

Bluebonnet's Energy Expo

Solar and Battery Storage 101



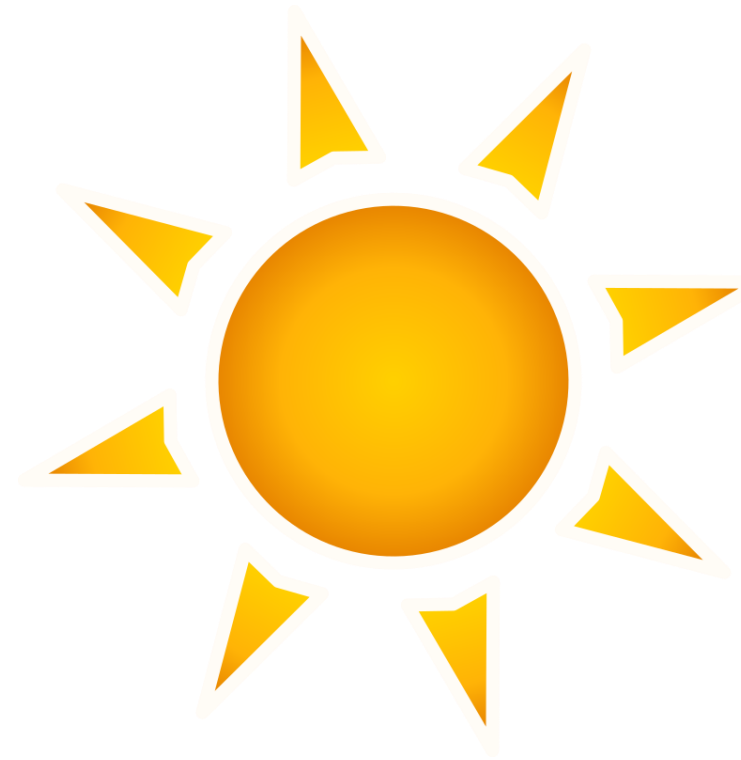
<https://sites.utexas.edu/mecc/files/2013/12/Pecan-St-Solar-panels-e1386057986786.jpg>

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Texas Solar Energy Society (TXSES)
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Agenda

- Why install solar
- Solar history
- Solar ABC's
- Solar and batteries
- Your solar home
- Battery sizing
- Electric vehicles
- Incentives
- Choosing an installer



Why install solar?

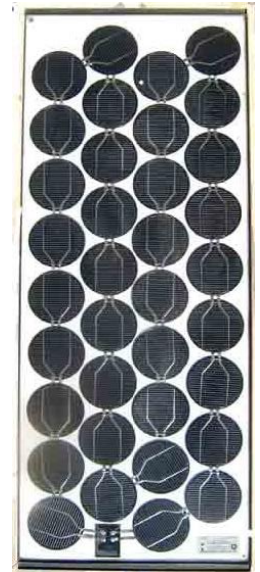
- Independence
 - Self-reliance
 - Hedge against future utility rate increases
 - Energy security
 - Can integrate with batteries
 - Solar = free fuel!
 - Fuel your electric car
- Investment
 - Prudent and low-risk
 - Favorable return on investment
 - Fixed electricity- levelized cost of energy
 - Increase home/business value
 - Tax incentives available
- Stewardship
 - Air
 - Greenhouse gases
 - Water
 - Be part of the solution
 - Generational values



Solar history

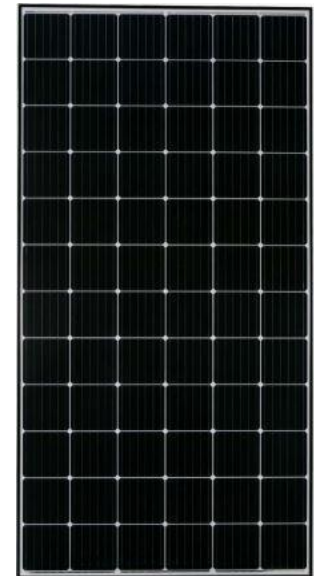
- Solar energy, or photovoltaics (PV), has been around in some form since 1954 and has been available since the 1970's
- Solar PV gained popularity in off-grid applications, but the massive growth recently has mostly been grid-tied only
- Grid-tied means that solar is interconnected with the grid

