

Global Energy Policy: An Overview

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with COMFAMA

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World Energy Outlook 2008 - IEA

In their reference case:

- IEA predicts that world primary energy will grow by 1.6% per year 2006-2030 – a 45% increase.
- Fossil fuels continue to account for 80% of world primary energy.
- China and India account for 50% of the growth in world primary energy consumption over this 24-year period.
- Assumes oil prices (in 2007 \$) are \$100 per barrel through 2015 and \$120 per barrel 2015-2030 (double 2006 assumptions).

Yet oil consumption increases from 85 million barrels in 2007 to 106 million barrels in 2030.

World Energy Outlook 2008 – IEA (continued)

- OPEC revenues for oil sales in 2030 will be \$2 trillion per year (today the level is approximately \$650 billion per year).
- Coal demand increases from 4.3 billion tons in 2006 to 7 billion in 2030 with China alone accounting for 4.6 billion tons in 2030.
- Energy consumption subsidies in non-OECD countries were over \$350 billion in 2007 (approximately 50% of which were in Iran, Russia, and China).

Global Energy (BAU Case)

- If non-hydro renewables grow at 7.2% per year between now and 2030, it will account for slightly more than 4% of world electricity generators in 2030. (If the growth rate can be doubled, the amount of renewable power will be four times higher.)
- BAU scenario will call for investment of over \$26 trillion (2007-2030) – about 50% in power sector. A scenario that calls for more investments in renewables will require greater sums.

Under continuation of BAU

- World use of primary energy reaches 2.5 times the 2000 level by 2050 and 4 times the 2000 level by 2100.
- World electricity generation reaches 3 times the 2000 level by 2050 and 5 times the 2000 level by 2100.

Addendum

In 2007-2030, China's use of oil as a transport fuel will increase 5.2% per year. US growth will be less than .3%. Yet in 2030, China's consumption will be 35% lower than US.

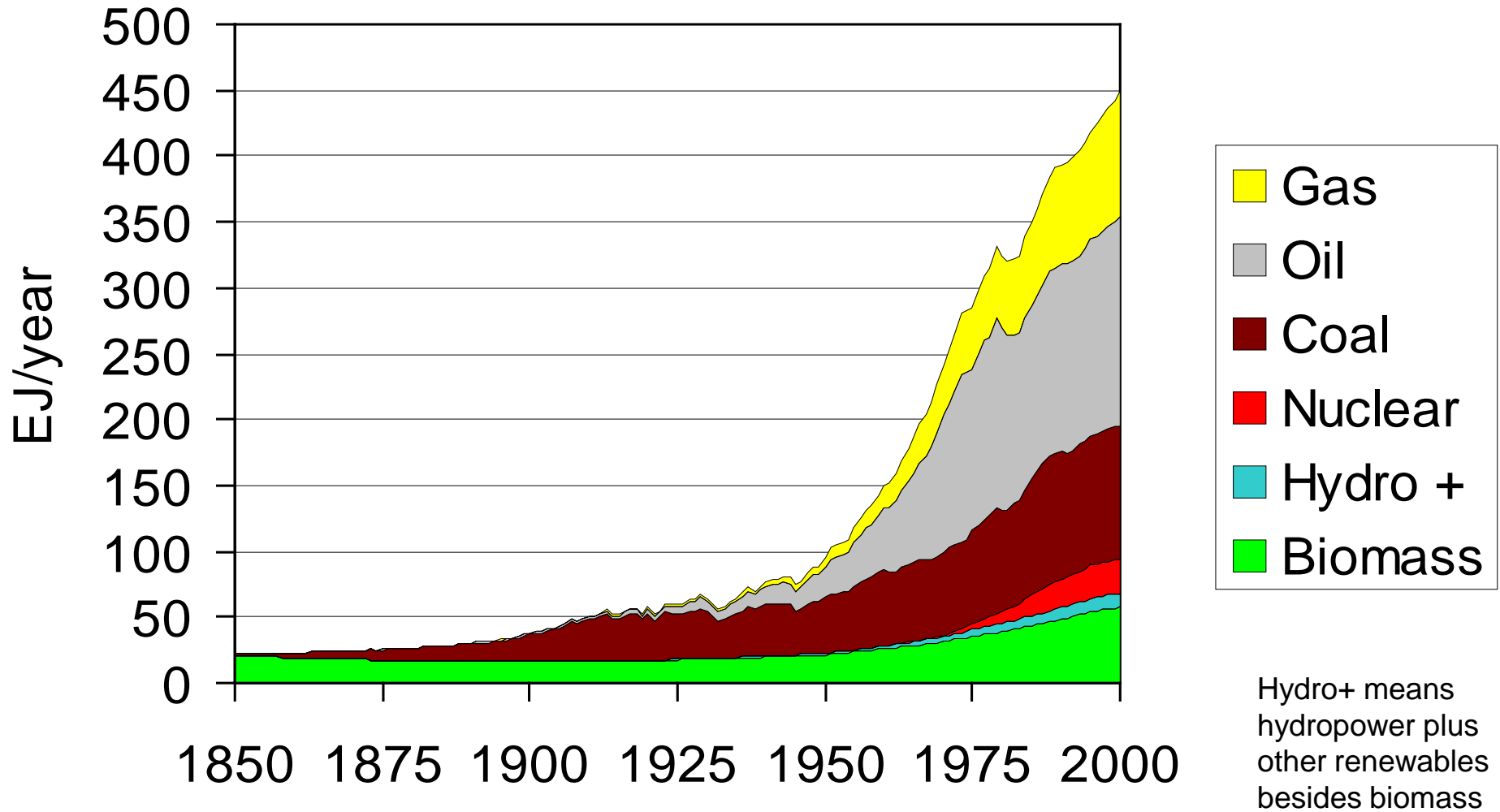
US CO₂ emissions will be approximately the same as today in 2030.

