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A Review of Grid Connected Solar PV Installation Feasibility for Selected SLRD and Community Facilities in Gold Bridge and Bralorne, BC

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1. Executive Summary

Riverside Energy Systems was asked by the SLRD to review 9 sites in the communities of Gold Bridge and Bralorne for solar PV system feasibility. In 8 cases, reviews were in consideration of possible grid-connected solar PV system implementations. The 9th case was regarding a need for equipment backup power during grid outages for Minto Communications; the community internet provider.

Based on our review we recommend the following as the most promising sites to consider for grid-connected solar PV projects:

- Gold Bridge Transfer Station
- Gold Bridge Fire, Library, Post Office Complex
- Haylmore Heritage Site
- Gold Bridge Community Club Facility
- Bralorne Bridge River Community Church

We further recommend the following project approaches as immediate strategies to consider with additional detail provided in Appendix B.

a) **6 kW ground mounted grid-connected solar system for the Gold Bridge Transfer Station at an estimated cost of $27,467.** The projected annual electrical harvest for this system is 6600 – 6900 kWh. Based on the 12 month electrical consumption figures provided for the transfer station (≈ 6070 kWh), solar production would result in the site meeting or exceed electrical net-zero operation. At 2015 rates, this installation would generate approximately $768 in energy savings and exported energy revenue in the first year of operation.

   For the financial scenarios considered, solar energy savings and revenues could lead to accumulated end-of-life net value of $18,000 - $46,000 with annualized lifetime ROI of 1.9% to 19.3%.

b) **6 kW roof mounted grid-connected solar system for the Gold Bridge Complex Building at an estimated cost of $27,603.** The projected annual electrical harvest for this system is 6300 – 6700 kWh. Based on the 12 month grid electrical consumption figures provided for the complex (≈ 29,000 kWh), the solar production should reduce site grid energy dependence consumption by about 23%. At 2015 rates, this installation would generate approximately $779 in energy savings in the first year of operation.

   For the financial scenarios considered, solar energy savings could lead to accumulated end-of-life net value of $24,000 - $58,000 with annualized lifetime ROI of 2.% to 24.2%.

c) **4 kW top-of-pole mounted grid-connected solar system for the Haylmore Heritage Site at an estimated cost of $19,908.** The projected annual electrical harvest for this system is 4000 – 4600 kWh. Based on the estimated 12 month grid electrical consumption projected in consultation with Mr. Sal Demare (≈ 3600 kWh), solar production would initially result in the site meeting or exceed electrical net-zero operation. This would change when site usage increases as hoped. At 2015 rates, this installation would generate approximately $502 in energy savings and exported energy revenue in the first year of operation.

For the financial scenarios considered, solar energy savings and revenues could lead to accumulated end-of-life net value of $8,300 - $23,000 with annualized lifetime ROI of 1.2% to 13.2%.

2. The Review Process

For each site we were asked to consider, the following steps were taken

2.1 Solar Photographic Assessment

Annual solar PV energy harvests available in a location depend not only on latitude and weather patterns, but also to a large extent on mountains, trees, buildings, and other potentially shade producing features of the site. Shading impacts are best evaluated using solar photography and shade analysis software. We performed photographic solar studies for all but the Bralorne Community Centre site. In each case, sites were scored for performance and effects of hypothetical remedial tree treatments assessed where appropriate.

2.2 Electrical Infrastructure Assessment

In order to grid connect a solar PV system, a site's electrical service hardware and capacity must be suitable. For all but one site we examined the electrical service configuration and capacity, to identify a suitable grid connection strategy for possible future solar PV system integration.

2.3 Solar PV Site Options and Projected Costs

Where a site's solar photographic results and electrical infrastructure were favourable, we next considered possible array size, racking strategies, structural concerns, security, etc. Solar PV options have been suggested with project designs and costing provided for the top 3 most promising sites.

3. Site Assessment Results

A total of nine potential SLRD and community facilities were considered in Gold Bridge and Bralorne as listed below:

SLRD Sites

- Gold Bridge Transfer Station
- Gold Bridge Water Pumping Station
- Gold Bridge Fire, Library, Post Office Complex
- Bralorne Water Pumping Station

Community Sites

- Gold Bridge Haylmore Heritage Site
- Gold Bridge Community Club
- Gold Bridge Minto Communications Facility
- Bralorne Community Hall
- Bralorne Bridge River Valley Community Church

i. Gold Bridge Transfer Station

This is an SLRD site which is staffed several days per week. The area is very open to the sun, and has several locations that could easily be levelled and prepared for ground mounted or top-of-pole solar array racking.

