New York State Energy Research and Development Authority

Albany, New York

NYSERDA Hydrogen Program

State & Regional Hydrogen Initiatives

July 12, 2006

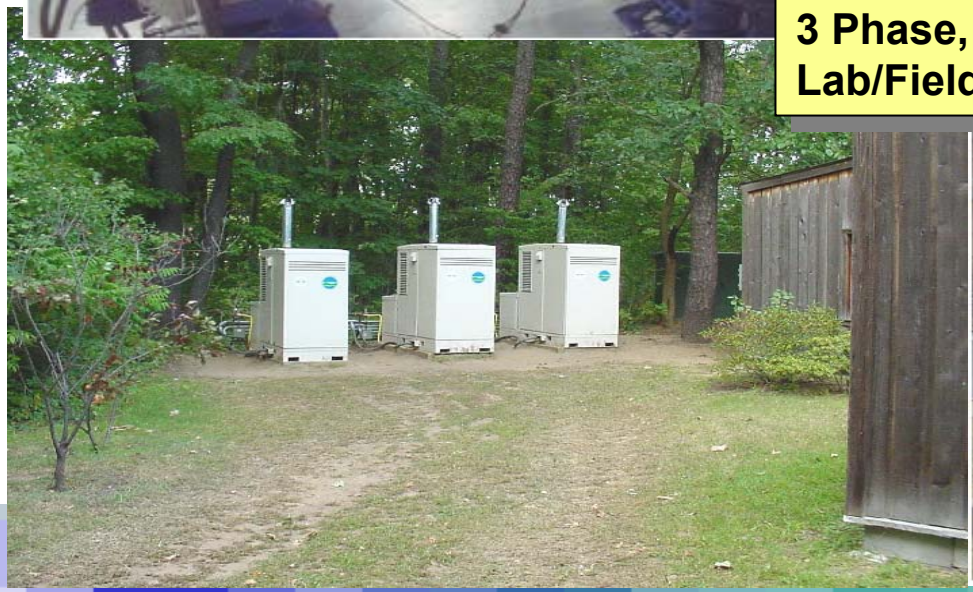
New York State Energy Research and Development Authority (NYSERDA)

- A Public Benefit Corp established in 1975 by State Legislature
- Mission: To identify solutions to State's energy challenges in ways that benefit the State's economy and environment
- Forge public/private partnerships with businesses, municipalities, residents, and other energy stakeholders to accomplish this goal.

Fuel Cell Product Dev. Projects

- PEM technology (8 projects, $5.2M)
  - Integrated Product Development - High Temp Stack, CHP Products, Telecom/UPS applications
  - Subsystems - Fuel processor (propane); Inverters /Power Conditioning
- SOFC (4 projects, $1.2M)
  - Materials, Components/Subsystems
- Direct Methanol (2 projects, $700k)
  - Integrated Systems

Fuel Cells: Product Demonstrations



3 Phase, 80 Unit Lab/Field Demos.

NYSERDA's Fuel Cell Demonstrations

Type	Application	Capacity	NYSERDA $	Comments
PAFC	Municipal WWT	1.6 MW	$1,000,000	8 fuel cells @ 4 Sites
PAFC	Bronx Zoo	200 kW	$584,030	WCS
PAFC	East Rochester K-12	200 kW	$833,430	ATSI Engineering
PAFC	Verizon - TeleCom.	1.4 MW	$425,000	7 fuel cells + Engines
MOFC	Sheraton Hotel	250 kW	$920,000	PPL
MOFC	Syracuse Univ-ESF	250 kW	$1,000,000	EO111
PEM	Various Product Demos	150 kW	$614,250	Power Systems Program
PEM	Albany NanoTech	150 kW	$614,250	UTC – Terminated Unavailable
SOFC	Verizon – Rome	250 kW	$1,000,000	Terminated – Unavail
PAFC	Multi-family	200 kW	$600,000	Terminated – Uneconomic

Fuel Cells at WWTP in NYC

- Eight UTC PAFC Fuel Cells at Four Municipal Waste Water Treatment Facilities in New York City (NYCDEP)
- Heat Recovered to Support Anearobic Digester
- Reduced On-site Emissions by Eliminating Flare
- NYSERDA: $1,000,000; NYPA: $12,000,000

