X.2 Employment Impacts of Infrastructure Development for Hydrogen and Fuel Cell Technologies

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Subcontractor
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Project Start Date: October 2012.
Project End Date: Project continuation and direction determined annually by DOE

Overall Objectives

- Facilitate early market deployment of fuel cells (FCs) by developing a downloadable, user-friendly tool to estimate economic impacts associated with the deployment of FCs and related infrastructure.
- Develop a consistent framework to identify opportunities to enhance the economic impact of FC production and deployment by better understanding where and how impacts occur and how infrastructure deployment produces economic benefits.
- Meet stakeholder needs for estimating impacts of FC and infrastructure deployment on state, regional and national employment, earnings, and economic output.

Fiscal Year (FY) 2014 Objectives

- Document the methodology and approach to estimating economic impacts of deploying hydrogen fueling infrastructure for early FC markets.
- Launch JOBS H2 (JOBS and economic impacts of Hydrogen) model.
- Examine sensitivity of job creation to modeling assumptions.

Challenges/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

(E) Unplanned Studies and Analysis

Contribution to Achievement of DOE Systems Analysis Milestones

This project contributes to achieving the following milestones for the Systems Analysis section of the Fuel Cell Technologies Office Multi-Year Research, Development, and Demonstration Plan:

- Milestones 2.2–2.6: Develop and maintain models and tools
- Milestones 1.7, 1.10 and 1.14: Perform studies and analyses of job impacts

FY 2014 Accomplishments

- Completed design and development of the JOBS H2 model. Launched JOBS H2 1.0 in a DOE-sponsored webinar on June 24, 2014.
- Continued close collaboration with stakeholders, hydrogen and fuel cell producers and other researchers via a series of teleconferences and webinars. Demonstrated beta version of the JOBS H2 (JOBS and economic impacts of Hydrogen) model to this group to (a) gain further insight into infrastructure development cost, deployment and other issues, (b) validate defaults, and (c) obtain feedback on desired functionality, granularity, and outputs.
- Developed a new website (http://jobsmodels.es.anl.gov) which contains documentation and publications related to both the hydrogen infrastructure model (JOBS H2) and the earlier JOBS FC (JOBS and economic impacts of Fuel Cells) model. Developed user resources for the site, including print documentation of JOBS FC, a set of video user guides to demonstrate the use of JOBS H2, and links to DOE-sponsored webinars.

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INTRODUCTION

The project is developing and applying a computer model to estimate economic impacts of deploying FCs and associated infrastructure in early markets. Insights from this work will assist Fuel Cell Technologies Office

and its stakeholders in estimating employment and other economic impacts from DOE technology development and in identifying FC markets and regions that are most likely to generate jobs and economic activity.

In earlier work, Argonne National Laboratory and RCF Economic & Financial Consulting designed and implemented a tool to calculate state, regional and national economic impacts of FC production, installation, and utilization in early markets. Known as JOBS FC (JOBS and economic impacts of Fuel Cells) that tool is a user-friendly, spreadsheet-based model. In FY 2013, work began on a companion tool, JOBS H2, using the same methodology. FY 2014 activities focused on beta testing, launching, and conducting sensitivity analyses of JOBS H2.

APPROACH

JOBS H2 is an Excel-based model that estimates economic impacts of activities associated with hydrogen station deployment based on user-specified scenarios. Activities include station design, engineering and permitting; site preparation; equipment production, shipping and installation; station operation and maintenance (O&M); and hydrogen production and delivery. The model calculates economic impacts along supply chains and from induced or ripple effects using input-output relationships from the U.S. Department of Commerce Bureau of Economic Analysis' Regional Input-output Modeling System. JOBS H2 can be run with default values (based on stakeholder input and engineering estimates from the published literature) or user inputs.

RESULTS

Model Development

JOBS H2 calculates the effect of hydrogen infrastructure deployment on any of 60 geographies—50 states, nine census regions, or the nation as a whole—by adjusting dollar flows among economic sectors within the relevant geography. As hydrogen infrastructure is deployed, those expenditures send dollars up the supply chain for station equipment (e.g., compressor packages, dispensers) and hydrogen fuel, as well as to the relevant supply chains for system integrators, installers, fuel suppliers and businesses providing O&M services. In the aggregate, the resulting web of transactions represents a nascent hydrogen retailing sector. Purchases include not only the hydrogen itself, but all transactions required to install, fuel and operate the station.

To demonstrate the model's capability, an illustrative scenario under which 25 stations are deployed for each of five years was postulated. As shown in Figure 1 under such a steady-state scenario, station development jobs rise quickly (to ~1,000 per year). As stations come online, jobs shift to new station development projects. However, if station development ceases, jobs associated those activities also cease. On the other hand, station operation jobs are not created until stations begin operation. These jobs rise steadily as more stations come online. Once all 125 stations in the illustrative scenario are online, station operation jobs level off at ~1,900/year.

Sensitivity Analysis

To examine the model's sensitivity a middle or base case was postulated along with upper and lower bounds for key parameters. These assumptions are shown in Table 1.

TABLE 1. Base Case Assumptions for Sensitivity Analyses

	Base Case Value		Lower Value	Upper Value
Station Size	200 kg/day		100 kg/day	400 kg/day
Station cost	$2.15 MM		$1.1 MM	$4.3 MM
Local shares	Installation & site prep	100%	0%	100%
	Equipment	50%	0%	100%
	Design & engineering	50%	0%	100%
	Station O&M	100%	0%	100%
	Hydrogen fuel	50%	0%	100%
Station utilization	50%		20%	80%

Employment impacts of expenditures associated with station development and operation are shown in Figures 2 and 3, respectively. Station development jobs are most sensitive to the proportion or share of expenditures that are spent in the region of interest, as well as to total expenditures. In the most extreme case shown, employment approximately triples. While station operation jobs are also sensitive to local shares, station throughput (a function of utilization and size) are also important. Note that station development jobs tend to be less numerous and of shorter duration than operational jobs which continue as long as the station remains in operation.

