IX.5 Employment Impacts of Infrastructure Development for Hydrogen and Fuel Cell Technologies

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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) 2015 Objectives

- Launch JOBS H2
- Analyze economic impacts associated with the hydrogen station deployment roadmap [1] developed by the California Fuel Cell Partnership (CaFCP)
- Add a stochastic simulation capability to JOBS H2 to enable it to explicitly account for uncertainty in key input variables

Challenges/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 (MYRDD) 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 contributes to achieving the following milestones from the Systems Analysis section of the FCTO MYRDD Plan:

- Milestones 2.3–2.6: Develop and maintain models and tools
- Milestones 1.7, 1.10, and 1.14: Perform studies and analyses of job impacts

FY 2015 Accomplishments

- Launched JOBS H2 1.0 in an Office of Energy Efficiency & Renewable Energy (EERE)-sponsored webinar on June 24, 2014
- Continued a program of close collaboration with stakeholders, hydrogen and fuel cell producers, and other researchers via a series of teleconferences and review of interim results
- Analyzed economic impacts associated with the CaFCP's hydrogen station deployment roadmap and published a report documenting the methodology and results of that analysis
- Developed a stochastic procedure for estimating the effect of uncertainty in key parameters of JOBS H2
- Expanded access to JOBS H2 (as well as JOBS FC) by providing links from the Alternative Fuels Data Center (AFDC) website and via smartphone readable Quick Response (QR) cards distributed by the Clean Cities Program

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 FCTO 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, ANL 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 2015 activities focused on enhancing 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

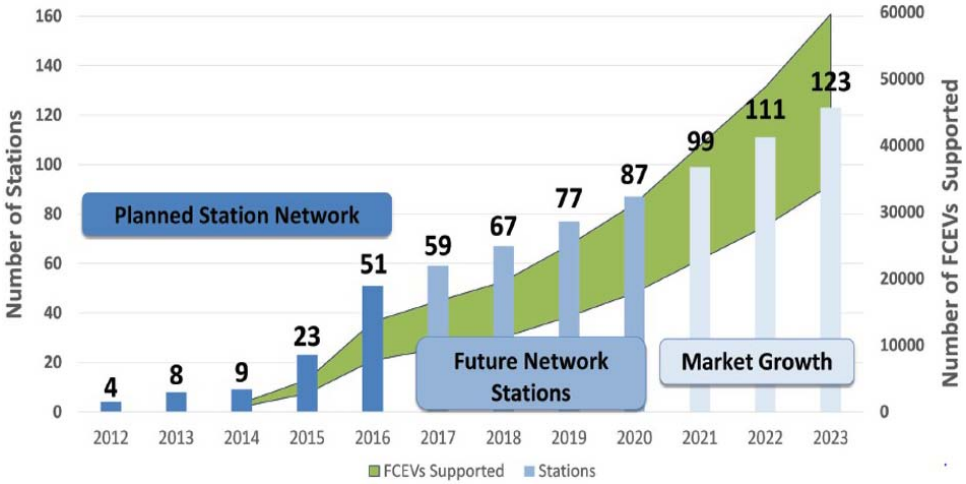
JOBS H2 calculates the effect of hydrogen infrastructure deployment on any of 60 geographies—50 states, nine census regions, or the nation as a whole—by adjusting dollar flows among economic sectors within the relevant geography. As hydrogen infrastructure is deployed, those expenditures send dollars up the supply chain for station equipment (e.g., compressor packages, dispensers) and H_2 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 H_2 retailing sector. Purchases include not only the H_2 itself, but all transactions required to install, fuel and operate the station.

Analysis

In FY 2015 JOBS H2 was employed to estimate economic impacts associated with the CaFCP's hydrogen station roadmap within the state of California. As shown in Figure 1, stations grow from 23 in 2015 to 123 in 2023 under the roadmap. Thus, the JOBS H2 analysis included the development of 100 new hydrogen stations of different sizes over the next eight years, the operation of those new stations as they came on line and their utilization evolved, and the operation of 23 existing hydrogen stations over the next eight years. As shown in Figure 2, employment rises in response to the rate of station deployment, increasing as more stations come online, and eventually leveling off when all stations are online. Induced jobs account for 30–40% of the total. Once all 123 stations in the roadmap are online, station operation jobs level off at ~1,000/year.

