SOLAR ELECTRIC SITE ANALYSIS

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Prepared for:
City of Port Alberni

viridian energy co-operative

SOLAR ELECTRIC SITE ANALYSIS

Methodology

The solar electric analysis was completed Viridian Energy Co-Operative using on site building measurements, site specific shading measurement and building electrical analysis. This was combined with satellite imagery, modeled with the assistance of Helioscope[1] software from Folsom Labs and the System Advisor Model (SAM) from the National Renewable Energy Laboratory[2].

The energy model and financial savings from the model were then combined with budgetary project estimates prepared by Viridian Energy Co-Operative to create the results of this preliminary analysis. Budgetary project estimates include all materials and labor for solar installation, commissioning and electrical permitting. **They do not include any structural engineering, building/roof upgrades, or building permits that may be required.**

Individual electricity consumption and BC Hydro rates were used for each building analysis allowing for building specific rate offsets to be applied to the financial return model. This allows for building specific comparisons since each buildings rates and consumption differ, resulting in different potential financial return. Some buildings have complex rates structures with fluctuating baselines and variable tiered rates and demand charges. In these cases, an average rate was used.

Climate data used is a typical year with mean solar insolation for Port Alberni, BC. The real energy production will vary based on the amount of sun in that month. BC Hydro load data was taken from the most recent year of BC Hydro bills (2015). Annual differences in energy consumption are expected based on weather.

A 30 year lifespan is used for energy and financial modeling for this analysis. Solar panel performance warranties are typically 25 years with modules expected to last 30+ years. The following parameters were used for all of the analysis'.

Annual System Energy Parameters

5% Soiling Losses
4.44% Total DC Power loss
1% AC losses
Lifetime Degradation 0.8%/year

Energy Rate Parameters

BC Hydro Published Electricity rate for Commercial Services (Building Specific)
2.5%/year beyond known rate increases

[1] https://helioscope.folsomlabs.com/
[2] National Renewable Energy Laboratory - https://sam.nrel.gov/

2.5% Inflation
Energy Consumption data based on BC Hydro Bills provided by Port Alberni City

BUILDING SUMMARY

Large Scale Energy Production Sites

Building	Industrial Heritage	Glenwood	Multiplex
Proposed System Size (kW)	108.54	82.08	106.47
Building Annual Energy Consumption (kWh)	71,269	47,530	1,421,880
System Cost	$290,766	$209,915	$285,276
30 Year Internal Rate of Return (%)	4.19%	4.44%	4.58%
Average Annual Building Energy Offset (%)	158%	178%	8%
30 Year Energy Production (MWh)	3,391	2,544	3,341
Cost per kWh (lifetime LCOE[3])	$0.086	$0.083	$0.085

Solar Demonstration Sites

Building	Quay	Gyro Park	City Hall
Proposed System Size (kW)	34.7	10.71	42.5
Building Annual Energy Consumption (kWh)	38,108	14,832	159,590
System Cost	$99,165	$28,163	$113,797
30 Year Internal Rate of Return (%)	3.44%	4.59%	3.78%
Average Annual Building Energy Offset (%)	89%	74%	26%
30 Year Energy Production (MWh)	1,020	330	1,251
Cost per kWh (lifetime LCOE)	$0.097	$0.085	$0.091

[3] Levelized Cost of Energy

GLENWOOD BUILDING
4480 VIMY ST. PORT ALBERNI BC

Summary

The Glenwood building is a large flat roof building with a membrane roof with clear south facing exposure. This building roof is ideal for rows of rack mounted solar arrays as there are few if any obstructions.

Preliminary analysis shows that approximately 304 60-cell 270W solar panels can fit on the roof with a Nominal Peak Wattage of 82kW of solar power.

