BRITISH
COLUMBIA

February 27, 2015

VIA EMAIL
Ref: 179857

To: All Secretary-Treasurers
All School Districts

Re: 2015/16 Carbon Neutral Capital Program

In November 2014, the Ministry issued a Call for Proposals under the Carbon Neutral Capital Program (CNCP). Applications were due January 9, 2015, and evaluations are now complete.

For the 2015/16 government fiscal year, $5 million in CNCP funding is being allocated based on CNCP proposals and supporting documentation submitted by school districts in the Call for Projects. The CNCP funding is meant to assist school districts with energy efficiency projects and to recognize the cost of carbon offsets paid by school districts annually.

Funding allocations and project numbers are listed by school district in the attached table.

The primary criteria in evaluating CNCP projects are emissions reductions and operational cost savings. Secondary considerations are contributions to the project from school districts and from third parties. Not every school district will receive CNCP individual project funding each year; however, the Ministry will ensure that over several years all school districts will receive at least as much CNCP funding as they spend on carbon offsets over those same years.

Boards of education will be issued a single Certificate of Approval (COA) for their CNCP capital allocation. If your school district is receiving CNCP funding this year, your Board must adopt a Capital Project Bylaw using the project number and total maximum allocation assigned to your school district in the attached table. Please forward the original bylaw document to the attention of Maureen MacDonald, Finance and Administration Officer, Resource Management Division, at the Ministry of Education.

Following registration of the bylaw, a COA will be issued to enable the District to draw the appropriate funds as needed. In accordance with Provincial Treasury policy, draws against the COA cannot occur until capital project expenditures have been made. **All COA's for the CNCP will expire March 31, 2016; therefore approved projects must be completed and funds drawn prior to that date.**

No additional capital will be available for the approved CNCP projects, so any unforeseen projects costs will be the sole responsibility of the school district.

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Ministry of Education
Resource Management Division
Mailing Address:
PO Box 9151 Stn Prov Govt
Victoria BC V8W 9H1
Location:
5th Floor, 620 Superior St
Victoria BC V8V 1V2

If you have any questions please contact Craig Harris, Planning Officer, at Craig.Harris@gov.bc.ca or 250-217-0514.

Sincerely,

Joel Palmer
Executive Director, Capital Management Branch

Attachment

pc: All Superintendents of Schools
Regional Directors, Capital Management Branch
Planning Officers, Capital Management Branch

2015/16 Ministry of Education Carbon Neutral Capital Program (CNCP) Projects and Funding

SD #	SD Name	School	Project Description	Project Number	Total 15/16 CNCP Funding	SD Contribution ($)	3rd Party Contribution ($s)	CNCP Funding Approved ($s)
10	Arrow Lakes	Lucerne Elem-Secondary	Solar	126827	74,200	$ 37,100	$ -	$ 49,827
		Nakusp Elementary School	Solar		25,453	$ 12,727	$ -	Incl.
19	Revelstoke	Columbia Park Elementary	Replace RTU with heat pumps	126828	366,000	$ 291,000	$ -	$ 75,000
22	Vernon	Clarence Fulton Secondary	Boiler Replacement	126829	187,000	$ -	$ 30,000	$ 157,000
23	Central Okanagan	Constable Neil Bruce Middle	Boiler Replacement	126830	169,200	$ -	$ 9,240	$ 159,960
27	Cariboo-Chilcotin	Cataline Elementary	Boiler, mechup, lighting	126831	1,757,902	$ 1,341,760	$ -	$ 416,142
33	Chilliwack	Mt. Slesse Middle	Boiler Replacement	126832	430,000	$ 106,000	$ 37,000	$ 287,000
34	Abbotsford	Yale Secondary	HVAC consolidation	126833	582,000	$ 236,000	$ 236,000	$ 110,000
35	Langley	Walnut Grove Secondary	Boiler Replacement	126834	403,975	$ 185,671	$ 38,304	$ 180,000
36	Surrey	Fleetwood Park Secondary	Boiler Replacement	126835	592,500	$ -	$ 27,000	$ 565,500
38	Richmond	Facilities, Maintenance & Ops	Purchase 3 electric vehicles	126836	111,893	$ 33,298	$ 12,000	$ 66,595
39	Vancouver	Various Locations (15)	DDCs & Communic Upgrades	126837	620,600	$ 211,000	$ 65,400	$ 344,200
42	Maple Ridge	Thomas Haney Secondary	Lighting, HVAC & HW	126838	605,416	$ 44,086	$ 100,000	$ 461,330
43	Coquitlam	Mary Hill Elementary	Boiler Replacement	126839	250,000	$ 62,500	$ 12,500	$ 175,000
44	North Vancouver	Boundary Elementary	Boiler Replacement	126840	545,300	$ 42,300	$ 23,000	$ 480,000
47	Powell River	James Thomson Elementary	Boiler Replacement	126841	77,800	$ 13,800	$ 12,000	$ 52,000
50	Haida Gwai'i	Queen Charlotte Secondary	Solar PV Panels	126842	89,000	$ 5,000		$ 84,000
51	Boundary	Grand Forks Secondary	Boiler Replacement	126843	230,000	$ 115,765	$ 28,000	$ 86,235
57	Prince George	Ecole Lac des Bois Elementary	Boiler Replacement	126844	460,700	$ 140,473	$ -	$ 320,227
61	Greater Victoria	Rockheights Middle School	Boiler Replacement	126845	250,000	$ -	$ 12,500	$ 237,500
71	Comox Valley	Royston Elementary	Boiler Replacement	126846	103,000	$ 6,600	$ 6,400	$ 90,000
72	Campbell River	Cedar Elementary	Boiler Replacement	126847	91,800	$ 41,800	$ -	$ 50,000
75	Mission	Mission Secondary	Boiler Replacement	126848	430,000	$ 204,515	$ -	$ 225,485
81	Fort Nelson	J S Clark Elementary	Boiler Replacement	126849	60,000	$ -	$ -	$ 60,000
91	Nechako Lakes	Fraser Lake Elem-Sec	Install AHUs	126850	500,000	$ 233,000	$ -	$ 267,000
					9,013,739	$ 3,364,395	$ 649,344	$ 5,000,001

2014 SD10 SOLAR FEASIBILITY STUDY

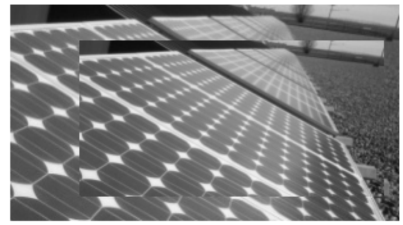
Submission
12/21/2014

HES PV

TABLE OF CONTENTS

ABOUT HES-PV

HESpv is a Victoria, BC & Barrie, ON based PV system designer and supplier. We have been in the Canadian solar industry for over 25 years. We are diversified into many solar markets, such as off-grid, grid-tie, mobile and remote. This gives us a strong platform as this solar industry develops.



HESpv has the experience to ensure the timely and successful design of PV power systems. Our staff has successfully designed systems for the 250KW Powerstream Offices, 100KW Eden Farm, 75KW T'Sou-ke Nation Demonstration Project, 250KW Arnprior system and many other PV based projects throughout Canada. Our experience includes many FIT and net metered projects on both the residential and small commercial scales.

HES's team has personnel with experience in all aspects of the solar project cycle with multi-disciplinary backgroundsfor delivering successful projects.

The component features of the systems are based on our experience of the preferred methodsof installing Canadian solar arrays for maximum performance, system reliability, safety and longevity. We understand the uniqueness of the Canadian environment and can ensure that the system will deliver the best ROI and customer satisfaction.

We hope this feasibility study meets your requirements,

Sincerely,

Dave Egles, President

Ed Knaggs, Vice President

Sample Projects can be found at: http://hespv.ca/commercial/projects

INTRODUCTION

School district 10 of British Columbia requested HESpv to conduct a feasibility study of grid-tied solar photovoltaic (PV) systems for four site locations.

Based on an analysis of the available roof space, and losses due to shading, HES has determined an approximate maximum system power for each of the four SD10 sites, as well as a smaller 13 kW system for Nakusp Elementary. Power and cost values will vary depending on the final equipment available, USD exchange rate, labour costsand shipping costs. The analysis assumes a roof mount system with standard efficiency 250 watt PV modules. Details are as follows;

SUMMARY

INSTALLED COST & ANNUAL PRODUCTION ESTIMATIONS

Nakusp Elementary School — 619 A 4th Street NW, Nakusp, BC

	13 kW PV System	73 kW PV System
Total Solar PV Array Size	**13 kW DC**	**73 kW DC**
Yearly Energy Production/Percent of load	**17,154kWh/8.13%**	**89,790 kWh/42.6%**
Cost Estimate / Payback	**$25,453 / 9.5yrs**	**$170,850 / 11.2yrs**

Nakusp Secondary School — 619 B 4th Street NW, Nakusp, BC

Total Solar PV Array Size	**39 kW DC**
Yearly Energy Production/Percent of load	**46,513 kWh/ 18.1%**
Cost Estimate / Payback	**$82,202 / 10.7yrs**

Lucerne Elementary/Secondary School — 604 7th Ave, New Denver, BC

Total Solar PV Array Size	**36 kW DC**	**50 kW DC**
Yearly Energy Production/Percent of load	**45,248 kWh**	**62,845kWh / 35.9%**
Cost Estimate / Payback	**$74,200**	**$99,909 / 10.0yrs**

Edgewood Elementary School — 409 Monashee Ave, Edgewood, BC

Total Solar PV Array Size	**26 kW DC**
Yearly Energy Production/Percent of load	**31,060 kWh / 33.4%**
Cost Estimate / Payback	**$54,693 / 10.7yrs**

The energy production estimates (kWh/year) are based on the results of computer simulations. The simulations determine output and performance by factoring in a variety of expected losses (e.g. shading, snow cover, thermal loss, etc.). These estimates can be verified by the test system provided after a year of being connected and collecting the data.

Snow cover is the major contributing factor to these losses. Heavy snow falls can cover the modules to the point where winter production is eliminated. For this study we have assumed 35% losses for January and 12% for February tapering toward spring and fall. These losses can be mitigated with manual snow clearing. However, winter production is minimal and snow clearing would have to be carefully evaluated.

The cost estimates are based on typical values of full installation costs. We estimated the costs based on the most common equipment available for systems of this nature. All equipment prices are subject to fluctuate with the USD exchange rate, for this study we used a rate of 0.90. The freight cost would need to be added once the final quantity and products were selected.

These estimates were also under the assumption that students could be utilized for labour components with the appropriate training. Typically, the installed cost of a 12kW PV system is between $3.00 and $4.00 per watt. The installed cost of a larger 120kW system will be closer to $2.00 - $3.00 per watt. By installing multiple systems on the four schools, the district can take advantage of the cost savings associated with a single large project.

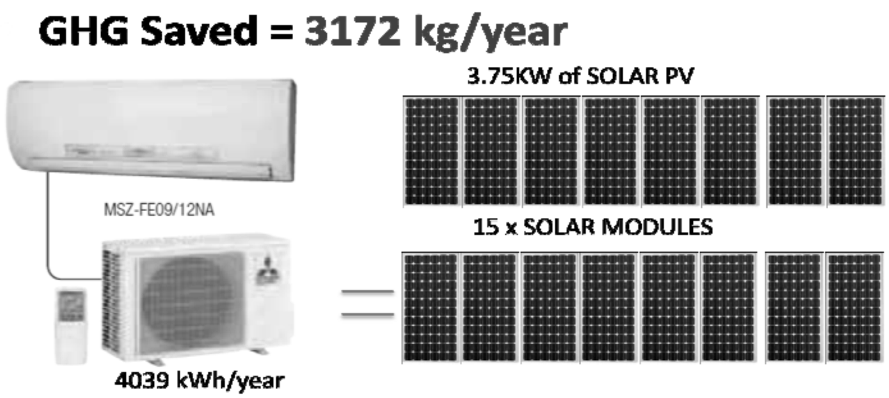
**Note: Cost estimates may vary due to the cost of component transportation, Exchange rate, labour and final selection of equipment or methods.*

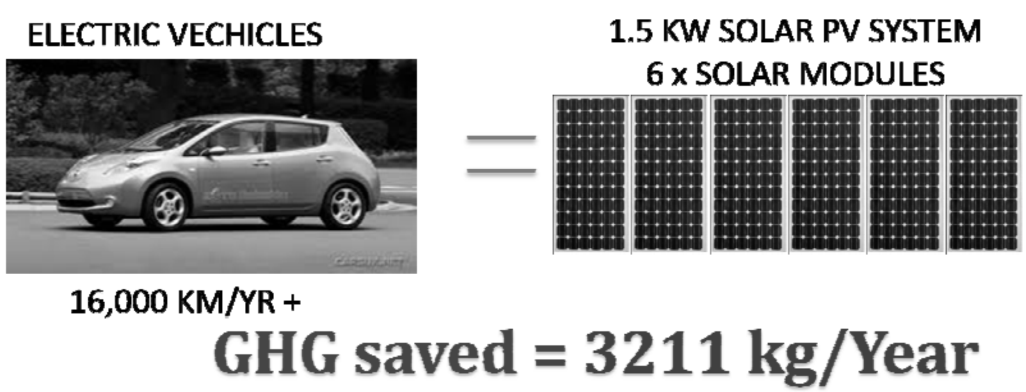
ADDITIONAL BENEFITS

These system are very reliable and require very little maintenance. The electrical production is just one of the base benefits to installing PV on schools. The education impact for students within the schools is substantial. Students would be able to use the real time monitoring to develop a picture of what is capable using PV production and the factors that affect the power output. The students will also gain an understanding of how to closely monitor the schools consumption against the production and learn what are some of the major contributors to energy waste.

