World Coal Institute

Coal's Contribution to Sustainable Development

World Bank Energy Week
Washington, 7 March 2006

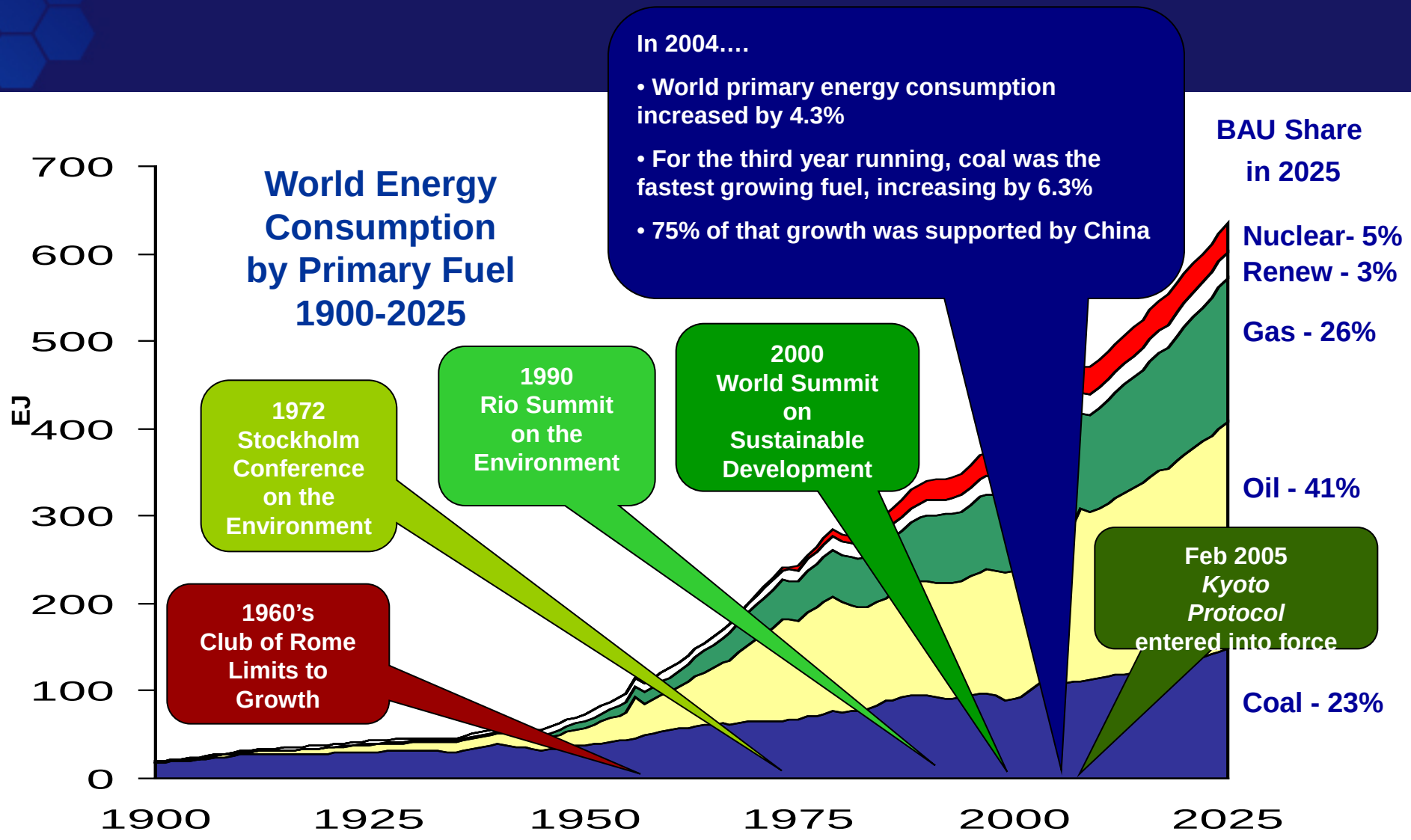
Preston Chiaro

WCI Corporate Members

WCI Associate Members

plus: Shaanxi Coalfields (**PRChina**) SIECESC (**Brazil**)

