

**El Suministro Global
de Petróleo.
Retos e Incertidumbres**

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What don't we know?

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WHAT DON'T WE KNOW?

The road from old to new energy sources can be bumpy, but the transitions have gone pretty smoothly in the past. After millennia of dependence on wood, society added coal and gravity-driven water to the energy mix. Industrialization took off. Oil arrived, and transportation by land and air soared, with hardly a worry about where the next log or lump of coal was coming from, or what the explosive growth in energy production might be doing to the world.

Times have changed. The price of oil has been climbing, and ice is melting around both poles as the mercury in the global thermometer rises. Whether the next big energy transition will be as smooth as past ones will depend in large part on three sets of questions: When will world oil production peak? How sensitive is Earth's climate to the carbon dioxide we are pouring into the atmosphere by burning fossil fuels? And will alternative energy sources be available at reasonable costs? The answers rest on science and technology, but how society responds will be firmly in the realm of politics.

There is little disagreement that the world will soon be running short of oil. The debate is over how soon. Global demand for oil has been rising at 1% or 2% each year, and we are now sucking almost 1000 barrels of oil from the ground every second. Pessimists—mostly former oil company geologists—expect oil production to peak very soon. They point to American geologist M. King Hubbert's successful 1956 prediction of the 1970 peak in U.S. production. Using the same method involving records of past production and discoveries, they predict a world oil peak by the end of the decade. Optimists—mostly resource economists—argue that oil production depends more on economics and politics than on how much happens to be in the ground. Technological innovation will intervene, and production will continue to rise, they say. Even so, midcentury is about as far as anyone is willing to push the peak. That's still "soon" considering that the United States, for one, will need to begin replacing oil's 40% contribution to its energy consumption by then. And as concerns about climate change

intensify, the transition to nonfossil fuels could become even more urgent (see p. 100).

If oil supplies do peak soon or climate concerns prompt a major shift away from fossil fuels, plenty of alternative energy supplies are waiting in the wings. The sun bathes Earth's surface with 86,000 trillion watts, or terawatts, of energy at all times, about 6600 times the amount used by all humans on the planet each year. Wind, biomass, and nuclear power are also plentiful. And there is no shortage of opportunities for using energy more efficiently.

Of course, alternative energy sources have their issues. Nuclear fission supporters have never found a noncontroversial solution for disposing of long-lived radioactive wastes, and concerns over liability and capi-

tal costs are scaring utility companies off. Renewable energy sources are diffuse, making it difficult and expensive to corral enough power from them at cheap prices. So far, wind is leading the way with a global installed capacity of more than 40 billion watts, or gigawatts, providing electricity for about 4.5 cents per kilowatt hour.

That sounds good, but the scale of renewable energy is still very small when compared to fossil fuel use. In the United States, renewables account for just 6% of overall energy production. And, with global energy demand expected to grow from approximately 13 terawatts a year now to somewhere between 30 and 60 terawatts by the middle of this century, use of renewables

Special Section

What Can Replace Cheap Oil—and When



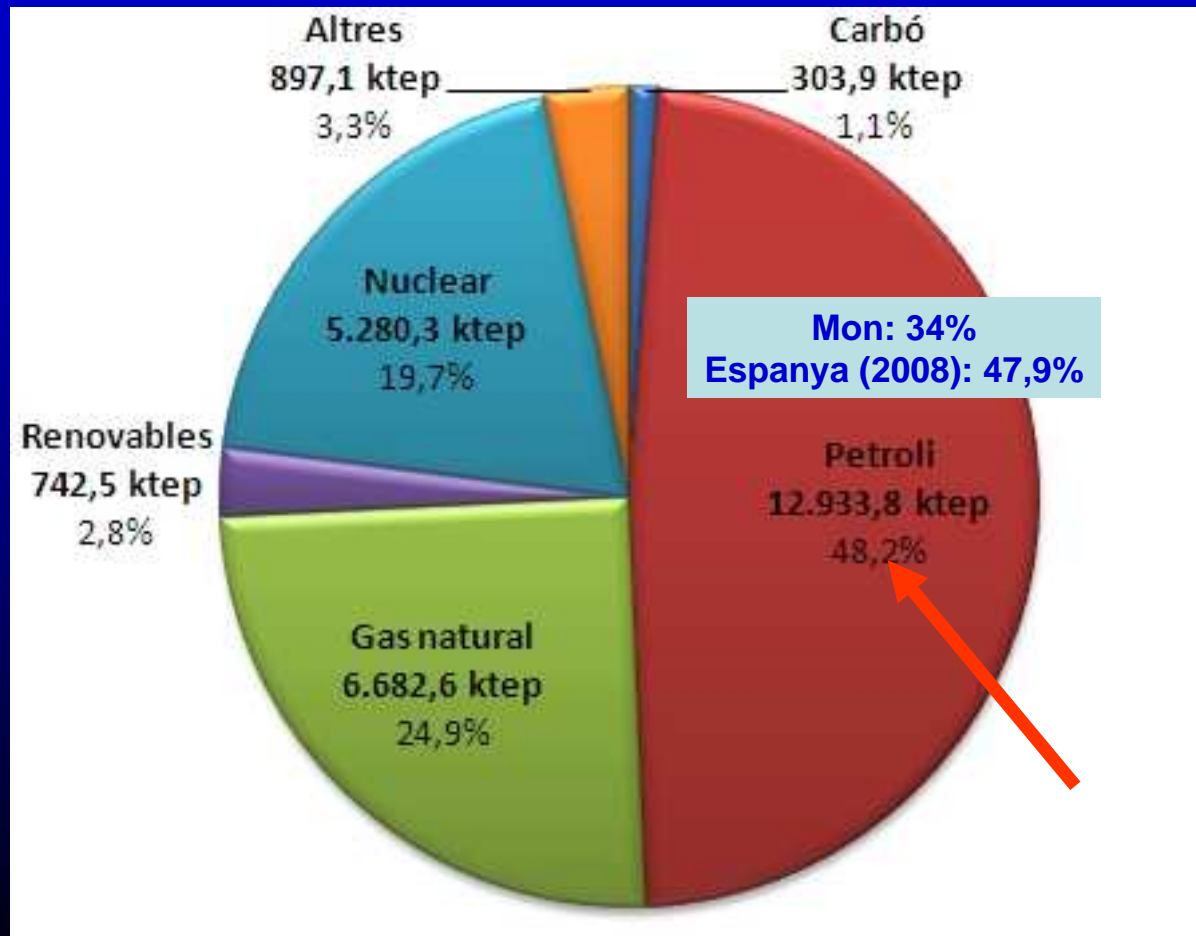
will have to expand enormously to replace current sources and have a significant impact on the world's future energy needs.

