School District 78 Fraser-Cascade

BOARD OF EDUCATION

OPERATIONS & FACILITIES COMMITTEE MEETING

February 23, 2021
4:30 p.m.
Via Zoom

AGENDA

1.	Call to Order/Acknowledgement of Indigenous Territory ……………..		Lowe
2.	Election of Chair ………………………………………………………………		Lowe
3.	Approval of the Agenda ……………………………………………………….		Chair
4.	Approval of the Minutes – December 8, 2020 ……………………………	Page 1	Chair
5.	Custodial review ………………………………………………………………		Templeton
6.	Maintenance scheduled work review ……………………………………		Templeton
7.	Snow removal …………………………………………………………………		Templeton
8.	Seat belt bus update ………………………………………………………….		Lowe
9.	20/21 AFG progress report a) SCE b) SBO c) Maintenance ………..		Templeton
10.	20/21 CNCP progress report a) SCE b) CES c) HSS…………………….		Templeton
11.	20/21 SEP progress report a) roofing SCE b) flooring SCE c) dust collector AESS …………………………………………………….		Templeton
12.	New MOE Capital Director ………………………………………………….		Templeton
13.	AFG 21/22 planning schedule a) BBES b)HHSE ………………………….	Page 6	Templeton
14.	Minor Capital requests 21/22 ………………………………………………..		Templeton
15.	SD78/BC HYDRO joint project - energy storage/solar charging HHES …………………………….	Page 12	Templeton
16.	Questions		

Adjournment

Next Meeting: **May 25, 2021**
4:30 p.m.
Via Zoom

BOARD OF EDUCATION
SCHOOL DISTRICT NO. 78 (FRASER-CASCADE)

DRAFT MINUTES OF THE OPERATIONS & FACILITIES COMMITTEE MEETING
December 8, 2020
Via Zoom Video Conference

PRESENT:

Board Representatives:

Heather Stewin	Trustee	Trustee
Wendy Colman-Lawley	Trustee	Trustee

Committee Representatives:

Lynne Marvell	President	FCTA
Peter Flynn	Vice Principal	FCPVPA
Anders Lunde	Teacher	FCTA
Gord Kearns	CMAWBC	
Diana Stromquist	IEC	

District Staff:

Balan Moorthy	Superintendent
Natalie Lowe	Secretary-Treasurer
Jenny Veenbaas	Assistant Secretary-Treasurer
Renge Bailie	Assistant Superintendent
Doug Templeton	Director of Facilities & Transportation
Laurie Bjorge	Recording Secretary

Regrets:

Marilyn Warren	Trustee
Karl Koslowsky	FCPVPA
Brad Bourel	CMAW
Crystal Hatzidimitriou	DPAC
Leanne Bowcott	IEC
Vacant	Parent Rep
Vacant	Student Rep

1. <u>Call to Order and Acknowledgement of Indigenous Territory</u>

The meeting was called to order by the Secretary-Treasurer at 4:31 p.m. via Zoom video conference. The meeting opened by acknowledging that the meeting was being held on the shared territory of the Cheam, Sts'ailes, Sq'éwlets, Seabird Island, Nlaka'pamux and Chawathil people.

2. <u>Election of Chair</u>

Only one Trustee was present at the time, so the election was tabled to the next meeting. Trustee Stewin agreed to chair the meeting.

3. **Approval of Agenda**

STEWIN/BAILIE

The Assistant Superintendent requested that `Community member concern update` be added to the agenda.

> THAT the agenda of the Operations and Facilities Committee meeting for December 8, 2020, be approved as amended.

CARRIED

4. **Approval of Previous Minutes – October 13, 2020**

KEARNS/STROMQUIST

> THAT the minutes of the Operations and Facilities Committee meeting held on October 13, 2020 be approved as presented.

CARRIED

5. **Covid-19 Update – Maintenance/Transportation/Operations**

The Director of Facilities & Transportation reported that the departments were coming along with the changes brought about by Covid-19 pandemic. Portable hand washing stations have been received. Changes stipulated by the Ministry of Education and WorkSafe BC are adhered to by all staff. Custodians are doing a tremendous job keeping up with cleaning and sanitizing protocols. Transportation staff is adapting to the changes in numbers using the buses, and following guidelines.

6. **20/21 AFG Progress Report**

The district receives close to $500,000 every year in AFG funding. AFG projects were scheduled to complete by March 31, 2021, but all have completed as of Dec 1st. These projects included painting, millwork, and electrical upgrades at Silver Creek Elementary. The District Education Office received flooring and lighting upgrades.

7. **20/21 CNCP Progress Report**

The Director of Facilities & Transportation reported on the boiler upgrades at Silver Creek Elementary, Coquihalla Elementary , and Hope Secondary. These projects were targeted to complete by March 31/21 but should be done within the next four weeks.

8. **20/21 SEP Progress Report**

The Director of Facilities & Transportation reported the roofing and flooring renewal at Silver Creek Elementary is completed. The new dust collector system installation at Agassiz Elementary Secondary School will complete by March 31/21.

9. AFG 21/22 Planning Schedule

The Director of Facilities & Transportation reported on the upcoming projects for the next five years:

April 2021 - March 2022 – Boston Bar Elementary Secondary
April 2021 - March 2022 – Harrison Hot Springs Elementary

April 2022 – March 2023 – Kent Elementary
April 2022 – March 2023 – Coquihalla Elementary

April 2023 – March 2024 – Agassiz Elementary Secondary
April 2023 – March 2024 – Two Rivers Education Centre

April 2024 – March 2025 – Hope Secondary
April 2024 – March 2025 – District Education Office

April 2025 – March 2026 – Silver Creek Elementary
April 2025 – March 2026 – Maintenance/Transportation

Through effective planning with site based teams and management staff, all requests have been accomplished so far.

10. Five Year Capital Plan

Three schools in district need high level seismic work to be done; Harrison Hot Springs Elementary, the old section at Agassiz Elementary Secondary, and the gym at Kent Elementary. The Director of Facilities & Transportation proposed to the Ministry that the district would be better served to replace some of these sites or partial replacement, instead of spending the funds on seismic upgrading.

Due to the anticipated population growth in the Agassiz area, the district is keeping watch for land to purchase for building an additional school in the area.

There are no planned bus purchases as the district fleet is in very good shape.

SEP 21/22

- Harrison Hot Springs Elementary - Solar power system. BC Hydro is committed to $100,000 towards this project as well as the Ministry has discussed providing some funding. The installation is planned to be completed this coming summer.
- Boston Bar Elementary Secondary – new fire sprinkler system to be installed
- Kent Elementary – partial roof replacement, flooring replacement, and fire sprinklers installation.

CNCP 21/22

- LED lighting upgrades to Boston Bar Elementary, Kent Elementary, and Harrison Hot Springs Elementary.
- Electric car charging station installation in the district
- Solar charging and battery backup system for Harrison Hot Springs Elementary

- Boiler upgrade at Yale School (leased out to the Regional District and used for a community centre)

Playground 21/22

- Coquihalla, Silver Creek, and Boston Bar Elementary schools are listed for playground equipment replacements.

11. Minor Capital Requests 21/22

As discussed.

12. Long Range Facilities Plan

As discussed.

13. Seat Belt Bus Update

The Secretary-Treasurer reported that this bus has been in service for about a month. There has been good compliance with the students using the belts. The district has not received the funding for the bus as of yet. The district has paid for the bus and is waiting for reimbursement. The district has to complete a Privacy Impact Assessment. Privacy issues are very low as we are not providing personal data.

14. Harrison Hot Springs Elementary Playground Update

The new playground should be installed by the end of next week. The cost is approximately $150,000 with $125,000 of that cost covered by government grant.

15. SD78/BC Hydro Joint Project Update

The equipment for the energy storage solar charging project at Harrison Hot Springs Elementary is anticipated to arrive in May 2021, with installation completed by September 2021. Total cost will be approximately $250,000 - $300,000. Payback will take time, but will provide positive carbon neutral benefits.

16. Community Member Concern Update

The Assistant Superintendent discussed the issue regarding the drug activity at the house across from Coquihalla Elementary. This has been an ongoing problem involving the school district, the District of Hope, as well as RCMP. The district is providing daily surveillance to ensure there was no drug paraphernalia around the school site. Lights were kept on all night, but now have gone back to shutting lights off around 11:30 pm and back on again early in morning. The district also has full camera surveillance. District staff have met with RCMP and the District of Hope staff. The Assistant Superintendent has responded back to parent.

17. Questions

- Question if there are any lights planned to be installed on the CE Barry walking path. Nothing is planned.
- Question if the Q'aLaTKu7eM School is included in AFG projects for example. Our district pays to rent the space from the band. The band is responsible for maintenance of the site.
- Question – when will the swings be installed at Silver Creek and Coquihalla Elementary

schools; should be arriving this week.

Next Meeting

Date: February 23, 2021
Location: District Education Office

Adjournment

STEWIN/

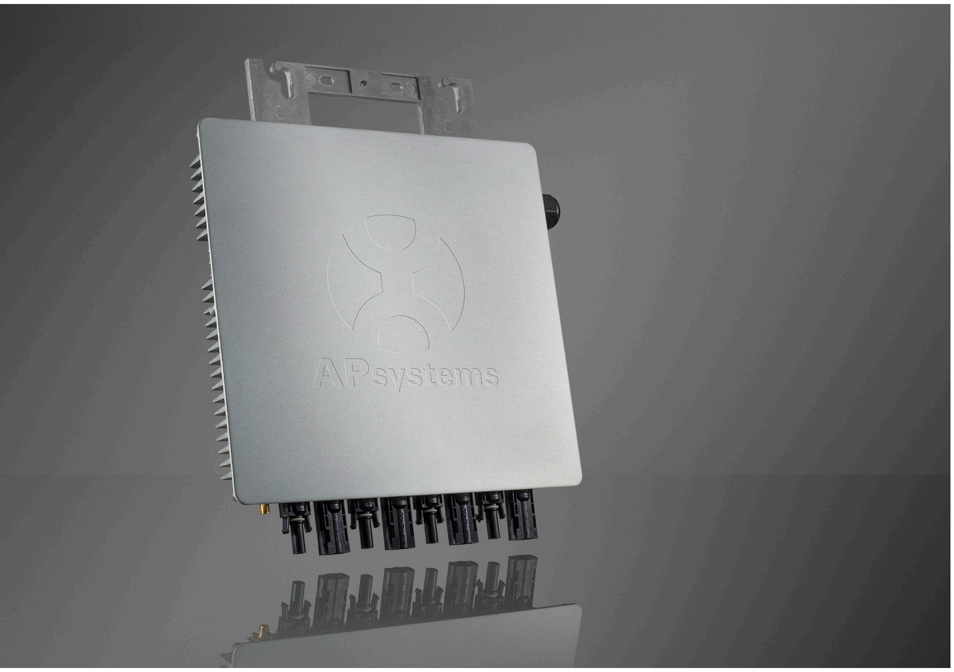
THAT the meeting be adjourned.

