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Making Northway, Alaska Resilient and Sustainable Through Energy Efficiency and Solar PV Power

A Project to Increase Sustainability and Reduce Energy Costs in Northway Village, AK

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Executive Summary

This project implemented energy efficiency measures and installed 6 kW solar arrays on three community buildings in Northway, Alaska, in a collaboration between the Department of Energy - Office of Indian Energy Policy and Programs, the Northway Village Council (NVC), the Tanana Chiefs Conference (TCC), and the Alaska Native Tribal Health Consortium (ANTHC). Northway is a small community in interior Alaska, close to the Canadian border, with high fuel and energy costs: $3.00 per gallon of diesel and $0.56 per kWh, respectively, in 2016, when the project began. The energy efficiency and solar power installation plans aligned with Northway's long-term energy goals of increasing renewable energy and decreasing reliance on fossil fuels, per the Northway Community Energy Action Plan, the Alaska Interior Regional Energy Plan, and TCC Comprehensive Economic Development Strategy. The project focused on three buildings: (1) the community hall (and later office) building, (2) the washeteria building, and (3) the water/sewer garage. It included multiple directions for energy efficiency measures, such as installing LED lighting upgrades, programmable thermostats, vending machine energy misers, efficient pumps, and adding glycol loops at the water/sewer plant. Since the village has a high potential for solar energy, in order to increase resilience and decrease costs, solar systems were installed on three community buildings. Later, a battery was installed in the community hall to capture solar power produced but not used during the day, and allow the flexibility to use that power during evening and night, further decreasing the reliance on grid power for that building. Electricity savings realized by the village between 2011-2012 and 2018-2019 by improving energy efficiencies in the buildings and adding solar was 23%. This is despite the community hall doubling in size during the same time period. If that is taken into consideration (by adding community hall usage into the 2011-2012 usage one additional time), the energy savings from 2011-2012 to 2018-2019 was 37%.

Project Objectives

The objective of this project was to install the first clean power system in the community of Northway, Alaska, and reduce the village's reliance on fossil fuels through energy efficiency improvements.

The village of Northway is located in Interior Alaska, 9 miles south of the Alaska Highway and approximately forty miles from the Canadian border. At about 63 degrees north latitude and inland location, its climate is defined as dry-winter continental subarctic climate: its average January high and low temperatures are -9.9°F and -26.6°F, respectively, and those for July are 69.5°F and 48°F, respectively. About 290 people live in the village and surrounding area. Most are of Athabascan heritage. The power is supplied by a diesel-fueled microgrid operated by Alaska Power and Telephone.

The Northway Village Council (referred to as the council, or NVC, below) owns and operates multiple community buildings, including the community hall / office building, the washeteria, the clinic, and the water treatment plant and garage.

The community hall hosts the elder meal program, potlatches, funeral services, and community gatherings. In 2016, an addition to the community hall was added for the council offices and new kitchen. This nearly doubled the size of the community hall building. The council moved into the new offices in September 2016. The washeteria supplies potable water, and had two showers, six washers, and six dryers in 2017. Since local homes typically lack washers and dryers, the washeteria serves a basic need of the village residents. Over the years, machines were added and old models were upgraded, resulting in increased use. The water/sewer garage houses the well pumps and plumbing, as well as indoor garage space for vehicles used for delivery of water to residents and removal of wastewater.

Northway has long wanted to decrease its power usage. In 2013, the TCC Rural Energy Department conducted an informal energy audit in the community buildings. Some of the recommendations were implemented starting that same year. In 2014, the village council completed a solar feasibility study for the water/sewer garage and the washeteria building.

In the meantime, due to the high energy costs, the NVC, in partnership with ANTHC and TCC, continued to implement energy efficiency and saving measures as feasible. The council perma-chinked the community hall, replaced doors, replaced windows with three-pane ones, bought energy-star rated appliances for the new kitchen in the community hall addition, installed new garage doors on the water/sewer garage, and installed some LED lights.

In 2016, the council, partnering with TCC and ANTHC, applied for the support from Office of Indian Energy for this solar and energy efficiency project, and received the funds. The project consisted of three phases spread over three years from 2017 to 2019.

The project objectives were:

1) Install the community's first clean energy system to reduce exclusive reliance on fossil fuels and the corresponding environmental, social, and health costs;
2) Train two local staff to install and maintain a variety of EEMs (energy efficiency measures) and the PV (photovoltaic) system;
3) Save at least $20,000 in annual utility expenses to reinvest in energy efficiency projects.

Measurable expected outcomes included:

1) Reduce energy usage in tribally owned buildings by approximately 25%;
2) Displace approximately 345,568 Kilo British Thermal Units (kBtu) annually;
3) Save a minimum of $366,000 over the lifetime of the project; and
4) Reduce greenhouse gas emissions by approximately 27.5 metric tons.

The project was split into the following phases:

Phase I - Energy efficiency: The energy efficiency portion of the project included replacing any remaining non-LED lights with LEDs, installing technologies that aid with energy efficiency, upgrading the glycol loops and replacing pumps in the water/sewer garage.

Phase II - Solar: The solar portion of the project included installing solar systems on three buildings in the community.

Phase III - Documentation: In this project phase, staff qualified the savings and improvements in the project buildings.

More specifically, energy efficiency measures for phase I included in all buildings replacing all lights with LED lights; installing programmable thermostats, occupancy sensors, and a vending machine miser; and in the water/sewer garage, replacing pumps with high-efficiency variable speed pumps, and heating improvements to maximize efficiency in water treatment operations.

Phase II reflected the village council's objective of decreasing reliance on fossil fuels, specifically in the generation of electricity. Up to that point, all electricity was generated by diesel powered engines. This phase consisted of installing a 6 kW solar system on each of three buildings: washeteria, water/sewer garage, and community hall.

Phase III is documented specifically in this report, as the expected outcomes are compared to real outcomes, and energy savings are quantified.

Description of Activities Performed

The following activities were performed for Phase I - energy efficiency measures:

Lamp replacements with LEDs and programmable thermostats

Due to high electricity costs, Northway Village Council has been replacing lights with LEDs in community buildings even before this project started. In June 2017 two ANTHC technicians travelled to Northway and worked with two Northway Village operators to replace all remaining lights with LEDs, in particular outdoor lights, *see Figure 1*. They also trained on and installed programmable thermostats, *see Figure 2*, and a vending machine miser. They installed low-flow showerheads, and trained the village operators on boiler operations. More LED replacements happened in July and August.

Well heat loop addition and replacement of all circulation pumps

In April 2018 two TCC and one ANTHC maintenance workers transported all materials and equipment necessary for pump replacement and well heat loop to Northway. There, assisted by two Northway maintenance workers, they replaced all circulation pumps with new Grundfos smart pumps in the water treatment plant and garage, *see Figure 3*. In all, six circulation pumps in the water plant, two main circulation pumps in the water/sewer garage, and a portable circulation pump, were all replaced. The technicians decided on the best layout for the new well heating glycol loop, and installed it. It was programmed to add heat when the well loop temperature drops below 42F.

Solar panel installation

In early 2018 the NVC and TCC considered the details of photovoltaic installation on or near three buildings in the community - the community hall, the washeteria, and the water/sewer garage. The decisions included whether to do a roof mount, the positioning, and orientations of the solar panels. A request for proposals was sent to qualified solar installers in Fairbanks, and one supplier was chosen. TCC worked with that supplier to alter the design to an easier roof mount system. TCC also consulted with Northway's power supplier, Alaska Power and Telephone, to ensure the interconnection worked. The community hall presented an extra challenge, as the roof was old and had to be replaced in order to have the integrity for the system. NVC received quotes for the community hall roof replacement

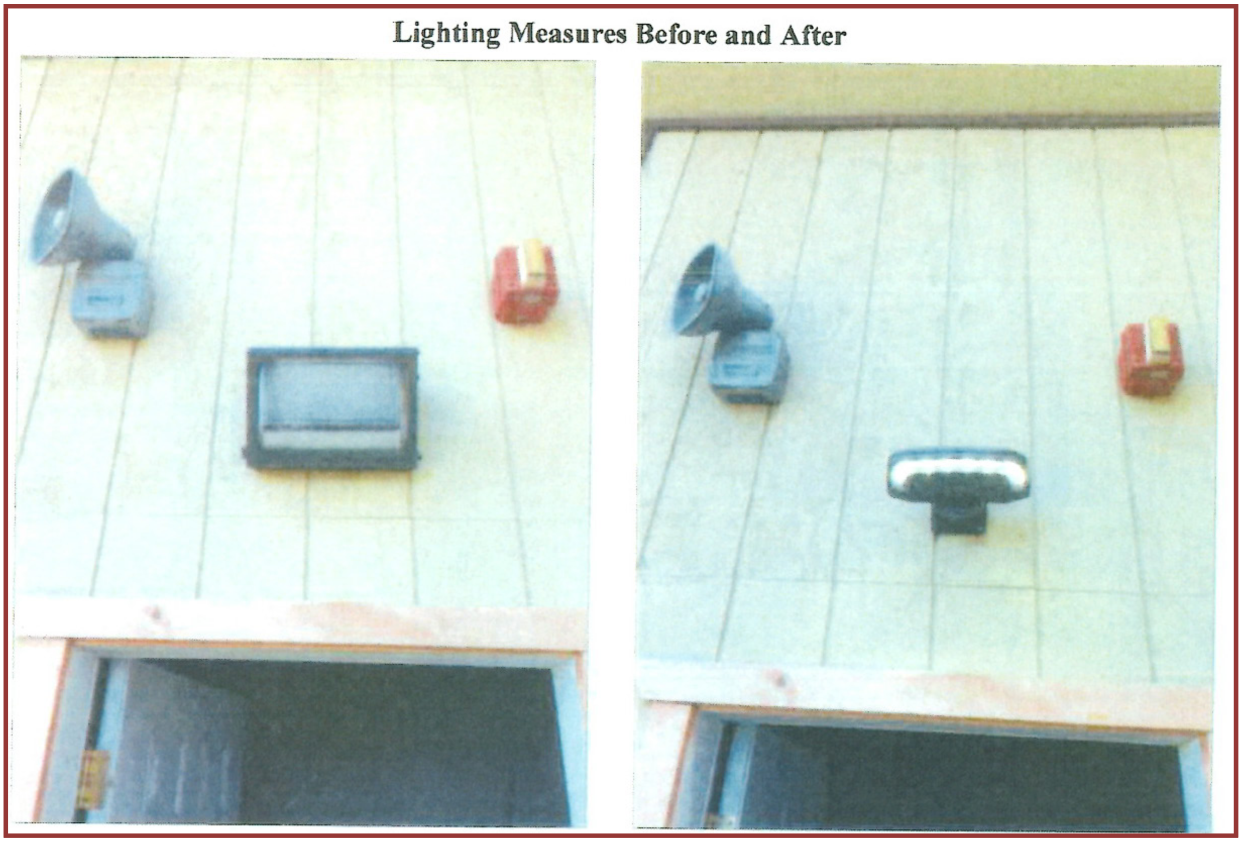


Figure 1: Old lights and new LED lights in Northway, July 2017. *Photo courtesy of ANTHC / Kameron Hartvigson.*

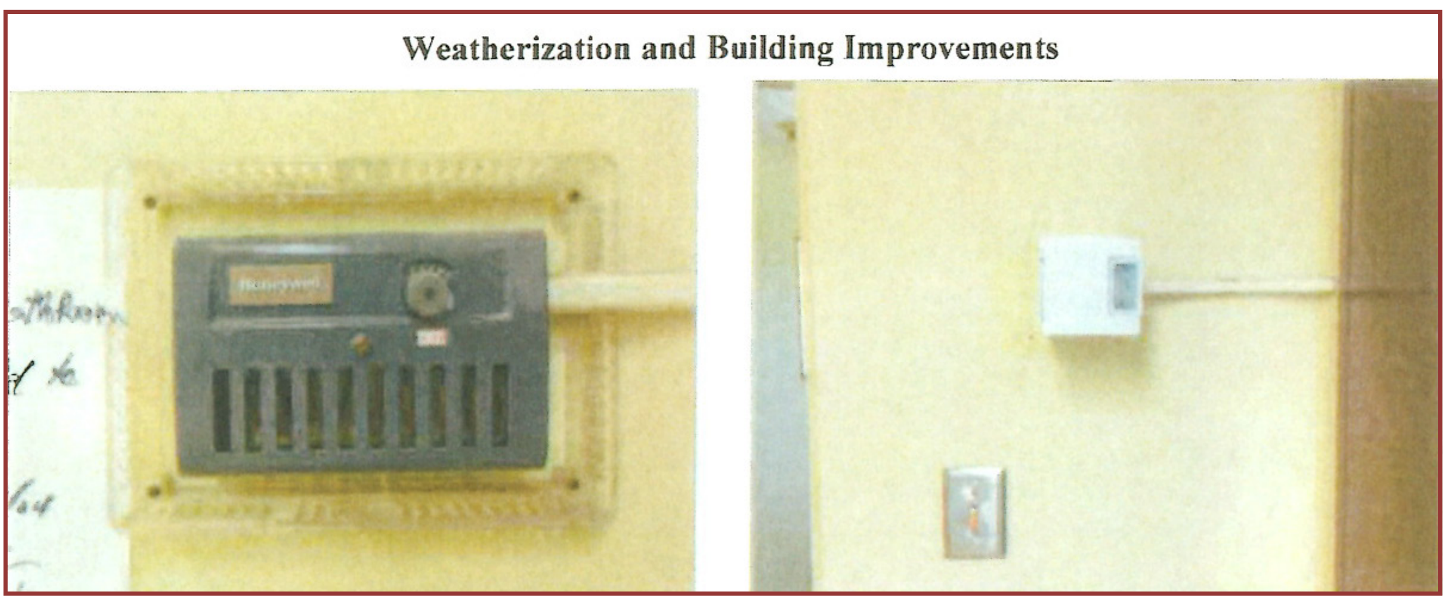


Figure 2: Old thermostat, and new programmable thermostat in its place. *Photo courtesy of ANTHC / Kameron Hartvigson.*

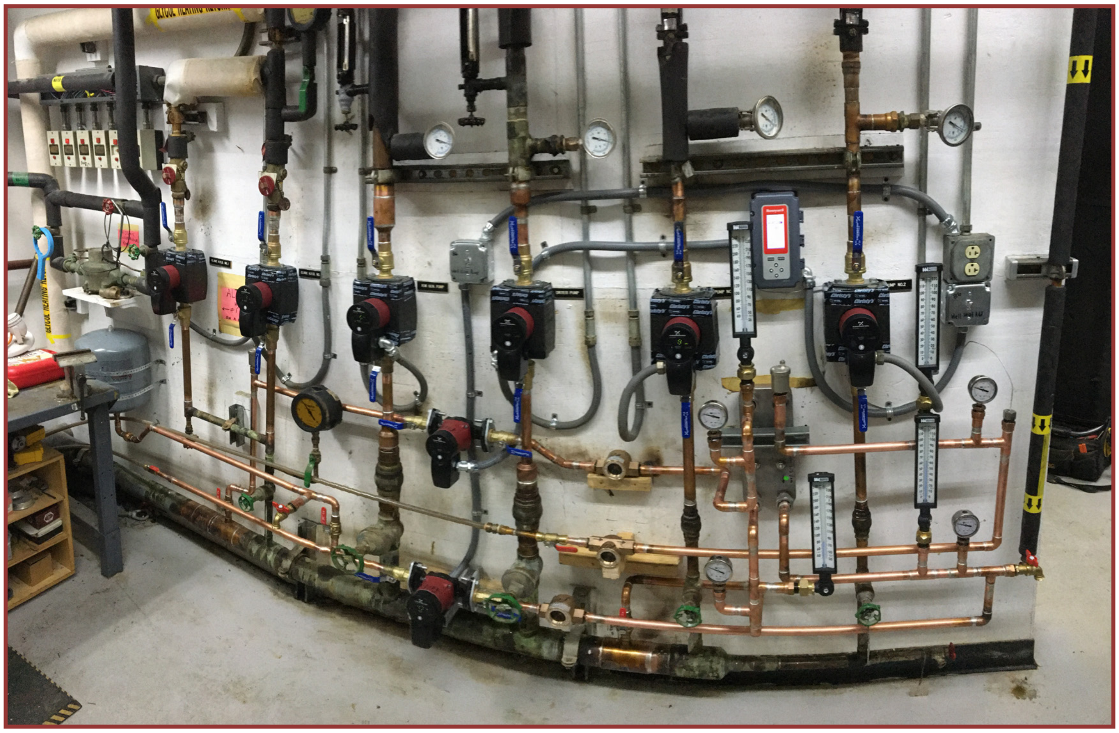


Figure 3: New Grundfos pumps and new glycol heating loop in Northway, Apr 2018. *Photo courtesy of TCC / David Pelunis-Messier.*

materials and the roof was replaced before the photovoltaic system installation.