What needs to happen for that to take place? Using energy more efficiently is likely to be the sine qua non of energy planning—not least to buy time for efficiency improvements in alternative energy. The cost of solar electric power modules has already dropped two orders of magnitude over the last 30 years. And most experts figure the price needs to drop 100-fold again before solar energy systems will be widely adopted. Advances in nanotechnology may help by providing novel semiconductor systems to boost the efficiency of solar energy collectors and perhaps produce chemical fuels directly from sunlight, CO₂, and water.

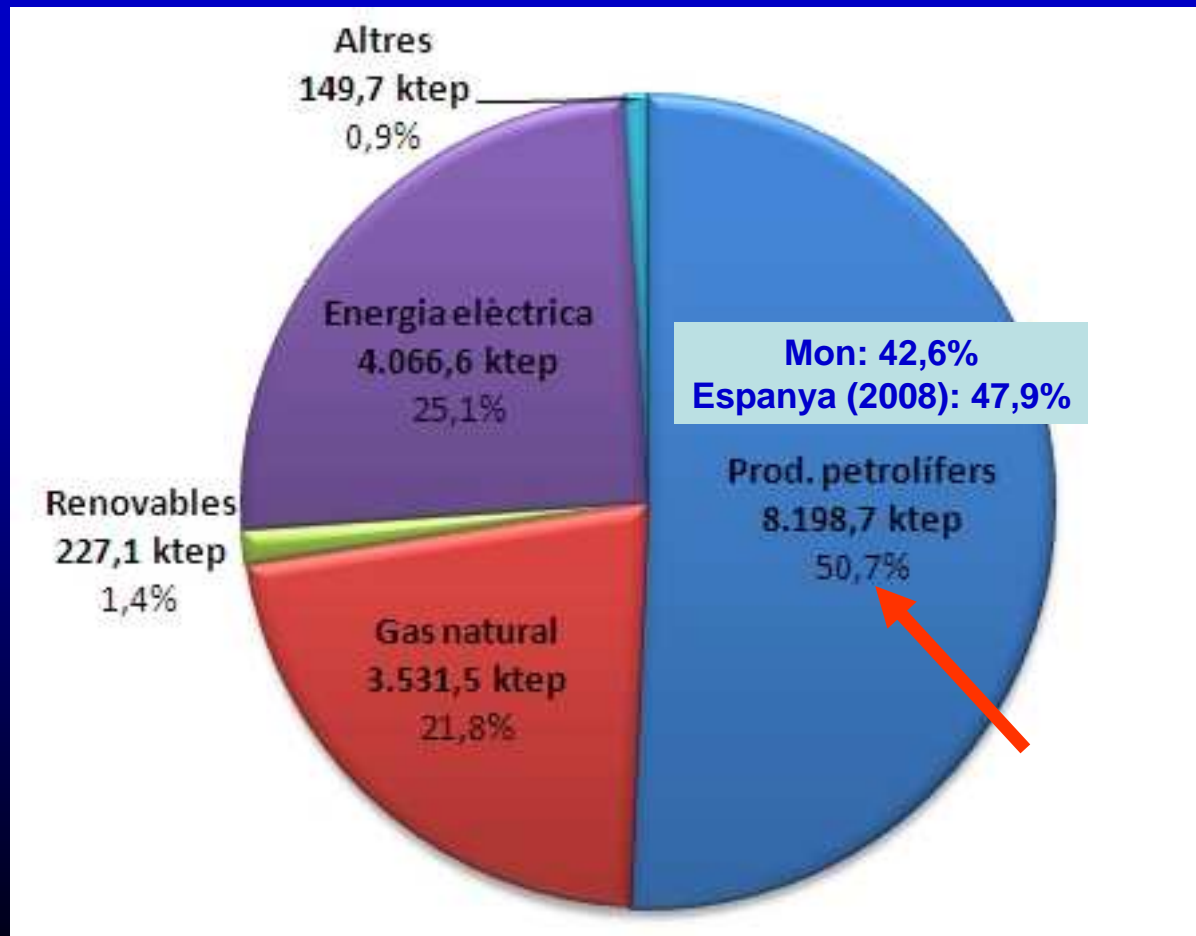
But whether these will come in time to avoid an energy crunch depends in part on how high a priority we give energy research and development. And it will require a global political consensus on what the science is telling us.

—RICHARD A. KERR AND ROBERT F. SERVICE

Consum d'energia primària a Catalunya Dades 2007 (ICAEN)



Catalunya: consum d'energia final Dades 2007 (ICAEN)

