Transportation Sustainability Issues

http://www4.uwm.edu/cuts/ite09.pdf

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Definitions

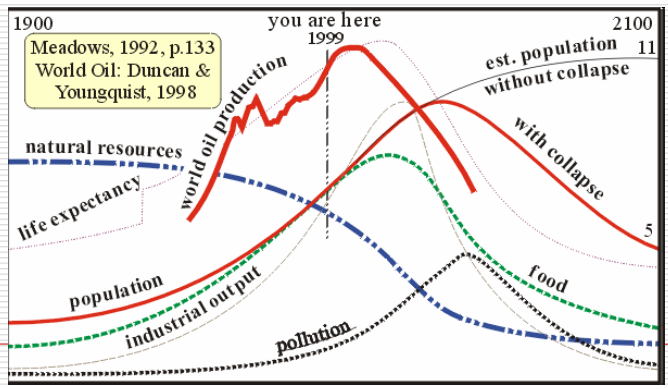
- Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs. (UN World Commission on Economic Development, 1987)
- Resources renew themselves at the same rate or faster than they are used.
- Example: sustainable forest: It supplies fuel, lumber, natural communities and food at a rate less than the rate they are consumed – forever.

What sustainability really means

- A system that is not sustainable is a Ponzi scheme – borrow resources from the future to pay for the present
- A system that is not sustainable will eventually collapse, the bubble pops
- The only questions are
  - When and how the collapse will occur,
  - What happens during the collapse
  - What needs to be done to cushion the collapse

Sustainability

- Requires a change from thinking from growth to understanding system dynamics and equilibrium http://dieoff.org/page25.htm



What resources are we concerned about in transportation?

- In a sustainable system, resources need to renew themselves at the same rate or faster than they are used.
  - Money
  - People
  - Materials
  - Energy
  - Air, water and climate

Financial sustainability

- Rising costs
  - Materials and labor costs
  - Costs of mega-projects
  - Bonding
- Declining or flat revenues,
  - VMT growth is slowing,
  - More efficient vehicles
  - Diversion of transportation funds for other (worthy) purposes
- Pubic and political resistance to any tax or fee increases
- Earmarking.

People (sustainability of work force)

- Universities are reluctant to hire faculty unless there is are assurances of research funding, (probably) from state sources.
  - Earmarking and cost share requirements limits other opportunities
  - Limited university resources (new faculty hires) especially in traffic engineering, public transit, highway design.
- Excessive outsourcing of engineering services by public agencies can lead to lack of permanent expertise to oversee projects
- Inadequate preparation in mathematics and sciences by entering students at universities, especially from urban schools, reduced summer job opportunities
- Undergraduates in the U.S. are reluctant to enter graduate school

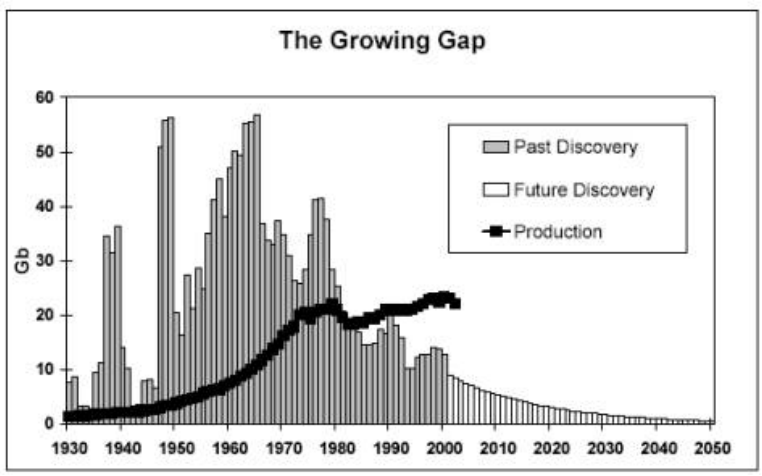
Materials sustainability

- Need to expand and enhance materials reuse and recycling
- Lack of maintenance leads to higher costs in the future. Good asset management needed.
- Local roads that use property taxes for support are seriously under funded
- Need a 'LEED certification' program for transportation – What elements of design and construction give the best long term fit with the environment?