The solar panels were mounted at a fixed angle roof mount on the community hall, and were mounted flat against the roof on the other two buildings. TCC initially made two trips to Northway to assist and train NVC personnel on the photovoltaic installation. The installation team faced some challenges from weather and wrong mounting screws. Despite the setbacks, the group finished the installation within a couple weeks. *Figures 4-8* and the cover figure of this report show the installation in progress, as well as the installed solar panels on the three community buildings and new meters on the community hall.

When the photovoltaic system was ready, an electrician made the final connection to each building's electrical circuit and the local power grid. Two of the systems came online without issue, the third one had a bad rapid shutdown, and required a third trip by TCC and electrician before being finally hooked up. The local utility, which does not pay customers for power produced, exchanged the meters to uni-directional meters. All systems became operational in late summer or early fall 2018.

Figure 4: Northway and TCC workers, left to right: Carl Carbon, David Pelunis-Messier, and Howard Sam install solar panels on a sunny day. *Photo courtesy of TCC / David Pelunis-Messier.*

Figure 6: Carl Carbon inspects the community hall meters. *Photo courtesy of TCC / David Pelunis-Messier.*

Figure 5: Satellite view image of Northway buildings that have solar panels installed as a result of this project. The solar panels are darker gray rectangles visible on the roofs of the buildings. The washeteria/clinic building is in the upper center; water/sewer garage is located in upper right; and the community hall and addition is visible in lower left corner of the figure. *Photo courtesy of Apple Maps.*

Figure 7: Solar panels on the washeteria/clinic building in Northway. *Photo courtesy of TCC / David Pelunis-Messier.*

Figure 8: Solar panels on the water/sewer garage. Due to the height of the roof, the panels are barely visible on the leading edge. *Photo courtesy of TCC / David Pelunis-Messier.*

The utility serving Northway, Alaska Power and Telephone, does not offer net metering, meaning that any electricity that is produced by the solar panels and not used within the building flows out into the grid but does not count towards offsetting the cost of grid-provided power. As a result, TCC and NVC looked into battery storage systems that would allow the battery to charge with unused solar power during the day, then provide that power back once the solar output no longer sufficed to run the building. This type of system offsets more electricity than with solar alone.

The battery system was specified, purchased, and installed in the community hall in 2019. The other two buildings did not receive this upgrade. The community hall system is composed of a SolarEdge StorEdge, with a 7.6 kW SolarEdge inverter and a LG Chem RESU 10H battery - a 400VDC battery capable of storing 9.8 kWh of power. A schematic of this battery system is shown in *Figure 9*. It shows that the power produced by the photovoltaic panels can be either converted into AC power and used

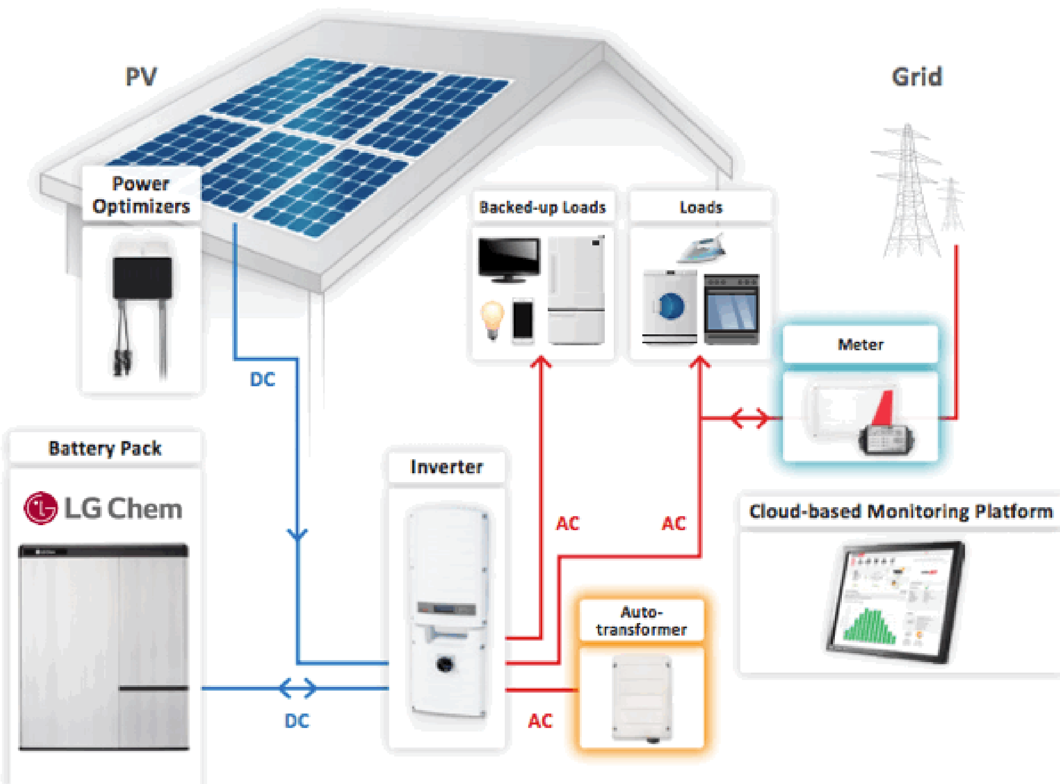


Figure 9: Schematic diagram of the solar photovoltaic system with battery backup, as installed in the community hall.

Figure 10: TCC technician, Wes Alexander, stands next to the new battery at the community hall. *Photo courtesy of TCC / David Pelunis-Messier.*

within the building or stored in a DC charge of the battery, or sent outside to the grid. A monitoring platform provides easy access to the information by partners at TCC. *Figure 10* shows the installed battery.

The battery system required additional training, for both TCC and NVC employees. Some personnel were trained on the LG Chem battery training to ensure proper and safe installation, as well as hazardous materials transportation training for transporting the battery to Northway.

The following charts show the billed electricity usage in the community hall, water/sewer garage, and washeteria buildings. As is so often the case with real life, other variables have changed during the time as well. In particular, for the community hall, the addition that was completed in 2016 nearly doubled the conditioned space of that building. In the washeteria, old washers and dryers were replaced with newer models, and additional machines were installed, resulting in increased use, as can be seen by the increased income from 2017 to 2019.

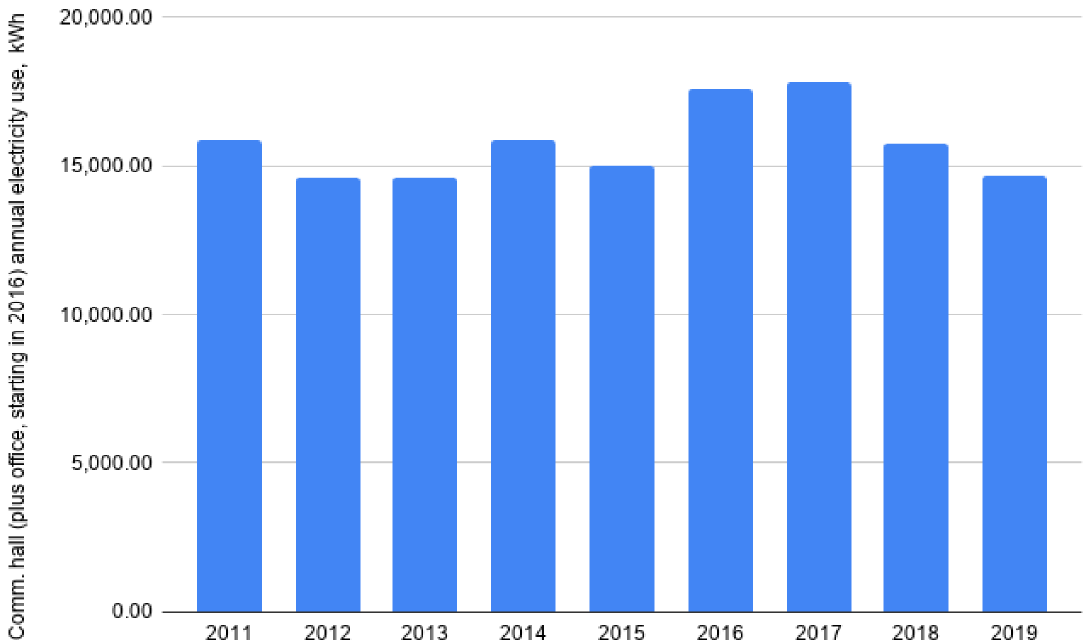


Figure 11: Community hall annual electricity usage from 2011 to 2019. Note that the addition to the community hall was built and occupied in 2016, effectively doubling the square footage of the building. Solar panels were installed in summer of 2018, and a battery in 2019.

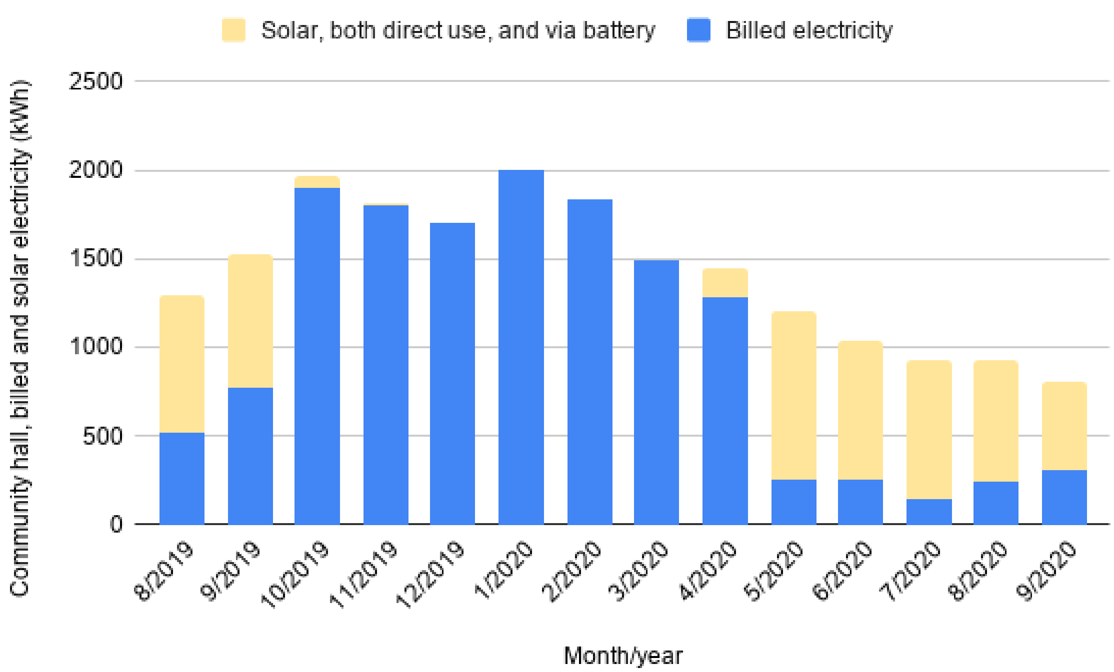


Figure 12: Community hall monthly electricity usage after the battery system was installed, from August 2019 to September 2020. Blue bars denote electricity bought from the power utility. Light yellow denote the electricity produced by the solar panels and either used immediately in the building, or stored in the battery and then used.

For the community hall, the electricity use has slightly decreased starting in 2011, when the community started on some of the energy efficiency improvements, such as replacing the lights, *see Figure 11*. The use then increased in 2016, when the addition, housing NVC offices, was finished. The addition increased the conditioned space of the community hall by 90%. The increase in electricity use in 2016 is thus not surprising. The solar panels were installed in 2018, decreasing the net electricity use in the hall. The battery was installed in 2019, further decreasing the net electricity usage. *Figure 12* shows both the billed electricity by the public utility, as well as the solar power used, since the installation of the battery in 2019.

The value of the battery system that was installed on the community hall can be seen in the snapshot from July 27, 2019, shown in *Figure 13*. Starting at midnight, purple color shows that the building was

Figure 13: Snapshot from the battery system installed in the community hall showing solar production, battery use, and electricity bought from the utility. The oscilllating horizontal line above 1k shows the electricity usage of the building, satisfied by either battery (purple), local power utility (red), or directly from solar production (blue). Excess solar production (green) goes into charging the battery so that it can power the building when the sun no longer shines on the panels.

using power stored in the battery from the previous day. The battery ran out around 3am, and the red color then shows that the electricity was bought from the local utility. Around 5am, the sun started shining on the panels and providing some of the electricity needed, shown in blue. Just before 8am, all of the electricity for the building was provided by the solar panels (no red). In fact, the solar panels provided more power than what the building used, and the excess, shown in green, was used to charge the battery, to get it ready for that evening. Around 6pm/18:00, the sun was no longer providing enough electricity for the entire building (no more green), and the battery supplemented the solar (purple). The sun stopped providing electricity completely around 9pm/21:00 (blue disappears, only purple remains), and the building ran entirely on battery until after midnight.

For that particular day, the statistics above the graph show that the total electricity usage was ~31 kWh. Of that, 17% of electricity (1/6 of total, ~ 6 kWh) was imported from the grid, and the rest, ~26 kWh, was produced by the solar panels or battery. Since the battery provided ~9 kWh, that means that ~16 kWh were produced by the solar panels and used immediately. That is approximately 1/2 of the total. Without a battery, that would have been the savings provided by the solar system. The battery provided a way to extend the self-consumption to 5/6 of the total electricity consumption on that particular day. Weather and season both impact the amount of solar electricity produced.

The production of solar electricity for the first year of the battery-connected PV system on the community hall was 4,304 kWh.

The water/sewer garage electricity use decreased from 2011 to 2016, *see Figure 14*. New pumps as well as a new glycol loops that required additional pumps were installed in 2017 and 2018, increasing the usage. The photovoltaic system was turned on in July 2018, and has offset significant portion of the electricity billed by the local power utility. This is especially well visible on the month-to-month electricity usage chart for the garage, *see Figure 15*. Based on the solar meter reading in October 2020, and 2.5 years of production, the annual production of the solar system on the water-sewer garage is 6,205 kWh.

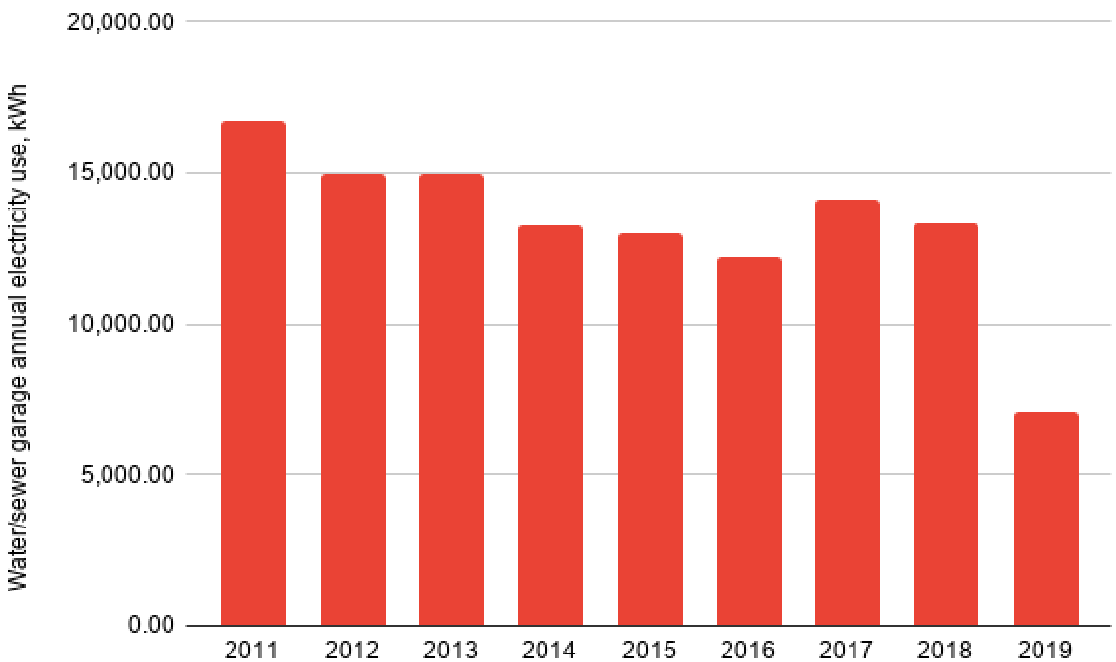


Figure 14: Water/sewer garage building annual electricity usage from 2011 to 2019. Glycol loop improvements and new pumps were installed in April 2018, and solar panels were installed in July 2018.

