Analysis Models and Tools

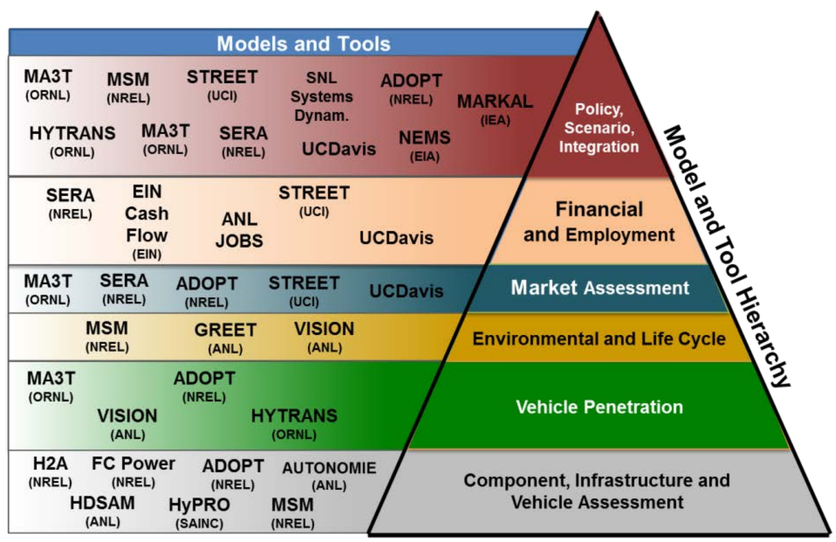
Systems Analysis of Hydrogen & Fuel Cells

With a multitude of end-uses—such as distributed power for back-up, primary, and combined heat-and-power systems; automobiles, buses, forklifts and other specialty vehicles; and auxiliary power units and portable electronics—fuel cell applications hold potential to dramatically impact the 21st century clean energy economy. Fuel cells can efficiently produce electricity from a number of domestic fuels, including bio-gas, natural gas, propane, methanol, diesel, and hydrogen. Compared with traditional energy inputs, fuels cells can provide improved performance and reliability in addition to reduced lifecycle costs. Fuel cells powering light-duty vehicles provide the greatest petroleum reduction and environmental benefits. However, they also face challenges, including the need to reduce cost and increase durability; to develop lightweight, compact fuel storage systems; to invest significantly in a hydrogen fueling infrastructure; and to develop large-scale manufacturing capability.

The ***Systems Analysis Program*** of the ***U.S. Department of Energy's Fuel Cell Technologies Office*** develops common bases for analyzing alternatives at the system, technology or component level in terms of cost, performance, benefit, and risk impact. Models and data are used by to perform hydrogen/fuel cell-related calculations, evaluations and environmental assessments. Results are used to formulate various analyses and aid in decision-making. The models provide the basis for analyzing alternatives at the system and technology level in terms of cost, performance, benefits, and risks.

Hierarchy of Models

Systems Analysis uses a consistent set of models and data for transparent analytical evaluations. Key models support a spectrum of analyses, including infrastructure development, resource consumption, environmental impacts, financial assessments, and energy market considerations. These models also provide the basis for analyzing alternatives at the system and technology levels in terms of costs, performance, benefits, and risks.



Hierarchy of Various Models Used for Hydrogen and Fuel Cell Analyses

There are six main evaluation categories. Each category includes a set of models primarily designed to perform the related evaluations. Some cross-cutting models belong to several categories. The "component, infrastructure, and vehicle assessment" category forms the basis of modeling and analysis, upon which other evaluations are built. As one moves up the hierarchy, factors beyond the basic technical feasibility (such as environmental impacts, market forces, policy needs, etc.) are taken into consideration, providing a life cycle-based and more realistic representation of future technology development.

Component, Infrastructure, and Vehicle Assessment

Organizations Involved: Argonne National Lab, National Renewable Energy Lab, Strategic Analysis, Inc.
Models: H2A, HDSAM, FC Power, HyPRO, ADOPT, MSM, Autonomie
Main Purpose: Component models are engineering models used to evaluate technology performance characteristics and costs. Information from these models often aid in program decisions regarding research focus in the component area.

Vehicle Penetration

Organizations Involved: Argonne National Lab, National Renewable Energy Lab, Oak Ridge National Lab
Models: MA3T, VISION, ADOPT, HYTRANS
Main Purpose: These models explore market penetration scenarios of various alternative fuel/vehicle technologies, while also comparing them against conventional technologies.

Environmental and Life Cycle

Organizations Involved: Argonne National Lab, National Renewable Energy Lab
Models: MSM, GREET, VISION
Main Purpose: Models in this category take a life cycle approach to assessing the energy use, oil use, and carbon emissions impacts of various alternative vehicle/fuel pathways.

Market Assessment

Organizations Involved: National Renewable Energy Lab, Oak Ridge National Lab, University of California-Irvine, University of California-Davis
Models: MA3T, SERA, ADOPT, STREET, UCDavis
Main Purpose: Market assessment models investigate how infrastructure development and vehicle adoption will progress in the marketplace, by considering technical, economic, and social factors and evaluating related impacts.

Financial and Employment

Organizations Involved: Argonne National Lab, National Renewable Energy Lab, University of California-Irvine, University of California-Davis, Energy Information Now (EIN)
Models: SERA, EIN Cash Flow, ANL JOBS, STREET, UCDavis
Main Purpose: Models in this category examine the monetary resources and incentives required for technology and infrastructure development, while also quantifying economic benefits such as job creation.

Policy, Scenario, and Integration

Organizations Involved: National Renewable Energy Lab, Oak Ridge National Lab, Sandia National Lab, University of California-Irvine, University of California-Davis
Models: MA3T, HYTRANS, MSM, ADOPT, STREET, SERA, SNL Systems Dynamics, UCDavis
Main Purpose: These models take a more holistic approach in investigating various pathways, integrating technology, economic, environmental, policy, and consumer based factors to envision possible transition scenarios and optimum pathways.