Humpback Hydro Inc. (Canada)
Atlantis Water Power LLC (US)

scalable
everywhere
consistent
ultra-efficient
reliable
endurance

SECURE
long duration
energy storage

presentation to Public Works Commission,
City of Beverly Hills

prepared by John Kelly, 416-738-9260

Humpback Hydro Inc. (Canada)
Atlantis Water Power LLC (US)

US Patent

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(12) **United States Patent**
Legacy

(10) **Patent No.: US 8,823,195 B2**
(45) **Date of Patent: Sep. 2, 2014**

(54) **HYDRO ELECTRIC ENERGY GENERATION AND STORAGE STRUCTURE**

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(72) Inventor: **Mark Robert John Legacy**, Dieppe (CA)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/855,865**

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(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**

F01D 15/10	(2006.01)
F02C 6/00	(2006.01)
H02K 7/18	(2006.01)
H02P 9/04	(2006.01)
F03B 13/08	(2006.01)
F03B 13/06	(2006.01)
F03B 13/00	(2006.01)
F03B 13/10	(2006.01)

(52) **U.S. Cl.**

CPC ***F03B 13/08*** (2013.01); *Y02E 10/22* (2013.01); *Y02E 60/17* (2013.01); ***F03B 13/06*** (2013.01)

USPC **290/52**; 290/43; 290/54; 60/325; 60/398

(58) **Field of Classification Search**

CPC Y02E 10/22; Y02E 60/17; Y02E 10/20; E02B 9/06

USPC 290/43, 52, 54; 60/325, 398

See application file for complete search history.

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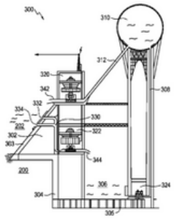
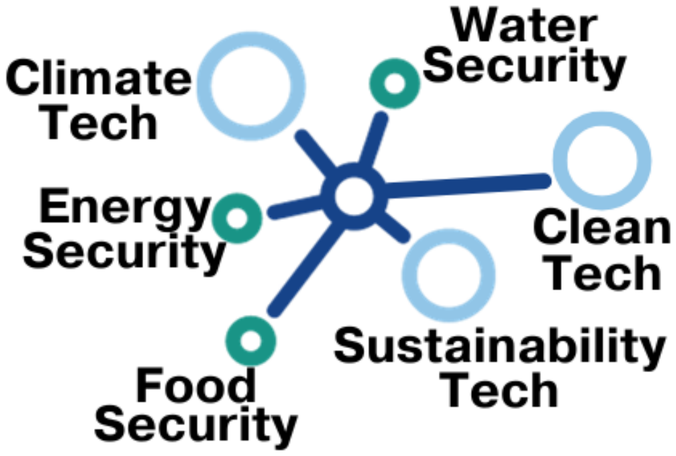
(57) **ABSTRACT**

A hydro electric energy generation structure is disclosed. The structure comprises: a gravity wall forming a closed outer perimeter extending above an upper water level of an existing hydraulic reservoir, and extending below the reservoir floor; at least one water inlet hydraulically connecting a first penstock to a first turbine generator below the water inlet. The structure further comprises: at least one lower water storage reservoir within the perimeter of the gravity wall receiving water from the first turbine generator; at least one pump receiving water from the lower water storage reservoir and pumping it through a pump delivery conduit to at least one upper water storage reservoir above the gravity wall; at least one second penstock delivering water from the upper water storage reservoir to a second turbine generator below; and a tailrace for returning the water into the existing reservoir.

19 Claims, 7 Drawing Sheets





team

Bryan Green
CEO

An innovative and dedicated corporate leader with thirty years of training, education and experience as a Commissioned Army Engineer and Special Operations Officer (Civil Affairs, Psychological Operations and Engineering Security) ranging from Science and Technology to major Global Construction Programs, GIS, IT innovation and Special Operations. Collaborating effortlessly with stakeholders to deliver nationally significant projects to protect lives, energize the economy and improve National Security. Extensive business acumen in building programs, developing cross-matrixed teams, innovation integration, technology transfer, commercialization and managing resources.