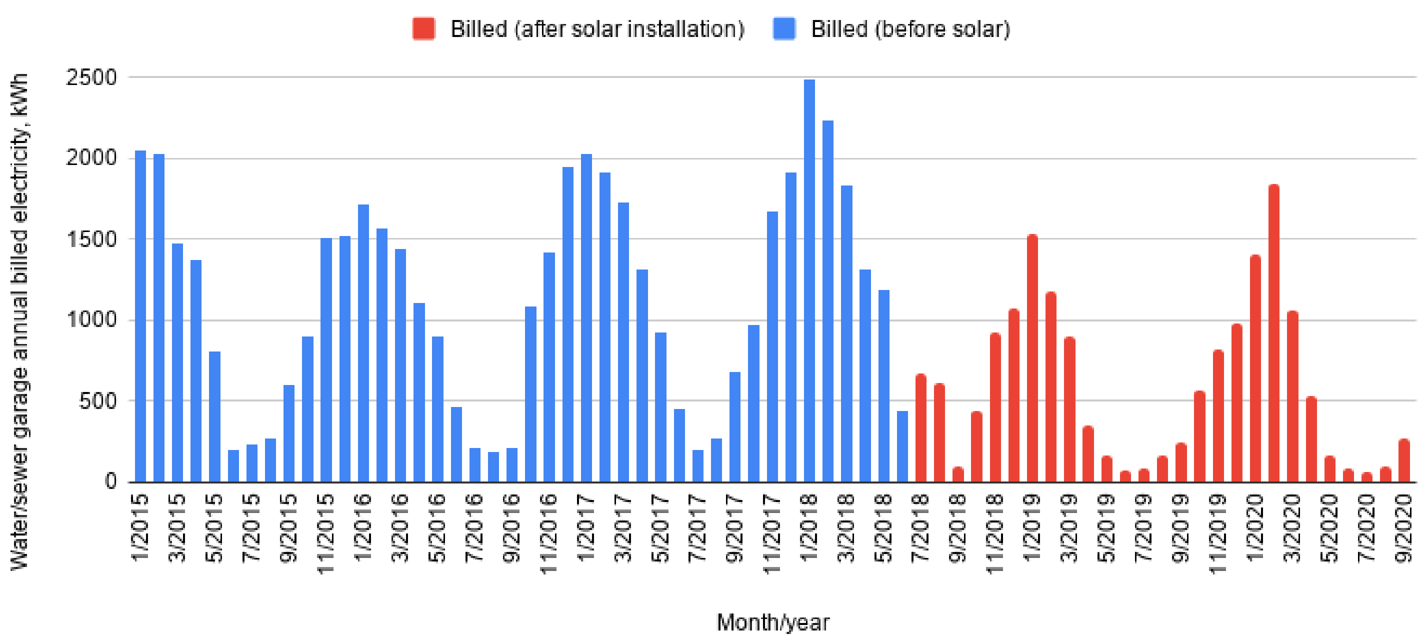


Figure 15: The water/sewer garage building saw a large decrease in electricity billed by the power utility after the pumps were replaced and solar panels were installed in 2018.

The washeteria electricity costs have decreased with the energy efficiency measures that NVC implemented. In the last three years of the data, including 2018 when the solar panels were installed, the electricity use is somewhat constant, *see Figure 16*. During that same period, the washeteria income, representative of the usage of the washeteria, has increased by 50% from 2017 to 2019. Given the significant increase in use of the washers and dryers, the lack of increase in electricity usage can be attributed to the photovoltaic system that is offsetting some of the electricity. Based on the readout of the solar meter in the washeteria in October 2020 after 2.5 years of production, the annual solar production of the PV system on the washeteria is 4,217 kWh.

The savings calculation is a bit complicated by the addition built onto the community hall that was finished in September 2016. This addition nearly doubled the area of the building: the original community hall is 3,640 sf, and the addition is 3,328 sf. Without accounting for the additional square footage in the addition, annual usage (calculated from two years) decreased by 23% between the start of the decade

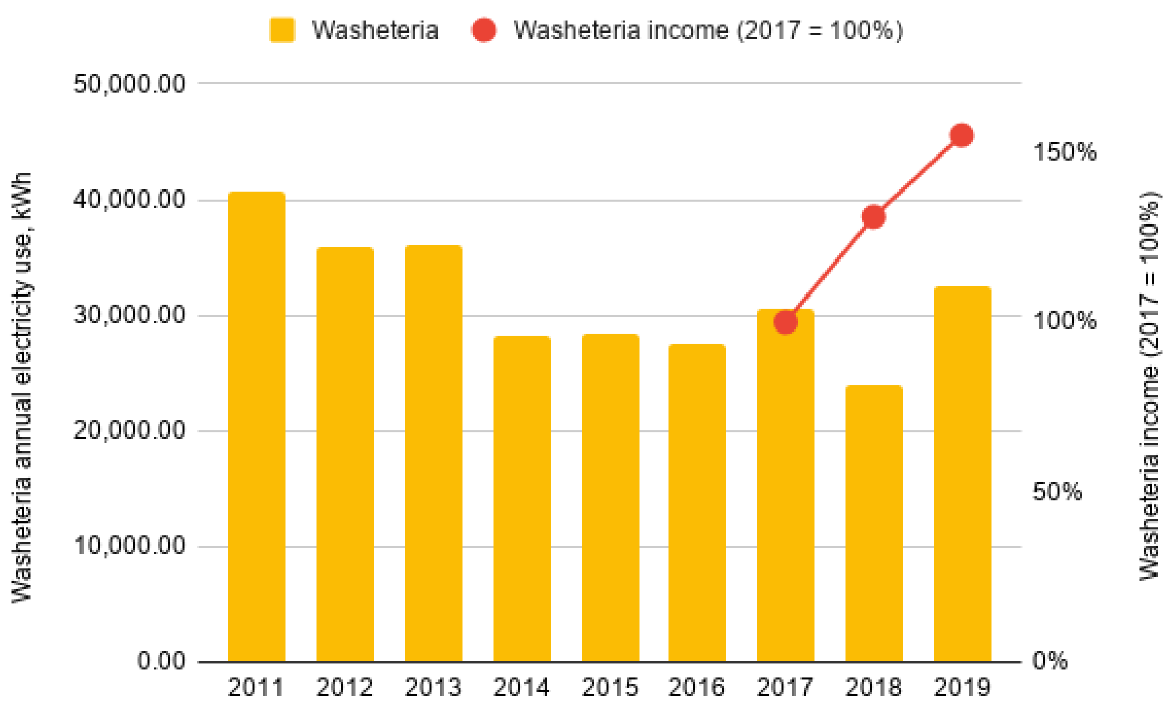


Figure 16: Washeteria annual electricity usage. Energy efficiency improvements occurred throughout the decade, solar panels were installed in 2018. The washing machines and dryers were upgraded in recent years, increasing the usage and washeteria income (red dots) by more than 50% from 2017 to 2019.

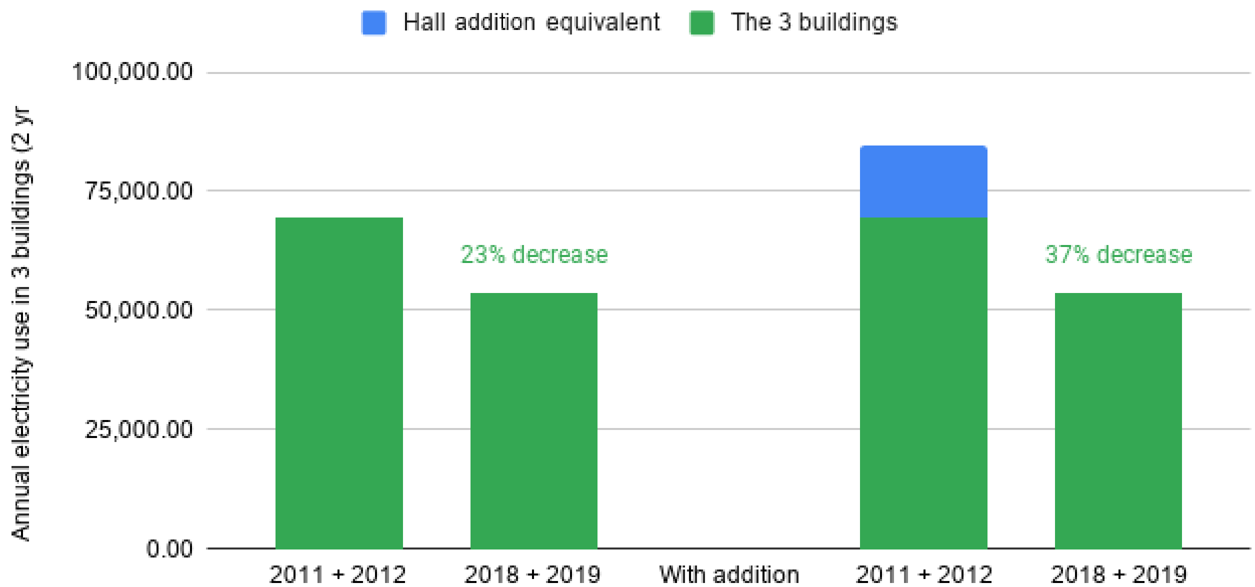


Figure 17: Annual electricity use in the three buildings discussed in this report, averaged over two years, 2011 and 2012; and 2018 and 2019. Note that the solar panels were installed in summer of 2018, and there would be additional reduction in electricity use of two full years with solar panels could be used for the comparison. Note also that the community hall addition was finished in 2016, effectively doubling its size. Electricity use decreased by 23%.

and the end of the decade, 2011-2012 average and 2018-2019 average. That is shown in the left half of *Figure 17*.

In order to show more clearly the energy savings for the same square footage, one can add the energy usage of the community hall one more time (doubling it) for the 2011+2012 average, and compare that to the 2018+2019 average. That is shown in the right half of the figure. The effective energy savings is 37%.

Note that the actual savings will be even greater once complete electricity use for 2020 is obtained, because one of the two years used in the final averages, 2018, includes half a summer when the solar panels were not yet installed.

The objectives of the project were to build the village's first renewable energy project, train two personnel, and save $20,000 annually. The first two were unequivocally achieved. The last was accomplished at approximately 85% or 125%, without or with accounting for the doubling of the community hall. The decrease in billed electricity is approximately $9,000, and solar provided an estimated $8,000 in offset electricity annually. Overall, that amounts to $17,000 that Northway is not paying for electricity. If one takes into account the doubling of the community hall, that number rises to $25,000 annual savings. (Calculation is based on the unsubsidized electricity rate of $0.56 per kWh.)

The measurable goals and impacts of the project were the following:

(1) Goal of displacing 25% of energy usage: this project displaced 23% or 37% of electricity use in the three community buildings, if one does not or does take into account the doubling in size of the community hall.

(2) Goal of displacing 345,568 kWh annually: approximately 30% or 45% of the goal was reached when one does not or does account for doubling of the square footage of the community hall in 2016. Offices typically use more electricity than a hall that is used only on occasion, so even this may be an underestimate. Likewise, the increase in use of washeteria was not accounted for.

(3) Goal of saving $366,000 over the lifetime: Over an 18-year period, the annual savings adds up to $308,000 or $461,000 total, respectively, without or with accounting for the doubling of the community hall area.

(4) Goal of reducing greenhouse gas emissions by 27.5 metric tons annually: achieved at 106% or 159%, if the doubling of area of community hall is not or is taken into account, respectively. (Calculating only involved carbon dioxide, at 2.11 lbs of CO_2 produced per diesel-generated kWh.)

All of the calculations were based on annual usage from 2011-2012 and 2018-2019, and as such do not fully account for solar, since the photovoltaic system was installed in mid-summer 2018, halfway through the year.

Conclusions and Recommendations

Northway Village Council proposed this project in order to increase renewable energies and decrease reliance on fossil fuels. Between energy efficiency improvements in three community buildings (community hall, washeteria, and water/sewer garage) and deployment of photovoltaic systems on top of these buildings, both of these long-term visions started taking shape. The NVC is saving approximately $8,800 annually from energy efficiencies (without taking into account that the community hall effectively doubled in size during this time period), and approximately $8,250 from electricity produced by the solar panels. This is a significant savings in both usage, greenhouse gas emissions, and cost. The village will be able to use the cost savings to invest in other projects around the community.

Lessons Learned

The lessons learned by NVC and TCC included the following:

- The community hall roof was 30 years old. A review found that it would not support the solar system mounts - it had to be replaced prior to installation of the PV system. The village applied for a community grant through TCC and replaced the roofing.
- Verifying details of the proposal by a vendor allowed TCC to suggest an option for mounting that was easier to install.
- The installation was delayed by one to two weeks due to rainy weather, and due to the supplier sending the wrong size mounting screws. Flexibility was important.
- After the photovoltaic system rooftop mounting was finished, a contract electrician and TCC energy specialist installed the final hookups, and the local utility installed new meters. Two of the three systems worked, the last had a bad component that required replacement and was delayed further.
- Communicating with the utility company is important in all stages of the process.
- The utility that serves Northway does not have “net metering” - it does not pay NVC for extra solar electricity that is not used by the buildings and is put back into the grid. This made the battery installation a viable option.
- At one point a TCC technician in Fairbanks noticed some faults with the PV battery system on the online monitoring system. Online monitoring allows for faster recognition of potential problems.

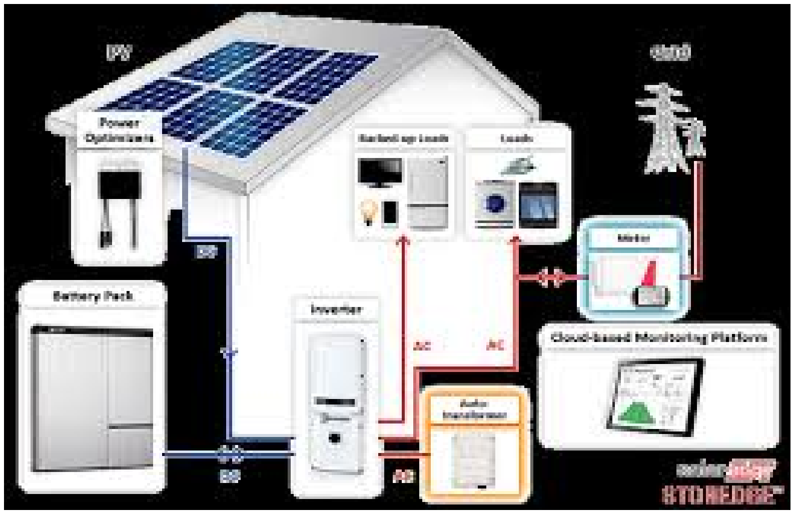
The Northway Village Council, Tanana Chiefs Conference and Alaska Native Tribal Health Consortium thank the Department of Energy for supporting this project.

Northway Tribal Hall

Solar Operation & Maintenance Manual

Installed and commissioned July, 2019 with the cooperation of the

Northway Tribal Council, Department of Energy, Office of Indian Energy and Tanana Chiefs Conference Energy Program.



General description and function of components in the Tribal Hall solar electric system:

Solar Panels: The roof mounted solar panels convert available sunlight into DC energy. DC energy then flows to the inverter.

Inverter: The inverter converts DC energy into AC energy. AC current is the type of energy that is available in a building such as at wall outlets or when you turn the lights on.

