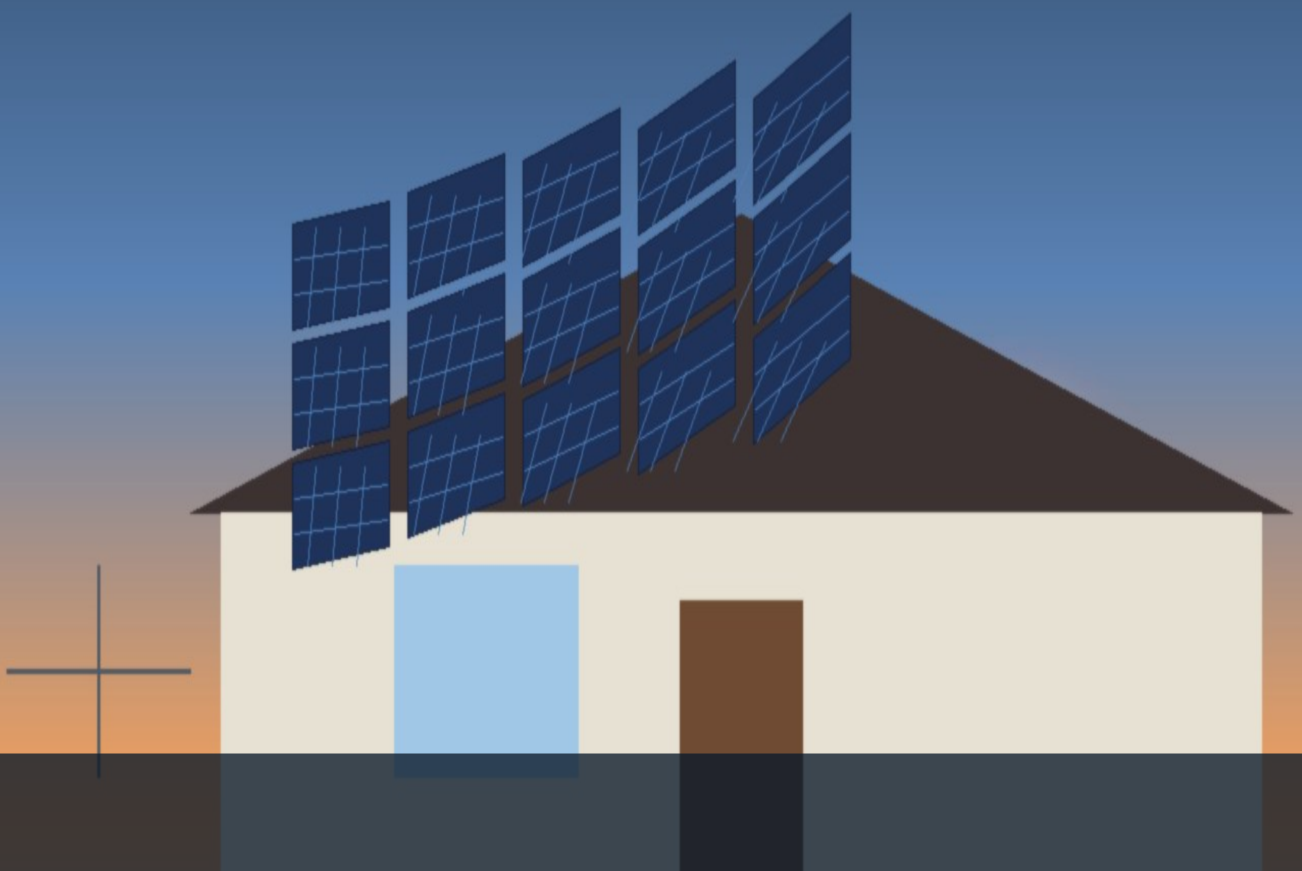


AESV

THE SOLAR BACKUP BUYER'S CHECKLIST

A 10-step, plain-English worksheet to size your battery, panels, and charge controller.

