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1. Introduction to Power Stations

A portable power station is a rechargeable battery system with AC outlets, USB ports, DC ports, and solar charging capability.

It acts like a silent generator with no gas, no fumes, and no maintenance. These systems are used for home backup, camping, RV travel, van life, and emergency needs.

2. Small Units (100–300W / 150–300Wh)

Small units are best for basic electronics such as phones, tablets, cameras, LED lights, and small fans. These compact units are ideal for travel, hiking, and emergency phone charging. They are lightweight and inexpensive but not meant for appliances or high-wattage devices.

3. Medium Units (300–700W / up to 1000Wh)

This is the most popular range. Bluetti's new 700W / 1000Wh mini fits perfectly here. They can run laptops, CPAP machines, mini fridges, 12V van and RV fridges, fans, lights, routers, and small TVs. They cannot run high-watt appliances like microwaves, coffee makers, air fryers, space heaters, or hair dryers. This range is perfect for camping, van life, RV travel, and home basics during outages.

Run-time examples:

300Wh unit: mini fridge 3–4 hours

700Wh unit: mini fridge 6–10 hours

1000Wh unit: mini fridge 10–14 hours

4. 1000W Units (800–1200Wh)

These are “serious starter” units for home backup and RV use. They can run:

- Full-size fridge (8–12 hours)
- CPAP (2–3 nights)
- TV + router + lights
- Power tools
- Microwave (short bursts)
- Coffee maker (short bursts)

Solar pairing: 200–400W panels.

5. 2000W Units (1500–2500Wh)

These are home backup workhorses. They can run a fridge and freezer, microwave, coffee maker, toaster, TV and router, CPAP machines, power tools, and medical devices. Solar pairing is typically 400–800 watts of panels. A 2000Wh unit can run a full-size fridge for about a day.

6. 3000–4000W Units (3000–5000Wh)

These are whole-home portable backup systems. They can run a fridge, freezer, microwave, coffee maker, air fryer, well pump, sump pump, multiple rooms of lights, a TV and router, and CPAP machines. Solar pairing for this range is typically 800–1200 watts.

7. Jackery HomePower 5000

A true generator replacement. Specs include 5000W output, a 5120Wh battery, and solar input up to 2000W. These systems can run a fridge and freezer for 4–5 days, a microwave, coffee maker, air fryer, sump pump, well pump, multiple rooms, and medical devices. With 1200–2000W of solar input, the unit can recharge fully each day in good weather.

8. Solar Panel Usage (Real-World Guide)

Solar panels rarely produce their full rated wattage. Real output ranges from about 60–80 watts for a 100W panel, 120–160 watts for a 200W panel, 250–320 watts for a 400W panel, 500–650 watts for an 800W array, and 800–1400 watts for a 1200–2000W array. A simple rule of thumb is solar watts multiplied by five hours equals daily watt-hours gained. For example, a 400W setup typically produces around 2000Wh per day. Solar turns a power station into a renewable system that can run appliances indefinitely in good weather.

9. Fridge & Freezer Energy Label Math

Energy Guide label example: 400 kWh per year
(Wh) = watt-hours - (kWh) = kilowatt-hours

Daily usage:

Look at your refrigerator card: $600 \text{ kWh} \div 365 \text{ days} = 1.643 \text{ kWh/day}$. $1.643 \text{ kWh} \times 1000 = 1643 \text{ Wh/day}$. A 600 kWh/year fridge uses about 1640 Wh per day.

Run-time examples of a 600 kWh/year fridge
(90% efficient):

- 1000Wh unit → about 1/2 day
- 2000Wh unit → about 1 day
- 4000Wh unit → about 2 days
- HomePower 5000 → about 3 days

10. Kill-A-Watt Meter Usage Measures

- watts
- volts
- amps

- kWh used
- daily usage
- peak usage

This tool gives real numbers for YOUR appliances, not guesses.

Example:
Mini fridge: 70W

1000Wh unit:
 $1000 \div 70 = 14.2$ hours
With 85–90% real world efficiency, actual runtime is about 12.1 to 12.8 hours

11. Appliance Watt Chart

This chart shows typical watt usage for common appliances. Actual wattage varies, but these numbers work well for sizing power stations.

