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Batteries 101:
Solar + Storage for the Home or Small Business

Storage has been getting a lot of press lately…

gtm:
A Wood Mackenzie Business

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America Leads Global Energy Storage Development, But China's Catching Up

A look at how energy storage is expanding across the world.

JULIAN SPECTOR | APRIL 11, 2018

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ENERGY

Tesla Switches on World's Biggest Lithium Ion Battery

The battery will feed Australia's shaky power grid

LG Chem

Energy storage prices forecast to tumble

BY ANDY EXTANCE | 17 JULY 2017

FEATURE

FERC order opens 'floodgates' for energy storage in wholesale markets

… what does it mean for you?

Presentation in three parts:

1. Technology
2. Economics
3. Future

Part 1:
Storage Technology Basics

Two things to consider

Backup Power for you

Save money or get paid to help the Grid

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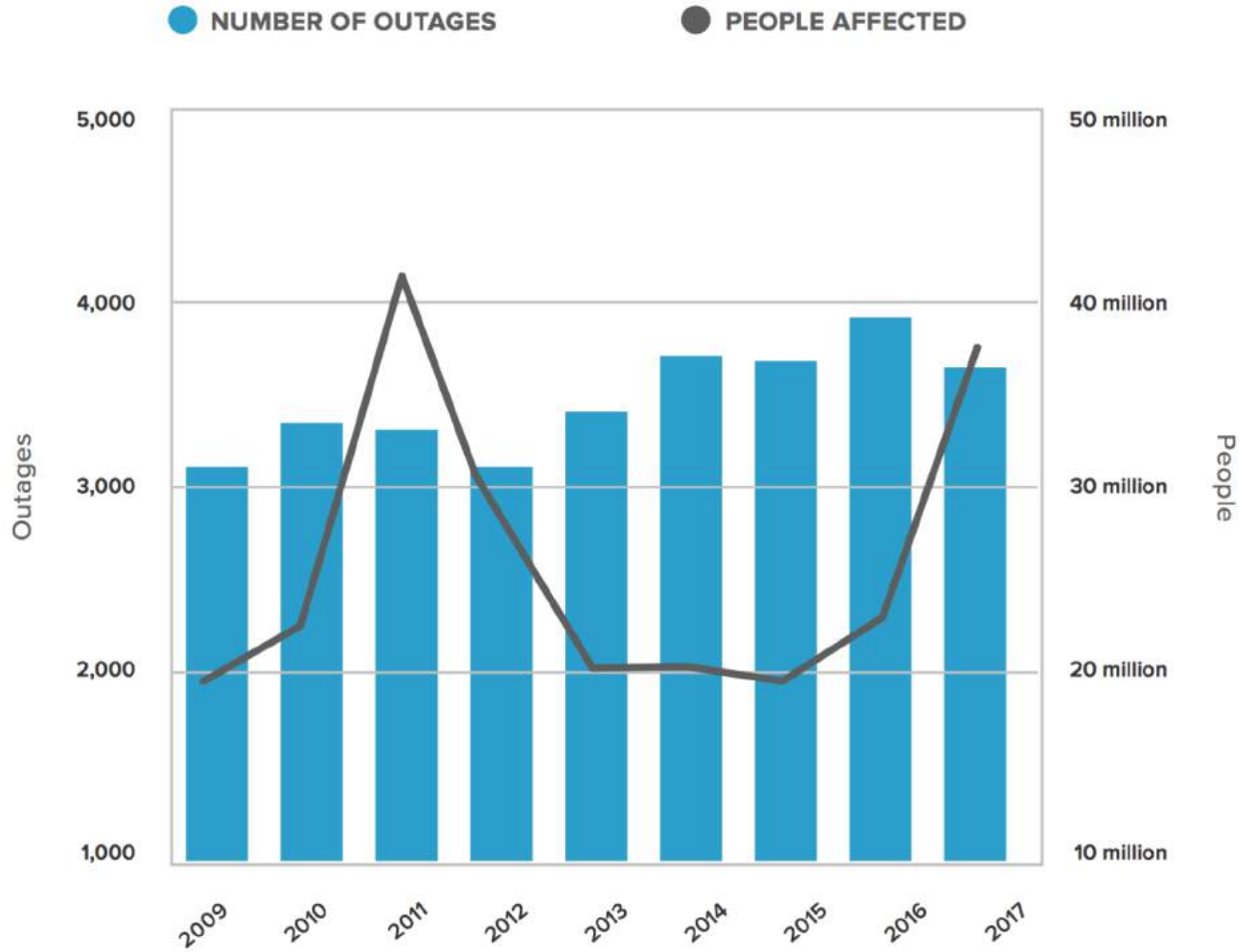
Backup power: when and for how long?

