SUNSHINE COAST
ElderCollege

Energy Projects: Which Do I Do First?

Sunshine Coast Community Solar Association

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COURSE OUTLINE

Week 1: Harnessing Solar Energy on the Coast
Week 2: Improving the efficiency of HVAC systems
Week 3: Upgrading the building envelope
Week 4: Domestic hot water, lighting & appliances

Harnessing Solar Energy

1. Introduction: The SCCSA, sponsor of this class. What are the learning objectives this week?
2. Backgound: Why do we all need to care about energy efficiency? Terminology and nomenclature.
3. Renewable Energy Production: Why solar? What factors impact efficiency? How to calculate payback.
4. Retrofit Incentives.
5. Resources and Take-Home Tools.
6. Wrap-Up and Questions

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INTRODUCTION

Who are we and what is this presentation about?

INTRODUCTION

What is the Sunshine Coast Community Solar Association?

- A registered BC non-profit
- Engineering interns, retired engineers, electricians, accountants
- ~70 active members!

What Do We Do?

- Promote low-carbon lifestyles
- Educate the public
- Encourage the implementation of energy-saving measures
  - **Free energy audits for public buildings!**

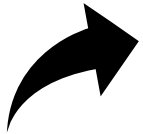
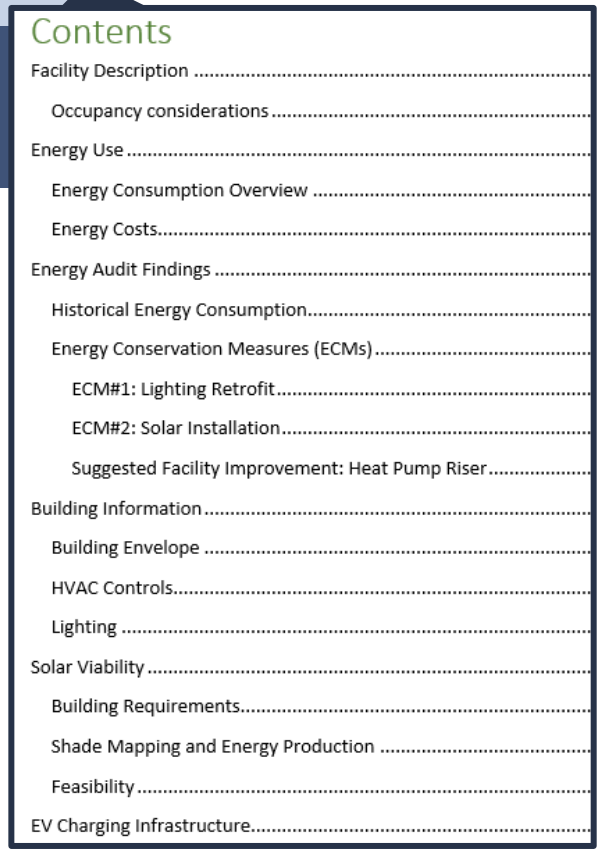


Table of contents of one of our reports.

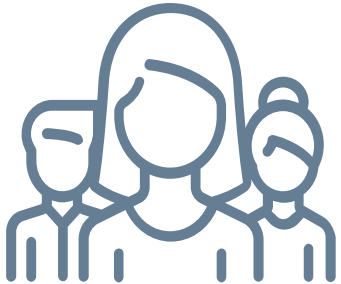


Contents

INTRODUCTION

What Will You Learn Today?

- Why renewable energies are important
- Energy terminology
- Ideal roof type for solar panels
- How much energy solar panels produce
- Financial incentives to install solar panels



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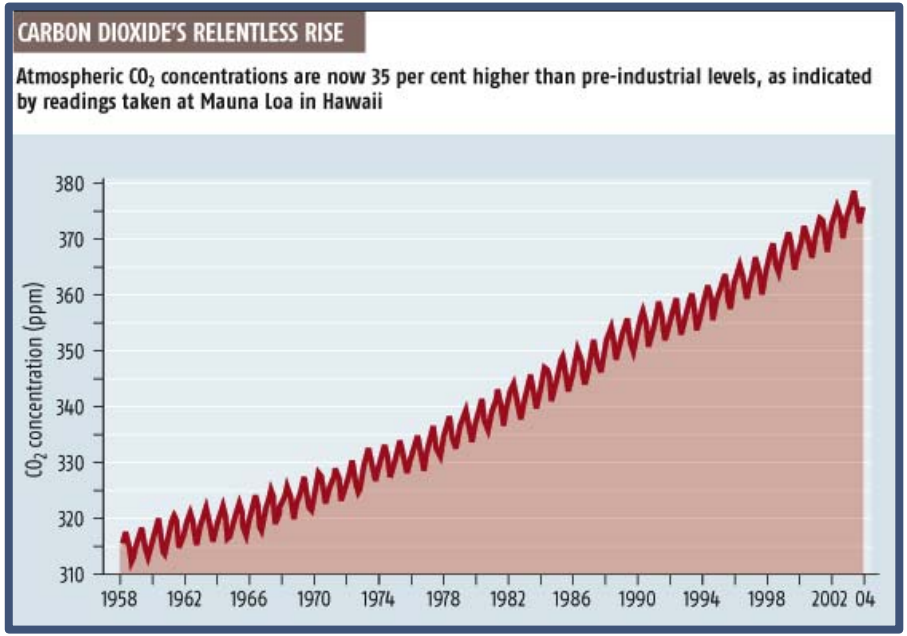
BACKGROUND INFORMATION

