Carnegie Mellon

MUSES: Material Use, Infrastructure Change, and Environmental Impacts for Alternative Fuels and Vehicles

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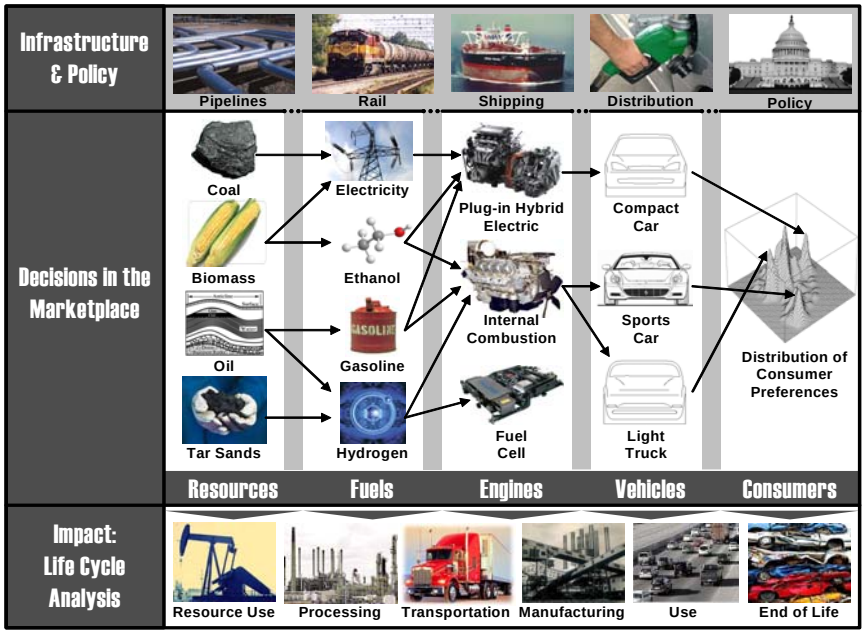
Background

The Green Design Institute received a grant from the National Science Foundation as part of the Materials Use: Science, Engineering, and Society (MUSES) program to analyze infrastructure requirements and best technologies for a future of sustainable alternative fuels. The adoption of any alternative fuel requires changes throughout the supply chain. Even a liquid fuel such as ethanol, that is compatible with current infrastructure, can induce dramatic changes. Proper accounting of infrastructure requirements, technology capabilities, policy incentives, and likely market responses is critical to a complete analysis of material flows and environmental impacts for a transition to sustainable infrastructure. We are exploring different infrastructure options by creating scenarios for each alternative fuel and light duty vehicle option of interest. Results from this work will suggest the most promising alternatives based on multifaceted criteria considering environmental, social, and economic issues.

Approach

We use the concept of industrial ecology as our system-wide approach to analyzing the body of issues related to material flows. We conduct hybrid life-cycle assessment involving both detailed process-level environmental data as well as economy-wide supply chain environmental impacts to assess the implications of infrastructure needed to produce and distribute alternative fuels. We also draw on engineering simulations and econometric models of consumer choice to predict attributes of alternative fuel vehicles and market responses to those attributes.



Scenarios

Some of the scenarios that we are examining include

- next generation gasoline electric hybrids improved from the current commercial versions;
- next generation gasoline electric hybrids with a recharging, plug-in capability;
- ethanol-fueled light duty vehicles, with infrastructure to refine and transport biomass based ethanol;
- hydrogen vehicles relying upon either domestic or imported liquid natural gas supplies;
- oil sands fuels, primarily for diesel engines; and
- bio-diesel fuel.

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