In 2017 there were 3,526 outages affecting 36 million people across all 50 states. Of the outages, 86 major disturbances resulted in customers collectively experiencing over 1 billion hours without power.



Source: SunRun

Utility power outages increasing in frequency

More and more people experiencing utility service interruptions

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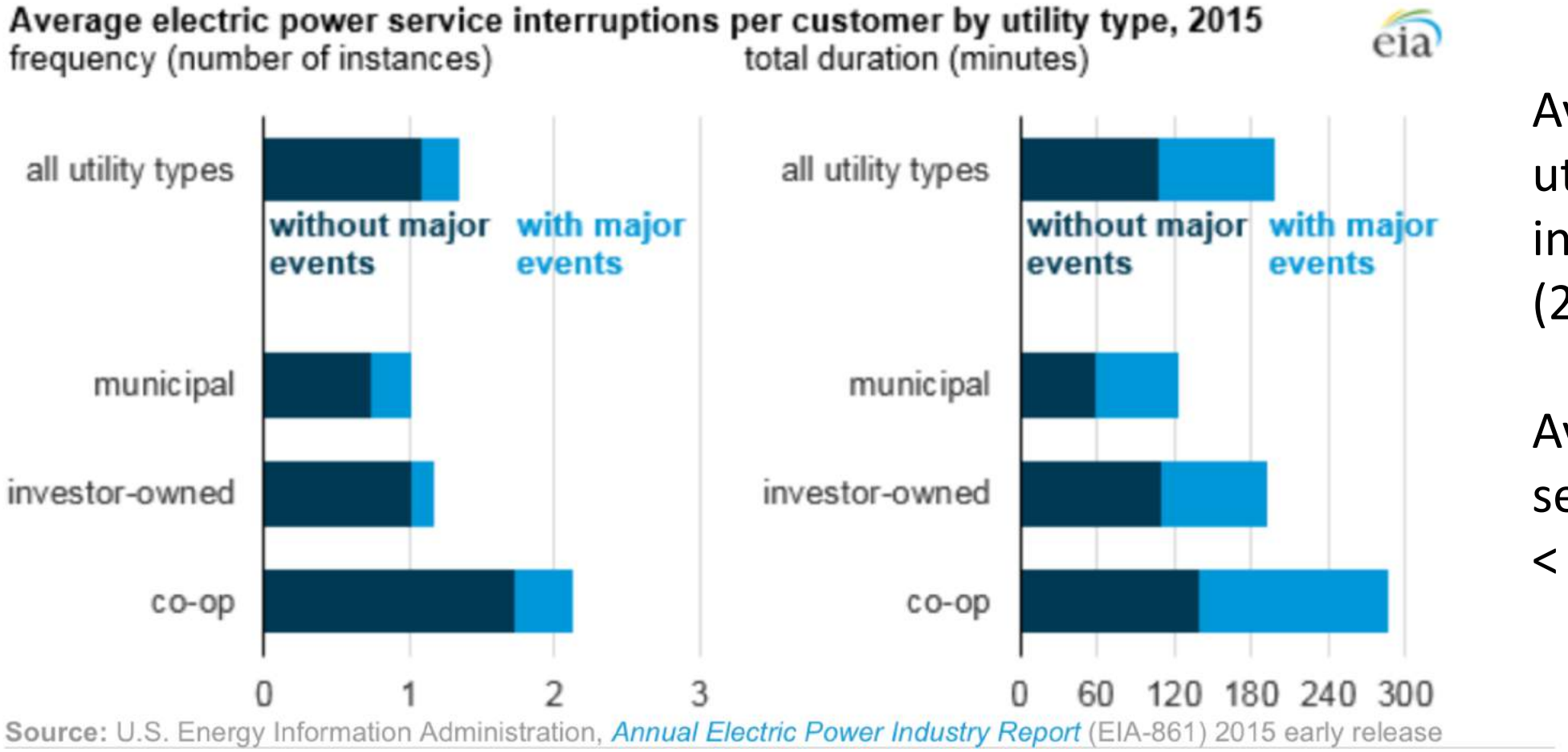
Backup power: when and for how long?