Growing energy demand and pressures



Source: RMI analysis, IEA 2004, EIA IEO 2004, BP Statistical Review 2003/4/5, IFP

Why coal?

safe **affordable** **reliable** **plentiful** **increasingly clean**

23% of world primary energy

39% of the world's electricity is produced using coal. Main fuel for electricity in USA, Germany, China, India, South Africa, Australia, much of central Europe

70% of the world's steel is produced using coal

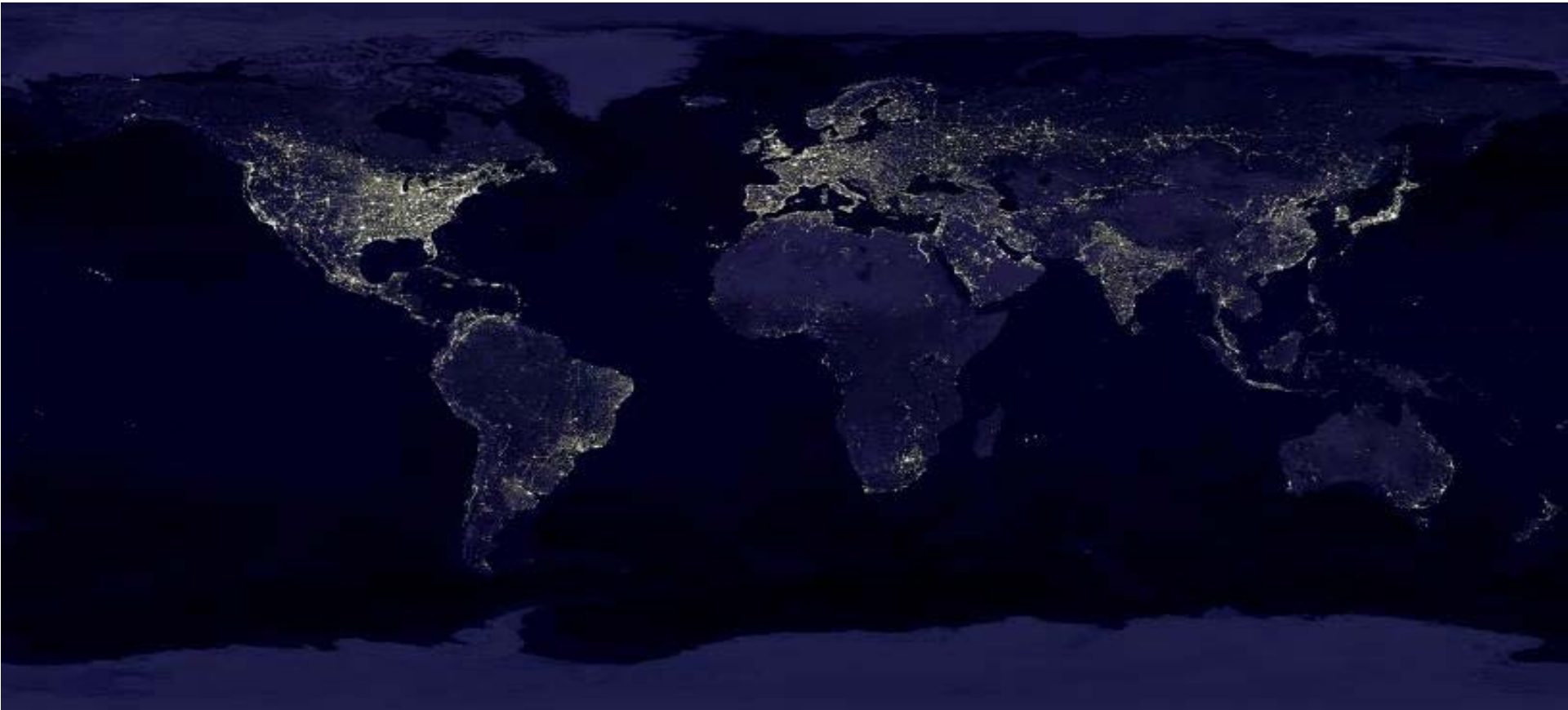
A necessary role in a developing world

In 2002

A world population of 6 billion and growing
1.6 billion without access to electricity
2.4 billion reliant on primitive/erratic sources

