

6th International Energy Security Conference
 Supply & Demand: Engaging with the Energy Industry

The Global Oil Demand Outlook

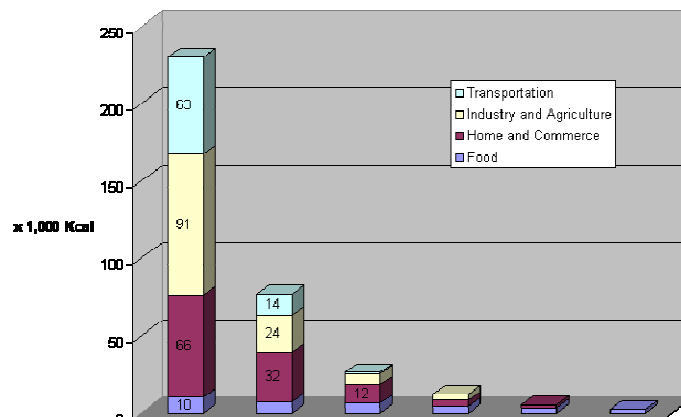
by

Dr. Herman Franssen
 President, International Energy Associates, Inc.

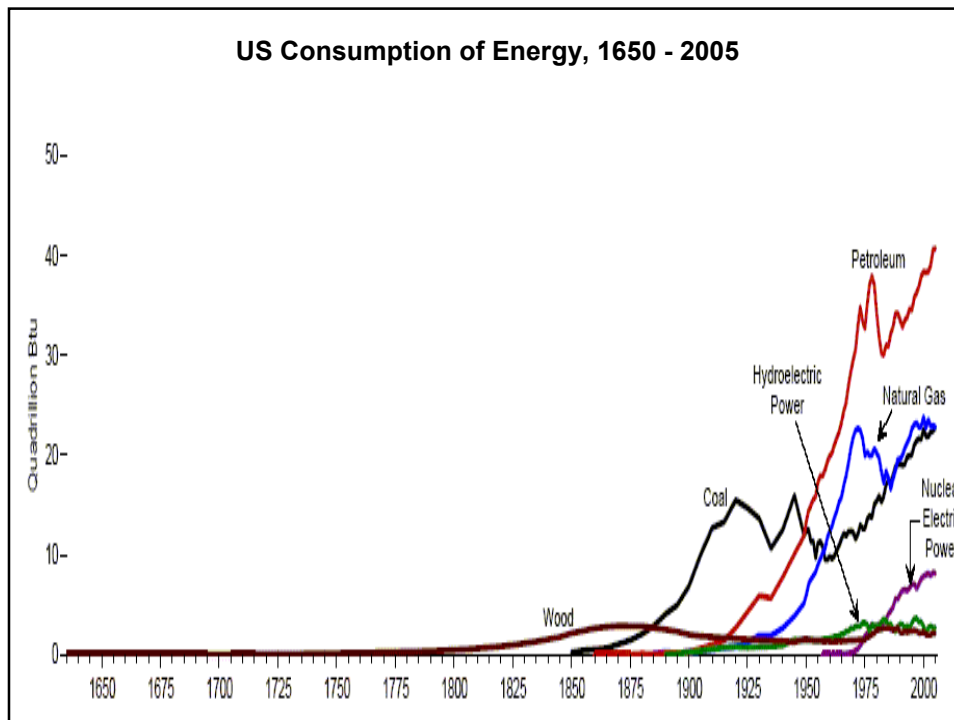
Cork, Ireland, September 17 & 18, 2007

Historical Development of Per Capita Energy Consumption

Daily Consumption of Energy Per Capita



	Technological Man	Industrial Man	Advanced Agricultural Man	Primitive Agricultural Man	Hunting Man	Primitive Man
Transportation	63	14	1	4		
Industry and Agriculture	91	24	7	4		
Home and Commerce	66	32	12	4	2	
Food	10	7	6	4	3	2



Post World War II Developments in the Global Oil Market

- **“Oil, an American fuel” prior to the 1950’s**
- **1950-1973: Europe and Japan recovered on an ocean of cheap Middle East and North African oil**
- **November 1973 – 1981: Ten-fold oil price rise, followed by major changes in oil markets and the oil industry**
- **1986: OPEC shifts course – prices collapse – followed by gradual return of market share (“Goldilocks years”)**
- **2004 - ? The fourth Oil Shock**
- **2004 – Demand explosion**
- **2005 - Non-OPEC production stagnant**
- **2006 - Markets driven by geopolitics, fear and expectations**
- **2006 – 2009 Fundamentals (half full or half empty?)**
- **Long term developments post 2010 – Providing Adequate Fuels at Reasonable Prices for the World’s Emerging Economies.**

**Historical Developments in Global Oil Demand 1950-2006
(in mbd)**

Country	1950	1960	1970	1973	1980	1985	1990	2000	2006
US/Canada	6.9	10.5	15.9	18.6	18.4	16.7	18.0	21.6	22.8
W. Europe	1.3	4.1	12.9	15.2	14.0	12.2	13.1	13.8	14.0
Japan	negl.	0.6	4.0	5.5	4.9	4.4	5.3	5.6	5.2
USSR	0.9	2.9*	6.7	8.3*	11.3**	10.7**	8.4 +	4.8+	5.2+
China	-	-	0.6	1.1	1.8	1.8	2.3	4.8	7.4
Other	1.7	3.5	6.3	8.4	11.2	13.3	18.6	25.7	29.1
Total World	10.8	21.6	46.4	57.1	61.6	59.1	65.7	76.3	83.7

* Includes China and Eastern Europe- ** Includes Eastern Europe only - + Russia and E.Europe.

Global Oil Consumption, 1950-2006

From these data we can arrive at the following conclusions:

- The postwar period until 1973 was characterized by the most robust growth in OECD and Soviet oil demand;
- The tenfold oil price increase between 1973 and 1982 brought major changes in OECD oil consumption patterns but Soviet oil consumption (not impacted by higher prices) continued until the collapse of the Soviet Empire;
- Market forces, taxes and government policies dramatically changed oil demand patterns in Europe and Japan but less so in the United States;
- Oil consumption in the developing world (Asia) increased sharply despite higher oil prices;
- While the US remains the largest oil consumer in the world, China and the Middle East provide most of the incremental demand growth in the 2000's.

