GUIDE · 4 PAGES

LCOE — the levelised cost of energy

Derived, worked on a 100 MW solar plant and stress-tested: the levelised tariff, three perspectives, real or nominal, and where it misleads.

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Project finance · renewables · platform management
mjsir.org · Edition October 2026



LCOE — the levelised cost of energy

The **levelised cost of energy (LCOE)** is the constant price per unit of energy at which a plant's lifetime revenue would exactly pay for its lifetime costs, including a return on the capital. It lets a solar farm, a wind farm and a gas plant be compared on one number, and it is the floor below which a tariff loses money. This guide derives it, works an example, shows what moves it and where it misleads.

1 The idea in one line

Suppose the plant sells every MWh at one price, T. The tariff just pays for the plant when the present value of the revenue equals the present value of the costs:

$$\Sigma\, T \times E_t \div (1+r)^t = \Sigma\, C_t \div (1+r)^t \;\Rightarrow\; \text{LCOE} = T = \text{PV(costs)} \div \text{PV(energy)}$$

E_t the energy sold in year t, C_t the capital and operating costs in year t, r the discount rate

That is why the energy is discounted too, which puzzles people at first: it is not that a MWh "loses value", but that the revenue it earns does. Dividing undiscounted costs by undiscounted energy gives a different — and wrong — number.

2 A worked example

Assumption	Value	Assumption	Value
Plant	100 MW solar	Capital cost (spent at the start)	USD 60 mn
Capacity factor	22%	Operating cost	USD 1.0 mn a year
First-year output (100 × 8,760 × 22%)	192,720 MWh	Life	25 years
Degradation	0.5% a year	Discount rate (real)	7%

The present value of the costs is 60 + 1.0 × 11.65 (the 25-year annuity factor at 7%) = **USD 71.65 mn**. The present value of the energy is **2.152 million MWh** (4.54 million MWh in total, discounted). So:

LCOE = 71.65 ÷ 2.152 = USD 33.3 per MWh (3.33 US cents per kWh), in today's money

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The capital cost is 84% of a solar plant's LCOE — which is why the cost of capital matters so much.

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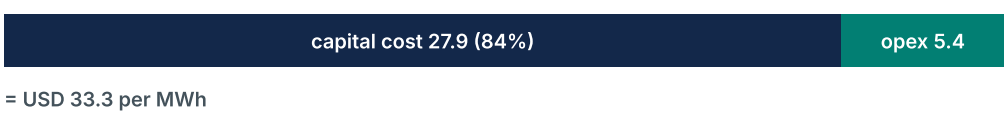

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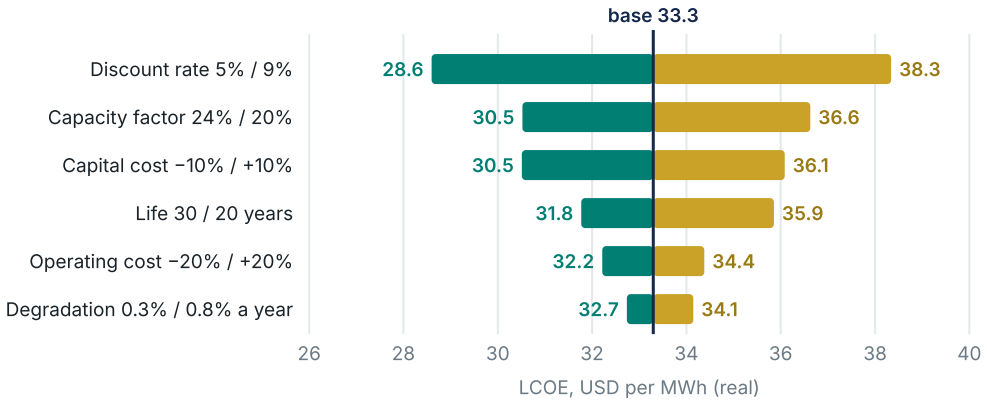
3 What moves it



Each assumption moved on its own, the rest at the base case.

For a plant whose cost is mostly paid up front, the **discount rate** and the **capacity factor** dominate: two points on the rate move the LCOE by about 15%, as much as a 10% change in the capital cost. That is why cheap, long-tenor debt and a good site matter as much as cheap panels — and why the same plant has a lower LCOE where finance is cheaper. Operating costs and degradation matter less for solar; for a gas plant the fuel would top the chart.

4 Cost-based LCOE and the levelised tariff

The LCOE above is **cost-based**: capital and operating costs at one discount rate, usually the WACC, before tax. A bidder setting a tariff needs more — the tariff must also pay the tax, meet the lenders' cover ratios and give the equity its return. The **levelised tariff** (a revenue-based LCOE) is the flat price that makes the equity reach its target return in the full model. For the same plant, with 70% debt at 6% repaid over 18 years, 25% tax and a 10% equity return, it comes to about **USD 37.5 per MWh** — 4.2 above the cost-based figure, the gap being the tax and the equity's return above the 7% rate.

Which one to use

- **Comparing technologies or sites:** cost-based LCOE, all at the same rate.
- **Pricing a bid or testing a tariff:** the levelised tariff from the full model; the margin between the tariff offered and the cost-based LCOE shows how much room there is.

5 Whose cost? Three perspectives

View	What is counted	Discounted at
The project	Capital, operating costs, and any payments to the government	The project's WACC
The builder (EPC)	The plant's cost only — the EPC price and the owner's costs, no operation	The project's WACC
The offtaker	The tariff it pays, plus the grid and delivery charges to get the energy to its customers	The offtaker's own rate

A flat tariff levelises to itself at any rate, but an indexed one does not: an offtaker with a low cost of money sees the later, inflated payments as more expensive than the developer does.

6 Real or nominal

The example is in today's money (real): USD 33.3 per MWh means a tariff that starts at 33.3 in today's money and rises with inflation. If the tariff is to stay flat in money terms instead, it must start higher to make up for the inflation it does not get: with 2.5% inflation (and the operating costs rising with it) the flat nominal tariff is about **USD 41.5 per MWh**. Always say which one a figure is, and never compare a real LCOE with a nominal tariff.

7 Where LCOE misleads

- **Not every MWh is worth the same.** Solar output arrives when prices are often lowest. Compare the LCOE with the price the plant actually captures, not with an average price.
- **Firm power costs more.** LCOE ignores what the system pays to back up variable output. A plant with storage has a higher LCOE but sells something more valuable; storage itself is measured by the levelised cost of storage (LCOS), per MWh discharged.
- **Grid and balancing costs** sit outside the plant's LCOE unless added, as in the offtaker's view.
- **Risk is hidden in the rate.** A merchant plant and a contracted one with the same LCOE at the same rate are not equally good: the merchant one deserves a higher rate.

8 Pitfalls

- Energy not discounted — a lower, flattering LCOE.
- A real rate on nominal costs, or the reverse.
- Construction-period spending and interest during construction left out, or the start date of discounting not stated.
- The gross output used instead of the energy sold after losses, availability and curtailment.
- Replacement capital (inverters, augmentation, overhauls) and decommissioning forgotten.

In Project Finance Studio: Output › Returns shows the cost-based LCOE with its parts, the revenue-based levelised tariff and the margin between them, the EPC view and the offtaker's cost with grid charges — at the project's WACC and at the offtaker's own rate side by side, per kWh or per MWh. The inputs are in Valuation › Levelised cost of energy; the Excel workbook calculates the same with XNPV on the model's dates.

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