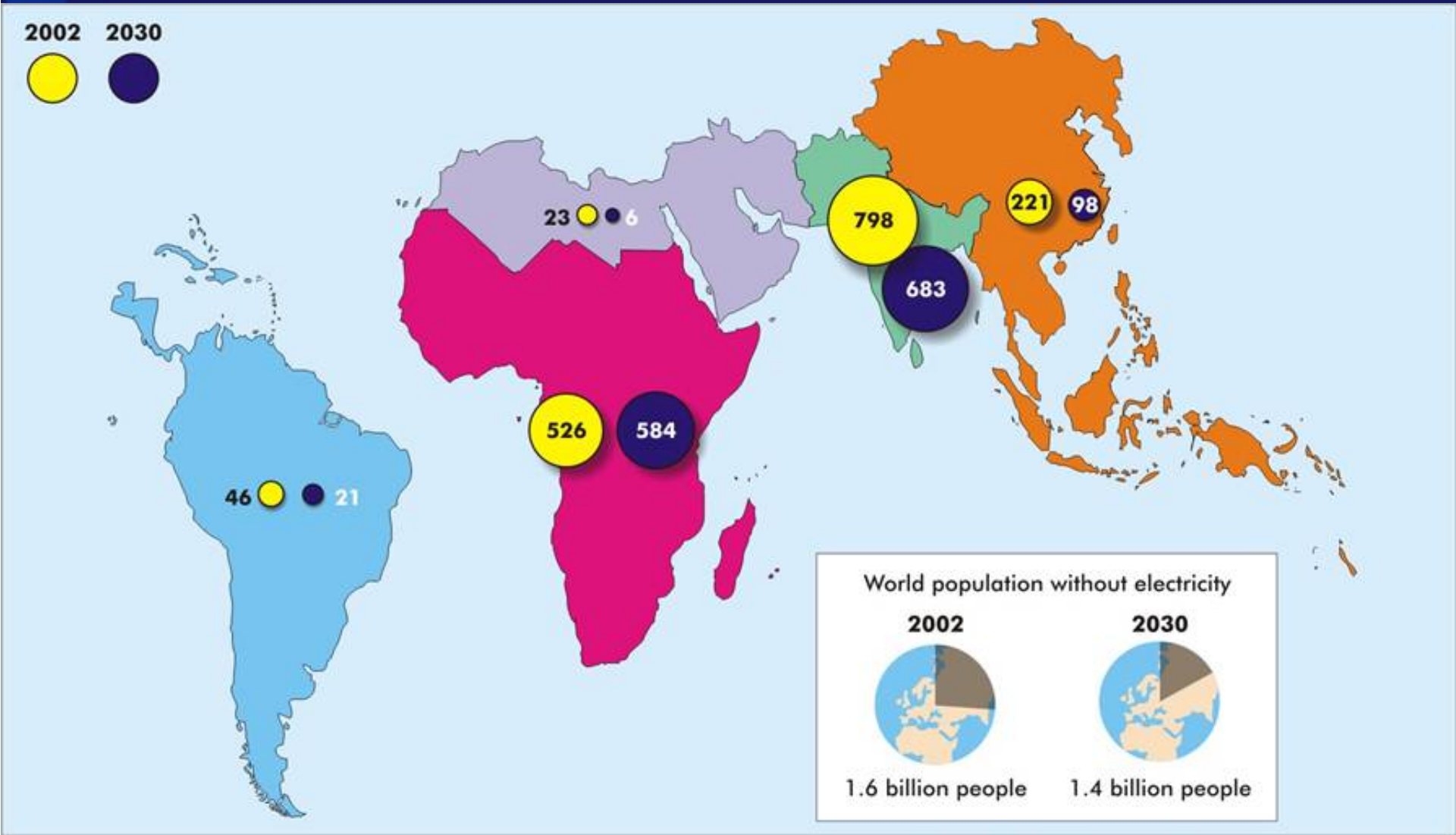
In 2030

A world population of 7.5 billion and growing
1.4 billion without access to electricity
2.6 billion still reliant on primitive and erratic sources



