CLEAN AIR TASK FORCE

The EU energy transition needs to look beyond LCOE

Europe's power system is undergoing a rapid transformation to meet the intertwined challenges of decarbonisation, affordability, and energy security. Ubiquitous, simple, standardised tools like Levelised Cost of Electricity (LCOE) are widely used by policymakers to compare energy technologies and guide investment decisions.

For instance, the European Commission references LCOE in its impact assessment of the EU's 2040 Climate Target Plan.[1] Some Member States, such as France[2] and Italy[3], have cited LCOE in their national energy strategies. Meanwhile, Spain's renewable electricity auction system is based partly on LCOE[4] and German firms tend to look at LCOE to determine energy investments.[5]

LCOE is not without its limitations, as outlined in a new CATF report, that make it unsuitable for comparing the value of different electricity generation and demand response technologies. LCOE does not account for macro-scale electricity grid system needs nor the generation profile of a given technology, and only considers projects from the perspective of developers (rather than ratepayers).

While LCOE offers a helpful snapshot of project-level costs, over-relying on LCOE risks overlooking the broader system needs and trade-offs critical to building a resilient, low-carbon grid. To achieve European security, affordability, and decarbonisation, a systems-level analysis is more apt—one that entails a diverse set of generation (both variable renewable and clean firm), storage, and demand-response technologies.

How LCOE falls short in informing the EU's energy transition

LCOE represents the average cost per unit of energy produced (€/MWh) for a particular electricity generating technology. It takes the net present value (NPV) of the capital and operational costs of the technology being assessed and divides them by the NPV of expected energy production over the technology's lifespan. LCOE changes dramatically over time depending on the technology and the region. For instance, while electricity generation with natural gas had a lower LCOE in the U.S. after the shale gas boom, it has had a higher LCOE in Europe—especially after Russia's invasion of Ukraine.

LCOE allows for a quick comparison of different technology costs, but has many limitations that affect its accuracy and appropriateness for informing policymaking and how the EU addresses ongoing energy challenges:

$$\text{LCOE} = \text{NPV}\left[\frac{\text{Lifetime costs (\$)}}{\text{Lifetime generation (MWh)}}\right]$$

1 **European Commission. (2024).** COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT REPORT Accompanying the document COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Securing our future Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society.
2 **Government of France. (2025).** French strategy for energy and climate: Multiannual energy programming (2025-2030, 2031-2035).
3 **Italian Ministry of the Environment and Energy Security. (2024).** National Plan Integrated for Energy and Climate.
4 **del Rio, P. & Kiefer, C. (2019).** The future design of renewable electricity auctions in Spain: A comment. Renewable Energy Law and Policy Review 9(3).
5 **Heymann, E. (2023).** Costs of electricity generation: System costs matter. Deutsche Bank Research.

1 **Challenge: The EU must decarbonise its electricity grid to address climate change.**

- **But:** LCOE has catalysed investments mostly in variable renewables, as the Draghi report cautions, leading to continued reliance on fossil fuels as firming technologies to address variability, making it harder to achieve grid decarbonisation.

2 **Challenge: The EU must increase the speed and scale of electrification, all while balancing affordability and reliability for citizens and industry.**

- **But:** LCOE often underestimates the cost for end users, as it only accounts for the cost of generating electricity and does not include system costs for transmission, distribution, and necessary storage—borne not by investors but incurred at a system level—which are all significant for boosting electrification and meeting reliability demands.
- **And:** LCOE fails to consider the dispatchability of a technology and becomes less appropriate with higher VRE penetration, resulting in a less reliable grid.

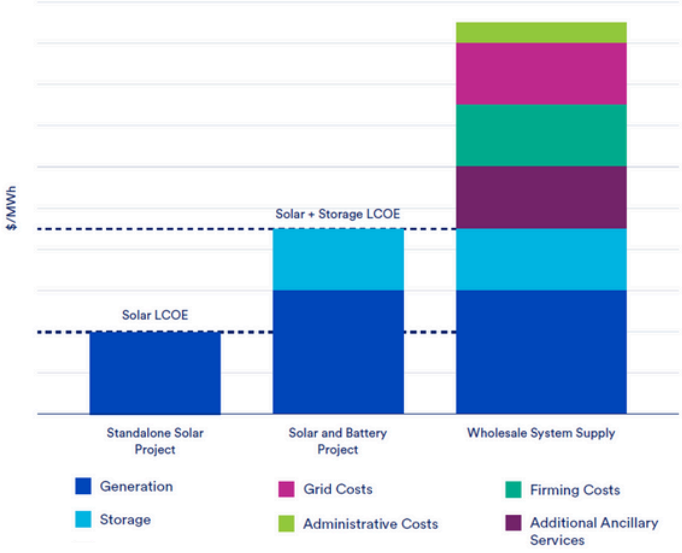

Figure 1: Illustrative breakdown of costs from several perspectives

(Left) The levelized costs of supplying an annual amount of energy using solar, equal to solar's LCOE
(Middle) The costs of supplying an hourly amount of energy using solar and storage
(Right) All costs that add up to customer costs

3 **Challenge: At the same time, a large amount of firm power capacity, which generates about 75% of electricity in the EU, is aging and due to be replaced before 2050.**

- **But:** LCOE overestimates the relative cost of clean firm power by considering only how much power is generated and not when this power is generated, resulting in underinvestment in maintaining or replacing clean firm capacity.

How Europe has used LCOE

LCOE has been used both at the EU level and by its Member States as a reference to set price-based support mechanisms, such as feed-in tariffs in Germany and auction-based premiums in the Netherlands, for different clean energy technologies. It has also been used as a measure to determine the impact of such support mechanisms.

Beyond LCOE

While LCOE remains a useful metric, relying solely on LCOE for informing policy decisions may make it more difficult for the EU to meet its long-term climate and grid reliability needs. To address these shortcomings, EU policymakers must look beyond LCOE by:

- **Using LCOE only when applicable** (such as tracking the effects of policies on the cost of a technology over time) and acknowledging its limitations when doing so.
- **Utilising a system-level analysis** for long-term policymaking that accounts for system needs and costs, spatial and temporal variability, and broader societal trade-offs (such as environmental impact and job creation).
- **Pursuing a diverse set of transmission, storage, clean firm, and demand-response technologies** for a reliable, decarbonised grid with lower costs for citizens.

Taken together, these actions can help EU policymakers, system planners, and investors make more informed decisions that reflect the full complexity of the energy transition. By moving beyond LCOE and embracing a broader set of metrics and tools, the EU and its Member States can better align clean energy investments with long-term goals for decarbonisation, reliability, affordability, and energy security.