Solar photography was performed at three suitable locations described and analysed in pages 2 through 5 of Appendix A. Shading factors range from 0.91-0.92 scoring the site as having "Very Good" annualized sun exposure with 9% or less annual harvest losses due to shading.

A 100 Amp, 120/240 VAC electrical service panel located in the attendant's booth, has space for two additional double pole breakers. Up to 14 kW of single phase inverter capacity could be accommodated here without modifications. Required cable lengths are not problematic with the longest solar array cable being about 380 ft to location 2 at the north end of the transfer station.

Though we do not know the exact annual transfer station electricity consumption, we expect the site could produce considerably more solar electricity than required by local loads.

Because of very good shading scores, various suitable ground mounted array locations, appropriate electrical infrastructure, and good security, we consider the Gold Bridge Transfer station to be a very good candidate for a grid connected solar PV installation.

ii. Gold Bridge Water Pumping Station

This is an unstaffed SLRD site which is not fenced.

The property is quite small and quite heavily shaded by trees. There is a gravel pit which appears inactive to the north of the building which is somewhat more open to the sun.

Equipment is enclosed in a locked building which also houses a 200 A, 120/240 VAC electrical service panel with space for solar inverter connections.

Solar photography was performed at two locations; one heavily shaded near the building and a 2nd less shaded north of the building in the gravel pit area. These are described and analysed in pages 6 – 10 of Appendix A. Use of the 2nd location may not be viable as it is on property not owned by SLRD.

Shading factors are 0.64 “Undesirable” and 0.81 “Acceptable” for the two locations prior to any tree treatments. Following hypothetical tree topping described in Appendix A, site shading factors improve to 0.78 “Marginal” and

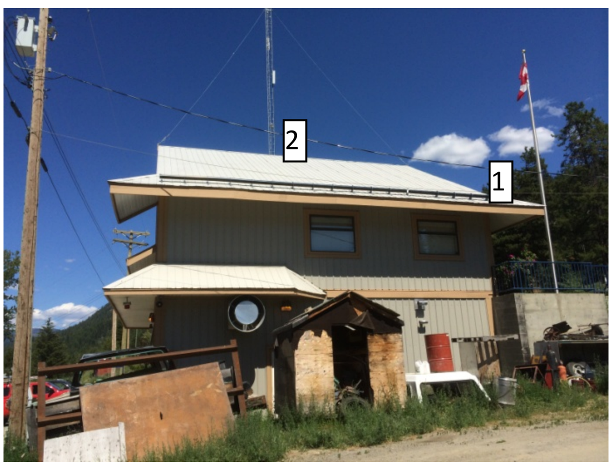
0.83 “Acceptable”. These treatments may not be desirable or possible since the trees in question may be outside the site property boundaries.

The site has good electrical capacity. However in our opinion, low shading scores, lack of available array locations within property boundaries, need for significant tree treatments, and relatively low security make the Gold Bridge Water Pumping Station a questionable choice for solar PV installation.

iii. Gold Bridge Fire, Library, Post Office Complex

This is a staffed, highly secure building in the centre of Gold Bridge, which is quite open to the sun. The metal roof as a fairly large SW facing section (azimuth 220 degrees) sloped at about 25 degrees off horizontal and to which a solar PV array could be secured.

Solar photography was performed at locations 1 low, and 2 high on the roof to determine worst and best case shading performance. Analysis is shown on pages 11-13 of Appendix A with resulting shading factors of 0.88 “Good” and 0.9 “Very Good” respectively. Harvest losses at azimuth 220 versus 180 (due south) are less than 4% so the orientation of the roof section will not be problematic.



The 200 Amp 120/240 VAC electrical service panel is located in the fire hall on the lower floor. The panel has a spare double pole breaker position to accommodate a solar inverter or to allow addition of a small sub-panel for the same purpose. There is suitable wall space for one or more string inverters near the electrical panel.

The roof structure is supported by trusses on 24 inch centres and sheeted with plywood. Metal roofing pans are screwed into the plywood sheeting.

Working from inside the attic, structural blocking could be added into which solar racking anchors could be secured from above using stainless steel hanger bolts. We do not recommend fastening solar anchors directly into roof trusses. Hanger bolt EPDM washers and metal roofing sealant would guard against roof membrane leaks.