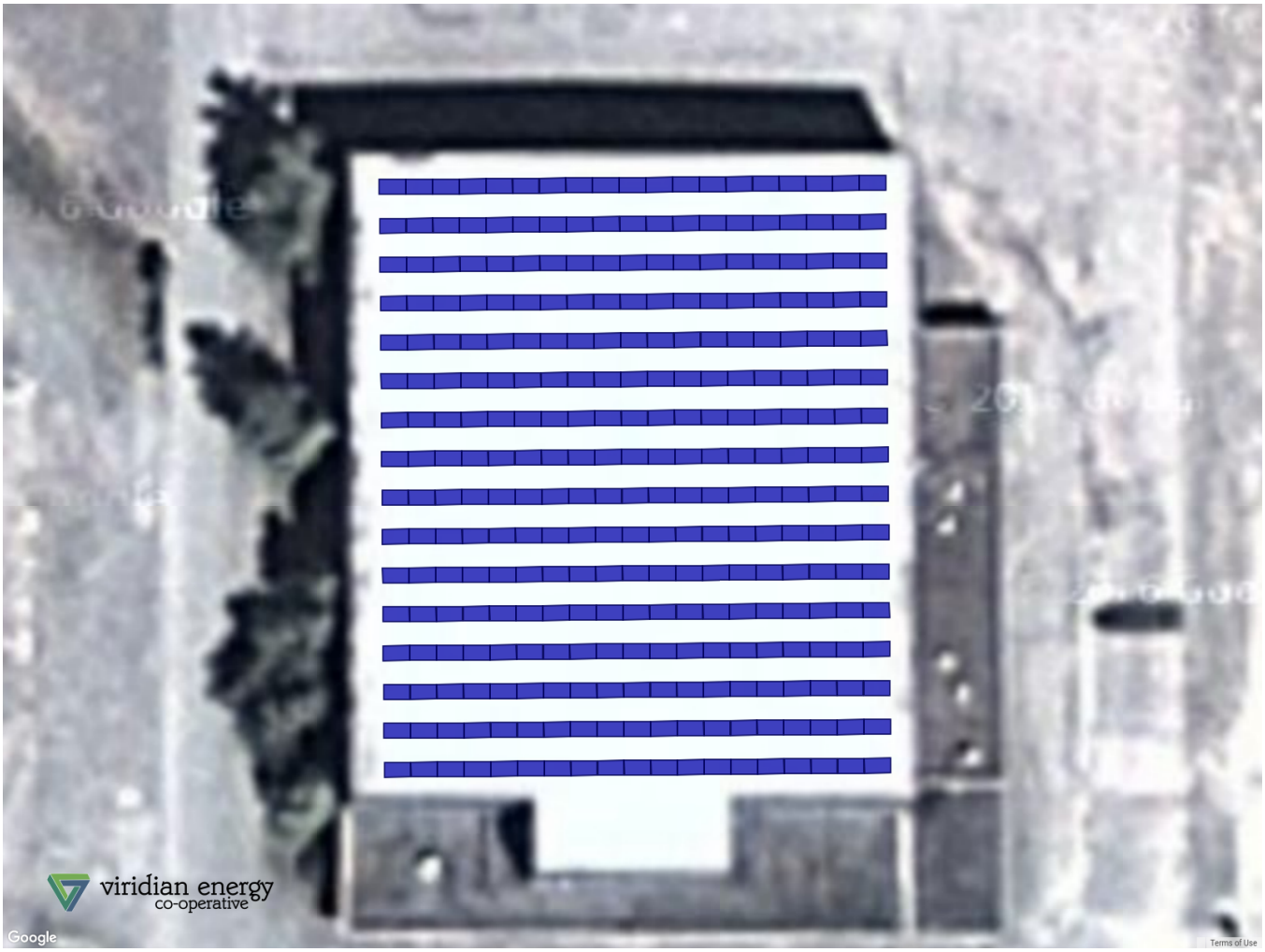


FIGURE 1 GLENWOOD ROOFTOP

Electrical Generation

Figure 2 shows comparison of the modeled energy production versus 2015 electricity consumption. Solar power generation at the Glenwood building far exceeds current energy demand. In this case, excess

annual energy would be expected to be bought by BC Hydro under the net metering program[4] at its current purchase rate of $0.099/kWh. The model estimates an average of 84,800kWh of electricity production per year in the 30+ year lifespan of the system, offsetting approximately 178% of the building's annual electricity use each year.