Long term Challenges

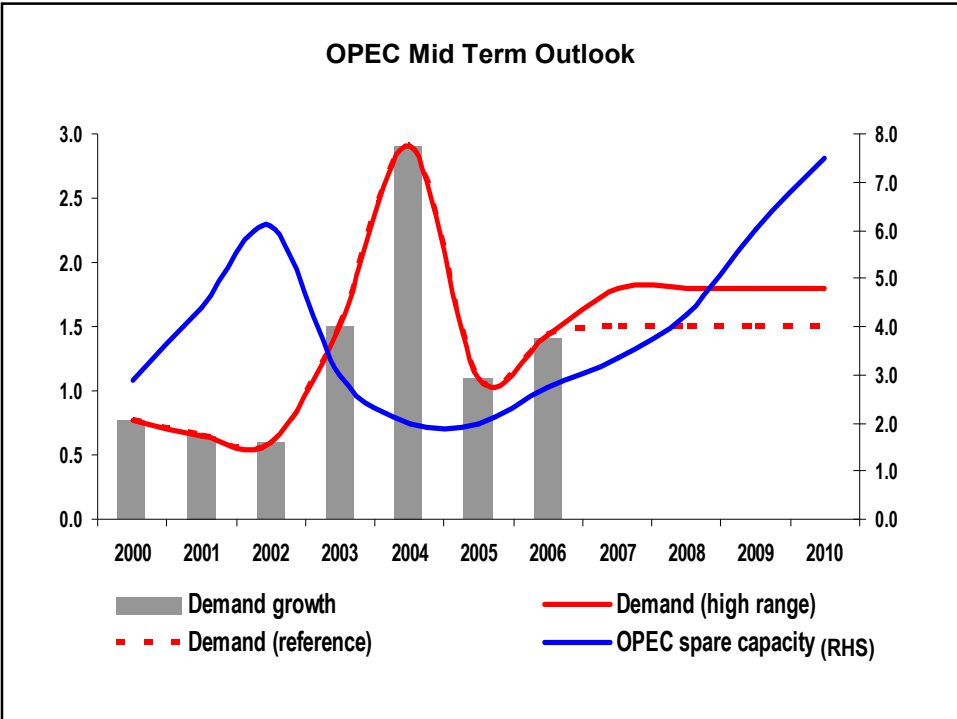
- Changing Global economy – Reversal of 150 years of economic history – center of global industrial activity shifting to Asia.
- Some 500-600 million Chinese and Indians as well as untold millions of other middle class consumers (in PPP) outside of the OECD are beginning to enjoy the benefits of the modern oil-based economy.
- South and East Asia are relatively poorly endowed with oil and gas resources which are concentrated largely in West Asia. Both China and India are richly endowed with coal reserves and resources.
- The emerging Asian industrial giants are faced with a dual challenge, i.e. “The End of Cheap Oil” and the emerging threat of Global Warming which puts limits on the use of their abundant coal resources without CO2 sequestration. How to resolve the dilemma?

Are High Prices Here to Stay?

Most Short and Medium Term Oil Market Assessments project future oil prices in a range of \$ 55 to \$ 70 a barrel. In the absence of worsening geopolitical developments, some analysts maintain the OPEC Supply management will be required to stabilize oil prices in the above range for the next few years.

The debate about oil prices in the next decade is focused on:

- * **Demand growth in the developing world and in particular Asia and the Middle East;**
- * **Prospects for Non-OPEC Incremental supply;**
- * **OPEC capacity growth;**
- * **Geopolitical developments**



IEA July 2007 Medium term Oil Market Outlook

Global Balance Summary

(million barrels per day)

	2007	2008	2009	2010	2011	2012
Global Demand	86.13	88.27	90.02	91.91	93.84	95.82
Non-OPEC Supply	49.98	50.99	51.65	51.94	52.20	52.56
OPEC NGLs, etc.	4.86	5.51	6.28	6.73	6.91	7.08
Global Supply excluding OPEC Crude	54.83	56.50	57.93	58.67	59.10	59.64
OPEC Crude Capacity	34.40	35.46	36.10	37.11	37.92	38.36
Call on OPEC Crude + Stock Ch.	31.30	31.77	32.10	33.24	34.74	36.18
Adjusted Call on OPEC Crude + Stock Ch. ¹	31.89	32.39	32.73	33.87	35.37	36.81
Implied OPEC Spare Capacity ²	3.09	3.69	4.00	3.87	3.18	2.18
Adjusted OPEC Spare Capacity ²	2.50	3.07	3.37	3.24	2.55	1.55
as percentage of global demand	2.9%	3.9%	3.7%	3.5%	2.7%	1.6%
Changes since February 2007 MTOMR						
Global Demand	0.18	0.68	0.65	0.59	0.51	
Non-OPEC Supply	-0.67	-0.72	-0.89	-0.89	-1.00	
OPEC NGLs, etc.	-0.03	0.20	0.28	0.31	0.21	
Global Supply excluding OPEC Crude	-0.70	-0.52	-0.81	-0.58	-0.79	
OPEC Crude Capacity	-0.34	-0.79	-0.85	-0.77	-0.38	
Call on OPEC Crude + Stock Ch.	0.88	1.21	1.25	1.18	1.30	
Adjusted Call on OPEC Crude + Stock Ch. ¹	0.67	1.03	1.07	1.00	1.12	
Implied OPEC Spare Capacity ²	-1.28	-2.07	-2.23	-2.25	-2.02	
Adjusted OPEC Spare Capacity ²	-1.07	-1.89	-2.05	-2.08	-1.84	

¹ Arithmetic 'Call on OPEC + Stock Ch.' adjusted to include the most recent 8-quarter average of Miscellaneous to balance (627 kb/d from 2007 onwards) from OMR.

² OPEC Capacity minus 'Call on Opec + Stock Ch.'

