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

HM Treasury Disincentivisation of Decarbonisation

Input to HM Treasury Select Committee Review June 2016

Her Majesty's Treasury has many ways in which it is impeding decarbonisation. This document focuses on the electricity system, because that is the scope of Storelectric's work. Storelectric is seeking to build innovative large-scale long-duration storage on the UK electricity system, and to build up a UK-based industry to address a multi-trillion dollar market with world-leading technology, but has been stalled for 6 years in doing so largely by Treasury disincentives. These split into two main categories: finance, and energy.

Energy

The government defines storage as consumption plus generation, meaning that all charges relating to both are applied to it, thereby triple charging storage for (for example) grid access and climate levies. Generally people talk about double charging (for import and for export of electricity), but the electricity purchased by storage already has those charges applied; therefore it is triple charging.

Energy storage generates no new electricity. It just moves electricity in time very similarly to interconnectors moving it in space: from when it's not wanted to when it is, while interconnectors move it from where it's not wanted to where it is. Therefore storage should be defined as storage, a grid service, based on the definition of interconnectors.

Treasury effects of this include that storage does not qualify for EIS or other investment incentives, thereby penalising it by redirecting funds that would otherwise be willing to invest. They are largely redirected into industries that don't help decarbonisation or the future of the country, whereas storage does.

The regulatory and contractual system for electricity is also exceedingly short-sighted, and has already resulted in higher electricity costs than neighbouring countries, together with the grid's assets aging greatly, and the need for any new strategic investment to be incentivised by a market-distorting special financial instrument. It would be relatively simple to construct a system that incentivises major capital investment, clean energy and the introduction of new technologies without costing a penny more in overall system costs. Please see the associated document "A 21st Century Electricity System".

Finance

Treasury's incentives for entrepreneurship and investment are all regardless of technology risk. Therefore, following good principles of financial management, because benefits are unrelated to whether or not financiers and investors take on technology risk, they don't. This means that private sector funding (especially at larger scales) is not available for innovative industries, businesses and technologies.

This means that we can finance a chain of restaurants or shops, but not innovative industry that can help UK PLC to grow.

Human beings define technology risk as any risk that is of a technical nature. But financiers define it as anything that hasn't been done before. This means that if I were to propose a cotton shirt with a plastic collar, they would define it as technical risk. But humans know that there's no technical risk involved (tens of thousands of sweatshops can make them), but that it's a commercial risk as nobody would buy them. Financiers' definitions need changing, because their entire philosophy and strategy are based on it and on risk aversion.

This risk aversion itself needs to be addressed by Treasury incentives. This is not an argument for additional money, but a change in the award definitions to incentive investment in prototypes and first-of-a-kind commercial products/plants. It would be worth considering allowing some mitigation of a first-of-a-kind plant's costs as a tax break, given that follow-on plants will almost always be more reliable and efficient. It applies to EIS investments, tax breaks for financial funds including pension schemes, R&D tax credits, etc.

A consequence of this aversion to technical risk, and the lack of incentivisation to take it on, is the de-stabilisation of the entire financial system. There are trillions of funds in any currency seeking "safe" investments. Nothing is considered safer than property – except a diversified portfolio of it, so everyone rushed into a sub-prime mortgage investment bubble. When that burst, they all sought the next safest investment and piled into SE Asia, creating another bubble that burst 2-3 years later. It keeps looking for safe investment after safe investment, de-stabilising each by the massive in-flow of too much money seeking too few assets in the category. If some of this money were redirected into innovative industries, not only would those industries be funded and lead national and world growth, but also the other industries would be re-stabilised by the re-balancing of risk and reward.

It would greatly help if funds were given a credit on condition that at least 5% of the fund is invested with significant and auditable technical risk. This means that 95% is still invested "safely", while 5% (which is a big sum when applied to trillions) goes into new technologies and their commercialisation, with the possibility of much higher returns. By all means, ensure that this money (to qualify) is invested in the UK.

We have had innumerable expressions of interest to finance follow-on plants, but not one to finance our first. For decades, British industry as a whole has been great at invention, but terrible at commercialisation – exactly for this reason. A decade and a half ago the US Secretary of State for Defense stated that one-third of all their new technologies are invented in Britain. They have to go to America to be commercialised, because there is no significant money available for doing so in Britain, for this reason. Given the trillions of pounds washing around our financial systems, this begs the question as to how (when the country was much poorer) we financed the Industrial Revolution.

Government's Clean Growth Strategy

The government's Clean Growth Strategy is very short-sighted and is leading the country into huge additional costs for that reason. For example,

