

Energy security, global warming and renewable energies

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We live in interesting times

National Geographic June 2004



Why the urgency?

Energy security of over-riding concern

Unstable regimes in Middle East

Peaking of oil supplies – approaching half-way point

Gas not coming to rescue

Global warming of over-riding concern

Continued emissions of CO₂ and other GHGs must be slowed

Transport activities an important and rising source

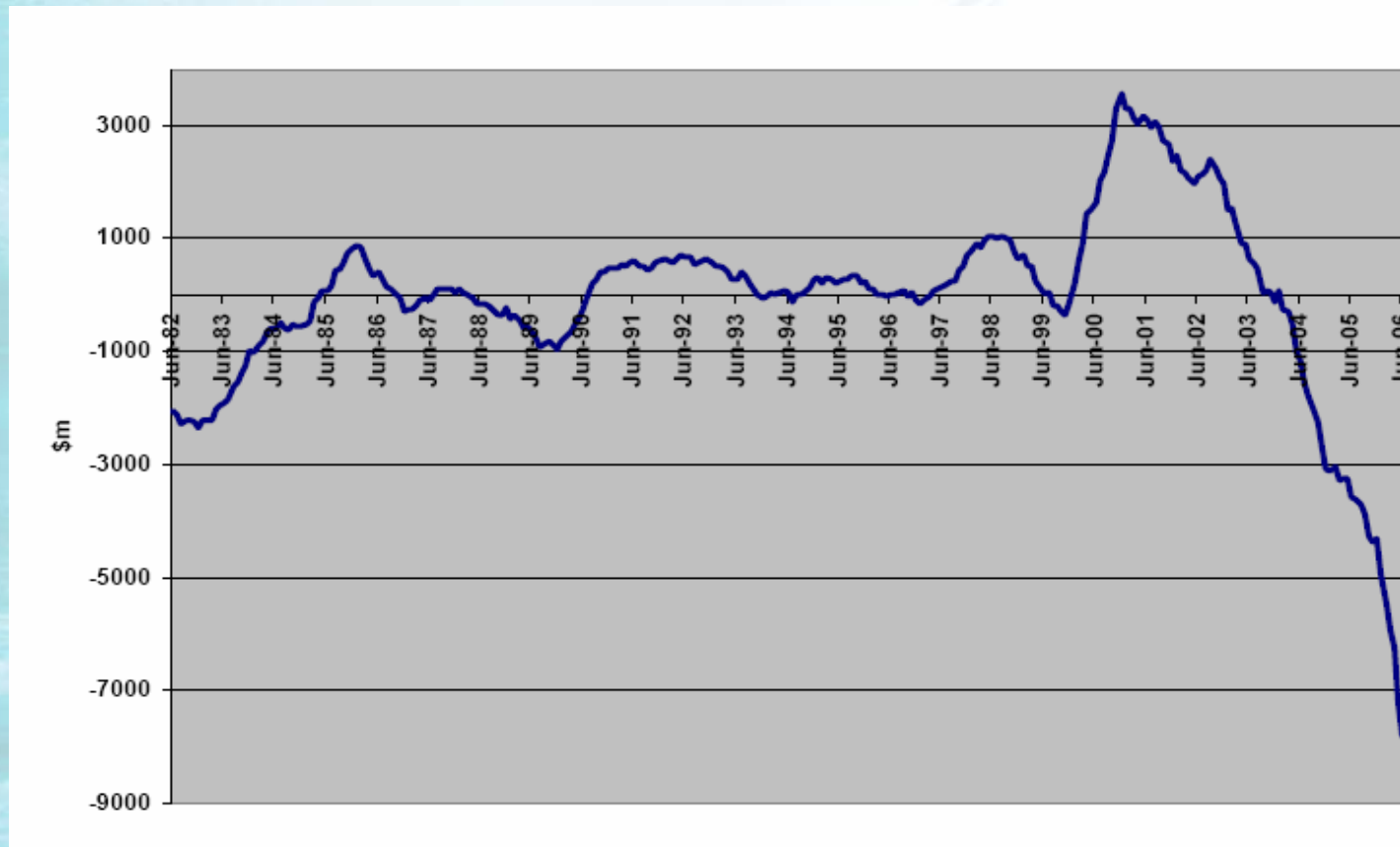
The conjunction of these two issues: A global energy crisis

