Costs of Storage

A detailed analysis of the cost levels of storage has been published in Joule online magazine[1] and reported on by Vox[2]. In a nutshell, they analyse the "energy storage capacity cost" levels which storage needs to achieve in order to be affordable as a back-up for renewable generation. They analyse the longest-duration weather patterns in four locations, for which such back-up would be needed, and the cost of renewable generation, and from this they derive a target cost of storage that would enable the retirement of fossil-fuelled back-up plant.

In Europe, the long low-renewables period is the *kalte dunkel Flaute*[3]. This covers most of the continent for a fortnight every couple of years. If the geography is reduced to a few countries, and the duration to a few days, then it's a frequent occurrence, many times annually. If negligible energy production overnight is considered, then it's very frequent.

What concerns me, even after looking at the original article, is the absence of a definition of "energy storage capacity cost" - which is it?

- Capital cost per MWh generated per annum?
- Levelised cost of storage?
- Levelised cost of electricity, i.e. including the cost of buying the input electricity?

Their costs are in $/kWh, so multiply by a thousand to get our $/MWh (I'm not doing the currency transition as that fluctuates too much). Their objective is "an energy storage capacity cost of $10-12/kWh" = $10-12k/MWh for a 100% availability grid.

For the 95% availability grid, the "energy storage capacity cost" threshold is $150.

Working this out for our 40MW 200MWh plant,

- Assuming that it operates for 4.5 hours a day, 350 days p.a., it would generate 63,000MW p.a. At $60m for the plant, this equates to a capex of $0.95/MWh generated; add a cost of capital for the year of 5%, and this rises to exactly $1.
  - Doubling our duration increases capex by ~30% for TES CAES and ~15% for CCGT CAES, so longer duration plants' capex per MWh are cheaper.
  - This version of "energy storage capacity cost", LCOS and LCOE don't benefit from scale in the same way as they depend largely on electricity throughput, rather than duration.
- Our estimated LCOS is $68/MWh.
- Our estimated LCOE is $110/MWh.

[1] https://www.cell.com/joule/fulltext/S2542-4351(19)30300-9
[2] https://www.vox.com/energy-and-environment/2019/8/9/20767886/renewable-energy-storage-cost-electricity
[3] https://energytransition.org/tag/dunkelflaute/

I think that the "energy storage capacity cost" to which they refer is the first of these: under Fig.1, for 100% grid availability, they calculate "this figure ... for cost-minimizing systems with generation costs of $1,500/kW for wind and $1,000/kW for solar and storage costs of $1,000/kW for power capacity and $20/kWh for energy capacity." Therefore it appears to be a capital cost per output kWh, for which I assume that the output kWh is an annual figure rather than a lifetime one.

- Therefore, our costs are below their $20/kWh even if our output is one-twentieth of our 4.5 hours per day, i.e. just 13.5 minutes per day. That's many multiples lower than the worst-possible estimates of plant utilisation that have ever been made for our technologies.

Our LCOS is already where batteries aspire to be in the mid-2030s, and batteries can never practically do our scale and duration owing to resource constraints of the various metals especially lithium, cobalt and rare earths.

Grid-scale electricity storage
using an innovative form of
Compressed Air Energy Storage

About Storelectric

Storelectric (www.storelectric.com) is developing truly grid-scale energy storage using an innovative form of Compressed Air Energy Storage (CAES). This uses existing, off-the-shelf equipment to create installations of 500MW, 2-21GWh with zero or low emissions, operating at 68-70% round trip efficiency, at a cost of £350m (€500m) (estimated for 3rd – 5th plant), and a levelised cost cheaper than that of gas-fired peaking plants (OCGT). Capex is one-third that of pumped hydro per MW and 1/75th per MWh; similar to 10-year target prices of batteries per MW and less than 1/1,000th per MWh. There is potential in the UK to store the entire continent's energy requirements for over a week; potential in mainland Europe and the USA is greater still, with global roll-out planned.

The next stage is to build a 40MW, 200MWh pilot plant with over 62% efficiency (grid-to-grid), using scale versions of the same technology, for which Storelectric is currently raising funds. Construction will take 2-3 years from funding, and the first full-scale plant a further 3-4 years. The consortium includes global multinationals who cover all the technologies involved, their installation, financial and legal aspects.

Storelectric has a second technology, CCGT CAES, which is the only CAES technology that is retro-fittable to a suitably located gas-fired power station (either CCGT or OCGT). As such it is a very good value technology that can almost halve emissions and add storage-related revenue streams, giving new life to stranded assets. It is an excellent transitional technology.

In the future, Storelectric will further develop both these and hybrid technologies, and other geologies for CAES.

About the Author

Mark Howitt is a founding director of Storelectric. He leads Storelectric's technical and operations, minimising technological risk, maximising efficiency and environmental friendliness, and speed to market. His degree was in Physics with Electronics. He has 12 years' management and innovation consultancy experience world-wide. In a rail multinational, Mark developed 3 profitable and successful businesses: in commercialising his technology, in logistics and in equipment overhaul. In electronics manufacturing, he developed and introduced to the markets 5 product ranges and helped 2 businesses grow strategically.