

IX.1 Employment Impacts of Hydrogen and Fuel Cell Technologies

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Subcontractors:

- RCF Economic and Financial Consulting, Inc., Chicago, IL
- Energetics, Inc., Columbia, MD

Project Start Date: October 1, 2015
Project End Date: September 30, 2018

Overall Objectives

- Update 2008 DOE Report to Congress, *Effects of a Transition to a Hydrogen Economy on Employment in the United States*.
- Expand the 2008 report by adding materials handling, backup power and other early market applications of fuel cells, and modeling the effects of market development between industries and regions.
- Estimate net impacts of hydrogen and fuel cell (FC) deployment on national and regional employment, earnings, and economic output under alternative scenarios.
- Identify implications of scenario results on work force development.

Fiscal Year (FY) 2016 Objectives

- Select most appropriate methodology and acquire model to be used for analysis.
- Identify industries likely to be impacted by hydrogen and FC deployment. Examine occupational composition of affected industries.
- Develop reference scenario and industry cost vectors.
- Initiate outreach to stakeholders.

Technical Barriers

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

- (A) Future Market Behavior
- (B) Stove-piped/Siloed Analytical Capability
- (C) Inconsistent Data, Assumptions and Guidelines
- (D) Insufficient Suite of Models and Tools

Contribution to Achievement of DOE Systems Analysis Milestones

This project will contribute to achieving the following milestones for the Systems Analysis section of the FCTO Multi-Year Research, Development, and Demonstration Plan.

- Milestones 1.7, 1.10, and 1.14: Perform Studies and Analysis
- Milestones 2.3–2.6: Develop and Maintain Models and Tools

FY 2016 Accomplishments

- Identified and procured the Regional Economic Models, Inc. (REMI) Policy Insight model in a configuration to permit detailed analysis for five regions.
- Summarized baseline trends in regional employment and wages for relevant industries and occupations within REMI.
- Held a web-enabled facilitated workshop (“webshop”) with stakeholders to review project plans and obtain input for development of reference and alternative scenarios.
- Compared existing forecasts of market growth and hydrogen and FC penetration in select applications. Assembled input data for construction of reference scenario within REMI.



INTRODUCTION

The project is analyzing long and short-term economic impacts associated with the deployment of FCs and associated hydrogen infrastructure. Insights from this work will assist FCTO and its stakeholders in estimating employment and other economic benefits from DOE

technology development and in identifying FC markets and regions that are most likely to see growth in jobs and economic activity from the deployment of these technologies. In earlier work, Argonne National Laboratory and RCF Economic and Financial Consulting analyzed economic impacts associated with a large-scale transition to hydrogen and fuel cells. That work formed the basis for a 2008 DOE Report to Congress [1] which is being updated and expanded in this effort.

APPROACH

FCs are being developed for a range of demands and duty cycles, from small portable devices to megawatt-scale, from steady-state to variable power output, and from continuous to quick-start backup operation. Each of these applications represents a unique market with different packaging and integration, installation, and operation and maintenance needs. Not only do these markets differ in size and anticipated growth, they also displace incumbent technologies with different production locations and supply chains. Thus, modeling the net effects of hydrogen and FC deployment requires an understanding of likely applications and their anticipated growth; the penetration of FCs into those markets and their associated hydrogen fueling needs; the cost of FCs, hydrogen, and the existing technologies currently serving those markets; and supply chains for hydrogen and FCs as well as incumbent technologies. Since economic impacts include induced as well as direct and indirect effects, modeling also requires a platform that can

capture second-order impacts from the respending of dollars in the economy.

RESULTS

As the initial year of a three-year project, FY 2016 efforts focused on model selection and acquisition, and data collection and evaluation to assist in scenario selection and to provide the context for the overall study.

Model Selection

Following a review of alternative options, the REMI Policy Insight model was selected for this analysis. REMI is a robust, integrated model incorporating elements of (a) input-output analysis which captures transactions between industries; (b) general equilibrium theory which balances supply and demand in response to long-run changes in prices, production, consumption, etc.; (c) econometric analysis; and (d) economic geography which captures effects of industry clustering and labor market access on interregional trade, productivity, and competitiveness. Figure 1 shows the five regions into which the model has been configured for this analysis. Unlike other models, U.S. results are the summation of regional results.

Scenario Development

Reference scenario parameters from the 2008 study were summarized and potential sources for updated estimates were reviewed with DOE and stakeholders at a web-enabled



ZEV – Zero emission vehicle

FIGURE 1. Economic analysis regions

webshop and in follow-up communications. Based on those discussions it was agreed that this study’s reference scenario should be based on the DOE Energy Information Administration *2016 Annual Energy Outlook*, utilizing existing FCTO-supported tools for any necessary expansion and regionalization.

