IEA Hydrogen Roadmap
Role of PEM Technology In Energy Storage

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Proton OnSite

- A global leader of Proton Exchange Membrane (PEM) hydrogen generators using electrolysis as well as nitrogen and zero air products.
- Founded in 1996
- Privately held – Tom Sullivan owner
- Over 2,000 installations operating in 80+ different countries.
Critical Needs for Energy Storage

• Renewable energy is growing rapidly world-wide in both wind and solar
  – Inherent intermittency has more impact as RE becomes a larger portion of the grid capacity
  – Up to 20-40% of wind energy can be stranded without storage

• Need generation technologies for storing excess renewable capacity & balancing loads on the grid

• Energy storage can also provide a linkage between utilities & transportation
  – OEM FCV rollouts progressing towards 2015
Energy Storage Segmentation Map

Broad Applicability of Hydrogen

Courtesy of Fraunhofer ISE, 2013
Large-scale Energy Storage

This much could be fed into a large pump storage:

8,000 MWh = 1M Chevy Volt vehicles

This much could be fed into an underground compressed air storage (2 Mio m³ salt cavern):

4,000 MWh

This much could be fed into an underground hydrogen reservoir (2 Mio m³ salt cavern):

600,000 MWh
(equals 3.6 Mio tank fills)

Only hydrogen offers storage capacity for several days

Source: C. Freese, 2009
Concepts (2MW shown)

In Building

Containerized
PEM versus Alkaline

- Lack of corrosive electrolyte.
- Smaller footprint.
- Ability to generate hydrogen at pressure while having oxygen at ambient.
- Ability to turn down to near zero production.
- Responds almost instantly to load variations.
- Extremely low maintenance costs.
Cost Challenges

• Power Supply – makes up ~ 30% of cost
  – Difficult to cost reduce
• Cell Stack – makes up ~ 30% of cost
  – Advances continue to reduce costs
  – Costs ride fuel cell cost curve down
• Balance of Plant
  – Standard industrial design
• Very confident in reaching costs in the $1,200/kW range
Cell Stacks Costs Coming Down

- Gen 1
  
  - 15% Increase in active area
  - Smaller overall footprint
  - 40% lower in cost

- Gen 2
Summary

- US has not seen first hand the issues with renewable penetration – like Germany.
- Electrolyzers do not play everywhere but have a role especially for longer duration storage.
- Thinking of the electric grid and the transportation sector as one energy stream is emerging (overseas first).
- The US is lagging most of the world in recognizing and addressing storage.
Thank You!!