Government of
Northwest Territories

2012 - 2017 GNWT SOLAR PHOTOVOLTAIC (PV) INVENTORY AND REPORTING

CONTENTS

EXECUTIVE SUMMARY

INTRODUCTION

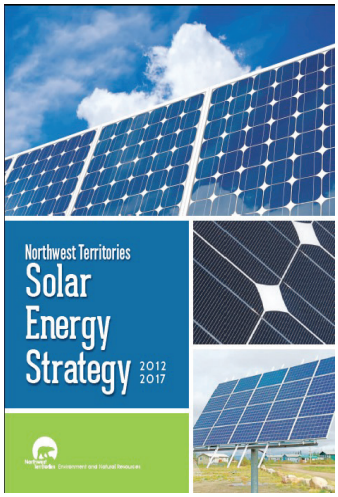
This document summarizes deployment of solar photovoltaic (PV) systems in the Northwest Territories since the release of the *Northwest Territories Solar Energy Strategy (2012-2017)* five years ago. It reports on installed capacity, greenhouse gas mitigation, uptake by sector, and uptake by community. This report card also provides information on operation and maintenance issues, and the importance of monitoring solar PV systems. Finally, this report discusses the decreasing cost of solar energy in the North and the opportunity to displace diesel for electricity generation.

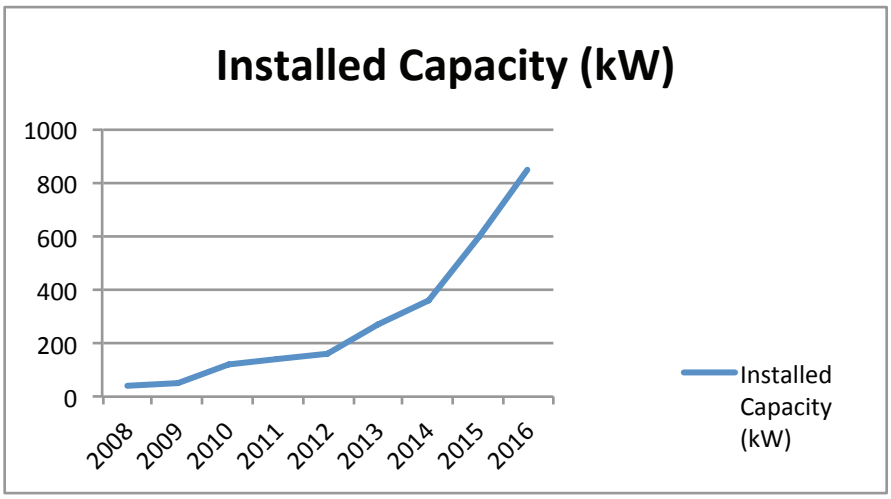
The use of modern solar technologies in the NWT dates back to the early 1980s. Cabin owners realized a battery could be charged with a solar photovoltaic (PV) panel during the long summer days. When the sun was blocked by clouds or dipped behind trees in the evening, the battery had enough stored energy to operate a cabin's radio and lighting until the next day. Solar charging systems—combining PV panels with battery storage and generator back-up—are now the most economical way to provide reliable electricity in remote camps, lodges and off-grid homes.

In the past five years, there has been a meaningful increase in the use of grid-connected solar systems because the cost of the technology is decreasing, and there is increased focus on greenhouse gas mitigation. Grid-connected systems provide power, and when solar energy is not available, electricity is purchased from the grid. Grid interconnection standards ensure that safety and power reliability is not compromised. A **Net-Metering Program** now underway in the NWT allows residential and business customers to connect privately-owned PV systems to the grid. Customers who produce surplus power—usually during the summer months—receive kilowatt-hour credits towards their next billing cycle.