1980's



https://cdn.shopify.com/s/files/1/0079/6003/5417/products/MissionSolarPanel420WBlackFrame72Cell-MSE420SX6W_1400x.jpg?v=1619647194

2020's



<https://us.v-cdn.net/6024911/uploads/editor/ep/bgc81t1qx6hx.jpg>

Solar history

- We're coming full circle on batteries

2011



1980's



<https://3vq5kdn38e1qxlmvqmrzi-wpengine.netdna-ssl.com/wp-content/uploads/2019/06/Crown-23-year-old-battery-bank.jpg>

2020's



<https://www.tesla.com/powerwall>



<https://sunfarmenergy.net/wp-content/uploads/2021/04/Enphase-battery-ensemble-1.jpg>

Solar history

- Hybrid grid-tied system with backup can:
 - Optimize your solar while grid-tied
 - Keep the power on during an outage



<https://planetstoryline.com/tesla-powerwall-review/>



<https://spheresolarenergy.com/service/battery-backup/>

Solar history

- Still, most solar today is grid-tied only
- Solar is instantaneous without storage and the grid is like your battery
- Sometimes your house is on 100% solar, sometimes 100% grid power, and sometimes a mix
- The sun rises and you save money each month



Solar ABC's

- Power vs. energy
 - Power is instantaneous
 - Kilowatt (kW)
 - Max power = Capacity
 - Energy takes time
 - Kilowatt-hours (kWh)
 - Your electric company bills you in kWh



Rate of flow = Power (kW)

Water in the bucket = Energy (kWh)

Solar ABC's

- Grid-tied solar includes:
 - Solar modules (panels)
 - Inverter(s)
 - Roof attachments
 - Racking (rails the panels are mounted on)
 - Wiring
 - Conduit (to carry the wiring)
 - Switchgear
 - Monitoring (Inverter or CT-based)
- Batteries are extra and come with:
 - Battery or batteries
 - Automatic transfer switch/gateway
 - Additional material and labor costs



[http://sunravisinfotech.in/wp-content/uploads/photo-gallery/Picture5%20\(1\).jpg](http://sunravisinfotech.in/wp-content/uploads/photo-gallery/Picture5%20(1).jpg)



<https://www.realwire.com/writeitfiles/HD-Wave-Single-Phase-Inverter-NA-S.jpg>



<https://www.hesolarllc.com/panasonic-vs-sunpower-vs-lg/>



Solar ABC's

- To protect linemen working during power outages, National Electric Code requires solar to shut down as well
- Unless you have batteries, or a generator, you won't have solar power during a grid outage



Solar ABC's

Grid-tied solar only

PV Meter (not required by Bluebonnet)

