

SOLAR ENERGY



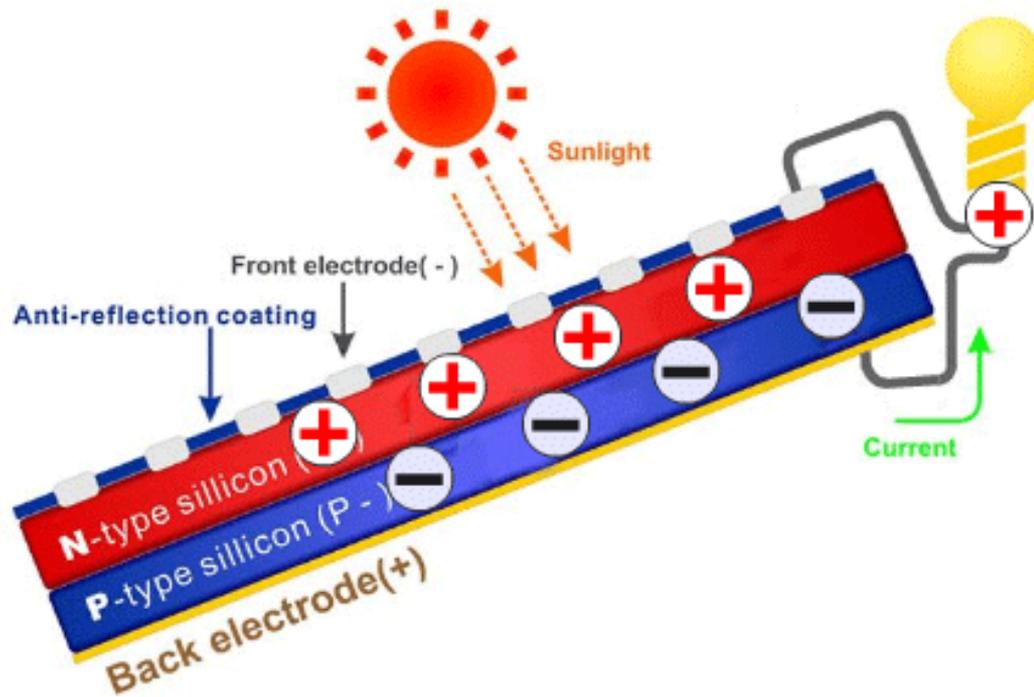
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BIMOSE TRIBAL COUNCIL

SOLAR ENERGY

1. Photovoltaics - What are they and how do they work?
2. The Solar Resource - Understanding, measuring and using data
3. Site Analysis
4. Types of Systems
5. Mechanical Attachment Options
6. Inverters & Balance of System
7. Feed In Tariff - FIT

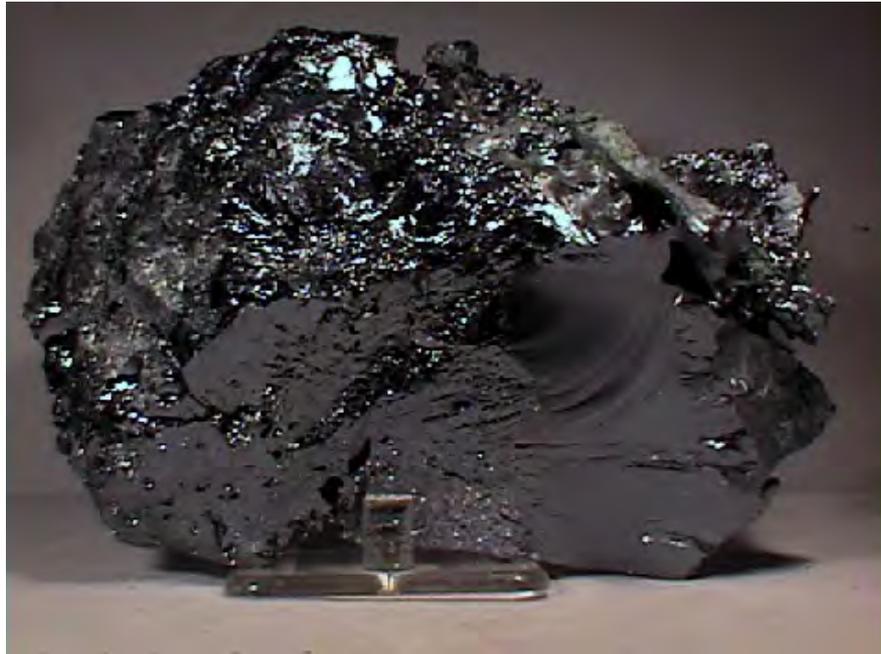
Photovoltaics - What are they and how do they work?

Photovoltaic Effect



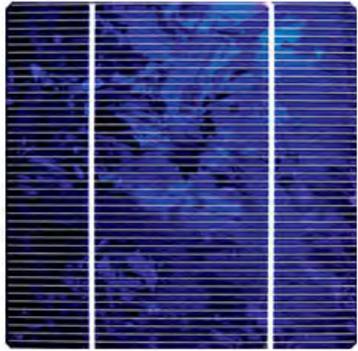
Photovoltaics - What are they and how do they work?

- Modules or panel cells are made of silicon.



Photovoltaics - What are they and how do they work?

Cell



Module

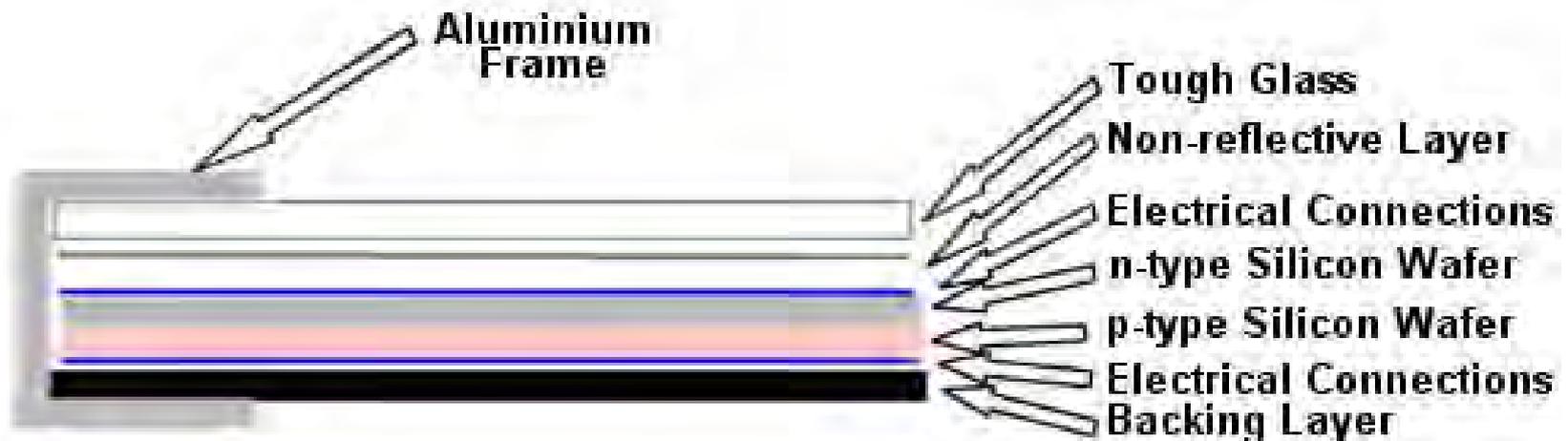


Array



Photovoltaics - What are they and how do they work?