CARRIED

The meeting adjourned at 5:40p.m.

APsystems
ALTENERGY POWER

Leading the Industry in
Solar Microinverter Technology



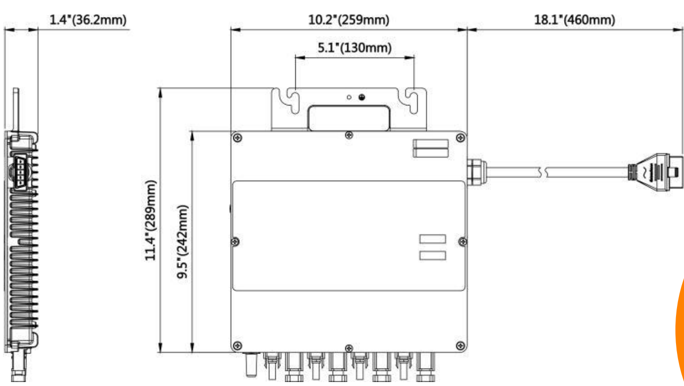
YC1000-3

Commercial Microinverter

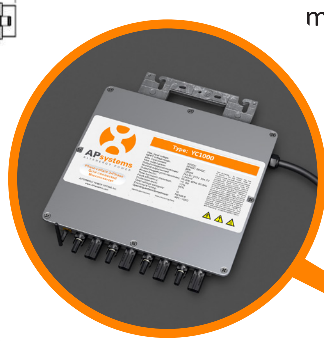
- Single unit connects up to four PV modules
- 1,130W AC output
- True 3-phase output (phase-balanced & phase-monitored)
- 120Y/208V or 277Y/480V
- ZigBee wireless communication and monitoring
- Up to 32 solar modules (60 or 72-cell) can be linked on a three-pole 15A breaker*

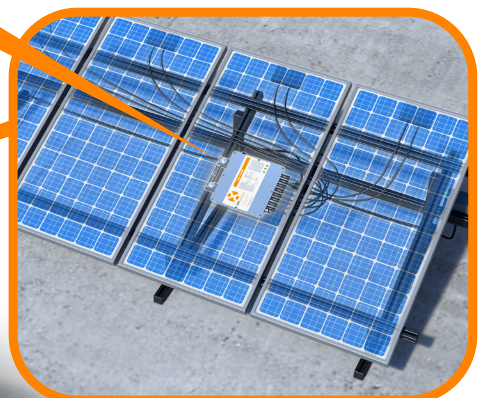
*Max # of modules is based on inverter voltage - see reverse side for more info.

DIMENSIONS



The YC1000-3 is the industry's first true 3-phase (phase balanced & phase monitored) solar microinverter, handling commercial grid voltages of 120Y/208V or 277Y/480V with 1,130 watts AC maximum output, ZigBee communication and an integrated ground. Each YC1000-3 supports up to 4 PV modules.





Four-module configuration shown

APsystems YC1000-3 Microinverter Datasheet

INPUT DATA (DC) PER CHANNEL

	Accommodates 3 modules up to 450W+ or 4 modules up to 355W
MPPT Voltage Range	16-55V
Maximum Input Voltage	60V
Maximum Input Current	14.8A
Startup Voltage	22V

OUTPUT DATA (AC)

	277Y/480V	**120Y/208V**
Maximum Output Power	1,130W	1,130W
3-Phase Grid Type	277Y/480V	120Y/208V
Nominal Output Current	1.35Ax3	3.14Ax3
Nominal Output Voltage	277Yx3	120Yx3
Nominal Output Frequency	60Hz /59.3-60.5Hz*	60Hz /59.3-60.5Hz*
Power Factor	>0.99	>0.99
Total Harmonic Distortion	<3%	<3%
Maximum Units per Branch	8 per 15Ax3-pole Breaker	3 per 15Ax3-pole Breaker

EFFICIENCY

Peak efficiency	95%
CEC Weighted Efficiency	94.5%
Nominal MPPT efficiency	99.9%
Night Power Consumption	300mW

MECHANICAL DATA

Operating Ambient temperature range	-40°F to +149°F (-40°C to +65°C)
Storage Temperature Range	-40°F to +185°F (-40°C to +85°C)
Dimensions (W x H x D)	10.2" X 9.5" X 1.4" (259mm X 242mm X 36mm)
Weight	7.7lbs (3.5kg)
Enclosure rating	NEMA 6
Cooling	Natural Convection - No Fans
AC Cable	14 AWG

FEATURES

Communication	ZigBee (wireless)
Integrated Ground Fault Protection (GFP)	The DC circuit meets the requirements for ungrounded PV arrays in NEC690.35. No additional ground is required. Ground fault protection (GFP) is integrated into microinverter.
Emissions & Immunity (EMC) Compliance	FCC Part 15; ANSI C63.4; ICES-003
Safety & Grid Connection Compliance	IEEE1547, CSA C22.2 No. 107.1-01, NEC 2017 690.12 ***
Warranty	10 years standard, extendable to 25 years

* Programmable per customer and utility requirements.
***Meets the standard requirements for Distributed Energy Resources (UL 1741) and identified with the ETL Listed Mark.

C ETL US LISTED Intertek

Specifications subject to change without notice – please ensure you are using the most recent update found at www.APsystems.com

APsystems ALTENERGY POWER

600 Ericksen Ave NE, Suite 200, Seattle, WA 98110 | 844.666.7035 | APsystems.com

CanadianSolar

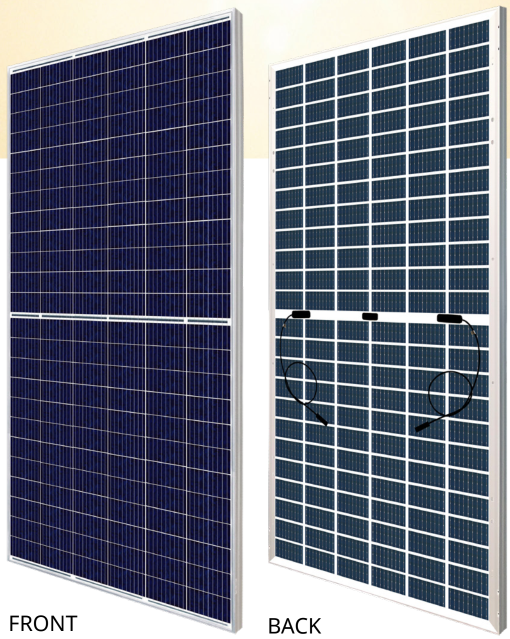
BiHiKu

HIGH POWER BIFACIAL POLY PERC MODULE

390 W ~ 415 W

UP TO 30% MORE POWER FROM THE BACK SIDE

CS3W-390|395|400|405|410|415PB-AG



MORE POWER

EXTRA POWER — Up to 30% more power from the back side

24 % higher front side power than conventional modules

41°C — Low NMOT: 41 ± 3 °C
Low temperature coefficient (Pmax): -0.36 % / °C

Better shading tolerance

MORE RELIABLE

Lower internal current, lower hot spot temperature

Minimizes micro-crack impacts

Heavy snow load up to 5400 Pa, wind load up to 3600 Pa *

* For detailed information, please refer to Installation Manual.

12 Years — **Enhanced Product Warranty on Materials and Workmanship***

30 Years — **Linear Power Performance Warranty***

1st year power degradation no more than 2%
Subsequent annual power degradation no more than 0.45%

*According to the applicable Canadian Solar Limited Warranty Statement.

MANAGEMENT SYSTEM CERTIFICATES*

ISO 9001:2015 / Quality management system
ISO 14001:2015 / Standards for environmental management system
ISO 45001: 2018 / International standards for occupational health & safety

PRODUCT CERTIFICATES*

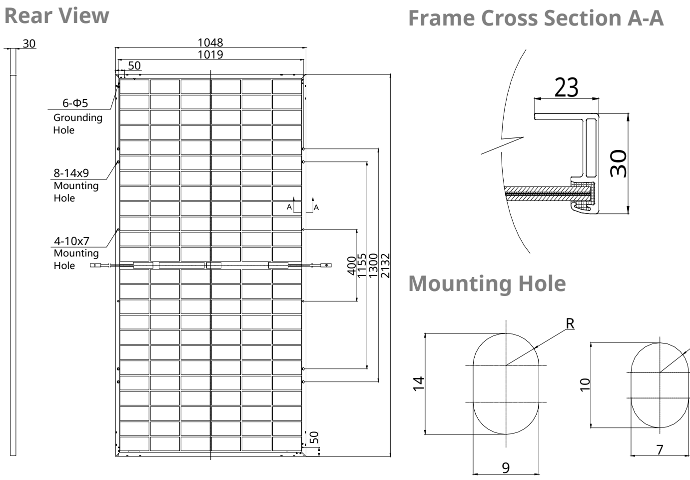
IEC 61215 / IEC 61730 / CE / MCS / INMETRO
CEC listed (US California) / FSEC (US Florida)
UL 61730 / IEC 61701 / IEC 62716 / IEC 60068-2-68
Take-e-way

* The specific certificates applicable to different module types and markets will vary, and therefore not all of the certifications listed herein will simultaneously apply to the products you order or use. Please contact your local Canadian Solar sales representative to confirm the specific certificates available for your product and applicable in the regions in which the products will be used.

