IX.1 Employment Impacts of Early Markets for Hydrogen and Fuel Cell Technologies

Marianne Mintz
Argonne National Laboratory
9700 S. Cass Ave.
Argonne, IL 60439
Phone: (630) 252-5627
E-mail: mmintz@anl.gov

DOE Managers
HQ: Fred Joseck
Phone: (202) 586-7932
E-mail: Fred.Joseck@ee.doe.gov
GO: Greg Kleen
Phone: (720) 356-1672
E-mail: Greg.Kleen@go.doe.gov

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Partner:
RCF Economic and Financial Consulting, Inc., Chicago, IL

Fiscal Year (FY) 2011 Objectives

- Facilitate early market deployment of fuel cells in prime power, backup power and material handling applications by developing a user-friendly tool to calculate economic impacts.
- Calculate gross direct and indirect economic impacts of fuel cell expenditures by state, geographic region, and the nation as a whole.
- Calculate net national changes in jobs and economic output.
- Meet stakeholder needs for identifying industry sectors benefiting most from fuel cell production and deployment.
- Explore impact of different fuel cell production and deployment options on state, regional and national employment, earnings and economic output.

Technical Barriers

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

(A) Lack of Readily Available, Objective, and Technically Accurate Information

(E) Regional Differences

(F) Difficulty of Measuring Success

Technical Targets

The project is developing and using a computer model to estimate the impact of deploying stationary fuel cells in early markets. Insights from the model will assist FCT and its stakeholders in estimating employment and other economic impacts from DOE technology development and in identifying fuel cell markets and industrial sectors that are most likely to generate jobs and economic activity.

FY 2011 Accomplishments

- Reviewed existing fuel cell market studies, impact assessment tools and assumptions in the 2008 Report to Congress.
- Identified viable near-term markets and technologies in the stationary power and specialty vehicle sectors.
- Characterized the supply chain (in terms of the dollar purchases from individual industrial sectors per fuel cell kW) for low temperature polymer electrolyte membrane (PEM) fuel cells; developed initial supply chain characterizations for phosphoric acid fuel cell (PAFC) and molten carbonate fuel cell (MCFC) technologies.
- Completed major portions of a spreadsheet model capable of projecting regional or national employment benefits of fuel cell deployment, including:
  - Design and implementation of input and output screens and user interface.
  - Design and implementation of state and regional interfaces.
  - Development of manufacturing cost algorithms incorporating economies of scale, learning-by-doing and technology advancement functions.
- Conducted a series of meetings/webinars with stakeholders including:
  - Connecticut Center for Advanced Technology
  - South Carolina Hydrogen and Fuel Cell Alliance
  - California Fuel Cell Partnership
  - California Stationary Fuel Cell Collaborative
  - Virginia Clean Cities
  - Clean Energy States Alliance
- Demonstrated early versions of the model to stakeholders and industry representatives to obtain feedback on desired functionality, granularity, and outputs.

Introduction

Section 1820 of the Energy Policy Act of 2005 (Public Law 109-58) directed DOE to assess the impact of a large-scale transition to hydrogen on U.S. employment. In response to that directive, RCF Economic and Financial Consulting, Inc., Argonne National Laboratory, and other partners undertook an in-depth analysis of the economic impacts of hydrogen deployment in the transportation sector. That study relied on input-output analysis to estimate net employment changes at the national level and produced a final report which was submitted to Congress in July 2008. But the study did not address the possibility that stationary fuel cells might be the initial wide-scale fuel cell application, with vehicle applications occurring later. Neither did it develop a model to permit the examination of alternative fuel cell deployment scenarios and their employment impacts. Now, however, it is increasingly important to estimate net and gross employment impacts associated with various scenarios of fuel cell early market development. Developing that modeling capability is the focus of this study.

Results

In FY 2011, Argonne National Laboratory and RCF Economic and Financial Consulting began work on the design and implementation of a spreadsheet tool to calculate the economic impact of fuel cell production, installation, and utilization in early markets (i.e., 2015–2020) at the state, regional and national level. Known as the Job and Output Benefits of Stationary Fuel Cells the tool is designed as a user-friendly, spreadsheet-based application. Figure 1 shows the various geographies incorporated into it. Note that the regions are groups of states that correspond to the nine U.S. census regions.