“I think we have a very brief window of opportunity to deal with climate change ... no longer than decade, at the most,”

James Hansen, US NASA scientist, Nov2006

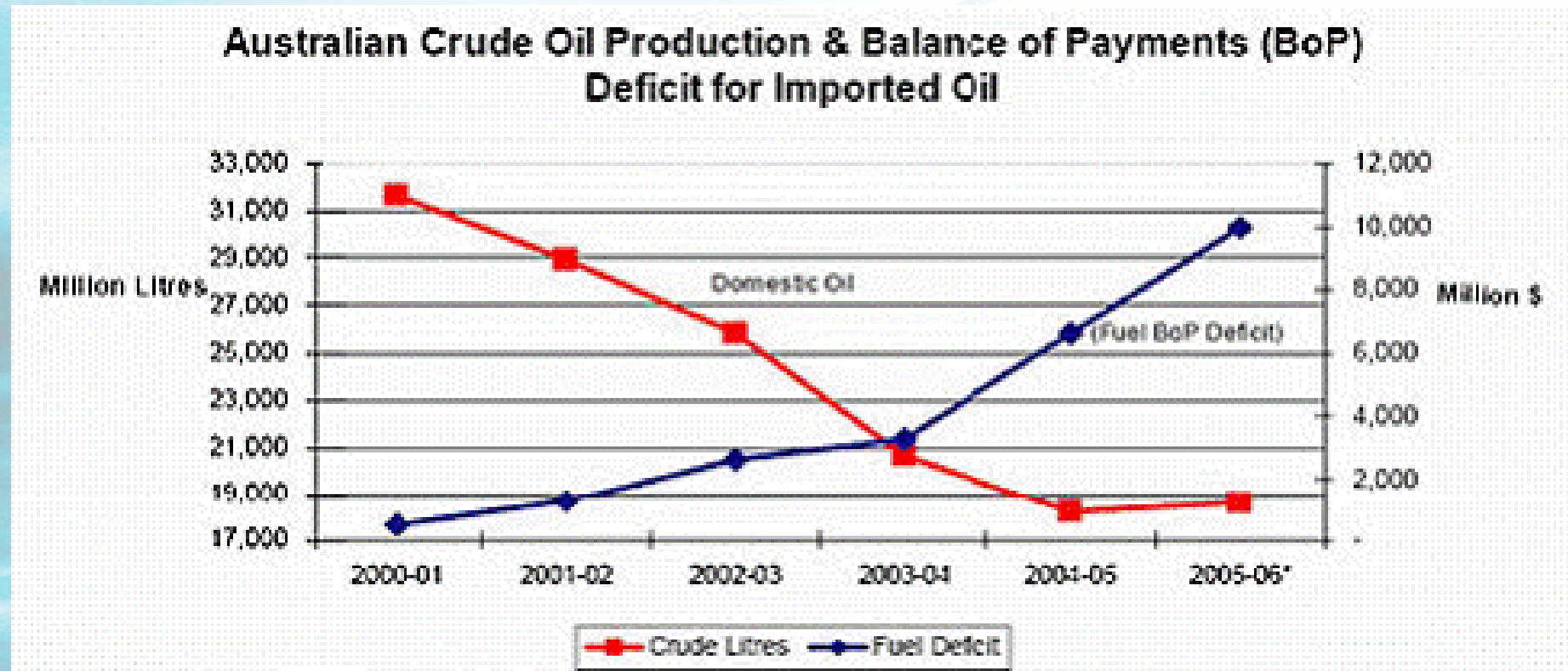


Australia: Petroleum trade deficit, 1982-2006



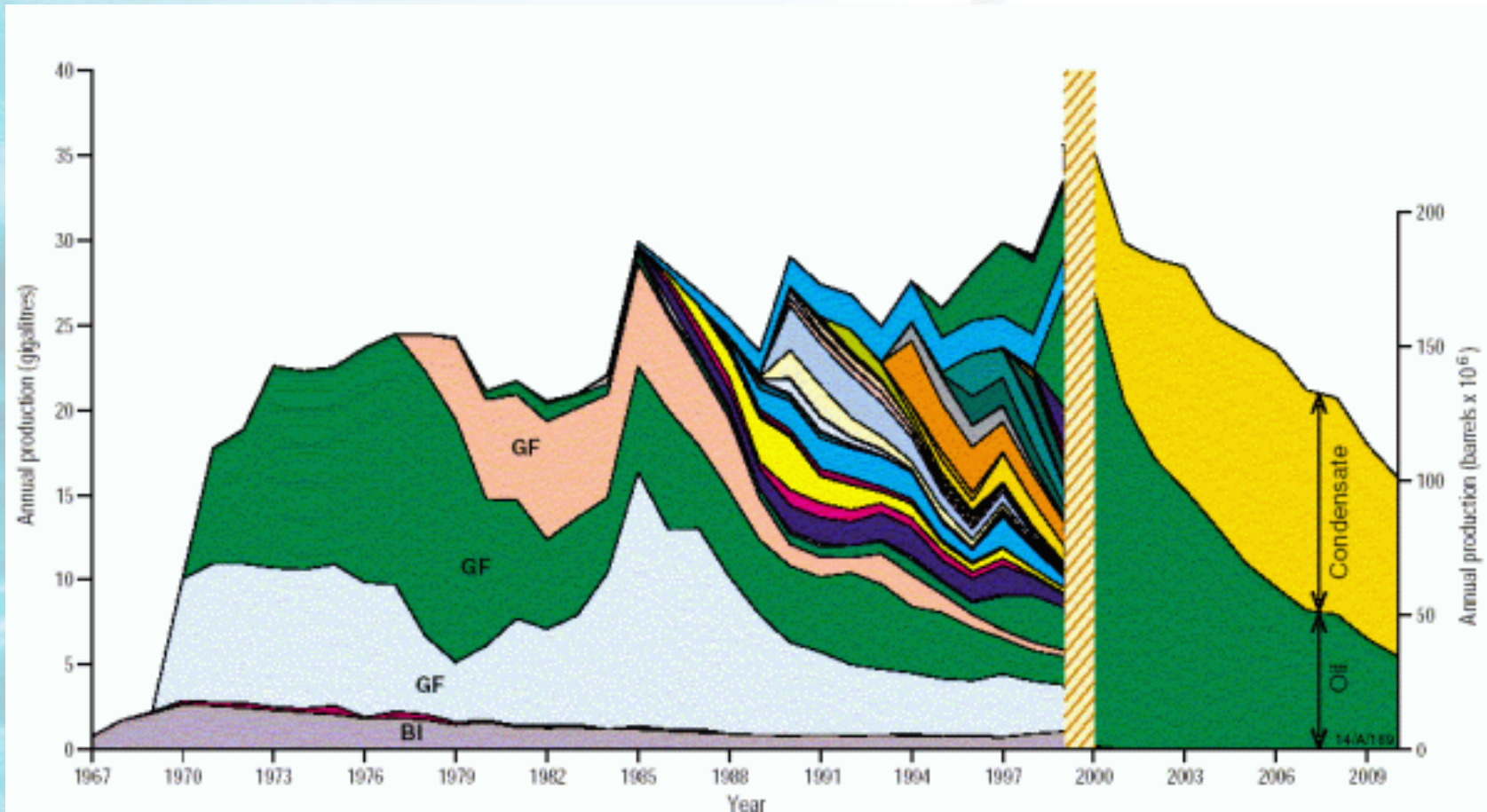
Source: EnergyQuest

Rising cost of oil imports: Australia



Source: Renewable Fuels Australia

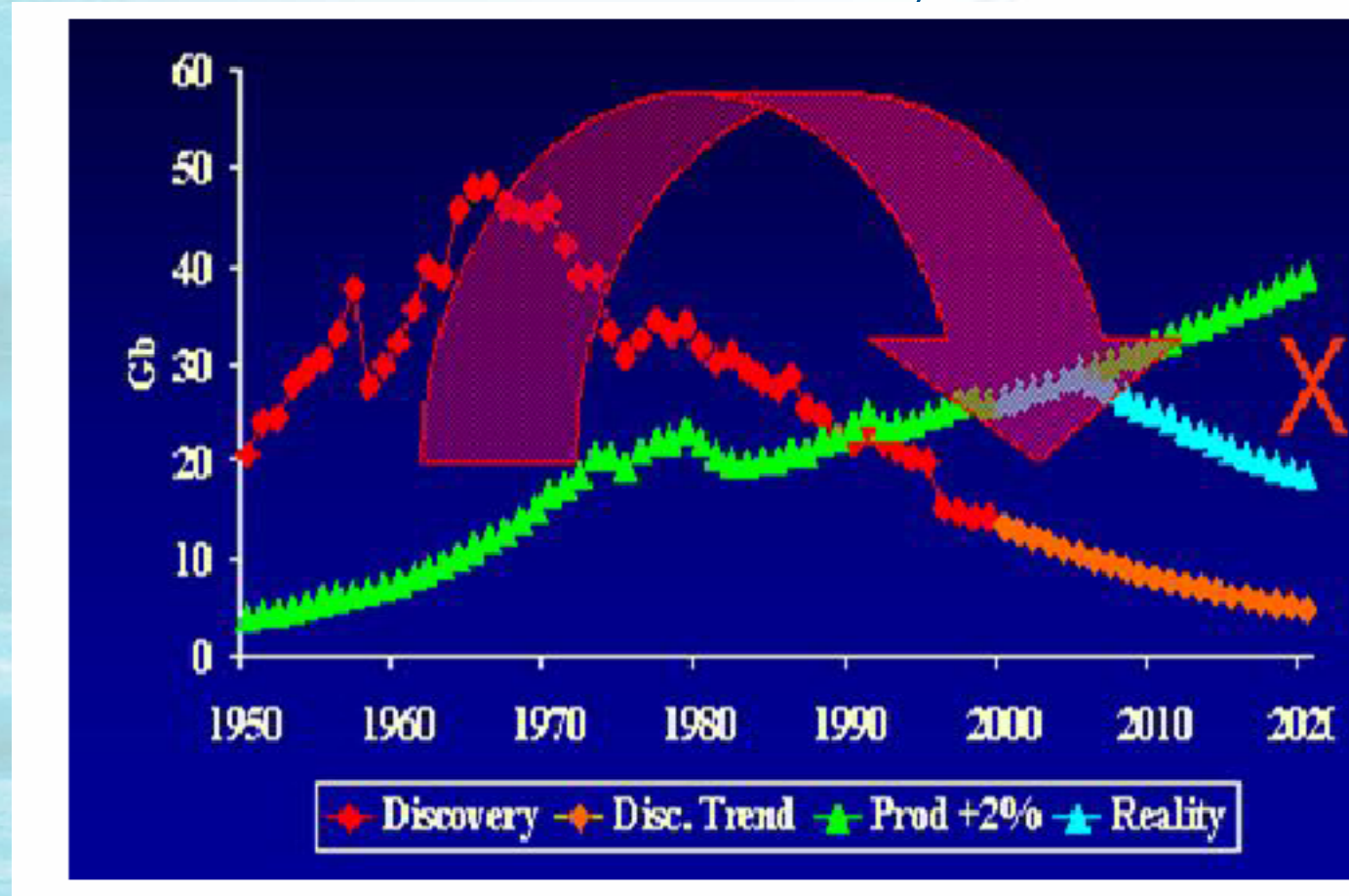
Peaking of oil supplies in Australia in 2000



Source: ASPO Australia

The ASPO view

Association for the Study of Peak Oil



Source: *C.J. Campbell Presentation* at the Technical University of Clausthal

The world consumes two barrels of oil for every barrel discovered.

So is this something you should be worried about?

The fact is, the world has been finding less oil than it's been using for twenty years now. Not only has demand been soaring, but the oil we've been finding is coming from places that are tough to reach. At the same time, more of this newly discovered oil is of the type that requires a greater investment to refine. And because demand for this precious resource will grow, according to some, by over 40% by 2025, fueling the world's growing economic prosperity will take a lot more energy from every possible source.

The energy industry needs to get more from existing fields while continuing to search for new reserves. Automakers must continue to improve fuel efficiency and perfect hybrid vehicles. Technological improvements are needed so that wind, solar and hydrogen can be more viable parts of the energy equation. Governments need to create energy policies that promote economically and environmentally sound development. Consumers must demand, and be willing to pay for, some of these solutions, while practicing conservation efforts of their own.

