

El model energètic i el canvi climàtic

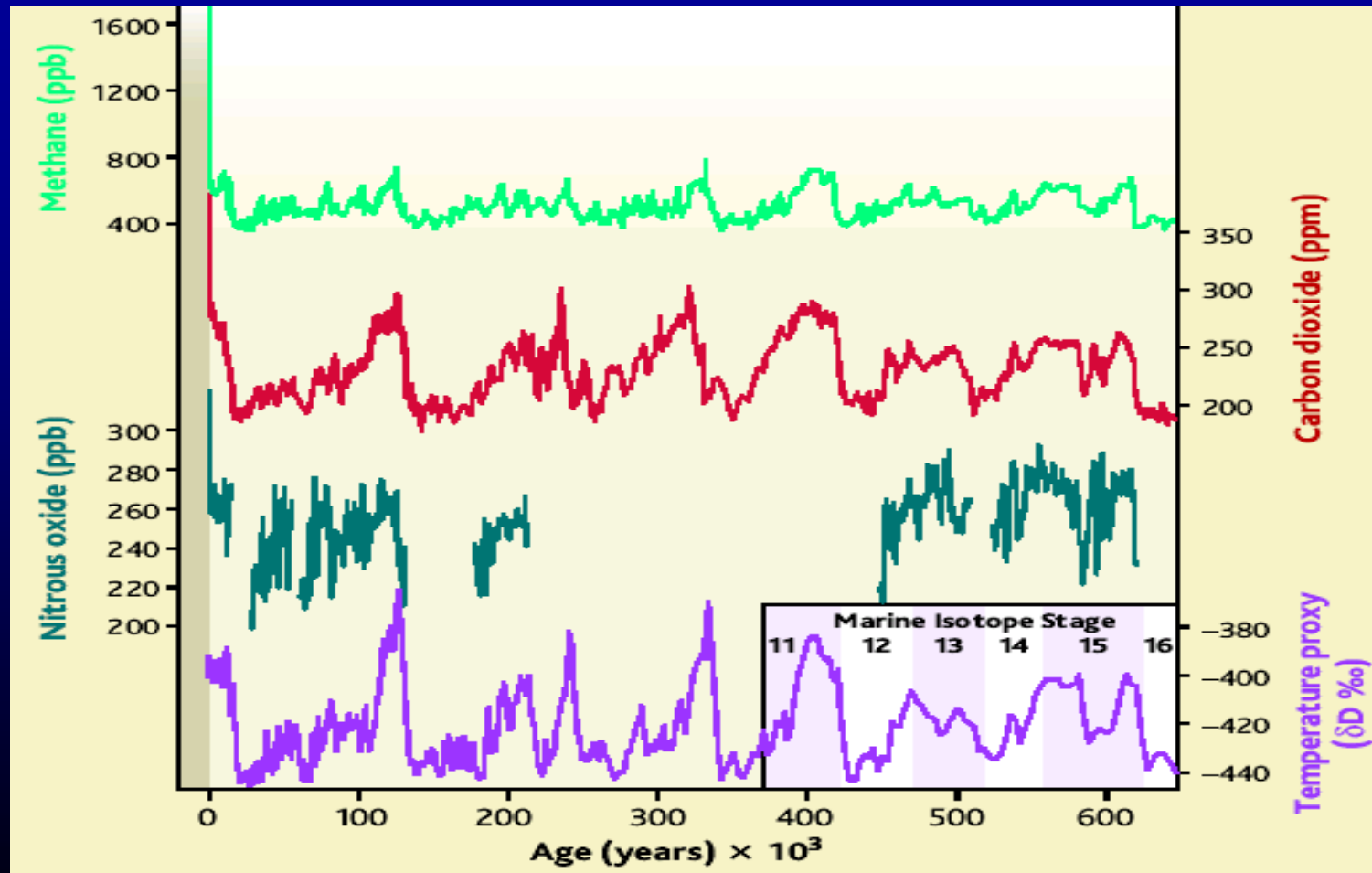
Mariano Marzo
Catedràtic de Recursos Energètics
Facultat de Geologia, UB

Jornades de sensibilització i debat
“La crisi energètica.
Anàlisi del fenomen i debat sobre alternatives de futur”

Sala d'Actes de Sa Nostra, Son Fuster, 4-3-2009



“Tiny bubbles tell all” Science 25-XII-2005

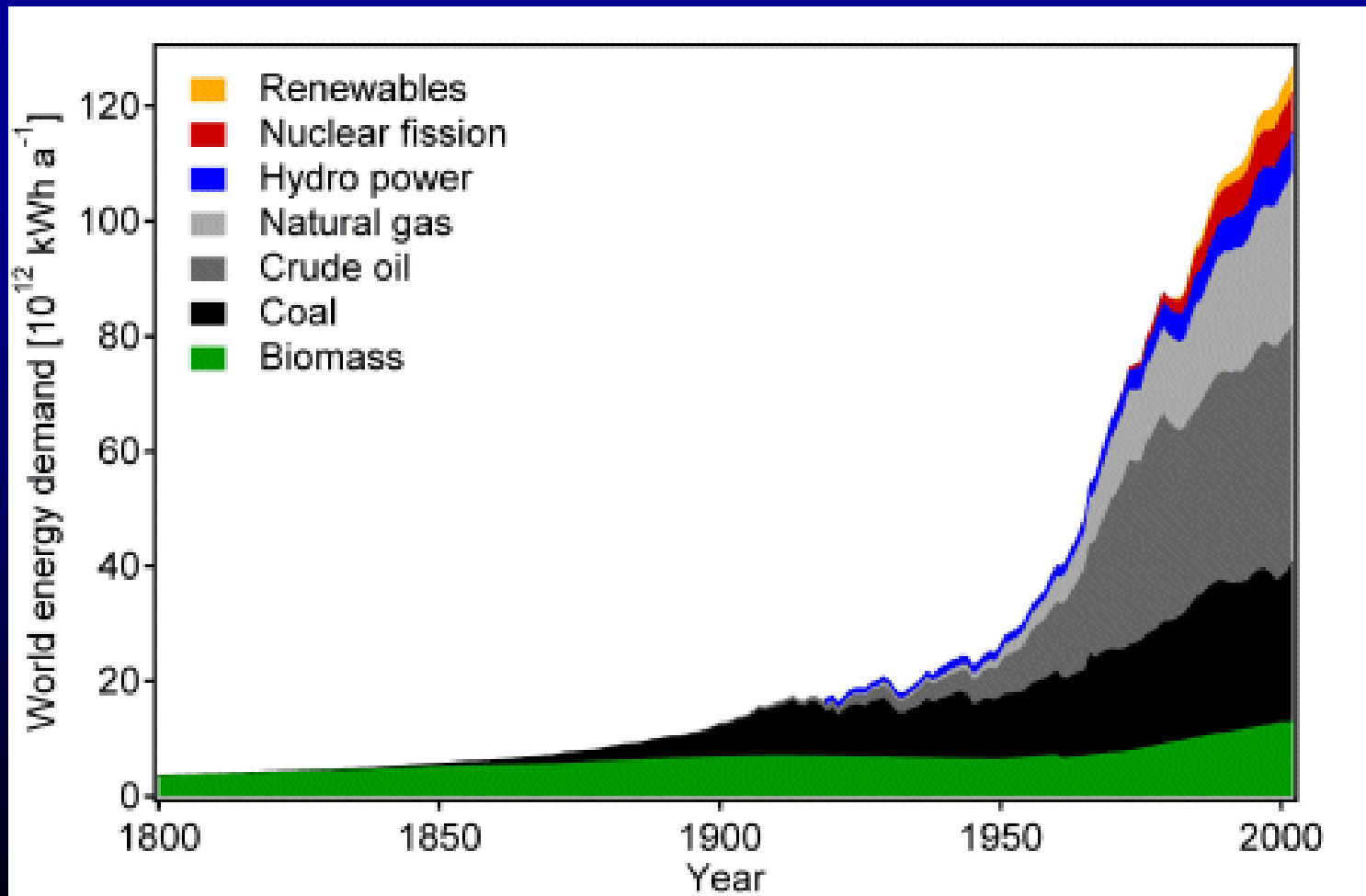


La part submergida de l'iceberg del canvi climàtic

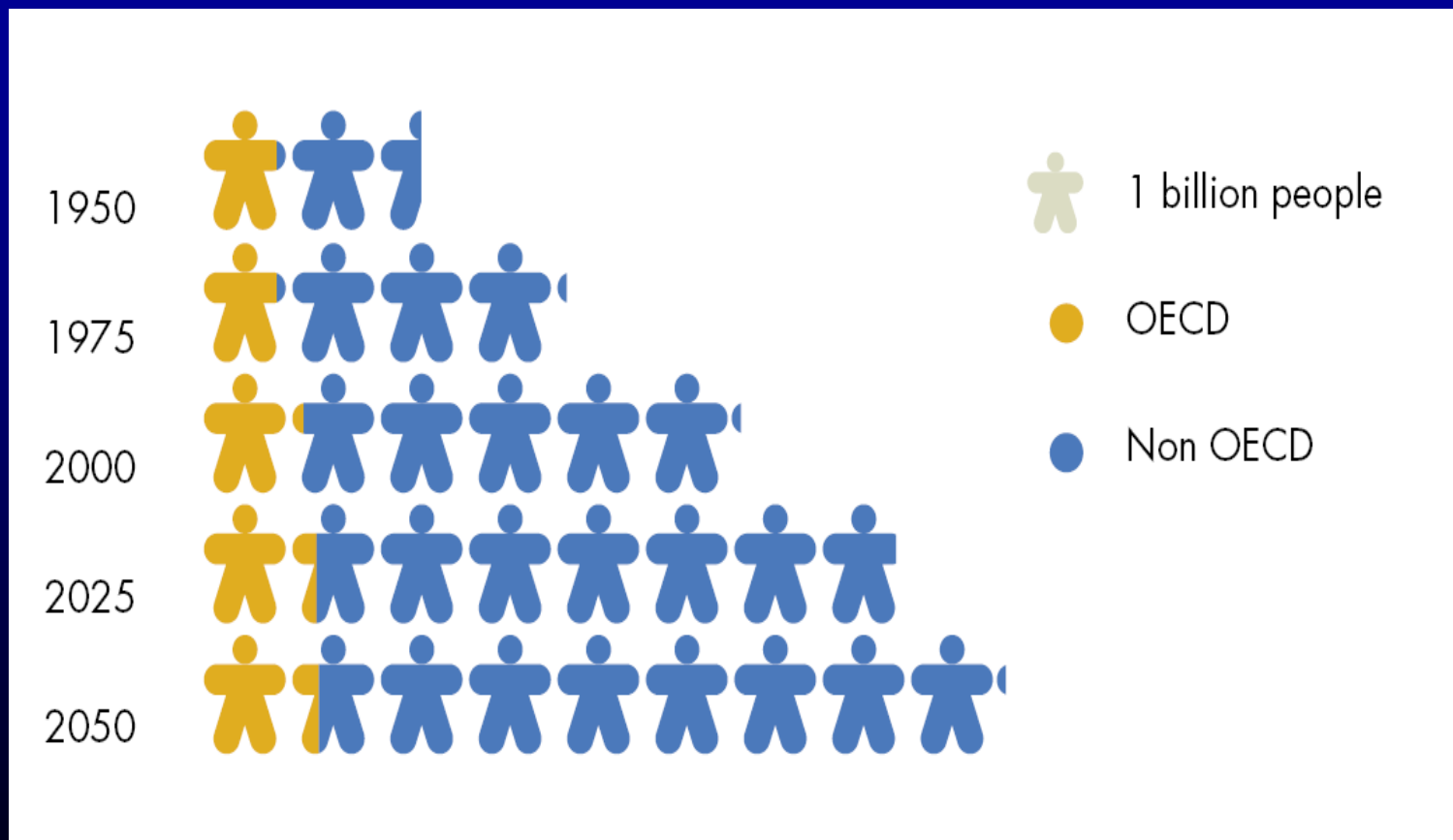


El canvi climàtic és, en bona part, conseqüència d'un desenvolupament econòmic i demogràfic sense precedents, possibilitat per l'ús massiu dels combustibles fòssils

Des de 1950, l'home de l'hidrocarbur ha multiplicat per cinc el seu consum energètic ...