Battery: APT, the local utility does not allow “net-metering” on their system therefore any electricity produced by the solar panels that is not consumed by the grid would go directly back to the grid and provide no benefit to the tribal council. To make up for that, a 10kWh battery was installed in summer 2019, with the battery excess energy that is produced and not consumed in the building is instead stored in the battery pack for later use. The building will typically draw energy from the battery when available sunlight diminishes such as at night or when the solar panels are shaded.

When the battery is charged to 100% with solar energy and all loads inside the building are met using solar energy, any excess energy that is produced is delivered back to the grid.

When available sunlight diminishes and the building has exhausted the energy stored in the battery, the building will then consume energy from the grid.

Energy management between the grid, battery and building load is designed to adjust automatically according to meteorological conditions and energy demand without any human interaction. However, the system parameters can be manually adjusted on site or via remote log in. Human interaction is needed on occasion to address system faults or to custom tailor the parameters to meet specific building energy needs.

Disconnects & outside meter: There is a solar disconnect and meter located on the outside of the building in the same vicinity of the main electrical service disconnect and meter. The disconnect is clearly labeled and can be turned off in case of an emergency or if any maintenance or modifications to the system are needed.

System monitoring: System performance and parameters can be monitored or modified at remote locations via the Solaredge online monitoring application.

Seasonal Maintenance for October – March

Solar panels: When snow accumulates on the solar array during the winter months, it is our recommendation that the tribe **does not attempt to remove it.** The amount of solar energy available for energy production is low this time of the year and not worth the risk of sliding off of the roof causing injury, causing damage to the solar components with snow removal tools or damage to the roof by stepping on the wrong locations.

Inverter: *Each spring and fall somebody at the tribe should login to the monitoring site mentioned below and ensure that the system is functioning and that the correct seasonal profile is activated.* The inverter is programed to place the battery out of service and in a dormant state during the winter months since there is no excess energy to be stored. These parameters are programmed into the seasonal profiles and customized for interior Alaska. The seasonal profile should be verified using the online monitoring platform. If the winter seasonal profile does not automatically activate by October 31st, call Solaredge Tech Support at: 1 (510) 498-3200. Your site ID number is: 1200952

Battery: The battery is kept out of service and in a 90-100% state of charge to maximize its longevity. The inverter controls the battery functions and should be monitored every other week via the Solaredge online platform to ensure that the battery is kept topped off.

Seasonal Maintenance for April – September

Solar panels: After the snow has melted off the roof and can be navigated safely, it's a good time to wipe off any dirt or residue that has collected on the panels, inspect the racking for loose hardware, replace zip ties that may have weathered and perform a general inspection of all components mounted on the roof. *Ideally once per year somebody should go through the system and make sure all bolts are tight that hold the racking and the panels.*

Inverter: The inverter will place the battery in service and back into the summer seasonal profile. This should be verified by April 1st via the Solaredge monitoring platform. If there are any issues with the automatic switch to the summer seasonal profile contact Solaredge tech support. They can remote-in to the site and make changes or correct faults if necessary. Make sure there are no boxes or items stacked or piled in front of the inverter as it needs adequate air circulation in order to keep cool. If there are any system faults they should be addressed by April 1st in order to ensure a productive solar energy harvest over the course of the summer. It is good practice to monitor the system performance via the Solaredge monitoring platform at least once a week During Spring, Summer, and Fall to ensure everything is functioning properly.

Battery: The battery should be in service and in maximum self-consumption mode. Make sure there are no boxes or items stacked in front or on top of the battery as it needs adequate air circulation to keep cool.

General: This is the prime season to harvest solar energy and significantly offset the electric bills. You want to make sure everything is functioning as designed by April 1st. If any system faults are present or system components are malfunctioning this is the time to call Solaredge tech support. They will provide detailed instructions how to get the system operating properly.

Information

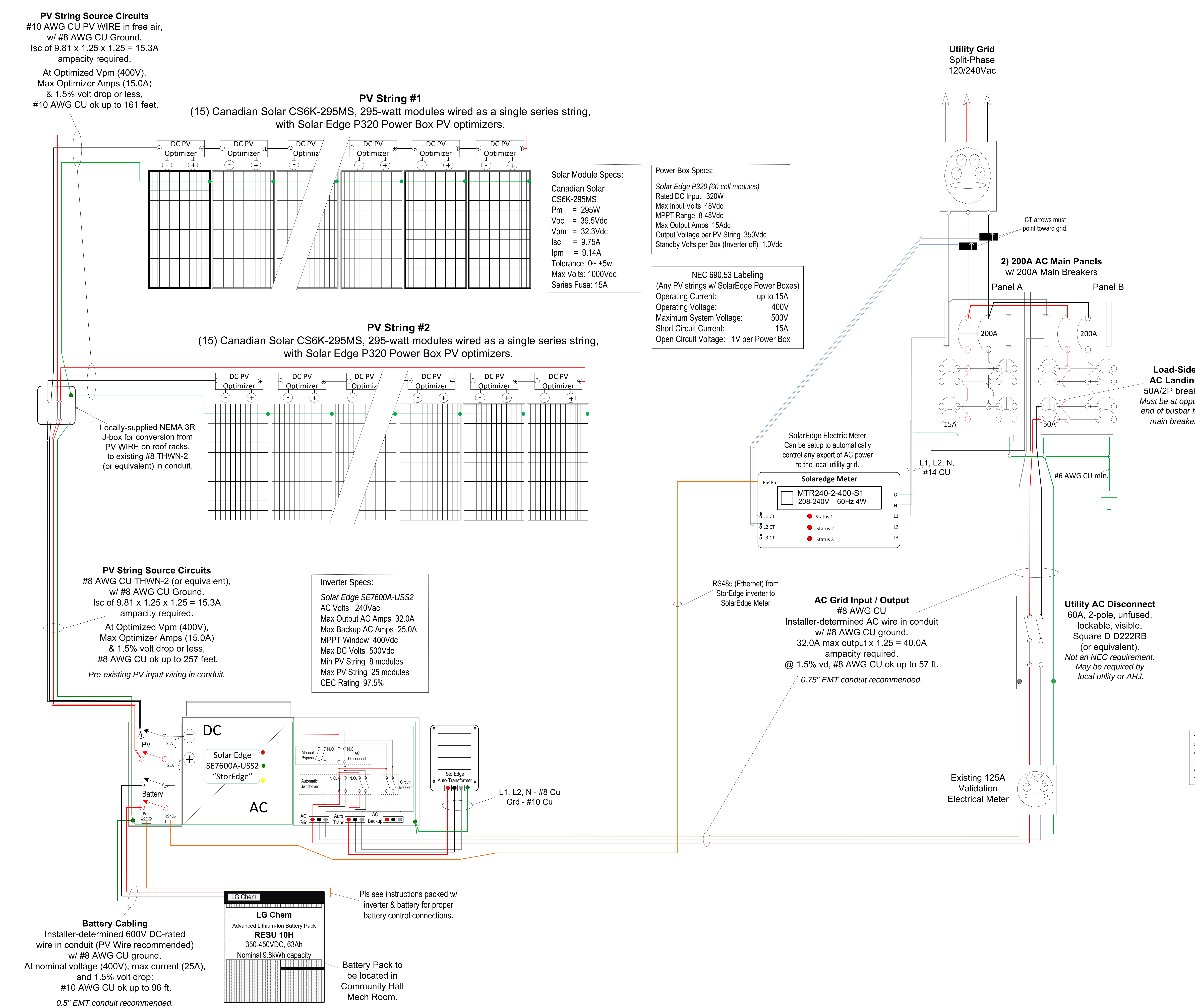
Phone Numbers:	Solaredge Technical Support	1 (510) 498-3200
	TCC Energy Department	452-8251 x3479
Inverter:	Solaredge SE-7600A-US	Serial number: 7F170F12-B7
Battery:	LG Chem RESU10H	Serial number: See side of Battery
Solar Panels:	Canadian Solar CS6K-295ms	Number of panels: 30

Monitoring: Northway Tribal Hall Site Identification Number: 1200952

Username: wes.alexander@tananachiefs.org

Password: TCCEnergy123!

Estimated Annual Production: 7,000 kWh/yr



Project Information

Northway Community Hall
PO Box 70
Northway, AK 99764

Contractor

Dave Messier
907-978-1866

AHJ Signature & Date

Revision Schedule		
No.	Date	Description
1.0	05/08/2019	As Released
1.1	05/09/2019	Revised AC landing & CTs
1.2	07/15/2019	Battery Control Cable

DRAWING NAME:
30)CS295 1)SE7600A-USS2 240v Grid-Tie w/Backup LgFmt

SYSTEM TYPE:
Grid-Tied Solar Electric System w/ Battery Backup

DRAWN BY:	DP
DATE:	05/09/2019
REV. DATE:	07/15/2019
REV. #:	1.2

SHEET TITLE
Electrical Wiring Diagram

SHEET NUMBER
E-1.0

Photovoltaic System Drawings Provided By:

Solar Schematics

solarschematics.com
doug@solarschematics.com
707-380-4314

This line diagram is provided as a service and is based on our understanding of the information supplied and current requirements. Subject to revision based on actual conditions, applicable edition of the National Electrical Code, and local governmental authorities. Installing dealer has sole responsibility for the correct selection and use of all equipment and materials.

☼ Conductor size provided includes ambient temperature adjustment only. Additional derating may be needed based on actual conditions of use; conduit fill, conduit location, etc.
☼ Wire ampacity is based on NEC 2017 75°C copper conductor tables at average highest temperature (due to typical device terminal max. temperature ratings).

CanadianSolar

SUPERPOWER

CS6K-290|295|300|305MS

Canadian Solar's new SuperPower modules with Mono-PERC cells significantly improve efficiency and reliability. The innovative technology offers superior low irradiance performance in the morning, in the evening and on cloudy days, increasing the energy output of the module and the overall yield of the solar system.

25 years linear power output warranty

10 years product warranty on materials and workmanship

KEY FEATURES

- 11 % more power than conventional modules
- Excellent performance at low irradiance of up to: 97.5 %
- High PTC rating of up to: 91.90 %
- Improved energy production due to low temperature coefficients
- IP68 junction box for long-term weather endurance
- Heavy snow load up to 6000 Pa, wind load up to 4000 Pa *

*For detail information, please refer to Installation Manual.

MANAGEMENT SYSTEM CERTIFICATES*

ISO 9001:2008 / Quality management system

ISO 14001:2004 / Standards for environmental management system

OHSAS 18001:2007 / International standards for occupational health & safety

PRODUCT CERTIFICATES*

IEC 61215 / IEC 61730: TÜV-Rheinland / VDE / CE / MCS / CEC AU / JET

UL 1703 / IEC 61215 performance: CEC listed (US) / FSEC (US Florida)

UL 1703: CSA / IEC 61701 ED2: VDE / IEC 62716: VDE

UNI 9177 Reaction to Fire: Class 1

IEC 60068-2-68: SGS

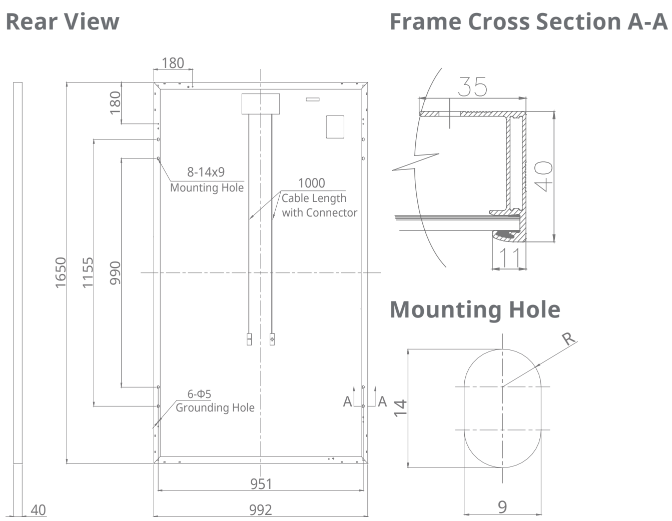
Take-e-way

* As there are different certification requirements in different markets, please contact your local Canadian Solar sales representative for the specific certificates applicable to the products in the region in which the products are to be used.

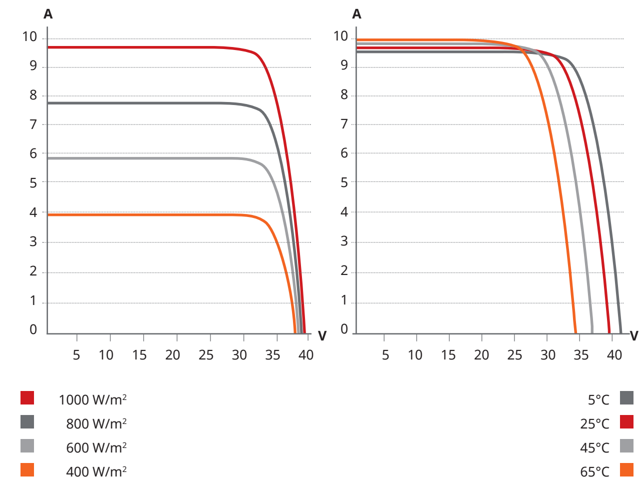
CANADIAN SOLAR (USA), INC. is committed to providing high quality solar products, solar system solutions and services to customers around the world. As a leading PV project developer and manufacturer of solar modules with over 21 GW deployed around the world since 2001, Canadian Solar Inc. (NASDAQ: CSIQ) is one of the most bankable solar companies worldwide.

CANADIAN SOLAR (USA), INC.
3000 Oak Road, Suite 400, Walnut Creek, CA 94597, USA | www.canadiansolar.com/na | sales.us@canadiansolar.com

ENGINEERING DRAWING (mm)



CS6K-295MS / I-V CURVES



ELECTRICAL DATA | STC*

CS6K	290MS	295MS	300MS	305MS
Nominal Max. Power (Pmax)	290 W	295 W	300 W	305 W
Opt. Operating Voltage (Vmp)	32.1 V	32.3 V	32.5 V	32.7 V
Opt. Operating Current (Imp)	9.05 A	9.14 A	9.24 A	9.33 A
Open Circuit Voltage (Voc)	39.3 V	39.5 V	39.7 V	39.9 V
Short Circuit Current (Isc)	9.67 A	9.75 A	9.83 A	9.91 A
Module Efficiency	17.72%	18.02%	18.33%	18.63%
Operating Temperature	-40°C ~ +85°C			
Max. System Voltage	1000 V (IEC) or 1000 V (UL)			
Module Fire Performance	TYPE 1 (UL 1703) or CLASS C (IEC 61730)			
Max. Series Fuse Rating	15 A			
Application Classification	Class A			
Power Tolerance	0 ~ + 5 W			

*Under Standard Test Conditions (STC) of irradiance of 1000 W/m2, spectrum AM 1.5 and cell temperature of 25°C.

MECHANICAL DATA

Specification	Data
Cell Type	Mono-crystalline, 6 inch
Cell Arrangement	60 (6×10)
Dimensions	1650×992×40 mm (65.0×39.1×1.57 in)
Weight	18.2 kg (40.1 lbs)
Front Cover	3.2 mm tempered glass
Frame Material	Anodized aluminium alloy
J-Box	IP68, 3 diodes
Cable	4.0 mm² (IEC), 12 AWG (UL), 1000 mm (39.4 in)
Connector	T4 series
Per Pallet	27 pieces, 538 kg (1186.1 lbs)
Per Container (40' HQ)	756 pieces

ELECTRICAL DATA | NMOT*

CS6K	290MS	295MS	300MS	305MS
Nominal Max. Power (Pmax)	215 W	218 W	222 W	226 W
Opt. Operating Voltage (Vmp)	29.7 V	29.8 V	30.0 V	30.2 V
Opt. Operating Current (Imp)	7.24 A	7.32 A	7.40 A	7.48 A
Open Circuit Voltage (Voc)	36.8 V	37.0 V	37.2 V	37.3 V
Short Circuit Current (Isc)	7.81 A	7.87 A	7.93 A	8.00 A

* Under Nominal Module Operating Temperature (NMOT), irradiance of 800 W/m2, spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s.