Energy (Petroleum) sustainability

- To be sustainable, oil supplies would need to be discovered and developed (or replaced) faster than they are being used, this has not been the case since about 1980.
- Well to wheel requirements: Net energy = energy produced – energy needed to produce the energy, newer sources require more energy to produce the energy
- System collapse is inevitable, probably in 10-30 years
- When it happens depends on primarily rate of increase in global demand for petroleum.

World Conventional Oil Production & Discoveries

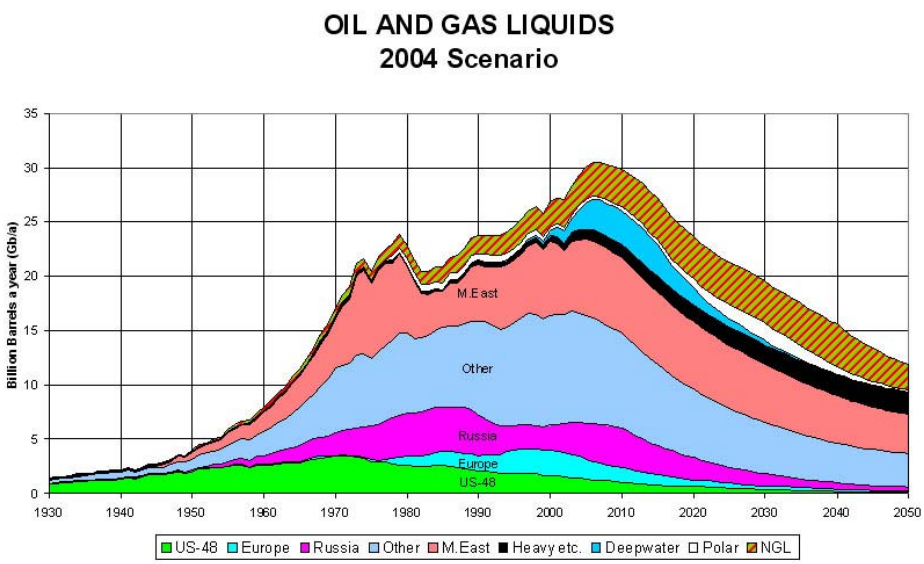


Some numbers

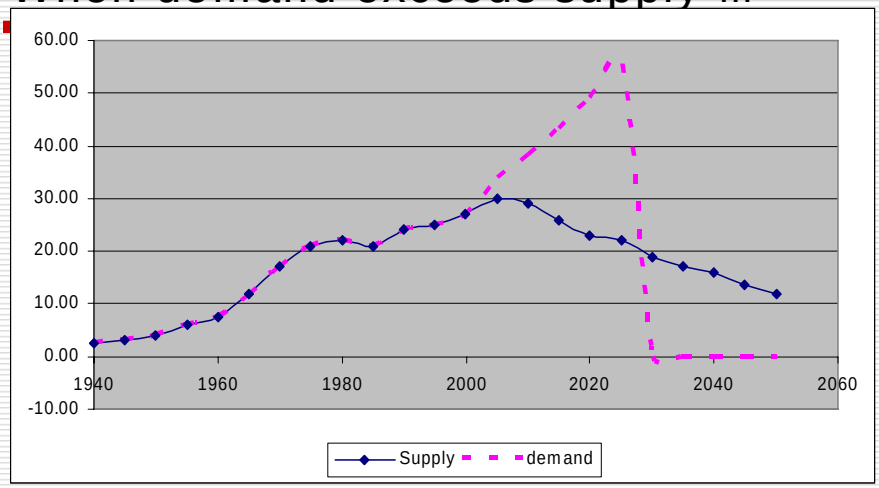
- World demand – 30 Billion barrels/yr expected to increase to 50 BB/yr
- U.S. demand – 7.5 Billion barrels/yr., about 5 Billion barrels/yr. imported
- US. Reserves – about 21 billion barrels from all sources – off shore, AWNR (4 Bbl), etc. global reserves 1 Trillion barrels ?
- Remaining sources require greater energy to extract. Net energy?