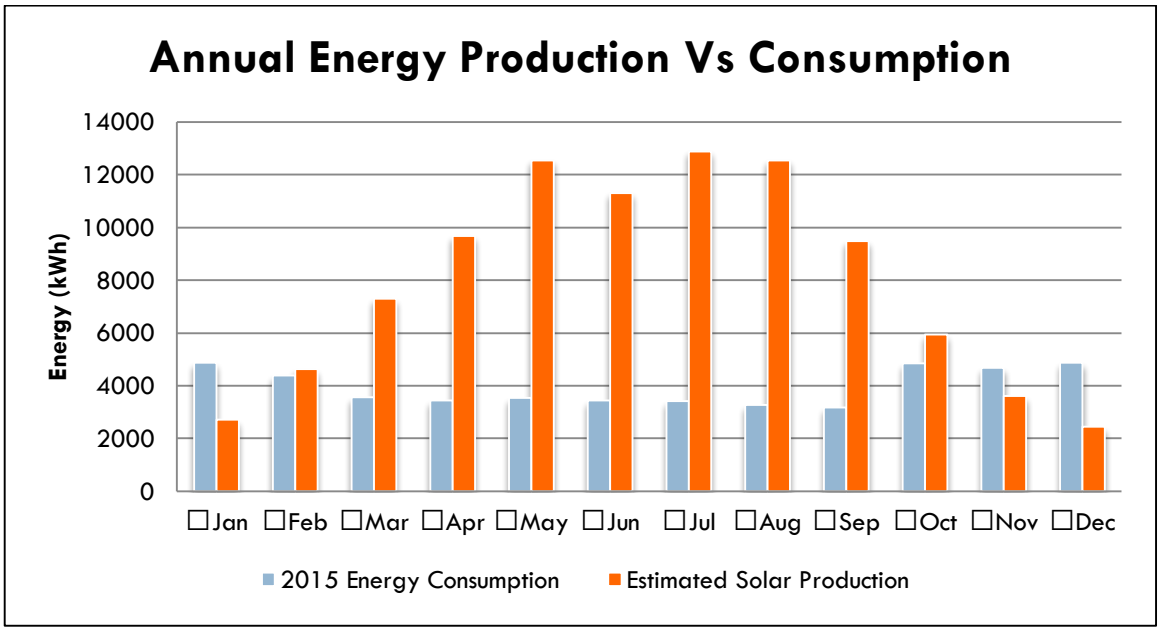


FIGURE 2 SYSTEM OUTPUT VERSUS ELECTRICITY CONSUMPTION

Financial Summary

Proposed System Size (kW)	82.08
Building Annual Energy Consumption (kWh)	47,530
System Cost	$209,915
30 Year After Tax ROI (%)	4.44%
Average Annual Building Energy Offset (%)	178%
30 Year Energy Production (MWh)	2,544
Cost per kWh (lifetime LCOE)	$0.083

[4] https://www.bchydro.com/energy-in-bc/acquiring_power/current_offerings/net_metering.html

INDUSTRIAL HERITAGE CENTER
3250 9TH AVENUE N., PORT ALBERNI, BC

Summary

This large complex housed the former curling arena and now hosts the Industrial Heritage society. This building has ample roof space for several large solar arrays. While the building is older, it appears structurally sound and in good condition[5]. Because of its former use as a Curling Arena it has the necessary electrical capacity to host a large photovoltaic array.

Preliminary analysis shows that approximately 402 60-cell 270W solar panels can fit on the roof with a Nominal Peak Wattage of 109kW of solar power. This building in faces no shading, excellent south facing solar exposure and excellent visibility from the park and surrounding area.

There are two main areas for the panels. The south facing cylindrical roof of the main building and the flat roof of the adjoining building.