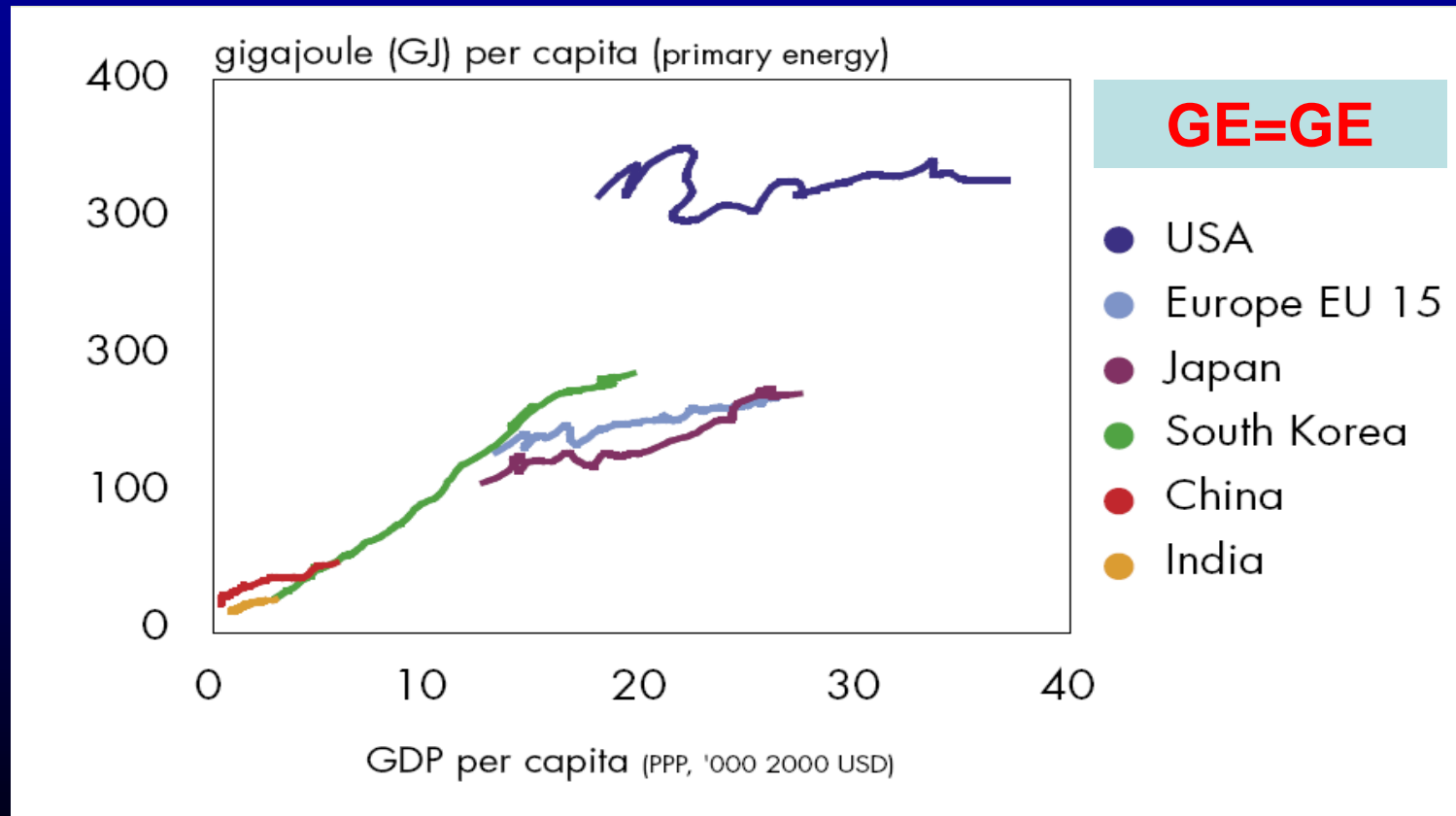


La població mundial s'ha multiplicat per més de dos des de 1950 i les previsions apunten a un increment proper al 40% per 2050 ...



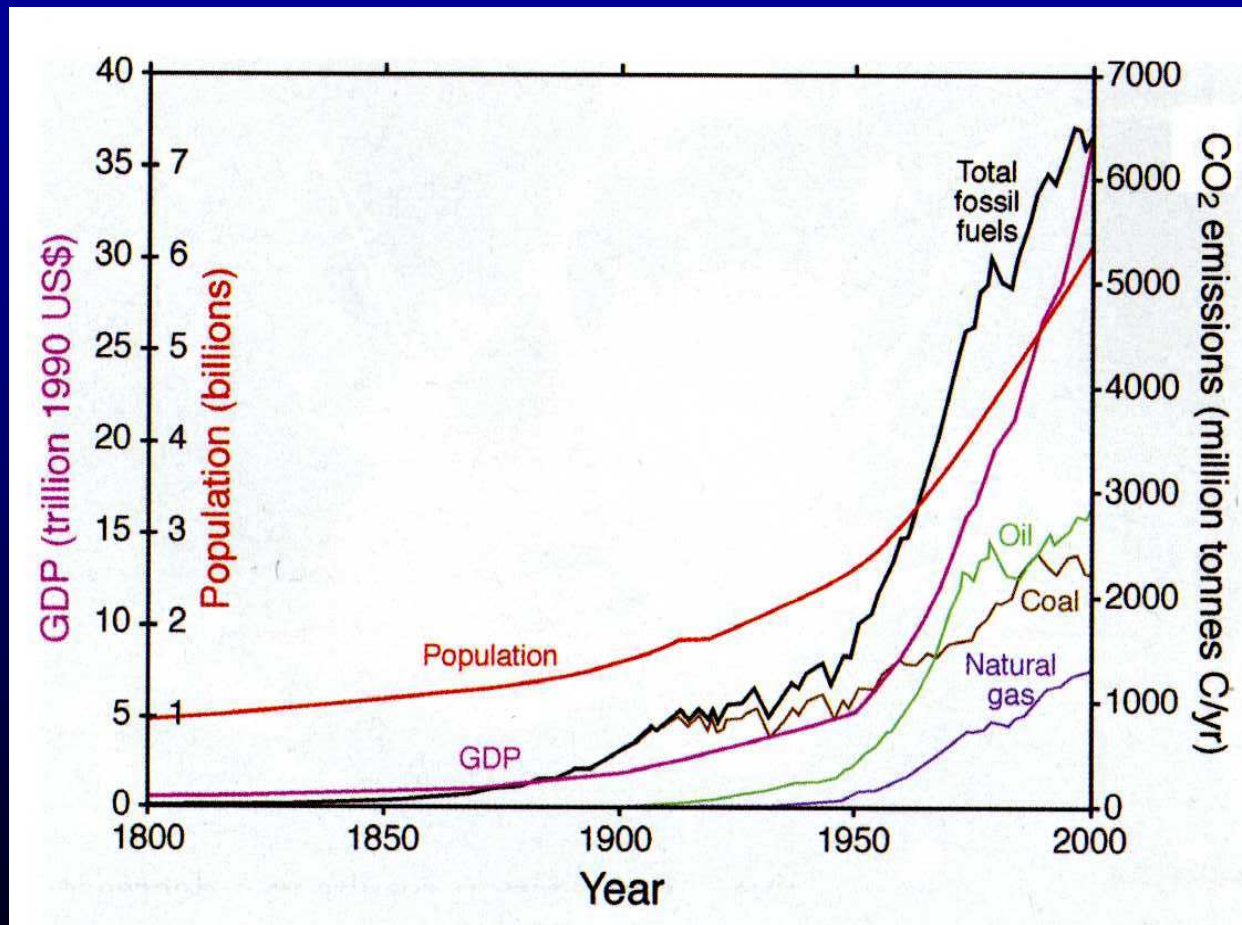
“Shell Global Scenarios to 2025”

La història ens demostra que l'augment de la riquesa i benestar de la població requereix un augment del consum energètic ...



“Shell Global Scenarios to 2025”

El creixement demogràfic i econòmic de l'home de l'hidrocarbur ha escalfat el planeta



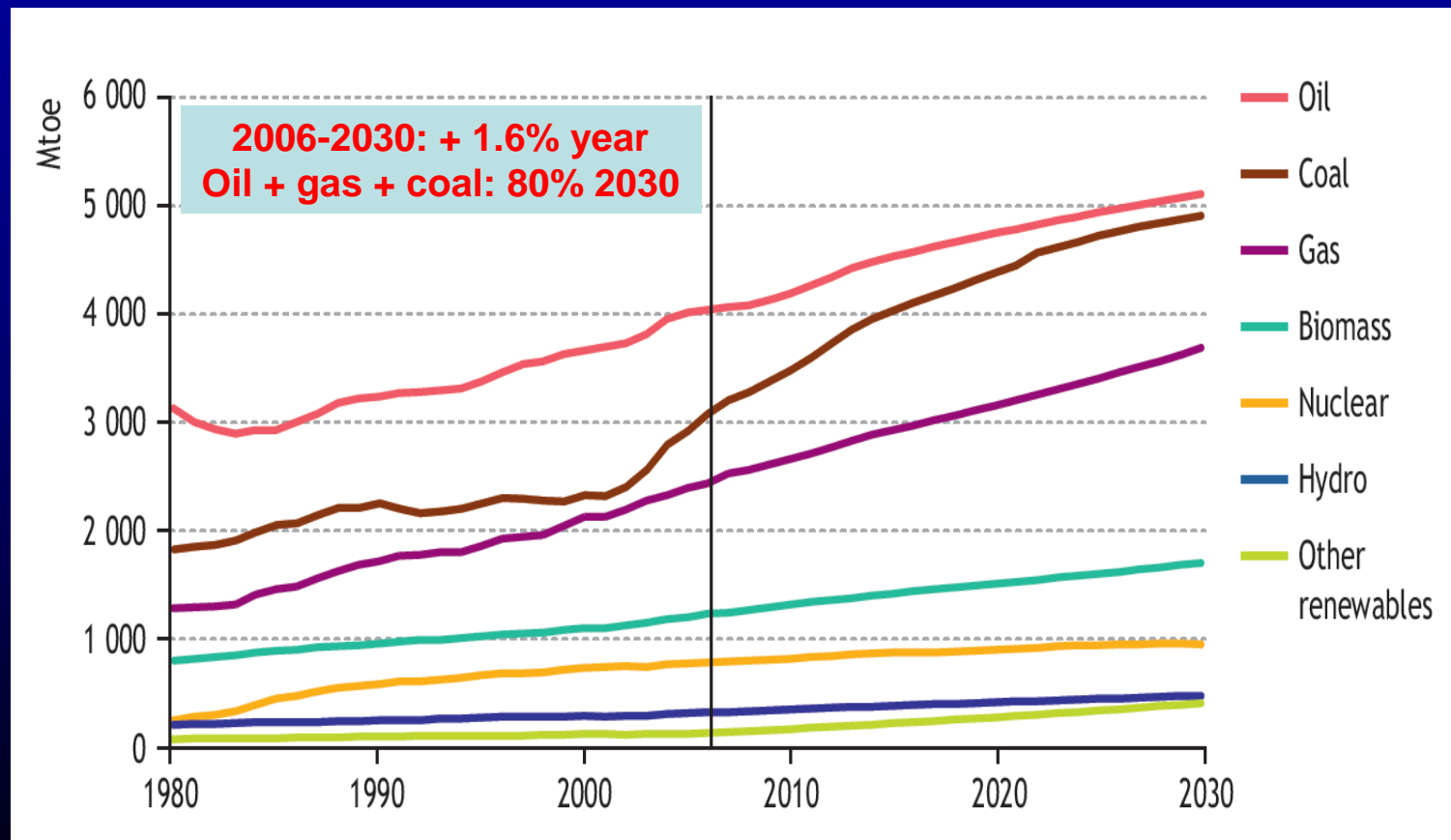
J. P. Richards, Geoscience Canada, v.35, n° 1, 2008

Resumint...

Identitat de Kaya

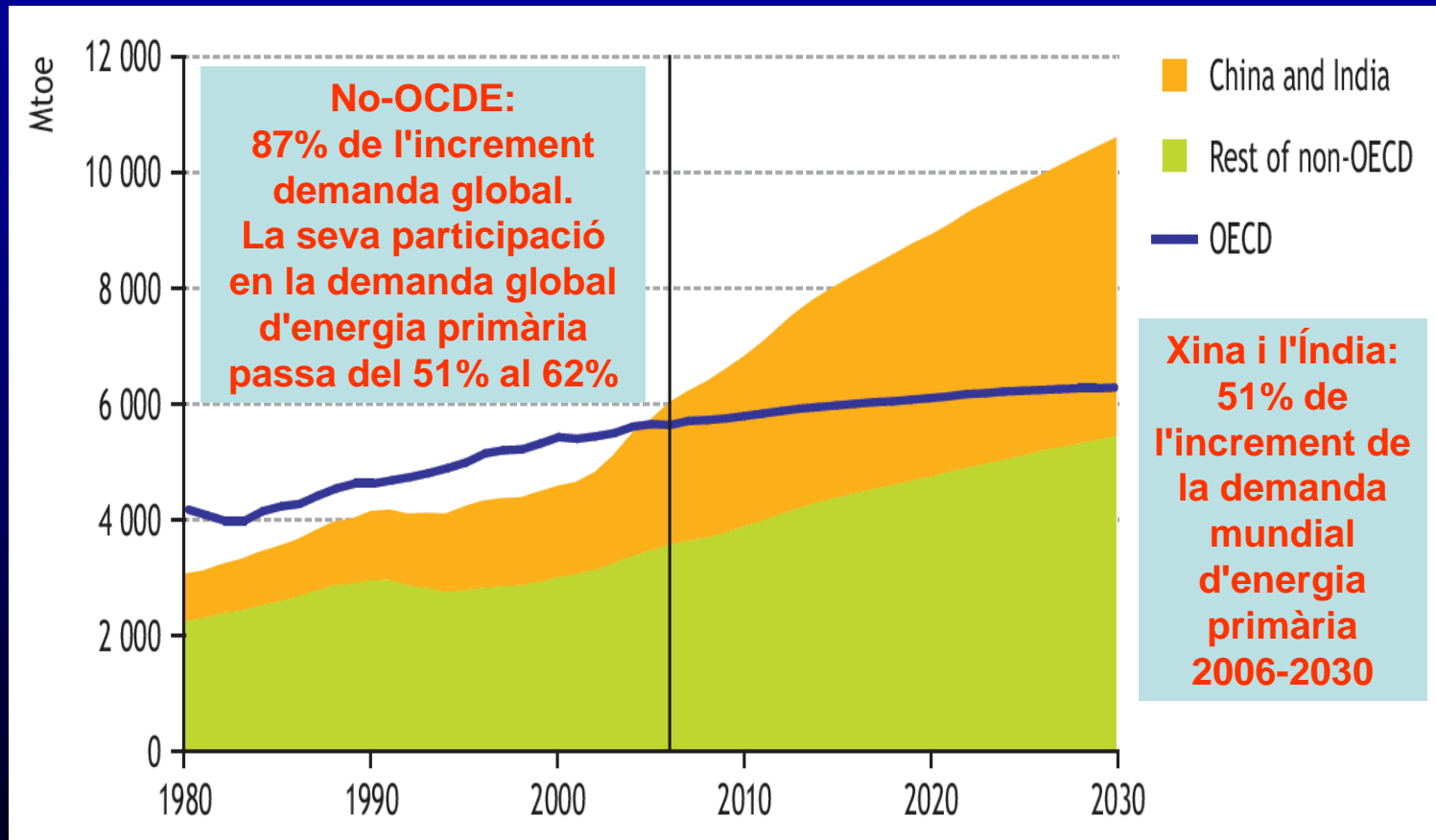
$$\text{CO}_2 = \text{renda per càpita (PIB}_i/\text{P}_i) * \text{població (P}_i) \\ * \text{intensitat energètica (E}_i/\text{PIB}_i) * \text{factor d'emissió (CO}_{2i}/\text{E}_i)$$

