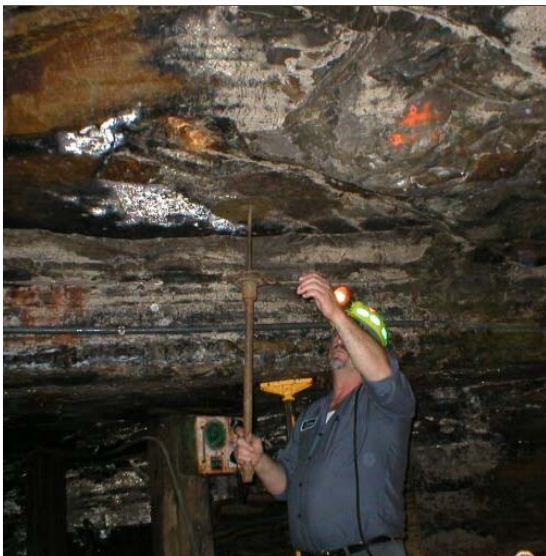




The Status of Future Energy Sources

Future of Energy Seminar
Houston, Texas
February 8, 2005

Presented by:
Matthew R. Simmons



Energy Is A Precious Resource



- Modern energy created our prosperity.
- Without it, virtually everything ends:
 - Potable water
 - Automated transportation
 - Most agriculture
 - Electricity
 - Health care
 - Etc., etc.
- Energy has been environment's best friend.

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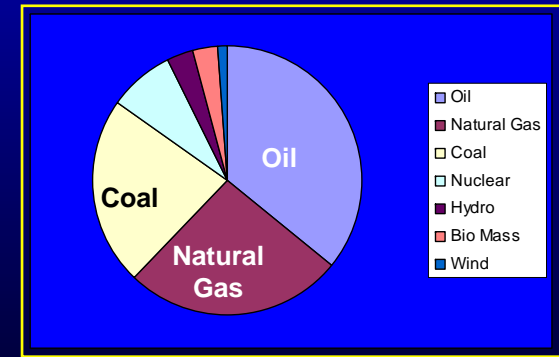
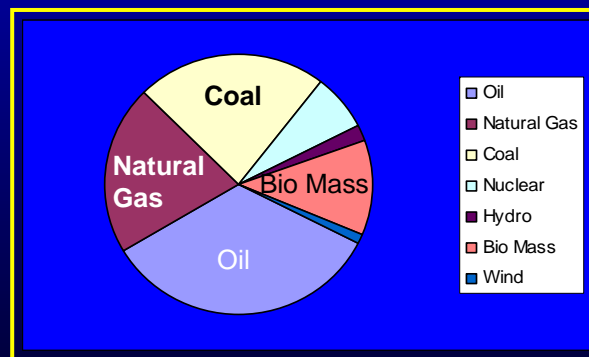
Energy Is Not Well Understood