By the AESV Technical Team

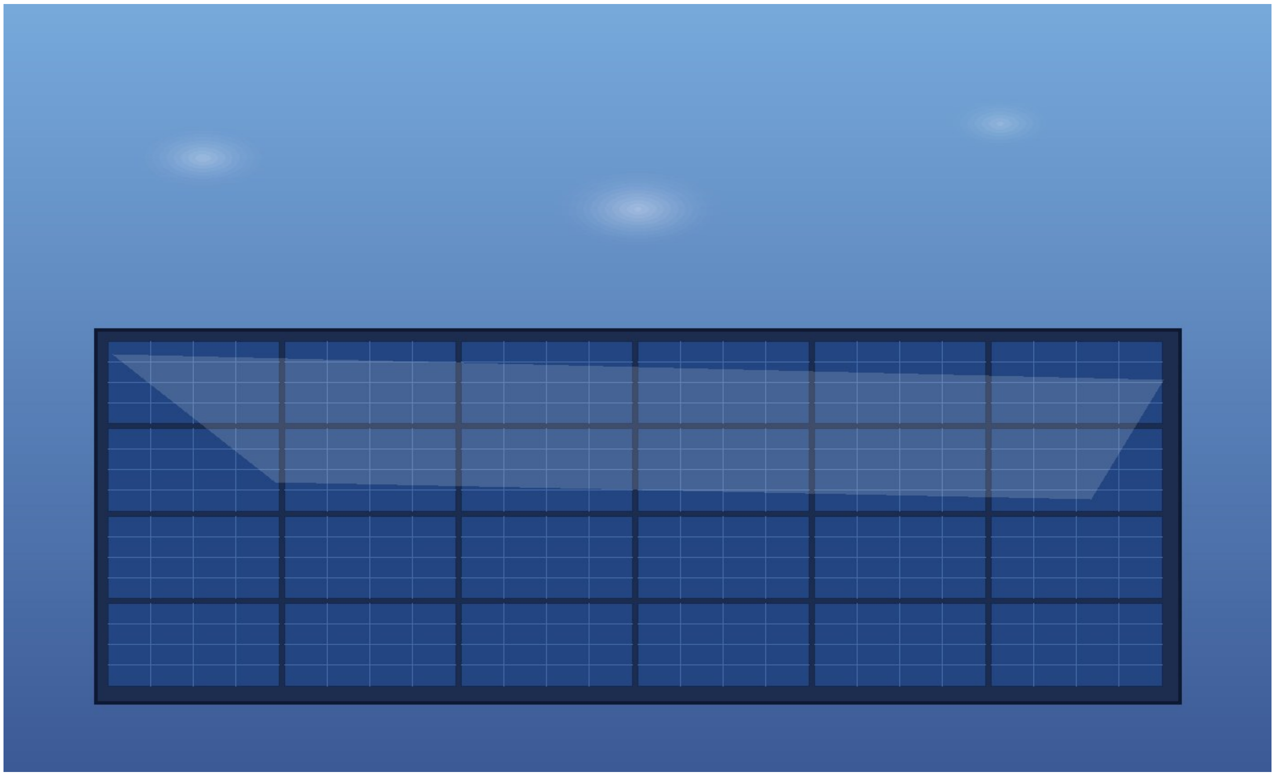
Alternative Energy Sources V · alternativeenergysourcesv.com

What’s inside

How to use this checklist: Work through it in order, one section at a time. Each section is short — you don’t need an engineering degree. By the end you’ll have a written spec sheet you can take to any solar retailer (or hand to an installer) and avoid buying the wrong gear.

Section 1

Your daily energy load — the starting point



Before you buy a single battery, you need to know **how much energy you actually use per day** in a blackout. Most people oversize — or worse, undersize — because they guess. Don’t guess.

How to estimate your daily load

For every appliance you want to keep running during an outage, write down:

- **Watts** (running power draw) — check the label or back of the unit.
- **Hours per day** you realistically expect to run it during an outage.
- **Quantity** — one fridge, two phones, five LED bulbs.

Worked example — a typical 24-hour outage load

Appliance	Watts	Hours/day	Wh/day
Refrigerator (Energy Star, cycled)	150	8	1,200
Home router + modem	20	24	480
5 LED light bulbs	45	6	270
Phone + laptop chargers	85	4	340
CPAP (no heated humidifier)	60	8	480
Wi-Fi radio + misc.	30	12	360
Total daily load			**3,130 Wh**

Your number to remember: ____________________ Wh/day (the bottom-right cell of your own table).

Section 2

How many backup hours or days do you really need?

Autonomy is the number of hours (or days) your battery must run **without a single ray of sunlight** recharging it. A common mistake is sizing for one evening and then being without power for two stormy days.