Renewables, solar panels, and some jargon

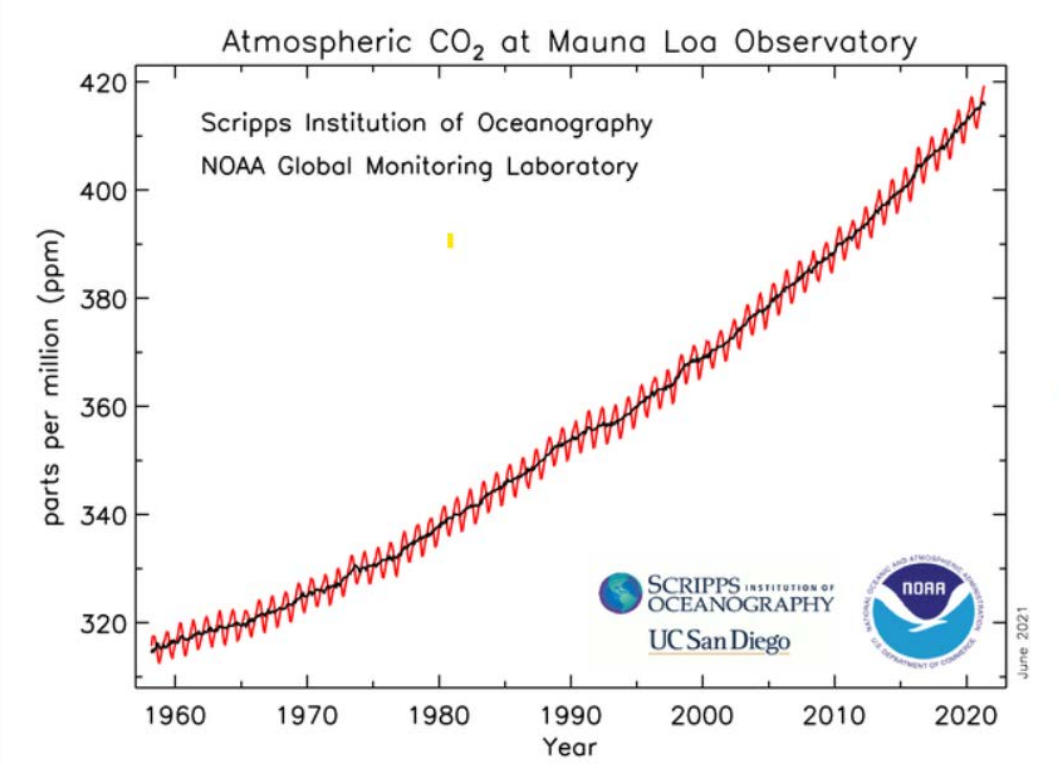
Why Are Renewable Energies Important?

- Air, land and water pollution
- Climate change (global warming)
- Rising energy costs
- Centralized control of resources/infrastructure
- Limited fuel supplies (coal, oil, gas)

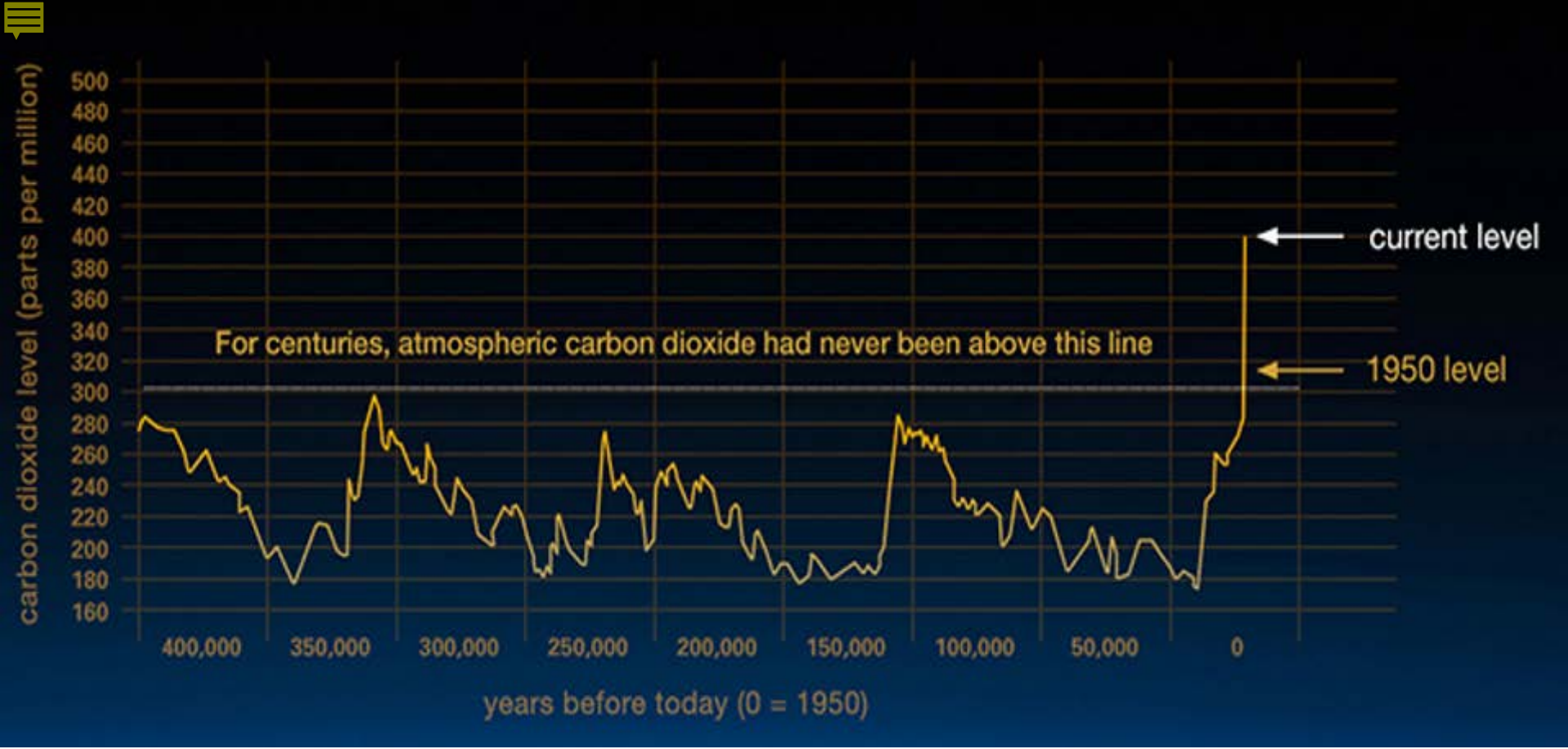


Fossil Fuel Pollutants:

- SO2, NOx,
- volatile organic components (VOCs)
- CO, CO2
- Methane
- Particulate Matter (PMs)
- Ground Level Ozone
- Heavy metals (mercury and lead)



GRAPH DEPICTS THE UPWARD TRAJECTORY OF CARBON DIOXIDE IN THE ATMOSPHERE AS MEASURE
THE MAUNA LOA ATMOSPHERIC BASELINE OBSERVATORY BY NOAA AND THE SCRIPPS INSTITUTION O
OCEANOGRAPHY. THE ANNUAL FLUCTUATION IS KNOWN AS THE KEELING CURVE. CREDIT: NOAA GLO
MONITORING LABORATORY



