Connection of Remote Communities in Ontario

Tabatha Bull
Senior Manager, First Nation and Métis Relations
IESO

March 30, 2017

Connecting Today. Powering Tomorrow.

Remote Communities in Ontario

The Need for Alternatives

- Many remote communities have faced capacity restriction
  - Restriction can last up to 10 years
  - Rotational use of electricity
  - Cannot connect new homes or community buildings
  - Limits ability for economic development and community growth
- Outages that last over 48 hours
- Rising cost of diesel fuel and transportation
  - Decrease in availability of winter road due to climate change
- Risk of environmental spills in transit and in the community
- Emissions, noise, health and quality of life impacts in communities

Diesel Powered Electricity is Unsustainable

ieso
Connecting Today.
Powering Tomorrow.

Transmission Connection Project - History

- A committee was formed in 2008 by local Tribal Councils and some independent communities (NWOFNTPC), with support provided by OPA, to develop a plan to connect the remote communities.
- In 2010, based on the Committee's early work, the Ontario Minister of Energy directed the OPA (now IESO) to formally evaluate a remote connection plan and to develop a business case for remote connection.
- The IESO worked with the NWOFNTPC to develop the Remote Connection Plan which was released to the committee in August 2012
- The Plan was released to the public in the summer of 2013 with the release of the draft North of Dryden Plan. The plan was updated publicly in August 2014

Conceptual Routing of Connection

Requires approximately:

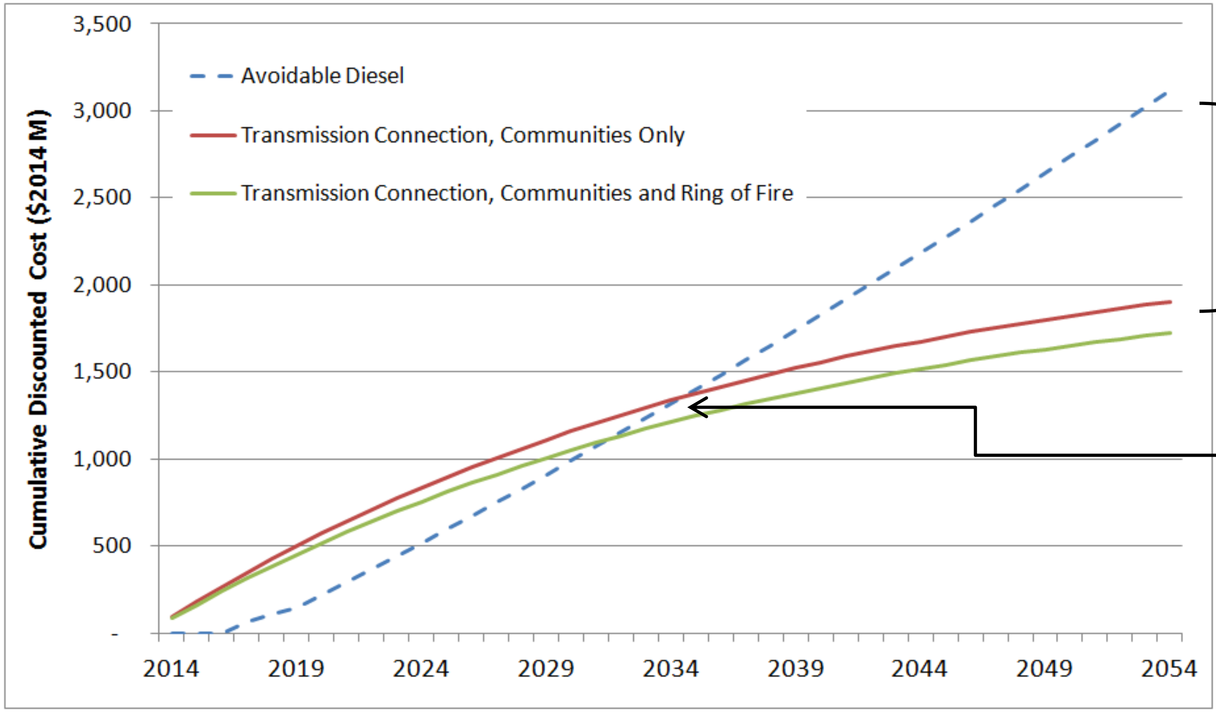
- 1,000 – 1,500 km of transmission
- 875 – 950 km of distribution
- 9 – 11 transformer stations
- 21 distribution stations
- Capital cost ~$1 billion

Note: Supply security was assumed to be provided by local backup generation

ieso
Connecting Today.
Powering Tomorrow.

Updated Business Case for Connection

- Transmission connection costs can be recovered through savings from eliminating diesel supply over 20 to 25 years
  - Less than half the expected asset life of transmission facilities



Transmission avoids $1 billion in diesel costs

Payback for transmission takes 20-25 years

Lines can last for more than 50 years

Current Status of Transmission Connection

- 22 First Nation communities have formed Watynikaneyap Power and partnered with RES Fortis to connect 16 of the current diesel remote communities plus 1 additional community.

- The 2014 draft Remote Community Connection Plan informed a July 29, 2016, Order in Council from the provincial government. This order confirms the need for the project to connect 16 remote communities

- A concurrent Order in Council designated Wataynikaneyap Power as the transmitter for connecting 16 communities and the new line to Pickle Lake.

- Development work and approvals are underway by the transmitter

- Construction is expected to begin on the line to Pickle Lake in Dec 2018

- First communities are to be connected in 2021, remaining communities scheduled to be complete in 2023. The connection for one community is advanced, and this community could be connected by the end of 2018.

Matawa First Nations

- The 5 remote Matawa First Nations are not currently part of the Watynikaneyap project
- All nine Matawa First Nations and the IESO have formed an Energy Working Group
  - Develop baseline data for communities
  - Build capacity on all energy options including transmission connection
  - Develop education materials for community members
  - Provide support on technical studies
  - Early community engagement – awareness, desires, oppositions

Remote Communities that are Currently Not Economic to Connect

- Four communities have been identified as not economic to connect at this time, regardless of potential connection configuration due to relatively small size and distance from other communities
- The Remote Community Connection Plan concludes that the cost of supplying electricity to these communities can still be reduced by looking further into:
  - Renewable energy resources such as small hydro, wind, solar and storage used together with existing diesel generation
  - These options reduce the need for diesel, but diesel is still needed when renewable resources are not available
- All four communities are currently implementing other solutions for reducing diesel consumption in their community

Support Needed

- Funding has been provided through the IESO to develop
  - Aboriginal Community Energy plans
    - $95,000 per community
  - Energy Partnerships Program
    - $500,000 to Watynikaneyap to aide in the work required for the partnership with RES
    - $500,000 for each community who is currently not economic to connect to develop projects to reduce diesel
- The IESO continues to support the project:
  - At the Ontario Energy Board
  - Participating in funding table discussions with the Provincial and Federal government
  - Continuing to build capacity and awareness amongst communities
- Continued support is needed to prepare communities for connection

Miigwetch

20/20 CATALYSTS PROGRAM

Building a community of practice for Indigenous clean energy project development, partnership, and planning.

Three-month Program designed to enable First Nations, Metis, and Inuit communities to maximize the social and economic benefits of clean energy projects.

The 20/20 Program aims to increase:

Leadership Capacity

Community Capacity

Community Readiness

In order to feel confident taking on clean energy projects driven by your community.

Building capacity through:

On-site Intensive Sessions	Online Collaborative Knowledge Centre	Mentorship & Coaching

With active support before, during, and after the Program.

Our Experience

Online Collaborative Knowledge Centre

- Innovative platform being developed with support from IBM and Publivate.
- Allows Catalysts to collaborate with each other throughout the Program and beyond.
- Gives Catalysts access to relevant project tools, resources, and templates.

Why 'Catalysts'?

- The 18 of us spend 3 separate weeks together learning from each other and from the numerous Mentors we met across the country
- It was very empowering to meet so many great First Nation people working so hard to improve the lives in our own communities and for other communities

Chief Denise Restoule (Program Mentor) and former Chief Marty Restoule – Dokis First Nation, ON

Replacing Diesel Generation with Renewable Sources in Arctic Communities

Claudio Canizares
Indrajit Das
Dept. Electrical & Computer Engineering
Waterloo Institute for Sustainable Energy

WISE
WATERLOO INSTITUTE FOR SUSTAINABLE ENERGY

UNIVERSITY OF WATERLOO

Outline

- Motivation and objectives
- Study procedure
- Pre-feasibility study:
  - Pre-selection
  - RE integration from HOMER based analysis
  - Ranking
- Feasibility study:
  - Optimization framework
  - Methodology
  - Community-wise results
- Conclusions and next steps

Motivation and Objectives

- Climate change poses a threat to the wildlife and environment in the Arctic.
- There are nearly 50 communities in the Canadian Arctic with most of them using diesel generators to generate electricity:
  - These generate emissions and pose a risk of spills while transporting and storing diesel.
  - Diesel fuel dependency is an economic problem in the North, as governments have to subsidize this costly fuel.
- There are environmentally friendly, economic, and technically sound sources of energy for Arctic communities that should help reduce diesel fuel dependency.
- WISE at the University of Waterloo has been involved in a consortium led by WWF-Canada, performing studies on the communities of Nunavut and the Inuvialuit Settlement Region (ISR) of the NWT to integrate Renewable Energy (RE) sources in their grids.
- This presentation describes the selection process of 5 of the 25 Nunavut communities for feasibility studies; followed by the detailed feasibility studies for the 5 selected communities for eventual deployment of RE sources.

Study Procedure

- The study to develop business cases for deployment of RE in Nunavut is divided in the following two tasks:
  - Pre-feasibility study (Pre-FS): To select 5 communities based on high-level data and HOMER studies considering wind and solar profiles, existing diesel generator portfolio, their location and associated transportation costs, community size, and energy demand for a 25 year horizon.
  - Feasibility study (FS): To determine optimal RE deployment in the selected communities, utilizing a developed optimization model, and detailed data regarding solar and wind energy generation for 10 and 20 year horizons.

Pre-FS: Methodology

- First, a pre-selection of 13 out of 25 communities in Nunavut was made based on high level size, demand, costs, and renewables data.
- HOMER was then used to determine the optimal generation plan for each of these pre-selected communities:
  - With and without RE.
  - Varying the energy storage (battery) capacity.
  - Optimal plan was selected based on minimum net present (NP) costs while satisfying HOMER's in-built stability criteria.
- Stopping criteria for battery capacity increase with RE:
  - Replacement of required new diesel generators with renewables.
  - O&M costs when introducing RE, including equipment costs, being more than the base case O&M costs, i.e., O&M savings becoming negative, or maximum O&M savings.