PV systems can be used in conjunction with electrification to drastically reduce GHG emissions. Some examples of how SD10 could utilise this concept would be to install EV charging stations for vehicles that travel between the schools in the district. The energy required to power the EV would be offset by the PV added to the buildings. Another form *would be to convert the grounds keeping equipment to electric and offsetting it's consumption with the PV installed on the buildings. Grounds keeping equipment motors are very inefficient and have a high GHG impact.*

The following are some examples of GHG reductions for EV's and Grounds Keeping:





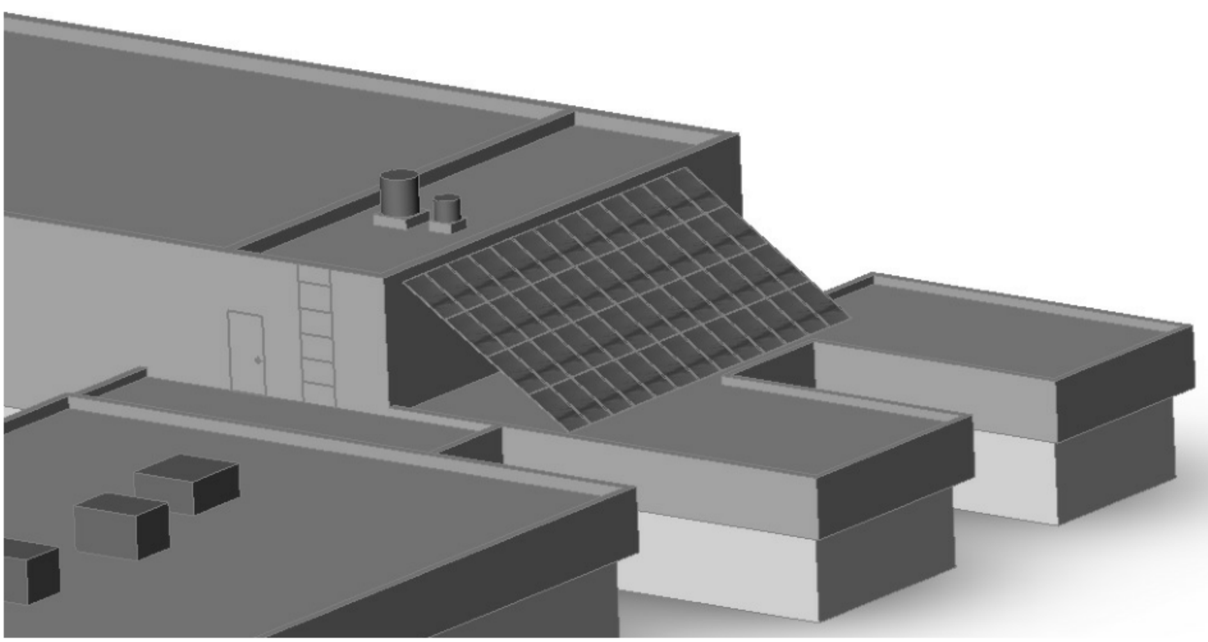
SITE ANALYSIS – SD10 NAKUSP ELEMENTARY SCHOOL

Address	619 A 4th Street NW, Nakusp, BC, Canada
GPS Coordinates	50.245° N, 117.805° W
Magnetic Declination	15.76° E
Solar Azimuth	9°
Altitude	457m

NAKUSP ELEMENTARY 13KW PV SYSTEM OVERVIEW

A 13kW system option would consist of 52 x HSL-250W solar panels grouped in series strings and paired with their own Fronius 11.4KW Inveter. Since string inverters are modular, future system expansion is simple. This system is recommended as a starting point for this site, to be expanded on when roof repairs make additional space available.

On this roof it would be possible to install a sloped system against the gym wall. The diagram below shows the location for this system. An advantage to this system is that it could be used to warm the air behind it, which would be pulled in through the heating duct for the gym.Also, the panels would be a prominent asthetic feature of the school, being visible from both the road and parking lot.



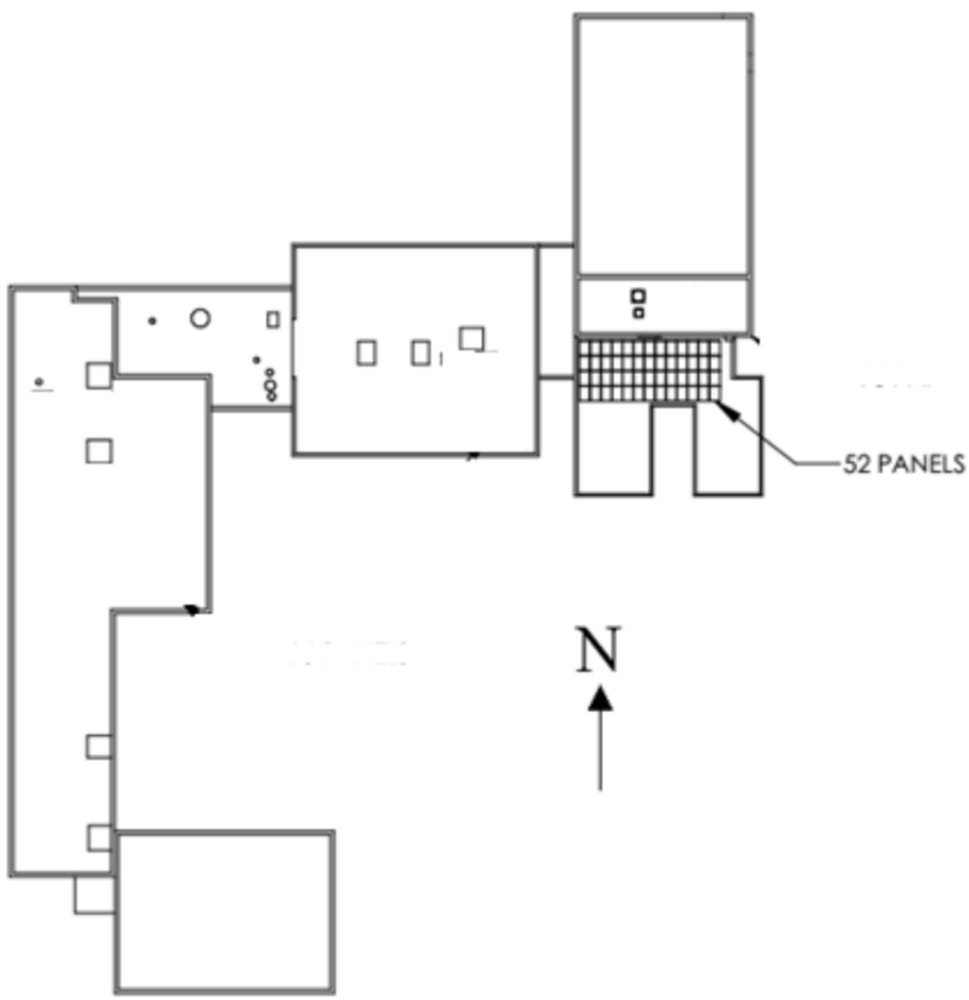
Nakusp Elementary 13kW Sloped Roof System

NAKUSP ELEMENTARY 13KW PV SOLAR MODULE LAYOUT

The solar modules are mounted on a slope in front of the gym wall in portrait, south facing, and at a tilt angle of 33°. This will give the system very good production during the winter months if kept clear of snow.

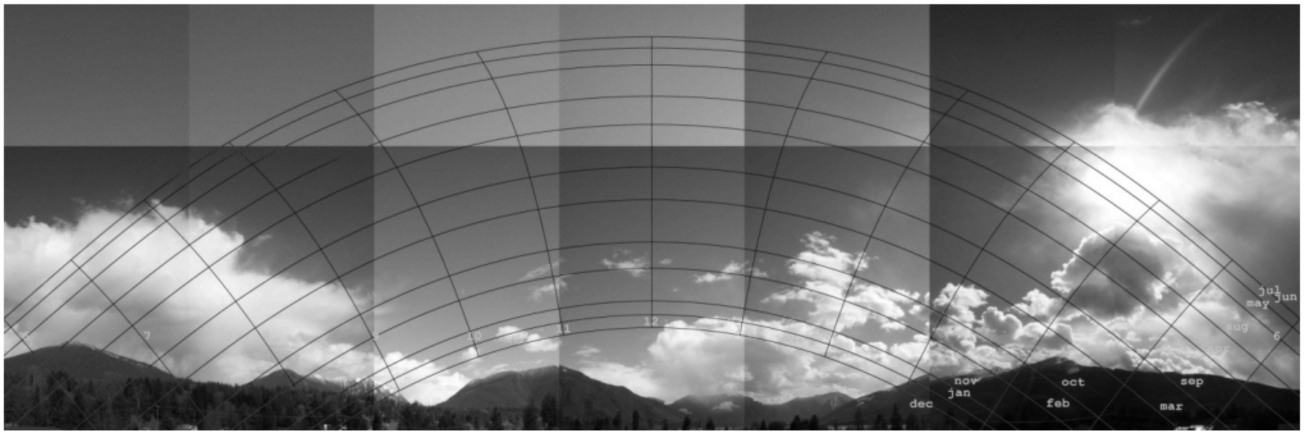
The azimuth angle is9° (angle clockwise from true south) this has very little impact on the system production as most of the energy is gathered when the sun is high on the horizon.

The mounting system used is typical of those used to mount to any sloped surface. The sloped surface would need to be built using 24" OC rafters to accommodate the solar racking.



NAKUSP ELEMENTARY 13KW PV SHADING LOSSES

There is very little shading at this site. There will be minor losses in the mornings and evenings due to the mountains. The southern horizon image below shows the various times of day and months of the year where these losses will occur. The total annual losses for shading are 0.9%.



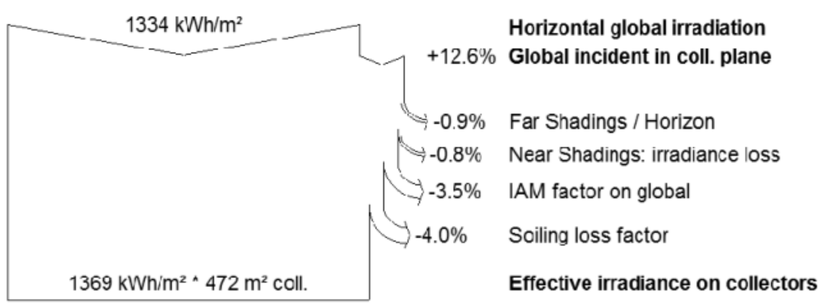
The above picture represents the shadings due to the horizon, this is not the only factor that will affect performance. Snow (soiling), temperature and other factors all affect the amount of sun available during the year. These factors have been taken into account in our analysis. Snow will also build up on the solar panels during the winter months. The chart below reflects the losses for snow cover during the winter months. The total losses for shading, temperature and snow coverage are 9.2%.

