Why is Transportation Important?

- Why is transportation so important?
  - Economic growth
  - National security
  - Access to medical services
  - Maintaining social life

- Some statistics:
  - 17.5% of U.S. GDP
  - 10% of the US work force
  - Each person travels on average one hour/day
Transportation Systems

- In the U.S., transportation accounts for
  - 28% of energy consumption
  - 67 percent of petroleum consumption

- About 57% of the U.S. population lives in areas that fail to meet federal clean air standards

- Highway congestion costs:
  - Roughly $65 billion per year
  - Uses 2.3 billion gallons of gasoline

- Highway Crashes

Transportation Engineering Profession

- Provide for the movement of people and goods in a fashion that is:
  - Safe
  - Economical
  - Comfortable
  - Convenient
  - Rapid
  - Environmentally compatible
Transportation Strategies for Sustainable Development

- Vehicle/Fuel Technological Change
  - Improved efficiency of existing vehicles
  - Alternative Vehicles
  - Alternative Fuels

- Road/Vehicle Operations Improvements
  - Conventional Improvements
  - Intelligent Transportation Systems
  - Improved Logistics and Fleet Management

- Demand Management
  - Modal Substitutions
  - Telecommunications Substitutions
  - Pricing Incentives/Disincentives
  - Land use-transportation strategies

Alternative Fuels

- Different Options:
  - Bio-diesel
  - Electricity
  - Ethanol
  - Hydrogen
Bio-diesel

- Renewable fuel from vegetable oils, animal fats, or recycled restaurant greases

- Blends of 20% bio-diesel with 80% petroleum diesel (B20) can generally be used in unmodified diesel engines

- Can also be used in its pure form (B100), but it requires engine modifications, and may not be suitable for wintertime use.

Ethanol

- Alcohol-based alternative fuel produced by fermenting and distilling starch crops, including corn, barley, and wheat.

- Ethanol is most commonly used to increase octane and improve the emissions quality of gasoline.

- All gasoline vehicles are capable of operating on gasoline/ethanol blends with up to 10% ethanol.
Electricity

- Electric Vehicles (EVs) store electricity in an energy storage device such as a battery.

- EV batteries have a limited storage capacity and their electricity must be replenished by plugging the vehicle into an electrical source.

- Hybrid Electric Vehicles (HEV) and Plug-in Hybrid Electric Vehicles (PHEV)

Hydrogen

- Hydrogen can be used in an internal combustion engine vehicles as pure hydrogen mixed with natural gas.

- Fuel Cell Technology:
  - Hydrogen and oxygen from air fed into a proton exchange membrane (PEM) fuel cell "stack" can produce enough electricity to power an electric automobile.
Challenges

- Existing Infrastructure
- Transition Time Horizon
- Unknown impacts

Road/Vehicle Operations Improvements

- Traditional Approaches:
  - Bottleneck identification
  - Optimal and adaptive signal timing
  - Alternative means of traffic control (e.g. roundabouts)
Intelligent Transportation Systems (ITS)

- ITS applies advanced technologies to make transportation systems safer, more efficient, more reliable and more environmentally-friendly, without necessarily having to physically alter existing infrastructure.

- ITS cuts across disciplines (transportation, engineering, communications, computer science, finance, electronic commerce and automobile manufacturing,…etc.).

ITS Applications

- **Real-time management & control of transportation networks**
  - Optimize network utilization
  - Avoid breakdowns
  - Real-time information about travel conditions and options
  - Improve air quality

- **Intelligent Vehicle-infrastructure systems**
  - Vehicles communicate with the infrastructure and among themselves
  - Automated Highways

- **Advanced Public Transportation Systems**
  - Encourage transit usage
  - Personalized and flexible systems
The Promise of ITS

- Improving travel without harming the environment
- Increasing transportation system efficiency
- Boosting productivity
- Improving safety

Demand Management

- Three different types of actions:
  - Reducing the demand
  - Shifting the demand
  - Repackaging the demand
Influencing Demand

- **Reduce:**
  - Shorter work weeks
  - Shorter trip length through effective landuse-transportation planning
  - More people to work at home
- **Shift:**
  - Staggered and flex working hours
- **Repackage:**
  - Carpooling and transit use

Transportation-Land Use Modeling

- **Transportation planning** moving toward activity-based, micro-simulation approaches
- **Land-Use Modeling**
  - UrbanSim uses an agent-based modeling approach