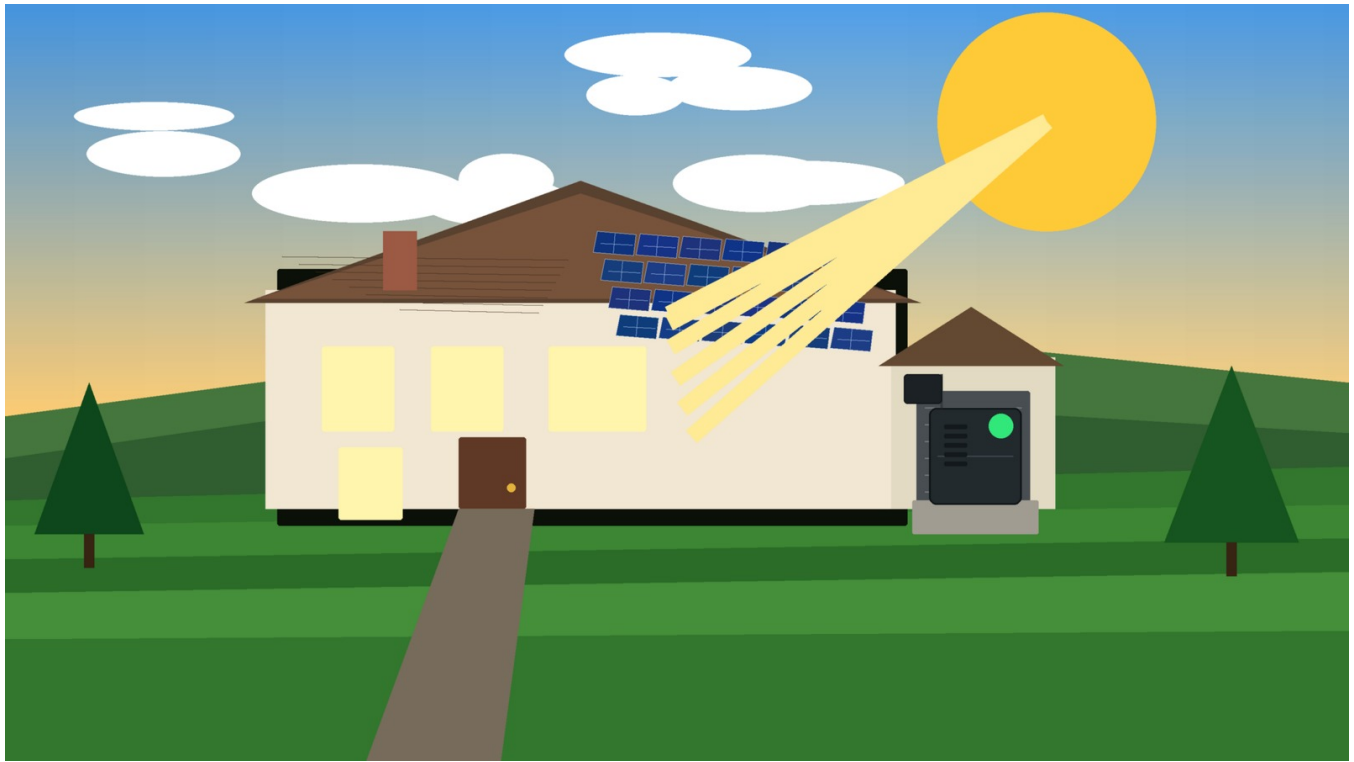




Home Solar + Battery Packages: A Start-to-Finish Buyer Guide

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A plain-language guide to residential rooftop solar plus home battery packages: panels-only versus a full package, how systems are sized in kW and kWh, AC versus DC coupling, buy versus lease, incentives after the federal credit cutoff, permits, and the first year of ownership.

Rooftop solar alone makes daytime power. A home battery stores some of that power for evening use, for a utility outage, or for a rate plan that charges more when the grid is busy. A solar-plus-battery package is both pieces sold and installed as one job: panels on the roof, an inverter path that turns sunlight into house power, a battery cabinet, and the switches and software that decide when to charge, when to feed the house, and when (if ever) to sell back to the utility.

This paper is a start-to-finish buyer guide for that package. It is not a bid, not a permit, and not tax advice. Local rules and utility interconnection rules win when they disagree with anything here.