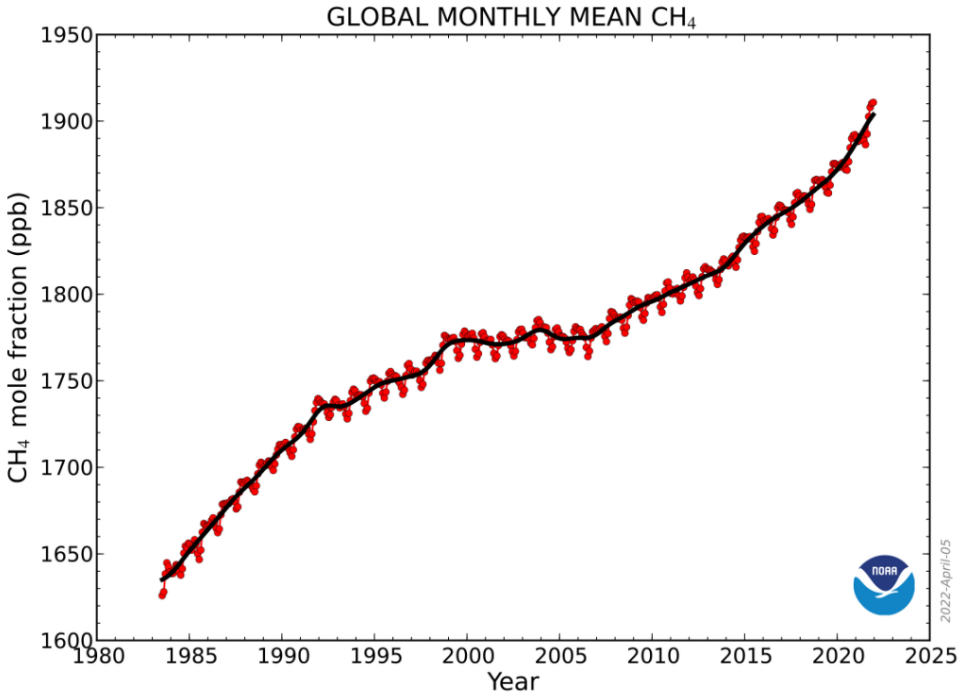
https://climate.nasa.gov/climate_resources/24/

Fossil Fuel Pollutants:

Atmospheric methane is also increasing rapidly due to:

- Increasing animal agriculture
- Fossil fuel extraction, transport and use
- Melting permafrost & organic decay in wetlands

Methane has 25x the heat trapping impact of CO_2 but does not have the extreme longevity of CO_2 so CH_4 reductions will have immediate mitigating effect.



CH4 trend: This graph shows globally-averaged, monthly mean atmospheric methane abundance determined from marine surface sites since 1983. Values for the last year are preliminary. (NOAA Global Monitoring Laboratory)

THE WORLD IS GETTING WARMER

Temperature plotted as the deviation from the 1960 to 1990 average

Yearly deviation 10-year smoothed trend

SOURCE: UCAR

TERMINOLOGY & NOMENCLATURE

VOLTAGE OR VOLT (V)

- Unit of electric potential
- You can imagine voltage as the water pressure in a dam. The greater the elevation of the dam the higher the potential

AMPS (A)

- Unit of electric current
- Measures electron flow past a point in one second
- Imagine current as the water flowing from a dam

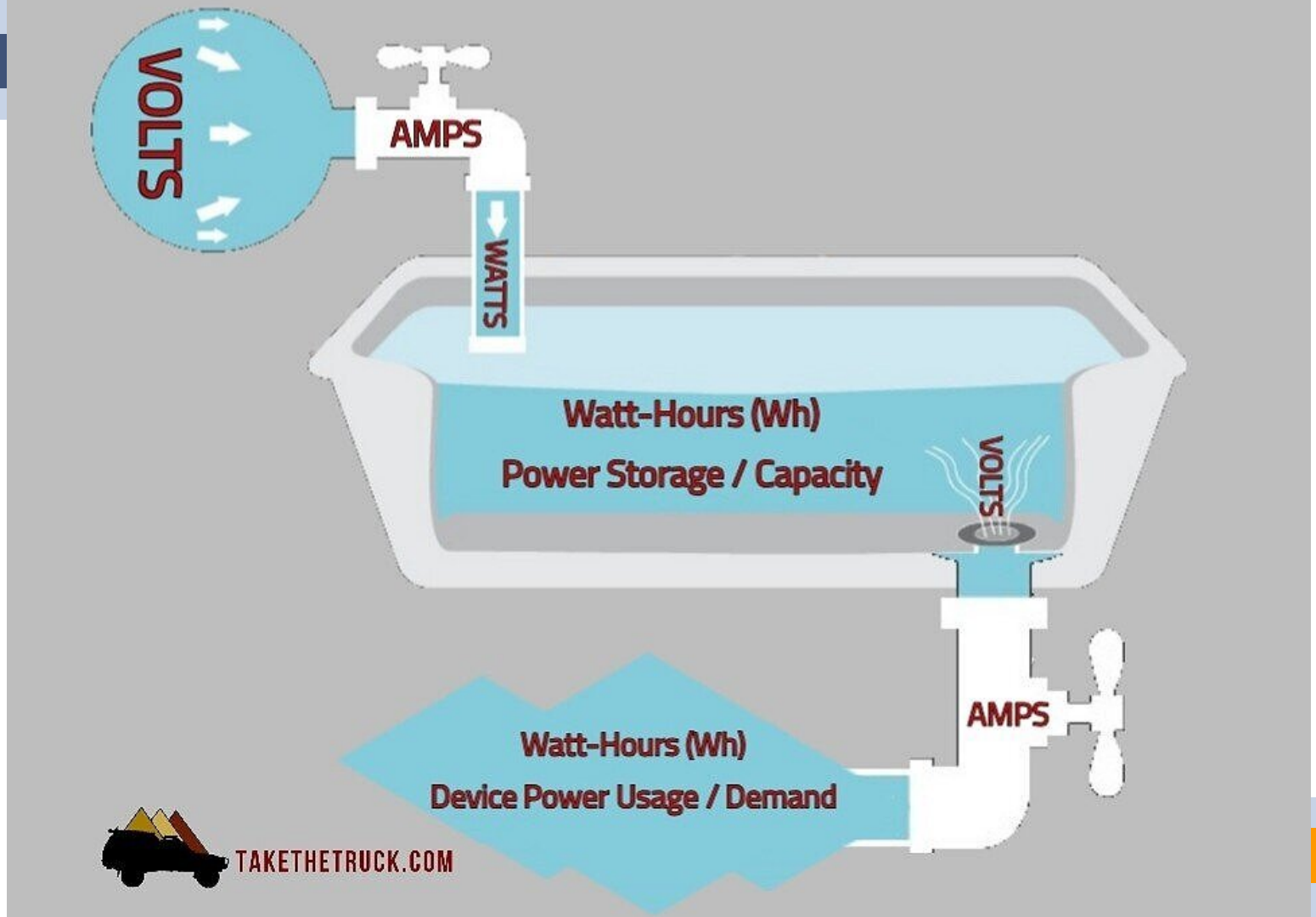
WATTS (W)