Les previsions en l'horitzó del 2030... més carbó, més petroli i més gas natural



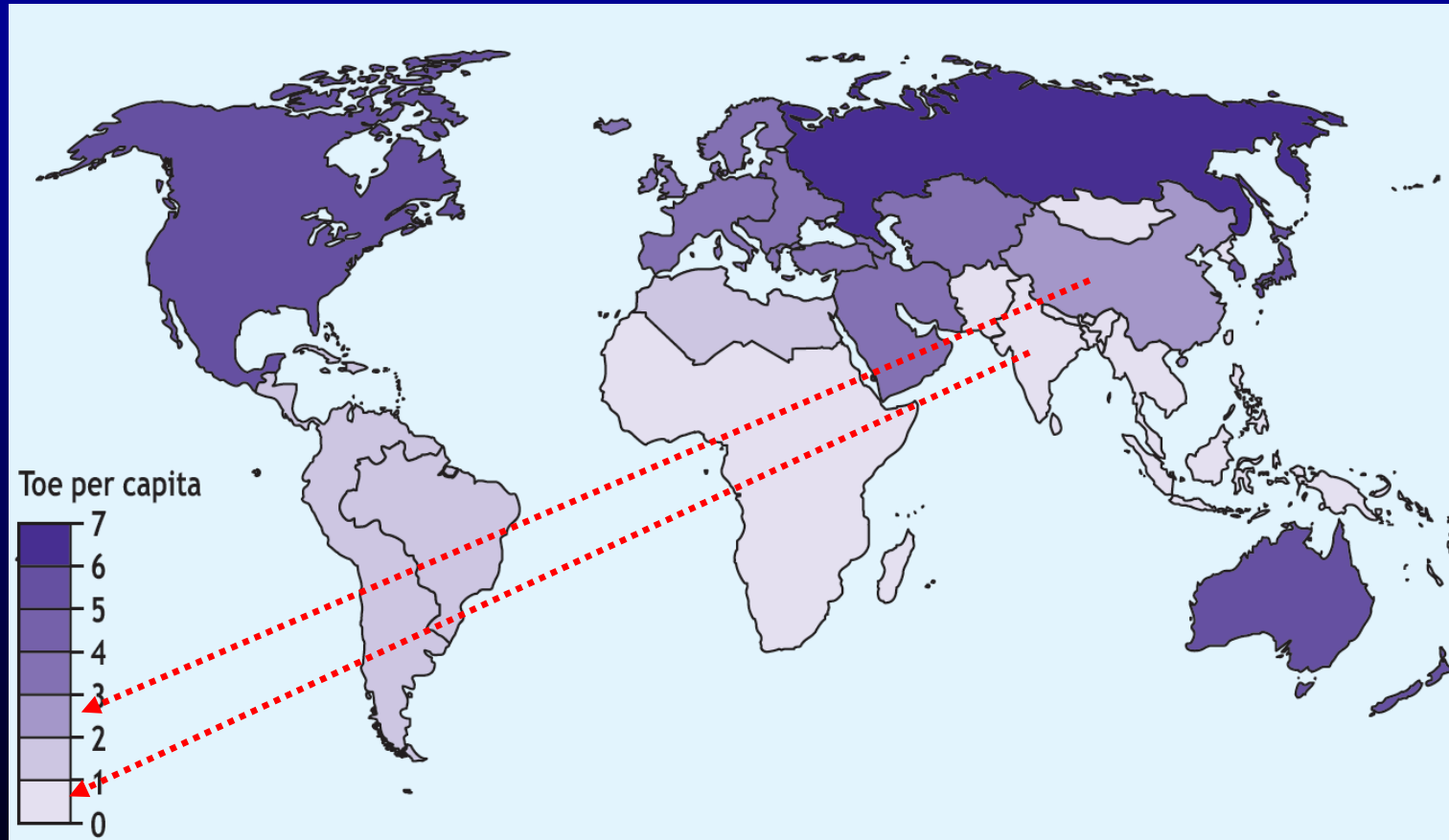
AIE, WEO 2008

El centre de gravetat del consum es desplaça als països en desenvolupament: la Xina, l'Índia...



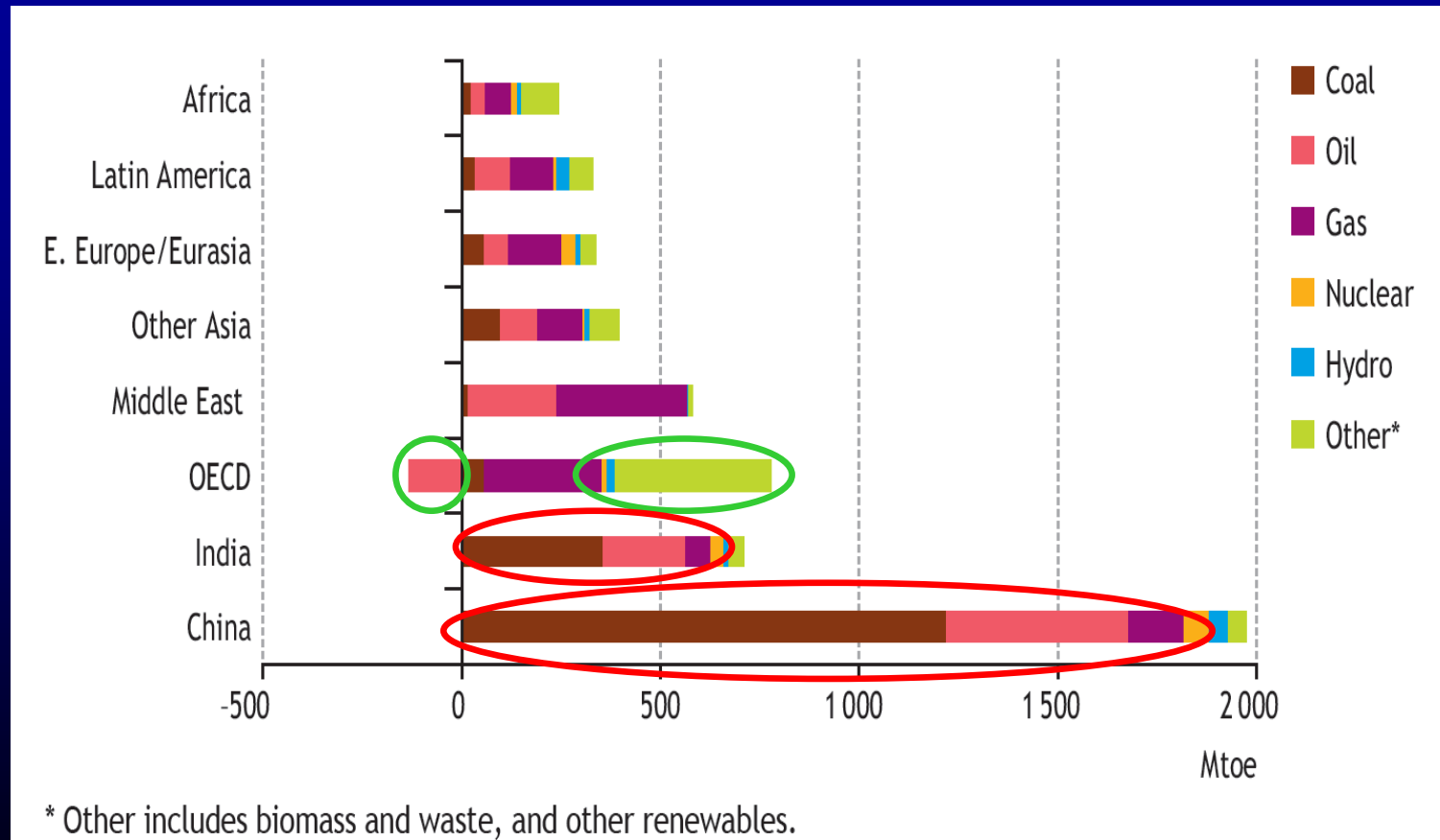
AIE, WEO 2008

No ens precipitem a buscar culpables: demanda energètica per càpita 2030



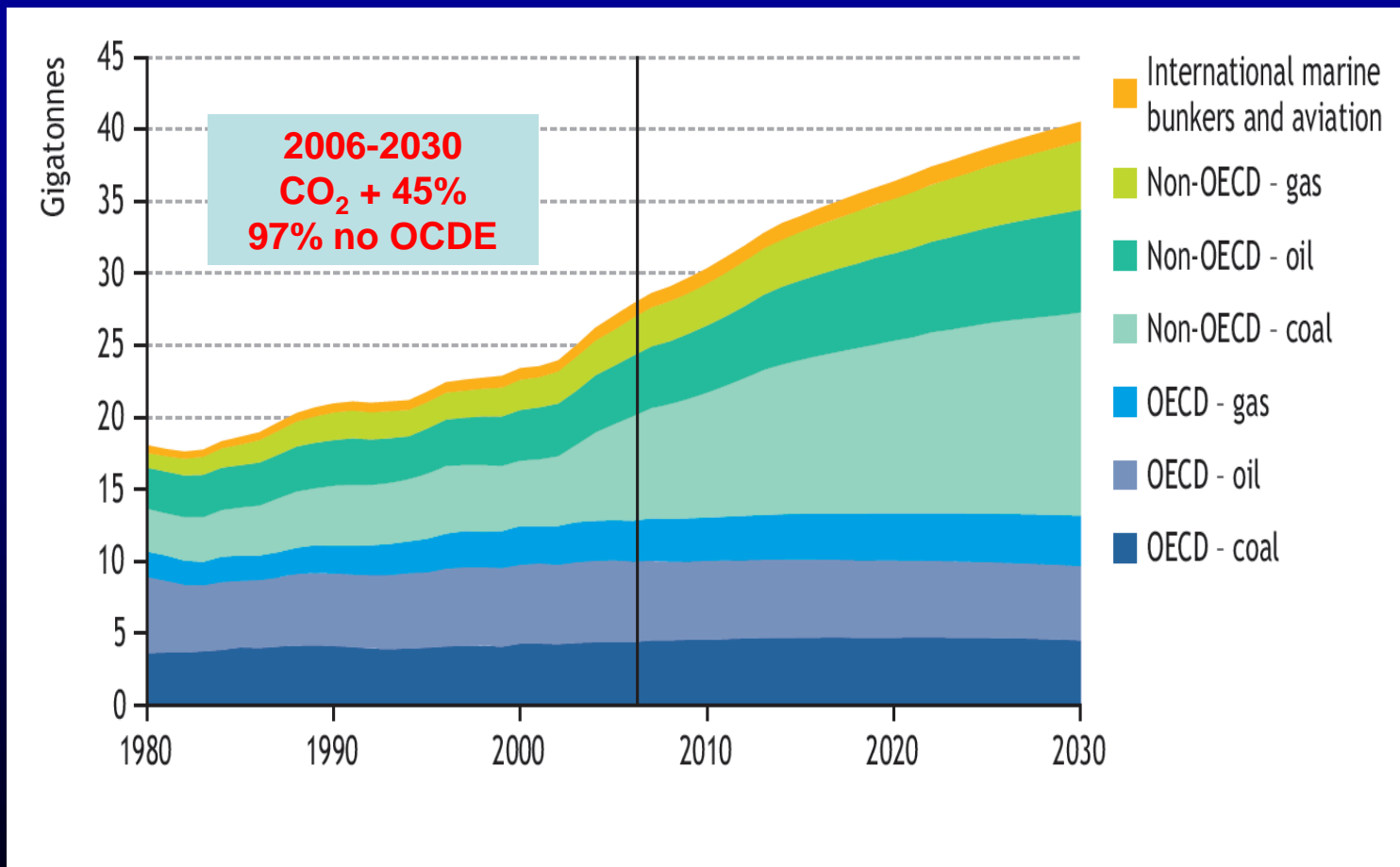
AIE, WEO 2008

Quines energies primàries impulsaran el creixement de les grans demografies?



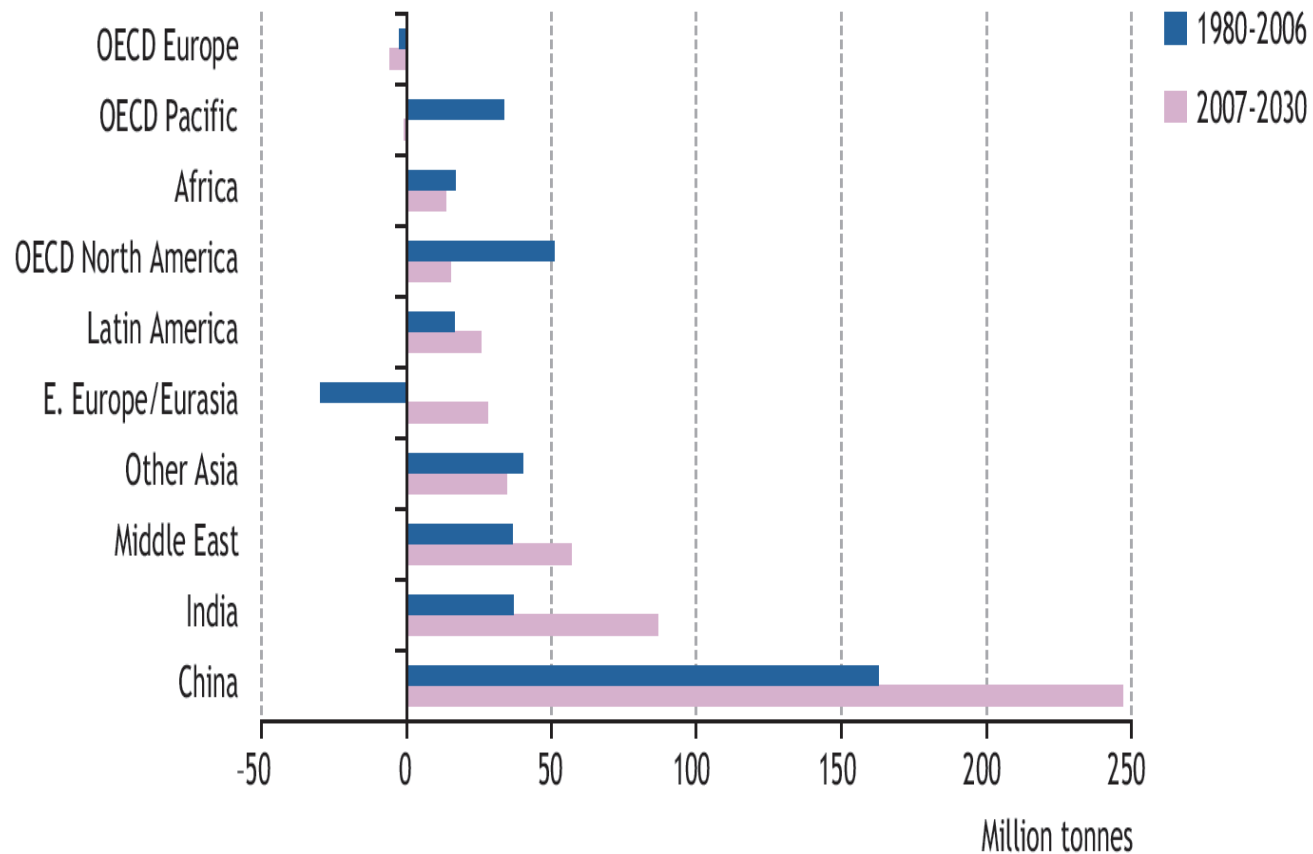
AIE, WEO 2008

Emissions de CO₂ per combustible i regió a l'Escenari de Referència



AIE, WEO 2008

Emissions de CO₂ vs. creixement econòmic i demogràfic



AIE, WEO 2008

Què podem fer?