PV Array loss factors

Array Soiling Losses

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
35.0%	12.0%	6.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	6.0%

Thermal Loss factor Uc (const) 20.0 W/m²K Uv (wind) 0.0 W/m²K / m/s



NAKUSP ELEMENTARY 13KW PRODUCTION ESTIMATE

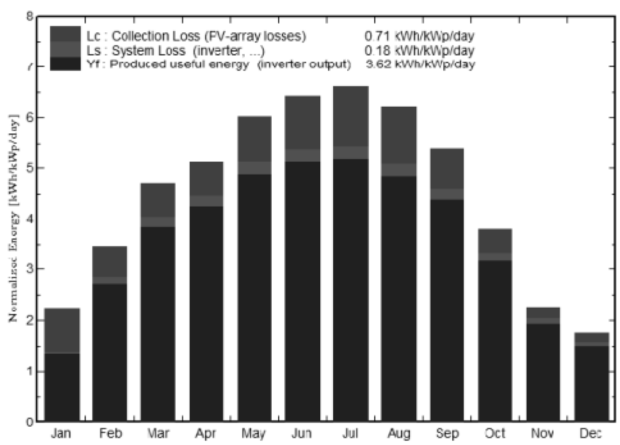
When all the factors above are used to reduce the amount of sunlight available for the area, we can then apply this to the equipment selected. This results in an annual electricity productionof **17,154 kWh/year**. This amount of energy generated represents 8.13% of the total buildings consumption.

Main simulation results

System Production — **Produced Energy** **17154 kWh/year** Specific prod. 1320 kWh/kWp/year

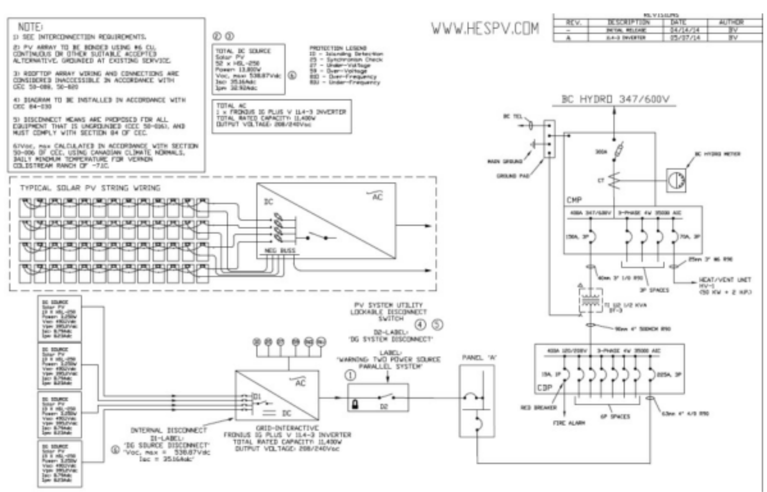
Performance Ratio PR 80.2 % Solar Fraction SF 8.1 %

Normalized productions (per installed kWp): Nominal power 13.00 kWp



NAKUSP ELEMENTARY 13KW ELECTRICAL

This system is small enough that it can utilize the existing electrical equipment and has an electrical room that is easy to access from the roof. There is an existing transformer to take the 600V service down to 208V in order to connect the system. This limits the system size, but avoids the cost of adding an additional transformer.

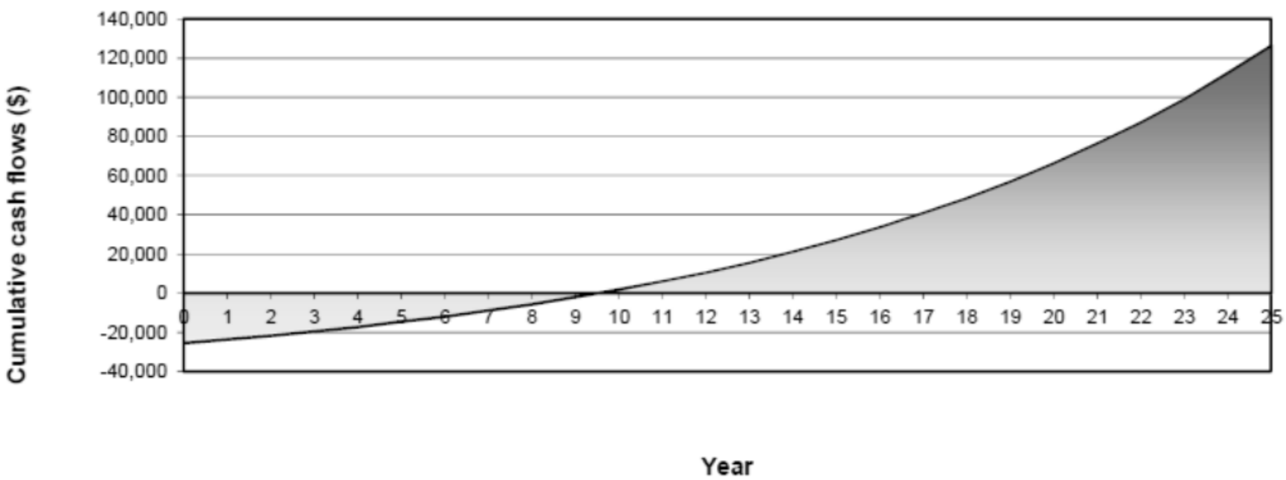


NAKUSP ELEMENTARY 13KW COST ESTIMATE&PAYBACK

Below is the breakdown for the different components of the system based on prices available in Canada today. This system has the cost advantage of mounting to a sloped area and connecting to existing electrical. These prices assume that the sloped area would be built prior to installation.

Solar PV Panels	$ 9,898.00
Inverter	$ 3,341.00
Mounting System	$ 2,902.00
Construction	$ 8,952.00
Monitoring	$ 360.00
Totals	$ 25,453.00
Wattage	13000
Price/W	$ 1.96

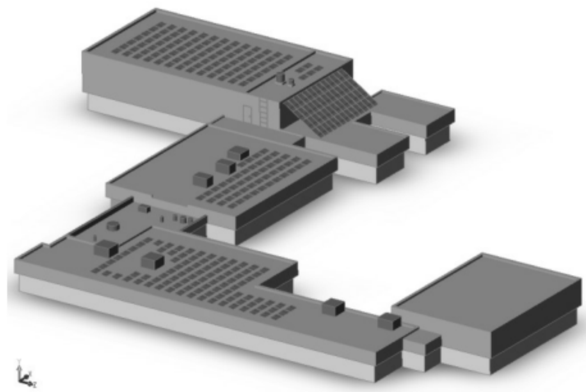
The payback for this system is less than 9.5 years.The current cost of power was taken from the 2013 utility bills step 2 rate as this is what the energy reductions would be applied to. The inflation rate over the 25 year life is unknown, so we assume 9% for this study.



SITE ANALYSIS – SD10 NAKUSP ELEMENTARY SCHOOL

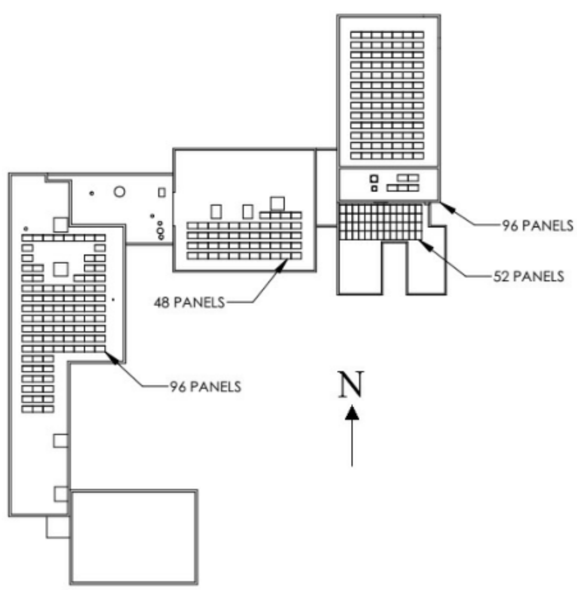
NAKUSP ELEMENTARY 73KW PV SYSTEM OVERVIEW

A 73kW system option would consist of 292 x HSL-250W solar panels wired in groups and paired with their own Fronius string inverter. This system is an expansion to the system above, and can be done in stages as the roof areas become available. The expanding of this system will require the addition of a new transformer, which increases the cost and payback.



NAKUSP ELEMENTARY 73KW PV SOLAR MODULE LAYOUT

This system is an expansion of the previous one's sloped array and three other additional arrays with a ballasted mount. The panels for the new arrays are mounted in landscape, south facing, and at a tilt angle of 10°. The tilt is chosen as such because it strikes a safe balance between maximized footprint and energy production while minimizing wind load.



NAKUSP ELEMENTARY 73KW PRODUCTION ESTIMATE

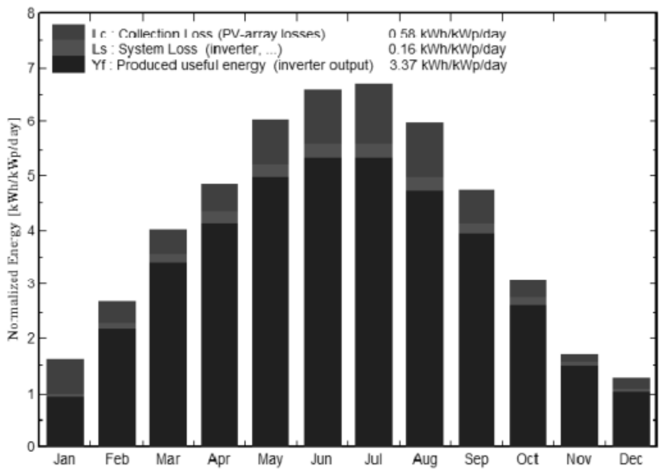
When all the factors above are used to reduce the amount of sunlight available for the area, we can then apply this to the equipment selected. This results in an annual electricity productionof 89,790 kWh/year. This represents 42.6% of the building annual consumption.

Main simulation results

System Production

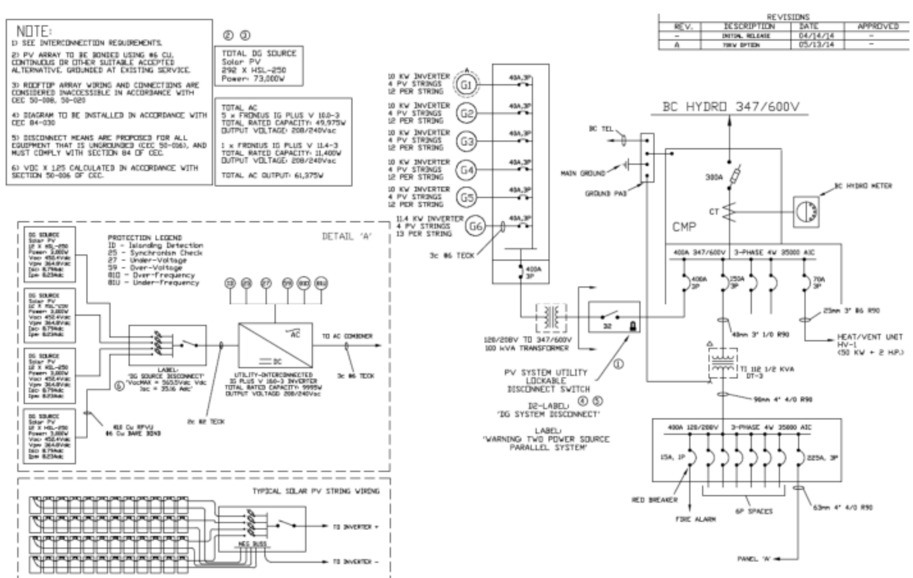
Produced Energy **89.79 MWh/year** Specific prod. 1230 kWh/kWp/year

Performance Ratio PR 81.9 % Solar Fraction SF 25.7 %



NAKUSP ELEMENTARY 73KW ELECTRICAL

This system would need the addition of a transformer to convert the inverters 208v output to the buildings 600v system. This adds cost, but allows the system to be much larger than some of the other schools.