Solar Module Construction



Photovoltaics - What are they and how do they work?

Mono Crystalline



Poly Crystalline



Photovoltaics - What are they and how do they work?

- Mono Crystalline
 - Single silicon cell is grown
 - Individual cells are cut in thin wafers
 - Round wafers are squared off and corners are cut
 - Current efficiency is 14-17%
 - Characteristic diamond shape between cells
 - More expensive than Poly crystalline

Photovoltaics - What are they and how do they work?

- Poly Crystalline
 - Molten silicon is poured into a mold and individual cells are cut from ingot
 - Current efficiency 11-14%
 - Cheaper to manufacturer than Mono crystalline

Photovoltaics - What are they and how do they work?

- Doesn't matter what it is made of 200W output is 200W.
- Modules degrade about 1%/year
- Output varies +/- 5%
- As temperature decreases output increases
- Every panel has a "sweet spot" where it produces the most electricity

Photovoltaics - What are they and how do they work?

Warranty

Manufacturer's

- Typical 5-10 year warranty on manufacturer's defects and workmanship

Power

- Typically a 90% 10 year limited & 80% 25 year limited

Example: A 200W module

After 10 years 90% of 200W = 180W

After 25 years 80% of 200W = 160W

SOLAR ENERGY

The Solar Resource -
Understanding, measuring and
using data

The Solar Resource - Understanding, measuring and using data

Effects on PV Output

- Location on the Earth
- Atmospheric Conditions
- Site Specific Conditions
 - RETScreen
- Earth's Energy Budget

The Solar Resource - Understanding, measuring and using data

Location on the Earth

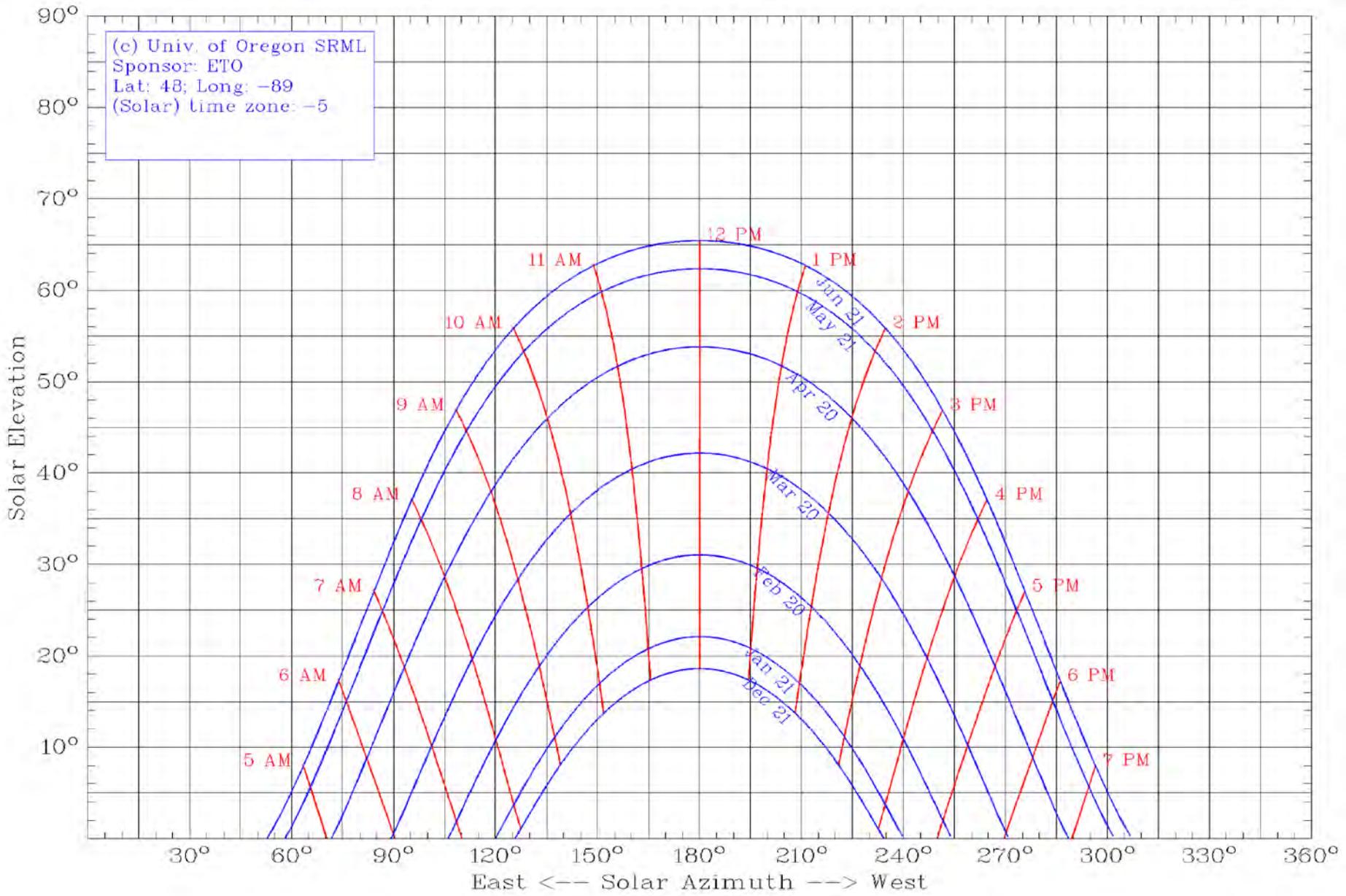
The sun has a specific path in the sky for a
location on the earth!

