Fads and Fallacies of the Energy Transition

Throughout the energy transition, technology after technology has been lauded as "the big thing" of the energy transition, "the solution" to the challenges involved. The energy transition isn't carefully thought through – it's driven by fads.

First Four Fads: Batteries, Distributed, Virtual, Demand-Side
The principle current fads are batteries, distributed, virtual and demand-side. They all fall down on a number of factors, including:

- ♦ All are small-scale and rely on the grid for back-up: what's on the grid providing that back-up? (Us...)
- ♦ All are DC connected and therefore have no inertia, real reactive power/load, grid-forming capability (unless expensively fitted out), voltage/frequency regulation etc.: what provides those naturally? (Us...)
- ♦ All are small scale: how do they expect to solve GW scale problems with kW or MW scale solutions? (We're at the right scale...)
- ♦ What happens after sunset on a windless winter evening, when batteries and DSR are exhausted by 6pm and there's no real power for virtual solutions to optimise? (Us...)

Fad 5: Interconnectors
When confronted with those, they all fall back on fad no. 5, interconnectors, saying that if renewables aren't generating somewhere, they are generating somewhere else:

- ♦ Sunset on a windless winter evening happens across Europe simultaneously. Weather patterns extend this to up to a fortnight (the *kalte Dunkelflaute*, cold dark doldrums). What then? (Us...)
- ♦ For generation from one corner of Europe to be balancing lack of generation in another would require 2,000-mile transmission lines of at least 500GW going along all points and half-points of the compass: prohibitively expensive, and environmentally unacceptable...
- ♦ ...And it would require enormous over-capacity of generation in every single corner of Europe to make up for lack of generation elsewhere – which is also prohibitively expensive, and environmentally unacceptable.
- ♦ And the interconnectors are DC systems, so carry no real inertia or real reactive power/load etc.

Fad 6: Hydrogen
At this point they jump on fad no. 6, hydrogen. However:

- ♦ If electrolysis absorbs the intermittency of generation, it needs 3-8 times as many expensive (both capex and opex) electrolysers...
- ♦ ... and doesn't solve the problem of demand variability, unless burning hydrogen in turbines whose theoretical maximum efficiency is barely over 40% for the electricity-to-electricity cycle, compared with our 70% with much cheaper kit.
- ♦ Hydrogen is great for feeding into industrial-chemical processes (e.g. steel making), the gas grid and use cases where the output is not electricity (e.g. fuel

cell vehicles where the output is portability and motive power), but not where the output is grid-based electricity.

- Electrolysis is focused on current PEM (Proton Exchange Membrane) technology which is fundamentally costly (over 6x cost of Steam Methane Reformation) and small-scale – even ramping up output 100-fold will only reduce this by less than 60%[1]. Alkali processes are proven and large-scale but use lots of noxious chemicals. There are other electrolysis processes that are fundamentally large-scale and cheap at such scales, but these are being ignored.

Fad 7: CCS

The final fall-back, fad no. 7, is CCS (carbon capture and storage) generation. This is advocated by the hydrocarbon industry desperate to get governments to invest billions and adopt burdensome legislation, all to give them a future. But they usually fail to consider a number of points, including:

- CCS equipment imposes a 20-30% inefficiency on any power station to which it's fitted, while increasing capital costs greatly (see, for example, studies by Harvard and Stanford Universities).
- Carbon capture effectiveness (i.e. capture %) isn't perfect (~85-90% in systems that are put forward as being potentially affordable within a decade or two), and its cost and inefficiency penalty increase exponentially with capture effectiveness (see the same studies).
- Any leak in the capture equipment, pipeline or storage location would cause an asphyxiating cloud of CO2 that would drift over population centres like a WW1 chlorine gas cloud, only it can't be seen or smelt, or fought by simple means (chlorine is resisted by breathing through a wet rag), and is 50% heavier and therefore much slower/harder to disperse.
- Most carbon usage (the U in CCUS) is merely delaying the emissions, not preventing them.

Which all begs the question: why are policy makers and regulators so determined to ignore large-scale long-duration storage, which can resolve every one of these issues? It has frequently been described as the missing link or Holy Grail of the energy transition, yet policymakers are determined not to support it with financing first-of-a-kind commercial-scale plants, and regulators are determined to undermine it by mis-defining storage as a type of generation, by eliminating contracts of durations that encourage investment, by salami-slicing contracts which split up services that such storage cannot deliver separately, and by wasting billions in supporting technologies that, frankly, can't do the job. That is not to say that those technologies are wrong: they have their place. But people seek magic bullets, one-size-fits-all solutions. They don't exist. But they do give them hundreds of excuses for not considering the issues in the round. Or, more bluntly, for giving as little thought to the challenges as they think that they can get away with.

[1] https://www.energy.gov/sites/prod/files/2014/08/f18/fcto_2014_electrolytic_h2_wkshp_colella1.pdf and https://www.sciencedirect.com/science/article/pii/S0360319917339435

Instead, a cost-effective energy transition requires an entire ecosystem not just of zero-carbon generation but also of supporting technologies, as described in a previous blog article. And it needs to be regulated sensibly, as outlined here. Storelectric has published many supporting articles on its website, such as on:

- Saving Billions on Grid Upgrades (UK experience, applicable globally)
- Black start
- Inertia and grid stability
- Synergies with renewables and interconnectors
- Other regulatory issues
- The scale of the need for storage

About Storelectric

Storelectric (www.storelectric.com) is developing transmission and distribution grid-scale energy storage to enable renewables to power grids reliably and cost-effectively: the world's most cost-effective and widely implementable large-scale energy storage technology, turning locally generated renewable energy into dispatchable electricity.

- Innovative adiabatic Compressed Air Energy Storage (Green CAES ™) will have zero / low emissions, operate at 68-70% round trip efficiency, levelised cost significantly below that of gas-fired peaking plants, and use existing, off-the-shelf equipment.
- Hydrogen CAES ™ technology converts & gives new economic life to gas-fired power stations, reducing emissions and adding storage revenues; hydrogen compatible.

Both technologies will operate at scales of 20MW to multi-GW and durations from 4 hours to multi-day. With the potential to store the entire continent's energy requirements for over a week, global potential is greater still. In the future, Storelectric will further develop both these and hybrid technologies, and other geologies for CAES, all of which will greatly improve storage cost, duration, efficiency and global potential.

About the Author

Mark Howitt is Chief Technical Officer, a founding director of Storelectric. He is also a United Nations expert advisor in energy transition technologies, economics, regulation and politics – invitation here.

A graduate in Physics with Electronics, he has 12 years' management and innovation consultancy experience world-wide. In a rail multinational, Mark transformed processes and developed 3 profitable and successful businesses: in commercialising a non-destructive technology he had innovated, in logistics (innovating services) and in equipment overhaul. In electronics manufacturing, he developed and introduced to the markets 5 product ranges and helped 2 businesses expand into new markets.

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