TEMPERATURE CHARACTERISTICS

Specification	Data
Temperature Coefficient (Pmax)	-0.39 % / °C
Temperature Coefficient (Voc)	-0.29 % / °C
Temperature Coefficient (Isc)	0.05 % / °C
Nominal Module Operating Temperature (NMOT)	42±2 °C

PERFORMANCE AT LOW IRRADIANCE

Excellent performance at low irradiance, with an average relative efficiency of 97.5 % for irradiances between 200 W/m2 and 1000 W/m2 (AM 1.5, 25°C).

The specification and key features described in this datasheet may deviate slightly and are not guaranteed. Due to on-going innovation, research and product enhancement, Canadian Solar Inc. reserves the right to make any adjustment to the information described herein at any time without notice. Please always obtain the most recent version of the datasheet which shall be duly incorporated into the binding contract made by the parties governing all transactions related to the purchase and sale of the products described herein.

Caution: For professional use only. The installation and handling of PV modules requires professional skills and should only be performed by qualified professionals. Please read the safety and installation instructions before using the modules.

PARTNER SECTION

Power Optimizer

For North America

P320 / P340 / P370 / P400 / P405 / P505

POWER OPTIMIZER

PV power optimization at the module-level

- Specifically designed to work with SolarEdge inverters
- Up to 25% more energy
- Superior efficiency (99.5%)
- Mitigates all types of module mismatch losses, from manufacturing tolerance to partial shading
- Flexible system design for maximum space utilization
- Fast installation with a single bolt
- Next generation maintenance with module-level monitoring
- Meets NEC requirements for arc fault protection (AFCI) and Photovoltaic Rapid Shutdown System (PVRSS)
- Module-level voltage shutdown for installer and firefighter safety

Power Optimizer

For North America

P320 / P340 / P370 / P400 / P405 / P505

Optimizer model (typical module compatibility)	P320 (for 60-cell modules)	P340 (for high-power 60-cell modules)	P370 (for higher-power 60 and 72-cell modules)	P400 (for 72 & 96-cell modules)	P405 (for thin film modules)	P505 (for higher current modules)	
INPUT							
Rated Input DC Power[1]	320	340	370	400	405	505	W
Absolute Maximum Input Voltage (Voc at lowest temperature)	48		60	80	125[2]	83[2]	Vdc
MPPT Operating Range	8 - 48		8 - 60	8 - 80	12.5 - 105	12.5 - 83	Vdc
Maximum Short Circuit Current (Isc)	11			10.1		14	Adc
Maximum DC Input Current	13.75			12.63		17.5	Adc
Maximum Efficiency	99.5						%
Weighted Efficiency	98.8					98.6	%
Overvoltage Category	II						
OUTPUT DURING OPERATION (POWER OPTIMIZER CONNECTED TO OPERATING SOLAREDGE INVERTER)							
Maximum Output Current	15						Adc
Maximum Output Voltage	60				85		Vdc
OUTPUT DURING STANDBY (POWER OPTIMIZER DISCONNECTED FROM SOLAREDGE INVERTER OR SOLAREDGE INVERTER OFF)							
Safety Output Voltage per Power Optimizer	1 ± 0.1						Vdc
STANDARD COMPLIANCE							
EMC	FCC Part15 Class B, IEC61000-6-2, IEC61000-6-3						
Safety	IEC62109-1 (class II safety), UL1741						
RoHS	Yes						
INSTALLATION SPECIFICATIONS							
Maximum Allowed System Voltage	1000						Vdc
Compatible inverters	All SolarEdge Single Phase and Three Phase inverters						
Dimensions (W x L x H)	129 x 153 x 27.5 / 5.1 x 6 x 1.1			129 x 153 x 33.5 / 5.1 x 6 x 1.3	129 x 159 x 49.5 / 5.1 x 6.3 x 1.9	129 x 162 x 59 / 5.1 x 6.4 x 2.3	mm / in
Weight (including cables)	630 / 1.4			750 / 1.7	845 / 1.9	1064 / 2.3	gr / lb
Input Connector	MC4[3]						
Output Wire Type / Connector	Double Insulated; MC4						
Output Wire Length	0.95 / 3.0		1.2 / 3.9				m / ft
Input Wire Length	0.16 / 0.52						m / ft
Operating Temperature Range	-40 - +85 / -40 - +185						˚C / ˚F
Protection Rating	IP68 / NEMA6P						
Relative Humidity	0 - 100						%

[1] Rated STC power of the module. Module of up to +5% power tolerance allowed
[2] NEC 2017 requires max input voltage be not more than 80V
[3] For other connector types please contact SolarEdge

PV System Design Using a SolarEdge Inverter[4][5]		Single Phase HD-Wave	Single phase	Three Phase 208V	Three Phase 480V	
Minimum String Length (Power Optimizers)	P320, P340, P370, P400	8		10	18	
	P405 / P505	6		8	14	
Maximum String Length (Power Optimizers)		25		25	50[6]	
Maximum Power per String		5700 (6000 with SE7600-US - SE11400-US)	5250	6000[7]	12750[8]	W
Parallel Strings of Different Lengths or Orientations		Yes				

[4] For detailed string sizing information refer to: http://www.solaredge.com/sites/default/files/string_sizing_na.pdf
[5] It is not allowed to mix P405/P505 with P320/P340/P370/P400 in one string
[6] A string with more than 30 optimizers does not meet NEC rapid shutdown requirements; safety voltage will be above the 30V requirement
[7] For SE14.4KUS/SE43.2KUS: It is allowed to install up to 6,500W per string when 3 strings are connected to the inverter (3 strings per unit for SE43.2KUS) and when the maximum power difference between the strings is up to 1,000W
[8] For SE30KUS/SE33.3KUS/SE66.6KUS/SE100KUS: It is allowed to install up to 15,000W per string when 3 strings are connected to the inverter (3 strings per unit for SE66.6KUS/SE100KUS) and when the maximum power difference between the strings is up to 2,000W

CE RoHS

solaredge

SolarEdge Single Phase StorEdge™ Solutions for North America

STOREDGE™

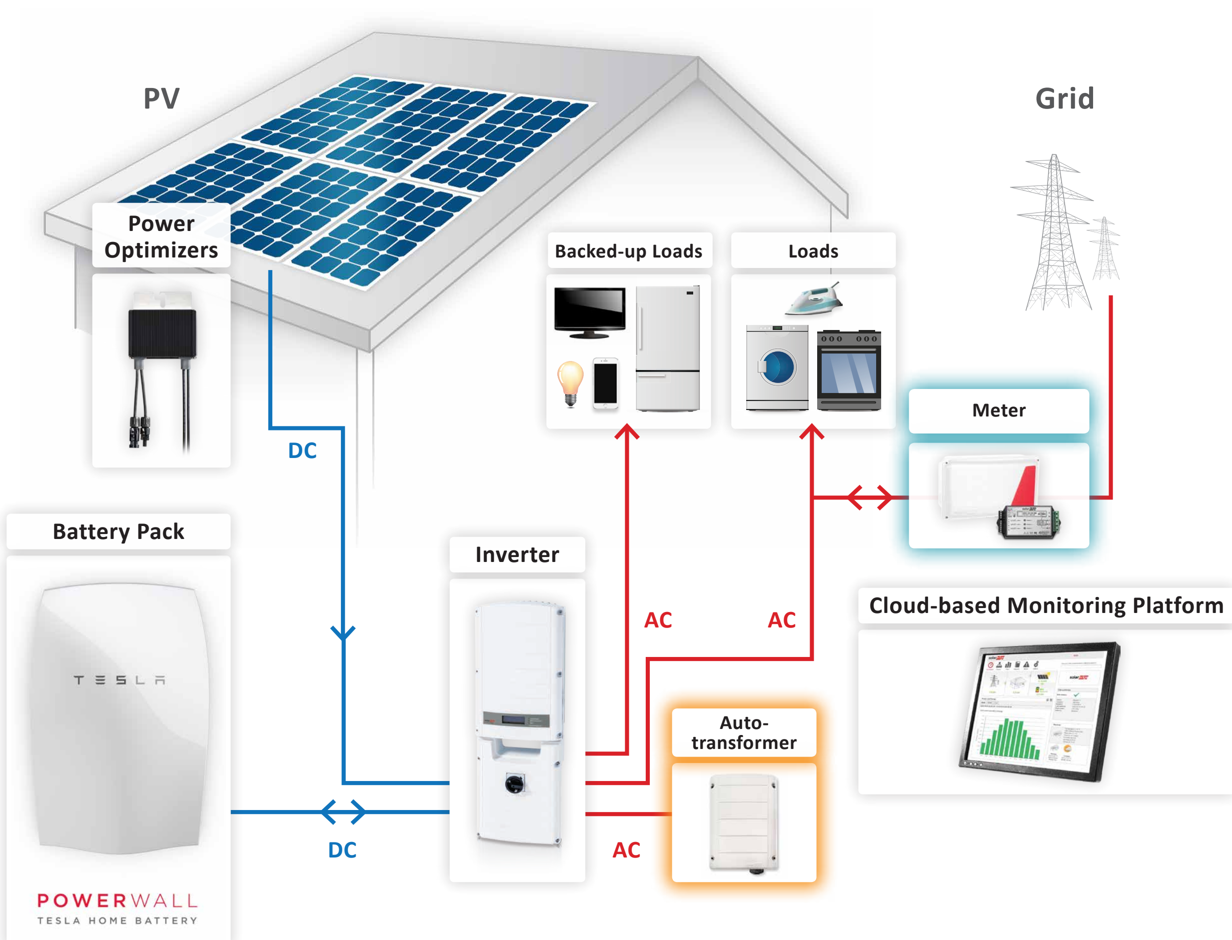
SolarEdge StorEdge™ Solutions Benefits:

- **More Energy** - DC-coupled architecture stores PV power directly to the battery without AC conversion losses
- **Simple Design & Installation** - single inverter for PV, battery storage, grid-tied and backup applications
- **Enhanced Safety** - no high voltage during installation, maintenance or firefighting
- **Full Visibility** - monitor battery status, PV production, remaining backup power and self-consumption data

SolarEdge Single Phase StorEdge™ Solutions for North America

StorEdge™ Features:

- Smart Energy Management - export control, time-of-use shifting, maximized self-consumption, demand response and peak shaving capabilities
- Backup power - automatically provides power to backed-up loads in the event of grid interruption
- All-in-one solution uses a single DC optimized phase inverter to manage and monitor both PV generation and energy storage
- Compatible with Tesla Powerwall Home Battery



SolarEdge StorEdge™ Solutions for North America - Product Selector				
	Grid-tied solar, backup power and smart energy management	Grid-tied solar and backup power	Grid-tied solar and smart energy management	
Single Phase StorEdge™ Inverter	✓	✓	✓	
Auto-transformer	✓	✓		
SolarEdge Electricity Meter	✓		✓	
Battery	✓	✓	✓	

SolarEdge Single Phase StorEdge Inverter
for North America SE7600A-USS2

- Single inverter for PV, grid-tied storage and backup power
- Includes the hardware required to provide automatic backup power to backed-up loads in case of grid interruption
- Includes all interfaces needed for battery connection

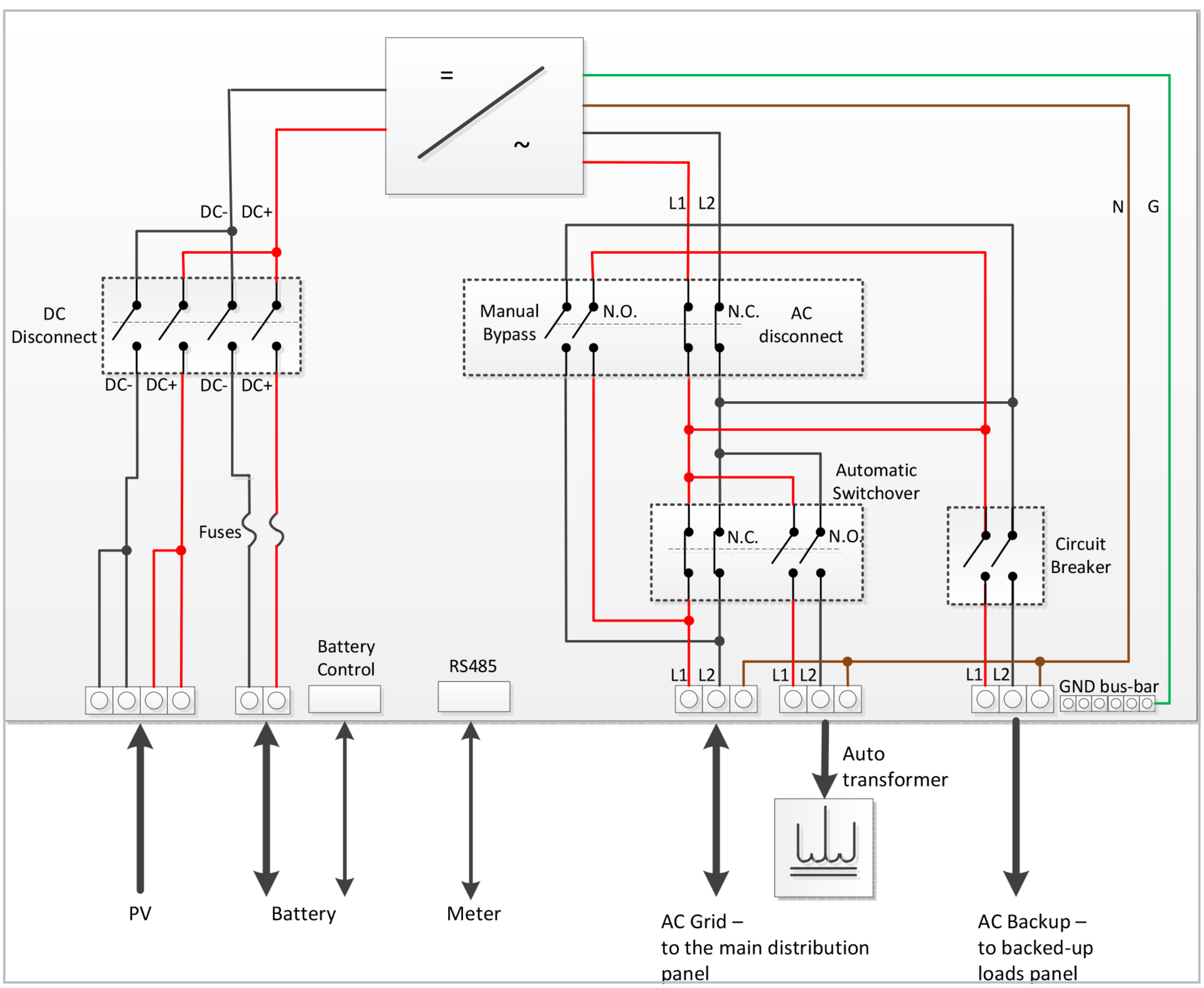
	SE7600A-USS2		
	Single Battery or High Capacity	High Power	
OUTPUT - AC (LOADS/GRID)			
Rated AC Power Output	7600		VA
Max AC Power Output	8350		VA
AC Output Voltage Min-Nom-Max (L-L)[1]	211-240-264		Vac
AC Frequency Min-Nom-Max [1]	59.3 - 60 - 60.5		Hz
Maximum Continuous Output Current @240V	32		A
GFDI	1		A
Utility Monitoring, Islanding Protection, Country Configurable Thresholds	Yes		
Charge Battery from AC (if Allowed)	Yes		
THD	<3		%
Power factor with rated power	>0.99 (configurable; 0.9 leading to 0.9 lagging)		
Typical Nighttime Power Consumption	<5		W
OUTPUT - AC (BACKUP POWER)[2]			
Rated AC Power Output	3300	5000	VA
Max AC Power Output - Surge	3300	6600	VA
AC Output Voltage Min-Nom-Max (L-L)	211-240-264		Vac
AC Output Voltage Min-Nom-Max (L-N)	105-120-132		Vac
AC Frequency Min-Nom-Max	55 - 60 - 65		Hz
Maximum Continuous Output Current @240V - Backup Mode	21		A
Max Continuous Output Current per Phase @120V	25		A
GFDI	1		A
AC Circuit Breaker	Yes		
THD	<5		%
Power factor with rated power	0.2 leading to 0.2 lagging		
Automatic switchover time	<2		sec
Typical Nighttime Power Consumption	<5		W
INPUT - DC (PV and BATTERY)			
Transformer-less, Ungrounded	Yes		
Max Input Voltage	500		Vdc
Nom DC Input Voltage	400		Vdc
Reverse-Polarity Protection	Yes		
Ground-Fault Isolation Detection	600kΩ Sensitivity		
Maximum Inverter Efficiency	98		%
CEC Weighted Efficiency	97.5		%
INPUT - DC (PV)			
Maximum DC Power (STC)	10250		W
Max Input Current [3]	23		Adc
2-pole Disconnection	Yes		
INPUT - DC (BATTERY)			
Continuous Peak Power	3300	6600	W
Number of Batteries per Inverter	Up to 2, for high capacity	2, for high power	
Supported Battery Types	Single battery: B, E Two batteries: B+B	B+E, E+E	
Max Input Current	8.5	17.5	Adc
2-pole Disconnection	Yes		
DC Fuses on Plus and Minus	12A (field replaceable)	25A (field replaceable)	
ADDITIONAL FEATURES			
Supported Communication Interfaces	RS485 for battery, RS485, Ethernet, ZigBee (optional)		
Battery Power Supply	Yes, 12V / 53W		
Revenue Grade Data, ANSI C12.1	Optional [4]		
Integrated AC, DC and Communication Connection Unit	Yes		
AC Disconnect	Yes		
Manual Inverter Bypass Switch	Yes		
DC Voltage Rapid Shutdown (PV and Battery)	Yes, according to NEC 2014 690.12		
Auto-transformer thermal protection	Yes		