The Solar Resource - Understanding, measuring and using data

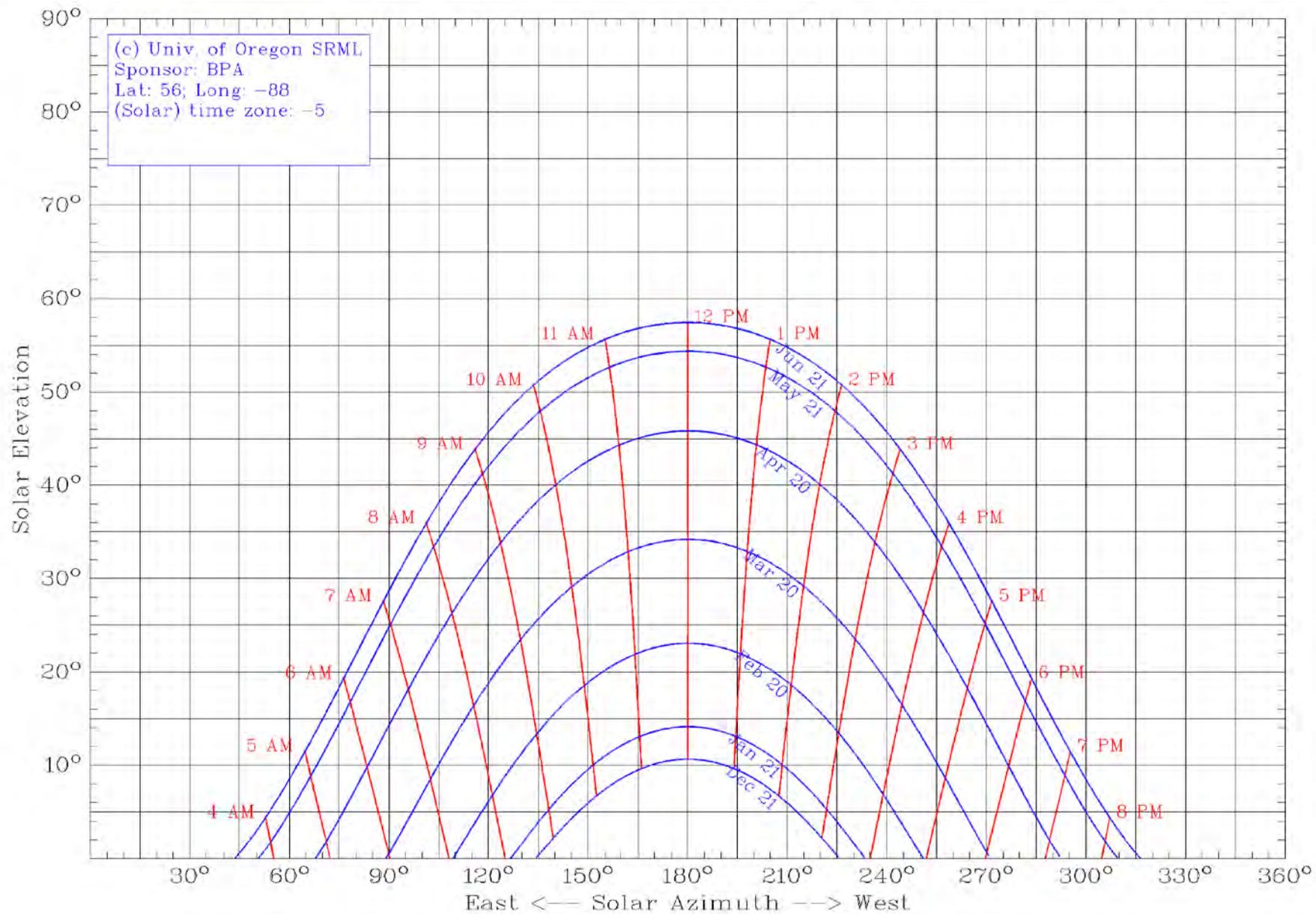
Sun path chart picture

<http://solardat.uoregon.edu/SunChartProgram.html>

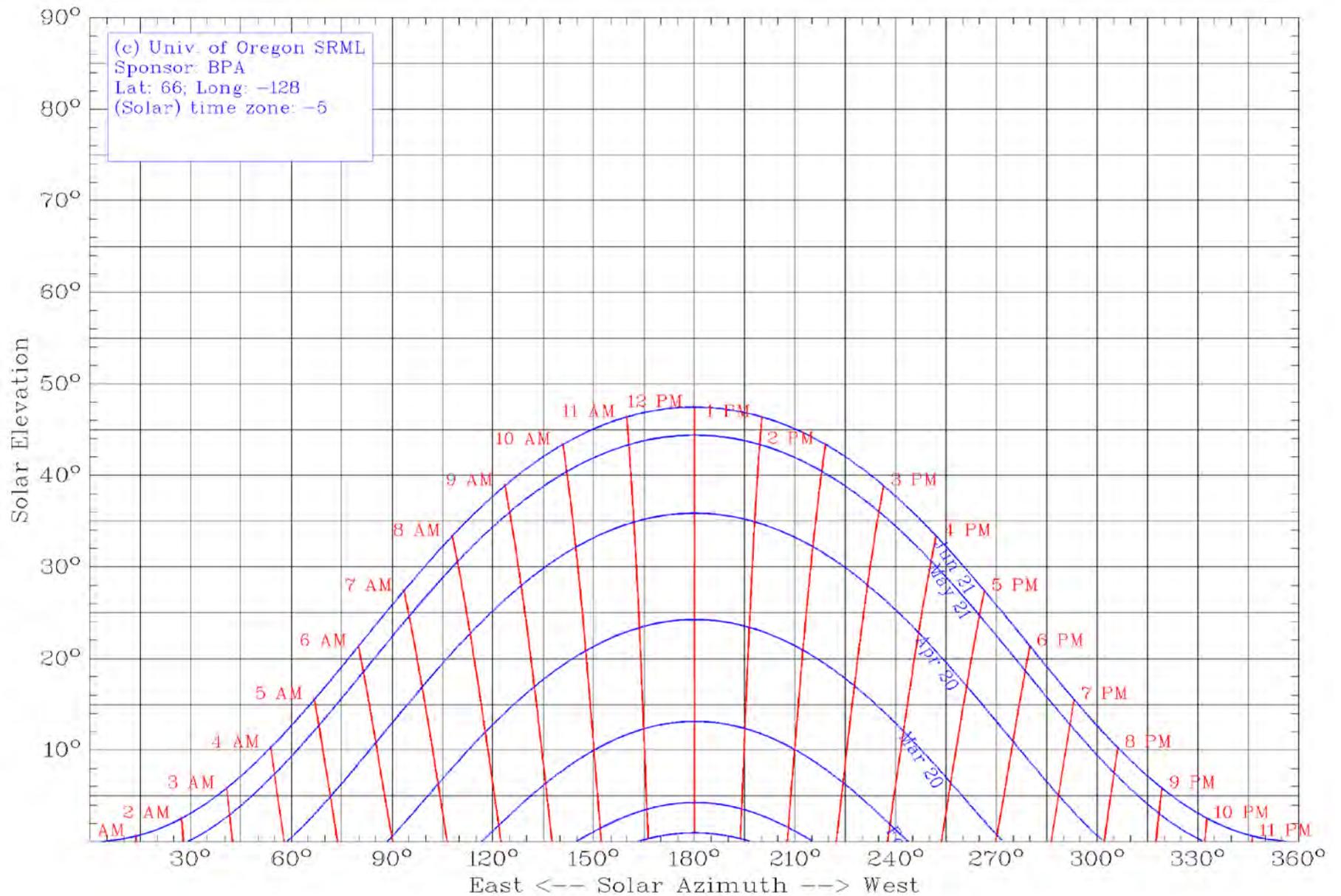
Thunder Bay, Ontario



Fort Severn First Nation, Ontario



Fort Good Hope First Nation, Yukon



The Solar Resource - Understanding, measuring and using data

Location on the Earth

Latitude greatly affects the amount of energy received from the sun.

The further north you go summer days become longer but the sun stays lower on the horizon.

Hours of sunlight in the winter are much less the further north you go. With the sun even lower on the horizon.

The Solar Resource - Understanding, measuring and using data

Location on the Earth

The sun intensity is greatest due south at noon.

This is “SOLAR NOON”

The Solar Resource - Understanding, measuring and using data

Atmospheric Conditions

- Direct Radiation – Water vapour, dust & airborne particles
- Diffuse Radiation – Scattering of sunlight from clouds, pollution and airborne particles
- Air Mass – As the sun gets closer to the horizon the light passes through more atmosphere

The Solar Resource - Understanding, measuring and using data

Site Specific Conditions

- Latitude
- Temperature – As temp. decreases output increases
- Terrain – Shading from trees, buildings and grass.

