How to Size Solar and Battery Storage for a Telecom Site

Calculate telecom PV and battery capacity from the 24-hour load, system losses, peak-sun-hour data, autonomy, discharge limits and recovery target.

PRODUCT KNOWLEDGE

How to Size Solar and Battery Storage for a Telecom Site

Turn a measured telecom load into a preliminary PV array, battery bank and recovery plan, while keeping the assumptions visible enough for an engineer, operator or buyer to challenge them.

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Engineering sizing guide
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Short answer: size solar and battery storage for a telecom site as three connected problems. The PV array must replace the site's energy in the design weather period, the battery must carry the load through the required source-free interval, and the power path must support peak load and recharge current. A daily-energy calculation alone cannot answer all three.

The method below is suitable for feasibility work and supplier comparison. It is not a construction design. Final equipment ratings depend on measured load, site weather, product curves, operator requirements and local electrical rules.

Collect data before choosing equipment

The most useful starting point is a time-aligned record of load and operating conditions. Site coordinates, an hourly or 15-minute load profile, voltage interfaces, outage history, autonomy target, generator information, climate and planned radio additions should be known before a battery model is selected.

If no interval meter is available, build a schedule by subsystem. Separate the radio and transmission load from cooling, heaters, obstruction lights, security equipment and maintenance sockets. Do not multiply every nameplate rating by 24 hours: nameplate input, typical demand and short-duration peak are different quantities.

Input	Minimum usable data	Preferred evidence
Load	Average watts, peak watts and DC/AC interface	15-minute or hourly profile by subsystem in hot and cool periods
Solar resource	Monthly peak-sun hours for the coordinates	Multi-year hourly irradiance and ambient temperature
Grid and generator	Source availability and rated power	Outage duration distribution, voltage quality, fuel records and start reliability
Environment	Temperature range and altitude	Wind, snow, dust, salt, humidity, flooding and enclosure temperature
Service target	Autonomy hours	Availability target, critical-load list, reserve state of charge and recovery deadline
Interfaces	Nominal bus voltage and available area	Operating voltage window, connector, protection, cable and structural constraints

For early resource screening, the European Commission's PVGIS provides solar radiation and PV performance data for locations in Europe and many other regions. NASA POWER's hourly service is another useful source for solar and meteorological time series. Modelled data should still be checked against site observations where service continuity is important.

Calculate daily energy and peak power separately

DAILY LOAD ENERGY

$$E_{load} = \Sigma(P_i \times h_i)$$

Daily energy, measured in kWh, drives the first estimate of PV and battery capacity. Peak power, measured in kW, drives rectifier, inverter, controller, busbar, cable and protection ratings. A site can have modest daily energy but still impose a high current when a cooling compressor starts or radios transmit at peak traffic.

Use a load schedule that reflects operating modes. For each item, record typical power, peak power, hours per day and whether the load is critical. Cooling should be linked to ambient temperature and internal heat rather than treated as a fixed annual load. If future radios are planned, add their expected profile as a visible growth case instead of burying growth inside an unexplained factor.

Keep conversion losses separate from demand growth and reserve margin. This matters because the same 10% loss can easily be counted once in the load, again in an efficiency factor and a third time in a generic design margin.

Estimate the PV array from the design solar period

PRELIMINARY PV POWER

P_PV = E_source ÷ (PSH_design × K_PV)

E_source is the daily energy that must arrive at the relevant source-side boundary. PSH_design is the peak-sun-hour value for the selected design month, and K_PV is a PV-side derating factor. For a critical off-grid site, annual-average sunshine is rarely the right design input. Use the relevant low-solar period and investigate consecutive poor-weather days.

Loss or allowance	Where it belongs	Typical design treatment
Module temperature, soiling, mismatch, shading, DC wiring and MPPT	PV side	Include in K_PV or in the PV simulation, not both
Rectifier, DC/DC, inverter and distribution losses	Downstream energy path	Apply between the PV source boundary and delivered load
Battery charge/discharge losses	Stored-energy path only	Apply to the share of energy that actually passes through the battery
Load growth, weather uncertainty and operating reserve	Design allowances	Show each allowance separately so it can be reviewed

The one-line formula is useful for screening, but it does not reveal hourly state of charge. A time-series model should test low-solar months, high-temperature load, cloudy sequences, source outages, curtailment and recovery. It should also verify PV string open-circuit voltage at the coldest expected module temperature and operating voltage at the hottest expected cell temperature.

Size storage for usable, not nameplate, energy

INITIAL NOMINAL STORAGE

C_bat = E_autonomy ÷ (DoD × η_discharge × F_EOL × F_temp)

E_autonomy is the energy consumed during the required autonomy interval. For a constant load, it is power multiplied by autonomy hours. DoD is allowable depth of discharge, η_discharge covers the defined battery-to-load path, F_EOL is the retained capacity required at end of life, and F_temp accounts for capacity available at the design temperature. Factors already included in a manufacturer’s usable-energy rating should not be applied twice.

