Battery Storage 101

Solar United Neighbors
What happens when the power goes out?

When grid is down, solar shuts off (safety mechanism)

Need batteries or special inverters if you want power during outages.
Storage has been getting a lot of press lately... what does it mean for you?

America Leads Global Energy Storage Development, But China’s Catching Up
A look at how energy storage is expanding across the world.

Tesla Switches on World’s Biggest Lithium Ion Battery
The battery will feed Australia’s shaky power grid

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

... what does it mean for you?
Energy Storage for Homeowners

You might want storage if...

- You’re at the end of grid and last one back up after an outage
- Frequent utility outages
- Critical loads at home (ex. well pumps, medical equipment)
- Emergency/disaster preparedness
Presentation in three parts:

1. Technology
2. Economics
3. Our work
Part 1: Technology
Two things to consider

- Backup Power for you
- Save money or get paid to help the Grid

Solar United Neighbors
Batteries similar to generator

Source: Sonnen

Source: alarmcentralsecurity.com
How is storage sized?

Energy vs Power

Energy
• Amount of work the battery can do over time
• Measured in kWh

Power
• Maximum work it can do at any given time
• 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?

Source: SimpliPhi
What can batteries power?

Critical home loads

Storage during a utility outage
- Seamless backup power
- Typically only power critical loads
  - Matched to battery size/amount
  - “Critical loads sub-panel”
What can batteries power?

A battery tied to critical home loads / sub-panels
The Johnsons lose power from the utility several times a year. Each time the power is out for at least a day.

**10 kWh Battery Bank**
- Re-charged by solar array daily
- NOTE: No solar = 1 day of backup power only

**What will run when the power is out:**
- Refrigerator; microwave; washer
- Some lights; some outlets
- Cable modem; television(s)
- Window AC unit or mini-split

**What they chose not to power:**
- Stove; dryer; electric water heater

*NOTE: Not a real-life example. The Johnsons are a fictional family.*
A home battery is like your smart phone.

The heavier the load the faster a battery drains. Texting occasionally uses less energy than streaming YouTube or Netflix.

It’s important to consider what you want to power most when the grid is disconnected.
How does storage work with solar?

Solar + Storage:
• Solar charges batteries for later
• Grid can charge batteries too
• Small amounts of energy keep batteries “topped off”
• Batteries only kick in (automatically!) when power is out
Connecting your batteries to your home

“DC Coupled”

“AC Coupled”
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.
Operations and Maintenance

Space Requirements

**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: Fire Mountain Solar

Source: Clean Technica

Source: Solar United Neighbors
Operations and Maintenance

Siting Considerations

- Batteries function best in **controlled environments**
- Specific conditions depend 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

<table>
<thead>
<tr>
<th>EQUIPMENT</th>
<th>BATTERY TYPE</th>
<th>WARRANTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tesla Powerwall 2</td>
<td>Lithium-ion</td>
<td>10 years (unlimited cycles)</td>
</tr>
<tr>
<td>LG Chem RESU10H</td>
<td>Lithium-ion</td>
<td>10 years (unlimited cycles)</td>
</tr>
<tr>
<td>Sonnen Eco 4</td>
<td>Lithium-ion</td>
<td>10 years or 10,000 full cycles</td>
</tr>
<tr>
<td>SimpliPhi</td>
<td>Lithium-ion</td>
<td>10 years or 10,000 cycles</td>
</tr>
<tr>
<td>Enphase storage (x 3)</td>
<td>Lithium-ion</td>
<td>10 years or 7,300 full cycles</td>
</tr>
<tr>
<td>Rolls AGM Lead Acid</td>
<td>Lead acid</td>
<td>2 to 5 years (prorated after year 2)</td>
</tr>
</tbody>
</table>

- 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
- Retrofitting

Source: www.24hplans.com
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
• Inverter replace or add
• Uncertain eligibility for solar Federal Tax Credit
Federal tax credit available for storage systems that are 100% charged by solar

- Value: a percentage** of the total system cost (hardware + installation) for fully solar-charged batteries

- Commercial storage systems that are at least 75% charged by solar are eligible for a portion of the full tax credit but residential systems must be charged 100% by the sun to qualify.