Main electrical panel

"Net" meter

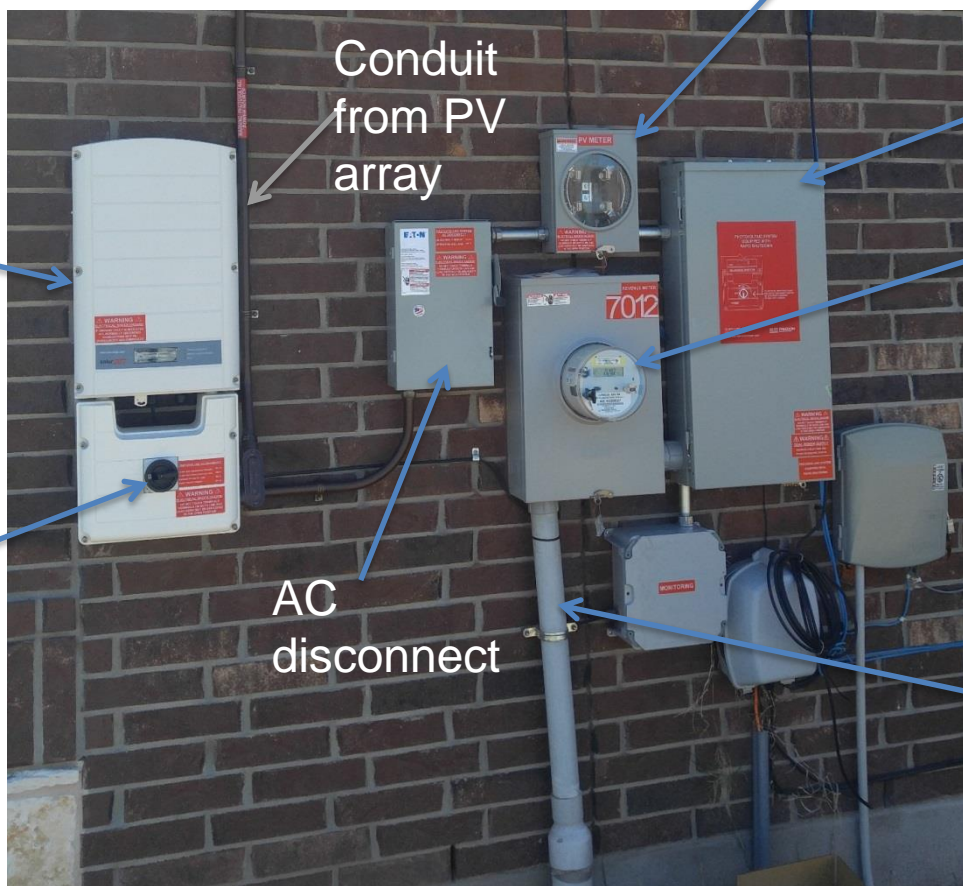
Conduit from PV array

AC disconnect

Conduit to/from the grid

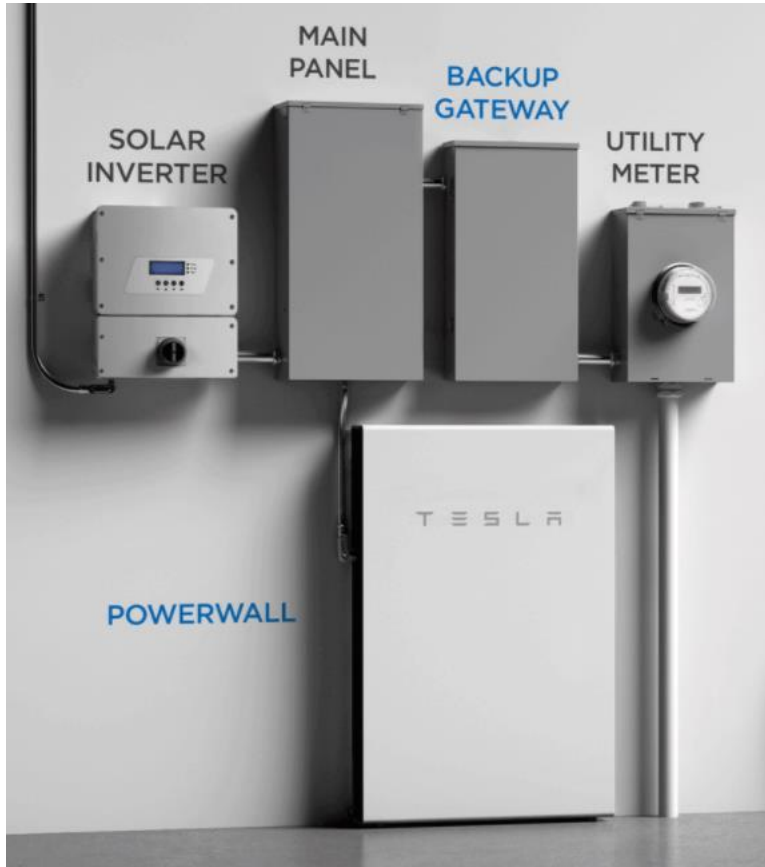
Inverter (string inverter)