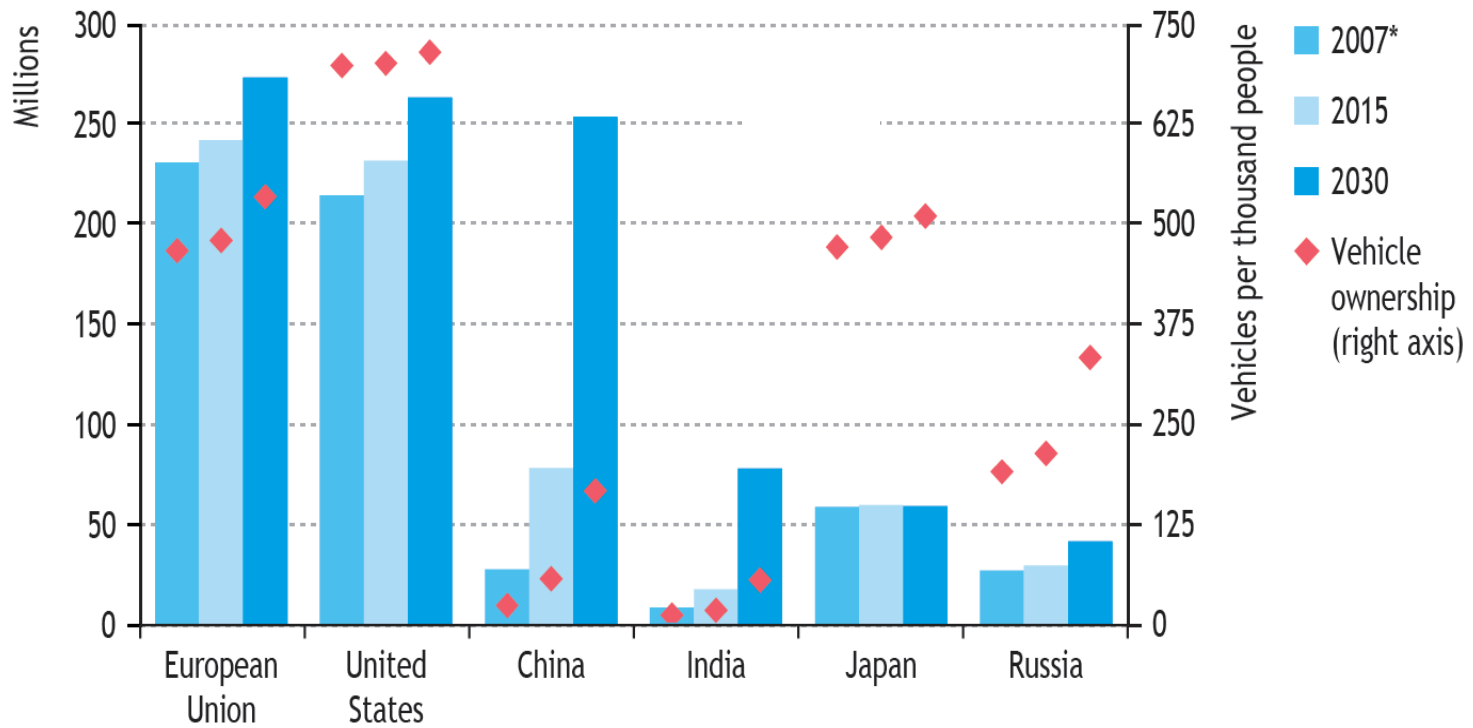


Transport és pràcticament sinònim de petroli

World final energy consumption by fuel and sector
in the Reference Scenario



Passenger light-duty vehicle fleet and ownership rates in key regions in the Reference Scenario



* IEA estimate.

Previsions sobre la demanda global de petroli (2007-2030). Escenari de Referència de la IEA (WEO, 2009)

Table 1.3 • Primary oil demand* by region in the Reference Scenario (mb/d)

	1980	2000	2008	2015	2030	2008-2030**
OECD	41.3	44.7	43.2	41.2	40.1	-0.3%
North America	20.8	22.9	22.8	22.2	21.8	-0.2%
United States	17.4	19.0	18.5	17.9	17.2	-0.3%
Europe	14.4	13.6	13.0	12.2	12.0	-0.4%
Pacific	6.1	8.2	7.4	6.8	6.2	-0.8%
Japan	4.8	5.3	4.5	3.8	3.1	-1.6%
Non-OECD	20.0	26.6	35.0	40.2	56.2	2.2%
E. Europe/Eurasia	9.0	4.2	4.6	4.7	5.3	0.6%
Russia	n.a.	2.6	2.8	2.8	3.1	0.5%
Asia	4.4	11.2	15.8	19.6	30.7	3.0%
China	1.9	4.6	7.7	10.4	16.3	3.5%
India	0.7	2.3	3.0	3.8	6.9	3.9%
ASEAN	1.1	3.0	3.5	3.8	5.3	1.8%
Middle East	1.9	4.5	6.4	7.6	9.9	2.1%
Africa	1.2	2.2	2.9	2.9	3.7	1.1%
Latin America	3.4	4.5	5.3	5.4	6.6	1.0%
Brazil	1.3	1.9	2.0	2.1	2.8	1.4%
International bunkers***	3.4	5.2	6.5	7.0	8.9	1.5%
World	64.8	76.5	84.7	88.4	105.2	1.0%
European Union	n.a.	12.9	12.4	11.7	11.3	-0.4%

* Excludes biofuels demand, which is projected to rise from 0.8 mb/d in 2008 to 1.6 mb/d in 2015 and to 2.7 mb/d in 2030.

** Compound average annual growth rate.

*** Includes international marine and aviation fuel. In previous WEOs, international aviation fuel was included at the regional level.

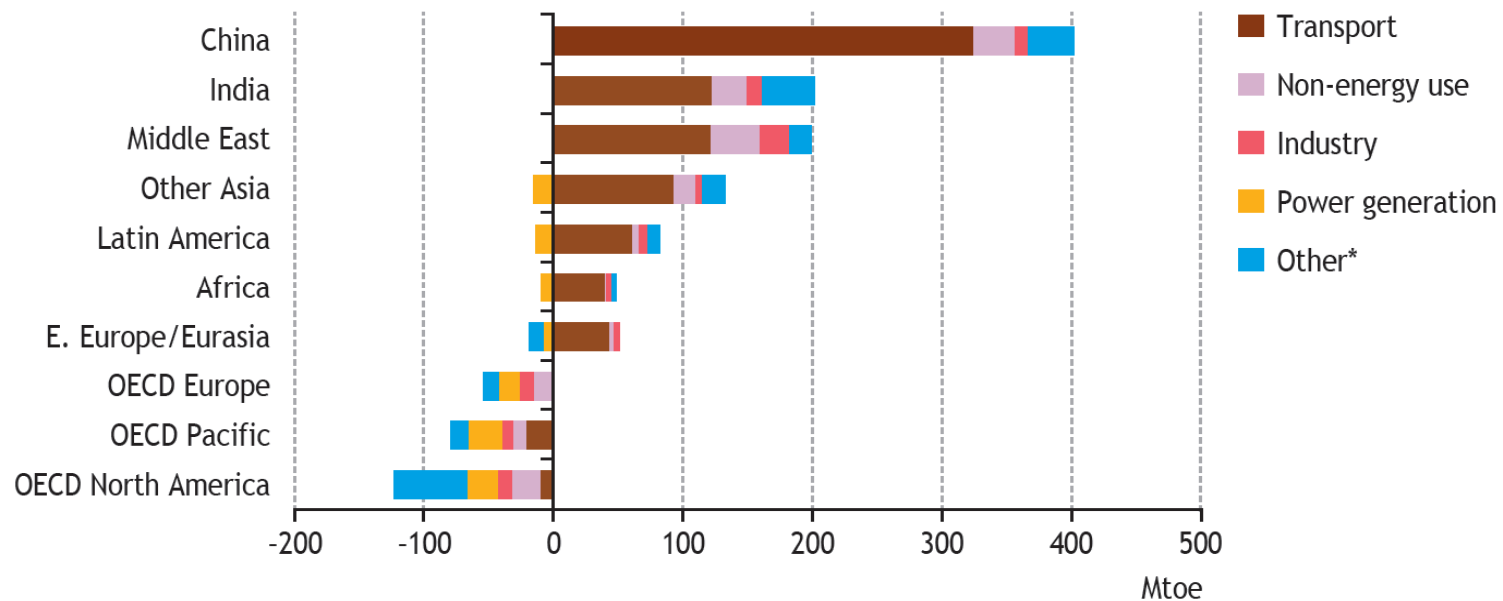
4. Preliminary data on total oil demand only are available for 2008 by region (the sectoral breakdown is available for 2007). Oil does not include biofuels derived from biomass. For this reason, and because of methodological differences, the oil projections in this report are not directly comparable with those published in the IEA's *Oil Market Report*.