Hydrogen Scoping Session

- Held June 10, 2003
- To understand the scope/role of hydrogen as a viable energy carrier in meeting NYS's future energy needs
- Set goals, objectives and priorities for a future hydrogen focused program for the State
- PON 829 "Hydrogen Roadmap, Outreach and Research"

PON 829 Hydrogen Roadmap

- PON 829 issued November ’03
- $750K total available
- Funding by NYSERDA, NYPA and LIPA
- Cat A - New York State Hydrogen Roadmap
- Cat B - NYS Hydrogen Outreach & Codes Review
- Cat C – Hydrogen R&D

PON 889 Hydrogen Demonstrations

- PON 889 issued September ’04
- Hydrogen technology demonstration projects
- $1.5 M total available
- $750 K per demonstration project
- Funding by NYSERDA and NYPA
- Production, Storage Distribution, Utilization

PON 957 Hydrogen Demonstrations

- PON 957 issued December ’05
- Hydrogen technology product development, demonstration projects and outreach activities tied to Roadmap recommendations
- $1.5 M total available
- Funding by NYSERDA and NYPA
- 26 proposals received
- 12 funded ($6.6M in projects, $3.5M NYSERDA share)

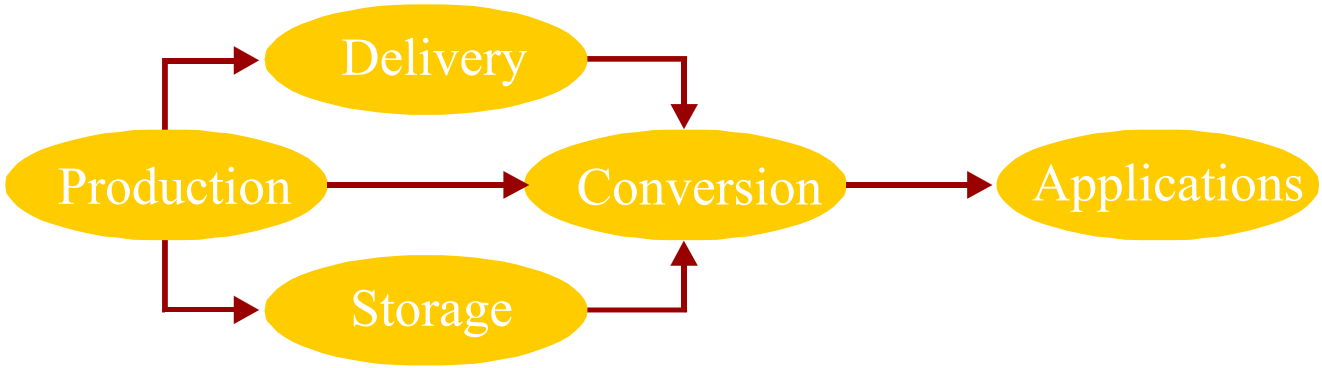
NYSERDA Hydrogen Program

- Future hydrogen solicitations to be based on Roadmap results:
  - Roadmap will set targets and decision points for development, investment and commercialization

NYS Drivers for a Hydrogen Economy

- Demand for Clean Energy Supplies
  - ↗ *A strategy for sustainable energy and economic growth*
  - ↗ *A strategy for carbon management*
- Reduced Dependence on Oil Imports
  - ↗ *An energy policy priority*
- Partnerships
  - ↗ *An approach for sharing risks and resources*

Elements of a Hydrogen Economy



Hydrogen Energy Infrastructure Elements	Explanation
Production	• The production of hydrogen from fossil fuels, biomass, or water • Involves thermal, electrolytic, and photolytic processes
Delivery	• The distribution of hydrogen from production and storage sites • Involves pipelines, trucks, barges, and fueling stations
Storage	• The confinement of hydrogen for delivery, conversion, and use • Involves tanks for both gases and liquids • Involves reversible and irreversible metal hydride systems
Conversion	• The making of electricity and/or thermal energy • Involves combustion turbines, reciprocating engines, and fuel cells
Applications	• The use of hydrogen for stationary energy systems, including mission critical, emergency, and combined heat and power applications • The use of hydrogen for portable power and transportation systems

