

# Off Grid and Grid Tie Solar Energy

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SkyFire Energy Inc



# SkyFire Energy Inc

- We have been installing for over 12 years in Western Canada
- CanSIA certified solar thermal installers on staff
- CanSIA/Seneca College Photovoltaic Technicians on staff
- CSA certified photovoltaic installer on staff
- Hundreds of installations across Canada



## Alberta Solar Potential

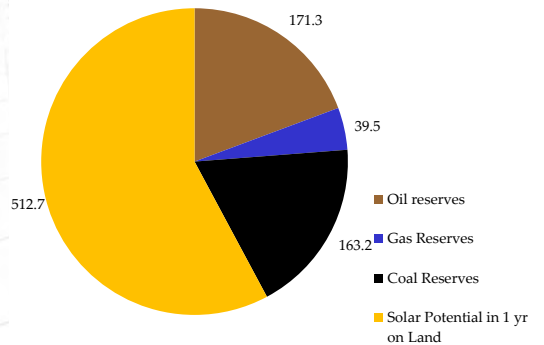
Ranking of Major Cities Worldwide in Terms of Yearly PV Potential	
City	Yearly PV Potential (kWh/kW)
Cairo, Egypt	1635
Los Angeles, USA	1485
Sydney, Australia	1343
Calgary, Alberta	1292
Edmonton, Alberta	1245
Washington, DC., USA	1133
Tokyo, Japan	885
Berlin, Germany	848
London, England	728

Source: Natural Resources Canada



## Alberta Energy Reserves

Billion Barrels of Oil Equivalent



## What is Driving the Growth?

Retail prices of photovoltaic systems are dropping

2001	600 watt array	\$12,000	\$20/ watt
2005	1952 watt array	\$20,000	\$10/watt
2013	2000 Watt array	\$8,500	\$4.25/watt



## Grid Parity

We are near grid parity:

$$\frac{4000 \text{ watts} \times \$4.00 \text{ per watt}}{4 \text{ kw} \times 1292 \text{ kWhr/kw/yr} \times 30 \text{ yrs}} = \frac{\$16,000}{155,040 \text{ kWhr}} = \$0.103/\text{kWhr}$$

Current retail rates are \$0.07- \$0.12 plus T&D in Alberta



## Active Solar Energy

- Electricity
  - Photovoltaic Modules (aka panels)



- Water Heating
  - Solar Thermal Collectors



## SOLAR PATHFINDER PLOT

Determines Solar Resource



## GRID - TIED SOLAR ELECTRIC SYSTEM



- 1) PHOTOVOLTAIC ARRAY
- 2) GRID - TIED INVERTER
- 3) ELECTRICAL PANEL
- 4) BIDIRECTIONAL METER - PROVIDED FREE OF CHARGE BY WORKS OWNER
- 5) ELECTRICAL GRID

## [e] ENPHASE MICROINVERTER



- One inverter per module instead of one inverter per array of modules
- Advantages
  - Maximum Power Point Tracking (MPPT) per module maximizes output of system and limits effects of shading
  - Cost is less for smaller systems
  - Monitoring system
  - Allows for modular systems - Start small and add later!
  - 15 year warranty (Standard for string inverters is 10)
- Disadvantages
  - Higher cost for larger systems
  - Demand is high
  - Newer product; not as proven



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Solar Energy Systems

## Typical Residential Array



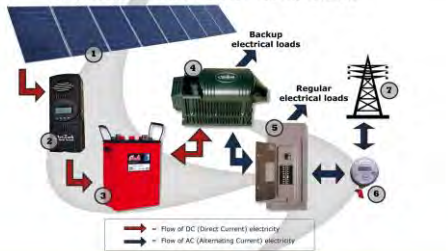
- Residential grid-tied system, Calgary
  - 2000 watt system
  - 10 x Sanyo 200 watt modules
  - Fronius 2000 watt inverter



- Residential grid-tied system, Calgary
  - Net Zero house - 5.33kW grid-tied system
  - 26 x 205 watt modules
  - 26 x Enphase Micro-inverters
  - Minimize effects of shading



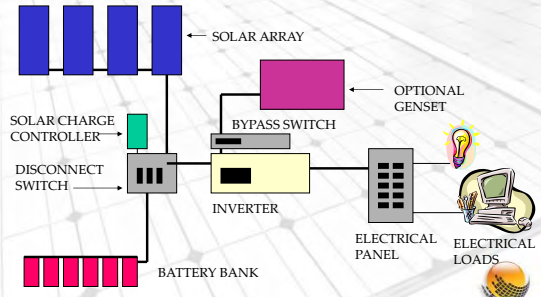
## GRID - TIED W/ BATTERY BACKUP SOLAR ELECTRIC SYSTEM