**Es preveu
que la demanda de petroli
(excloent els
biocombustibles)
creixi anualment un 1%,
de 85,2 milions de barrils
diaris (mbd) al 2007,
a 105,2 mbd al 2030.**

**Si es consideren
els biocombustibles
-que evolucionarien
de 0,8 mbd al 2008,
fins a 2,7 mbd al 2030-
la demanda total de líquids
pujaria a 107,9 mbd**

Els països aliens a l'OCDE, especialment els d'Àsia i Orient Mitjà, absorbiran la totalitat de l'increment de la demanda de petroli previst per a les pròximes dos dècades. El 97% d'aquest increment provindrà del sector del transport.

Change in primary oil demand by region and sector in the Reference Scenario, 2007-2030



* Includes residential, services, agriculture and other energy sectors.

Les xifres sobre recursos i reserves són dispars i no hi ha consens. No obstant això, aquestes xifres permeten suposar que les limitacions geològiques no constitueixen el major desafiament a afrontar en un futur immediat



El problema no és a la bóta sinó a l'aixeta !

A més de conèixer la disponibilitat de recursos i reserves, resulta fonamental conèixer si la transformació d'aquests en fluxos productius es realitzarà a la velocitat necessària per cobrir la demanda projectada.

En relació amb aquesta qüestió, el National Petroleum Council ens avisa d'una realitat preocupant:

«el món no s'està quedant sense recursos fòssils, però l'augment continuat de l'extracció de petroli a partir de fonts convencionals presenta cada vegada més riscos i aquests constitueixen un seriós obstacle per a assegurar la demanda a mitjà termini »

HARD TRUTHS

Facing the Hard Truths about Energy

A comprehensive view to 2030 of global oil and natural gas



2007
NATIONAL
PETROLEUM COUNCIL



Riscos tècnics

Descobriments a la baixa.

Costos a l'alça.

Nova producció vs. declivi.

Carestia de personal

EROEI

Riscos geopolítics

Concentració de les reserves i la producció

Més dependència de l'OPEP, Orient Mitjà i Rússia

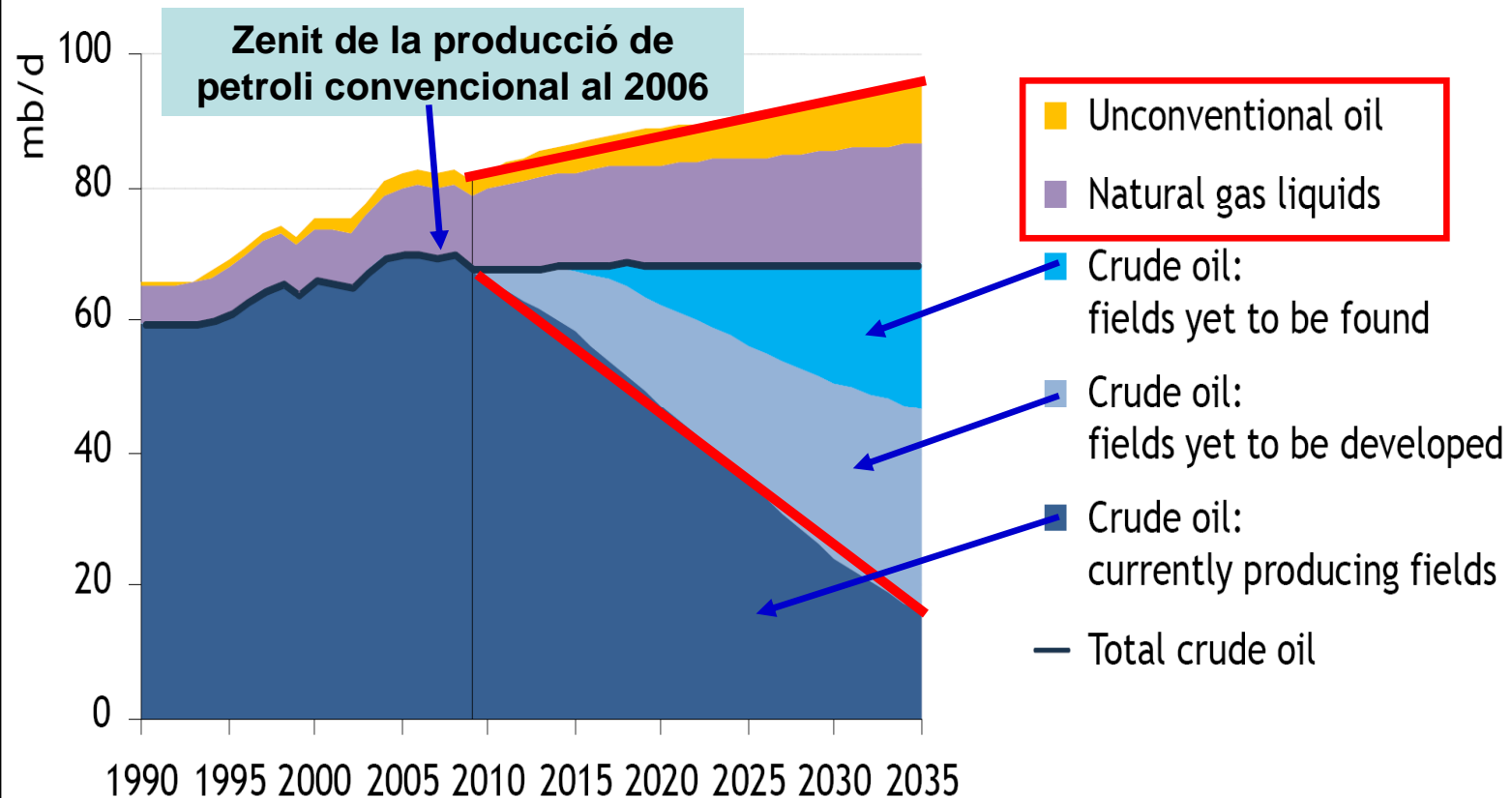
Conflictes, terrorisme (països d'origen i de trànsit)

Grans inversions ¿a temps?

