Solar 101:
PV,
Net Metering,
Storage,
and EV Integration

Ark Valley Coalition
For a Sustainable Energy Future

Ken Regelson

4/5/2023

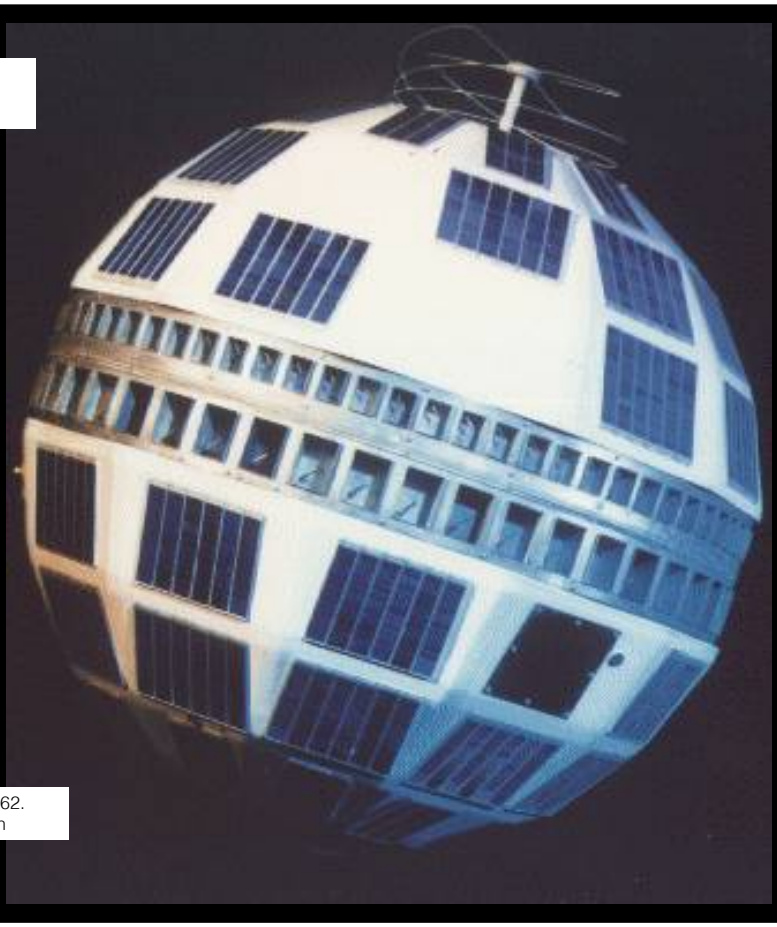
EnergyShouldBe.org

Image: pixabay.com

EnergyShouldBe.org

Drive a rapid transition to a reliable, cost-effective, responsible, and clean energy future based on data driven actions.

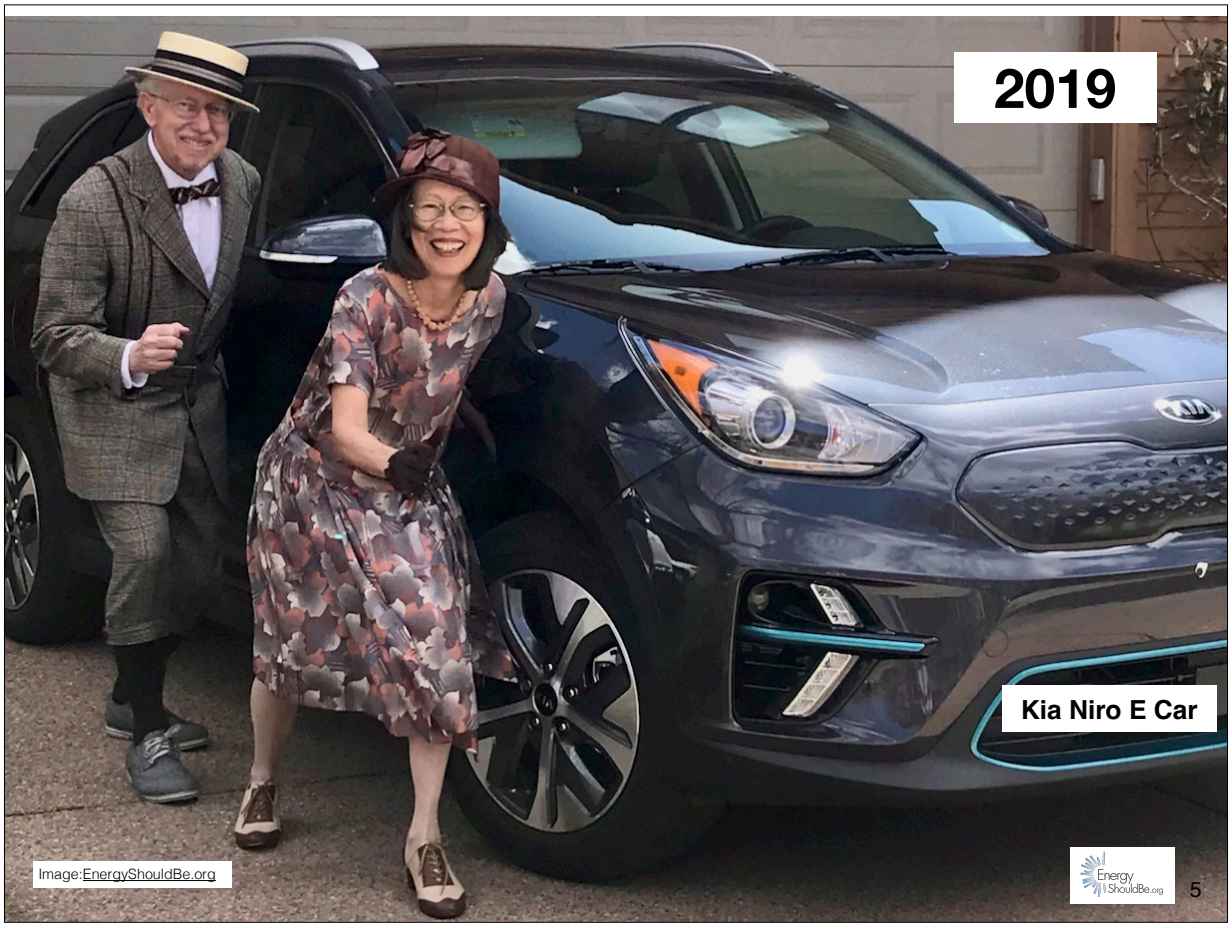
1962



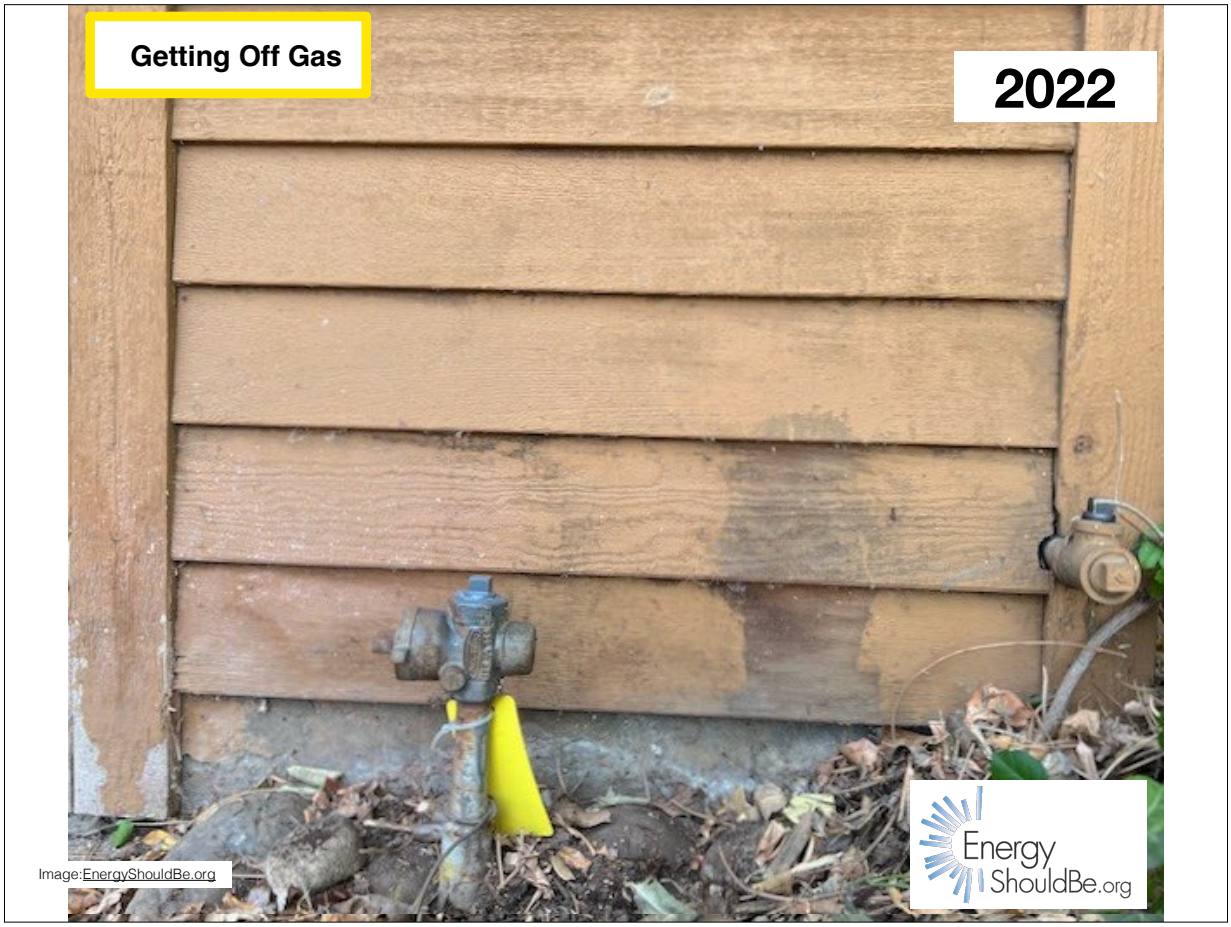
Telstar 1 launched 1962.
Image: Public Domain

