LOW CARBON TECHNOLOGY COST EVOLUTIONS: IS SMALL BEAUTIFUL?

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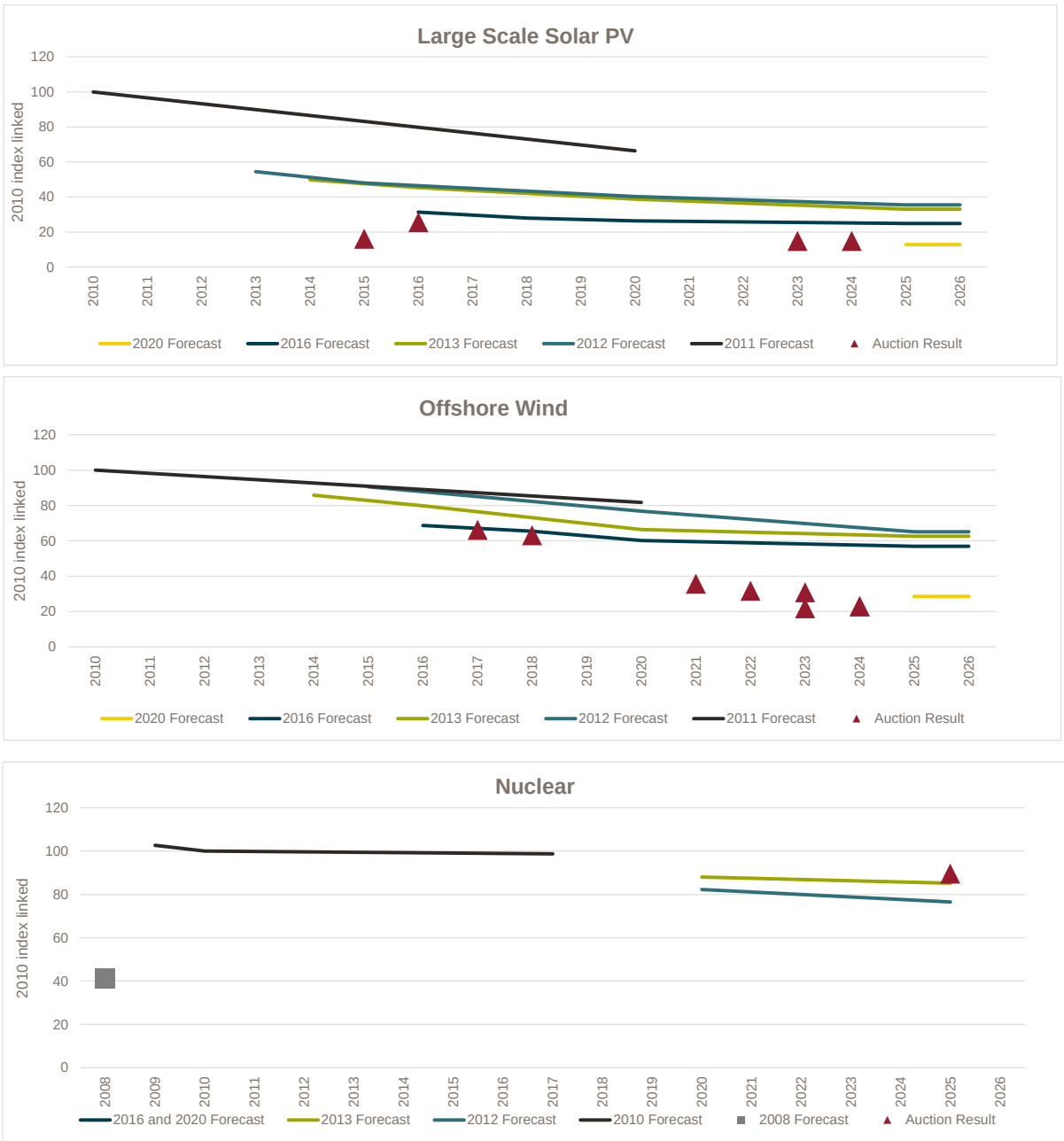
The costs of certain low carbon energy technologies have tumbled in recent years, repeatedly exceeding expectations. However, cost reductions have not been uniform across low carbon technologies. Technologies that can be rolled out in small increments, with improvements made along the way, such as solar PV and offshore wind are able to benefit from technological advancements, and learning and economies of scale in their value chain. In contrast technologies involving large one-off investments and bespoke designs (such as nuclear) benefit less from these dramatic technological improvements. What can we learn from this for remaining low carbon energy battles?

Charts – cost projections and auction clearing results

The charts below, based on UK data, depict the projected levelised costs of electricity (LCOE) from various BEIS forecasts over time, and the auction clearing-result.[1] The LCOE is an estimate of the per unit cost of electricity generation for a generator over its lifetime. Data reflects the date of the planned delivery of the asset.