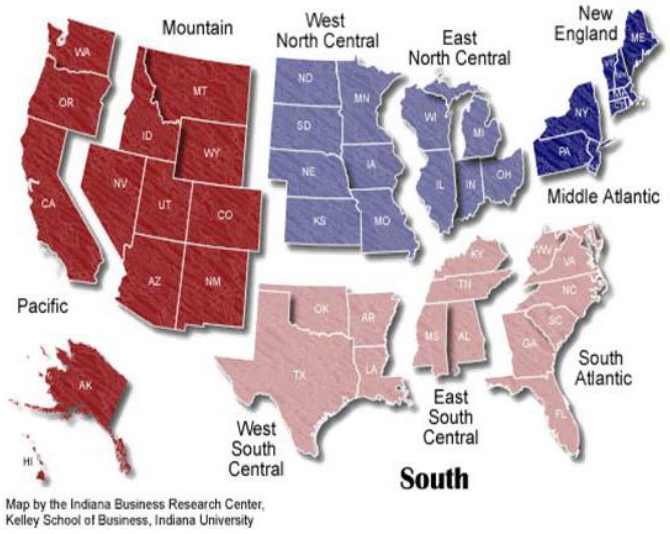


FIGURE 1. U.S. Census Regions

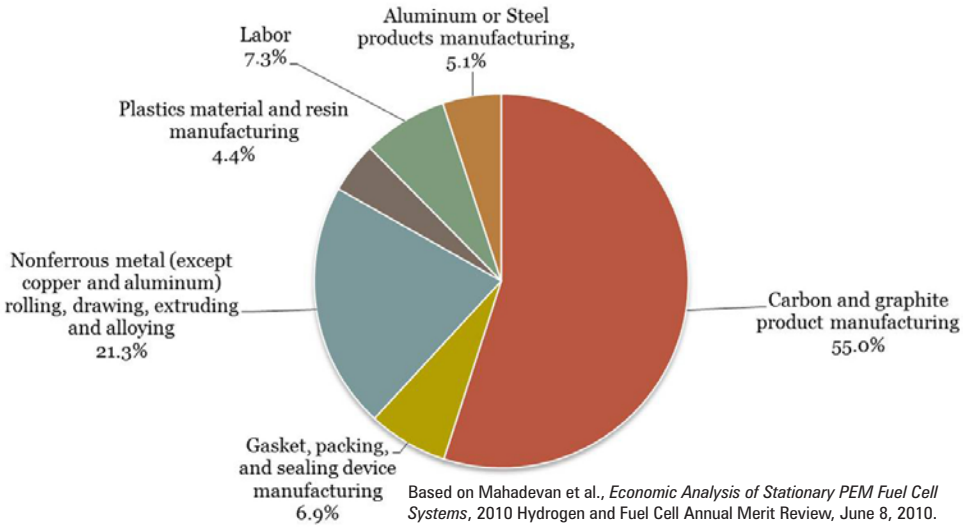
For each of these 60 geographies – 50 states, nine census regions and the nation as a whole – Job and Output Benefits of Stationary Fuel Cells estimates the effect of fuel cell deployment. It does so by adjusting the dollar flows among 440 existing economic sectors. Supply chains for PEM fuel cell, PAFC and MCFC technologies are used to modify those flows to represent purchases by and sales from a nascent fuel cell industrial sector. Figures 2 and 3 illustrate supply chains for the manufacture of PEM fuel cell stacks and balance of plant (BOP). Similar supply chains were developed for MCFC and PAFC stacks and BOP. Note that the underlying dollar flow among existing sectors are based on the Regional Input-Output Modeling System (RIMS) input-output model.

In addition to selecting a geographic area or region of interest and a fuel cell type, users must also select an application (material handling, backup power or prime power) and a market (e.g., Class 1-2 or Class 3 forklifts, cell phone towers or emergency responders) as well as such other variables as fuel cell size, current and future in-region production volumes, imports and exports, and analysis time. These variables define both the overall scenario and anticipated changes in fuel cell manufacturing cost. The manufacturing cost module incorporates the combined effects of manufacturing scale, learning and technology development, based on recent work by Greene et al. (Status and Outlook for the U.S. Non-Automotive Fuel Cell Industry: Impacts of Government Policies and Assessment of Future Opportunities, ORNL/TM-2011/101, May 2011.)

Figure 3 illustrates a representative scenario for deploying roughly 2,000 domestically produced forklifts per year plus a much smaller number of imported units in the out years. Note that indirect employment associated with fuel cell manufacturing, installation and fueling/operation and maintenance (O&M) exceeds direct employment for those categories in all years. Also, since employment in fuel cell installation and fueling/O&M depends on the stock of fuel cells in operation, it grows faster than employment in fuel cell manufacturing which tracks new sales.

