Solar Lamp Project

Sustainability Grant Proposal - Submitted February 10th 2016

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Kamloops, BC

Overview

The Solar Street Lamp project would showcase TRU's commitments to sustainable design by utilizing a combination of LEDs and solar energy to light it's outdoor campus walkways. This project aims to promote the widespread use of these technologies by inspiring students and stimulating interest.

We propose the installation of 50 individually mounted solar panels on select street lamp posts located throughout TRU Campus. As to not require the need for batteries, individual panels will directly contribute electricity to the grid on a Net Metering basis. This ensures the renewable integrity of the lighting system, lamps will be powered by recycled excess Peak Demand Power at electrical charge rates. implementing these modifications should result in better efficiency, less required maintenance and overall lighting independence.

Emphasis on:

1. Promoting sustainable design at Thompson Rivers University
2. Financial viability
3. Student and faculty education
4. Partnership with Electrical foundation program
5. Erecting visible installations in high traffic areas
6. Stimulating student interest in photovoltaics technology
7. Reducing TRUs GHG emissions and carbon footprint
8. Exterior pathway lighting independence
9. Planned execution and proper timeline
10. Easy installation and dismantling of system

System Specifications

This project consists of the installation of fixed panel mounts fitted with one solar panel, micro-inverter system and all necessary AC wiring for grid interconnection.

Each Solar panel fixture will be composed of several cost effective parts. We have selected the IronRidge SP/01A universal Side-of-Post Mounts for their advertized durability and corrosion resistance. Each mount can withstand 120km/h winds and support 30cm snow loads. Each mount kit will include all required bolts, latches and panel fasteners and can be installed using basic tools.

Figure 1. IronRidge SP/01A universal Side-of-Post Mount

All fixtures will be installed at a height that does not obstruct walkway light or signage. After having spoken to the TRU facilities services on January 22nd 2016, we have received permission to adjust campus post banners accordingly, as to avoid panel interference with their visibility from ground level. Mounts only require two hose latches with a spacing of 5 inches and can be positioned and fastened on all size posts.

We have chosen to use BlueSun 160 watt BSM160P-36 Polycrystalline photovoltaic solar panels for our proposed lamp post sites. We will order panels directly from the manufacturer, all of which will come with a limited 25 year warranty and tested to operate at temperatures below -35 degrees celsius. We have opted to use this model for it's compatibility with the IronRidge SP/01A mount. Using these panel, the total capacity of our proposed system will be 8,000 Watts or 8Kw DC. All panels will be retrofitted to sit south facing at a 45 degree angle on posts which have limited to no daytime shading. A panel angle of 45 degrees should provide the highest system efficiency under a fixed tilt installation (based on calculations from PVwatts - National Renewable Energy Laboratory).

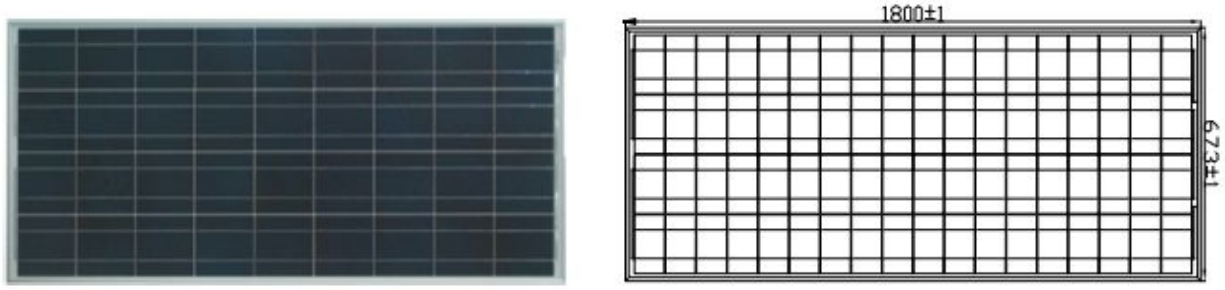


Figure 2. BlueSun 160 watt BSM160P-36 Polycrystalline photovoltaic solar panel

All panels will be connected to their individual micro-inverter unit. We will utilize Solar Leading Giant-250W micro-inverter units for all panel fixtures. We will order micro-inverter directly from the manufacturer, all of which will come with a 25 year warranty and tested to operate at temperatures of -40 degrees celsius. We have opted to source micro-inverters from a reputable chinese firm as they produce reliable products at a cost effective price.