What a package is — and what panels-only is not

A panels-only job puts photovoltaic (PV) modules on the roof and an inverter on the wall or under the panels. When the sun is up, the house uses solar first and may export surplus to the grid under whatever net-metering or export rules your utility allows. When the sun is down, the house buys from the utility again. When the grid fails, most grid-tied solar shuts off on purpose so it cannot backfeed a line where a crew is working. That shutoff is not a defect. It is the safety design.

A solar-plus-battery package adds storage and usually a backup path. The battery charges from solar (and sometimes from the grid, if the installer and the utility allow it). Software decides the daily pattern:

self-consumption, time-of-use shifting, or backup reserve. In an outage, a transfer device isolates a backup subpanel — or, on some whole-home designs, the whole house — and the battery (with solar when the sun is up) keeps selected loads on.

You are buying a system, not a single box:

- Panels, sized in kilowatts (kW) of DC nameplate.
- Inverters or microinverters that convert DC to AC.
- Battery capacity in kilowatt-hours (kWh) of usable storage, plus a continuous and peak power rating in kW.
- Mounting, roof penetrations, wiring, grounding, and often a dedicated backup panel or smart breakers.
- Monitoring, warranties, and the interconnection agreement with the utility.

Manufacturer education pages are the right place to read product families, not a store cart. Enphase publishes residential solar and battery product material: <https://www.enphase.com/> — Tesla's Powerwall education and product overview: <https://www.tesla.com/powerwall> — SolarEdge's homeowner and residential storage pages: <https://www.solaredge.com/>

When the package is the right tool

A solar-plus-battery package earns a hard look when several of these are true at once.

- Your roof (or a ground rack) gets useful sun after shade, pitch, and orientation are honest.
- You want evening use of midday solar, not only a bill credit for exports.
- Outages matter: a well, a sump, medical equipment with its own battery in front, heat or cooling that cannot wait, or a fridge that must stay cold.
- Your utility's export rate is weak, capped, or timed so that storing power for yourself beats dumping it at noon.
- You can place a battery where the install manual and the inspector allow: clearances, weight on a wall or pad, and ventilation if the product needs it.

It is the wrong tool if you only want the cheapest daytime bill cut and your utility still pays a full retail credit for every exported kilowatt-hour with no plans to change. In that narrow case, panels-only can be enough. It is also the wrong tool if the roof is due for replacement in a few years, the structure cannot take the load, or shade kills production for most of the day. Fix the roof and the trees first, or look at community solar if that exists in your area. The U.S. Department of Energy's homeowner solar guide covers suitability, shade, and community solar: <https://www.energy.gov/eere/solar/homeowners-guide-going-solar>

A battery is also the wrong tool if you need unlimited multi-day whole-home power with no load discipline. Storage is finite. A generator or a hybrid plan may fit long outages better. The companion Notice Nearby paper on whole-home standby generators covers that machine: <https://noticenearby.com/papers/whole-home-standby-generators>

How systems are sized: kW of panels, kWh of battery, and the loads

Two numbers do most of the work.

Panel size is in kilowatts (kW). One kilowatt of panels under good sun can make roughly a few kilowatt-hours (kWh) over a day; the exact yield depends on location, tilt, azimuth, shade, temperature, and dirt. NREL's PVWatts calculator estimates annual production for a stated system size and location: <https://pvwatts.nrel.gov/>

— The Department of Energy notes that NREL analyses often use an average residential system around 7 kW DC, with a wider practical range for real roofs:
<https://www.energy.gov/eere/solar/homeowners-guide-going-solar>

Battery size is in kilowatt-hours (kWh) of usable energy, plus power in kilowatts (kW). Energy is how long you can run. Power is how many things you can run at once. A 10 kWh battery at 5 kW continuous can run a 5 kW load for about two hours in a simple model, or a 2.5 kW load for about four hours — before you account for inverter losses, reserve settings, and cold-weather derates. Usable capacity is usually less than the marketing “nameplate” if the product keeps a buffer for longevity.

Match the battery to a load list, not to a neighbor’s Instagram.

1. Critical loads you want in an outage: fridge, lights, Wi-Fi or modem, a furnace blower or a heat-pump circuit if the battery can start it, a well or sump, medical devices.
2. Comfort loads you will shed: dryer, range, second air conditioner, EV charger.
3. Daily evening loads if the goal is bill shifting: dinner cooking, lighting, entertainment, partial HVAC.