Average annual utility service interruptions (2015): 1.2

Average duration of service interruption: < 2 hours

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Batteries similar to generator

Source: Sonnen

Source: alarmcentralsecurity.com

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How is storage sized?

Energy vs Power

Source: SimpliPhi

Energy

- Amount of work the battery can do <u>over time</u>
- Measured in kWh

Power

- Maximum work it can do <u>at any given time</u>
- Measured in kW

Your storage system will be custom for you:

- How much energy do you consume?
- What do you need to power during an outage?
- Available space for storage?

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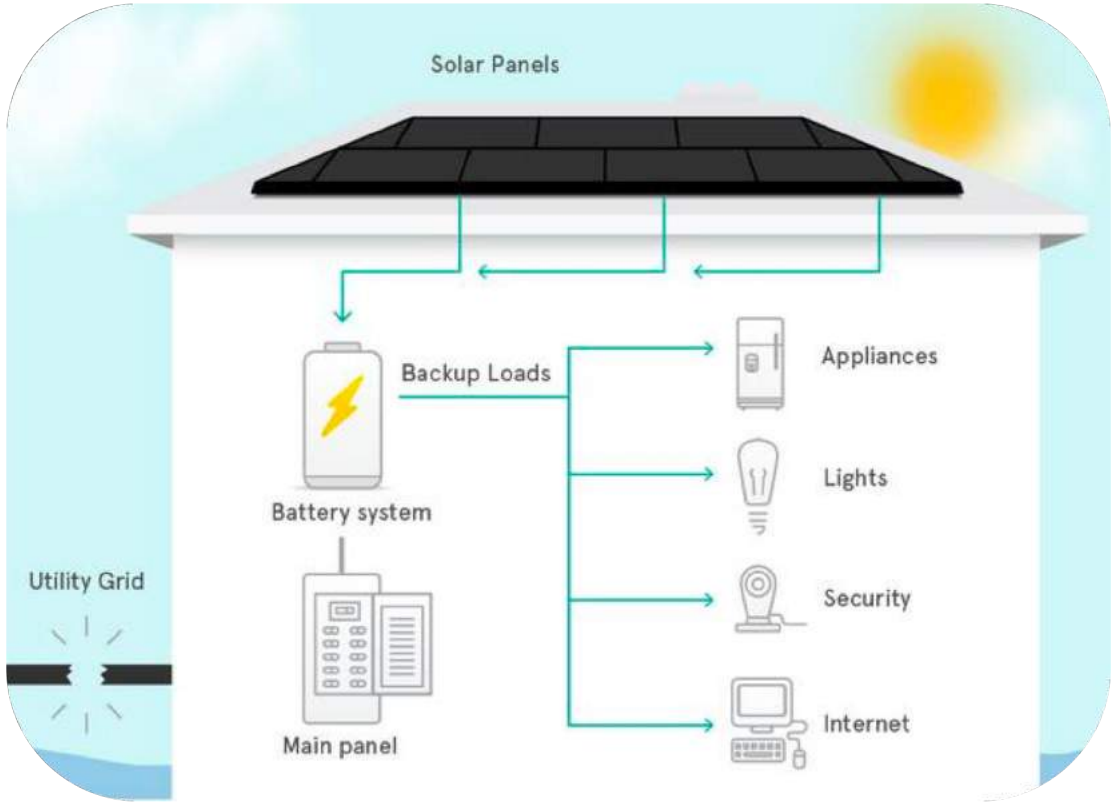
What can batteries power?

Critical home loads



Source: SolarCity

Storage during a utility outage

- Seamless backup power
- Typically only power critical loads
  - Matched to battery size/amount
  - “Critical loads sub-panel”