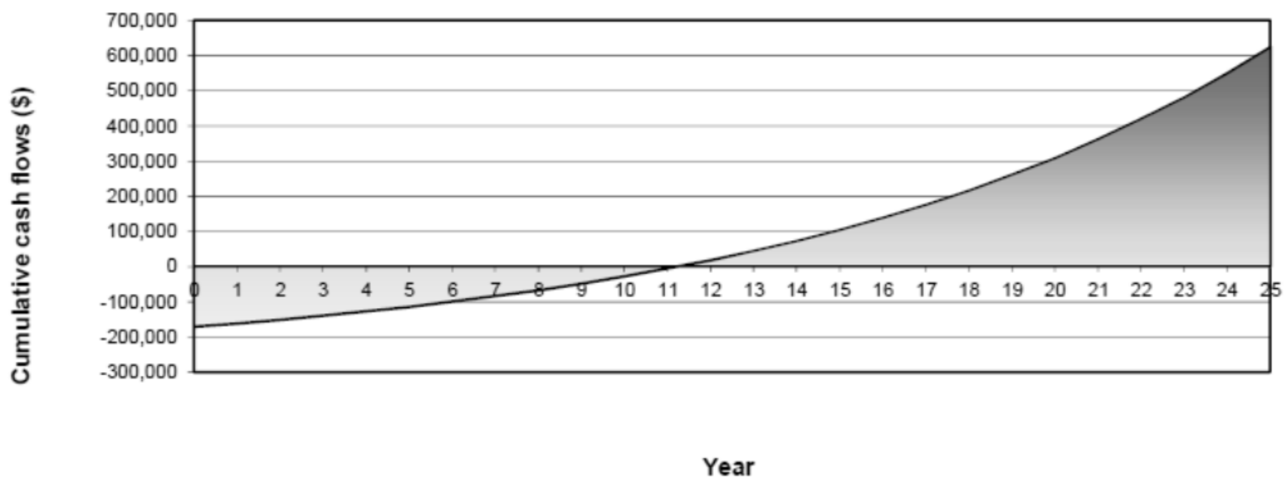


NAKUSP ELEMENTARY 73KW COST ESTIMATE & PAYBACK

Below is the breakdown for the different components of the system based on prices available in Canada today. This system has a cost disadvantage, mainly due to the transformer requirements and the distance arrays are located from the electrical room.

Solar PV Modules	$ 54,344.00
Inverter	$ 21,830.00
Mounting System	$ 30,966.00
Construction	$ 63,092.00
Monitoring	$ 618.00
Totals	$ 170,850.00
Wattage	73,000
Price/W	$ 2.34

The payback for this system just over 11 years.The current cost of power was taken from the 2013 utility bills step 2 rate as this is what the energy reductions would be applied to. The inflation rate over the 25 year life is unknown, so we assume 9% for this study.



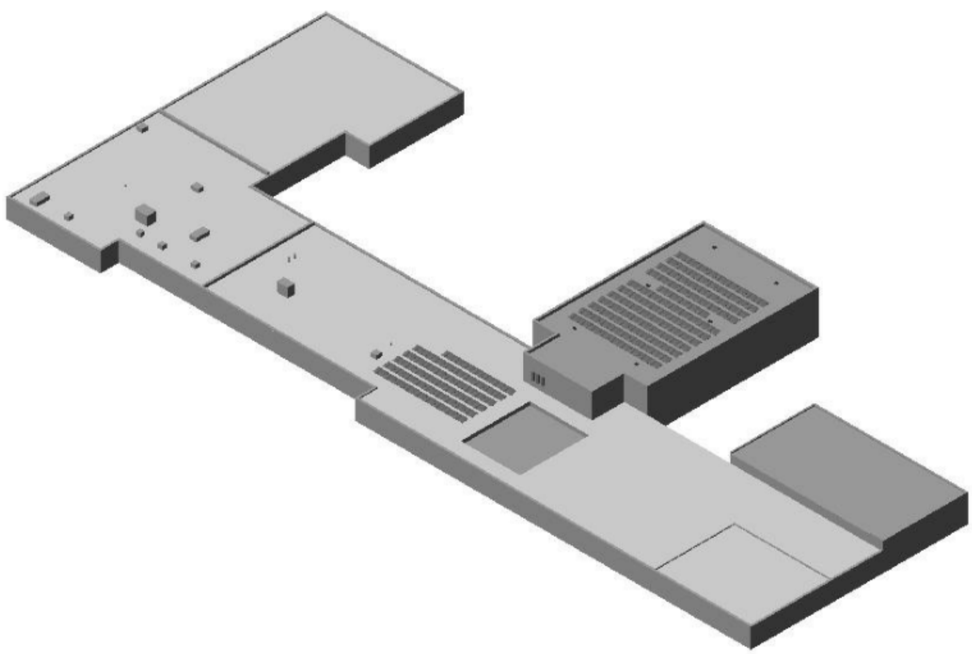
SITE ANALYSIS – SD10 NAKUSP SECONDARY SCHOOL

Address	619 B 4th Street NW, Nakusp, BC, Canada
GPS Coordinates	50.244°E,117.803° W
Magnetic Declination	15.76° E
Solar Azimuth	9°
Altitude	457 m

NAKUSP SECONDARY 39KW PV SYSTEM OVERVIEW

A 39kW system option would consist of 156 x HSL-250W solar panels wired in groups and paired with their own 11.4kw Fronius string inverter.

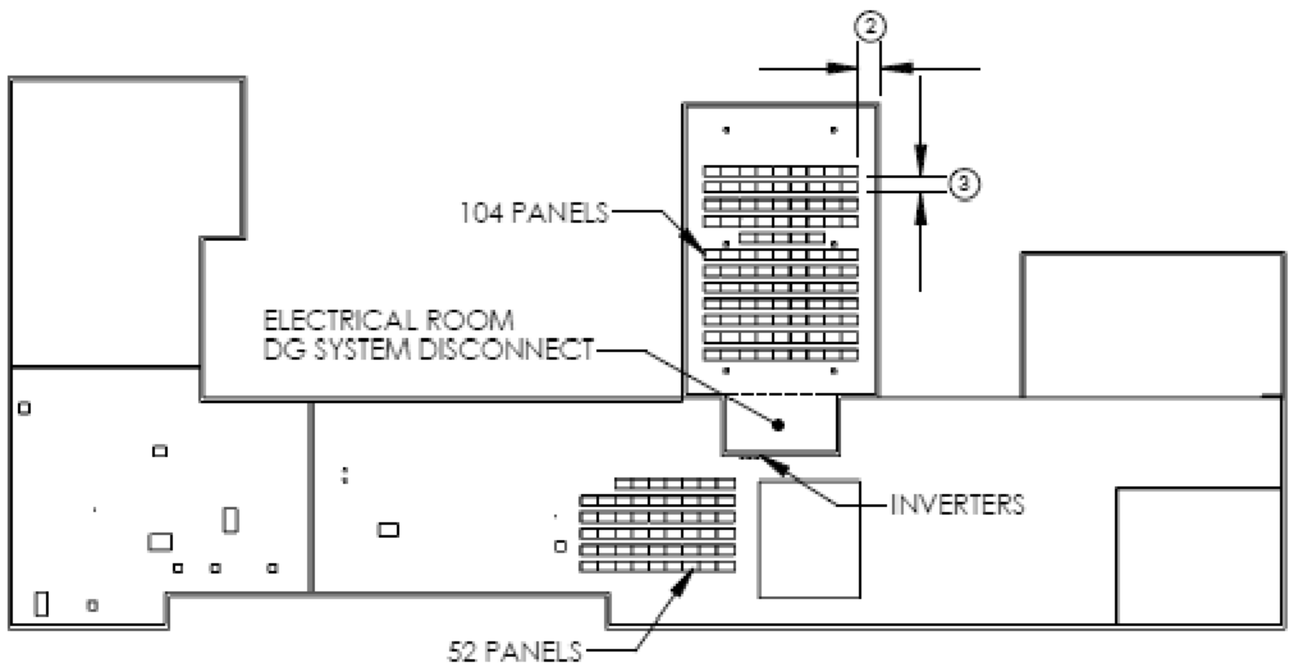
This system is limited electrically due to the size of the existing equipment. Therefore we selected mounting locaions near the electrical room to reduce wiring costs. There may be further savings that can be explored with the wiring routes and labour. We could also look at using other roof areas to increas the tilt angle for more production.



NAKUSP SECONDARY 39KWPV SOLAR MODULE LAYOUT

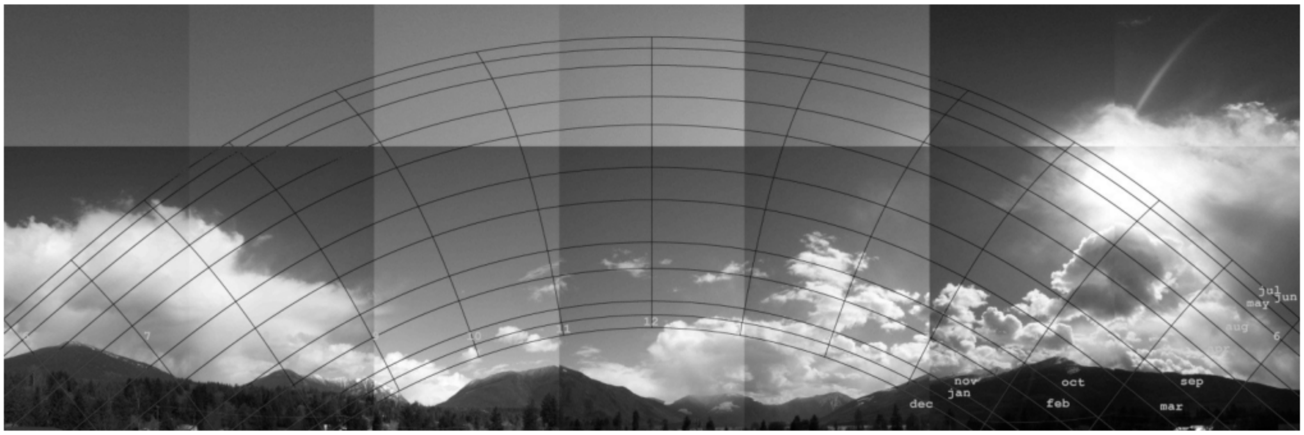
Because the system is limited by the electrical supply, the layout was contained to the areas closer to the electrical room with the least amount of obstructions using a ballasted roof mount system. The modules are mounted in landscape, south facing, and at a tilt angle of 10°. This system could also be installed with a higher tilt angle and an increased foot print for the module area.

The azimuth angle is 9° (angle clockwise from true south) this has very little impact on the system production as most of the energy is gathered when the sun is high on the horizon.



NAKUSP SECONDARY 39KWPV SHADING LOSSES

There is some shading at this site from the mountains in the distance. The southern horizon image below shows the various times of day and months of the year where these losses will occur. The total annual losses for shading are 1.9%.



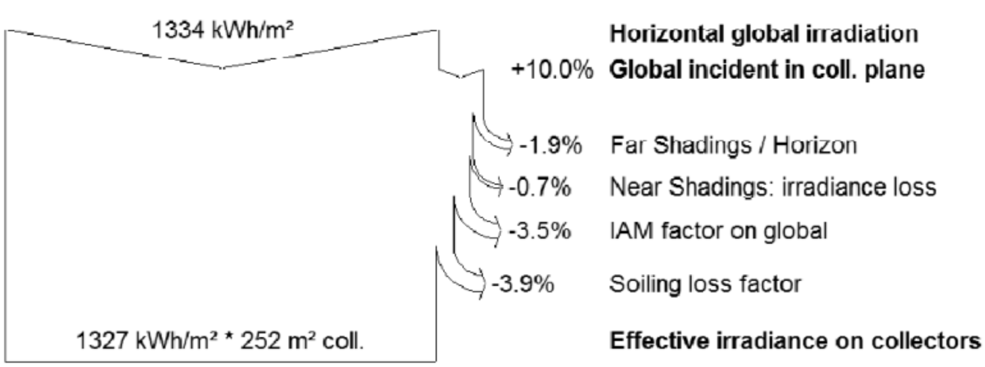
Snow will also build up on the solar panels during the winter months. This has been taken into account with our analysis. The chart below reflects the losses for snow cover during the winter months. The total losses for shading, temperature and snow coverage are10%.