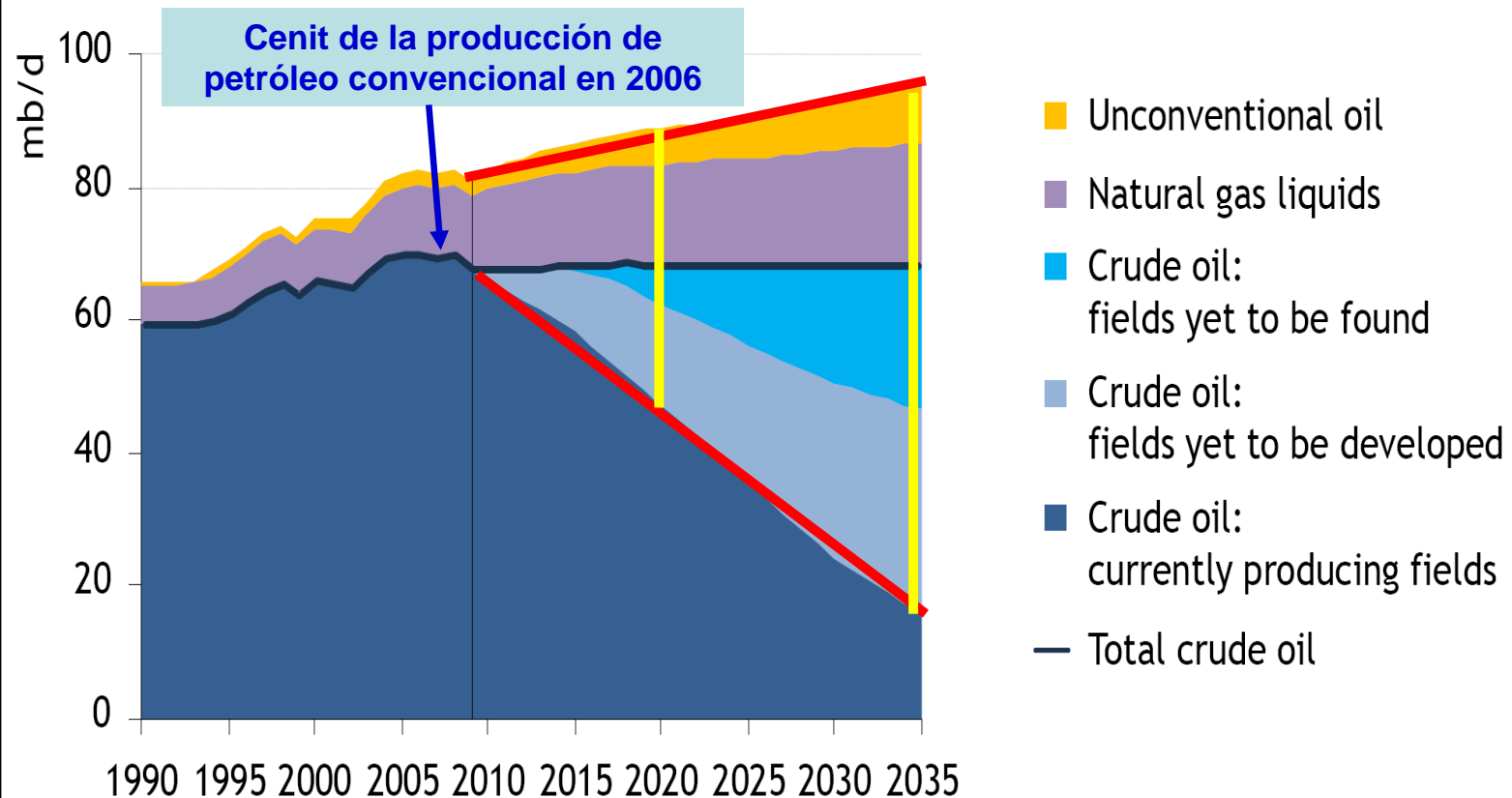
Petronacionalisme (limitacions al lliure mercat)

NOC's vs. IOC's.

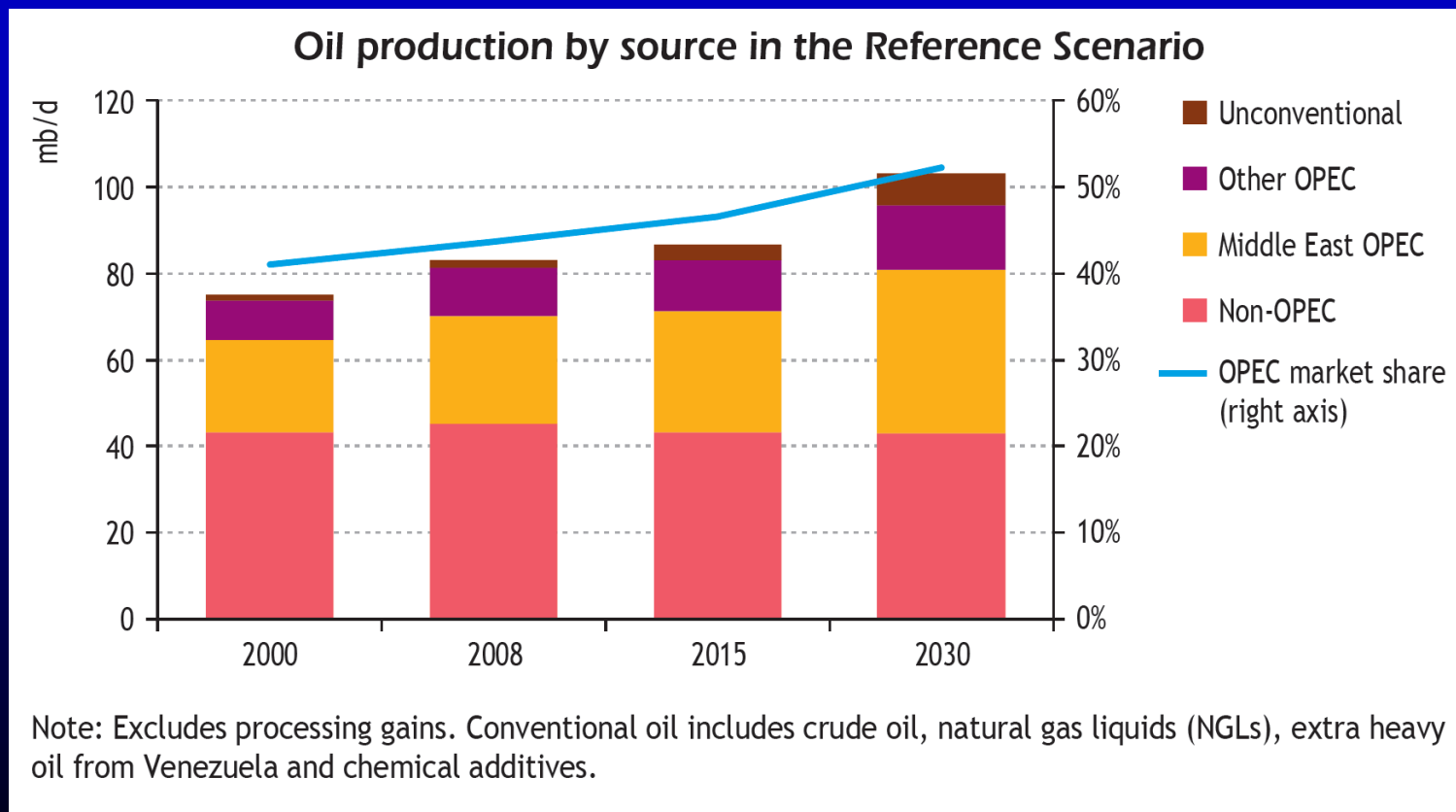
IEA, WEO 2010 (NPS): no s'espera que en el període 2010-2035 la producció mundial de crus convencionals superi el màxim de 70 mbd assolits el 2006 i això sí



