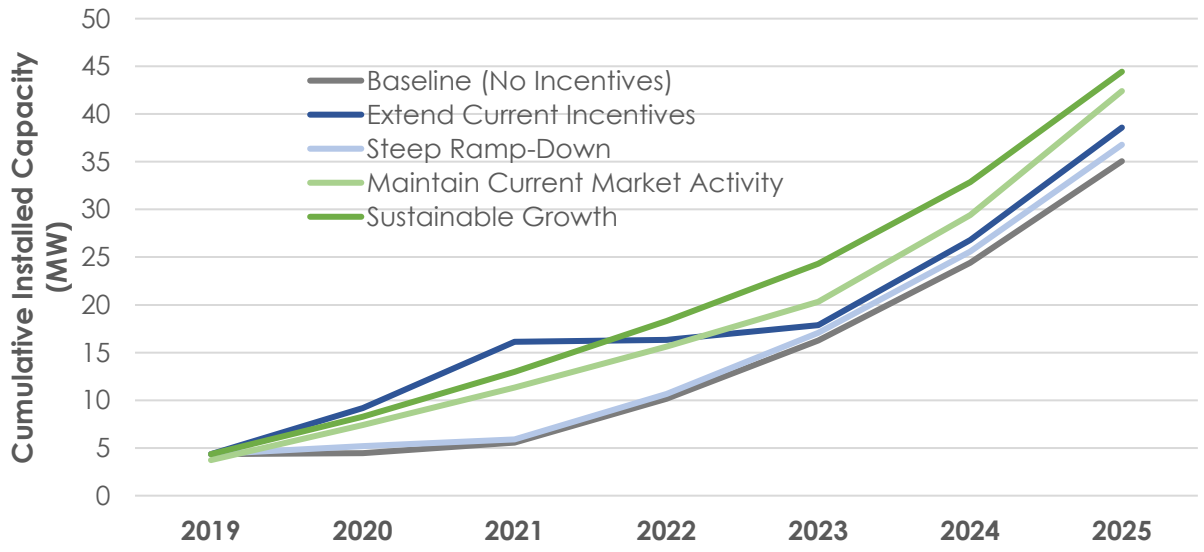


Table 5: Forecasted Cumulative Uptake Under Modeled Incentive Scenarios

Cumulative Installed Capacity	Immediate Term (2020)	Medium Term (2025)	Long Term (2030)
Baseline (No Incentives)	4.4 MW	35 MW	140 MW
Extend Current Incentives	9.2 MW	39 MW	154 MW
Steep Ramp-Down	5.2 MW	37 MW	146 MW
Maintain Current Market Activity	7.4 MW	42 MW	170 MW
Support Sustainable Growth	8.3 MW	44 MW	178 MW

OTHER CONSIDERATIONS

In addition to market uncertainties and policy levers investigated earlier, a number of additional market and policy factors can have significant impacts on solar uptake.

Availability of Financing Programs and Products

Cash-flow-based financing solutions are defined as low-cost and long-term (15 years or longer) financing options that allow customers to match their annual payments with the solar PV energy bill savings. This predominantly includes Third-Party Ownership (TPO) models, such as solar leases and Power Purchase Agreements (PPAs), but also extends to Property Assessed Clean Energy (PACE) financing, Local Improvement Charges (LIC) financing and other specialized zero-down solar financing products. These solutions have proven to be a key enabler of solar adoption.

In the early years of solar markets in the U.S., TPO models were key to increasing the deployment of residential solar in emerging markets, with as much as 72% of residential systems installed in in the U.S. 2014 being TPO. As the market matured, self-ownership become increasingly popular and market share of TPO systems dropped to less than 40%[18]. This trend was primarily caused by the increasing availability and competition between alternative financing products (such as zero-down loans, PACE financing, etc.) as well as paybacks falling to the 10-year mark, which is often considered the desirable investment threshold for the majority of homeowners.

While a number of low-cost financing products are available to Nova Scotia homeowners to finance their solar systems including PACE/LIC (such as Halifax SolarCity), Home Equity Line of Credit (HELOC) and CUA's GoGreen, most of these programs offer a 10-year repayment tenor, well below existing paybacks for residential solar systems. Increased availability of TPO leases or Power Purchase Agreement (PPA) models in Nova Scotia can alleviate upfront cost barriers associated with solar and accelerate early adoption of residential solar in the province. Additionally, the introduction of longer-term solar financing products (20 years +) is likely to increase uptake both in the immediate and long terms.

Alternative Compensation Mechanisms

Numerous studies by utilities, regulators and other entities have been conducted to identify the value of distributed solar to utilities through quantifying the benefits and costs associated with solar adoption and net-metering[19]. While utilities benefit from avoided costs related to energy generation, infrastructure investments[20], system losses, environmental compliance and other value streams, lost energy sale revenues are also a key consideration. The difference between the benefits and costs associated with solar adoption impact utilities' revenue requirements, potentially resulting in a rate increase for their entire customer base and raising questions about the cost-allocation between electricity customers with and without solar.

[18] Wood Mackenzie (2018), U.S. Residential Solar Finance: H1 2018

[19] Hansen, Lena, Virginia Lacy, and Devi Glick (2013), A review of solar PV benefit & cost studies." Rocky Mountain Institute.

[20] Nova Scotia's system peak demand occurs in the evening during the winter. As such, its peak demand hours have no coincidence with solar production, meaning that it is unlikely that solar will avoid or defer any new distribution or transmission infrastructure investments during the times solar is generating electricity. However, targeted deployment of distributed solar at constrained areas of the distribution system may result in system benefits and investment deferral during daylight hours. In addition, a number of jurisdictions are currently implementing Non-Wire Alternatives (NWA) initiatives to manage and optimize their grids by taking advantage of solar generation through utilizing storage and active load management to offset need at other times of high demand.

Some jurisdictions with increased solar penetration have begun transitioning customers to alternatives to net-metering, such as net-billing or other value-based compensation mechanisms:

- **Net-Billing:** Unlike net-metering, where customers get paid full retail value for energy exported to the grid, under some of these alternative set-ups customer exports are often valued at a lower rate. These changes result in a negative impact on the economics of solar, however, over the long term they provide a signal to new customers that encourages them to optimize their system sizes for self-consumption and minimize exports. Under net-billing, the business case and uptake of storage-paired solar systems would also be expected to increase.

- **Value-based mechanisms** ensure that distributed solar are compensated for benefits and services provided to the grid relating to avoided costs, and often include time and location-based elements that encourage adoption where it brings the most value to utilities, the grid and other customers. In many cases, where system-wide benefits of solar are found to be higher than incurred costs, value-based compensation will result in higher rates for exports and more adoption.

Alternative Rate Structures

In addition to compensation mechanisms, electricity rate designs and structures also have a significant impact on solar. Alternative rate structures have also been used in some judications to address similar concerns around the allocation of costs and benefits between customers and to ensure correct market price signals are being provided to customers. Existing and proposed rate designs include higher fixed fees, peak demand charges or Time of Use (TOU) rates. These rate structures often result in less "avoidable" costs for solar, thus reducing the business case for solar adoption.