PV Array loss factors

Array Soiling Losses

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
35.0%	12.0%	6.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	6.0%

Thermal Loss factor	Uc (const)	20.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	59 mOhm	Loss Fraction	1.5 % at STC
Module Quality Loss			Loss Fraction	-0.8 %
Module Mismatch Losses			Loss Fraction	1.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Param.	0.05

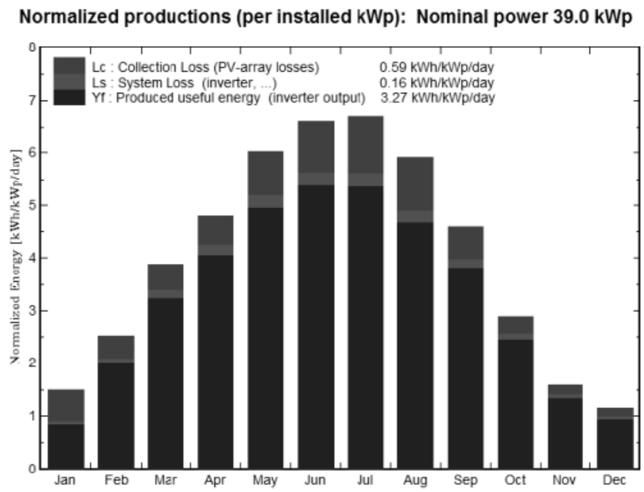


NAKUSP SECONDARY 39KWPRODUCTION ESTIMATE

When all the factors above are used to reduce the amount of sunlight available for the area, we can then apply this to the equipment selected. This results in an annual electricity productionof 46,513 kWh/year. This is 18.1% of the total load consumption.

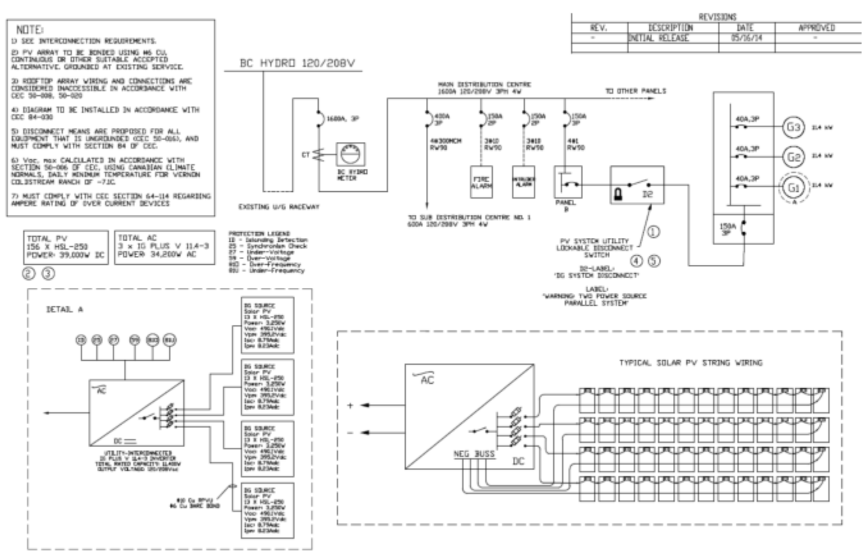
Main simulation results

System Production	**Produced Energy**	**46513 kWh/year**	Specific prod.	1193 kWh/kWp/year
	Performance Ratio PR	81.2 %	Solar Fraction SF	17.7 %



NAKUSP SECONDARY 39KW ELECTRICAL

This system can utilize the existing electrical equipment and has an electrical room that is easy to access from the roof. The system size is limited by the electrical code restrictions for adding a source to existing electrical systems. The inverter equipment can be located just outside the electrical room, saving costs on long, difficult wire runs.

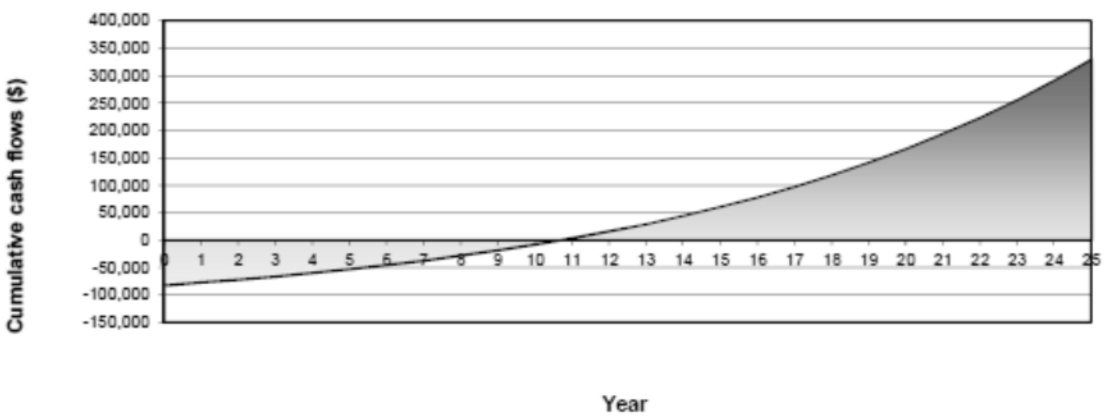


NAKUSP SECONDARY 39KWCOST ESTIMATE & PAYBACK

Below is the breakdown for the different components of the system based on prices available in Canada today. This system has a cost advantage because of the proximity of the solar array to the electrical room. There may be possible further savings to build a sloped array as shown for the elementary school.

Solar PV Modules	$ 29,033.00
Inverter	$ 10,066.00
Mounting System	$ 18,353.00
Construction	$ 24,324.00
Monitoring	$ 426.00
Totals	$ 82,202.00
Wattage	39,000
Price/W	$ 2.11

The payback for this system is less than 10.7 years.The current cost of power was taken from the 2013 utility bills step 2 rate as this is what the energy reductions would be applied to. The inflation rate over the 25 year life is unknown, so we assume 9% for this study.



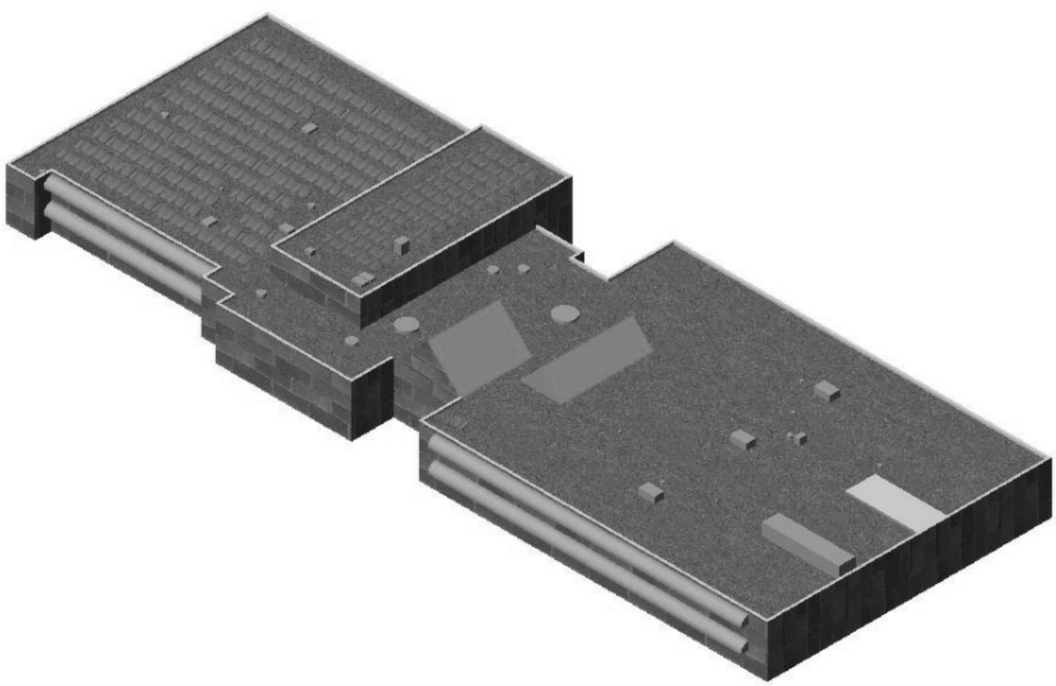
SITE ANALYSIS – SD10 LUCERNE ELEMENTARY/SECONDARY SCHOOL

Address	604 7th Ave, New Denver, BC, Canada
GPS Coordinates	49.993° N, 117.370° W
Magnetic Declination	15.57° E
Solar Azimuth	5°
Altitude	565 m

LUCERNE 50KW PV SYSTEM OVERVIEW

A 50kW system option would consist of 200 x HSL-250W solar panels wired in groups and paired with their own Fronius string inverters. This system is limited by the electrical connection point available.

This systems allows for a higher tilt angle, giving slightly better production during the spring and fall. Since the system is limited in size, areas closer to the electrical room were selected to lower the costs.

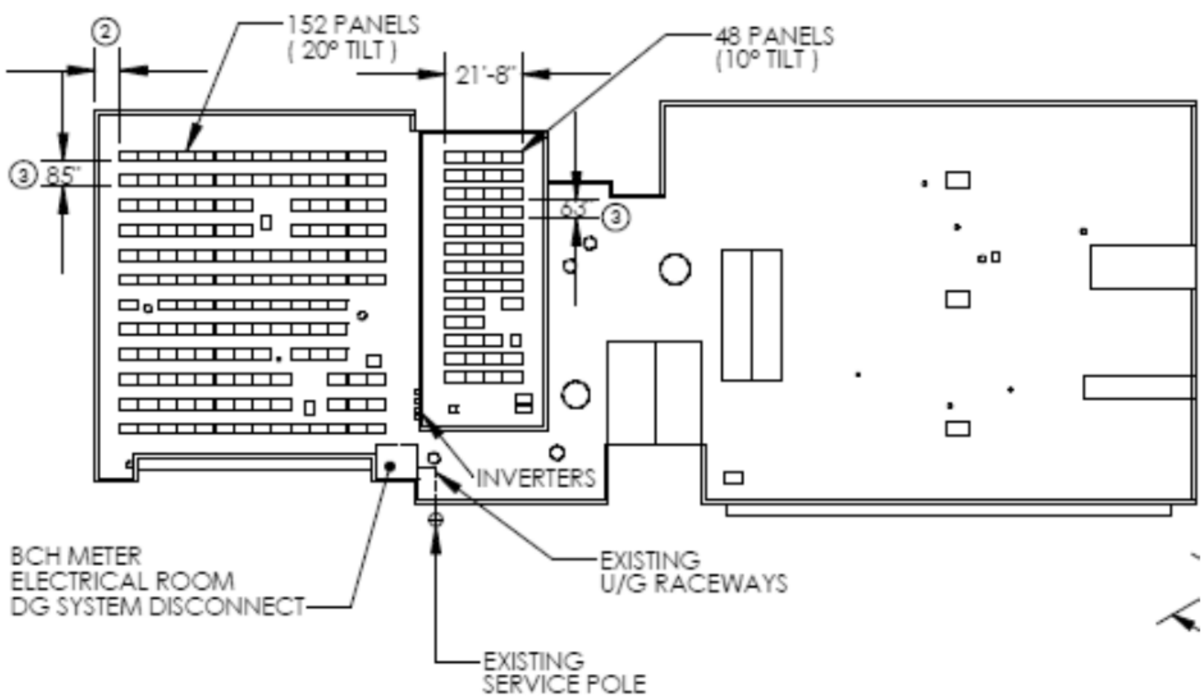


LUCERNE 50KW PV SOLAR MODULE LAYOUT

Because the system is limited by the electrical supply, the layout was contained to the areas closer to the electrical room with the least amount of obstructions. The diagram below show two ballasted mounting areas. One with a 10 degree tilt (to fit more panels) and the other with a 20 degree tilt (increased production).

