MAPMYSUN
SOLAR SIMPLIFIED

OFF GRID

SOLAR FEASIBILITY REPORT

Date: **January 1, 2020**
Report #: [redacted]
Report Type: **OFF GRID**

Name	:	**JOHN SMITH**
Email	:	[redacted]
Phone	:	[redacted]
Daily Electricity Consumption (From Energy Consumption Calculator)	:	[redacted] **kWh**
Address	:	[redacted]
City	:	[redacted]
Province / Territory	:	[redacted]
Country	:	[redacted]

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1. ABOUT MAPMYSUN

MapMySun Inc. is a Canadian Solar consulting company which aims at helping its users understand the cost and benefits of switching to solar. The MapMySun report is an easy-to-understand customized online solar Feasibility Report which provides users with techno-financial information of a solar Photovoltaic (PV) system for their chosen location helping them make an informed decision before investing in a solar PV system. The report provides information such as system size, 25 years worth of Cost vs Savings, Return on Investment, Payback Period, Environmental Benefits, and a lot more. MapMySun reports are of two types: Grid-Connected and Off-Grid Report.

2. EXECUTIVE SUMMARY

Congratulations, on taking the first step in becoming more energy independent! Using solar energy is one of the most natural and economic ways of powering your energy needs and is a fantastic sustainable lifestyle choice. However, investing in a solar PV system does not only require a substantial amount of initial investment but is also a long-term commitment. The purpose of this report is to ensure that the user is informed of the major steps and considerations when buying a solar PV system.

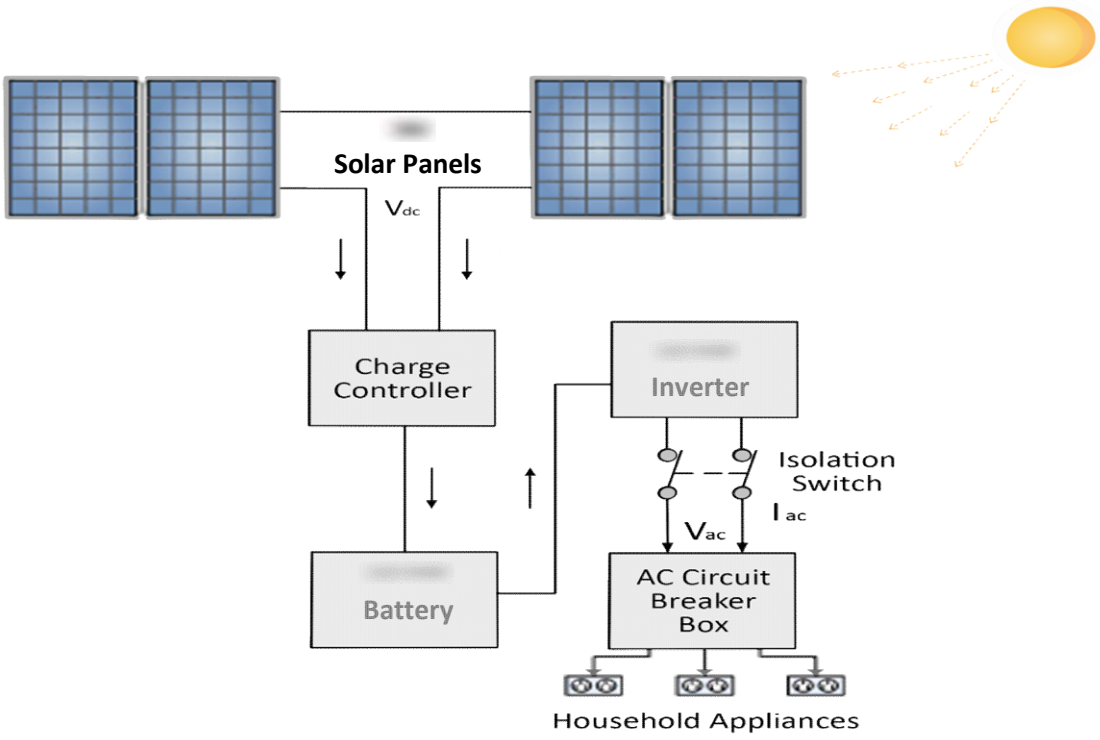
MapMySun is a simple to understand report which aims at providing all the essential information that is required before investing in a solar PV system including a 25-year Cost vs Savings analysis to get a long-term perspective of the investment. The only information required from the user is the location of the solar PV system and the daily energy usage (electricity consumption) which can be obtained by using the energy consumption calculator with appliance and usage details. This report provides its users with an option to choose between two battery sizes; based on one day and three-day autonomy (reserve time). Days of autonomy is the number of days the batteries can supply power on their own without receiving little or no charging. Both these systems are then compared based on several techno-financial information such as component sizing, cost vs savings, payback period, levelized cost of electricity (LCOE), etc. The LCOE is the cost of electricity produced by the solar PV system and is typically warrantied for the life of the system. This means the solar PV system will produce power at this same per unit rate throughout its life. This report uses images, graphs, charts, and tables to make things simpler and easy to understand.