2004

Image:EnergyShouldBe.org


2019
Kia Niro E Car
Image:EnergyShouldBe.org
Energy ShouldBe.org

5

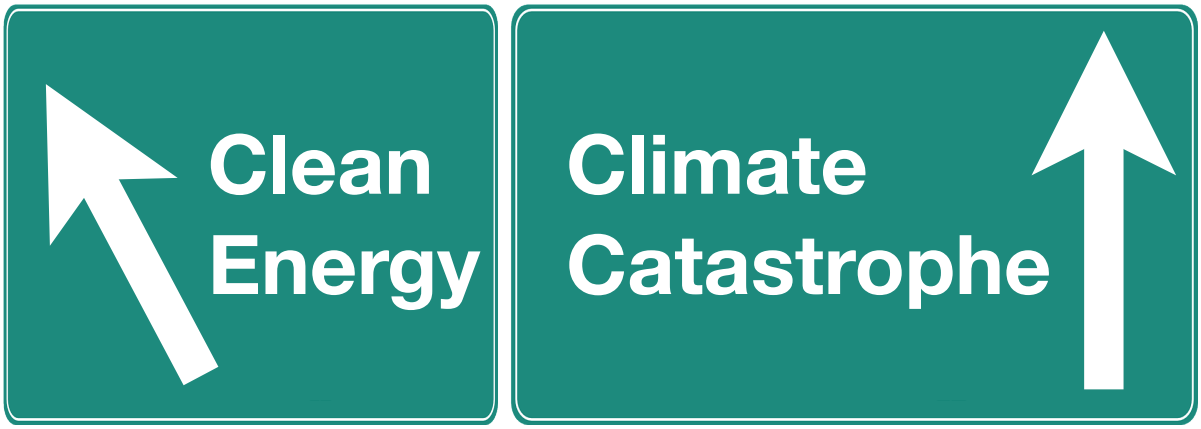

Getting Off Gas
2022
Image:EnergyShouldBe.org
Energy ShouldBe.org

Grant me the courage to change the things I can change…

Topics:

- **The Things I Can Change**
- **Why rapid change now?**
- **Solar 101**
- **Net Metering**
- **Use Electricity When Sunny or Windy**
- **Local Storage**
- **EV Integration with Home & Grid**

Image: pixabay.com



All men should strive to learn before they die, what they are running from, and to, and why.

James Thurber

Images:EnergyShouldBe.org and pixabay.com

Visit Sage & Family:

- Get from here to there:
  - ☞ Drive (EV) to Airport
  - ☞ Park
  - ☞ Plane to Chicago
  - ☞ Plane to Champaign
- Spend the day with Sage

etc
etc

Images:EnergyShouldBe.org and pixabay.com

Clean Energy Future

1 part Use Energy Efficiency
1 part 90 -100% Renewable Electricity
1 part *Electrify All* - Everything Else

Data Driven

Cost, Cost Effectiveness Over Time, and Greenhouse Gasses

- Efficiency

US Fuel Cost High to Low

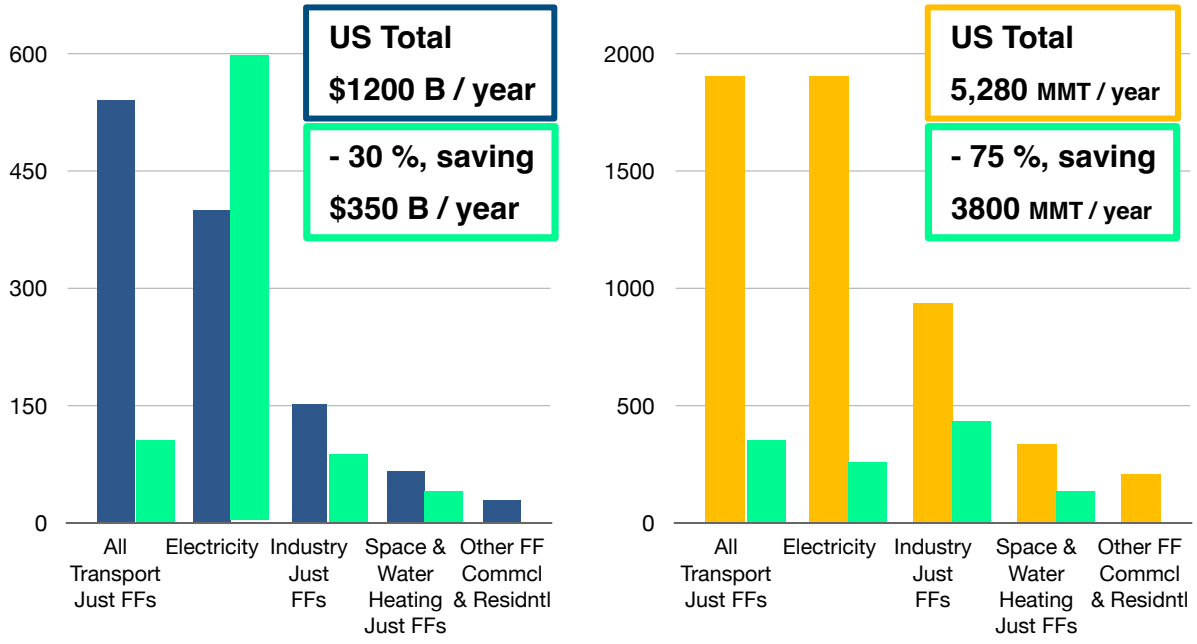
1. All Transport
2. Electricity
3. Industry
4. Space & Water Heating
5. Other Fossil Fuel Commercial and Residential

US Energy Cost
Billion $ Per Year

2015

2035 90% Renewable Electricity. 80% EVs. Electrify 50% of industry and Heating.

US - GHGs
Million MT CO2*e*



Images: EnergyShouldBe.org Data analysis EnergyShouldBe.org based on EIA 2015 US data.

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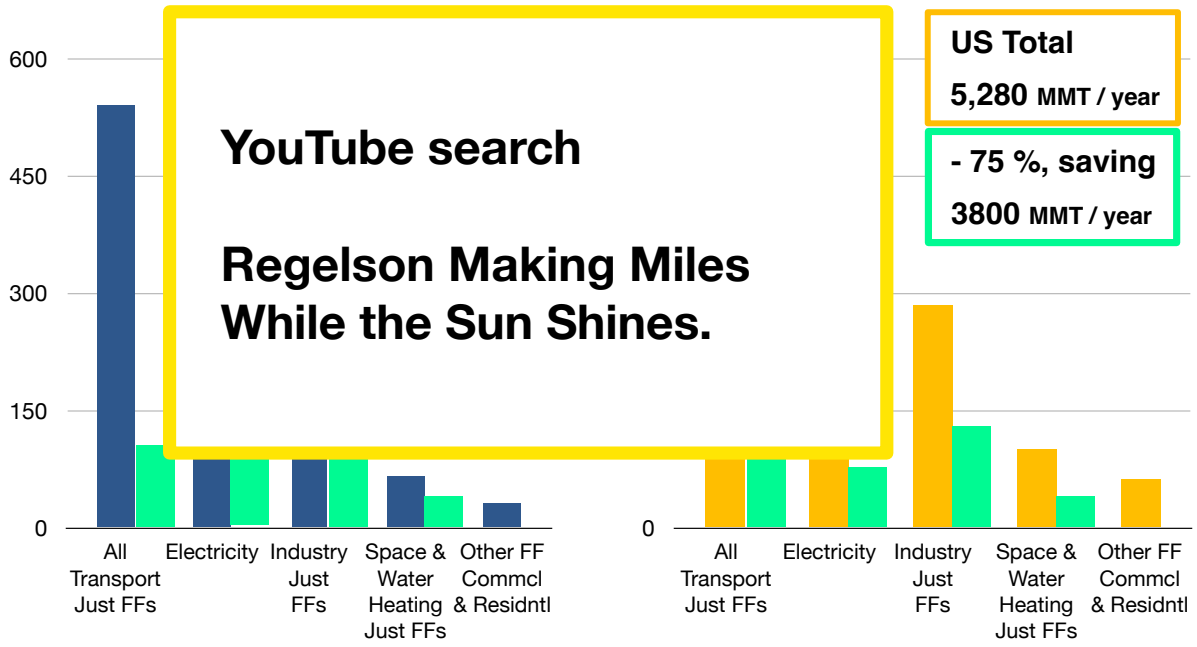
YouTube search

Regelson Making Miles While the Sun Shines.



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4 Community Actions I Can Take

Community
- ✔ **Advocate**
- ✔ **Vote**
- ✔ **Educate**
- ✔ **Organize**

Ark Valley Coalition
For a Sustainable Energy Future

- Efficiency

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8 Personal ☞ Actions I Can Take

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  - ☞ **Buy/lease an EV - Electric Vehicle**
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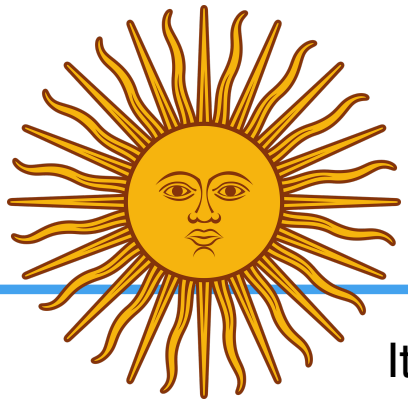
Bank at the Federally insured Clean Energy Credit Union

CLEAN ENERGY CREDIT UNION



Topics:

The Things I Can Change

Why rapid change now?

Solar 101

It's the MONEY!!!

It's the Climate Catastrophe!!!

Image: pixabay.com

These Make the Same Amount of Electricity per year

Competition and Mass Production always means costs go down!