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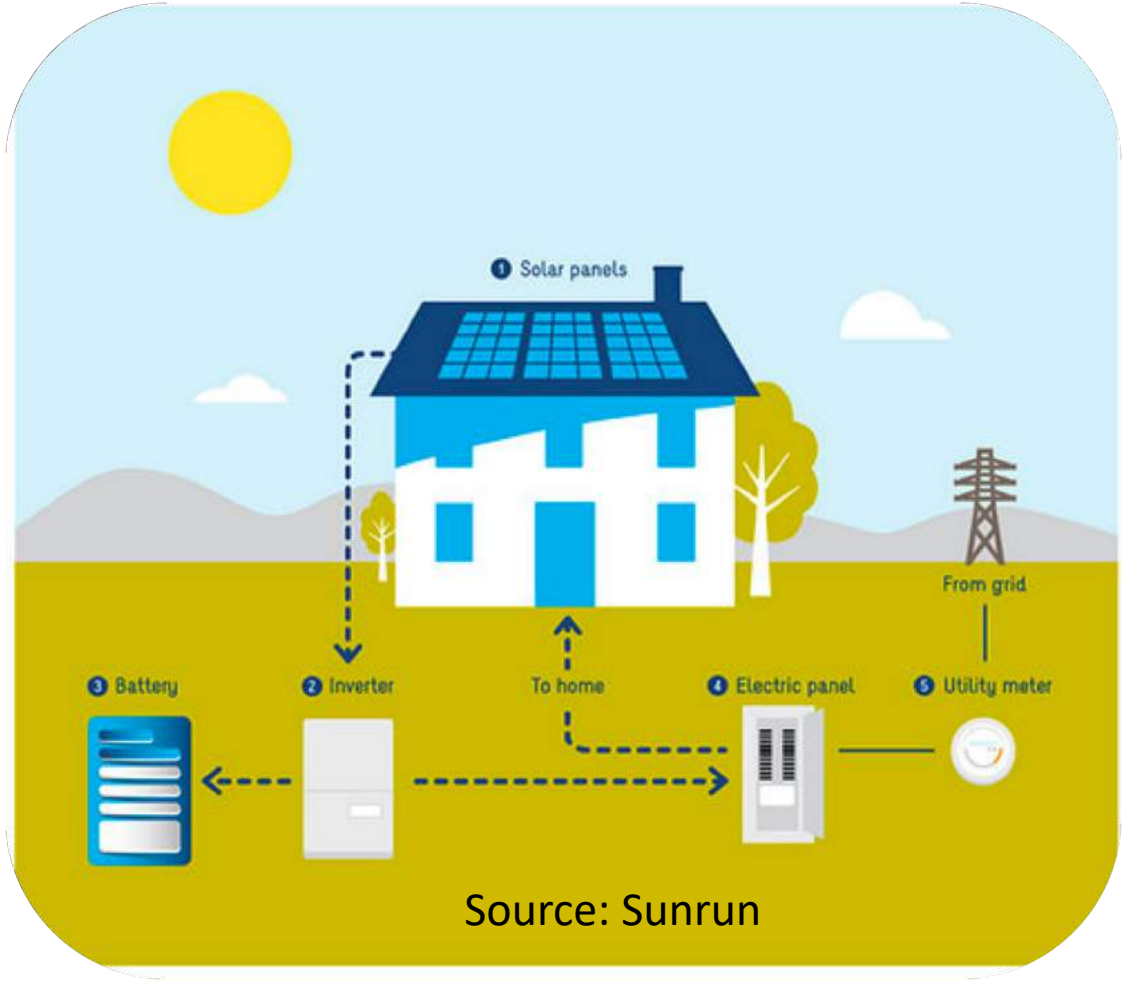
How does storage work with solar?

Installation:

- Same time as solar or retrofitted
- May require additional hardware

Solar + Storage:

- Solar charges batteries for later use
- Grid energy can charge batteries too
- Small amounts of energy keep batteries “topped off”
- Batteries only kick in (automatically!) when power is out



Source: Sunrun

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What can batteries power? (small example)

The Johnsons lose power from the utility several times a year. Each time the power is out for at least a day.

6 kWh Battery Bank

- Fully re-charged by solar (5.6 kW) daily
- NOTE: No solar = 1 day only

What will run when the power is out:

- Refrigerator; small microwave
- Some lights; some outlets
- Cable modem

What they chose not to power:

- Stove; dryer; electric water heater

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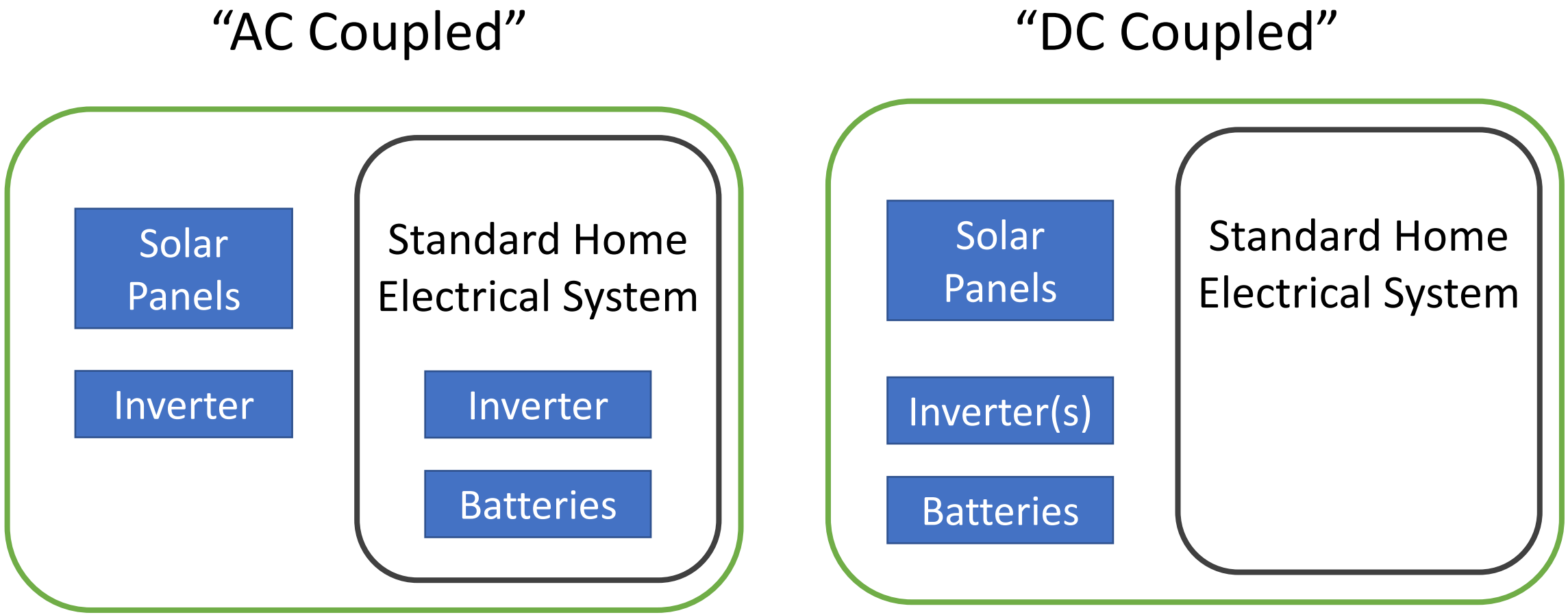
Connecting your batteries to your home



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Most common home batteries

Lead-acid

Pros:
- Lower upfront cost
- Tried and true

Cons:
- Maintenance requirement
- Slow energy discharge (power)
- High space requirement
- Shorter lifespan
- Less usable energy per cycle

Lithium Ion

Pros:
- High energy density
- Lower lifetime costs
- Longer lifespan
- Small space requirement
- More usable energy per cycle

Cons:
- Higher upfront cost
- Newer to market

But wait, there's more!

There are other chemistries used in battery applications, but their deployment is **much less common**

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Operations and Maintenance

Space Requirements

Source: Fire Mountain Solar

Lead Acid

- Small, shoe box-sized battery
- Wired together in a group
- Can sit directly on floor or shelf
- Requires more space

Lithium Ion

- Single, larger box
- Wall-mounted or floor-mounted
- Can often also be wired together

Source: Clean Technica

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Operations and Maintenance

Siting Considerations

- Batteries function best in **controlled environments**
- Specific conditions depends on chemistry:
  - Lead-acid
    - Stable temperatures (ideal: 50°F – 80°F)
    - No extreme heat or freezing air
    - Often installed indoors (garage/basement)
    - Special ventilation required for unsealed batteries
  - Lithium Ion
    - Wider temperature range (~32°F - 100°F)
    - Some can be installed outdoors in stable climates

Operations and Maintenance

Warranties

- Two common warranty types:
  - Specific time period (**years**) OR duration of use (**cycles**)

- Typical Li-ion warranty: 10 years
- Examples:
  - Sonnen: 70% of max. capacity for 10,000 cycles (or 10 years)
  - Tesla: Free of defects for 10 years with unlimited cycles
- Typical lead acid warranty: 2 to 5 years
- Installer's labor should be warranted (wiring)

Note: Solar panels are warranted for 25 years

Source: https://blog.pickmysolar.com/home-battery-backup-comparison-tesla-sonnenbatterie

Other considerations

- Insurance
- Local permitting requirements
- Utility requirements
- Installer qualifications
- Equipment availability

Source: www.24hplans.com

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Part 2: Economics

Installing Storage with Solar vs. Later

With Solar

- Immediate backup power benefits
- May reduce some shared labor and admin costs by paying a contractor once instead of twice
- Eligible for solar Federal Tax Credit

Later

- Solar now and wait for battery prices to fall further
- AC-coupled or retrofit existing solar array (DC-coupled)
- Inverter replace or add
- Still eligible for solar Federal Tax Credit

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How is storage priced?