A solar PV system contributes significantly to the environment by reducing greenhouse gas emissions. This report highlights the environmental benefits gained by using the system over its lifetime as well as compares the benefits and drawbacks of installing the system. As battery is a critical component of the Off-Grid solar PV system there is a dedicated section on batteries explaining the battery design & selection process. This report also touches upon the solar vendor selection criteria and explains the conflict resolution process with the vendor. Towards the end of this report there's some information pertaining to the making and maintaining of a solar PV system such as the list of components of a solar PV system and a stepwise Operation & Maintenance guide all of which are aimed at making a user's solar journey successful.

3. TECHNICAL FEATURES

This section provides a technical snapshot comparing both systems (i.e. system with 1-day and 3-day autonomy). It also covers system sizing information such as number of solar panels, inverter size, battery size, etc. It provides an estimate of the area required to install the solar panels which helps you understand if your roof has adequate space to install the system.

DETAILS	BATTERY AUTONOMY: 1 DAY	BATTERY AUTONOMY: 3 DAYS	UNIT
Your Solar System Size			kW
No. Of Solar Panels That You Will Need			Nos.
Area Required To Install The Panels			Sq.Ft.
Inverter Size			kW
Battery Bank Size (kWh)			kWh
Battery Bank Size (Ah)			Ah
Electricity Produced By Solar Per Year (Average)			kWh
Electricity Produced By Solar In 25 Years			kWh