- |                       |                                   |
|-----------------------|-----------------------------------|
| 1) PHOTOVOLTAIC ARRAY | 5) ELECTRICAL PANEL               |
| 2) CHARGE CONTROLLER  | 6) BIDIRECTIONAL METER - PROVIDES |
| 3) BATTERY BANK       | ENERGY CHARGE BY HOME OWNER       |
| 4) INVERTER / CHARGER | 7) UTILITY GRID                   |



## Off Grid AC System



## Off Grid Systems Require Detailed Load Analysis

Load Analysis Spreadsheet



## Component Selection

### Component Selection

- Solar module
  - Polycrystalline
  - Monocrystalline
  - Amorphous
  - Thin film
  - Nominal 12 volt (17 Voc)
  - High voltage (35-50 Voc)
- Rack
  - Parallel roof mount
  - Elevated roof mount
  - Ground mount (single post or multi post)



## Component Selection

### Component Selection

- **Charge Controller**
  - PWM
  - MPPT (more energy harvest from solar array)
- **Batteries**
  - VRLA
  - Flooded (requires maintenance and venting)
- **Inverter**
  - Modified sine wave (may cause problems with some devices)
  - Sine wave
  - Grid tie only (no backup during power failure)
  - Off grid only
  - Grid tie with battery backup
  - Battery charge circuit built in to some battery based inverters



## GROUND MOUNT SOLAR

### MILLERVILLE, AB

5760 W ground mount multi post screw pile



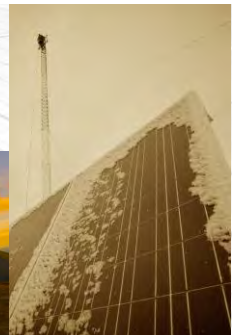
## Battery Backed Up Grid Tie

7.2 kW inverter bank  
1100 Ahr 48V battery bank  
Expanded to 2200 Ahr



## Radio Repeater Site Grande Cache, AB

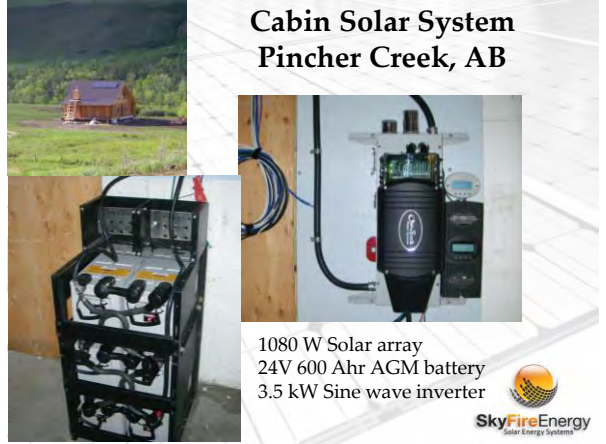
1800 W solar array  
12V 800 Ahr battery bank