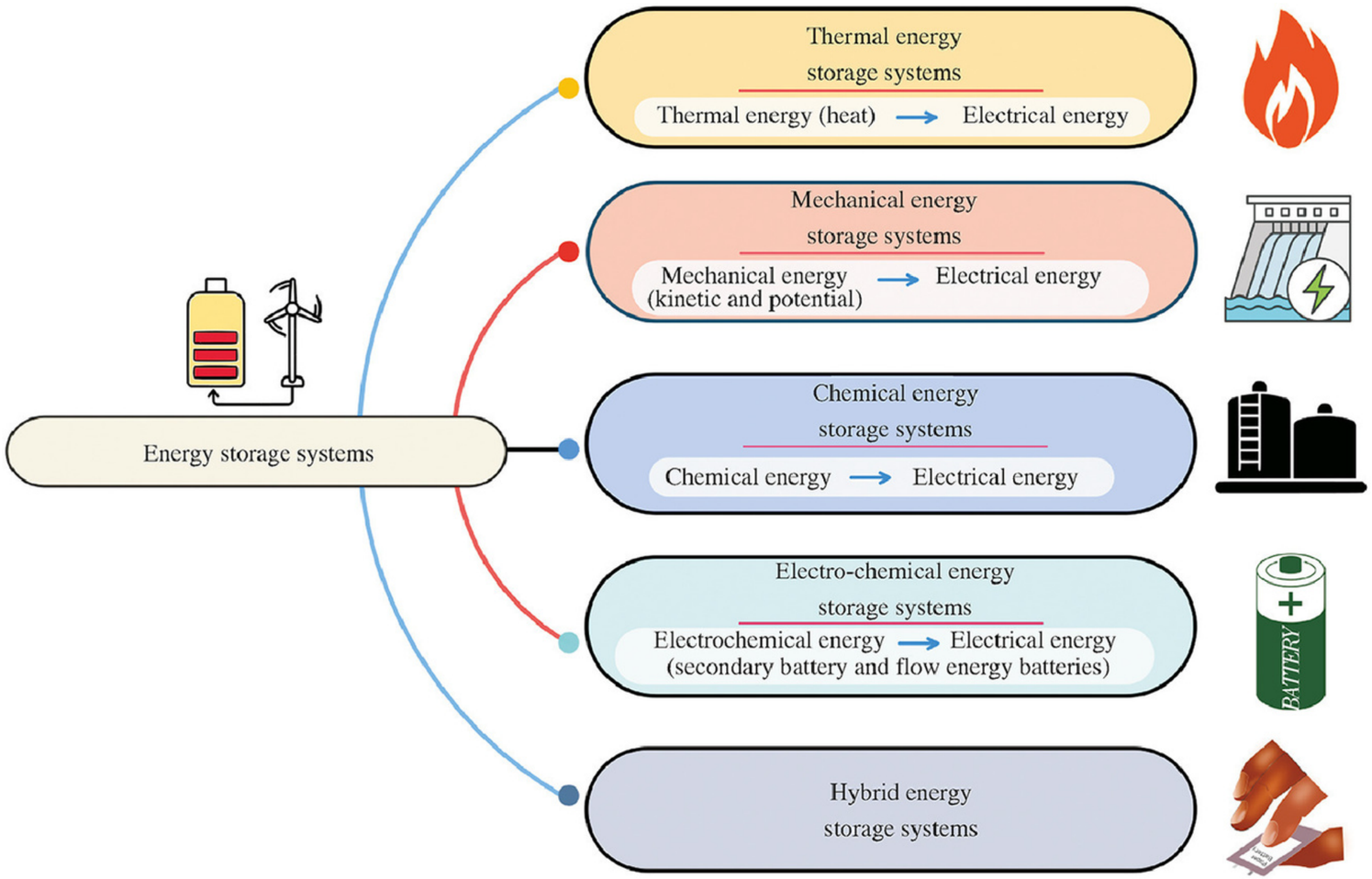
Mark Legacy
CTO

A true polymath as well as a hands-on inventor focused on solving complex problems for a world in need of climate change solutions with an environmental justice focus. His work has spanned the construction industry, including as a carpenter, mason, builder and welder as well as blacksmith. He has devoted himself to research and development with a focus on marine energy storage, design and structural engineering. The work culminated with a patent granted without prior art in 2014 for Humpback Hydro, a long duration pumped hydro energy storage solution (US 8823195-B2). More patents are in process.

