Hyperscale Energy Storage Options

Hyper Scale Energy Storage (HSES) for long durations simply does not exist. All other technologies offer 4-24 hours of storage. EIC is the only technology provider that is focusing on large scale (1 GW, TWhrs) and long term (40 days) energy storage. As such, this competitive assessment is designed to describe what's available today, and how EIC's iCAES is superior.

- In the absence of meaningful alternatives, technology choices are limited to addressing base load, intermediate and peaker plants with batteries, which, in turn, lead to sub-optimal solutions. This is precisely why EIC's solution will provide a much better answer: lower delivered energy costs over a thirty-year project life, with very high availability.

- Without tax subsidy, solar power is already cost competitive with Combined Cycle Power Systems using Natural gas. Coupling this with EIC's long term energy storage provides an unbeatable proposition compared to natural gas plants, while enabling a green future with zero carbon emissions.

- Relative to conventional CAES, EIC iCAES achieves near-isothermal compression using Liquid piston technology, thereby avoiding use of adiabatic, high temperature compression using centrifugal compressors. Likewise, the expansion cycle is made much simpler, again with near-isothermal operation. No heat exchangers or burning of fossil fuel is required, making iCAES truly zero carbon technology.

- Pumped Hydro has captured 95% of the energy storage market today. It is more expensive at the hyper scale and long term (40 days) than EIC. While EIC technology is constrained by availability of sub-surface storage, such reservoirs are much more ubiquitous than hills and mountains across the globe.

- Li-ion batteries have excelled as the primary chemistry of choice in consumer electronics for the last decade, and are now finding a limited role on the grid. In general, Li-ion batteries have excellent energy and power densities and round-trip efficiency. However, their average duration of 4 hours limits their ability to support the integration of high percentages of renewable energy.

- There is large uncertainty in nascent hydrogen and fuel cell technologies, but best estimate is several times the cost of of iCAES. For hydrogen, the problem has been that the end-to-end efficiency of electrolysis-based hydrogen energy storage has typically been less than half that achieved by a lithium ion battery. That said, If and when hydrogen as an energy storage option becomes viable, our liquid pistons will provide a more cost-competitive way to achieve the compression step.

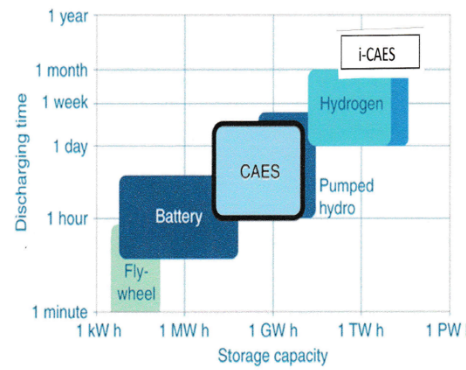
Hyperscale Energy Storage Options

Comparison of Various Storage Options: <12 hours of storage

The two most relevant factors of comparison for different solutions are the cost basis of the $/KWh delivered, and the total capital cost. The former is the best indicator for viability and the latter for affordability and ability to finance the project. Other relevant factors for comparison include Technology Readiness, Sustainability, Scalability and Locatability. Hydrogen is not included since it is too early to make value judgments on all parameters.

The below table, that compares options along multiple dimensions has a major caveat: <12 hours of storage. Once longer-term storage is called for to support 100% renewable energy, most of the technologies do not compete. As shown in Fig 1, only CAES and Pumped Hydro can deliver several days of storage. EIC's i-CAES improves on the problems associated with conventional CAES, while being more locatable and less expensive than Pumped Hydro. Hydrogen holds promise for the future but is a decade or more away from broad commercial deployment.

Figure 1: Storage Technologies



COMPARISON OF VARIOUS STORAGE (**<12 Hrs**) TECHNOLOGIES

Technology	Low Capex	Low Opex	Maturity	Scalability, Expandability	Sustain-ability	Efficiency Rel to 80%	Lifespan 30+ yrs	Locat-ability
i-CAES	●	●	◕	●	●	◕	●	◑
CAES	●	◕	●	◕	◑	◑	●	◑
PUMPED HYDRO	◕	◕	●	◕	◕	●	●	◔
FLOW BATTERY	◑	◑	◑	◑	◑	◕	◕	●
Li-ion BATTERY	◑	◕	◕	◑	◑	●	◔	●
LIQUID AIR	◑	◕	◑	◑	●	◕	◕	●