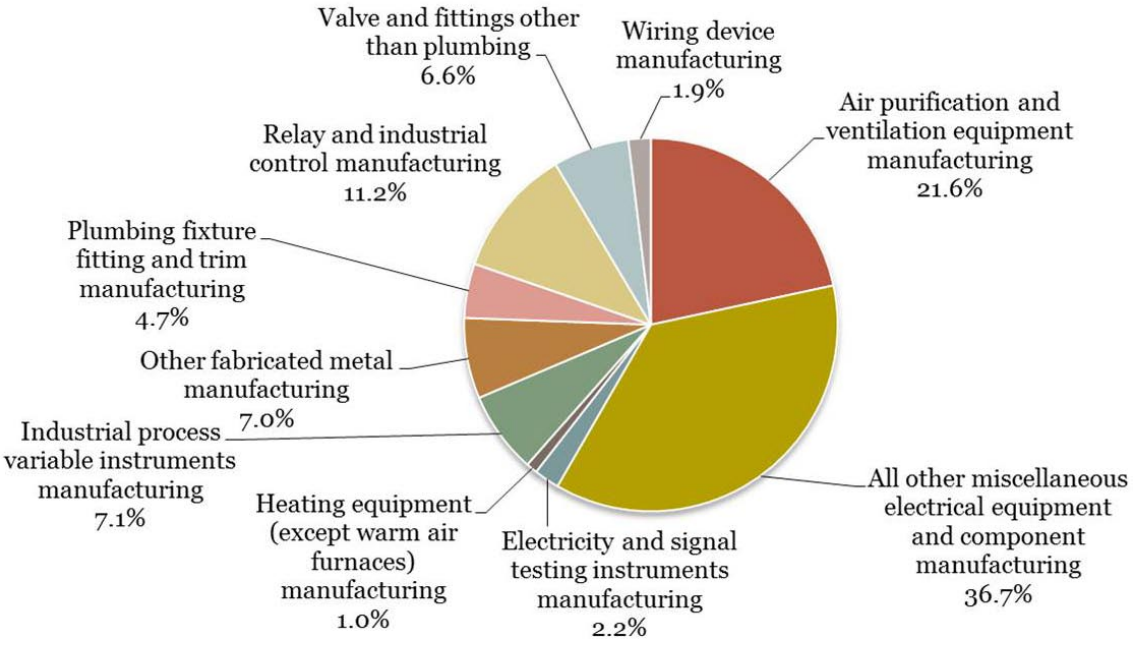
Conclusions and Future Directions

FY 2011 work focused on developing a prototype spreadsheet model to estimate gross state, regional and national economic and employment impacts from the manufacture, installation fueling and operation of fuel cells in distributed prime power, backup power and material handling (e.g. forklift) applications. That work included a review of technology and manufacturing progress; model design and development; discussions with industry and subject matter experts to characterize fuel cell costs and supply chains; the formation of a stakeholder panel to provide input on model design, functionality, data sources and validation; and meetings/presentations to stakeholder groups. FY 2012 work will build on that



Based on Mahadevan et al., *Economic Analysis of Stationary PEM Fuel Cell Systems*, 2010 Hydrogen and Fuel Cell Annual Merit Review, June 8, 2010.

FIGURE 2. Supply Chain for PEM Fuel Cell Stack



Based on Mahadevan et al., *Economic Analysis of Stationary PEM Fuel Cell Systems*, 2010 Hydrogen and Fuel Cell Annual Merit Review, June 8, 2010.

FIGURE 3. Supply Chain for PEM Fuel Cell Balance of Plant

effort, incorporating stakeholder recommendations for enhancements to the functionality and scope of the model, as well as review and beta testing of the tool, and application of it to estimate the employment impacts of projects funded under the American Recovery and Reinvestment Act.

Model enhancements include adding solid oxide fuel cell and high temperature PEM options for prime power, distributed hydrogen production as an option for forklift fueling, the capability of modeling site-specific installations, and the ability to estimate employment impacts of DOE's hydrogen and fuel cell research and development funding.

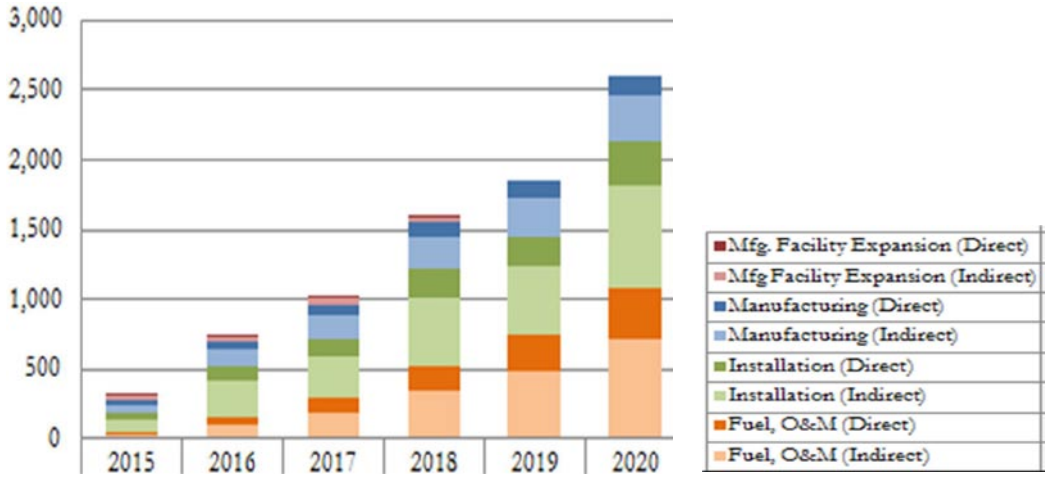


FIGURE 4. Illustrative Example of Gross Jobs Created for a National PEM Fuel Cell Forklift Deployment Scenario