Pre-FS: Pre-selection

COMMUNITIES	OVERALL RANK	WIND SPEED	SOLAR ENERGY	Tr. COST SEA	Tr. COST AIR	COMM. SIZE	ENERGY DEMAND	GHG EMISSION	ELECTR. RATE	REGION
Rankin Inlet	1	H	H	ML	L	H	H	ML	L	Kivalliq
Iqaluit	2	MH	MH	L	ML	H	H	MH	L	Qikiqtaaluk
Arviat	3	H	H	ML	L	H	ML	ML	ML	Kivalliq
Cape Dorset	4	H	MH	L	L	H	ML	ML	L	Qikiqtaaluk
Baker Lake	5	H	H	ML	L	H	ML	L	L	Kivalliq
Repulse Bay	6	H	MH	ML	L	H	ML	L	ML	Kivalliq
Sanikiluaq	7	H	H	ML	L	MH	ML	L	ML	Qikiqtaaluk
Chesterfield Inlet	8	H	H	ML	L	L	MH	ML	MH	Kivalliq
Coral Harbour	9	MH	H	ML	L	MH	ML	L	MH	Kivalliq
Whale Cove	10	H	H	ML	L	L	ML	ML	H	Kivalliq
Pangnirtung	11	MH	MH	L	ML	H	ML	L	L	Qikiqtaaluk
Igloolik	12	H	MH	ML	H	H	ML	MH	L	Qikiqtaaluk
Qikiqtarjuaq	13	H	MH	MH	ML	ML	MH	ML	ML	Qikiqtaaluk
Hall Beach	14	H	MH	ML	H	MH	ML	L	MH	Qikiqtaaluk
Clyde River	15	H	ML	MH	H	H	ML	ML	ML	Qikiqtaaluk
Cambridge Bay	16	H	ML	H	H	H	MH	ML	ML	Kitikmeot
Kugaaruk	17	H	MH	MH	H	MH	ML	L	H	Kitikmeot
Gjoa Haven	18	MH	MH	H	MH	H	ML	L	MH	Kitikmeot
Kimmirut	19	MH	MH	L	H	L	ML	ML	H	Qikiqtaaluk
Grise Fiord	20--21	MH	L	MH	H	L	H	H	H	Qikiqtaaluk
Resolute Bay	20--21	MH	L	MH	H	L	H	H	H	Qikiqtaaluk
Kugluktuk	22--23	ML	ML	H	MH	H	ML	L	MH	Kitikmeot
Pond Inlet	22--23	ML	ML	MH	H	H	ML	L	MH	Qikiqtaaluk
Taloyoak	24	MH	ML	H	H	MH	ML	L	H	Kitikmeot
Arctic Bay	25	ML	ML	MH	H	MH	ML	L	MH	Qikiqtaaluk

Pre-FS: O&M Savings vs RE Installation Costs

Community (Alphabetical)	(NPV)O&M Savings $	Installation Costs (NPV) $	O&M Savings %	RE and Associated CAPACITIES: Battery kWh	PV kW	Wind kW	Converter kW	RE Penetration %	CO2 Reduction %	Rankings based on: O&M Savings % (Descend)	Installation Costs of RE (Ascend)
Arviat	837,705	907,600	1.70	0	0	100	0	2.6	2.46	16	3
Baker Lake	3,648,351	4,047,500	6.73	1,000	500	0	500	7.1	7.36	14	8
Cambridge Bay	6,198,906	5,879,400	7.39	1,500	600	100	700	8.3	9.07	13	9
Cape Dorset	580,989	591,400	1.21	0	100	0	100	0.6	1.41	18	1
Clyde River	3,053,834	3,087,000	9.92	800	200	100	200	11.3	13.49	8	7
Hall Beach	2,429,447	2,374,200	7.95	700	100	100	200	9.8	11.27	11	6
Hall Beach	8,332,737	7,940,400	27.25	1,500	400	400	500	36.2	37.25	3	12
Igloolik	735,488	721,800	1.50	100	100	0	100	1.7	1.66	17	2
Iqaluit	36,739,335	37,081,000	9.62	12,500	2,000	1,500	3,000	13.5	14.99	9	16
Iqaluit	96,285,121	84,714,992	25.21	21,500	2,000	6,000	5,500	39.3	40.08	4	17
Iqaluit	93,116,687	90,651,504	24.28	25,000	0	7,500	5,500	41.4	42.25	5	18
Kugaaruk	6,285,116	6,138,500	18.45	1,100	500	200	500	25.9	25.84	7	10
Kugaaruk	7,471,944	7,572,900	21.94	1,500	500	300	600	31.5	31.55	6	11
Pangnirtung	1,944,607	1,863,800	3.85	100	300	0	300	4.7	4.57	15	5
Qikiqtarjuaq	1,898,300	1,730,400	7.41	500	200	0	200	6.7	9.22	12	4
Rankin Inlet	11,197,390	12,392,600	9.43	4,000	500	600	800	13.8	14.79	10	14
Rankin Inlet	33,006,219	32,523,800	27.79	7,000	1,300	2,000	2,200	39.2	39.06	2	15
Sanikiluaq	11,292,466	11,537,900	33.99	10,000	400	600	700	52.1	53.06	1	13

Pre-FS: Rankings

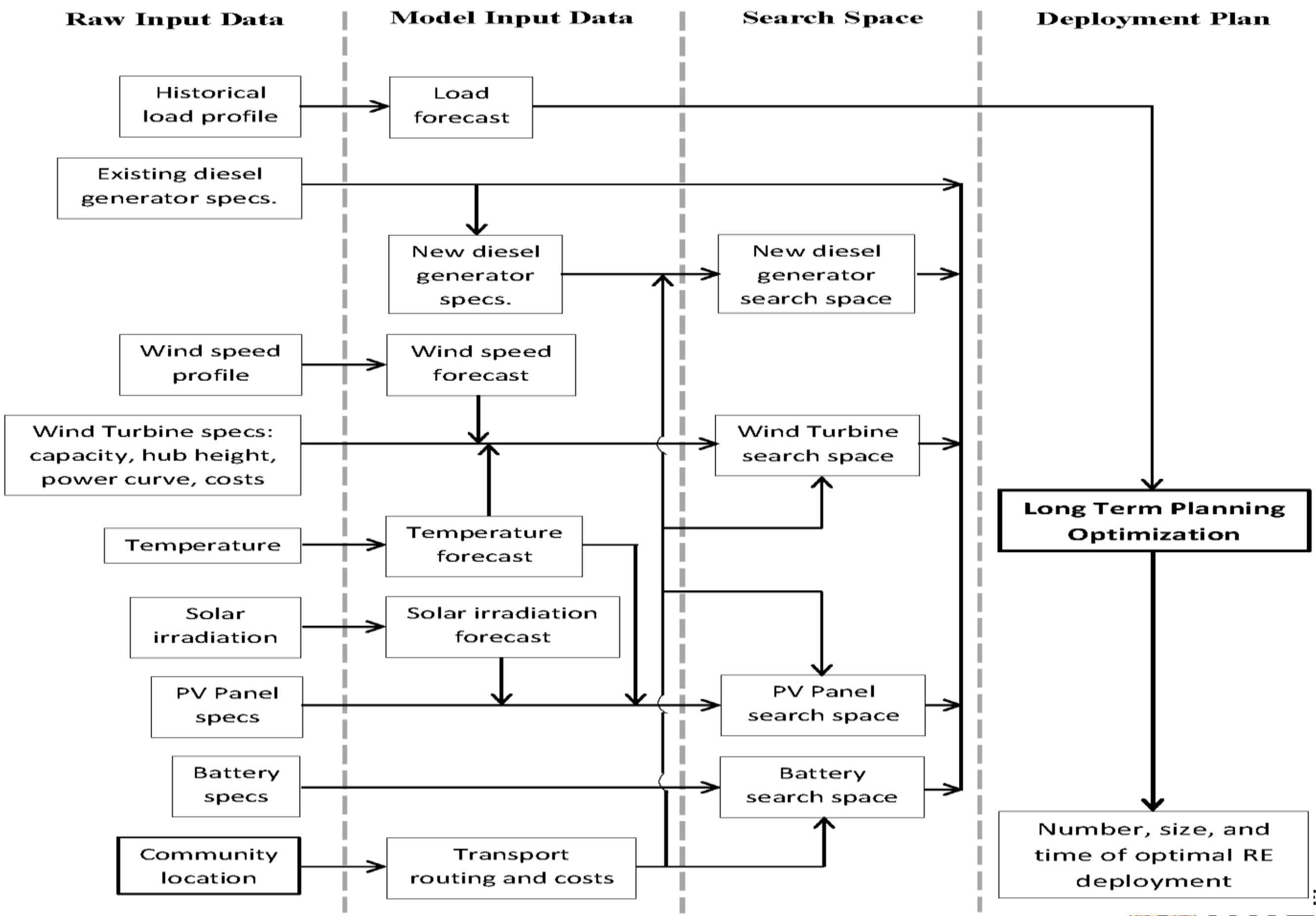
- The Nunavut Communities selected for feasibility studies are:
  1. Sanikiluaq
  2. Iqaluit
  3. Rankin Inlet
  4. Baker Lake
  5. Arviat

Pre-FS: Rankings

- The top 4 ranked communities in Nunavut remained in the top 5 for all criteria used in this study, indicating that these communities definitely deserve a detailed feasibility study.
- The results of this pre-feasibility study indicate that substantial reduction in CO_2 emission could be achieved at a lower initial investment cost.
- At least 36% RE penetration could be potentially achieved in the cases of the top 5 communities in Nunavut, except for Baker Lake, while avoiding the purchase of a new diesel generator.
- Feasibility studies for the 5 selected Nunavut communities are presented next:
  - These studies are based on detailed low-level data and modeling using the well-known mathematical programming tool GAMS (General Algebraic Modeling System).

