Modeling Investment Strategies in the Transition to a Hydrogen Transportation Economy

Matthew R. Mahalik[1], **Craig H. Stephan**[1], **Guenter Conzelmann**[1], **Marianne M. Mintz**[2], **George S. Tolley**[3] and **Donald Jones**[3], (1)Center for Energy, Environmental, and Economic Systems Analysis, Argonne National Laboratory, 9700 South Cass Ave., Bldg. 900, Argonne, IL 60439, (2)Center for Transportation Research, Argonne National Laboratory, (3)RCF Economic and Financial Consulting, Inc., Chicago, IL

In a mature "hydrogen economy" personal vehicles will be powered by either fuel cells or hydrogen-fueled internal combustion engines. The "hydrogen economy" will not appear overnight and it will not be built entirely from scratch. However, how will it evolve? In particular, how will it resolve the "chicken and egg" problem of building a hydrogen supply and distribution infrastructure in the absence of an existing market? And, conversely, how will consumers be induced to invest in hydrogen vehicles when the supply infrastructure is sparse? The problem is more daunting than those facing less infrastructure-dependent new vehicle technologies like hybrid-electric vehicles or "flex-fuel" ethanol vehicles. Thus, it is important to understand the dynamics of how a transition might occur.

Under DOE sponsorship, we have developed an agent-based computer simulation of how such a transition might unfold in the Los Angeles metropolitan area. This method is of particular utility in a case where a large number of diverse participants interact with one another in complex ways. In our simulation, agents are of two types: potential buyers of hydrogen vehicles and potential investors in hydrogen fueling stations. An investigation focusing on the driver agents and how they drive the demand for hydrogen fuel was reported at the 2008 NHA Conference. In this report we shift the focus to the investor agents. In a major infrastructure rollout a single investor may act alone and exert a great deal of control over the timing and placement of hydrogen fueling stations, or many investors may compete with one another to capture a piece of the emerging market. In our model, investors are characterized by their willingness to take risks, the amount of capital at their disposal, the degree of market research they are willing to undertake, and their ability to learn from past experience. In a speculative market, investors must anticipate growth in demand over time and how building more supply infrastructure impels this growth. In a competitive market it is equally important to anticipate the actions of one's competitors, particularly how much competing supply will be put in place over time and at which locations. Also not to be ignored when considering the building of a new station is the potential for cannibalizing sales from the investor's existing portfolio of stations. We explore various techniques for simulating these behaviors. If investors predict inaccurately they suffer financially, but they are able to learn from their mistakes and refine their prediction ability. Depending upon how rapidly investors build new infrastructure and how drivers react to the sparse but growing number of hydrogen fueling stations, the transition may occur more or less rapidly, or may fail altogether. Model results showing how such transitions occur under a number of different scenarios will be presented, key features of successful and unsuccessful transitions will be identified, and factors that appear to be most salient in influencing success will be discussed.

Title: Modeling Investment Strategies in the Transition to a Hydrogen Transportation Economy

Submitter's E-mail Address: mahalik@anl.gov

First author

Presenting Author
Matthew R. Mahalik
Center for Energy, Environmental, and Economic Systems Analysis
Decision and Information Science Division
Argonne National Laboratory
9700 South Cass Ave.
Bldg. 900
Argonne, IL 60439
Phone Number: (630) 252-9913
Email: mahalik@anl.gov
Biographical Sketch: Matthew Mahalik has been with Argonne National Laboratory since 2000 as a software engineer and energy market modeler. His work focuses on developing power market models, the analysis of hydropower resource management in open power markets, and using agent-based modeling for energy market analysis. Recently, he has been the key developer of a new agent-based hydrogen transition model. Mr. Mahalik holds a degree in Computer Science from the University of St. Francis.

Second author

Craig H. Stephan
Center for Energy, Environmental, and Economic Systems Analysis
Decision and Information Science Division
Argonne National Laboratory
9700 South Cass Ave.
Bldg. 900
Argonne, IL 60439
Phone Number: (630) 252-1474
Email: cstephan@anl.gov

Third author

Guenter Conzelmann
Center for Energy, Environmental, and Economic Systems Analysis
Decision and Information Science Division
Argonne National Laboratory
9700 South Cass Ave.
Bldg. 900
Argonne, IL 60439
Phone Number: (630) 252-7173
Email: guenter@anl.gov

Fourth author

Marianne M. Mintz
Center for Transportation Research
Energy Systems Division
Argonne National Laboratory
9700 South Cass Ave.

Bldg. 362
Argonne, IL 60439
Phone Number: (630) 252-5627
Email: mmintz@anl.gov

Fifth author

George S. Tolley
RCF Economic and Financial Consulting, Inc.
Chicago, IL
Email: GTolley@rcfecon.com

Sixth author

Donald Jones
RCF Economic and Financial Consulting, Inc.
Chicago, IL
Email: DJones@rcfecon.com