The Solar Resource - Understanding, measuring and using data

Site Specific Conditions

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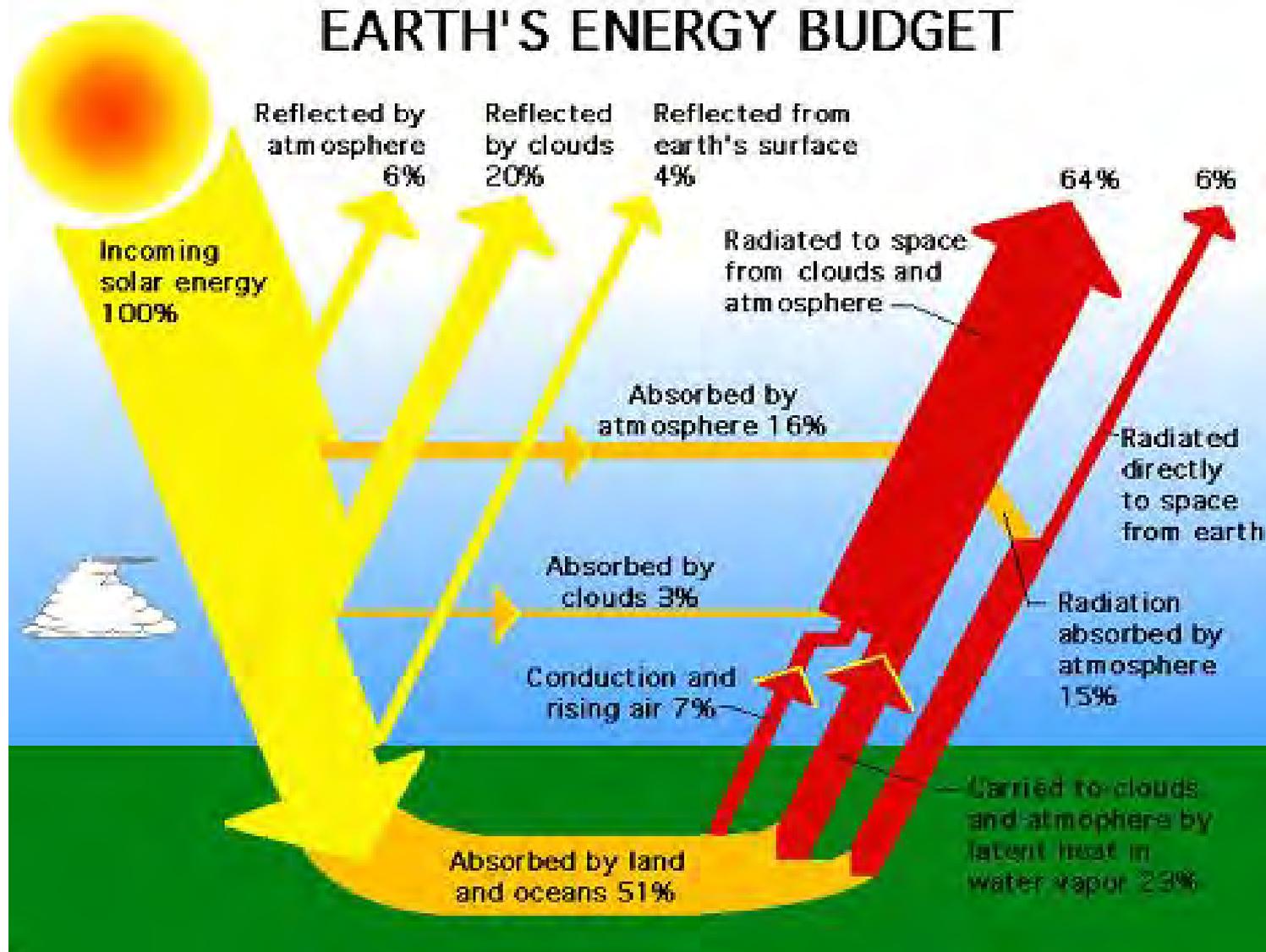
The Solar Resource - Understanding, measuring and using data

RETScreen

- Natural Resources Canada (NRCAN) software that can produce/provide, environmental information, system parameters and payback period for all types of renewable energy projects.

The Solar Resource - Understanding, measuring and using data

EARTH'S ENERGY BUDGET



The Solar Resource - Understanding, measuring and using data

Solar Potential

The sun's power received over a given area of a
given time is:

INSOLATION

Measured in: kWh/m²/day

The Solar Resource - Understanding, measuring and using data

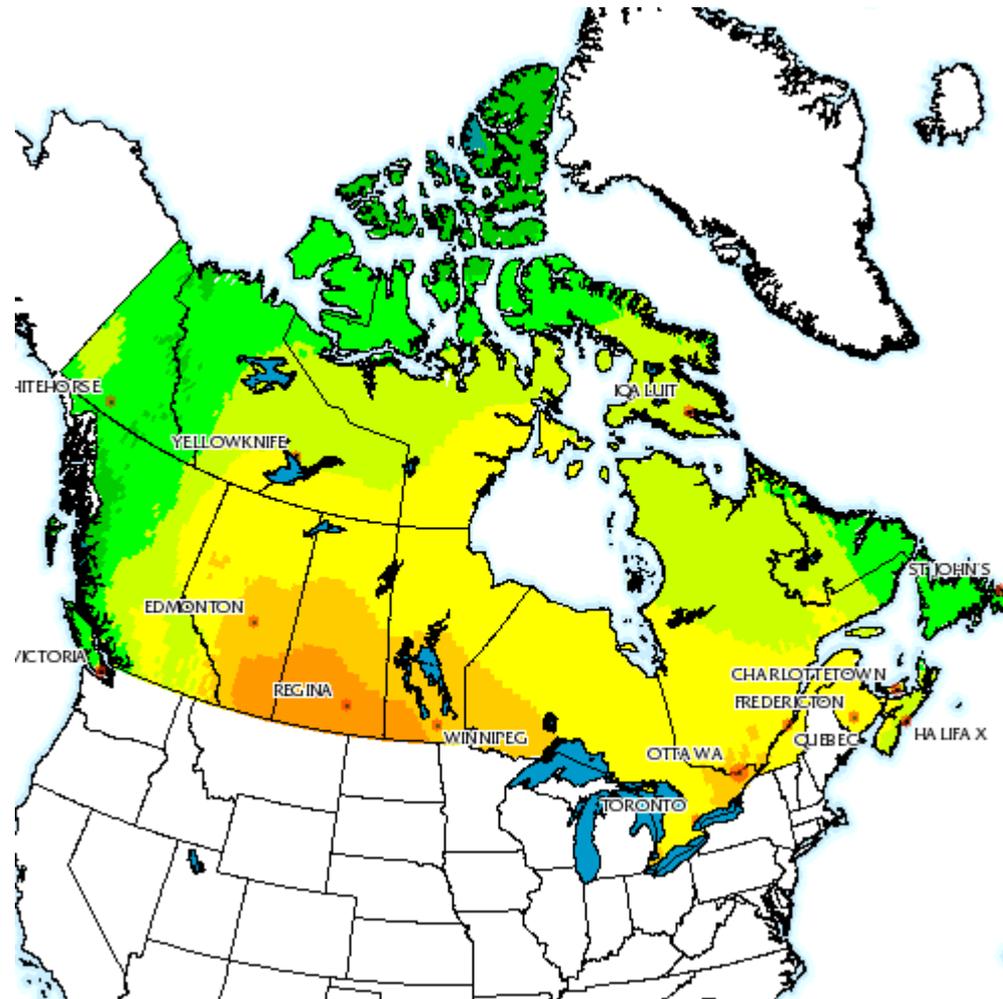
Solar Potential

The sun provides the earth on average 84TW of
Power each day!!

