



The Market Acceptance of Advanced Automotive Technologies (MA³T) Model

The Market Acceptance of Advanced Automotive Technologies (MA³T) model has been developed by Oak Ridge National Laboratory (ORNL) to project U.S. consumer demand for automotive powertrain technologies. Implemented using Microsoft[®] Excel for Windows, MA³T simulates market demand for advanced vehicle technologies by representing relevant attributes of technologies and consumer behavior, such as technological learning by doing, range anxiety, access to recharging points, daily driving patterns and willingness to accept technological innovation. Much remains to be learned about how consumers will evaluate novel vehicle technologies, such as plug-in hybrid electric vehicles (PHEV), extended-range electric vehicle (EREV), battery electric vehicles (BEV) and fuel cell vehicles (FCV), as well as how these vehicles are likely to be operated. Due to data limitation, the approach taken in developing the MA³T model is to create a framework for integrating data and behavioral models at an appropriate level of detail, whether or not the data are fully available or the behaviors are fully understood at the present time. As more is learned about the advanced vehicle technologies and consumers' preferences towards them, the model will be continuously updated and improved.

Currently, MA³T includes 40 choices, consisting of 20 powertrain technologies for each of the 2 vehicle size classes—passenger cars and light-duty trucks. MA³T considers the U.S. household users of light-duty vehicles (LDV) as the consumer market, which is disaggregated into 1,458 segments by six dimensions: 9 census divisions, 3 residential areas, 3 attitudes towards novel technology, 3 driving patterns, 3 home recharging situations, and 2 work recharging situations. MA³T currently has a planning horizon from 2005 to 2050, with prices expressed in 2005 US dollars.

In its core, MA³T uses the nested multinomial logit (NMNL) method to predict purchase probabilities among 36 choices by each of the 1,458 consumer segments, based on value components associated with vehicle attributes, user behavior, infrastructure, energy prices, and policies (Figure 1). The segment purchase probabilities are translated into market penetrations, sales, populations, petroleum use, and greenhouse gas (GHG) emissions. Some of the outputs serve as feedback signals and, together with other exogenous inputs from various sources, affect the purchase probabilities.