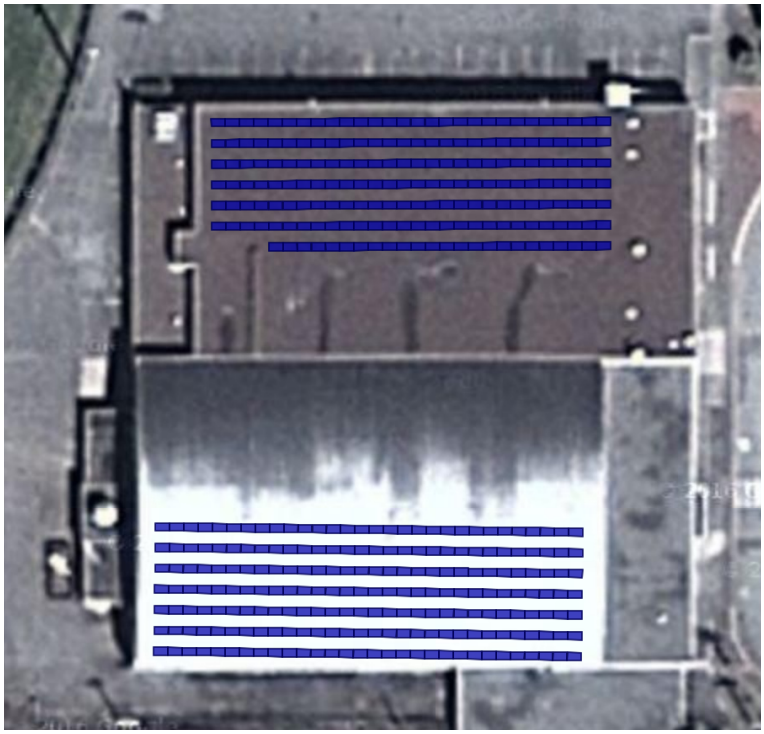


FIGURE 3 INDUSTRIAL HERITAGE BUIDLING

Electrical Energy Generation

[5] Subject to structural engineering review if this is selected as a candidate for solar.

The preliminary analysis shows energy production and consumption as show in the following chart. The model estimates an average of 113,000Wh of electricity production per year in the 30+ year lifespan of the system, offsetting approximately 158% of the building's annual electricity use each year.

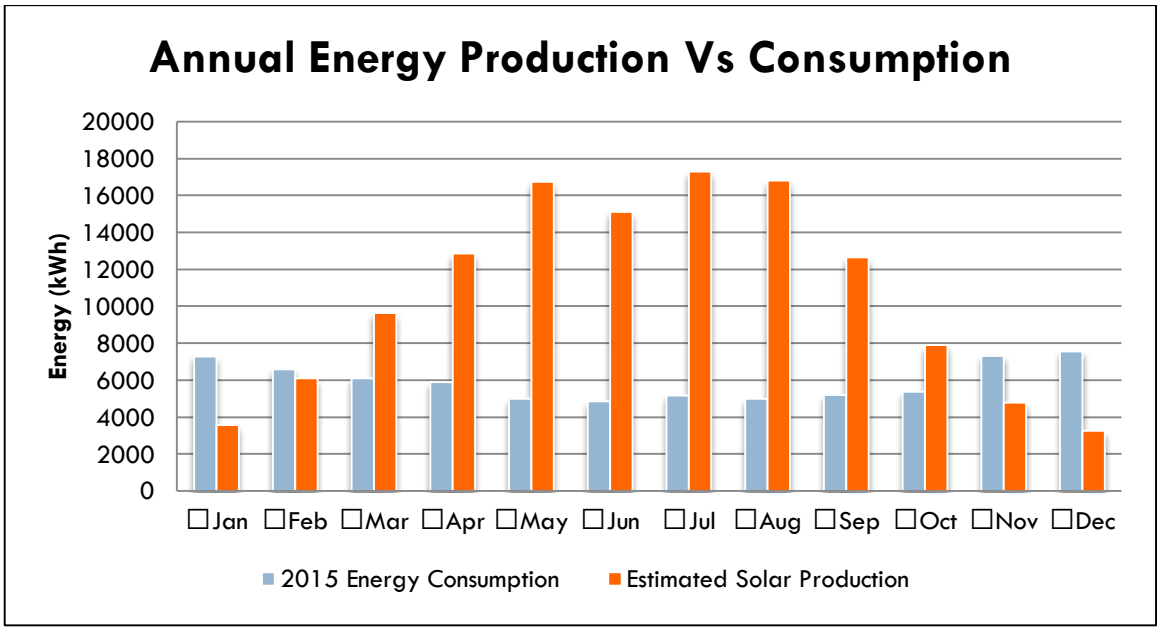


FIGURE 4 SYSTEM OUTPUT VERSUS ELECTRICITY CONSUMPTION

Financial Summary

Proposed System Size (kW)	108.54
Building Annual Energy Consumption (kWh)	71,269
System Cost	$290,766
30 Year After Tax ROI (%)	4.19%
Average Annual Building Energy Offset (%)	158%
30 Year Energy Production (mWh)	3,391
Cost per kWh (lifetime LCOE)	$0.086
Cost/Watt	$2.68

ALBERNI VALLEY MULTI-PLEX
3737 ROGER STREET PORT ALBERNI BC

Summary

The Alberni Valley Multi-plex is one of the largest single structures in the valley and a prime location for solar electricity. The flat roof has room for a sizeable array. Although not included as part of the initial assessment because of the aging roof, it has been included here because once the roof is updated it presents one of the prime locations for a solar electric generation project.