FS: Framework

- From utility perspective:

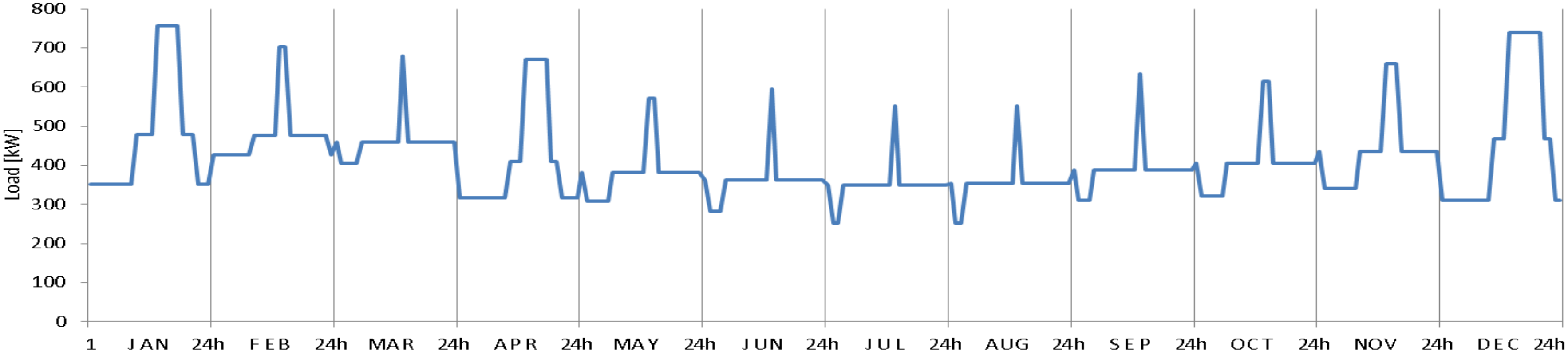


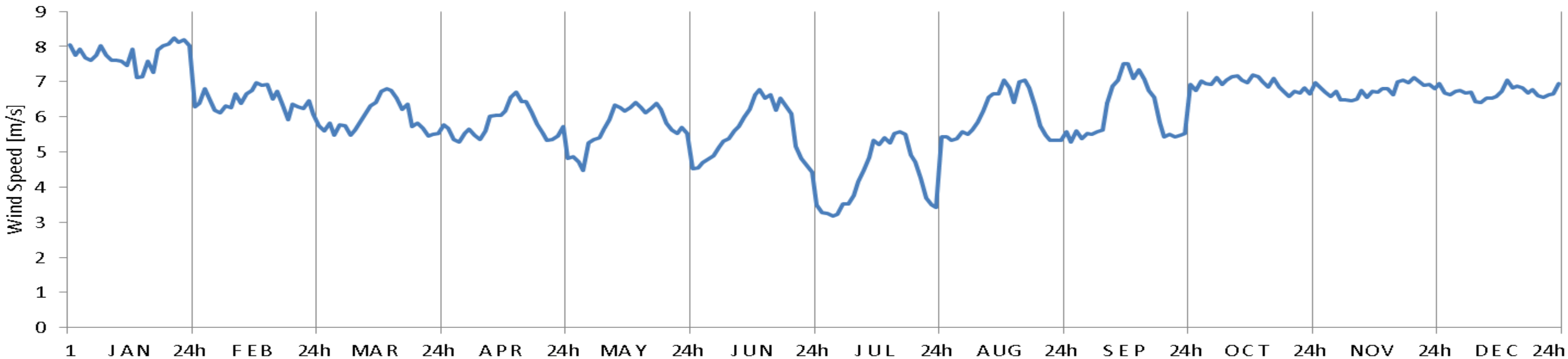
FS: Methodology

- The work is based on seven case studies as follows:
  - NoRE: Business As Usual (BAU) case involving only diesel generation.
  - S: Only solar energy.
  - W: Only wind energy.
  - SW: Both solar and wind energy.
  - SB: Solar with battery storage.
  - SW: Wind with battery storage.
  - SWB: Both solar and wind with battery storage.
- Minimization of the Net Present Cost (NPC) for 20-year project horizons.

FS: Sanikiluaq

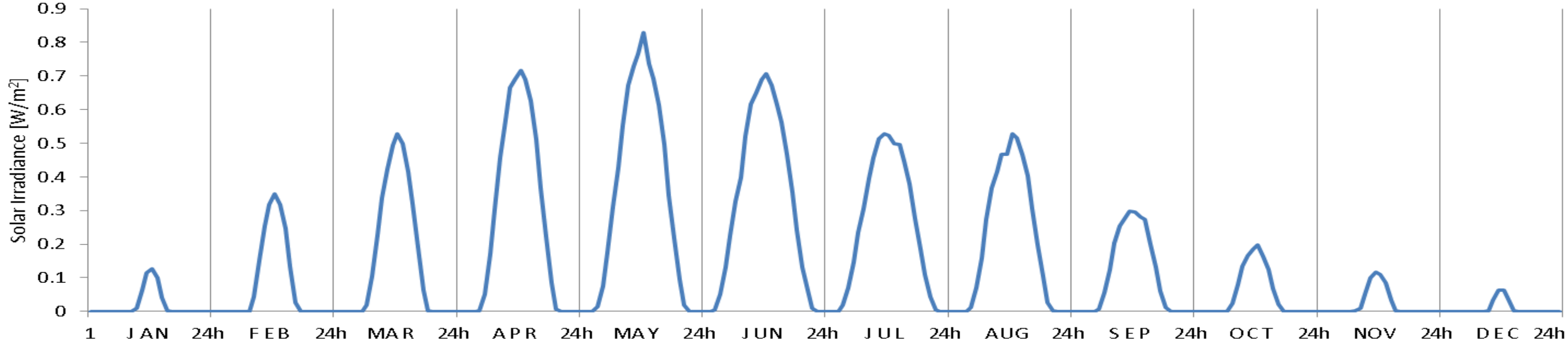
- Hourly profiles daily averages per month for load (for the first year) and wind speed profile @21m height:

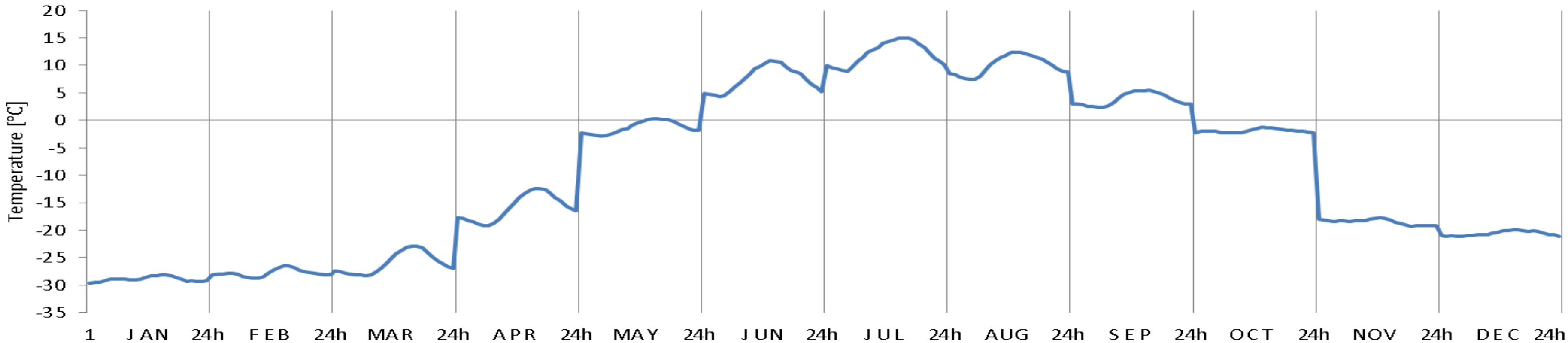




FS: Sanikiluaq

- Hourly profiles daily averages per month for solar irradiation and temperature:

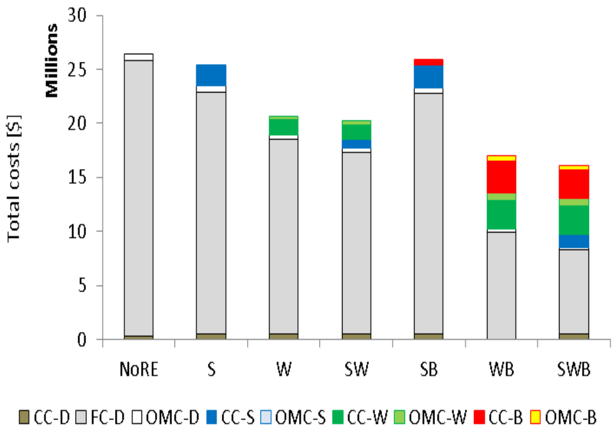


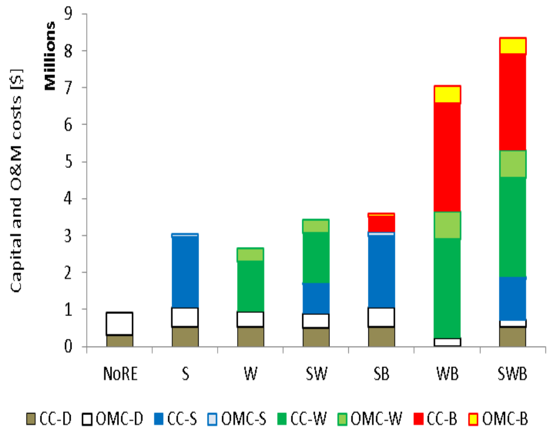


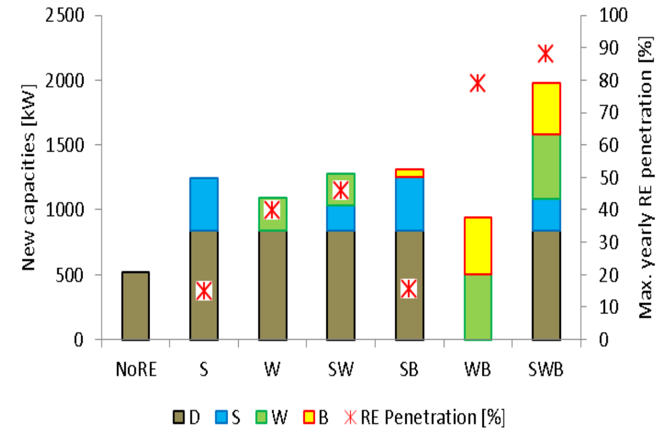
FS: Sanikiluaq

WISE
WATERLOO INSTITUTE
FOR SUSTAINABLE ENERGY

- Optimal results for 20-year horizon considering S $5082/kW, W $7943 to $8614/kW, and B $1504/kWh:







- Observations:
  - Maximum reduction of fuel cost (FC) occurs when wind is deployed.
  - NPCs of optimal total costs for RE cases are less than BAU (NoRE) by ~$1.5 million (~5.5 %), thus justifying RE deployment in all cases.
  - Maximum diesel use reduction of about 69.5 % occurs for the SWB case with a maximum RE penetration of all communities, at close to 90 %, and total savings of ~$10 million (~39 %).
  - No new generator requirement occurs in the WB case.

UNIVERSITY OF WATERLOO

Conclusions and Next Steps

- Feasibility study results:

Communities	Best Case Scenario	Annual RE Penetration		GHG Reduction over 20-yr. [%]	Savings over 20-yr.		Total RE Investment Required [M$]
		Average [%]	Maximum [%]		Cost [M$]	Fuel [M$]	
Arviat	SWB	66.49	72.96	60.40	9.32	19.63	10.80
Baker Lake	WB	81.59	89.03	74.12	13.39	28.83	18.41
Iqaluit	SWB	28.82	31.01	26.17	29.70	72.61	45.22
Rankin Inlet	WB	53.32	57.48	48.35	26.83	42.88	20.37
Sanikiluaq	SWB	81.48	87.92	74.24	10.32	17.75	7.62
Sachs Harbour	SW	38.99	42.15	35.41	0.44	1.57	0.98

  - Wind is the preferable RE option for all communities.
  - Battery addition reduces fuel use, but it is an overall more expensive solution for some communities.
- WWF is currently discussing RE deployments at Rankin Inlet and Baker Lake based on these studies.
- Report providing the details of the prefeasibility studies can be found at http://awsassets.wwf.ca/downloads/summary_and_prefeasibility_report.pdf.
- Report providing the details of the feasibility studies is available at http://assets.wwf.ca/downloads/full_report___feasibility.pdf.

