HUIJUE GROUP



How Can Telecom Operators Reduce Diesel Costs with Solar Hybrid Power Systems?

See where a solar hybrid retrofit cuts diesel use, then verify the result with a worked fuel baseline, a cost bridge and sensitivity checks.

PRODUCT KNOWLEDGE

How Can Telecom Operators Reduce Diesel Costs with Solar Hybrid Power Systems?

Identify which operating changes cut fuel use, then separate verified diesel reduction from changes in load, fuel price and maintenance cost.

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Diesel savings verification
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Telecom operators can reduce diesel costs by using solar generation to displace generator energy, storing usable surplus for later operation, and coordinating generator runs with the load and battery charging limits. The financial benefit depends on how much fuel those changes actually avoid, which delivery and service expenses disappear, and what the new equipment costs to operate.

A lower fuel invoice is not enough to prove that benefit. A tower may have lost a tenant, received more grid power or finished the month with less fuel in its tank. This guide follows the result from physical fuel reduction to a comparable operating-cost calculation. It is intended for operators and EPC teams reviewing a retrofit, including sites in Nigeria; the numerical example below is fictional and uses no Nigerian market prices or Huijue project results.

Editorial illustration of a telecom hybrid fuel-cost review; not a photograph of a named site or evidence of achieved savings.

Which changes in a solar hybrid system actually reduce diesel use?

Solar power reduces diesel use when it replaces energy that the generator would otherwise supply. Batteries can extend that displacement beyond daylight and permit generator-off periods, while coordinated charging can avoid long, lightly loaded runs. These effects depend on the actual operating schedule; installed PV capacity alone does not establish a saving.

Use solar energy at the load before it is curtailed

Check the daytime load against available solar output. If the generator remains running at its required minimum load while the battery cannot accept further charging, some potential PV production may be curtailed. More panels may then produce little additional fuel reduction. The first useful improvement may be changing an operating window within approved equipment limits, rather than expanding the array.

Use storage to create useful generator-off periods

A battery charged from solar can supply the site later. A battery charged from diesel shifts generator operation rather than replacing its fuel source: any benefit must outweigh charging, storage and conversion losses. Reserve requirements, battery current limits and the next charging opportunity constrain both approaches. Do not spend emergency reserve simply to make today’s runtime figure look better.

Reduce avoidable load and match the remaining generator duty

Correcting unnecessary cooling or obsolete always-on equipment can reduce the energy the sources must supply. If these changes accompany the solar retrofit, report them as part of the combined project or separate their contribution; do not attribute all improvement to PV. Generator loading and fuel use should be checked together. The NREL energy-system modelling paper illustrates why a load-dependent fuel curve may include a nonzero running component. It does not supply a universal telecom fuel rate.

Consequently, halving generator hours does not necessarily halve litres. A shorter run may carry a higher charging load, and start-up or maintenance running may remain. Use metered consumption or a validated site-specific fuel model to quantify the outcome. The broader off-grid telecom architecture guide covers the choice of sources; here the task is to verify what the chosen retrofit achieves.

Keep the service comparable before comparing fuel

The comparison must cover the same useful service. Establish the telecom and auxiliary loads included in the measurement, the time period, and the required availability. Record grid availability separately from telecom service availability: more grid supply can reduce diesel use without any solar improvement, whereas an unpowered radio can

consume less fuel while delivering worse service.

For credible **diesel savings verification**, retain the interval load, source availability and outage records alongside fuel consumption. Note equipment additions, cooling changes, meter replacements and control changes at their actual dates. If a period contains lost service, quantify it and investigate the cause; do not label the resulting consumption reduction as efficiency.

Use consumption, not simply purchases. Fuel deliveries and opening or closing inventory can fall in different accounting periods. Resolve those records before the savings calculation; the separate telecom diesel delivery reconciliation guide addresses that task. Likewise, a tenant’s bill is not the site’s total operating cost. Keep this analysis at one stated project boundary rather than mixing tenant allocation with system performance.

How should a telecom diesel baseline be adjusted after a retrofit?

Estimate how much fuel the old system would have consumed under the reporting period’s load, source availability and service requirements, then compare that estimate with the retrofit’s actual consumption. Do not compare unlike months without adjustment, and do not assume that fuel changes in direct proportion to load energy.