John Kelly
Stakeholder Relations

30 years' experience as a finance lawyer with IP, project & corporate equity & debt finance as well as blended finance experience across media, aerospace, retail, clean tech, clean energy and EV industries; founder global UNEP project focused on youth engagement in climate journalism

Types of Energy Storage

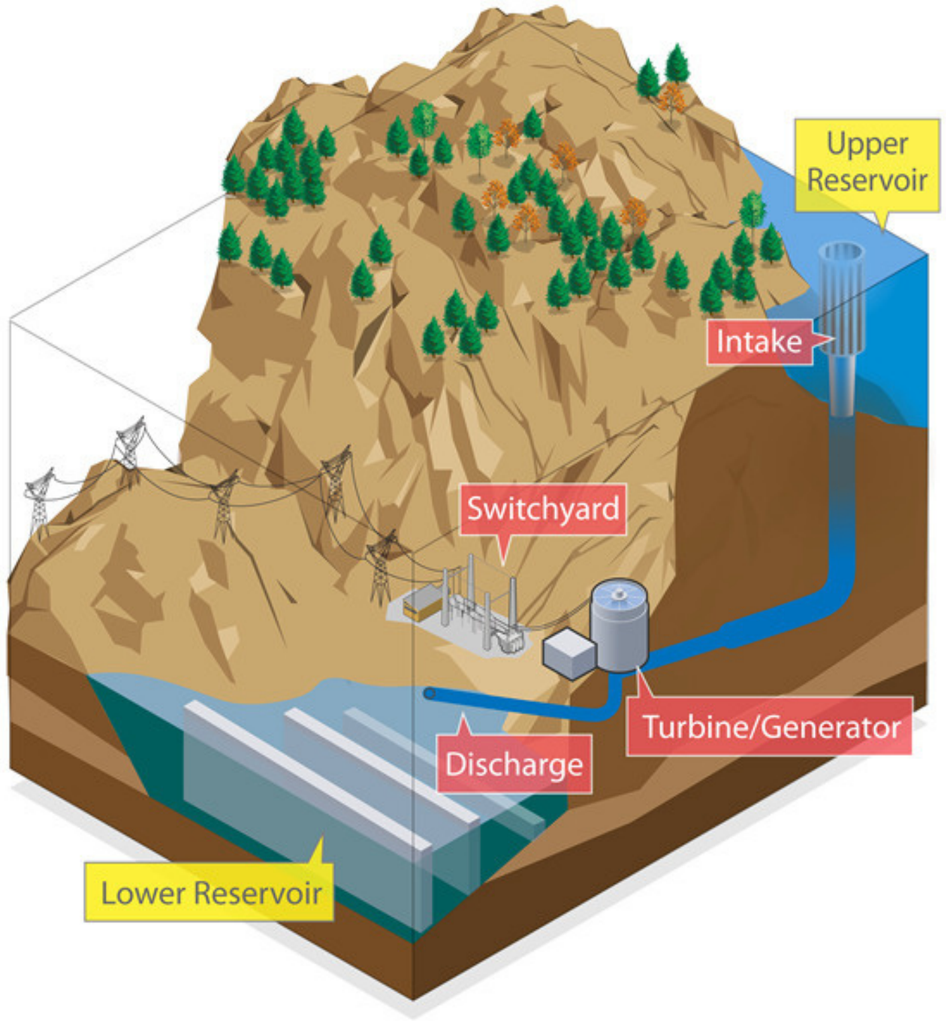


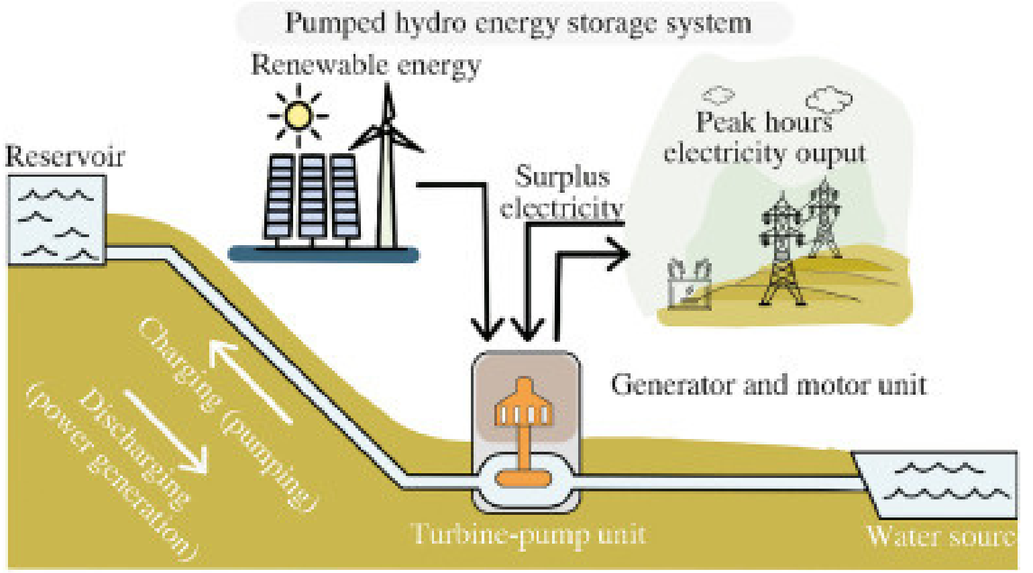
Pumped Hydro Energy Storage

Battery Energy Storage