Identitat de Kaya

$$\text{CO}_2 = \text{renda per càpita (PIB}_i/\text{P}_i) * \text{població (P}_i) \\ * \text{intensitat energètica (E}_i/\text{PIB}_i) * \text{factor d'emissió (CO}_{2i}/\text{E}_i)$$

L'opció radical

Identitat de Kaya

$$\text{CO}_2 = \text{renta per cápita } (\text{PIB}_i / P_i) * \text{población } (P_i)$$

* intensidad energética (E_i / PIB_i) * factor de emisión (CO_{2i} / E_i)

L'opció reformista

Identitat de Kaya

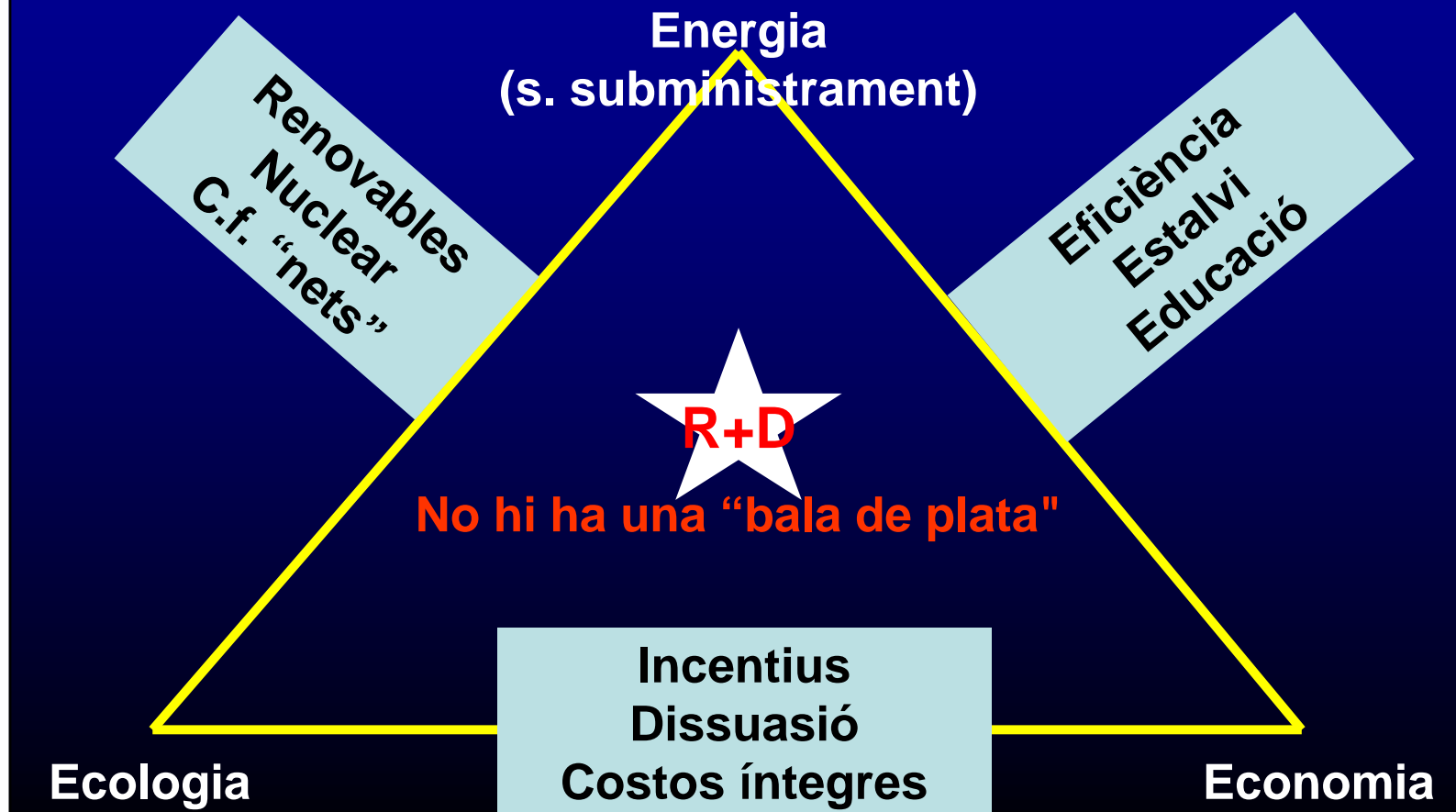
$CO_2 = \text{renta per cápita (PIBi/Pi)} * \text{población (Pi)}$

$* \text{intensidad energética (Ei/PIBi)} * \text{factor de emisión (CO2i/Ei)}$

Cercar l'equilibri entre les 3 "és" ...

Integrar política energètica amb les polítiques econòmiques, ambientals, de seguretat, afers exteriors i de R + D

Pacte d'estat i estats

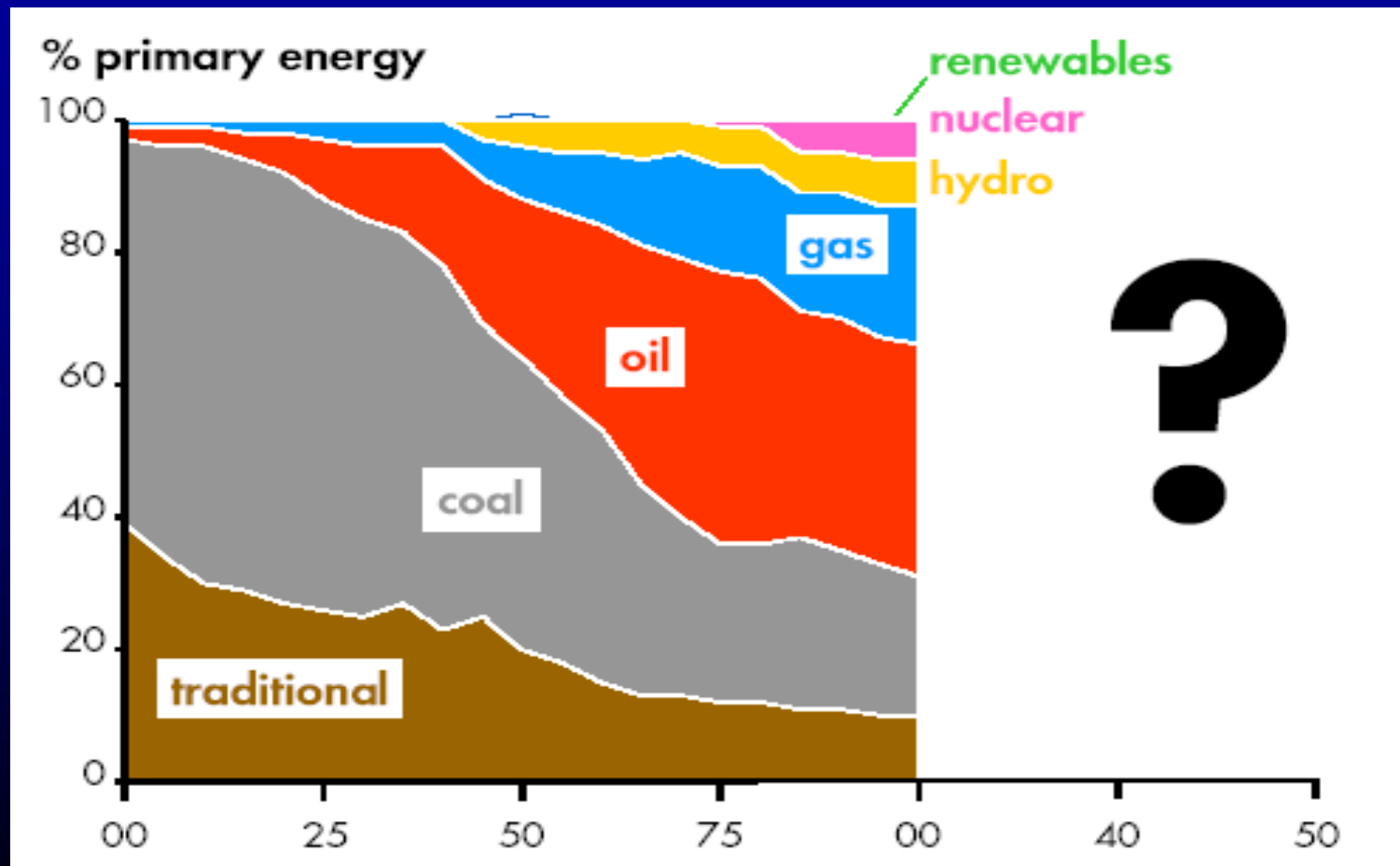


El somni reformista ...



Newsweek, 6-13 September 2004

... implica una revolució energètica



Raons per posar-se en camí (1)

The Intergovernmental Panel on Climate Change (IPCC) was set up jointly by the World Meteorological Organization and the United Nations Environment Programme to provide an authoritative international statement of scientific understanding of climate change. The IPCC's periodic assessments of the causes, impacts and possible response strategies to climate change are the most comprehensive and up-to-date reports available on the subject, and form the standard reference for all concerned with climate change in academia, government and industry worldwide. This Synthesis Report is the fourth element of the IPCC Fourth Assessment Report "Climate Change 2007". Through three working groups, many hundreds of international experts assess climate change in this Report. The three working group contributions are available from Cambridge University Press:

Climate Change 2007 – The Physical Science Basis

Contribution of Working Group I to the Fourth Assessment Report of the IPCC
(ISBN 978 0521 88009-1 Hardback; 978 0521 70596-7 Paperback)

Climate Change 2007 – Impacts, Adaptation and Vulnerability

Contribution of Working Group II to the Fourth Assessment Report of the IPCC
(978 0521 88010-7 Hardback; 978 0521 70597-4 Paperback)

Climate Change 2007 – Mitigation of Climate Change

Contribution of Working Group III to the Fourth Assessment Report of the IPCC
(978 0521 88011-4 Hardback; 978 0521 70598-1 Paperback)

Climate Change 2007 – Synthesis Report is based on the assessment carried out by the three Working Groups of the IPCC. It provides an integrated view of climate change and addresses the following topics:

- Observed changes in climate and their effects
- Causes of change
- Climate change and its impacts in the near and long term under different scenarios
- Adaptation and mitigation options and responses, and the interrelationship with sustainable development, at global and regional levels
- The long-term perspectives: scientific and socio-economic aspects relevant to adaptation and mitigation, consistent with the objectives and provisions of the Convention, and in the context of sustainable development
- Robust findings, key uncertainties

CLIMATE CHANGE 2007 SYNTHESIS REPORT



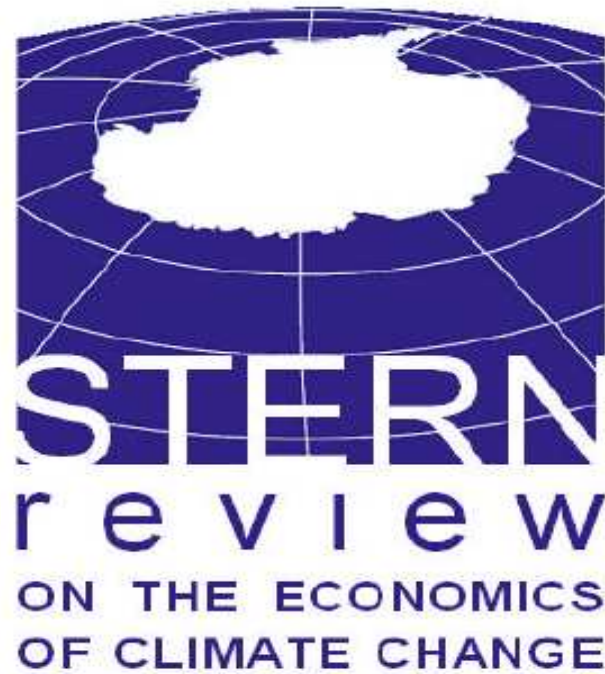
CLIMATE CHANGE 2007 – SYNTHESIS REPORT



A Report of the Intergovernmental Panel on Climate Change



Raons per posar-se en camí (2)



October 30, 2006

Raons per posar-se en camí (3)

