Transportation Energy: Supply, Demand and the Future

http://www.uwm.edu/Dept/CUTS//2050/energy05.pdf

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Presentation to the District IV Conference
Institute of Transportation Engineers
June, 2005, updated September, 2007, June 2008

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The problem

- Transportation in nearly 100% dependant on petroleum as a source of energy.
- Global supply and demand trends will have a profound impact on the ability to use our transportation system and on economic activity.
- Alternatives are slow in development and implementation. Short term impacts are likely to be extreme and massively disruptive
- The ability to finance future transportation programs will be severely impacted.
- Related issues – Global climate change, air quality

Demand

- Worldwide demand for petroleum is growing, particularly as related to economic trends in China, India, Eastern Europe and other developing areas.
  - China oil demand +104% by 2030, India +91%, Africa +105%, Central and South America +98 to 112%, US, Europe +22 to 34% (Exxon)
- Transportation energy demand in the U.S. has increased because of the greater use of less fuel efficient vehicles. – a transportation finance bonus

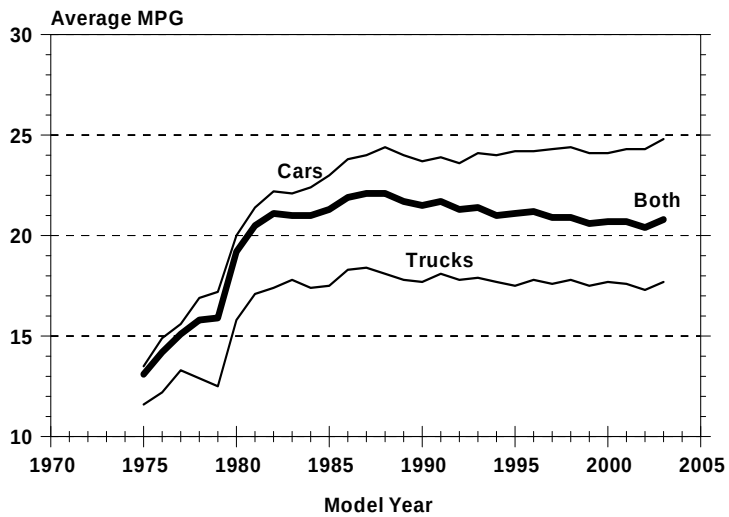
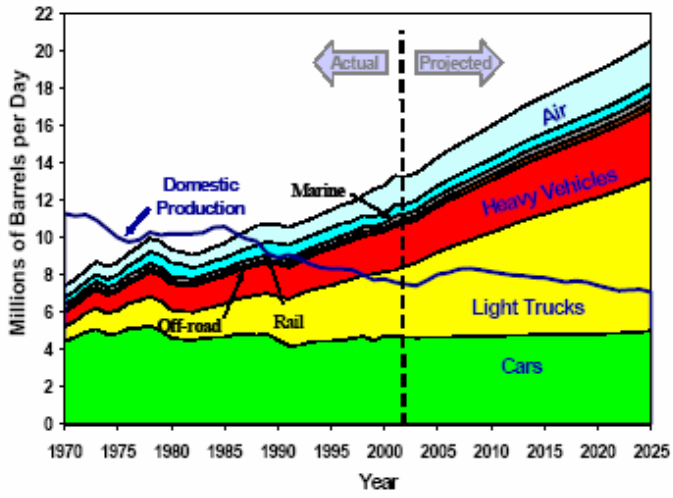


Figure 1.7. United States Petroleum Production and Consumption, 1970–2025



Source:
See Tables 1.12 and 2.5. Projections are from the Energy Information Administration, *Annual Energy Outlook 2004*, January 2004.