Because of good shading scores, appropriate roof orientation and sub-structure, acceptable racking attachment options, suitable electrical infrastructure, and good security, we consider the Gold Bridge Complex building SW facing roof a good choice for a grid connected solar PV installation.

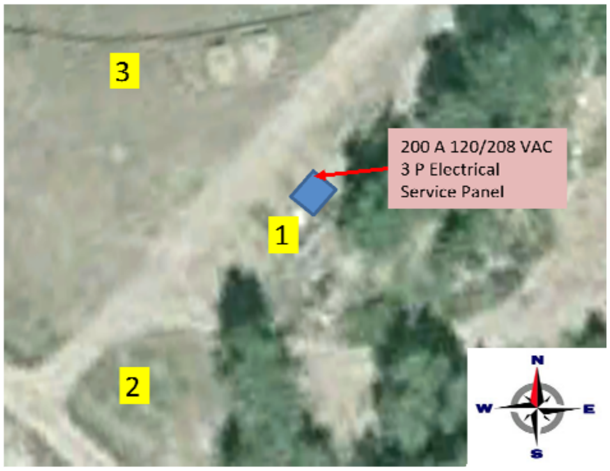
iv. <u>Bralorne Water Pumping Station</u>

This is an unstaffed and unfenced SLRD site.

The property is quite small and heavily shaded by trees. There is a ball diamond and grassy field the north, as well as a grassy road side section to the west of the building, both of which are somewhat more open to the sun than the pump building itself.

Equipment is enclosed in a locked building which also houses a 200 A, 120/208 VAC 3P electrical service panel with space for solar inverter connections.

Solar photography was performed at three locations; one heavily shaded near the building and the other two at less shaded locations north and west of the building. These are analysed in pages 14 - 20 of Appendix A. Use of the 2^{nd} and 3 rd locations may not be viable as they are on property not owned by SLRD.



Shading factors are 0.7 “Undesirable”, 0.79 “Marginal”, and 0.83 “Acceptable” for locations 1, 2, and 3 prior to any tree treatments. Following hypothetical tree topping described in Appendix A, site shading factors improve to 0.85 “Good”, 0.87 “Good”, and 0.86 “Good”. These treatments may not be desirable or possible since the trees in question may be outside the site property boundaries.

The site has good electrical capacity. However in our opinion, low shading scores, lack of available array locations within property boundaries, need for significant tree treatments, and relatively low security make the Bralorne Water Pumping Station a questionable choice for solar PV installation.

v. Gold Bridge Haylmore Heritage Site

This is a presently unstaffed, gated, historical site under restoration and development for community social and recreational use. The property is quite extensive with areas ranging from heavily shaded to relatively open to the sun.

A temporary electric service is installed centrally on the property at a location that will likely become a permanent electrical shed in the future. This building will easily house ample electrical service capacity and can have dedicated wall space for solar inverters.

Solar photography was performed at six locations as shown below. Each is on level terrain and would be appropriate for ground mounted or top-of-pole racking. Location 1, could be suitable for a sizeable picnic shelter with a solar array on it's rooftop. Locations 3 through 5 have been considered by the community because they are removed from the heritage buildings, and on level grassy terrain under the 60 kV transmission line right of way passing through the site. The locations are analysed in pages 22 – 33 of Appendix A and summarized below.

Location	Shading Factor	Shading Factor with Tree Treatments	Approximate Cable Length
1	0.87 "Good"	0.9 "Very Good"	110'
2	0.82 "Acceptable"	0.9 "Very Good"	75'
3	0.83 "Acceptable"	0.91 "Very Good"	320'
3a	0.86 "Good"	0.91 "Very Good"	385'
4	0.76 "Marginal"	0.89 "Good"	415'
5	0.83 "Acceptable"	0.88 "Good"	450'

Even though they are further from heritage buildings so would be less aesthetically distracting, locations 3 – 5 require significant tree topping to achieve "Good" or "Very Good" performance in contrast to locations 1 or 2.