That's 84,000,000,000,000W of Power

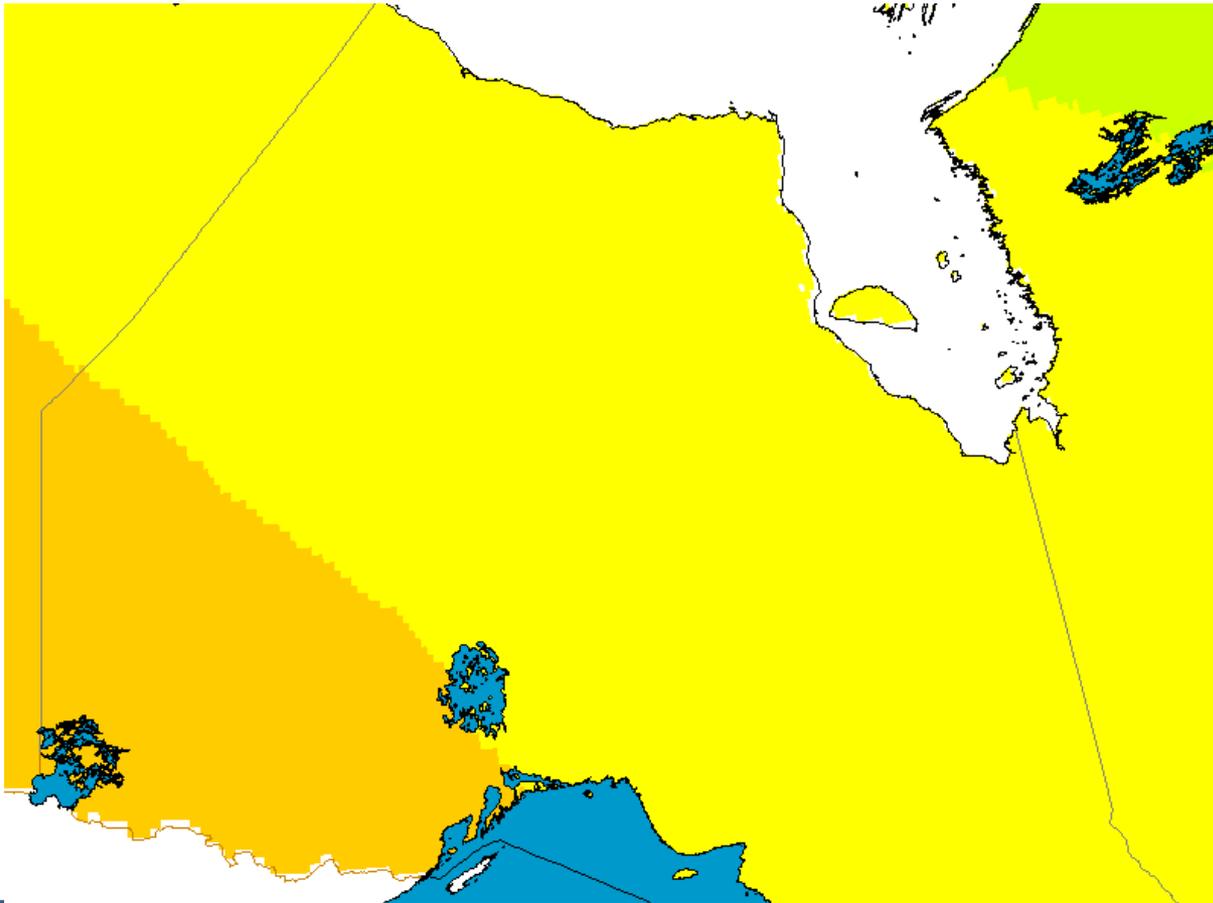
An average home uses 6000W of Power each day
that's 14 billion homes.

The Solar Resource - Understanding, measuring and using data



The Solar Resource - Understanding, measuring and using data

Solar Potential



Site Analysis

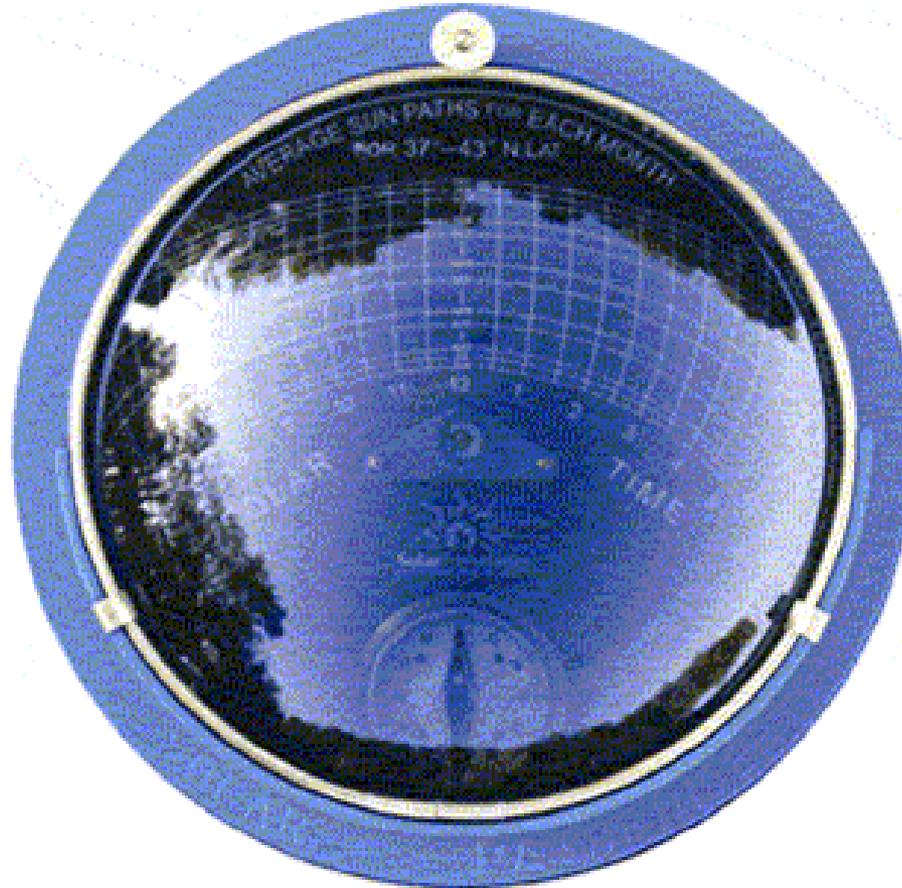
- Determine EXACT location of the module or array
- Shading analysis
- Can be done for free by a solar company but only if you have a system installed

Site Analysis

Solar pathfinder



Site Analysis



Site Analysis

Acme Solar Site Evaluation Tool - ASSET



Site Analysis

Shading

- Remember that trees and grass grow.
- Consider future development for buildings and houses.
- Don't forget about features on the building such as hips/valleys, chimneys, TV dishes and vent stacks.
- Solar panels need sun to produce electricity so the more shade = less production.
- Chain link fencing casts a shadow too.