³ OPEC Capacity minus 'Adjusted Call on OPEC Crude + Stock Ch.' Historically effective OPEC spare capacity averages 1 mb/d below notional spare capacity.

The Need for Iraqi Oil

Sustainable OPEC Crude Production Capacity

(million barrels per day, yearly average)

	2006	2007	2008	2009	2010	2011	2012	Increment 2007-2012
Algeria	1.38	1.38	1.42	1.51	1.60	1.61	1.56	0.19
Indonesia	0.92	0.87	0.88	0.87	0.90	0.94	0.90	0.03
Iran	4.01	3.96	4.00	4.00	3.86	3.82	3.77	-0.19
Kuwait	2.60	2.65	2.83	2.84	2.98	3.07	3.06	0.42
Libya	1.70	1.75	1.84	1.84	1.88	1.94	1.92	0.17
Nigeria	2.46	2.47	2.37	2.48	2.62	2.78	2.84	0.37
Qatar	0.88	0.95	1.05	1.10	1.16	1.17	1.16	0.21
Saudi Arabia	10.73	10.80	11.17	11.46	12.17	12.31	12.57	1.77
UAE	2.67	2.88	2.89	2.85	2.90	3.17	3.38	0.50
Venezuela	2.67	2.62	2.62	2.62	2.62	2.62	2.62	0.00
Sub-total OPEC 10	30.01	30.33	31.06	31.57	32.69	33.43	33.79	3.46
Angola	1.37	1.67	2.00	2.13	2.02	2.09	2.17	0.50
Iraq	2.50	2.40	2.40	2.40	2.40	2.40	2.40	0.00
Total OPEC	33.88	34.40	35.46	36.10	37.11	37.92	38.36	3.96
<i>annual increment</i>	<i>0.67</i>	<i>0.51</i>	<i>1.06</i>	<i>0.64</i>	<i>1.01</i>	<i>0.81</i>	<i>0.44</i>	

IEA Chief Economist on the Need for Iraqi Oil

“If Iraqi production does not rise exponentially by 2015, we have a very big problem, even if Saudi Arabia fulfills all its promises. The numbers are very simple, there's no need to be an expert”.

Fatih Birol
Chief Economist, IEA,
Paris, June 28, 2007

Longer Term Oil Market Outlook

- **Assuming Oil Prices in the Current Range of \$ 55-\$ 70 a Barrel, oil consumption is projected to grow at 1.5 to 2 percent per year, global demand would reach 96-99 mbd in 2015; 103-110 mbd in 2020 and 111-121 mbd by 2025. The IEA, EIA and OPEC project global oil demand at between 116-118 mbd by 2030.**
- * **It is not inconceivable that global oil demand will rise at a faster rate if global economic growth – spearheaded by China – continues at close to current rates in the foreseeable future. It may take decades before demand for oil products begins to stabilize.**

Future Oil Demand and Supply Outlook

- The 2006 IEA World Energy Outlook through 2030 declared “non-sustainable” by its authors.
- There is a huge per capita energy gap between the rich, middle income and poor countries and within these countries. Some are on track to catch up with the West – consequences!
- The IEA Reference case projects 50-60% growth in energy demand and CO2 emissions.
- Oil demand is projected to grow at a much slower rate but even at that rate demand may outpace available supplies causing prices to rise further;
- Oil is becoming primarily a transportation fuel and there are no adequate alternative for oil in that sector. Oil production may reach a global plateau perhaps early into the next decade;
- Mitigation is needed now to make a gradual transition to alternative fuels (will take decades) and no single fuel will solve all problems.

The IEA's View of the Future of Oil

The World Energy Outlook: The IEA View

Is it Sustainable and what are the Consequences

- Oil, Gas and Coal reserves make up 85% of OECD energy consumption;
- Most hydrocarbons are concentrated in a few countries;
- The IEA projects about 50% growth in world energy consumption;
- Until this year the IEA did not foresee major problems to meet global oil demand through 2030. this year the IEA is talking about “unsustainable” long term oil demand growth

The Energy Future: We are We heading?

IEA's View of Global Energy Consumption – a 50% increase

Fossil Fuels will remain dominant;

Oil's Share of total energy will decline somewhat – limited inter fuel substitution;

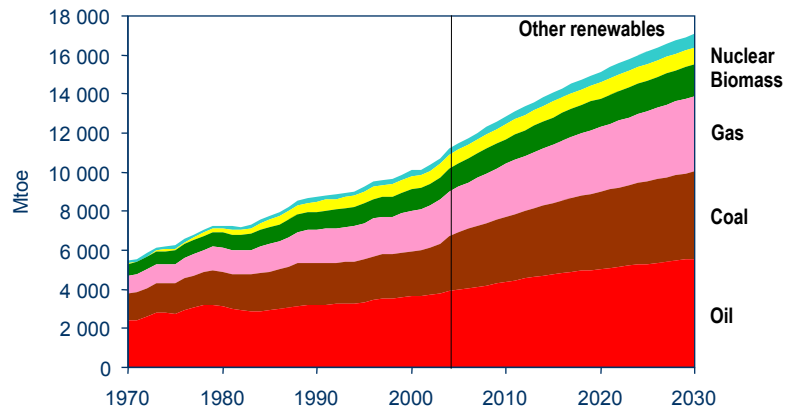
Some 70% of the oil demand growth expected to come from Developing regions in the world.

Oil is largely a Transportation fuel in the OECD;

Middle East and FSU main incremental supply sources

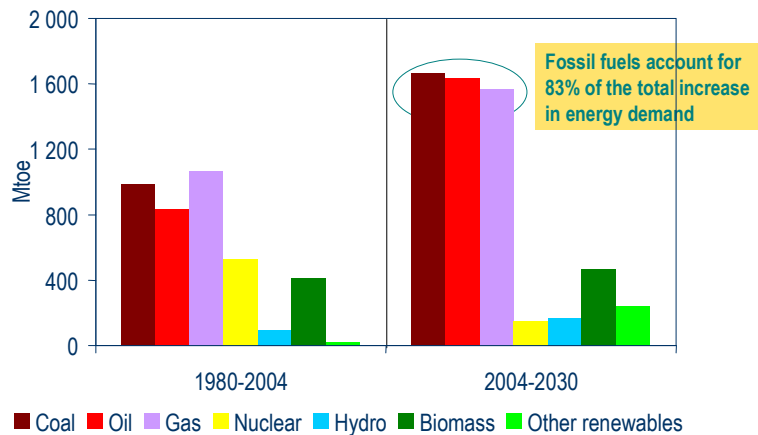
OPEC's Share to Grow Significantly if projected world oil demand is to be met.