Electricity Deprivation

(IEA – World Energy Outlook 2004)



Tackling energy poverty

- **CHINA**
  - 700 million people over past 20 years
  - Electrification rate of 99%
  - Serviced by a generation industry 77% dependent on coal

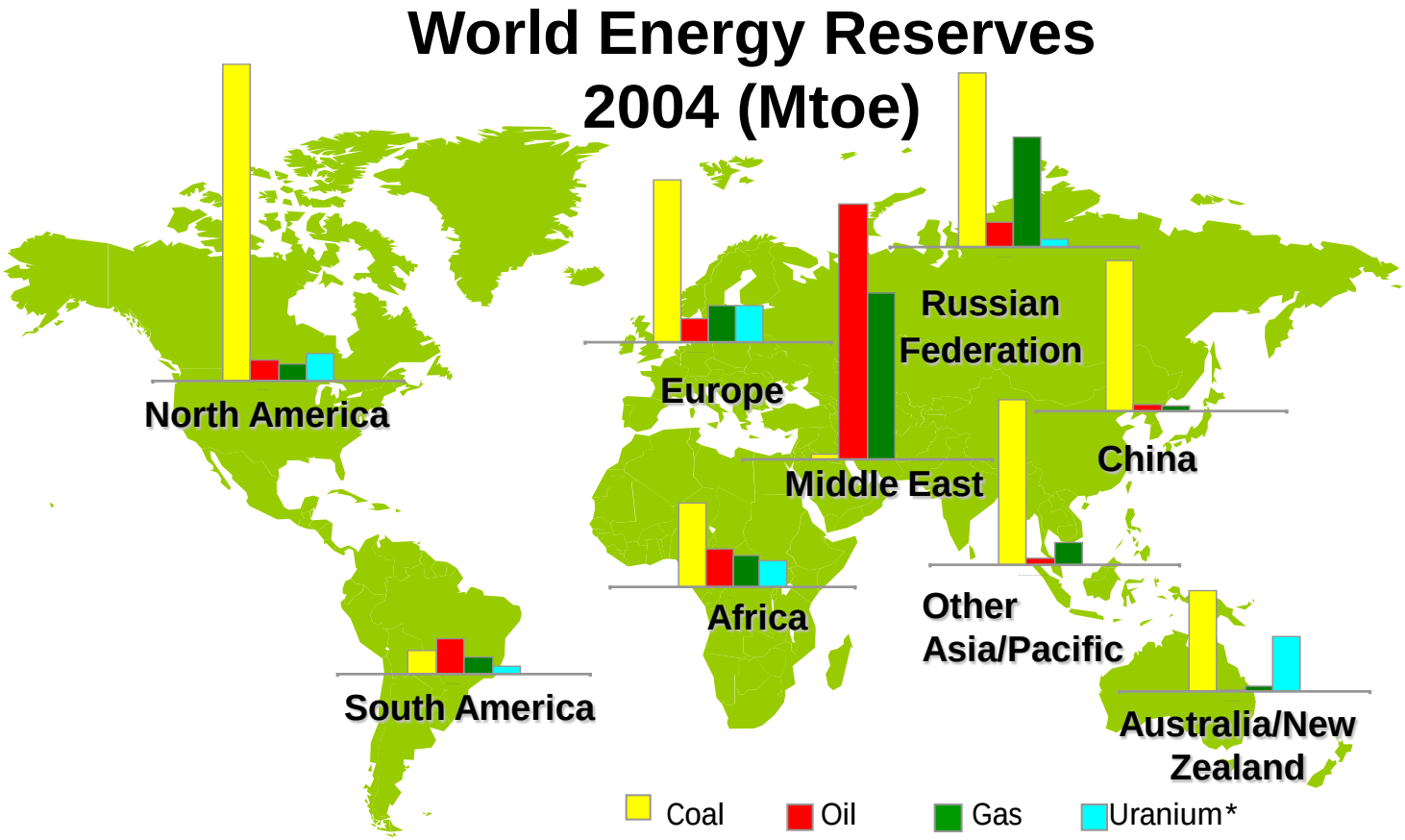
- **SOUTH AFRICA**
  - Electrification rate doubled in a decade (35% to 66%)
  - Serviced by a generation industry 90% dependent on coal