Total cost = hardware costs + installation costs + lifetime maintenance costs

Hardware +

- Price per kW (power)
  OR
- Price per kWh (energy)

Note: Depends on battery type and and installation of new inverter (for AC coupling)

$$$

Installation +

- Cost of design, installation, and permitting
- Additional equipment

$$

Lifetime maintenance

- Battery replacement
- Associated labor cost

$

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Basic cost estimates (example)

Hardware cost (examples) +

Equipment	Cost	Size
Powerwall 2 (Li-ion)	$6,200	13.5 kWh
Powerwall 1 (Li-ion)	$3,000	6.4 kWh
LG Chem (Li-ion)	$6,000	6.6 kWh
Sonnen Eco 4 (Li-ion)	$10,000	4 kWh
Sealed Lead Acid	$5,200	12 kWh

Installation costs +

$3,000 - $5,000 for standalone installation and additional equipment

Maintenance costs

Varies between installers and battery chemistries

Pricing for our small 6 kWh battery example:

~$6,000 + $4,000 + $1,000

= ~$11,000

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Basic cost estimates

For backup power applications, remember:

- Value *only* when the grid is down
- No cost savings/earnings over time

The value of resiliency

Losing power does have a cost

Power the refrigerator vs.

- Food loss ($)
- New refrigerator ($$)

Staying at home vs.

- hotel ($$)

Keep sump pump operating vs.

- Flooded basement ($$$)

Home medical equipment working vs.

- Hospital visit (????)

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Federal Tax Credit for Storage

30% federal tax credit available for storage systems that are 100% charged by solar

- Value: **30% of the total system cost** (hardware + installation) for fully solar-charged batteries
- Storage systems that are **at least 75%** charged by solar are eligible for a portion of the full tax credit
- Storage system that are **less than 75%** charged by solar are ineligible for the tax credit

IRS
Department of the Treasury
Internal Revenue Service

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Latest update from the IRS

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IRS Letter on Home Batteries Could 'Open Floodgates for Residential Storage Retrofits'

A private-letter ruling says it's OK to add a battery to your rooftop solar system and get the 30
—as long as it only charges from the sun.

JEFF ST. JOHN | MARCH 05, 2018

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The IRS is hinting at broader tax credit guidelines for home batteries paired with solar.

In **March 2018**, the IRS issued a private-letter ruling clarifying:

- Adding storage to an existing rooftop solar array will qualify for the 30% Federal Tax Credit
- Solar charging stipulations still apply

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Part 3: The Future of Storage

Opportunities for residential storage

Maryland's Storage Tax Credit (Residential and Commercial)

- Legislation passed in 2017
- Run by Maryland Energy Administration

How it works for **residential installations**:

- 30% state income tax credit (= 30% of total storage cost)
- Maximum tax credit: $5,000
- First come, first serve application process
- No restrictions on battery type/manufacturer