Phones: 5–10W

Tablets: 10–20W

Laptops: 40–90W

Routers: 10–20W

LED Lights: 5–15W

Box Fan: 40–70W

Tower Fan: 50–100W

CPAP Machine: 30–60W

Mini Fridge: 60–100W

Full-Size Fridge: 100–200W running,
600W startup

Freezer: 80–150W running,
600W startup

TV (32–55"): 50–120W

Microwave: 800–1500W

Coffee Maker: 800–1200W

Air Fryer: 1400–1700W

Toaster: 800–1200W

Blender: 300–800W

Space Heater: 1500W

Well Pump: 1000–2000W startup

Sump Pump: 800–1500W startup

12. “What Size Do YOU Need?” Quiz

Answer these quick questions to find your ideal power station size.

1. Do you need to run a fridge alone?

- Yes → 1000Wh minimum
- No → continue

2. Do you need to run microwave or coffee maker alone?

- Yes → 2000W unit
- No → continue

3. Do you need overnight CPAP alone?

- Yes → 500–1000Wh
- No → continue

4. Is this for camping or van life?

- Yes → 300–700W / 500–1000Wh

- No → continue5. Is this for home backup?

- Yes → 2000–4000W / 2000–5000Wh- No → continue

6. Do you want solar charging?

- Yes → choose a model with MPPT and 200–800W solar input
- No → any model works

13. RV / Van Life Setup Guide

Daily RV/van usage is usually 300–800Wh per day.

Typical items:

- 12V fridge: 30–60W
- LED lights: 5–10W each
- Fans: 40–70W
- Phone/laptop charging: 20–50W
- Water pump: 60–100W (short bursts)

Recommended power station sizes:

- Weekend trips: 300–700W / 500–700Wh
- Full-time van life: 700–1500W / 1000–2000Wh
- RV with microwave: 2000W+

Solar:

- 200–400W solar keeps a van powered indefinitely
- 400–800W solar is ideal for full-time RV living

14. Home Backup Setup Guide

Home backup needs depend on what you want to run.

Essentials:

- Fridge: 100–200W
- Freezer: 80–150W
- Lights: 5–15W each
- Router: 10–20W
- TV: 50–120W
- CPAP: 30–60W

Recommended sizes:

- Basic outage: 1000–1500Wh
- Multi-day outage: 2000–4000Wh
- Whole-home portable backup: 5000Wh+

Solar:

- 400–800W solar keeps essentials running daily
- 1200–2000W solar can recharge large units fully

15. Daily Usage Scenarios

Storm Outage:

- Fridge + freezer + lights + router
- Needs 1500–3000Wh per day

Camping Weekend:

- Lights, fans, phones, small fridge
- Needs 300–700Wh per day

RV Travel Day:

- 12V fridge, fans, laptops
- Needs 400–800Wh per day

Van Life Routine:

- 12V fridge, lights, fans, charging
- Needs 500–1000Wh per day

16. Generator vs. Power Station Comparison

Generators:

- Loud
- Gas required
- Fumes
- Outdoor only
- Maintenance needed
- High watt output

Power Stations:

- Silent
- No gas
- Indoor safe
- Solar compatible
- No maintenance
- Instant power
- Limited watt output compared to gas generators

Best for:

- Indoor use
- Apartments
 - RVs
- Camping
- Emergency backup

17. Solar + Battery Sizing Examples

These examples show real-world setups so you can match your power station to your needs.

Example 1: Basic Home Backup

Use: fridge + lights + router

Total: 1300Wh/day

Recommended: 1500–2000Wh + 400W solar

Example 2: RV Weekend Trip

Use: fridge + fans + charging

Total: 800Wh/day

Recommended: 1000Wh + 200–400W solar

Example 3: Van Life Full-Time

Use: fridge + fans + lights + laptop

Total: 1050Wh/day

Recommended: 1500–2000Wh + 400–600W solar

Example 4: Whole-Home Backup

Use: fridge + freezer + lights + kitchen

Total: 2600Wh/day

Recommended: 3000–5000Wh + 800–2000W solar

Example 5: Best for:

- Home backup
- RV travel
- Van life
- Emergency use

18. Understanding Surge Watts vs Running Watts

Running watts = the normal watt usage while the appliance is operating.

Surge watts = the temporary spike when the appliance starts.

Examples:

- Fridge: 150W running, 600W surge
- Freezer: 120W running, 600W surge
- Well pump: 1200W running, 2000W surge
- Sump pump: 800W running, 1500W surge

Your power station must handle BOTH:

- Running watts (continuous rating)
- Surge watts (peak rating)

If surge watts exceed the inverter limit, the appliance will not start.

19. Solar Panel Positioning Tips

To get maximum solar output:

1. Face panels directly at the sun.
2. Adjust angle every 1–2 hours.
3. Avoid shade — even 10% cuts power 50%.
4. Keep panels clean.
5. Use MC4 extensions, but avoid long cables.