figure 3. Solar Leading Giant-250W micro-inverter unit

Each 250w micro-inverter unit will be latched on the backside and connected to one 160w solar panel. We have opted to use this particular 250w micro-inverter unit for it's efficiency rating, cost per unit and durability. Each inverter output cable (seen above on image; right) will be fitted with one 14AWG AC wire, ground wire and R90 x-links cable. After having spoken to TRU Facilities services, we may be granted permission to bore a small hole into the lamp post. We anticipate to feed the output cable down the hollow interior of the lamp post, reaching the point of coupling at ground level. The system will not utilize battery technology as to remain as environmentally sustainable as possible. On sunny days, the project aims to produce 4x the electricity required to power one 250w HPS MHL bulb required per night.

All solar panels, micro-inverters and wiring will be installed by students enrolled within the TRU Electrical Foundations Program, under the supervision and guidance of faculty and Sikrinaktok Energy Inc.. Smart meter installation and system interconnection will be performed on site by BC Hydro.

Project Sites

The proposed 50 street lamp sites as seen below in figure 4. Are all located in highly visible locations across campus. All lamp post have direct south facing exposure to sunlight. Only campus walkway street lamps in high traffic areas have been selected.

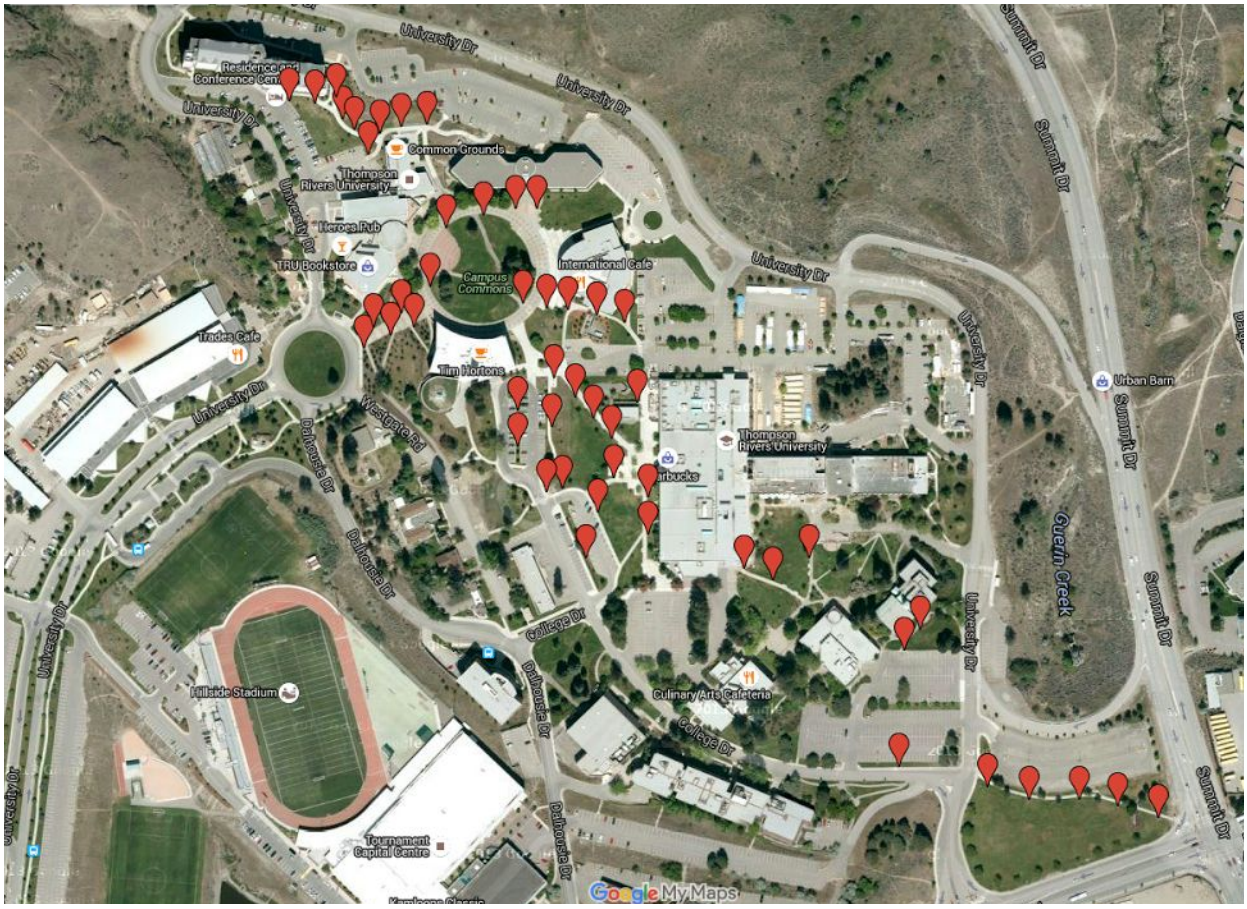


Figure 4. Proposed project sites

Project Budget

Please find bellow a summarized budget of total system costs $45,736CAD (after taxes) and installed cost per installed Watt of $5.72CAD (after taxes). The costs per installed watt is inflated above our original estimates of $4.50CAD/In-watt, this being caused by a recent devaluation of Canadian Currency. However, this project is financially viable,

producing electricity at a nominal levelized cost of 42.9 cents/kWh LCEO during its 25 year life.

Project Budget - TRU Sustainability Grant Fund				
	A	B	C	
EXPENDITURES	Total project cost	Amount of project cost supplied by applicants	Amount in Column A requested from the Sustainability Grant Fund	Cost Specifications and Comments (including Taxes, tarrifs and customs fees)
Labour Costs	$10,800	$0	$10,800	Sikrinaktok Energy Corp. Labourers, Quoted Price in $CAD
Consultants/Professional Fees	$0	$0	$0	Partnership with TRU Electrical Foundations Program