SOLAR LABOUR FORCE

SOLAR SUPPLY CHAIN

To assess the potential job creation opportunities solar may bring to Nova Scotia, we begin by defining the solar supply chain. Generally, a product or service's supply chain captures the sequence of steps and processes involved its' production, distribution and ultimate delivery to the end customer. While many conventions exist, in this study we define the solar supply chain as shown in the Table 6 below.

Table 6: Solar Supply Chain

Supply Chain Step	Description
Research and Development	Activities relating to innovation leading to the development of new products or services
Manufacturing	Production of goods required by the solar sector, including cells, modules, inverters, mounting structures and other balance of system equipment
Distribution	Wholesale, retail, shipping and other activities that help deliver PV equipment to installers and project developers
Sales and Customer Acquisition	Lead generation, marketing and sales activities relating to acquiring new customers
Engineering and Design	Site-specific assessment, design and engineering related to technical, electrical and structural specifications of a solar system
Project Development	Ancillary activities in commissioning of a solar system, including permitting, interconnections, financing, and other related administrative tasks.
Installation	On-site activities related to the installation of solar PV including both electrical and structural work
Operations and Maintenance	Routine system servicing and cleaning as well as repair and replacement of components during system lifetime
Decommissioning	Dismantling, removal, recycling, and waste management of solar system components at end of life.

SUPPLY CHAIN ASSESSMENT

To identify the current status of the solar supply chain in Nova Scotia as well as the potential for new opportunities to take place locally, a Supply Chain Assessment was conducted through desk reviews of available data[21], stakeholder engagement and expert interviews. The assessment highlighted the following key takeaways:

- **Strong and growing local solar industry:** Most of the existing solar business activity in Nova Scotia is focused on system installation and related services (Sales & Customer Acquisition, Engineering & Design). The momentum gained from Efficiency Nova Scotia's SolarHomes program has resulted in significant growth in the local solar industry, with an estimated 51 active installers in Nova Scotia today. Input from stakeholders highlights that there are currently low barriers to entry for installation companies, and that the strong interest and support from the province and municipalities is likely to spur further growth. Electrical contractors and service providers are well-positioned to expand beyond their traditional core expertise and into the solar PV installation activities.
- **Local cell manufacturing unlikely, but potential for local Balance of System (BOS) hardware manufacturing:** Despite manufacturing being the activity with the largest potential economic value in the solar supply chain, the majority of materials and equipment used in the solar PV industry in Nova Scotia are imported. This is in line with other markets across North America where cell, wafer and module manufacturing are mostly dominated by manufacturers in Asia and local manufacturing activities are restricted to ancillary balance of system hardware. Despite the growing local and global demand for PV, high competition with established manufacturers internationally, who in some cases have access to cheap labour, resources, and low energy prices, may be a barrier to entry. Nova Scotia currently has manufacturers involved in solar thermal equipment, which could potentially serve as an entry point for BOS manufacturing. Additionally, existing manufacturing facilities in the province could be retooled to focus on ancillary non-module hardware including mounting structures, combiner boxes, sensors, controls and other balance of system hardware.
- **Strong opportunities for Nova Scotia in distribution activities**: Activities related to distribution are limited in in the province today, however our assessment highlighted that Nova Scotia is well positioned to serve as a distribution hub for Atlantic Canada and globally, with its access to shipping ports serving as a competitive advantage over other markets. Several stakeholders have reported that local distribution could alleviate high transportation costs for individual companies, and therefore consolidation of distribution would be beneficial.
- **Competitive advantage in engaging in emerging areas of the solar supply-chain:**
    - **Research and Development (R&D):** With the highest number of academic institutions per capita in Canada as well as significant applied research capabilities, Nova Scotia has the key ingredients for a strong local R&D base. Today, institutions and researchers across Nova Scotia are engaged in ongoing research activities related to solar and clean energy technologies, including a collaboration between Tesla, Dalhousie University and the Natural Sciences and Engineering Research Council of Canada (NSERC) to develop lithium ion batteries with longer lifetime, higher energy density and lower cost. In addition, the Applied Energy Research team at the Nova Scotia Community College develops and tests sustainable energy alternatives and has extensive experience in solar energy technologies, monitoring devices, and microgrids. With the support of a $2.3-million NSERC grant, a five-year project is underway to integrate

[21] Solar Nova Scotia (2018). The Sun Shines on Atlantic Canada: As Assessment of the Solar Energy Industry

energy hardware, sensors, software, and data analytics to generate new energy products and services. Stakeholders have suggested that a local hub that connects and consolidates research activity would be beneficial moving-forward.

- **Decommissioning:** With recycling and waste management expected to become a major component of the solar supply chain in coming years, research and stakeholder input noted that Nova Scotia's leadership in, and commitment to, waste resource management and recycling could spur local opportunities in activities related to decommissioning of solar PV panels. Despite the relatively small size of opportunities in this area today, as the market matures and existing installations reach end-of-life, new opportunities may emerge in decommissioning activities.

SOLAR JOB METRICS

To forecast the number of jobs that can be expected in the solar sector in Nova Scotia in the future, we start by developing an average annual Full-Time Equivalent (FTE) per MW installed metric for Nova Scotia. The study is focused on the assessment of direct and indirect jobs associated with residential solar deployment, while induced jobs are only addressed qualitatively.

In this study, we use **Full-Time Equivalents (FTEs)** to measure jobs; which is defined as one full-time position (i.e. 40 hours per week) for a period of one year. While FTEs are defined as one full-time position for a period of one year, in reality, this may be a mix of part-time and full-time positions that when combined make up the FTE metric and applied results.

Additionally, we defined three types of job creation associated with solar:

- **Direct jobs:** those employed in down-stream project-related activities such as sales, engineering, installation and O&M
- **Indirect jobs:** ancillary functions that support the project such as manufacturing and distribution
- **Induced jobs:** jobs created in other goods and services industries as a result of the increased spending and consumption resulting from the lower costs of doing business and freed-up consumer spending.

DIRECT AND INDIRECT JOBS

To arrive at this metric, we used results from a scan of eight employment studies from other jurisdictions, data from surveyed companies engaged in the solar industry in Nova Scotia, and a review of existing research and data on the Nova Scotia solar market. Table 7 shows the resulting metrics. When possible, metrics were calculated at the supply-chain level and then aggregated to develop a combined metric for direct and indirect jobs. The estimated job metrics exclude both R&D and decommissioning activities[22].

[22] Job creation metrics do not include Research & Development activities given that this field is highly varied, and we did not receive any survey responses regarding this area of the supply chain. Decommissioning was also not included, as few solar panels have reached end-of-life, and therefore employment data is not currently available.