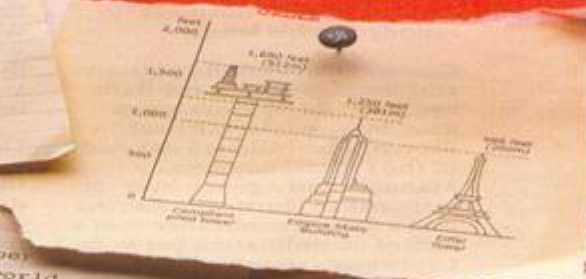
Inaction is not an option. But if everyone works together, we can balance this equation. We're taking some of the steps needed to get started, but we need your help to get the rest of the way.

willyoujoinus.com

The world consumes 84 million barrels of oil a day.

By 2030 the number of cars in the world will increase by 50%.

World Energy Demand



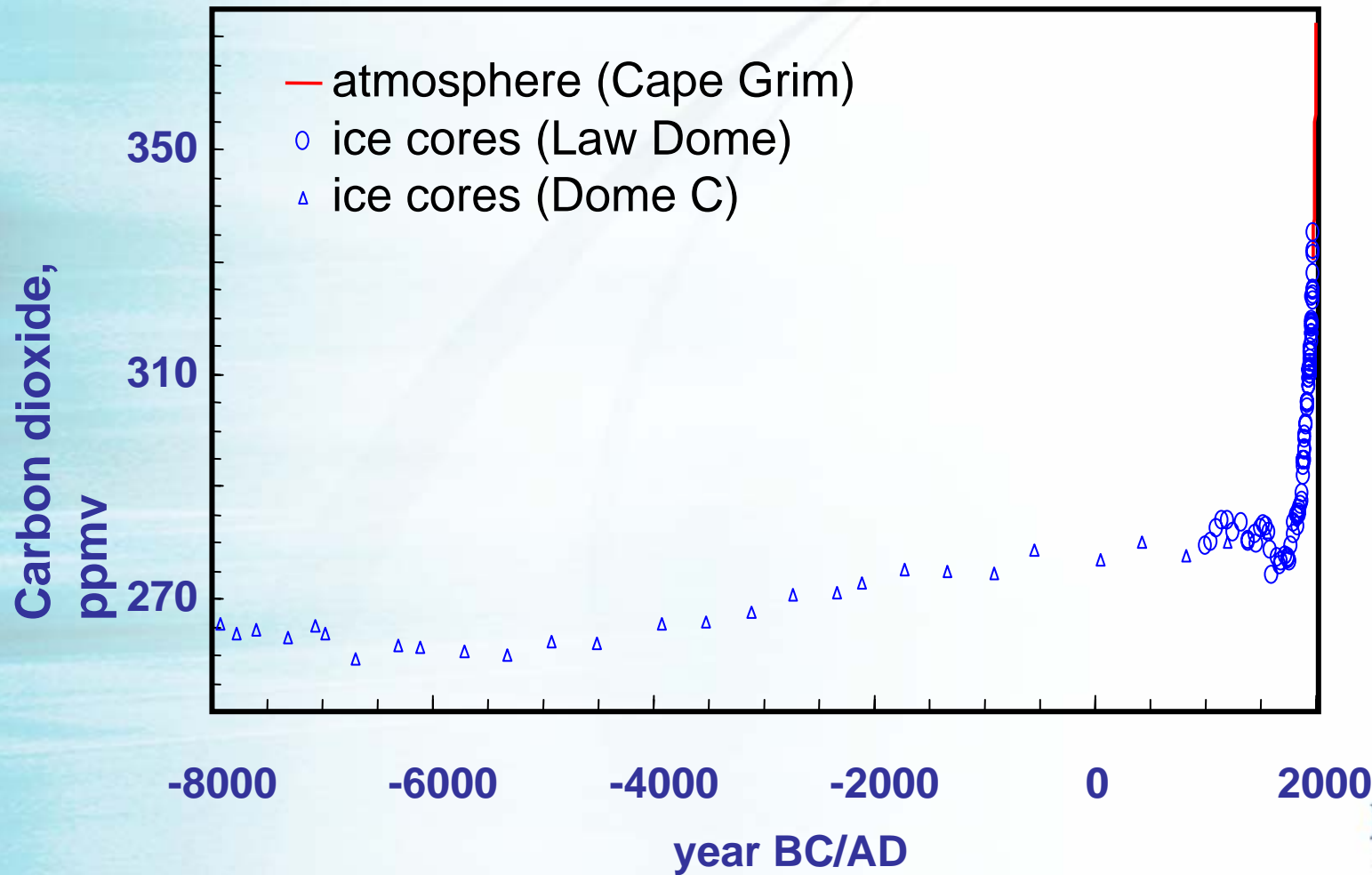
⚠️ Chevron Steps Taken:

- Thinking to the future:**
- Committing over \$100 million every year on renewable energies, alternative fuels and improving efficiency
- Finding even more energy today:**
- In 2004, achieved exploration record 78% higher than 10-year industry average
 - Using steamflooding to extract heavy oil that was previously unrecoverable - more than 1.3 billion barrels from one field alone

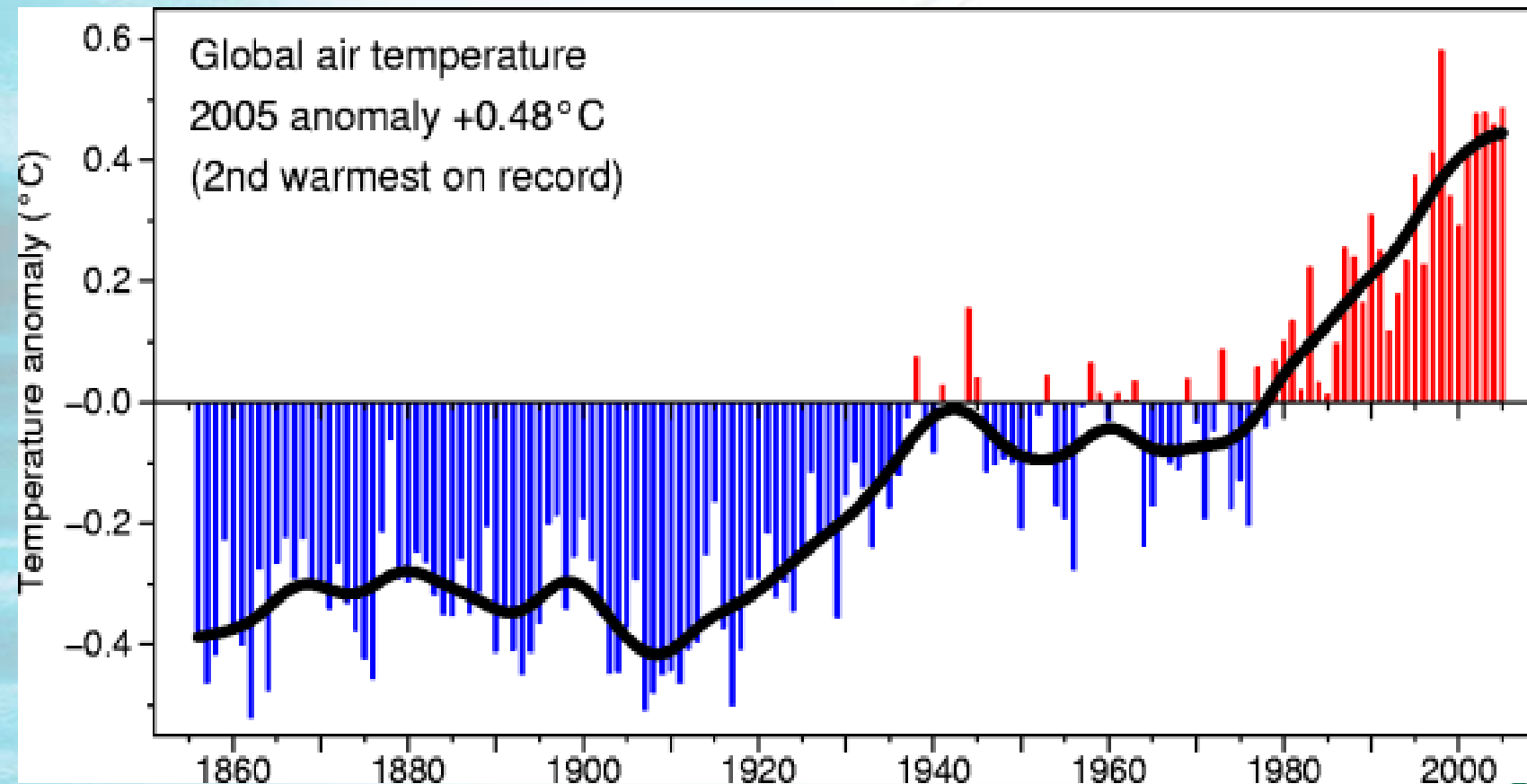


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Climate change Rising levels of CO₂...

