HUIJUE GROUP

Telecom Site Energy KPIs That Drive Better Operations

Use telecom energy KPIs to track availability, solar yield, battery health, generator runtime, alarms, temperature and operating cost.

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Telecom Site Energy KPIs That Drive Better Operations

Move beyond alarm collection by measuring service availability, energy balance, battery readiness, thermal stress, response quality and the business cost of operating each site.

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Operations reference
Approx. 9 minute read

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The practical rule: a telecom energy KPI is useful only when it has a defined boundary, formula, data source, owner and response. “Battery low” is an alarm. “Sites expected to fall below two hours of reserve within the next 24 hours” is an operational decision queue.

Before building a dashboard, write a KPI dictionary. It should state the site or equipment population, time zone, reporting interval, unit, calculation formula, exclusions, missing-data rule, threshold and accountable team. Without that dictionary, two departments can report different availability or renewable-energy results from the same site data.

Availability KPIs

Start with the service outcome. The power system exists to keep approved critical telecom loads within their operating voltage range. A utility outage is therefore not automatically a service-power outage. If batteries or a generator carry the critical load without interruption, grid availability fell, but power-system availability at the telecom DC boundary did not.

- Critical-load power availability and unserved minutes

- Utility, PV, battery and generator source availability
- Low-voltage events and cumulative time outside the approved DC range
- Time below the protected battery reserve threshold
- Transfer failures, failed starts and incomplete automatic recovery
- Unserved energy for critical and noncritical loads

CRITICAL-LOAD POWER AVAILABILITY

Availability = (observation time - unserved time) ÷ observation time × 100%

Define when an outage starts and ends. A practical definition may require the critical DC bus to remain outside its approved range for a stated persistence period, preventing a millisecond sensor spike from becoming a service outage. State whether planned maintenance is included, excluded or reported separately.

Illustrative example: a 30-day month contains 43,200 minutes. The grid is unavailable for three hours, but batteries supply the load for 162 minutes. A transfer failure then leaves the critical load unserved for 18 minutes. Grid availability is 99.583%, while critical-load power availability is approximately 99.958%. Reporting only the grid outage would misrepresent the site’s delivered resilience.

Classify each interruption by initiating cause: utility, generator, battery, DC distribution, cooling-related shutdown, control failure, human action or unknown. Preserve the event sequence. Grid loss followed by battery discharge, a failed generator start and low-voltage shutdown is one incident chain, not four unrelated events.

Energy and cost KPIs

An EMS should reconcile energy entering, leaving and being stored at the site. Use cumulative energy meters where possible; instantaneous power snapshots cannot reliably reconstruct monthly energy when communications are intermittent.

- Total source energy and energy delivered to telecom loads
- Auxiliary energy for cooling, controls, lighting and security
- PV yield, self-consumed PV and curtailed solar energy
- Grid energy by tariff period and recorded demand peaks
- Generator runtime, starts, fuel consumption and litres per delivered kWh
- Battery charge and discharge energy, including conversion losses
- Energy OPEX per site and per agreed service unit

KPI	Practical definition	Data needed	Decision supported
Renewable fraction	Renewable energy serving the defined load divided by total energy	Aligned PV, battery-source attribution and load energy	PV and storage utilization

KPI	Practical definition	Data needed	Decision supported
	serving that load		
PV specific yield	PV energy divided by installed array capacity, in kWh/kWp	PV energy, installed kWp and reporting period	Compare similar sites and find underperformance
Auxiliary share	Cooling and other support energy divided by total site energy	Sub-metered auxiliary and total energy	Prioritize cooling or cabinet work
Generator fuel intensity	Fuel consumed divided by generator energy delivered, in L/kWh	Calibrated fuel data and generator-output energy	Detect low-load operation, leakage or maintenance need
Energy OPEX/site	Grid, fuel and defined energy-service cost over the reporting period	Tariffs, invoices, fuel, service cost and measured consumption	Rank investment and maintenance priorities

Battery charging complicates renewable accounting because stored energy may come from both PV and the grid. State the attribution method rather than labelling every later battery discharge as renewable. Also calculate an energy-balance residual. A persistent unexplained difference between source meters, load meters, battery energy change and expected losses often reveals a meter, scaling or timestamp problem.

ENERGY-BALANCE RESIDUAL

Residual = source energy - load energy - auxiliary energy - change in stored energy - estimated conversion loss

Battery KPIs

State of charge (SoC) estimates the energy available now. State of health (SoH) estimates remaining capability relative to a defined reference. Neither is a direct laboratory truth. Both depend on the battery model, current and temperature measurements, calibration history and operating profile.

- SoC, usable reserve energy and estimated autonomy at current load
- SoH, measured-capacity trend and internal-resistance trend where supported
- Charge and discharge throughput, equivalent full cycles and depth-of-discharge distribution
- Cell-voltage spread, module-temperature spread and time outside approved limits
- BMS communication loss, protection, insulation and contactor events
- Time at high SoC or high temperature when relevant to the chemistry and warranty

ESTIMATED BATTERY AUTONOMY

Autonomy = usable battery energy above protected reserve × path efficiency ÷ current critical load

Autonomy should be presented as an estimate with assumptions, not a guaranteed countdown. A sudden load increase, cold or hot battery, BMS limit or ageing can change the result. Compare SoH with controlled capacity tests where appropriate, real discharge events, temperature history and the battery's voltage response under load.