Table 7: Summary of Jurisdictional Scan, Survey and Final Results

Supply Chain Step		FTE/MW METRIC			
		Jurisdictional Scan	Survey	Final Metric	
Manufacturing	PV Cells, etc.	11	N/A	**11**	**Indirect Jobs** 15.1 FTE/MW
	Balance of System	2.8	N/A	**2.8**	
Distribution		1.1	1.4	**1.3**	
Sales & Customer Acquisition		3.0	3.3	**3.2**	**Direct Jobs** 21.5 FTE/MW
Engineering & Design		2.1	3.6	**2.9**	
Project Development		1.6	2.4	**2**	
Installation		16.3	9.9	**13.1**	
Operations & Maintenance		0.3	N/A	**0.3**	

As highlighted in the table, metrics computed through survey results are in-line with findings from the jurisdictional scan. As Nova Scotia's solar market is relatively young, the metrics from other jurisdictions were combined with the survey results to establish a Nova Scotia-specific baseline estimate for job creation over a longer time-horizon.

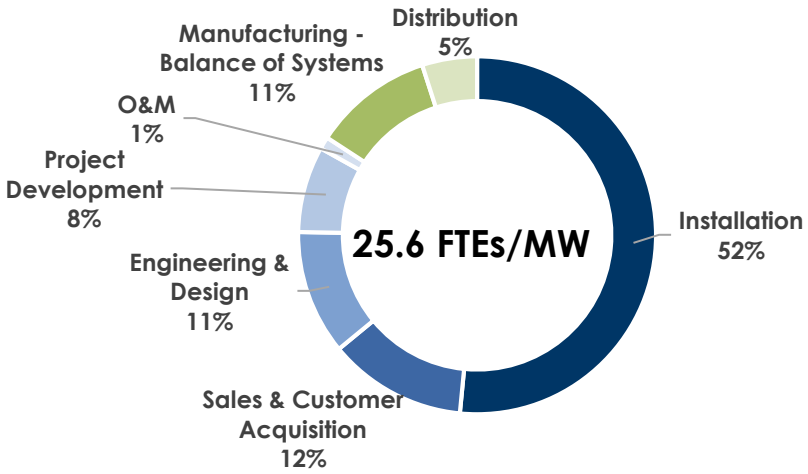
Technology advancements, efficiencies in the manufacturing, development and installation of solar as well as increase in labors' skills and training have resulted in significant efficiencies in the solar supply chain over the past decades. These efficiencies are expected to continue, particularly in labour-intensive functions such as manufacturing and installation. Given limited information about how this value will change into the future, we have not applied an efficiency factor to the Nova Scotia jobs forecasts presented in this report.

The results highlight the following takeaways:

- **The majority of solar job creation is expected to be in installation services**, which represents 36% of all job creation. Expanding this to other project-related functions (such as sales, engineering and project development, and O&M) highlights that 60% of job creation prospects from solar will be direct. **The majority, if not all, of these direct solar jobs are expected to be created locally in Nova Scotia by local businesses.**

- 40% of the job creation by residential solar is expected to be indirect employment in upstream activities. **These indirect jobs will likely to be created in jurisdictions where the corresponding activity is done (for example where the PV cells and manufactured).** The biggest and most labour-intensive area of the solar chain is manufacturing of PV cells, wafers and modules, which is estimated to create 11 FTEs per MW**.** Despite the significant opportunities that lie in manufacturing, based on the Nova Scotia Supply Chain Assessment, we have identified that it is unlikely that PV cell, wafer and module manufacturing activities will take place locally in the near future, meaning that the jobs created in manufacturing these components will likely be in other jurisdictions. On the other hand, local manufacturing of the balance of system components could take place locally, addressing the growing local demand and creating a possible export opportunity to other markets. Additionally, Nova Scotia was found to be well-positioned to serve as a hub for the distribution of solar components both for Atlantic Canada and the rest of the country.

Figure 6: Distribution of Jobs Supported per MW of Residential by Function in Nova Scotia



Based on these conclusions, we aggregate the appropriate multipliers from Table 7, and **estimate that residential solar deployment can support 25.6 FTEs per MW installed in Nova Scotia;** with 21.5 direct FTEs/MW and 4.1 indirect FTEs/MW. As shown in Figure 6, 52% of the created jobs are expected to be in installation, with an additional 32% in ancillary project functions such as sales, project development, engineering and design. 16% of jobs are then created in indirect upstream activities related to BoS hardware manufacturing and distribution activities.

INDUCED JOBS

Induced jobs are generally created in goods and services industries as a result of dollars that were previously spent on electricity bills by households being redirected to other sectors of the economy. As consumers save money on electricity, less money goes to the utility sector, which tends to have a lower job intensity than other sectors, and is instead redirected elsewhere in the economy[23,24]. Estimates highlight that nearly 10 net new jobs can be created per every million dollars of spending moved from the utility sector to other economic activities [25].

LABOUR FORCE OUTLOOK

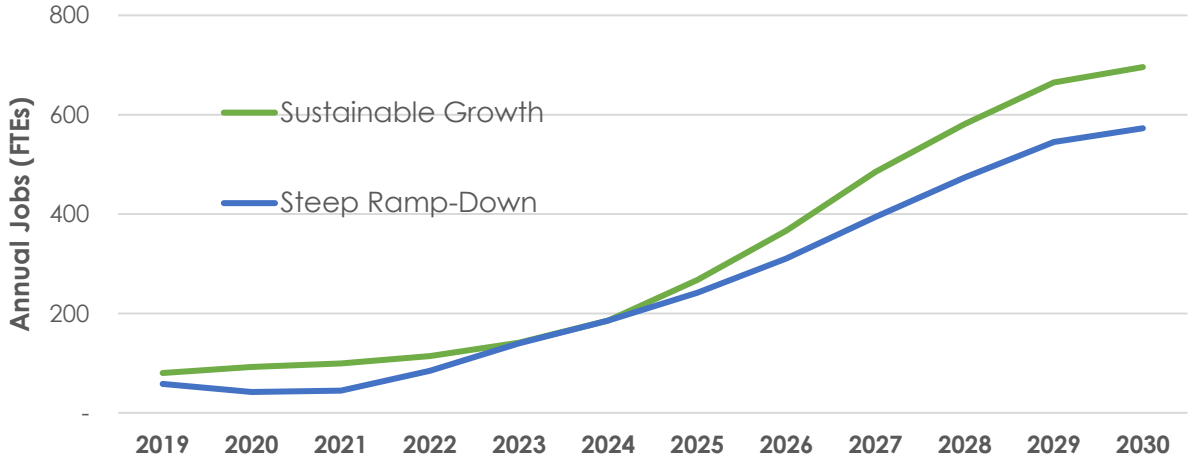
To estimate the job impacts associated with solar deployment, we use the developed metrics and forecasted solar demand to obtain an estimate of direct jobs supported annually by the residential solar market**.** As highlighted earlier, the jobs are presented in FTEs; where 1 FTE represents 1 person being employed in a full-time position for one year or two people being employed in part-time position for one year or similar equivalent arrangements.

