Energy Efficient Transportation

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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.
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)

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Fuel Economy Improvement (%) - Distance Uncorrected</th>
<th>Fuel Economy Improvement (%) - Distance Corrected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan Control using Future Road Grade</td>
<td>3.8 - 4.3%*</td>
<td>4.2 - 4.7%*</td>
</tr>
<tr>
<td>Knowledge of Future Road Grade for Power Restriction</td>
<td>0.3 - 0.5%‡</td>
<td>0.1 - 0.2%‡</td>
</tr>
<tr>
<td>Road Grade Time History</td>
<td>0.1 - 0.2%‡</td>
<td>0.1%‡</td>
</tr>
</tbody>
</table>

* 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

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

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.