A useful fleet indicator is **reserve compliance**: the percentage of valid reporting intervals in which estimated autonomy remains above the operator's target. It is often more actionable than average SoC because a site can have a healthy monthly average while repeatedly entering the evening outage window with inadequate reserve.

Cabinet and cooling KPIs

Temperature affects battery life, converter derating and alarm reliability. One sensor near a cool air outlet does not represent the cabinet. Record the sensor position and compare inlet, outlet, battery and upper-cabinet zones where the configuration warrants it.

- Median, 95th-percentile and maximum internal temperature
- Minutes above component warning and derating thresholds
- Temperature spread between battery modules or cabinet zones
- Cooling runtime, starts, duty ratio and energy consumption
- Fan speed, compressor state, filter-maintenance interval and door-open duration
- Ambient-to-cabinet temperature difference under comparable load

Correlate temperature with telecom load, solar gain, ambient conditions and cooling state. A high internal temperature with a stopped fan suggests a fault. The same temperature during extreme ambient heat with all cooling devices at full output may indicate insufficient thermal capacity. These cases require different responses.

Design alarms around response and consequence

Every alarm needs an owner, severity, persistence rule, probable causes, response target and clearing condition. Delay and hysteresis can reduce nuisance storms, but protection trips and immediate safety events must retain their correct urgency.

- **Critical:** service or safety is at risk now; immediate action or automatic recovery is required.
- **Major:** redundancy, reserve or a primary function is degraded; intervention is time-sensitive.
- **Minor:** maintenance or performance issue without immediate service impact.
- **Advisory:** trend, forecast or optimization opportunity for planned work.

Track alarm quality as well as alarm count. Useful measures include standing alarms,

repeated alarms per asset, alarms with no assigned action, acknowledgment time, restoration time and the percentage of incidents closed with a confirmed cause. A lower alarm count is not automatically better if filtering hides real events.

Alarm metric	What it reveals	Operational response
Standing alarms by age	Unresolved risk and maintenance backlog	Escalate old critical and major conditions
Repeat rate per asset	Chronic fault or poor threshold design	Investigate root cause or revise persistence rules
Mean acknowledgment time	NOC response and ownership clarity	Adjust routing, staffing or escalation
Unknown-cause closure rate	Weak diagnosis or incomplete event history	Improve logs, event correlation and field feedback

Data quality and secure integration

Data quality is itself an operational KPI. Define clock synchronization, acquisition interval, transmission interval, unit, scaling, accuracy, missing-value flag, counter rollover, retention and late-data handling. Never silently turn a missing value into zero; zero PV generation and missing PV data mean different things.

- Valid-record completeness: valid records divided by expected records
- Data latency: time from measurement to availability in the central platform
- Clock drift and out-of-order event rate
- Meter reconciliation residual and unexplained counter resets
- Sensor plausibility failures and frozen-value duration
- Percentage of assets with current firmware and approved configuration backup

ITU-T L.1395 (07/2025) provides a generic monitoring and control interface reference for telecom power, cooling and building-environment systems. ITU-T L.1396 (10/2025) addresses power, energy and environmental parameter monitoring for ICT equipment. ITU-T L.1350 remains useful when agreeing the whole-site energy boundary.

Remote-control functions require role-based access, authenticated and encrypted communications, approved configuration changes, firmware governance and audit logs. Separate read-only monitoring from control permissions. Define safe local fallback when the WAN, central EMS or vendor service is unavailable, and test that fallback during commissioning.

Use three dashboard layers

1. **NOC view:** current service risk, estimated reserve time, critical incidents, failed automatic actions and safe remote commands.
2. **Energy and maintenance view:** source mix, generator fuel intensity, battery readiness, thermal stress, data-quality exceptions and prioritized work orders.

3. **Management view:** delivered availability, energy OPEX, renewable fraction, avoided generator operation, recurring risk and verified improvement by site class.

Each layer should answer a small set of questions. What needs attention now? Which assets are likely to fail the resilience target next? Where is energy or fuel being lost? Which intervention produced a measurable improvement? A dashboard that cannot support one of these decisions is probably displaying data rather than managing performance.

Begin deployment with a representative group of sites. Validate meter direction, scaling, timestamps and event sequences in the field; compare EMS totals with invoices, fuel records and portable measurements. Once the data dictionary and calculations survive that test, expand by site class rather than copying uncertain KPIs across the entire portfolio.

Huijue can map available controller, BMS, meter and environmental data to an agreed KPI dictionary for a defined project. Final formulas, thresholds, alarm ownership and remote-control permissions should remain under the operator’s approved operating policy.

Build an EMS dashboard around operational decisions.

Bring the site boundary, load profile, autonomy target, tariff structure, alarm policy and available data-point list into the first review. The useful output is not the largest dashboard; it is a trusted queue of actions.

Discuss monitoring requirements through your established Huijue sales or engineering contact.

Related engineering guides

Diesel Reduction Measurement Telecom Battery Health Complete EMS Framework

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