IEA, WEO 2010 (NPS): ¡más de tres veces Arabia Saudita en 10 anys i més de set a 25!



El món serà cada vegada més dependent de les exportacions de l'OPEP. Això implica la consolidació d'un mercat oligopolista, no competitiu, i un perill cert per a l'existència d'un «lliure mercat» del petroli

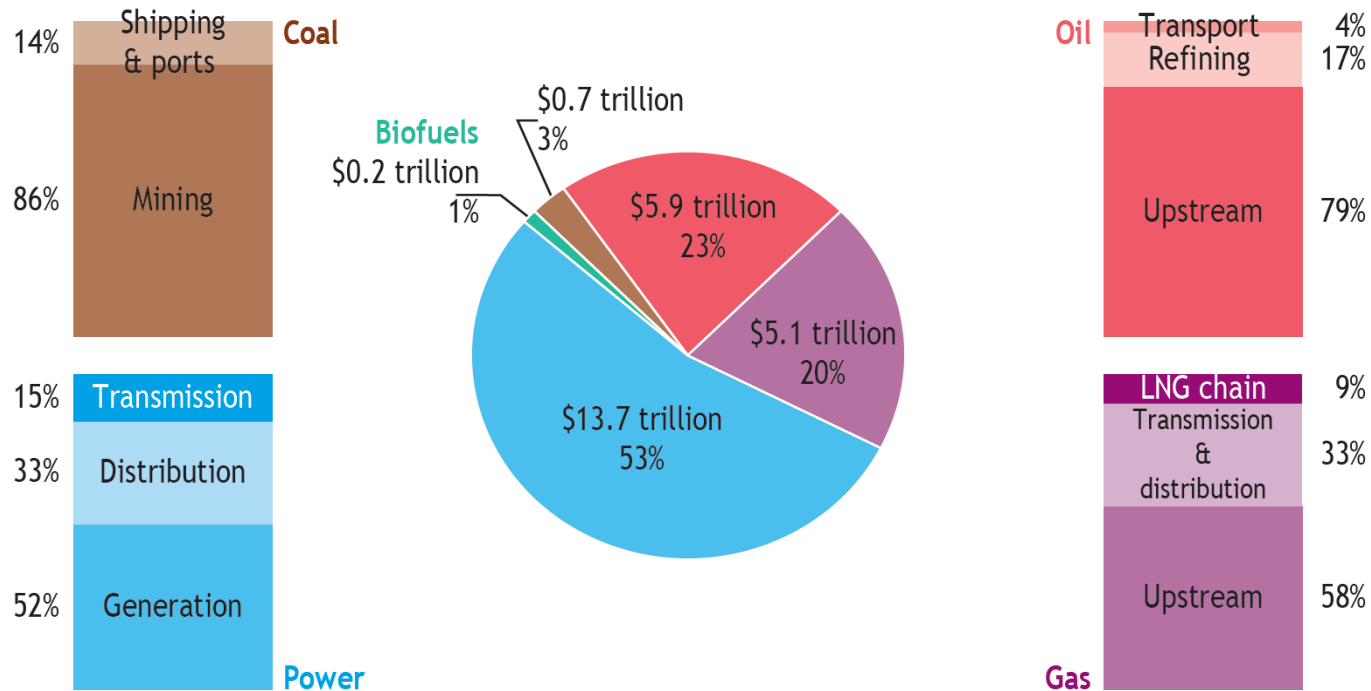


IEA, WEO 2009

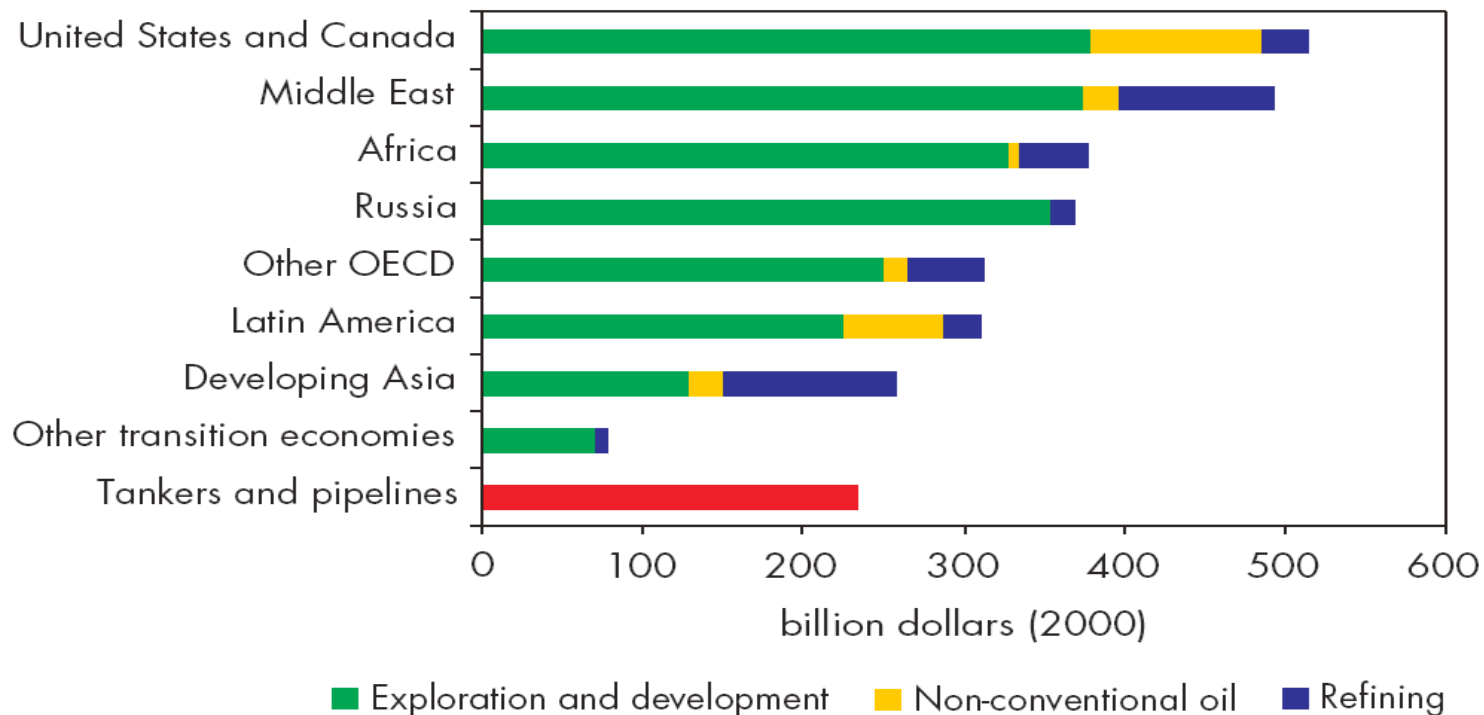
Cobrir la demanda mundial de petroli prevista entre 2008 i 2030 requereix una inversió acumulada propera als 5,9 bilions de dòlars (del 2008)