Cargo ship Transporation Costs	$2,650	$0	$2,650	2x shipping fees Quoted Prices in $5000CAD (including Vancouver port fees of $800US plus $25 duty)
Vancouver to Kamloops Transporation Costs	$2,300	$0	$2,300	Hard Impact Mechanical Inc. Quoted Price in $CAD (for round trip)
Fees Sub-total:	$15,750	$0	$15,750	
Direct Costs				
Site Preparation	$500	$500	$0	Site preparation, sign repositioning and BC hydro Interconnection
Equipment rental	$850	$0	$850	PPE, construction tools and other equipment rental (Facilities will provide lift platform)
Side-of-Pole solar mount Costs	$5,356	$0	$5,356	50x IronRidge Universal Side-of-Pole Mount UNI-SP/01A ($93.50CAD/$62.10USD per unit plus GST/HST)
Solar panel Costs	$6,785	$0	$6,785	50x BSM 160P Polycristaline Panels ($118CAD/$76.8USD per unit plus 5% GST and 10% customs rate)
Micro-Inverter Costs	$12,075	$0	$12,075	50x Giant-250W Micro Inverter System ($210CAD/$144USD per unit plus 5% GST and 10% customs rate)
Wiring Costs	$500	$0	$500	50x 14AWG cables, ground wires, R-90 cables, equipment and wirring harness ($10CAD per unit)
inverter mount latch Costs	$263	$0	$263	50x Home Depot latches and bolts ($5.25CAD per mount plus)
Direct Costs Sub-total:	$26,329	$500	$25,829	
Communications or Training				
Technical Video Production	$300	$300	$0	Student Collaboration to produce technical video for TRU website
Marketing, publicity and promotion	$400	$400	$0	TRU event and publicity post-project completion
Communications Sub-total:	$700	$700	$0	
Overhead				
Transporation Costs for labourers	$400	$400	$0	Estimated accumulated fuel and electricity costs during construction period.
Overhead Sub-total:	$400	$400	$0	
ADD ALL SUB-TOTALS	$43,179	$1,600	$41,579	
Contingency Amount (please include 10% of the Sub-Total as a contingency amount):	$4,318	$160	$4,158	Includes an estimated $3,000CAD cost (quoted from RBC) for converting $CAD to $USD when purchasing foreign goods. Includes transaction costs and unforseen expenses.
TOTAL OF ALL COLUMNS	$47,496	$1,760	$45,736	

Figure 5. Project Budget in $CAD

Installation

Sikrinaktok Energy Inc. will be performing the installation of all solar panels in collaboration with the Electrical Foundations program at TRU under the leadership of Amie Schellenberg and fellow faculty. We anticipate this partnership with the electrical foundations program will foster renewable energy education and innovation at TRU for years to come.