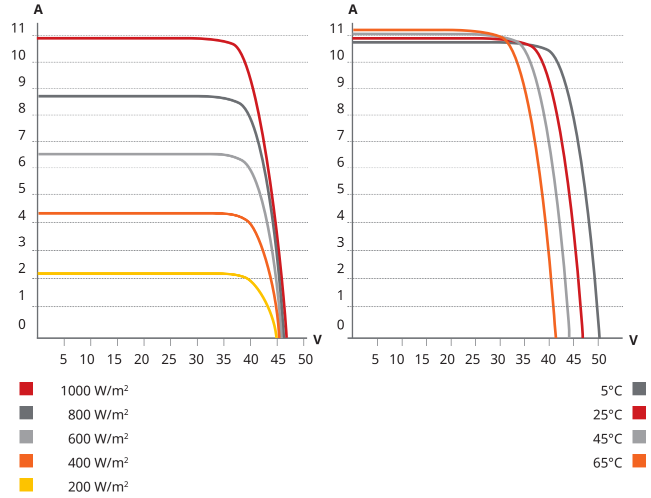
CSI Solar Co., Ltd. is committed to providing high quality solar products, solar system solutions and services to customers around the world. Canadian Solar was recognized as the No. 1 module supplier for quality and performance/price ratio in the IHS Module Customer Insight Survey, and is a leading PV project developer and manufacturer of solar modules, with over 50 GW deployed around the world since 2001.

CSI Solar Co., Ltd.
199 Lushan Road, SND, Suzhou, Jiangsu, China, 215129, www.csisolar.com, support@csisolar.com

ENGINEERING DRAWING (mm)



CS3W-400PB-AG / I-V CURVES



ELECTRICAL DATA | STC*

		Nominal Max. Power (Pmax)	Opt. Operating Voltage (Vmp)	Opt. Operating Current (Imp)	Open Circuit Voltage (Voc)	Short Circuit Current (Isc)	Module Efficiency
CS3W-390PB-AG		390 W	38.3 V	10.19 A	46.8 V	10.74 A	17.5%
Bifacial Gain**	5%	410 W	38.3 V	10.71 A	46.8 V	11.28 A	18.3%
	10%	429 W	38.3 V	11.21 A	46.8 V	11.81 A	19.2%
	20%	468 W	38.3 V	12.23 A	46.8 V	12.89 A	20.9%
	30%	507 W	38.3 V	13.25 A	46.8 V	13.96 A	22.7%
CS3W-395PB-AG		395 W	38.5 V	10.26 A	47 V	10.82 A	17.7%
Bifacial Gain**	5%	415 W	38.5 V	10.78 A	47 V	11.36 A	18.6%
	10%	435 W	38.5 V	11.3 A	47 V	11.9 A	19.5%
	20%	474 W	38.5 V	12.31 A	47 V	12.98 A	21.2%
	30%	513 W	38.5 V	13.34 A	47 V	14.07 A	23.0%
CS3W-400PB-AG		400 W	38.7 V	10.34 A	47.2 V	10.9 A	17.9%
Bifacial Gain**	5%	420 W	38.7 V	10.86 A	47.2 V	11.45 A	18.8%
	10%	440 W	38.7 V	11.37 A	47.2 V	11.99 A	19.7%
	20%	480 W	38.7 V	12.41 A	47.2 V	13.08 A	21.5%
	30%	520 W	38.7 V	13.44 A	47.2 V	14.17 A	23.3%
CS3W-405PB-AG		405 W	38.9 V	10.42 A	47.4 V	10.98 A	18.1%
Bifacial Gain**	5%	425 W	38.9 V	10.94 A	47.4 V	11.53 A	19.0%
	10%	445 W	38.9 V	11.46 A	47.4 V	12.08 A	19.9%
	20%	486 W	38.9 V	12.5 A	47.4 V	13.18 A	21.8%
	30%	527 W	38.9 V	13.56 A	47.4 V	14.27 A	23.6%
CS3W-410PB-AG		410 W	39.1 V	10.49 A	47.6 V	11.06 A	18.3%
Bifacial Gain**	5%	431 W	39.1 V	11.03 A	47.6 V	11.61 A	19.3%
	10%	451 W	39.1 V	11.54 A	47.6 V	12.17 A	20.2%
	20%	492 W	39.1 V	12.59 A	47.6 V	13.27 A	22.0%
	30%	533 W	39.1 V	13.64 A	47.6 V	14.38 A	23.9%
CS3W-415PB-AG		415 W	39.3 V	10.56 A	47.8 V	11.14 A	18.6%
Bifacial Gain**	5%	436 W	39.3 V	11.10 A	47.8 V	11.70 A	19.5%
	10%	457 W	39.3 V	11.63 A	47.8 V	12.25 A	20.5%
	20%	498 W	39.3 V	12.67 A	47.8 V	13.37 A	22.3%
	30%	540 W	39.3 V	13.75 A	47.8 V	14.48 A	24.2%

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

** Bifacial Gain: The additional gain from the back side compared to the power of the front side at the standard test condition. It depends on mounting (structure, height, tilt angle etc.) and albedo of the ground.

ELECTRICAL DATA | NMOT*

	Nominal Max. Power (Pmax)	Opt. Operating Voltage (Vmp)	Opt. Operating Current (Imp)	Open Circuit Voltage (Voc)	Short Circuit Current (Isc)
CS3W-390PB-AG	292 W	35.8 V	8.15 A	44.1 V	8.66 A
CS3W-395PB-AG	295 W	36.0 V	8.21 A	44.3 V	8.72 A
CS3W-400PB-AG	299 W	36.2 V	8.27 A	44.5 V	8.79 A
CS3W-405PB-AG	303 W	36.3 V	8.33 A	44.7 V	8.85 A
CS3W-410PB-AG	307 W	36.5 V	8.39 A	44.8 V	8.92 A
CS3W-415PB-AG	310 W	36.7 V	8.45 A	45.0 V	8.98 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.

MECHANICAL DATA

Specification	Data
Cell Type	Poly-crystalline
Cell Arrangement	144 [2 X (12 X 6)]
Dimensions	2132 × 1048 × 30 mm (83.9 × 41.3 × 1.2 in)
Weight	28.4 kg (62.6 lbs)
Front / Back Glass	2.0 mm heat strengthened glass
Frame	Anodized aluminium alloy
J-Box	IP68, 3 diodes
Cable	4.0 mm² (IEC), 12 AWG (UL)
Cable Length (Including Connector)	400 mm (15.7 in) (+) / 280 mm (11.0 in) (-) or customized length*
Connector	T4 series or H4 UTX or MC4-EVO2
Per Pallet	33 pieces
Per Container (40' HQ)	660 pieces or 561 pieces (only for US)

* For detailed information, please contact your local Canadian Solar sales and technical representatives.

ELECTRICAL DATA

Operating Temperature	-40°C ~ +85°C
Max. System Voltage	1500 V (IEC/UL) or 1000 V (IEC/UL)
Module Fire Performance	TYPE 29 (UL 61730) or CLASS C (IEC61730)
Max. Series Fuse Rating	25 A
Application Classification	Class A
Power Tolerance	0 ~ + 10 W
Power Bifaciality*	70 %

* Power Bifaciality = $Pmax_{rear}$ / $Pmax_{front}$, both $Pmax_{rear}$ and $Pmax_{front}$ are tested under STC, Bifaciality Tolerance: ± 5 %

TEMPERATURE CHARACTERISTICS

Specification	Data
Temperature Coefficient (Pmax)	-0.36 % / °C
Temperature Coefficient (Voc)	-0.28 % / °C
Temperature Coefficient (Isc)	0.05 % / °C
Nominal Module Operating Temperature	41 ± 3°C

* The specifications and key features contained in this datasheet may deviate slightly from our actual products due to the on-going innovation and product enhancement. CSI Solar Co., Ltd. reserves the right to make necessary adjustment to the information described herein at any time without further notice.

Please be kindly advised that PV modules should be handled and installed by qualified people who have professional skills and please carefully read the safety and installation instructions before using our PV modules.

PARTNER SECTION

CSI Solar Co., Ltd.
199 Lushan Road, SND, Suzhou, Jiangsu, China, 215129, www.csisolar.com, support@csisolar.com

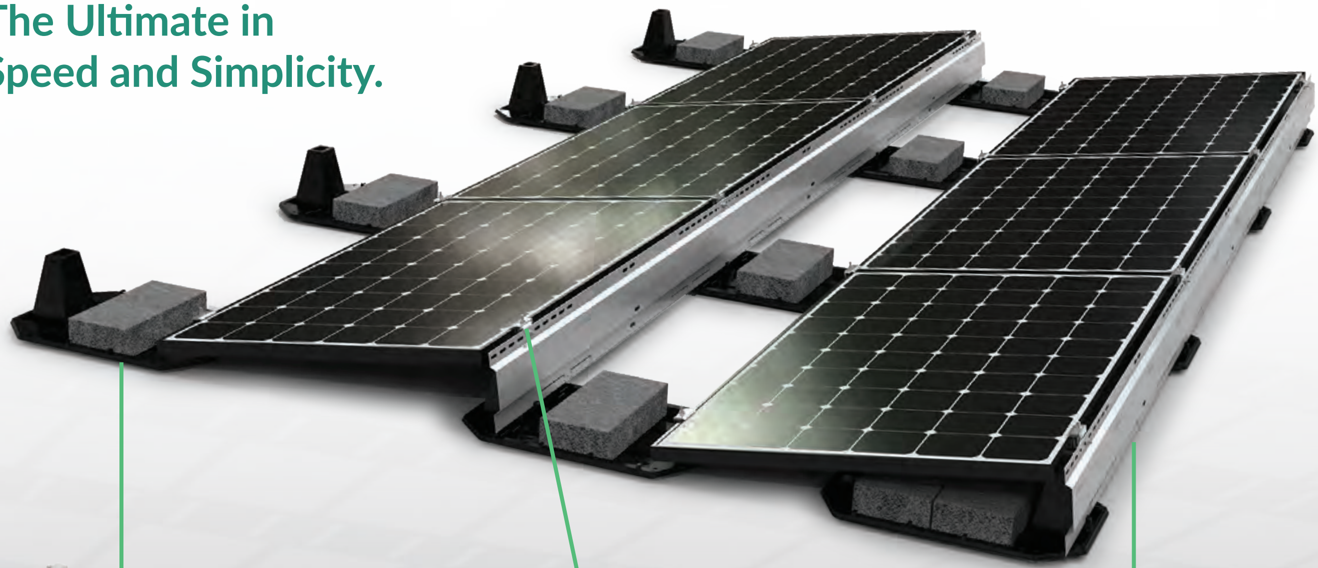
EcoFoot2+®

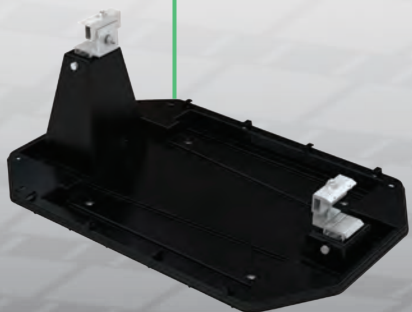
Ballasted Racking System

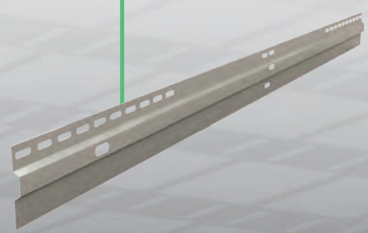
Installer-Preferred for Low-Slope Roofs

Three Main Components.