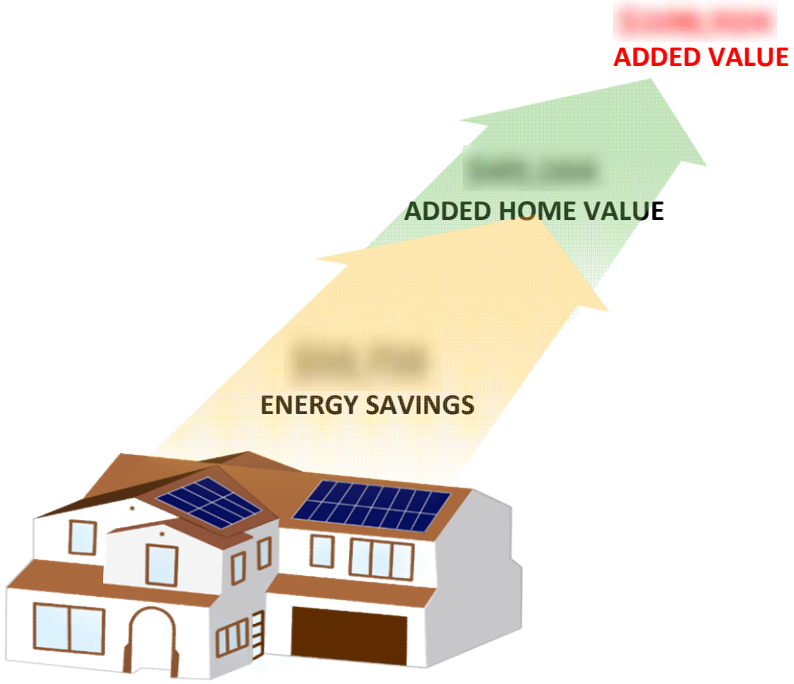


4. FINANCIAL FEATURES

The financial section provides information related to system costs which includes the initial upfront cost or Capital Expense (CapEx) and the Total System Cost for 25 years which is combination of CapEx and Operational Expense (OpEx). This section also includes the savings that the system can yield in 25 years which is calculated factoring in the inflation, panel degradation, etc. This is averaged out to get an estimate on yearly savings.

Studies have shown that solar system increases the value of a home by drawing buyers who are seeking ways to reduce utility bills, save energy and help the environment. This report shows by how much a property value could increase by installing solar.

DETAILS	BATTERY AUTONOMY: 1 DAY	BATTERY AUTONOMY: 3 DAYS	UNIT
System Installation Cost (CapEx) (Component costs + Design + Manpower + Installation)	[illegible]	[illegible]	CAD ($)
System Cost In 25 Years (CapEx + OpEx) (Installation Cost + Component Replacement + O&M Expenses)	[illegible]	[illegible]	CAD ($)
Your Savings From Solar Per Year (Average)	[illegible]	[illegible]	CAD ($)
Your Savings From Solar In 25 Years	[illegible]	[illegible]	CAD ($)
Levelized Cost Of Electricity (LCOE) (Electricity Cost Per Unit Produced By The Solar Plant)	[illegible]	[illegible]	CAD ($)
Your Property Value Could Increase By	[illegible]	[illegible]	CAD ($)



5. CHART - COMPONENT COST: 1-DAY AUTONOMY vs 3-DAY AUTONOMY

The below pie charts compare the approximate percentage share of individual component cost to a typical system cost as well as total cost (25 years); for both battery systems. This section also takes into account other costs such as license, permitting, design and labor cost. It can be seen that Solar panels, Inverters and Batteries are the three components which constitute more than [illegible] of the project cost. Other components include structures, electrical accessories, junction boxes, cables, etc. are further listed in Section 15. In the two charts below it can be seen that replacing a battery is about [illegible] of the system lifetime cost. Thus, it is imperative that batteries should be properly operated and maintained to ensure their useful life of [illegible] years. Check out section 14 for tips on how to operate and maintain the system.

SYSTEM INSTALLATION COST (CapEx): **1-DAY AUTONOMY**

- MODULE
- INVERTER
- BATTERY
- COMPONENTS
- LICENSES & PERMITS
- DESIGN & LABOUR

V/S

SYSTEM INSTALLATION COST (CapEx): **3-DAY AUTONOMY**

- MODULE
- INVERTER
- BATTERY
- COMPONENTS
- LICENSES & PERMITS
- DESIGN & LABOUR

SYSTEM COST IN 25 YEARS (CapEx + OpEx): **1-DAY AUTONOMY**

- SYSTEM INSTALLATION COST (CapEx)
- INVERTER REPLACEMENT (OpEx)
- BATTERY REPLACEMENT (OpEx)
- OPERATIONS & MAINTENANCE (OpEx)

V/S

SYSTEM COST IN 25 YEARS (CapEx + OpEx) **3-DAY AUTONOMY**

- SYSTEM INSTALLATION COST (CapEx)
- INVERTER REPLACEMENT (OpEx)
- BATTERY REPLACEMENT (OpEx)
- OPERATIONS & MAINTENANCE (OpEx)

6. COMPARISON: COST vs SAVINGS (IN 25 YEARS)

This section compares a year-on-year Cost and Savings from installing the solar PV system at a 5 year interval upto the system life of 25 years. The savings are determined by calculating the cost of electricity produced by the solar PV system using local electricity rates factoring in the inflation and panel degradation.