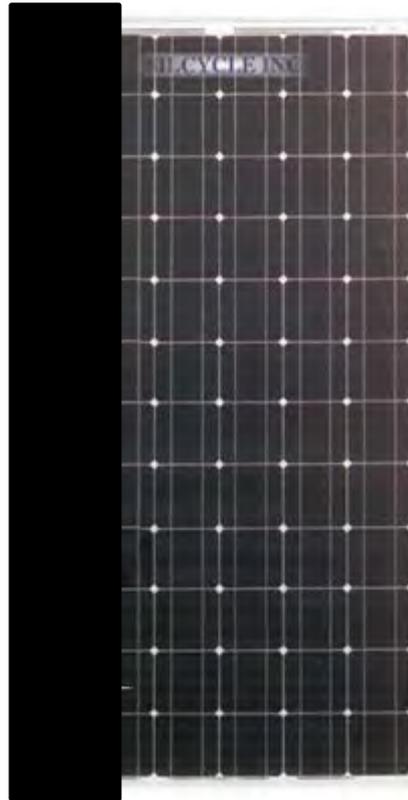
Site Analysis Shading



Site Analysis Shading



BAD



VERY BAD



DO NOT DO!!!!!!

Types of Photovoltaic Systems

Grid Tie

- Connected to the Electrical Grid

Modules-Inverter-Meter

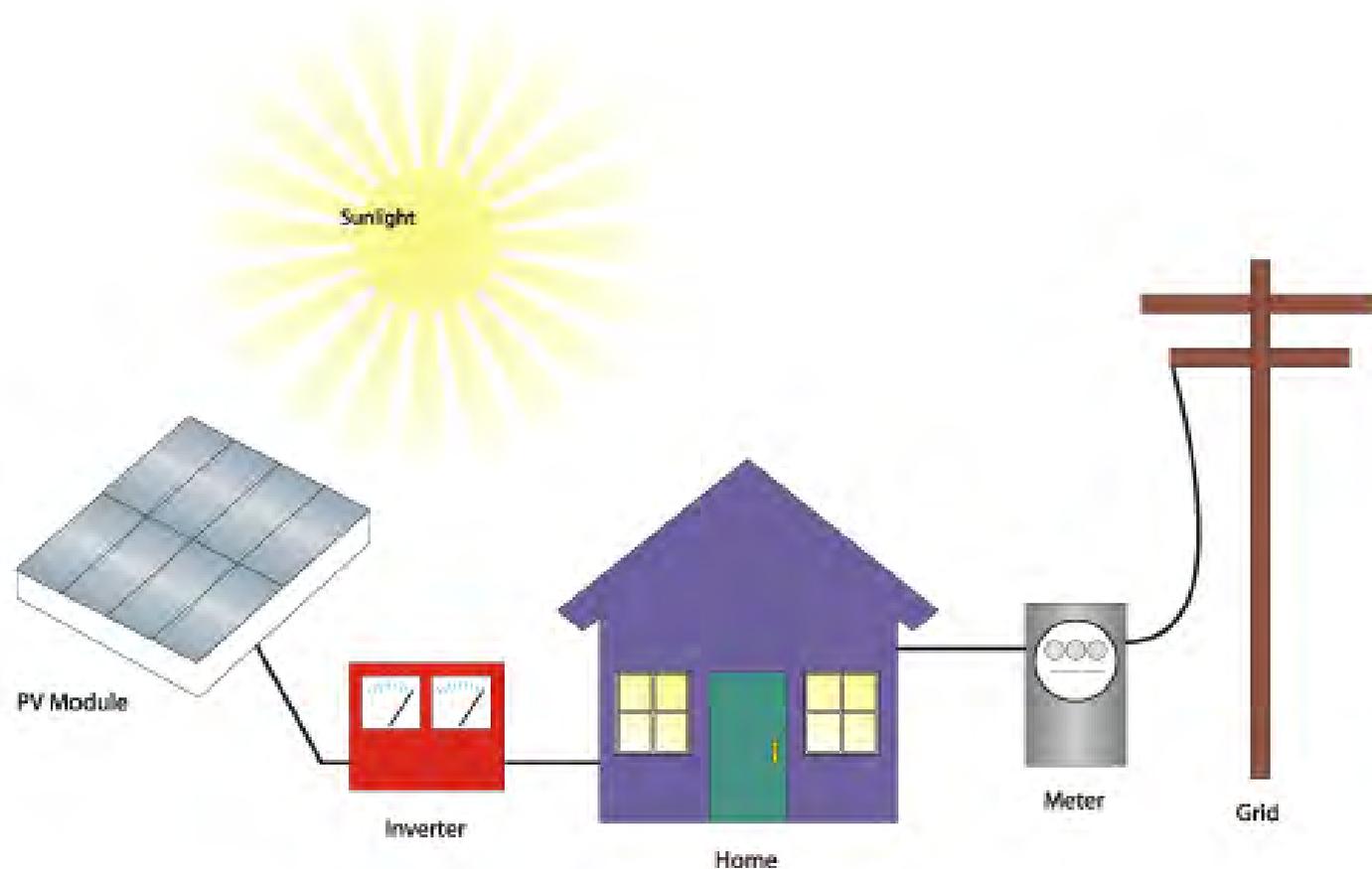
Off Grid

- Not Connected to the Electrical Grid

Modules-Charge Controller-Batteries-Inverter-AC use

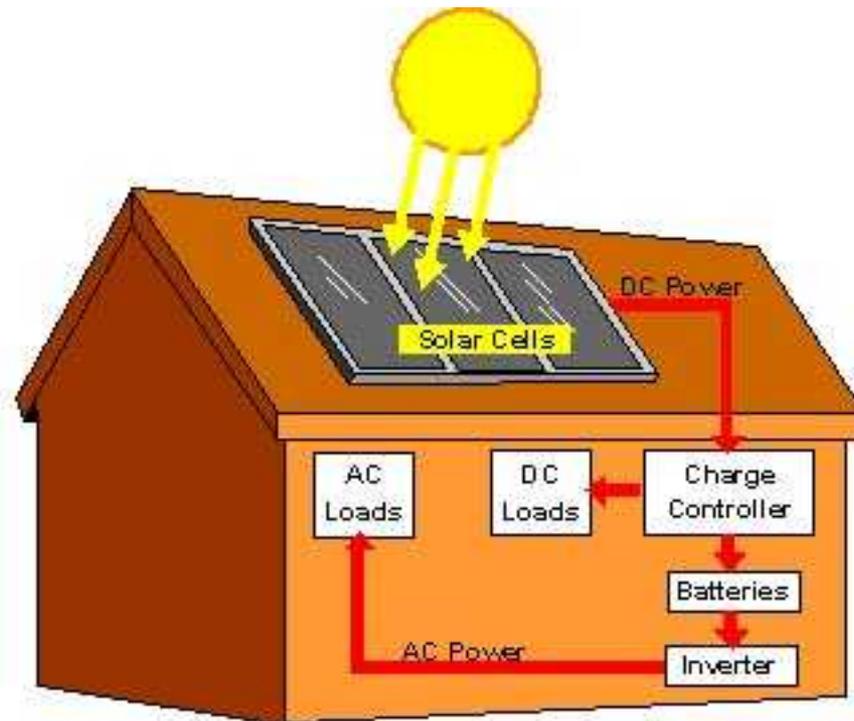
Types of Photovoltaic Systems

Grid Tie



Types of Photovoltaic Systems

Off Grid



Mechanical Attachment Options

Roof Mount

Ground Mount

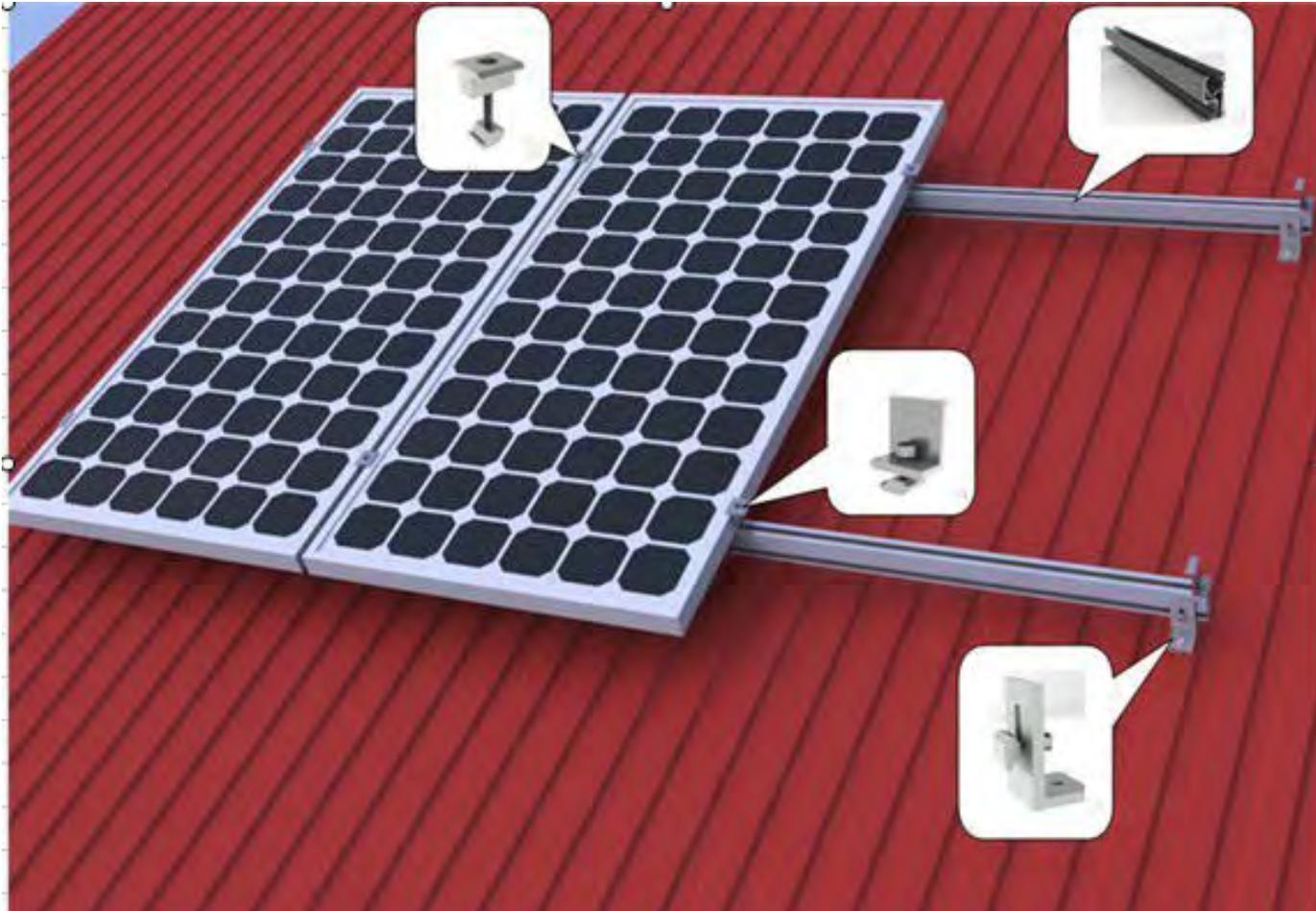
Mechanical Attachment Options

Roof Mount

1. Sloped Roof Mount
2. Flat Roof Mount

Mechanical Attachment Options

Sloped Roof Mount



Mechanical Attachment Options

Sloped Roof Mount

Manufactured in:



Ontario



K-Rack System