The EU's CO₂ emissions will be 6% lower.

China's CO₂ emissions will have doubled. The Middle East's CO₂ emissions will have doubled. India's CO₂ emissions will have increased 250%.

The rise of global dependence on fossil fuels

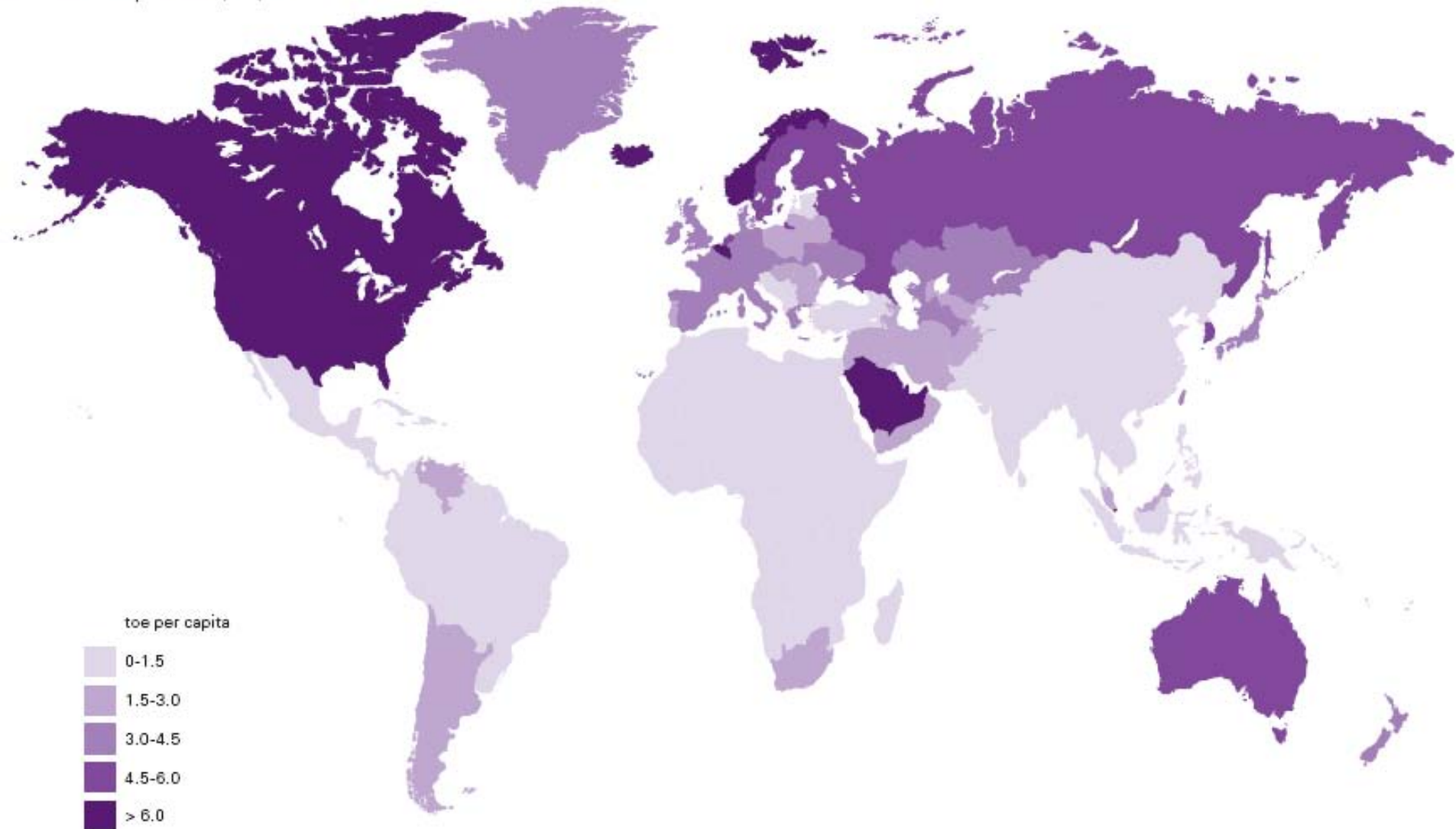
World primary energy supply, 1850-2000



Coal drove growth 1850-1950; oil & gas drove it (2x faster) 1950-2000

Per-person use of commercial energy forms, 2005

Consumption per capita
Tonnes oil equivalent (toe)