** Federal tax credit is 30% for 2019, 26% for 2020, and 22% for 2021 before dropping to 0%
How is storage priced?

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

**Hardware +**
- Price per kW (power)
- Price per kWh (energy)

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

**Installation +**
- Cost of design, installation, and permitting
- Additional equipment

**Lifetime maintenance**
- Battery replacement
- Associated labor cost

$\$\$$\$
$\$$
\$

Solar United Neighbors
Basic cost estimates (example)

Hardware cost (examples) +

- 4 kWh to 13 kWh
- Lithium Ion - $5K to $15K
- Sealed Lead Acid - $2K to $6K

Installation costs +

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

Maintenance costs

Varies between installers and battery chemistries

Pricing for our small 10 kWh Li-On battery example:

- $10,000 + $4,000 + $1,000
- ≈ $15,000
Basic cost estimates

For backup power applications, remember:
- Value *only* when the grid is down
- No cost savings/earnings over time
- NOTE: depending on where you live it may be beneficial to power your home using stored power during certain time windows
## The value of resiliency

Losing power does have a cost

<table>
<thead>
<tr>
<th>ITEM</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spoiled food</td>
<td>$50 - $500</td>
</tr>
<tr>
<td>New refrigerator</td>
<td>$500 - $1,000</td>
</tr>
<tr>
<td>Hotel stay</td>
<td>$500+</td>
</tr>
<tr>
<td>Clean-up of a flooded basement because of an unpowered sump pump</td>
<td>$5,000+</td>
</tr>
<tr>
<td>Life-sustaining home medical equipment</td>
<td>Priceless</td>
</tr>
</tbody>
</table>
What to look for

What should be included in your proposal:

• Full cost (equipment, materials, & installation)
• Payment milestones
• Equipment details
• Warranties
• O&M Plan
• Permitting
• Pricing guarantee – no hidden fees
• Installer information
Part 3: Our work

Solar United Neighbors
Check out our Residential Storage Guide!
Current and future uses for storage

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

Creating value and resiliency for communities

Storage technology is changing fast. It offers not only resilience but also the potential to reduce costs. Organizations and businesses can use solar + storage to reduce energy costs and help citizens from natural disasters.

The main barrier to growing solar + storage isn’t due to technical or public support; it's cost. While new storage technologies are being developed, the cost of both small and large-scale systems is dropping, energy storage is becoming more affordable in certain markets.

While costs are major obstacles, energy storage policies and regulations are also significantly to widespread deployment and economic feasibility. Many energy storage systems are being deployed in locations where local regulations enable energy storage, either where additional incentives for stored energy are offered or where energy storage solutions are too costly.

It is becoming increasingly feasible to add back-up storage solutions to our most important institutions, including fire departments, police stations, and shelters that provide critical emergency services. Cities like San Francisco are adding energy storage into emergency response plans to improve resilience. New York is promoting micro-grids that often feature solar + storage components in their resiliency planning.

Understanding the intricacies of solar+storage for residential applications
Battery Storage for Homeowners Guide

SolarUnitedNeighbors.org/Storage

Storage Webinar – watch it over and over again!

SolarUnitedNeighbors.org/BatteryStorage101

Check to see if there’s a Co-op Near You!

SolarUnitedNeighbors.org/co-ops
Thanks a million kilowatt hours!

Jody Finver and Team Florida
Solar United Neighbors
Flteam@solarunitedneighbors.org
Future Applications of Storage

DEMAND CHARGE AND STORAGE

- Flat demand charge (same no matter how much power your need)
- Variable demand charge you avoid because your battery provided it

Power Supplied by Storage

Utility charges more above here (if you use more power)

Day of Month

1 & 2 Really cold days and you had your space heaters on.
3 You were out of town.
4 You ran the dryer, your microwave, your oven, and you blow dryer all at once.
Future Applications of Storage

TIME OF USE AND STORAGE

- kWh Supplied by Utility
- kWh Supplied by Your Battery

1. You are getting ready for work in the morning.
2. You are home from work, making dinner, kids are watching TV, and you just turned your AC back on.