To highlight the impact of policy, particularly future incentive programs on job creation in the province, we estimate the numbers of jobs supported under the *Steep Ramp-Down* and *Sustainable Growth* incentives scenarios presented earlier. As shown in Figure 7, under steep ramp-down strategies, where incentives are phased out abruptly in 2020/2021, the market will suffer from limited-to-no market demand for 2 to 3 years. This prolonged flat-line demand will directly hurt the local industry and result in

[23] Stickles, B., Mauer, J., Barrett, J., deLaski, A. (2018). Jobs Created by Appliance Standards. Available Online: www.appliance-standards.org/sites/default/files/Jobs_Report.pdf
[24] Clean Energy Canada and Dunsky Energy Consulting. (2018). The Economic Impact of Improved Energy Efficiency In Canada. Available online: www.efficiencycanada.org/wp-content/uploads/2018/04/Economic-Impact-of-Pan-Canadian-Framework-Energy-Effciency.pdf
[25] Nadel, S. 2017. Capturing the Co-Benefits of Energy Efficiency towards Sustainable Development: Enabling Universal Energy Access and Creating Green Jobs. In Proceedings of the International Symposium to Promote Innovation and Research in Energy Efficiency.

reduced employment, breaking the momentum the industry has gained through SolarHomes. Less aggressive incentive phase-out scenarios, like the *Sustainable Growth* scenario where incentives are phased-out gradually over a longer timeframe**,** continue to support the industry and create new employment opportunities, even during the transition from an incentives to a non-incentives regime.

Figure 7: Estimated Direct Job Creation Under Different Incentive Scenarios



Assuming future incentives in Nova Scotia follow a gradual phase-out trajectory similar to that of the Sustainable Growth incentive and the recently announced rebate reduction from $1 to $0.85 per Watt, we estimate that **residential solar deployment would support 700 direct jobs in the province in 2030** as shown in Figure 8. Considering uncertainty in key market factors explored earlier, the number of supported jobs can increase to 980 jobs by 2030, whereas under the most unfavourable scenario approximately 430 jobs are expected to be supported in the industry [26]. In addition to direct job creation in direct project functions such as installation**, 80 – 190 indirect FTEs are estimated to be supported in Nova Scotia by 2030** in manufacturing of BoS hardware and distribution activities.

Figure 8: Projected Direct Jobs from Residential Solar Deployment in Nova Scotia

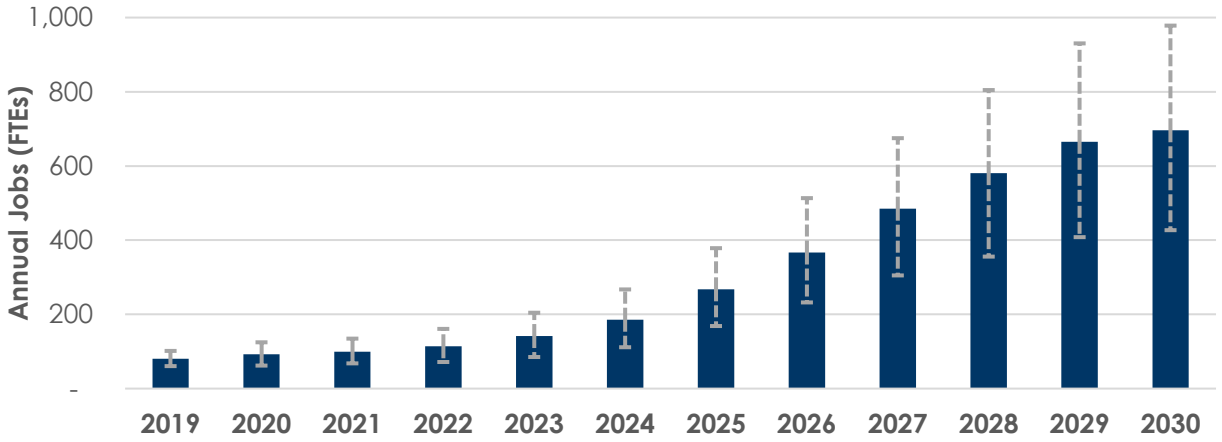


Table 8: Projected Direct Solar Jobs under Sustainable Growth Incentive Scenario

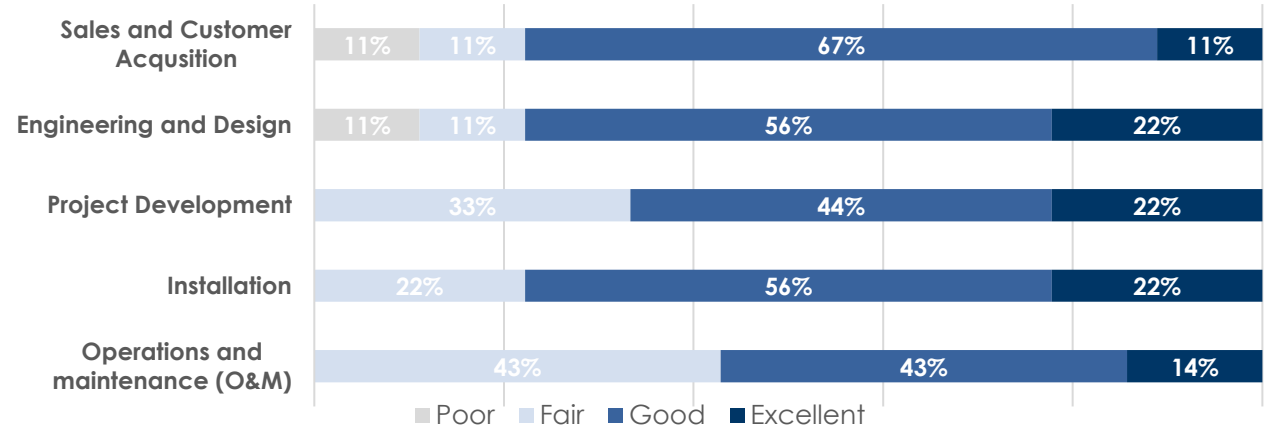
Cumulative Installed Capacity	Immediate Term (2020)	Medium Term (2025)	Long Term (2030)
Annual Jobs Supported	**80 FTEs** (60 – 100)	**270 FTEs** (170 – 380)	**700 FTEs** (430 – 980)

[26] A three-year average was used to reflect market realities and smooth the impact of sudden spikes or drops in solar demand on industry jobs. The upper and lower bound of the forecasts represent the 10th and 90th percentile of scenario outputs

SKILLS AND TRAINING

To achieve the forecasted growth in the solar market and associated job creation prospects, there is a need for a local skilled labour force that can meet the projected market demand. In order to assess the current status of the solar labour force, survey participants were asked to rate how well the current labour force met their needs with respect to skills for each area of the supply chain that they work in. As noted in Figure 9 below**,** most respondents reported skills as either excellent or good, indicating that generally Nova Scotia's existing labour force is ready to address market needs.