REST OF SUB-SAHARAN AFRICA

-Electrification rate of only **10%**

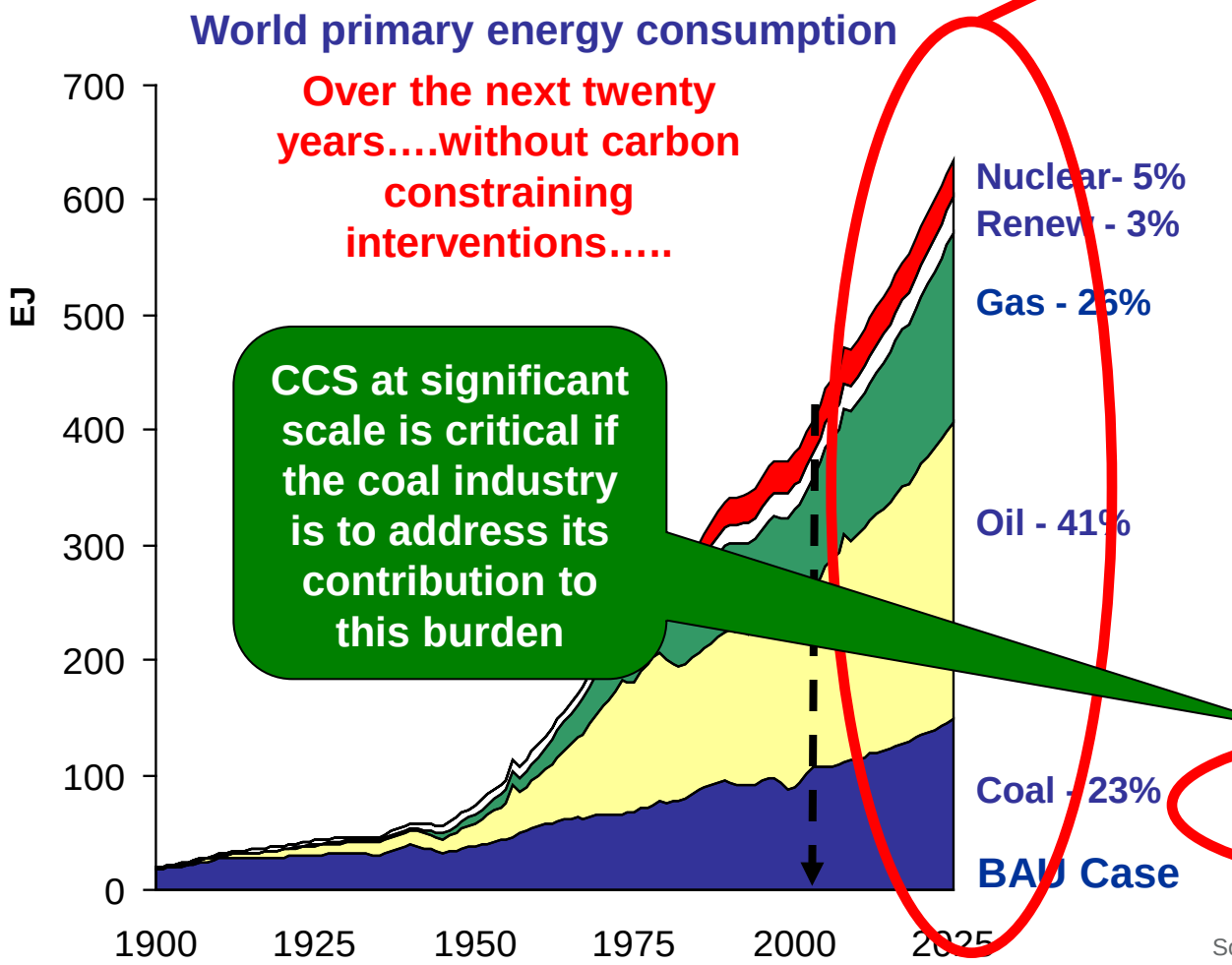
-575 million people rely on biomass for energy