Pick a target autonomy

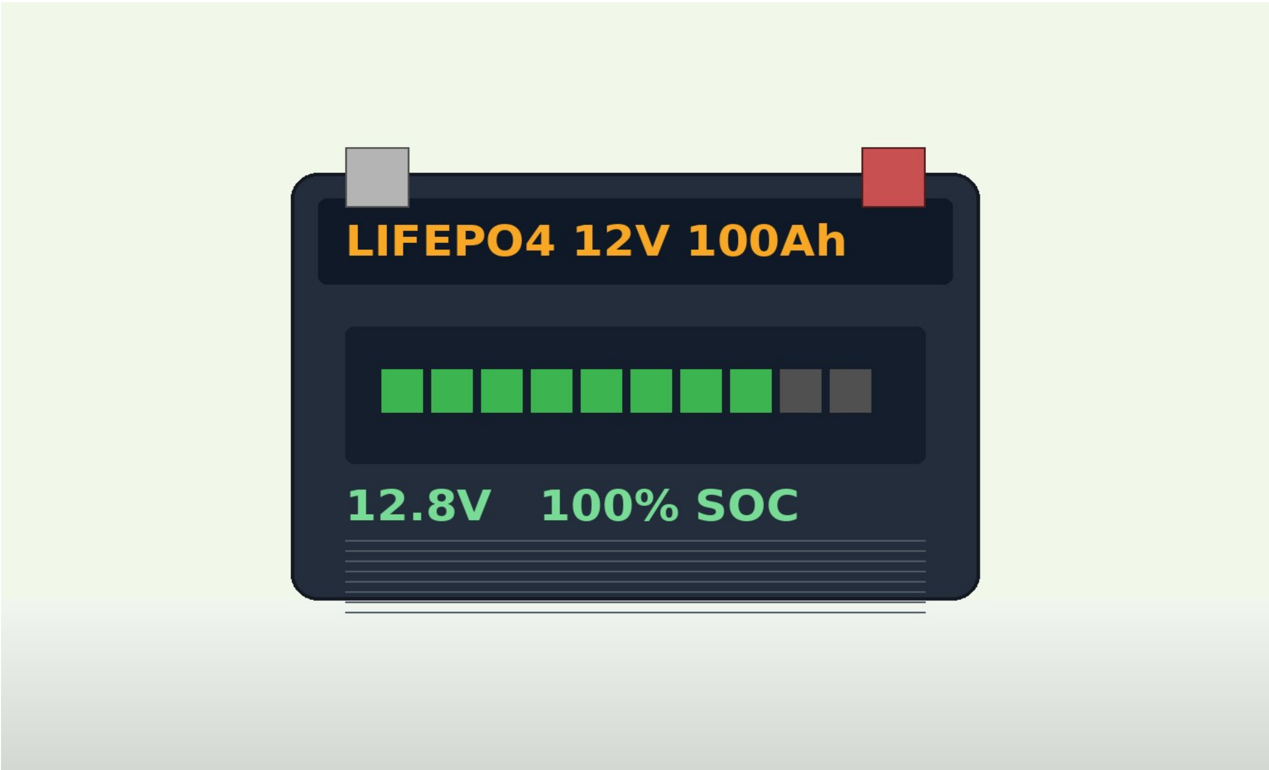
Profile	Recommended autonomy	Why
Weekend cabin / RV	1 day (24 h)	You can drive to a plug or sit out a short storm.
Suburban home, occasional outages	2 days (48 h)	Covers most grid failures and a stormy night.
Off-grid home / rural	3 days (72 h)	Snow, hurricanes, or wildfire PSPS events can last longer.
Medical equipment or full-time off-grid	5+ days	Lives depend on the system staying up.

Your number to remember: ____________________ days of autonomy.

Practical tip: If storms in your area routinely last 48–72 hours and your roof space for panels is limited, you almost always need *more* battery, not more panel. Most beginners under-buy the battery first.

Section 3

Pick your battery voltage (12V, 24V, or 48V)



Battery voltage is the “size of the pipe” that carries energy from your battery to your inverter. Higher voltage = thinner cables for the same power. You don’t need to overthink it — here’s the rule of thumb:

System size	Battery voltage	Why
Under 1,500 Wh / cabin / RV	12V	Cheap, common, simple. Lots of accessories.
1,500 to 5,000 Wh / small home	24V	Better efficiency, smaller cables, mid-cost.
Over 5,000 Wh / whole-home backup	48V	Lowest cable cost, highest efficiency, future-proof.

Your pick: [ ] 12V [ ] 24V [ ] 48V

Common trap: Mixing 12V and 24V batteries in the same bank is a safety hazard and will destroy cells. All batteries in a bank must be the same voltage, same brand, same age, and same capacity.