Link to Net Metering Program: http://www.ntpc.com/docs/default-source/default-document-library/ntpc-net-metering-13-08-14.pdf?sfvrsn=2

In the fall of 2012, the GNWT released the Northwest Territories Solar Energy Strategy (2012-2017). The 5-year strategy promotes the use of solar technologies throughout the NWT, and guides government actions to reduce the emissions associated with the use of fossil fuels. The Strategy set a target to install solar systems with the capability to supply up to 20 percent of the average load in NWT diesel communities, or approximately 1800 kilowatts (kW) of collective installed capacity. By the end of 2017, the NWT reached approximately 900 kW of solar capacity—50% of this target. At the current rate of solar deployment, the full target could be met by 2020.





INTRODUCTION (CONTINUED)

The Solar Energy Strategy places an emphasis on advancing the use of solar in communities that rely primarily on burning diesel to generate electricity (diesel generation). Battery energy storage, variable-speed generators and advanced control systems can allow communities to use more of the available solar energy to displace larger amounts of diesel. Expanding the use of high-penetration solar/battery/diesel hybrid systems is identified as a key action in the *Solar Strategy*.

The *2030 Draft Energy Strategy* identifies solar PV as one of the technologies that will help the NWT to reduce greenhouse gas emissions from electricity generation in diesel communities by 25% by 2030. A capital investment of $14 million in solar PV would reduce greenhouse gas emissions by approximately 2000 tonnes of CO2 equivalents per year.

Rebates for individuals, communities and businesses interested in installing solar systems are available through the **Arctic Energy Alliance (AEA)**.

Link to Arctic Energy Alliance renewable energy programs: http://aea.nt.ca/programs/alternative-energy-technologies-program

In the NWT, solar energy technologies are being operated by residents, businesses, communities and First Nations development corporations, as well as the NWT Housing Corporation (NWTHC), the Department of Infrastructure (INF), and the Northwest Territories Power Corporation (NTPC).

Bertha Alan Senior Center, Inuvik (10 kilowatts). Photo: Wade Carpenter

Since 2001, 842 kilowatts (kW) of grid-connected solar PV systems have been deployed in the NWT. Most of this capacity is located on diesel micro-grids, and reduces the use of diesel by an estimated 225,000 litres per year. According to the Canadian Solar Industries Association, the NWT currently ranks second in the country in installed solar capacity on a per capita basis—about 20 watts of solar per person.

The cost of solar panels has decreased by over 50% since 2010, becoming a more feasible solution for offsetting diesel consumption in remote communities.

At current prices, solar energy in the NWT is still about twice the cost of diesel generation. Solar can be produced for about 60 cents per kilowatt hour (kWh), and the displaced cost of diesel can be up to 30 cents per kWh.

New solar PV panels function for more than 30 years, with an estimated decline in power production of about one percent per year. As prices continue to drop, solar PV panels are becoming competitive with the cost of diesel generation.

The GNWT prioritizes communities for solar projects based on:

- Considerations for integration with the diesel power plant;
- The economic feasibility of a particular project;
- Highest displaced cost of diesel;
- Close proximity of solar site to the diesel plant or power lines;
- Communities with little or no existing renewable energy generation; and
- Interest from the community.