Primary Energy Source

% of Worlds Energy

% of U.S. Energy

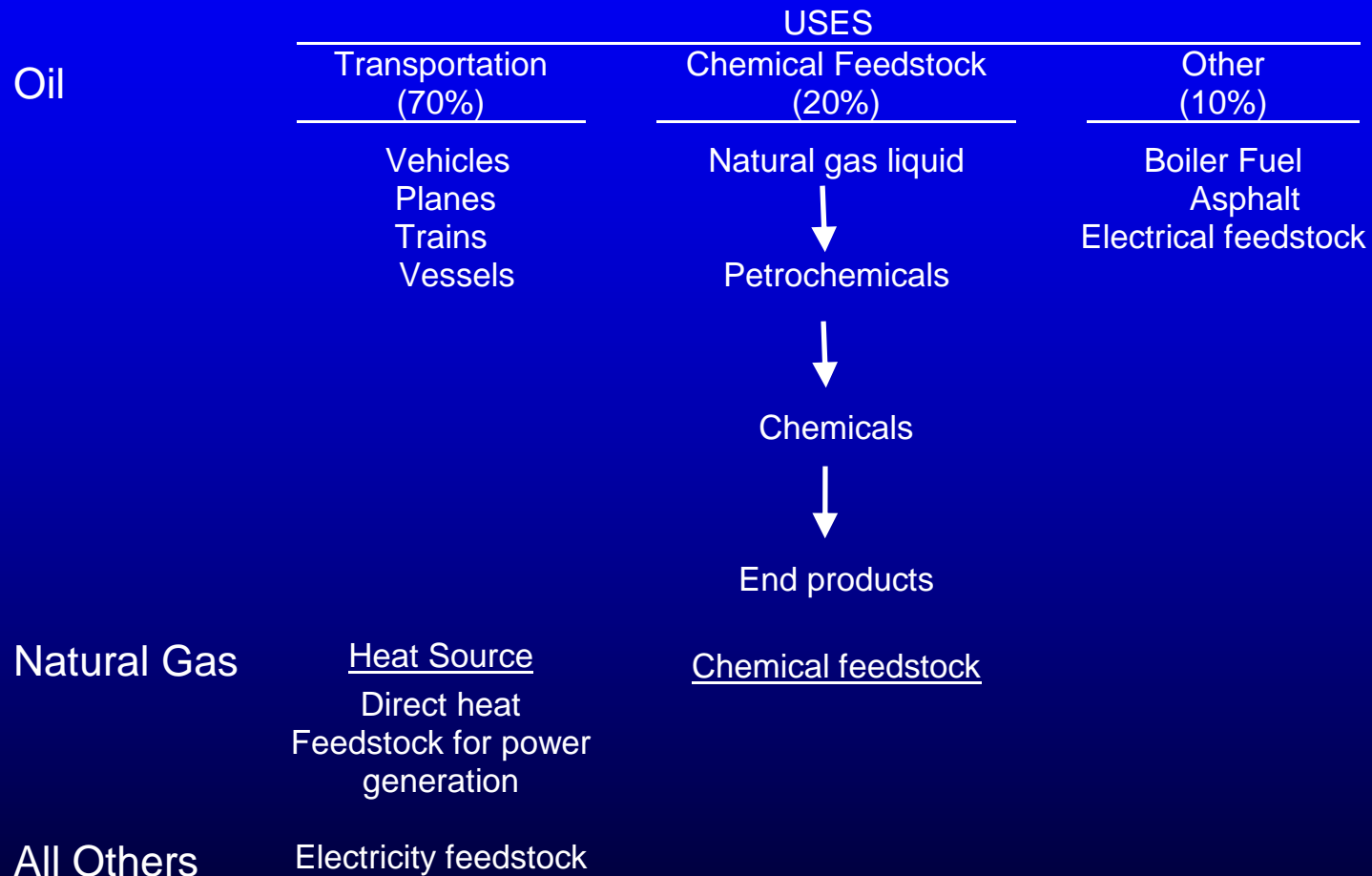
Oil	34	35
Natural gas	21	26
Coal gas	23	22
Uranium/Nuclear	7	8
Water flow	2	3
Bio energy	12	3
Wind	<1	<1



Source: IEA 2004 World Energy Outlook

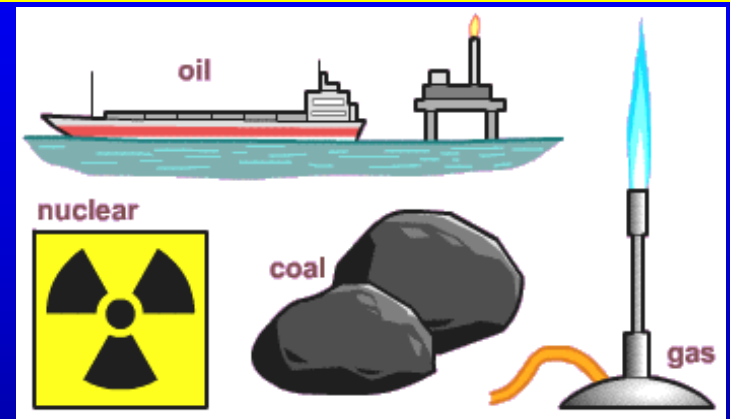
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Most Energy Sources Are Not Substitutable

