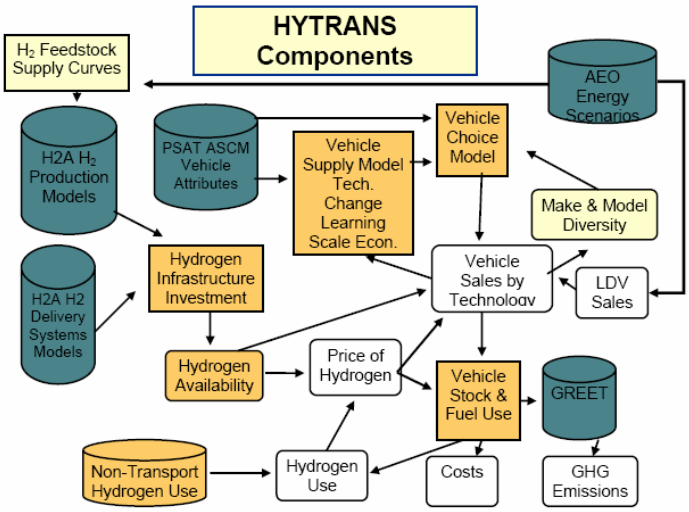
HyTrans - Hydrogen Transition Model, Scenarios of the Early Transition

An integrated market model of all major components of the Hydrogen Fuel and Vehicle System

Background

Understanding how a transition to hydrogen can be achieved efficiently and effectively is critically important to the success of the DOE Hydrogen Program. This project develops the HyTrans model, a tool for simulating market transitions to a hydrogen transportation system, and applies the model to develop and analyze scenarios of the early transition to hydrogen vehicles**.** By incorporating other established models such as DOE's H2A Hydrogen Production and Delivery Model, HyTrans is able to consistently represent all key interdependent factors affecting the transition.



Components of the Hydrogen Vehicle and Fuel Market Integrated in HyTrans

Technology

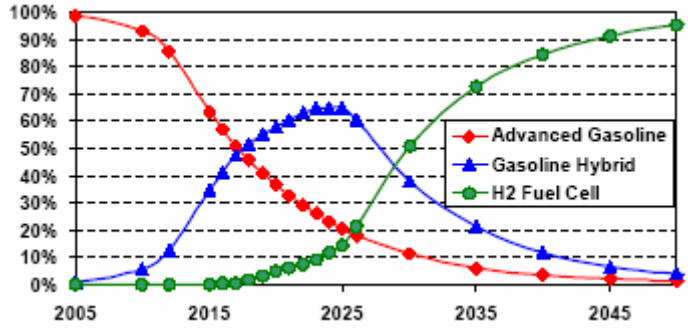
The HyTrans market-equilibrium model represents interdependent decisions of hydrogen suppliers, vehicle manufacturers and consumers in the period from 2000 to 2050. It finds competitive market solutions by maximizing producers' profits and consumers' welfare. Decision-making to 2050 can be based on perfect foresight, myopia, or other expectation models.

HyTrans incorporates reduced form representations of production, delivery, and forecourt technologies from the models developed by the H2A working group. It uses vehicle technology characterizations from the PSAT model and cost estimates developed by the ASCM model. Greenhouse gas emissions estimates are from the GREET model, and HyTrans is calibrated to the NEMS model's 2006 AEO projections extrapolated to 2050.

HyTrans models the impacts of the accomplishment of the DOE Hydrogen Program's technical goals and the effects of policies that could increase the baseline numbers of hydrogen vehicles in the early years of transition. The model can also be used to estimate the impact of carbon constraining policies on carbon emissions.

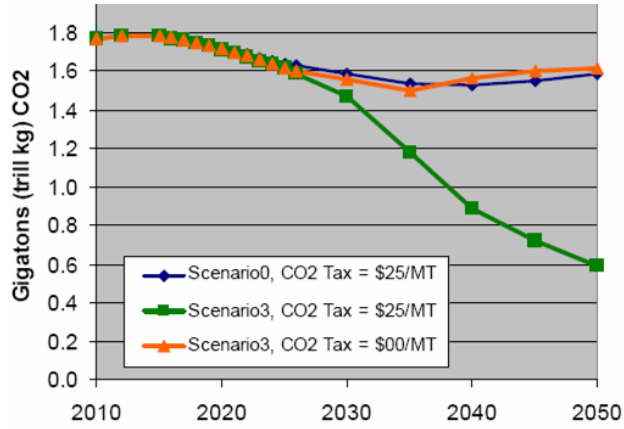
Results

In the absence of policy actions, HyTrans predicts a transition to advanced gasoline hybrid vehicles, even with the achievement of the Hydrogen Program's technical goals. However, if decisive actions are taken to place between 2 and 10 million fuel cell vehicles are on the road by 2025, no further incentives would be needed to complete the transition to hydrogen if program technology goals are achieved.



Vehicle Production share assuming 10 million hydrogen fuel cells vehicles are on the road by 2025

Another implication of the model results is that reducing carbon emissions requires both a strong carbon constraining policy (penalties of \$10/tCO_2 in 2010 to \$25/tCO_2 in 2025) and the transition from gasoline to hydrogen vehicles.



Carbon emissions form light duty vehicles under various carbon constraints and hydrogen vehicle scenarios

Benefits

- The HyTrans Model enables an integrated market model of the hydrogen transition.
- The model identifies key enablers and critical barriers to the transition to hydrogen
- The model describes the sustainability, costs, and benefits to greenhouse gas emissions and fossil fuel use.

Points of Contact

David Greene, 865-946-1310, dlgreene@ornl.gov
T. Armstrong, 865-574-7996, armstrongt@ornl.gov