NWT SOLAR INSTALLATIONS

INSTALLATIONS BY OWNER TYPE

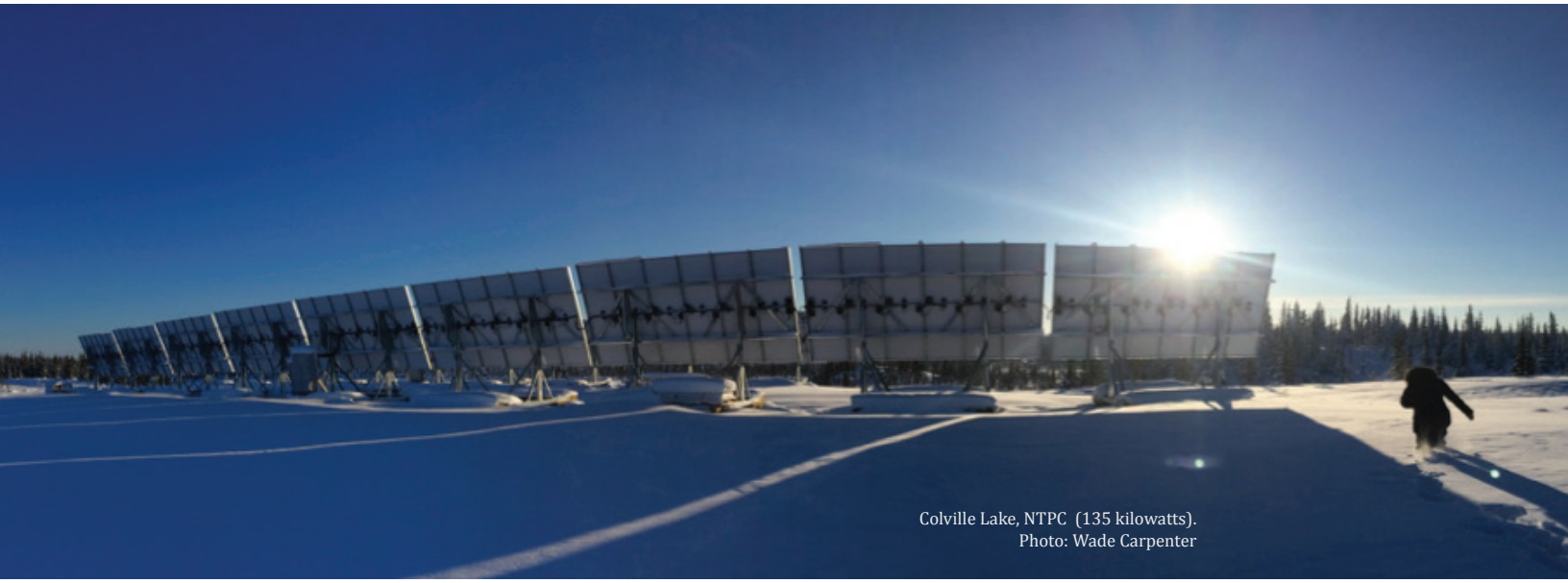
Current solar PV installations are generating just below 900 kW of grid-tied solar capacity. The thermal generating zone (i.e. communities with diesel or natural gas generation) has more than three times more installed solar capacity than hydro communities. The Installation by Owner Type table shows that Utilities, the Territorial Government and Local Governments heavily favour installations in the thermal zone, while commercial and residential owners lean toward hydro zone installations. The federal government has one installation in the hydro zone.

Solar PV is installed for two main reasons. First, PV represents an up-front capital investment rather than an ongoing cost. The cost of energy is therefore the total upfront cost divided by the expected lifetime output. If the upfront capital cost is low enough, then it is possible that the lifetime cost of electricity will be lower than other energy generation methods, such as burning fossil fuels. Second, solar PV does not produce emissions. Organizations such as the GNWT consider greenhouse gas reduction valuable, so this value also needs to be considered when evaluating whether to implement solar PV.

It is worth noting that the price of residential electricity in thermal communities is subsidized (up to a cap) down to the cost of electricity in the hydro zones. However, no such subsidy exists for commercial or government installations. While the motivation for the GNWT installations in thermal zones is greenhouse gas reductions, residential and commercial owners in the hydro zones appear to be investing in solar to hedge against future rate increases. Even though the Arctic Energy Alliance rebate for solar is twice the amount in thermal zones, more residential and commercial solar continues to be deployed in hydro zones. More work needs to take place to demonstrate the environmental benefits of installing solar in thermal zones instead of hydro zones.

Table 1. Solar capacity (kilowatts) by owner type and zone.