Section 4

Pick your battery chemistry (LiFePO4 vs. Lead-Acid)

This is the single biggest decision affecting cost, weight, and lifespan. You only need to understand two main families:

Factor	LiFePO4 (Lithium Iron Phosphate)	Sealed Lead-Acid (AGM / Gel)
Upfront cost	Higher ($$)	Lower ($)
Usable capacity (DOD)	Up to 80 to 90%	Only 50%
Cycle life	3,000 to 6,000 cycles	300 to 800 cycles
Real-world lifespan	10+ years	2 to 4 years
Weight (same capacity)	About 1/3 the weight	Heavy
Cold-weather charging	Below 0°C needs heater or insulation	OK, but loses capacity
Maintenance	None — sealed	None if sealed; check terminals
Safety	Very stable chemistry	Can vent gas if overcharged

For 95% of new buyers, AESV recommends LiFePO4. The lower lifetime cost (10+ years vs. 2–4) usually beats the higher sticker price — and you can safely use 80% of the rated capacity, so you need a smaller bank to do the same job.

Section 5

Depth of discharge — the hidden sizing trap

Depth of discharge (DOD) is the percentage of the battery you actually drain in use. Every chemistry has a safe DOD — go past it and the battery is permanently damaged.

The two numbers to remember

Chemistry	Safe DOD	Multiply your usable energy by
LiFePO4	80%	1.25
Sealed Lead-Acid (AGM / Gel)	50%	2.0
Flooded Lead-Acid	50%	2.0

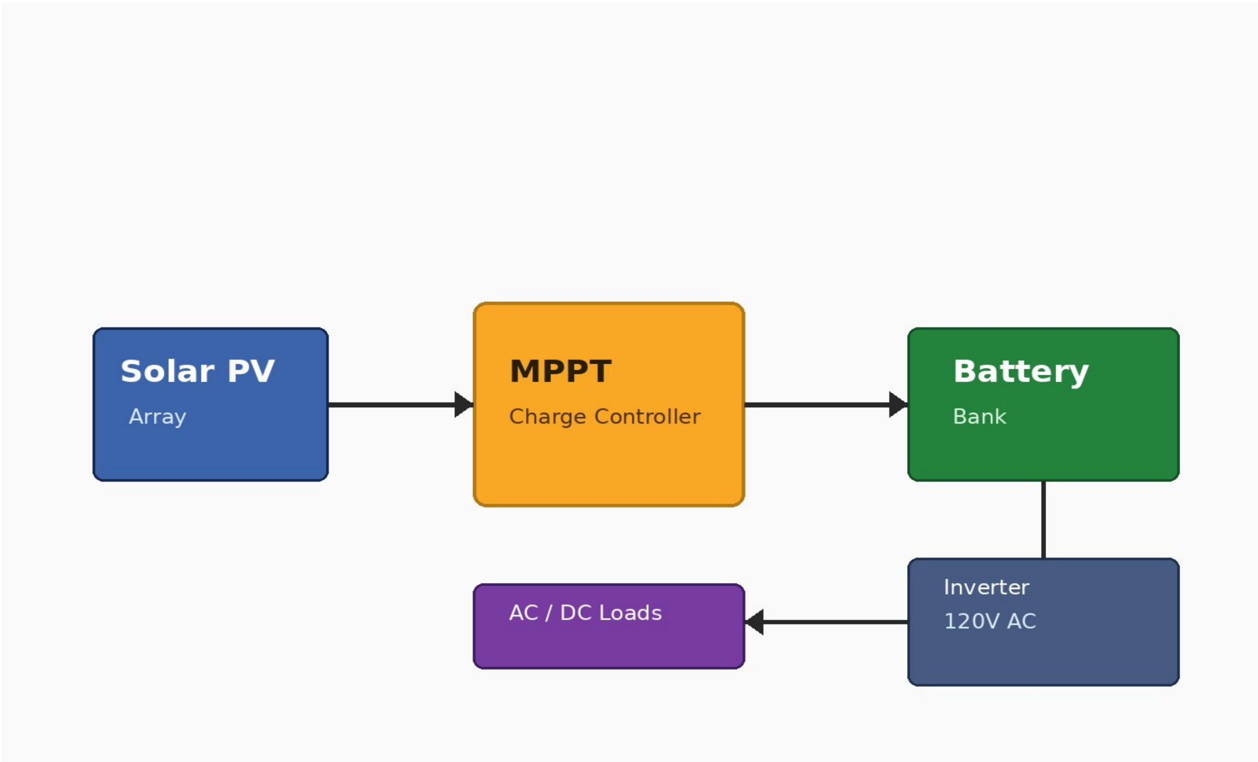
Worked example: You need 3,000 Wh of usable storage per day (Section 1), and 2 days of autonomy (Section 2). With LiFePO4 at 80% DOD:

Physical bank = (3,000 Wh × 2 days) ÷ 0.80 = 7,500 Wh

If you chose lead-acid at 50% DOD, that same scenario would need 12,000 Wh — nearly **double** the batteries for the same usable energy.