Preliminary analysis shows that approximately 338 72-cell 315W solar panels can fit on the west section for the roof with a Nominal Peak Wattage of 106kW of solar power. This building has a flat tar and gravel roof with no shading and excellent south facing solar exposure.

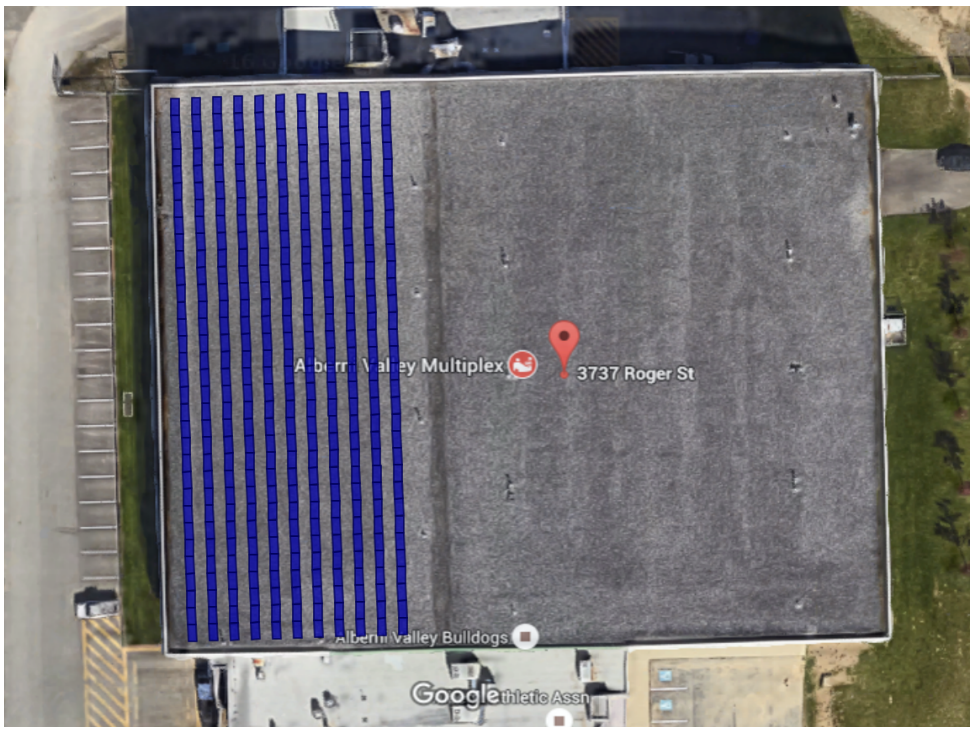


FIGURE 5 SOLAR PV ARRAY LAYOUT

Electricity Generation

The model estimates an average of 111,000Wh of electricity production per year in the 30+ year lifespan of the system, offsetting approximately 8% of the building's annual electricity use each year.