New York State Hydrogen Energy Vision

- **By 2020**, **New York** is widely recognized as the Renewable Clean Energy State and **its sustainable hydrogen economy is in place and rapidly growing**.
- As a result of a coordinated and integrated state-wide effort, **New York is a world leader** in hydrogen technology development and deployment in many markets: energy; electric power; and transportation.
- **Hydrogen is a publicly accepted energy carrier and fuel** due to its safety, cost competitiveness, and availability in New York State.
- **Hydrogen is a key part of the New York energy mix** and operates in a complementary manner with other energy sources and carriers.
- **Hydrogen is well-integrated with regional systems**, including the Northeast and Mid-Atlantic states and Canada.
- **State-wide networks for clean, efficient, and secure hydrogen** production, storage, and delivery have been established. Most fueling stations in New York have hydrogen fueling capacity.
- **New York's favorable business and regulatory climate** has attracted many new jobs and high-tech industries and its **competitive advantages** in R&D, market pull, and access to financial markets have all contributed to its success.

Hydrogen Energy Economy Challenges

- Cost Competitiveness
- Safety, Codes and Standards
- Public Education and Acceptance
- Infrastructure Development
- Technology Readiness and R&D Breakthroughs
- Industry Investment and Incentives
- Policy Development
- New Concepts and Unexplored Issues

Roadmap for Developing the New York State Hydrogen Energy Economy

Phase I
Demonstrate Pre-Commercial H_2 Technologies

High Profile Demonstrations

- R&D to refine the technologies – validate performance
- Raise public awareness (outreach & education at K-12 and university levels)
- Establish basis for codes & standards, siting, & safety
- Support NY universities and NY companies
- Put in place public policies to foster sufficient public and private investments

Phase II
Build the 3C's: H_2 Cities, Clusters, and Corridors (Market Entry)

H_2 Cities, Clusters, and Corridors – Integrated H_2 Production, Fleets, Fueling, Power Parks

- Bring down the cost of H_2 production, storage, and delivery
- Create anchor points for the NYS H_2 network
- State creates market pull
- Concentration of private sector activity creates a value chain of NY H_2 companies

Phase III
Link H_2 Clusters (Commercialization)

State-Wide H_2 Networks

- Expand H_2 markets
- State-wide infrastructure is in place
- Markets function on own with decreasing government role

2010 2015 2020

Suggested Opportunities

- **Demonstrate Innovative Technologies in Integrated Systems**
  - Commit to create a hydrogen network throughout the State
  - Designate “Hydrogen Cities”
  - Build a hydrogen corridor (Buffalo to NYC)
  - Convert airports and ground fleets
  - Integrate H2 technologies at critical service facilities (hospitals, financial data centers) that must be secure from grid interruptions
  - Build a hydrogen power park to demonstrate local renewable-based production and a dedicated infrastructure
  - Convert Statue of Liberty and Staten Island ferries
  - H2 powered cars at Watkins Glen racetrack
  - Many other suggested demonstrations

Suggested Opportunities (continued)

- **Support Pre-Commercial R&D**
  - Expand R&D at NY universities to solve scientific and technical barriers to the deployment of H2 fuel and infrastructure
- **Support Technology Development**
  - More cost-shared R&D with the private sector
  - State take the leadership role in developing codes and standards to promote early adoption
  - Enhance renewable energy initiatives
- **Support Current New York Companies**
  - Maintain broad suite of business assistance programs
  - Market New York State as the hydrogen state
  - State as early customer. Set targets for H2 use in NYS.

Suggested Opportunities (continued)

- **Foster a Supportive Business Climate and Early Adoption**
  - Governor should establish a H2 Cluster Business Group across State departments and agencies
  - Coordinate policies to encourage public-private partnerships and facilitate H2 and FC commercialization
- **Build the NYS Hydrogen Value Chain**
- **Attract New Companies**

Some Big Questions and Issues

- What and where are the impacts of hydrogen production?
- Energy Return on Energy Investment (EROEI)?
- Capital cost of infrastructure
- Competing energy R&D alternatives
- Competing energy technologies