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Long Duration Energy Storage - Biomass Waste to Value (WTV)

Additional submitted attachment is included below.

ELECTRIC PROGRAM INVESTMENT CHARGE (2021-2025) (EPIC 4)

Comments on Technology Advancements for Energy Storage

Need and Role of Mid-to-Long Duration Energy Storage: California is making unprecedented progress to transition to renewable energy systems in a short time to combat climate change. The state is transitioning from fossil power plants which have been reliable sources of electricity for decades. The overproduction during the day has led to curtailment and expensive export of the excess electricity to neighboring states. There are also safety concerns associated with electric lines which have led to forest fires. The severe drought conditions and prolonged record-high temperatures have increased the intensity, frequency and acreage of forest fires. PG&E is proposing to put all high voltage lines underground to prevent which is estimated to cost over $10 billion. The intermittency of renewables poses a demand-supply balancing challenge for the utilities especially for the long duration. More cost-effective, innovative solutions are needed. This challenge can only be resolved by Energy Storage, short-term, mid-term, long-term, and seasonal energy storage.

Energy Storage for Grid Reliability: As the Californian economy strengthens and moves increasingly to digital communication, the reliability of the grid becomes ever more important. Increasing the reliability beyond 99% is needed; however, this becomes much harder when exceptionally high demand and/or low generation must be balanced. Balancing this gap is with conventional batteries is expensive as the batteries installed to achieve the last 1% will be sitting idle for 99% of the time. This begs the need for alternate innovative solution, such as Hydrogen (H_2) and renewable natural gas (RNG)– for which the marginal cost of additional hours of energy storage is small. (**Figure 1)**.

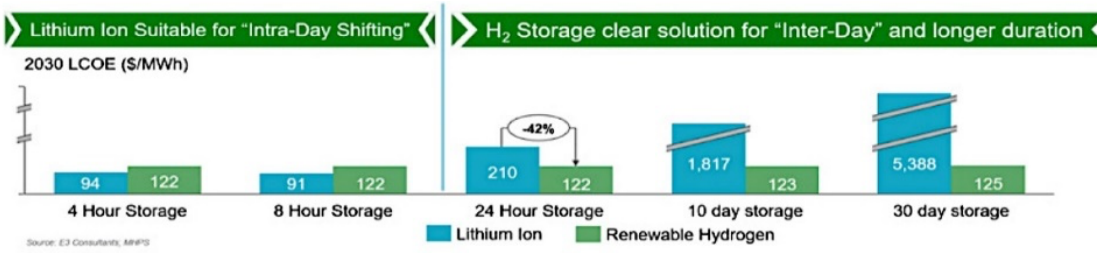

Figure 1. Cost of Energy Storage - Battery vs Hydrogen:
H_2 energy storage becomes competitive for long-term energy storage.

Lowering Energy and Infrastructure costs for electric vehicle (EV) Integration: California is leading the nation in EV adoption. It has made excellent progress in supporting the EV infrastructure. The EV charging in evening is increasing causing additional demand on the grid when the solar production is lower. The California utilities are already facing shortages in the evening (more than 25,000 MW or 25% of the state's generation capacity) as shown by the duck curve (**Figure 2**).

There is a huge trough in net electricity demand during the day when solar energy is at its peak. Increased penetration of EVs into the grid will exacerbate the duck curve. As shown in **Figure 3**, the EV charging is concentrated around the hours when the sun does not shine. H_2 energy storage is a win-win solution to provide the much-needed grid support, as well as facilitate the EV and fuel cell electric vehicle (FCEV) infrastructure. H_2 energy storage also provides backup for critical facilities while supporting greater penetration of renewables to meet CA state mandates.

