Do CAFE Standards Meaningfully Affect U.S. Vehicle Emissions?

Motivation

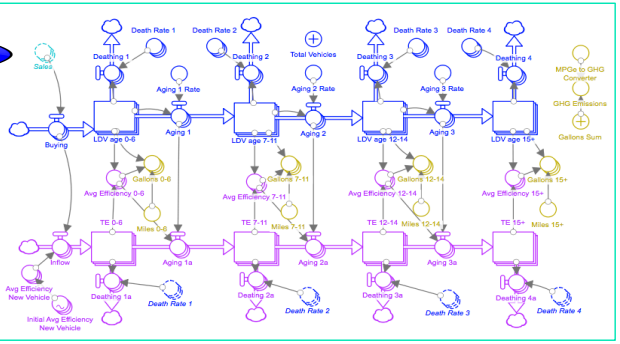
- The U.S. Transportation sector account for over 28% of annual GHG Emissions
- Threats from new governance has potential impacts on the make-up of the light-duty fleet of vehicles and the emissions stemming from them
- This model searches for levers that can have a greater impact on reduction of GHGe emissions over the next 35 years

Approach

Three part model (Years 2015-2050)

- Consumer choice modeling via logit probability function consisting of 4 different external factors
  - -Price, Fueling Speed, MPGe, Visibility
- Fleet aging characteristics of 4 vehicle classes in 4 age groups over time
- Attribute tracking of efficiency with aging

BEV = Battery Electric Cars/Crossovers
PHEV = Plug-in Hybrid Electric Cars/Crossovers
ICE = Internal Combustion Engine Cars/Crossovers
Trucks = ICE Pick-up Trucks, Vans, SUVs

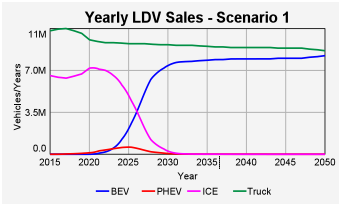


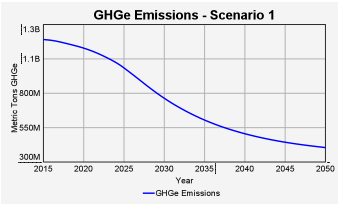
Test Model Runs

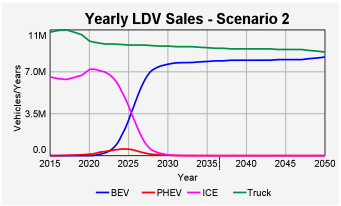
Model Assumptions:

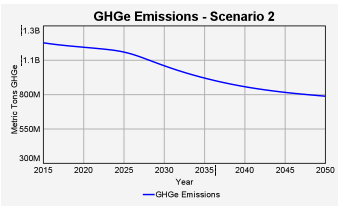
- CAFE standards increasing MPG and rate of change decreases beyond the year 2025 (growing at slower rate)
- Initial subsidies taken into account of prices
- Unsubsidized price parity of EV/ICE by 2022
- Miles driven constant over time, decreasing in successive age cohort
- Emissions based of MPGe conversion (EPA)
- Consistent survival rate of vehicles over time (NEMS)
- Sales rate set at 17M per year
- ICE Trucks not included in logit choice model, percentage of truck sold per year based off EIA forecasts

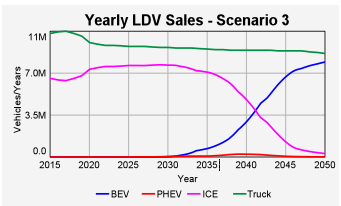
	Price	CAFE	Fill-up Factor	Scenario Description
Scenario 1	Price Reduction Normal	CAFE Standards Continue	Charging Time Sub 10 min by 2025	Base/Current Trajectory
Scenario 2	Price Reduction Normal	CAFE Standards Removed	Charging Time Sub 10 min by 2025	Potential No EPA but Continued Subsidies
Scenario 3	Price Reduction Delayed	CAFE Standards Removed	Charging Time Sub 10 min by 2025	No EPA and No Subsidies
Scenario 4	No Price Reduction	CAFE Standards Continue	Charging Time Sub 10 min by 2050	EPA/CAFE Continues, No Subsidies/ Charging Infrastructure

