NWT Commercial Solar Case Study

Why we should allow 50 KW Grid Tied Renewable Energy Systems

Current Regulations

One of the biggest challenges facing businesses operating in the Northwest Territories is the high cost of electricity and until recently there were no meaningful ways to mitigate this challenge. However, the diminishing cost of alternative power sources, particularly solar with its low cost and modular applications, has exploded globally with consumers, businesses, and governments saving billions of dollars per year.

The Government of the Northwest Territories (GNWT) took a step in the right direction by launching the NWT Solar Energy Strategy which set a goal of reaching 20% solar grid penetration in thermal communities, with future plans of expanding this target up to 75%[i]. To support these targets, the GNWT introduced a net metering program to the territory which entered its first phase in January of 2014.

Net Metering allows consumers and businesses to install small renewable energy generation systems to accumulate credits on their monthly electricity bills during months when they produce more energy than they consume. These customers are able to use these credits during months when they consume more energy than they produce in order to minimize their electricity bills.

While the program has been successful in promoting the adoption of renewable energy on a small scale, system sizes are currently capped at 5KW. While this allows many residential users to offset roughly 50% of their current electrical needs, businesses, who traditionally consume much greater amounts of electricity than homeowners, benefit very little.

In order to give the NWT business community an opportunity to meaningfully participate in Net Metering, we propose that the Public Utility Board considers increasing the allowable system size to 50KW. This maximum is proposed based on the success of a similar program launched in the Yukon in 2014 which allows businesses to install renewable energy systems on a scale that will have a substantial impact on reducing their energy cost/consumption.

Yukon vs. NWT

The Yukon and Northwest Territories are perhaps the two territories with the most in common when comparing different electrical jurisdictions across Canada. As such, it only makes sense that we adopt the best practices from each other to provide best possible and affordable services for residential and commercial energy consumers.

The following table demonstrates the similarities between the two territories, including statistics from there two largest population centers: Whitehorse and Yellowknife.

	Yukon (Whitehorse)	**Northwest Territories (Yellowknife)**
Population:	37,642 (2016)[ii]	44,340(2016)[iii]
Population (Major Community):	28,872 (2015)[iv]	20,300 (2013)[v]
Grid Types:	Majorly Hydro with Isolated Thermal (Diesel) Grids	Majorly Hydro with Isolated Thermal (Diesel) Grids
Average Annual Base Load:	~40MW (Yukon)	~20MW (Yellowknife)
Hydro Grid Capacity:	~92MW (Yukon)[vi]	~34MW (Yellowknife)[vii]
Peak Demand:	~78MW (Yukon)	~32.3MW (Yellowknife)
Generating Capacity	40MW Hydro (Whitehorse) 37MW Hydro (Aishihik) 15MW Hydro (Mayo) 8.8MW (LNG) .65MW Wind (Haeckel Hill)	33.9MW Hydro (Snare/Bluefish facilities) 30MW Diesel (Jackfish/Behchoko Facilities)
Net Metering:	Yes	Yes
System Size Limits:	Up to 50KW	5KW

Case Study

To illustrate the level of impact an expanded Net Metering program would have we have created a case study using 2016 Northern Canada Solar Installation figures and electricity costs from the NWT's most "affordable" jurisdiction: Yellowknife.

The following case study is representative of a small to mid-sized commercial operation located in Yellowknife and has been verified from utility bills collected from Northland Utility customers. In this example, our business uses 100,000 KWhs annually at a cost of roughly $32,000 per annum. It is worth noting that the following results would be even more dramatic if this were set in a thermal community where electricity rates can be dramatically higher.

5KW – Current Max. System Size

As a reference point we have first modeled a 5KW solar system (the current maximum size) using the near ideal conditions of 12/12 roof pitch facing due south with no shading issues. Such a system would produce the following metrics:

System Size	5 KW
Total Cost	$22,000 including GST
Cost per Watt	$4.40
Current Power Used Annually	~100,000KWh
Annual Power Produced	6,388 KWh
Value of Power	$1,572
Inflation	3%
Simple Payback	14.0 Years
Equity Payback	11.6 Years
Pre-tax IRR	9.5%

See Appendix A for power production analysis modeled using Retscreen.