31 March 2017 WISE
Challenges of deploying Solar Energy Systems in the remote indigenous communities of Arctic Canada

Green SunRising

Green Sun Rising Inc.
1680 Kildare Road
Windsor, ON N8W 2W4
Phone: 519-946-0408
Email: info@GreenSunRising.com

RET-Center

Green SunRising

Renewable Energy Technology

Agenda:

1. Who we are
2. 2017 solar PV project in Inuvik NWT
3. 2016 solar PV project in Kugluktuk NU
4. 2016 solar PV projects in Iqaluit NU
5. 2015 solar PV project 15kW Sachs Harbour NWT
6. 2015 solar PV project 82 kW Colville Lake NWT
7. 2014 solar PV project 60 kW Hay River NWT
8. energy cabin – deployable energy package
9. Q&A

Green SunRising

Renewable Energy Technology

1. Who we are Green Sun Rising:

Windsor’s longest operating solar company.
Founded in January 2008, before the Ontario Green Energy Act. Professional engineering company, for solar PV and solar thermal. Over 250 solar projects across Canada completed.
Well over 1,800 kW of implemented grid-connected PV systems, over 2.8 MW of solar mounting systems, and ST.
Manufacturing our own solar mounting system.

Green SunRising

Renewable Energy Systems

2. Solar PV Project in Inuvik NWT

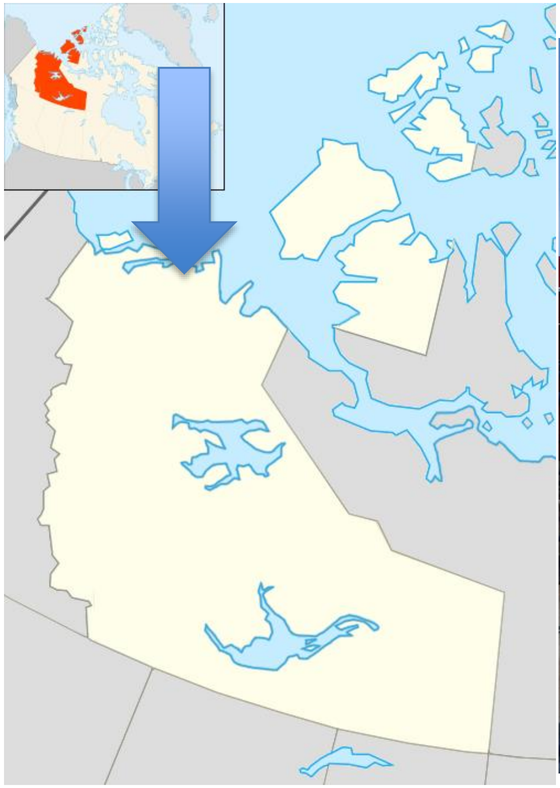
Inuvik Cold Storage Container
22 modules 265W each; 5.83 kW DC
String inverter Fronius 5kW AC 240VAC 1-phase
Roof-top on a steel container using the mounts4solar system

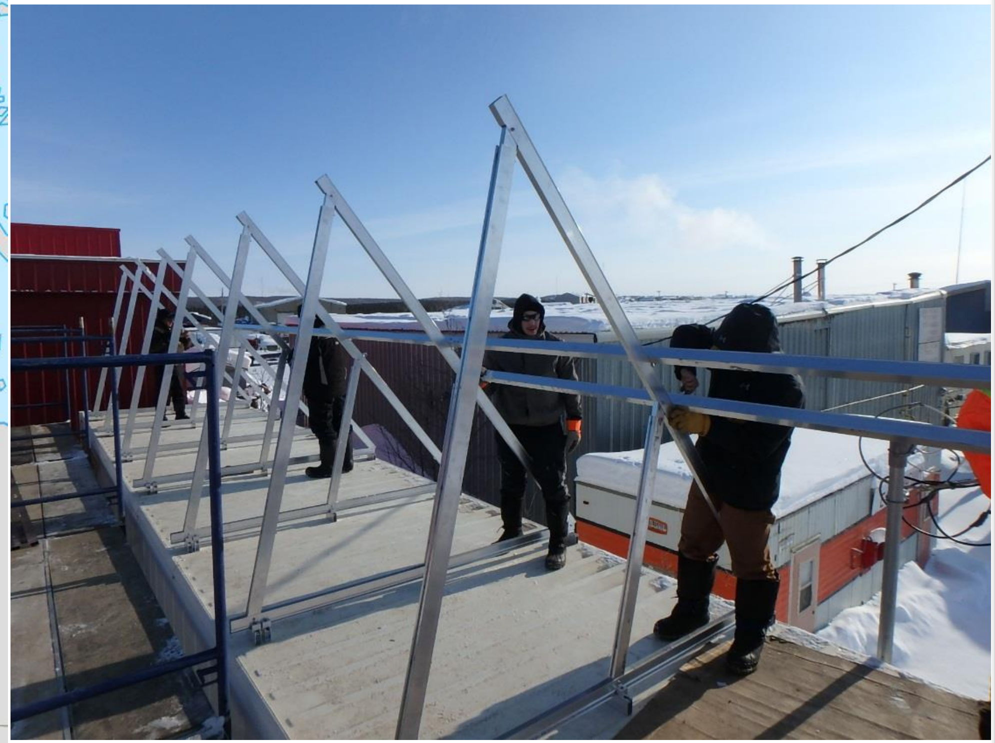
www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

2. Solar PV Project in Inuvik NWT





Challenges:
Winter installation in March 2017
Working on scaffolding and on container top
Training a new crew in solar installation

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

2. Solar PV Project in Inuvik NWT

The team did great, trained, installed and commissioned in 3 ½ days.

Green SunRising

Renewable Energy Systems

3. Solar PV Project in Kugluktuk NU

Kugluktuk Recreational Complex
40 modules 260W each; 10.4 kW DC
String inverter Fronius 10kW AC 208VAC 3-phase
Roof-top on a curved metal roof using the mounts4solar system

www.GreenSunRising.com







Green SunRising

Renewable Energy Systems

3. Solar PV Project in Kugluktuk NU

Challenges:
Location and Logistics
Weather
Curved roof
Safety from wild life

www.GreenSunRising.com

3. Solar PV Project in Kugluktuk NU

Air transport of materials by a DC 3 Buffalo Airways Yellowknife to Kugluktuk

3. Solar PV Project in Kugluktuk NU

Special mounting system design with telescoping legs for the curved nature of the roof

www.GreenSunRising.com

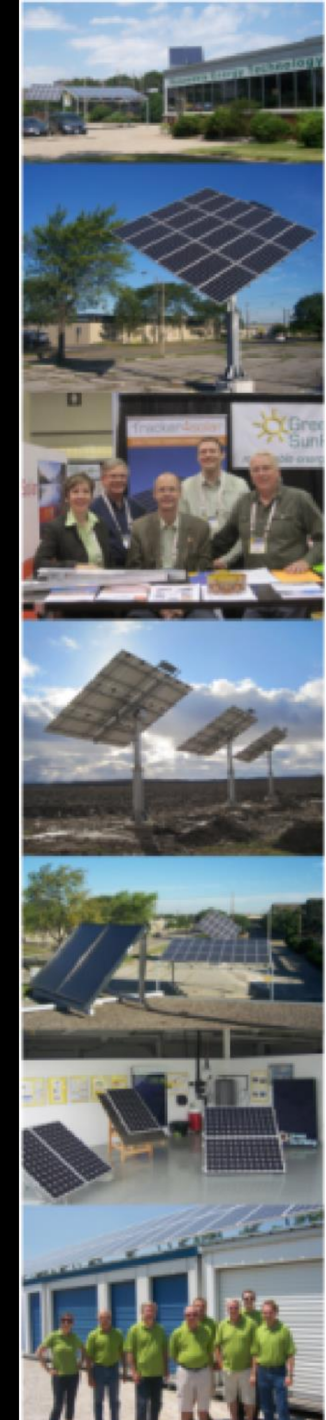
Green SunRising

Renewable Energy Systems

4. Solar PV Projects in Iqaluit NU

Qulliq Energy Corp – Main Power Station in Iqaluit – pilot project
Modular design: 1 string of 11 modules 260W each; 2.86 kW DC
String inverter Fronius 10kW AC 208VAC 3-phase
Expandable to 11.44 kW DC by adding 3 more rows

