Frank Verrastro
The chart below provides the relative fuel shares now and in the future.

Verrastro noted that oil has been king will likely remain so even through the coming years of increasing demand with relatively little change in the overall market shares of the various fuel types. That is:

- We can expect a 60% increase in demand by 2030
- But, the developing world’s use of various fuels would be different from that of US
- Overall share distribution remains about the same
- After 2030 the role of fossil fuels begins to change
Regional variations will be seen in fuel use between 2003 and 2030:
- Demand will almost double in non-OECD countries
- Non-OECD countries use will outpace that of the OCD countries before 2015
- 90% of fuels in non-OECD countries will be fossil fuel
  - Most are not capable of using the newer fuel sources
  - Tremendous amounts of coal are available in China
- Must take this usage into account or cannot solve the greenhouse emissions problem
  - Most future emissions will be in non-OECD countries

Oil Resources are concentrated in only a few areas
- Primarily Saudi Arabia and Canada (tar sands)
- Natural gas deposits are in about the same places as oil deposits
- The US can be considered the Saudi Arabia of coal
- See charts below

![World Oil Resources](image-url)
World Natural Gas Resources
Trillion Cubic Feet

Source: Oil & Gas Journal

World Coal Reserves
Billion Short Tons (EIA 2004)

Source: EIA
Emerging Global Energy Trends

- Global energy demand for power generation & transport accelerating everywhere
- No longer have excess capacity for refining crude oil – especially in the US since 2004 with several incidents of hurricane damage
- Energy supply and demand growth centers are not co-located which puts more pressure on delivery infrastructure and choke points
- Importance of government activities in oil production including involving bilateral alliances
- Production areas are also often areas of political instability
- Growing interest in/concern for environmental effects of increasing emissions

World Oil Demand Growth

- In 2004 there was a major spike in growth
- Twice the average of the previous years
- Much, but not all, was from Chinese needs
- 2005-2007 seem to be more normal growth
- Spike may have been partially a data collection issue
- Also China had a major problem with hydroelectric power
  - Not enough rain
  - Used more oil for electricity production
- Prices were relatively low so supported demands
Refining Trends

- Even if there is a lot of crude oil available, there will be a problem with refining capacity
- Capacity has increased over the years but not beyond the level of need
- During low demand periods of the year can build up amount that has been refined
  - Have problems with both hurricanes and instabilities world-wide
  - Less opportunity to build up refined stocks

World oil consumption is increasing faster each year while production has suffered

- 1985: 60 billion barrels
- 2025: 119 billion barrels
- Spare production capacity has dropped dramatically in recent years and will likely stay low
  - It takes 10-14 years to get such major production plants working
  - Involves a great deal of negotiations with governments even before building begins
  - Will the cost of fuel still warrant such investments?
- Several major producing countries have lost capacity since 1979
  - Libya, Iran and Iraq especially
  - Overall production has dropped from 38.8 million barrels per day to 31.6
- Without the cushion of extra capacity in the system, the market becomes more volatile
  - Tight markets result in higher prices (see chart below)

![Tight Global Markets Result in High Crude Oil Prices](image)

World Energy Flow Predictions and Complications
Problem: While the fuel comes from only a few places, demand is growing in many places

- Major production regions: Russia, Middle East, Africa, Several smaller non-conventional sources
- Major consumers US, EU, China, Japan, Asia, Japan
- Will concentrated supplies raise concerns about infrastructure and transport
- Result: Increased security / geopolitical / weather problems could delay deliveries
- Choke points increase in importance as threats rise with majority of all oil passing through top 5 choke points
  - Strait of Hormuz – 17 mmb/d – to US, Japan, EU
  - Strait of Malacca – 12 mmb/d – Japan, So. Korea, China and Pacific rim
  - Suez Canal and Sumed – 4.2 mmb/d – EU, US predominantly (flow goes both N &S)
  - Bab el-Mandab – 3+ mmb/d to EU, US, Asia
  - Bosporus – 3.1 mmb/d – Europe & West

Delivery delays can be as bad as production and refining limitations

**Global Oil Supply & Demand**

The Second Quarter is always very important because low demand allows for the build up in supply providing a cushion

- Moving from heating to driving seasons causes dip in demand
- Less variation in seasonal demand in countries not in the more industrialized countries that are in the OECD
- There is a need to produce/refine at a steady rate to make up requirements for high demand periods during annual periods of low demand
- Overall, the world is adequately supplied with crude oil
- 2005 hurricanes in the Gulf of Mexico caused major losses of production/refinement capabilities – most prominent among the long list of reasons for rising gas prices