1. Investment in many interim solutions such as fracking and encouragement of a second dash-for-gas is helpful in achieving our 2030 goals of reducing emissions, but every one of these new assets would be stranded by 2040 or 2050 because the need then is to eliminate emissions.
2. This is leading to a pious faith in magical solutions such as biomass energy with carbon capture use and storage (CCUS). There is insufficient land on the planet for that amount of biomass. And CCUS is so expensive (without considering the 30% "hit" on power station efficiency) that even in America every single project has been killed before construction: if they can't afford it, what hope have we? Finally, nobody has solved the insurance question: CO_2 is heavier than air, so if any North Sea storage were breached (e.g. by earthquake), the resultant burp of CO_2 would hover on the water asphyxiating anyone in ships above. This risk remains until the tectonic plate is subducted. All 6 North Sea countries decided that this was too great a risk for any country to bear, so asked the EU to do so. The EU looked into it carefully and said that they couldn't. The Peterhead and White Rose CCS projects were cancelled a fortnight later: coincidence?
3. Incrementalism in (for example) adding hydrogen to gas grids will result in multiple conversion programmes like the transition from town gas to natural gas in the 1970s as the combustion characteristics of the gas will be different as the hydrogen percentage increases; what's needed is a leap to 100% hydrogen in one part of the country (with a single conversion project), gradually to be rolled out elsewhere. That is merely one example.
4. The asset-sweating strategy regarding the electricity grid is greatly impeding investment and decarbonisation.
    - If 10,000 EVs were projected for each of Warwick and Leamington Spa, and in fact 15,000 were to be bought in Warwick and 5,000 in Leamington, the grid would be totally disrupted and unable to cope: our forecasts are too inaccurate (numbers of EVs in 2018 are over 40 times the forecast 10 years before, if I remember correctly), so we must build excess capacity because of the lead time to construct grid reinforcements.
    - As the ENA (Electricity Networks Association) will tell you, there is a case study in Southern Australia where investment was deferred as being too expensive; when the need became critical just a couple of years later, it cost three times as much to undertake the work as an emergency programme – so even if a small proportion of the built-ahead-of-need assets prove unneeded, the overall programme cost is greatly decreased by building ahead of need.
    - The time and cost to build and install new grid connections is so great that many useful and excellent projects are not proposed: it is not only the direct costs, but the indirect costs of tying up money and resources for extended periods.
    - There is a regulatory and governmental obsession that National Grid "gold-plated" the system, but in fact almost every asset built then has proved

useful even if that use has come a few years later than the original forecast.
- If we had only built to proven need, the National Grid would never have been built.

5. The short-sighted focus on meeting 2030 targets is failing to put in the investment and incentives required to develop, test and roll out the technologies required to meet our 2040 and 2050 targets.

Instead, the government and all regulators and departments should determine their 2050 objectives, together with alternatives, and undertake / incentivise all investments into plant, networks and technologies accordingly. They should structure all contracts and regulations to deliver this. Otherwise the costs of the energy transition will become unacceptably high to the entire country, and be passed onto either government as subsidies or consumers as charges – or both.

The Opportunity

The UK has immense innovative capacity in all fields, including in technologies that lead to decarbonisation. If we overcome the many disincentives in HM Treasury and elsewhere to their development, commercialisation and adoption, the opportunity to develop world-beating businesses, technologies, products and services, and to keep those businesses based in Britain.

This would have the additional benefit of regional re-balancing: most of the industries considered “low risk” by the financial services sector are in the South East; most technical innovation is done and wishes to be developed elsewhere in Britain.

Conclusion

In conclusion, to support the UK economy as a whole and decarbonisation in particular,

1. Reduce incentives where there is no technical risk, using this freed-up money to increase incentives for first-of-a-kind plants and products, and their commercialisation;
2. Incentivise financial funds to invest at least 5% in technically risky ventures;
3. Ensure that strategies, regulations, concepts and incentives are geared towards 2050 targets rather than any intermediate stages;
4. Invest in infrastructure according to forecast rather than need, to enable the transition and minimise the cost and timescale of building the infrastructure;
5. Re-define energy storage as storage, a grid service, regardless as to whether or not other branches of government do so.

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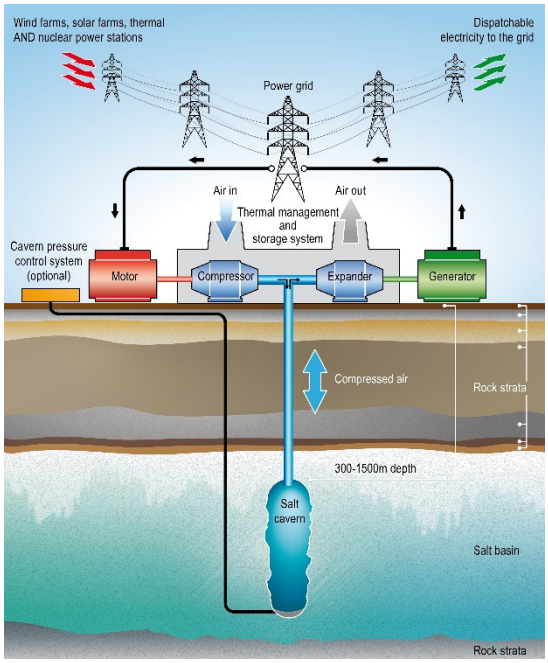
About Storelectric

Storelectric (www.storelectric.com) is developing transmission and distribution grid-scale energy storage.

- Innovative adiabatic Compressed Air Energy Storage (TES CAES). Our 500MW, 2.5-21GWh installations 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.
- Their CCGT CAES technology converts and gives new economic life to gas-fired power stations, halving emissions and adding storage revenues. Addresses the entire energy trilemma: the world's most cost-effective and widely implementable large scale energy storage technology, turning locally generated renewable energy into dispatchable electricity.



The potential to store the entire continent's energy requirements for over a week; potential globally is greater still. In the future, Storelectric will further develop both these and hybrid technologies, and other geologies for CAES.

About the Author

Mark Howitt is Chief Technical Officer, a founding director of Storelectric. He leads Storelectric's technical and operations, minimising technological risk, maximising efficiency and environmental friendliness, and speed to market. He focuses on technologically simple solutions using proven technologies wherever possible.

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 a non-destructive technology he had innovated, 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.