www.GreenSunRising.com



Renewable Energy Systems

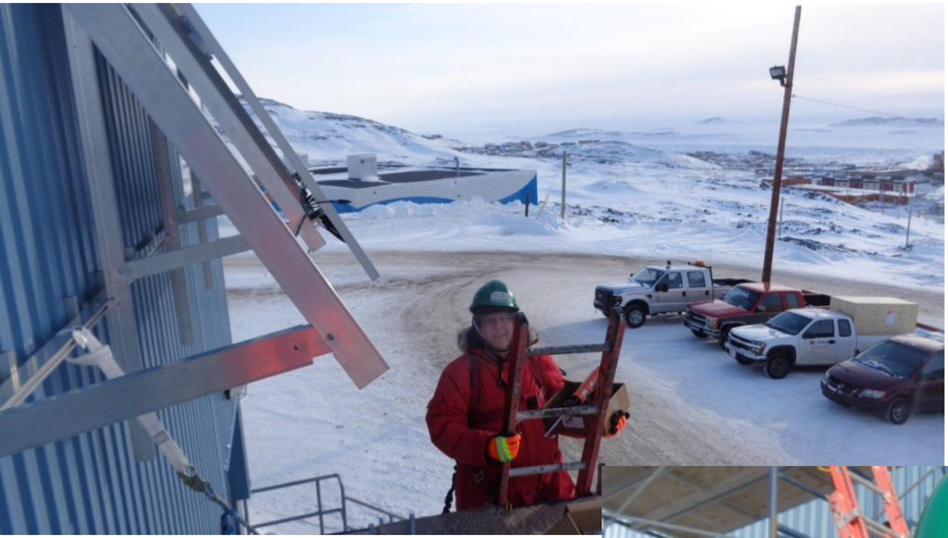
4. Solar PV Projects in Iqaluit NU

Challenges:
Weather
Location and logistics
Safely working at heights

www.GreenSunRising.com

Renewable Energy Systems

4. Solar PV Projects in Iqaluit NU

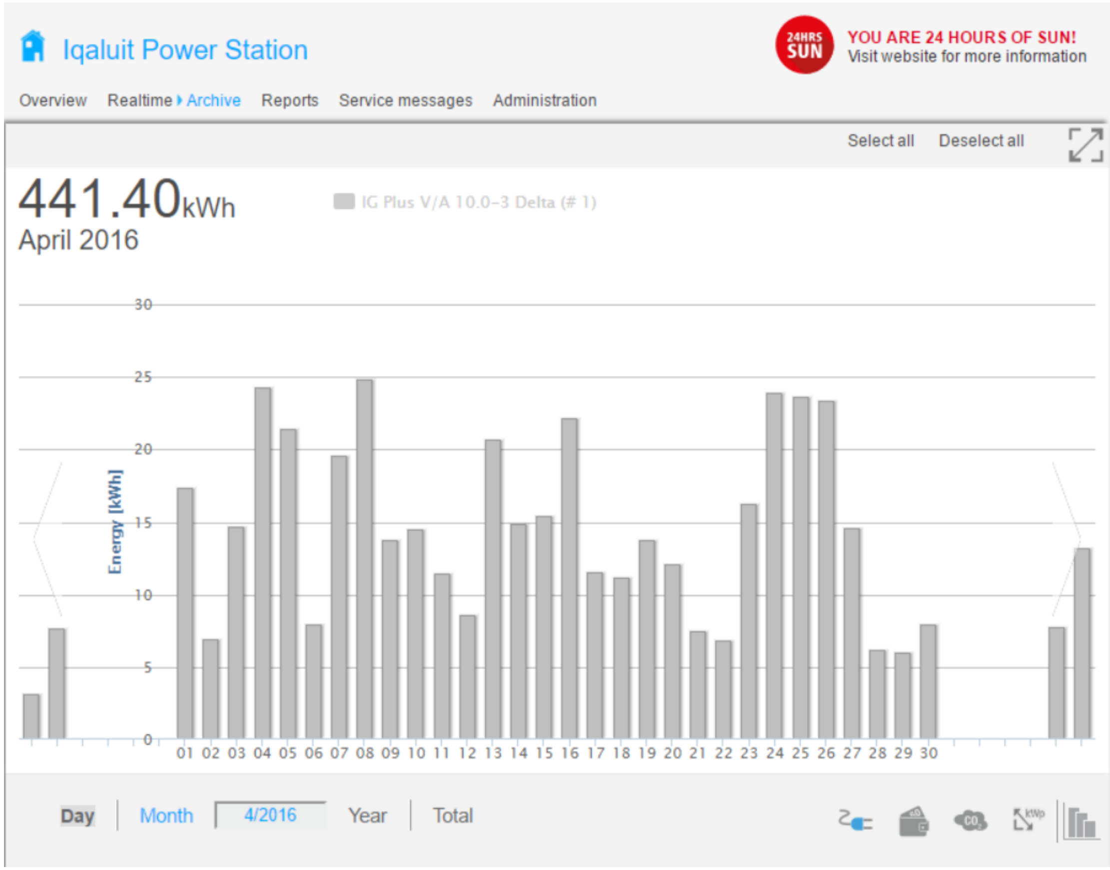


www.GreenSunRising.com

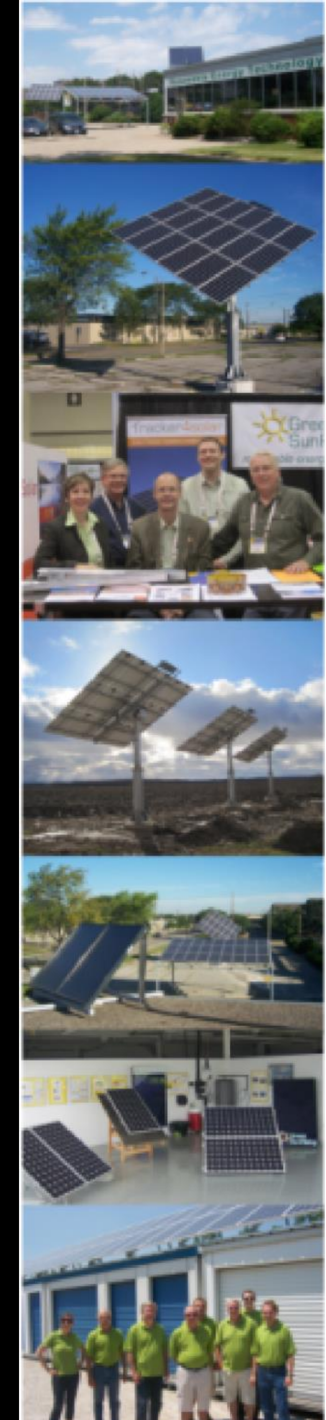
Green SunRising

Renewable Energy Systems

4. Solar PV Projects in Iqaluit NU



solar harvest data example QES solar PV system



www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

4. Solar PV Projects in Iqaluit NU

City of Iqaluit – AWG Arena in Iqaluit
Modular design: 4 strings of 10 modules 260W each; 10.4 kW DC
String inverter Fronius 10kW AC 208VAC 3-phase

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

4. Solar PV Projects in Iqaluit NU

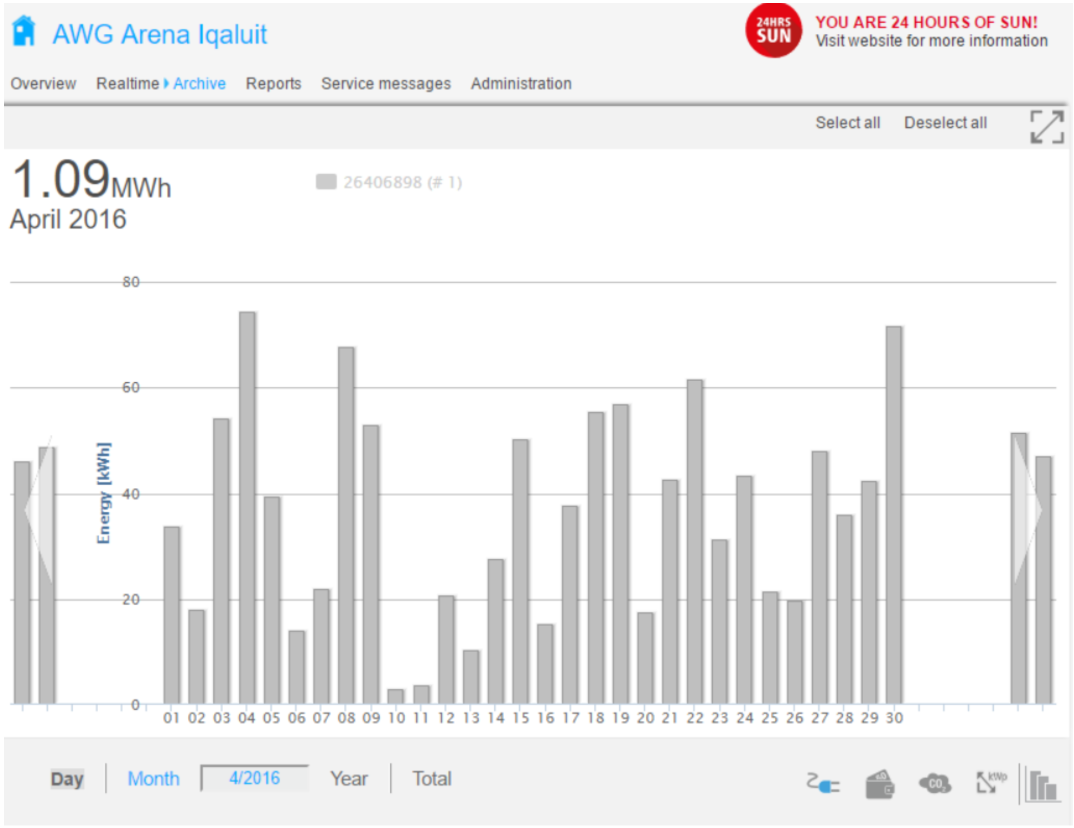
White-out conditions
Working safely at heights with snow and ice

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

4. Solar PV Projects in Iqaluit NU



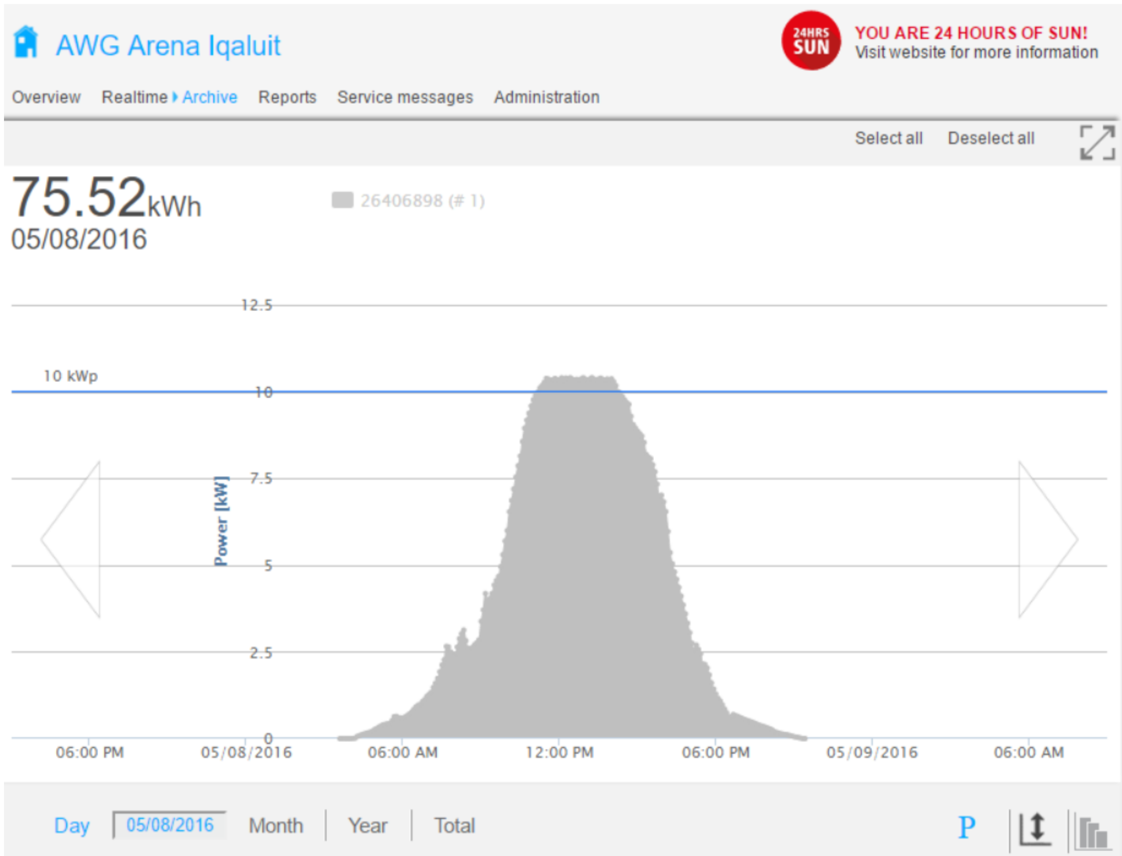
1,090 kWh generated in April 2016

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

4. Solar PV Projects in Iqaluit NU



08 May 2016 – 75.52 kWh generated in one day

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

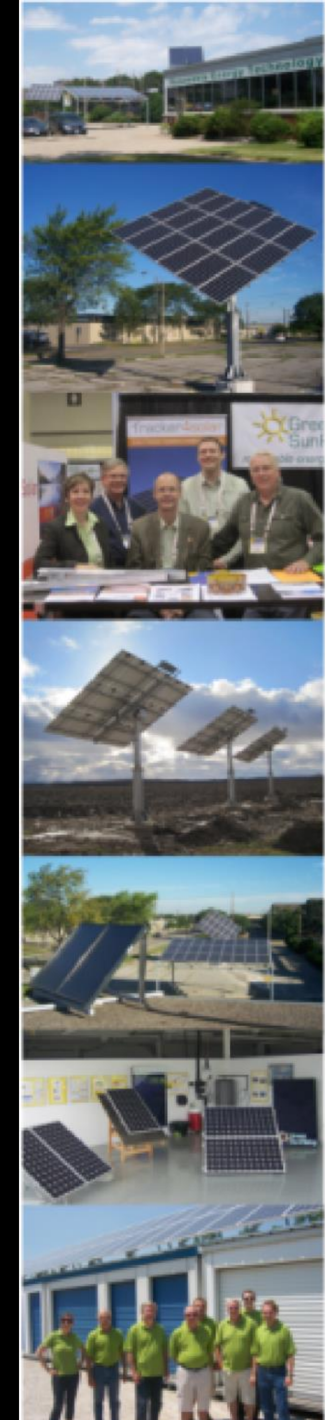
4. Solar PV Projects in Iqaluit NU

Actual DC generation higher than rated generation:

1. Lower ambient temperatures
   negative temperature coefficient: - 0.41 % / C
   at – 15 C ambient versus rated + 25 C, delta is 40 C
   16.4 % higher actual generation due to lower ambient temp.