Solid Fuel Reserves



Sources: BP Statistical Review 2005; WEC Survey of Energy Resources 2001; Reasonably Assured Sources plus inferred resources to US$80/kg U 1/1/03 from OECD NEA & IAEA Uranium 2003; Resources, Production & Demand updated 2005; *energy equivalence of uranium assumed to be ~20,000 times that of coal

The future



- World primary energy consumption increases 60%
- Two-thirds of that increase arises in developing countries
- China and India account for more than two thirds of the increase in global coal use
- CO_2 emissions increase by 60%
- Two-thirds of the increase in CO_2 emissions arises in developing countries
- Contribution to CO2 emissions growth attributable to oil 37%; coal 33% and gas 30%

Source: RMI analysis, IEA 2004, EIA IEO 2004, BP Statistical Review 2003, IFP

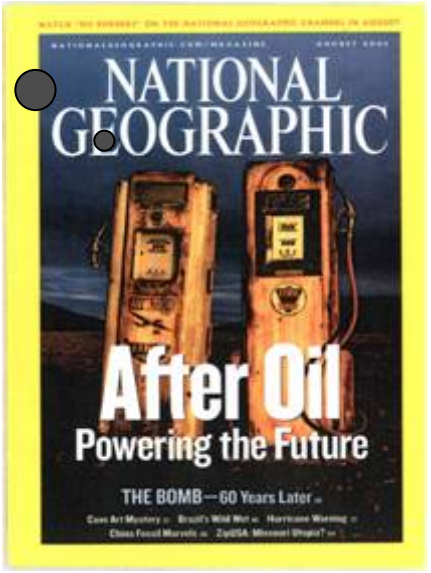
Carbon emissions

In 1600's....

280 molecules of every million = CO2

380 molecules of every million = CO2

….. in 2005

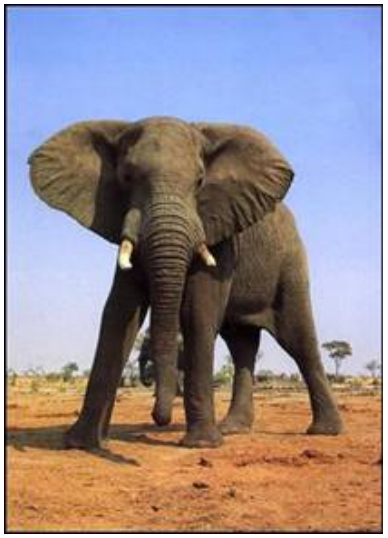


Source : Prof R H Socolow – Scientific American

Carbon emissions: the scale of the problem

- **Current carbon emissions of 7 Gt carbon per year and increasing**
- **So how big is just one gigaton?**