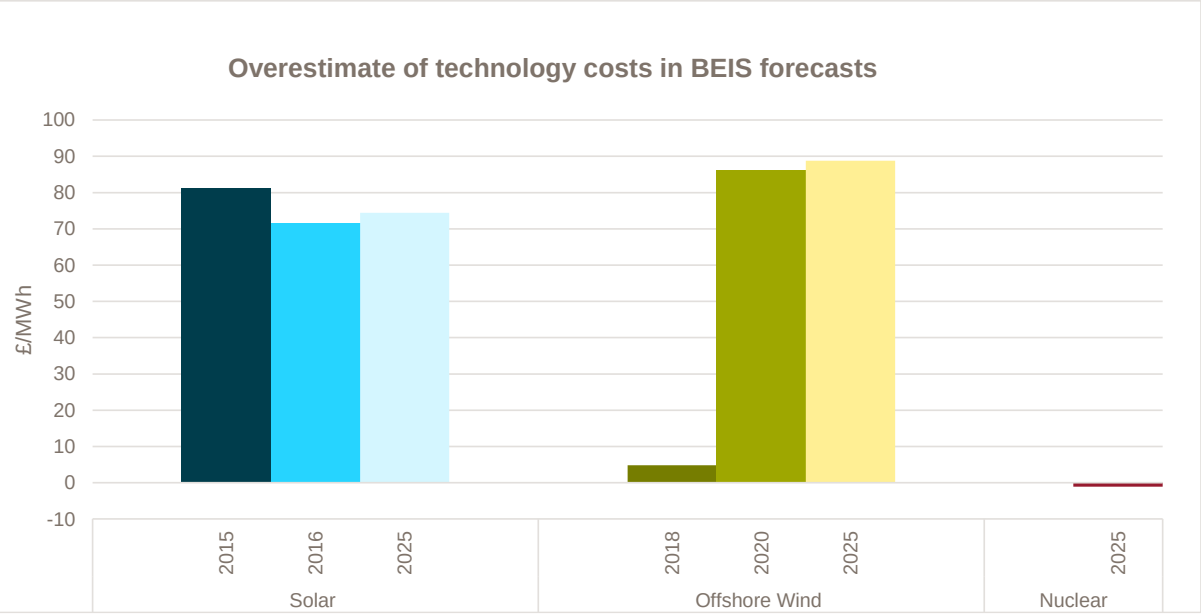
[1] For large scale solar PV, onshore wind and offshore wind, the auction result is taken from the CfD Auction Allocation Rounds. For nuclear, the auction result is the agreed CfD for Hinkley Point C. Data is in 2021 prices.

Figure 1



The chart below illustrates the overestimate of technology costs by BEIS forecasts. That is, the difference, for each low carbon technology, between the earliest available BEIS forecast levelised cost of electricity and the auction clearing-result for projects commissioning in the year shown. Data is in 2021 prices.

Figure 2



One size does not fit all

It is clear that we have systematically underestimated the potential for cost reductions in solar PV and offshore wind (the same pattern has also been observed for batteries). Even though BEIS's cost forecasts have been repeatedly revised downwards, and despite the fact that forecasters include 'learning rates' in their projections[2], observed prices have been dramatically lower than expected.

However, the same cost reduction story does not apply to nuclear. Neither does it for other major infrastructure investments such as HS2 and Crossrail, where outturn costs have greatly exceeded forecasts[3,4].

What is going on here? The tendency for decision makers to be over optimistic on the costs and duration of major projects is well understood. For example, in its guidance on 'optimism bias', HM Treasury suggests systematically adjusting cost projections upwards by between 6-66% for non-standard civil engineering works[5]. But given the tendency of engineering-based studies to overestimate future costs of more modular technologies, should we also be adjusting more for 'pessimism bias' when considering some types of assets?

Recognising this 'pessimism bias' might make us focus more on solutions where the cost reduction potential is greatest. For example, we could pay greater attention to policies that aim to the roll out

[2] For example, BEIS (2020) defines the learning rate as "the rate at which capital costs decrease as more plants are built, resulting from greater technical and construction experience – to reflect the projected decreases in capital costs over time". https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/911817/electricity-generation-cost-report-2020.pdf

[3] https://www.instituteforgovernment.org.uk/explainers/high-speed-2-costs

[4] https://www.nao.org.uk/wp-content/uploads/2021/07/Crossrail-a-progress-update-Summary.pdf

[5] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/191507/Optimism_bias.pdf

standardised, modular technologies, that are being rolled out globally, rather than *grands projets* that require major infrastructure programmes or bespoke designs. We could also concentrate on ensuring that policies give the supply chain time to ramp up and exploit production economies of scale.

These considerations may be particularly important as we begin in earnest to tackle the challenges of decarbonising heating. Small, modular projects may not give politicians an opportunity to 'cut a ribbon' but it may be here where the potential to deliver a truly cost-effective green transition may lie.[6]

Sources

- Levelised cost of electricity estimates are sourced from BEIS's *Energy Generation Cost Projection* reports, available here. Data has been extracted from the 2010, 2011, 2012, 2013, 2016 and 2020 publications.
- Actual costs for solar PV, onshore wind and offshore wind are sourced from BEIS' CFD Auction Allocation Round results (AR1-AR4), available here. Data reflects the planned date of delivery.
- Actual costs for nuclear are sourced from BEIS' CFD for Hinkley Point C, available here.
- All data extracted has been converted into 2021 prices using CPIH, sourced from the ONS's CPIH Index, available here.

[6] Farmer et al (2021) find that, if solar PV, wind, batteries and hydrogen electrolyzers continue to follow their current exponentially increasing deployment trends for another decade, near-net-zero emissions can be achieved in the energy system within 25 years, and that a green-energy transition will likely result in overall net savings of trillions of dollars. In contrast, a slower transition or nuclear driven transition is far more expensive. The report is available at: https://www.inet.ox.ac.uk/files/energy_transition_paper-INET-working-paper.pdf?utm_source=substack&utm_medium=email