The DOE FEMP measurement and verification guidelines provide the general basis for comparing performance with an adjusted baseline and documenting changing conditions. This article applies that principle to telecom diesel use; it is not a claim of FEMP certification or a mandatory method for Nigerian projects.

An **adjusted fuel baseline** needs a model that fits the old system’s behaviour. Depending on the available records, that may mean comparing matched operating intervals, using a calibrated fuel-versus-output relationship, or reconstructing the previous source schedule. Test the model against baseline data that were not used to fit it. Show the error and the range of operating conditions it can represent.

Historical generator hours cannot automatically be replaced by the hybrid’s shorter runtime when predicting the old system. The counterfactual asks what the old plant would have done without the retrofit. At a continuously diesel-powered site, the old generator may still need to run throughout the reporting month. At a weak-grid site, the model must instead account for the actual pattern of grid returns and interruptions.

If the reporting load lies outside the observed baseline range, disclose the extrapolation and gather more evidence. A convenient spreadsheet fit is not a substitute for a credible operating model. Seasonal cooling, changed generator condition or additional tenants

may require separate adjustment rather than one percentage multiplier.

Adjusted fuel reduction (L) = predicted old-system fuel at reporting conditions (L) − reporting-period fuel consumed (L).

A worked review: the load increased, but the generator used less fuel

Consider two hypothetical 30-day periods at an off-grid tower. All required telecom service is delivered in both periods, there is no grid input, and the same load meter includes telecom equipment and cooling. Delivered load energy rises from 3,600 to 4,500 kWh. Assume no change in equipment condition, climate effect or starting and ending stored energy that would need a further adjustment.

For teaching purposes only, suppose the old plant’s aggregate fuel relationship at that load-meter boundary is 0.75 litres per generator-on hour plus 0.20 litres per delivered kWh. These invented coefficients are not a generator specification or a recommended design value. They represent the complete old power path within this example, so no additional rectifier-loss factor is applied. The old plant would run for all 720 hours in either month.

Review item	Calculation or stipulated reading	Result
Historical fuel	0.75 × 720 + 0.20 × 3,600	1,260 L
Old-system fuel at the higher reporting load	0.75 × 720 + 0.20 × 4,500	1,440 L
Hybrid reporting-period consumption	Assumed reconciled measurement	600 L
Unadjusted before/after reduction	1,260 − 600	660 L; 52.4%
Adjusted reduction	1,440 − 600	840 L; 58.3%

The 180-litre difference between the two baselines is the assumed effect of serving the additional 900 kWh with the old plant. The adjusted percentage uses 1,440 litres as its denominator. The higher result is defensible only if that baseline relationship and its applicability are defensible; changing a denominator to improve a presentation is not verification.

Multiplying historical fuel by the 25% load increase would give 1,575 litres, which overstates this example’s adjusted baseline. The old plant’s running component did not increase: the period is still 720 hours. This is why even a simple fuel relationship is more informative than a blanket load-ratio adjustment.

The useful conclusion is limited: under the stated assumptions, the hybrid avoided 840 litres during this reporting period while serving the higher load. It does not demonstrate an annual saving, prove a particular battery capacity, or establish that the generator can be removed.

How do avoided litres become net operating-cost savings?

Value avoided litres at one explicitly chosen fuel-price basis, add delivery and generator-service costs that genuinely disappear, then subtract additional hybrid operating costs. Keep price changes and capital expenditure visible instead of folding them into one claimed fuel-saving percentage.

Continue the fictional example using US dollars solely for transparent arithmetic. Assume the historical fuel purchase price was $1.00/L and the reporting-period reference price is $1.20/L, both excluding separately accounted delivery costs. No current Nigerian diesel price or exchange rate is implied.

The historical fuel cost was $1,260. The hybrid fuel cost is $720, giving an unadjusted fuel-cost decrease of $540. At reporting conditions and the same $1.20/L reference price, however, the old plant would have cost $1,728. Avoided fuel cost is therefore $1,008. Both comparisons can be reported, but they answer different questions.