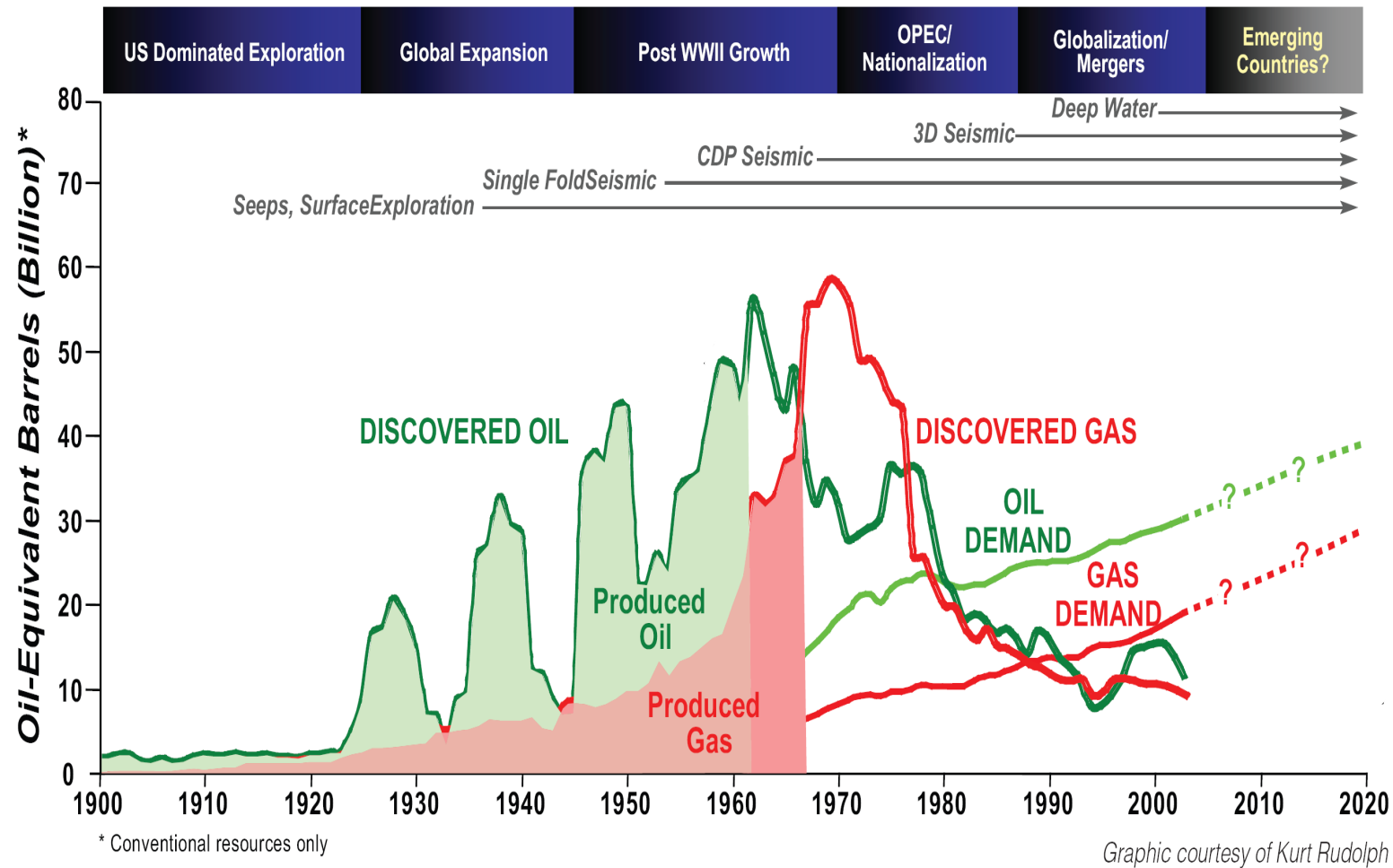
NEWSFOCUS

SCIENCE,
21 November 2008,
Vol 322

World Oil Crunch Looming?

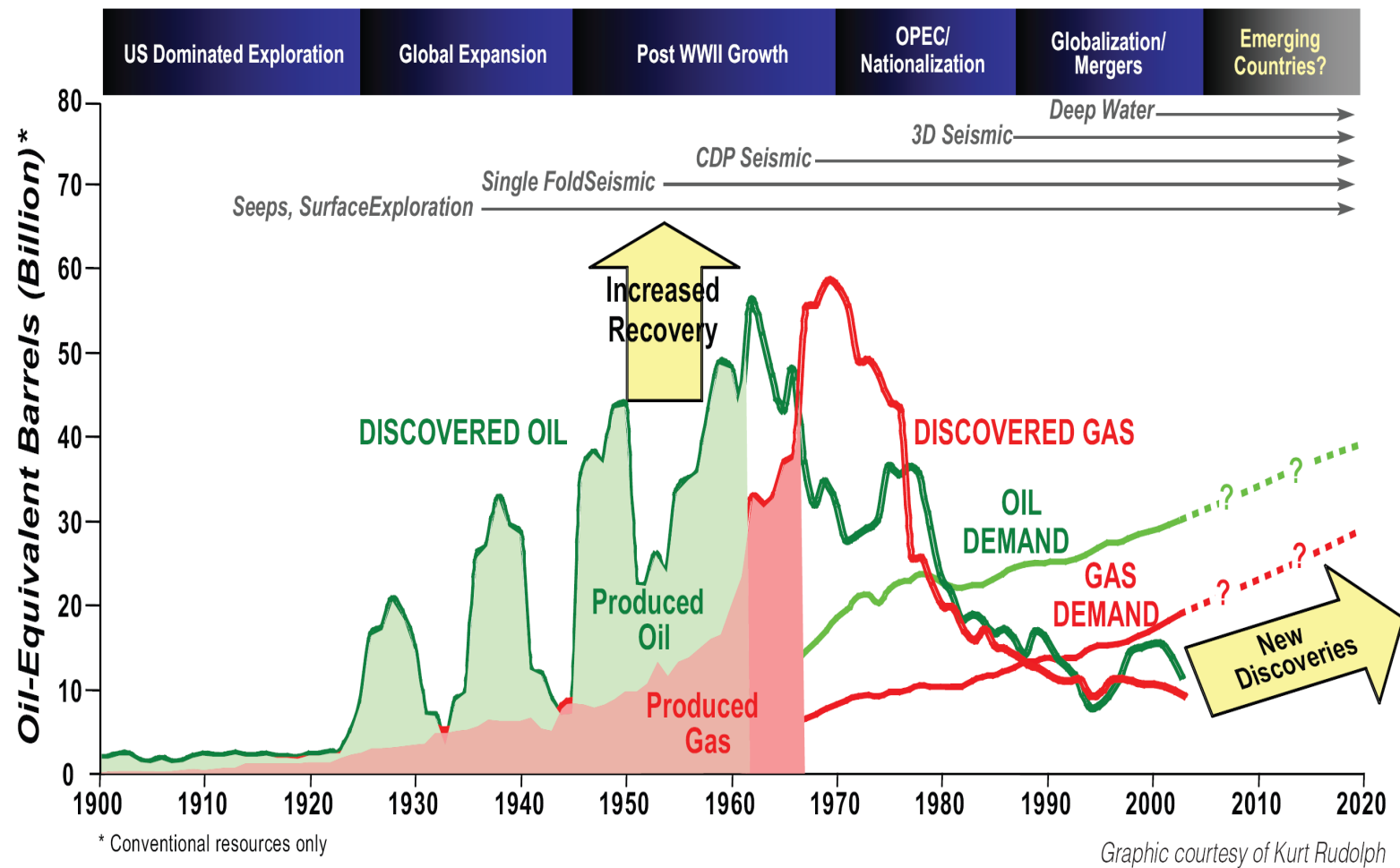
Even those who believe there's plenty of oil left in the ground to meet rising demand are warning that the final crisis could come uncomfortably soon

Historical Perspective



AAPG Explorer, March 2007

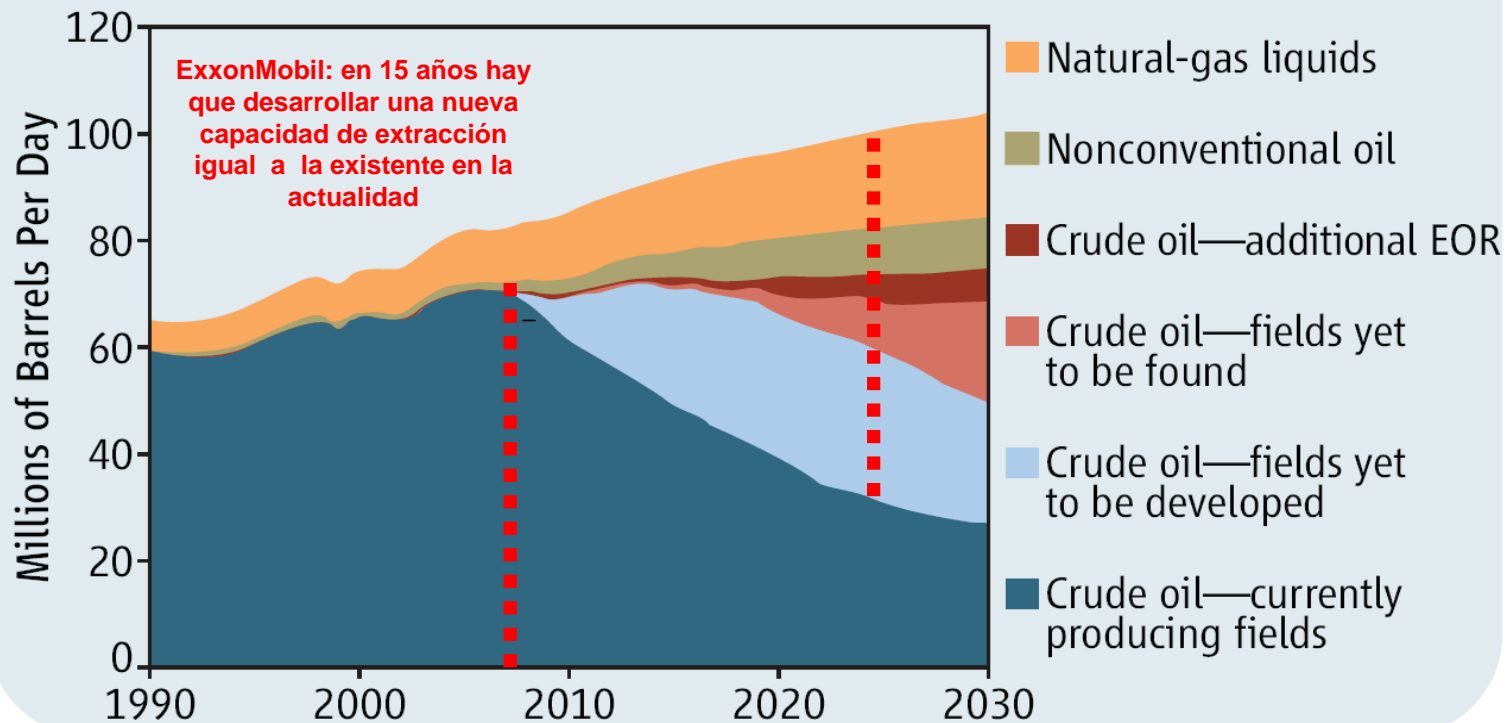
Historical Perspective



AAPG Explorer, March 2007

Sense "relleu generacional" la producció de molts jaciments ha entrat en declivi (5-11% anual)

IEA WORLD OIL PRODUCTION SCENARIO



SCIENCE, 21 November 2008, Vol 322

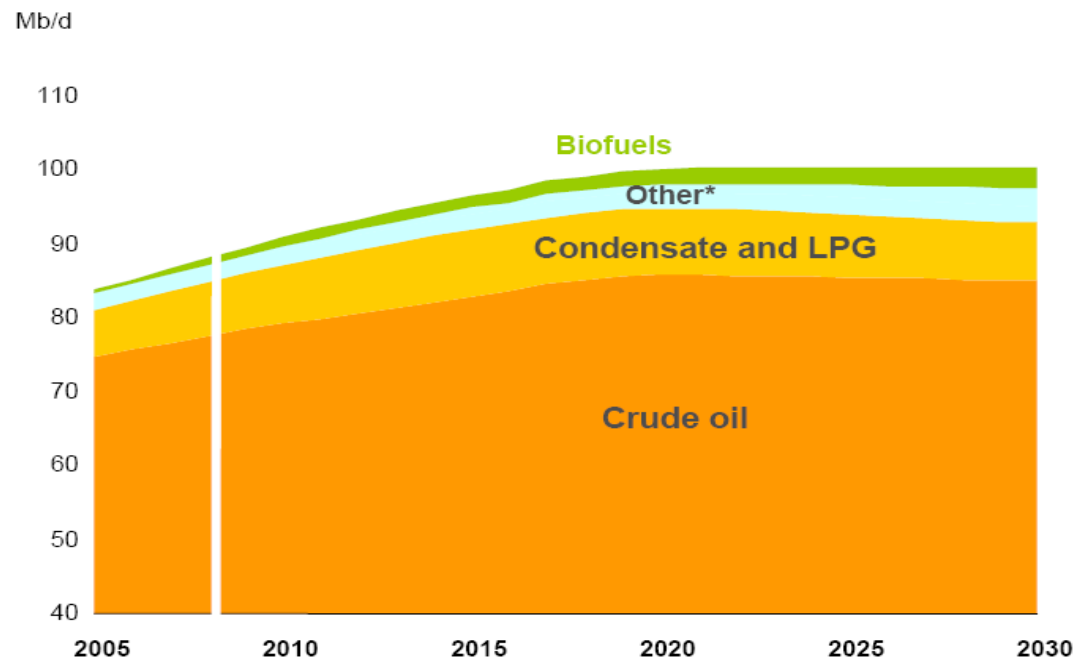
The Energy Outlook in 2030 According to Total

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

Energy & Environment Press Seminar - June 2, 2008



2020: La demanda de líquids es tindrà d'adaptar a un límit de subministrament proper als 100 Mb/d

