Track II: Energy Efficiency
May 12, 2014
2:00 - 3:10 pm
Century Ballroom C

Energy Efficient Transportation

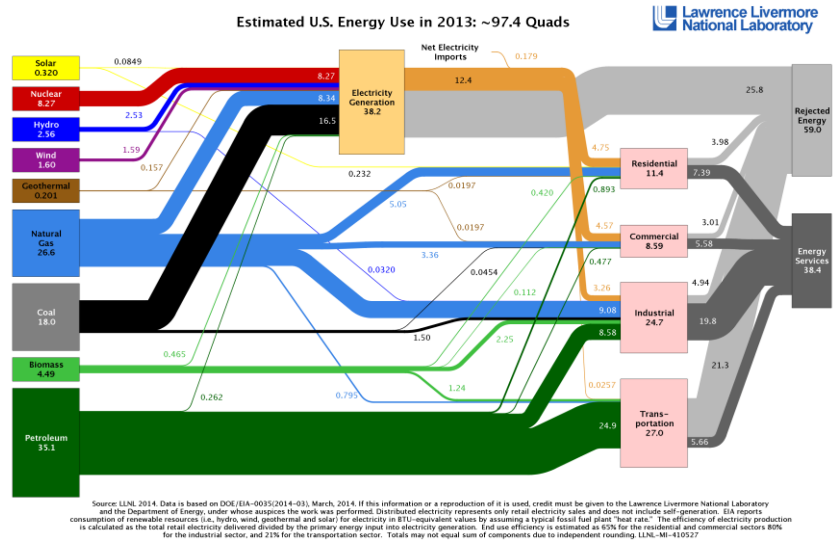
John Nuszkowski, Ph.D.
University of North Florida
Jacksonville, FL USA 32224
Phone: (904) 620-1683
Email: john.nuszkowski@unf.edu

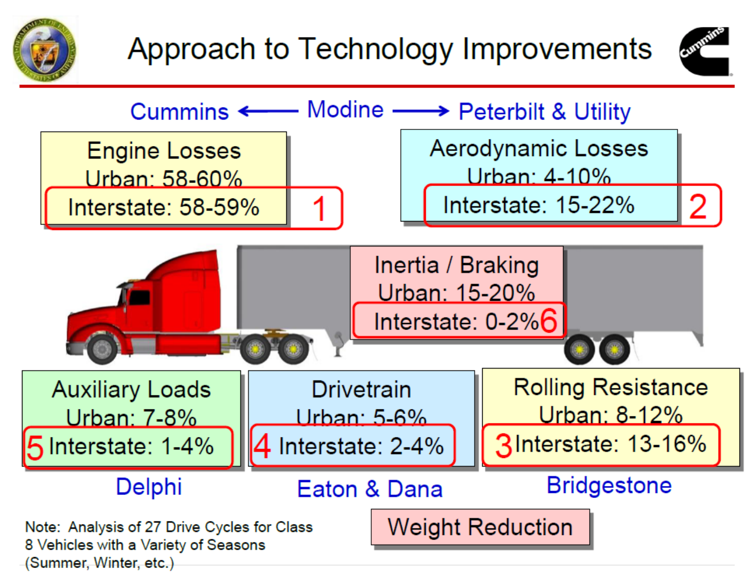
Florida Energy Systems Consortium (FESC) Workshop
Gainesville, FL
May 12-13, 2014

Transportation Energy Use

- **Continual innovation** is required to **reduce emissions** and **increase fuel efficiency** to displace foreign oil importation in the transportation and heavy-duty vehicle sectors.

- The transportation industry currently **consumes ~30% of the U.S. energy**. This is a local, state, country, and global issue.





Source: Koeberlein, D., "Supertruck technologies for 55% thermal efficiency and 68% freight efficiency," Directions in Engine-Efficiency and Emissions Research Conference (Detroit, Michigan), October 2012.

Vehicle Efficiency Projects

- Objective was to **examine complete powertrain strategies** that promote efficient operation of a vehicle's engine and transmission for reduced fuel consumption while maintaining acceptable overall performance.

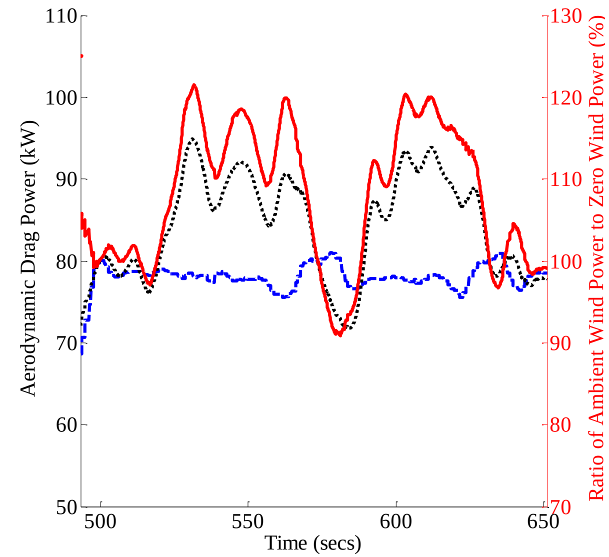
Vehicle Simulation Results using Powertrain System Analysis Toolkit (PSAT)