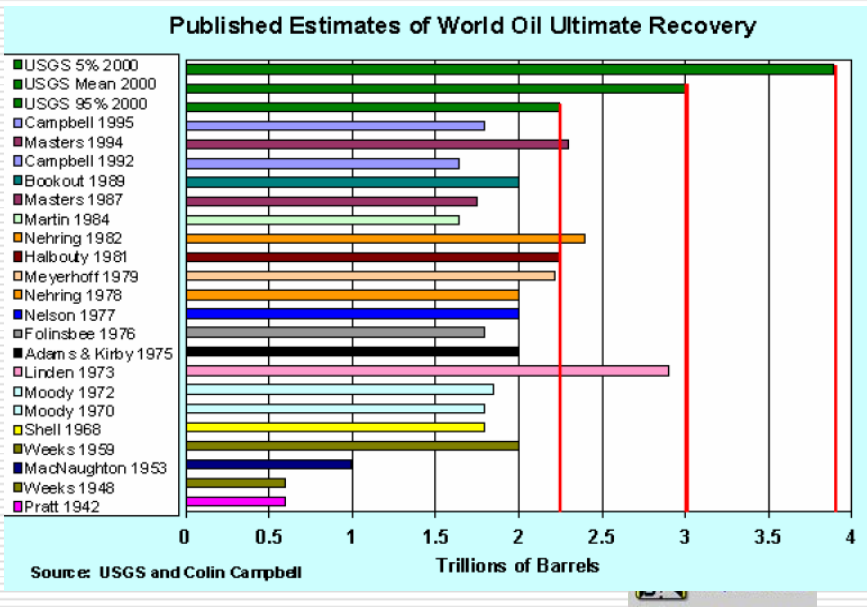
Supply

- Different predictions of the total global supply of petroleum and related products.
- Some believe we may have reached the global peak of production. (peak oil)
- Rates of discovery have slowed, there may be few places left to find petroleum.
- As easy sources are used up, the cost, risk and energy required to extract the resource will increase.
- Major oil companies have reduced estimates of reserves and reduced investment in finding new sources

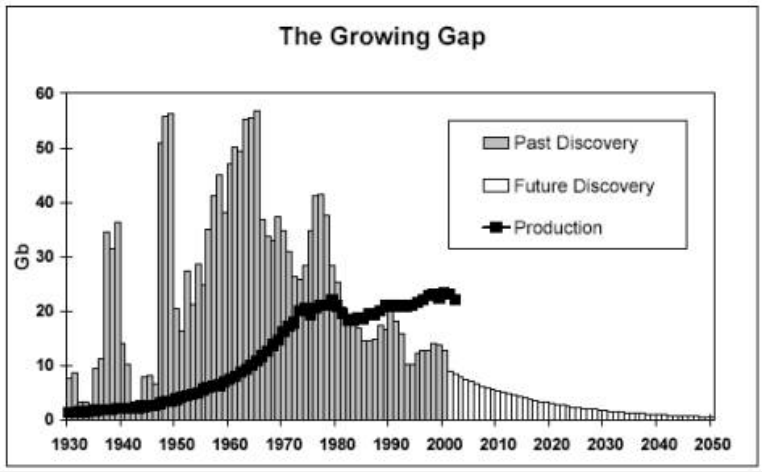
Basic Numbers

- World demand – 30 Billion barrels/yr
- U.S. demand – 7.5 Billion barrels/yr., about 5 Billion barrels/yr. imported
- US. Reserves – about 21 billion barrels from all sources – off shore, AWNR (4 Bbl), etc.
- Remaining sources require greater energy to extract.
- Demand increases in the future?
- http://tonto.eia.doe.gov/dnav/pet/pet_crd_gom_s1_a.htm