DC disconnect



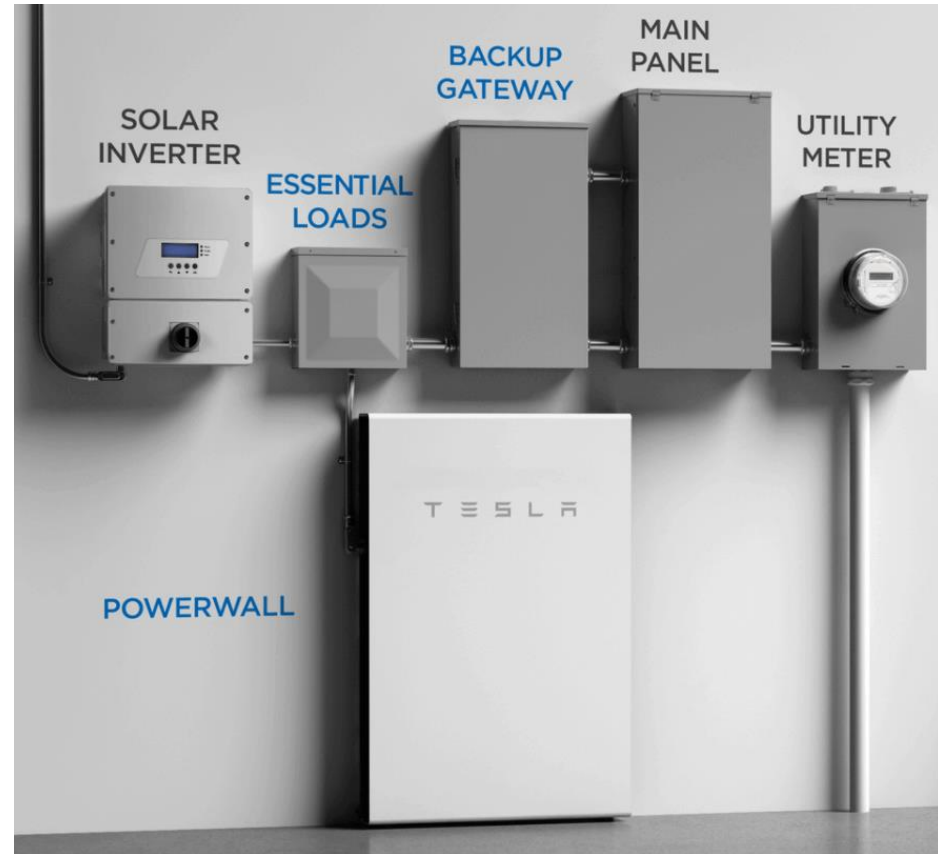
Solar and batteries

Whole home backup



<https://suncommon.com/wp-content/uploads/2020/09/Screen-Shot-2020-09-12-at-10.07.31-AM.png>

Partial backup



<https://i0.wp.com/redgreenandblue.org/wp-content/uploads/2019/01/tesla-powerwall-installation-layout-essential-loads.png?fit=2048%2C1052>

Solar and batteries

- Choose the configuration that works for you
- Ensure there's an automatic transfer switch
- Installation likely needs power shut off

Many battery brands have their own transfer switches



https://cdn11.bigcommerce.com/s-3nrr5bfo5i/images/stencil/1280x1280/products/625/1115/Enphase_Empower_91270.1576116119.jpg?c=2?imbypass=on



https://cdn11.bigcommerce.com/s-3nrr5bfo5i/images/stencil/500x659/products/2834/12557/Generac_PWRcell-ATS_768x480_87166.1603040240.jpg?c=2