1

425

13,000,000

Number of wind turbine and solar panel calculations by EnergyShouldBe.org from common data sources for Colorado.
Images of coal plant, wind turbines and solar panels EnergyShouldBe.org For copy bible, Gutenberg press, and high speed press, pixabay.com

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Billions
of batteries for Electric Vehicles

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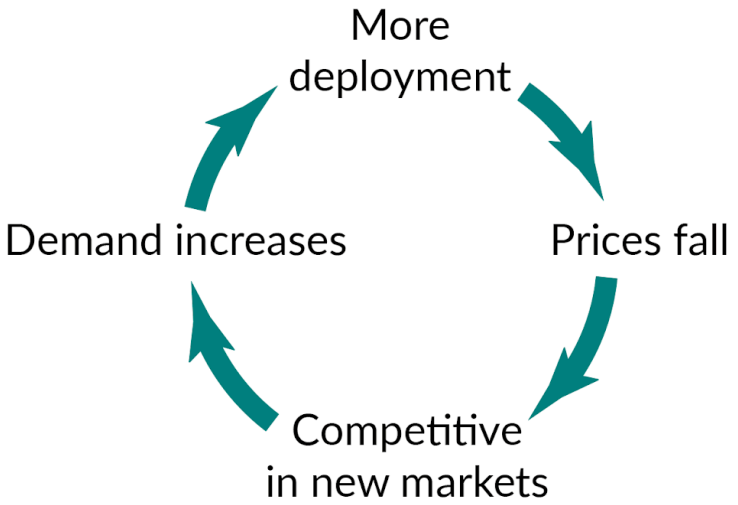
Technologies that become cheaper with increasing production enter a virtuous cycle

Our World in Data



https://ourworldindata.org/cheap-renewables-growth

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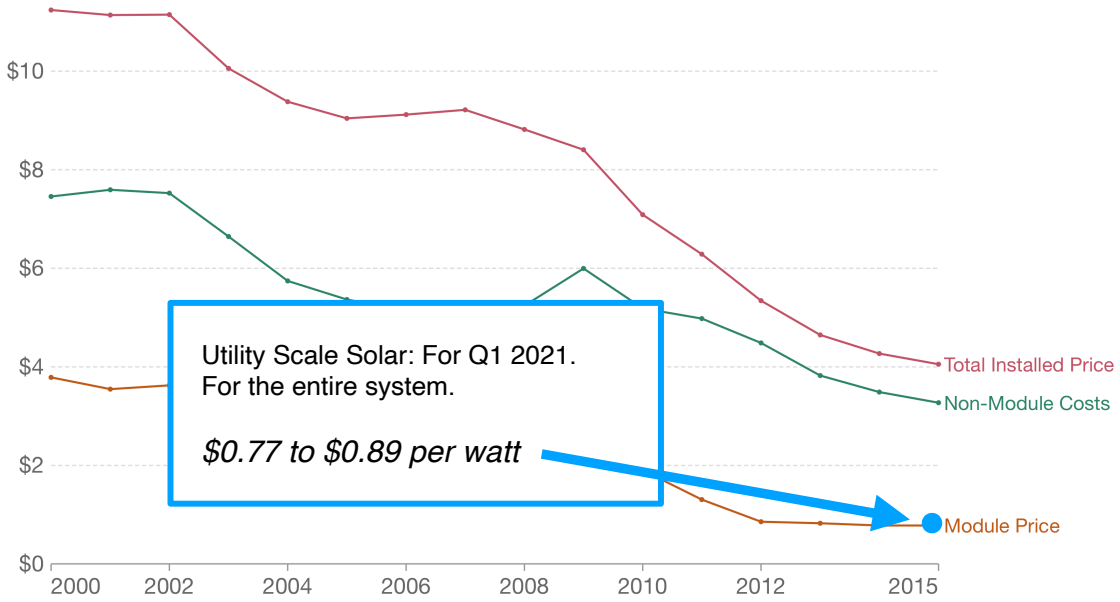

Source: Barbose and Darghouth (2016)

source for: $0.77 to $0.89 per watt
https://www.solarreviews.com/blog/how-does-utility-scale-solar-work

OurWorldInData.org/energy • CC BY

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Image: pixabay.com

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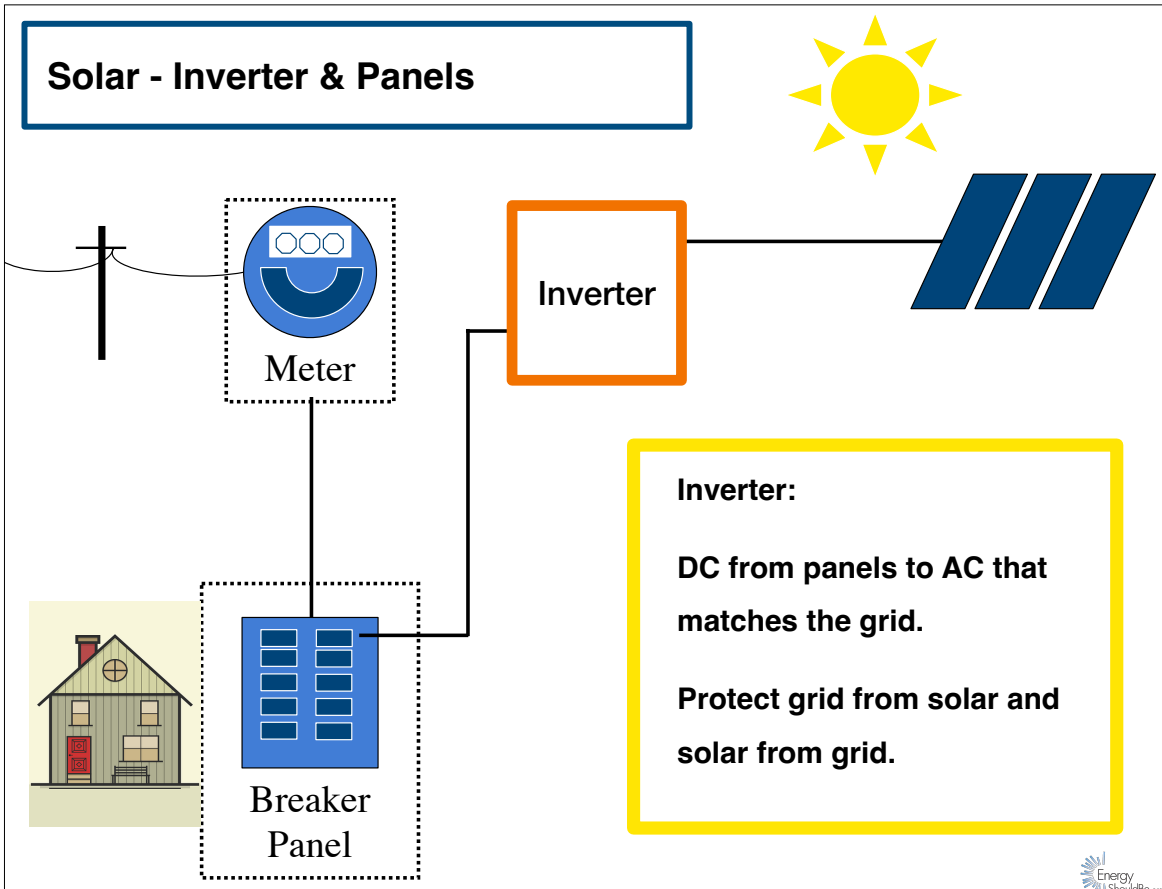
Solar - Inverter & Panels



Inverter:

DC from panels to AC that matches the grid.

Protect grid from solar and solar from grid.

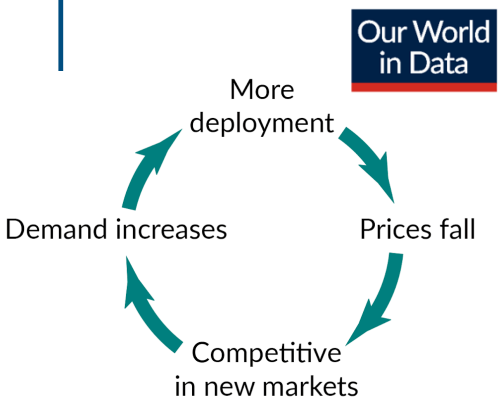
Solar - Why Own Solar?

Residential Cost and Payback - Tim.

Increase the value of your home.

The more solar bought, the more solar drops in price.

With Storage, you can get solar electricity during a black out and maximize the use of your solar generation.



Solar - Why Own Solar?

Images: EnergyShouldBe.org

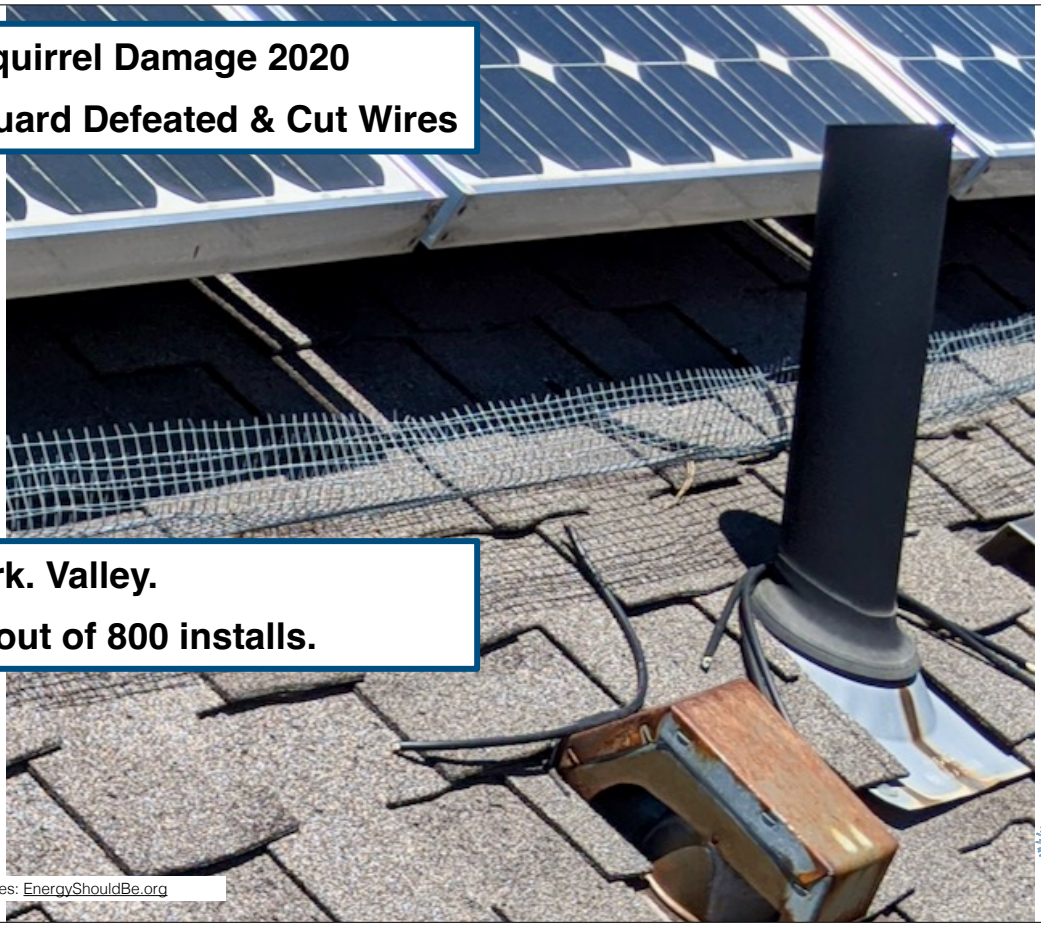
Squirrel Damage 2006

Cut Wires

Images: EnergyShouldBe.org

Squirrel Damage 2020

Guard Defeated & Cut Wires



Ark. Valley.