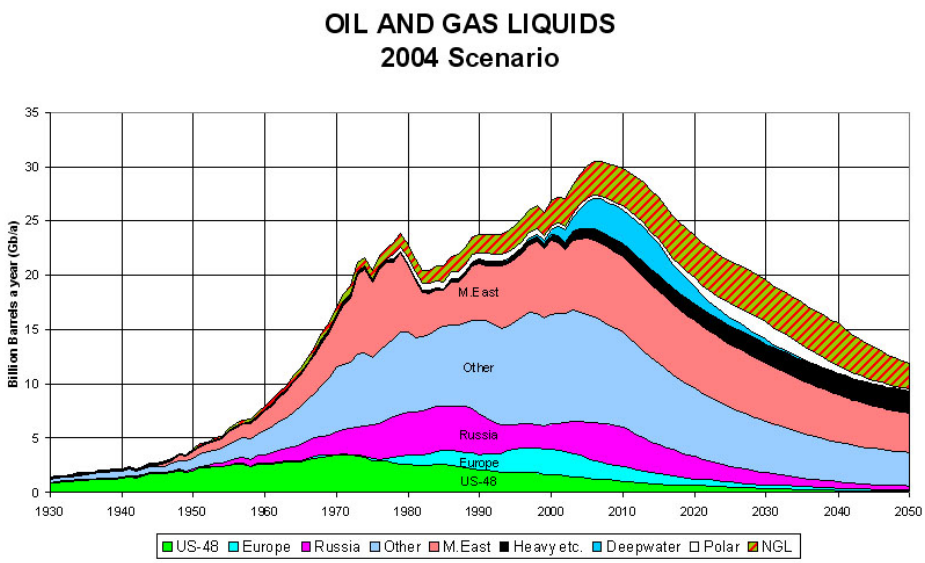
U.S. DOE, source:
http://tonto.eia.doe.gov/FTPROOT/features/longterm.pdf#search='oil%20supply'



World Conventional Oil Production & Discoveries



Campbell's prediction "the end of cheap oil"



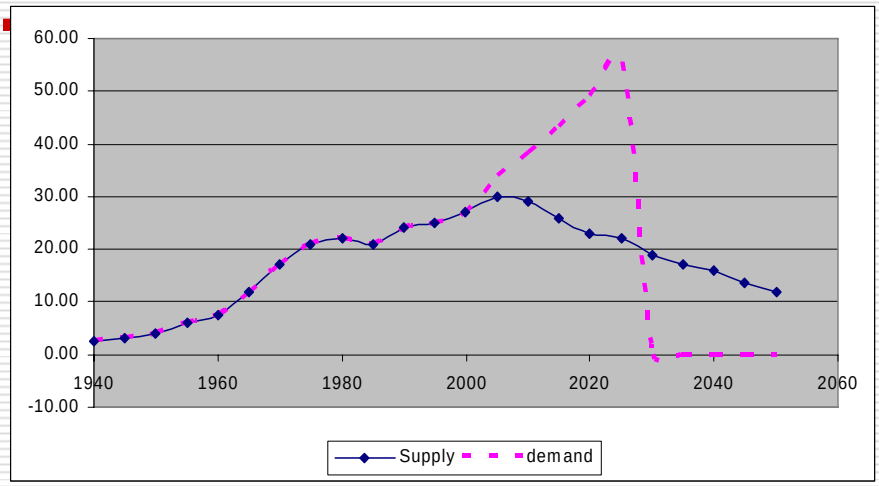
Definitions

- Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs. (UN World Commission on Economic Development, 1987)
- A system is sustainable if resources renew themselves at the same rate or faster than they are used.
- Example: sustainable forest: Supplies fuel, lumber and food are used at a rate less than the rate of growth , forever.
- For more definitions, see TDM encyclopedia http://www.vtpi.org/tdm/tdm67.htm