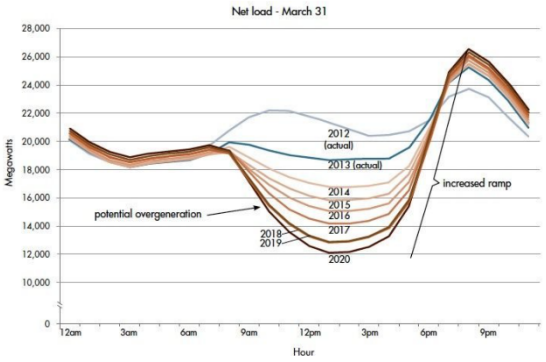

Figure 2. More Renewables Lead to Grid Instability: Huge fluctuations in supply/demand and electricity prices.

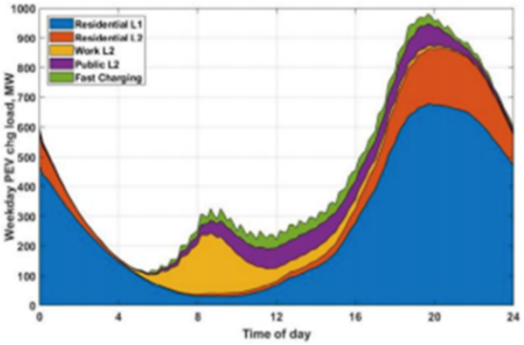

Figure 3. Impact of EV Penetration Worsens California's Grid with Intermittent Renewables: H_2 based energy storage facilitates EV charging during peak demand.

Most promising near-term technologies: Batteries are the obvious candidate for short-term energy storage given the huge global investment in its R&D and manufacturing. CEC should keep supporting battery technologies for short-term energy storage. California is among the largest economies in the country in agriculture and food processing sectors. This corresponds to generating large amounts of wasted biomass resources. In addition, trees cleared from transmission line right-of-way also produce waste biomass. A win-win strategy will be to create higher value energy storage from these wasted biomass resources.

H_2 energy storage is a promising technology for long-term energy storage. Current renewable H_2 production is focused on water electrolysis. Though a promising technology, it is capital intensive to install and operate. It can put additional stress on the water supply of the drought-prone California.

As per DOE estimations, there is enough biomass waste to make the CA grid 100% green and renewable. CEC should support projects to utilize the wasted biomass resources and convert them into valuable products like green H_2, RNG (syngas), fertilizers, etc.

<u>The most promising opportunities are:</u>

1. The current CEC investment in advanced oxygen-free electrolysis technology promises huge returns in the energy storage portfolio.
2. The most promising strategy is to support **hybrid energy storage** that integrates the benefits of multiple energy storage technologies, e.g., fuel cell and battery hybrids used in FCEVs.

Technologies barriers that can be resolved by EPIC: CEC should support the development of alternate fuels that consume little or no water. California has a huge potential for waste biomass which can be leveraged to produce these fuels. Since we're under the gun of climate change, CEC should support the demonstration of nascent but promising technologies at industrial sites.

1. Multi-purpose solutions to supply side issues (waste) and demand side (energy storage).
2. Producing green syngas from waste which can be used for H_2 energy storage as well for chemical industries for a greater revenue.
3. Support pilot-scale validation tests
4. Support pre-commercial prototype development and testing to gain stakeholder acceptance.
5. Support manufacturing R&D to retain jobs in the state and create export potential.

Efforts that can bridge the gaps between researchers, utilities, and policy makers:

1. Provide a platform for information exchange between the stakeholders.
2. Showcase data from current CEC funded projects to benefit all stakeholders.
3. Actively create and promote public-private partnership opportunities.
4. Pro-actively collaborate with federal agencies to leverage Californian resources and lead innovations.
5. Facilitate transition from basic research to applied research for the solutions created by researchers and universities
6. Hold workshops with policy makers to educate about emerging innovative solutions: Provide strategy for incentives for energy storage, policy classification for products created from wastes (solid, liquid and gaseous wastes).
7. Provide a special classification support for H_2 created from waste so that it is considered green H_2.