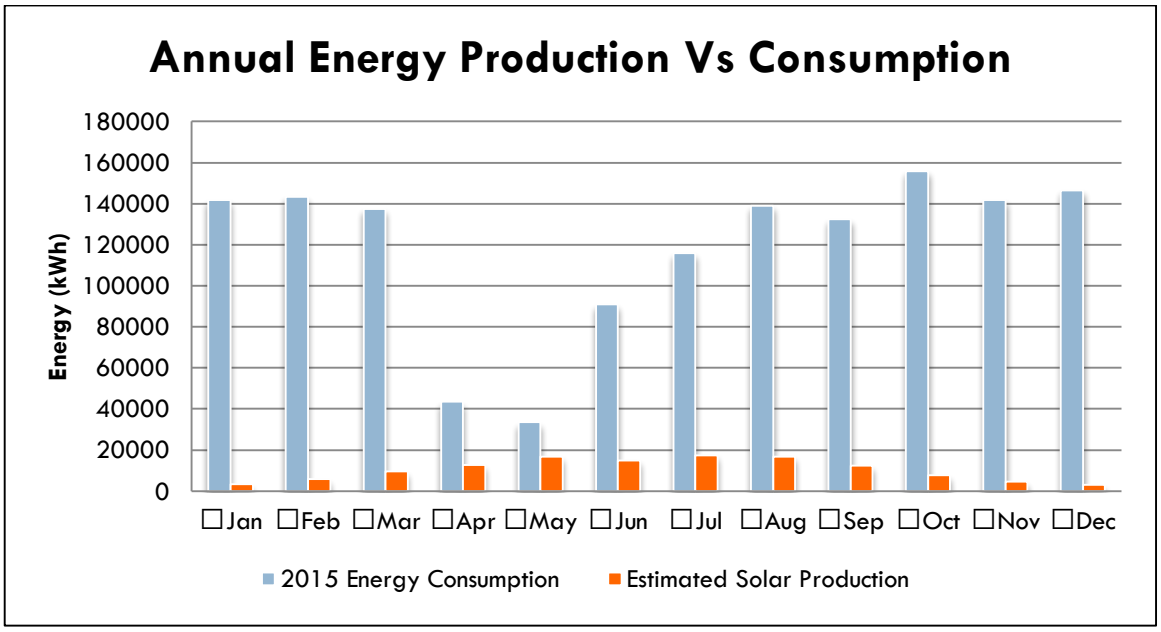


FIGURE 6 SYSTEM OUTPUT VERSUS ELECTRICITY CONSUMPTION

Financial Summary

Proposed System Size (kW)	106.47
Building Annual Energy Consumption (kWh)	1,421,880
System Cost	$285,276
30 Year After Tax ROI (%)	4.58%
Average Annual Building Energy Offset (%)	7.83%
30 Year Energy Production (MWh)	3,341
Cost per kWh (lifetime LCOE)	$0.085

ALBERNI VALLEY QUAY

5440 ARGYLE STREET PORT ALBERNI BC

Summary

The Alberni Valley Quay is an excellent solar demonstration area and has several suitable rooftops for solar generation. These include the main commercial building at the round-about and the covered-walkway.

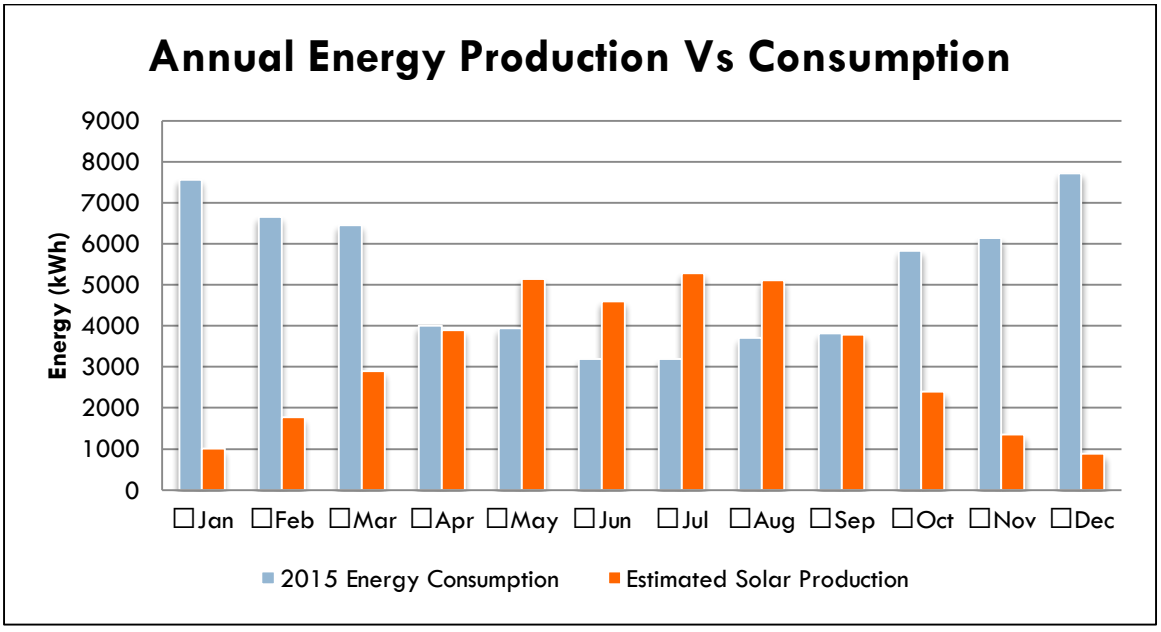
The commercial building has a south-west orientation. There are several deciduous trees along the walkway but as long as kept pruned will not offer any significant shading to the proposed array. Initial assessment shows that 70 72-cell 315W modules will fit flush mount on the upper roof and along the upper portion of the main roof in a south-west orientation. These will offer good energy production for the building and excellent visibility.