A battery's kWh rating does not confirm that it can serve the site. Check continuous and peak discharge power, BMS current limits, low-temperature charge restrictions, high-temperature derating, minimum state-of-charge reserve and the actual DC voltage window. For a nominal DC system, Ah = Wh ÷ V is only a screening conversion; current and capacity should be verified across the operating voltage range.

End-of-life capacity deserves an explicit line in the calculation. If a site needs the full autonomy at the end of the planned service period and the selected battery is expected to retain 80% of initial capacity, divide the beginning-of-life requirement by 0.80 before choosing modules.

Worked screening example

Consider a hypothetical telecom site with a measured average demand of 1.2 kW over 24 hours. Assume 3.5 design peak-sun hours, a 0.78 PV-side derating factor, 85% downstream energy-path efficiency and a separate 15% planning margin. The battery must provide 1.5 days of autonomy, with 80% allowable depth of discharge and 93% discharge-path efficiency.

Step	Calculation	Screening result
Delivered daily load	1.2 kW × 24 h	28.8 kWh/day
Required source energy	28.8 ÷ 0.85 × 1.15	39.0 kWh/day
PV array	39.0 ÷ (3.5 × 0.78)	14.3 kWp
Autonomy load energy	28.8 × 1.5	43.2 kWh delivered
Battery before EOL allowance	43.2 ÷ (0.80 × 0.93)	58.1 kWh nominal
Initial battery for 80% EOL retention	58.1 ÷ 0.80	72.6 kWh nominal

The 85% downstream efficiency and 0.78 PV derating describe different parts of the system. Keeping those boundaries separate avoids double counting. The 72.6 kWh result also assumes that the project requires the stated autonomy at 80% retained capacity. If autonomy is only a beginning-of-life requirement, the procurement rule may differ.

Changed assumption	Result before module rounding	What it shows
3.0 design peak-sun hours	16.7 kWp PV	A weaker solar month increases array size
4.0 design peak-sun hours	12.5 kWp PV	Better resource reduces the screening array
1 day autonomy	38.7 kWh battery before EOL allowance	Storage changes almost directly with autonomy
2 days autonomy	77.4 kWh battery before EOL allowance	Long autonomy can dominate cost and footprint

Why this example is not a quotation: it has no site coordinates, measured peak profile, equipment curves or operator availability target. A supplier can use it to explain assumptions, but should not turn it directly into a bill of materials.

Check recovery time and DC current

Autonomy answers how long the battery can support the load. Recovery answers whether the system can restore that reserve before the next outage or poor-sun interval. During recovery, the telecom load continues to run, so available source power must serve the live load and charge the battery at the same time.

In the example, restoring 43.2 kWh of delivered autonomy energy within eight hours would require about 5.8 kW of charging input if charging-path efficiency is 93%. Add the continuing 1.2 kW site load and the source must supply more than 7.0 kW before other losses and operating headroom. Solar variability may require a larger array or a longer recovery window. A generator must also remain within its approved loading range and the battery’s permitted charge current.

Current is equally important. On a confirmed nominal 48 V bus, the 1.2 kW load represents roughly 25 A before losses. A simplified 7.0 kW combined load-and-charge condition is about 146 A at 48 V. These are screening values: actual current changes with bus voltage, efficiency, charge control and equipment limits. Verify cable ampacity, voltage drop, terminals, fuses, breakers, contactors, rectifiers and BMS limits at the worst operating point.

Validate the whole system

- Run hour-by-hour state-of-charge analysis for the design months and consecutive low-sun periods.
- Test measured peak load, startup demand, traffic growth and cooling demand under high ambient temperature.
- Confirm autonomy and recovery at beginning of life and at the specified end-of-life capacity.
- Check battery charge and discharge limits across enclosure temperature and state of charge.
- Verify PV string voltage over the full module temperature range and controller operating window.
- Check generator start reliability, fuel autonomy, minimum loading and recharge runtime in hybrid designs.
- Coordinate protection and verify cable voltage drop, grounding, lightning and surge protection.
- Review mounting structure, wind, snow, corrosion, dust, drainage, access and theft protection.
- Define controller failure states, local fallback operation, alarm ownership and remote-access permissions.
- Record every data source, efficiency boundary and margin in the controlled engineering file.

For telecom power architecture and resilience principles, ITU-T Recommendation L.1210 is a useful current reference. The final design should also follow the network operator's specification, equipment instructions and the electrical, structural and fire-safety requirements that apply at the project location.

Huijue can prepare a preliminary energy model and equipment proposal from site data. Because solar resource, operating policy and approval requirements vary by country and operator, final ratings should remain subject to project-specific engineering and local review.

A preliminary calculation is not a construction design. Final ratings require approved weather data, measured or defensible load profiles, equipment curves, protection design and local compliance review.

Need a site-specific energy model?

Prepare the site coordinates, load profile, autonomy target, voltage interface, climate limits, available area and grid or generator history.

Send the project data through your established Huijue sales or engineering contact.

Related resources

Telecom Site Energy Guide
Telecom Lithium Battery Guide
Diesel Replacement Strategy

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