X.0 Systems Analysis Sub-Program Overview

Introduction

Systems Analysis supports decision-making by providing greater understanding of the contribution of individual components to the hydrogen energy system as a whole, and the interaction of the components and their effects on the system. Analysis will be used to continually evaluate the alternatives for satisfying the functions and requirements of the future hydrogen system/economy and the Hydrogen Program's progress. Analysis is conducted to assess cross-cutting and overall hydrogen system issues, and to support the development of the production, delivery, storage, fuel cell and safety technologies. Particular emphasis is given to transition analysis, as recommended by the National Research Council in their February report, *The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs*.

The Systems Analysis activity made several significant contributions to the Hydrogen Program during Fiscal Year 2008. Several analytical tools including the Hydrogen Demand and Resource Analysis (HyDRA) and Macro-System models were completed and peer reviewed to support the analytical process. Resource and infrastructure analyses were conducted to better understand hydrogen supply issues. A report on the scenario analysis for various fuel cell vehicle penetration rates to understand the infrastructure, hydrogen supply and policy issues to transform the fuel and vehicle system to hydrogen was issued. Analysis for early market opportunities for fuel cells and environmental impacts of hydrogen on the atmosphere began in FY 2008.

Goal

Provide system-level analysis products to support transition-strategy development and the 2015 technology readiness goal by evaluating technologies and pathways, guiding the selection of research, development and demonstration (RD&D) projects, and estimating the potential value of RD&D efforts.

Objectives

- By 2009, identify and evaluate feasible transition scenarios consistent with infrastructure and hydrogen resources, including an assessment of timing and sequencing issues for an operational hydrogen economy.
- By 2011, enhance the Marco-System Model to include the stationary electrical generation and infrastructure for a full hydrogen economy.
- By 2014, complete environmental studies that are necessary for the 2015 technology readiness goal.
- By 2015, analyze the ultimate potential for hydrogen and fuel cell vehicles. The analysis will address necessary resources, hydrogen production, transportation infrastructure, vehicle performance, and interactions between a hydrogen economic sector and other sectors.
- Provide milestone-based analysis, including risk analysis, independent reviews, financial evaluations and environmental analysis, to support the program's needs prior to the 2015 technology readiness milestone.
- On an annual basis, update the well-to-wheels (WTW) analysis for technologies and pathways for the Hydrogen Program to include technological advances or changes.

FY 2008 Status

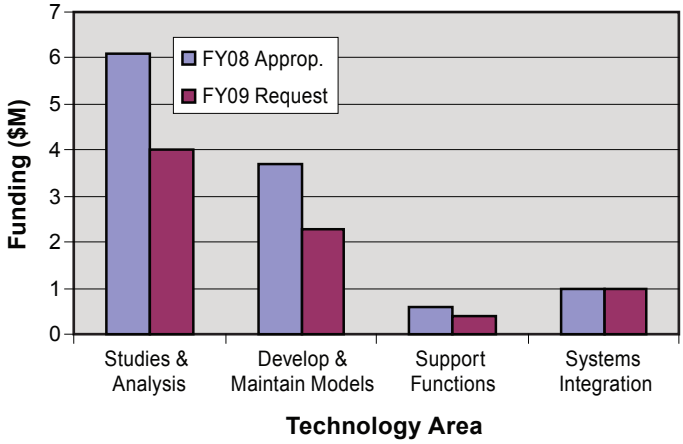
Systems Analysis was established within the DOE Hydrogen Program to develop a consistent, comprehensive framework for examining the economics, benefits, risks, realities, opportunities, and impacts of a hydrogen economy. Analysis and model projects were evaluated in FY 2008 to identify modeling and analysis gaps.

FY 2008 Accomplishments

- The Macro-Systems Model was completed. This tool is a dynamic engineering transition model that will simulate the performance and evolution of hydrogen infrastructure using a distributed architecture to link existing and emerging models for system components, was completed. The model was peer reviewed in the later part of FY 2008. The model was used to analyze the delivered hydrogen cost, WTW parameters (greenhouse gas emissions, petroleum energy use and total energy use) and hydrogen losses for several pathways. The results of nine analyses using the Macro-System Model were compared to results from the European Commission-funded HyWAYS project to analyze hydrogen pathway cost and WTW oil use and greenhouse gas emissions. The comparison showed that the results were fundamentally the same, although there were discrepancies, such as a financial focus on business cases in the Marco-System Model as compared to a focus on policy support in the HyWAYS project.
- Oak Ridge National Laboratory (ORNL) published the scenario analysis for various fuel cell vehicle penetration rates to understand the infrastructure, hydrogen supply and policy issues to transform the fuel and vehicle system to hydrogen. This analysis included input and feedback from industry, academia and the national models on the vehicle penetration scenarios and infrastructure requirements for supporting these scenarios. The analysis suggests that costs over the early transition period are feasible, between $10 billion and $50 billion over 14 years.
- The Hydrogen Demand and Resource Analysis (HyDRA) model development was completed to enable resource and infrastructure analysis for various hydrogen pathways. The model was peer reviewed in FY 2008.
- Early market analysis was completed to understand the impacts of government purchase programs on fuel cell cost and WTW greenhouse gas reductions for early market adoption of fuel cells for distributed power and forklifts. The analysis was conducted with the ORNL HyTrans and the Argonne National Laboratory Greenhouse gases, Regulated Emissions and Energy use in Transportation (GREET) models and showed, using conservative assumptions for scale economies and learning-by-doing, that a federal acquisition program could catalyze a sustainable North American polymer electrolyte membrane fuel cell industry, driving costs down enough to make fuel cell products competitive with incumbent technologies by 2015.
- The H2A Production model was updated and revised to include new features such as capital equipment and feedrate scaling, cost analysis for CO_2 sequestration for coal and biomass gasification and updated technology information. The format of the model was improved by adding a graphical user interface for data input. The model and production cases were posted on the Energy Efficiency and Renewable Energy Web site for public access in FY 2008.

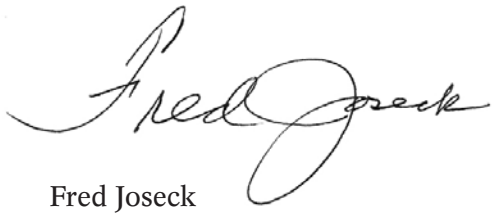
Budget

The budget for the Systems Analysis activity is consistent with the goals and objectives of the effort and is responsive to the recommendations of the National Research Council. The FY 2009 budget request includes funding for transition, resource and infrastructure analysis, as well as increases for environmental analysis, program analysis, modeling, and systems integration.



FY 2009 Plans

The Systems Analysis activity for FY 2009 will focus on conducting analyses with available models to resolve known gaps in understanding of hydrogen and fuel cell systems and infrastructure. Analyses will be focused on understanding the tradeoffs and regional impacts of hydrogen fuel cell vehicles with other alternative fuels and plug-in hybrid vehicles on a WTW basis, and the synergies of linking stationary fuel cell power generation with the hydrogen requirements for the transportation sector to accelerate infrastructure build-out. The FY 2008 appropriation included $11.5 million for Systems Analysis; the FY 2008 request is $7.7 million. The budget request for FY 2009 reflects the recommendation of the National Research Council to increase funding for WTW, transition, resource, and infrastructure analysis.



Fred Joseck
Systems Analyst
Department of Energy
Hydrogen, Fuel Cells & Infrastructure Technologies
EE-2H, 1000 Independence Ave., SW
Washington, D.C. 20585-0121
Office: (202) 586-7932
E-mail: Fred.Joseck@ee.doe.gov