OWNER TYPE	THERMAL ZONE	HYDRO ZONE	TOTAL
COMMERCIAL	33	42	**76**
FEDERAL GOVERNMENT	0	34	**34**
LOCAL GOVERNMENT	146	38	**184**
RESIDENTIAL	16	35	**51**
TERRITORIAL GOVERNMENT	140	68	**208**
UTILITY	343	1	**344**
GRAND TOTAL	**678**	**218**	**896**



Colville Lake, NTPC (135 kilowatts).
Photo: Wade Carpenter

FUNDING FOR PHOTOVOLTAIC

Much of the solar PV that has been installed has had either direct government funding or indirect funding via the Arctic Energy Alliance. The funding trends show that the bulk of spending has been on utility assets, followed by local and territorial government projects. Commercial installations in the thermal zone received significantly more funding than hydro zone installs, while most funding for residential installs has been in the hydro zone.

Table 2. Total GNWT Funding for Solar Projects

OWNER TYPE	THERMAL ZONE	HYDRO ZONE	TOTAL
COMMERCIAL	$128,727	$22,391	**$151,118**
FEDERAL GOVERNMENT	$0	$0	**$0**
LOCAL GOVERNMENT	$425,000	$110,491	**$535,491**
RESIDENTIAL	$10,000	$33,500	**$43,500**
TERRITORIAL GOVERNMENT	$811,697	$402,250	**$1,213,947**
UTILITIES	$4,170,000	$10,000	**$4,180,000**
GRAND TOTAL	**$5,545,424**	**$578,632**	**$6,124,056**

Roughly 90% of GNWT funding has been used for projects that reduce GHG emissions in diesel generation communities.

Table 3. Existing solar capacity and remaining amount of solar capacity by community.

COMMUNITY	COMMUNITY AVERAGE LOAD (KW)	ESTIMATE AVAILABLE SOLAR CAPACITY (KW)	CURRENT SOLAR CAPACITY INSTALLED (KW) - CALCULATED	PLANNED PROJECT (KW) - CALCULATED	AVAILABLE CAPACITY (KW) - CALCULATED
AKLAVIK	363	73	75	0	-2
BEHCHOKO	814	163	34	0	129
COLVILLE LAKE	77	15	135	0	-120
DELINE	314	63	0	0	63
FORT GOOD HOPE	313	63	5	0	58
FORT LIARD	259	52	59	0	-7
FORT MACPHERSON	397	79	10	0	69
FORT RESOLUTION	293	59	0	0	59
FORT SIMPSON	867	173	143	5	25
FORT SMITH	3000	600	5	0	595
GAMETI	170	34	10	0	24
INUVIK	3349	670	122	0	547
JEAN MARIE RIVER	38	8	7	0	0.7
LUTSEL K'E	216	43	33	0	10
NAHANNI BUTTE	45	9	5	0	4
NORMAN WELLS	1108	222	0	0	222
PAULATUK	166	33	7	0	27
SACHS HARBOR	109	22	19	0	3
TSIIGEHTCHIC	89	18	0	0	18
TUKTOYAKTUK	481	96	0	0	96
TULITA	277	55	10	45	0
ULUKHAKTOK	235	47	0	0	47
WHATI	237	47	5	20	22
WRIGLEY	84	17	10	0	7
WEKWEETI	70	14	0	0	14
FORT PROVIDENCE	330	66	15	0	51
KAKISA	30	6	0	0	6
TROUT LAKE	45	9	0	0	9
YELLOWKNIFE DETTAH N'DILO	18000	3617	108	0	3509
HAY RIVER ENTERPRISE	3400	678	67	0	611
TOTAL		**7050**	**884**	**70**	

SOLAR MAINTENANCE AND MONITORING

One common concern emerges when funding is provided to pay for up-front capital costs of projects: is there certainty that once a system is operating that it will be operated and maintained over the long term. With solar PV, O&M requirements are fairly minimal, which has both advantages and disadvantages: If installations are allowed to run without periodic verification of operations, it is completely possible that an installation could continue to run for many years without any intervention, and have no issues. On the other hand, if there is no periodic O&M, then an issue could develop and not be noticed to the outside viewer because PV has no moving parts, what appears to be a fully functioning solar array could in fact be doing nothing. Modern PV systems generally have straightforward and easy interfaces that allow a public facing webpage that shows production, system faults etc. An examination of existing systems found the following for the existing installs:

From January to March, 2017, the Arctic Energy Alliance coordinated a project to install on-line monitoring equipment on Solar PV systems that had been funded by the GNWT in previous years. In some cases, the systems were not operational and efforts were made to repair the systems before installing the monitoring equipment. This work identified several gaps in the operation and maintenance of solar PV systems in the NWT. The chart below describes how GNWT funded solar projects are maintained by owner type.

SOLAR PV SYSTEM OWNER TYPE	MAINTENANCE
NORTHWEST TERRITORIES POWER CORPORATION	Maintenance plans in place to keep the systems operational throughout their lifetimes.
GNWT- HOUSING CORPORATION	Monitoring and maintenance is left to the local housing authority (LHO) or the building manager. LHO's may be unfamiliar with the technology and reluctant to monitor or maintain the systems. No long term plan identified for maintenance.
GNWT-SCHOOLS	Monitoring and maintenance is left to individual schools and/or school districts. Difficult to get buy-in from maintenance staff. No long term plan identified for maintenance.
GNWT-INFRASTRUCTURE DEPARTMENT	Maintenance plans in place to keep the systems operational throughout their lifetimes.
COMMUNITY OWNED	Monitoring and maintenance is left to individual community governments. Difficult to determine if solar PV systems are being maintained unless remote monitoring is in place.
BUSINESSES	Monitoring and maintenance is left to the building owner. More likely to maintain PV systems because the benefits accrue directly to them.
RESIDENTS	Monitoring and maintenance is left to the building owner. More likely to maintain PV systems because the benefits accrue directly to them.

CONCLUSIONS

The number of installations has increased dramatically over the course of the Solar Energy Strategy. This has been due to a steady decrease in the cost of solar installations as well as government funding for PV. In the future, a review of funding should determine if the purpose of funding is primarily to offset GHGs or to reduce the electricity costs for system owners. Finally, the utility seems best at ensuring systems are operational. The GNWT set aside a small fund to be used to initiate repairs on the systems. The findings of this program can be found in the appendix.