Strategy	Fuel Economy Improvement (%) - Distance Uncorrected	Fuel Economy Improvement (%) - Distance Corrected
Fan Control using Future Road Grade	3.8 - 4.3%*	4.2 - 4.7%*
Knowledge of Future Road Grade for Power Restriction	0.3 - 0.5%‡	0.1 - 0.2%‡
Road Grade Time History	0.1 - 0.2%‡	0.1%‡
* Compared to the fan always on		
‡ Compared to road load power restriction using current road grade		

Source: **Nuszkowski, J.**, Olatunji, I., Clark, N., Werner, T., and McLaughlin, S., "Predicting and Utilizing the Vehicle's Past and Future Road Grade," Directions in Engine-Efficiency and Emissions Research Conference (Detroit, Michigan), October 2011.

- Objective was to **understand the effect that ambient wind** has on the required **vehicle power** to overcome the aerodynamic friction energy of a commercial vehicle.

Ambient Wind and Assumed Zero Ambient Wind Aerodynamic Power for a Portion of a Test

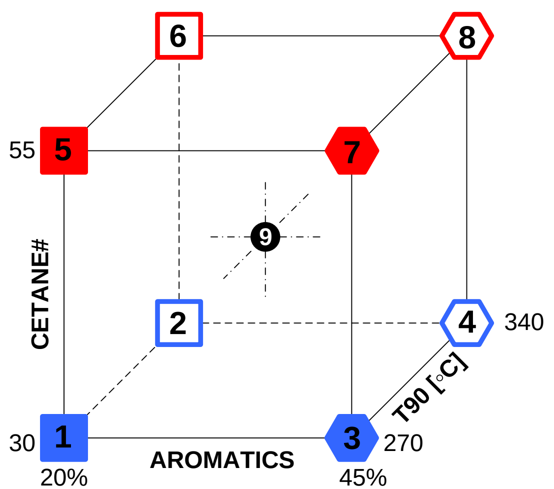


Source: **Nuszkowski, J.**, Chvala, J., McCollum, M., and Kinnaly, E., "The Influence of Ambient Wind Conditions on Aerodynamic Friction Energy during On-road Vehicle Operation," Proceedings of the Institution of Mechanical Engineers, Part D: Journal of Automobile Engineering, (Submitted February 2013).

Advanced Combustion Project

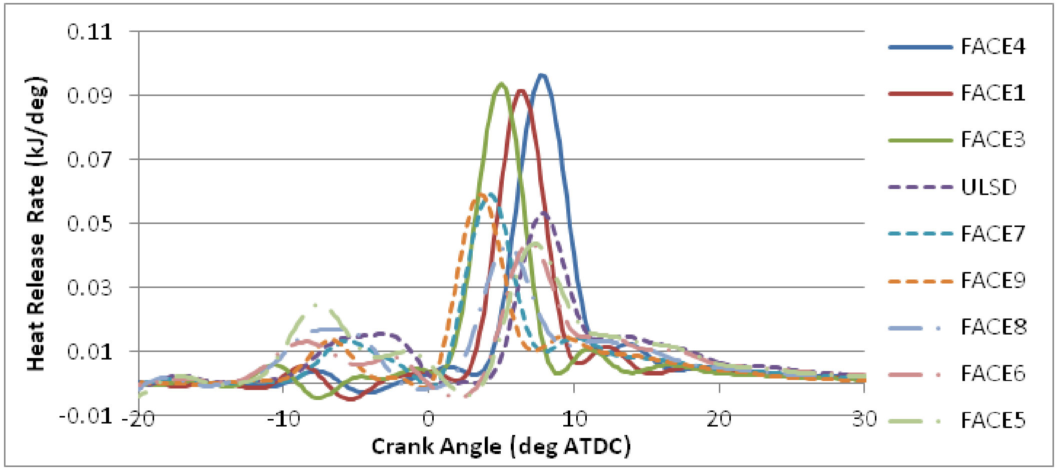
- Objective was to identify the characteristics of **advanced fuels** that affect the achievable **advanced combustion** operating range of light-duty diesel engines

