Hydrogen Power Park

Rob Regan (Primary Contact), Ryan Waddington, Murray Davis, Bruce Whitney
DTE Energy Company
2000 2nd Avenue
Detroit, MI 48226-1279
Phone: (313) 235-9152; Fax: (313) 235-0239; E-mail: reganr@dteenergy.com

DOE Technology Development Manager: Chris Bordeaux
Phone: (202) 586-3070; Fax: (202) 586-9811, E-mail: Christopher.Bordeaux@ee.doe.gov

Objectives

Discover and document whether the power park concept is technically and economically viable as a clean energy system, and if so, under what operating and market conditions. Specific objectives include:

- Identify the drivers of economic performance for multi-use hydrogen energy systems including energy sources (renewable & conventional fuel sources), capital costs, operation and maintenance (O&M) costs, and emissions (cost benefit analysis vis-à-vis pollution non-attainment areas).
- Determine conditions for system optimization and cost reduction for hydrogen systems, including design footprint and multi-use energy station applications.
- Identify the characteristics of an economically viable hydrogen-based energy system designed for peak shaving and vehicle fueling applications.
- Accelerate the development of technology delivery, system operations, and applications experience in hydrogen energy systems.
- Collect and evaluate operational, durability, and efficiency information for an integrated renewable/ electrolyzer system.
- Contribute to development of relevant safety standards and protocols for hydrogen-based power systems.
- Evaluate the market for integrated hydrogen energy systems: develop a business plan for distributed hydrogen energy systems, as appropriate; test potential for "green power" customers.
- Educate the public: promote awareness of hydrogen-based energy systems through development of educational materials and group sponsored events.

Technical Barriers

This project addresses the following technical barriers from the Technology Validation section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year R,D&D Plan:

- C. Hydrogen Refueling Infrastructure
- D. Maintenance and Training Facilities
- E. Codes and Standards
- H. Hydrogen from Renewable Resources
- I. Hydrogen and Electricity Coproduction

Approach

- Develop, install, and operate a hydrogen co-production facility capable of delivering ~500 kWh/day of on-site electricity and ~15 kg/day of compressed hydrogen for vehicle refueling.
- Integrate renewable energy into an end-to-end hydrogen energy station concept that utilizes solar & biomass power combined with electrolysis and stationary PEM fuel cell technology to take advantage of power during off-peak hours to generate hydrogen for on-peak power generation and vehicle fueling.
- Using the latest hydrogen generation, storage, regeneration and control technologies, evaluate opportunities to reduce overall system cost and maximize performance through optimization of system design & operation, practical approaches to permitting, and integration of power and transportation applications using a common hydrogen infrastructure.
- Obtain permits and install an integrated electrolytic hydrogen production, storage, on-site power generation, and vehicle refueling facility in the State of Michigan.

Accomplishments

- Selected team
- Established optimal technologies and sources
- Developed work plan & budget
- Established codes & standards framework
- Selected system site
- Began system design & permitting - 20% complete
- Procured equipment - 75% complete

Future Directions

- Install & commission system
- Develop education & outreach program
- Operate, monitor, and maintain system
- Develop project technical report
- Assess economics & develop business plan, as appropriate
- Document and publish project results

Introduction

Given the potential for the commercialization of hydrogen as a replacement energy carrier for fossil fuels, this demonstration project, which models a complete renewable hydrogen system, from biomass/solar power to hydrogen generation and storage to electrical generation and vehicle fueling, will provide meaningful information to overcoming the technical and economic challenges of realizing a hydrogen-based economy.

The project develops, installs, and operates a hydrogen co-production facility capable of delivering ~500 kWh/day of on-site electricity and ~15 kg/day of compressed hydrogen for vehicle refueling (Figure 1). By incorporating the most commercially representative units into a complete system operated under realistic scenarios, this approach can provide data necessary to validate component technical targets and feedback for efficient Department of Energy R&D program management.

