X.15 Adapting the H2A Hydrogen Production Cost Analysis Model to Stationary Applications

Darlene Steward (Primary Contact),
Michael Penev
National Renewable Energy Laboratory
1617 Cole Blvd.
Golden, CO 80401
Phone: (303) 275-3837; Fax: (303) 275-3840
E-mail: darlene_steward@nrel.gov

DOE Technology Development Manager:
Fred Joseck
Phone: (202) 586-7932; Fax: (202) 586-9811
E-mail: Fred.Joseck@ee.doe.gov

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(H2A Stationary Model Version 1.0)

Objectives

Expand the capabilities of the H2A model to evaluate stationary production of the following:

- Electrical power
- Heat cogeneration
- Hydrogen cogeneration

Technical Barriers

This project addresses the following technical barriers from the Systems Analysis section (4.5) of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

(B) Stove-piped/Siloed Analytical Capability
(C) Inconsistent Data, Assumptions and Guidelines
(D) Suite of Models and Tools
(E) Unplanned Studies and Analysis

Achievement of DOE Systems Analysis Milestones

This project will help achieve the following DOE milestones from the Systems Analysis section of the Hydrogen, Fuel Cells, and Infrastructure Technologies Program Multi-Year Research, Development, and Demonstration Plan:

- **Milestone 5:** Complete analysis and studies of resource/feedstock, production/delivery and existing infrastructure for various hydrogen scenarios. (4Q, 2009)
- **Milestone 39:** Annual update of analysis portfolio (4Q, 2008; 4Q, 2009).

Introduction

The H2A model platform is based on a discounted cash-flow economic analysis for hydrogen production. The model provides for inputs such as production efficiency, feedstock type, capital cost, installation period, internal rate of return, scrap value, and the like, to enhance the flexibility of the analyses. The use of stationary fuel cell applications is seen by the DOE as a critical step for early market transformation. For this reason, a modification of the H2A model has been requested to help evaluate stationary fuel cell and other hydrogen technology combinations. The H2A platform was a prime choice for this effort as it provides a transparent, consistent and comparable Excel-based analysis. H2A is a familiar and readily available model. In addition Excel is the platform of choice for the DOE as it makes their models more consistent and easily integrated with each other. The Excel platform can be readily modified to accommodate such an analysis by means of the introduction of an hourly energy analysis module (see Figure 1).

Approach

The H2A model is being modified to evaluate the cost of producing electricity, heat, and hydrogen by allowing the modeling of energy conversion devices such as a high-temperature fuel cell system, low-temperature fuel cell, electrolyzer, hydrogen storage, peak burner, solar panels, and heat sink (see Figure 2). Additional renewable energy sources will be added in subsequent versions of the model. Energy demands and renewables profiles will then be fed into a new H2A energy prioritization routine. The module prioritizes resource consumption using the criteria of grid-connected electric or heat load-following. Total resource use, energy supplied, and associated capital and operating costs are then fed into H2A. Based on H2A calculations, the cost of energy supplied is then calculated. The model user will determine how the cost is divided for the customer among electricity, heat, and hydrogen rates.

The project was broken down into the following four tasks:

1. Develop model of hourly energy use; refine model based on industry and partner feedback.

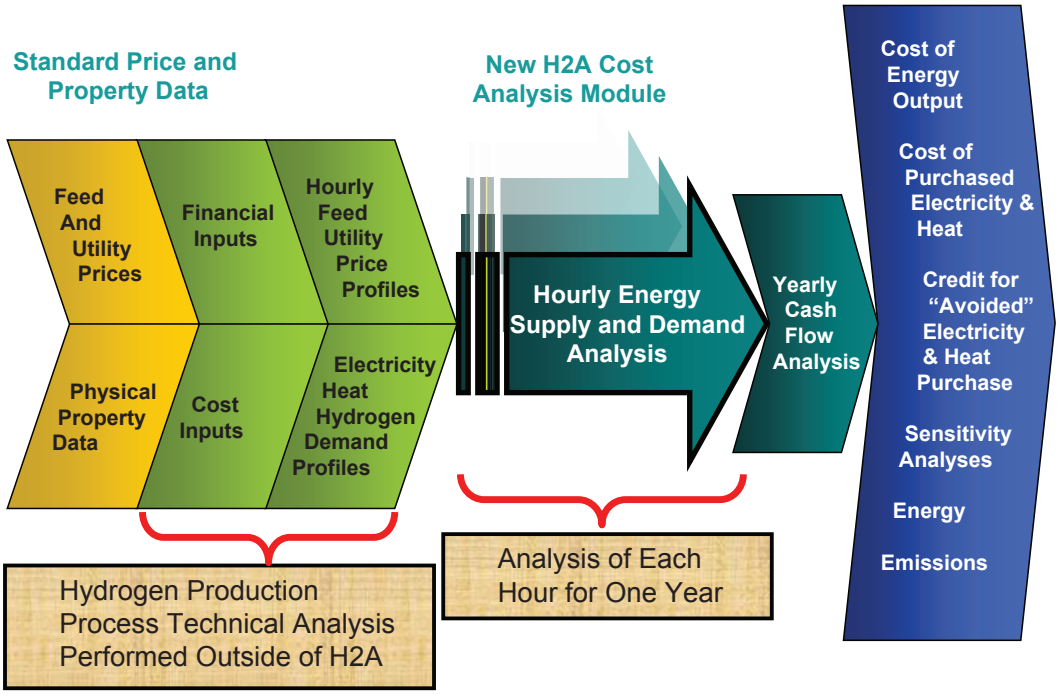

FIGURE 1. Layout of H2A Stationary Introduction of Hourly Energy Analysis Module

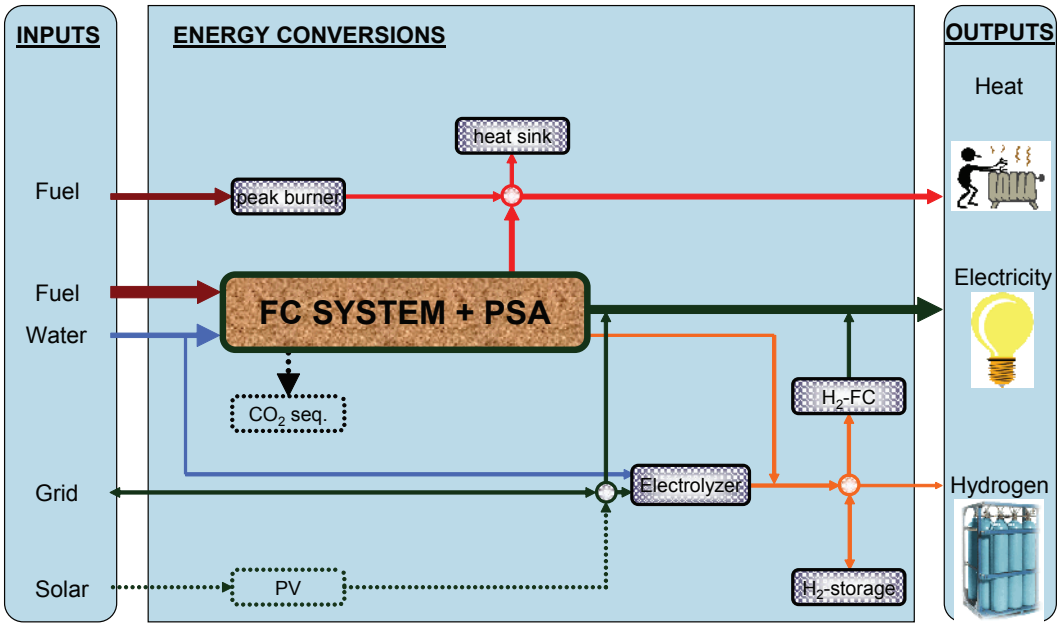

FIGURE 2. Layout of component evaluation selection - this energy connectivity diagram is the basis for resource prioritization. Note that the user does not have to use all energy conversion technologies; for example, a fuel cell system can be evaluated stand-alone.

2. Develop and implement energy demand profile input strategy as well as equipment cost and performance input sheets; refine input strategy based on industry and partner feedback.
3. Integrate task 1 and 2 outputs into H2A model structure and cash flow analysis.
4. Review and refine version 1 of H2A life-cycle analysis model for stationary applications.

Accomplishments

- Analysts met with industry partners and introduced first implementation of annual energy calculation module.
- Initial industry feedback was integrated into energy model.

Future Direction

- Complete H2A Stationary Model Version 1.0 for second round of industry review.
- Validate the model through internal and external review and testing.
- Develop the final version 1.0 of the H2A stationary.
- The H2A stationary model will be widely used in analysis of power parks for federal and private facilities as part of market transformation studies. For example, the model may be used to explore the cogeneration of hydrogen in combined heat and power systems during early hydrogen market penetration.

FY 2008 Publications/Presentations

1. Poster, DOE Hydrogen Program 2008 Annual Merit Review & Peer Evaluation, Washington, D.C., June 2008.