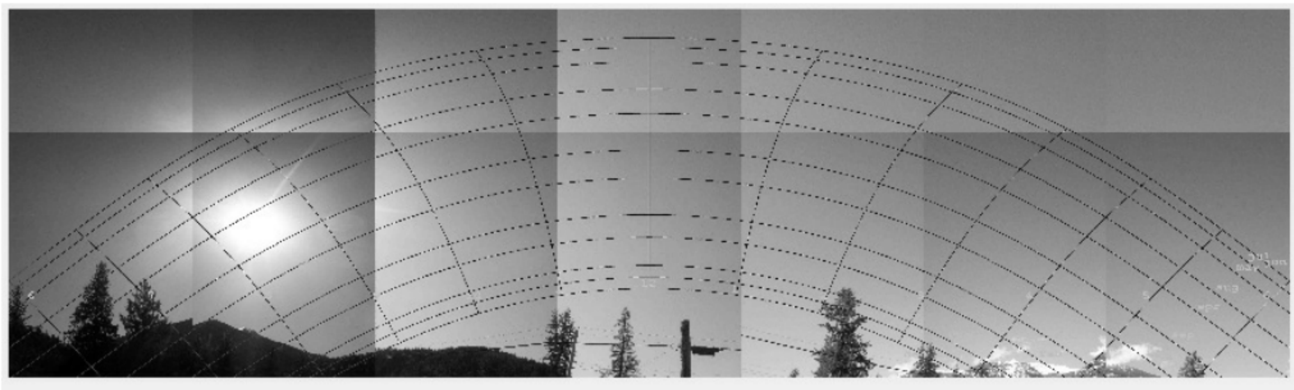
The azimuth angle is 5° (angle clockwise from true south) this has very little impact on the system production as most of the energy is gathered when the sun is high on the horizon.

The roof surface at this location is fairly new and can be used for a ballasted solar system right away.



LUCERNE 50KW PV SHADING LOSSES

There is some shading at this site from the upper sections to the roof. There were areas to be avoided due to obstruction shading, such as the power pole at the front entrance. The southern horizon image below shows the various times of day and months of the year where these losses will occur. The total annual losses for shading are 1.5%.



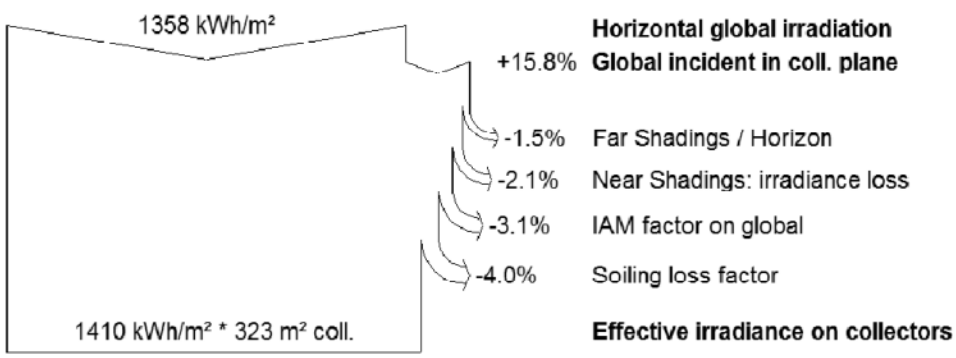
In addition to the horizon losses above are soiling (snow), temperature and other losses. This has been taken into account with our analysis. The chart below reflects the losses for snow cover during the winter months. The total losses for shading and snow coverage are10.7%.

PV Array loss factors

Array Soiling Losses

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
35.0%	12.0%	6.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	6.0%

Thermal Loss factor	Uc (const)	20.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
Wiring Ohmic Loss	Array#1	88 mOhm	Loss Fraction	1.5 % at STC
	Array#2	163 mOhm	Loss Fraction	1.5 % at STC
	Array#3	163 mOhm	Loss Fraction	1.5 % at STC
	Global		Loss Fraction	1.5 % at STC
Module Quality Loss			Loss Fraction	-0.8 %
Module Mismatch Losses			Loss Fraction	1.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Param.	0.05



LUCERN 50KW PRODUCTION ESTIMATE

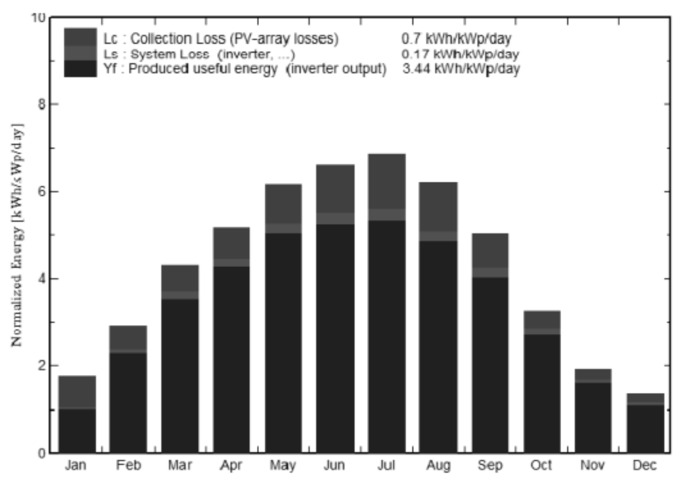
When all the factors above are used to reduce the amount of sunlight available for the area, we can then apply this to the equipment selected. This results in an annual electricity production of 62,845 kWh/year, almost 35.9% of the power consumed.

Main simulation results

System Production

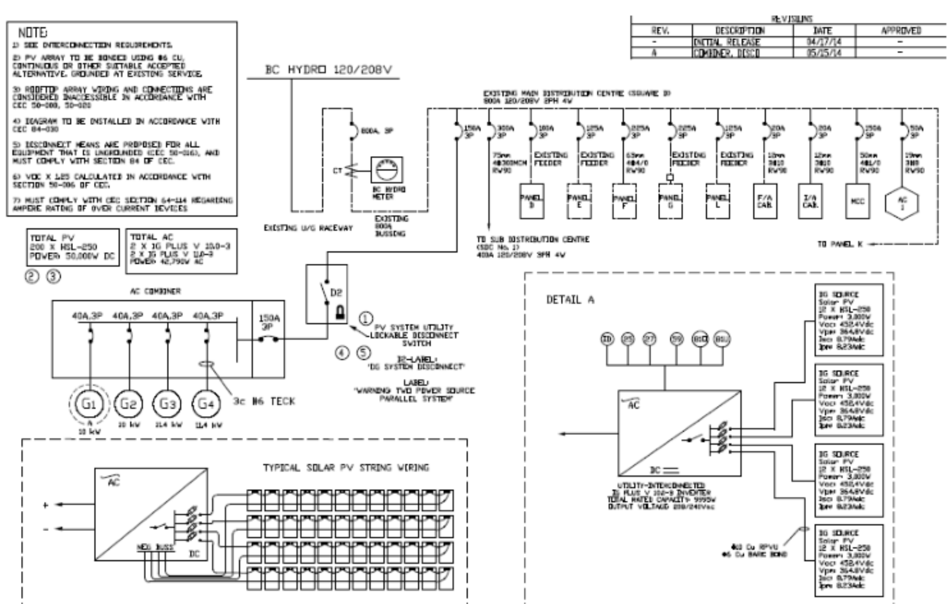
Produced Energy	**62845 kWh/year**	Specific prod.	1257 kWh/kWp/year
Performance Ratio PR	79.9 %	Solar Fraction SF	27.6 %

Normalized productions (per installed kWp): Nominal power 50.0 kWp



LUCERN 50KW ELECTRICAL

This system can utilize the existing electrical equipment that can be accessed through the mechanical room on the roof. The service is already 120/208v to match the inverter outputs, avoiding costs of transformers.

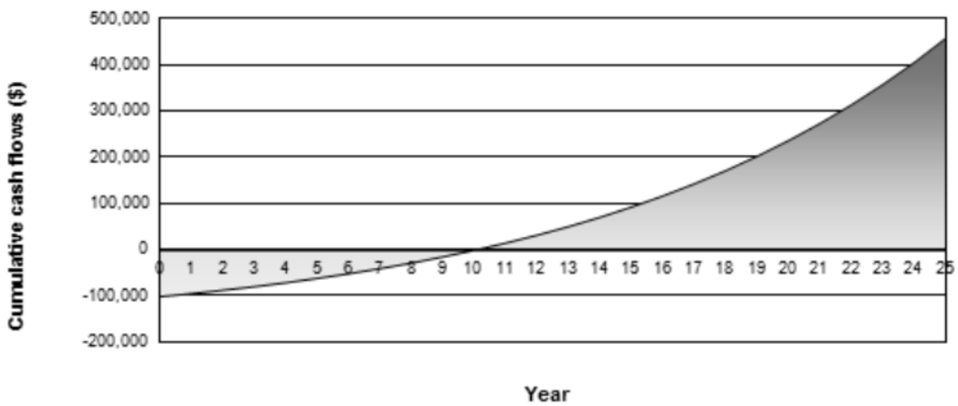


LUCERN 50KW COST ESTIMATE & PAYBACK

Below is the breakdown for the different components of the system based on prices available in Canada today. This system has a cost advantage because of the simplicity of the layout and proximity of the solar array to the inverters.

Solar PV Modules	$ 37,222.00
Inverter	$ 12,827.00
Mounting System	$ 23,529.00
Construction	$ 25,841.00
Monitoring	$ 490.00
Totals	$ 99,909.00
Wattage	50,000
Price/W	$ 2.00

The payback for this system is less than 10 years and would generate a pre-tax IRR of 12.8%.The current cost of power was taken from the 2013 utility bills step 2 rate as this is what the energy reductions would be applied to. Si nce the inflation rate over the 25 year life is unknown, we assume 9% for this study.



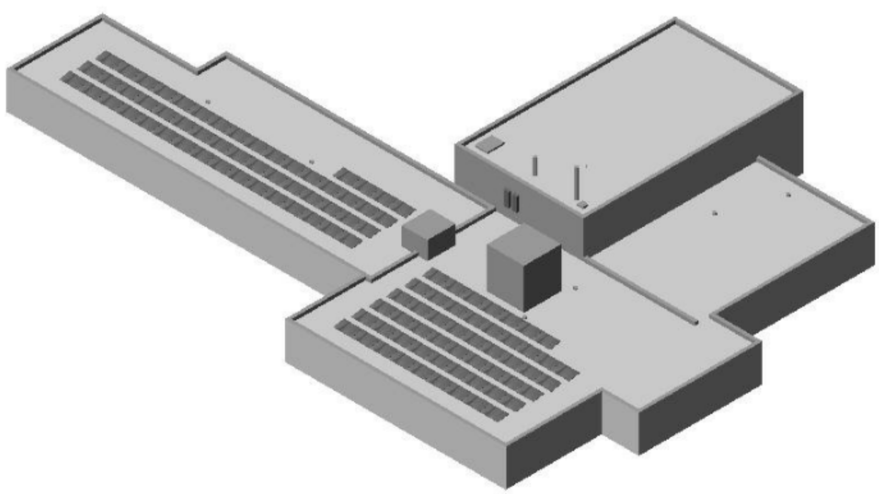
SITE ANALYSIS – SD10 EDGEWOOD ELEMENTARY SCHOOL

Address	409 Monashee Ave, Edgewood, BC, Canada
GPS Coordinates	49.781° N, 118.147° W
Magnetic Declination	15.75° E
Solar Azimuth	15°
Altitude	472 m

EDGEWOOD 26KW PV SYSTEM OVERVIEW

A 26kW system option would consist of 104 x HSL-250W solar panels wired in groups and paired with two Fronius 11.4kw string inverters. This system may be installed in two stages starting with the new section of roofing to the west and expanding to the southwest section once the roof is re-done.