Supply = Area under the curve

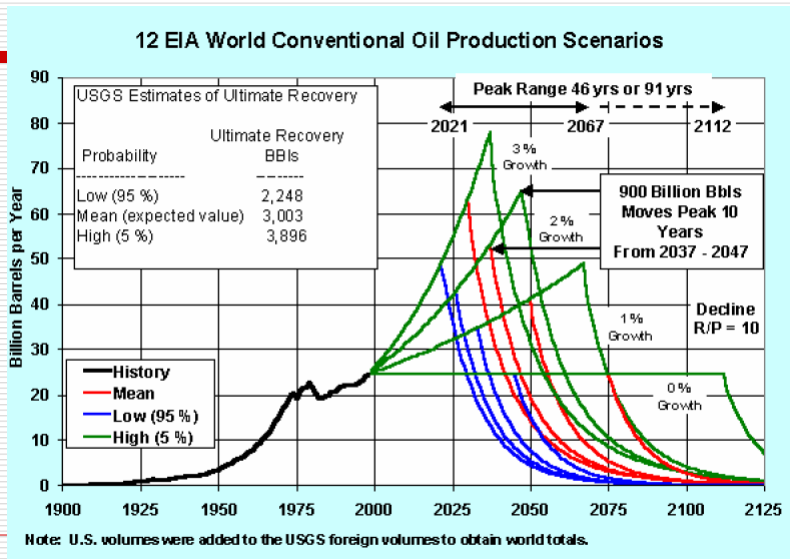
Campbell's prediction "the end of cheap oil"



When demand exceeds supply …



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



Petroleum Collapse - worst case

- Collapse of petroleum system could (will) have severe consequences
  - Investor speculation leading to wide price swings
  - Global economic recession/depression
  - Severe inflation
  - Removal of environmental controls over remaining resources
  - Most of the world, including the U.S. will be highly dependant on sources from a few, mostly unfriendly or hostile foreign locations.
  - Transfer of wealth to countries with remaining resources
  - Political/military conflict over remaining resources
  - Rise of autocratic governments
  - Increasing poverty in third world countries

Crude Oil Price Trends:1970-2006

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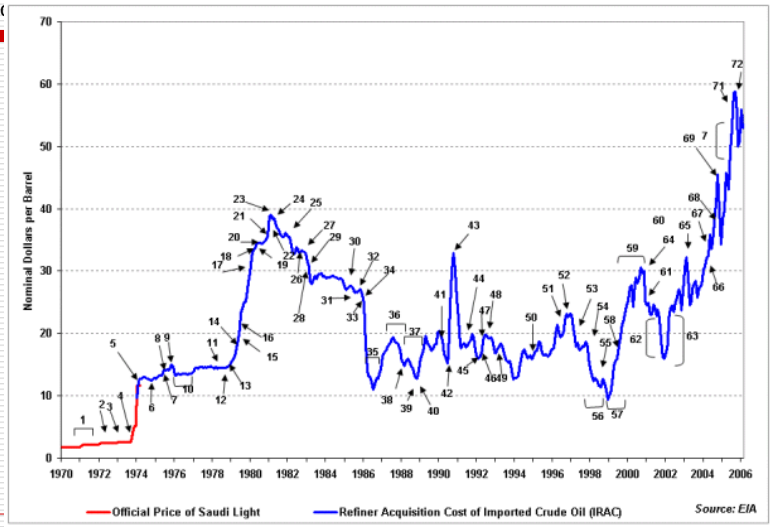
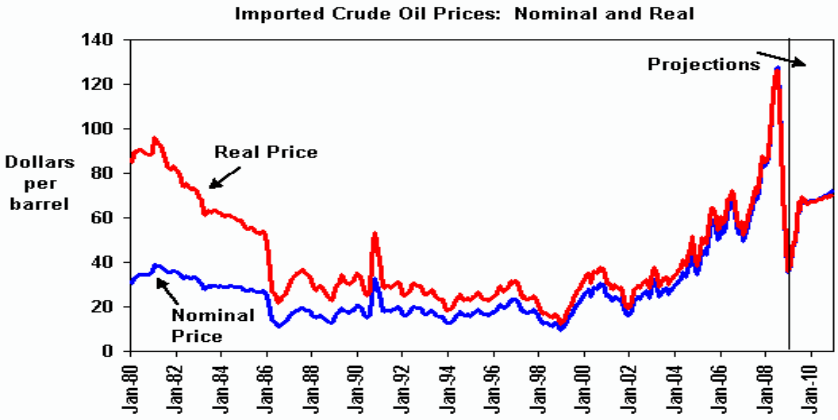
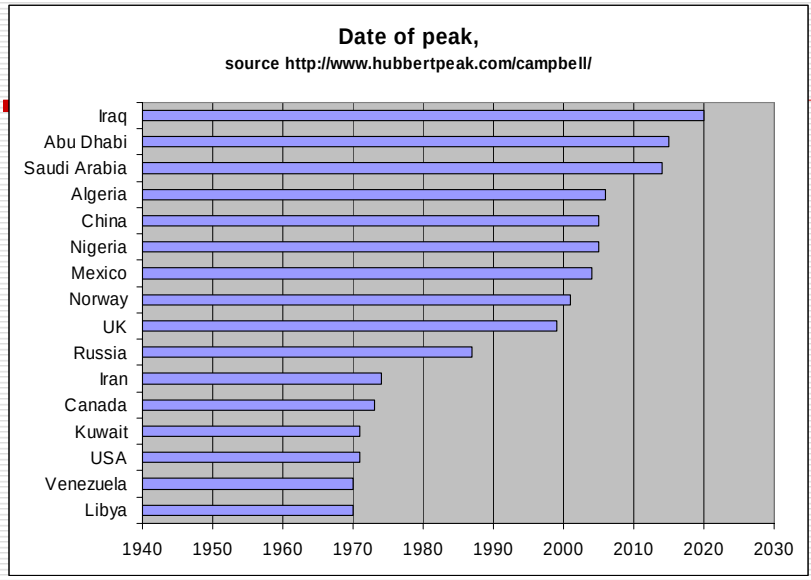