Model Development

In FY 2015 JOBS H2 also was enhanced with a stochastic simulation capability to permit it to explicitly



FCEVs – fuel cell electric vehicles

FIGURE 1. California Fuel Cell Partnership station roadmap (CaFCP 2014)

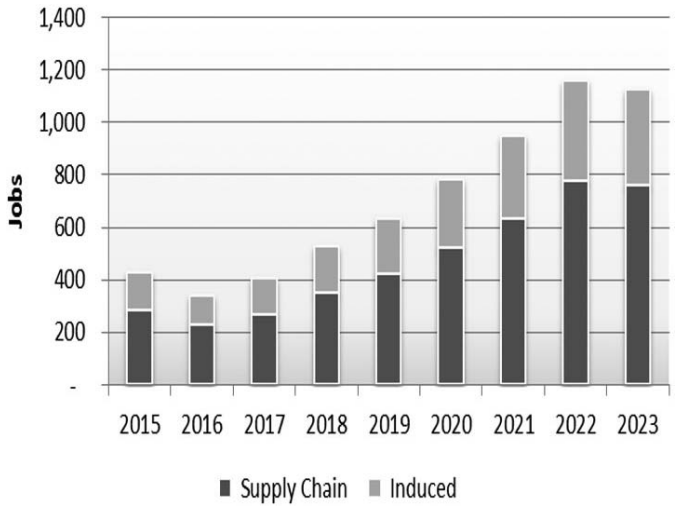


FIGURE 2. JOBS H2 estimate of California employment associated with the CaFCP H_2 station roadmap

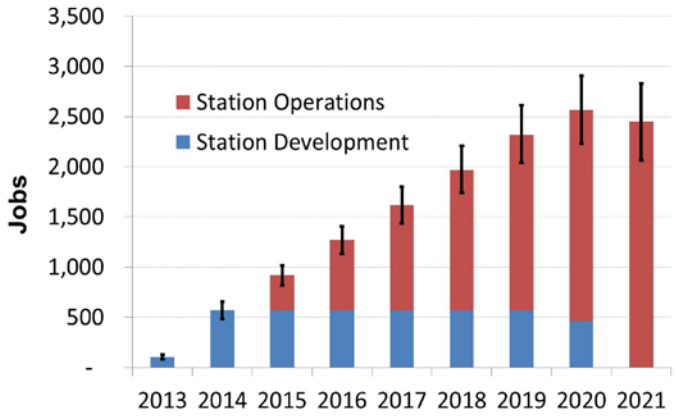


FIGURE 3. JOBS H2 estimate of United States employment associated with a station rollout similar to the CaFCP roadmap

account for uncertainty in key input parameters. Probability density functions were specified for a number of development, equipment, and operational expense categories and the model was configured to sample inputs from those distributions for thousands of simulations. The resulting outputs can be displayed as a range of results bounded by 10% and 90% probabilities. In Figure 3 those ranges are shown as bars surrounding most probable (or mean) estimates of United States employment for a scenario similar to the CaFCP roadmap.

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, links from EERE's AFDC and QR cards, and a website (http://jobsmodels.es.anl.gov). The latter features user access to the model itself along with video user guides, links to EERE-sponsored webinars, and copies of publications and presentations.

CONCLUSIONS AND FUTURE DIRECTIONS

FY 2015 work focused on enhancement of the JOBS H2 model. Work included the initial model launch, development of a stochastic capability to estimate uncertainty, and analysis of the CaFCP hydrogen station roadmap. FY 2016 work will build on these efforts, including expanding the model to include liquid hydrogen delivery and larger capacity stations, examining station rollout plans in the northeast, and validating California results with a more detailed analysis of the CaFCP program.

Potential future model enhancements include expanding hydrogen delivery and dispensing options to include distributed production and mobile fuelers, and analyzing the impacts of alternative hydrogen station rollout scenarios.

SPECIAL RECOGNITIONS & AWARDS

1. 2015 DOE Hydrogen and Fuel Cells Program Team R&D Award, June 2015.

FY 2015 PUBLICATIONS/PRESENTATIONS

1. Mintz, M., J. Gillette, C. Mertes, and E. Stewart, "Economic Impacts Associated with Commercializing Fuel Cell Electric Vehicles in California: An Analysis of the California Roadmap Using the JOBS H2 Model," Argonne National Laboratory Report, ANL/ESD-15/1, Dec. 31, 2014.

2. 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).

REFERENCES

1. CaFCP, 2014. *A California Roadmap, 2014 Update*, "Hydrogen Progress, Priorities and Opportunities," July.