**Snapshot of supply and demand in 2006 (mmb/d)**

- Current quota for OPEC’s 10 countries: 28 mmb/d
• June 06 OPEC production ~29.95 mmb/d (includes Iraq’s 2.12 mmb/d)

<table>
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<th>1Q</th>
<th>2Q</th>
<th>3Q</th>
<th>4Q</th>
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<td>83.3</td>
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<td>27.5</td>
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Definitions of Energy Security vary with positions
• For Producers – consistency and predictability of demand requirements
• For Consumers – available, reliable, affordable and secure sources of supply
• For Governments – secure supplies at predictable and stable prices to support economic growth, preserve national security interests, and meet consumer needs
• Need to remember that hydrocarbon world will remain for foreseeable future

Alan Hegburg
Mr. Hegburg (biography) began his part of the talk by remarking that we are likely to remain a hydrocarbon world for the foreseeable future
• But already getting higher than expected CO₂ emissions
• Is that sustainable?
• Decisions need to be made
• Current supply / demand forecasts may not remain viable
  ▪ Fuel price is a major element of demand forecasting
  ▪ Energy Information Administration does a very good job of forecasting
    ▪ Provides official statistics for US government
    ▪ Offers historical data and predictions
    ▪ World-renowned for work

Forecasting
Things can change rapidly - different from forecasts
• Prices dropped dramatically in 3 months time in 1986
• Commodities usually react in cycles
  ▪ Within laws of economics
  ▪ We may now be experiencing longer cycles for major price changes
• High oil prices make CO₂ emissions worse because of greater use of coal
  ▪ Also increases use of non-conventional energy sources
• Ramping up new resources would eventually reduce the load on OPEC
• Will not change the nature of the security question – will just provide more time before crisis
  ▪ Will it be enough to make other changes?

Price impact includes
• Commercial activity for refining – not a government issue
• US is already at the peak of its refining capacity
• No new refineries built in 25 years but capacity has increased by increasing the capability of existing refineries
  ▪ Investments are more likely to go to existing infrastructures to improve them
• Same thing happens with production facilities
  ▪ To keep an oil field going requires vast amounts of investment in heritage assets
  ▪ To keep heritage assets producing is less costly than building new ones
  ▪ However, world is about at the end of what can be still be usefully done there
  ▪ Now must look to new locations: Kazakhstan, Azerbaijan, etc.
• They could produce up to 6-7 mb/d
• Equal to one field in Saudi Arabia
• Need good access to such countries to be willing to invest
• Transport is also a tight market – shortage of tankers

**Investment Strategy**
• Based most only 1) cash flow and 2) price forecasts
• More likely to invest in refining capacity when prices drop to $30 a barrel
  ▪ Result: not investing in refining now
• Current investment money
  ▪ Aramco, the state-owned oil monopoly of Saudi Arabia, operates like a private sector company, believes that the market will stay tight
  ▪ Result: Aramco is ahead of the pack and is the only entity investing now

Thinking about energy security issues
• President Carter deregulated oil prices and opened foreign investment
  ▪ Others like to invest in the US because it is easy to do so
  ▪ Easy to get money back out and all are treated equally
  ▪ Result: Venezuela and Saudi Arabia still want to do business with the US
• Question: Is this sustainable for maintaining energy security?
  ▪ Even if become less dependant on overseas oil, will still need natural gas for generating electricity
• Commercial entities want stable demand which can only be estimated
• Consumers want energy that is always available, reliable, cheap, etc.
  ▪ And they have had it that way
  ▪ Wanting clean energy is a new element
  ▪ Also, growing importance of energy sources that do not cause global warming
• Governments basically do not want energy hassles
  ▪ Nuclear power is good on many fronts but comes with a security premium
  ▪ So cannot compete with oil and other sources
  ▪ Nuclear power costs would have to be passed on to residential customers which would not go over well

**Investors take risks**
Risk involved in a country is only part of the equation especially if there is good potential for gain
Some investors will want a variety of risk situations at different levels
Different companies have different risk profiles

**Historical Components of Energy Investment Risk**
• Geologic Risk – are hydrocarbons present?
• Technologic Risk – is the energy source accessible with available technology?
• Commercial Risk – how long will it take to get a good return on investment?
• Political Risk – are there political implications / potential political changes / manageable risks
  ▪ Must assume that the best deal you have will be the first one
  ▪ Later negotiations will always be more favorable to the host government
  ▪ Result: need to get as much back on investment as soon as possible
  ▪ Need to be able to work with existing and potential governments
  ▪ US is a good place to invest because of its transparency and stability