Site security will likely be good considering plans for surveillance cameras and intended frequent use by the community. Suitable electrical infrastructure can be included in site restoration plans to accommodate solar arrays of considerable size. Tree treatments are needed to improve shading factors, at several of the locations considered. However, these are sufficiently distance from the central property core to reduce aesthetic impact and there are multiple workable solar PV locations on the property. The site has the potential to produce considerably more solar electricity than foreseeable local loads will require. In our view, the Haylmore site is a very good candidate for a grid-connected solar PV project.

vi. Gold Bridge Community Club

This is a frequently used facility with a golf course, parking, and outdoor eating area. The site is very open to the sun with several locations appropriate to ground mounted or top-of-pole solar arrays. A picnic shelter with roof-top solar as suggested for the Haylmore heritage site, may also be suitable for consideration. The building's metal roof faces about 45 degrees off south (azimuth 135 degrees), is sloped at about 15 degrees, and is quite expansive. A roof mounted array could also be appropriate.

The building was locked so we were unable to see the electrical service. However Mr. Sal Demare, my host for the evening, felt there would be ample space in the service panel to accommodate solar inverters.

Solar photography was performed at three locations as shown below. The locations are analysed in pages 34 – 37 of Appendix A and summarized here.

Location shading factors range from 0.91 to 0.92 scoring the site as "Very Good".

Because of very good shading scores, suitable ground mounted and roof mounted array options, and relatively high security, we consider the Gold Bridge Community Club facilities a very good candidate for a grid connected solar PV installation. Electrical service capacity would need to be confirmed.

vii. Gold Bridge Minto Communications Facility

Minto Communications maintains an equipment shed adjacent to the Gold Bridge Community Resource building, which requires backup power in the event of grid outages. Michelle Nortje (Minto Communications) asked that we have a look at this situation during our time in Gold Bridge in consideration of possible solar based backup power options.

The equipment shed and Community Resource property as a whole are quite heavily shaded by trees on and surrounding the property.

Three possible solar array locations were considered as shown below, and analysed in pages 38 – 41 of Appendix A. Shading factors range from 0.66 “Undesirable” for location 1 (on the property), to 0.82 “Acceptable” and 0.86 “Good” for locations 2 and 3 across the street to the North.

Top-of-pole arrays at locations 2 or 3 are workable if the challenges of permission from adjacent property owners and tunnelling cable under the roadway could be overcome.

Using a battery based off-grid inverter/charger, it may be possible to provide backup power with little or no solar PV depending on Minto equipment energy consumption and lengths of grid outages.

These matters require further discussion with Minto Communications before recommendations can be made.

viii. Bralorne Bridge River Community Church

This property is unfenced, and the building infrequently used. The building has one SW oriented roof surface that would be appropriate for solar PV were it not extensively shaded by neighbouring trees (shown in yellow). The lawn area in the NW corner of the property shown below is analysed on pages 43 – 44 of Appendix A for a possible top-of-pole solar application.

Solar factor is 0.88 “Good” with improvement to 0.9 “Very Good” after tree treatments.

The 100 A 120/240 VAC electrical service, located in the church basement as space to accommodate a grid connected solar system.

The physical vulnerability and aesthetics of a ground mounted solar array at this site may be a concern. Otherwise, the site is electrically suitable and has acceptable shading scores. Depending on primary motives for solar at this location, Bridge River Community Church may be appropriate for a grid connected solar PV project.

ix. Bralorne Community Hall

The building as an extensive SE facing roof section which is well suited to a large solar array. We also noticed and were made aware of the following:

- The metal roof membrane is very corroded and worn.
- The roof structure appeared wavy and uneven; possibly indicative of structural problems beneath.
- The building is used very little.
- The external finishes are worn and in need of extensive repair.
- The electrical/mechanical systems are in need of repairs and upgrading to meet current standards.

We did not perform solar photography on the SE roof though a solar array would almost certainly perform very well there; especially after removal of some neighbouring trees.

It seems considerable other site work would be more appropriately completed before considering a solar PV system for the building.

4. Project Suggestions, Costing, and Project Timelines

Based on our review we recommend the following as priority sites to consider for grid-connected solar PV projects:

- Gold Bridge Transfer Station
- Gold Bridge Fire, Library, Post Office Complex
- Haylmore Heritage Site

Appropriate solar PV design strategies for each site are suggested below.

a) Gold Bridge Transfer Station

The Transfer Station terrain and locations studied are well suited to ground mounted or top-of-pole solar array strategies as shown in the 8 kW and 4.5 kW system examples below.

Each of the three locations studied has space to readily accommodate 6 kW (24 – 250 watt panels) or more or array capacity. With the location's high shading factor scores, we anticipate 1100-1150 kWh/kW/year of electricity production; i.e. about 6600-6900 kWh per year from a 6 kW installation.