Traditional Pumped Hydro Energy Storage

has been called “the perfect battery”





Energy Storage Grand Challenge Market Report 2020 December 2020

US and Japan have highest installed capacity of PHES globally

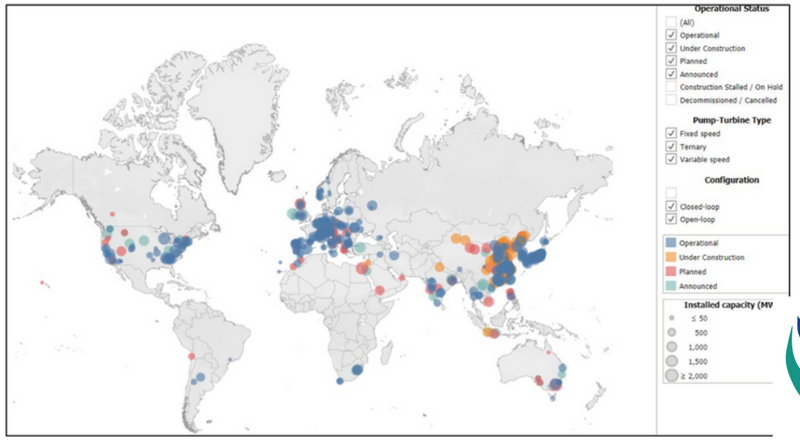
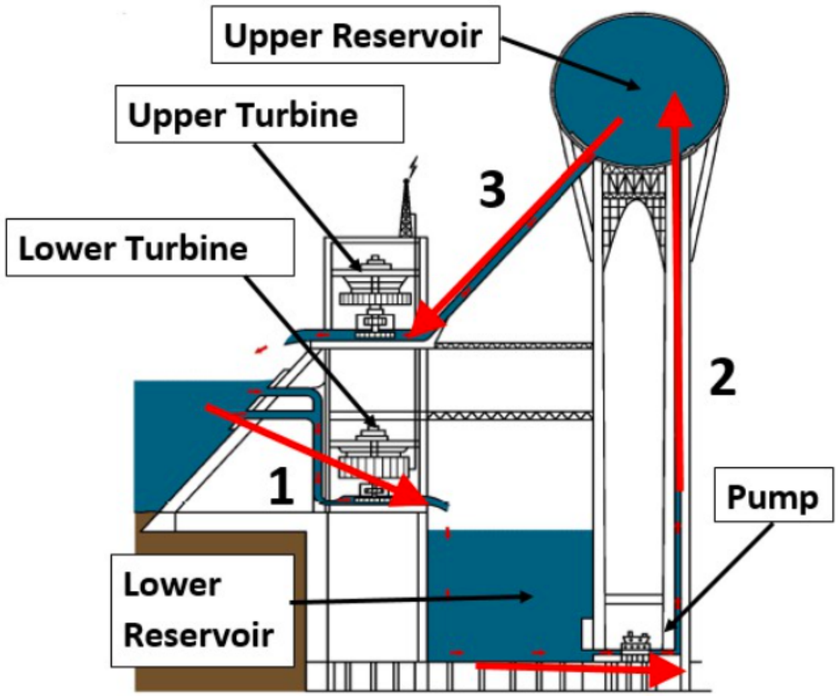


Figure 30. Global PSH installations

Source: [24] International Hydropower Association, “Pumped Storage Tracking Tool.” IHA. https://www.hydropower.org/hydropower-pumpe storage-tool (Accessed Sep. 20, 2020).