Figure 9: Survey Responses Rating Skills of Existing Labour force



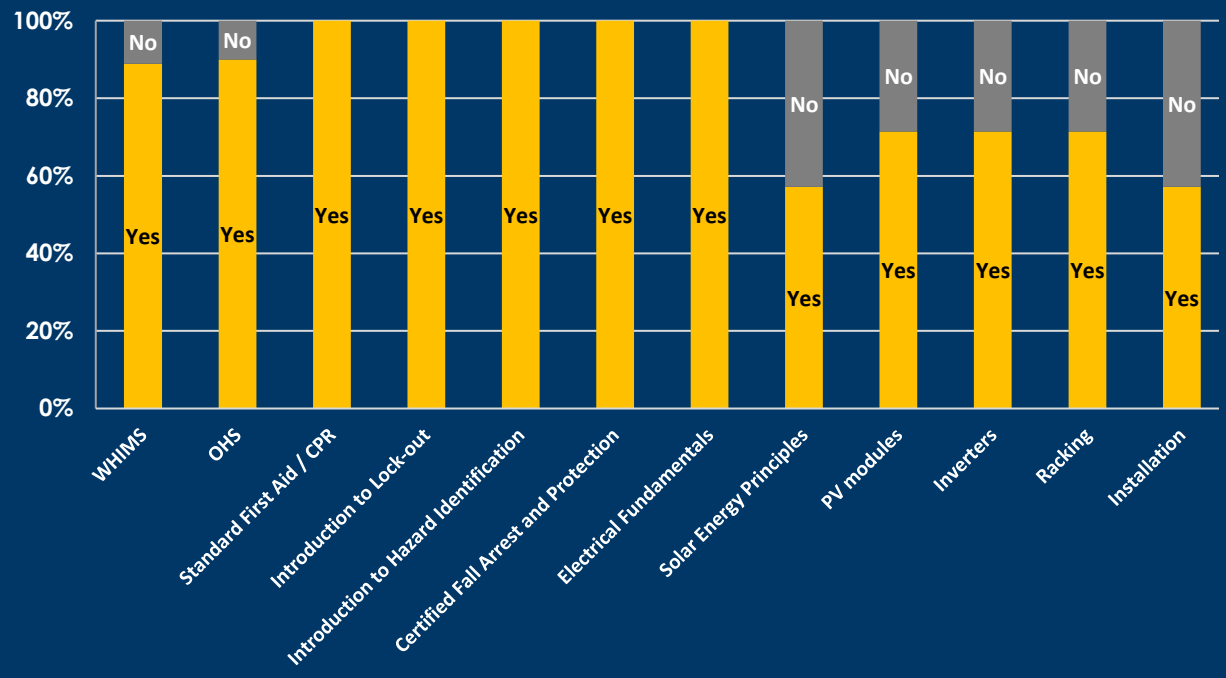
To become an Approved Solar Installer under the SolarHomes program, installation staff working for a firm must have either relevant work experience or proof of completion of a solar installer training course. Training courses are required to cover, at minimum, electrical fundamentals, solar energy principles, PV modules, inverters, racking, and hands-on installation experience. Installation staff also require proof of completion of safety training requirements, such as Workplace Hazardous Materials Information System (WHMIS), Occupational Health & Safety (OHS), First Aid and Cardiopulmonary Resuscitation (CPR).

Considering the SolarHomes Requirements as the industry-benchmark for required labour force skills, survey respondents were asked to assess whether their staff were able to access the required training and certification opportunities that would allow them to demonstrate ability as a professional solar installer. As anticipated, survey respondents indicated that courses that involve skills and knowledge that are transferrable to other industries – namely safety related and electrical fundamentals courses – are widely available and easier to find. However, solar-specific opportunities present more of a challenge, with 29 to 43% of participants reporting that they are unable to find relevant courses related to solar energy principles, PV modules, inverters, racking and installation.

SolarHomes Approved Installer Requirements

To become an Approved Solar Installer, installation staff working for a firm must have either relevant work experience or proof of completion of a solar installer training course.

Survey respondents were asked to assess whether their staff were able to access the required training and certification opportunities that would allow them to demonstrate ability as a professional solar installer.



Despite the high ratings, respondents did flag several gaps related to local skills and training:

- **Limited experience of existing labour force is a short-term challenge, and training programs are needed to bridge the gaps**: Respondents indicated that the current solar labour force in Nova Scotia has limited experience in solar installation and solar-specific engineering functions. Although lack of experience is not likely to be an issue in the long-term as the industry grows and builds up its proficiency, in the short-term, training and certification programs available to Nova Scotia labour force will be very important in alleviating some of the concerns. In addition to supporting the industry to meet forecasted demand for the skilled labour force in the coming years, training and certification opportunities will also ensure the continuous development of the workforce in the years to come.

- **Standardized and consolidated training and certification programs flagged as key to the industry's growth:** Industry-standard training for solar installers was identified as covering safety, electricity basics, solar 101, installation, and system components training; all of which are required to qualify as an Approved Installer in Nova Scotia under SolarHomes. Although local, national and online channels for training programs were identified, several installers, through both the survey and stakeholder engagement, reported limited access to adequate courses as a major challenge. This indicates the need for further marketing and advertising of available opportunities or establishing a hub for solar-related training and certification that could serve as a "one-stop-shop" for both existing and potential members of the industry.

- **Need for standardized guidelines for project development functions**: Several respondents highlighted that lack of standardisation in some processes related to interconnection, electrical inspection and municipal permitting are major issues and potential bottle necks for the market's growth.

- **Solar-specific training for non-technical job functions could be beneficial:** In addition to specialized technical skills, more general staff with transferrable skills from other industries are needed for sales and other ancillary activities. Survey respondents mentioned that relevant solar-specific training in those areas, which would benefit staff performing those functions, was not available.

Nova Scotia Community College Solar Installation Course

The Nova Scotia Community College, with support from the Department of Energy and Mines (DOEM), has developed a course in solar photovoltaic panel installation for non-electricians. The course is 45 hours in length and covers both theory and hands-on components. It is designed to provide the knowledge and skills necessary for the installation of photovoltaic (PV) panels on a roof or ground level and also includes bonding and wire management. Course outcomes include:

- Describing various aspects of solar energy and related terms
- Explaining the PV panel manufacture's ratings
- Calculating series and parallel connections of PV panels
- Describing the differences between string and micro-inverters
- Explaining the different types of racking systems available
- Explaining wire management involved in mounting PV panels and micro-inverters to racking systems (including bonding wire)
- Explaining the function of a battery in the PV system.

EMERGING TECHNOLOGIES

In this section, we assess the potential for the solar industry to engage in business activities related to emerging technologies; namely battery storage and Electric Vehicles (EVs). For each of the two technologies, we assess the potential size of the market as well as the industry's readiness to engage in these areas, based on responses from survey industry participants.

BATTERY STORAGE

MARKET POTENTIAL

Batteries have several distinct features that make them unique resources; namely their scalability, versatility of services they can provide, and the potential for stacking multiple value streams. In addition to benefits to adopting customers, battery storage can be utilized as grid assets, with a number of utilities across North America currently piloting the use of distributed solar-plus-storage systems as a dispatchable grid resource.

Spotlight on Nova Scotia

The Surrette Battery Company is a lead-acid battery manufacturer located in Springhill, Nova Scotia. Surrette's manufacturing plant has operated in Nova Scotia since the 1950s and was initially focused on battery applications in the marine, industrial, and automotive sectors. In recent years, renewables have become a fast-growing source of business for the company, providing continued opportunities for local employment for Nova Scotians.