2 out of 800 installs.

Images: EnergyShouldBe.org

Solar Requirements

If it is reasonable for you:

- **Squirrel Guard**
- **Battery Installed or Battery Ready**
- **EV Integration Ready (maybe a plan)**
- **Grid Integration Ready (maybe a plan)**

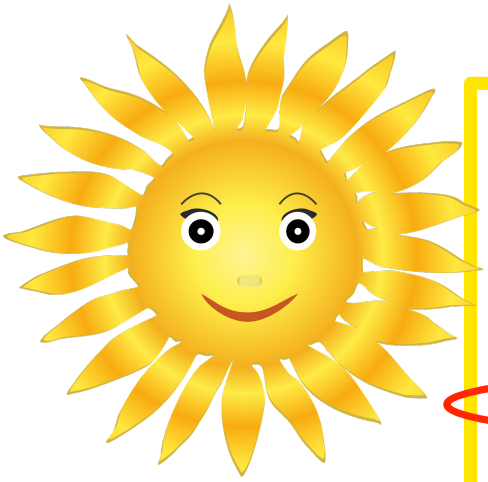


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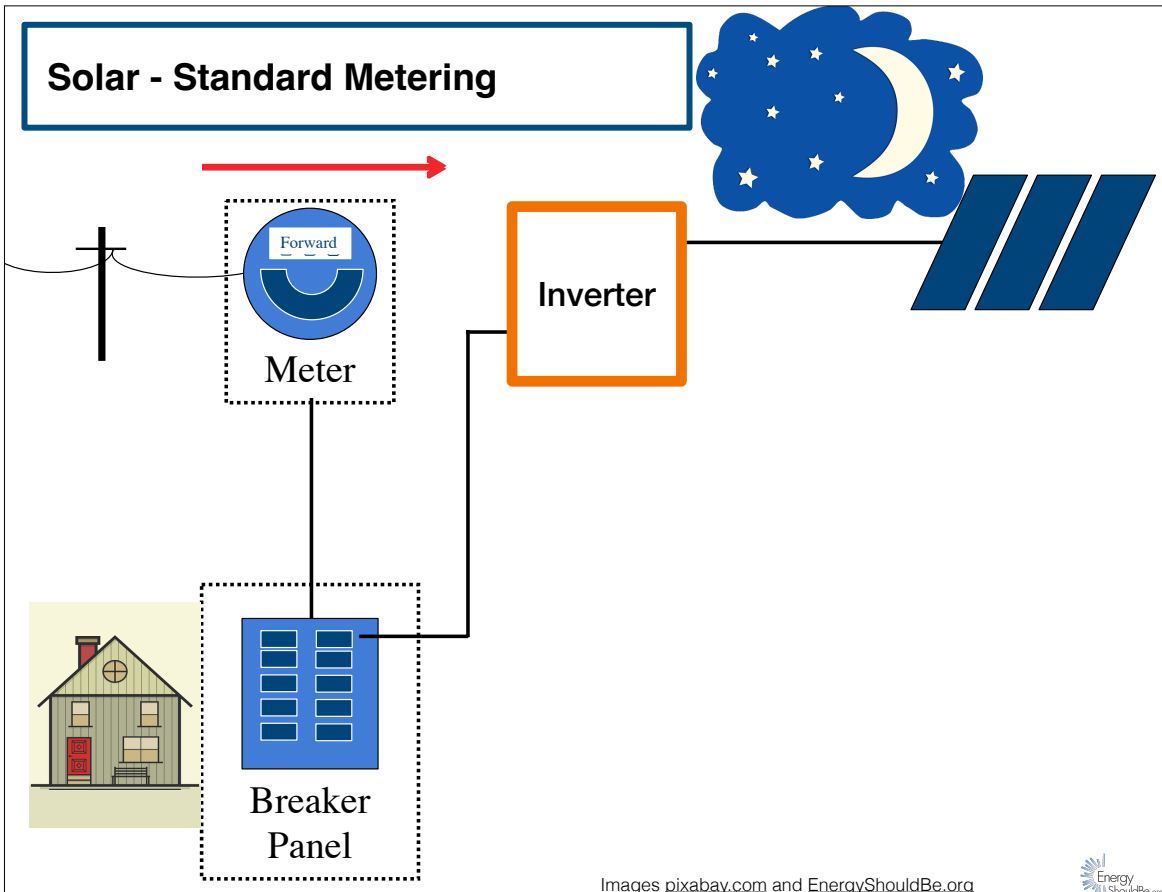
Image: pixabay.com

COSEIA - Colorado Solar Energy Industry Association

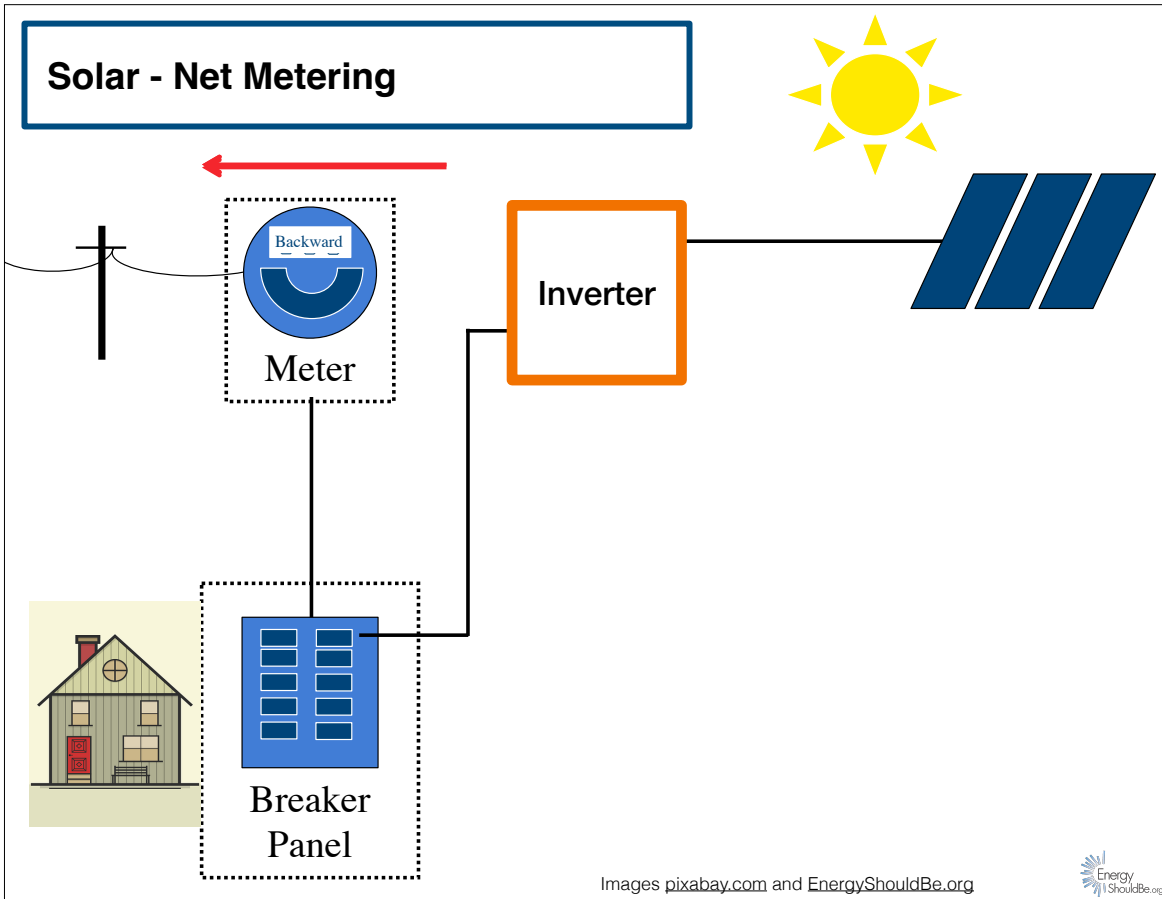
2008 Governor Ritter signs a solar bill

Solar - Standard Metering



Images pixabay.com and EnergyShouldBe.org

Solar - Net Metering



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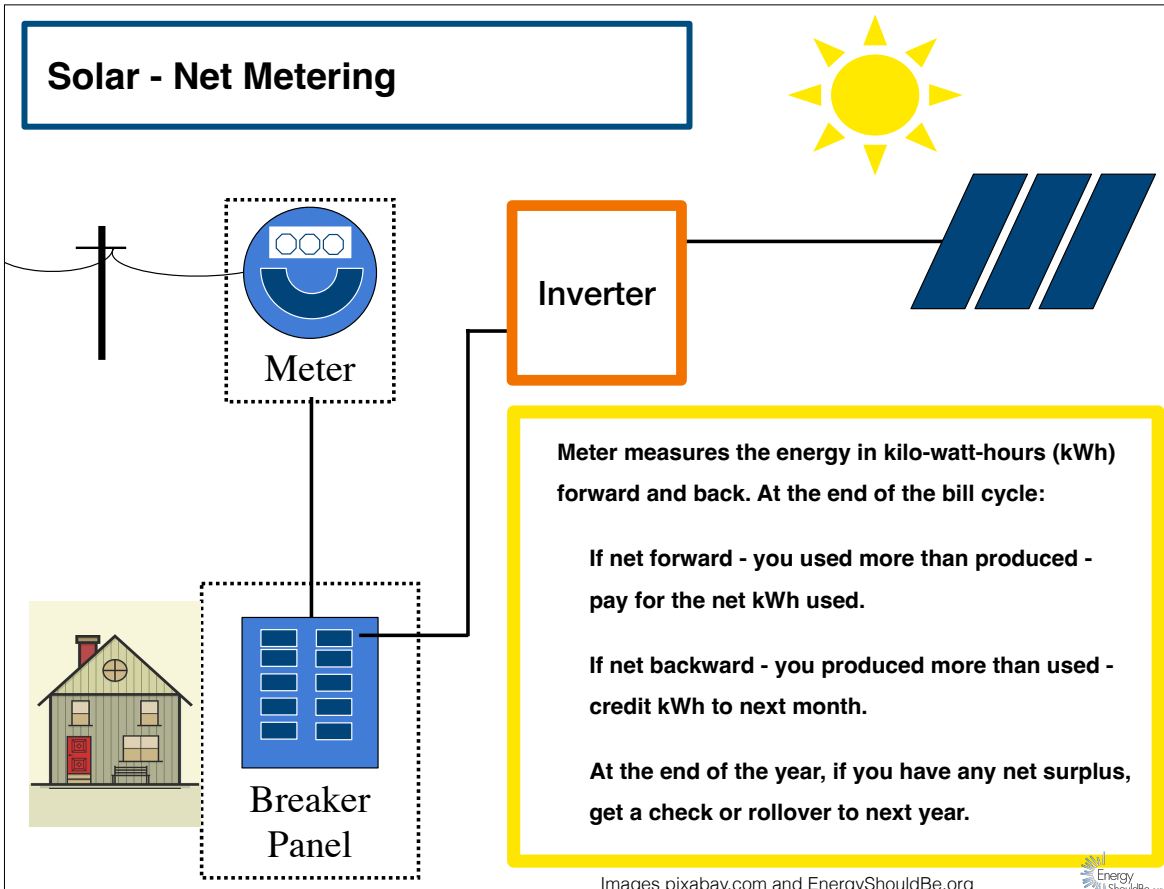

Meter measures the energy in kilo-watt-hours (kWh) forward and back. At the end of the bill cycle:

If net forward - you used more than produced - pay for the net kWh used.