The site is serviced by BC Hydro under rate schedule 1300 where consumption is billed at $0.1073/kWh and subject to a 5% rate tariff plus GST. SLRD is able to recover GST payments on electricity so total loaded charges are $0.1127/kWh.

Based on figures provided by SLRD staff, the transfer station uses about 6070 kWh of electricity annually. In this case a 6 kW system would likely make the site electrically net-zero or beyond.

Presently in BC, ground mounted systems can be installed for approximately $4.25 to $4.60 per watt depending on location, terrain, and racking type selected. Additional challenges with material deliveries, accommodations, and travel associated with remote locations can further increase installed costs.

We recommend considering a 6 kW ground mounted system on poured concrete foundations for the transfer station as summarized below:

System Capacity	Approximate Cost	Energy Produced kWh/Yr
6.0 kW	$25,500 – $27,600	6600 - 6900

Given the site's high shading scores the design is based on using a single 7 kW solar inverter with two strings of 12 solar modules. Racking would be configured for 3 rows x 8 columns with modules in landscape. Design and costing details for this system are provided in Appendix B.

With careful planning, the proposed system could be installed and commissioned in 7 – 10 days following site preparation.

b) Gold Bridge Fire, Library, Post Office Complex

A solar PV system for the complex building would mount on the on the SW roof surface as described in Appendix A. A rail-based racking system anchored into the roof using weather proof stainless steel hanger bolts would be appropriate and have a similar appearance to the system below.

The usable roof surface is approximately 34' x 20' providing sufficient space for up to 3 rows of 9 panels; about 6.75 kW.

Even though this roof section is oriented about 40 degrees off true south, because it is not excessively steep, annual harvests for a 6 kW system should still be about 6300 – 6700 kWh.

This building is also serviced by BC Hydro under rate schedule 1300 where consumption is billed at $0.1073/kWh and subject to a 5% rate tariff plus GST. SLRD is able to recover GST payments on electricity so total loaded charges are again $0.1127/kWh.

Based on figures provided by SLRD staff, the Gold Bridge Complex uses about 29,000 kWh of electricity annually. The proposed 6 kW system should thus reduce the building's grid electricity dependence by about 23% - 24%.

Presently in BC, roof mounted systems can be installed for approximately $3.85 to $4.65 per watt depending on roof structure, roof surface complexity, building height, membrane type, and whether a structural review is required. Cost can be considerably higher for complex membranes such as roof tiles or wooden shakes. Additional challenges with material deliveries, accommodations, and travel associated with remote locations can further increase installed costs.

We recommend considering a 6 kW flush roof mounted system using stainless hanger bolt anchors and anodized aluminum rails for the Gold Bridge Complex roof as summarized below:

System Capacity	Approximate Cost	Energy Produced kWh/Yr
6.0 kW	$23,100 – $27,900	6300 - 6700

The array would be configured as 3 rows or 8 modules in portrait. Because of the partial shading periodically expected from the building's flag pole and neighbouring trees, the design incorporates micro-inverters for each solar module to optimize harvest.

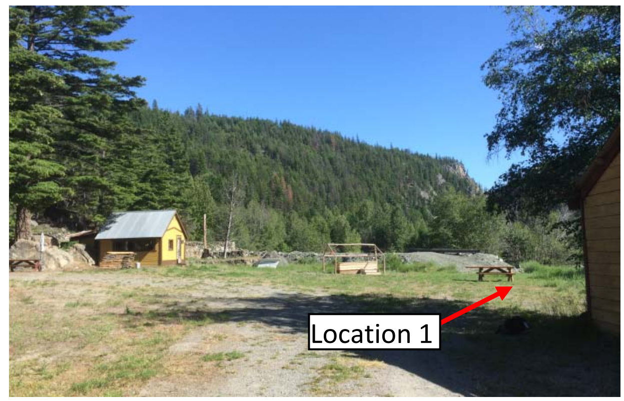
Design and costing details for this system are provided in Appendix B. Supply and installation of structural wooden blocking between trusses to receive hanger bolt anchors is included in the costing, as is a review by a structural engineer. This approach is required to avoid the questionable (in our opinion) practice of anchoring directly into existing wooden roof trusses.