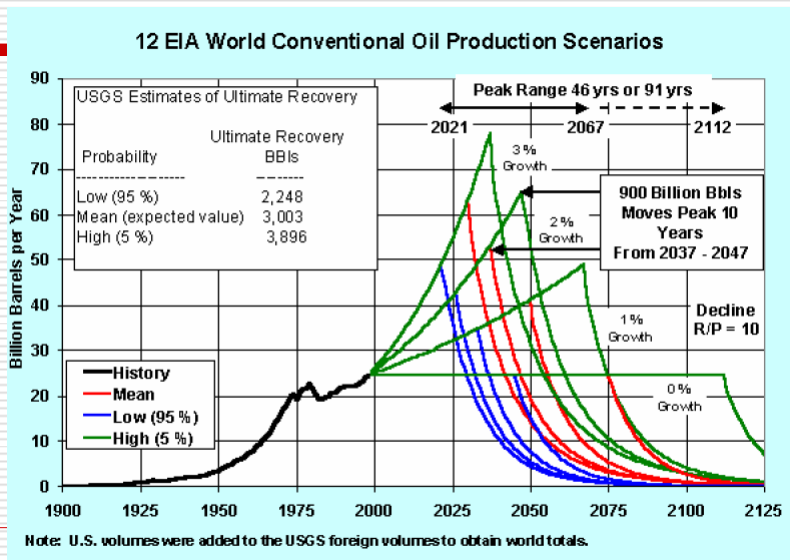
What sustainability really means

- A system that is not sustainable will eventually collapse
- Collapse occurs quickly with increasing demand and a declining supply
- The higher it rises, the greater the fall.
- the only questions are
  - When will the collapse occur?
  - How will it occur?
  - What happens during collapse?
  - What needs to be done to cushion the collapse?

When petroleum demand exceeds supply, collapse occurs …



U.S. DOE viewpoint,
source:http://tonto.eia.doe.gov/FTPROOT/features/longterm.pdf#search='oil%20supply'



Collapse - worst case

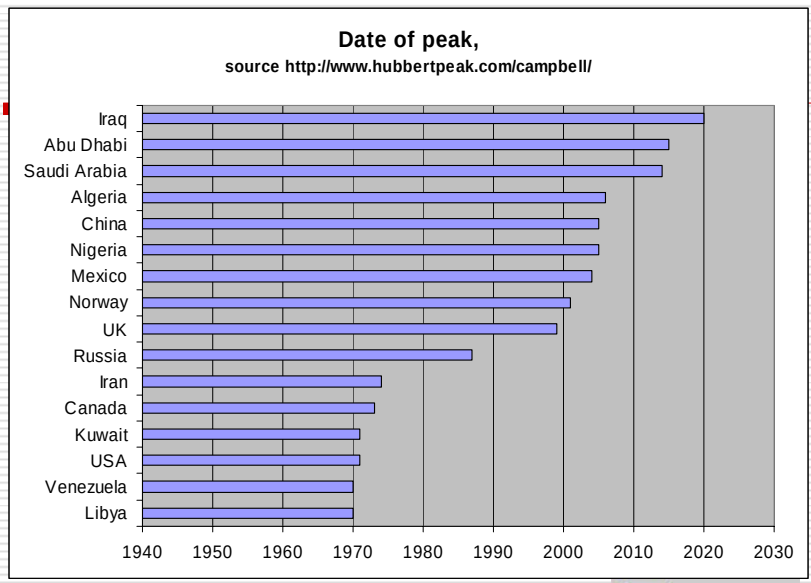
- Collapse of petroleum system could have sever consequences
  - Global economic recession/depression
  - Severe inflation
  - Investor speculation leading to wide price swings
  - Removal of environmental controls over remaining resources
  - Transfer of wealth to countries with remaining resources
  - Rise of autocratic governments
  - Increasing poverty in third world countries
  - Political/military conflict over remaining resources

Increasing supply paradox

- If additional supply is found or developed, it can result in a delay of the collapse, but the magnitude of the collapse will be greater.
- Efforts to deal with the collapse are generally good things to do, even if the collapse never occurs.
  - Alternate fuels
  - Conservation
  - Demand reduction