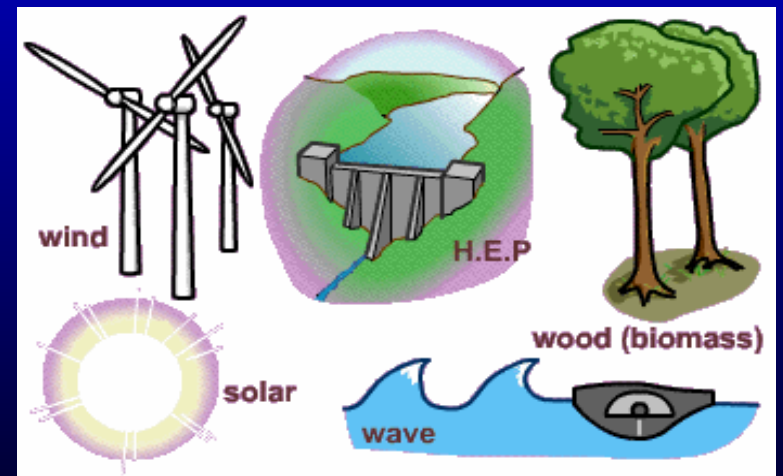


Most Energy Sources Are Non-Renewable

- Oil, natural gas, coal and uranium have finite supply.



- Renewable energy supplies are tiny part of energy mix:
 - Some are occasionally renewed (water)
 - Others renew sporadically (sun and wind)
- Others are exhausted rapidly or do not travel:
 - Waste
 - Geothermal



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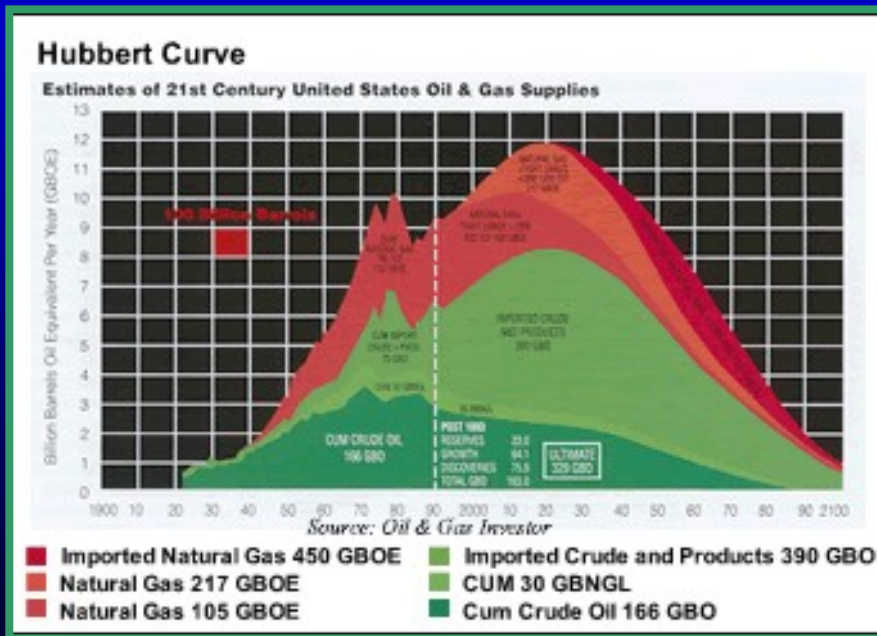
Creating Energy Is Expensive



- No form of modern energy is simple and inexpensive to create.
- Adding incremental energy supply is costly.
- Keeping energy supply system modernized is costly.
- IEA's future cost of energy: \$16 trillion to 2030:
 - \$10 trillion for Power Sector.
 - \$6 trillion for oil and gas.
- Oil and gas estimates are way too low.

Hydrocarbon Supply Will Peak

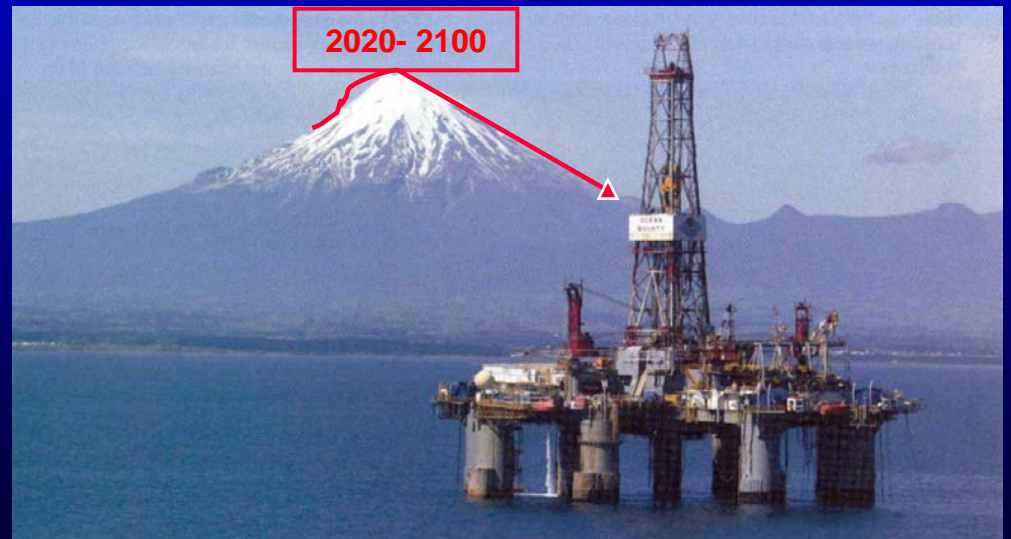
- “Peaking of Oil” has been a fierce debate:
 - Debate participants are few.
 - Skeptics tend to not understand the issues.
 - Advocates have “fuzzy data.”
 - Most energy observers are ignorant about the issue.