With careful planning, the proposed system could be installed and commissioned in 6 – 8 days.

c) Haylmore Heritage Site

The size and diversity of the Haylmore property allow for a number of viable solar PV array alternatives at all 6 locations considered including ground mounting and top-of-pole mounting as suggested for the Gold Bridge Transfer Station.

Alternately for location 1, a picnic shelter of historically relevant construction, with a solar PV rooftop array might be a tasteful concept to consider. This approach has been used in many solar installations such as the 4.5 kW example below.



While locations 3 – 5 are perhaps attractive due to their separation from the heritage buildings, initial tree treatments and ongoing tree topping will be required to ensure acceptable ongoing shading factors. This should be factored into ongoing maintenance costs.

Based on projected annual electrical consumption of ≈ 3300 kWh (provided by Mr. Sal Demare) a 4 kW solar PV system would initially make the site a next exporter of electricity (beyond net-zero). As site usage expands, consumption will grow and solar system expansion may be desirable.

As mentioned, roof mounted installations cost approximately $3.85 to $4.65 per watt, and ground-mounted or top-of-pole approximately $4.25 to $4.60 per watt. Suitable Haylmore site solar PV alternatives we suggest considering include the following:

System Capacity	Location(s)	Approximate Cost	Energy Produced kWh/Yr
2.0 kW top-of-pole	1, 2	$8500 - $9000	2200 - 2300
3.0 kW roof-top	1	$11,550 - $12,750	3300 - 3450
4.0 kW roof-top	1	$15,400 - $17,000	4400 - 4600
4.0 kW top-of-pole	**3, 3a, 4, 5**	**$17,000 - $18,400**	**4400 - 4600**
6.0 kW ground	3, 3a, 4, 5	$25,500 - $27,000	6600 - 6900
8.0 kW ground	3, 3a, 4, 5	$34,000 - $36,000	8800 - 9200
9.0 kW ground	3, 3a, 4, 5	$38,250 - $40,500	9900 – 10,350

As a starting point, we recommend a 4 kW top-of-pole system installed at location 3a highlighted in blue in the table above. For ease of installation we recommend two separate 2 kW top-of-pole arrays similar to the examples below.

Design and costing details including estimated tree treatments required for this system are provided in Appendix B.

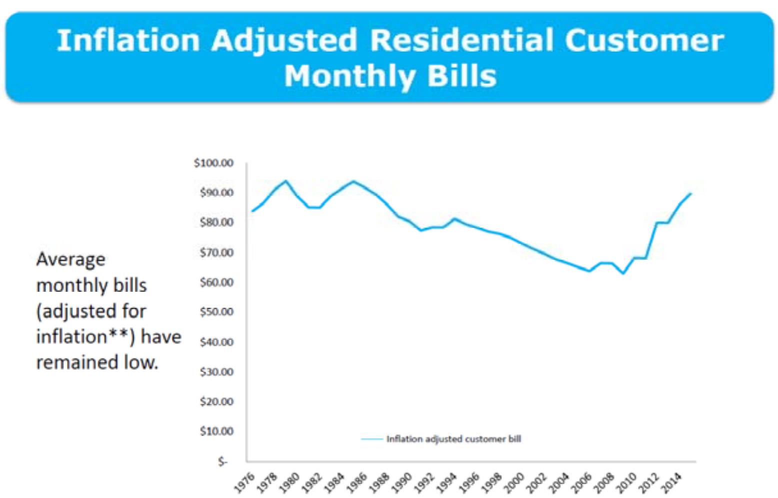
With careful planning, the proposed system could be installed and commissioned in 5 – 6 days.

5. Project Benefits

"Solar grid parity" occurs when solar generated electricity costs the same as buying from the grid. Due to falling solar costs and rising utility rates, many areas of the world, including parts of the US and Canada have reached or surpassed solar grid parity. Not surprisingly, solar PV deployment is accelerating world wide. While predictions suggest BC solar grid parity will not happen until sometime 2018 – 2022, some hold it may already be happening.

Once the world's most aggressive solar adopter, Germany has been surpassed as China, Japan, and the USA engage aggressive solar programs. BC's provincial average annual solar harvest of 1000 kWh/kW exceeds Berlin, Germany at about 860 kWh/kW. Parts of BC including the Thompson-Okanagan, Cariboo, and SE regions have even higher potential for annual solar harvests of 1150-1250 kWh/kW; comparable to China, Japan, and northern US states.