Reference Scenario: World Primary Energy Demand



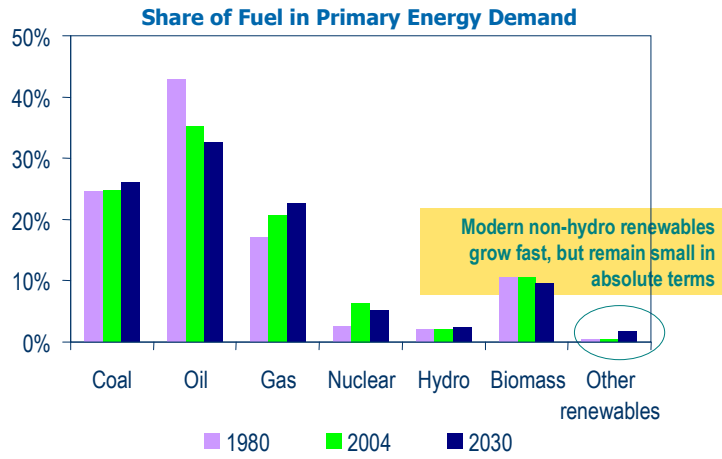
Global demand grows by more than half over the next quarter of a century, with coal use rising most in absolute terms

Reference Scenario: Incremental World Primary Energy Demand



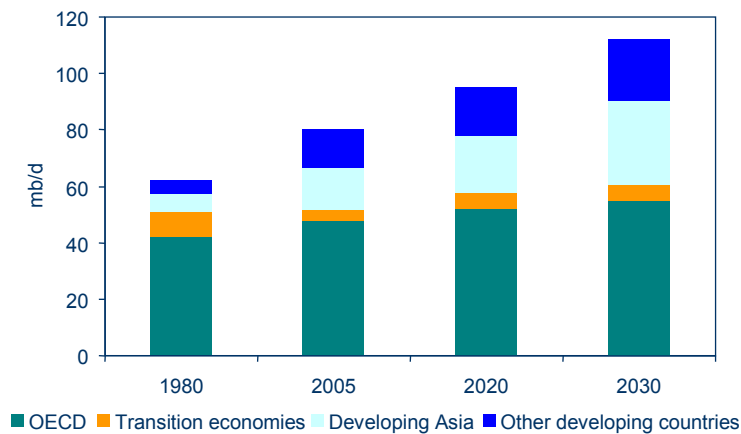
Fossil fuels account for most of the increase in global energy demand between now & 2030, though non-hydro renewables grows fastest

Reference Scenario: World Primary Energy Demand by Fuel



Oil remains the most important fuel, but its share in the global energy mix drops while those of gas, coal & modern renewables rise

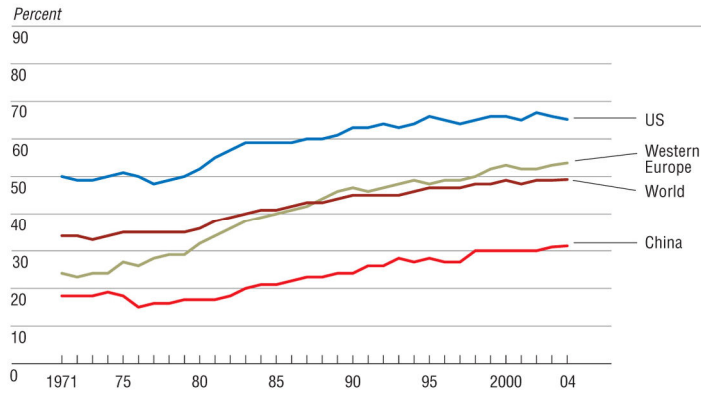
Reference Scenario: Primary Oil Demand



Most of the increase in oil demand comes from developing countries, where economic growth – the main driver of oil demand – is most rapid

Advanced Transportation Technologies Slowly Gaining Momentum

Transport Share of Oil Consumption, 1971-2004

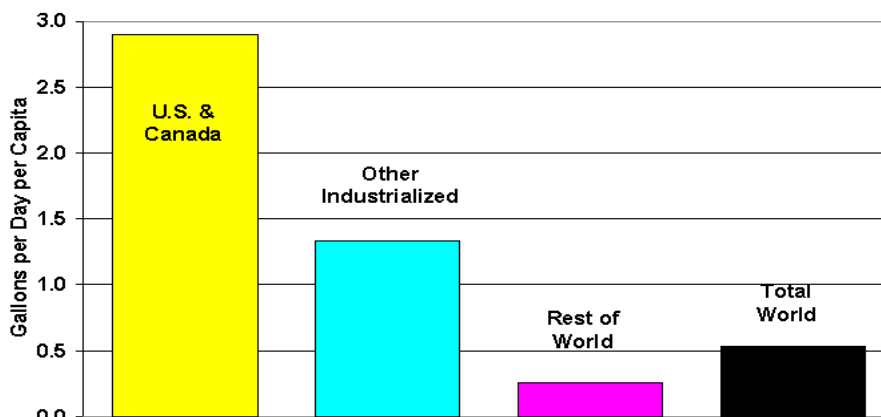


Transportation accounts for nearly half of the 86 million barrels per day of oil consumed in the world and is a primary factor for continued reliance on imported petroleum from the volatile Middle East. Pressures on global supplies will grow over the next two decades as demand intensifies for transport fuels, especially gasoline and diesel. Advanced energy technologies for transportation and alternative fuel-based vehicles are being considered worldwide as a means of reducing dependence on fossil fuel, enhancing energy security, and curbing air emissions.

Source: International Energy Agency, 2006.