## GROUND MOUNT SOLAR JASPER, AB



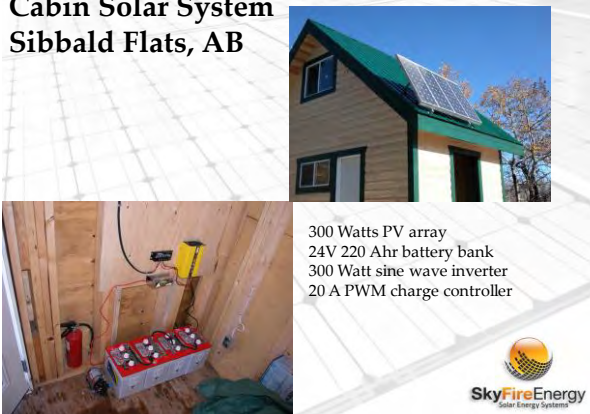
## Cabin Solar System Pincher Creek, AB



1080 W Solar array  
24V 600 Ahr AGM battery  
3.5 kW Sine wave inverter



## Cabin Solar System Sibbald Flats, AB

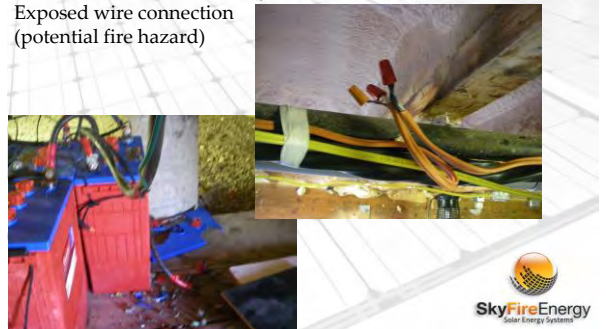


300 Watts PV array  
24V 220 Ahr battery bank  
300 Watt sine wave inverter  
20 A PWM charge controller



## Things Done Wrong

Charge controller settings wrong (battery exploded spaying acid in customer's basement)  
Exposed wire connection (potential fire hazard)





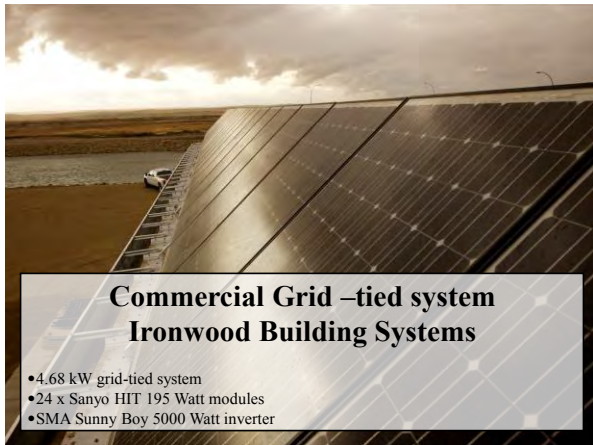
Skyfire Standoff



Rental Standoff



# Commercial Photovoltaic Installations



## Commercial Grid-tied system Ironwood Building Systems

- 4.68 kW grid-tied system
- 24 x Sanyo HIT 195 Watt modules
- SMA Sunny Boy 5000 Watt inverter

## Grande Cache Correctional Facility

- 13.5 kW grid-tied system





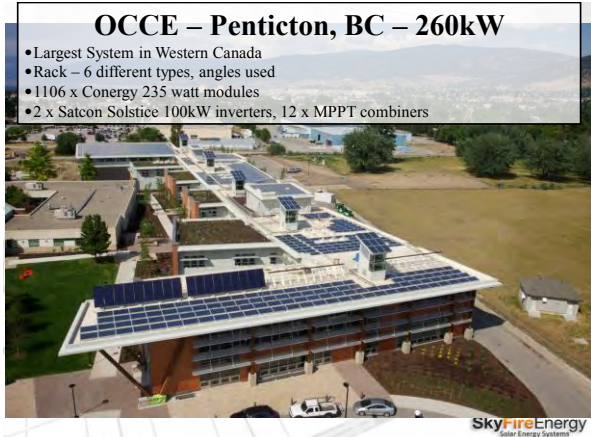
**City of Calgary Municipal Building**

- 1.02 kW Grid-tied system
- 1800U Sunny Boy inverter
- Kiosk
- Internet monitoring device



**MNC Geomatics Ltd.**

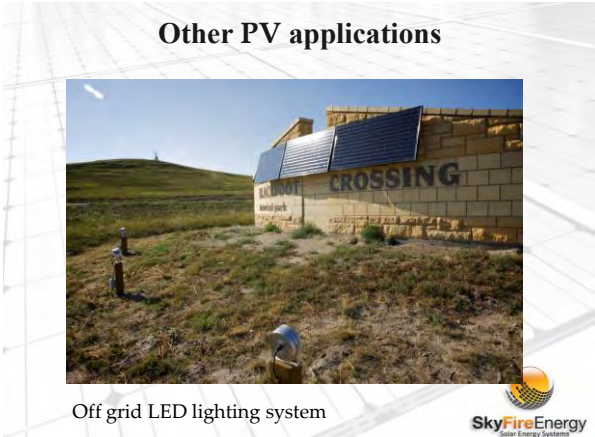
- 5.2 kW grid-tied system
- 26 - Canadian Solar Inc. 200 Watt modules
- SMA Sunny Boy 6000 Watt inverter



**OCCE – Penticton, BC – 260kW**

- Largest System in Western Canada
- Rack – 6 different types, angles used
- 1106 x Conergy 235 watt modules
- 2 x Satcon Solstice 100kW inverters, 12 x MPPT combiners

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**Other PV applications**

Off grid LED lighting system

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Questions?

[www.SkyFireEnergy.com](http://www.SkyFireEnergy.com) | 403-251-0668