YEAR(S)	BATTERY AUTONOMY: 1 DAY			BATTERY AUTONOMY: 3 DAYS		
	ELECTRICITY PRODUCED BY SOLAR (kWh)	AVERAGE SYSTEM COST (CAD $)	SAVINGS FROM SOLAR (CAD $)	ELECTRICITY PRODUCED BY SOLAR (kWh)	AVERAGE SYSTEM COST (CAD $)	SAVINGS FROM SOLAR (CAD $)
1						
5						
10						
15						
20						
25						

'Electricity Produced' by solar decreases every year due to panel degradation
'Average System Cost' is the cost of the solar PV system averaged out per year
'Savings From Solar' is the amount of electricity generated by the solar PV system in a year considering the local electricity tariffs, inflation, panel degradation, etc

7. BATTERY

7.1. Battery Bank Sizing Methodology

In an Off-grid solar PV system, a battery bank is one of the most critical components which constitute a major portion of the investment, hence the need for a dedicated section on batteries. A meticulously designed battery bank and correct use can avoid blackouts and increase battery life resulting in less replacements and lower costs. Below are some of the main features to consider while designing a battery bank and are the basis for our calculations.

Battery Bank Voltage:

Battery Wiring:

Days of Autonomy:

Depth of Discharge (DOD):

Temperature:

7.2. Types of Batteries

There are various battery technologies available in the market. We have listed the three most common types used for an Off-grid solar PV system:

Flooded lead Acid:

Sealed Lead Acid:

Lithium-ion:

7.3. Battery Selection Criteria

There is no 'One size fits all' solution when it comes to batteries. The battery needs to be selected after carefully analyzing the application that it is intended for, the user's power needs, temperature, site conditions, etc. We have chosen our battery keeping in mind the below factors when determining the total cost of ownership over the life of the battery.

Price:

Capacity:

Battery Cycle Life:

7.4. Rationale For Choosing Lithium-Ion Batteries

Lithium is one of the lightest of all metals and is the most evolved technology. While Lithium-ion batteries have advantages as well as some limitations, its benefits far outweigh its drawbacks.

Advantage:

Disadvantage:

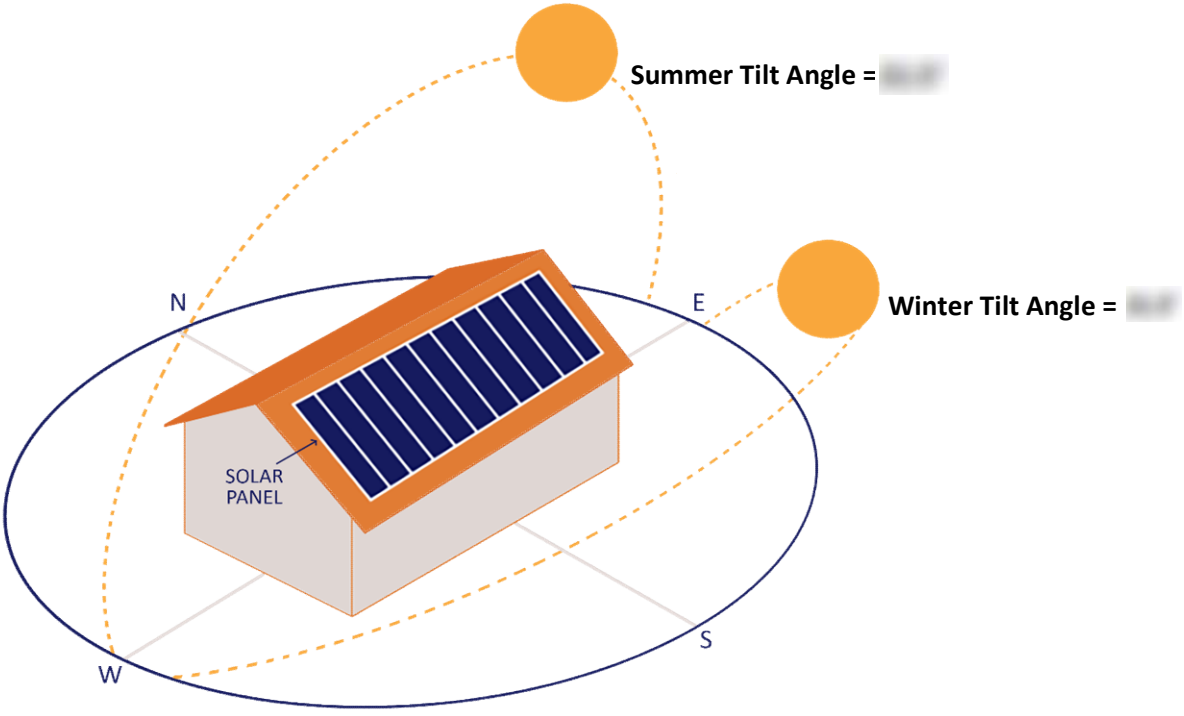
Recommendation:

8. PANEL TILT ANGLE & DIRECTION

Solar panels need the maximum amount of sunlight to produce optimum solar power. Solar panels produce best results when they face [redacted]
This is called the 'Panel Direction'.

'Tilt Angle' is the angle at which the solar panels are mounted with the horizontal plane (ground level). This angle is calculated based on the latitude of the solar system's location. As the sun has different positions during summers and winters one can capture the most of it by changing the Tilt Angle seasonally. The seasonal change in tilt is possible only in systems with adjustable tilts or with trackers. While this is not mandatory, it is recommended to get the most solar energy over the whole year. Moreover, as Canada experiences snow during winters, adjusting the panels to a [redacted] angle in winter makes it more likely that they will shed snow. A panel covered in snow produces little or no power.

DETAILS	VALUE	UNIT
Panel Tilt Angle In Summer	[redacted]	**Deg**
Panel Tilt Angle In Winter	[redacted]	**Deg**
Panel Direction (Ideal)	[redacted]	**Direction**



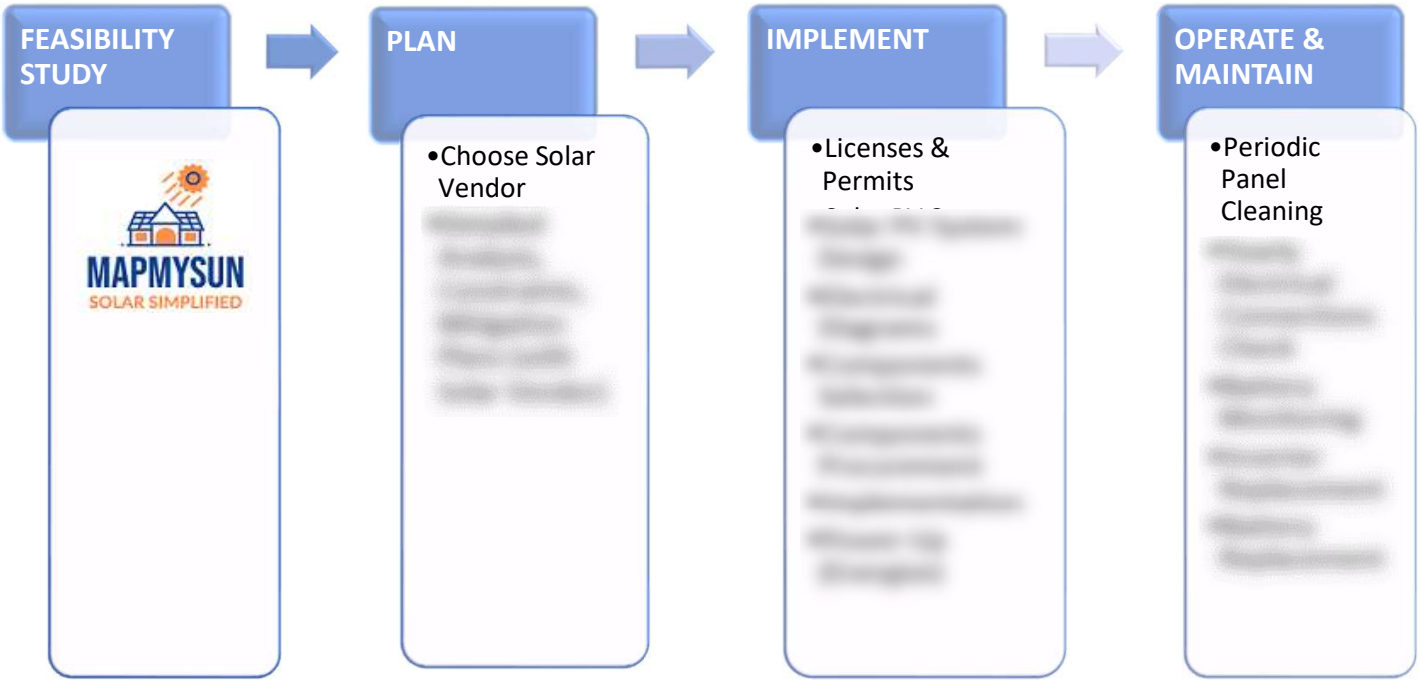
9. METHODOLOGY

This report uses MapMySun modelled calculations which are endorsed by the best-in-class solar installation companies. The solar radiation data is obtained from one of the most trusted sources; the National Renewable Energy Laboratory (NREL). For each province, a yearly average of solar data is obtained for a chosen few city to get the solar data for that province. While solar systems last even longer, for calculations, the life span of the solar system is considered as 25 years and a solar panel of 300 watt is used. Inverter sizing calculations assume a margin of [redacted] considering the safety factor. For mounting solar panels, it is recommended that the panels should be facing [redacted] The recommended panel tilt angle values are provided for summer and winter months for maximum solar irradiation.