Cumulative investment in energy-supply infrastructure in the Reference Scenario, 2008-2030 (in year-2008 dollars)

Total investment = \$25.6 trillion (2008)



El 75% de la inversió en E&P correspondria a països no-OCDE i, en molts d'aquests, la mobilització de les inversions requerirà superar moltes barreres legislatives, normatives i comercials (a mes dels riscos associats a la inestabilitat política, terrorisme i conflictes armats)



IEA, WEO 2004

“Petronacionalisme”: NOC’s vs IOC’s
Els governs que tenen les reserves poden controlar el ritme d’inversió i d’extracció segons els seus interessos

Figure 1: World oil reserves by company



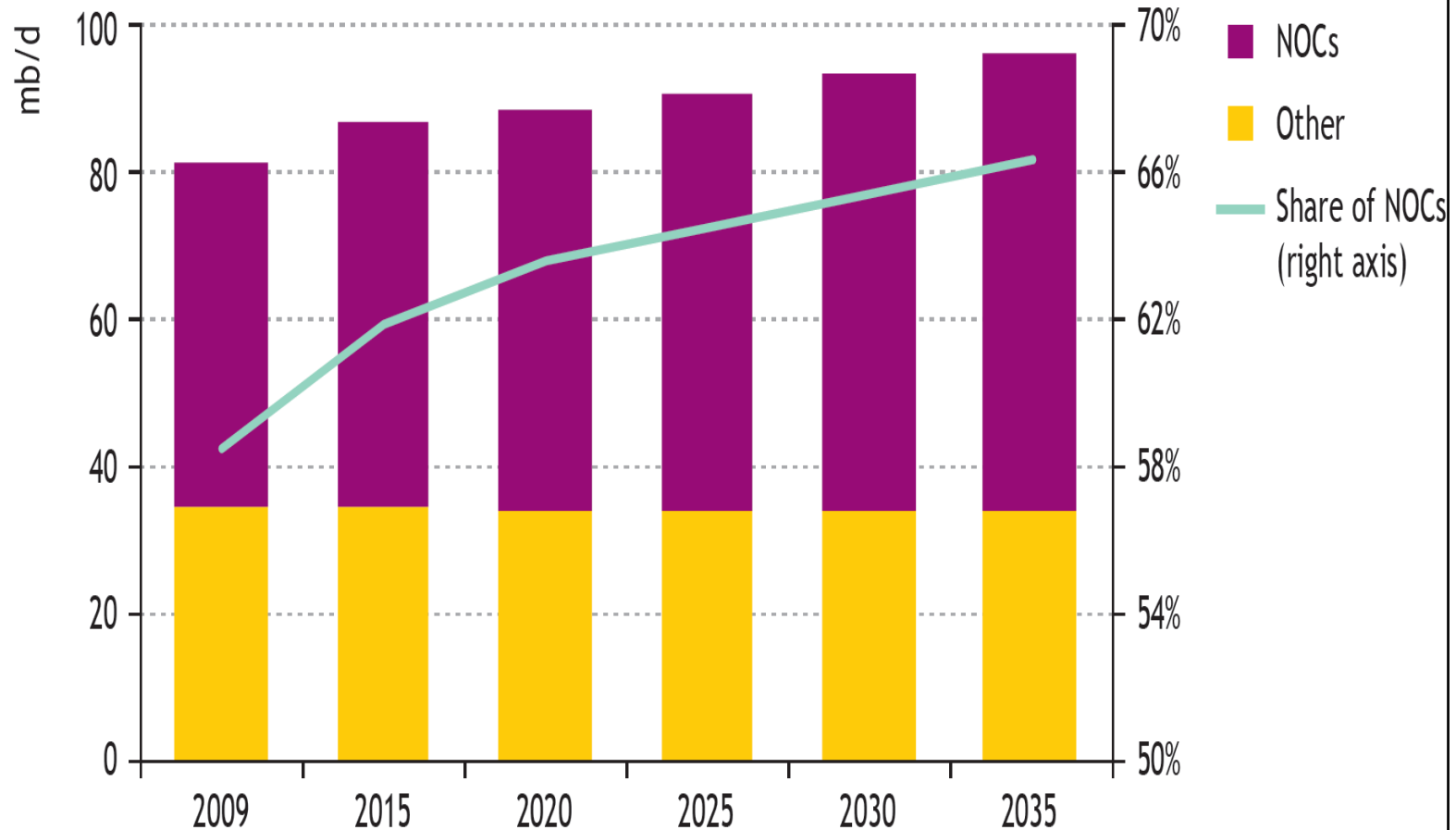
Figure 2: World gas reserves by company



Source: Wood Mackenzie

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IEA, WEO 2010 (NPS): producción mundial de petróleo por tipo de compañía. ¡Que vienen las estatales!