The Ultimate in Speed and Simplicity.







Base

UL-Listed ASA based resin is a durable material commonly used for automotive and construction products. Wire Clips are built-in for easy wire management. Class A fire rated and UL2703 Certified.

Universal Clamp

The preassembled Universal Clamp is ready to go right out of the box. Simply drop the Clamp into the Base. Integrated Bond Pin achieves integrated grounding without the use of grounding washers. Fits 30-50mm module frames with a single component.

Wind Deflector

Corrosion-resistant wind deflector on every module helps minimize uplift, reduce ballast requirements and carries UL2703 validated ground path from modules and racking components.

EcolibriumSolar

Contact: 740.249.1877 | sales@ecolibriumsolar.com | www.ecolibriumsolar.com

Pure Performance

Unbeatable, Right Out of the Box.

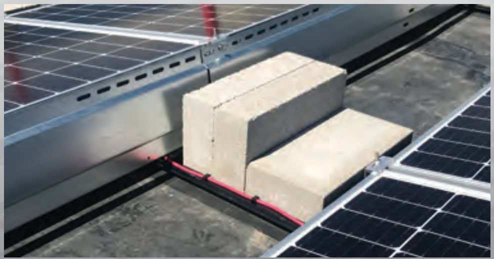
No other racking products install flat roof arrays better than EcoFoot2+ Racking Solution. Installers prefer EcoFoot2+ because it's fast, simple, and durable. The line-up is unbeatable:

- Ready-to-go, preassembled components and simple installation
- No PV panel prep required: bases self-align
- Low-effort roof layout, just two chalk lines required
- No training required, 5-minute learning curve

Commercial

Residential

Design Flexibility



Wire Management Built-In

Master the Most Challenging Rooftop

Stackable Bases fit up to 50kW of Bases delivered on a standard pallet.

System Benefits

- Low part count
- Rapid system deployment
- Preassembled Universal Clamp
- Increased design flexibility
- More ballast capacity
- Simplified logistics
- Ship up to 50kW per pallet

Validation Summary

- Certified to UL2703 Fire Class A for Type I and II modules
- Certified to UL2703
- Grounding and Bonding
- Wind tunnel tested to 150mph
- SEAOC seismic compliant
- CFD and structurally tested
- DNV GL rated at 13.5 panels per installer-hour

Technical Specifications

Dimensions: 26.5"L x 18.25"W x 8.3"H
Typical System Weight: 3.5–6 lbs. per sq. ft.
Module orientation: Landscape/Portrait
Tilt angle: Landscape 10°/Portrait 5°
Module inter-row spacing: 18.9"
Roof pitch: 0° to 7°
Clamping range: 30-50mm
Ballast requirements: 4" x 8" x 16"
Warranty: 25 years
Slip sheets: not required by Ecolibrium Solar. If required by roofer, use 20"x29" under Base.

EcolibriumSolar

740-249-1877 | www.ecolibriumsolar.com
507 Richland Avenue, Athens, OH 45701

19-036 School District No. 78

BATTERY STORAGE AND SOLAR FEASIBILITY STUDY

Submitted To:
School District 78 & BC Hydro
Attention: Cory Farquharson,
Doug Templeton, Christy Intihar

Prepared By:
Hedgehog Technologies Inc.
Unit 206 – 2250 Boundary Road,
Burnaby, B.C. V5M 3Z3

Submitted: 2020-04-06
Revision: 1.0

Document Revisions

Rev	Date	Description	Prepared By	Reviewed By	Approved By
1.0	2020-04-06	Issued for Review	AG/MK	MK/YR	YR

Executive Summary

School District 78 (Fraser-Cascade) is working with BC Hydro to understand the requirements of supplying back up power during blackouts to one of their schools at 501 Hot Spring Rd. Additionally, green initiatives are of high value to both stakeholders, motivating them to investigate battery storage integrated with solar PV power solution in the regards. Hedgehog Technologies was engaged to perform the feasibility study and recommend battery storage and/or solar PV power solution.

Being able to continue school for the day is identified as the most important metric so that children are not sent home prematurely disrupting both their learning and the ability for their families to pick them up. Since the blackouts can be random and the effectiveness of solar is weather dependent, the battery must be sized to the worst-case energy demand with solar being used for non-essential loads or charging the battery during off-hours. However, the cost-effectiveness of the solution is an important factor for both School District 78 and BC Hydro.

With the above-mentioned criteria in mind, a typical school day was identified to be Monday to Friday, from 8:30 AM to 3:30 PM. The school's utility bills, including 5-minute interval demand records for the last year, were analyzed to determine the daily demand and energy usage on a typical school day. This analysis identified that the maximum daily energy usage and peak demand in 2019 are 286 kWh and 57 kW, respectively.

A battery storage sized to the peak daily energy usage of 286 kWh will provide adequate backup power during a blackout on any given school day. The estimated EPC costs for a 286 kWh lithium-ion battery storage will be around $286,000. However, with the low likelihood of a blackout occurring for the entire 7 hours during peak energy school time, a 286 kWh battery storage for this application seems excessive.

In order to present more options for battery storage size while keeping in mind financial feasibility, several scenarios are considered in the report. These scenarios are based on elimination of unnecessary loads during a blackout, hence minimizing the required battery storage. Due to the absence of a detailed energy audit, these scenarios are presented in the form of potential reduction from maximum daily energy usage. By analyzing the school utility bills for the 5-minute interval demand in 2019, the average daily energy usage is found to be 188 kWh. This is equivalent to a 34% reduction from the maximum daily energy usage. The average daily energy usage is presented as one of the options for the size of battery storage in this report. The table below shows multiple scenarios between daily peak energy up to 60% reduction in peak.

Maximum Daily Energy For Sizing Battery Storage	Peak	Peak Less 10%	Peak Less 20%	Average	Peak Less 40%	Peak Less 50%	Peak Less 60%
Energy (kWh)	286	257.4	228.8	188	171.6	143	114.4
Power (kW)	57	57	57	57	57	57	57
Number of Weekdays/Year with Lower Energy Demand	260	236	205	133	98	50	10
% Weekdays/Year with Lower Energy Demand	100%	91%	79%	51%	38%	19%	4%
Battery Size (kWh)	286	260	230	188	170	143	115
Battery Storage EPC Costs	$286,000	$260,000	$230,000	$188,000	$170,000	$143,000	$115,000
5 kW Solar EPC Costs	$17,500	$17,500	$17,500	$17,500	$17,500	$17,500	$17,500
Total System EPC Costs	**$303,500**	**$277,500**	**$247,500**	**$205,500**	**$187,500**	**$160,500**	**$132,500**

To meet the objective of green initiatives intended by the stakeholders, solar PV power is proposed with battery storage. Since the battery storage system is designed to be the primary source of energy during a blackout, the PV system is kept fixed at 5 kW with the costs shown in the above table. The primary purpose of the solar panel installation at this site is to offset the load during school hours as well as charge the battery storage backup system if needed. The PV system is expected to generate 4,671 kWh of energy per year. Using the net metering program, excess PV generated on days with no school or during summer break can be delivered to the grid.

An AC-coupled configuration is recommended to interconnect the proposed PV plus grid storage system. The bi-directional inverter used in this interconnection allows the battery storage to directly respond to the demand requested by BC Hydro. Considering the battery storage system is used for small amount of peak shaving during the day, it is expected over 95% of full battery capacity is available to BC Hydro for a period of four hours from 5 PM to 9 PM to feed electricity back to the grid.

The cost savings options considered for this report are reducing the demand charge, energy fee savings from the solar system including net metering, and potential savings through the demand response agreement. The overall savings are estimated to be $1143/yr with savings of $400, $470, $273 for the demand savings, net metering and demand response, respectively.

The recommendation for the next steps is to establish a detailed budget for the project. Once obtained, it will dictate the size of the battery storage system that can be installed. The secondary recommendation is to perform an energy audit to pinpoint non-essential loads. This will further help reduce the required battery size and meet budgetary requirements.

Table of Contents

Tables and Figures

List of Tables

List of Figures

Definitions & Abbreviations

Item	Definition
DC	Direct Current
EPC	Engineering Procurement Construction
HVAC	Heating Ventilation & Air Conditioning System
Kilo (k)	1,000 (One thousand)
Kilowatt-hour	Measure of total energy used to measure quantity of electricity consumed.
Mega (M)	1,000,000 (One Million)
Power (Watt)	A measure of energy output per second
PV	Photovoltaic
V / kV– Volt/ kilovolt (1000 Volts)	Volt/ kilovolt (1000 Volts)
Wh / kWh / MWh	Wh / kWh / MWh – Watt-hour, kilowatt-hour

References

[1] Pacific Northwest National Laboratory, "Energy Storage Technology and Cost Characterization Report," U.S Department of Energy, 2019.

[2] R. Franks, "Safety of Stationary Grid-Connected Energy Storage Systems," CSA Group, November 2017. [Online]. Available: https://www.csagroup.org/documents/resources-insights/gcmp-special-tech/CSA_Group_Safety_ESS_White_Paper_NA_PrV.pdf. [Accessed 22 March 2020].

[3] J. Green, "New Developments in North American Energy Storage System Compliance," CSA Group, [Online]. Available: https://www.csagroup.org/article/new-developments-north-american-energy-storage-system-compliance/. [Accessed 22 March 2020].

[4] BC Hydro, "Distribution Generation Technical Interconnection Requirements 100kW and Below," BC Hydro, 17 October 2014. [Online]. Available: https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/integrated-resource-plans/current-plan/dgtir100.pdf. [Accessed 01 April 2020].

1 Scope

The scope of this document is to specify optimal storage size, operational requirements and order of magnitude installation cost for a battery and/or solar system at an elementary school located in School District No. 78. The analysis is based on the electricity records for the school provided by BC Hydro. The single line and load profile are provided by School District No. 78. This report also outlines performance expected and possible design of a solar panel installation at the same elementary school.