**New considerations for Investment Decisions**
• New geopolitical alliances
• Supply reliability & price predictability – more important than resource size
• Environmental issues are growing sensitivity – climate change
• End of Cold War produced new nations, new instabilities that go on for decades
• Power shift to areas with strategic commodities
• Succession issues in many nations
• Human rights & distributive (wealth) issues – revenues supposed to go to the people but rarely do
• HIV/Aids, poverty, other cultural concerns
• Terrorism is current focus, especially threats to facilities and transit choke points
• A single attack at the right place in Saudi Arabia could take 7-8 mmbls/day away from the 85+ mmbls that are needed
• Could be hard to handle for long
• Everything made that much more touchy because of the tight market

Producers:
• In high-price markets: all are capitalists
• In low-price markets: all are socialists
• In general must work with governments because nations own the oil
• Even in the US where control comes from public legislation
  ▪ Must get a license for rights to produce
• Saudi Arabia oil companies are making good use of recent profits but some going to the government, too

What needs to be done for future US Oil Security
• Encourage new sources of supply – conventional, non-conventional, domestic and foreign
• Demand restraint/efficiency – taxes, fuel switching, CAFÉ standards, environmental regulation and market pricing
• Build up domestic and international oil stockpiles
• Commitment to protect energy infrastructure and keep transit routes (sea lanes) open
• Recognize need to rely on Saudi Arabia for price stability & OPEC moderation to maintain the swing supply

Issues that are complicating US policy agenda on energy
• Increasing interest in alternative fuels although some developing very slowly
  ▪ Some now on the verge of making big advances
• Many threats to infrastructure, transportation, etc. – especially with growing concentration of production facilities
• Markets for concepts like carbon credits is growing and may start driving policy
• Some geopolitical moves and attitudes may reduce the fungibility of the oil market
• Using a lot more politically charged rhetoric when referring to energy
  ▪ Talk of “addiction to oil” / call for energy independence
  ▪ Increased advocacy of alternatives

Current Price volatility caused by many factors
• Expect renewed demand growth, despite higher prices in both the US and Asia, particularly in China
  ▪ Demand “destruction” by high prices may be overrated
• Limited spare production capacity globally
  ▪ Questions about the ability of producers (Russia, Nigeria, Iraq, Iran, US, etc.) to continue to deliver needed oil volumes to the market
  ▪ Exacerbated by both real and potential losses of supply
• Investment in Russia has about peaked after making major advances from improved efficiency
• Places like Nigeria are getting worse
• Refining/processing constraints from political and environmental issues
• Role of speculative investors in price movements

Specific Threats to Energy Production
• China
Demand is rising but data is not accurate
- Energy industry is not efficient and a highly charged political issue
- Government does not have control over producers so working slowly
  - Not like full control leadership has of Party or military
  - Explains problem with UNICAL – leadership was told that there would be no problem
- Russia
  - Big problem with aging, inefficient infrastructure – pipelines especially
  - Declining output because investments have not been adequate
  - Also have to deal with ethnic and environmental issues in various areas
- Iraq
  - The oil problem can only be resolved at the end of all the other internal negotiations and political discussions
  - There is a question of how fast they could ramp up to absorb a large amount of investment
    - Probably will waste a lot of what is invested
    - Also have had very little information about what was in oil fields
- Iran
  - Have great resources but in need of new technology to pull out hydrocarbons
  - Output is actually declining to about 80% below its quota
  - Nuclear ambitions complicate the issue

Upcoming problems
- If US has the same hurricane season this year as last, could cause very large problems in energy
- What is going on is not just market fundamental variations
- Long term price forecasts put oil at something closer to $50/bl overall
  - Refined costs might be more like $60/bl but much is lower quality crude oil
  - Speculative markets would be higher

Question and Answer Session
- Non-conventional energy sources
  - Could go to lighter fuels for transport
  - Could go to heavier fuels (tar sands from Canada) but they are difficult to make work
- We can expect a messier market overall
  - There is no single replacement for oil because oil is so cheap
  - 90% of transport uses oil
  - The infrastructure is already there
  - Anything else would be significantly more inefficient
- There are complaints that the industry has not invested enough in new infrastructure
  - It takes 1 to 2 years to see where the market is really going
  - Some areas will never be stabilized
- Coal is likely to be used more in power generation in the future
  - EIA has a chart with predictions of what is likely to occur
  - Only 10% is likely to come from unconventional sources
  - Coal to liquids is not really working yet
  - Could only be a very small part
  - Investors only now looking at alternative fuels
  - More so that the commercial field
- Military obviously wants to get away from the need to transport oil for fuel
  - Their interest could help to speed up process
GDP versus price volatility