- Measure of power (energy per unit time)
- Imagine power as the amount of water flowing combined with the water pressure

TERMINOLOGY & NOMENCLATURE

KILOWATT HOUR (kWh)

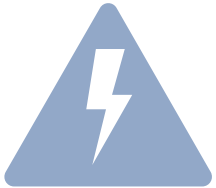
- Amount of energy consumed
- 1 kWh = 1 kW of power expended over 1 hour


VOLTS
AMPS
WATTS
Watt-Hours (Wh)
Power Storage / Capacity
VOLTS
AMPS
Watt-Hours (Wh)
Device Power Usage / Demand
TAKETHETRUCK.COM

TERMINOLOGY & NOMENCLATURE

WATTS PER SQUARE METER (W/m^2)

- Used to describe the amount of solar energy that reaches the solar panel cells



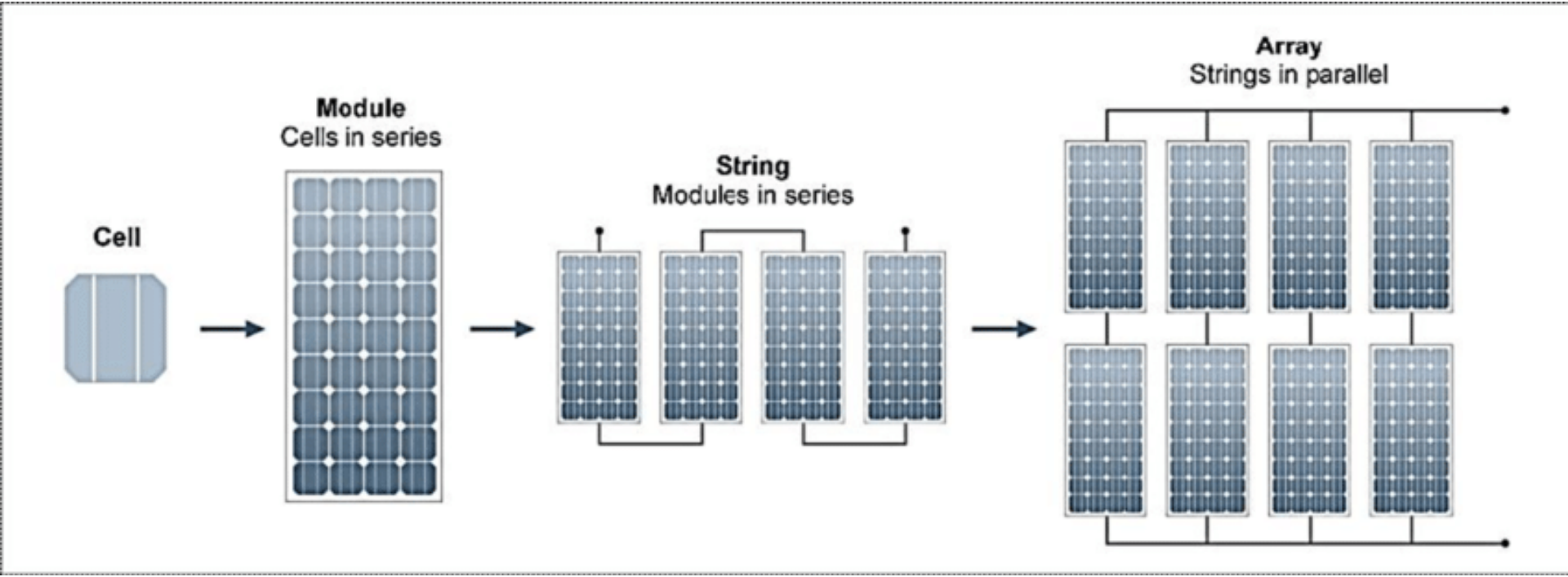
DIRECT CURRENT (DC)

- Direction of current flow does not change with time
- The type of current that solar panels generate

ALTERNATING CURRENT (AC)

- The type of current that is used for most household appliances

Solar Photovoltaic (PV) Terminology



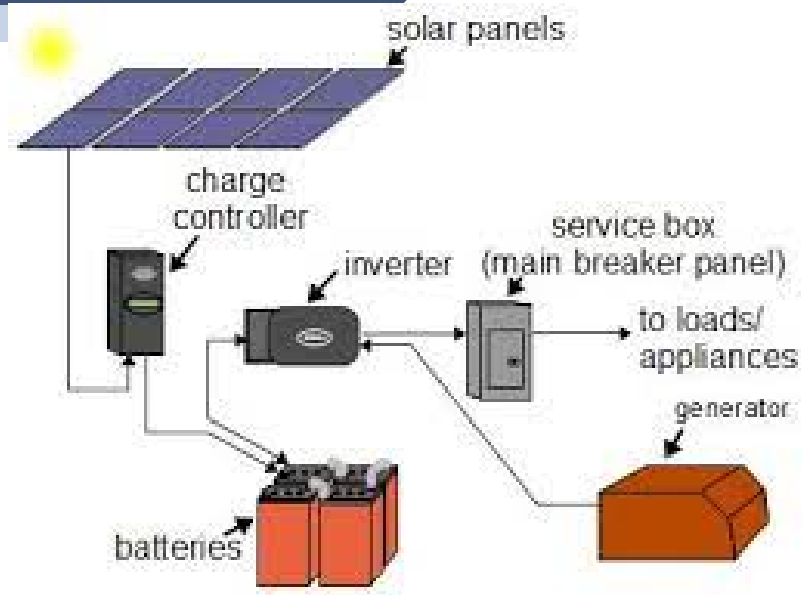
Source: https://www.researchgate.net/figure/Figure-17-Configuration-of-cell-module-and-array34_fig5_342736081

COMPONENTS OF A PV ARRAY

- String inverters (with optimizers) or microinverters (DC to AC)
- Distribution Panel
- Transformers (to change the voltage)
- Smart meter

For Off-Grid add:

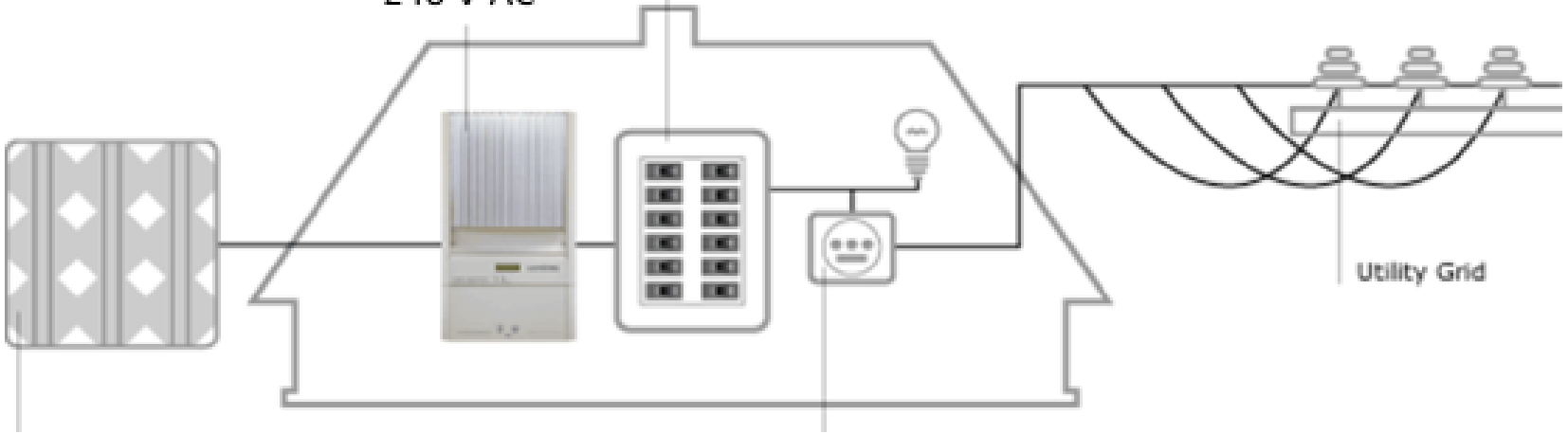
- Battery Back-up
- Generator Back-up
- Charge Controller
- Rectifier (AC to DC)
- Disconnect/transfer switches



Off-Grid Solar Power System

Inverter converts DC to 240 V AC

Main Utility Service Panel distributes 120 V AC and 240 V AC to house circuits



Solar cell puts out 0.5 V DC
Solar panel 12 to 40 V DC
String up to 600V DC

Conventional meter measures energy consumption **from** grid.
Smart meter can also measure energy sent **to** grid

3

ENERGY PRODUCTION

How much energy can different technologies produce?

RENEWABLE ENERGY TECHNOLOGY

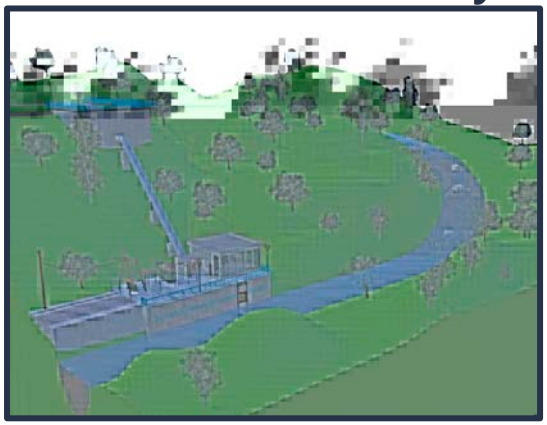
Geothermal

- Requires a large, hot underground water reservoir
- Highly dependent on geography

Wind

Not enough wind on the Sunshine Coast to have good payback

Run-of-the-River Hydro



Dependent on geography, requires permits.

Solar!

Water Heating

- Direct Domestic Hot Water heater
- Evacuated tubes
- Can place on roof or ground

- Pool heating solar mats
- Inexpensive
- Simple to install

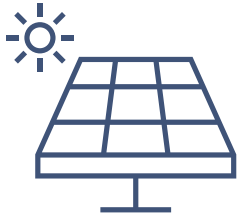
Energy Production

- Solar PV Panels for electricity production
- Solar is best option for thermal or electric energy production in this area

ENERGY PRODUCTION FACTORS

The amount of energy a PV system can produce depends on:

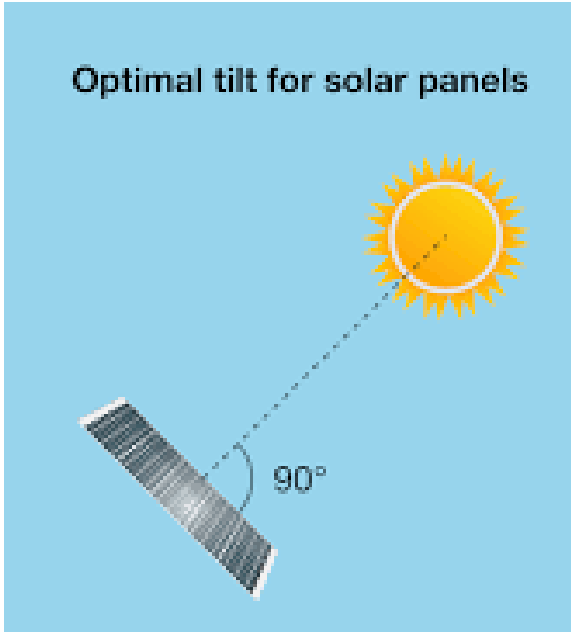
- Amount of roof shading
- Solar panel angle relative to sun rays
- Solar panel direction relative to South
- Solar panel efficiency
- Weather/Season



ENERGY PRODUCTION FACTORS

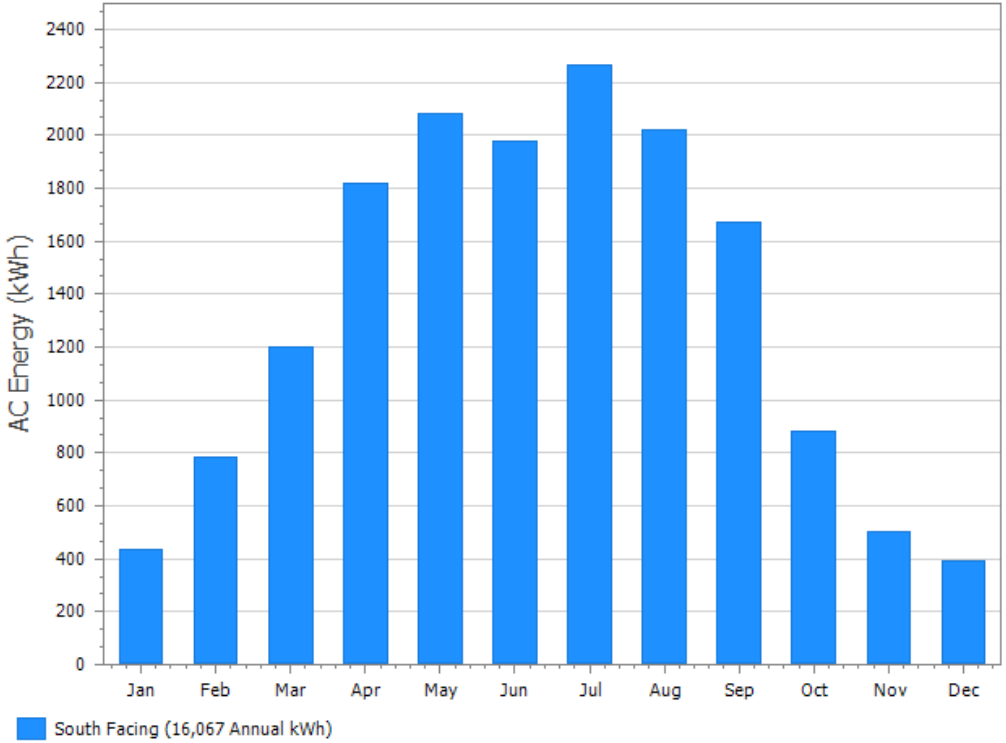
The ideal solar panel will:

- Be South-facing
- Have no obstructions (shading)
- Have high efficiency
- Be perpendicular to the sun’s rays
- Have optimizers (if string inverters)



Best case: Full Exposure– South Facing (180°)

Roof With 30° Pitch

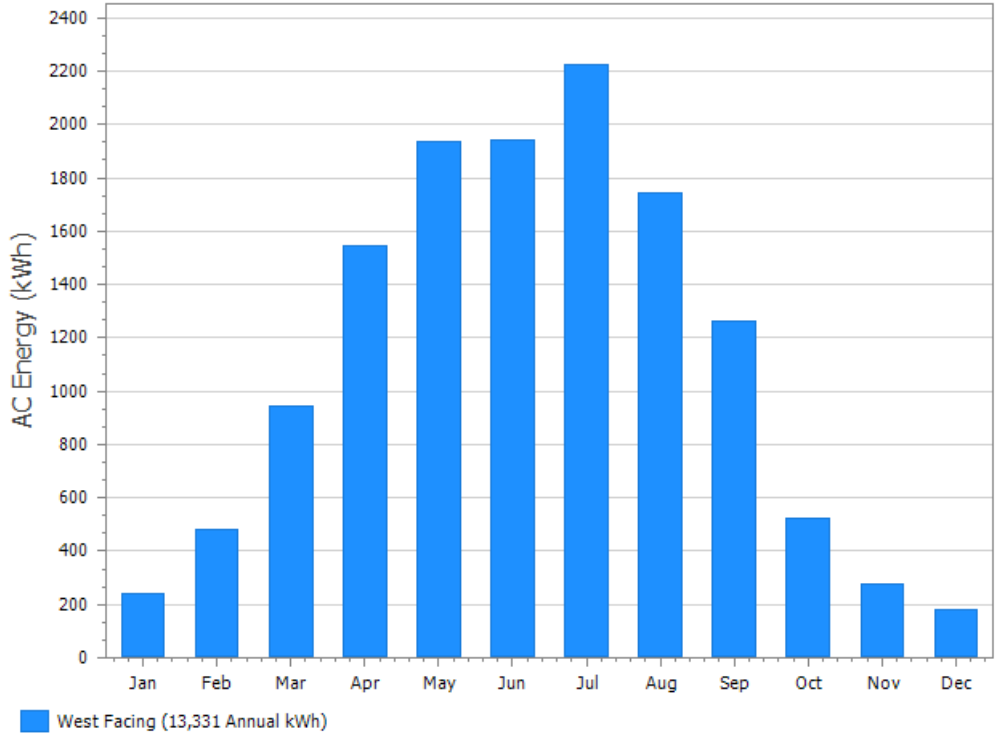


Roof Size (ft^2)	**Solar Modules** 385Wp Canadian Solar	**Energy Produced** (kWh/Year)
1,000	36 Panels	***16,067***

The avg. single-family detached home in BC used ***15,348*** kWh of electricity in 2019 (with electric heating) -BCHydro

Scenario 2: Full Exposure – West Facing (270°)

Roof With 30° Pitch

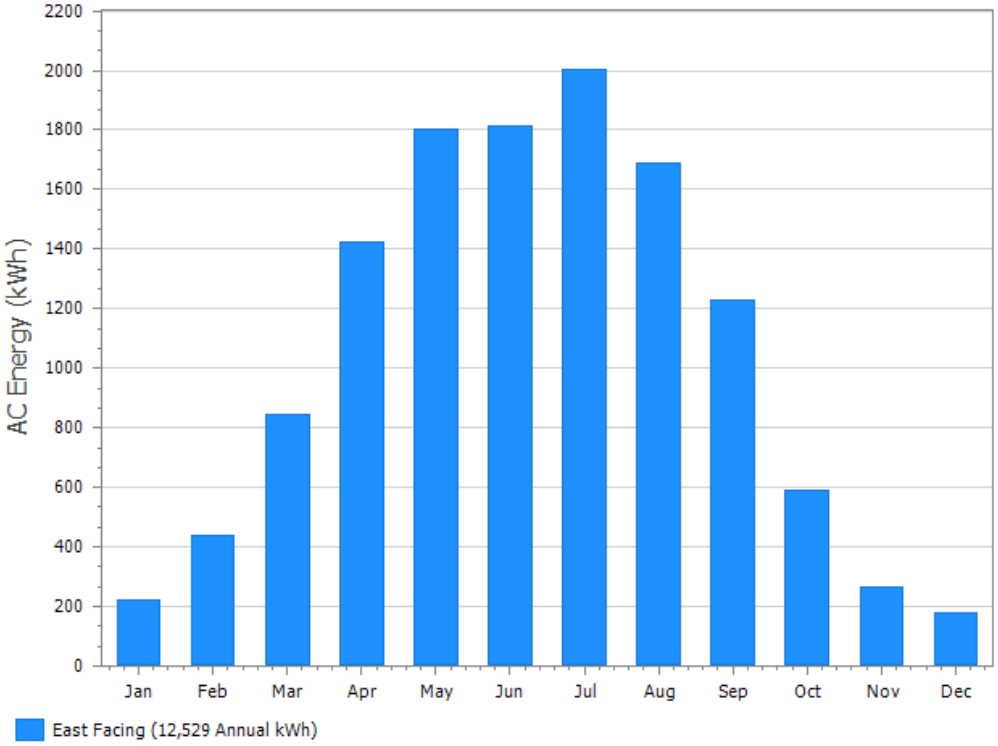


Roof Size (ft^2)	**Solar Modules** 385Wp Canadian Solar	**Energy Produced** (kWh/Year)
1,000	36 Panels	***13,331***

The avg. single-family detached home in BC used ***15,348*** kWh of electricity in 2019 (with electric heating) -BCHydro