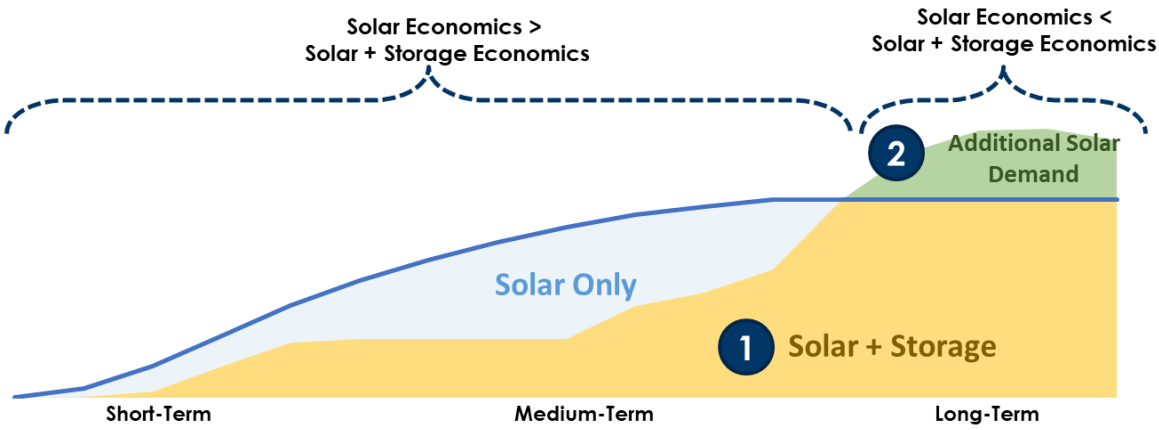
As illustrated in Figure 10 below, batteries have two impacts on the uptake of solar PV:

1. **Increasing portion of solar adopters opting in for storage-paired solar:** Storage-paired with solar solutions have emerged as a popular option in the past few years, with data from the U.S. showing that 74% of solar PV shoppers expressed interest in battery storage[27]. Despite the ability to add storage to existing solar systems, the simultaneous installation of solar and storage can result in 10% cost savings to customers. Customer interest in mostly driven by interest in resiliency during outages. With further reduction in battery costs and increased customer interest in self-supply, an increasing share of solar uptake is estimated to be storage-paired.

2. **Additional demand for solar if and when the business case for storage-paired solar exceeds stand-alone solar:** In addition to addressing customer interest in resiliency and self-supply, combining battery storage with PV systems may improve the business case for solar PV under changes to compensation mechanisms (for example switch from net-metering to net-billing) or rate structures (such as time-of-use rates, demand charges, etc.), and result in an increase in the total uptake of solar. For example, storage-paired solar system may increase the value proposition of solar to customers through:
    - Increasing self-consumption of produced electricity and minimizing exports to the grid.
    - Reducing peak demand charges.
    - Optimizing purchases and exports of electricity under time-of-use rates.

[27] EnergySage (2018). Solar Marketplace Intel Report H1 2017 to H2 2017 (April 2018). Available Online: www.energysage.com/data/#reports

Figure 10: Illustration of Impact of Battery Storage on Solar Uptake



Under status-quo conditions in Nova Scotia, incremental costs of coupling battery storage with residential solar currently exceed the associated benefits. In the short and medium terms, the market is likely to have few installs that are primarily motivated by non-economic considerations (i.e. for back-up power and resiliency purposes). **Based on a high-level assessment of residential solar-plus-storage systems, we estimate that 15 - 35% of solar deployment in Nova Scotia by 2030 will be storage-paired solar.**

In the long-term, the declining costs of battery storage as well as potential changes to net-metering or switch to TOU rates may increase the value proposition, and market demand, of residential storage-paired solar relative to stand-alone solar. Additionally, government and/or utility incentives for storage through direct rebates or compensation for provision of grid services through Demand Response (DR) programs or other mechanisms, will improve the business case for storage deployment.

Similar to storage-paired solar, limited business case currently exists for stand-alone storage in the residential sector. Unlike residential customers, commercial and industrial customers have a better business case for storage through the potential for avoided peak demand charges.

INDUSTRY READINESS AND OPPORTUNITIES

Survey participants were asked about the readiness of their companies and employees (from a skills, certification, and training perspective) to engage in the emerging battery storage market. Only 9% of participants reported as being already active in the battery storage, while 55% reported being "Very Ready" to engage in the market. Those who reported that they were not ready, or only moderately ready, to add storage to their business offerings highlighted some of the potential challenges that they see with this market. These ranged from difficulty finding qualified personnel with battery storage experience to variation in building code requirements and inspector practices between jurisdictions. As highlighted by the opportunity assessment, it was similarly pointed out by respondents that there is limited financial incentive to install storage in Nova Scotia given relatively low time-of-use rates and commercial demand chargers.

Based on data obtained from industry participants, the National Renewable Energy Laboratory (NREL)[28] and Tesla[29], an average FTE per system installed metric was developed. Using our estimate of 15 – 35% of residential solar deployment in Nova Scotia being storage-paired**, we forecast an additional 10 – 30 FTEs could be supported in residential battery storage installation services by 2030.**

[28] Ardani, Kristen, et al. (2016). Installed cost benchmarks and deployment barriers for residential solar photovoltaics with energy storage: National Renewable Energy Lab (NREL).

[29]Estimated installation cost from Tesla Powerwall's website. Available Online: https://www.tesla.com/en_CA/powerwall [Accessed April 2019]

ELECTRIC VEHICLE CHARGING

MARKET POTENTIAL

An estimated 30,000 – 100,000 EVs are projected to be on the road in Nova Scotia by 2030[30]. With more than 80% of charging expected to take place at home, demand for home charger installations is expected to be significant. Despite the availability of Level 1 (120 Volt) charging to EV users through standard wall outlets without any special installations, most EV users prefer faster Level 2 chargers (240 Volt) which may require installation by a professional electrician. Charger installations do not require any more skills or training beyond what solar installers would be qualified for.

INDUSTRY READINESS AND OPPORTUNITIES

12% of survey participants stated that they already participate in the EV charger installation market, and an additional 62% reported being "Very Ready". Generally, participants reported interest in this area, however noted concerns related to the small scale of the market in the short-term.

The solar industry in Nova Scotia has two opportunities in this space:

1. **Generate new revenue streams** by engaging in EV home charger sales and installation services. As a relatively new market, there are currently few market players in the EV space, therefore established solar businesses can tackle market demand for home charger installation services with minimal changes to their existing practices. In addition to home charger installation, the solar industry can also engage in other activities relating to work place or public charging infrastructure deployments.

2. **New lead generation channels for solar business** by targeting their EV customers and dealerships. Early adopters of EVs and distributed solar have been shown to have very similar characteristics, and therefore industry members engaged in EV home charger installation can leverage their customer base to unlock new potential opportunities for their solar practice. Solar installers could present solar PV and home charging as packaged products for sustainable and renewable transportation options.

To date, no studies that Dunsky is aware of have highlighted the job creation associated with EV home charging installations. Based on information obtained from industry participants and data on labor costs of charger installations[31], and using NSPI's forecasted EV adoption, **we estimate that 20 – 70 FTEs could be supported in EV home charger installation services by 2030**[32].