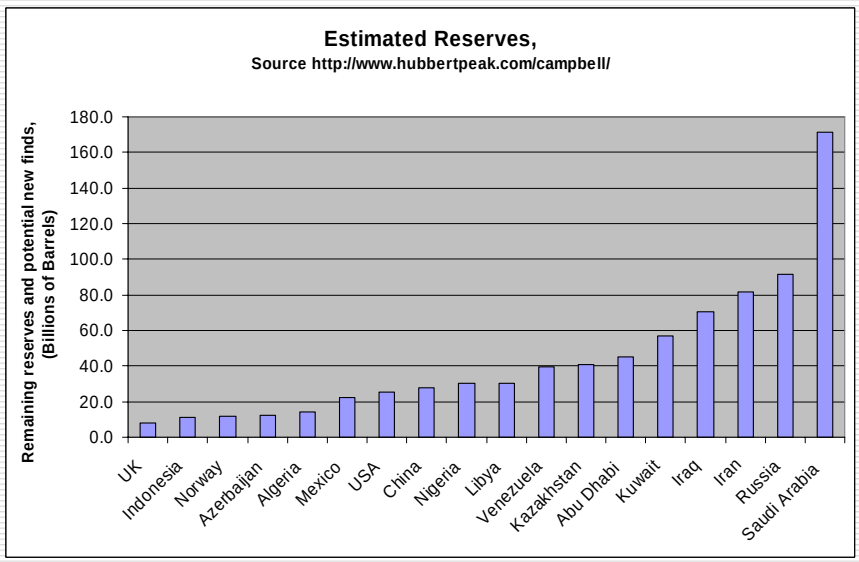
Recent price trends



Sources of supply

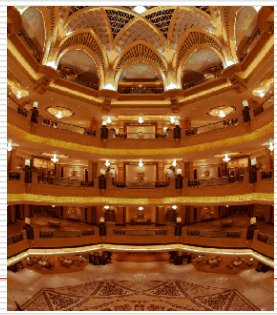
- Remaining sources require more energy input and are more difficult to process than in the past
- Many producing countries have moved past their peak production and are in a period of decline and are becoming net importers. (Oman, Indonesia, China, UK, Iran?)
- Exceptions are in the middle east (Saudi 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.