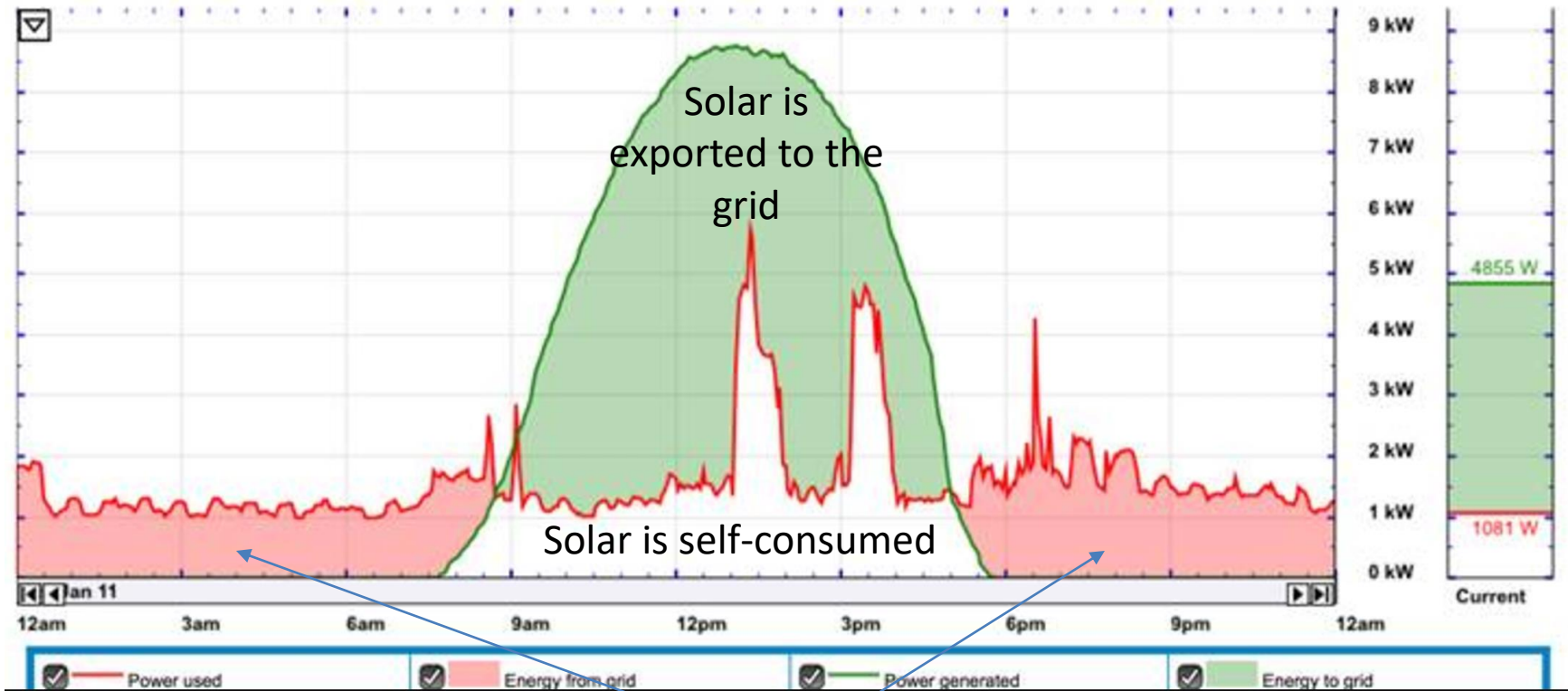


<https://www.rpc.com.au/catalog/images/ip004504.jpg>

Your solar home

Red = Home's consumption

Green = Solar production



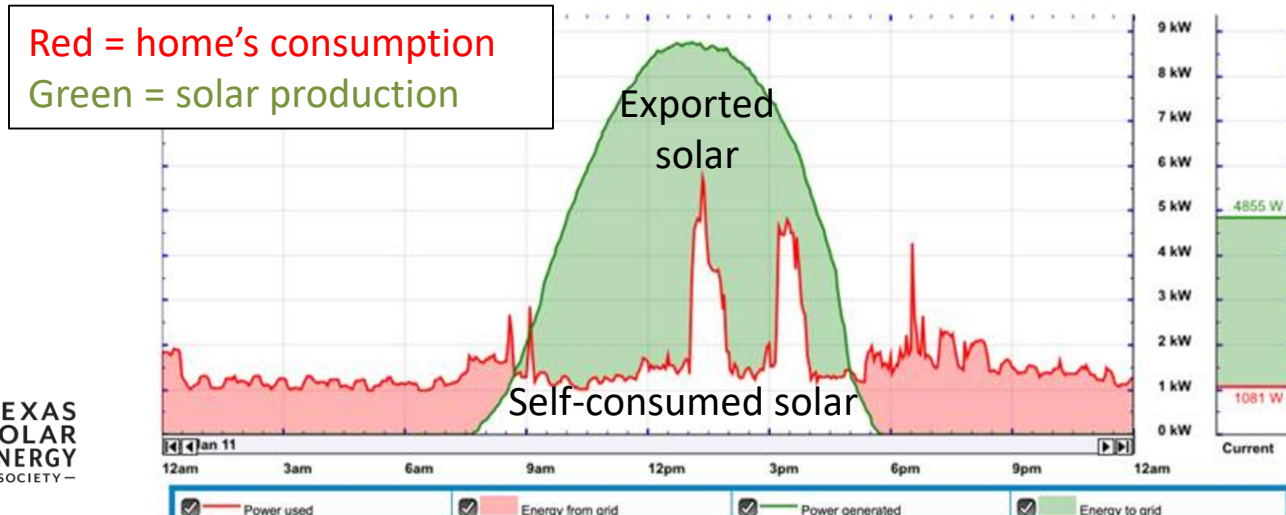
<http://barleypfeiffer.com/wp-content/uploads/2014/01/hi-star.jpg>

Grid power only. No solar available (night time).