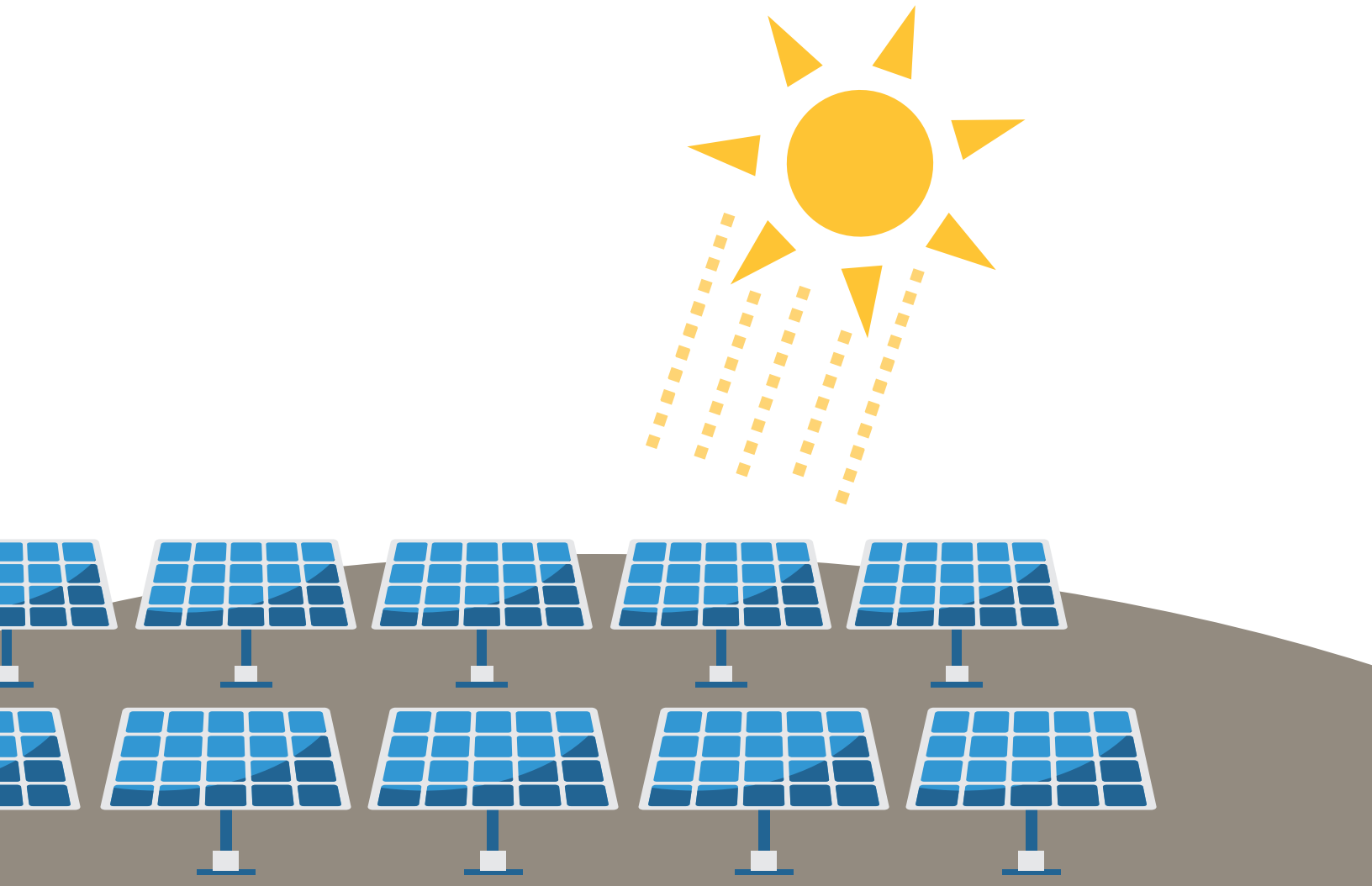
SOLAR STATISTICS IN THE NWT (2017)

Estimated Annual GHG Reductions (kg)

515,213 kg

Estimated Annual liters of diesel saved

191,529 litres



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English

Si vous voulez ces informations dans une autre langue officielle, contactez-nous.
French

Kīspin ki nitawihtīn ē nīhīyawihk ōma ācimōwin, tipwāsinān.
Cree

Tłı̨chǫ yatı k’ę̀è. Dı wegodı newǫ dè, gots’o gonede.
Tłı̨chǫ

ʔerıhtł’ís Dëne Sųłıné yatı t’a huts’elkër xa beyáyatı theɔ́ą ɔat’e, nuwe ts’ën yółtı.
Chipewyan

Edı gondı dehgáh got’ı̨e zhatıé k’ę́é edatł’éh enahddhę nıde naxets’é edahłí.
South Slavey

K’áhshó got’ı̨ne xədə k’é hederı ɔedı̨htl’é yerınıwę nídé dúle.
North Slavey

Jii gwandak izhii ginjìk vat’atr’ijąhch’uu zhit yinohthan jì’, diits’àt ginohkhìi.
Gwich’in

Uvanittuaq ilitchurisukupku Inuvialuktun, ququaqluta.
Inuvialuktun

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Inuktitut

Hapkua titiqqat pijumagupkit Inuinnaqtun, uvaptinnut hivajarlutit.
Inuinnaqtun

INFRASTRUCTURE DEPARTMENT/ENERGY DIVISION