SolarEdge Single Phase StorEdge Inverter
for North America SE7600A-USS2

	SE7600A-USS2		
	Single Battery or High Capacity	High Power	
STANDARD COMPLIANCE			
Safety	UL1741, UL1699B, UL1998, CSA 22.2		
Grid Connection Standards	IEEE1547, Rule 21, Rule 14		
Emissions	FCC part15 class B		
INSTALLATION SPECIFICATIONS			
AC Output (Loads/Grid) conduit size / AWG range	1" / 14-6 AWG		
AC Output (Backup) conduit size / AWG range	0.75-1" knockouts / 14-6 AWG		
AC Input (Auto-transformer) conduit size / AWG range	0.75-1" / 14-6 AWG		
DC Input (PV) conduit size / AWG range	0.75" / 14-8 AWG		
DC Input (Battery) conduit size / AWG range	0.75" / 16-10 AWG		
Dimensions with Connection Unit (HxWxD)	37 x 12.5 x 7.2 / 940 x 315 x 184		in / mm
Weight with Connection Unit	58.5 / 26.5		lb / kg
Cooling	Natural convection and internal fan (user replaceable)		
Noise	<50		dBA
Min - Max Operating Temperature	-13 to +140 / -25 to +60		˚F / ˚C
Protection Rating	NEMA 3R		

(1) For other regional settings please contact SolarEdge Support
(2) Not designed for standalone applications and requires AC for commissioning
(3) A higher current source may be used; the inverter will limit its input current to the values stated
(4) Revenue grade inverter P/N: SE7600A-USS00NNM2

Inverter Interface



SolarEdge Auto-transformer

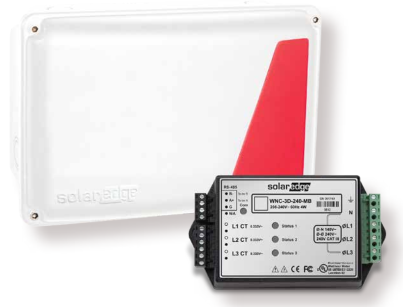
SEAUTO-TX-5000

	SEAUTO-TX-5000	
ELECTRICAL RATINGS		
Rated Power - Continuous	5000	VA
Rated Power - Peak	7600 for 10sec	VA
Output Voltage	120/240V Split Phase	
Max Continuous Output Current per Phase @120V	25	A
Split Phase Imbalance (@Rated Power)	Yes, up to 25A difference between phases	
Thermal Protection	Yes	
INSTALLATION SPECIFICATIONS		
AC Output conduit size / AWG range	0.75" / 14-6 AWG	
Dimensions (HxWxD)	6.7 x 7.9 x 5.5 / 170 x 200 x 140	in / mm
Weight	29.7 / 13.5	lb / kg
Min - Max Operating Temperature	-13 to +140 / -25 to +60	˚F / ˚C
Protection Rating	NEMA 3R	
Installation	Wall mounted	

SolarEdge Electricity Meter for North America

SE-MTR240-2-200-S1 / SE-MTR240-2-400-S1

For meter specifications refer to: http://www.solaredge.us/files/pdfs/products/se_electricity_meter_na.pdf



RESU10H

9.8kWh Battery Pack Product Specification

LG Chem

LG Chem

Product Specification (1/2)

RESU10H

Solaredge compatible

Electrical Characteristics		
Total Energy		9.8 kWh @25°C (77°F)
Usable Energy[1]		9.3 kWh @25°C (77°F)
Voltage Range	**Charge**	400 ~ 450 VDC
	Discharge	350 ~ 430 VDC
Absolute Max. Voltage		520VDC
Max. Charge/Discharge Current		11.9A@420V / 14.3A@350V
Max. Charge/Discharge Power [2]		5kW
Peak Power (only discharging)[3]		7kW for 10 sec.
Peak Current (only discharging)		18.9A@370V for 10 sec.
Communication Interface		RS485
DC Disconnect		Circuit Breaker, 25A, 600V rating
Connection Method		Spring Type Connector
User interface		LEDs for Normal and Fault operation
Protection Features		Over Voltage / Over Current / short circuit / Reverse Polarity
Scalability (Total Energy, Max. Charge/Discharge Power, Peak Power (only discharging))		Max. 2 in parallel (19.6 kWh @25°C (77°F), 6.6KW, 7kW for 10 sec.)

Operating Conditions	
Installation Location	Indoor(Wall-Mounted) / Outdoor
Operating Temperature	14 ~ 113°F (-10 ~ 45°C)
Operating Temperature (Recommended)	59 ~ 86°F (15 ~ 30°C)
Storage Temperature	-22 ~ 131°F (-30 ~ 55°C)
Humidity	5%~95%
Altitude	Max. 6,562ft (2,000m)
Cooling Strategy	Natural Convection

Certification		
Safety	**Cell**	UL1642
	Battery Pack	UL1973 / CE / RCM / TUV (IEC 62619)
Emissions		FCC
Hazardous Materials Classification		Class 9
Transportation		UN38.3 (UNDOT)
Ingress Rating		IP55

※ Test Conditions - Temperature 25°C, at the beginning of life
※ Total Energy is measured under specific condition from LGC(0.3CCCV/0.3CC)
※ DC/DC Discharge Efficiency 94.5%

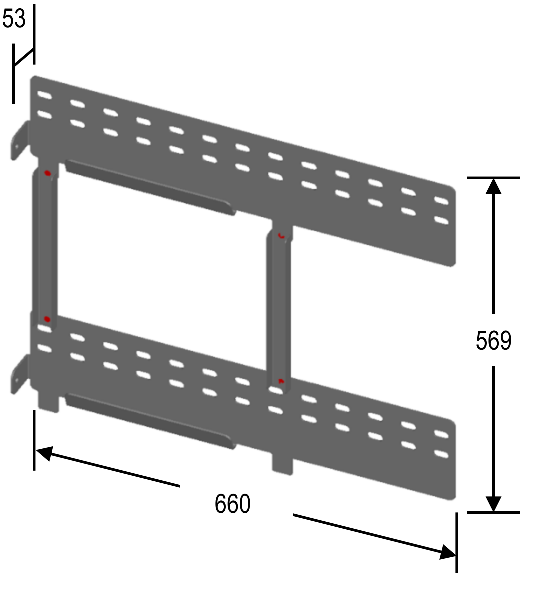
1) Value for Battery Cell Only (Depth of Discharge 95%), 2kW charge/discharge power.
2) LG Chem recommends 3.3kW for maximum battery lifetime
3) Peak Current excludes repeated short duration (less than 10 sec. of current pattern).

Product Specification (2/2)

RESU10H

Solaredge compatible

Mechanical Characteristics		
Dimensions	**Width**	744 mm (29.3’’)
	Height	907 mm (35.7’’)
	Depth	206 mm (8.1’’)
Weight		97 kg (214lbs)



LG Chem
ESS Battery Division

HQ: LG Twin Towers 128, Yeoui-daero, Yeongdeungpo-gu, Seoul, Korea. 150-721
TEL : (82) 2-3773-1114 FAX : (82) 2-3773-7005
http://www.lgesspartner.com http://www.lgchem.com

Consumption Monitoring - Application Note (for North America)

The SolarEdge cloud-based monitoring platform allows monitoring of the house electricity consumption and self-consumption in addition to the monitoring PV production. Consumption monitoring allows you to adapt your electricity consumption according to the PV production, thus increasing self-consumption and minimizing electricity bills. To monitor consumption using the monitoring platform, a SolarEdge Electricity Meter should be connected to the inverter.

The SolarEdge Electricity Meter enables measuring the power consumption or the import/ export power of a site; the SolarEdge inverter uses these measurements for the following applications:

- Consumption monitoring
- SolarEdge on-grid applications
- Import/ export monitoring for export limitation

The meters can be defined according to their point of connection:

- *Export/ Import meter* - A meter that is installed at the grid connection point and reads the energy/ power exported/ imported to/ from the grid.
- *Consumption meter* - A meter that is installed at the load consumption point and reads the energy/ power consumed by the site.

In addition, production monitoring is available for all inverters connected to the monitoring platform using the inverter energy measurements. For revenue grade production monitoring, you can use a revenue grade inverter (a SolarEdge inverter with a built-in meter).

This document describes the information displayed in the monitoring platform when a consumption meter is installed: PV production, house energy consumption and self-consumption throughout the day.

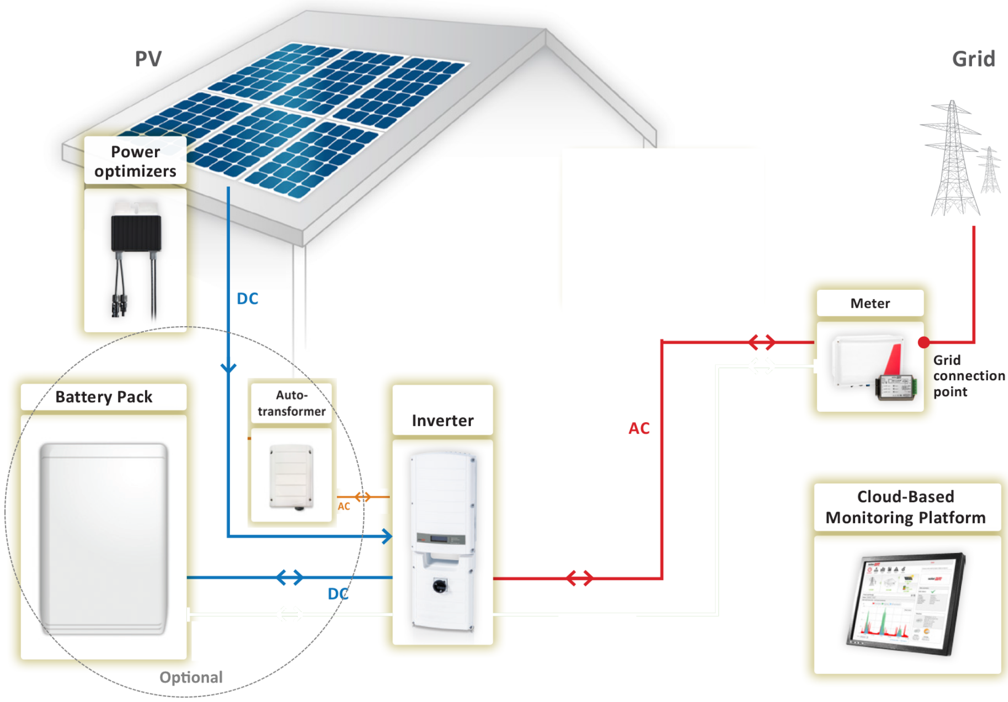


Figure 1: Typical installation with consumption meter

For details about meter installation and configuration refer to http://www.solaredge.com/sites/default/files/electricity_meter_installation_guide_na.pdf.

Make sure the meter is configured correctly for consumption monitoring (using the **Communication → RS485-X Conf.** inverter LCD menu):

- Device Type: Revenue Meter
- Protocol: WattNode
- Meter Func.: Consumption

A meter configured as above is referred to as a consumption meter throughout this document.

Power and Energy Information in the Dashboard

The site dashboard screen in the cloud-based monitoring platform displays power and energy information for a week, month and year. The information is graphically displayed in three panes using the following color-codes (see *Figure 2*):

Color	Description
Light blue	*Self-consumption* - the PV energy consumed by the site; value and percentage out of the produced / consumed energy
Dark green	*System Production*- the produced PV energy, with value and percentage of exported energy to the grid; out of the produced energy
Red	*Consumption* - the PV energy purchased from the grid; value and percentage out of the consumed energy

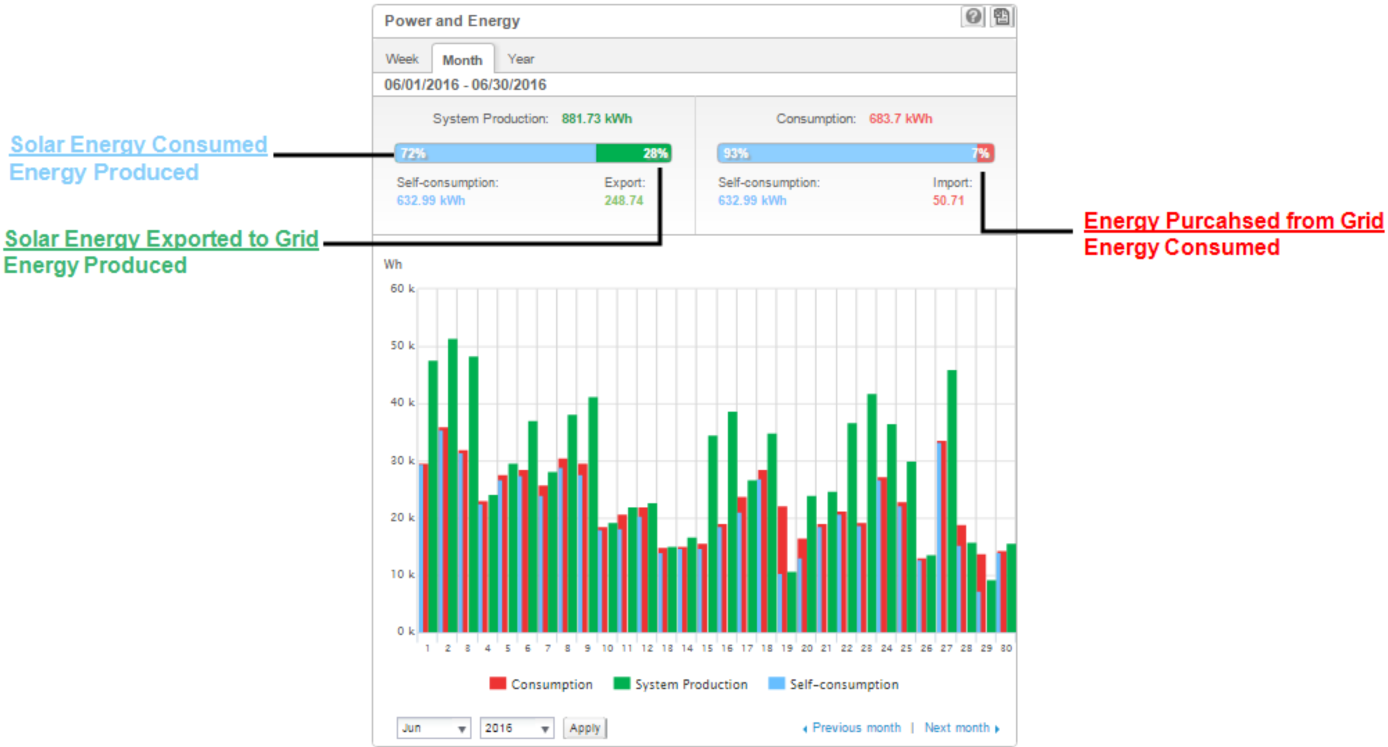


Figure 2: The dashboard window showing monthly information

Zooming-in allows analyzing the energy data by drilling-in as deep as 15-minute intervals. To zoom-in, select an area by clicking, dragging and releasing the mouse. To return to default zoom, click **Reset Zoom** at the top of the chart.