Mechanical Attachment Options

Flat Roof Mount



Ballast Mount System

- No punctures in the roofing membrane
- Weight is added to rail system to prevent wind uplift

Mechanical Attachment Options

Flat Roof Mount



“Foot” or Standoff Mount System

- Must be integrated at time of construction

Mechanical Attachment Options

Ground Mount



Rail of Fixed System

Mechanical Attachment Options

Ground Mount



Single Axis Tracker

- Manual or Motorized Operation
- May Increase Output by up to 20%

Mechanical Attachment Options

Ground Mount



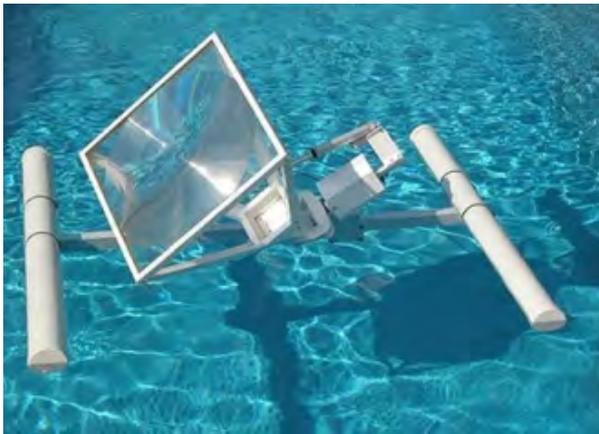
Dual Axis Tracker

- Motorized computer software or “sun spot”
 - May increase output by 40%
 - Large foundations needed for mast

Mechanical Attachment Options



Car Mount System



Liquid Solar Array

Attachment Options

Roof Mount



8,844 Modules!!!