2. Higher irradiation due to cold and dry air
   cosmic solar constant: 1,361 kW / m2
   solar irradiation at rated conditions: 1,000 W / m2
   no hard data available, estimated gain 5 to 10%

3. Albedo – reflections from bright surfaces such as snow & ice
   very site and weather and time of year dependent
   no hard data available, estimated gain up to 25 to 30%
   (example snow blindness)

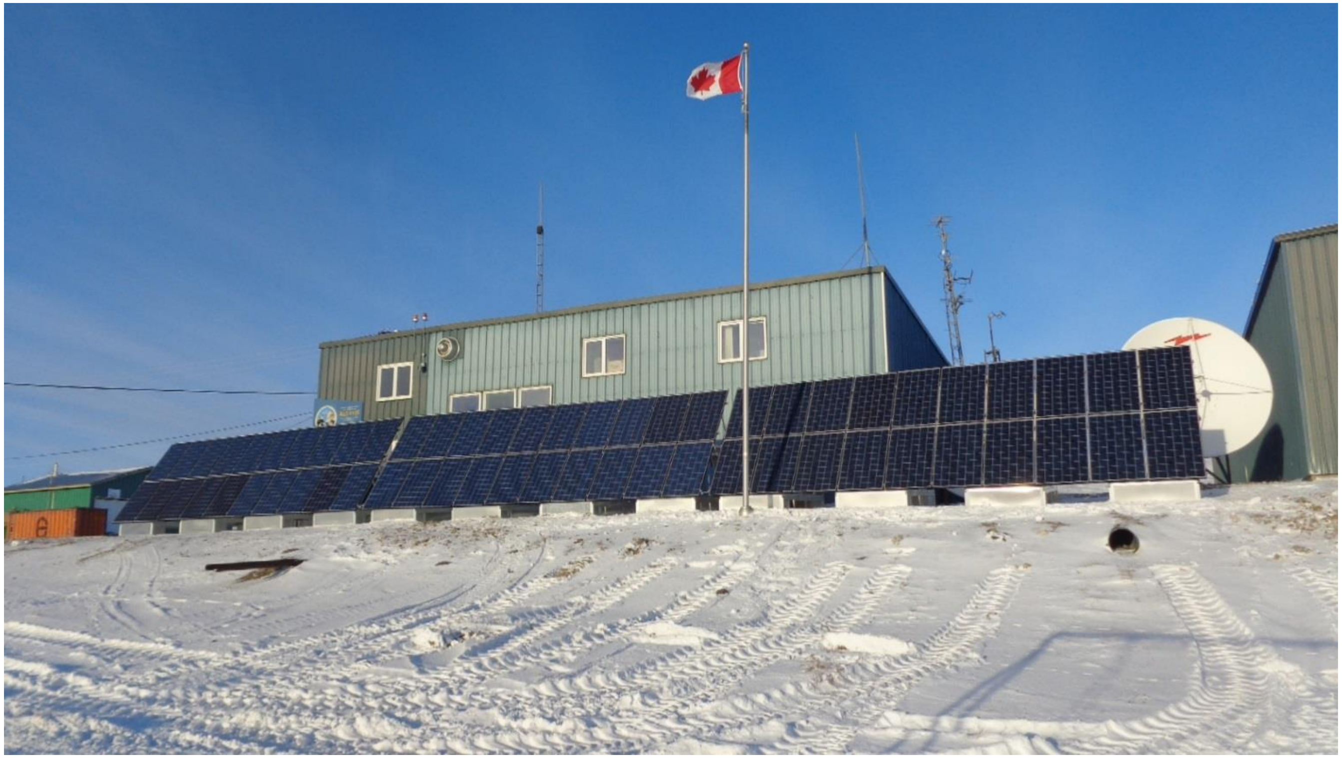


www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

5. 2015 Solar PV Project in Sachs Harbour

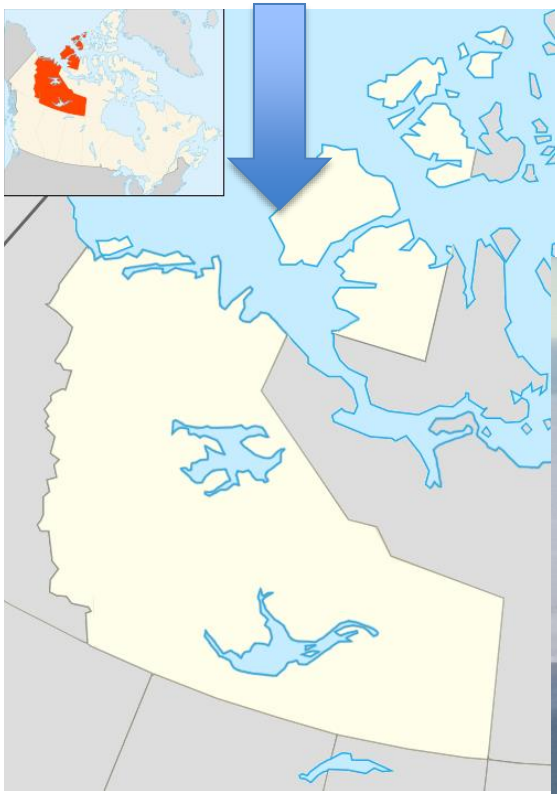


Modular design: 1 row of 3 sections in 240VAC 1-phase
each section has 20 modules of 260W DC each, 5.2 kW DC
each section has 1 string inverter 5 kW AC each, total 15kW AC

www.GreenSunRising.com

Renewable Energy Systems

5. 2015 Solar PV Project in Sachs Harbour



Challenges:
Location and Logistics
Weather
Safety from wild life – polar bears

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

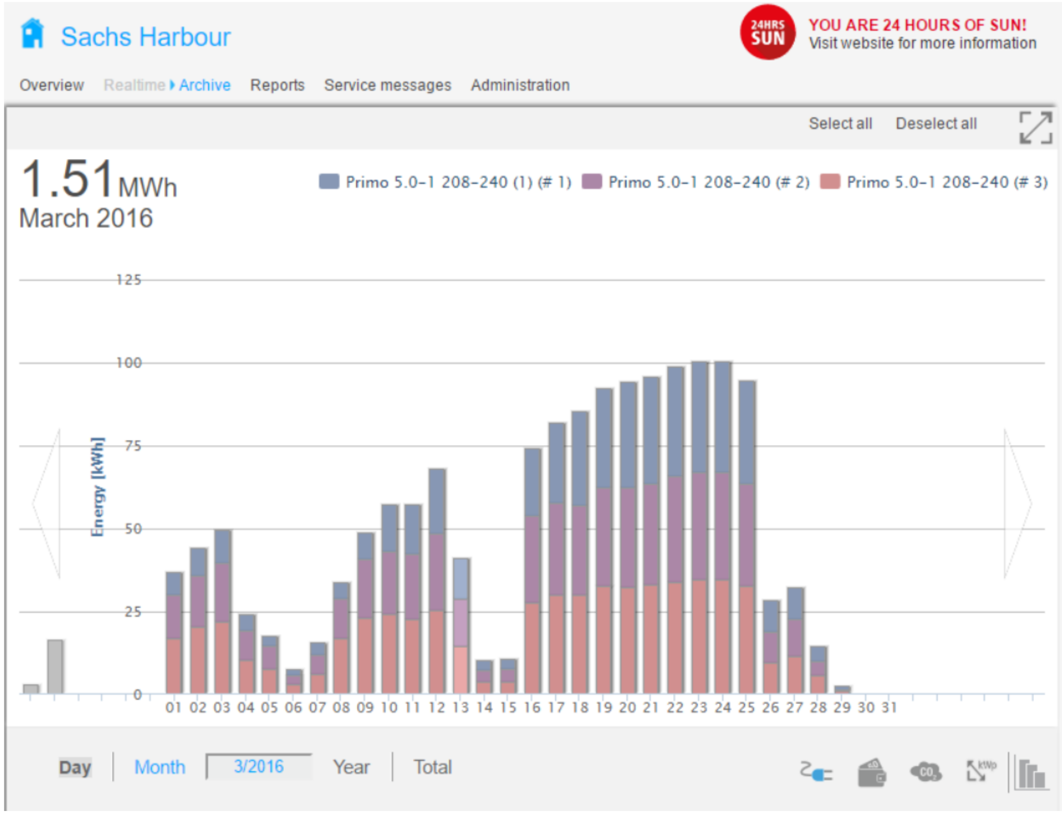
5. 2015 Solar PV Project in Sachs Harbour

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

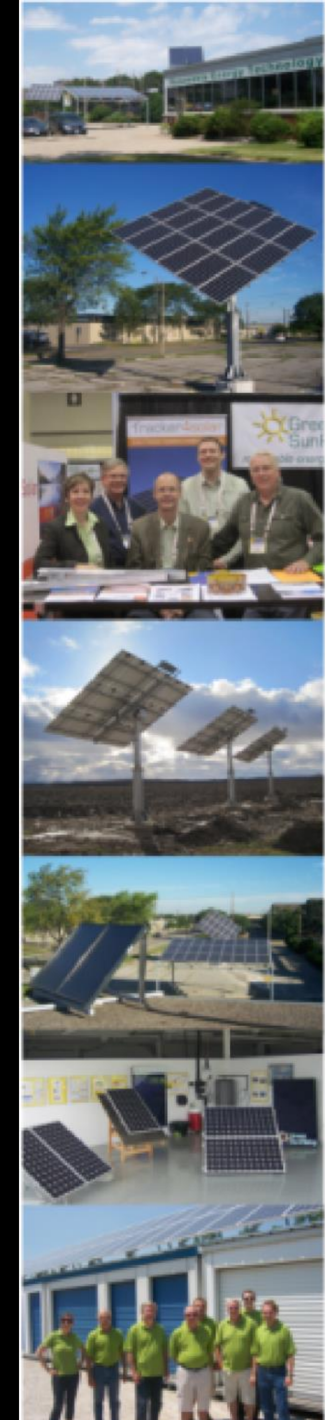
5. 2015 Solar PV Project in Sachs Harbour



