NETSCORE 21
Transportation Sector

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Outline

➢ What has been done:
  – Data
  – Review of investment tools
  – Review of sustainability metrics

➢ Future steps:
  – Forecasting models
  – Model integration

➢ Thoughts about the project
Freight Transportation

Data

• Commodities (CFS 2002, next survey available in 2009)
• Shipments by value ($), ton, ton-miles
• Mode of transportation: Truck, rail, barge
• Majority of commodities moved by rail or truck
  - tons: 74% by truck, 15% by rail
  - ton-miles: 47% by truck, 44% by rail
• Origin-destination of shipments
# Freight Transportation

## Top commodities (ton-miles)

<table>
<thead>
<tr>
<th>Commodities</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>Rail</td>
</tr>
<tr>
<td>Cereal grains</td>
<td>Rail</td>
</tr>
<tr>
<td>Other prepared foodstuffs and fats and oil</td>
<td>Truck</td>
</tr>
<tr>
<td>Nonmetallic mineral products</td>
<td>Truck</td>
</tr>
<tr>
<td>Base metal</td>
<td>Truck</td>
</tr>
<tr>
<td>Wood products</td>
<td>Truck</td>
</tr>
<tr>
<td>Gasoline and aviation turbine fuel</td>
<td>Private truck</td>
</tr>
<tr>
<td>Basic chemicals</td>
<td>Rail</td>
</tr>
</tbody>
</table>

## Top commodities (tons)

<table>
<thead>
<tr>
<th>Commodities</th>
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<tbody>
<tr>
<td>Gravel and crushed stone</td>
<td>Truck</td>
</tr>
<tr>
<td>Coal</td>
<td>Rail</td>
</tr>
<tr>
<td>Gasoline and aviation turbine fuel</td>
<td>Private truck</td>
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<tr>
<td>Nonmetallic mineral products</td>
<td>Truck</td>
</tr>
<tr>
<td>Cereal grains</td>
<td>Rail</td>
</tr>
<tr>
<td>Natural sands</td>
<td>Truck</td>
</tr>
<tr>
<td>Other prepared foodstuffs and fats and oils</td>
<td>Truck</td>
</tr>
<tr>
<td>Basic chemicals</td>
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</tbody>
</table>
Freight Transportation
Completed research

- Iowa Freight Transportation *(Senior Design Team)*
  - Top commodities (rail: cereal grains, coal truck: animal feed and products of animals, base metal)
  - Origin-Destination of shipments
  - Infrastructure (length of railroad, length of highway)
  - Scenarios about Iowa

- Freight transportation in Midwest *(Independent Study)*
  - Top commodities: Gravel and crushed stone, cereal grains, gasoline and aviation turbine fuel
  - Mode of transportation (ton-miles): 64% by truck, 16% by rail
  - Scenarios about Midwest
Passenger transportation

Data

• Vehicle Miles Traveled (for trucks, cars)
• Passenger-miles (air, highway, transit, rail)
• NHTS 2001 (next survey available in September 2009)
• Air trips: passenger-miles, passengers, # of flights
• Amtrak: passenger-miles, map of network
Passenger transportation

Short trips vs. long trips

• Short trips: daily trips (work, shopping):
  – Mode of trip to work: car (86.5%), transit (4.9%)

• Long trips: by car or by plane
  – Mode of trip: car (89.5%), airplane (7.4%), rail (<1%)
Infrastructure

Need to look for data for:

- **Operation cost**
- **Maintenance cost**
- **Investment cost**
- **Capacity (corridors, main segments)**

<table>
<thead>
<tr>
<th>Infrastructure</th>
<th>Data</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Highway</td>
<td>Interstate</td>
<td>Lane-miles by type of road and by state</td>
</tr>
<tr>
<td>Rail</td>
<td>Class I</td>
<td>Rail-miles by class and by state</td>
</tr>
</tbody>
</table>
Reviews

• **Highway Investment tools**: Review of existing investment tools for highways.

  Investment tools based on benefit-cost analysis. Few investment tools (HERS, STEAM, Cal-B/C) include sustainability indicators (reduction of accidents, reduction of emissions) estimate them in terms of cost. No available published investment tool include resiliency in its analysis.
Reviews

• **Railway Capacity**: Review of studies about railway capacity. Factors affecting capacity, ways to estimate capacity. Various ways to estimate capacity, the majority of them implemented in Europe.

• **Railway Investment tools**: Review of existing investment tools for rail. Few published available investment tools for rail.
Sustainability metrics

- **Addressing Sustainability in Transportation Systems**
  - Sustainable Transportation system must impact at three areas: economy, environment and social well-being
  - Safety indicators (injury or fatality crashes)
  - Environmental indicators (vehicle emissions and fuel consumption)

- **Sustainability: metrics, specific indicators and preference index**
  - Environmental systems
  - Reducing environmental stresses
  - Social and institutional capacity
Sustainability metrics

- **Sustainability Assessment at the transportation planning level: performance measures and indexes**
  - *Transportation system effectiveness indicators*: average freeway speed, vehicle miles traveled per capita
  - *Environmental sustainability indicators*:
    - daily emissions of CO2
    - daily emissions of two precursors of ozone
    - land consumed by transportation infrastructure systems
  - *Economic sustainability systems*: vehicle hours traveled per capita, average trip duration
  - *Social sustainability indicators*: equity of exposure to emissions, exposed population to emissions, actual exposure to pollutant concentrations
Future Steps
Passenger Transportation

Forecasting model for passenger trips on highways

- **Dependent variable:** Passenger-miles
- **Function of:**
  - Population
  - Income
  - Miles of lanes
  - **Price of fuel** (dollars/ million BTU) (petroleum gases, E85, motor gasoline, jet fuel, diesel fuel, residual, fuel oil, natural gas, electricity).
  - Mode to commute
  - Trip to work
  - Type of car (still need data about this)
  - Gender
  - Race
  - Region of residence (need data)
Passenger Transportation

- Forecasting model for air passenger-miles: similar to highway passenger model

- New technology-modes:
  - Plug-in Hybrid Electric Vehicles (PHEV)
  - Rail for passengers

- Forecasting models for these modes
- Estimate mode split
Freight Transportation
Forecasting models

• Highways (commodities transported by truck)
• Rail (commodities transported by rail): Ton-miles of coal

➢ Interdependencies among the freight modes
Use of Models

➢ In different scenarios

• **Scenario based on the existing technology:** forecast future trips according to the existing technology, split them to different modes and use them to design new infrastructure

• **Scenario based on new technology:** include new technology in models, forecast future trips according to new technology and use the forecasts to design new infrastructure
Candidate Scenarios

- 50% reduction in coal by using alternatives types of energy:
  - Reduction in freight shipments by rail
  - Capacity used for passenger rail, how this affect trips by car/air?
  - Transfer of commodities from trucks to rail
  - Reduction in freight shipments by trucks
  - Decrease in new highway investments?
Thoughts...

• How the outputs of our work will be used to the NETSCORE21 model?
• How to incorporate the scenarios?