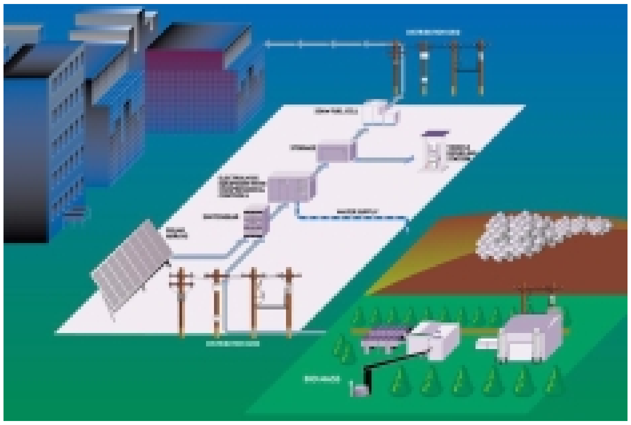

Figure 1. DTE Energy Hydrogen Power Park, Southfield, MI

Approach

This project integrates renewable energy into an end-to-end hydrogen energy station concept that utilizes solar & biomass power combined with electrolysis and stationary PEM fuel cell technology to take advantage of power during off-peak hours to generate hydrogen for on-peak power generation and vehicle fueling (Figure 2).

Using the latest hydrogen generation, storage, regeneration and control technologies, the project will evaluate opportunities to reduce overall system cost and maximize performance through optimization of system design and operation, practical approaches to permitting, and integration of power and transportation applications using a common hydrogen infrastructure.

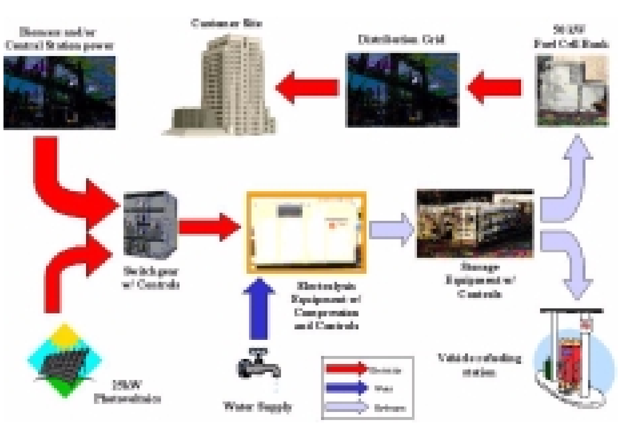

Figure 2. Hydrogen Power Park - Conceptual Drawing

The system components include: ~170 kW electrolyzer (effective for low volume on-site hydrogen requirements); compressed gas storage at +5,000 psi (proven, safe, relatively cost effective); 25 - 75 kW fuel cell bank (quiet, clean, efficient); refueling dispenser at up to 5,000 psi (state-of-the-art).

Results

Phase I (months 1 - 6) of the overall project plan has been completed with Phase II (months 7 - 18) in progress. Milestones achieved in Phase I included project team selection, establishment of optimal component/system technologies and sources, development of work plan and budget, establishment of codes and standards framework, and system site selection.

Key activities currently underway include system design & permitting - 20% complete, and equipment procurement - 75% complete. Future milestones include installation and commissioning of system (April 2004); development of an education and outreach program; operation, monitoring, and maintenance of the system; development of the project technical report; assessment of the economics and development of a business plan for distributed hydrogen energy systems, as appropriate; and documentation and publication of project results.

Conclusions

The project remains on-schedule with the original plan, despite a delay in reimbursement monies from FY03 to FY04 and a lack of fully developed subsystems that are representative of commercial units. Industry dynamics resulting from increased economic pressures and changing target markets have resulted in a lack of fuel cell power generation and hydrogen production subsystems that are ready for market. This presents increased risk of execution for system designers and integrators, as these subsystems must first be demonstrated and tested before being incorporated into complete systems and tested under real-world operating conditions.

In addition to these challenges, the current level of hydrogen codes and standards development has resulted in modifying system design and implementation plans to mitigate project execution risk.

The above challenges have, however, accelerated the development of component and hydrogen system applications knowledge within the company. This kind of rapid experience building is an important outcome of the technology validation program that increases the likelihood of successful development of technically and economically viable hydrogen energy systems.

FY 2003 Presentations

1. R. Regan, "DTE Energy Hydrogen Power Park" poster session, DOE Merit Review, Berkeley, CA (2003)