The second location is along the covered walk-way to the south of the round-about overlooking the park and playground. This location fits 46 60-cell 275W modules along the walkway roof on the south and west roof and offers good energy production and excellent visibility in this area.

The total nominal peak power from this combined location is 34.7kW.

Electricity Generation

The model estimates an average of 33,000Wh of electricity production per year in the 30+ year lifespan of the system, offsetting approximately 89% of the building's annual electricity use each year.



Financial Summary

Proposed System Size (kW)	34.7

Building Annual Energy Consumption (kWh)	38,108
System Cost	$99,165
30 Year After Tax ROI (%)	3.44%
Average Annual Building Energy Offset (%)	89%
30 Year Energy Production (mWh)	1,020
Cost per kWh (lifetime LCOE)	$0.097
Cost/Watt	$2.86

PORT ALBERNI GYRO CENTER
3245 7TH AVE., PORT ALBERNI, BC

Summary

The Gyro Centre is a smaller building with a pitched roof and the potential for a small demonstration array similar in size to a large residential system that would make the average home in BC Net Zero energy.

Preliminary analysis shows that approximately 34 72-cell 315W solar panels can fit on the roof with a Nominal Peak Wattage of 10.7kW of solar power. This building in Gyro Park faces no shading and the upper park offers an excellent view of the array.

FIGURE 7 GYRO PARK BUILDING

Electrical Generation

The model estimates an average of 11,000Wh of electricity production per year in the 30+ year lifespan of the system, offsetting approximately 75% of the building's annual electricity use each year. This is very close to a residential home use and an example of near net-zero offset.