As you can see, even under ideal conditions the maximum system size provides a proverbial "drop in the bucket" with a 6% reduction in annual energy consumption. By contrast if the same business was permitted to install a 50KW system, it would yield enough energy savings to make a significant difference to the business's bottom line and ability to compete with competitors from lower cost jurisdictions.

50KW – Proposed Expansion

For a 50KW system we have modelled two different scenarios, one conservative and one using ideal "conditions," to accurately depict the range of potential impacts an expanded program may have on a commercial operations.

The first conservative scenario represent a less-than-ideal building which has a shallow roof pitch roof pitch of 1/12 (4.5 degrees) facing 60 degrees off of due south. On the opposite end of the spectrum we modelled a building that has near ideal conditions of being oriented due south with a roof at a much steeper pitch 12/12 (45 degrees).

	Conservative	**Ideal**
System Size	50 KW	50 KW
Total Cost	$125,000	$125,000
Cost per Watt	$2.50	$2.50
Current Power Used Annually	~100,000KWh	~100,000KWh
Annual Power Produced	47,187 KWh	63,879 KWh
Value of Power	$11,892	$15,719
Inflation	3%	3%
Simple Payback	10.5 Years	8 Years
Equity Payback	9.0 Years	7 Years
Pre-tax IRR	12.3%	15.7%

See Appendix B & C for power production analysis modeled using Retscreen.

As you can see, our same medium sized enterprise would be able to offset between 47%-63% of their energy usage with a moderate investment, yielding a high and stable return with extremely low volatility.

Tax Benefits

With payback periods approaching the 7 year mark on an energy system that will last 35+ years there is already significant incentive for NWT businesses to consider adding solar to their operations. However, there are also significant Capital Cost Allowances which further improves the economics and viability for businesses owners. The rule is as follows:

"Under Classes 43.1 and 43.2 in Schedule II of the Income Tax Regulations, *certain capital costs of systems that produce energy by using renewable energy sources are eligible for accelerated capital cost allowance. For renewable energy systems (including solar) acquired after February 22, 2005 and before year 2020 they may be written-off at 50 percent per year on a declining balance basis under Class 43.2.*[viii] "

Building on our 50KW case study from above our medium size business would be eligible for the following write offs:

Year	**UCC ($)**	**CCA ($)**
1	125,000	31,250*
2	93,750	46,875
3	46,875	23,437
4	23,437	11,718
5	11,718	5,859
Etc.		

Under the half-year rule only one-half of the CCA is allowed in year 1.

When combining the tax write offs and energy cost savings most businesses will recoup their initial Capital Expenditure by the end of Year 3 furthering the case for adding Solar to their operations.

Benefits to the community

While businesses certainly stand to benefit from an increased Net Metering program this would also yield numerous benefits to the Northwest Territories as a whole including:

- Help attract future investment by branding the NWT as a forward looking jurisdiction that is willing to implement new technology to continuously improve the costs of operating in northern Canada
- Increase (well-paying) jobs and investment in a burgeoning northern solar industry.
- Lower operating costs mean lower cost of goods to consumers (much needed relief for the NWT, which is one of the most expensive places to live in Canada).
- Lower operating costs frees up cash for investment in growth.
- Demonstrate to the rest of Canada that the NWT is committed to reduced GHG emissions in a meaningful way without having to pay a Carbon Tax

- Lower tax burdens (recently the GNWT had to commit up to $29.7M[ix] to cover to cost of running back up diesel generators).
- Lower GHG emissions, helping residents, businesses, and GNWT to get ahead of the potential for future carbon taxes.

Benefits to the Grid

Increasing solar capacity in the territory will also yield a number of benefits to the existing transmission structure, including:

- Bridge the gap in capacity between Hydro capacity and diesel generators in "Hydro Communities".
- Allow for reduced Hydro usage during the summer and fall months and allow reservoirs to be kept at a higher level, reducing diesel use during the winter and spring months.
- Incentivise businesses in thermal generation communities to install solar capacity, allowing thermal communities to reach the initial Solar Energy Strategy target of 20% with less direct investment from governments.
- Provide long term, reliable and consistent energy generation with minimal operating costs.
- Increase grid capacity without further straining government budgets.
- Localized generation will limit the usage rate of major grid infrastructure.
- Lay a foundation for behind the meter storage to be added as energy storage technology prices drop further.