2 Introduction

2.1 Background

School District No. 78 (Fraser-Cascade) incapsulates ten schools including Hope, Agassiz, Harrison Hot Springs, Boston Bar, in the Fraser Canyon and Fraser Valley. Working with BC Hydro, the school district has engaged Hedgehog Technologies to perform a feasibility study to understand the requirements of supplying battery and/or solar back up power to one of their schools in the Harrison location, 501 Hot Spring Dr. Green initiatives are of high value to both stakeholders, and consideration for solar panels is important.

2.2 School District No. 78 Objective

The most important metric for School District No. 78 is being able to continue school for the day so that children are not sent home prematurely disrupting both their learning and the ability for their families to pick them up. The school district wishes to understand considerations, impact, and the cost of installing and operating battery storage and/or solar back up power.

2.3 BC Hydro Objective

BC Hydro is interested in supporting the school district for delivering power during blackouts and for peak load management using demand response triggers. The feasibility study is the first step in providing battery and/or solar backup power to School District No. 78. The cost-effectiveness of the solution, as well as the dynamics of the operational requirements, are of interest to other schools and districts.

3 System Assessment

3.1 Overview

The elementary school at 501 Hot Spring Rd under the jurisdiction of School District No. 78 is the subject of this feasibility study. Two members of the Hedgehog Technologies team travelled to the school and conducted a site assessment to determine the facility's baseline and infrastructure requirements.

Due to lack of proper electrical drawings, a hand sketch single line diagram was provided by the school's electrician (See Appendix A).

3.2 Electrical Infrastructure Review

Hedgehog team confirmed the following during the site visit:

a) Main distribution panel in the electrical room with eight (8) branch circuits (Figure 1):
   i. Sub A – 100 A
   ii. Sub E (Portable Building) – 100 A
   iii. Gym Furnace – 30 A (Not in Service)
   iv. Sub B (Library) – 70 A
   v. Sub D (Room 34) – 125 A
   vi. Electric Heater – 30 A
   vii. Spare – 50 A
   viii. HVAC – (Overcurrent protection not in the main distribution panel). See the subpanel single line diagram (Appendix A).

Figure 1: Main Distribution Panel

b) The size of the main electrical room is sufficient for installing the battery provided the floor space is cleared, and access to wall for wiring is provided (Figure 2)

Figure 2: Electrical Room

c) Hedgehog team also investigated rooftop for solar installation and identified the flat roof section on the school gym facing south ideal for the application (Figure 3).

Figure 3: Site for Rooftop Solar Installation

3.3 Load Budget

Utility bills from the past ten years were analyzed to establish a baseline load for the facility. As evident from Figure 4, the peak load has dropped and stayed consistently low from 2013 onwards. The peak load before 2013 was 92 kW and post 2013 is 57 kW. Some part of the reduction in peak load is attributed to the school district successfully transitioning to 100% LED lighting.

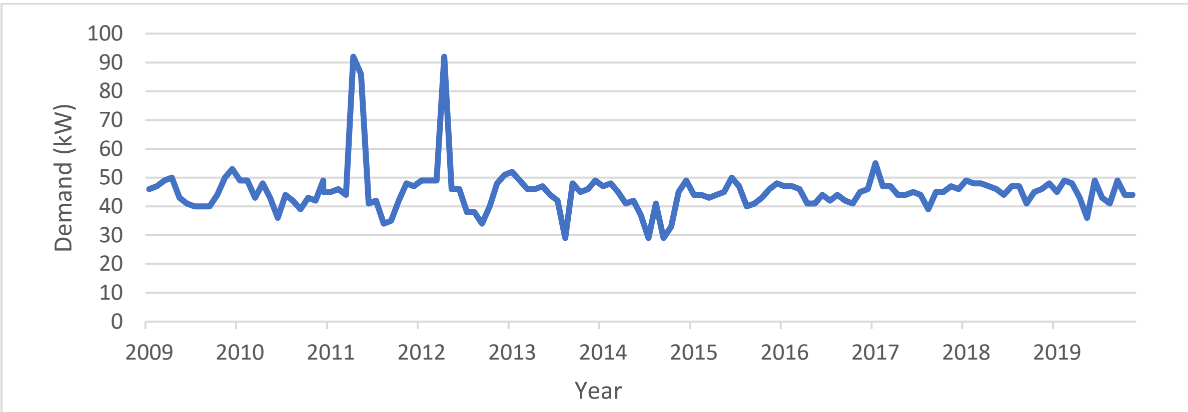


Figure 4: The School Monthly Peak Demand (2009-2019)

Even though the maximum peak demand has dropped in the past ten years, the yearly energy demand has not. As shown in Figure 5, the highest total energy used was in 2018 at 139 MWh.

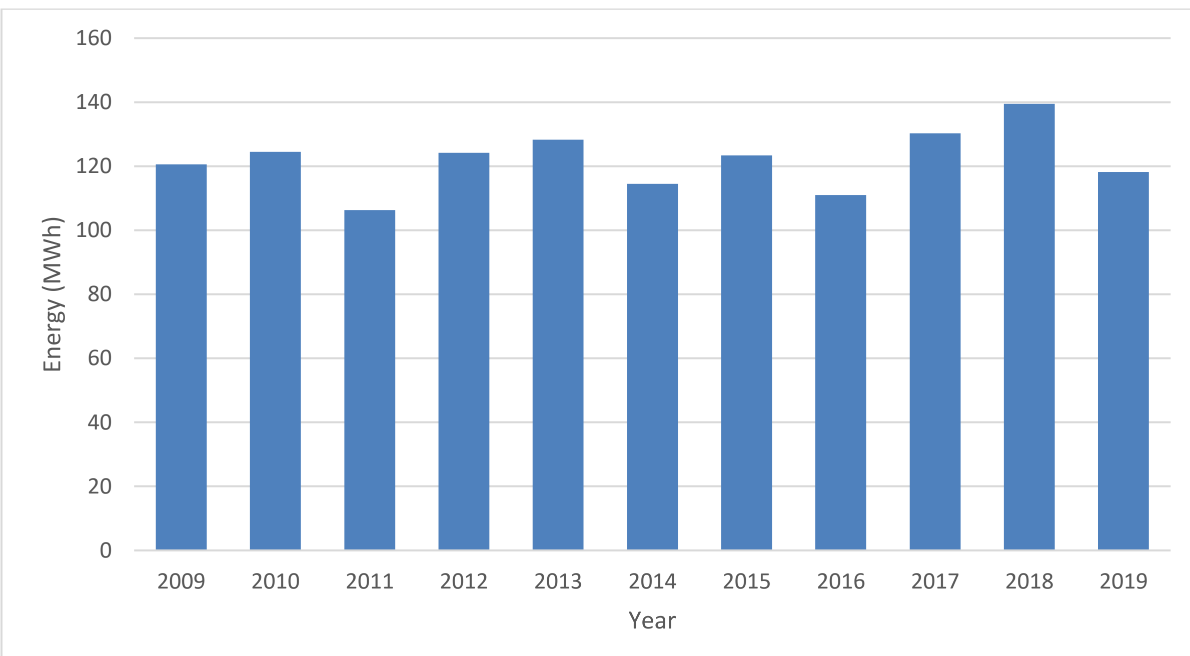


Figure 5: The School Yearly Energy Usage (2009-2019)

Since the school was not able to provide complete electrical drawings, the single line diagram (Appendix A) along with utility bills from the most recent year (2019) are used to provide a load budget baseline for the purpose of this report. A detailed energy audit of the facility is recommended to further identify individual loads.

4 Demand Characteristics and Battery Storage Sizing

4.1 Overview

This section of the report highlights the energy usage and power profile based on operating conditions. The demand characteristics are used to size the battery storage system accordingly.

4.2 Battery Sizing Methodology

The battery sizing methodology is a process of determining an optimal size for the proposed storage battery system. Since being able to continue school for a day is defined as the most important metric, the optimal battery size is determined using the highest daily demand curve over seven hours between 8:30 AM to 3:30 PM.

The following steps are taken as part of the battery sizing methodology:

1. Review the historical demand curves using 5-minute and hourly intervals from 2019 utility bills.
2. Determine electrical energy needs based on the historical demand curves.
3. Compare battery storage technology options and recommend a suitable type for this application
4. Present battery size options based on multiple budget estimates.

Assumptions made for this application consider a full day of school to be Monday to Friday, 8:30 AM to 3:30 PM. For the option in which battery is used to respond to the demand requested by BC Hydro, 95% of full battery capacity is considered for four hours from 5 PM to 9 PM to feed electricity back to the grid.

4.3 Demand Characteristics Analysis

4.3.1 Historical Demand Data

As shown in Figure 4, the monthly demand since 2013 has stayed consistent. To perform a more detailed analysis of daily peak demand 5-minute and hourly data from 2019 was used to calculate the school's current peak demand (kW) and energy usage (kWh). As expected, the energy demand during weekdays is higher than the weekend (Figure 6). From the available 2019 data, the peak demand day was June 14 at 57 kW.

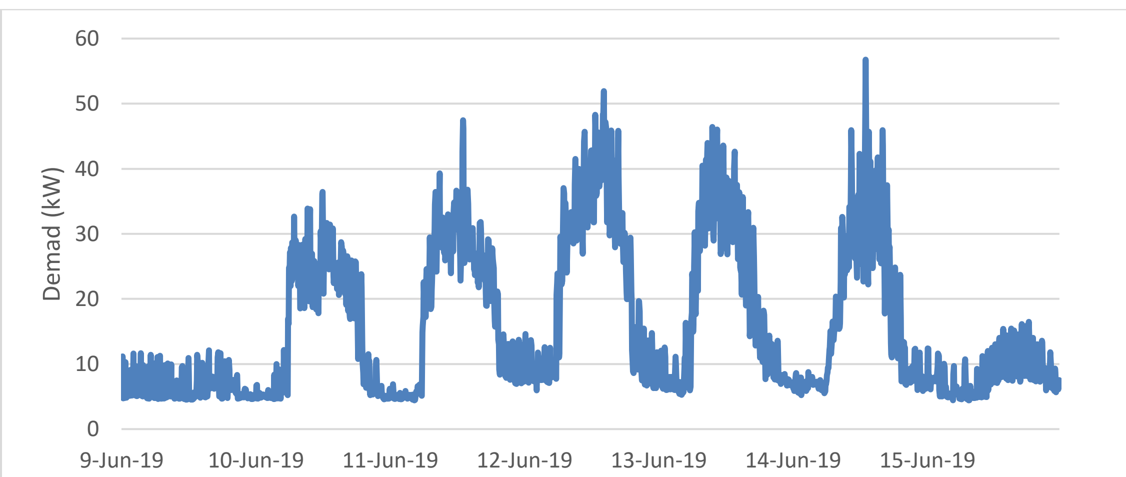


Figure 6: Typical Weekly Demand (Sunday to Saturday)

Since the most important metric for battery size is the continuation of a full day of school, the battery is sized according to the highest energy demand for a day in a year. Although the highest peak (kW) was recorded on June 14, the maximum energy (kWh) demand over 24 hours was February 4 at 720 kWh.