6,200 Sydney Opera Houses



OR 143 million African elephants

Source : WBCSD, Battelle, National Geographic, R H Socolow; Scientific American

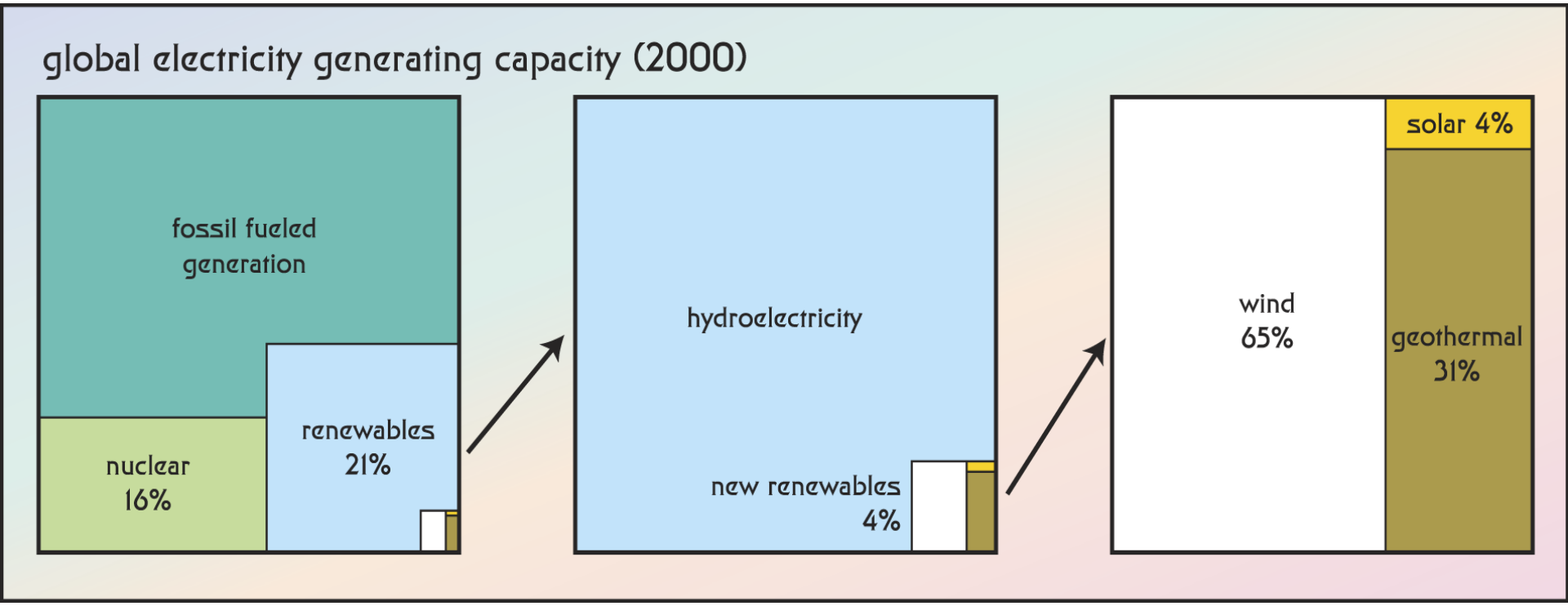
What will deliver 1 Gigaton of carbon mitigation?

- **700 x 1000 MW nuclear stations**
  - **Will public acceptance and the policies to support such a move be forthcoming …… recent MIMBY speculation?**
- **700 x 1000 MW of coal fired capacity with CCS**
  - **A key technical challenge**
- **300,000 x 5 MW wind turbines covering the land area of Portugal**
  - **Spatial, cost and NIMBY considerations are likely to constrain the renewables contribution**

The world will need <u>all</u> of
safe & cheap *nuclear*, reliable &cheap *renewables*, and much more clean *coal*
together with energy efficiency.

Can renewables deliver?

Aside from questions of technology, *size does matter*:



e.g. … the largest Wind Farm in Europe (Whinash, UK)

Can oil and gas deliver?

- **Similar environmental challenge to coal**

- **Peak oil? Peak gas?**
  - Comparisons of known reserves depletion at current depletion levels
    (BP Statistical Review of World Energy 2005)
    - OIL 41 years
    - GAS 67 years
    - COAL 164 years (some countries around 500 years)

Carbon Capture & Storage

- **R&D**
- **Demonstration – Weyburn, Sleipner, Snohvit, In Salah & more.**
- **Futuregen**
- **CSLF**
- **Timescales?**
- **Costs?**