- “Peak Oil” (or gas) is a world-class crisis:
 - Series of unforeseen consequences are limitless.
 - It rivals or exceeds “Global Warming.”

“Peak Oil”:Skeptics’ Views

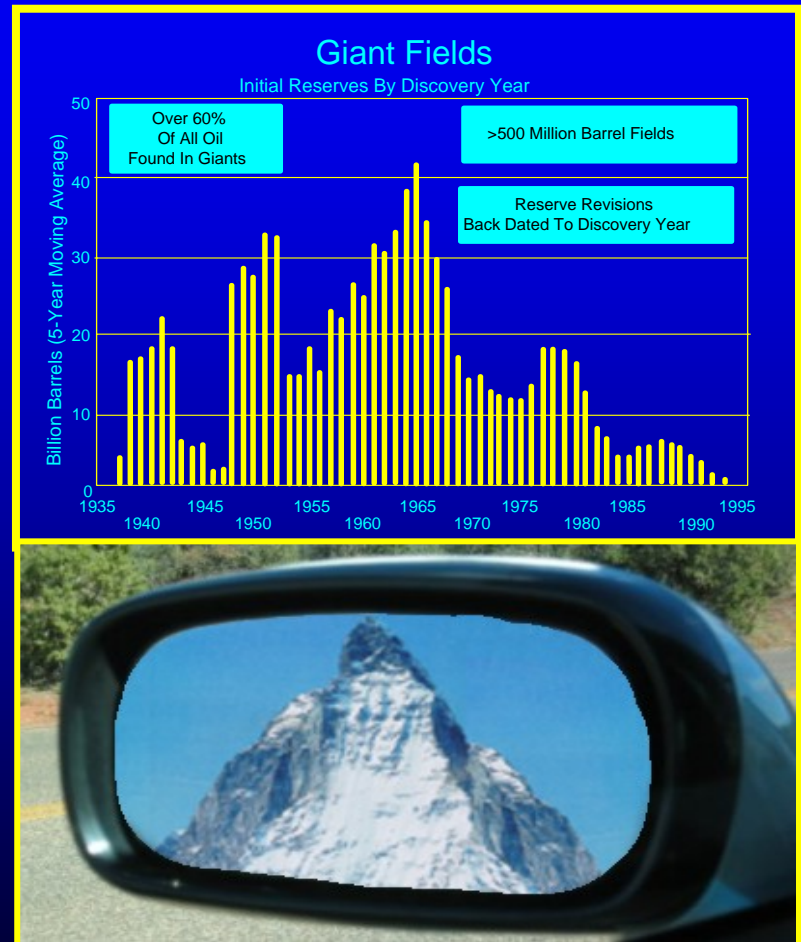
- World has always been about to run out of oil (crying wolf is always a false alarm).
- Ingenuity and hard work will always find more oil.
- Technology is now recovering far more oil than already found.
- High prices bring on new supplies fast.
- Peaking, if real, is a distant issue (2020 – 2100).