Figure 7 shows the energy demand on February 4, 2019 and has clearly shaded areas for typical school hours. The energy demand between the hours of 8:30 AM and 3:30 PM is 286 kWh.

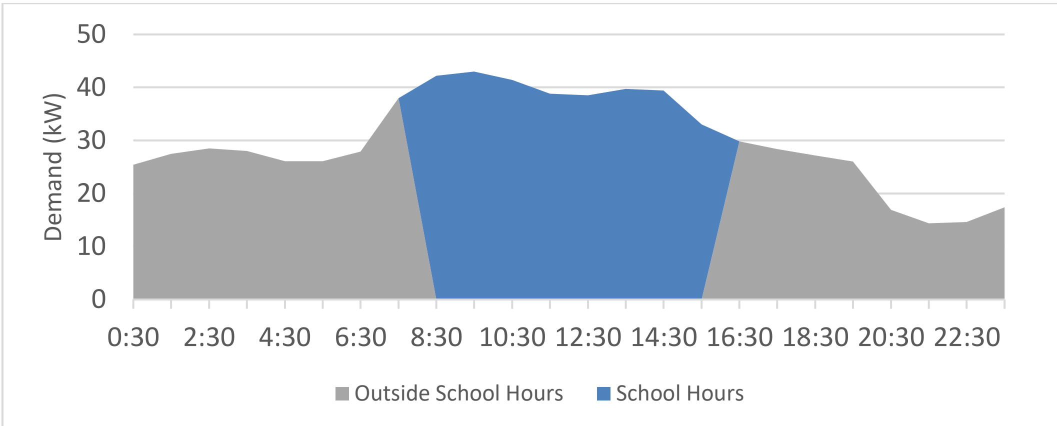


Figure 7: Peak Energy Demand (Feb 4, 2019)

4.4 Battery Storage System

4.4.1 Battery Technology Options

Many battery technologies exist in the market today, which can be used to meet the objectives of this study. Technologies such as lead-acid batteries, flow batteries and lithium-Ion were considered for this application.

Table 1: Typical Battery Storage Technology Installed Total Cost [1]

Storage Technology	Maturity	Cycles @ 80%	Power ($/kW)	Energy ($/kWh)
Lead-Acid Batteries	Mature	900	2,194	549
Flow Redox Batteries	Emerging Tech	10,000	3,430	469
Lithium-Ion	Mature	3,500	1,876	858

After a review of the storage technologies considered (Table 1), lead-acid batteries were rejected for their limited cycles and flow redox batteries for being an emerging technology. Lithium-ion batteries are commonly used for commercial and utility-scale energy storage and are currently the most suitable option available on the market.

4.4.2 Fire and Safety Regulations

Battery energy storage systems offer an effective way to manage electricity supply and use. The application here is used to store and release electricity on-demand, provide backup power and integrate with renewable energy sources (solar). Due to the custom application of the system, there are a variety of compliance requirements from component to system level. Risks include fire, explosion, and burns, as well as the potential for electrical shock and arc flash. Toxic or hazardous substances are sources of risks related to chemical exposure and unsafe chemical concentrations can represent inhalation or explosion and fire hazards [2].

Ultimately, the safety of energy storage systems is a shared responsibility and requires project owners and manufacturers to meet a broad array of requirements. A summary of some of the essential requirements in North America is shown in Table 2 [3].

Table 2: Fire and Safety Requirements

Category	Standard
Component Standards	
Battery System	UL/CSA 1973
Enclosure	CSA-C22.2 No. 60529
Inverter	C22.2 No. 107.1
Relevant Codes and Installation Standards	
National Electric Code	CSA C22.1
Special Inspection/Field Evaluation	SPE-1000

The battery energy storage system safety process is divided into four main steps [2]:

1. Identification of System Requirements: A preliminary review of the project should be conducted to formulate a plan for formal safety evaluation – including any component approvals or additional inspections and certification needs. This step should be performed after the battery and inverter manufacturers are picked and install location finalized.
2. Information Collection and Analysis: An in-depth review of the formal system design is conducted in this stage. The functional safety of the final system is addressed through hazard analysis and appropriate automated safety systems are identified. A failure mode and effect analysis (FMEA) is recommended to be performed to identify critical safety components in the system.
3. Equipment Safety Testing: Batteries, inverters or certain other system components must be individually tested and certified to meet applicable product safety requirements. For this application, it is recommended to purchase a commercially available product with all required certifications.
4. Field Evaluation and Inspection. Field evaluation is conducted by the testing organization at the installation location to confirm that the final system conforms to the applicable safety requirements. Included are national and international safety standards, as well as state and local installation codes.

Since this application is considered a commercial or industrial system, it must follow requirements dictated by local Authorities having Jurisdictions (AHJs) and ensure components being installed are certified by a Nationally Recognized Testing Laboratory (NRTL) such as CSA Group.

A field evaluation is required when the final system integration takes place. The field evaluation process provides additional review of a unique application system and results in a special label for the specific installation.

5 Solar Panel Modeling with Estimated Performance

5.1 Overview

Green initiatives are of high value to both BC Hydro and School District 78. The primary purpose of the solar panel installation at this site is to offset the load during school hours as well as charging the battery storage backup system if needed. Additionally, with the net metering program, BC Hydro provides a way for customers to connect a small energy source to the BC Hydro distribution system to offset their loads or sell excess power back to the grid.

5.2 Methodology

The methodology used in developing the rooftop solar solution includes:

1. Analysis of the potential solar locations and roof structures, angles and materials.
2. Modelling a rooftop solar system using 3D modelling software.
3. Analyzing school power data to determine a size for the solar system.

5.3 Solar Model

For the application at 501 Hot Spring Rd, a 5 kW solar is considered due to limiting factors like budget, size of rooftop and high shading from the hill in the west.

As shown in Figure 8, the hill in the west casts a significant shadow on most of the school's buildings. The gym roof highlighted in red is selected as the rooftop with the least shading to maximize energy generated.

Figure 8: Aerial View (501 Hot Spring Rd)

Climate data from Agassiz, B.C. is used to design a PV system with the following specifications and expected yield (Appendix B).

Table 3: PV System specification

Grid-Connected PV System	
Climate Data	Agassiz Cda BC, CAN (1991 – 2010)
PV Generator Output	4.88 kWp
PV Generator Surface	29.2 m^2
Number of PV Modules	15
Number of Inverters	1

Table 4: PV System Expected Yield

The Yield	
PV Generator Energy (AC grid)	4,671 kWh
Spec. annual yield	958.08 kWh/kWp
Performance Ration (PR)	87.8%
CO_2 Emissions avoided	2,802 kg/year

The PV system is expected to generate 4,671 kWh of energy per year.

Figure 9 shows the monthly distribution of energy with the highest generation during the month of July. Since the school is expected to be closed for summer during July and August, an estimated 1,251 kWh of energy can be put on the grid.

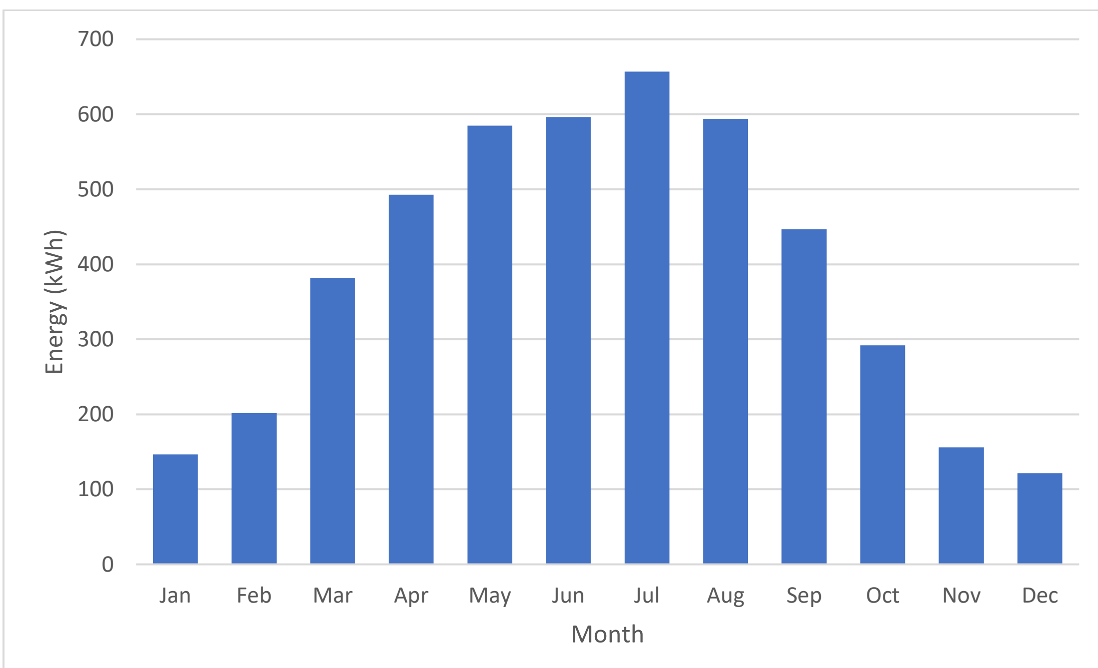


Figure 9: Solar Energy Generation

Figure 10 shows a 3D rendition of the solar panels installed on the gym rooftop.