- Look at the 1970s and see significantly improved efficiency
  - Higher prices force people to rethink energy use
  - Use to say that at about $55/bl demand would drop
  - But price already at $70 and considered no big deal
  - Even with the cost rise this year, would only make a $12 difference over average of last year’s family vacation plans
  - Costs are just beginning to work through the economy
  - Coming from older builds-ups
- China’s energy intensity is rising
  - US intensity is already very high but is slowly falling
  - China can’t sustain such intensity for long
  - Biggest problems are for the poor who can only afford to drive very inefficient clunkers
  - For the well-off, price rises are not that much of a problem
  - Price of transportation may be going up but it can be absorbed
- Oil’s share of the GDP was much bigger in the past
  - Medical costs now at 15% but oil is much lower

New technologies are beginning to come available now.
Examples:

- New technology allows oil explorers to see below the salt level in the ocean
- Much more efficient than drilling without knowledge about what is there
- Pumping / drilling can now be done from a laptop miles away and more precisely than in the past
- 4-D imaging can put drills precisely where they need to be
- Natural gas is now used rather than burned off as it was in the 1970s
- Long term: We are not yet at the peak production of available underground resources
- However things are different when considering above ground realities
  - Example: In the 1980s visiting Chinese wanted a Cray computer from an oil company
  - Could not give it to them then because it was restricted from export
  - Had great potential for weapons and missiles
  - Chinese said they wanted it for oil production control
  - Now that same sorts of things could be done on any laptop
  - Technical leaps coming on extracting more from existing oil fields
  - Can’t model the potential improvements
  - Result: need to keep investing in various technologies to find right one

EIA Forecasts

- The National Energy Modeling System considers GDP growth & other factors
- It is assumed that oil and other resources will be available
- Problems could come from government regulations, shortages of tankers, etc.
- Unconventional fuels may be growing fast but starting from very small bases
  - Will remain only a small part of the market
  - Especially true in the transport sector where no short term solution available
- In the 1970s the US Government did develop an energy policy – need one now
- But prices went down again in 1981 and Government lost interest in CAFÉ Standards
- In 1979 Government asked Ford/GM to build cars with an average 20mpg
  - Car makers said it could not be done but it was
  - Law didn’t cover trucks: small number of farm trucks did not need 20mpg
- In 1998 over 50% of new vehicles were “light trucks” not subject to rules
  - Now category includes vans and SUVs – not business vehicle
  - Need a new policy to make these changes
• EIA produces one of two demand forecasts; the other is international
  o There are some complaints to make it better but it is better than nothing
  o Does not consider several issues
  o World as it is now may not be sustainable

• Lightweight plastics in the body of vehicles could improve fuel usage by 50%
  o Rocky Mountain Institute has done much work on this
  o (See Rethinking Seminar by Amory Lovins from RMI on this topic)

Energy Policy

• Must be reasonable and palatable to public to get it passed by Congress
  o Public does not see energy issues as a major problem yet
• An array of options and an array of issues complicate the decision-making
• May need government mandates to make cars better at using fuel
• Any policy must be global
  o If we don’t fix the problems in India, nothing we do here will matter
• Need to accelerate research
• Cutting back on foreign imports would not be an important improvement
  o Less than 17% comes from Middle East
  o But getting off Mid east oil makes for good political rhetoric
• Much of recent improvements in industry has been made by replacing inefficient equipment with much better equipment
  o Now must make similar improvements for consumers
  o Need to push industry to do more research
    ▪ Example: converting waste to useable methane mostly for power generation
• Need a Marshall Plan for energy
  ▪ US needs to provide the financing
  ▪ All new rolling stock/etc. due to devastation allowed Germany to advance rapidly after WWII
  ▪ Compared to England after World War II
  ▪ May need to do something similar without the war
• Suggested imperatives for a new energy policy (see below)
Imperatives for 2006 Energy Policy

- Address all forms of energy supply, including renewables AND demand, including improved efficiency and conservation
- Encourage investment in strategic facilities and infrastructure AND research for new technologies
- Must be global in scope, encompassing security, foreign policy, environmental and economic considerations; Energy Independence is misguided
- Rebuild Alliances with producers and consumers while advancing transformational agenda
- Promote public education effort and political leadership
- Realign Policy Calculus – Foreign, Economic, Environmental, Energy, Security, etc.