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“PeakOil”: Advocates’ Views

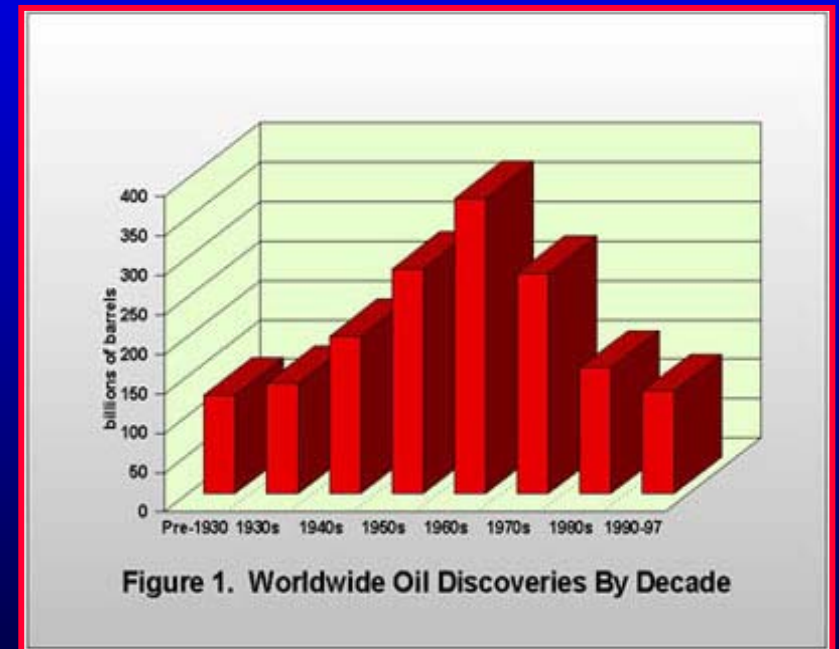
- When 50% of known resources are used, supplies begin to decline.
- For three decades, world has used more oil than it found.
- If current reserves are accurate, we are nearing 50%.
- All new finds are small and peak fast.
- Peaking is approaching.
- Only proof will be through a rear-view mirror.



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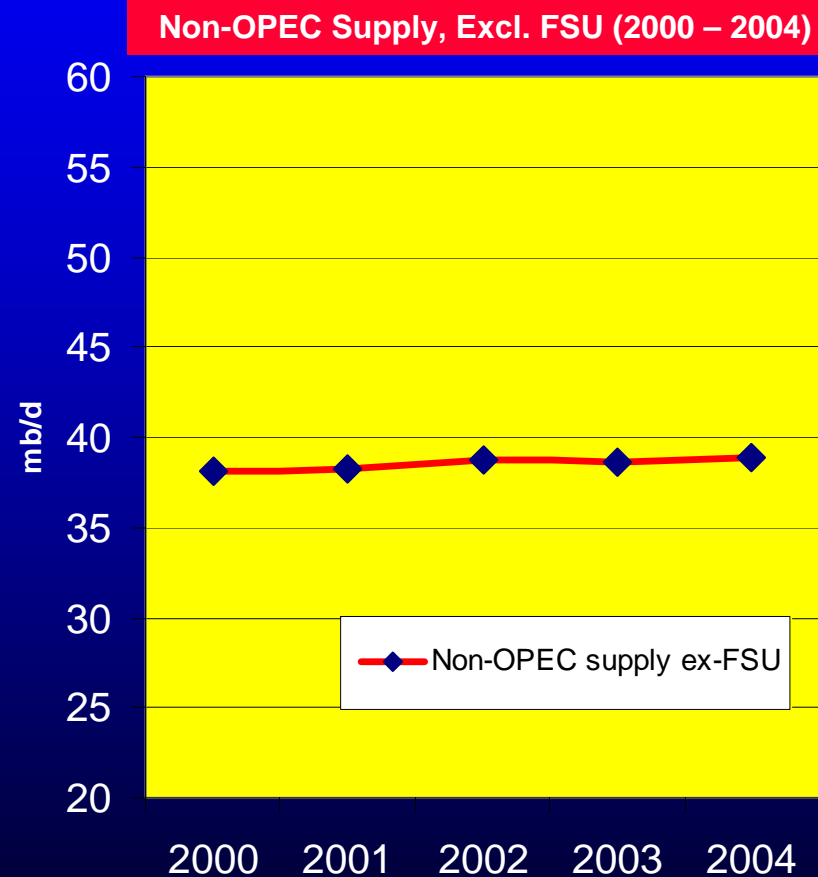
“Peak Oil” Is A Serious Risk