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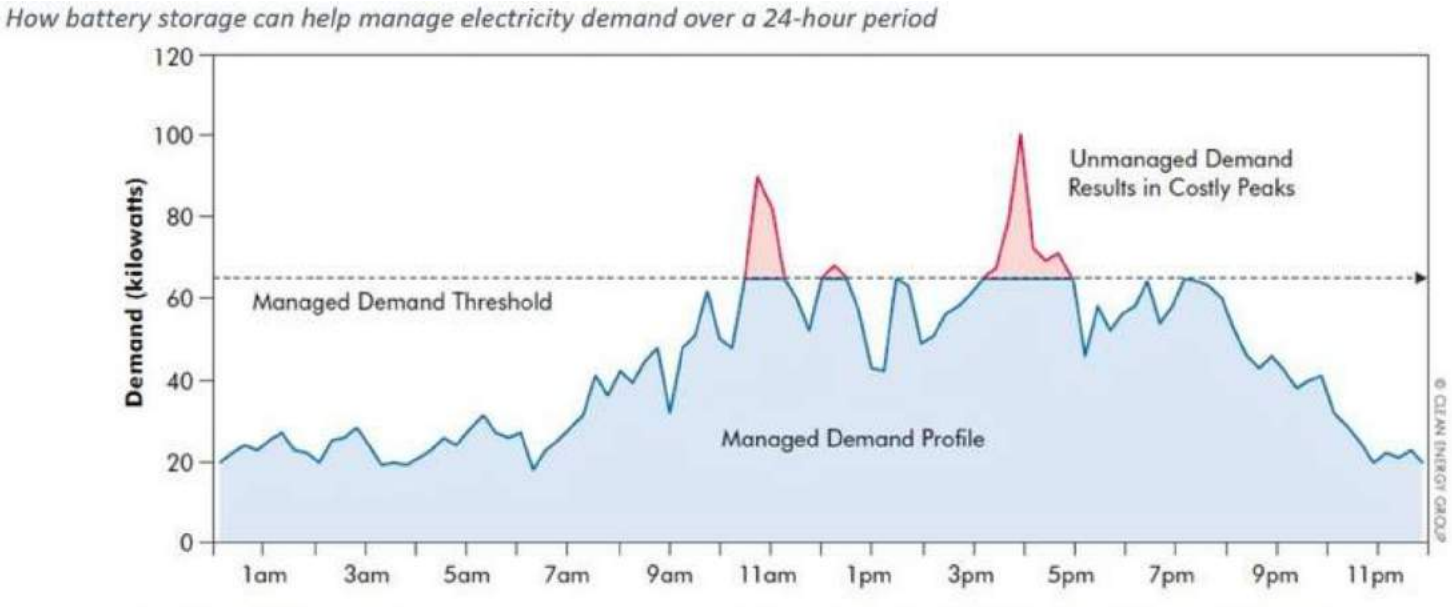
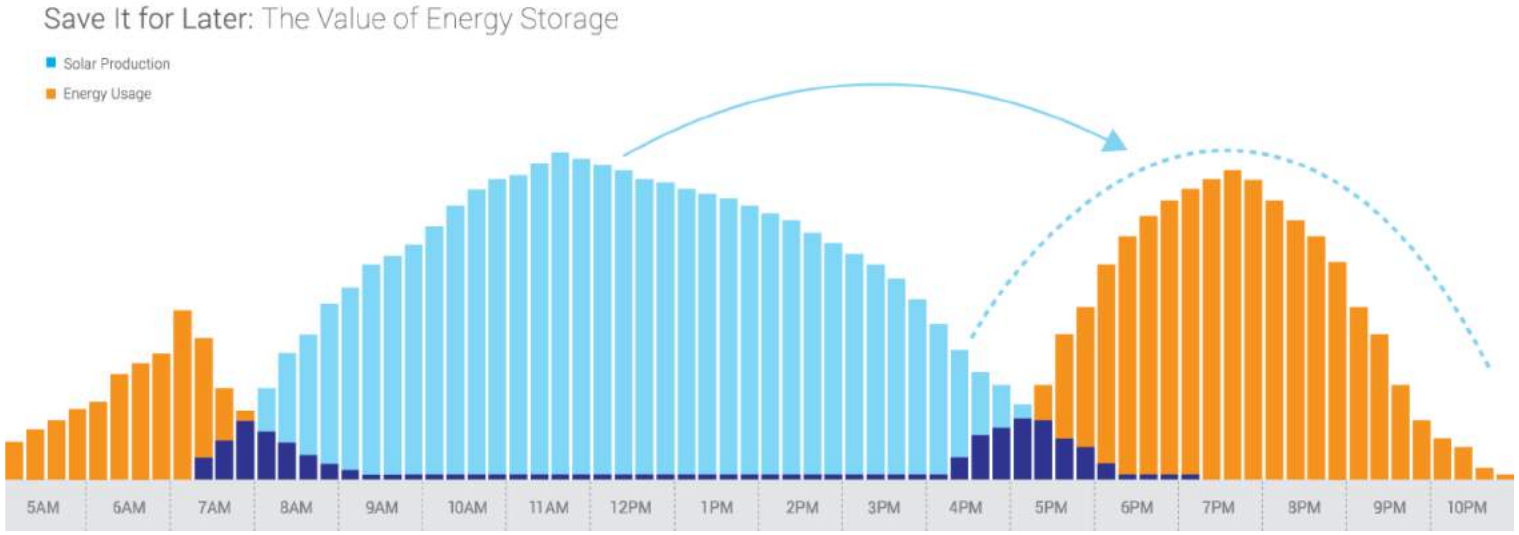
Future Applications of Storage