Alternatives – No Silver Bullet

OPTION

CHALLENGE

Oil

Price is highly volatile, but will still remain the cheapest option to fuel our transportation systems. Hence, reducing oil consumption will be a challenge

Natural gas

More expensive than coal, but supply may be much more plentiful than previously thought. Conventional supplies in 3 countries: Russia, Iran, Qatar

Coal

Will require new technologies to reduce or capture and sequester carbon emissions

Alternatives (con)

- Renewable Electricity Options
 - Must identify sufficient land, sites and locations
 - Must integrate into the existing electricity network (wind and solar)
- Biofuels
 - Must minimize impact on food prices
 - Must minimize environmental impacts, especially on water supplies
 - Will require significant amounts of land, even assuming increased yield per acre

Alternatives (con)

- Nuclear
 - Must reduce costs
 - Must develop a new generation of nuclear engines
- Energy Efficiency
 - Must reduce market failures and barriers and convince millions of households and businesses to make investments

Challenges

- Historically, it has taken about 50 years to significantly change energy systems.
- This time around, the task is more complicated. There are more people in the world. There are more economies competing for energy sources. The value of the investment in existing infrastructure is much larger.

Oil

Oil Resources

- To date, man has used 21% of the ultimately recoverable oil resources. We are not running out of oil, but we may be running out of cheap oil
- Estimate of remaining conventional oil resources: 2.6 trillion barrels
- Estimate of unconventional oil supplies: 7 trillion barrels
- BP estimates that there are 4.5 trillion barrels of oil recoverable at a price of \$120/bbl. This is four times the total consumption expected over the next 25 years

Where Is Oil (Geographically)?

(Proved Reserves, January 2007)

Middle East	742.7 billion barrels (+133 billion)
North America	60 billion barrels (-18.8 billion)
South America	103.5 billion barrels (+22 billion) (76% in Venezuela)
Former Soviet Union	128 billion barrels (not available) (Russia, Kazakhstan, Uzbekistan, Azerbaijan)
Africa	112 billion barrels (+52 billion)
Asia Pacific (inc China)	40.5 billion barrels (+1.3 billion)

Non-OPEC = 14%
OPEC = 86 %

Saudi Arabia = 30%
Iraq = 12%
Middle East = 63%

(change since 1994)

Where Is Oil Consumed? (2006)

Middle East	7.2%
North America	28.9%
South America	6.1%
Russia	3.3%
Africa	3.4%
Asia Pacific	29.5%
Europe and Central Asia	24.9%

In 2002-2006, North American demand increased 4%, but Asian demand increased 12.2%

Natural Gas

Where Are the Natural Gas Reserves?

(Jan 1, 2007)

Russia	1,682 Trillion Cubic Feet
Iran	993
Qatar	895
Saudi Arabia	249
UAE	213
USA	209
Nigeria	183
Algeria	159
Trinidad and Tobago	153
Venezuela	152
Iraq	112
Kazakhstan	106
Norway	102
Turkmenistan	100
Indonesia	92

Distribution by region

Middle East	40.5%
Russia	26.3%
Europe	9%
North America	4.14%

Total Reserve: 6,405 Tcf
Total Consumption: 101 Tcf
in 2005

Source: British Petroleum Review

Policy Questions

- Will shale gas make a large difference?
- Will natural gas be able to take the market from coal (power), oil (transport), and electricity (industrial and residential)?

Coal

Proven Coal Reserves 2006

Reserves	Share of Total	R/P Ratio
United States	27.1%	234 years
China	12.6%	48 years
Russia	17.3%	> 500 years
India	10.2%	207 years
Australia	8.6%	210 years

Coal Production

(millions of tons of oil equivalent)

Production	2006	1994	Growth 2002-2006
China*	1,212	619	65%
USA	595	553	8%
India	210	126	25%
Russia	144	121	23%
Australia	202	123	10%
Poland	67	90	-6%
Germany	50	78	-9%
UK	11.3	28.3	-39%

* 656 in 2000

Coal's Challenge

- Infrastructure
- Mine safety
- Coal to liquid technologies

Challenges

- Climate Issue
- Energy Supply Constrained
 - Will be located in fewer places
 - Oil – Arabian Gulf
 - Gas – Russia & Iran
 - Coal – US, Russia & Australia
- Land Use
 - Renewables are land intensive, and in case of biofuels, water intensive
 - Institutions and governance structures to oversee increasingly valuable land resources absent in most of the world