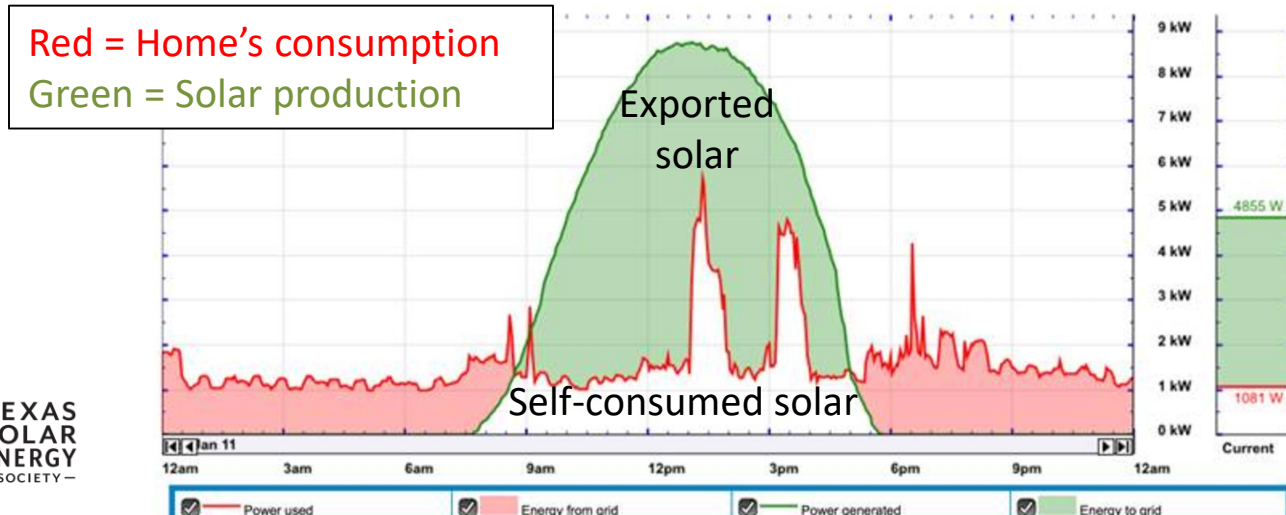
Your solar home

- Bluebonnet Electric Co-op – solar rate
 - One “Net” meter counts the kWh’s being delivered to your home and the kWh’s being exported to the grid
 - You are only charged for the energy sent to you by the utility
 - No charge for self-consumed solar energy
 - Credits you will received (exported) energy with an enhanced rate
 - You get ~\$0.060631 per kWh for what you send back to the grid
 - Self-consume as much of your solar as possible for the best value



Your solar home

- How can batteries help your solar payback period?
 - You are only charged for the energy sent to you by the utility
 - No charge for self-consumed solar energy
 - Batteries can help you self-consume as much of your solar as possible to get the best value
 - Store excess solar and consume it from the battery when the sun goes down
 - Can be programmed and automated



Battery sizing

- Batteries have two main ratings:
 - Power (kW): peak and continuous output
 - How fast can the battery discharge?
 - How many things can be powered by it at one time?
 - Energy (kWh): Capacity of the battery
 - How much energy can the battery hold?
 - More capacity means the lights stay on longer



Jug = energy capacity (kWh)

Spout = potential power output (kW)

Battery sizing

- Battery capabilities
 - Each 1 ton of air conditioning requires roughly 1 kW of power
 - Consumes 1 kWh's each hour per ton
 - 3-ton A/C (1,800 sq ft) consumes ~3 kWh in an hour
 - Other appliances:
 - Electric furnace = roughly 20 kW
 - Oven = 2 kW
 - Refrigerator = 0.25 kW
 - Laptop/TV = 0.1 kW
 - Many batteries are rated around 4-5 kW, and 10 – 13 kWh
 - Can usually run an A/C, but not for very long



10 kWh
capacity

5 kW max
power output

Battery sizing

- Consider:
 - Days of autonomy – how many days can the battery supply the home without the sun?
 - Multiple batteries; they can be added modularly with limitations
 - Partial backup rather than whole home backup
 - If installed for whole home, switch off high-consumption circuits at the breakers to budget energy
 - Including a generator to supplement



Electric vehicles (EVs)