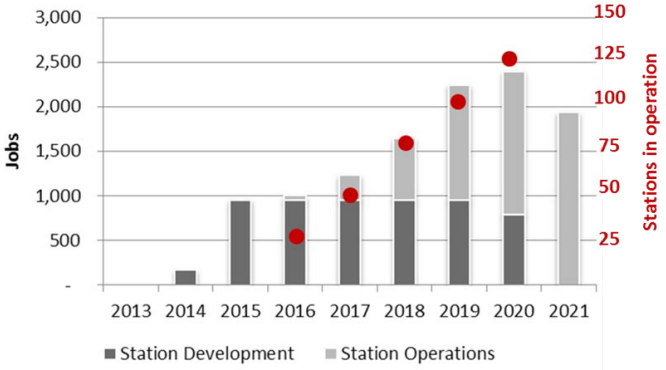

FIGURE 1. Station Development and Station Operation Jobs Associated with Deploying 25 Stations per Year for Six Years under an Illustrative Scenario

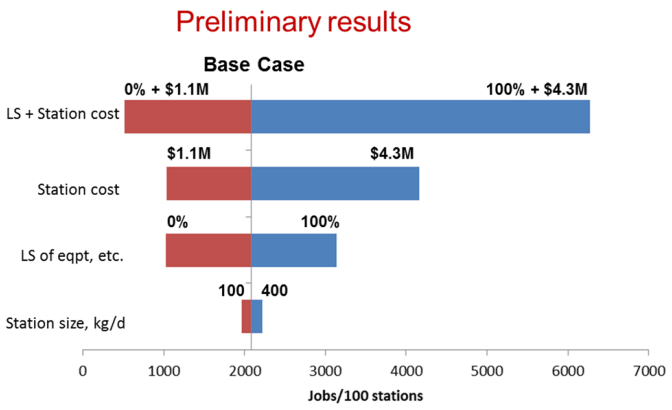

FIGURE 2. Station Development Jobs as a Function of Station Size, Cost and Local Share (LS) of Expenditures

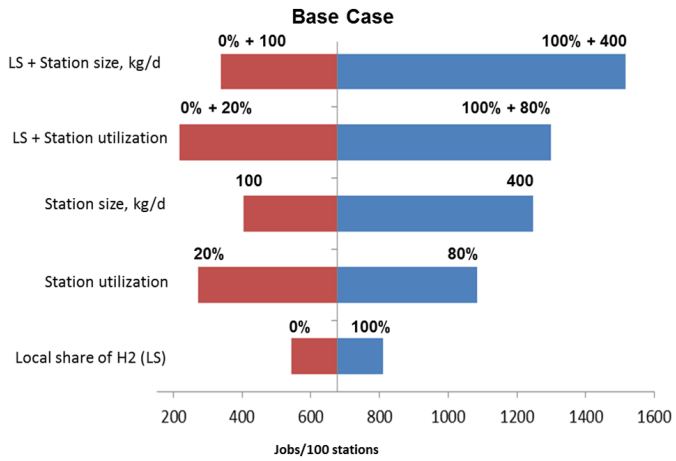

FIGURE 3. Station Operation Jobs as a Function of Station Size, Utilization and Local Share of Expenditures

User Resources

Stakeholders have been heavily involved in the development of JOBS H2. An advisory group consisting of representatives from the hydrogen and FC industry, station developers and state/local agencies assisted in data validation, requirements specification/review of the user interface, and beta testing of JOBS H2. Outreach included one-on-one conversations, webinars, and a website (http://jobsmodels.es.anl.gov). The latter features user access to a free downloadable copy of JOBS H2, along with video user guides, links to DOE-sponsored webinars, and copies of publications/presentations.

CONCLUSIONS AND FUTURE DIRECTIONS

FY 2014 work focused on development of the JOBS H2 model. Work included outreach to stakeholders to develop and validate input data and refine the user interface; model testing and quality assurance via a series of webinars, beta tests and sensitivity analyses; and model launch. FY 2015 work will build on these efforts, incorporating stakeholder recommendations for enhancements to the functionality and scope of the model, as well as developing estimates of employment impacts to support ongoing infrastructure deployment programs.

Potential future model enhancements include adding a capability to show uncertainty in results, expanding hydrogen delivery and dispensing options, and analyzing the impacts of alternative hydrogen station rollout scenarios.

FY 2014 PUBLICATIONS/PRESENTATIONS

1. Mintz, M., J. Gillette, C. Mertes and E. Stewart, *Employment Impacts of Hydrogen Infrastructure Deployment: Methodology and Initial Results,* Argonne National Laboratory, ANL/ESD-13/15, Sept. 2013.

2. Mintz, M., J. Gillette, C. Mertes and E. Stewart, *JOBS and Economic Impacts of Fuel Cells (JOBS FC) Model Documentation,* Argonne National Laboratory, ANL/ESD-13/14, Dec. 2013.

3. Mintz, M., *Employment Impacts of Hydrogen Fueling Infrastructure*, Alternative Clean Transportation (ACT) Expo, Long Beach, CA, May 8, 2014.

4. Mintz, M., C. Mertes and E. Stewart, *Employment and Economic Impacts of Hydrogen Station Deployment,* EERE webinar, June 24, 2014 (http://energy.gov/eere/fuelcells/2014-webinar-archives#date062414).