Zooming-in in the Month and Year tabs will change the display from a column chart to an area chart. For StorEdge systems , an additional light-green colored graph is added to the screen: *Solar Production*. This graph represents the power produced by the PV modules.

Hovering over the chart displays information about the specific point: power type (production, self consumption, consumption), value, date and time.

The following figure explains the meaning of colors in the graphs.

Figure 3: The Week tab, showing an area chart (zoomed-in)

StorEdge System Information

For StorEdge systems, the cloud-based monitoring platform also provides insight into household PV production and consumption, displaying the power flow between the PV array, battery, grid and house loads as well as tracking real-time system data. The battery discharge and discharge percentage is displayed as well.

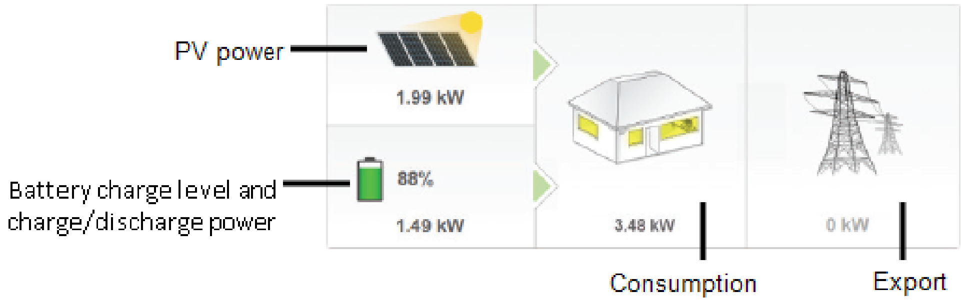


Figure 4: Power flow in the Dashboard window

Meter Details in the Logical Layout Tab

You can view the readings of installed and calculated meters in the monitoring platform Dashboard. Calculated meter readings (also referred to as "virtual meters"), such as self-consumption, are calculated using the data measured by the meter and the inverter(s).

Verify that the meter type is set correctly in the **Admin** page > **Logical Layout** > **Meter** details:

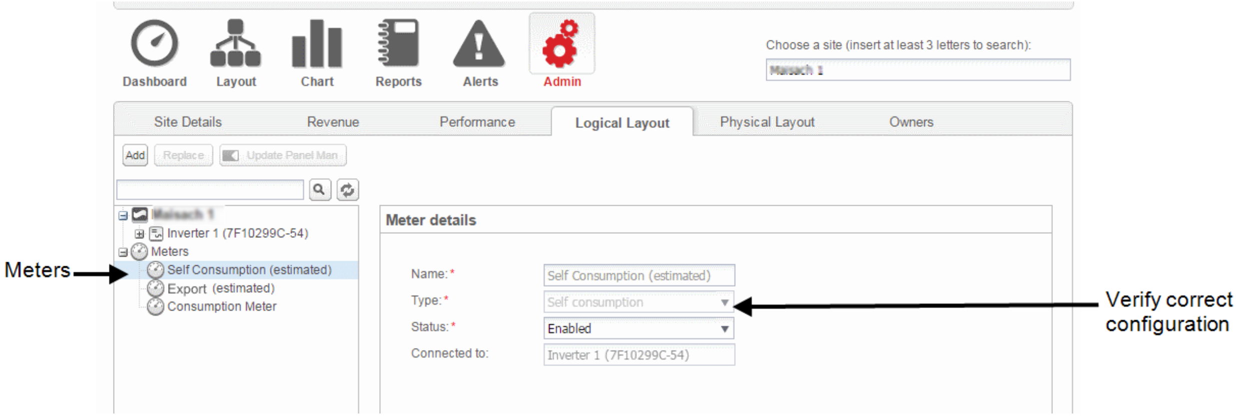


Figure 5: Setting the Meter details in the monitoring platform

The production data originates from the inverter and not the meter.

The displayed data depends on the meter(s) location: grid connection point (export), or load consumption point (consumption). The tables below detail the displayed information per meter location.

Export Meter:

Data	Displayed in Monitoring Dashboard	Displayed in Monitoring Charts
Production	✔	✔
Consumption	✔ (calculated)	✔ (calculated)
Self-consumption	✔ (calculated)	✔ (calculated)
Export	X	✔
Import	X	✔

Consumption Meter:

Data	Displayed in Monitoring Dashboard	Displayed in Monitoring Charts
Production	✔	✔
Consumption	✔	✔
Self-consumption	✔ (calculated)	✔ (calculated)
Export	X	✔ (calculated)
Import	X	X

The data from the inverters and from installed meters is displayed in the Dashboard and Charts tabs of the monitoring platform.

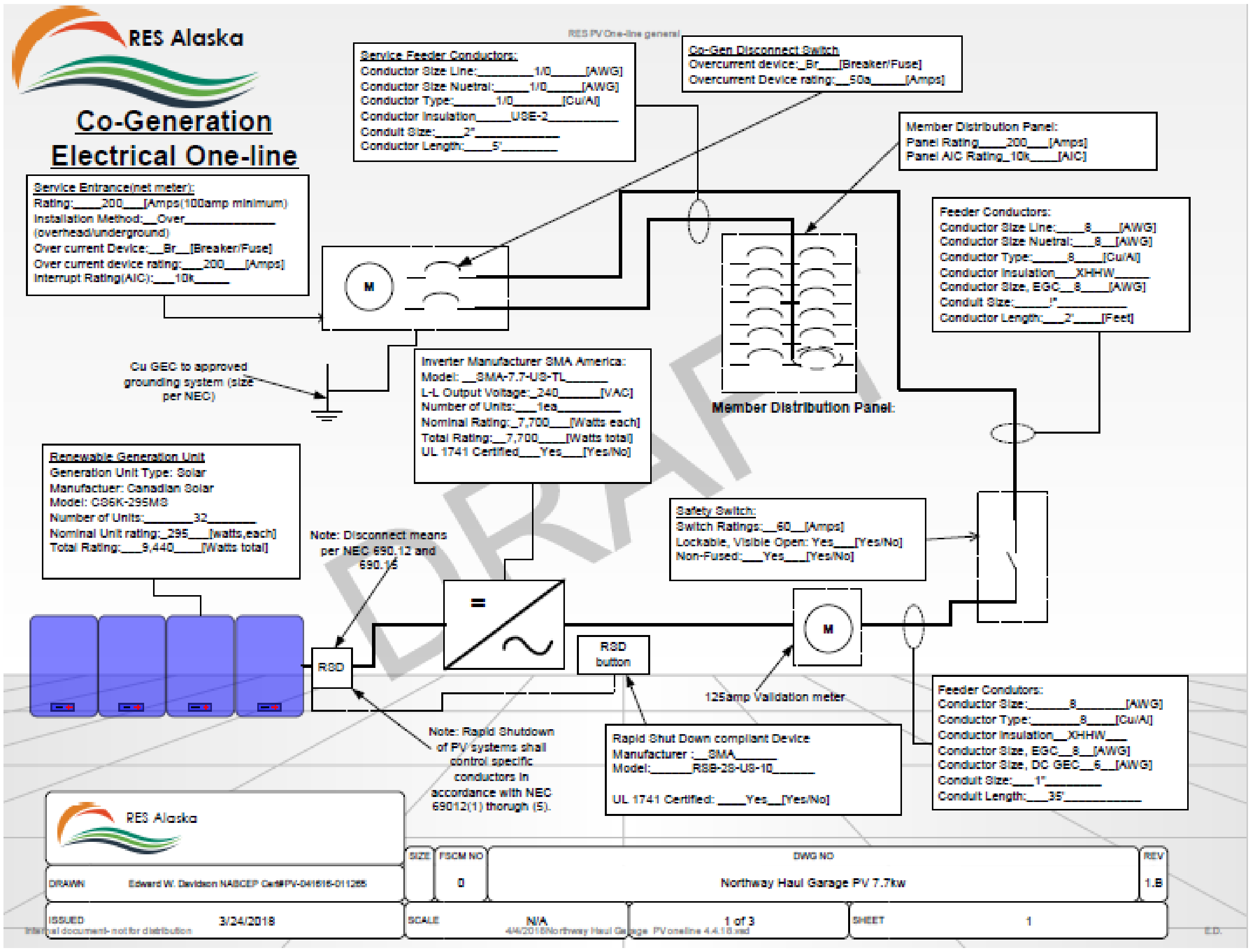
Northway Laundromat and Water/Sewer Garage

Solar Operation & Maintenance Manual

Installed and commissioned July, 2018 with the cooperation of the

Northway Tribal Council, Department of Energy, Office of Indian Energy and Tanana Chiefs Conference Energy Program.

One-Line Diagram drawing for PV system



General description of the Solar System: Both the Water/Sewer Garage Solar system and the Laundromat Solar System are simple grid-tied energy systems. They will produce power when they are clear of snow and only when the APT electric grid is fully functioning. When the village electric grid is de-energized the PV panels will not send any electricity to the grid and will not produce power.

Solar Panels: The roof mounted solar panels convert available sunlight into DC energy. DC energy then flows to the inverter.

Inverter: The inverter converts DC energy into AC energy. AC current is the type of energy that is available in a building such as at wall outlets or when you turn the lights on. The Inverter sends AC power to the main building electrical drop and first goes through a disconnect.

Disconnects & outside meter: There is a solar disconnect and meter located on the outside of the building in the same vicinity of the main electrical service disconnect and meter. The disconnect is clearly labeled and can be turned off in case of an emergency or if any maintenance or modifications to the system are needed. The meter is an independent method of verifying that the solar PV panels are producing electricity.

System monitoring: Neither monitor is hooked up to the SMA monitoring site so you cannot login to either monitor remotely. As a result you need to go to the water/sewer garage and laundromat to inspect the front of the inverters and ensure operation.

Annual Maintenance for Grid-Tied Solar PV Systems

Solar panels: When snow accumulates on the solar array during the winter months, it is our recommendation that the tribe **does not attempt to remove it.** The amount of solar energy available for energy production is low this time of the year and not worth the risk of sliding off of the roof causing injury, causing damage to the solar components with snow removal tools or damage to the roof by stepping on the wrong locations.

Inverter: *Each spring and fall somebody at the tribe should stop at the inverter and ensure the system is operating by looking at the lights on the front of the inverter*. There should be no maintenance on these systems aside from ensuring that the rapid shutdown switch has not tripped off and that the inverter is reporting power produced. If there are issues with the inverter or an error code is reading the best course of action is to call SMA help, provide them the serial number for the array and ask them to walk you through the trouble shooting. You can track the production of the panels by writing down the number on the analog number each day. If the system is functioning fully then the numbers on the meters should be doing up.

General: Spring and Summer is the prime season to harvest solar energy and significantly offset the electric bills. Once per year during the summer months a maintenance person can get on the roof and ensure all of the bolts holding the panels to the roof are still tight.

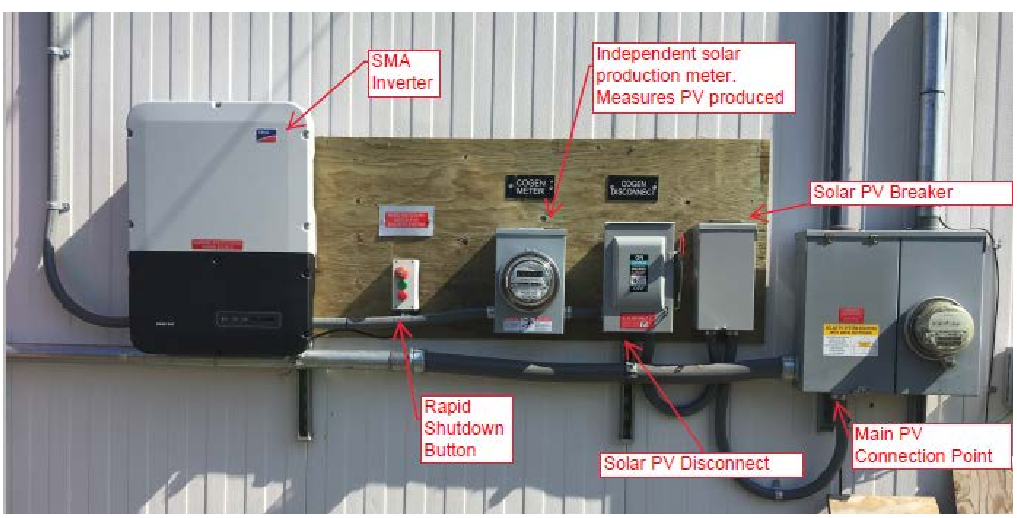


Figure 1. The side of the water/sewer garage showing how the solar electricity gets into the main meter base

Information

Phone Numbers:	SMA Technical Support	1 877 697 6283
	TCC Energy Department	452-8251 x3479

Inverter: SB7.7-1SP-US-40 Serial number: 1990036975 (Laundromat)

Solar Panels: Canadian Solar CS6K-295ms Number of panels per system: 16

Monitoring: No internet hookup thus all monitoring is on the inverters

Estimated Annual Production: 7,000 kWh/yr per system

CanadianSolar

SUPERPOWER
CS6K-290|295|300|305MS

Canadian Solar's new SuperPower modules with Mono-PERC cells significantly improve efficiency and reliability. The innovative technology offers superior low irradiance performance in the morning, in the evening and on cloudy days, increasing the energy output of the module and the overall yield of the solar system.

25 years linear power output warranty

10 years product warranty on materials and workmanship

KEY FEATURES

- 11 % more power than conventional modules
- Excellent performance at low irradiance of up to: 97.5 %
- High PTC — High PTC rating of up to: 91.90 %
- Improved energy production due to low temperature coefficients
- IP68 — IP68 junction box for long-term weather endurance
- Heavy snow load up to 6000 Pa, wind load up to 4000 Pa *

*For detail information, please refer to Installation Manual.

MANAGEMENT SYSTEM CERTIFICATES*

ISO 9001:2008 / Quality management system

ISO 14001:2004 / Standards for environmental management system

OHSAS 18001:2007 / International standards for occupational health & safety

PRODUCT CERTIFICATES*

IEC 61215 / IEC 61730: TÜV-Rheinland / VDE / CE / MCS / CEC AU / JET

UL 1703 / IEC 61215 performance: CEC listed (US) / FSEC (US Florida)

UL 1703: CSA / IEC 61701 ED2: VDE / IEC 62716: VDE

UNI 9177 Reaction to Fire: Class 1

IEC 60068-2-68: SGS

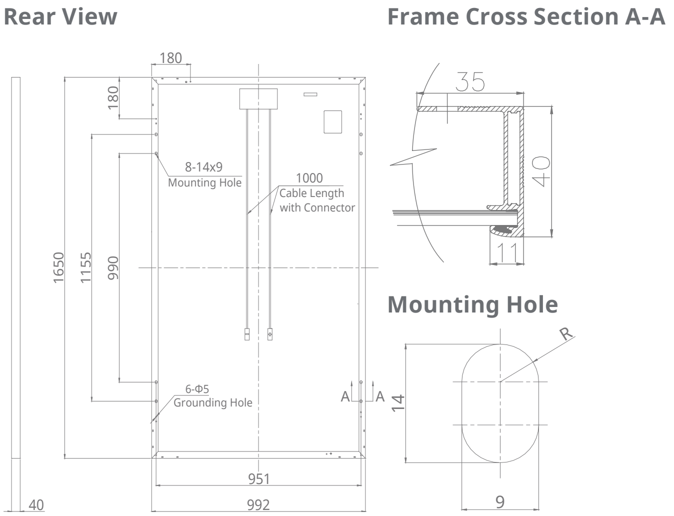
Take-e-way

* As there are different certification requirements in different markets, please contact your local Canadian Solar sales representative for the specific certificates applicable to the products in the region in which the products are to be used.

