Impact on solar energy costs of tripling renewables capacity by 2030

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New estimates show a tripling of renewables by 2030 results in an expected decline of 40-50% in global average solar costs.

In May 2023 COP28 president Sultan Al Jabar called for a global ramp up of renewable energy, including a tripling of capacity by 2030[i]. Solar and wind are already the cheapest forms of new-build electricity generation in most places on the planet[ii], but they are also both subject to strong technology learning effects[iii], so this ramp up is likely to lead to even lower costs in future.

Decisions about which technologies to deploy, and when, in order to reach climate goals, are highly influenced by expectations of their future costs. Historically, energy-economy models have vastly overestimated the costs of several key clean energy technologies[iv], and in doing so, they have also overestimated the difficulty of rapidly transitioning to a net-zero energy system[v].

Using recently developed probabilistic technology cost forecasts, we estimate the impact of tripling renewable capacity in the eight years 2023-2030 and find that this would likely lead to solar costs being halved over the course of the decade.

While solar costs increased marginally since 2021 due to Covid-19 related supply chain disruptions and the invasion of Ukraine, the multi-decadal time series shows that where there have been cost increases in the past, solar has returned to the trend of cost declines within a number of years.

Rapid deployment of green energy technologies that are subject to strong learning effects, such as solar, wind, and batteries, increases the probability of further technological progress and cost reductions, in a virtuous cycle that then leads to further deployment[vi].

Methods

We use the empirically validated experience curve cost forecasting method that was developed by Lafond et al[vii], and applied to the energy system as a whole by Way et al.[viii] at the University of Oxford. We assume a constant capacity factor so that the proposed tripling of capacity is associated with a tripling of energy generation too, and we apply the forecasting method to the scenario of tripling renewable electricity generation by 2030.

A tripling of renewables in the eight years 2023-2030 would correspond to an average annual growth rate of 15%. But in recent years, solar deployment has been growing at 25-30% per year[ix]. In addition, solar currently has far lower deployment than wind[x], and has a stronger learning curve, so there is more scope for solar to grow faster than wind over the coming years. Therefore, rather than assuming that solar growth slows to 15%, in our **central case** we **assume annual growth of 20% for solar** to 2030, and we use the observed 2021 cost of **48$/MWh** given by IRENA[xi]. The median of our 2030 probabilistic forecast for the global average cost of photovoltaics (PV) is **27$/MWh**. This is the value given by the deterministic experience curve model. The 50% confidence interval is 20-35$/MWh, and the 95% confidence interval is 12-60$/MWh.

Assuming annual growth of 25% for solar to 2030, the median of our 2030 probabilistic forecast for the global average cost of PV is **25$/MWh**. The 50% confidence interval is 18-33$/MWh, and the 95% confidence interval is 11-56$/MWh.

Assuming annual growth of 15% for solar to 2030, the median of our 2030 probabilistic forecast for the global average cost of PV is **32$/MWh**. The 50% confidence interval is 24-42$/MWh, and the 95% confidence interval is 14-71$/MWh.

In all cases the median of the cost forecast is well below unabated fossil fuel generation costs.

Comparing the initial cost of 48$/MWh in 2021 with forecast costs of 25$/MW or 27$/MWh in 2030 corresponds to approximately a 40-50% cost reduction.

References

[i] See e.g. https://www.middleeaststar.com/news/273808934/cop28-chair-urges-tripling-of-renewables-capacity-by-2030
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[ix] Way et al. 2022, Empirically grounded technology forecasts and the energy transition
[x] International Energy Agency, World Energy Outlook 2022
[xi] IRENA 2022, Power Generation Costs in 2021