

X.8 Tri-Generation Fuel Cell Technologies for Location-Specific Applications

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Technical Barriers

This project addresses the following technical barriers from the Systems Analysis section of the Fuel Cell Technologies Office Multi-Year Research, Development, and Demonstration Plan:

- (A) Future Market Behavior
- (B) Stove-piped/Siloed Analytical Capability
- (E) Unplanned Studies and Analysis

This project will contribute to achievement of the following DOE milestones from the Systems Analysis section of the Fuel Cell Technologies Office Multi-Year Research, Development, and Demonstration Plan:

- Milestone 1.9: Complete analysis and studies of resource/feedstock, production/delivery, and existing infrastructure for technology readiness. (4Q, 2014)
- Milestone 1.12: Complete an analysis of the hydrogen infrastructure and technical target progress for technology readiness. (4Q, 2015)
- Milestone 1.13: Complete environmental analysis of the technology environmental impacts for hydrogen and fuel cell scenarios and technology readiness. (4Q, 2015)

Overall Objectives

Assess the potential number and location of tri-generation (Tri-Gen) fuel cell systems, producing electricity, high-quality waste heat, and hydrogen in an early fuel cell electric vehicle (FCEV) market scenario (circa 2015) in NY, NJ, CT, and MA:

- Consider use of natural gas and anaerobic digester gas as feedstock.
- Also consider the viability of the Tri-Gen units serving as a local hub for hydrogen production.

Fiscal Year (FY) 2014 Objectives

- Sensitivity studies:
 - Assess the effect that vehicle data sales selection/market distribution has on the resulting necessary Tri-Gen and/or hydrogen refueling infrastructure.
- Complete the acquisition and cleanup of data regarding wastewater treatment plants (WWTP) and landfills.
- Complete the identification of Tri-Gen sites.
- Complete the identification of Tri-Gen central hubs.
- Estimate the hydrogen, electricity, and heat production from the aforementioned identified Tri-Gen sites.
- Conduct an economic analysis to compare cost of hydrogen across the different scenarios.

FY 2014 Accomplishments

- Ascertained the locations of the WWTPs in NY, NJ, CT, and MA (~432 total).
- Ascertained the locations of the landfills in NY, NJ, CT, and MA (~96 total).
- Ascertained the locations of potential building heat and electrical loads in NY, NJ, CT, and MA via the U.S. Board on Geographic Names. These include schools, airports, hospitals, and so forth.
- Alternative vehicle sales data which serves as proxy for potential FCEV sales was combined with high resolution population data and used to determine an early FCEV market.
 - Subsequently, the number of hydrogen refueling stations to ensure 6-minute service coverage for that early FCEV market was determined.
- An initial analysis was completed which identifies favorable WWTPs and landfills to site a Tri-Gen system based on:
 - Covering the most alternative vehicle sales.
 - Serving as a central hub of hydrogen production and serving the most nearby hydrogen refueling stations as possible.



FUTURE DIRECTIONS

- Refine the identification of WWTPs and landfills in the Northeast that would be favorable candidate sites for the deployment of Tri-Gen fuel cell systems operating on renewable biogas with an onsite hydrogen refueling station. Analysis will be repeated for the use of conventional natural gas.
- Refine the identification of WWTPs and landfills in the Northeast that could favorably serve as a central hub and provide hydrogen to nearby hydrogen refueling stations. The number of, and which specific hydrogen refueling stations that will be served by a given central hub site will be noted.
- Estimate the hydrogen, electricity, and heat production for the different Tri-Gen scenarios.
- An economic analysis will be done to compare the cost of hydrogen in the different scenarios considered (e.g., hub production versus onsite).

FY 2014 PUBLICATIONS/PRESENTATIONS

1. K.S. Manlicic, B.P. Shaffer (presenter), G.S. Samuelsen. Tri-Generation Fuel Cell Technologies for Location-Specific Applications. U.S. Department of Energy. 2014 Annual Merit Review. Washington D.C., June 8–12, 2014.