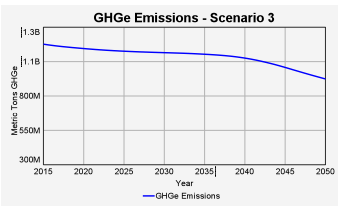


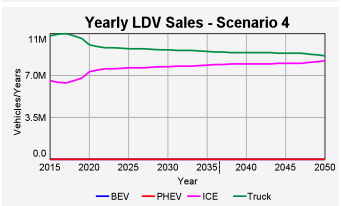


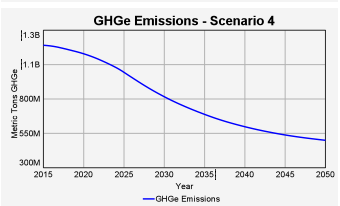












Conclusions and Implications

- **Scenario 1** leads to a significant decrease in LDV emissions by 2050, decreasing faster when EVs replace ICE cars/crossovers
- **Scenario 2** shows a moderate decrease in emissions as EVs increase avg fleet MPGe, the effect is damped by maintaining low MPGe for 7M+ trucks
- **Scenario 3** sees an even slower reduction in emissions as fleet MPGe stagnates and EV cost reduction delays, making lower MPGe vehicles dominate
- **Scenario 4** shows the individual effect of the CAFE standards as an ICE fleet reduces emissions greatly
- Biggest levers for widespread adoption of EVs are vehicle costs and charging times
- CAFE standards actually make ICE vehicles more attractive and delay the adoption of EVs, total emissions decrease significantly even without adoption of EVs
- Removal of CAFE standards causes EVs to be adopted sooner as long as costs drop but emissions remain high due to poor truck efficiency

Next Steps

- Extend model to include more vehicle options
- Integrate additional utility driving variables in the consumer choice sector
- Build in yearly mileage as a function of driving costs
- Anticipate additional classes of EVs (Trucks) and include Trucks into the logit choice function

References and Acknowledgements

- "Chapter 7: Transportation Energy Use and Environmental Impacts | Bureau of Transportation Statistics." Chapter 7: Transportation Energy Use and Environmental Impacts | Bureau of Transportation Statistics. N.p., n.d. Web. 06 Mar. 2017. https://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/transportation_statistics_annual_report/2015/chapter7.html.
- Davis, Stacy C., Susan E. Williams, and Robert G. Boundy. "Transportation Energy Data Book: Edition 35 - cta.ornl.gov." Center for Transportation Analysis. Oak Ridge National Laboratory, n.d. Web. 6 Mar. 2017. http://www.cta.ornl.gov/data/tedb35/Edition35_Full_Doc.pdf.
- "EV Everywhere Grand Challenge Blueprint." U.S. Department of Energy. N.p., 31 Jan. 2013. Web. 6 Mar. 2017. https://energy.gov/sites/prod/files/2016/05/f31/eveverywhere_blueprint.pdf.
- "Greenhouse Gases Equivalencies Calculator - Calculations and References." EPA. Environmental Protection Agency, 24 Jan. 2017. Web. 06 Mar. 2017. https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.
- Kockelman, Kara M., Binny M. Paul, and Sashank Musti. "The Light-Duty-Vehicle Fleet's Evolution: Anticipating PHEV Adoption and Greenhouse Gas Emissions Across The U.S. Fleet." Transportation Research Record 2252 (2011): 107-17. Web. 6 Mar. 2017. http://www.ce.utexas.edu/prof/kockelman/public_html/trb11fleetevolutionus.pdf.
- Lambert, Fred. "Elon Musk teases new 'Tesla Supercharger V3' with over 350 kW power output and off-grid solar Powerpacks." Electrek. N.p., 10 Jan. 2017. Web. 06 Mar. 2017. https://electrek.co/2016/12/24/tesla-supercharger-v3-over-350-off-grid-solar-powerpack-elon-musk/.
- Randall, Tom. "Here's How Electric Cars Will Cause the Next Oil Crisis." Bloomberg.com. Bloomberg, 24 Feb. 2016. Web. 06 Mar. 2017. https://www.bloomberg.com/features/2016-ev-oil-crisis/.
- "U.S. Energy Information Administration - EIA - Independent Statistics and Analysis." EIA - Annual Energy Outlook 2017. N.p., n.d. Web. 06 Mar. 2017. http://www.eia.gov/outlooks/aeo/.