Internet connection lost on 29 March 2016

Approx. 500 liter of Diesel generation displaced in one month alone

www.GreenSunRising.com



Green SunRising

Renewable Energy Systems

5. 2015 Solar PV Project in Sachs Harbour

While we were there …………

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

6. Solar PV Project 82kW Colville Lake NWT

Modular design: 3 rows of 5 sections each in 208VAC 3-phase
each section has 22 modules of 260W DC each, 5.72 kW DC
each section has 22 micro-inverters 250W AC each, 5.5 kW AC

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

6. Solar PV Project 82kW Colville Lake NWT

Challenges:

Location and Logistics

Weather

Safety from wild life – bears

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

6. Solar PV Project 82kW Colville Lake NWT

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

6. aerial view AC Colville Lake NT

www.GreenSunRising.com

Renewable Energy Systems

6. Colville Lake NT

5 section per each row – perfectly scalable up or down

www.GreenSunRising.com

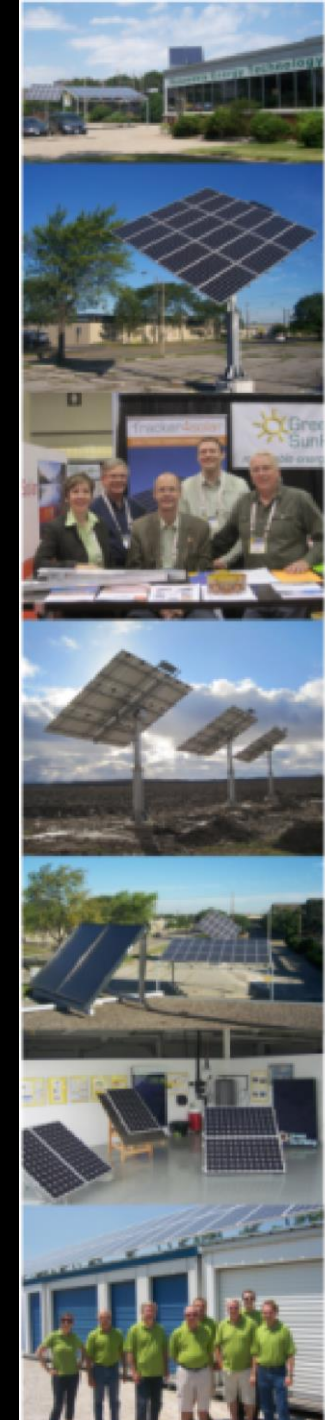
Green SunRising

Renewable Energy Systems

6. Tuesday June 02nd assembly work station built from crate wood

pre-assembled units are ready for unloading and assembly, then positioning and installation *www.mounts4solar.com*

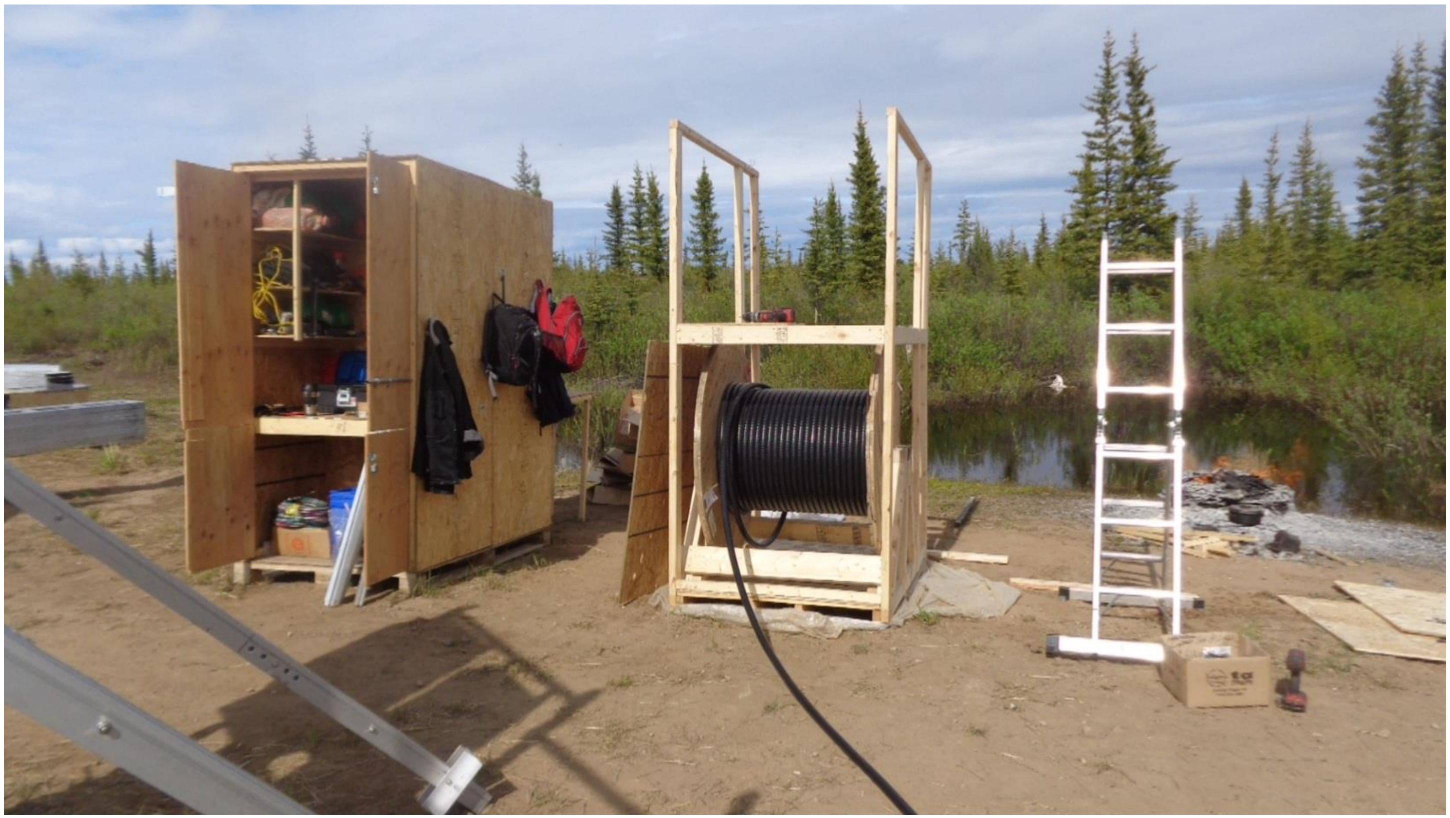
www.GreenSunRising.com



Green SunRising

Renewable Energy Systems

6. custom designed and built crates for the solar materials, as well as a special crate as tool crate and also serving as a kitchenette; cable reel built into crate; over 15 tons of material shipped via the winter ice road



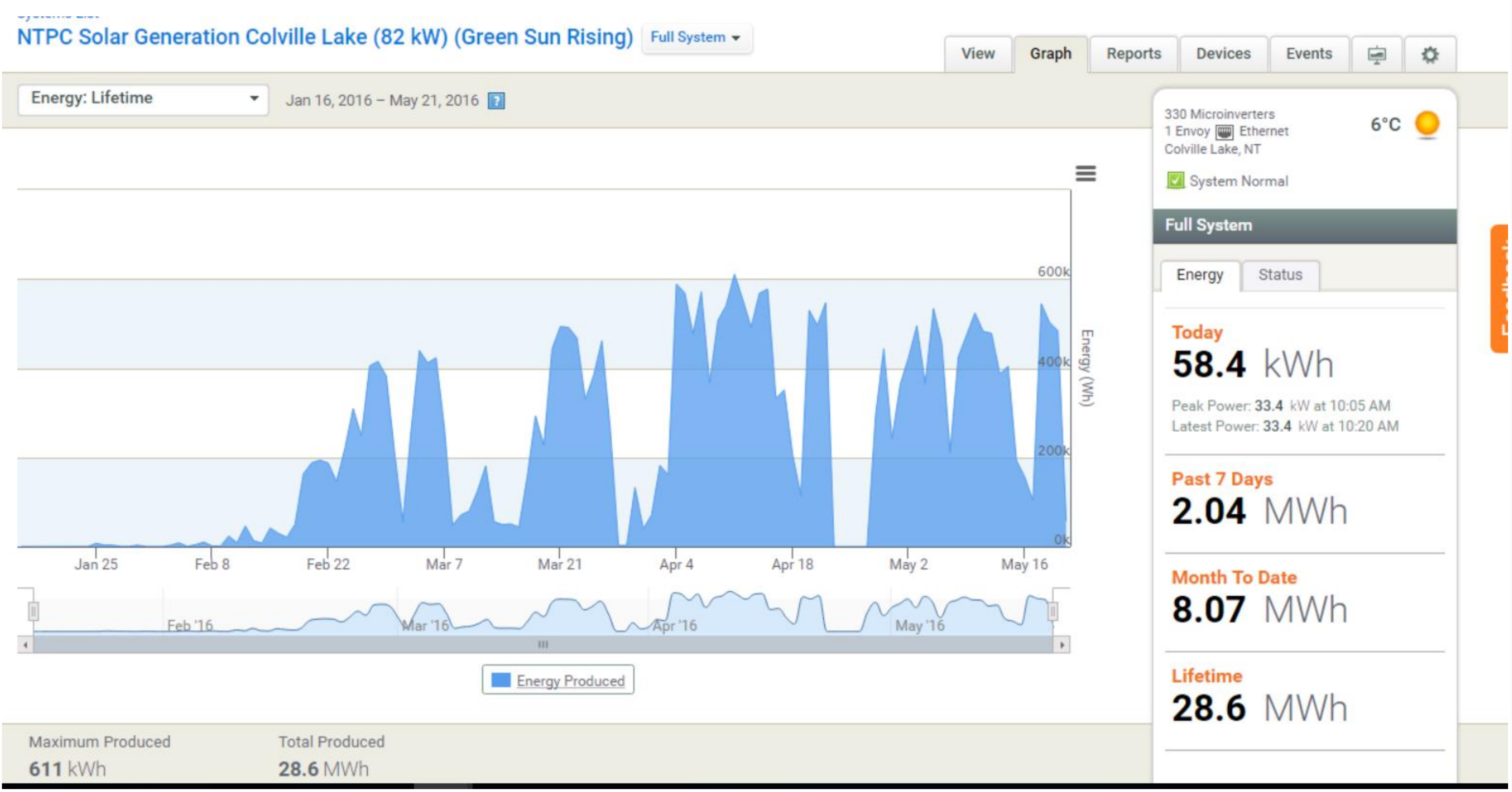
www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