Real-world solar rule:

- Expect 60–80% of rated wattage.
- Expect 4–6 hours of good sun daily.

20. Battery Chemistry Overview (LFP vs NMC)

LFP (LiFePO₄):

- 3000–5000 cycle lifespan
- Safer and more stable
- Heavier
- Best for home backup and RVs

NMC:

- 500–800 cycle lifespan
- Lighter
- Higher energy density
- Best for travel and lightweight setups

Most modern power stations use LFP for the long lifespan.

21. How to Extend Battery Life

Tips to maximize lifespan:

- Avoid storing at 0% or 100% for long periods.
 - Ideal storage: 40–60%.
 - Keep temperature between 40–80°F.
 - Use solar regularly to keep battery active.
- Avoid running heavy loads at very low battery levels.
 - Keep firmware updated if your unit supports it.

22. Final Buying Checklist

Before buying a power station, confirm:

1. Watt output matches your appliances.
2. Battery size matches your daily usage.
3. Solar input is high enough for fast charging.
4. It uses LFP battery chemistry (preferred).
5. It has enough AC outlets.
6. It supports pass-through charging if needed.
7. It has a good display showing watts in/out.
8. It supports MC4 solar connections.
9. It has a reliable brand warranty.

This checklist may help you decide which unit
is right for your needs.

23. Glossary of Power Station Terms

AC Output:

Standard household outlet power used for appliances like fridges, microwaves, and TVs.

DC Output:

Direct current ports used for car fridges, 12V devices, and some lights.

USB Ports:

Used for charging phones, tablets, cameras, and small electronics.

Inverter:

Converts battery DC power into AC power.
Determines watt output.

Running Watts:

The continuous watt usage of an appliance while operating.

Surge Watts:

The temporary spike in watt usage when an appliance starts.

Wh (Watt-Hours):

A measurement of battery capacity. Higher Wh means longer run times.

MPPT:

A solar charging system that maximizes solar efficiency. Most modern units include MPPT.

LFP (LiFePO₄):

Long-life battery chemistry with 3000–5000 cycles. Best for home backup and RVs.

24. Troubleshooting Common Issues

Problem: Appliance won't start.

Cause: Surge watts exceed inverter limit.

Fix: Use a higher-watt power station.

Problem: Solar panels produce low wattage.

Cause: Shade, angle, clouds, or dirty panels.

Fix: Clean panels, reposition, avoid shade.

Problem: Battery drains too fast.

Cause: High-watt loads or fridge startup cycles.

Fix: Use a larger battery or add solar.

Problem: Power station shuts off unexpectedly.

Cause: Overload or low battery.

Fix: Reduce load or recharge.

Problem: Solar won't charge.

Cause: Wrong cable, wrong polarity, or
incompatible panel.

Fix: Use MC4 cables and check polarity.

25. Safety Tips

- Keep power stations dry and away from moisture.
- Do not block ventilation during heavy loads.
- Avoid running heaters or high-watt appliances on small units.
- Store batteries at manufacturer recommendations if unused for long periods.
- Keep units out of extreme heat or cold.
- Use proper gauge cables for solar extensions.
- Do not attempt to repair internal components yourself.

26. Best Brands Overview

Bluetti • Jackery • CTOLITY • EcoFlow

All major brands are capable of:

- Running fridges, freezers, lights, routers, CPAP, fans, and small appliances.
- Charging from solar, wall, and car.
- Providing built-in safety protections (BMS, over-voltage, over-current, temperature control).
- Offering multiple output ports (AC, USB-A, USB-C, DC).
- Using modern battery chemistry (mostly LFP now).
- Showing real-time usage data on screen or app.
- Expanding with solar panels.
- Working for emergencies, camping, and short home backup.

27. Future Trends in Portable Power

- Larger LFP batteries with 6000+ cycles.
- Higher solar input (2000–3000W).
- Faster charging using AC + solar hybrid systems.
- Modular expansion batteries.
- Smart home integration.
- EV-style charging ports.
- Lightweight high-density cells.
- Sodium-ion batteries for lower cost and better cold-weather performance.
- Solid-state batteries for higher energy density and safer operation.

28. Final Summary

Portable power stations are becoming essential for:

- Home backup
 - RV travel
 - Van life
 - Camping
- Emergency preparedness

Choosing the right unit depends on:

- Watt output
- Battery size
- Solar input
- Appliance needs
- Daily usage

With the right setup, you can run:

- Fridges
- Freezers
- CPAP machines
 - Fans
 - Lights
 - TVs
 - Tools
- Medical devices

All silently, mostly safe, and without gas.

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