Scenario 3: Full Exposure– East Facing (90°)

Roof With 30° Pitch

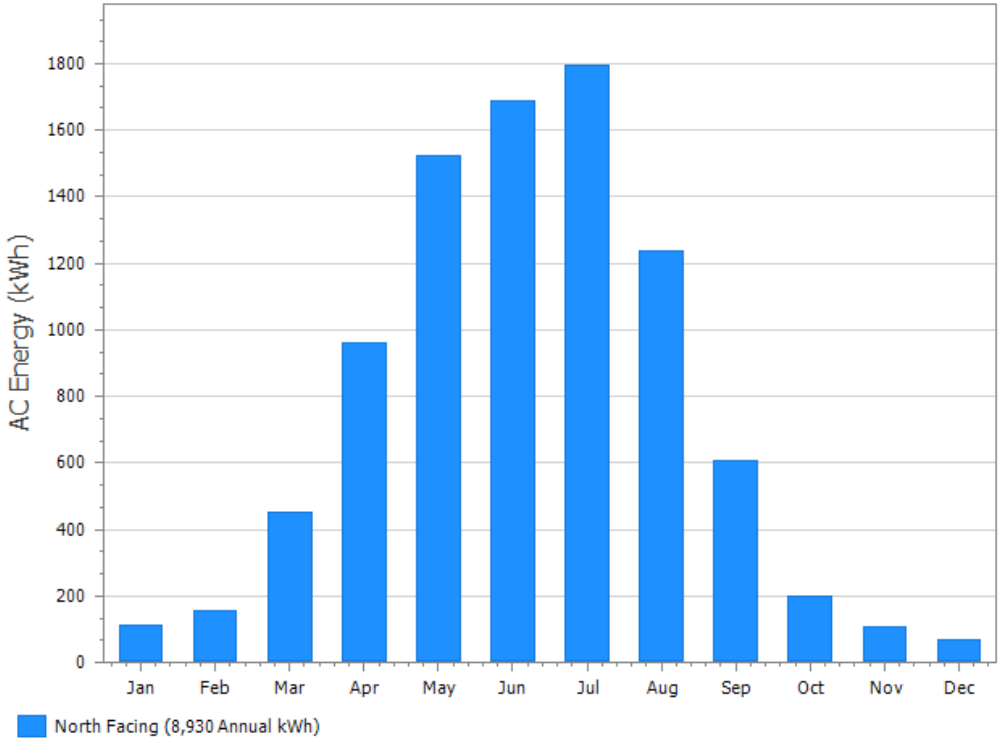


Roof Size (ft^2)	**Solar Modules** 385Wp Canadian Solar	**Energy Produced** (kWh/Year)
1,000	36 Panels	***12,529***

The avg. single-family detached home in BC used ***15,348*** kWh of electricity in 2019 (with electric heating) -BCHydro

Scenario 4: Full Exposure– North Facing (0°)

Roof With 30° Pitch

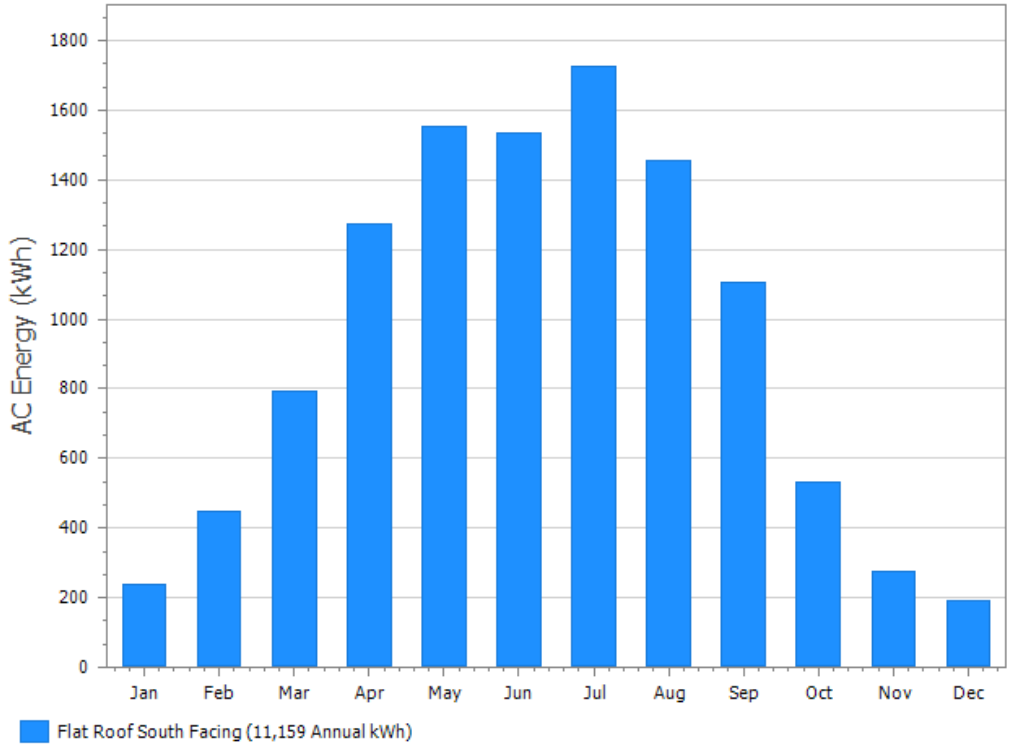


Roof Size (ft^2)	**Solar Modules** 385Wp Canadian Solar	**Energy Produced** (kWh/Year)
1,000	36 Panels	***8,930***

The avg. single-family detached home in BC used ***15,348*** kWh of electricity in 2019 (with electric heating) -BCHydro

Scenario 5: Full Exposure– Flat Roof

Flat Roof – Panels will have 10° angle and 2’ inter-row



Roof Size (ft^2)	**Solar Modules** 385Wp Canadian Solar	**Energy Produced** (kWh/Year)
1,000	Only room for 27 panels, not 36	***11,159***

The avg. single-family detached home in BC used ***15,348*** kWh of electricity in 2019 (with electric heating) -BCHydro