[30] Nova Scotia Power (2018). Electric Vehicles in Nova Scotia Current State and Upcoming Initiatives

[31] Rocky Mountain Institute (2014). Pulling Back the Veil on EV Charging Station Costs. Available online: www. rmi.org/pulling-back-veil-ev-charging-station-costs/

[32] The design and installation services of a single EV home charger are estimated to take approximately 6 hours. An FTE is defined as 40 hours of work per week for 52 weeks minus personal and civic holidays.

CONCLUSION

Findings from the study highlight the following key takeaways:

1 SIGNIFICANT MARKET POTENTIAL OVER THE NEXT 10 YEARS

140 MW, approximately 17,500 solar homes, are forecasted to be installed in Nova Scotia by 2030 under baseline conditions. The market is sensitive to local market factors relating to system costs, electricity rates, and system sizes which could alter the forecasted market demand between 96 – 187 MW. Electricity generated from forecasted residential solar uptake is estimated to generate 100 – 200 GWh by 2030, representing 1% - 1.9% of Nova Scotia's total electricity consumption.

Policy direction, in the form of future incentives and the incentive phase out approach, will significantly alter the market's outlook in the short-term as well as long-term. Sudden and abrupt incentive drops are expected to cause 2 – 3 years of limited market demand, while more balanced gradual phase-out strategies will continue the market growth and ensure natural hand-off from incented to non-incented regime.

Under gradual rebate step-down strategy, we project that 44 MW of residential solar capacity will be installed in the province by 2025, and 178 MW by 2030; corresponding to approximately 22,000 residential solar installations in Nova Scotia. The announced SolarHomes rebates reduction from $1 per Watt to $0.85 per Watt is a step in ensuring the market's sustainable growth both in the immediate-term and post-program.

2 OPPORTUNITIES FOR LOCAL ECONOMIC DEVELOPMENT AND JOB CREATION

Nova Scotia's solar industry is growing, particularly in down-stream direct project-functions, such as sales, engineering and design, project development and installation. Currently, local manufacturing and distribution activities are limited, however there is some potential for future growth in these areas.

By 2030, we forecast that up to 980 direct jobs would be supported through residential solar deployment in the province. Future incentives will be critical in the short-term to ensure growth of the industry, as a period of flat-line demand caused by sudden drops in incentive levels could break the momentum the industry has gained and result in reduced employment.

Nova Scotia has potential to unleash further job creation and economic development opportunities through several areas of the solar supply chain. Nova Scotia is well-positioned to grow a local solar distribution industry as well as a manufacturing of racking and other balance of system components required for the solar industry, with could create another 80 - 190 indirect jobs in Nova Scotia.

Developing local, accessible and well-advertised training programs will be critical for industry's success and continued growth. For example, establishing a "one-stop-shop" for solar-specific training for engineers, installers and other general labourers in the industry would help mitigate concerns about

labour force's lack of experience and ensure that the industry is ready to meet the forecasted market demand.

3 POTENTIAL OPPORTUNITIES FOR THE SOLAR INDUSTRY IN EMERGING TECHNOLOGIES

Under current conditions, limited opportunities exist for large-scale deployment of residential storage, with only 15 – 35% of new residential solar installations estimated to be storage-paired by 2035. The solar industry is well-positioned to tackle the market demand for storage, which is expected to create 10 – 30 additional FTEs by 2030. Under alternative rates or solar compensation structures, which may increase the value proposition of storage-paired solar, market demand and corresponding economic impacts are expected to increase significantly.

Engaging in services relating to sales and installations of EV home charging stations could result in interesting business opportunities for industry through additional revenue streams from new services as well as expanding lead generation channels for solar business. Based on NSPI's forecasted EV adoption in Nova Scotia, we estimate that 20 – 70 FTEs could be supported in EV home charger installation services by 2030.

APPENDICES

APPENDIX A: METHODOLOGY

DUNSKY'S SOLAR ADOPTION MODEL (SAM)

Dunsky's Solar Adoption Model (SAM) was built in-house to address a growing need by our clients to understand the potential for solar deployment in their jurisdictions. The model is based on a methodology developed by the National Renewable Energy Laboratory (NREL) in the U.S., and is complemented with rigorous research and survey data from academia and industry, as well as Dunsky's own knowledgebase.

SAM is used to project market demand of distributed solar PV in client-defined regions using jurisdiction-specific inputs. The model projects demand under business-as-usual conditions as well as under alternative policy and market scenarios. To date, the model has been leveraged to forecast market demand for distributed solar PV and storage systems in the residential, commercial, industrial and institutional segments in California, New York, Ontario, Alberta, New Brunswick and other jurisdictions across North America.

Using jurisdiction-specific inputs, SAM forecasts market demand based on:

- **Customer economics**: which captures expected uptake driven by customer economics based on calculated payback, internal rate of return, or bill savings.
- **Technology adoption and market barriers**: to determine the rate of deployment of PV technologies given local market characteristics

In addition to using jurisdiction-specific inputs on building stock, electricity consumption and pricing, solar system outputs and other factors, we use historical adoption data and inputs to calibrate SAM to local market characteristics. This is achieved by benchmarking the model output to historical adoption and adjusting key model parameters to represent the closest fit between historical and projected annual uptake. The calibrated model settings are then used in projecting future adoption rates.

JURSDICTIONAL SCAN

In conducting a jurisdictional scan to develop an estimate for solar job creation metrics (FTE/MW), the following studies were reviewed:

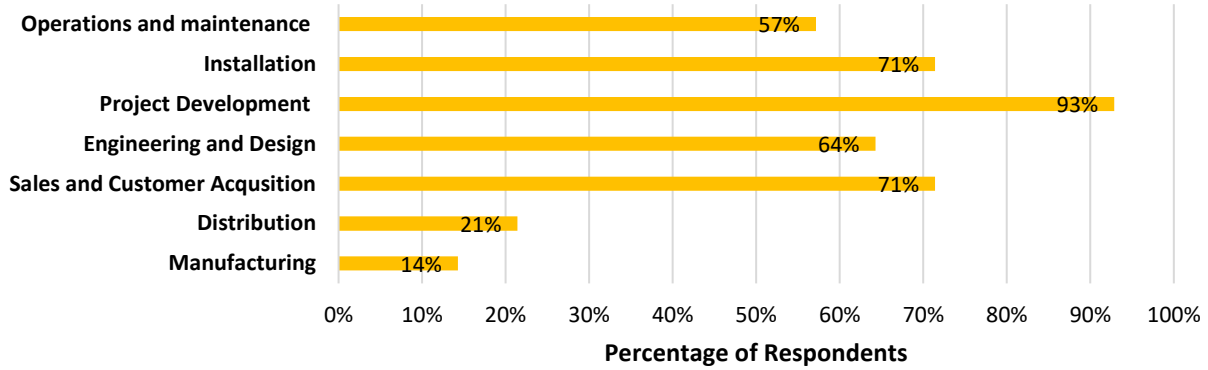
- Pembina Institute. (2016). Job Growth in Clean Energy: Employment in Alberta's Emerging Renewables and Energy Efficiency Sectors. Available online: https://www.pembina.org/pub/job-growth-clean-energy
- CanWEA/CanSIA Submission to the Alberta Climate Change Advisory Panel, September 30, 2015
- National Renewable Energy Laboratory. "Jobs and Economic Development Impact Models." Available online: https://www.nrel.gov/analysis/jedi/
- Cameron, L., Zwaan, B. (2015). Employment factors for wind and solar energy technologies: A literature review. *Renewable and Sustainable Energy Reviews,* 45.
- Pembina Institute. (2015). British Columbia Clean Energy Jobs: Methodology Backgrounder. Available online: https://www.pembina.org/reports/bc-clean-jobs-map-methodology-backgrounder-27042015.pdf
- BlueGreen Alliance Foundation. (2011). Overview of the Solar Energy Industry and Supply Chain. Available online: https://www.bgafoundation.org/wp-content/uploads/2016/08/Solar-Overview-for-BGA-Final-Jan-2011.pdf
- The Solar Foundation. (2018). National Solar Jobs Census. Available online: https://www.thesolarfoundation.org/national/
- Solas Energy Consulting (2018). Alberta's Solar PV Value Chain Opportunities. Available online: https://solaralberta.ca/sites/default/files/Alberta%27s%20Solar%20PV%20Supply%20Value%20Chain%20Opportunities%20Report.pdf

