Alberta Solar Performance Data

Solar PV Reference Array

Introduction

The City of Edmonton PV Reference system at NAIT has been designed to provide solar designers, installers and the general public with site-specific information to address questions regarding the impact of array tilt angles and snow accumulation on overall solar system production.

Screen Shot 2015-08-18 at 9.14.05 AM.png

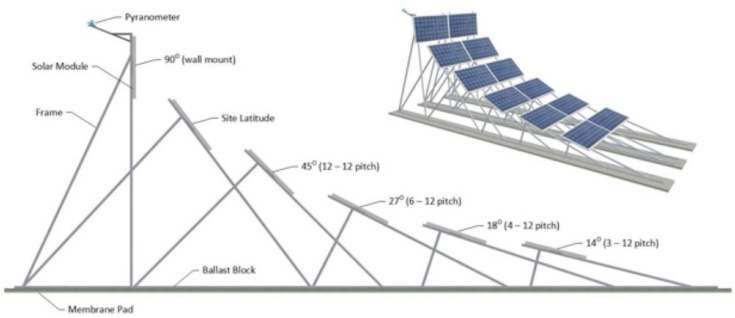
Situated on the roof of the NAIT is a solar photovoltaic array consisting of six pairs of solar modules. NAIT's main campus is located at 11762 106 Street NW, Edmonton, Alberta.

Reference array details:

- Array has 100% solar access (there are no trees or buildings shading the array)
- Modules face True South at 53° latitude
- Each pair of modules is at a different pitch ranging from 14° to 90°
- Snow is removed from the West (left) side each snowfall day, as soon as the snowfall has stopped
- Photos are taken immediately before and after every snow clearing event
- Microinverters take a snapshot of system performance every five minutes providing data on: Time, AC voltage, DC voltage, DC current, inverter temperature and power production

Four of the angles were chosen because they are the most common roofing angles (14°, 18°, 27°, 45°). In addition, the angle of 53° was chosen because it is Edmonton's latitude and 90° was chosen to represent a wall mount installation.

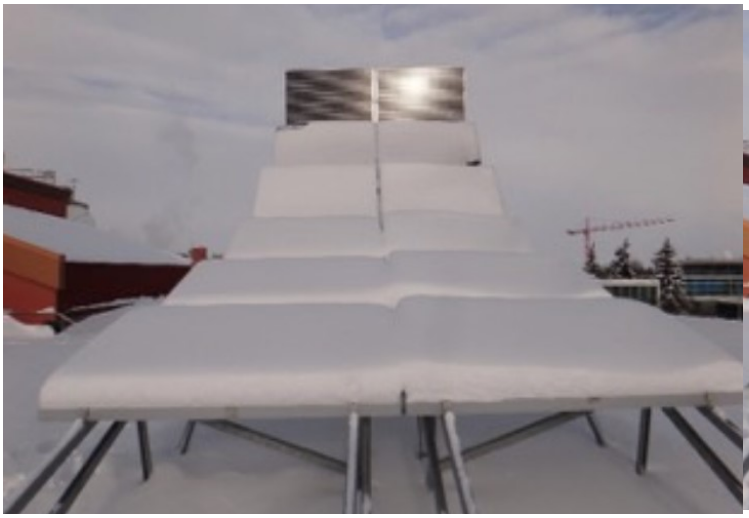
Screen Shot 2015-08-18 at 9.15.24 AM.png



The reference array design including angles in degrees and in roofing terms.

Since 2012, snow-clearing maintenance has occurred an average of 24 times on the West side modules, during each winter season. A 2-meter long automotive brush and scraper has proven to be the best tool for cleaning the modules. The extendable brush dismisses the need for ladders and ensures a safe environment.

Screen Shot 2015-08-18 at 9.16.12 AM.png Screen Shot 2015-08-18 at 9.17.17 AM.pn



Prior to being cleaned.

After a snow cleaning event.

Conclusions

See latest attached report for the latest data

The following conclusions are drawn from the six possible angles set points of the reference array. Actual optimum angles would likely fall between these numbers.

Snow Impact

The snow naturally slides off as the tilt angle increases. At a tilt angle of 90°, there was no snow accumulation for 99.5% of the winter. As the module angle decreased from 53° to 14° a greater difference in energy output occurred between the cleared module and the unmaintained module.

Is it worth clearing my modules to get a better performance?

The reference array demonstrated that clearing your modules offers a gain of 0.85%-5.31% more energy depending on the module tilt angle.

In general, individuals with on-grid systems do not clear their modules throughout the winter. It does vary for the type of system; a ground mount array would be easier to clean than an array that necessitates climbing onto the roof. Off-grid systems owners generally do clear the snow regularly, but it is a judgement that solar system owners have to make for themselves.

What is the optimum summer angle?

- A tilt angle of 27° provided the highest production during the summer April 1 – September 30.

Optimum tilt angle (Summer)

Month	Optimum Angle (°)
April	45
May	18
June	18
July	18

August	27
September	53

What is the optimum winter angle?

- A tilt angle of 53° provided the highest production (Oct. 1-Mar. 31) with snow clearing.
- A tilt angle of 90° and 53° tied for providing the highest production (Oct. 1-Mar. 31) without snow clearing.

Optimum tilt angle (Winter)

Month	Optimum Angle (°)
October	53
November	90
December	90
January	90
February	53
March	53

What is the optimum year-round angle?

- On a year-round basis a tilt angle of 53° generated the most energy with snow clearing.
- On a year-round basis a tilt angle of 53° generated the most energy without snow clearing.

With off-grid systems it is in the best interest of the owner to change the angle of the array twice a year at spring and autumn equinox. It is a judgement that solar system owners have to make for themselves.

Snow Cleared vs Snow Uncleared
Production Data from
April 1, 2012 to March 7, 2015

Angle (°)	Increase when cleared (%)
14	5.28
18	5.31
27	4.14
45	1.99
53	1.63

There are additional factors to consider:

- Safety hazards of climbing on the roof in winter.
- During warm sunny periods in the winter the snow will melt and sluff off, depending on the array tilt.
- The months of the year with the most snow have the shortest days, the lowest sun angle and the weakest light conditions.

Predicting Production

The NAIT reference array recorded a 17% difference in total output between the first and second winters. This demonstrates that system production can vary significantly year to year. This project will be able to provide more and more reliable information as additional years of data are accumulated.

Reports: Points of Interest from 2013-2014

- Highest Recorded Power for a Single Module = 226W
- Highest Module Output for Single Day = 1.82 kWh May 27, 2012 at 18 degrees
- Highest Array Output for a Single Month = 442 kWh May 2013
- Lowest Recorded Inverter Temperature = -31.0C December 06, 2013
- Highest Recorded Inverter Temperature = 46.0C July 02, 2013

For more information, see the attached Northern Alberta Institute of Technology Solar Photovoltaic Reference Array Report – March 31, 2015.

View current and historical system performance data.

The Solar Energy Society of Alberta would like to acknowledge the hard work of the following people on this project:

a) Original idea: Rob Harlan, Solar Energy Society of Alberta
b) Funding: City of Edmonton
c) Tilt angles, electrical design and development: Gordon Howell, Howell Mayhew Engineering
d) Structural design and operational maintenance: Tim Matthews, NAIT
e) Installation: Clifton Lofthaug, Great Canadian Solar

For more information about the NAIT Alternative Energy Technology Program go to: http://www.nait.ca/program_home_76007.htm

Reference: Northern Institute of Technology (Tim Matthews). (2014). Solar photovoltaic reference array report. *Alternative Energy Program.* Last update: August 18, 2015