Section 6

Right-size your solar panel array



Your solar panels must refill your battery bank on a typical day in your area. The key input is **peak sun hours** — the equivalent number of hours of full, direct overhead sun your roof gets per day.

Typical peak sun hours by region

Region	Peak sun hours/day	Compared to the US average
US Southwest, Australia, Middle East	5.5 to 6.5 h	1.3× the national average
US Southeast, Mediterranean, Latin America	4.0 to 5.0 h	About average
US Pacific NW, Northern Europe, UK	3.0 to 4.0 h	0.8× the national average
Northern Canada, Scandinavia (winter)	2.0 to 3.0 h	Half the average

Sizing formula: Required Array (W) = Daily Load (Wh) ÷ Peak Sun Hours × 1.25

The 1.25 multiplier accounts for real-world losses: wire resistance, dust on the panels, heat derating in summer, and the angle of your roof not being perfectly aimed at the sun. **Never** skip it — undersized arrays are the #1 cause of “my battery never fully charges” complaints.

Section 7

Size your charge controller amps safely

A charge controller is the “traffic cop” between your solar panels and your battery. Too small and it overheats. The U.S. National Electrical Code (NEC) requires a **1.25× safety multiplier** on top of the calculated size.

Formula: Controller Amps = Solar Array (W) ÷ Battery Voltage × 1.25

Choose PWM or MPPT

Type	Best for	Price	Efficiency
PWM	Small 12V systems, budget builds	$	About 75% of panel rating
MPPT	Larger arrays, 24V/48V systems, cold or cloudy sites	$$$	Up to 98% of panel rating

Your number to remember: ___________ A charge controller, [ ] PWM or [ ] MPPT.

Safety reminder: Round UP to the next standard size. A controller that runs at 95% of its rating all day in summer heat will cook itself. 10A, 20A, 30A, 40A, 60A, 80A, 100A are common sizes — buy the next size up, not the exact match.

Section 8

Compatibility checks before you click ‘Buy’

Most returns and dead-on-arrival units are caused by **incompatibility between components that were technically each fine**. Run this checklist before you spend any money.

- [ ] Battery voltage matches inverter input (e.g., 24V battery → 24V-capable inverter)
- [ ] Inverter continuous wattage ≥ the sum of your largest simultaneous loads
- [ ] Inverter surge rating covers the start-up spike of any motor (well pump, fridge, AC)
- [ ] Charge controller max PV input voltage (Voc) is higher than your panel array’s open-circuit voltage, including the coldest-day multiplier
- [ ] All batteries in a bank are the same brand, model, age, and capacity
- [ ] Cable gauge is sized for the max current at the run length
- [ ] Inline fuses or breakers are installed within 18 inches of every battery terminal
- [ ] Solar panel connector type matches the charge controller input (MC4 is the most common)
- [ ] Battery management system (BMS) rating exceeds the max charge/discharge current of your system
- [ ] Inverter and charge controller brands speak the same protocol if you want them to share data

Section 9

Pre-purchase shopping notes & red flags

A practical list of “don’t get burned” rules that we wish someone had told us before our first install.

Green flags — the seller is probably fine

[+] Published spec sheets with brand, model, and country of origin.

[+] Warranty at least 10 years for panels, 5 years for LiFePO4 batteries, 2 years for inverters.

[+] Real, traceable business address and a working support phone number.

[+] Customer reviews that include photos of the actual install, not just stock images.

[+] Stated cycle life based on a published test standard (e.g., 80% DOD at 1C).

Red flags — walk away

[-] “Same specs as Brand X, half the price” with no UL / ETL / CE certification.

[-] Capacity claims like “12V 200Ah” on a battery that physically weighs 15 lbs (it’s actually 50Ah).

[-] Seller refuses to publish the cell manufacturer (most legit LiFePO4 cells come from EVE, CATL, BYD, or REPT).