A critical-load subpanel is the honest way to buy a mid-size battery. Whole-home backup needs more kWh, more continuous kW, and often load shedding so the air conditioner and the EV charger do not empty the pack in an hour. Ask the installer for a modeled outage duration on your actual list, not a slogan.

Rough frames, not a bid:

- Evening self-consumption with light backup (fridge, lights, internet): often a smaller pack in the single-digit to low-teens of usable kWh, if HVAC stays on the grid or is heavily managed.
- Partial home backup through a night and into a cloudy morning: mid-teens to twenties of kWh is a common conversation range, still with load discipline.
- Whole-home ambition with heat pump and well: look hard at power (kW) as much as energy (kWh), and expect to shed the EV charger first.

String the panel size to your annual kWh use and your export rules. A system that covers most of your yearly use is a different product from a small “starter” array that only shaves the bill. PVWatts plus a year of utility bills beats a sales flyer.

Batteries and inverters without the jargon dump

Most home packages today use lithium chemistries sold as complete energy storage systems. You do not need a chemistry lecture to buy one. You need four lines from the data sheet.

- Usable kWh and round-trip efficiency (how much you get back after charge and discharge losses).
- Continuous and peak power in kW (can it start the well or the heat pump?).
- Operating temperature range and whether the product needs indoor placement, outdoor rating, or heating in cold climates.
- Warranty: years, throughput (total MWh), and what capacity remains at the end (for example, a guaranteed percentage of original usable energy).

AC-coupled versus DC-coupled is the big architecture fork.

- AC-coupled: solar inverters make AC for the house; the battery has its own inverter and charges from AC. Easy to add a battery to an existing solar system. Each conversion step costs a little efficiency.

- DC-coupled: solar and battery share more of the DC bus before a hybrid inverter makes AC. Can be efficient for new builds that charge the battery straight from the array. Retrofit paths differ by brand.

Microinverters (one small inverter per panel or per pair) and string inverters (one larger inverter for a string of panels) are the solar side of that choice. Microinverters handle shade and panel-level monitoring well. String systems with optimizers are another common path. The right answer is the one that fits your roof shade map and the battery the installer will actually support under one warranty umbrella.

Safety listings matter more than brochure adjectives. UL Solutions describes UL 9540 as the system-level standard for energy storage systems and equipment, and points to related standards such as UL 1741 for inverters and interconnection equipment:

<https://www.ul.com/services/energy-storage-system-testing-and-certification> — Ask the bid for the exact listing on the storage system (often UL 9540) and on the inverter equipment (often UL 1741, including grid-support supplements where the utility requires them). Tesla publishes educational material on lithium ESS safety standards including UL 9540 and UL 1741: <https://energylibrary.tesla.com/docs/Public/EnergyStorage/Powerwall/General/Compliance/SafetyStandardsLithiumIonElectrochemical/en-us/index.html> — Enphase publishes UL 1741 / UL 9540 compliance notes for its IQ Battery products:

<https://enphase.com/download/ul-1741-compliance-iq-battery-5p-system-components-technical-note>

Roof, shade, orientation, and the electrical service

Sun is geometry. South-facing roofs in the continental U.S. are the usual best case; east and west still work with different daily shapes. Steep shade from a neighbor's tree or a dormer can erase a string. A site survey with a shade report is not optional theater. It is the production forecast.

Roof age and structure come next. Panels last longer than many asphalt roofs. If the roof has five years left, replace the roof before or with the solar job. Penetrations must be flashed to the roofing manufacturer's rules and the local code. Ground mounts avoid the roof but need land, fencing in some places, and longer wire runs.

Electrical service realities kill more daydreams than panel shopping does.

- Main panel ampacity and busbar room: the new inverter backfeed has to fit the National Electrical Code rules your inspector enforces. A service upgrade (new panel, new meter base, sometimes a utility transformer request) can cost as much as a chunk of the solar itself.

- Grounding and bonding must follow the adopted electrical code.

- Battery weight on a garage wall, seismic strapping, and working clearances are code and manual items, not preferences.

- Internet for monitoring is almost always required for warranty support and for the app you will actually use.

National Electrical Code work for PV and storage lives in NFPA 70. Articles that commonly come up on these jobs include PV systems, interconnected power sources, and energy storage systems; your city or county adopts a specific edition and may amend it. Entry point:

<https://www.nfpa.org/codes-and-standards/nfpa-70-standard-development/70> — The inspector enforces that edition, not a blog.