The Rest of the World has a lot of catching up to do!

Global Consumption of Oil per Capita, 2003

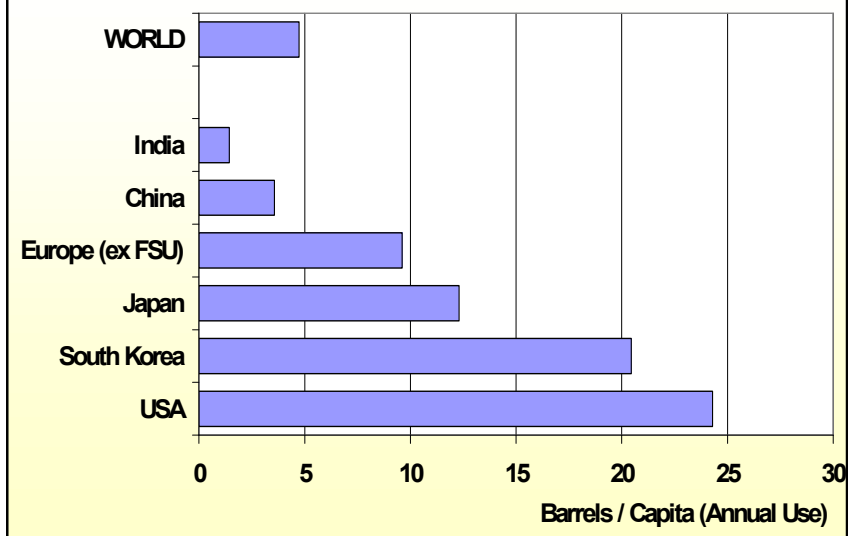


Per Capita Oil Consumption (in barrels p. person per year)

United States	26	Saudi Arabia	24
Europe	13	Kuwait	36
Europe (15)	16	UAE	35
Japan	15	Qatar	29
South Korea	16	Iran	7
Taiwan	14		
Malaysia	8		
Mexico	7		
Thailand	5		
China	2		
India	<1		

IEA projects China to reach the Thai level of consumption by 2025 (very conservative number) and India about 2 bbls/person/year.

2025: Estimated Oil Demand Per Capita



OIL INTENSITY

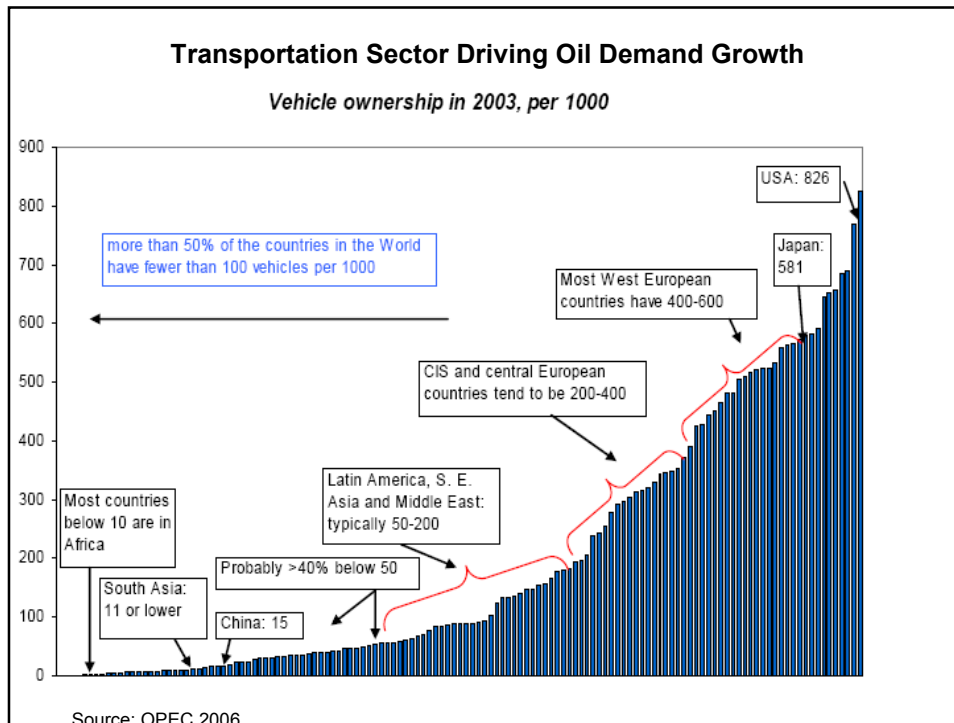
- **Average per capita demand rate, oil demand, 2005**

Country/Region	barrels	World demand at this rate
USA	25.6	454 Mbd
South Korea	16.5	288 Mbd
Italy	12.4	216 Mbd
Germany	11.8	205 Mbd
China	2.5	40.5 Mbd
India	1.3	29 Mbd
Rural areas, LDCs	0.2	3.5 Mbd

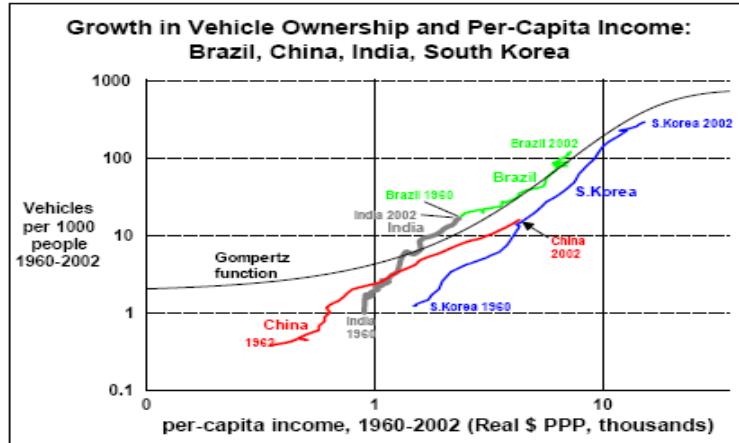
- **Real world** **4.78** **84.5 Mbd**

- Annual 'latent demand' increase for population growth 75 Million = 0.98 Mbd/year
- Data Sources for above Table / Population data UN Population Information Network, Oil demand BP Amoco, IEA, EIA, Eurostat