In Closing

While increasing the renewable energy system size to 50KW under the Net Metering program is not a "Silver Bullet" to the high cost of electricity, it can provide significant benefits to the business community and the Territory as a whole. For businesses, they would be able to significantly improve their bottom line, set a buffer against future increases in energy costs, and make the Northwest Territories a more competitive place in which to do business.

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Appendix A

RETScreen Energy Model - Power project ☐ Show alternative units

Proposed case power system | **Incremental initial costs**

Analysis type ○ Method 1 ◉ Method 2

Resource assessment

Solar tracking mode		Fixed
Slope	°	45.0
Azimuth	°	0.0

☑ Show data

Month	Daily solar radiation - horizontal kWh/m²/d	Daily solar radiation - tilted kWh/m²/d	Electricity export rate $/MWh	Electricity exported to grid MWh
January	0.31	1.87	220.0	0.277
February	1.16	3.58	220.0	0.467
March	3.04	6.23	220.0	0.866
April	5.05	7.17	260.0	0.920
May	5.65	5.96	260.0	0.765
June	6.24	6.08	260.0	0.732
July	5.71	5.74	260.0	0.705
August	4.24	4.88	260.0	0.607
September	2.43	3.48	260.0	0.435
October	0.96	1.90	220.0	0.257
November	0.38	1.49	220.0	0.205
December	0.15	1.04	220.0	0.153
Annu	**2.95**	**4.12**	**246.07**	**6.388**

Annual solar radiation - horizontal	MWh/m²	1.08
Annual solar radiation - tilted	MWh/m²	1.50

Photovoltaic

Type		mono-Si		
Power capacity	kW	5.00	$ 22,000	See product database
Manufacturer				
Model				
Efficiency	%	16.1%		
Nominal operating cell temperature	°C	45		
Temperature coefficient	% / °C	0.40%		
Solar collector area	m²	31		
Miscellaneous losses	%	15.0%		

Inverter

Efficiency	%	98.0%
Capacity	kW	5.0
Miscellaneous losses	%	

Summary

Capacity factor	%	14.6%
Electricity exported to grid	MWh	6,388

☑ **Emission Analysis**

Base case electricity system (Baseline) Country - region	Fuel type	GHG emission factor (excl. T&D) tCO2/MWh	T&D losses %	GHG emission factor tCO2/MWh
Canada - Territories	All types	0.047		0.047
Electricity exported to grid	MWh	6	T&D losses	

GHG emission

Base case	tCO2	0.3			
Proposed case	tCO2	0.0			
Gross annual GHG emission reduction	tCO2	0.3			
GHG credits transaction fee	%				
Net annual GHG emission reduction	tCO2	0.3	is equivalent to	0.1	Cars & light trucks not used

GHG reduction income

GHG reduction credit rate	$/tCO2	

Financial Analysis

Financial parameters

Inflation rate	%	3.0%
Project life	yr	35
Debt ratio	%	

Initial costs

Power system	$	22,000	100.0%
Other	$		0.0%
Total initial costs	$	22,000	100.0%
Incentives and grants	$		0.0%

Annual costs and debt payments

O&M (savings) costs	$	
Fuel cost - proposed case	$	0
	$	
Total annual costs	$	0

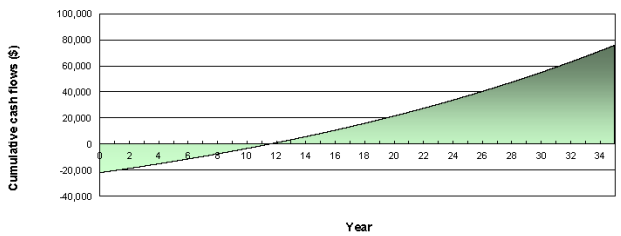
Annual savings and income

Fuel cost - base case	$	0
Electricity export income	$	1,572
	$	
Total annual savings and income	$	1,572