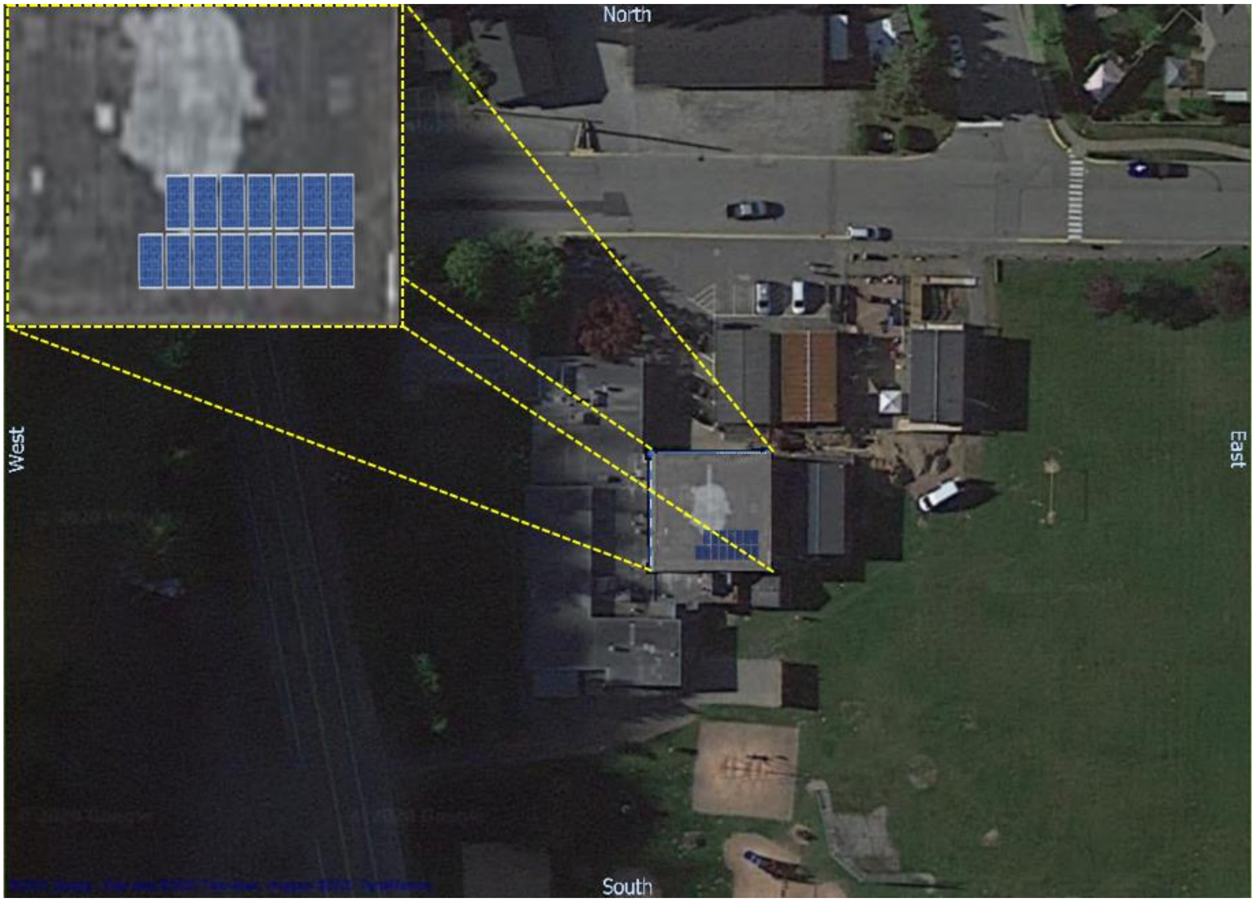


Figure 10: 3D Model of Solar PV Panels (501 Hot Spring Rd)

6 System Interconnection

6.1 Grid Interconnection Options

There are two main interconnection models for PV and battery storage systems. When combining PV and battery storage systems, the subsystem can be connected by a DC-coupled or AC-coupled configuration.

Figure 11 shows a DC-coupled system. A DC-coupled system needs only one bi-directional inverter, connects battery storage directly to the PV array, and enables the battery to charge and discharge from the grid.

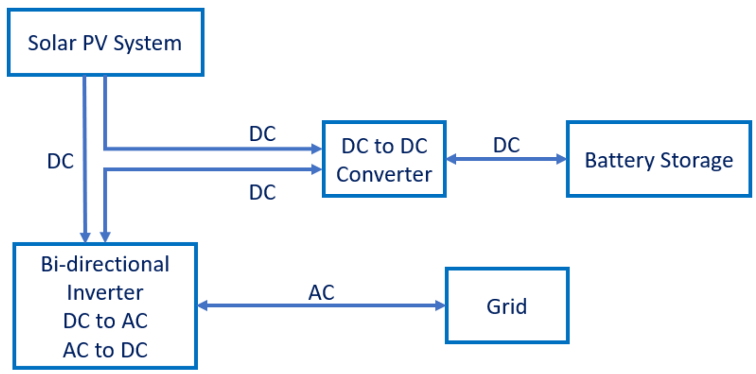


Figure 11: DC-Coupled System

On the other hand, an AC-coupled system needs both a PV inverter and a bi-directional inverter. As shown in Figure 12, there are multiple conversion steps between DC and AC to charge or discharge the battery.

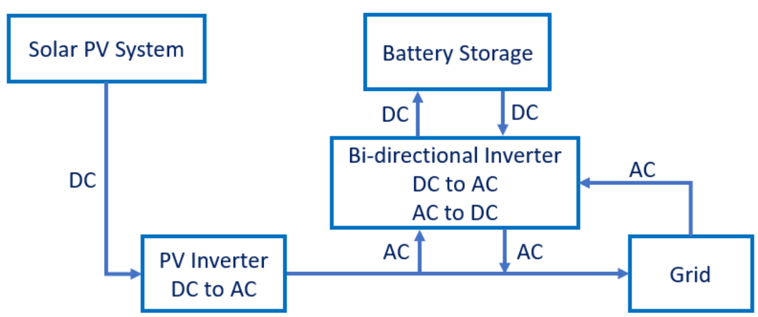


Figure 12: AC-Coupled System

Table 5 shows the comparison of DC and AC coupling systems for a PV plus grid storage system. The clear advantage of a DC-coupled system is that it uses a single bi-directional inverter instead of 2 inverters required for an AC-coupled system, thus reducing cost for the inverter, inverter wiring and housing. Since in DC-Coupled system, the battery is connected directly to the solar array, excess PV generation can be sent directly to charge the battery. An AC-coupled system is more advantageous where the system owner needs the flexibility to upgrade PV and battery separately or where the two systems cannot be placed in close proximity. Since AC-coupled systems can have batteries located outside the PV field, maintenance work is quicker and more comfortable.

Table 5: Comparison of DC-coupled vs AC-coupled system

Component	DC-Coupled Configuration	AC-Coupled Configuration
Number of inverters	1 (bi-directional inverter for battery)	2 (bi-directional inverter for battery plus grid-tied inverter for PV, resulting in higher costs for the inverter, inverter wiring, and inverter housing)
Battery rack size	Smaller (because the battery is directly connected to PV), resulting in more heating, ventilating, and air conditioning (HVAC) and fire-suppression systems required	Larger
Structural Balance of System (BOS)	More due to smaller battery rack size	Less
Electrical Balance of System (BOS)	Less but needs additional DC-to-DC converters	More due to additional wiring for inverters
Installation (labour cost)	More (due to smaller battery rack size, and more skilled labour and labour hours required for DC work)	Less
EPC Overhead	More (due to higher installation labour cost)	Less

The limiting factor for this application is the size of the electrical room. If DC coupled configuration is chosen, the smaller battery rack size results in more heating and requires additional fire-suppression systems (ventilation and HVAC). From Table 5 above, the biggest disadvantage for AC coupling configuration is the cost for an extra inverter and additional wiring. For the battery-solar system designed in this application here, the cost of an extra inverter and wiring will be minimal compared to requirements for a different installation site with more ventilation. Hence, the AC-coupling configuration is recommended for interconnection.

6.2 BC Hydro Interconnection Requirements

With the net metering program, BC Hydro provides a way for customers to connect a small energy source to the BC Hydro distribution system to offset their loads. As per BC Hydro guidelines [4], the system here is classified as a Complex Distribution Generator since the aggregate inverter rating is greater than 27 kW.

The system owner should work with a qualified personnel to address all technical design requirements listed in section 4.2 of BC Hydro interconnection requirements guideline [4] during the detailed design phase.

Once the system is designed, an application for technical review must be submitted to BC Hydro. In order to participate in the net metering program, the system must meet the following interconnection requirements [4]:

1. All equipment shall comply with the following standards (as applicable):
    a. CEC Part I (See sections 50, 64 and 84)
    b. CAN/CSA-C22.2 No. 257-06

   c. CAN/CSA-C22.3 No. 9-08
   d. CSA C22.2 No. 107.1-01
2. The system design owner is responsible for all design, construction, inspection, maintenance and operation of all facilities on their side of the point of common coupling (PCC).
3. Means of safe disconnection must be provided for all generators interconnected with the distribution system in accordance with CEC Part I. A warning label must be installed at the revenue meter location and at the disconnect means. A single line, legible diagram of interconnected system shall also be installed at the disconnecting means.
4. Prior to completion of system commissioning, a verification test shall be performed as recommended by the manufacturer and required by CAN/CSA-C22.2 No. 257-06.

The system owner must ensure that all requirements of the manufacturer and Local Regulatory Authority are met. The system owner must retain a complete set of manuals, installation drawings, permits, inspections and verification test reports.

The system owner shall verify the generator’s interconnection protective functions according to the manufacturer’s recommended schedule, or at least once a year as required by CAN/CSA-C22.2 No. 257

7 Operation Costs and Yearly Savings

This section of the report evaluates the variable costs related to the operation and maintenance of the battery-solar system as well as yearly cost savings from three main areas: demand charge, net metering and demand response.

The usable life of lithium-ion battery systems depends on cycles of usage. Since the battery is primarily sized for backup power, the actual usage of battery is very low. For this application, the operation and maintenance cost is estimated at $150/yr. The expected variable cost of the recommended system is negligible.

The cost savings options considered for this report are reducing the demand charge, energy fee savings from the solar system including net metering, and potential savings through the demand response agreement. The overall savings are estimated to be $1143/yr as seen in Table 7 with savings of $400, $470, $273 for the demand savings, net metering and demand response, respectively.

Table 6: Yearly Cost Savings

Cost Saving Area	Estimated Savings/Year
Demand Charge	$ 400
Net Metering*	$ 470
Demand Response	$ 273 (48 hrs/year @ 57 kW @ $0.0999/kWh)
Total	$ 1143

*Combined savings of net metering (energy sold to grid $0.0999/kWh) and cost saved by solar usage.