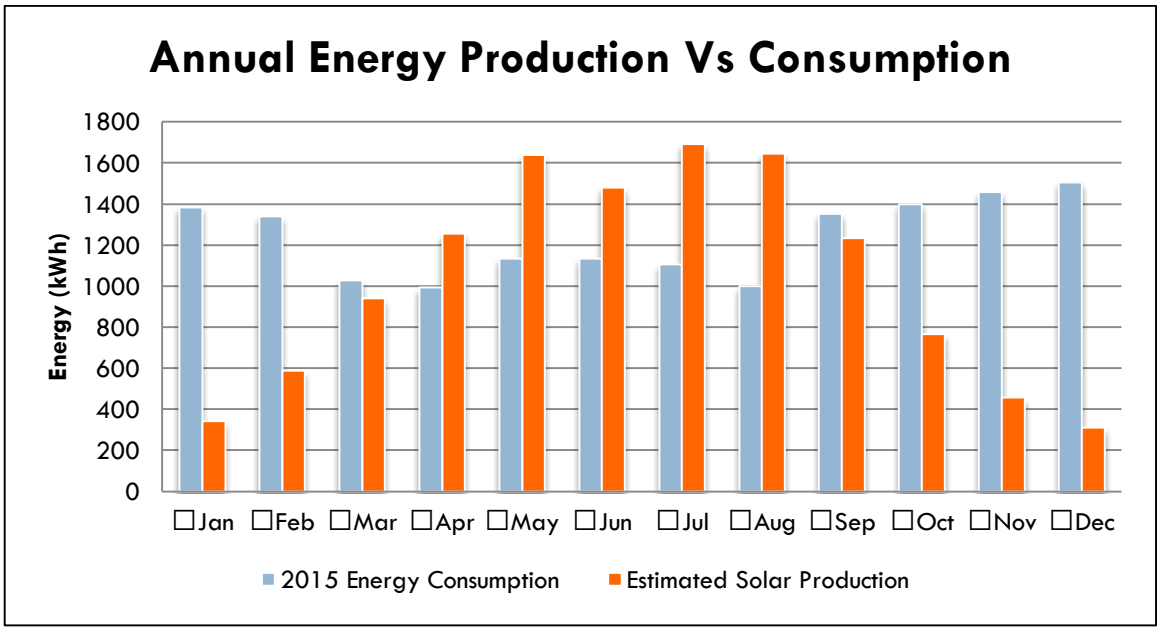


FIGURE 8 SYSTEM OUTPUT VERSUS ELECTRICITY CONSUMPTION

Financial Summary

Building	Gyro Park
Proposed System Size (kW)	10.71
Building Annual Energy Consumption (kWh)	14,832
System Cost	$28,163
30 Year After Tax ROI (%)	4.59%
Average Annual Building Energy Offset (%)	74%
30 Year Energy Production (mWh)	330
Cost per kWh (lifetime LCOE)	$0.085

PORT ALBERNI CITY HALL
4850 ARGYLE ST. PORT ALBERNI, BC

Summary

The Port Alberni City Hall building features a flat roof with ample space for a roof mounted array. Although there are several heat-pumps and roof vents, there are adequately large areas for several solar arrays. There is little to no shading on the roof and the solar array can be oriented to south for maximum solar energy production.

Preliminary analysis shows that approximately 135 72-cell 315W solar panels can fit on the roof with a Nominal Peak Wattage of 42.5kW of solar power.

FIGURE 9 SOLAR PV ARRAY LAYOUT

Electrical Generation

The model estimates an average of 42,000kWh of electricity production per year in the 30+ year lifespan of the system, offsetting approximately 26% of the building's annual electricity use each year.

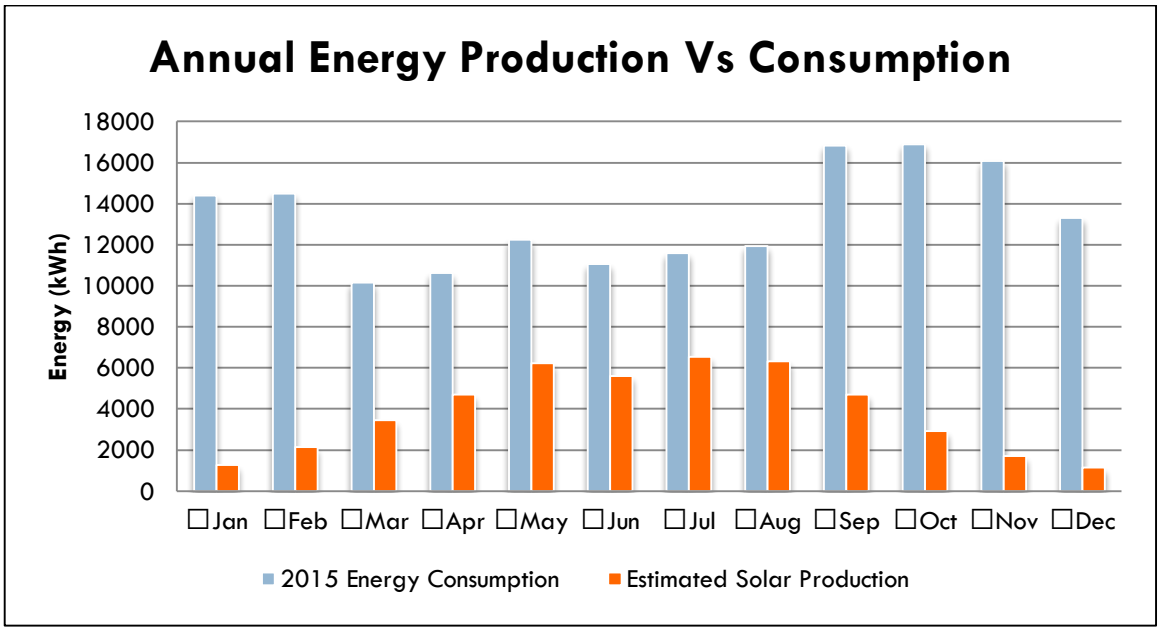


FIGURE 10 SYSTEM OUTPUT WITH 43.2 KW SOLAR PV ARRAY

Financial Summary

Proposed System Size (kW)	42.5
Building Annual Energy Consumption (kWh)	159,590
System Cost ($)	$113,797
30 Year ROI (%)	3.78%
Average Annual Building Energy Offset (%)	26%
30 Year Energy Production (MWh)	1,250
Cost per kWh (lifetime LCOE)	$0.091

Appendix