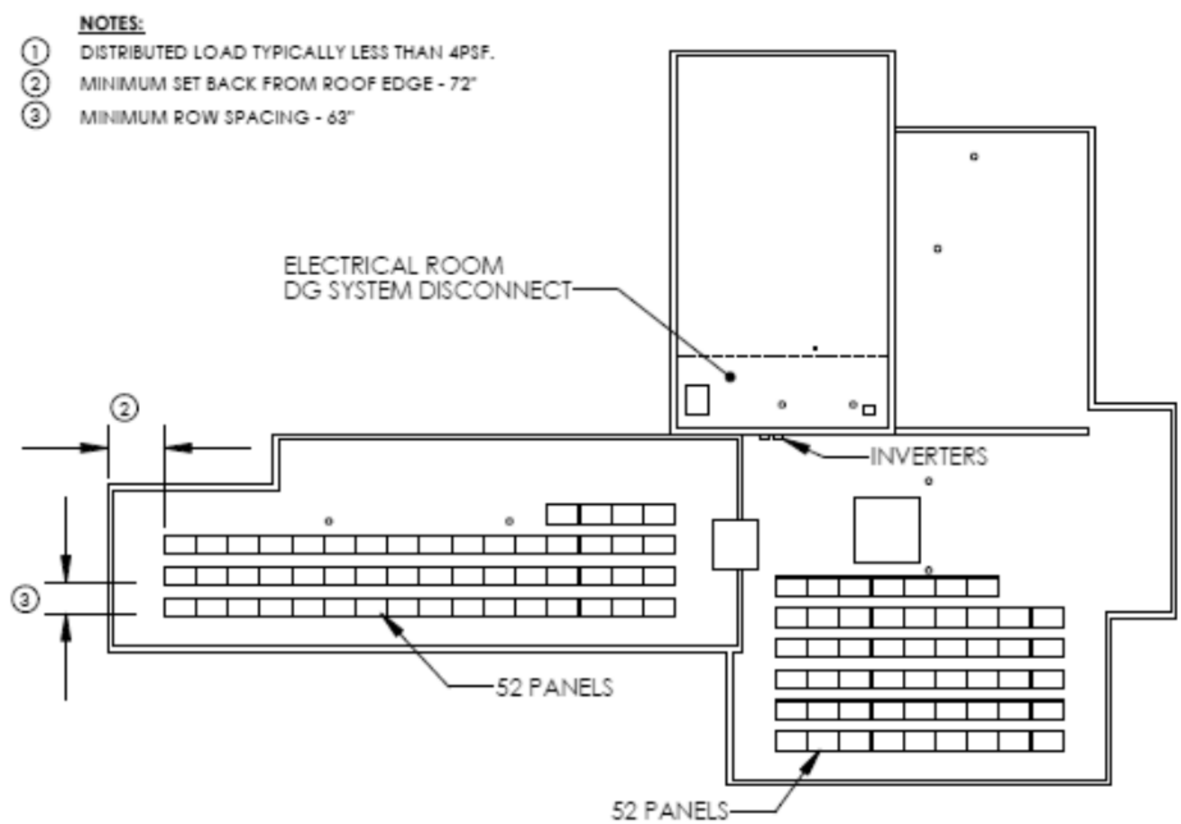
The system size is limited because of the existing electrical equipment. We chose locations closest to the electrical room with the best south exposure and minimal shading obstructions.



EDGEWOOD 26KW PV SOLAR MODULE LAYOUT

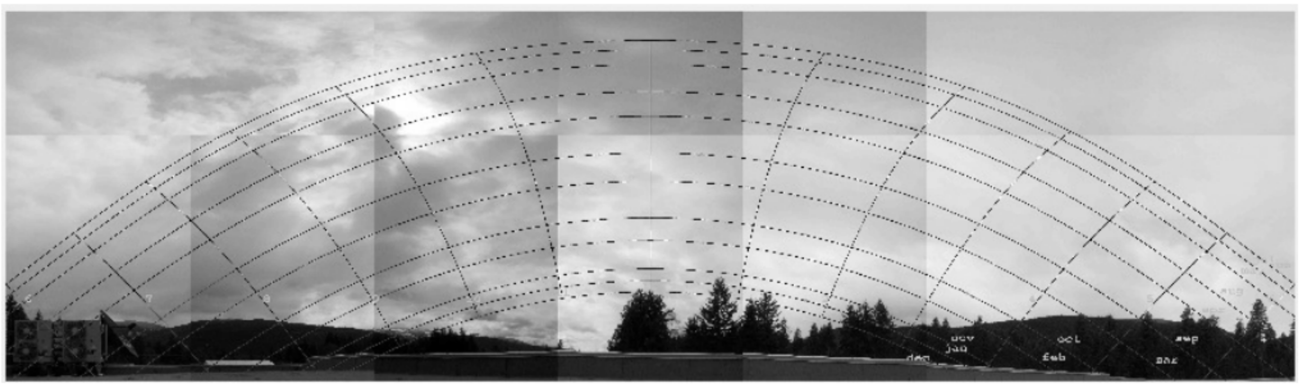
This system uses a ballasted mounting solution on two roof sections. Because the system is limited by the electrical supply, the layout was contained to the areas closer to the electrical room with the least amount of obstructions.The modules are mounted in landscape, south facing, and at a tilt angle of 10°. This system could also be done with a higher tilt angle and an increase foot print for the module area.

The azimuth angle is 15° (angle clockwise from true south). This has very little impact on the system production as most of the energy is gathered when the sun is high on the horizon.



EDGEWOOD 26KW PV SHADING LOSSES

There is some shading at this site from the satellite dish and the upper roof. There were areas to be avoided due to obstruction shading, such as behind the dish and near the HVAC equipment. The southern horizon image below shows the various times of day and months of the year where these losses will occur. The total annual losses for shading are 1.4%.



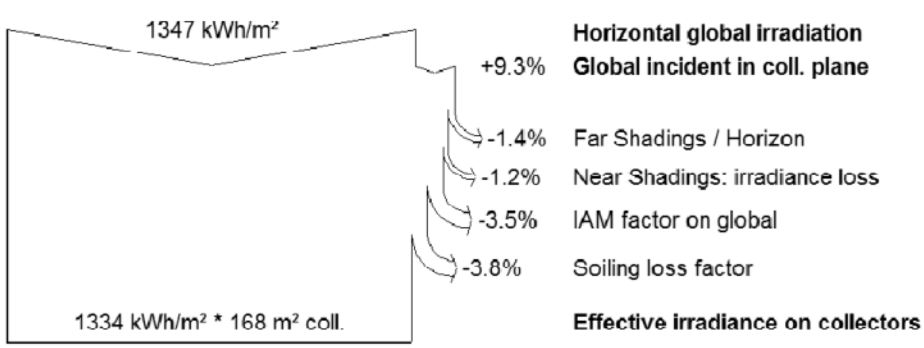
Beside the horizon, snow (soiling), temperature and other factors all affect the amount of sun available during the year. These factor have been taken into account in our analysis. The total losses for shading, temperature and snow coverage are9.9%.

PV Array loss factors

Array Soiling Losses

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
35.0%	12.0%	6.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	6.0%

Thermal Loss factor	Uc (const)	20.0 W/m²K	Uv (wind)	0.0 W/m²K / m/s
Wiring Ohmic Loss	Global array res.	88 mOhm	Loss Fraction	1.5 % at STC
Module Quality Loss			Loss Fraction	-0.8 %
Module Mismatch Losses			Loss Fraction	1.0 % at MPP
Incidence effect, ASHRAE parametrization	IAM =	1 - bo (1/cos i - 1)	bo Param.	0.05



EDGEWOOD 26KW PRODUCTION ESTIMATE

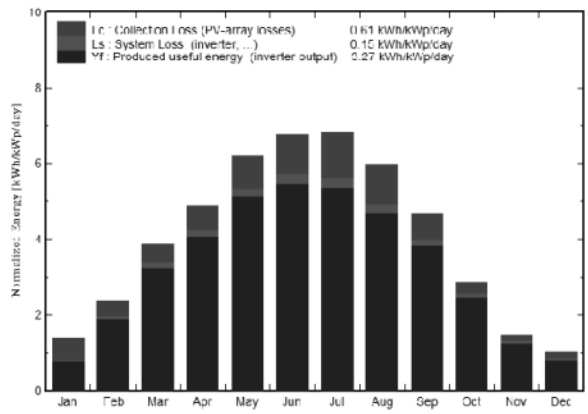
When all the factors above are used to reduce the amount of sunlight available for the area, we can then apply this to the equipment selected. This results in an annual electricity productionof 31,060 kWh/year. This is 33.4% of the total consumption at the site.

Main simulation results

System Production

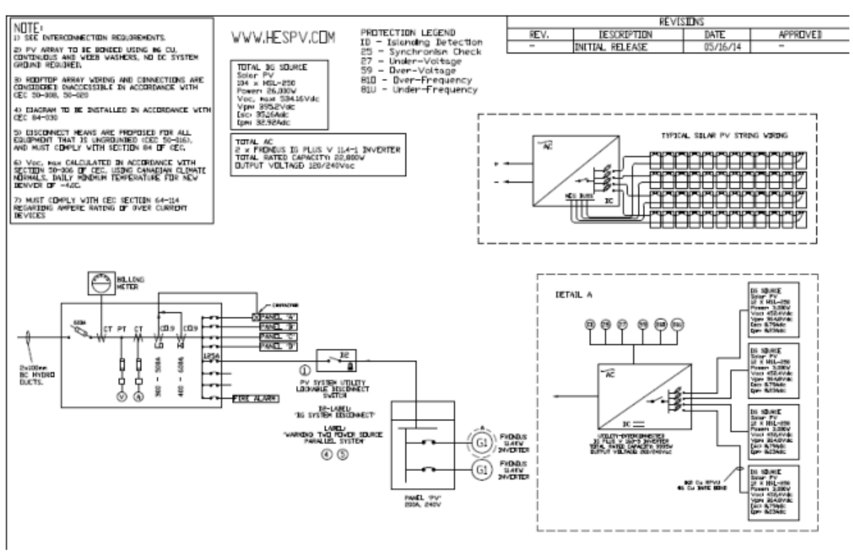
Produced Energy	**31.06 MWh/year**	Specific prod.	1195 kWh/kWp/year
Performance Ratio PR	81.1 %	Solar Fraction SF	21.0 %

Normalized productions (per installed kWp): Nominal power 26.00 kWp



EDGEWOOD 26KW ELECTRICAL

This system is unique as the building is only 240V single phase. This is the major limiting factor for this site, however it allows the inverters to connect directly into the existing system. This limits the system size, but avoids the cost of adding an additional transformer.

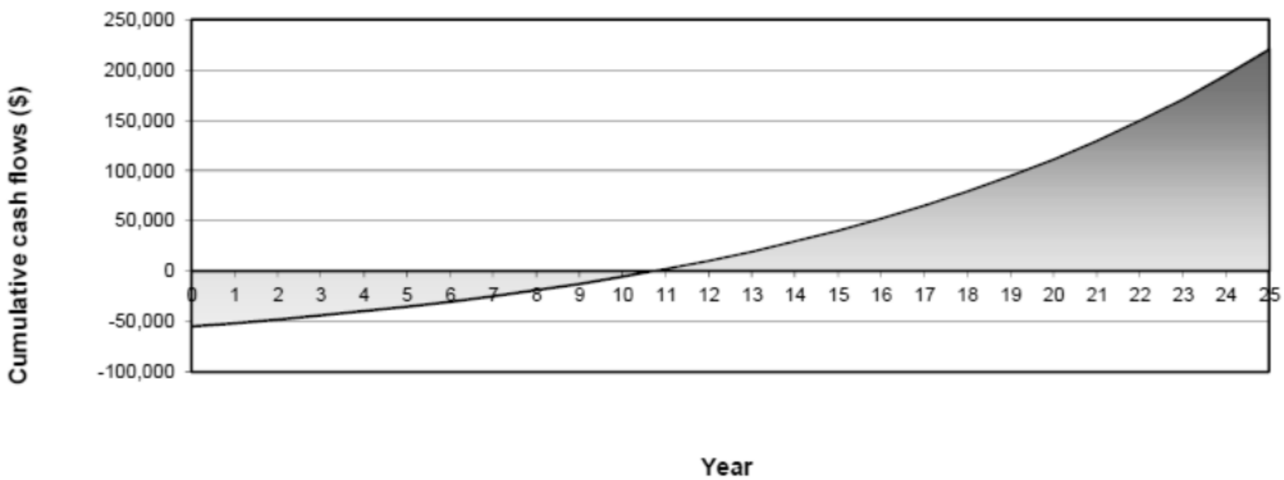


EDGEWOOD 26KW COST ESTIMATE & PAYBACK

Below is the breakdown for the different components of the system based on prices available in Canada today. This system has a cost advantage because of the proximity of the solar array to the inverters and then onto the electrical room.The cost of the transformer is also avoided.

Solar PV Modules	$ 19,356.00
Inverter	$ 6,370.00
Mounting System	$ 12,235.00
Construction	$ 15,909.00
Monitoring	$ 490.00
Totals	$ 54,693.00
Wattage	26,000
Price/W	$ 2.10

The payback for this system is just over 10 years.The current cost of power was taken from the 2013 utility bills step 2 rate as this is what the energy reductions would be applied to. The inflation rate over the 25 year life is unknown, so we assume 9% for this study.