Value of energy produced

Under the standardized BC hydro Net metering program, our proposed system should produce an estimated 9,955 KWhs in total AC electrical output per year. If TRU incurs an average cost of $0.082 per KWh, this should result in energy charge savings of **$816** per year. Also, knowing Peak demand rates are **$10.55 per Kw**, all generated power from system would be used to reduce TRU's daytime Demand Charge bill. This proposed project could therefore save TRU an estimated **$1,878** in total electricity costs per year. This being equivalent to **$46,950 over a 25 year period**. Knowing the BC hydro Domtar™ Biomass plant produces 230 gCO_2eq per KWh of generated electricity, this project would directly reduce Kamloops greenhouse gas emissions by approximately **22.8 GHG Tonnes per year**. This being the equivalent of **570 GHG tonnes of CO_2 over a 25 year period**.

Results	Solar Radiation	AC Energy
	(kWh/m2/day)	(kWh)
Jan	2,134.39	454
Feb	3,257.56	615
Mar	4,768.48	964
Apr	5,605.45	1,052
May	5,619.4	1,069
Jun	5,832.26	1,057
Jul	5,927.48	1,080
Aug	6,166.51	1,133
Sep	5,522.23	1,002
Oct	3,793.66	756
Nov	2,011.98	405
Dec	1,688.59	363
Year	4,360.66	9,955

Month	Without System	With System	Savings
Jan	208,455	208,379	76
Feb	207,190	207,084	106
Mar	240,706	240,508	198
Apr	248,844	248,642	202
May	280,189	279,976	213
Jun	305,839	305,631	207
Jul	320,819	320,626	193
Aug	325,995	325,777	218
Sep	291,906	291,718	187
Oct	271,733	271,585	147
Nov	236,383	236,315	$ 68
Dec	199,197	199,136	61
Annual	3,137,262	3,135,383	1,878

Figure 6. Total estimated annual electricity savings (PVWatts - National Renewable Energy Laboratory)

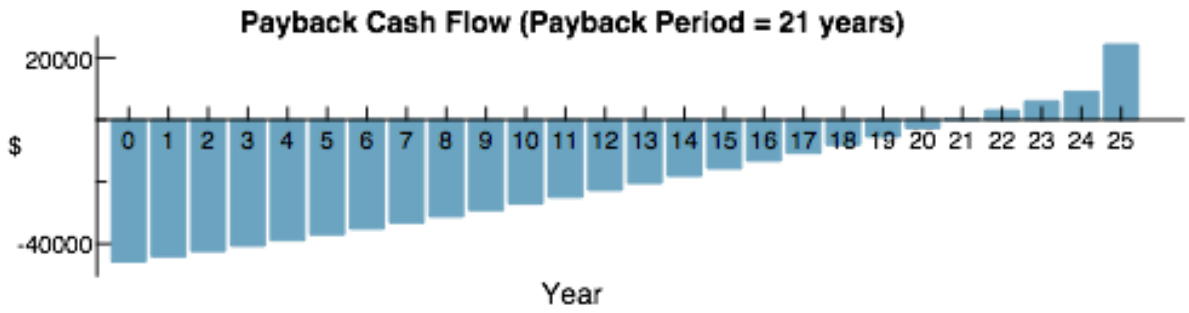


Figure 7. Payback period including energy and demand charge plus resale value (SAM - National Renewable Energy Laboratory)

Project Timeline

All equipment will be purchased from our selected suppliers on February 27th or at the discretion of the sustainability committee while funds are held in escrow on our behalf. A majority of these funds will be exchanged to US currency as to facilitate these foreign transactions. The required amounts will be converted to USD within a CIBC corporate company bank account. All equipment will be inspected and delivered to port Vancouver under the services of freight transport brokers recommended by our individual suppliers. Hard Impact Mechanical will be responsible to store and transport all equipment from port Vancouver to TRU campus.

	JAN	FEB	MAR	APR	MAY	JUN
Proposal Due Diligence	■	■				
Project reviewed by committee		■				
Equipment Purchases		■				
Transportation of equipment to site		■	■	■	■	
Project Installation					■	
System connected by BC Hydro					■	■
Electricity production						■

Figure 8. Project Timeline Chart - 2016

Project installation will commence in early May 2016 under the guidance and discretion of the Electrical foundations program faculty and students. We anticipate installation

completion by end of May 2016 and electricity production by early June 2016 at the latest. We anticipate to install a minimum of 4 panels per day during construction.