6. team photo after finish – Friday June 12th, 2015

Renewable Energy Systems



2016 monitoring data Colville Lake 82kW AC system

www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

7. 60 kW Hay River NT - Whispering Willows Senior Residence

www.GreenSunRising.com

Green SunRising

Renewable Energy Technology

240 units of 250W solar modules, total 60 kW DC

www.GreenSunRising.com

Renewable Energy Systems

7. panoramic view of the South array

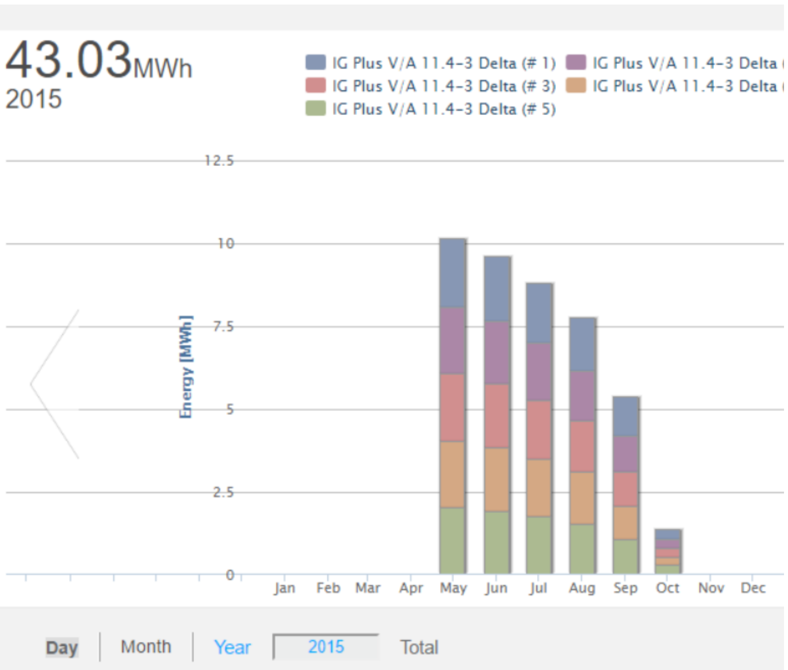
installed, inspected and grid-connected in 9 working days

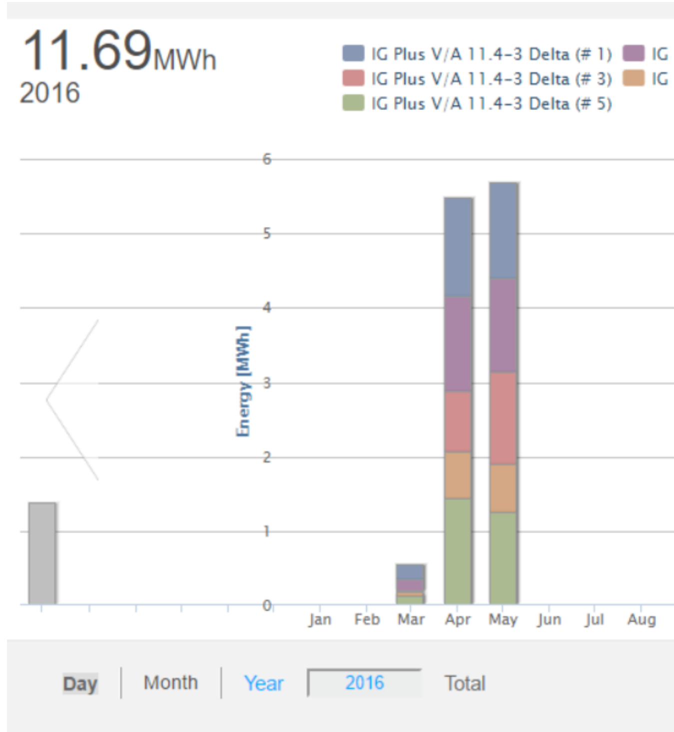
www.GreenSunRising.com

Green SunRising

Renewable Energy Systems

internet based monitoring for the solar system





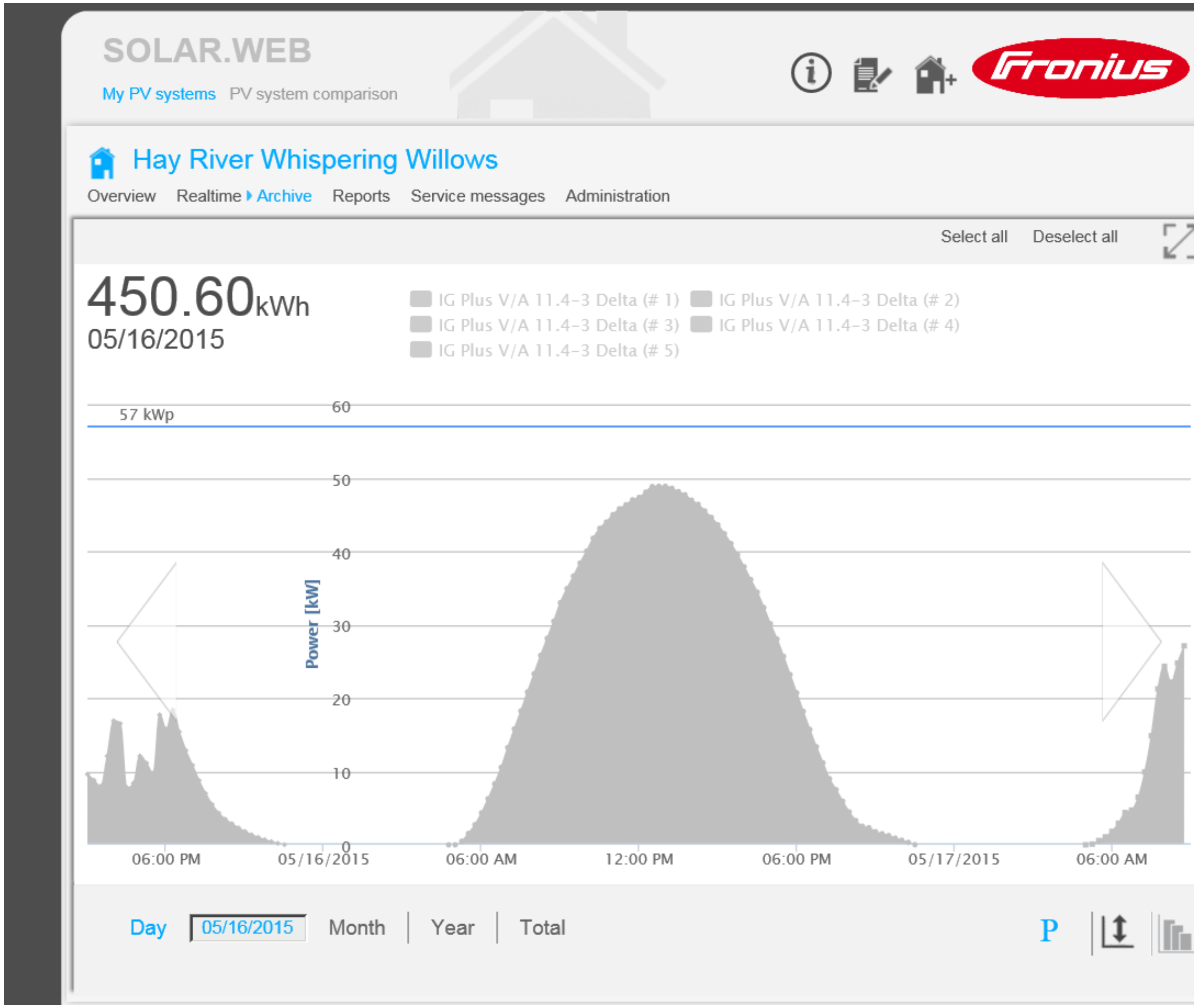
2015 monthly data

2016 monthly data

www.GreenSunRising.com

Renewable Energy Systems

7. internet based monitoring for the solar system

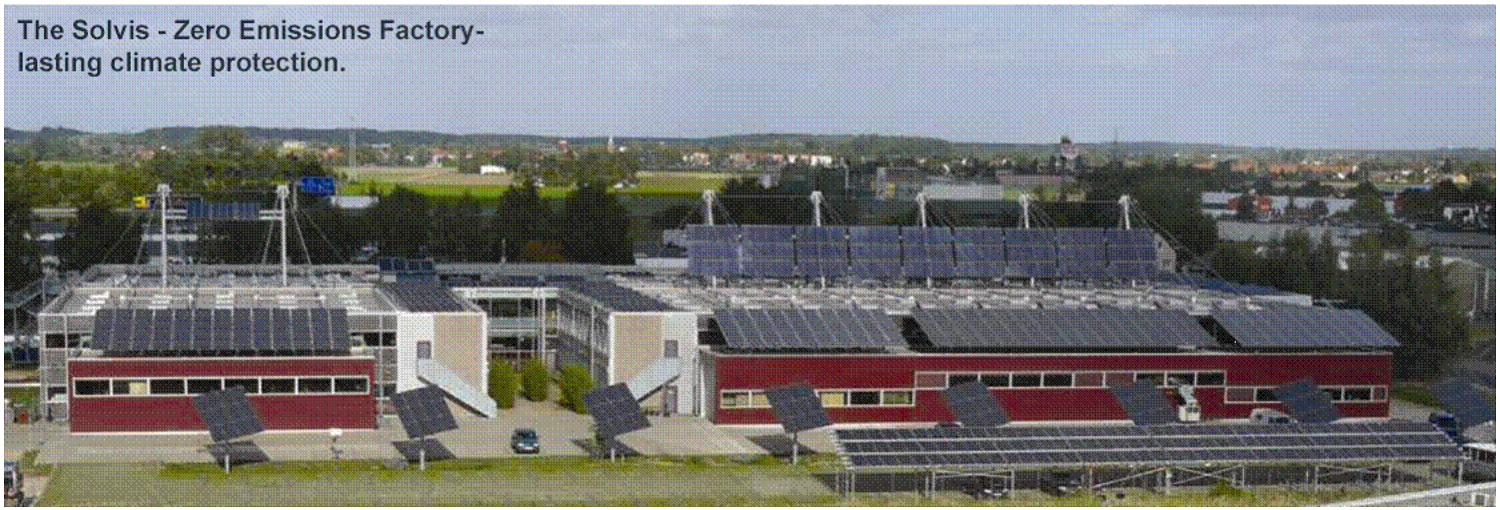


www.GreenSunRising.com

Green SunRising

Renewable Energy Technology

8. Questions & Answers



RET-Center Windsor
(previous Windsor Tool
& Die Factory)
1680 Kildare Road
Windsor ON
www.RET-Center.com
519-946-0408