IFP's Bauquis and Mathieu: "The world may never see liquid hydrocarbons above 100 mbd"

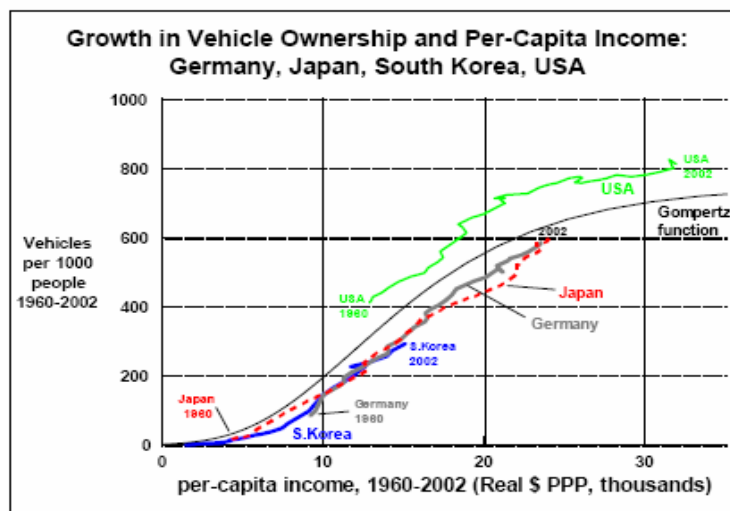


Car Ownership Function of Per Capita GDP



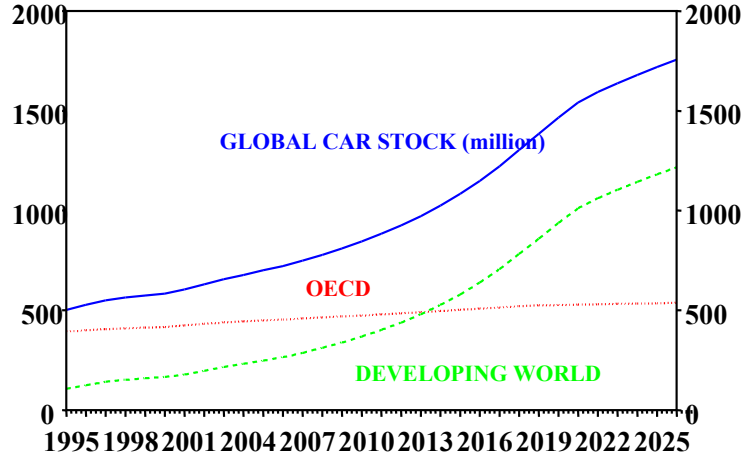
Prof. Dermot Gately, NYU

Car Ownership Rises with Per Capita GDP Growth



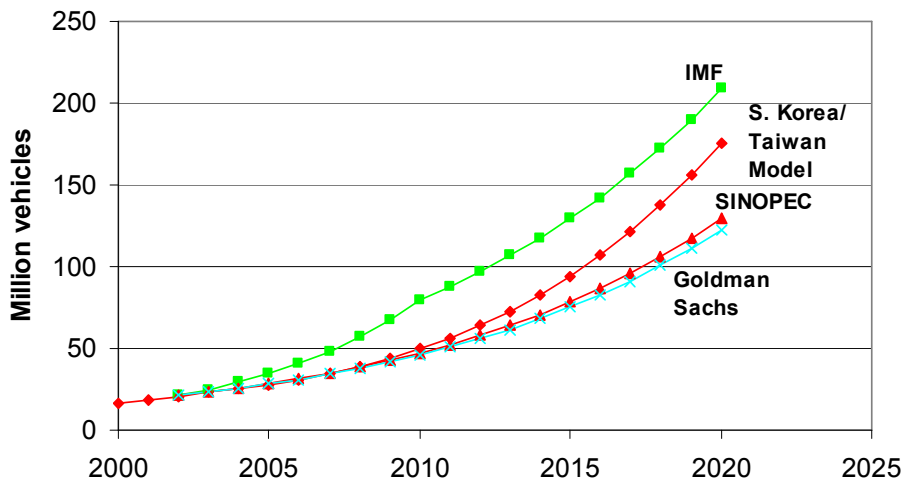
World

Car pool up by 1 billion?

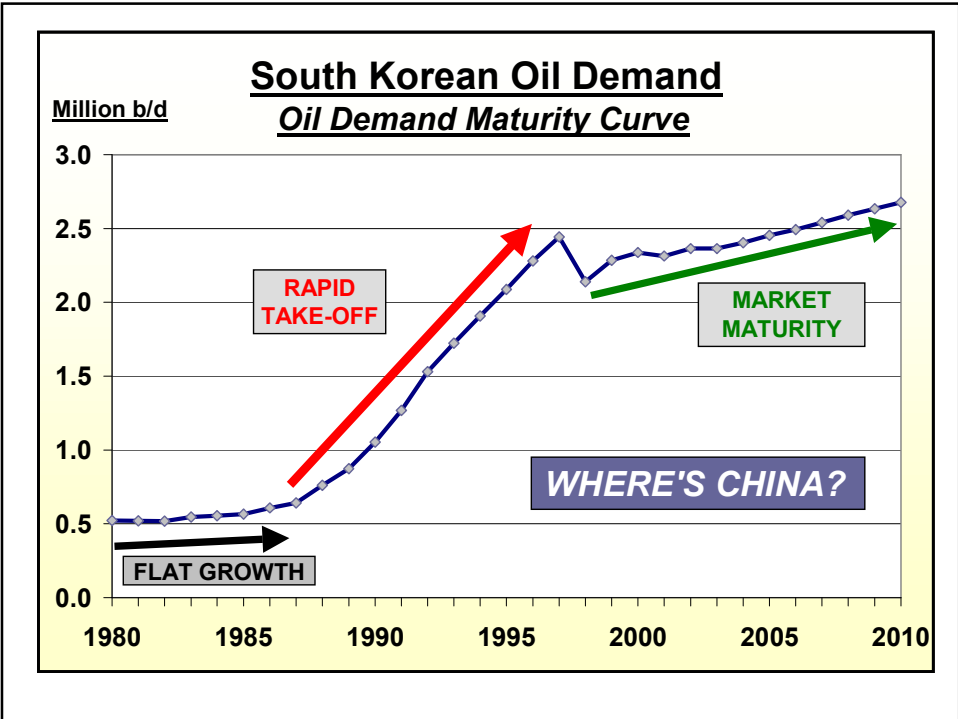


Source: Vanessa Rossi, Oxford Economics, San Francisco presentation, 2007.