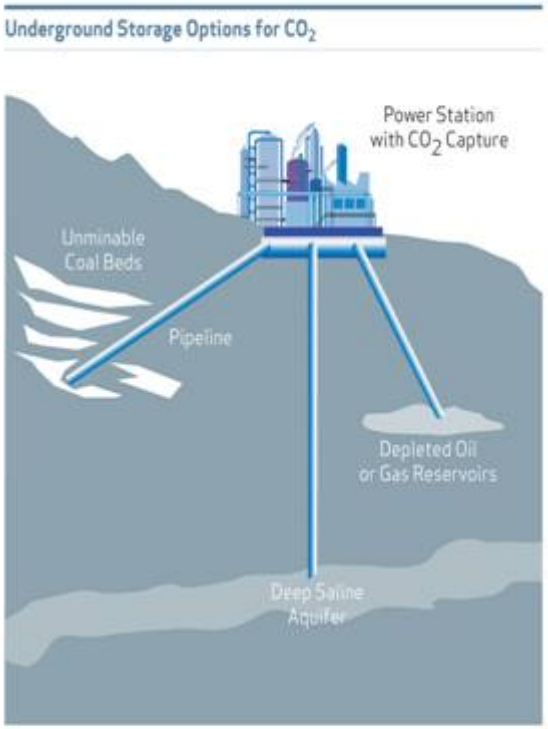
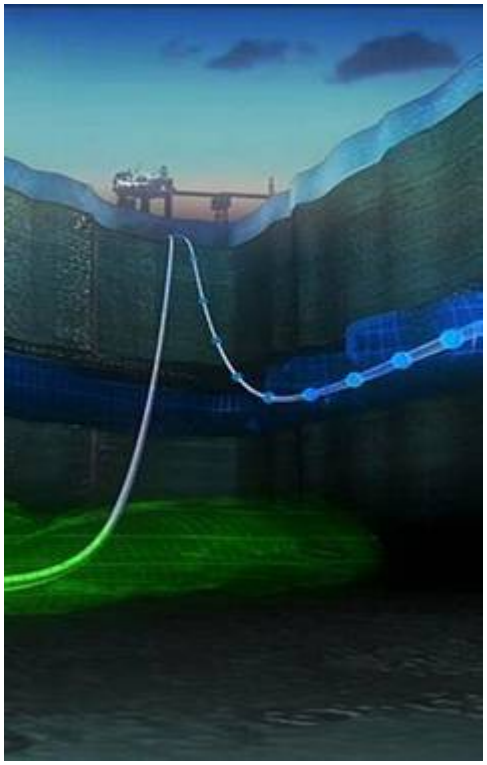


Diagram courtesy of IEA GHG R&D Programme



Carbon Capture & Storage: is it a realistic option?

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC)

***Special Report on Carbon Capture & Storage*, 2005**

- **No single technology option will provide all of the emissions reductions needed**
- **Power plants with CCS could reduce CO_2 emissions by 80-90% net**
- **Applying CCS to power generation is estimated to increase costs by about US$0.01 – 0.05 per kilowatt hour**
- **It is likely* there is a technical potential of at least 2,000 Gt CO_2 storage capacity in geological formations**
  - **ocean storage *could* add thousands of Gt to this capacity**
- **In most scenarios, CCS reduces costs of stabilising CO_2 concentrations by 30% or more**

Will the CO_2 leak?!

- **"Observations from engineered and natural analogues, as well as models, suggest that the fraction retained in appropriately selected and managed geological reservoirs**
  - **is very likely** to exceed 99% over 100 years, and**
  - **is likely to exceed 99% over 1,000 years."**

*** "Likely" is a probability between 66 and 90%. ** "Very likely" is a probability between 90 and 99%.)**

Costs?

International Energy Agency

- US$16 trillion will be needed to meet global energy demand next 30 years
  - US$4 billion of that for coal-fired power generation.

Princeton University (Sokolow) / Columbia University (Sachs, Lackner)

- Carbon emission charges of about US$100/tC would enable commercialisation of CCS and all other necessary technologies
  - i.e. about US$30/t$CO_2$ or €20/tCO_2 or the October 2005 EU trading price
  - This equates to about 1-2% of global GNP to stabilise emissions at today's rate

What role for:

- Governments
- Industry
- Public private partnerships
- Clean Development Mechanism
- Asia-Pacific Partnership
- Foreign direct investment

Can international policies deliver?

- **Kyoto Protocol on Climate Change**
  - Clean Development Mechanism
  - Emissions Trading
- **G8 Gleneagles Plan of Action**
  - International Energy Agency (IEA)
  - Carbon Sequestration Leadership Forum
- **Asia-Pacific Partnership for Clean Development & Climate** (AP6)

Can coal deliver in the 21st century?

- **The 21st century needs *heavy lifting* power**
  - To confront energy poverty
  - To fuel economic development
  - To maintain living standards
  - To enhance energy security
- **The 21st century needs *clean* power**
  - This can be realised through carbon capture & storage
- **The 21st century needs COAL**
  - *safe*, *affordable*, *reliable*, *plentiful*, and *increasingly clean*

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Thank you

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