The electricity tariffs are obtained from various utility providers (as per province and territory) and are updated regularly. Average price of electricity is considered based on monthly electricity consumption of [redacted] which includes both fixed and variable costs. From historical data available by the Canada Energy Board, an annual electricity tariff escalation of 3% is considered for the purpose of calculations. Some provinces and territories may have rebate programs for residential, commercial, and community projects. However, due to their intermittent nature, these are not considered in calculations.

The installation cost of the solar PV system is based on rates from local installers and is comprised of design, build, component, and manpower costs. The lifetime system cost includes the system installation cost, Inverter replacement cost as well as costs for operating and maintaining the system. Inverter and Battery replacement cost are based on the fact that they will be replaced once in [redacted] years, assuming that they are properly operated and maintained. The savings from solar system are derived by calculating how much would it cost to buy the amount of electricity produced by the solar PV system using local electricity tariffs.

10. STEPS TO GO SOLAR



11. VENDOR SELECTION

If you have decided to go ahead with a solar PV system, the next and one of the most important decisions to make is the selection of a qualified solar Installation company / vendor. The solar installer must be someone who you look forward to working with over the period of design, installation, and ongoing delivery of power. Below are some points to consider while selecting an installer and what questions to ask them:

A. Vendor Selection:

B. Costs:

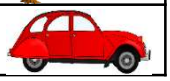
C. Site/Equipment Selection:

D. Performance warranty in the contract:

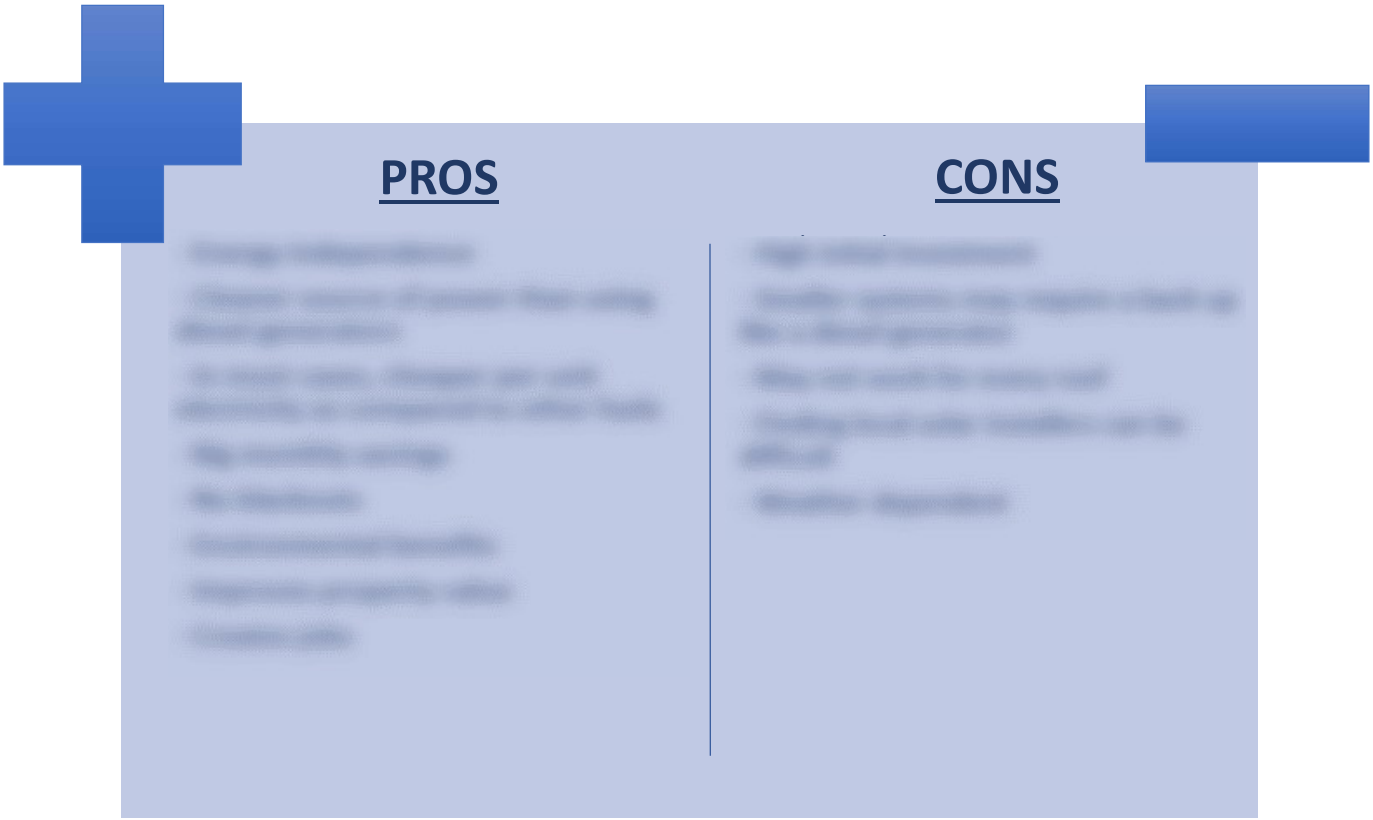
DISPUTE RESOLUTION WITH YOUR SOLAR VENDOR

12. ENVIRONMENTAL BENEFITS OF SOLAR

Solar energy is one of the cleanest sources of energy. Today solar not only helps to reduce greenhouse gas emissions and threat to climate change but is also an economically viable option. This section will help you understand how your system can contribute to the environment by reducing CO2 emissions.