Financial viability

Pre-tax IRR - assets	%	9.5%
Simple payback	yr	14.0
Equity payback	yr	11.6

Cumulative cash flows graph



Appendix B

RETScreen Energy Model - Power project

☐ Show alternative units

Proposed case power system | **Incremental initial costs**

Analysis type: ○ Method 1 ◉ Method 2

Resource assessment

Solar tracking mode		Fixed
Slope	°	45
Azimuth	°	60.0

☑ Show data

Month	Daily solar radiation - horizontal kWh/m²/d	Daily solar radiation - tilted kWh/m²/d	Electricity export rate $/MWh	Electricity exported to grid MWh
January	0.31	0.40	220.0	0.612
February	1.16	1.30	220.0	1.763
March	3.04	3.26	220.0	4.690
April	5.05	5.20	260.0	6.840
May	5.65	5.71	260.0	7.446
June	6.24	6.27	260.0	7.636
July	5.71	5.75	260.0	7.158
August	4.24	4.32	260.0	5.472
September	2.43	2.51	260.0	3.216
October	0.96	1.02	220.0	1.418
November	0.38	0.44	220.0	0.630
December	0.15	0.20	220.0	0.305
Annu	**2.95**	**3.04**	**252.02**	**47.187**

Annual solar radiation - horizontal	MWh/m²	1.08
Annual solar radiation - tilted	MWh/m²	1.11

Photovoltaic

Type		mono-Si		
Power capacity	kW	50.00	$ 125,000	See product database
Manufacturer				
Model				
Efficiency	%	16.1%		
Nominal operating cell temperature	°C	45		
Temperature coefficient	% / °C	0.40%		
Solar collector area	m²	311		
Miscellaneous losses	%	15.0%		

Inverter

Efficiency	%	98.0%
Capacity	kW	50.0
Miscellaneous losses	%	

Summary

Capacity factor	%	10.8%
Electricity exported to grid	MWh	47,187

☑ **Emission Analysis**

Base case electricity system (Baseline) Country - region	Fuel type	GHG emission factor (excl. T&D) tCO2/MWh	T&D losses %	GHG emission factor tCO2/MWh
Canada - Territories	All types	0.047		0.047
Electricity exported to grid	MWh	47	T&D losses	

GHG emission

Base case	tCO2	2.2			
Proposed case	tCO2	0.0			
Gross annual GHG emission reduction	tCO2	2.2			
GHG credits transaction fee	%				
Net annual GHG emission reduction	tCO2	2.2	is equivalent to	0.4	Cars & light trucks not used

GHG reduction income

GHG reduction credit rate	$/tCO2	

Financial Analysis

Financial parameters

Inflation rate	%	3.0%
Project life	yr	35
Debt ratio	%	

Initial costs

Power system	$	125,000	100.0%
Other	$		0.0%
Total initial costs	$	125,000	100.0%
Incentives and grants	$		0.0%

Annual costs and debt payments

O&M (savings) costs	$	
Fuel cost - proposed case	$	0
	$	
Total annual costs	$	0

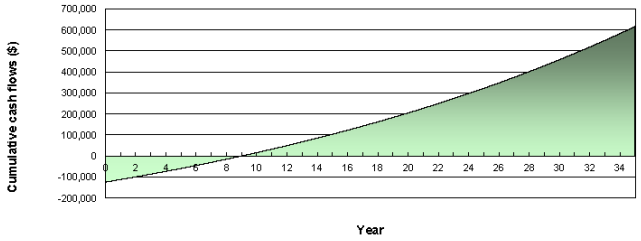
Annual savings and income

Fuel cost - base case	$	0
Electricity export income	$	11,892
	$	
Total annual savings and income	$	11,892