Research Areas

Freight Flows

Passenger Flows

Supply Chain
Efficiency

Transportation:
Energy
Environment

Safety
Security

Vehicle
Technologies

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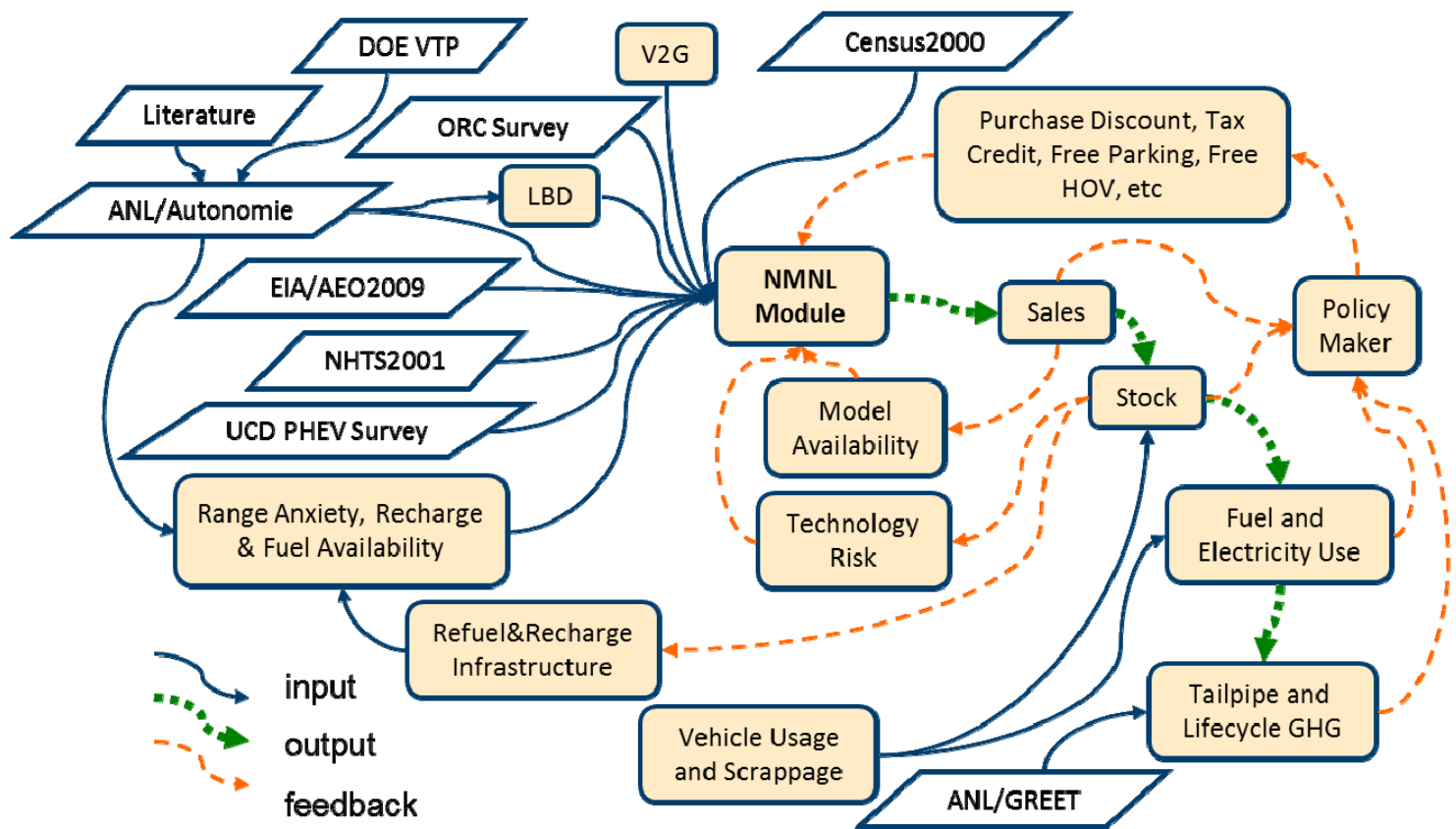


Figure 1. MA³T Model Framework.

Related publications and presentations:

- Lin, Z., Dong, J., Liu, C., and Greene, D. L. (2012). "PHEV Energy Use Estimation: Validating the Gamma Distribution for Representing the Random Daily Driving Distance." *Transportation Research Record*, in press.
- Dong, J., Lin, Z. (2012). "Within-Day Recharge of Plug-In Hybrid Electric Vehicles: Energy Impact of Public Charging Infrastructure." *Transportation Research Part D*, 17(5), pp. 405–412.
- Dong, J., and Lin, Z. (2012). "Exploring the Paths to One Million Plug-in Electric Vehicles by 2015 Using MA3T Model." *The 26th International Battery, Hybrid and Fuel Cell Electric Vehicle Symposium*, Los Angeles, California, May 6-9, 2012.
- Lin, Z., and Greene, D. (2011). "Promoting the Market for Plug-in Hybrid and Battery Electric Vehicles: the Role of Recharge Availability." *Transportation Research Record*, No. 2252, pp. 49-56.
- Lin, Z., and Greene, D. (2011). "Assessing Energy Impact of Plug-In Hybrid Electric Vehicles: Significance of Daily Distance Variation over Time and among Drivers." *Transportation Research Record*, No. 2252, pp. 99-106.
- Lin, Z., and Greene, D. (2010). "Who Will More Likely Buy PHEV: A Detailed Market Segmentation Analysis." *The 25th World Battery, Hybrid and Fuel Cell Electric Vehicle Symposium & Exhibition*, Shenzhen, China, November 5–9, 2010.
- Lin, Z., and Greene, D. (2010). "A Plug-in Hybrid Consumer Choice Model with Detailed Market Segmentation." *The 89th Annual Meeting of Transportation Research Board*, Washington, DC, January 10–14, 2010.
- Sikes, K. G., Gross, T. J., Lin, Z., Sullivan, J. L., Cleary, T., and Ward, J. (2009). "The Plug-in Hybrid Electric Vehicle (PHEV) Market Introduction Study." ORNL/TM-2009/019, Oak Ridge National Lab, Knoxville, TN.