DETAILS	BATTERY AUTONOMY: 1 DAY	BATTERY AUTONOMY: 3 DAYS	UNIT
CO_2 Emissions Saved In 25 Years	[illegible]	[illegible]	lbs
No. Of Trees Saved In 25 Years	[illegible]	[illegible]	
No. Of Cars Avoided For 25 Years	[illegible]	[illegible]	

13. PROS & CONS OF SOLAR



14. OPERATION & MAINTENANCE OF A SOLAR PV SYSTEM

Operation & Maintenance is the key to ensure that the solar PV system gives the best possible power generation throughout its life. Below are a few simple points which if followed on a regular basis can help improve longevity and ensure optimum power generation:

1. Inspect solar panels for damage
2. Regular cleaning of solar panels (taking care of dust, snow, bird droppings, etc.)

15. COMPONENTS OF A TYPICAL SOLAR PV SYSTEM

1. Solar panels
2. Solar inverters

16. GLOSSARY OF TERMS

AC (Alternating Current): Electric current which periodically changes direction
DC (Direct Current): Electric current which flows only in one direction
Ah (Ampere-hour): Amount of energy charge in a battery that will allow one ampere of current to slow for one hour
DOD (Depth of Discharge): The percentage of the battery that has been discharged relative to the overall capacity of the battery
kW (Kilowatt): A measure of 1000 watts of electrical power
kWh (Kilowatt Hour): 1kWh = 1 unit of energy
PV (Photovoltaic): Photovoltaics is the conversion of light into electricity using semiconducting materials that exhibit the photovoltaic effect
V (Voltage): An electromotive force or potential difference expressed in volts
LCOE (Levelized Cost of Electricity): Measure of the average net present cost of electricity generation for a generating system over its lifetime
CapEx (Capital Expense): Expenditure which includes upfront cost for design, installation, and commissioning of the system
OpEx (Operational Expense): Day to day costs that are required for running the solar PV system
IRR (Internal Rate of Return): This is the measure of the solar systems rate of return
ROI (Return on Investment): Performance measure use to evaluate the efficiency of an investment
C02 (Carbon dioxide): Colorless gas with a density about 60% higher than that of dry air
EPC: Engineering, Procurement & Construction
Grid: An electrical grid is an interconnected network for delivering electricity from producers to consumers
Grid-Connected: An electricity generating solar PV system that is connected to the utility grid
Off-Grid: An electricity generating solar PV system that is not connected to the utility grid
NREL (National Renewable Energy Laboratory): A federal laboratory dedicated to research, development, and deployment of renewable energy technologies
O&M (Operation & Maintenance): All services that ensure maximum efficiency of the solar PV system

17. ASSUMPTIONS & FAQs

All currency values are in Canadian Dollars (CAD $)
Calculations are based considering typical life of a solar plant of 25 years
Solar irradiation values are obtained from NREL. A yearly average value of irradiation of selected few cities in each province is considered
The system is designed for worst month (winter sun hours are considered)
Ideal conditions, temperature, a shade-free area and a south facing roof are considered
Inverters if properly maintained typically have a lifespan of [redacted] years. Calculations assume that Inverter will be replaced once in the lifetime of solar system
300Wp solar panels have been considered in calculations
Panel degradation rate of 0.5% annually is considered
Calculations are based on a [redacted] DC system
Batteries if properly maintained typically have a lifespan of [redacted] years. Calculations assume that batteries will be replaced once in the lifetime of solar system
Lithium Ion batteries have been considered for calculations
Depth of Discharge of 80% has been considered for batteries
The electricity tariffs used in calculations include both, fixed and variable tariff components
The electricity production values do not consider tilt angles
The latitudes used in calculations are rounded off for provinces

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Have Questions? Check our FAQs @ ***www.mapmysun.com/pages/faqs***

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