HTAC Annual Report: *Hydrogen and Fuel Cell Technical Development and Commercialization Activity*

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Outline

Goal: Provide balanced overview of hydrogen and fuel cell technology and commercialization activities

- Summary
- Commercialization Initiatives
- Policy, Regulations, Codes and Standards
- Financial Climate
- Research & Development
- Continuing Challenges
- Conclusions
- Reports

Outline

- **Summary**
  - Significant growth in deployment of FCs in stationary applications (e.g. back-up power)
  - Automobile manufacturers have announced plans to produce FCEVs; substantial partnerships (e.g. Honda/GM, Toyota/BMW)
  - Signals from auto companies led to major commitments to increase R&D to accelerate infrastructure development
  - H_2 generation from renewables demonstrated and a number of power-to-gas projects launched
  - Policies/regulations helping to smooth pathway to more rapid growth of hydrogen and fuel cell industries

Outline

- **Summary**
- **Commercialization Initiatives**
  - Fuel Cells for Stationary Applications (80% of units)
    - Most activity in Asia: successful Ene-Farm in Japan (75k units)
  - Fuel Cells for Transportation
    - Honda, Toyota, Hyundai plan production in 2014; partnerships!
  - Fuel Cells for Materials Handling (>4,000 forklifts)
  - Fuel Cells for Back-up Power
  - Grid Storage Applications
  - Hydrogen Infrastructure
    - H2USA, public-private partnership, launched

Outline

- **Summary**
- **Commercialization Initiatives**
- **Policy, Regulations, Codes and Standards**
  - EU, Japan and California made significant new commitments for research, demonstration and infrastructure deployment
  - California Governor's office released "2013 ZEV Action Plan" with goal to have 1.5M ZEVs by 2025
  - California committed up to $100 M for H_2 infrastructure through 2024 as part of $2B commitment to clean vehicles/low-C fuels
  - Connecticut released 2013 Comprehensive Energy Strategy which outlines strategies for state to sustainably meet energy needs; to meet 20% by 2020 renewable portfolio standard, state will have to increase Class I resources (fuel cells, solar, and wind) by 3 GW

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- **Commercialization Initiatives**
- **Policy, Regulations, Codes and Standards**
- **Financial Climate**
  - Climate gloomy at beginning of year with some resource reallocations and exits
  - Transactions were very modest when made
  - Start-ups found it difficult to raise capital
  - End of year saw some more significant investments
    - Air Liquide made $6.5M structured investment in Plug Power
    - Bloom Energy (SOFC) raised additional $130M, bringing total invested capital to reported $1.1B

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- **Financial Climate**
- **Research & Development**
  - After years of leading clean tech innovation, number of FC related patents dropped slightly (top 5 companies are GM, Honda, Toyota, Samsung and ClearEdge)
  - Publication of research papers is robust
  - Funding levels continue to be relatively low (declined in recent years)

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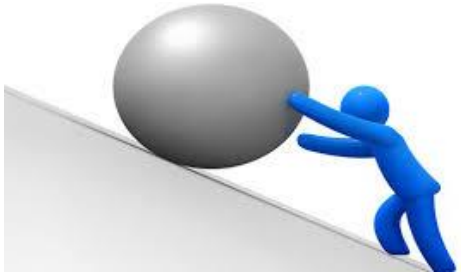
- **Research & Development**
- **Continuing Challenges**
  - 60% reduction in funding has created severe limitations on progress
  - Progress toward DOE goals has stalled in hydrogen production, hydrogen storage, stationary power



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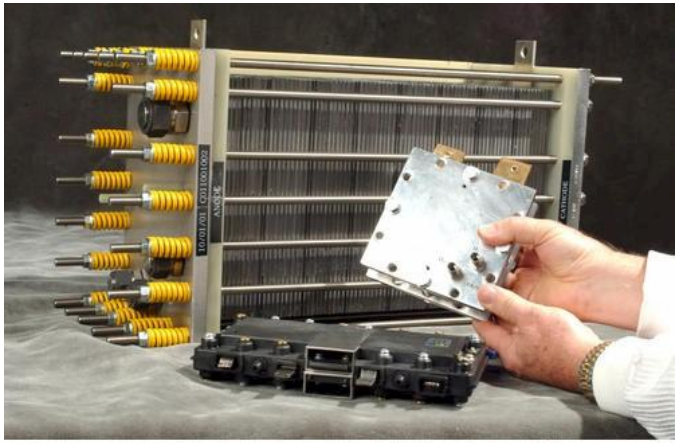
- **Continuing Challenges**
- **Conclusions**
  - Expanded deployment in stationary (e.g. Ene-Farm in Japan) and materials handling applications
  - Partnerships suggest that cost/performance within range
  - Funding continues to be incommensurate with expectations



Courtesy of The National Renewable Energy Laboratory (NREL)