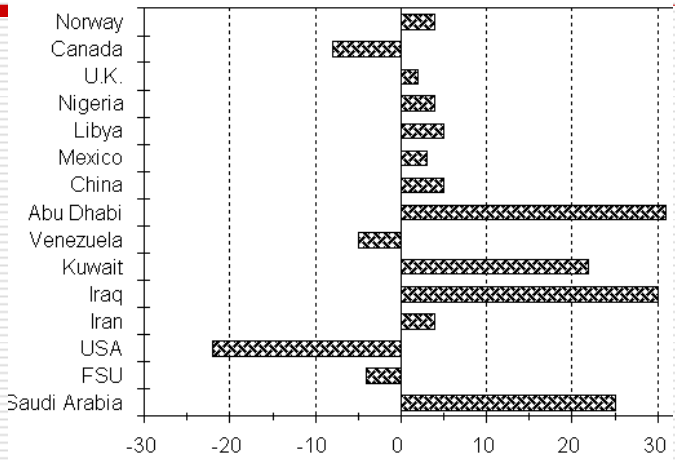
Sources of supply

- Remaining sources require more energy input and are more difficult to process than in the past
- Many producing countries have moved past their peak production and are in a period of decline and are becoming net importers. (Oman, Indonesia, China, UK, Iran?)
- Exceptions are in the middle east (Saudi Arabia, Iraq, Kuwait, Abu Daubi)
- No matter when we reach the peak, most of the world, including the U.S. will be highly dependant on sources from a few mostly unfriendly, hostile foreign locations.



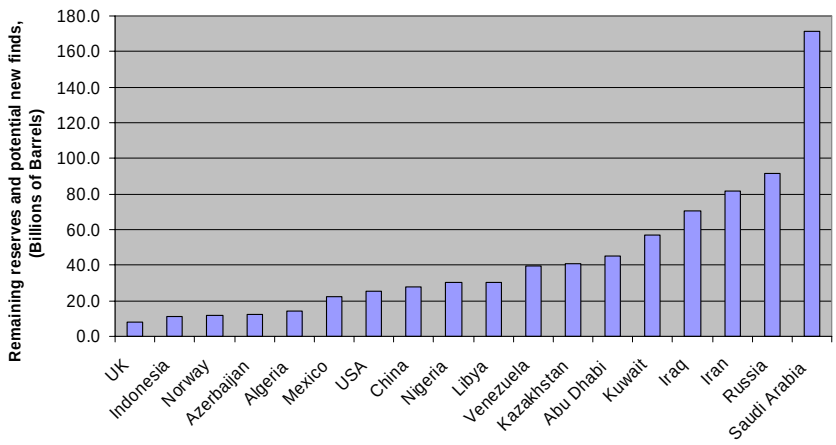
Time to Depletion Midpoint

yr 2000, source: http://www.hubbertpeak.com/summary.htm



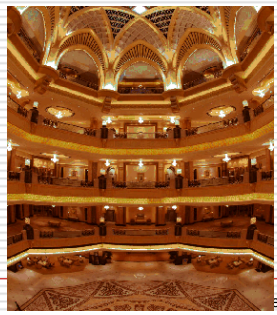
Estimated Reserves,

Source http://www.hubbertpeak.com/campbell/



Where does the Money go?

(Emirates Palace Hotel and Conference Center, Abu Daubi)



