The Bowman Centre For Sustainable Energy

Grid Scale Electricity Storage in Southwestern Ontario - *Batteries Not Included*

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Grid scale energy storage is key to sustaining and improving Ontario's low carbon intensity electrical grid. Bulk energy storage is an important component of Ontario's future grid.

Bulk low carbon hydrogen storage in salt caverns is an economically viable alternative to conventional grid scale batteries and offers advantages over Li-ion batteries.

The Ontario Government announced an intent to procure up to 1,500MWs of storage to help meet growing demand and reduce cost to consumers as stated in the **Ontario Building More Electricity Generation and Storage to Meet Growing Demand** press release.

Lithium-ion batteries are being deployed in Ontario along with pumped storage, flywheels, and other technologies. Bulk storage of low-carbon hydrogen deserves serious consideration.

Sarnia Lambton Hydrogen Based Battery compared to a Li-ion battery system

Features	H_2 Battery	Conventional Battery
Capital Cost (3,000 MWh)	200 $/KW-h	400$/KW-h
Construction Jobs	Yes ++++	Yes +
Long Term Ops Jobs	Significant	Minimal
Aligned with Ontario's Low-Carbon H2 Strategy	Yes	No
Aligned with the Federal Hydrogen Strategy	Yes	No
Seasonal Storage	Yes	No
Enable an Ontario H2 Hub	Yes	No
Develop Ontario and Canadian IP	Yes	No
Oxygen by-product for sale	Yes	No

For more information on the socio-economic benefits of a hydrogen and cavern based 'battery' contact the *Bowman Centre for Sustainable Energy (BCSE)*.

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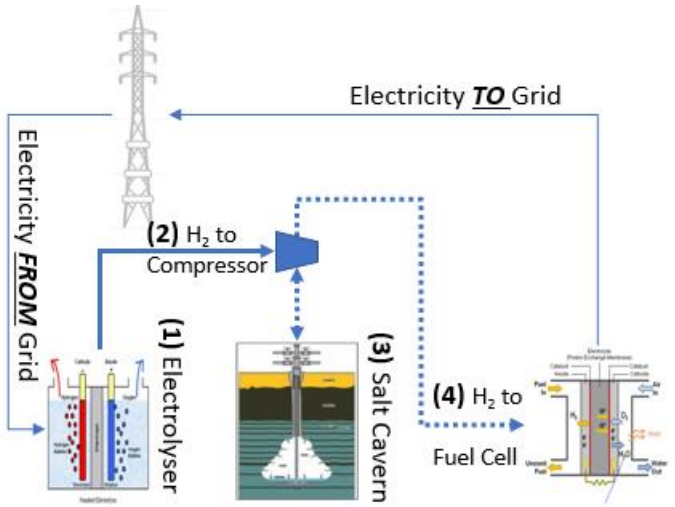
HOW A HYDROGEN/SALT CAVERN BATTERY WORKS

A stored hydrogen system uses four proven technologies configured to function like a battery.



System Components

(1) Electrolysers to produce low carbon hydrogen and oxygen from water.
(2) Compressor to inject bulk hydrogen into the salt cavern until needed.

(3) Salt Cavern to store hydrogen until needed by the grid operator (IESO).

(4) Hydrogen Fuel Cells to convert hydrogen to electricity and water. The water will be reused in the system.

The Process

The system is 'charged' using low carbon intensity electricity from the Ontario grid to energise the electrolysers **(1)**. This produces low carbon hydrogen and oxygen. The low carbon hydrogen is compressed **(2**) and injected into an underground storage cavern **(3)**. The BCSE conceptual design uses a 30,000m^3 well to store about 140 tonnes of hydrogen containing enough energy to return 3,000 MW-hrs of electricity via fuel cells **(4)** to the grid.

The estimated installed cost for the BCSE Sarnia Lambton low carbon hydrogen based 'battery' is economically comparable to a Tesla Megapack. In addition, the electrolysis-based system co-produces a chemically pure and low carbon intensity oxygen by-product. This offers a significant revenue source that is unavailable to electrochemical battery systems. These and other advantages of hydrogen-based batteries are well understood and documented.

A recent MIT study[1] compared chemical batteries to hydrogen-based batteries and concluded that hydrogen batteries perform better and are cheaper than chemical batteries.

For additional information please contact the

Bowman Centre for Sustainable Energy.

[1] Techno-economic analysis of balancing California's power system on a seasonal basis: Hydrogen vs. lithium-ion batteries - ScienceDirect (fee required). Public domain; MIT Study Sees Hydrogen for Grid Backup, Despite Emissions Impact of Gas Feedstocks - The Energy Mix