If net backward - you produced more than used - credit kWh to next month.

At the end of the year, if you have any net surplus, get a check or rollover to next year.

Images pixabay.com and EnergyShouldBe.org

Solar - Net Metering

Rates Should be BLIND to a customer with and without solar.

An Act

(c) Nondiscriminatory rates. A COOPERATIVE ELECTRIC ASSOCIATION SHALL PROVIDE NET METERING SERVICE AT NONDISCRIMINATORY RATES.

House Bill 08-1160

Images pixabay.com and EnergyShouldBe.org

Solar - Net Metering

Caveat:

Ken is NOT A Lawyer.

Rates Should be BLIND to a customer with and without solar.

Not OK for coops:

Paying for an extra meter.

A special fee or rate for solar.

Rates that cause a house with solar to pay more than a house without.

OK:

Increasing the standard monthly fee for everyone - all residential pay the same.

Time of Use Rates for everyone as long as they are Net for each rate/time period.

Images pixabay.com and EnergyShouldBe.org

Solar - Net Metering

Ark Valley Coalition
For a Sustainable Energy Future

AVEF won the battle against SDCEA's discriminatory rates because you were willing to go to court to prove Sangre wrong.

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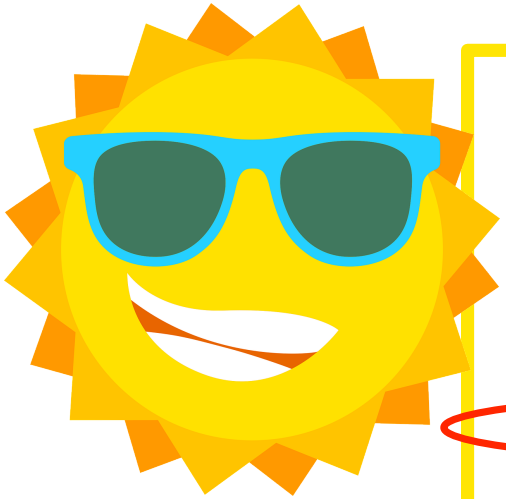

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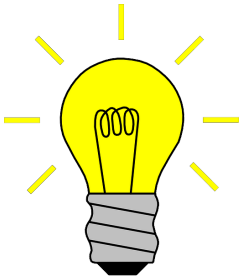
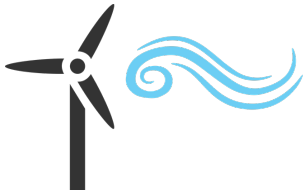
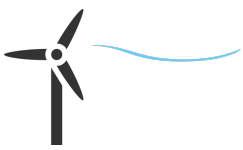
Image: pixabay.com

Above 30% of electricity from wind and solar there will be surplus. Why?







Blackout = no electricity use!

Images pixabay.com and EnergyShouldBe.org

Above 30% of electricity from wind and solar there will be surplus. Why?

When there is lots of solar and/or lots of wind, and little use of electricity there will be surplus!

Selling the surplus, even for cheap, keeps rates low.

Images pixabay.com and EnergyShouldBe.org

How much surplus in cars charged per year?

In testimony at the PUC in 2020 Xcel Colorado revealed that they expect

950,756 MWh

of potential wind energy to not be delivered in 2021.

Not delivered means "Curtailed" or thrown away.

If that amount were instead used to charge customer EVs for free or very cheap

350,000 EVs/year

could be charged from that amount of surplus 30 miles driving per day.

Math: (1000 kWh/Mwh * 950,756 MWh surplus) / ((30 miles average / day / 4 miles in an EV / kWh) * 365 day/year) = 347,000 EVs / year

SDCEA: total 2020 electricity sales:

133,206 MWh

SDCEA data from: https://www.myelectric.coop/2020-annual-report/
Xcel data from PUC Staff Witness Joseph McCabe, TEP docket 20A-0204E

Images pixabay.com

Rewarding Flexible Use of Surplus Electricity

Xcel 2021 Charging EVs on Otherwise Curtailed Wind & Solar. **35% Renewable. 300,000 Plug-ins.**

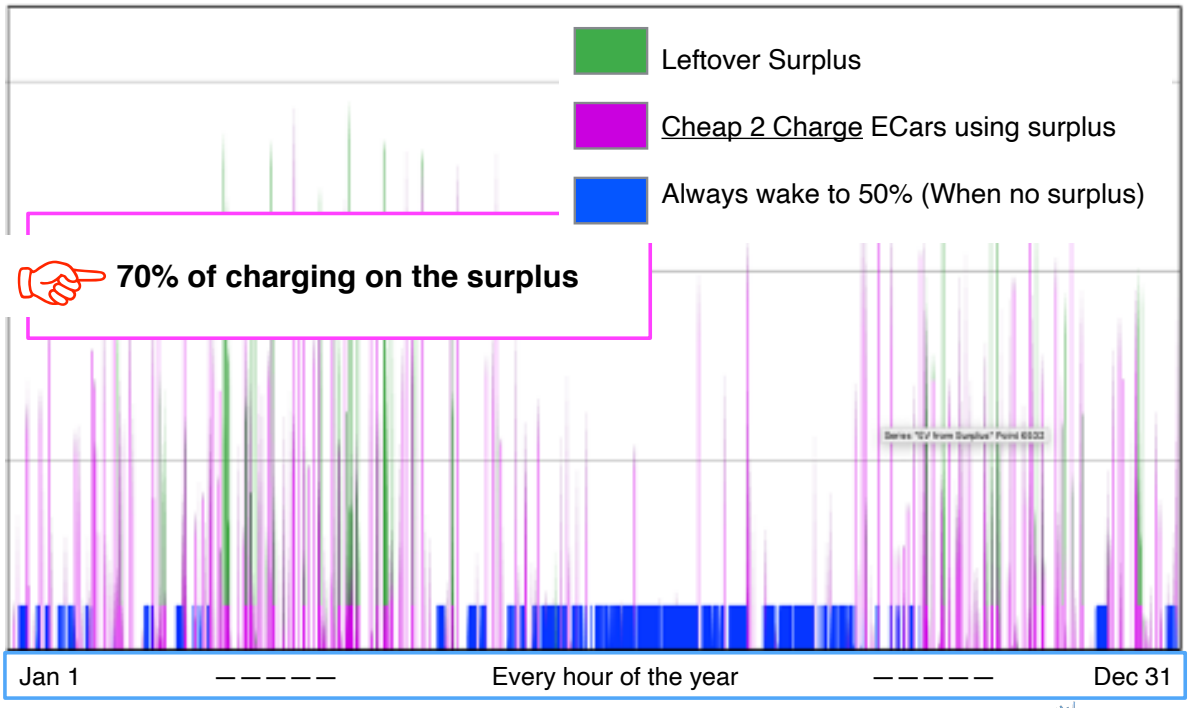


Image and hourly modeling: EnergyShouldBe.org based on data from Platte River Power Authority and Xcel Energy Colorado

Net Metering

Use Electricity When Sunny or Windy

Local Storage

If I have solar and storage, or an EV, I should be able to sell my electricity to the grid when there is insufficient renewables to meet the grid's needs.

Images pixabay.com

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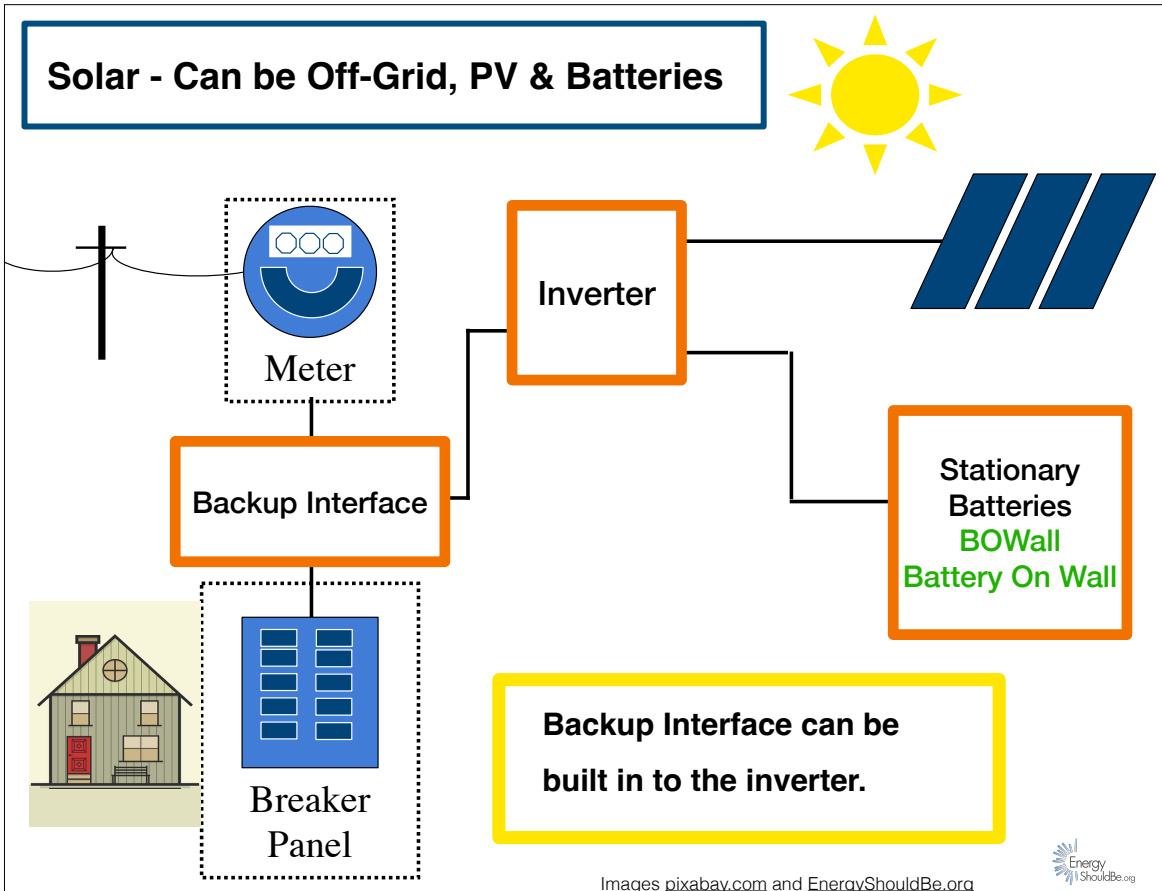
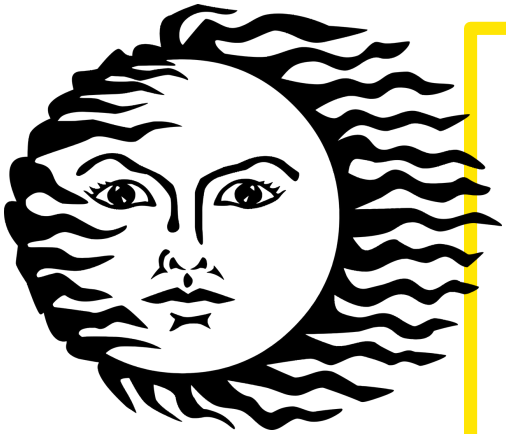
Image: pixabay.com