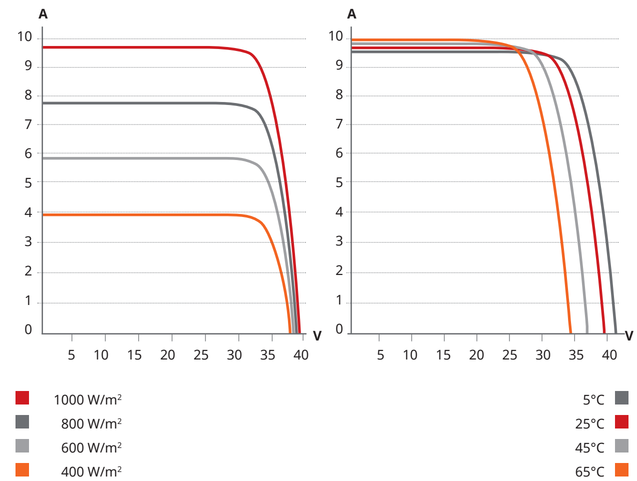
CANADIAN SOLAR (USA), INC. is committed to providing high quality solar products, solar system solutions and services to customers around the world. As a leading PV project developer and manufacturer of solar modules with over 21 GW deployed around the world since 2001, Canadian Solar Inc. (NASDAQ: CSIQ) is one of the most bankable solar companies worldwide.

CANADIAN SOLAR (USA), INC.
3000 Oak Road, Suite 400, Walnut Creek, CA 94597, USA | www.canadiansolar.com/na | sales.us@canadiansolar.com

ENGINEERING DRAWING (mm)



CS6K-295MS / I-V CURVES



ELECTRICAL DATA | STC*

CS6K	290MS	295MS	300MS	305MS
Nominal Max. Power (Pmax)	290 W	295 W	300 W	305 W
Opt. Operating Voltage (Vmp)	32.1 V	32.3 V	32.5 V	32.7 V
Opt. Operating Current (Imp)	9.05 A	9.14 A	9.24 A	9.33 A
Open Circuit Voltage (Voc)	39.3 V	39.5 V	39.7 V	39.9 V
Short Circuit Current (Isc)	9.67 A	9.75 A	9.83 A	9.91 A
Module Efficiency	17.72%	18.02%	18.33%	18.63%
Operating Temperature	-40°C ~ +85°C			
Max. System Voltage	1000 V (IEC) or 1000 V (UL)			
Module Fire Performance	TYPE 1 (UL 1703) or CLASS C (IEC 61730)			
Max. Series Fuse Rating	15 A			
Application Classification	Class A			
Power Tolerance	0 ~ + 5 W			

*Under Standard Test Conditions (STC) of irradiance of 1000 W/m2, spectrum AM 1.5 and cell temperature of 25°C.

MECHANICAL DATA

Specification	Data
Cell Type	Mono-crystalline, 6 inch
Cell Arrangement	60 (6×10)
Dimensions	1650×992×40 mm (65.0×39.1×1.57 in)
Weight	18.2 kg (40.1 lbs)
Front Cover	3.2 mm tempered glass
Frame Material	Anodized aluminium alloy
J-Box	IP68, 3 diodes
Cable	4.0 mm² (IEC), 12 AWG (UL), 1000 mm (39.4 in)
Connector	T4 series
Per Pallet	27 pieces, 538 kg (1186.1 lbs)
Per Container (40' HQ)	756 pieces

ELECTRICAL DATA | NMOT*

CS6K	290MS	295MS	300MS	305MS
Nominal Max. Power (Pmax)	215 W	218 W	222 W	226 W
Opt. Operating Voltage (Vmp)	29.7 V	29.8 V	30.0 V	30.2 V
Opt. Operating Current (Imp)	7.24 A	7.32 A	7.40 A	7.48 A
Open Circuit Voltage (Voc)	36.8 V	37.0 V	37.2 V	37.3 V
Short Circuit Current (Isc)	7.81 A	7.87 A	7.93 A	8.00 A

* Under Nominal Module Operating Temperature (NMOT), irradiance of 800 W/m2, spectrum AM 1.5, ambient temperature 20°C, wind speed 1 m/s.

TEMPERATURE CHARACTERISTICS

Specification	Data
Temperature Coefficient (Pmax)	-0.39 % / °C
Temperature Coefficient (Voc)	-0.29 % / °C
Temperature Coefficient (Isc)	0.05 % / °C
Nominal Module Operating Temperature (NMOT)	42±2 °C

PERFORMANCE AT LOW IRRADIANCE

Excellent performance at low irradiance, with an average relative efficiency of 97.5 % for irradiances between 200 W/m2 and 1000 W/m2 (AM 1.5, 25°C).

The specification and key features described in this datasheet may deviate slightly and are not guaranteed. Due to on-going innovation, research and product enhancement, Canadian Solar Inc. reserves the right to make any adjustment to the information described herein at any time without notice. Please always obtain the most recent version of the datasheet which shall be duly incorporated into the binding contract made by the parties governing all transactions related to the purchase and sale of the products described herein.

Caution: For professional use only. The installation and handling of PV modules requires professional skills and should only be performed by qualified professionals. Please read the safety and installation instructions before using the modules.

PARTNER SECTION

SUNNY BOY
3.0-US / 3.8-US / 5.0-US / 6.0-US / 7.0-US / 7.7-US

SMA

Value-Added Improvements

- World's first Secure Power Supply now offers up to 2,000 W
- Full grid management capabilities ensure a utility-compliant solution for any market

Reduced Labor

- New Installation Assistant with direct access via smartphone minimizes time in the field
- Integrated disconnect simplifies equipment stocking and speeds installation

Unmatched Flexibility

- SMA's proprietary OptiTrac™ Global Peak technology mitigates shade with ease
- Multiple independent MPPTs accommodate hundreds of stringing possibilities

Trouble-Free Servicing

- Two-part enclosure concept allows for simple, expedited servicing
- Enhanced AFCI technology reduces false tripping while improving sensitivity in real arcs

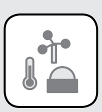
SUNNY BOY
3.0-US / 3.8-US / 5.0-US / 6.0-US / 7.0-US / 7.7-US

Reduce costs across your entire residential business model

The residential PV market is changing rapidly, and we understand that your bottom line matters more than ever. That's why we've designed a superior residential solution that will help you decrease costs throughout all stages of your business operations. The Sunny Boy 3.0-US/3.8-US/5.0-US/6.0-US/7.0-US/7.7-US join the SMA lineup of field-proven solar technology backed by the world's #1 service team, along with a wealth of improvements. Simple design, improved stocking and ordering, value driven sales support and streamlined installation are just some of the ways that SMA is working to help your business operate more efficiently.

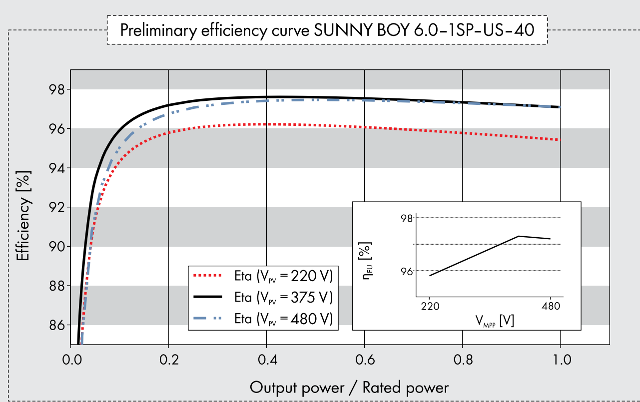
Technical data	Sunny Boy 3.0-US		Sunny Boy 3.8-US		Sunny Boy 5.0-US	
	208 V	240 V	208 V	240 V	208 V	240 V
Input (DC)						
Max. usable DC power	3100 W	3100 W	3450 W	4000 W	5150 W	5150 W
Max. DC voltage	600 V					
Rated MPP voltage range	155 - 480 V		195 - 480 V		220 – 480 V	
MPPT operating voltage range	100 – 550 V					
Min. DC voltage / start voltage	100 V / 125 V					
Max. operating input current per MPPT	10 A					
Max. short circuit current per MPPT	18 A					
Number of MPPT tracker / string per MPPT tracker	2/1				3 / 1	
Output (AC)						
AC nominal power	3000 W	3000 W	3330 W	3800 W	5000 W	5000 W
Max. AC apparent power	3000 VA	3000 VA	3330 VA	3800 VA	5000 VA	5000 VA
Nominal voltage / adjustable	208 V / ●	240 V / ●	208 V / ●	240 V / ●	208 V / ●	240 V / ●
AC voltage range	183 – 229 V	211 – 264 V	183 – 229 V	211 – 264 V	183 – 229 V	211 – 264 V
AC grid frequency	60 Hz / 50 Hz					
Max. output current	14.5 A	12.5 A	16.0 A	16.0 A	24.0 A	24.0 A
Power factor (cos φ)	1					
Output phases / line connections	1 / 2					
Harmonics	< 4 %					
Efficiency						
Max. efficiency	97.2 %	97.6 %	97.2 %	97.5 %	97.2 %	97.5 %
CEC efficiency	96 %	96.5 %	96.5 %	96.5 %	96.5 %	97 %
Protection devices						
DC disconnect device	●					
DC reverse polarity protection	●					
Ground fault monitoring / Grid monitoring	●					
AC short circuit protection	●					
All-pole sensitive residual current monitoring unit (RCMU)	●					
Arc fault circuit interrupter (AFCI)	●					
Protection class / overvoltage category	I / IV					
General data						
Dimensions (W / H / D) in mm (in)	535 x 730 x 198 (21.1 x 28.5 x 7.8)					
Packaging Dimensions (W / H / D) in mm (in)	600 x 800 x 300 (23.6 x 31.5 x 11.8)					
Weight	26 kg (57 lb)					
Packaging weight	30 kg (66 lb)					
Operating temperature range	– 25°C ...+60°C					
Noise emission (typical)	39 dB(A)					
Internal power consumption at night	< 5 W					
Topology	Transformerless					
Cooling concept	Convection					
Features						
Secure Power Supply	●					
Display (2 x 16 characters)	●					
Interfaces: Ethernet / WLAN	● / ●					
Sensor module / External WLAN antenna	○ / ○					
Warranty: 10 / 15 / 20 years	●/○/○					
Certificates and approvals	UL 1741, UL 1998, UL 1699B, IEEE1547, FCC Part 15 (Class A & B), CAN/CSA V22.2 107.1-1					
● Standard features ○ Optional features — Not available Data at nominal conditions NOTE: US inverters ship with gray lids.						
Type designation	SB3.0-1SP-US-40		SB3.8-1SP-US-40		SB5.0-1SP-US-40	

Accessories



Sensor module
MD.SEN-US-40

External WLAN antenna
EXTANT-US-40



Technical data	Sunny Boy 6.0-US		Sunny Boy 7.0-US		Sunny Boy 7.7-US	
	208 V	240 V	208 V	240 V	208 V	240 V
Input (DC)						
Max usable DC power	5400 W	6200 W	6900 W	7200 W	6900 W	7950 W
Max. DC Voltage	600 V					
Rated MPP Voltage range	220 – 480 V		245 - 480 V		270 - 480 V	
MPPT operating voltage range	100 – 550 V					
Min. DC voltage / start voltage	100 V / 125 V					
Max. operating input current per MPPT	10 A					
Max. short circuit current per MPPT	18 A					
Number of MPPT tracker / string per MPPT tracker	3 / 1					
Output (AC)						
AC nominal power	5200 W	6000 W	6660 W	7000 W	6660 W	7680 W
Max. AC apparent power	5200 VA	6000 VA	6660 VA	7000 VA	6660 VA	7680 VA
Nominal voltage / adjustable	208 V / ●	240 V / ●	208 V / ●	240 V / ●	208 V / ●	240 V / ●
AC voltage range	183 – 229 V	211 – 264 V	183 – 229 V	211 – 264 V	183 – 229 V	211 – 264 V
AC grid frequency	60 Hz / 50 Hz					
Max. output current	25.0 A	25.0 A	32.0 A	29.2 A	32.0 A	32.0 A
Power factor (cos φ)	1					
Output phases / line connections	1 / 2					
Harmonics	< 4 %					
Efficiency						
Max. efficiency	97.2 %	97.6 %	97.1 %	97.5 %	97.1 %	97.5 %
CEC efficiency	96.5 %	97 %	96.5 %	97 %	96.5 %	97 %
Protection devices						
DC disconnect device	●					
DC reverse polarity protection	●					
Ground fault monitoring / Grid monitoring	●					
AC short circuit protection	●					
All-pole sensitive residual current monitoring unit (RCMU)	●					
Arc fault circuit interrupter (AFCI)	●					
Protection class / overvoltage category	I / IV					
General data						
Dimensions (W / H / D) in mm (in)	535 x 730 x 198 (21.1 x 28.5 x 7.8)					
Packaging Dimensions (W / H / D) in mm (in)	600 x 800 x 300 (23.6 x 31.5 x 11.8)					
Weight	26 kg (57 lb)					
Packaging weight	30 kg (66 lb)					
Operating temperature range	– 25°C ...+60°C					
Noise emission (typical)	36 dB(A)		45 dB(A)			
Internal power consumption at night	< 5 W					
Topology	Transformerless					
Cooling concept	Convection		Fan			
Features						
Secure Power Supply	●					
Display (2 x 16 characters)	●					
Interfaces: Ethernet / WLAN	● / ●					
Sensor module / External WLAN antenna	○ / ○					
Warranty: 10 / 15 / 20 years	●/○/○					
Certificates and approvals	UL 1741, UL 1998, UL 1699B, IEEE1547, FCC Part 15 (Class A & B), CAN/CSA V22.2 107.1-1					
● Standard features ○ Optional features – Not available	Data at nominal conditions NOTE: US inverters ship with gray lids.					
Type designation	SB6.0-1SP-US-40		SB7.0-1SP-US-40		SB7.7-1SP-US-40	

SAME NAME, NEW GAME

The Sunny Boy 3.0-US through 7.7-US are once again raising the bar by offering improved performance, enhanced features, and most importantly, an economical approach to residential solar. Your business model is a value chain. The new Sunny Boy-US series can help you stay competitive in an increasingly price sensitive residential market by driving down costs across all of your business operations.

SIMPLE, FLEXIBLE DESIGN

Speed the completion of customer proposals and maximize the efficiency of your design team with the Sunny Boy-US series, which provides a new level of flexibility in system design by offering:

- » Hundreds of stringing configurations and multiple independent MPPTs
- » SMA's proprietary OptiTrac™ Global Peak shade mitigation technology
- » Diverse application options including on- and off-grid compatibility

VALUE-DRIVEN SALES ENABLEMENT

SMA wants to enable your sales team by arming them with an abundance of feature/benefit support. Show your customers the value of the Sunny Boy-US series by utilizing:

- » Secure Power Supply, now with 2,000 W of opportunity power in the event of a grid outage, as an increased value-add or upsell opportunity
- » SMA's 35 year history and status as the #1 global inverter manufacturer instills homeowners with peace of mind and the long-term security they demand from a PV investment
- » An economical solution for shade mitigation and the challenges of complex roofs

IMPROVED STOCKING AND ORDERING

Ensure that your back office business operations run smoothly and succinctly while mitigating potential errors. The Sunny Boy-US series can help achieve cost savings in these areas by providing:

- » An integrated DC disconnect that simplifies equipment stocking and allows for a single inverter part number
- » All communications integrated into the inverter, eliminating the need to order additional equipment

STREAMLINED INSTALLATION AND COMMISSIONING

Expedite your operations in the field by taking advantage of the new Sunny Boy's installer-friendly feature set including:

- » Direct access via smartphone and utilization of SMA's Installation Assistant, which minimizes time/labor spent in the field and speeds the path to commissioning
- » Improved communication—no need to install additional equipment
- » Integrated DC disconnect that simplifies onsite logistics and eliminates the need to install a separate disconnect unit, speeding overall installation time

SUPERIOR SERVICE

SMA understands the factors that contribute to lifetime PV ownership cost, that's why the Sunny Boy-US series was designed for maximum reliability and backstopped by an unmatched service offering. Benefit from:

- » The new Sunny Boy's two-part enclosure concept that separates the connection unit from the power unit, which allows for simple, expedited servicing
- » The #1 service team in the PV industry, as recognized by IMS research, with experience servicing an installed base of more than 40 GW