Projected Vehicle Ownership in China, 2000-2020



Note: Following pattern in South Korea and Taiwan (dark blue); Slower growth scenario forecast by Chinese government (red); Various Western and Chinese sources, 2004-2005.



Car Ownership Rises with Per Capita GDP Growth

Vehicle Ownership and Per-Capita Income: Projections 2002-2030

Country	per-capita GDP (thousands, real, PPP)			Vehicles per 1000 population			Total Vehicles (millions)			ratio of growth rates: Veh. Own. to per-cap. GDP
	2002	2030	Average annual growth rate	2002	2030	Average annual growth rate	2002	2030	Average annual growth rate	
United States	32	57	2.1%	812	849	0.2%	234	314	1.1%	0.08
Germany	23	38	1.7%	586	705	0.7%	48	57	0.6%	0.38
France	24	41	2.0%	576	779	1.1%	35	50	1.3%	0.54
Great Britain	24	43	2.2%	515	685	1.0%	31	44	1.3%	0.47
Japan	24	42	2.0%	599	716	0.6%	76	87	0.5%	0.31
Brazil	7	16	2.9%	121	377	4.1%	21	84	5.1%	1.43
China	4	16	4.8%	16	269	10.6%	21	390	11.1%	2.20
Indonesia	3	7	3.4%	29	166	6.5%	6	46	7.4%	1.89
India	2	6	3.5%	17	110	7.0%	17	156	8.1%	1.98
OECD Total	22	42	1.5%	548	713	0.6%	617	908	1.4%	0.42
Non-OECD Total	4	9	2.2%	38	169	3.6%	195	1172	6.6%	1.61
Total World	7	14	1.7%	130	254	1.6%	812	2080	3.4%	0.94

Chinese Oil Demand to Rise with Income Growth

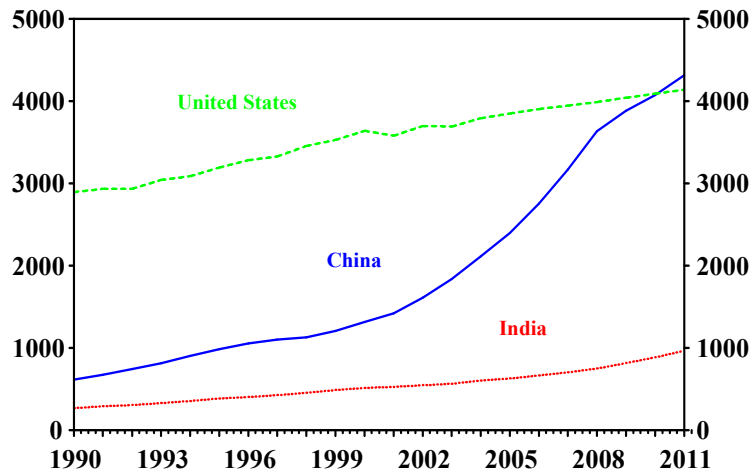
- China's "income elasticity" of oil demand. Its oil demand will grow almost as rapidly as its income. Even with flat demand for Resid, the demand for all other oil products will grow about as rapidly as income.
- China's vehicle ownership will grow twice as rapidly as its income for next two decades. By 2030 it will have nearly 400 million vehicles -- nearly 20 times as many vehicles as in 2002 -- and more vehicles than the USA.
- But its vehicle ownership of 270 per 1000 people -- about where South Korea was in 2002 -- will still be only one-third of ultimate saturation levels.

Dermot Gately, NYU, New York ,October 2006

Is China's Energy Demand Growth Sustainable?

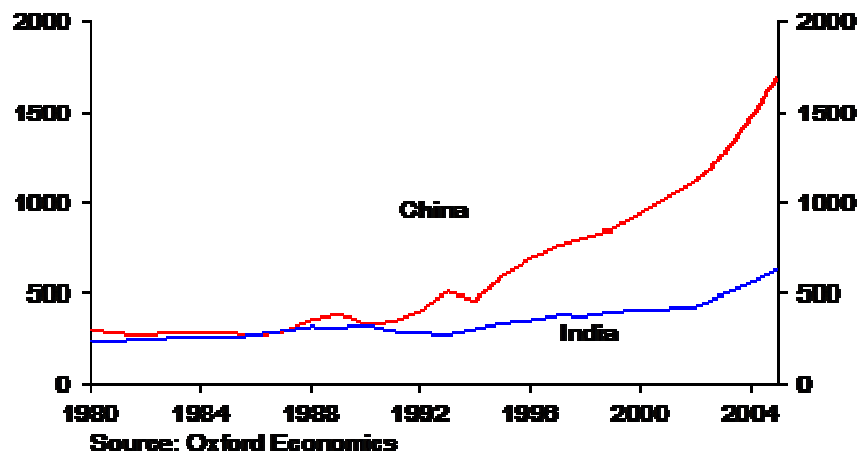
- China may have the **greatest impact** on world energy over the next two decades and beyond.
- Increased attention needed on **coal, improved efficiencies, and vehicle use.**
- Potential energy bottlenecks could **constrain future economic growth** affecting both China and rest of world.
- **Is China's current energy and economic path sustainable?** If not, how will the Chinese government respond to the problems?