Buy, lease, or power purchase agreement

Cash purchase or a loan where you own the system:

- You own the panels and the battery. Tax and incentive eligibility, if any remain for your install date, usually require ownership. Confirm with a tax professional and the current IRS rules — do not trust a salesperson's memory.
- You keep production and residual value when you sell the house, subject to how appraisers treat the system.
- You pay for repairs outside warranty and for monitoring subscriptions if the brand charges one.

Lease or power purchase agreement (PPA):

- A third party owns the system. You host it and pay a monthly lease or a per-kWh PPA rate.
- Up-front cash can be near zero. That is the product.
- You generally do not claim the federal residential clean energy credit, because you do not own the property. The third party takes whatever tax position the law allows for them.
- Read the term, the production guarantee, the escalator on the payment, what happens if you sell the house, and who pays to remove and reinstall panels for a roof replacement.
- Transfer fees and buyer approval can complicate a sale. Get the contract language before you romanticize “no money down.”

Put five-to-ten-year cash on one sheet: purchase price minus any real incentives you will actually receive, plus loan interest, versus the sum of lease/PPA payments. Then add the bill savings under a realistic export rate — not under a net-metering story that no longer exists in your territory. The Department of Energy's homeowner guide summarizes buy versus lease/PPA at a high level and warns that third-party ownership usually means you are not the one taking the residential tax credit:

<https://www.energy.gov/eere/solar/homeowners-guide-going-solar>

Incentives and the federal credit — check the live IRS page

Do not invent a percentage from memory. As of this paper's date (October 4, 2026), the IRS states that the Residential Clean Energy Credit equals 30% of the costs of new, qualified clean energy property installed from 2022 through December 31, 2025, and that the credit is not available for any property placed in service after December 31, 2025: <https://www.irs.gov/credits-deductions/residential-clean-energy-credit>

Qualified property on that IRS page has included solar electric panels and, beginning in 2023, battery storage technology with a capacity of at least 3 kilowatt hours, among other categories. The credit is claimed on Form 5695 for the tax year the property is installed. About Form 5695:

<https://www.irs.gov/forms-pubs/about-form-5695> — Draft 2026 Form 5695 materials describe a carryforward of unused residential clean energy credit from earlier years, not a new credit for post-2025 placed-in-service property. Always read the current-year form and instructions before you file.

What that means for a buyer signing in late 2026:

- Do not budget a new 30% federal residential credit for a system placed in service after December 31, 2025 unless Congress changes the law and the IRS updates the page. As of this writing, the IRS page says that credit is not available after that date.
- If you installed in 2025 and have unused credit to carry forward, Form 5695 and a tax professional are the path — not this paper.
- State, utility, and local rebates still exist in many places and change often. They can be larger or smaller than the old federal credit. An installer should list them in writing. A public starting map for many state incentives is

DSIRE (Database of State Incentives for Renewables & Efficiency), operated with Department of Energy roots and pointed from DOE's solar guide: start from <https://www.energy.gov/eere/solar/homeowners-guide-going-solar> and follow the DSIRE reference there, or search DSIRE for your state.

- Utility rebates and bill credits are purchase-price adjustments in some tax situations. The IRS residential clean energy page discusses how subsidies and rebates can reduce qualified expenses when a federal credit applies. Read that page; do not invent a formula here.

If a salesperson still quotes "30% off from the feds" for a 2026 install without pointing to a current IRS page that restores the credit, slow down. Ask for the IRS link in the proposal.

Permits, interconnection, and inspection

A normal path looks like this.

1. Site survey, shade report, structural check, and a load / service review.
2. Signed scope: panel count and model, inverter model, battery model and usable kWh, backup loads list, monitoring, warranty, and who pulls which permit.
3. Building and electrical permits from the city or county. Some places also want fire review for energy storage.
4. Utility interconnection application. The utility studies the system, may require a specific inverter setting list (IEEE 1547 / UL 1741 grid support), and issues permission to operate only after inspection.
5. Install: roof work, battery placement, wiring, labeling.
6. Local inspection, then utility meter or reconnect work if required.
7. Commissioning: app login, backup test, and a walkthrough of reserve settings.

Interconnection timelines vary from weeks to many months. A "we can install next Tuesday" pitch that skips the utility queue is a red flag. Permission to operate is the real finish line for grid-tied systems. Exporting before approval can violate the utility agreement.