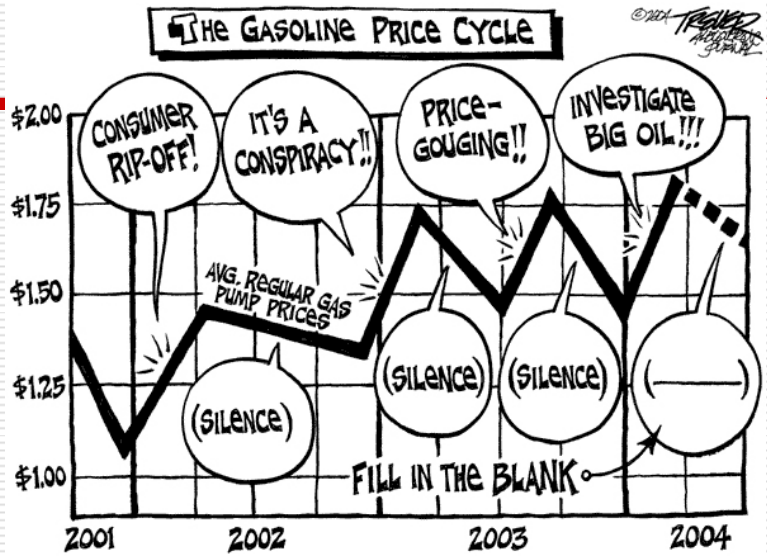
Some Quotes

- "Simply put, the era of easy access to energy is over. In part, this is because we are experiencing the convergence of geological difficulty with geopolitical instability... [W]e are seeing the beginnings of a bidding war for Mideast supplies between East and West.“ David J. O'Reilly Chairman and CEO, ChevronTexaco
- “The supply side is limited, We are reaching the limits of the planet very soon” Dr. Ali Samsam Bakhtiari, Senior Planner, National Iranian Oil Company
- “By some estimates, there will be an average of two-percent annual growth in global oil demand over the years ahead, along with, **conservatively**, a three-percent natural decline in production from existing reserves. That means by 2010 we will need on the order of an additional 50 million barrels a day.” Vice President Cheney

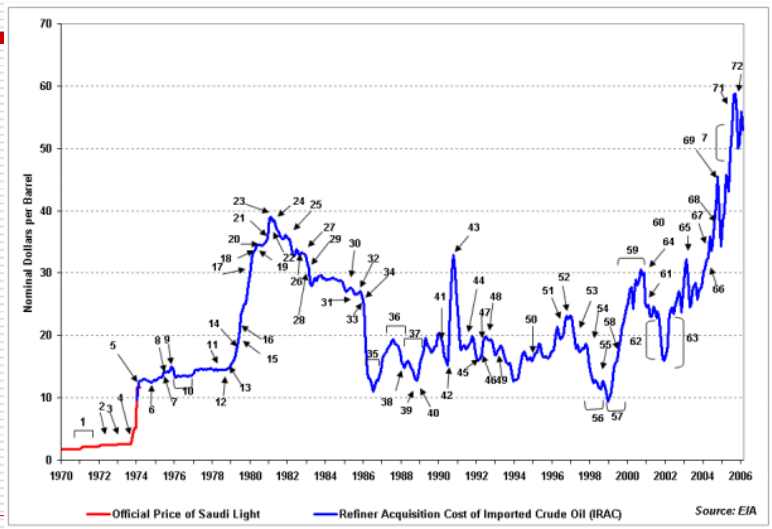
The Future??

Prices

- We are operating on a very thin, thin edge to balance supply and demand. Minor events can significantly affect prices.
- The current system is not sustainable
- The result will be a series of major oil price shocks with rapidly increasing prices with a high potential for conflict over remaining resources.
- Short term effects are likely to be very severe with few options. “over a barrel”
- Highly visible prices
- Prices will rise and fall, but are likely to generally continue upwards.
- Speculators lead to wide price swings

