The Future Role of Hydrogen

Hydrogen will play a significant role in zero-carbon economies in the future.

1. It can be stored at large scale, especially in salt caverns which can be formed in much of the world;
2. It can be stored at ultra-high pressure – vehicle makers are considering up to 700bar: it's more compressible than other gases as its molecule size is so small;
3. There are increasingly promising developments in high-density and safe storage, especially for portable / transportation applications;
4. It can directly replace gas in a gas grid, though modifications will be required for its handling (avoiding leakage, accommodating the higher flows required per kWh) and combustion (flame characteristics are different);
5. It's much more suitable than batteries for long-distance and large-vehicle transportation (which may include ships and possibly even aircraft), through fuel cells, and can be re-fuelled much more quickly;
6. Hydrogen is also a feedstock for other industries, such as fertiliser / ammonia.

To achieve all this, electrolysis needs to get much cheaper and higher volume, which is why the above role in zero-carbon economies won't be for another 5–10 years. Methane reformation is not the way forward: CCS / CCUS technologies are only (at best) 80% effective at capturing CO_2, with costs rising exponentially with effectiveness; they add too much to the cost of hydrogen; CO_2 use merely defers emissions rather than sequestering them; and nobody's identified a solution to the insurance risk of CO_2 storage.

Proton Exchange Membrane (PEM) electrolysis is not the way forward: it's too small-scale and expensive, not least with the limited life of the membranes. It will retain a significant and fast-growing market at the smaller scale and possibly also for mobile devices such as on-board ships, but grid- and industrial-use will be with other technologies.

There are, however, some promising large-scale electrolysis technologies being worked on at present, which may well yield the volumes and costs required to enable it all.

As ever, the trick is not to "pick a winning technology" as so many seek to do, but to identify the best niche for each technology and to knit them all together into a system that covers all needs. This is very similar to what mankind has done to date, with no energy technology ruling the roost but all having their right places in the mix. And, just as happens today, there are also suitable applications that use more than one technology to deliver a complete solution.

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.