Fire and electrical labels on the battery and the disconnects are for the next person who opens the panel in an emergency. Do not peel them off for aesthetics.

The first year of ownership

Week one: confirm the app shows production, consumption, and battery state of charge. Run a controlled backup test while you are home so you know which circuits stay on. Set a reserve percentage that matches your outage fear — 20% reserve for bill shifting is a different product from 80% reserve for storms.

Month one: compare actual kWh to the proposal's weather-adjusted estimate. Weather will not match the sales year. Directional gaps matter more than a single cloudy week. If production is far below the shade-adjusted model, call the installer while the punch list is still warm.

Warranties: panel product and performance warranties are often separate from inverter and battery warranties. Register everything. Missing registration is a common way to lose support. Read whether the battery warranty is in years, in throughput MWh, or both, and what capacity is guaranteed at the end.

Degradation is real. Panels lose a fraction of output each year under their performance warranty curve. Batteries lose usable capacity with time and with energy throughput. A proposal that shows year-one savings

forever without degradation is selling a cartoon. Ask for year-ten production and year-ten usable battery capacity in the same workbook as the payment schedule.

Monitoring subscriptions, cellular backups when Wi-Fi dies, and firmware updates are part of living with the system. So is vegetation: a tree that was short at install can shade a string five years later.

What surprises people:

- Grid-tied solar without a battery still dies in an outage.
- A battery set to maximize bill savings may arrive at a storm with a low reserve if you did not change the mode.
- Time-of-use rate changes by the utility can rewrite the savings story overnight.
- Roof work later means a remove-and-reinstall line item — know who pays under a lease.
- Selling the house needs manuals, permit sign-offs, and clear ownership (especially with a lease or PPA).

A short decision list

Before you sign, answer these in one sitting.

- Panels-only or solar-plus-battery — and which outages or rate problems is the battery solving?
- What usable kWh and continuous kW does the battery need for the critical-load list?
- AC-coupled retrofit or DC-coupled new build, and is the whole stack under one installer warranty?
- Roof age, shade report, and service-panel capacity — any upgrade priced in writing?
- Buy versus lease/PPA — five-to-ten-year cash, and who owns the system when you sell?
- Which incentives still apply on the install date? Link the IRS or state page; do not rely on a verbal “30%.”
- Who pulls the building permit, who files interconnection, and what is the estimated permission-to-operate date?
- What do year-one and year-ten production and battery capacity look like on one sheet?

If a bid cannot answer those, it is not ready.

Sources

1. U.S. Department of Energy, Homeowner’s Guide to Going Solar (suitability, PVWatts pointer, storage overview, buy vs lease/PPA, net metering questions):
<https://www.energy.gov/eere/solar/homeowners-guide-going-solar>
2. NREL / NLR PVWatts Calculator (grid-connected PV production estimates): <https://pvwatts.nrel.gov/>
3. Internal Revenue Service, Residential Clean Energy Credit (30% for qualified property placed in service 2022 through Dec. 31, 2025; not available after Dec. 31, 2025; battery storage at least 3 kWh when credit applied):
<https://www.irs.gov/credits-deductions/residential-clean-energy-credit>
4. Internal Revenue Service, About Form 5695, Residential Energy Credits:
<https://www.irs.gov/forms-pubs/about-form-5695>
5. UL Solutions, Energy Storage System Testing and Certification (UL 9540 system standard; related UL 1741 inverter/interconnection equipment):

<https://www.ul.com/services/energy-storage-system-testing-and-certification>

6. NFPA 70, National Electrical Code, standard development page:
<https://www.nfpa.org/codes-and-standards/nfpa-70-standard-development/70>

7. Enphase residential / battery product and compliance material: <https://www.enphase.com/> and
<https://enphase.com/download/ul-1741-compliance-iq-battery-5p-system-components-technical-note>

8. Tesla Powerwall product/education and lithium ESS safety standards overview:
<https://www.tesla.com/powerwall> and <https://energylibrary.tesla.com/docs/Public/EnergyStorage/Powerwall/General/Compliance/SafetyStandardsLithiumIonElectrochemical/en-us/index.html>

9. SolarEdge residential pages: <https://www.solaredge.com/>

10. SEIA (Solar Energy Industries Association) industry consumer orientation: <https://www.seia.org/>

Local building departments and utilities adopt their own code editions, interconnection handbooks, and rate tariffs. If this paper and the inspector or the utility disagree, they win.

Notes

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