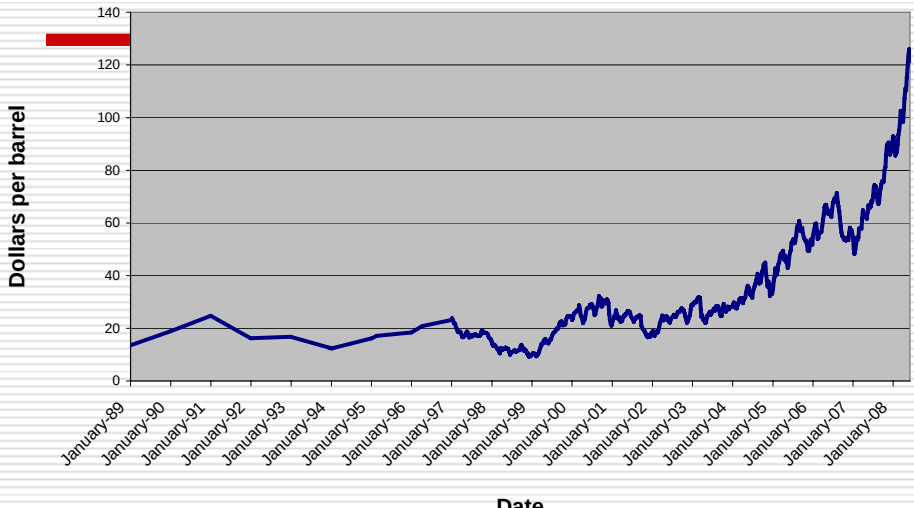


Crude Oil Price Trends:
Source: http://www.eia.doe.gov/emeu/cabs/chron.html



Recent World Oil Prices

http://tonto.eia.doe.gov/dnav/pet/hist/wtotworldw.htm



The Future

- No easy long term solution, a combination of thousands of actions
  - Price increases
  - Conservation
  - Alternative Fuels
  - Increased efficiency
  - New sources
  - Economic impacts

Can Conservation Solve the Problem?

- More efficient vehicles, price pressures and general conservation can delay the problem, but are not enough.
- "You can only turn off the lights once"
- Price increases will force more conservation
- More conservation of fuels means less revenue for transportation purposes.

The Future

- Can Technology and Alternative Fuels solve the problems?
  - Possibly, in the long run, but some will take a long lead time to happen
    - Technology development - 6-15 years
    - Infrastructure deployment -10-15 years
    - Market penetration occurs along with above
    - Fleet turnover – 12 years
    - Total 20-40 years for full effect to be felt
  - Fuels that use existing infrastructure can somewhat shorter lead time.

Alternative Fuels

- An ideal fuel has
  - high energy content per unit of volume – (vehicle range),
  - is easily converted to useful transport energy,
  - is easily transported,
  - doesn't take more energy to produce than it returns as a useful fuel (positive EROEI),
  - has low emissions and
  - has an existing infrastructure
- (Gasoline or Diesel fuel)

Alternative fuels

- Most require substantial energy to produce, what is the net gain?
  - Ethanol converts diesel fuel and natural gas into diesel fuel and a gasoline substitute, a small gain
  - Hydrogen from natural gas or electricity
  - Methanol, ethanol need fuel, fertilizer and heat from fossil fuels
  - Electricity as a source to convert fuels, generally uses coal, natural gas or nuclear fuels
  - New petroleum sources are more difficult to extract and require substantial energy input

Contingency Planning for the near term

- Conservation is not enough and there is not adequate time to develop and deploy alternatives
- "If it could happen, it will happen" So, what strategies should be used when it does happen?
- Prepare for the worst, hope for the best, Similar to preparation of a disaster plan
- Must plan for the crisis in advance because there is no time to plan for it when it does actually happen.
- Goal: To increase the ability to respond to an energy shortfall through an adjustment of demand without causing severe problems for households, or the economy.

Question of Allocation & Conservation

Who gets the scarce resources and how is that decision made?

- Who is vulnerable to price swings and availability issues?
- What essentials do these groups need?
- At what stage are these essentials provided?
- Prioritize policies based on effectiveness (work trips, short trips, long trips, etc.)
- Implement contingency plan

Transportation Implications

- Major financial shortfalls because of increased costs, flat revenues and needs to pay off bonding
- Substantial price increases will affect demand somewhat, but there needs to be reasonable alternatives available.
- Travel growth will slow for multiple reasons, most trends that led to fast growth in the past have moderated or reached a saturation point.

Conclusions

- The current system is not sustainable
- Energy issues will dominate the future of transportation and the economy
- Failure to act early will lead to more severe consequences
- Contingency planning is essential
- Transportation finance will be radically affected by future energy factors
- To do project planning or development without a thorough knowledge of future energy situations is a waste of time
- Become knowledgeable about the issue

Web sites

- Millions of web sites on Google or Yahoo
- http://www.hubbertpeak.com/index.asp
- www.eia.doe.gov
- http://www.eia.doe.gov/oiaf/ieo/index.html
- http://www.eere.energy.gov/afdc/
- http://www.oilanalytics.org/netentop.html
- http://tonto.eia.doe.gov/FTPROOT/features/longterm.pdf#search='oil%20supply'
- i/
- http://www.drydipstick.com/