INDUSTRY SURVEY

A survey was developed and disseminated to industry members. The survey included three key question segments:

- **Current Business Practices:** Information about the company's operations, activities and employees across different components of the solar supply chain, with a focus on residential activity in Nova Scotia.
- **Skills, Training and Certification:** Assessment of available labour force skills, certifications and training as well as questions related to the Nova Scotia SolarHomes Approved Installer Training Curriculum.
- **Emerging Service Areas:** Identified opportunities and challenges in engaging in activities related to battery storage and electric vehicle home charger installation, as well as readiness of companies and their employees to address future demand for these services.

14 responses were received to the survey. Although a larger sample size would be required to provide statistically significant results, we feel this sample represents a large enough portion of the current industry - which remains in the early stages of development - to illustrate key trends in industry development, barriers, and more. In addition, the survey respondents are involved in a range of supply chain activities, as shown in the figure below.



STAKEHOLDER ENGAGEMENT

Interactive Engagement Session A session was held during the 2018 Nova Scotia Solar Summit to present interim results from the study to the industry and obtain input from industry members. Using an interactive engagement approach, four key topics were discussed:

- Market and policy drivers and barriers to residential solar
- Opportunities and challenges in employment growth in the solar industry
- Expanding the solar supply chain in Nova Scotia
- Solar industry's role in emerging technologies

Session proceedings were summarized and used to guide key elements of the study; namely the Supply Chain Assessment and Labour Force Study.

Targeted Interviews: 6 targeted interviews were conducted with key stakeholders to obtain input on

- Key inputs and assumptions for modeling baseline and incentive scenarios
- Market and policy drivers and barriers to residential solar in Nova Scotia
- Opportunities and challenges that face expanding local activities across the solar supply chain

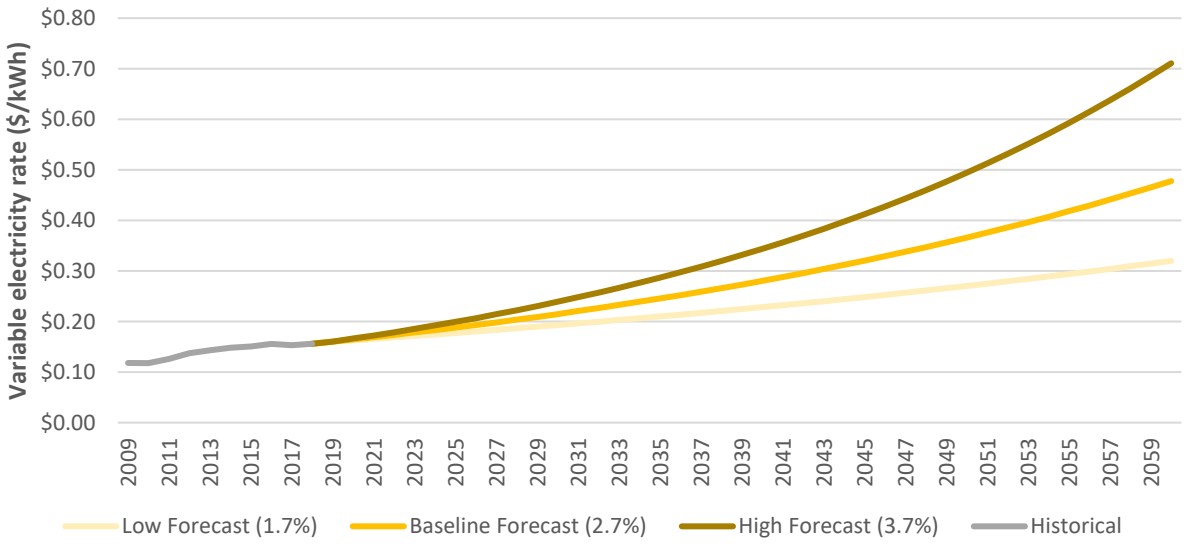
APPENDIX B: KEY INPUTS AND ASSUMPTIONS

GENERAL INPUTS AND ASSUMPTIONS

	INPUT	ASSUMPTION	SOURCE / NOTES
Market	**Relevant Market Size**	187,655	Estimate of **single-family owner-occupied homes** based on data from Statistics Canada
	Percentage of Buildings Suitable for Solar Installations	75%	Estimate based on U.S. Data [National Renewable Energy Laboratory (2016), *Rooftop Solar Photovoltaic Technical Potential in the United States: A Detailed Assessment]*
	Annual Growth Rate	0.9%	Historic population growth between 2008 and 2018
Installed PV Systems	**Average Installed DC Capacity per System (kW DC)**	8 kW	Average of reported installations by NSPI and SolarHomes
	Average Energy Yield (kWh AC/kW DC)	1,100 kWh/year (12.5% capacity factor)	Solar Nova Scotia Data
	PV System Lifetime	30 years	Standard value
	Degradation Factor	0.5% per year	Standard value

ELECTRICITY RATES

The model uses variable rates ($/kWh based) paid for electricity consumption to assess the economic returns of PV systems to adopting customers. Electricity rates for the duration of the system's assumed lifetime (30 years) are required, therefore we project electricity rates out to 2060 (30 years after last year of forecasts; 2030). For baseline scenario, an assumption of 2.7% annual rate escalation is used based on forecasts by NSPI. Low and high rate forecasts are also developed assuming 1.7% and 3.7% annual cost escalation respectively. Historical electricity rates were used for model calibration.



SYSTEM COSTS

Based on data provided through SolarHomes applications, average residential system cost is assumed to be $2.50/Watt in 2018. Low, Medium and High system cost reduction scenarios were developed based on projections from International Energy Agency (IEA), U.S. Energy Information Agency (EIA), Bloomberg New Energy Finance (BNEF) and National Renewable Energy Laboratory (NREL).

Operations and Maintenance (O&M) costs are estimated at $25 per kW installed per year