Yet Canada's solar adoption rates are amongst the lowest in the world, with BC trailing behind many other provinces. Our supply of inexpensive renewable hydro-electric energy, high costs of solar PV, and few available grants or incentives have often been cited as factors trumping our solar PV harvest potential. The chart below, from the Ministry of Energy and Mines presentation of the 10 Year Plan for BC Hydro given on Dec 26, 2013, shows inflation adjusted residential energy costs shrinking during 1976 – 2006 (30 years). Since then this trend has sharply reversed. In concert with globally decreasing solar PV costs, this is increasingly attracting more British Columbians' attention.



Potential benefits of the three proposed solar PV projects include:

- Savings on reduced grid energy purchases and earnings on exported solar energy surpluses.
- Available re-investment gains on solar related savings and earnings.
- Increased solar energy savings and earnings with future electricity rate increases.
- Demonstrating leadership in environmental and energy sustainability.
- Leveraging projects to include solar PV education and training opportunities.

Many of these are not easily quantified. However, we have attempted to project possible outcomes for consideration based on the following:

i. Proposed project sites receive BC Hydro service under rate schedule 1300.
ii. SLRD does not pay GST on electricity purchases.
iii. BC Hydro rate increases have significant effects and must be considered.
iv. Increases to annual net export benefits of $0.099/kWh have not occurred nd are not likely to in the near future.
v. Re-investing solar generated energy savings and export revenues will improve ROI and help support capital replacement.
vi. Possible equipment failure/replacement costs should be considered.
vii. Module efficiency degradation should be incorporated.
viii. Manufacturers provide 25 year solar module efficiency degradation warranties and 35 year solar system lifetimes are plausible.
ix. Initial capital cost reductions may occur through grants or subsidies.
x. Solar PV harvests are modelled conservatively using recognized methods.
xi. Known or projected site annual electricity consumptions are used to calculate solar PV generated energy savings and revenues.
xii. Inflation rates may be applied to deflate future projected energy savings/revenues and inflate future maintenance/capital replacement costs.

It is difficult to project electrical rate increases, investment interest rates, inflation, tax changes, solar PV incentives, and other influences even 3 years into the future let alone 35. Never-the-less conscientious planning efforts of governments, utilities, banks, corporations, and other institutions require just such forward looking projections. For the suggested SLRD solar PV projects, studying “what if” scenarios can clarify potential future benefits. The most influential factors will be

- future BC Hydro rate increases
- availability of grants or other incentives
- rates of return available on reinvested energy savings/revenues.

Based on applications to the BCUC and other public documentation, BC Hydro plans to maintain or increase ROE (Return on Equity) and decrease Debt:Equity ratio during fiscal years F15 – F24. Reducing dividend payments to the province of BC, and rate increases will be two means to this end as shown in the slide below (also from the Ministry of Energy and Mines presentation of the 10 Year Plan for BC Hydro given on Dec 26, 2013).

Fiscal Summary

	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24
Rate Increase *	9.0%	6.0%	4.0%	3.5%	3.0%	-	-	-	-	-
Return on Equity (%)	11.84%	11.84%	11.84%	11.40%	10.91%	10.59%	10.49%	10.51%	10.50%	10.42%
Net Income ($M)	$582	$652	$701	$715	$730	$746	$761	$777	$794	$810
Water Rentals ($M)	$393	$382	$391	$345	$375	$383	$392	$399	$409	$416
Grants & Taxes ($M)	$214	$221	$230	$241	$249	$260	$268	$276	$284	$293
Dividend ($M)	$262	$463	$481	$385	$285	$185	$85	$0	$0	$0
Regulatory Account (SM)	$181	$339	$672	$940	$1,010	$1,088	$1,075	$914	$560	$0
Total Debt	$16,656	$17,409	$18,288	$19,217	$19,686	$19,642	$19,309	$18,751	$17,876	$17,352
Debt to Equity Ratio	80 : 20	80 : 20	80 : 20	80 : 20	79 : 21	77 : 23	75 : 25	72 : 28	69 : 31	66 : 34

In 2011 BC Hydro applied for a 32.1% rate increase over three years, which was reduced to 17% following BCUC review. Approved 9% and 6% for F15 and F16 have already implemented, with F17 – F19 proposed rate increase caps of 4%, 3.5%, and 3.0%. Beyond F19, we can assume meeting BC Hydro's fiscal goals may require further rate increases, particularly if capital project expenditures such as Site C are to proceed.