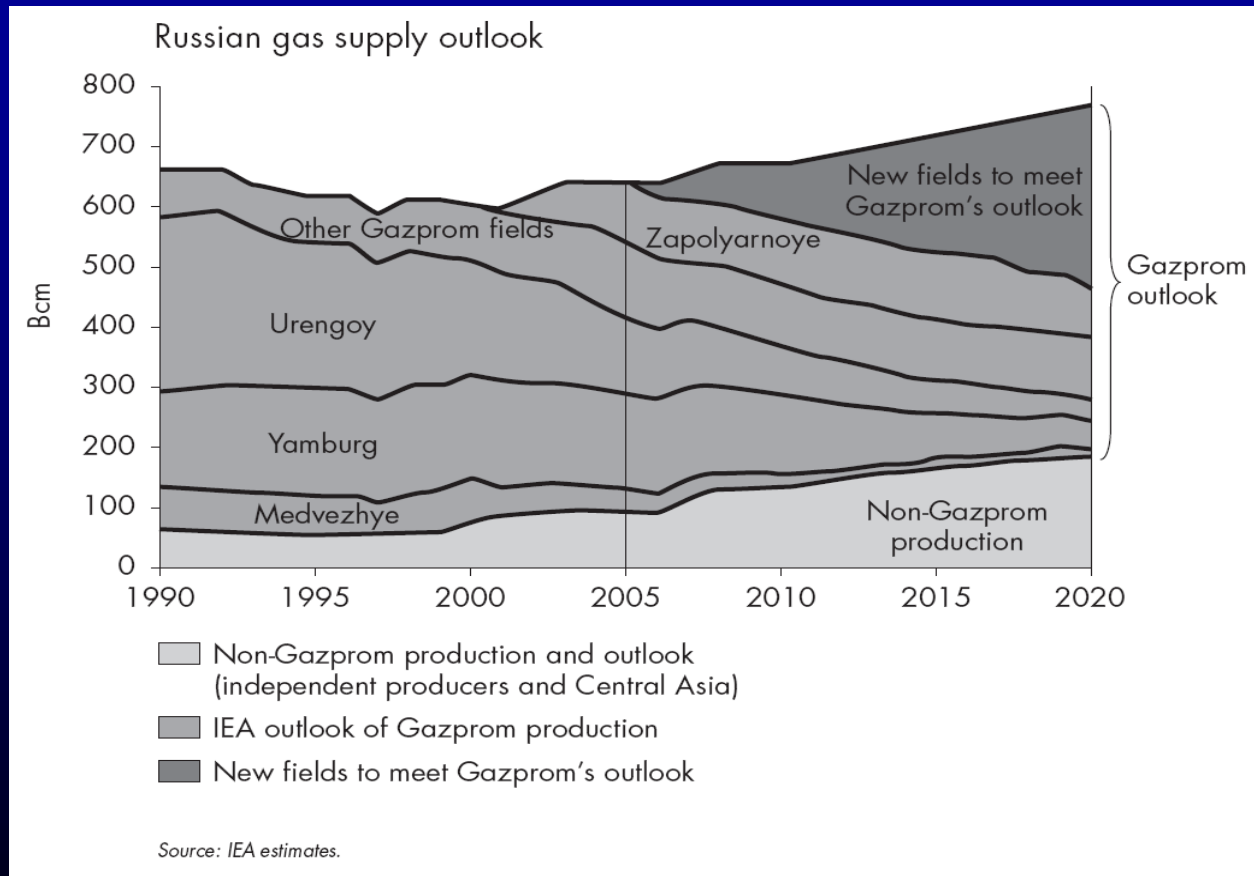


* Other: GTL + CTL and refining gains.

7 Energy & Environment Press Seminar - June 2, 2008



Guerra del gas: el problema serà alimentar els gasoductes





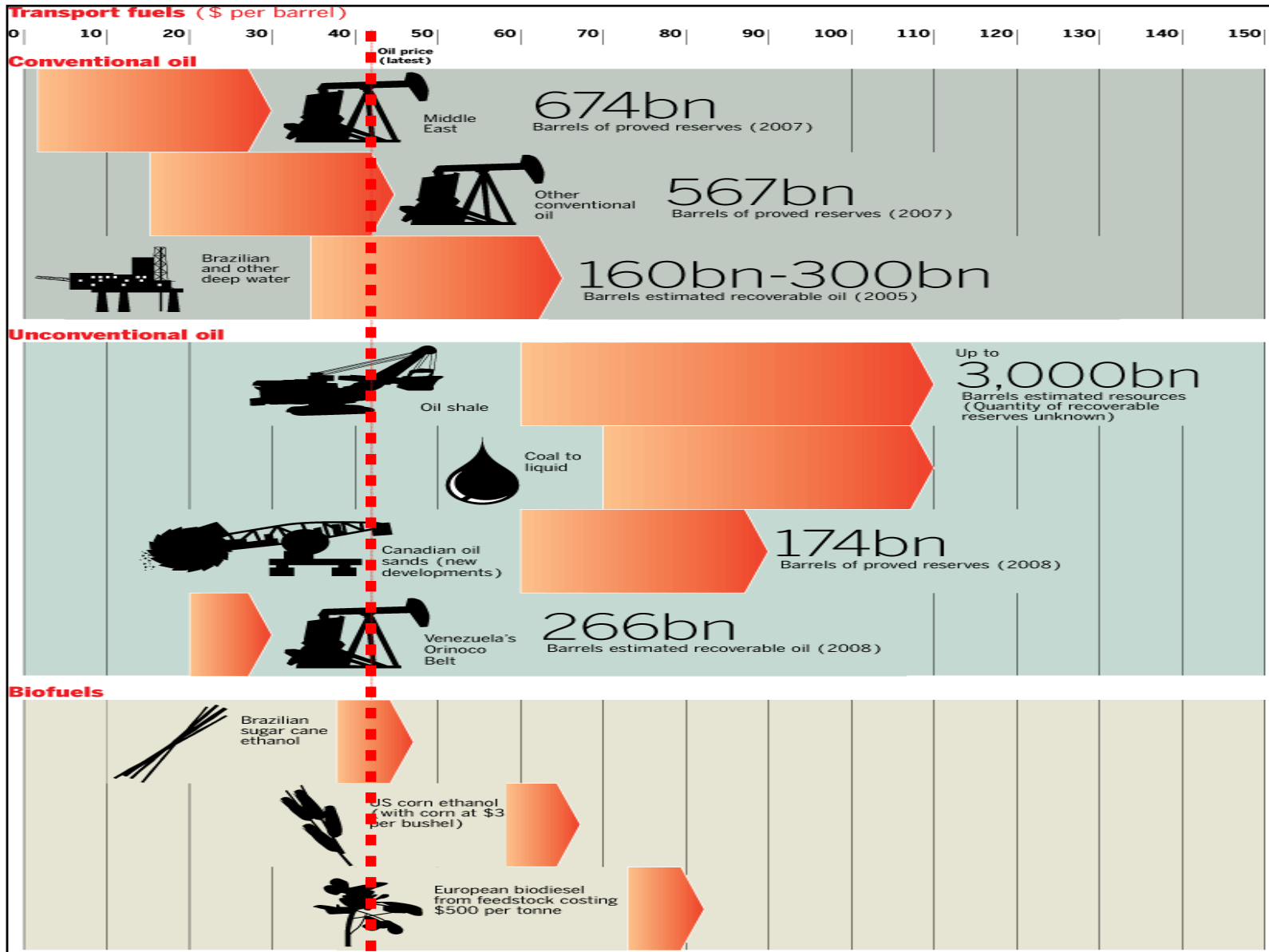




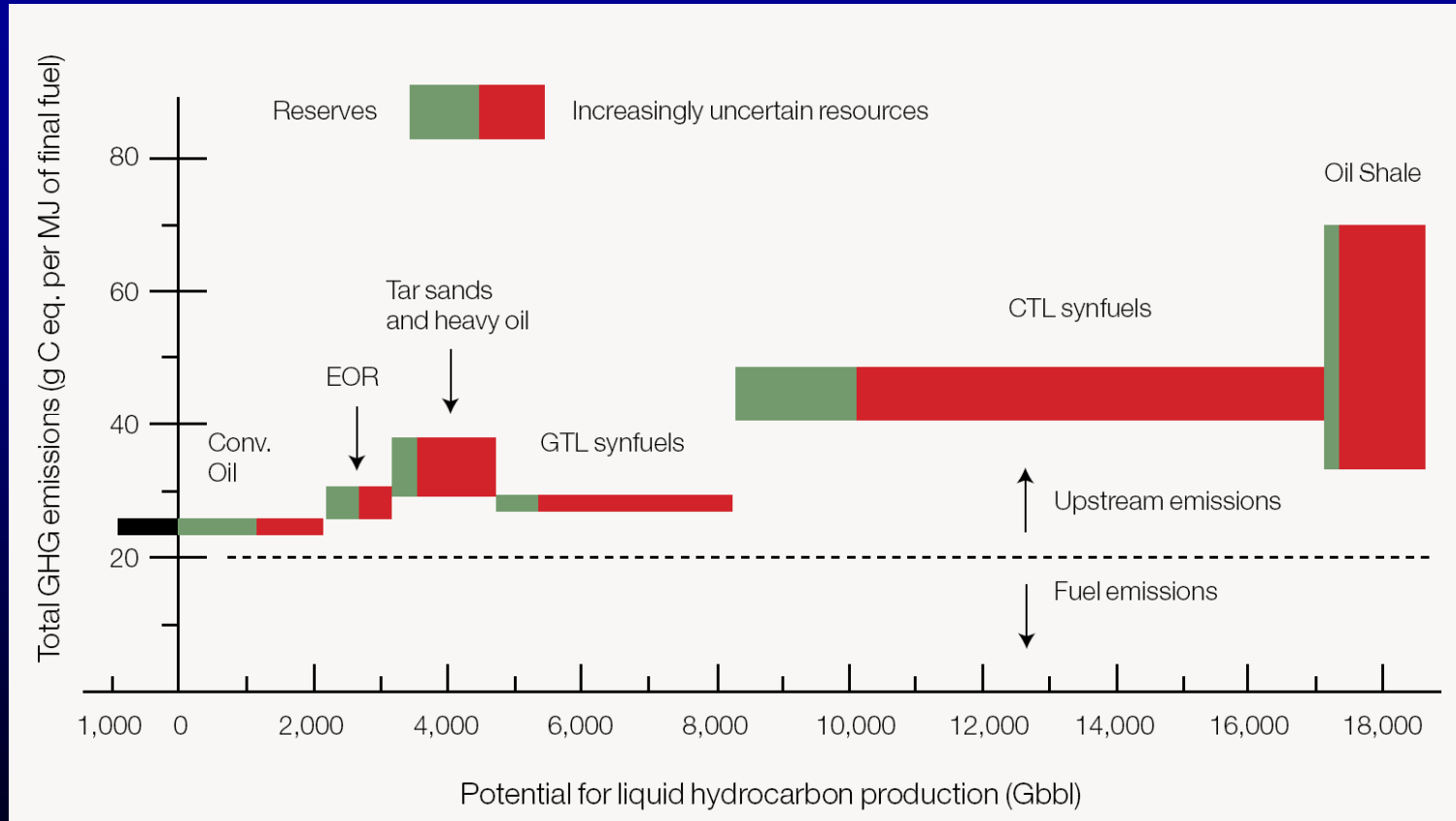


*400 tonne trucks, the size of a house,
at the Shell Albian mine.*





Emissions de gasos d'efecte hivernacle per la producció de combustibles fòssils

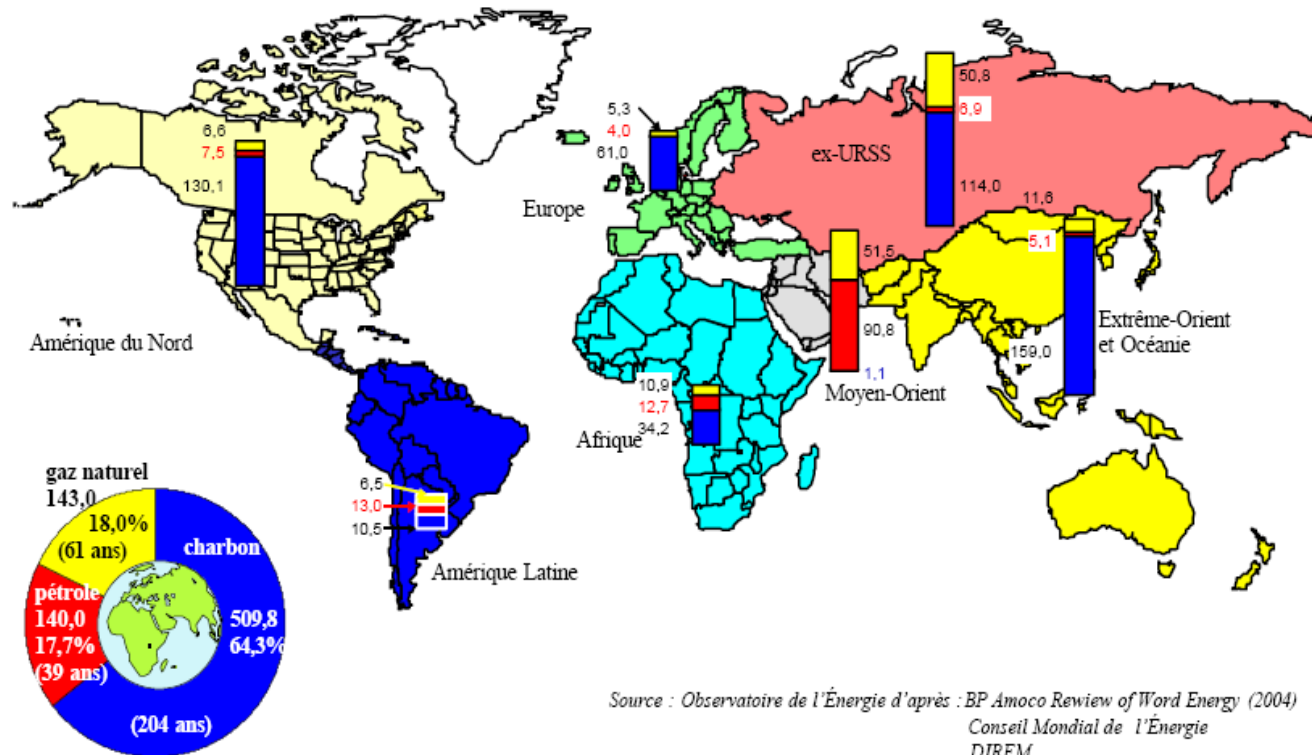


Brandt and Farrell (2006)

El futur del carbó no és negre, però ¿serà net?