Financial viability

Pre-tax IRR - assets	%	12.3%
Simple payback	yr	10.5
Equity payback	yr	9.0

Cumulative cash flows graph



Appendix C

Proposed case power system | **Incremental initial costs**

Analysis type: ○ Method 1 ◉ Method 2

Resource assessment

Solar tracking mode		Fixed
Slope	°	45.0
Azimuth	°	0.0

☑ Show data

Month	Daily solar radiation - horizontal kWh/m²/d	Daily solar radiation - tilted kWh/m²/d	Electricity export rate $/MWh	Electricity exported to grid MWh
January	0.31	1.87	220.0	2.765
February	1.16	3.58	220.0	4.668
March	3.04	6.23	220.0	8.662
April	5.05	7.17	260.0	9.199
May	5.65	5.96	260.0	7.649
June	6.24	6.08	260.0	7.319
July	5.71	5.74	260.0	7.045
August	4.24	4.88	260.0	6.075
September	2.43	3.48	260.0	4.353
October	0.96	1.90	220.0	2.571
November	0.38	1.49	220.0	2.046
December	0.15	1.04	220.0	1.526
Annı	**2.95**	**4.12**	**246.07**	**63.879**

Annual solar radiation - horizontal	MWh/m²	1.08
Annual solar radiation - tilted	MWh/m²	1.50

Photovoltaic

Type		mono-Si		
Power capacity	kW	50.00	$ 125,000	See product database
Manufacturer				
Model				
Efficiency	%	16.1%		
Nominal operating cell temperature	°C	45		
Temperature coefficient	% / °C	0.40%		
Solar collector area	m²	311		
Miscellaneous losses	%	15.0%		

Inverter

Efficiency	%	98.0%
Capacity	kW	50.0
Miscellaneous losses	%	

Summary

Capacity factor	%	14.6%
Electricity exported to grid	MWh	63.879

☑ Emission Analysis

Base case electricity system (Baseline) Country - region	Fuel type	GHG emission factor (excl. T&D) tCO2/MWh	T&D losses %	GHG emission factor tCO2/MWh
Canada - Territories	All types	0.047		0.047
Electricity exported to grid	MWh	64	T&D losses	

GHG emission

Base case	tCO2	3.0			
Proposed case	tCO2	0.0			
Gross annual GHG emission reduction	tCO2	3.0			
GHG credits transaction fee	%				
Net annual GHG emission reduction	tCO2	3.0	is equivalent to	0.6	Cars & light trucks not used

GHG reduction income

GHG reduction credit rate	$/tCO2	

Financial Analysis

Financial parameters

Inflation rate	%	3.0%
Project life	yr	35
Debt ratio	%	

Initial costs

Power system	$	125,000	100.0%
Other	$		0.0%
Total initial costs	$	125,000	100.0%
Incentives and grants	$		0.0%

Annual costs and debt payments

O&M (savings) costs	$	
Fuel cost - proposed case	$	0
	$	
Total annual costs	$	0

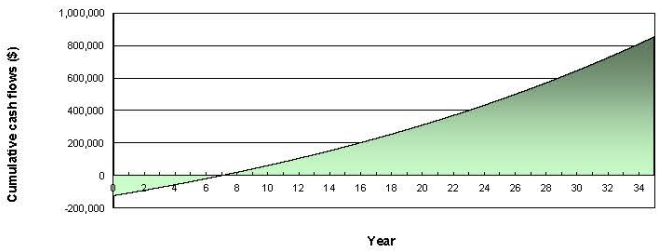
Annual savings and income

Fuel cost - base case	$	0
Electricity export income	$	15,719
	$	
Total annual savings and income	$	15,719

Financial viability

Pre-tax IRR - assets	%	15.7%
Simple payback	yr	8.0
Equity payback	yr	7.0

Cumulative cash flows graph



[i] http://www.pws.gov.nt.ca/pdf/ParkingLot/Solar_Energy_Strategy_2012-2017_0.pdf
[ii] http://www.eco.gov.yk.ca/stats/pdf/populationMar_2016.pdf
[iii] http://www.statsnwt.ca/population/population-estimates/
[iv] http://www.eco.gov.yk.ca/stats/pdf/populationMar_2016.pdf
[v] https://www.yellowknife.ca/en/doing-business/demographics-and-statistics.asp
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[viii] http://www.nrcan.gc.ca/energy/efficiency/industry/financial-assistance/5147
[ix] http://www.gov.nt.ca/newsroom/gnwt-contribution-ntpc-prevent-power-rate-increase