Peak demand reduction



Time of use

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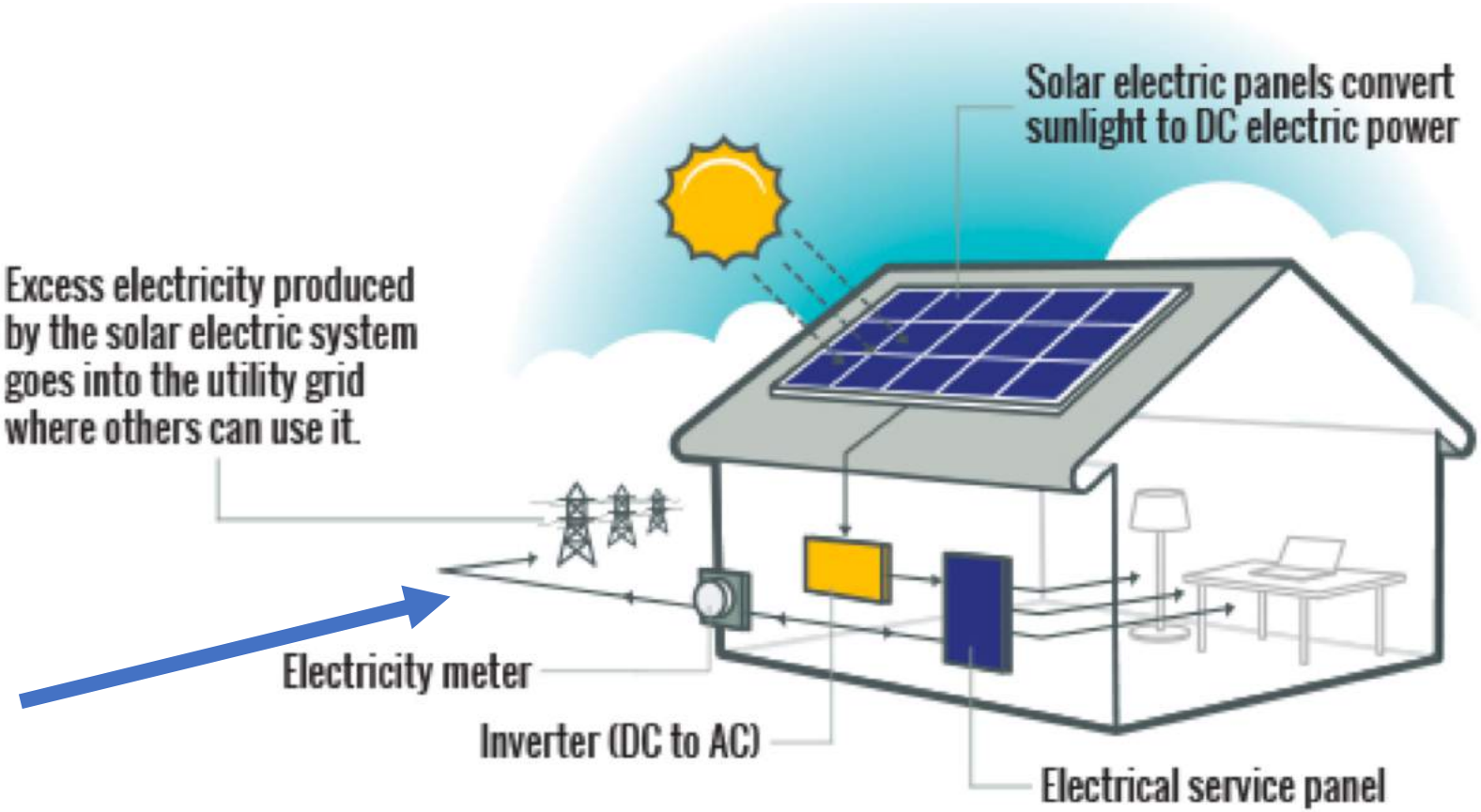
Future Applications of Storage

Low net metering rate
OR
No net metering



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Additional Resources

Storage 101 Slides:

www.solarunitedneighbors.org/westvirginiasolarcongress

Solar + Storage Web Page:

www.solarunitedneighbors.org/learn-the-issues/solar-storage

Solar United Neighbors of West Virginia Website:

www.solarunitedneighbors.org/westvirginia

Thank You!

Autumn Long
Program Director
Solar United Neighbors of West Virginia