Réserves énergétiques mondiales (1^{er} janvier 2003)

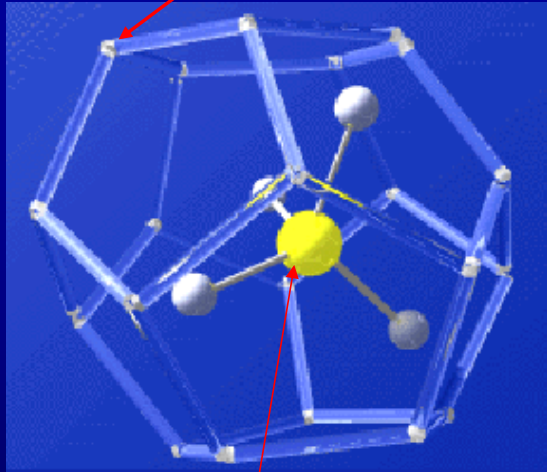
Unité : Milliard de tep



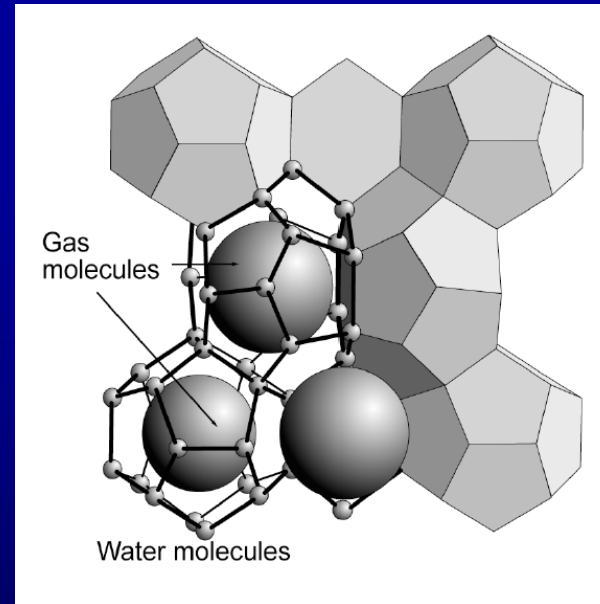
Hidratos de gas: hielo inflamable



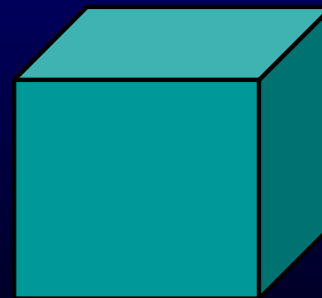
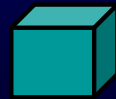
Moléculas de agua



Molécula de metano



a presión y temperatura estándar



+



1 m³ hidrato de gas

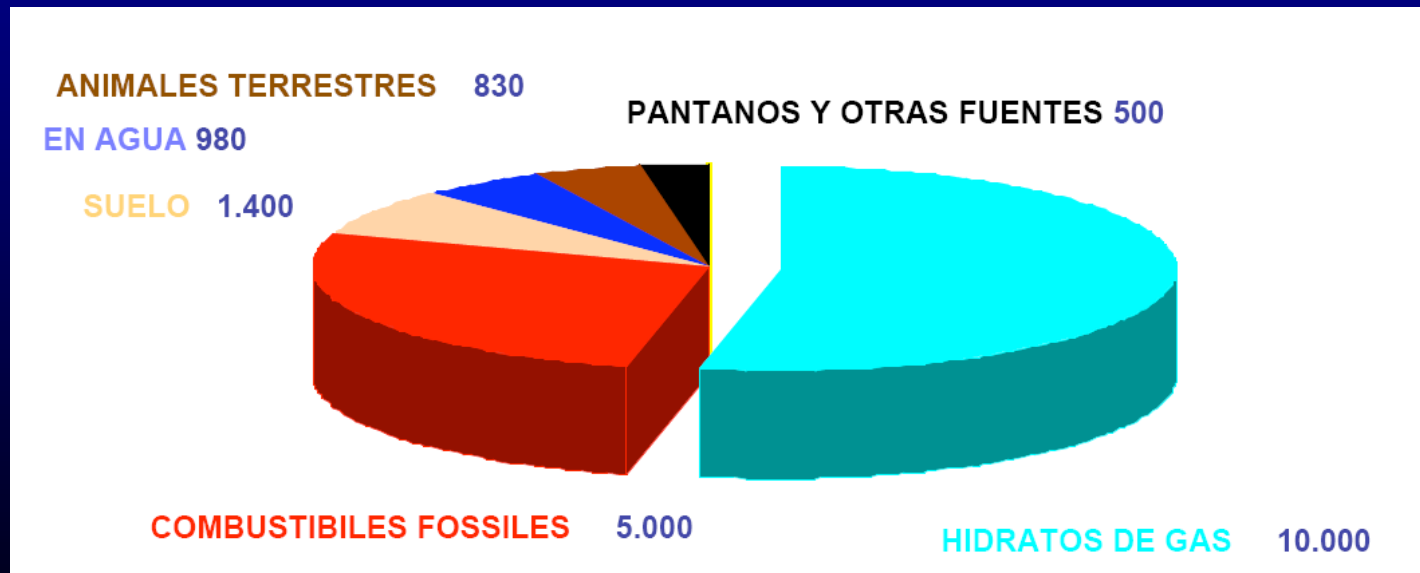
164 m³ gas

0.8 m³ agua

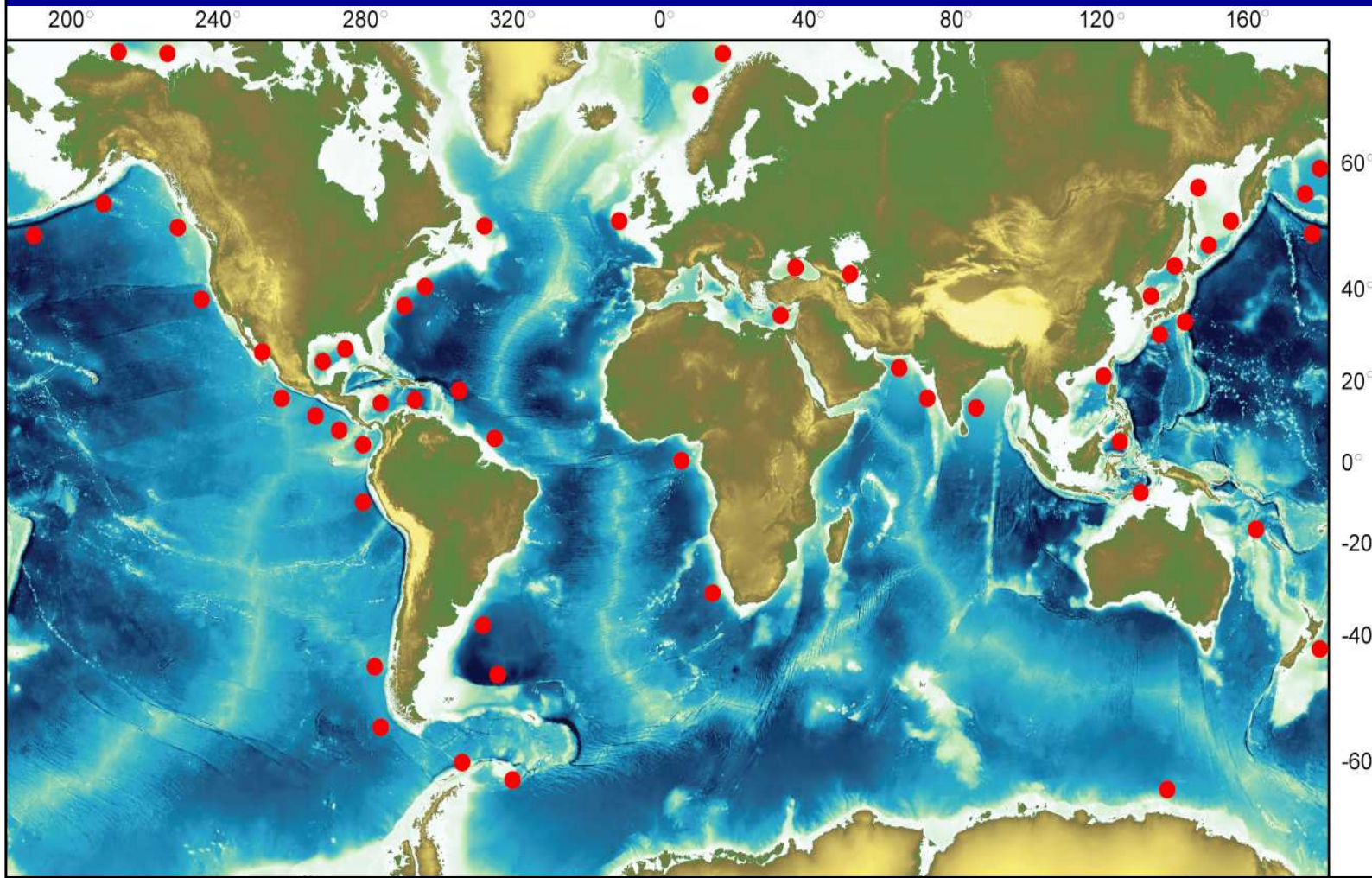
Hydrates concentrate 160 times more methane in the same space as free gas at atmospheric pressure.

¿Cuántos hidratos de gas hay? Son la reserva de metano mas grande del planeta

Estimación en cantidad de átomos de carbono (10^{15} g)



