V.A.9 Stationary and Emerging Market Fuel Cell System Cost Analysis

Kathya Mahadevan (Primary Contact),
VinceContini, Matt Goshe, and Fritz Eubanks
Battelle
505 King Avenue
Columbus, OH 43201
Phone: (614) 424-3197
Email: mahadevank@battelle.org

DOE Managers
HQ: Jason Marcinkoski
Phone: (202) 586-7466
Email: Jason.Marcinkoski@ee.doe.gov
GO: Reg Tyler
Phone: (720) 356-1805
Email: Reginald.Tyler@go.doe.gov

Contract Number: DE-EE0005250/001

Project Start Date: September 30, 2011
Project End Date: Project continuation and direction determined annually by DOE

Fiscal Year (FY) 2012 Objectives

To assist the DOE in developing fuel cell systems for stationary and emerging markets by developing independent cost models and costs estimates for manufacture and ownership. In FY 2012, the project will estimate costs of:

- 10-kW and 25-kW polymer electrolyte membrane fuel cell (PEMFC) for material handling equipment applications at annual production volumes of 100 units, 1,000 units, and 10,000 units.
- 1- and 5-kW solid oxide fuel cells (SOFC) and high-temperature polymer electrolyte membrane (HTPEM) fuel cells for auxiliary power unit applications at annual production volumes of 100 units, 1,000 units, and 10,000 units.

Technical Barriers

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

(B) Cost

Technical Targets

To widely deploy fuel cells significant strides must be made in lowering the cost of components and systems without compromising reliability and durability. This cost analysis will identify the fundamental drivers of component and system cost and the sensitivity of the cost to various component and system parameters. The cost analyses will provide the DOE information on the impact of production volumes on lowering costs of fuel cells and the types of high volume manufacturing processes that must be developed to enable the widespread commercialization. The study will also provide insights into the optimization needed for use of off-the-shelf components in fuel cell systems to drive down system costs. Finally, the study will analyze the lifecycle costs of owning and operating a fuel cell to estimate primary costs drivers to the end user in applicable markets.

Approach

Battelle will apply the established methodology used successfully on the previous fuel cell cost analysis study for the DOE [1-3]. The technical approach consists of four steps – market assessment, system design, cost modeling, and sensitivity analysis (Figure 1). The first step characterizes the potential market and defines the requirements for system design. The second step involves developing a viable system design and associated manufacturing process vetted by industry. The third step involves building the cost models and gathering inputs to estimate manufacturing costs. Manufacturing costs will be derived using the Boothroyd-Dewhurst Design for Manufacture Assembly Software (DFMA®). Custom manufacturing process models will be defined where necessary and parametrically modeled based on knowledge of the machine, energy and labor requirements for individual steps that comprise the custom process. The fourth step will evaluate the sensitivity of stack and system costs to various design parameters. Both single factor sensitivity analysis and Monte Carlo analysis will be performed. Single factor sensitivity analysis helps determine the impact of individual parameters on system costs. The Monte Carlo analysis will help determine the impacts of cost variability. In addition to the sensitivity analysis, we will conduct a lifecycle cost analysis to estimate total cost of ownership for the target application and markets.

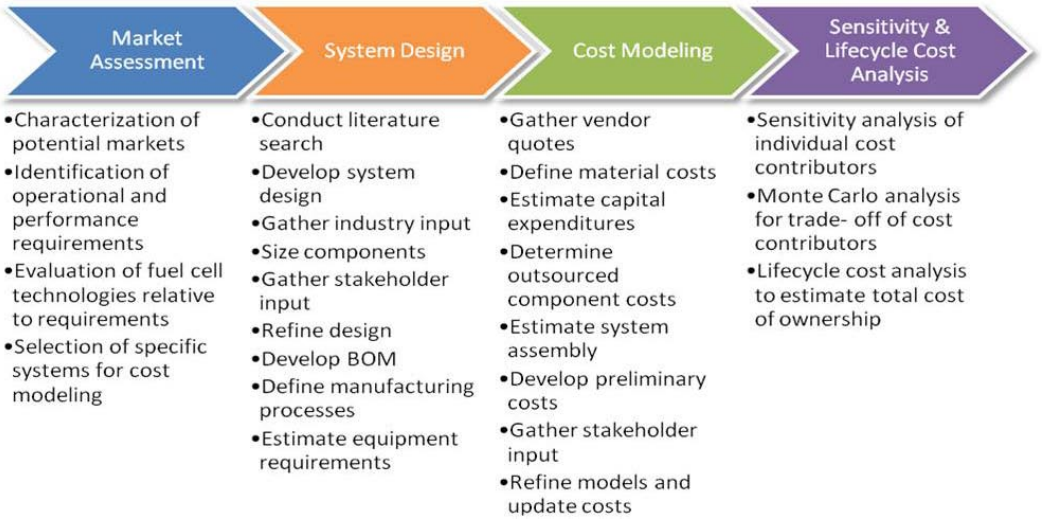

FIGURE 1. Battelle's Cost Analysis Methodology

FY 2012 Accomplishments

- Completed the market assessment for the material handling equipment and auxiliary power unit markets:
  - Defined the application requirements.
  - Selected appropriate fuel cell technologies and system sizes to meet requirements.
- Detailed performance specifications and system requirements and completed preliminary system design of:
  - 10-kW and 25-kW PEMFCs for material handling equipment specifically forklifts.
  - 1-kW and 5-kW SOFCs for auxiliary power units.

Next Steps

In FY 2012, Battelle will:

- Finalize design of the PEM and SOFC systems.
- Initiate and finalize design of the high temperature PEM system for auxiliary power applications.
- Complete full cost assessment of 10-kW and 25-kW PEMFC systems for material handling applications.
- Complete full cost assessment of 1-kW and 5-kW SOFC and HTPEM systems for auxiliary power applications.

References

1. Battelle. 2011. The High Volume Manufacture Cost Analysis of 5 kW Direct Hydrogen Polymer Electrolyte Membrane (PEM) Fuel Cell for Backup Power Applications. Contract No. DE-FC36GO13110.

2. K. Mahadevan, K. Judd, H. Stone, J. Zewatsky, A. Thomas, H. Mahy, and D. Paul. 2007. Identification and characterization of near-term direct hydrogen proton exchange membrane fuel cell markets. Contract No. DE-FC36GO13110. Available at http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/pemfc_econ_2006_report_final_0407.pdf.

3. H. Stone, K. Mahadevan, K. Judd, H. Stein, V. Contini, J. Myers, J. Sanford, J. Amaya, and D. Paul. 2006. Economics of Stationary Proton Exchange Membrane Fuel Cells, Interim Report. Contract No. DE-FC36GO13110.