Estimation and Environmental Assessment of Transportation of US Goods and Services for Sustainability

Anny Huang, Rachael Nealer, Chris Hendrickson, Scott Matthews and Chris Weber

Background
This project will develop systematic models of life cycle freight and passenger transportation for economic sectors and individual products and services, including commuting, delivery and supply chain effects. The models will be based upon the latest economic input-output model of transactions within the entire US economy, augmented with data about 2002 transportation use and environmental impacts. The models will estimate ton-miles (or ton-kms) for multiple transportation modes including air, light vehicles, rail, transit, truck, and waterway. These models will be applied to estimate delivery and manufacturing impacts, reverse logistics impacts for extended producer responsibility of products and videoconferencing or telework strategies to reduce life cycle transportation emissions. The models will be made available on the Internet so that other transportation and sustainability researchers can pursue their own inquiries.

Broader Impacts
Pursuit of sustainability will require a broad set of changes in our transportation behavior. The models and methods developed in this project will identify opportunities for reducing the environmental impacts related to transport in the United States for all sectors. The new model will be available on the Internet, updated to the latest data available (2002) and will give a more accurate characterization of the sustainability and environmental implications of changes in economic activity related to transport. It will enable supply chain-wide estimates of transportation demands needed to produce every product in the US. The project will enable large numbers of consumers to gain understanding on the life cycle impacts of their decisions, and enable behavioral change.

Results and Conclusions
This project is planned to be active beginning in 2008 and ending in 2010. Using data from the Department of Transportation (DOT) and the U.S. Environmental Protection Agency (EPA), employee commute mode profile is constructed. To estimate the impacts from employee business travel, data from the Bureau of Economic Analysis’s, DOT, and other process LCA data sources were used. It was found that employee commute, business travel, and freight transport generally are not major portions of the total carbon footprint, except for certain industry groups like the service sectors and earth mineral manufacturing. Appearing below are preliminary results analyzing the importance of commuting, business travel, and freight transportation to the supply chain footprint of US industrial sectors.

Total Life Cycle GHG impacts Contributed by Direct Suppliers

The horizontal axis indicates 24 general industries. The vertical axis indicates the fraction of total life cycle GHG emissions attributed to certain activities or direct upstream suppliers. Employee air business travel is in light blue; commute is shown in yellow; while direct freight transportation is in purple.

Similarly, two methods were used to calculate ton-km estimates for commodities by mode: (1) using data from the 2002 Commodity Flow Survey from the Bureau of Transportation Statistics and (2) using the transportation costs from the Bureau of Economic Analysis and a calculated ton-km per dollar estimate. These results will be used to estimate energy and GHG emissions of the transportation phase for each sector and will be compared to overall supply chain of the commodities and related industries.

Financial Support
Financial support from the National Science Foundation under grant CBET-0755672 is gratefully acknowledged.

For more information contact:
Anny Huang Rachael Nealer
yah@cmu.edu rnealer@gmail.com

Chris Hendrickson
chh@cmu.edu
(412) 268-1066