Some Current Transportation Models Used in the Vehicle Technologies Program

Phil Patterson, 4/06/09

1. **VISION: This model is calibrated to EIA's NEMS each year.**
   An Excel spreadsheet model that takes assumptions about VMT growth, car and light truck share, and market penetration of efficient vehicles and alternative fuel use in both light and heavy vehicles to project energy and oil use, composite vehicle fuel economy, and life-cycle carbon emissions to 2050 (and 2100) in various scenarios. It has been used to make runs for OMB, EPA, and others in addition to numerous runs for VT and HFCIT. Over 600 downloaded of this model have been made from the Internet. Versions of this model have been made for California, Texas, and several other states. *[Margaret Singh and Anant Vyas, ANL]* It is available on the ANL website at:
   http://www.transportation.anl.gov/modeling_simulation/VISION/index.html

2. **TRUCK: (GPRA/PDS Heavy Vehicle Choice Model) and the Energy Balance Model (EBM): Outputs are used as inputs to NEMS and MARKAL for the purpose of estimating Heavy Truck benefits for the Vehicle Technologies program.**
   TRUCK estimates the new vehicle market shares for conventional and alternative technologies for medium and heavy trucks based upon the characteristics of the vehicles (initial cost and fuel economy) and fuel prices. The EBM estimates the fuel economy of heavy trucks based upon assumptions with respect to the technologies employed on the trucks. These models are used for estimating GPRA benefits. *[Jim Moore, TAE]* Documentation is on pp. 33-52 in the Program Analysis Methodology at:
   http://www1.eere.energy.gov/ba/pba/pdfs/41347_AppF.pdf

3. **GREET (Greenhouse gases, Regulated Emissions, and Energy use in Transportation):** Estimates the fuel-cycle energy use, oil use, carbon emitted, and criteria pollutants emitted on a per vehicle basis for dozens of alternative fuel vehicles relative to a conventional gasoline vehicle for both the near- and the long-term. It is used by several EERE programs and has over 9000 users worldwide. *[Michael Wang, ANL]* It is available at: http://www.transportation.anl.gov/modeling_simulation/GREET/index.html

4. **Oil Peaking Model (OPM)**
   The OPM is a tool for using and modifying global oil scenarios to 2050, and for exploring the impacts of alternative futures for North America's transportation systems in the context of those scenarios. OPM includes a detailed representation of the depletion of world conventional and unconventional oil resources. It includes data from three alternative world oil resource assessments and allows varied assumptions about the extent of undiscovered resources, reserve expansion and rates of technological change. The initial version focuses on exploring the transition from reliance on conventional oil resources to unconventional sources, such as heavy oil, tar sands and oil shale. *[David Greene, Janet Hopson, Jia Li ORNL]* It was used to estimate oil peaking date in the June 2004 issue of National Geographic Magazine.
   An article describing this model and its results is at:
   http://www-cta.ornl.gov/cta/Publications/Reports/Have_We_Run_Out_of_Oil_Yet.pdf

5. **Feebate Model**
   Estimates the fuel economy that can be achieved by means of feebates, rebates or gas-guzzler taxes. Estimates effects on sales mix and use of technology to increase the mpg of 805 individual makes and models of passenger cars and light trucks. Predicts fuel savings, vehicle price increases, changes in consumers' surplus and government revenues/expenditures. *[David Greene, ORNL]*
   An article in Energy Policy on this model is at:
   http://www-cta.ornl.gov/cta/Publications/Reports/Have_We_Run_Out_of_Oil_Yet.pdf

6. **Oil Security Metrics Model (OSMM): The estimates from this model will be included as GPRA benefits for the VT and HFCIT programs.**
   This model estimates the program benefits during disrupted market conditions as compared to the program benefits during normal market conditions. *[David Greene and Paul Leiby, ORNL]*
   A paper describing this model is at:
   http://www-cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2006_505.pdf

7. **ORNL PHEV Choice Model: Version 1**
   In this first version of a model that will be improved and updated by June 2009, one can input vehicle prices and other characteristics and obtain estimates of the market shares for PHEV10s and PHEV40s and for Conventional Vehicles, Diesels, HEVs, and FCVs. This model includes features such as early adopters, nine regions of the U.S., and urban/suburban/ rural differences. *[David Greene and Zhenhong Lin, ORNL and Jake Ward, DOE]*

8. **PSAT (*Powertrain System Analysis Toolkit*)**
   Allows dynamic analysis of vehicle performance and efficiency to support detailed design, hardware development, and validation. A driver model attempts to follow a driving cycle, sending a torque demand to the vehicle controller, which, in turn sends a demand to the propulsion components (commonly referred to as “forward-facing” simulation). Dynamic component models react to the demand (using transient equation-based models) and feed back their status to the controller. The process iterates on a sub-second basis to achieve the desired result (similar to the operation of a vehicle). The forward architecture is suitable for detailed analysis of vehicles/propulsion systems, and the realistic command-controlfeedback capability is directly translatable to PSAT-PRO control software for testing in the laboratory. Capabilities include transient performance, efficiency and emissions (conventional, hybrid, plug-in hybrid, and fuel cell vehicles), development and optimization of energy management strategies, and identification of transient control requirements.

9. **PSAT-PRO (*PSAT rapid control PROtotyping software*)**
   Allows dynamic control of components and subsystems in Rapid Control Prototyping (RCP) or hardware-in-the-loop (HIL) testing. Hardware components are controlled in an emulated vehicle environment (i.e., a controlled dynamometer and driveline components) according to the control strategy, control signals, and feedback of the components and vehicle as determined using PSAT. The combination of PSAT-PRO and RCP/HIL is suitable for propulsion system integration and control system development, as well as rigorous validation of control strategies, components, or subsystems in a vehicle context (without building a vehicle). Capabilities include transient component, subsystem, and dynamometer control with hardware operational safeguards compatible with standard control systems.