Solar - Can be Off-Grid, PV & Batteries



Backup Interface can be built in to the inverter.

Images pixabay.com and EnergyShouldBe.org



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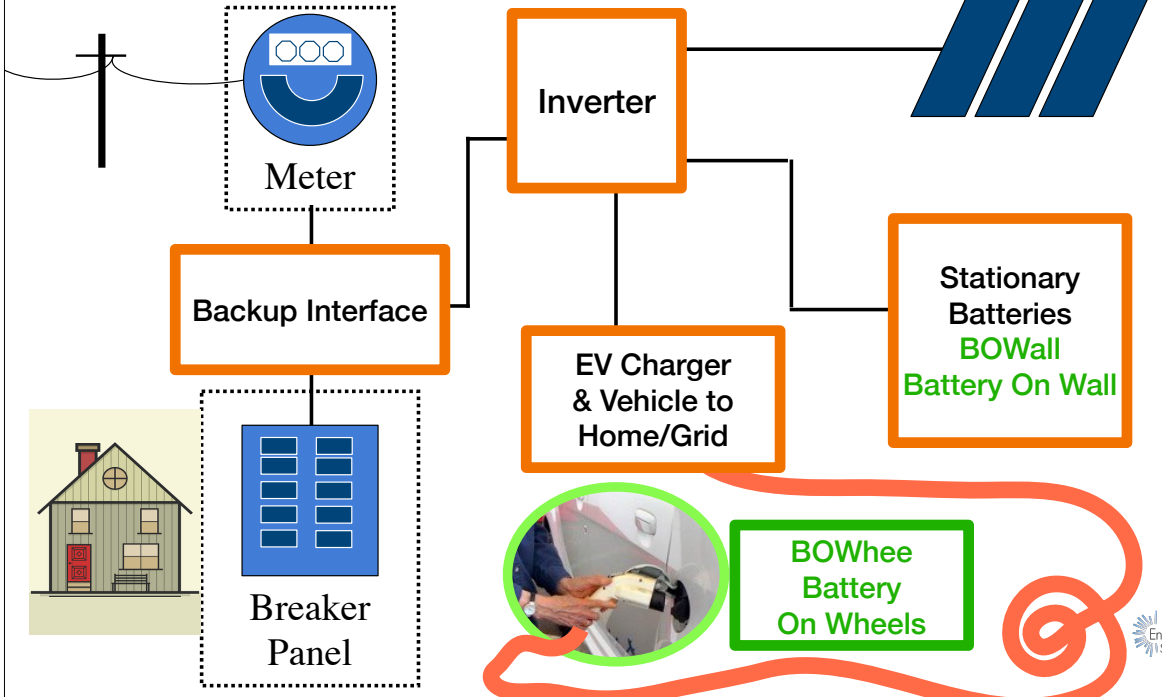
Solar - Integrated PV, EV, Batteries



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V2H or V2G

V2H

Vehicle to Home

or Bidirectional Charging

V2G

Vehicle to Grid

or Bidirectional Charging

EV Charger & Vehicle to Home/Grid

BOWhee Battery On Wheels

Energy ShouldBe.org

Images pixabay.com and EnergyShouldBe.org

BOWall vs. BOWhee.

Why? The Big Battery in a BOWhee

Stationary Batteries BOWa Battery On Wall	Tesla Powerwall $1000/kWh

Ford F-150 Lightning

EV $640/kWh 100 kWh

Can charge an EV at 10 kW

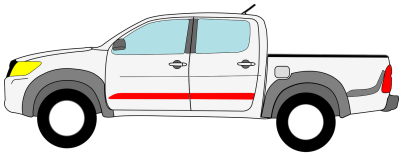
Kia EV6

$653/kWh 75 kWh

Can charge an EV at 2 kW

Chevy Bolt EV

$430/kWh 65 kWh



Kia Niro EV shown, not an EV6

Images Ford Media download and EnergyShouldBe.org Kia Niro EV shown, not an EV6

Prices & kWh as of 4/2023. Tesla PowerWall 13.5 kWh each. Roughly $18,000 $1300/kWh for 1. $28,000 $1000/kWh for 2

F-150 configured with standard range 100 kWh battery $64K with 10 kW pro power kit. Additional $5K plus install for V2H V2G. Base Chevy Bolt $28K 65 kWh $430/kWh. Kia EV6 $49K 75 kWh. EV6 1900 watt on board power generator

Energy ShouldBe.org

Summary

Image: pixabay.com

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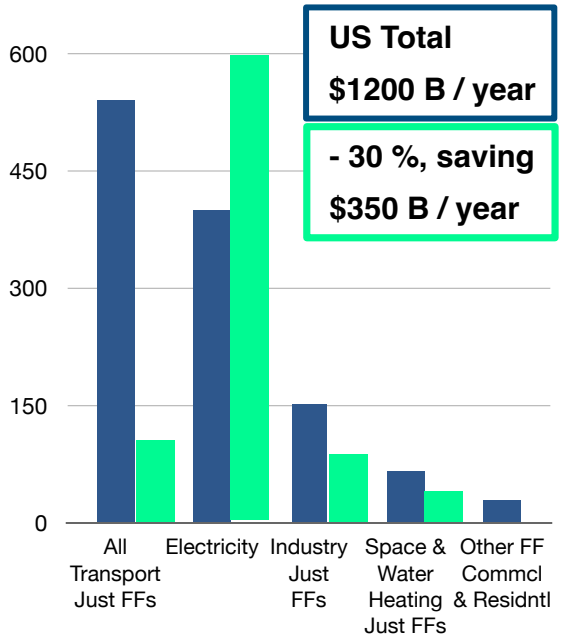

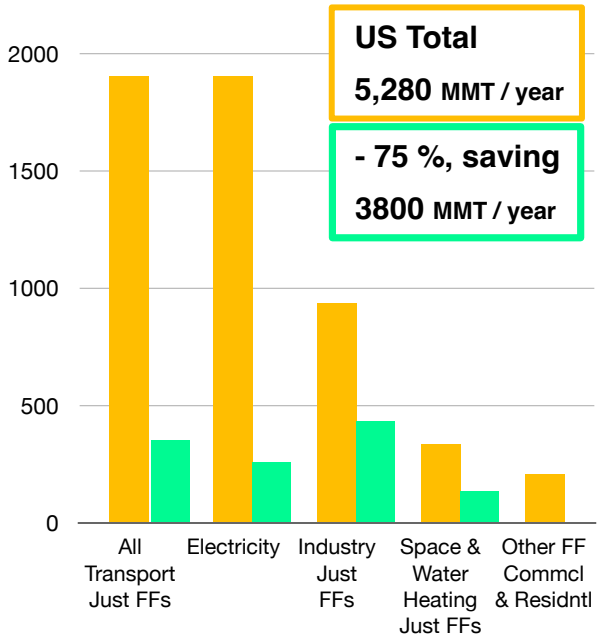

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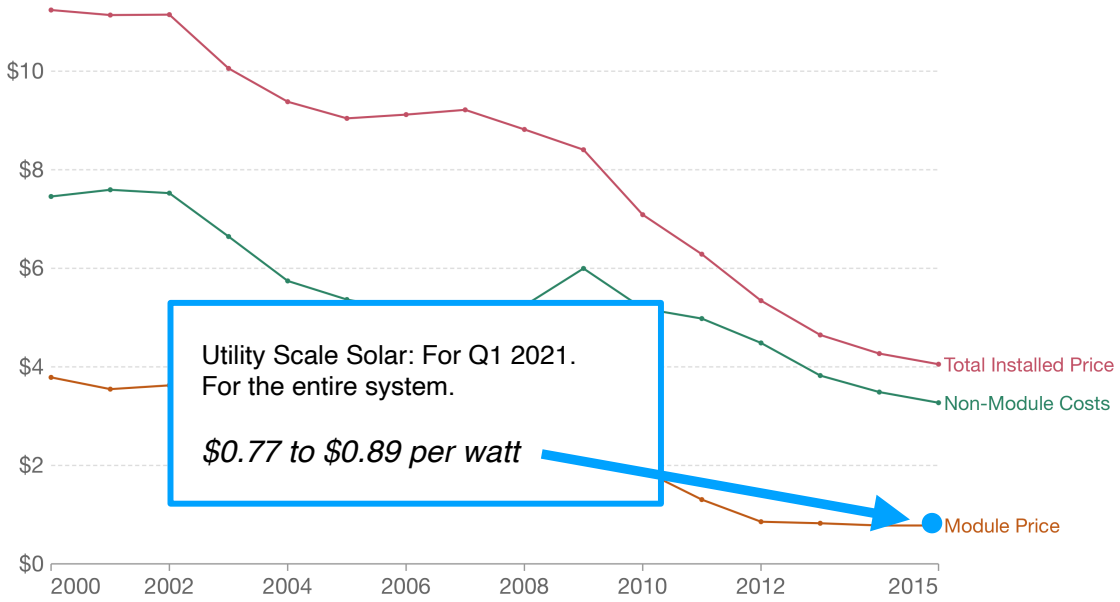