Bridge from the historical fuel cost	Change	Running total
Historical 1,260 L at $1.00/L	Starting point	$1,260
Additional old-system fuel for the higher load	+180 L × $1.00/L	$1,440
Price change on the adjusted 1,440 L	+1,440 L × $0.20/L	$1,728
Fuel avoided by the hybrid	−840 L × $1.20/L	$720

This stated sequence separates load, price and retrofit effects; the price term is applied after the load adjustment. It explains why the unadjusted fuel-cost decrease of $540 and the same-conditions $1,008 avoided fuel cost are not contradictory. Neither calculation alone establishes cash paid: inventory and payment timing can differ from fuel consumption.

Include only costs that change

Suppose the retrofit also avoids $80 in delivery costs and $60 in generator service costs during the period, but adds $70 in solar, battery and monitoring operating costs. These are assumed incremental amounts, not tariffs or automatic consequences of lower runtime. The **net operating savings** are $1,008 + $80 + $60 − $70 = $1,078 for the period.

A fixed delivery contract may cost the same even after litres fall. A service interval may be based on elapsed time as well as engine hours. In either case, do not credit cash that remains payable. If the diesel price already includes transport, remove the separate delivery credit. Add changed grid bills, energy-service fees or other operating costs where they exist; they are zero in this off-grid example, not universally absent.

Distinguish paid invoices from accrued maintenance estimates, and document the difference. A service expense deferred to next month is not necessarily eliminated. Battery replacement is normally a lifecycle cash-flow item rather than a monthly operating invoice; if an accounting reserve is shown, label it and do not count it again as a separate replacement cost in the same economic total.

Test whether the conclusion survives less favourable assumptions

A single monthly result can hide uncertainty in the baseline or fuel measurement. Suppose the example’s adjusted baseline has a conservative uncertainty allowance of ±60 L and the reporting consumption ±20 L. Adding those allowances gives a worst-case avoided-fuel range of 760–920 L, not a statistical confidence interval. At $1.20/L with the same $70 net non-fuel benefit, the operating result spans $982–$1,174.

For a forward-looking decision, test a wider range separately. The table below changes assumed avoided litres and fuel purchase price, retaining the $70 net non-fuel benefit. These are illustrative stress cases, not a probability forecast and not a claim about current fuel prices.

Assumed avoided fuel	$0.90/L	$1.20/L	$1.50/L
600 L per period	$610	$790	$970
840 L per period	$826	$1,078	$1,330
1,080 L per period	$1,042	$1,366	$1,690

The low case leaves $610 before capital recovery, financing and replacement costs. That is the number to carry into a conservative investment test, not a reason to promise a payback period. If the supposed delivery and service savings remain payable, the net non-fuel contribution becomes −$70 instead of +$70, reducing every result by $140.

Investigate a weak result at the source. Low usable PV suggests checking shading, curtailment or operating windows. High generator fuel with few runtime hours suggests checking actual loading and charging losses. An apparently excellent result alongside reduced served energy or missing meter intervals calls for a data and service review before a performance claim. Retain the site energy and availability indicators needed to distinguish these cases.

From an operating result to an investment decision

Do not multiply one favourable month by twelve without examining seasonal solar output, cooling demand, access conditions and network growth. Extend the observation period or use a calibrated forecast that represents those changes, stating which values are measured and which are projected. Keep the verified period result visible even when the investment model changes.

A **lifecycle cost comparison** then adds installed capital, financing where relevant, planned maintenance, battery and other component replacements, and end-of-life costs over one stated analysis period. Compare alternatives delivering the same required service. Show discount and escalation assumptions consistently; do not mix nominal price increases with a real discount rate without converting the basis.

The review should finish with three distinct conclusions: fuel avoided during the assessed period, net operating cost avoided at the stated price basis, and the forward-looking investment result with its uncertainty. An operator can accept the first two while requesting more evidence for the third. A solar retrofit can save fuel yet still fail an investment hurdle because of installation cost, remaining site lease or replacement timing.

Prepare a site-specific retrofit review

Start with one representative site’s load record, reconciled fuel consumption, generator hours, fuel and delivery invoices, and outage history. Add the available PV area and existing cabinet, battery and rectifier configuration. These inputs let Huijue discuss an integrated telecom power configuration without treating a generic savings percentage as a specification.

Ask for the proposed operating changes and a baseline-to-cost comparison with explicit assumptions, then agree how performance will be checked after commissioning. Use the Huijue telecom power products and services scope to identify the equipment under discussion and the responsibilities that still need to be agreed.

Discuss a measured diesel-reduction retrofit

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