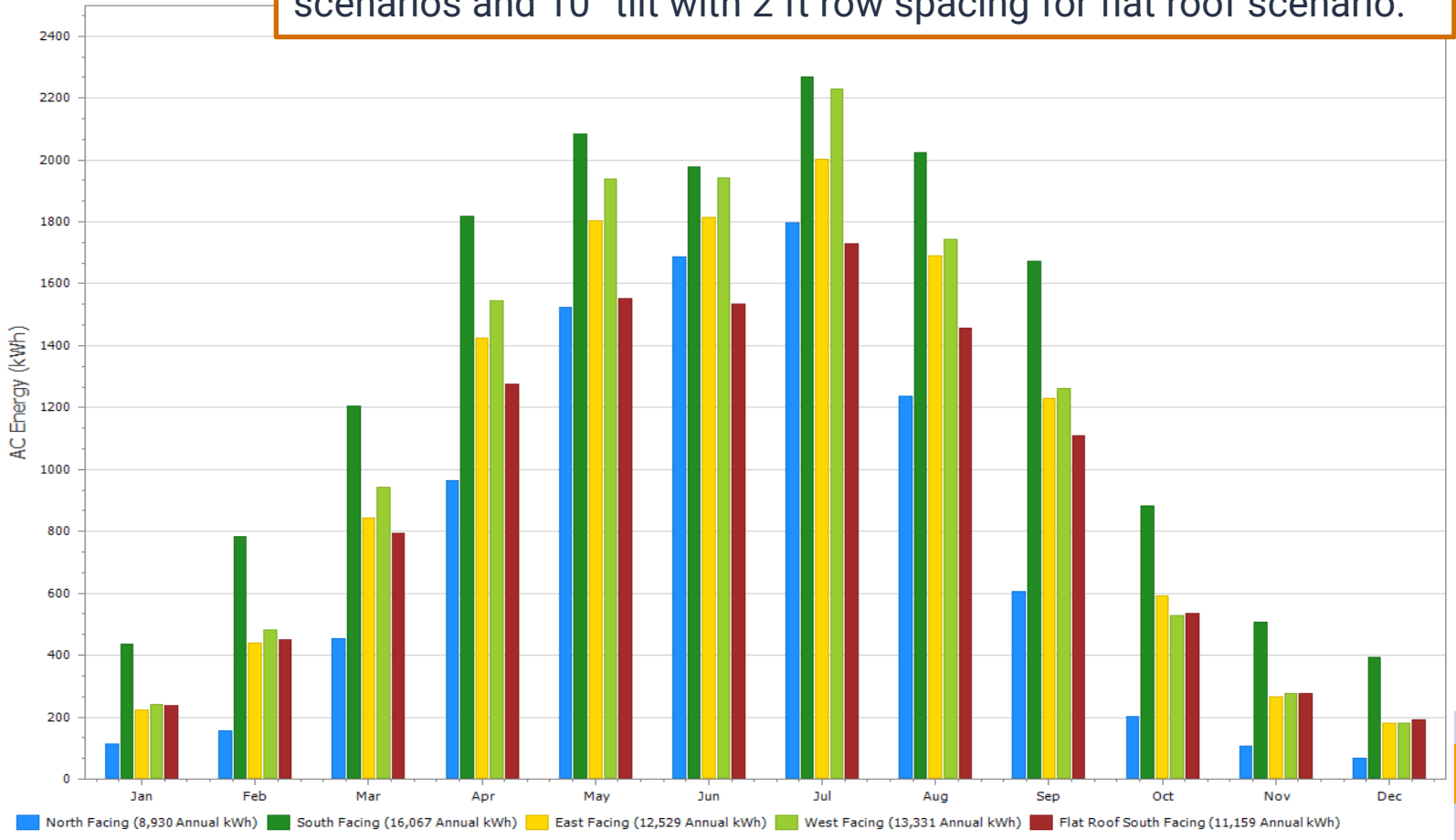
Overall Comparison

Roof Orientation	# of Panels (385Wp Canadian Solar)	Energy Produced (kWh/Year)	Simple Payback (Years)	Probable payback due to inflation & taxes (Years)
South	36	***16,067***	***13.3***	***8.6***
West	36	***13,331***	***16.1***	***10.0***
East	36	***12,529***	***17.1***	***10.4***
North	36	***8,930***	***24.0***	***13.4***
Flat	27	***11,159***	***14.4***	***9.2***

Summary of results for a 1,000ft^2 roof with a 30° pitch for first four scenarios and 10° panel angle and 2 ft row spacing for flat roof scenario.

Annual energy production by month

Summary of results for a 1,000ft^2 roof with a 30° tilt for first four scenarios and 10° tilt with 2 ft row spacing for flat roof scenario.



ESTIMATING # OF PANELS

1. Add up BC Hydro consumption history for past 12 months. (kWh/y).
2. Divide kWh/y by 1,200 kWh/y /kWp to get installed array size (kWp) to achieve net zero assuming perfect exposure.
3. Divide array kWp by panel nameplate rating kWp to get number of panels.

ESTIMATING # OF PANELS

1. Determine if the “net zero” number of panels will fit in location available for installation. A typical panel is 1 m x 1.6 m and they can be installed in portrait or landscape orientation.
2. # of panels will be the lesser of “net zero” or # that fit.

ESTIMATING SIMPLE PAYBACK

1. Typical residential arrays currently have installed cost between $2.10/W and 3:20/W.
2. Assuming:

- 13,500 kWh/y consumption
- 1,200 kWh/y /kWp
- 385 watt panel rating (0.385 kWp)

3. Then we need 29 panels.

ESTIMATING SIMPLE PAYBACK

1. Assuming cost of $2.40/W, then 29 x 385 W x $2.40/W = $26,746 installed cost.
2. Assuming current hydro cost of $0.145/kWh the savings will be 13,500 kWh/y x $0.145 = $1,957/y.
3. Simple payback = $26,746/$1,957 = 13.7 y
4. Note real payback much better since saving after tax dollars and now inflation-proof.

4

RETROFIT INCENTIVES

Ways to reduce costs for retrofitting your home

HOME RETROFIT INCENTIVES

To access any of the links, hold “CTRL” and then click the link

- BCHydro Net Metering Program
- Canada Greener Homes Initiative
- Canada Greener Homes Initiative Eligibility and Application
- CleanBC Rebates Program
- BCHydro Home Renovation Rebates

5

TOOLS & RESOURCES

Ways to reduce costs for retrofitting your home

TAKE-HOME TOOLS & RESOURCES

To access any of the links, hold “CTRL” and then click the link

- Our Website
- Our Email: suncoastcsa@gmail.com
- Solar Thermal Water Heating Systems Info
- DIY home audit Checklist

SCCSA MEMBERSHIP BENEFITS

Support solar in your community!

- Bi-monthly Newsletters
- Only $20/year for membership
- More members = more grants for the association = more solar panel and emissions reduction projects in your community

SCCSA MEMBERSHIP SIGN UP

Support solar in your community!

- Sign up online at https://suncoastcommsolar.weebly.com/membership.html

THANK YOU!

Do you have any questions?

JOIN US OUTSIDE TO SEE SOME SOLAR PANELS IN ACTION!

Halfmoon Bay Festival Set-Up