- Large percent of current supply comes from old oilfields:
 - 20% from 14 super giant fields (average age is > 50 years).
 - 70% of oil production comes from fields found > 30 years ago.
- Last new frontier was found decades ago:
 - Arctic oil (North Slope and Western Siberia) = 1960s
 - North Sea = 1970s
- Deepwater oil in mature basins was final frontier = 1990s
 - Gulf of Mexico - Peaking (?)
 - Brazil - Peaking (?)
 - West Africa



Non-OPEC, Non-FSU Oil Supply Has Been Flat

- Last five years has seen tiny growth:
 - Too many areas have now peaked;
 - Lag in accurate data tends to overstate current supply.
- FSU oil growth was unexpected and might be unsustainable:
 - Few gains from new production;
 - Most gains through workovers of “oil left behind”.
- List of probable growth countries is small:
 - Angola
 - Malaysia
 - Trinidad
 - Sudan
 - Chad



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OPEC Oil Supplies Are Fragile Too

- No OPEC producer has inventory of new discoveries or shut-in supply “on the shelf.”
- Several key OPEC producers are past peak supply.

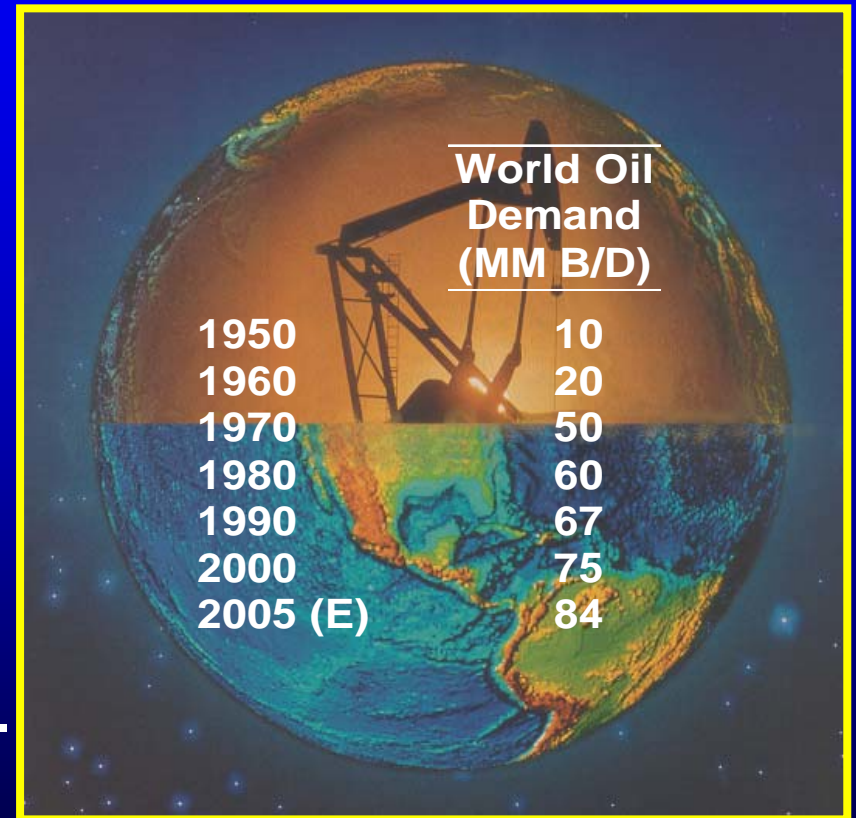
	MMB/D		
	<u>Peak Year</u>	<u>Peak Amount</u>	<u>Current</u>
Indonesia	1991	1.6	1.1
Iran	1974	6.0	3.5
Iraq	1979	3.4	2.0
Kuwait	1972	3.5	2.0
Libya	1970	3.3	1.4
Saudi Arabia	1981	10.0	8.0-9.0
Venezuela	1970	3.3	2.5

Source: EIA

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World Oil Demand Is Steadily Growing

- Past decade's fear: Oil demand was slowing down.
- Past decade's truth: Oil demand steadily grew.
- 1995-2005: Growth of 14 mmb/d (from everywhere).