Humpback Hydro Long Duration Energy Storage

the perfect battery, with modern advancements



<u>our modernized approach:</u>

- ultra high performance concrete
- advanced fluid dynamics
- integrating Francis turbine
- composite reinforcement materials
- advanced construction techniques

scalable	from MW (neighbourhoods) to GW (utilities)
everywhere	don't need topography
consistent	continuous discharge and charge
ultra-efficient	91.4% round-trip efficiency
reliable	black-start operations
endurance	100 year+ lifetime
<u>**and**</u> **environmental**	lowest GHGs

Energy Storage Head-to-Head

BESS

- 60MW delivers 240MWh:
  - 4 hour discharge
  - Requires 20 hours to charge
- Area required: from 2-10 acres
- 90% efficiency degrades at 4% / year

- 10 years output: 660,615 MWh
- Year 11 and beyond: replace or continue at greatly reduced efficiency
- Lifetime cost (20 year): $80/MWh
- Cannot charge and discharge at the same time

HH

- 10MW delivers 240MWh:
  - continuous discharge
  - continuous charge
- Area required: 1 acre
- 90% efficiency does not degrade

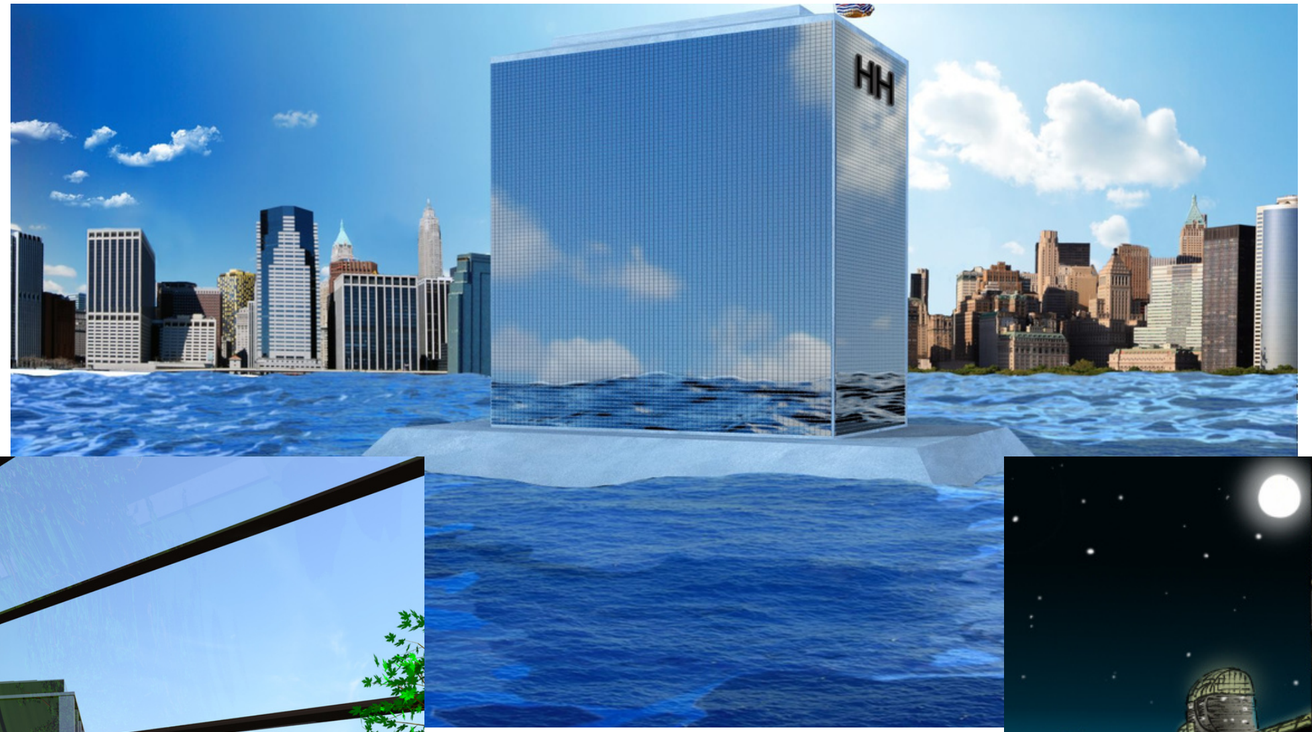
- 10 years output: 788,400 MWh
- Years 11-30 (and beyond): continues to produce at same rate of MWh
- Total cost (20 year): $31/MWh
- Can charge and discharge at the same time