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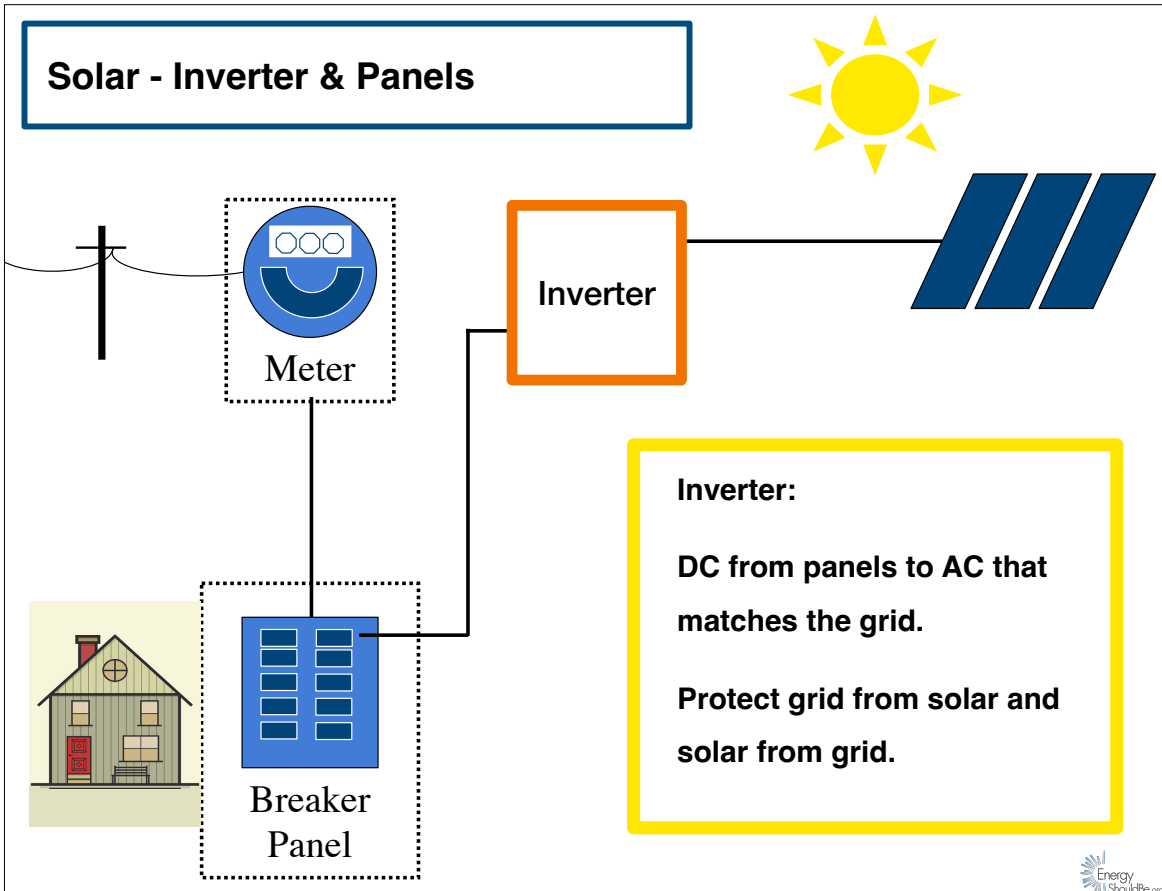


Inverter:

DC from panels to AC that matches the grid.

Protect grid from solar and solar from grid.

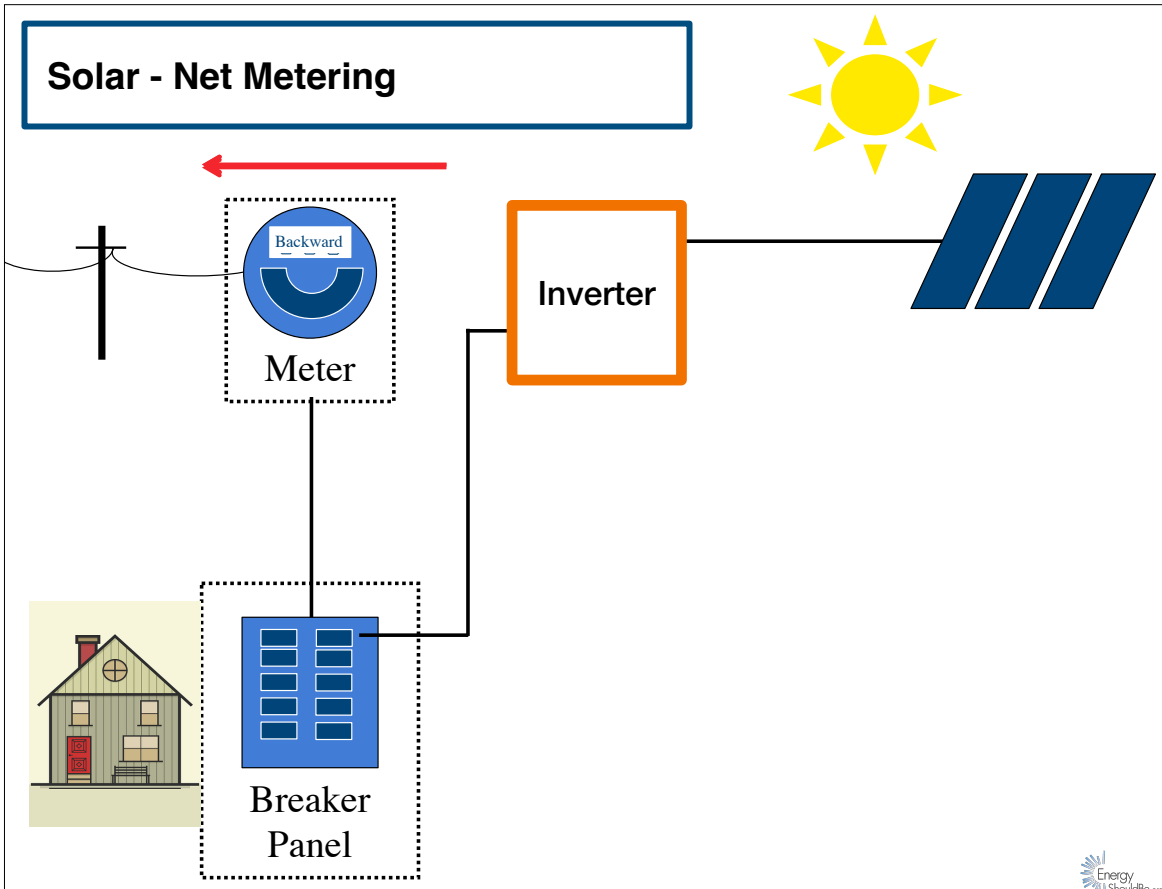
Energy ShouldBe.org 54

Solar Requirements

If it is reasonable for you:

- **Squirrel Guard**
- **Battery Installed or Battery Ready**
- **EV Integration Ready (maybe a plan)**
- **Grid Integration Ready (maybe a plan)**

Solar - Net Metering



Solar - Net Metering

Caveat:

Ken is NOT A Lawyer.

Rates Should be BLIND to a customer with and without solar.

Not OK for coops:

Paying for an extra meter.

A special fee or rate for solar.

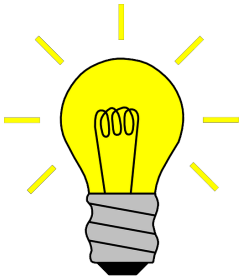
Rates that cause a house with solar to pay more than a house without.

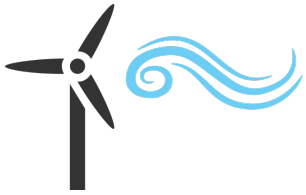
OK:

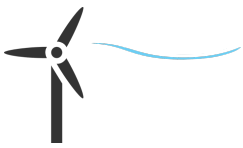
Increasing the standard monthly fee for everyone - all residential pay the same.

Time of Use Rates for everyone as long as they are Net for each rate/time period.

Above 30% of electricity from wind and solar there will be surplus. Why?







Blackout = no electricity use!

Images pixabay.com

How much surplus in cars charged per year?

In testimony at the PUC in 2020 Xcel Colorado revealed that they expect

950,756 MWh

of potential wind energy to not be delivered in 2021.

Curtailed or thrown away or sold to other utilities for cheap (often free).

If that amount were instead used to charge customer EVs for free or very cheap

350,000 EVs/year

could be charged from that amount of surplus 30 miles driving per day.

Math: (1000 kWh/Mwh * 950,756 MWh surplus) / ((30 miles average / day / 4 miles in an EV / kWh) * 365 day/year) = 347,000 EVs / year

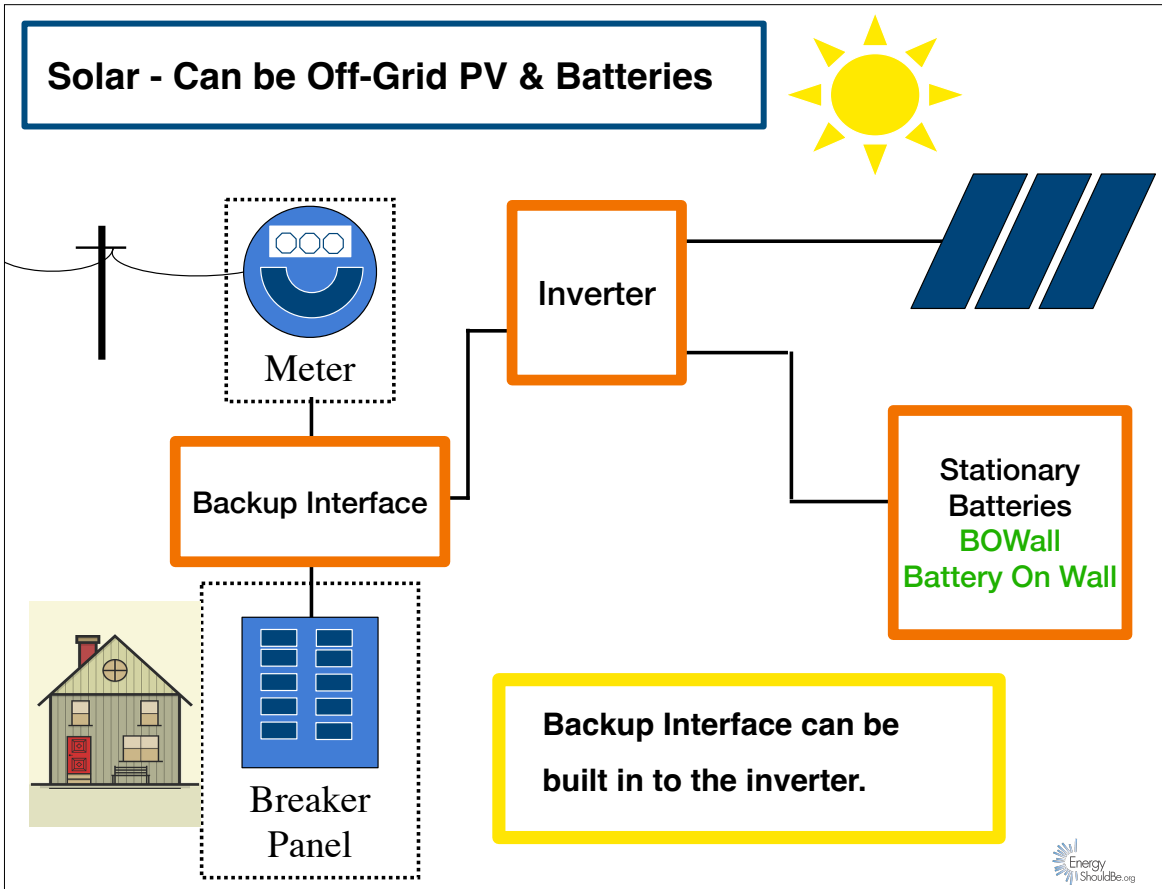
SDCEA: total 2020 electricity sales:

133,206 MWh

SDCEA data from: https://www.myelectric.coop/2020-annual-report/

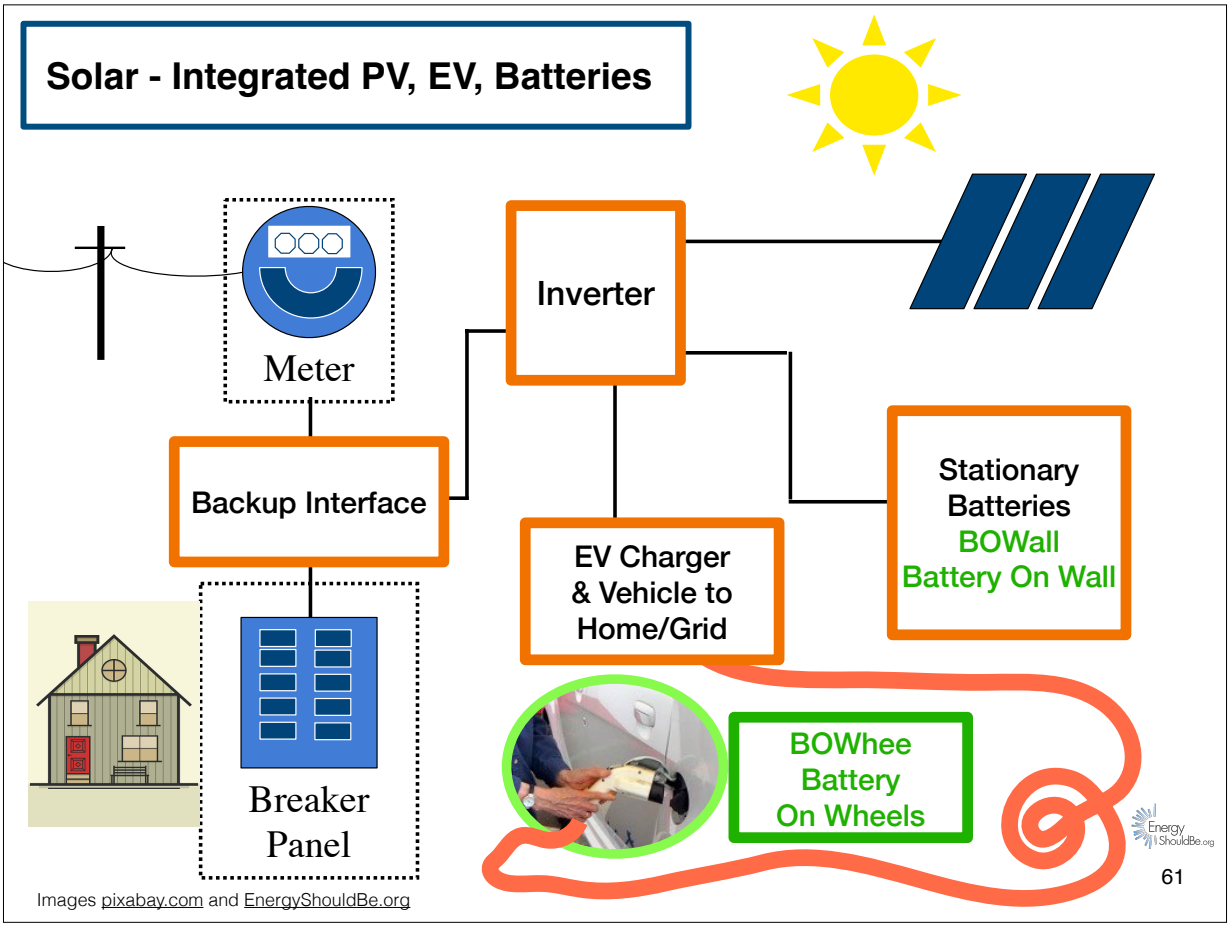
Images pixabay.com

Solar - Can be Off-Grid PV & Batteries



Backup Interface can be built in to the inverter.

Solar - Integrated PV, EV, Batteries



Images pixabay.com and EnergyShouldBe.org

BOWall vs. BOWhee.
Why? The Big Battery in a BOWhee

Stationary Batteries BOWa Battery On Wall	Tesla Powerwall $1000/kWh

Ford F-150 Lightning

EV $640/kWh 100 kWh

Can charge an EV at 10 kW

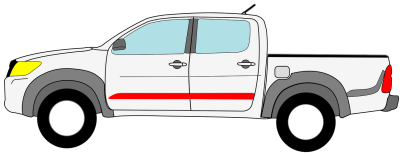
Kia EV6

$653/kWh 75 kWh

Can charge an EV at 2 kW

Chevy Bolt EV

$430/kWh 65 kWh

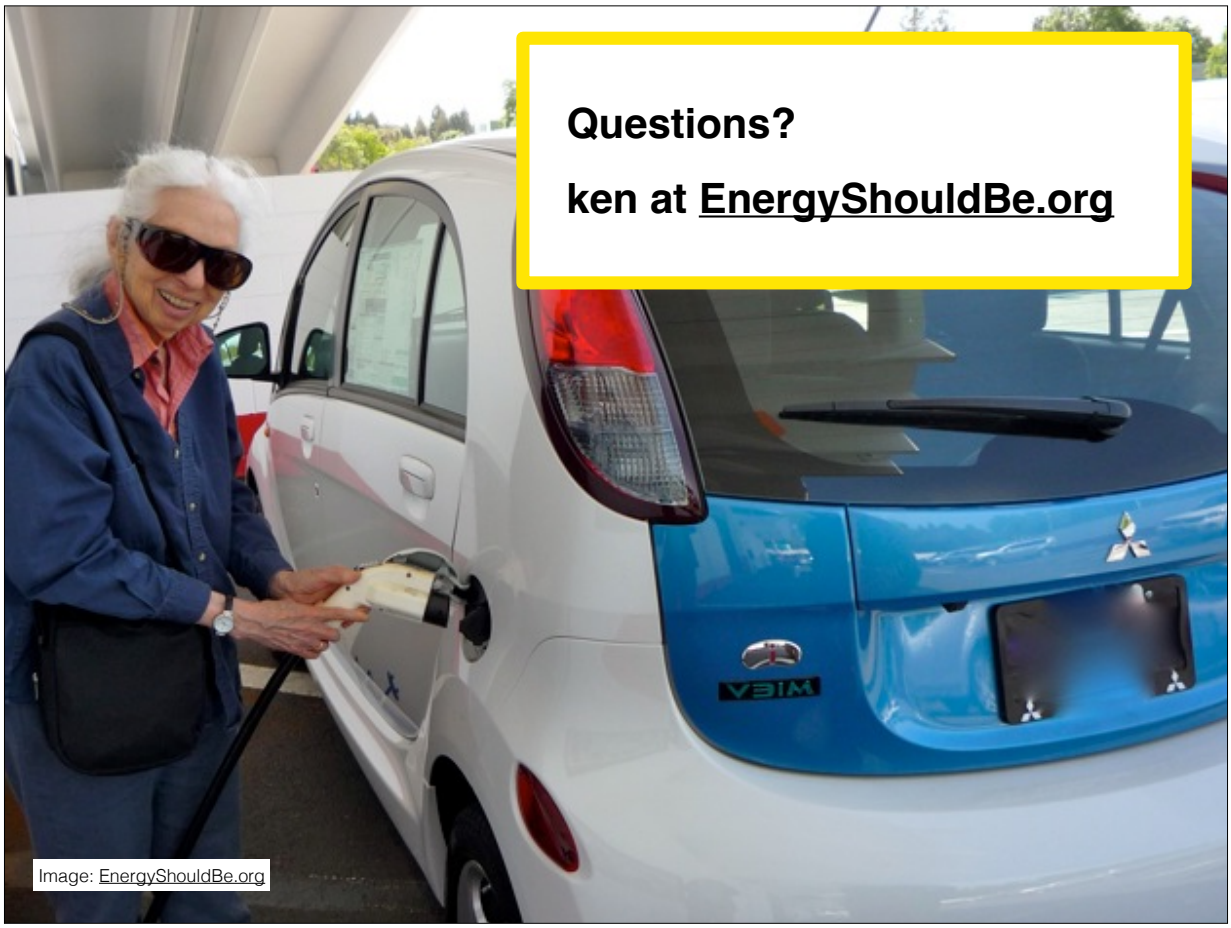


Kia Niro EV shown, not an EV6

Images Ford Media download and EnergyShouldBe.org Kia Niro EV shown, not an EV6

Prices & kWh as of 4/2023. Tesla PowerWall 13.5 kWh each. Roughly $18,000 $1300/kWh for 1. $28,000 $1000/kWh for 2

F-150 configured with standard range 100 kWh battery $64K with 10 kW pro power kit. Additional $5K plus install for V2H V2G. Base Chevy Bolt $28K 65 kWh $430/kWh. Kia EV6 $49K 75 kWh. EV6 1900 watt on board power generator


Questions?
ken at EnergyShouldBe.org
Image: EnergyShouldBe.org