Electricity output



India Is Still Far Behind China in per Capita GDP

GDP per head, US\$ at current prices



... so forecasts go up

- **Car sales in China were near 4m units last year – over 10,000 new cars per day - so the car stock is now about 20m (40m total vehicles) and rising at more than 20% pa**
- ***At this rate, by 2025, the car stock will be 300m and total vehicles 500m (using oil?)***
- **India has 12m cars, 4m other vehicles – so the market is smaller and slightly different in structure to China – but it has started rising faster and could also take off**

China “powering ahead”

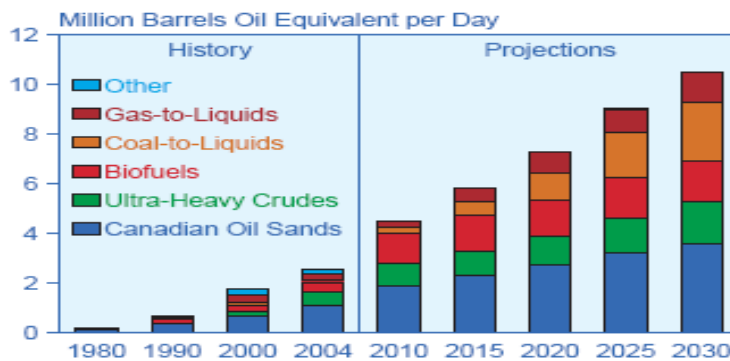
- **China built 2 new GW power plants per week in 2006, adding more than 100GW and now has over 600GW installed - produces around three times more power than Japan, similar to the Eurozone and 75% of US output**
- **India is hardly adding 1 GW per month and produces about a fifth the power of China, officially anyway – much of it not paid for**
- **Yet India’s 5 yr plan is considered ambitious – adding \$300-400bn to infrastructure**

China “powering ahead”

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Can Non-Conventional Fuels Ever Replace Conventional Oil Products?

Figure 32. World Unconventional Liquids Production in the Reference Case, 1980-2030



Note: “Other” includes shale oils and other unidentified sources of unconventional liquid fuels.

Sources: 1980-2004: Energy Information Administration (EIA), *Short-Term Energy Outlook* (October 2006), and *International Energy Annual 2004* (May-July 2006), web site www.eia.doe.gov/iea. Projections: EIA, *System for the Analysis of Global Energy Markets* (2007).

Will Non-Conventional Fuels Solve Long Term Demand for Transportation fuels?

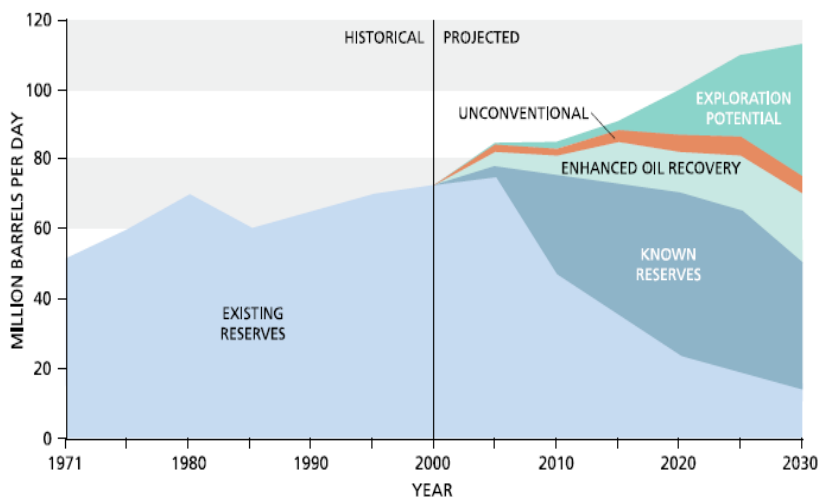
The IEA and EIA are optimistic about the future contribution of oil sands and extra heavy oil but less bullish on biofuels. Why?

There are serious limits on the contribution of the current crop of biofuels which are competing with the global food supply and, The energy input-output analysis is not very attractive. Cellulosic Ethanol could be a solution but requires some basic technological breakthroughs.

The contribution of GTL and CTL is expected to remain marginal.

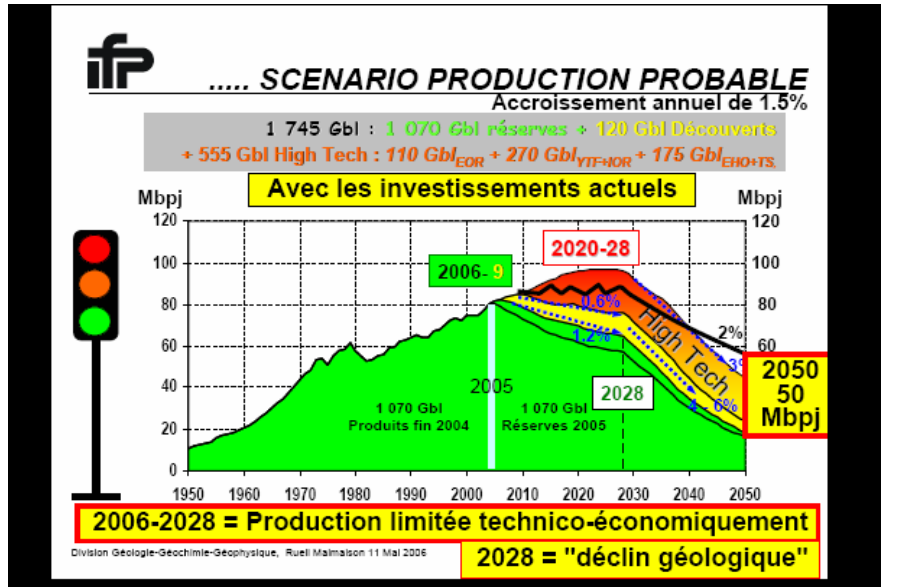
The US EIG (March 2006 outlook) is not too optimistic about the future penetration of hybrid and fuel efficient diesel engines (7% market penetration each by 2025).
However, new CAFÉ standards in the US could save as much as 3-4 Mbd by 2030.

NPC Report 2007



Data Source: International Energy Agency and National Petroleum Council,

IFP Upstream study, 2006



Source: Yves Mathieu, Quelles Reserves de Petrole et de Gaz, IFP, 11 May 2006