benefits to utility

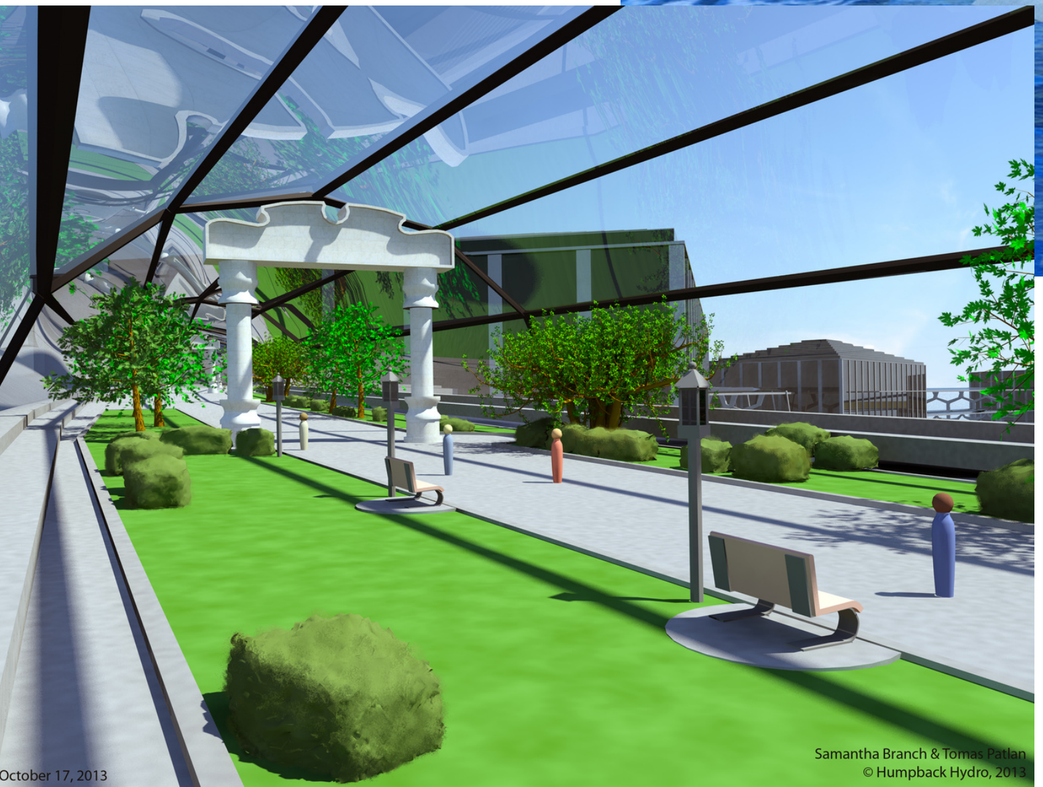
- proven technology with a modern twist
- longest asset life of any storage option
- lowest O&M
- CAPEX cost certainty
- black start operations
- price certainty on energy sales
- arbitrage
- inter-day AND inter-seasonal storage
- risk reduction (thermal runaway)

benefits to community

food security



water security



energy security

co-benefits:

- desalination
- marine ecosystems preserved
- permits other non-traditional uses
  - parking lot with fully integrated EV charging
  - multi-use commercial / residential
  - other municipal services
  - indoor vertical farm

thank you