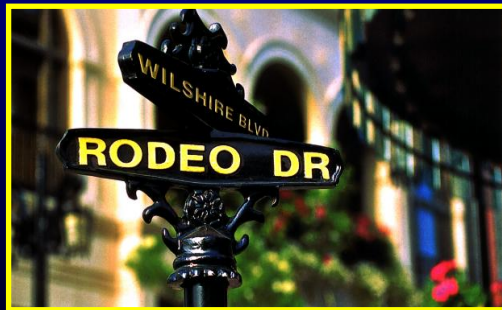


All Models Show Growth Continuing

IEA Model	
2010	95 mmb/d
2020	105 mmb/d
2030	115 mmb/d

} **Slower than current growth**

- Fueling this growth are the two “P’s”:
 - Prosperity (OECD’s 1 billion people.)
 - Poverty (Rest of the world’s 5 billion people.)



Saudi Arabia Has Been The World's Swing Producer

- All supply/demand models are demand driven.
- Supply is then met in on country-by-country best case.
- The plug figure to balance demand is Saudi Arabia:
 - With 260 billion barrels of proven reserves = 90 years' supply;
 - Future production estimates rise from 8 to 20 mmb/d or to 25 mmb/d;
 - Few have ever questioned whether this is even possible.
- My research leads me to believe it cannot happen.



The Saudi Arabian Oil Story

- Four super giant fields have anchored Saudi Arabia's Oil Supply

	MMB/D		
	<u>Discovery</u>	<u>Peak Production</u>	<u>Current (Estimate)</u>
Ghawar	1948	5.8	4.5
Abqaiq	1946	1.2	0.5
Berri	1964	0.8	0.4
Safaniyah	1951	1.6	0.6

- Three giant fields have supplied most of the balance:

Zuluf	1965	0.8	0.5
Shaybah	1967	0.5	0.5
Marjan	1966	0.3	0.2

The Best Parts Of Each Great Fields Are Depleting

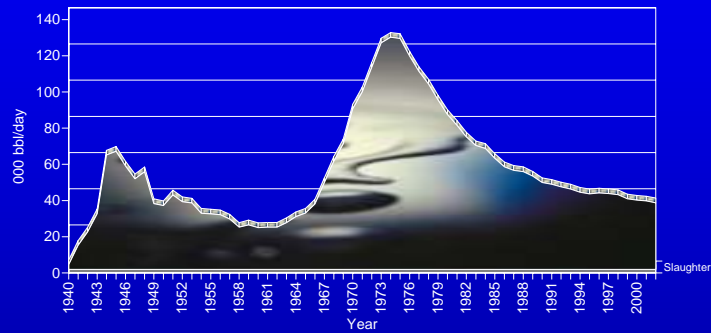


- 10 - 15% of Ghawar produced 80% of its oil.
- The balance consists of poorer rocks and less viscous oil.
- Abqaiq's and Berri's richest areas are nearly depleted.
- Safaniyah's oil is heavy and its best areas are depleting.
- Other fields have massive reserves but have been tough to produce at high rates.
- The production/reserves questions are serious issues.

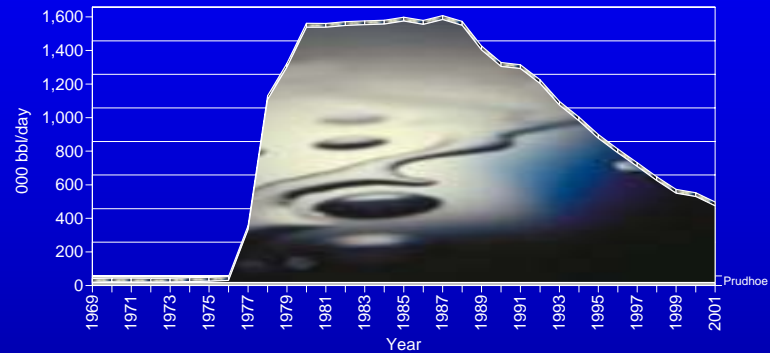
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When Giant Oilfields Deplete, They Fall Fast