REMI estimates of initial or baseline employment and wages for each region were summarized by broad industrial and occupational categories to provide a picture of how jobs are expected to evolve in the absence of a concerted effort to deploy hydrogen and FCs. The resulting categories were constructed from the 160 industries and 95 occupational groups contained in REMI. Figure 2 shows annual estimates of employment (in millions of jobs) from 2015 through 2025 for seven occupational categories and two regions. The seven occupational categories represent the occupations likely to see the greatest impact from hydrogen and FC deployment and account for approximately 25% of total employment in these two regions. As shown in Figure 2, the largest occupational category (assemblers, fabricators) is expected to see a decline in jobs over the next decade while the construction category (e.g., pipefitters, carpenters, electricians) is expected to see the most rapid growth.

CONCLUSIONS AND FUTURE DIRECTIONS

FY 2016 work focused on identifying and acquiring the most suitable model for this effort, defining a reference case and beginning work on the largest hydrogen and FC application that will be considered in this analysis, namely light-duty vehicles. Estimation of industry cost vectors for the light-duty vehicle supply chain began in FY 2016 and will conclude by the end of the calendar year. A similar effort to estimate industry cost vectors for other applications (including material handling equipment, backup power, and prime power) will begin in FY 2017.

FY 2016 PUBLICATIONS/PRESENTATIONS

1. Jones, D., 2016. *Summary of 2008 DOE Report to Congress, Economic Impact of Hydrogen and Fuel Cell Deployment Webshop*, Argonne National Laboratory, April 28.
2. Mintz, M., 2016. *Study Rationale, Economic Impact of Hydrogen and Fuel Cell Deployment Webshop*, Argonne National Laboratory, April 28, 2016.
3. Mertes, C., 2016. *Modeling Economic Impacts, Economic Impact of Hydrogen and Fuel Cell Deployment Webshop*, Argonne National Laboratory, April 28.

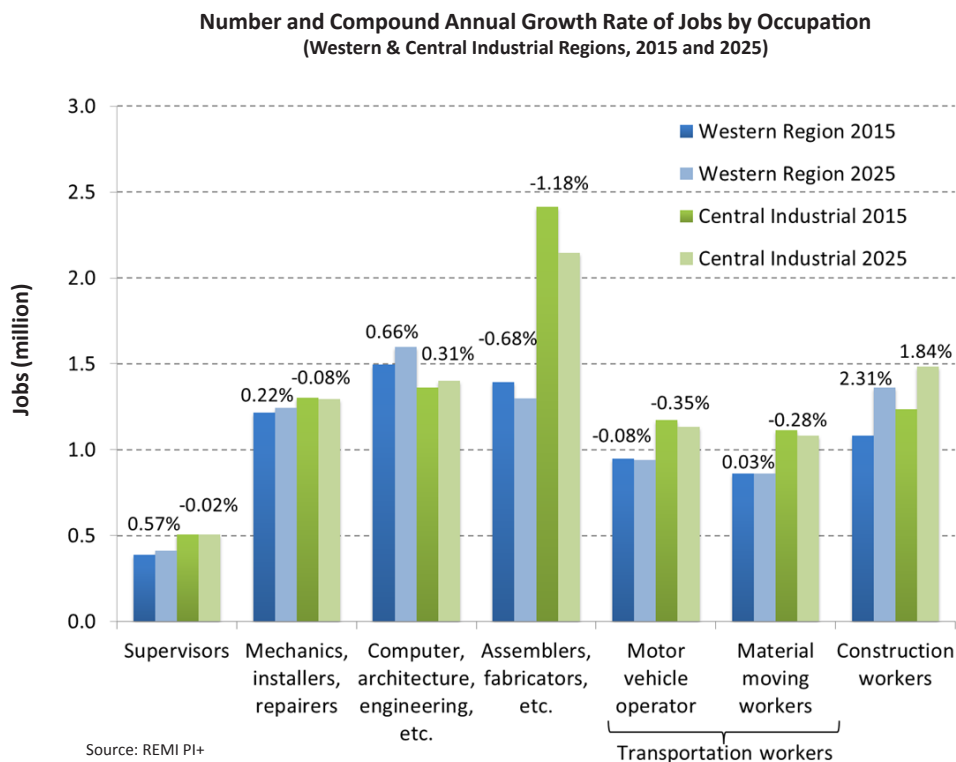


FIGURE 2. Jobs by occupation, western, and central industrial regions, 2015–2025

4. Mertes, C., 2016. *Modeling Economic Impacts of Hydrogen and Fuel Cell Deployment with REMI-PI+*, Regional Economic Models, Inc. Conference, Chicago, June 3.

REFERENCES

1. U.S. Department of Energy, 2008. *Effects of a Transition to a Hydrogen Economy on Employment in the United States: Report to Congress*, July.