Inverters and Balance of System - BOS

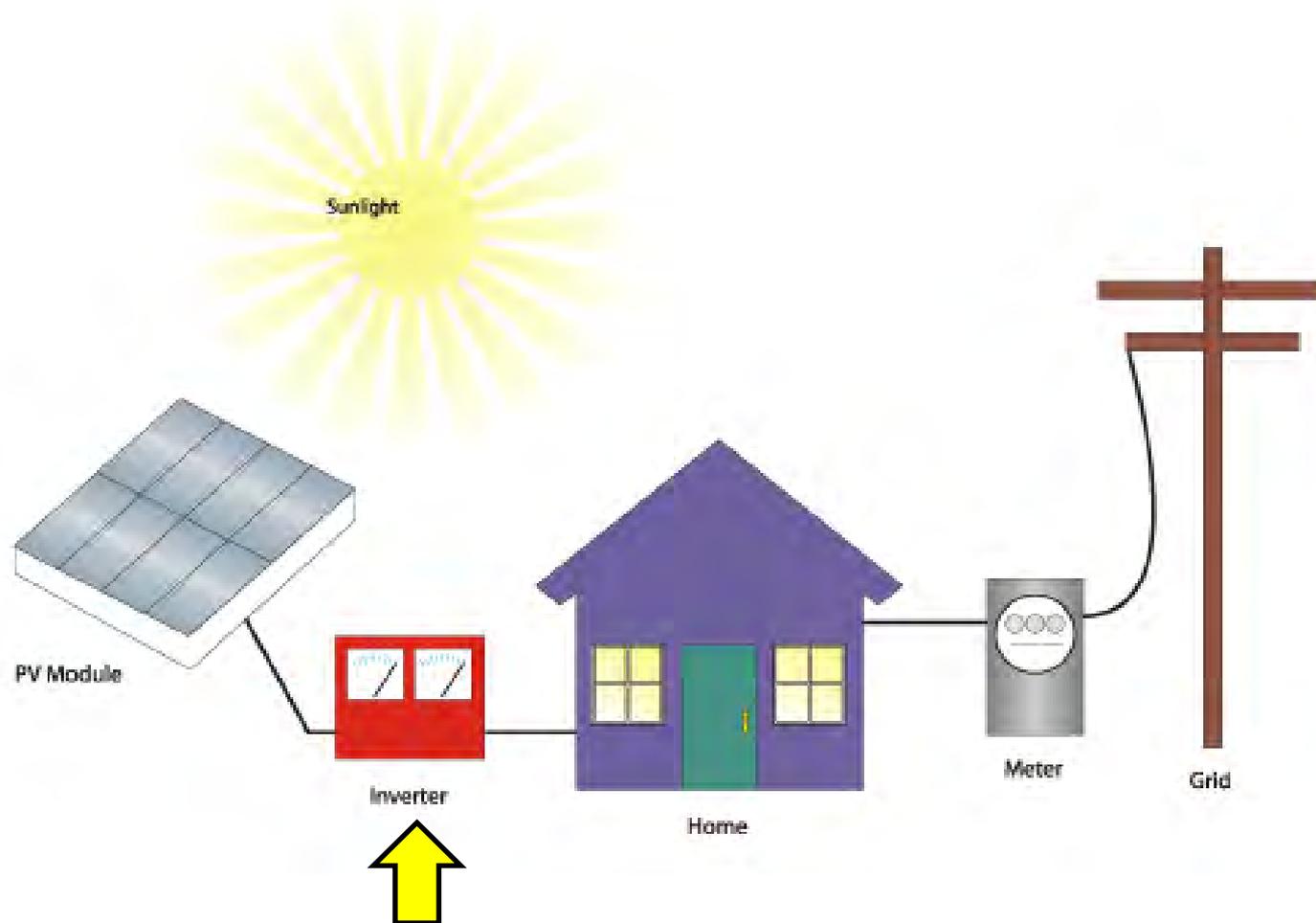
Inverter

Grid-Tie

- Panels produce DC power, the grid is AC, an Inverter Converts DC power from the modules to AC to supply to the grid.

Inverters and Balance of System - BOS

Inverter – Grid Tie



Inverters and Balance of System (BOS)

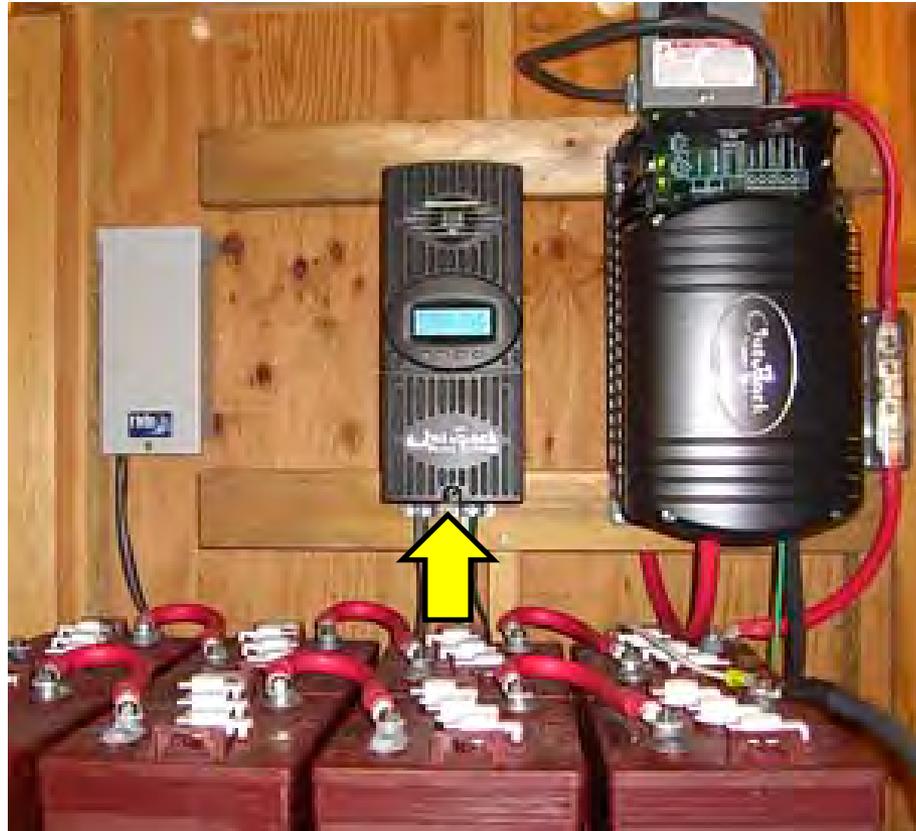
Inverter

Off Grid

- Panels produce DC power, the house or building wiring is AC, an Inverter Converts DC power from the battery bank or generator to supply the house or building.

Inverters and Balance of System - BOS

Inverter – Off Grid



Inverters and Balance of System (BOS)

Balance of System (BOS)

- Everything else you will need besides modules and inverters.

Grid Tie

- Fuses & Breakers
- Disconnects
- Junction Boxes
- All Typically done by certified electrician

Off Grid

- Everything for Grid Tie Plus
- Charge Controller
- Batteries
- Some sort of back up

Feed In Tariff - FIT

The FIT Program is divided into two streams -

FIT and microFIT. The FIT Program is for renewable energy projects that can generate more than 10 kilowatts (kW) of electricity.

Very small projects, at a home or small business, that can generate 10 kW or less come under the microFIT Program.

Feed In Tariff - FIT

Aboriginal Projects

One of the core goals of the FIT Program is to encourage the development of Aboriginal renewable energy projects. This is done through reduced security payments, additional price incentives and the creation of the “Aboriginal Energy Partnerships Program”.

Feed In Tariff - FIT

Aboriginal Energy Partnerships Program

The Aboriginal Energy Partnerships Program seeks to maximize First Nations and Métis participation in renewable energy development while helping to build the province's energy supply. The program will provide funding for many of the key developmental stages needed to bring projects on stream, including:

- feasibility studies
- resource assessment

Feed In Tariff - FIT

Aboriginal Energy Partnerships Program

- technical research
- developing business cases
- regulatory approval studies
- engineering activities
- community energy plans
- creation of an [Aboriginal Renewable Energy Network](#).

Feed In Tariff - FIT

Aboriginal Energy Partnerships Program

Visit www.aboriginalenergy.ca for more information, including details on the Aboriginal Renewable Energy Fund.

**NOW LETS GO SEE
SOME SOLAR
MODULES!!!!!!**