We understand SRLD is mandated to budget for end-of-life replacement of capital equipment infrastructure. Relatively safe investment strategies for solar energy savings and revenues such as GICs or government bonds may help in accumulating PV system replacement funding. Over the last 30 years, yields on these and even traditional savings accounts have ranged between all time highs lows. Predicting long re-investment returns with confidence is thus challenging.

Financial outcomes have been projected for 6 kW Transfer Station, 6 kW Gold Bridge Complex, and 4 kW Haylmore solar PV projects based on the following assumptions and the rates/grants scenarios in Table 1:

- 0.25% annual module efficiency degradation.
- Inverter replacements ½ way through system life.
- Annual maintenance costs estimated and deducted from project returns.
- Inflation at 1.3 % annually to deflate future returns and inflate future costs to better reflect their present values.
- System lifetime of 35 years.

Table 1 – Rates and Grants Scenarios Considered

Scenario Specific Financial Analysis Assumptions			
Scenario	Annual Utility Rate Increase	Available Annual Investment Return	Costs Covered by Grants/Incentives
1	2.0%	2.0%	0.0%
2	2.5%	2.5%	30.0%
3	3.0%	3.0%	50.0%
4	3.5%	3.5%	75.0%

End of life outcomes are given in Table 2 for each project under the assumptions and scenarios described above.

Table 2: Projected Solar PV Project End-of- Life Financial Outcomes

Transfer Station 6 kW	Accumulated EOL Net Value (Invested)	Accumulated EOL Net Value (Non-Invested)	Average 35 Year ROI (Invested)	Average 35 Year ROI (Non-Invested)	Lifetime Cost of Maintenance
$27,467					
Scenario 1	$25,838	$18,057	2.69%	1.88%	$10,128
Scenario 2	$31,533	$20,386	4.69%	3.03%	$10,128
Scenario 3	$38,299	$22,986	7.97%	4.78%	$10,128
Scenario 4	$46,325	$25,891	19.27%	10.77%	$10,128
Gold Bridge Complex 6 kW	**Accumulated EOL Value (Invested)**	**Accumulated EOL Value (Non-Invested)**	**Average 35 Year ROI (Invested)**	**Average 35 Year ROI (Non-Invested)**	**Lifetime Cost of Maintenance**
$27,603					
Scenario 1	$33,897	$23,981	3.51%	2.48%	$5,400
Scenario 2	$40,714	$26,635	6.02%	3.94%	$5,400
Scenario 3	$48,784	$29,598	10.10%	6.13%	$5,400
Scenario 4	$58,323	$32,910	24.15%	13.63%	$5,400
Haylmore 4 kW	**Accumulated EOL Value (Invested)**	**Accumulated EOL Value (Non-Invested)**	**Average 35 Year ROI (Invested)**	**Average 35 Year ROI (Non-Invested)**	**Lifetime Cost of Maintenance**
$19,908					
Scenario 1	$12,133	$8,308	1.74%	1.19%	$9,544
Scenario 2	$15,113	$9,574	3.10%	1.96%	$9,544
Scenario 3	$18,670	$10,987	5.36%	3.15%	$9,544
Scenario 4	$22,906	$12,567	13.15%	7.21%	$9,544

Further details are provided in Appendix B.

Summarized Conclusions

a) The Halymore project will have the lowest projected annualized average returns (1.2% - 13.2%) due to maintenance costs of regular tree topping required for continued good solar performance. At 2015 rates, this installation would generate approximately $502 in energy savings and exported energy revenue in the first year of operation.

b) The Gold Bridge Complex project will have the highest projected annualized average returns (2.5% - 24.2%) due to lower $/watt capital cost and virtually no maintenance required for roof top systems. At 2015 rates, this installation would generate approximately $779 in energy savings in the first year of operation.

c) The Transfer Station Project will have projected annualized average returns (1.9% - 19.3%), lower than the Complex due to higher $/watt capital cost and some maintenance required for weed control. At 2015 rates, this installation would generate approximately $768 in energy savings in the first year of operation.

d) At end of life (EOL) only inverters, solar panels, and some wiring would typical require replacement. Full function could thus be restored at no more than 60% of original capital cost; likely less due to technological advancements. Under the most conservative scenario 1, with no grants available, even the Haylmore site would accumulate sufficient EOL (End of Life) value to replace itself if savings/revenues are re-invested.

e) Pursuing savings/revenue investment opportunities, securing grants, and larger utility rate increases will each improve outcomes drastically.