External benefits and Student engagement

Converting existing street lights to use solar power would provide a very strong visual statement supporting Thompson Rivers University's ongoing commitment to sustainability on campus. By having the electrical foundation program involved, the student electricians will gain vital experience installing solar photovoltaic systems, learning the positive implications of this popular up-and-coming technology.

With all selected sites being in high traffic areas, student will be continuously reminded of TRU's Green initiatives and programs, further inspiring our youth.

We would like to thank all our local partners, faculty, staff and student members for their support and efforts towards realizing this project.

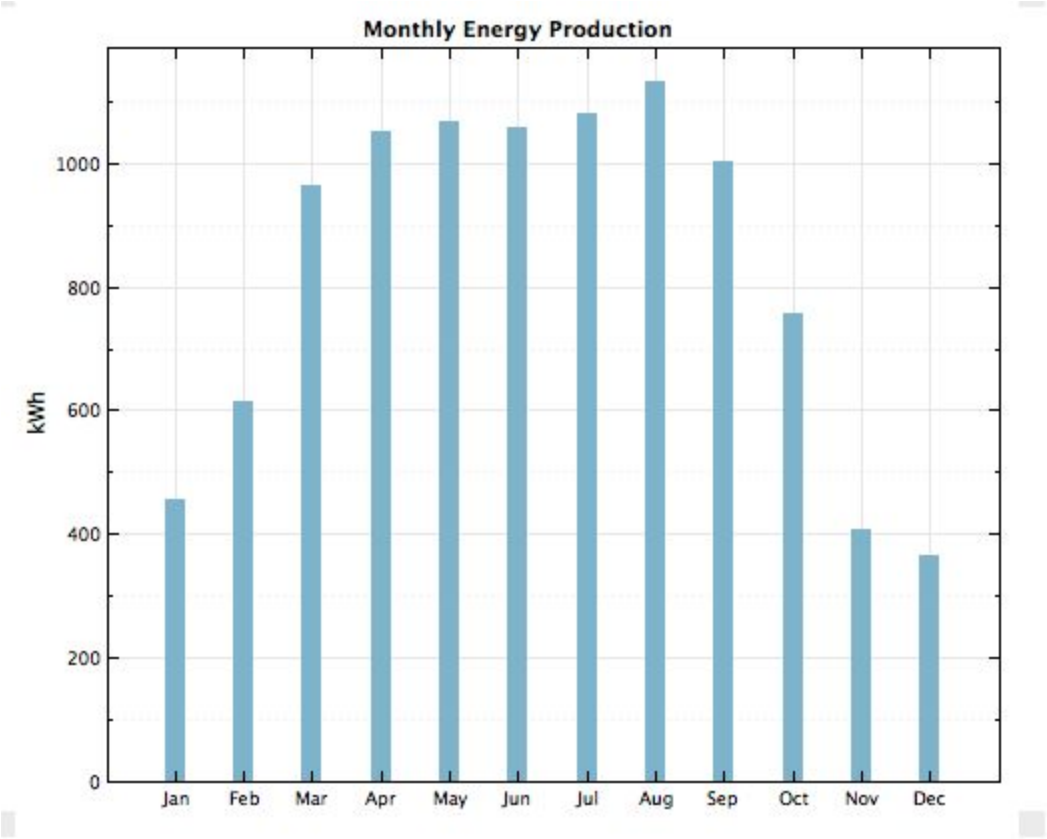
We also would like to send a special thanks to the sustainability committee for their time and kind considerations.

References

Supplier Websites:

1. http://www.alibaba.com/product-detail/UL-TUV-E40-E27-100W-LED_60397818747.html?spm=a2700.7724838.30.1.LWt82V
2. http://www.solar-electric.com/solar-panels-mounts-kits-accessories/panel-mounts/twoseunsopam/siofpomo/uni-sp-01a.html
3. http://www.alibaba.com/product-detail/Bluesun-good-price-high-quality-poly_60111447000.html
4. http://www.alibaba.com/product-detail/High-efficiency-solar-panel-micro-inverter_60178914251.html?spm=a2700.7724838.30.1.WwD8cY

SAM Report and PVWatts diagram:



1. file:///Users/ericlittle/Desktop/JOLT%20TECH/Legal/Sikrinaktok%20Energy%20Corp./TRU%20Solar%20Lamps.pdf

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