Distribución global de hidratos de gas en sedimentos oceánicos



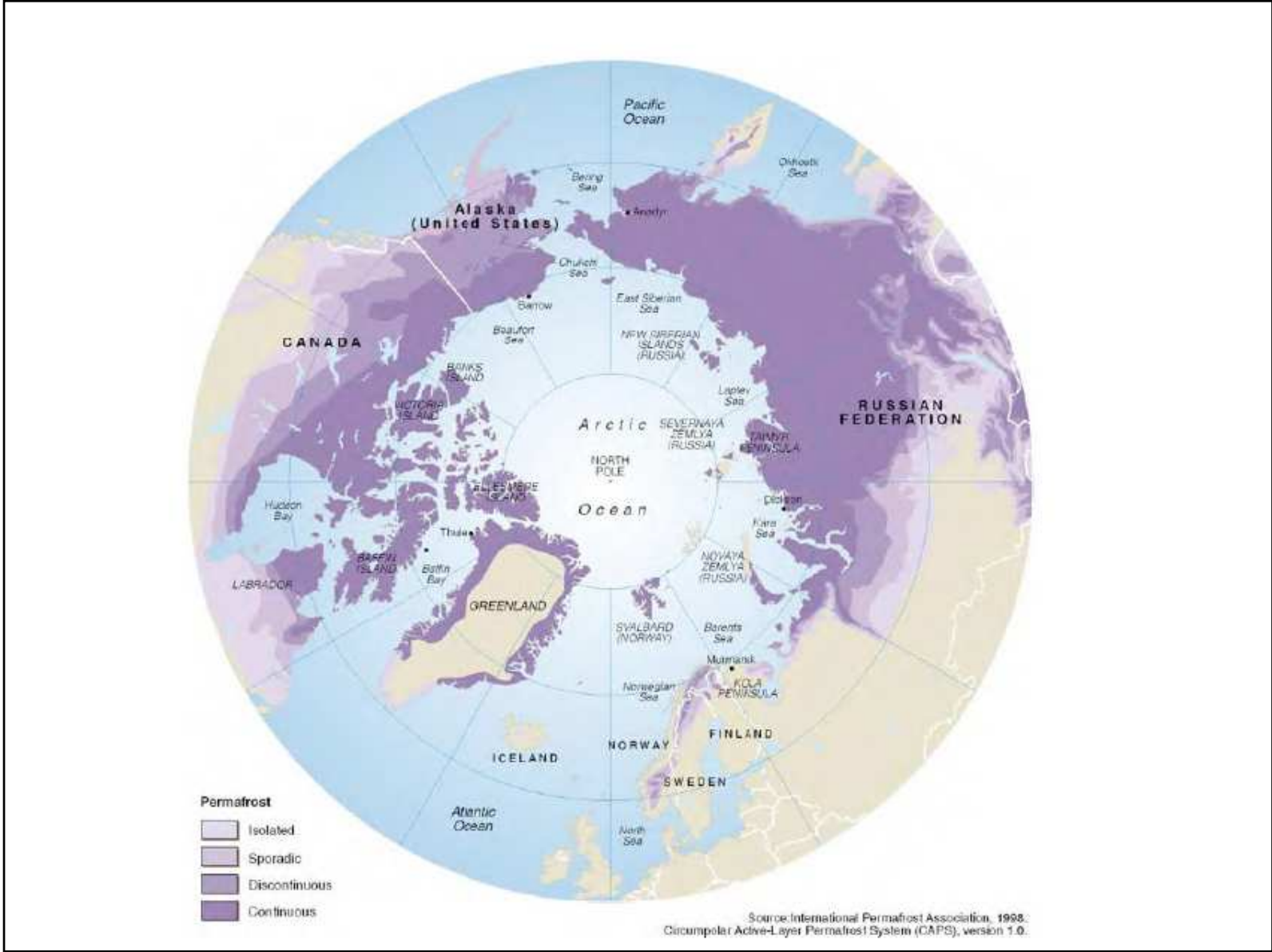
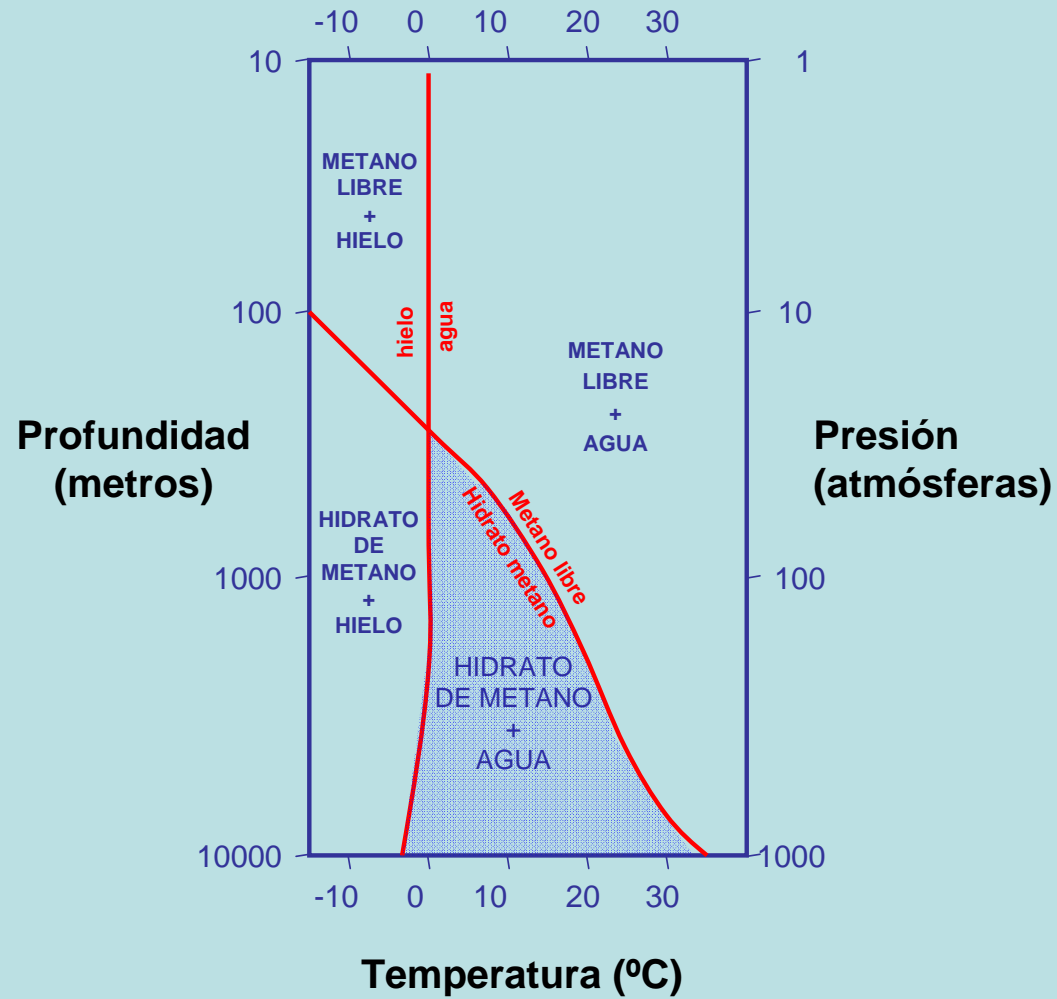
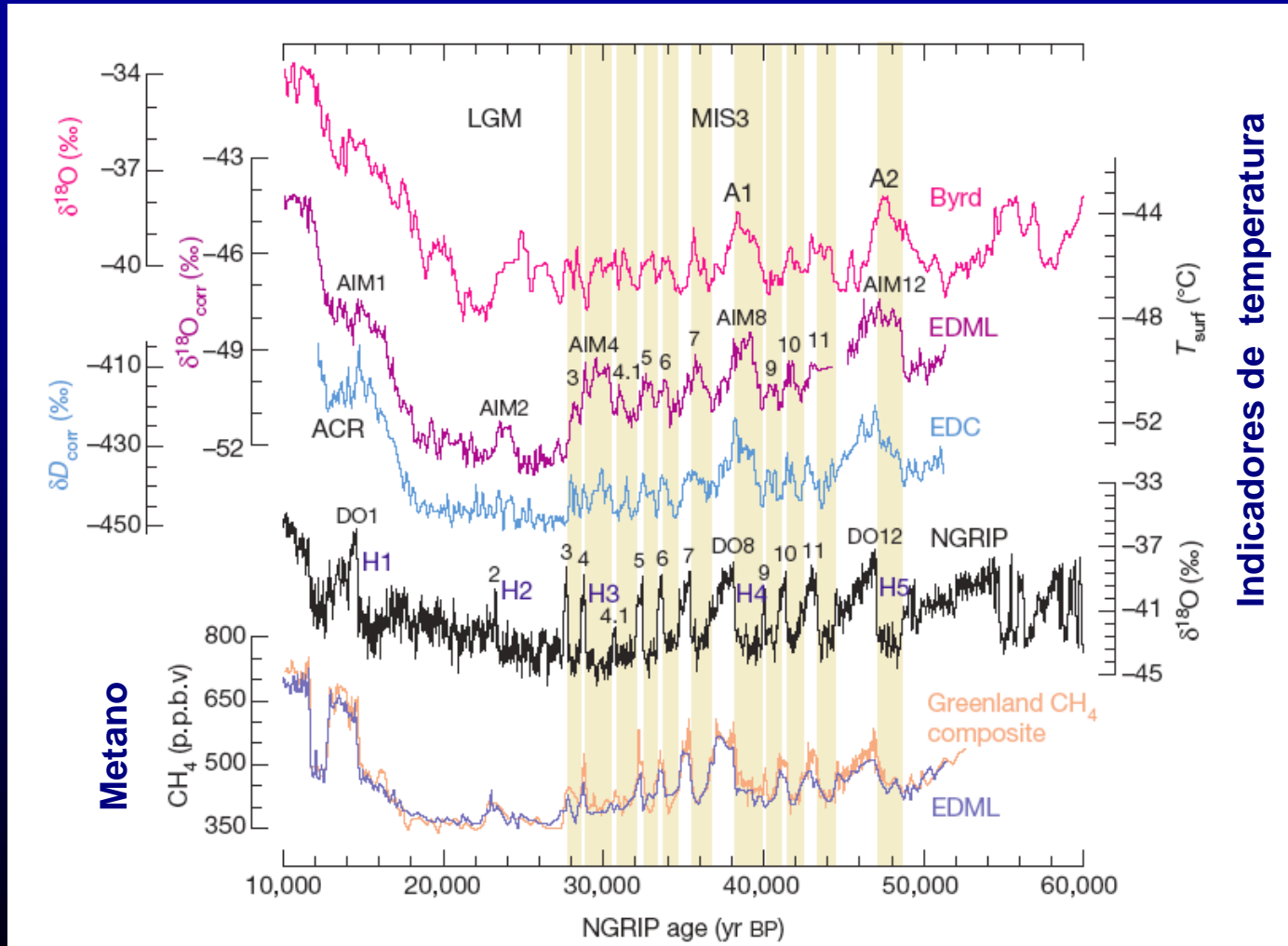


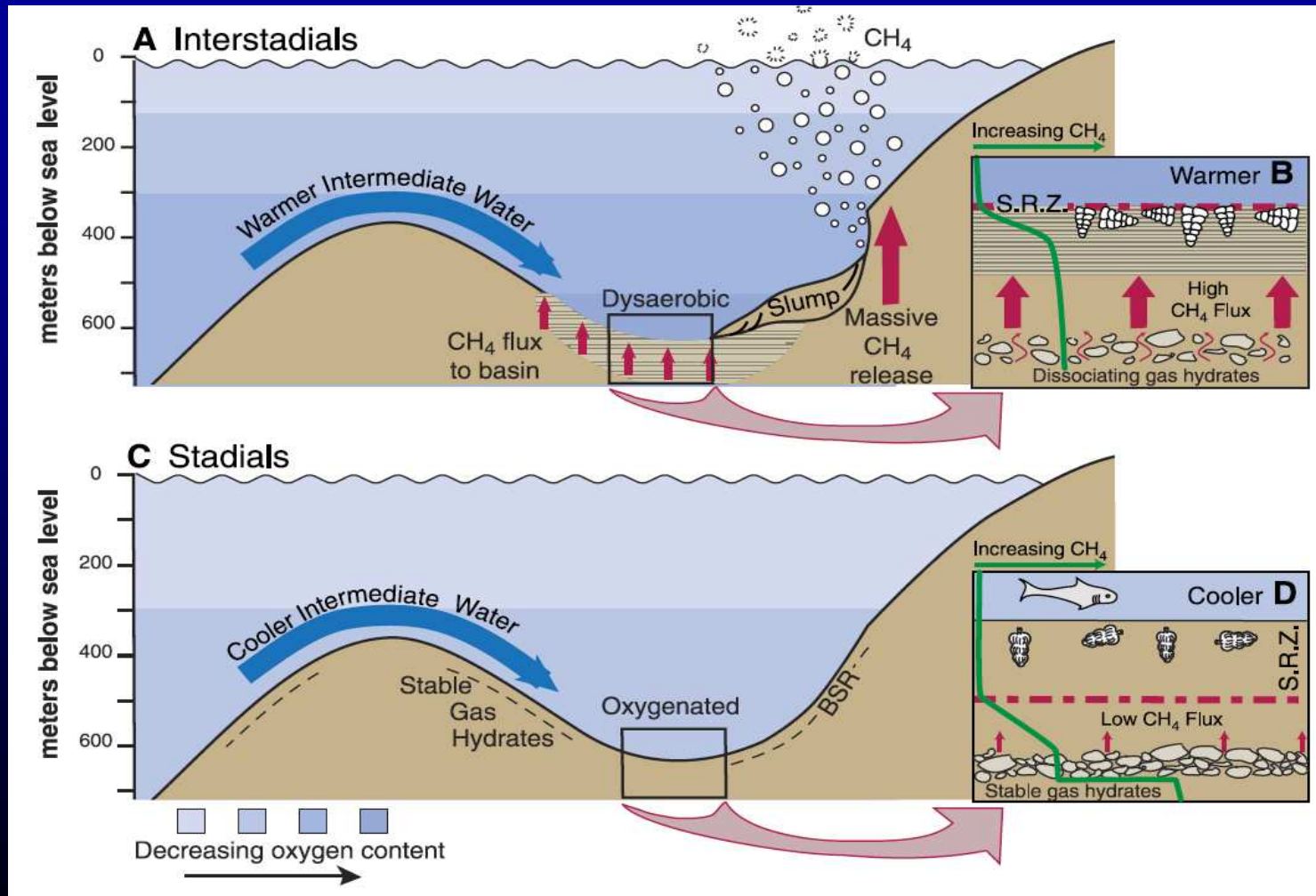
Diagrama de fases de los hidratos de gas



Mas metano atmosférico en periodos de clima calido



The clathrate gun hypothesis



Kennett et alii, Science, 2000

Raons per posar-se en camí (4)



KAL's cartoon, Jan 8th 2009, *The Economist*

Raons per posar-se en camí (5)



Oil and the New Economic Order

by Gal Luft



February 2008
Institute for the Analysis of Global Security (IAGS)

At \$100 oil OPEC could potentially buy Bank of America in two months worth of production, Apple Computers in two weeks and GM in just 6 days. It would take less than three years of production for OPEC to own 20% (which essentially ensures a voting block in most corporations) of every S&P 500 company.

In order to avoid OPEC's economic hegemony consumers should do their utmost to strip oil of its power, to turn it from a strategic commodity into just another commodity.

Canvi de prioritats?



La piràmide de Maslow per l'energia i el desenvolupament

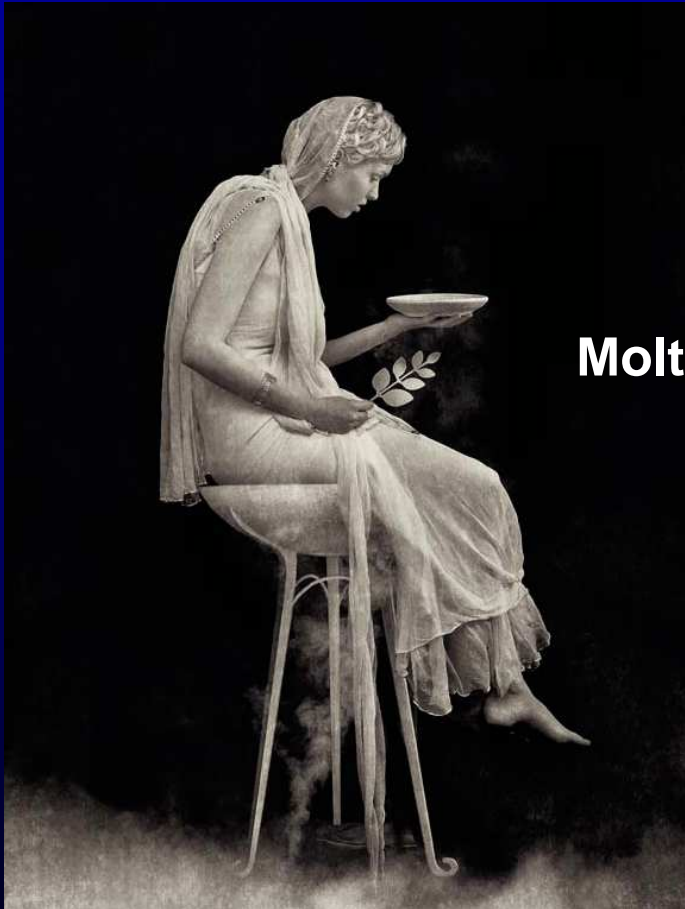
The Green Rescue

WHY OBAMA, BROWN, SARKOZY AND OTHER WORLD LEADERS ARE PUSHING
A GREEN SOLUTION TO THE ECONOMIC CRISIS



Newsweek , 3-11-2008

Geologia, hidrocarburs i l'oracle de Delfos



Moltes gràcies