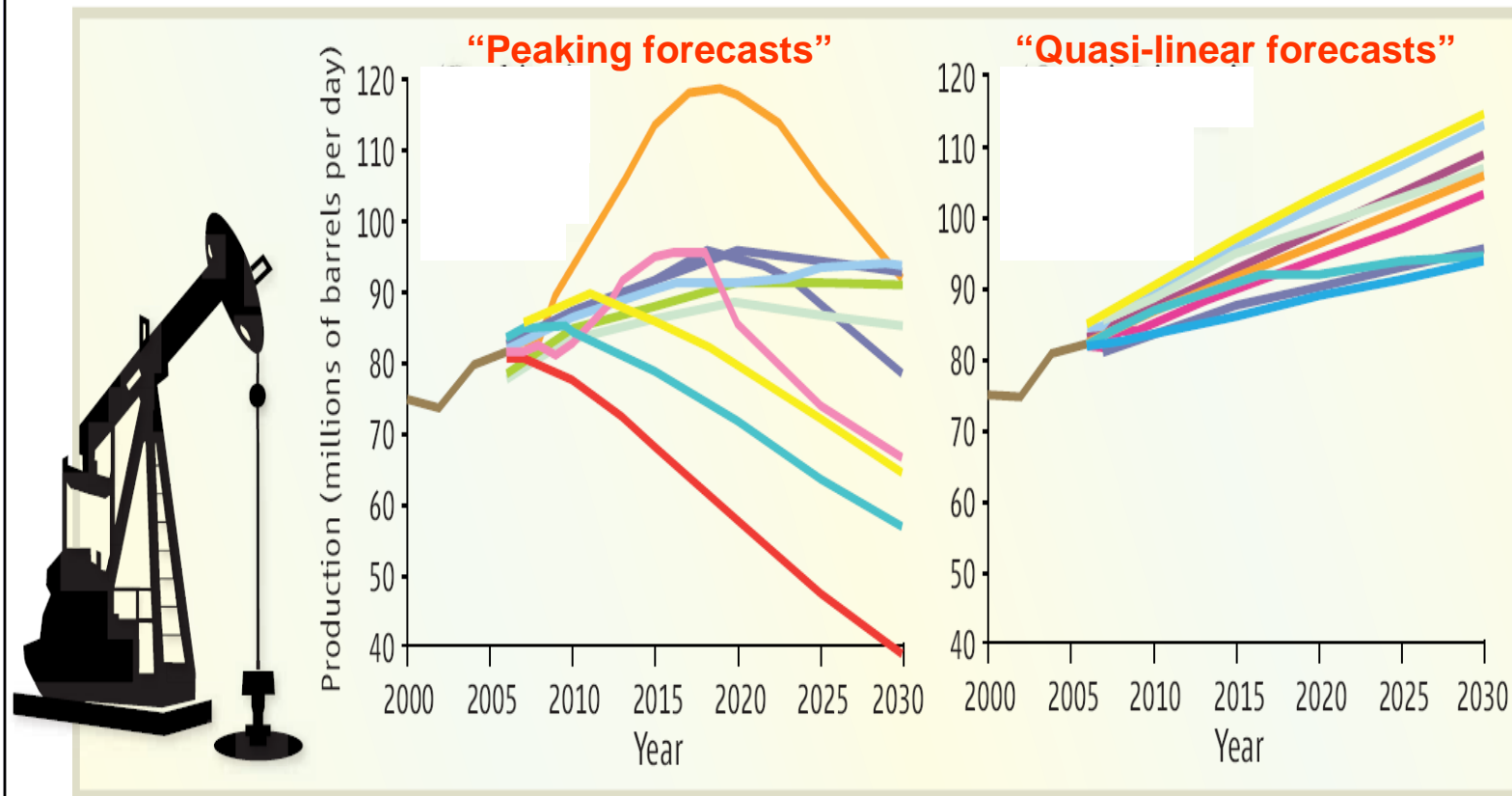


Note: NOCs are national oil companies.

“National Oil Companies” o “State International Oil Companies”?



Previsions balanç oferta / demanda a llarg termini. Dos grans grups de models



R. A. Kerr, Science, 20 November 2009, Vol. 326

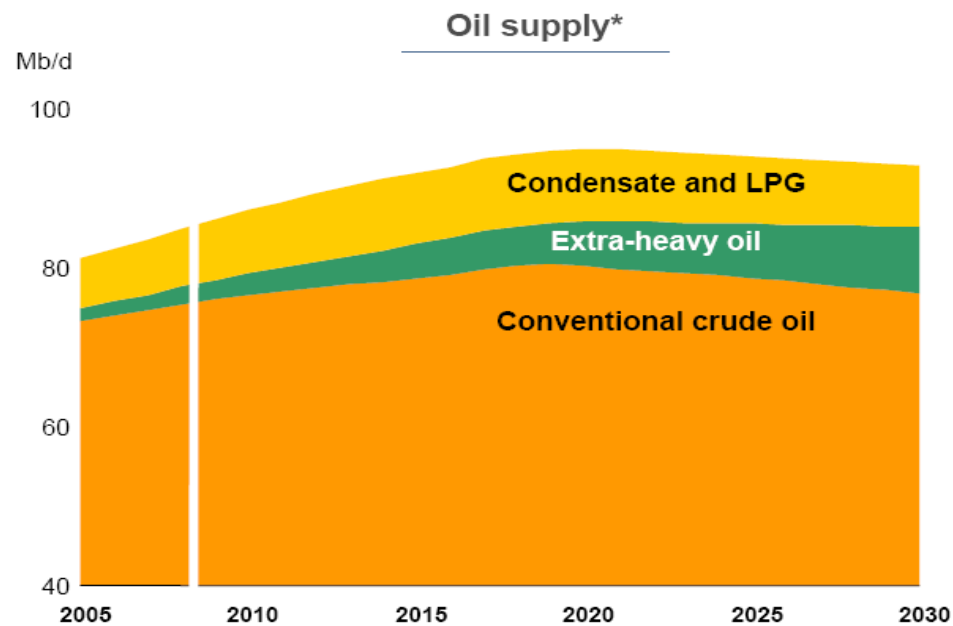
The Energy Outlook in 2030 According to Total

Jean-Jacques Mosconi
**Vice President, Strategic Planning & Economic
Intelligence**

Energy & Environment Press Seminar - June 2, 2008



La producció de petroli s'estabilitzarà al voltants dels 95 Mb/d en 2020



Developing extra-heavy oil requires substantial capital expenditure and raises major environmental challenges

* Excluding biofuels, CTL, GTL.

6 Energy & Environment Press Seminar - June 2, 2008