Nine Fuels with Varying Fuel Properties

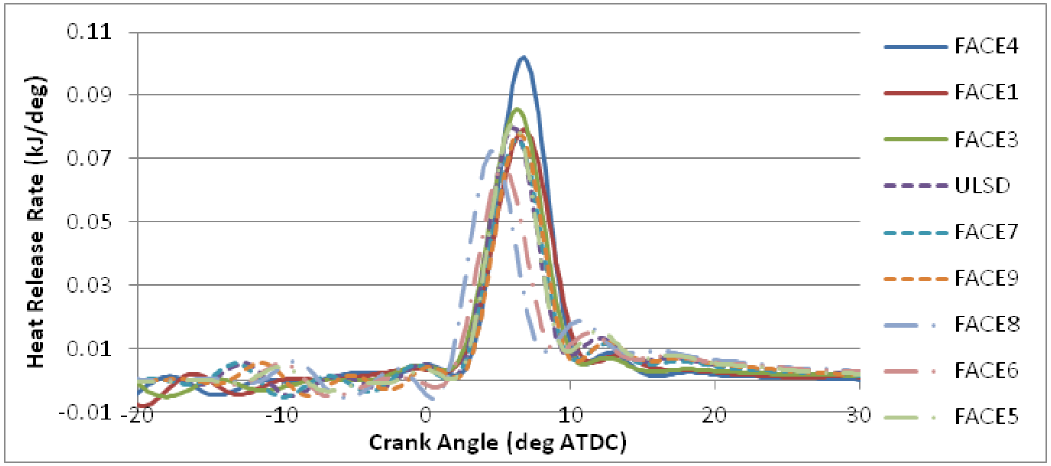


Source: Carder, D., Ryskamp, R., **Nuszkowski, J.**, Li, H., Clark, N., Thompson, G., Gautam, M., and Wayne, S., "Fuels to Enable Light-Duty Diesel Advanced Combustion Regimes," Coordinating Research Council, Inc., August, 2012.

In-cylinder Heat Release Rate for Split Injection Control Strategy



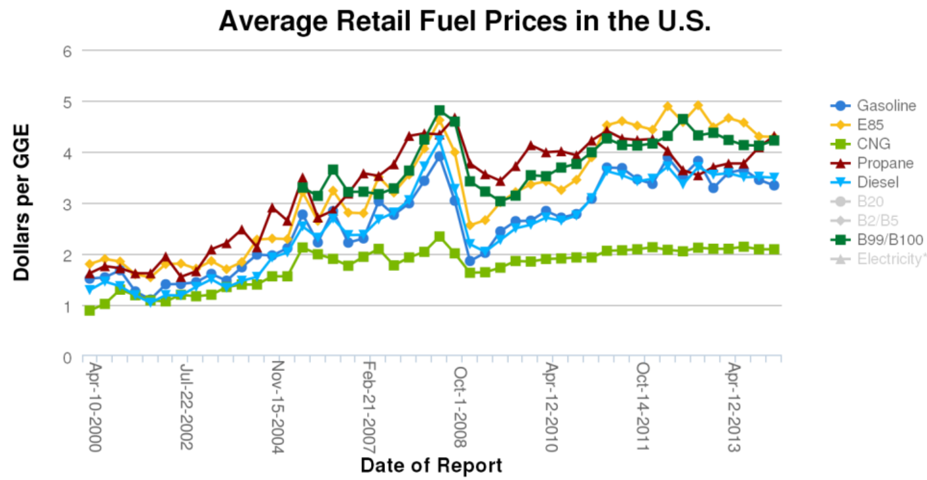
In-cylinder Heat Release Rate for Single Injection Control Strategy



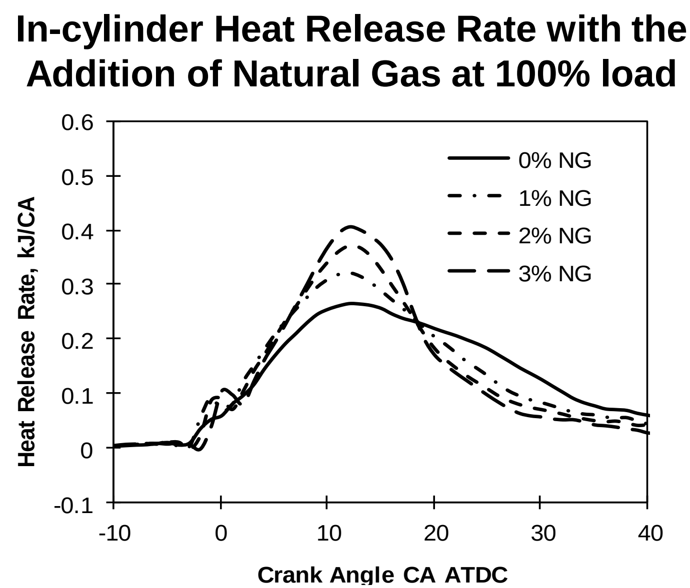
Natural Gas Transportation

- **NG utilization** as a transportation fuel is **economically viable**.
  - **High cost of diesel** (~$4.00/gal), low cost of natural gas (NG) (~$1.75/diesel gallon equivalent)
  - Reduced **dependence on petroleum imports** (55% of the petroleum consumed by the U.S. in 2011 was domestic)
  - Increased dependence on **domestic NG reserves** (92% of the NG consumed by U.S. in 2011 was domestic)

- Conversions of existing diesel ships and locomotives to dedicated or **dual fuel applications require fundamental understanding of combustion** from these types of engines due to the **larger displacement** and **lower operating speeds** as compared to existing on-road engines.



Source: Clean Cities Alternative Fuel Price Reports



Source: S. Liu, H. Li , T. Gatts, C. Liew, N. Clark, J. Nuszkowski, "Combustion Process of a Heavy-Duty Dual Fuel Engine Operated with Natural Gas and Hydrogen as Supplemental Fuel," (In Progress) 2014.