NOTES ON EQUIPMENT

SOLAR MODULES

When considering solar panels for your Canadian grid tie system there are a few main things to consider. All electrical equipment must have Canadian certifications (CSA, ETLc or ULc test to ULC ORD 1703). Price will vary depending on the certifications and quality of manufacturing. Most solar panels sold in Canada have a 10-12 year workmanship warranty and a 25 year power output warranty. When selecting a solar module for your project, careful consideration should be given to the details of the warranty and the stability/bankability of the company providing it. You want to know if you have problems in 10, 15 or 25 years that the company will still be around. Brands preferred for their bankability, quality, performance, and warranty are Hanwha Solar and Sharp Solar. For this feasibility we selected the Hanwha HSL-250-60P, 250W, 60 cell solar module.

Typical features of modern solar panels include:

- 60 or 72-cell, 250 or 310 watt power output
- 2 x 1 meter area
- Hail resistant tempered glass surface
- Corrosion resistant aluminum frame
- Warranty - 25 year output and 12 year workmanship

INVERTERS

As with solar panels, when choosing an inverter manufacturer you are required to choose a product that has Canadian certifications (CSA 22.2 107.1). It is also important to choose a manufacturer that has been around for a long time and will stand the test of time. Typical grid-tie inverters have warranties between 10 and 25years.There are two main options available for grid tie power inverters meeting these small systems size requirements. One option is micro-inverters that mount to the back of each solar panel on the roof. The other option is string inverters, which are typically mounted in a central location near the main panel in the electrical room. They can both be wired in single-phase (120/240V) or three-phase (120/208V). With string inverters your solar modules must be grouped (strung in series) and the group is wired back to the central location. String Inverters cost less and are more durable, but have a lower warranty and don't perform as well in shaded conditions. Micro Inverters may cost more, but can offer improved performance in shaded areas. Both micro inverters and string inverters have monitoring systems available. Brands preferred for their quality, performance, and warranty are Enphase micro inverters and as well as Fronius, Power-One and SolarEdge string inverters. For this feasibility study we selected Fronius string inverters.

SOLAR PANEL MOUNTING SYSTEM

Two types of tilt mounting systems are appropriate for flat roofs: penetrated vertical roof mounting and ballasted floating roof mounting.Vertical roof mounts are adjustable with tilt angles up to 45 degrees for maximum solar performance. They attach to roof decking with user provided roof jacks, or beams attached to the structure, and support single panel rows in portrait. Floating roof mounting is a non-penetrating ballasted mounting system that typically weighs less than 5 lbs/ft^2. These systems are modular, and provide layout flexibility on roofs with vents, skylights, and HVAC systems. They are typically available in tilt angles of 10 to 20 degrees. For this feasibility study we have selected a ballasted floating roof mount. There may be cost saving opportunities for the areas where a new roof surface is required and can incorporate the attachment points for the penetrated roof system.

MONITORING

Monitoring systems for schools tend to be quite important as the grid tie system is often incorporated into students' lessons to create awareness regarding how much power the system is producing (daily/annually), how much carbon the array is offsetting, as well as how much the array is offsetting the utility bill.Typical monitoring systems include system level data and production figures that can be viewed as a web page. With this feature, each system can be monitored from any computer with an internet connection.

NOTES ON INSTALLATION

Wiring Methods

All wiring methods and materials should conform to the Canadian Electrical Code. All exterior electrical runs should be in rigid steel conduit, or Tech cable. Careful consideration on aesthetics and longevity will dictate material choices. All conductors should be sized to minimize system losses due to voltage drop. All equipment, switches, and conductors should be permanently and clearly labelledwith weatherproof labels (e.g. plastic lamacoid).

Rooftop wiring should be supported in cable tray on top of Durabloc stands. Within the array, RPVU flexible cables can be used for interconnecting he modules.

Roof Protection Details

Ballasted racking systems do not penetrate roofs, and typically a layer of material is placed between the roof deck and the roof blocks to prevent damage to the roof. Walkways should be installed between the PV arrays during installation to protect the roof from foot traffic. If penetrations are required, they would need to be done by a qualified roofing contractor that can maintain the existing warranty of the roof.

CONSIDERATIONS

Structural Considerations

General loading capacities of each roof should be verified. Ballasted mounting systems have roof-loads varying from 3.5 to 5.0 psf. The structural integrity and the roofs ability to handle the additional load would need to be verified prior to installing a system.

LABOUR Considerations

The labour cost component of these installations can be high. We have assumed that SD10 could use the installation as a training program for students. These students would gain experience and understanding of the PV industry best practices for installing. Each student would also receive their certification or roof safety and fall arrest. These students would not only gain additional skills, but would develop an appreciation for PV technology and the system that they helped install.

COST Considerations

Cost estimates may vary due to the cost of component transportation, labour and final selection of equipment or methods. The prices we have used for the equipment assumes that the systems would be all purchased at the same time, allowing for bulk discounting. Since the installation period is unknown, the equipment selection, pricing and shipping points may change. We have assumed prices based on the most common components available and have not included the freight values to Nakusp.

Ministry of Education
Resource Management Division

Submission Date (yyyy-mm-dd)	09-01-2015
School District Ref. No.	10-0002

CNCP Project Proposal - 2015/16 Call for Projects

Project Data Sheet (complete one per proposal and attach supporting documentation)

Project Identification

School District No. / Name: School District #10 (Arrow Lakes)

Facility No. / Name: Nakusp Elementary School

Facility Street Address: 619A 4th Street NW — Municipality: Nakusp

Project Contact

Name: Art Olson — Phone: 250 265 1075 — Email: art.olson@sd10.bc.ca

Project Description: Purchase and installation of 13 kW DC Photovoltaic (PV) system.

Other Program Links: AFG

Project Benefits: Reduced operating costs for electricity (building) and fuel costs (grounds keeping equipment).
Opportunities for reduced Greenhouse Gas emissions including rechargeable power tools and electric vehicles.
Learning opportunities for students related to installing PV system, monitoring PV system on an on-going basis, environmental learning regarding solar energy systems.

Project Costs

Total Project Cost ($)	$25,453
CNCP Funding ($)	$12,726
School District Funding ($) *	$12,727
Third Party Funding ($) *	
Total Funding ($)	$25,453
Surplus/Shortfall ($)	$0

*** Other Funding Sources**: There may be a potential for additional funding from Columbia Basin Trust related to student education

School District Funding Proportion (%)	50.00%
Third Party Funding Proportion (%)	0.00%

Energy Cost Savings

Annual Fuel Cost Savings ($)	
Annual Electricity Cost Savings ($)	$2,670
Total Annual Energy Cost Savings ($)	$2,670

Stationary GHG Emissions

2014 SmartTool Emissions (TCO2e)	247.41

Energy and Emission Reductions

Fuel Type	01. N/A
Annual Fuel Usage Reduction (GJ)	
Annual Avoided Emissions (tCO2e)	0.000
Electricity Supplier	03. BC Hydro
Annual Electricity Usage Reduction (kWh)	17154
Annual Avoided Emissions (TCO2e)	0.17154
Total Annual Avoided Emissions (TCO2e)	0.17
Annual Emissions Reduction from 2014 (%)	0.07%
Annual Avoided Carbon Offsets ($)	$4
Payback Period (years)	9.5

Project Information

Facility Condition Index	0.34
Capacity	20K/150E
Grades	K-7

Enrolment

Current	2014/15	165
Projected	2015/16	165
	2016/17	165
	2017/18	165
	2018/19	165

Consultant Reports

Energy Study Date	(yyyy-mm-dd)	2014-12-21
Mechanical Study Date	(yyyy-mm-dd)	N/A

Technology Industry-Proven? (Y/N)	Y
Technology Previously Used by SD? (Y/N)	N

Current Project Stage

Concept (%)	100
Design (%)	100
Tender (%)	0

Project Start Date	(yyyy-mm-dd)	2015-06-01
Project Completion Date	(yyyy-mm-dd)	2015-06-30

Additional Comments
The proposed PV system at LESS and NES is aimed at reducing escalating electricity costs and reducing greenhouse gas emissions. The attached consultant report indicates a [potential] payback for NES of less than 10 years. Resulting electricity savings will be applied to future energy reduction initiatives. Students will be involved in the installation of the proposed system and will be involved in monitoring the system on an on-going basis.

Project Proposal Prepared by:
Susan Brenna-Smith
Ph: 1 250 265 3638 X3916
Fax: 1 250 265 3701
Email: susan.brenna-smith@sd10.bc.ca

Consultant Report Contact:
Ed Knaggs P.Eng.
Ph: 1.866.258.0110 ext 201
Fax: 1.866.437.5531
Victoria-Edmonton-Calgary-Barrie-Toronto-Montréal
Web: www.hespv.ca
Email: eknaggs@hespv.ca

Ministry of Education
Resource Management Division

Submission Date (yyyy-mm-dd)	09-01-2015
School District Ref. No.	10-0001

CNCP Project Proposal - 2015/16 Call for Projects

Project Data Sheet (complete one per proposal and attach supporting documentation)

Project Identification

School District No. / Name	School District #10 (Arrow Lakes)
Facility No. / Name	Lucerne Elementary Secondary School
Facility Street Address	604 7th Avenue
Municipality	New Denver

Project Contact

Name: Art Olson | Phone: 250 265 1075 | Email: art.olson@sd10.bc.ca

Project Description	Purchase and installation of 36 kW DC Photovoltaic (PV) system.
Other Program Links	AFG
Project Benefits	Reduced operating costs for electricity (building) and fuel costs (grounds keeping equipment). Opportunities for reduced Greenhouse Gas emissions including rechargeable power tools and electric vehicles. Learning opportunities for students related to installing PV system, monitoring PV system on an on-going basis, environmental learning regarding solar energy systems.

Project Costs

Total Project Cost ($)	$74,200
CNCP Funding ($)	$37,100
School District Funding ($) *	$37,100
Third Party Funding ($) *	
Total Funding ($)	$74,200
Surplus/Shortfall ($)	$0

*** Other Funding Sources**: There may be a potential for additional funding from Columbia Basin Trust related to student education.

School District Funding Proportion (%)	50.00%
Third Party Funding Proportion (%)	0.00%

Energy Cost Savings

Annual Fuel Cost Savings ($)	
Annual Electricity Cost Savings ($)	$6,940
Total Annual Energy Cost Savings ($)	$6,940

Stationary GHG Emissions

2014 SmartTool Emissions (TCO2e)	143.14

Energy and Emission Reductions

Fuel Type	01. N/A
Annual Fuel Usage Reduction (GJ)	
Annual Avoided Emissions (tCO2e)	0.000
Electricity Supplier	03. BC Hydro
Annual Electricity Usage Reduction (kWh)	45248
Annual Avoided Emissions (TCO2e)	0.45248
Total Annual Avoided Emissions (TCO2e)	0.45
Annual Emissions Reduction from 2014 (%)	0.32%
Annual Avoided Carbon Offsets ($)	$11
Payback Period (years)	10.7

Project Information

Facility Condition Index	0.48
Capacity	20K/125E/125S
Grades	K-12

Enrolment

Current	2014/15	96
Projected	2015/16	96
	2016/17	96
	2017/18	96
	2018/19	96

Consultant Reports

Energy Study Date	(yyyy-mm-dd)	2014-12-21
Mechanical Study Date	(yyyy-mm-dd)	N/A

Technology Industry-Proven? (Y/N)	Y
Technology Previously Used by SD? (Y/N)	N

Current Project Stage

Concept (%)	100
Design (%)	100
Tender (%)	0

Project Start Date	(yyyy-mm-dd)	2015-06-01
Project Completion Date	(yyyy-mm-dd)	2015-06-30

Additional Comments

The proposed PV system at LESS and NES is aimed at reducing escalating electricity costs and reducing greenhouse gas emissions. The attached consultant report indicates a [potential] payback for LESS of less than 11 years. Resulting electricity savings will be applied to future energy reduction initiatives. Students will be involved in the installation of the proposed system and will be involved in monitoring the system on an on-going basis.

Project Proposal Prepared by:

Susan Brenna-Smith
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Fax: 1 250 265 3701
Email: susan.brenna-smith@sd10.bc.ca

Consultant Report Contact:

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Fax: 1.866.437.5531
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