Date of peak,
source http://www.hubbertpeak.com/campbell/
Iraq
Abu Dhabi
Saudi Arabia
Algeria
China
Nigeria
Mexico
Norway
UK
Russia
Iran
Canada
Kuwait
USA
Venezuela
Libya
1940
1950
1960
1970
1980
1990
2000
2010
2020
2030


Estimated Reserves,
Source http://www.hubbertpeak.com/campbell/
Remaining reserves and potential new finds, (Billions of Barrels)
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
UK
Indonesia
Norway
Azerbaijan
Algeria
Mexico
USA
China
Nigeria
Libya
Venezuela
Kazakhstan
Abu Dhabi
Kuwait
Iraq
Iran
Russia
Saudi Arabia

Where does the Money go?

(Emirates Palace Hotel and Conference Center, Abu Daubi)



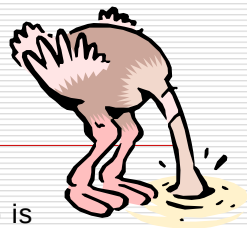
More bad news

- 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.
- Remaining sources require more energy input and are more difficult to process and transport than in the past
- Alternate fuels require petroleum input to acquire and transport. (e.g. coal)
- Unstable prices discourage or delay investment in alternatives (alternative sources, fuels, technology, etc)

Even more bad news

- More efficient vehicles, price pressures and general conservation can delay the problem, but are not enough. “You can only turn off the lights once”
- 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

The four stages of grief



- **Denial** – “It won’t happen”:
  - A question of risk, the prudent thing to do is prepare for the worst, hope for the best,
  - Similar to preparation of a disaster plan
  - “If it could happen, it will happen” So, what strategies should be used when it does happen?
  - Most actions to lead towards sustainability are good things to do anyways
- **Anger** – “Blame someone else”:
  - Useless, the problems don’t go away
- **Acceptance** – “We are doomed”
- **Negotiation**
  - what can we do to create a momentum to move in a different direction:

What to do? Financial sustainability

- Learn to do more with less - fix it first?
- Invest in preventative maintenance
- Improved operations of existing facilities.
- Spread the message, if the experts don't, who will?
- Explore alternative funding sources – tolls, congestion pricing,

The future?

What to do? People

- Support your local university
  - Get to know the dean of engineering
  - Understand the changed role of research at universities
- Support and participate in mentoring programs
- Support summer jobs for students

What to do? Materials/planning, design & operations

- Think sustainability on all phases of project planning, design, construction and operations
- Many actions are well known for the preparation and operation of transportation services
  - Provide transportation choices – freight, transit, pedestrian, bicycle, ride sharing, pricing and policy.
  - Design for maintenance and flexibility
  - Consider the role of transportation in land use
- Move towards LEED certification for transportation projects.

What to do: Energy - 1

- The most difficult issue, especially in the short term
- Need to provide time for the implementation and impact of long term actions
- Beyond the realm of transportation engineers
- Contingency planning is essential
  - Question is: How to allocate scarce resources?
  - Must plan for the crisis in advance because there will be 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.

What to do? Energy -2

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

Conclusions

(presentation posted @http://www4.uwm.edu/cuts/ite09.pdf)

- The current system is not sustainable
- We need to understand system dynamics and equilibrium
- Transportation finance will be radically affected by future revenue declines, cost increases and other factors
- Education of future professionals in transportation is in jeopardy.
- There are many know actions that can improve the sustainability of transportation facilities and operations
- 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
- To do project planning, development or operations without a thorough knowledge of future situations is a waste of time
- Become knowledgeable about the issue

And Finally,

- For a good time see: http://www4.uwm.edu/cuts/signs/

Web sites

- http://www.uwm.edu/Dept/CUTS/ce790/trbsus.pdf
- http://www.uwm.edu/Dept/CUTS//2050/energy05.pdf
- http://www.uwm.edu/Dept/CUTS/ce790/sustpp.pdf
- http://www.vtpi.org/tdm/tdm67.htm
- http://tonto.eia.doe.gov/FTPROOT/features/longterm.pdf #search='oil%20supply'

Background: the four stages of grief

- Denial: It is not really happening, ignore it and it will go away
- Anger: It is someone else's fault, someone else has to deal with it.
- Negotiation: Maybe we can change a just a few things
- Acceptance: We are doomed