[-] Ships from overseas with no domestic return address; no replacement guarantee.

[-] “No paperwork needed” for grid-tie inverters — you need UL 1741 + IEEE 1547 in the US.

One more: If a deal seems too good to be true, it is. We have personally seen 5 kWh “LiFePO4” batteries ship with 1.2 kWh of actual capacity. Buy from a known brand with verifiable cell origin.

Section 10

Your final spec sheet (print this page)

Fill this out before you order. Take it to a solar retailer or share it with an installer. It is the single page that turns the rest of this checklist into an actual purchase order.

Project owner	____ _
Site address	____ _
Date	____ _
Daily energy load (Section 1)	_____________ Wh/day
Backup autonomy (Section 2)	_____________ days
Battery voltage (Section 3)	_____________ V
Battery chemistry (Section 4)	[ ] LiFePO4 [ ] Lead-Acid
Depth of discharge (Section 5)	_____________ %
Physical battery bank needed	_____________ Wh
Peak sun hours (Section 6)	_____________ h/day
Required solar array	_____________ W
Charge controller type (Section 7)	[ ] MPPT [ ] PWM
Charge controller size	_____________ A
Inverter continuous rating	_____________ W
Inverter surge rating	_____________ W

Notes & questions for the installer:

____

____

____

Bonus: A complete worked example

Sarah and Tom in suburban Texas want a backup system that can run their fridge, router, lights, and phone chargers for two days in a power outage.

Step 1 — Daily load (from Section 1)	**3,130 Wh/day**
Step 2 — Autonomy (from Section 2)	**2 days**
Step 3 — Battery voltage (from Section 3)	**24 V (small-home size)**
Step 4 — Battery chemistry (from Section 4)	**LiFePO4**
Step 5 — Physical bank = (3,130 × 2) ÷ 0.80	**7,825 Wh**
In 24V terms: 7,825 Wh ÷ 24 V	≈ **326 Ah at 24V**
Step 6 — Peak sun hours in Texas	**5.5 h/day**
Solar array = 3,130 ÷ 5.5 × 1.25	≈ **711 W (round up to 800 W)**
Step 7 — Controller amps = 800 ÷ 24 × 1.25	≈ **42 A (round up to 60 A MPPT)**
Inverter continuous: largest simultaneous load	≈ **350 W (round to 1,000 W for headroom)**
Inverter surge: well pump or fridge compressor start	≈ **2,000 W surge**

Sarah and Tom's shopping list: 24V 330Ah LiFePO4 battery, 800 W solar array (e.g., 4× 200W panels), 60A MPPT charge controller, 1,000 W (2,000 W surge) pure sine wave inverter, appropriately sized cables and fuses. They will pay roughly $2,000 to $3,000 for a system that keeps the lights on and the fridge cold for two stormy Texas nights.

Frequently asked questions

Can I just buy a portable solar generator instead of building a system?

For under about 1,500 Wh of daily load, yes. A 2 to 3 kWh portable power station with a foldable panel is faster and often cheaper than a custom LiFePO4 build. Above 1,500 Wh/day, building a fixed battery bank + inverter + panel system is almost always more cost-effective per kWh.

How long do lithium batteries actually last?

A quality LiFePO4 cell rated for 3,500 to 6,000 full charge cycles at 80% DOD will last 10 to 15 years in a typical home-backup use case (one cycle every few days). Lead-acid lasts 2 to 4 years under the same usage pattern.

Do I need a permit?

For off-grid or stand-by backup that never touches your main breaker panel, usually no. For grid-tie or any wiring that backfeeds your household panel, yes — almost every U.S. jurisdiction requires an electrical permit and licensed installer. Check with your local building department before you buy.

Can I mix old and new batteries?

No. The weak old battery drags down the new one, and they discharge unevenly. If you must expand, add a second complete bank of the same batteries, connected through separate fuses, in parallel with the original bank.

How do I find my local peak sun hours?

The U.S. National Renewable Energy Laboratory publishes free maps and a tool called PVWatts. Enter your address, and it gives you the year-round average plus monthly breakdowns.

About this checklist

This free guide is published by **Alternative Energy Sources V (AESV)**. Our goal is to help you buy the right solar, battery, and off-grid gear the first time — without the marketing fluff. Use it freely, share it with a friend, and check out our full-size interactive sizing calculator at alternativeenergysourcesv.com/calculator/ for a custom report based on your actual appliances.