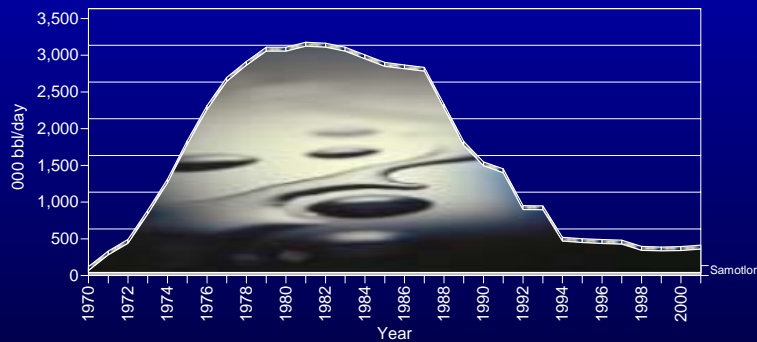
Slaughter, Texas



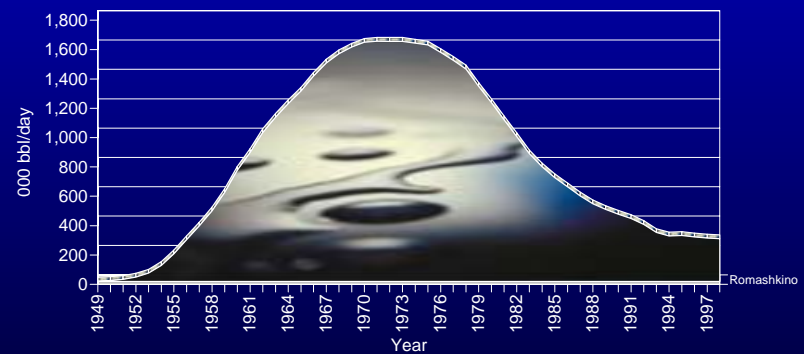
Prudhoe Bay, Alaska



Samotlor, Russia



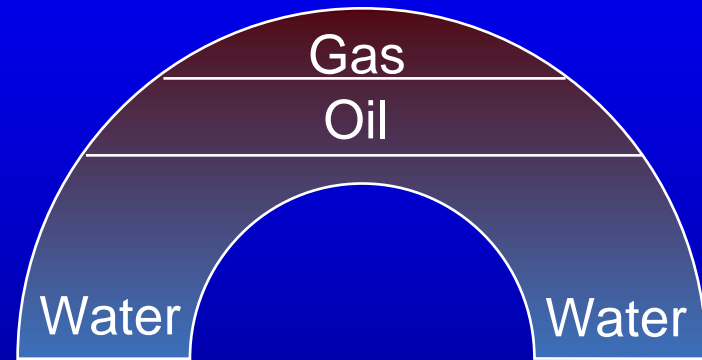
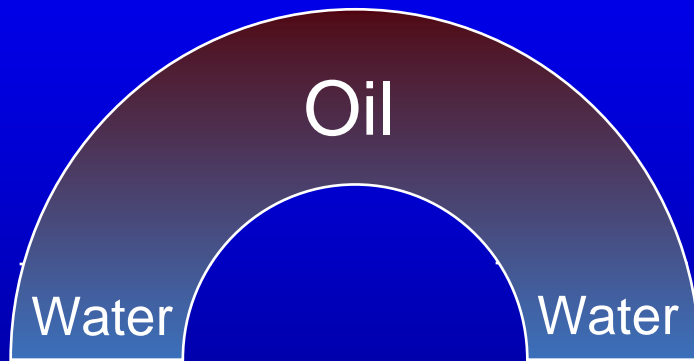
Romashkino, Russia



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Why Oil And Gas Fields Decline

New Field



Best Prevention From Declines: Slow Production

- Over producing a reservoir is easiest way to end high flows and leave much more oil unrecovered.
- Slowing production is only sure cure to staving off production declines.
- The world might now be overproducing key fields.
- If so, world's oil supply could be at peak NOW.

Some Consequences Of Peak Oil

- Peak Oil means supply never grows and probably begins to decline.
- Demand then exceeds supply.
- Prices rise (but supplies do not).
- Fierce energy competition ensues among key users.
- Lifestyles have to change to accommodate less supply.
- “Economic rationing” will divert supplies to highest price purchasers and highest need areas.

Some Probable Post Peak Oil Events

- World embarks on search for new energy sources.
- Conservation steps become urgent:
 - End of suburbia?
 - Globalization shifts to “stay at home”;
 - Era of energy-savings product innovation;
 - Implementation proves slow and difficult.
- Global energy competition between countries:
“China vs. USA”:The main event

The Future For Energy Is Serious

- Difficult to assure the world that continuing current use of modern energy is secure. Growth is far more difficult.
- The world should have focused on this as a key problem.
- Instead, planners focused on environment, global warming, weapons of mass destruction and Palestine/Israel.
- **Do we have time to mend our ways?**



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