- EV's have a large battery that has a kW and kWh rating
 - Driving = 4 miles/kWh, less efficient with AC/Heat, fast driving, heavier vehicles
 - Chevrolet Bolt = 65 kWh; 259 mile range
 - Ford F-150 Lightning = 98 – 131 kWh; 230 – 320 range
- Charging your EV with your solar energy while the sun is shining or at night from your home battery can help you self-consume solar energy
- Vehicle to home (V2H) is already here
 - Requires extra equipment
 - Vehicle to grid (V2G) is coming



<https://insideevs.com/news/489852/chevy-bolt-ev-ev-super-cruise-no-auto-lane-change/>



<https://media.ford.com/content/fordmedia/fna/us/en/news/2022/02/02/f-150-lightning-power-play.html>

Incentives

Solar Investment Tax Credit (ITC)

- 30% of total system cost for solar and/or batteries
 - Recently increased and extended to 2032
- Dollar for dollar (credit, not deduction)
- Reduces the amount you would otherwise pay in income taxes
- To calculate the tax credit:
 - Total installed cost of system
 - Subtract any discounts or utility rebates
 - Multiply by 0.3
- Consult a tax professional with any questions
- More here:
www.energy.gov/eere/solar/homeowners-guide-federal-tax-credit-solar-photovoltaics



**I WANT YOU
TO GO SOLAR!**

<http://images.huffingtonpost.com/2016-07-20-1469053229-4258017-UNCLESAMWANTSYOU.jpg>



$$\begin{aligned} \$21,000 * 30\% &= \$6,300 \text{ tax credit} \\ \$21,000 - \$6,300 &= \$14,700 \text{ net cost} \end{aligned}$$

Choosing an installer

- Find companies by asking people you trust and doing research
 - Better Business Bureau; Yelp; TXSES - txses.org/texas-solar-energy-societys-business-members/
- Get at least 3 solar proposals/bids
 - Don't succumb to high-pressure sales; ask questions; negotiate; nothing is free; you will always have a utility bill
- Make sure your solar installer is a licensed Electrical Contractor with the Texas Department of Licensing and Regulations (TDLR)
 - www.tdlr.texas.gov/LicenseSearch/
 - Must be licensed to perform or offer to perform electrical work
- Read your contract
 - 3-day right to cancel; arbitration clauses; timeline; verbal promises; subcontractors
- Compare your proposals apples-to-apples and ask questions
 - Tax Credit Calculation; Price per Watt (\$/W); Production Factor (kWh in year 1 per kW); Utility Rate Escalator

Choosing an installer

- Compare your proposals apples-to-apples
 - Price per watt (\$/W)
 - Calculate using the system price (after discounts and before the tax credit)
 - Divide by the solar system size (1,000 W = 1 kW)

System A:

9 kW for \$22,500

\$2.50/W

System B:

7.5 kW for \$22,500

\$3.00/W

System C:

6.5 kW for \$22,500

\$3.46/W

Choosing an installer

- Compare your proposals apples-to-apples
 - Production factor = Year one production estimate (kWh) /System Size (kW)
 - Kilowatt-hours per year per kilowatt (kWh/year/kW)
 - How many kWh per year will each kW of solar produce?
 - Use PVWatts – www.pvwatts.nrel.gov

System A:

9 kW & 10,350 kWh/year

1,150 kWh/year/kW

System B:

7.5 kW & 10,500 kWh/year

1,400 kWh/year/kW

System C:

6.5 kW & 11,375 kWh/year

1,750 kWh/year/kW

Choosing an installer

- Compare your proposals apples-to-apples
 - Utility rate scalator (Utility Inflation Rate)
 - Assumption that utility rates will increase by a certain percentage each year
 - Higher utility rates mean that solar energy will offset greater and greater values, so the financial models look more favorable
 - Bluebonnet Electric Cooperative's rates have remained relatively flat

Installer questions

- Questions to ask installers:
 - What's the total system price after discounts and rebates, but before calculating the federal tax credit?
 - Why is your price per watt higher/lower than others?
 - Why is your production estimate higher/lower than others?
 - What utility escalation rate are you assuming? Will you adjust it to match that of my utility company?
 - What is the estimated timeline for this installation?
 - Is your company a licensed electrical contractor with TDLR?
 - Will your company be subcontracting any of the work to other companies?



Thank you!



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ENERGY SOCIETY

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