The demand charge is a monthly fee based on the maximum demand from the client in the month. School District No. 78 is considered a medium general service provider with a monthly fee of $5.37/kW (maximum monthly power). The battery and solar system can be used to reduce this daily peak demand. A proprietary software owned by Hedgehog Technologies is used to calculate optimized peak demand shaving at 19%. For a 170 kWh battery and 5 kW solar system, a 19% reduction results in a yearly saving of $400.

Net metering agreements allow BC Hydro clients to sell excess energy back to the grid. While the total yearly energy of a 5 kW solar install is around 4.7 MWh, the majority is used to offset site energy. The offset site energy is billed at the medium general service rate of $0.0958. Any excess energy is sold back to the grid at a net metering price of $0.0999/kWh. The total return and savings is $470.

Demand response agreements are used by BC Hydro to request clients to actively offset their own demand to a higher level or actively return energy to the grid. Assuming 48 hrs/year are requested and a fee structure (assuming the net metering price) of $0.0999/kWh, a total demand response savings would be $273.

8 Conclusion

School District 78 working with BC Hydro wishes to install a battery and/or solar system to provide back up power during blackouts. The main objective for the school district is to continue school for the day, so children are not sent home prematurely. BC Hydro supports the above objective and is also interested in peak load management using demand response triggers.

From three different battery storage technologies discussed in this report, lithium-ion is recommended considering the readiness of technology, the number of cycles at 80% and cost per kWh. For battery size between 100 kWh to 400 kWh, the total installed cost is around $1,000/kWh.

With the above-mentioned criteria in mind, a typical school day was identified to be Monday to Friday, from 8:30 AM to 3:30 PM. The school's utility bills, including 5-minute interval demand records for the last year, were analyzed to determine the daily demand and energy usage on a typical school day. The maximum daily energy usage in 2019 was 286 kWh. This is referred to as peak energy day in Table 7.

With a battery storage sized to 286 kWh, the school will have minimum of 7 hours of backup power during a blackout on any given school day in a year. The estimate EPC costs for 286 kWh lithium-ion battery storage will be around $286,000. This is considered the most expensive scenario. However, with the low likelihood of a blackout occurring for the entire 7 hours during peak energy school time, a 286 kWh battery storage for this application seems excessive. A more reasonable expectation of the required battery size is the average daily energy usage instead of the peak.

The average daily energy in 2019 for Monday-Friday [8:30 AM - 3:30 PM] was calculated to be 188 kWh. Even considering the day with highest daily energy usage (Feb 4, 2019), at 188 kWh the school can function with full loads from 8:30 AM to 1:00 PM. This gives the school enough time to reduce non-essential loads or inform parents.

Table 7 presents more options for battery storage size while keeping in mind financial feasibility. These scenarios are based on the elimination of unnecessary loads during a blackout, hence minimizing the required battery storage. Due to the absence of a detailed energy audit, these scenarios are presented in the form of potential reduction from maximum daily energy usage.

Table 7: Battery Storage System Analysis

Maximum Daily Energy For Sizing Battery Storage	Peak	Peak Less 10%	Peak Less 20%	Average	Peak Less 40%	Peak Less 50%	Peak Less 60%
Energy (kWh)	286	257.4	228.8	188	171.6	143	114.4
Power (kW)	57	57	57	57	57	57	57
Number of Weekdays/Year with Lower Energy Demand	260	236	205	133	98	50	10
% Weekdays/Year with Lower Energy Demand	100%	91%	79%	51%	38%	19%	4%
Battery Size (kWh)	286	260	230	188	170	143	115
Battery Storage EPC Costs	$286,000	$260,000	$230,000	$188,000	$170,000	$143,000	$115,000
5 kW Solar EPC Costs	$17,500	$17,500	$17,500	$17,500	$17,500	$17,500	$17,500
Total System EPC Costs	$303,500	$277,500	$247,500	$205,500	$187,500	$160,500	$132,500

For the application at 501 Hot Spring Rd, a 5 kW solar is considered due to limiting factors like budget, size of rooftop and high shading from the hill in the west. The battery storage system is designed to be the primary source of energy during a blackout. The primary purpose of the solar panel installation at this site is to offset the load during school hours as well as charge the battery storage backup system if needed. This PV system is expected to generate 4,671 kWh of energy per year. Using the net metering program, excess PV generated on days with no school can be delivered to the grid.

An AC-coupled configuration is recommended to interconnect the proposed PV plus grid storage system. The bi-directional inverter used in this interconnection allows the battery storage to directly respond to the demand requested by BC Hydro. For the battery-solar system designed in this application here, the cost of an extra inverter and wiring will be minimal compared to requirements for a different installation site with more ventilation. Considering the battery storage system is used for a small amount of peak shaving during the day, it is expected over 95% of full battery capacity is available to BC Hydro for a period of four hours from 5 PM to 9 PM to feed electricity back to the grid.

The cost savings options considered for this report are reducing the demand charge, energy fee savings from the solar system including net metering, and potential savings through the demand response agreement. The overall savings are estimated to be $1143/yr with savings of $400, $470, $273 for the demand savings, net metering and demand response, respectively.

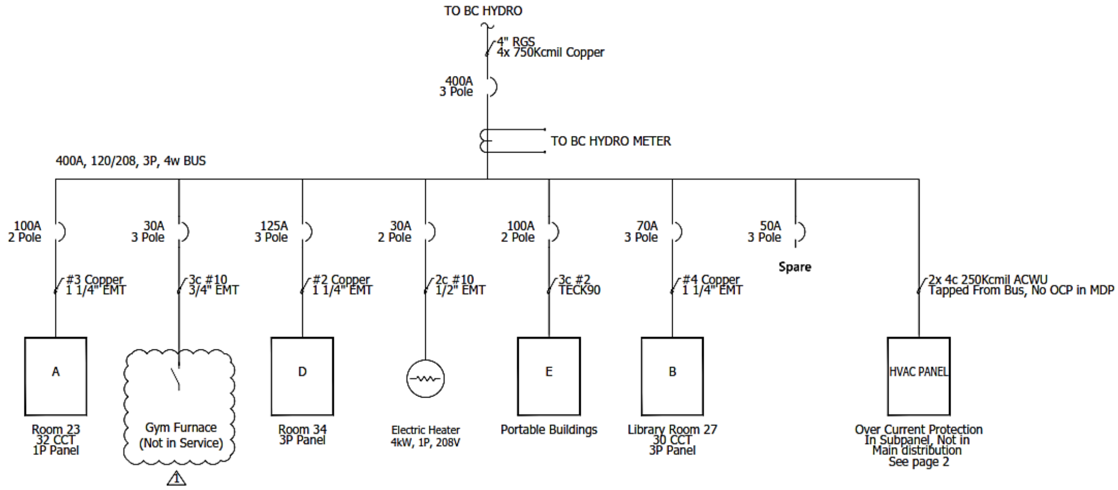
9 Recommended Next Steps

The main recommendation for next steps is to establish a detailed budget for the project. Once obtained, it will dictate the size of the battery storage system that can be installed. Additional work should also be done to confirm battery footprint and ventilation requirements in the electrical room. This is possible once the battery size is confirmed.

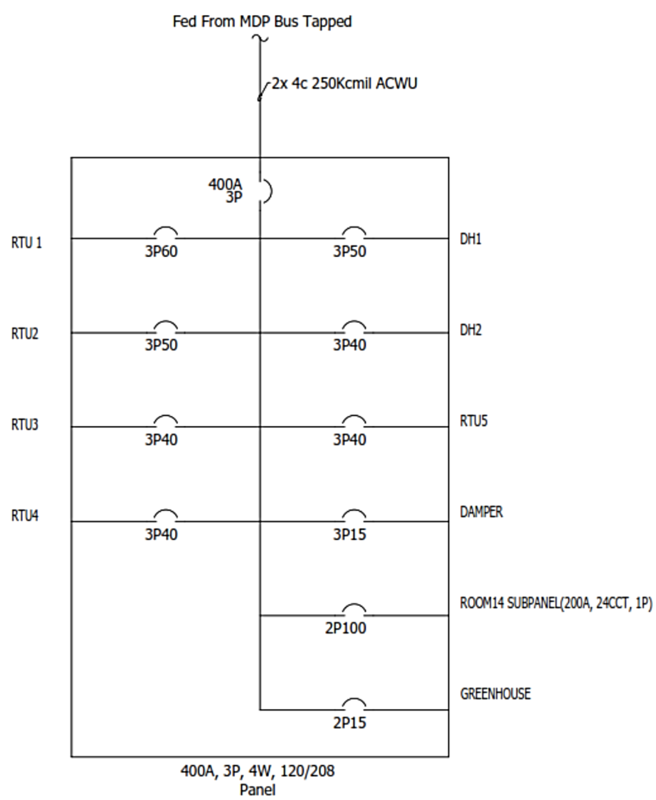
The secondary recommendation is to perform an energy audit to pinpoint non-essential loads. This will further help reduce the required battery size and meet budgetary requirements.

Appendix A

Note: The information below is copied directly from a hand-drawn singe line diagram provided by SD78.



⚠ EQUIPMENT HAS BEEN REMOVED, ONLY LOCAL DISCONNECT REMAINS.



Appendix B

Detailed system overview and simulations of the PV system.

System Overview

System Data	
Type of System	Grid-connected PV System
Start of Operation	3/30/2020

Climate Data	
Location	Agassiz Cda BC, CAN (1991 - 2010)
Resolution of the data	1 h
Simulation model used:	
- Diffuse Irradiation onto Horizontal Plane	Hofmann
- Irradiance onto tilted surface	Hay & Davies

Module Area 1

PV Generator, Module Area 1	
Name	Module Area 1
PV Modules	15 x CS6U-325P
Manufacturer	Canadian Solar Inc.
Inclination	20 °
Orientation	South 180 °
Installation Type	Mounted - Roof
PV Generator Surface	29.2 m²

Inverter configuration

Configuration 1	
Module Area	Module Area 1
Inverter 1	
Manufacturer	Fronius USA
Model	Fronius Primo 5.0-1 / 208V
Quantity	1
Sizing Factor	97.5 %
Configuration	MPP 1: 1 x 8
	MPP 2: 1 x 7

Simulation Results Total System

PV System	
PV Generator Output	4.9 kWp
Spec. Annual Yield	958.08 kWh/kWp
Performance Ratio (PR)	87.8 %
Grid Feed-in	4,671 kWh/year
Grid Feed-in in the first year (incl. module degradation)	4,671 kWh/year
Standby Consumption (Inverter)	13 kWh/year
CO_2 Emissions avoided	2,802 kg / year