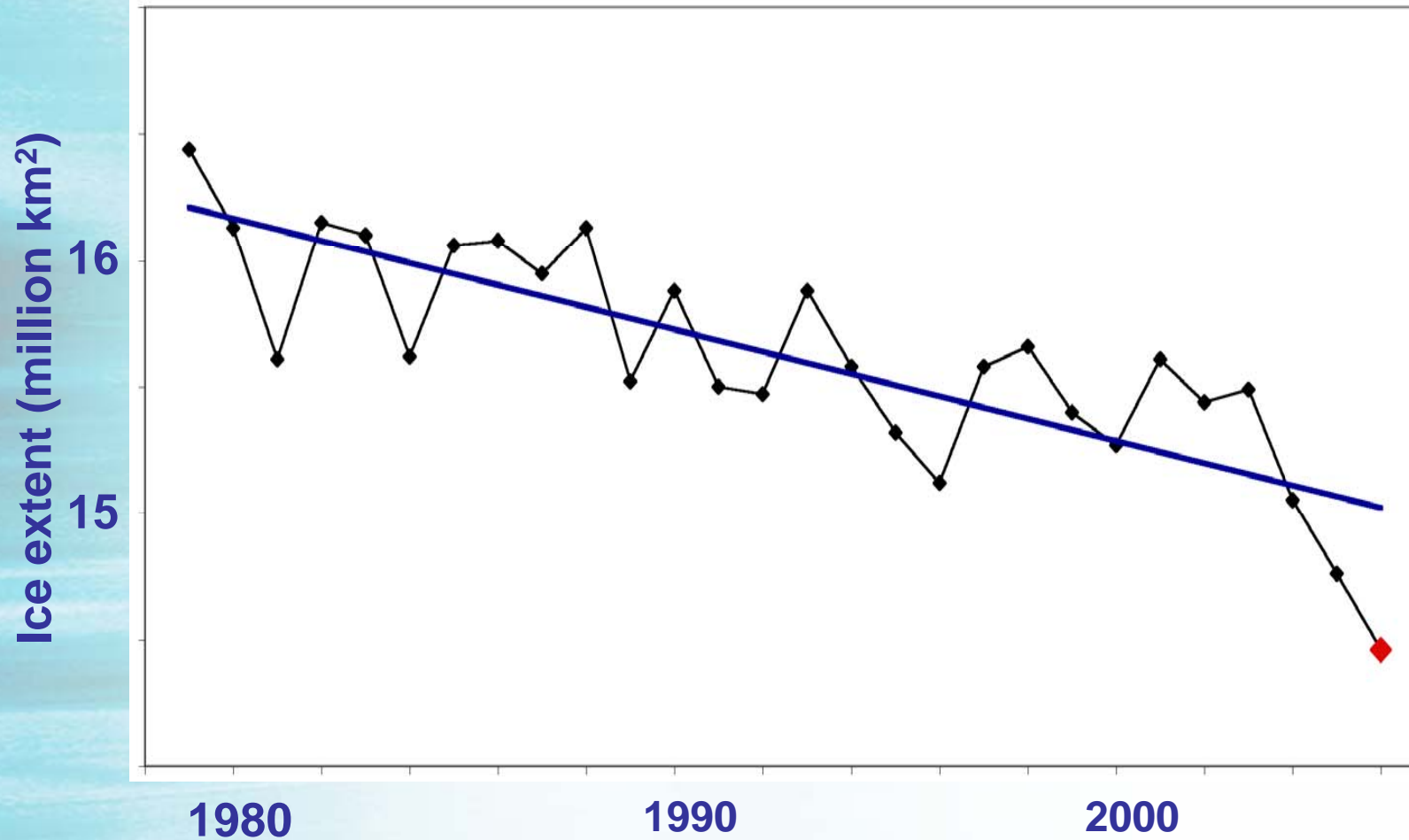


.. Lead to rising average earth surface temperature ...

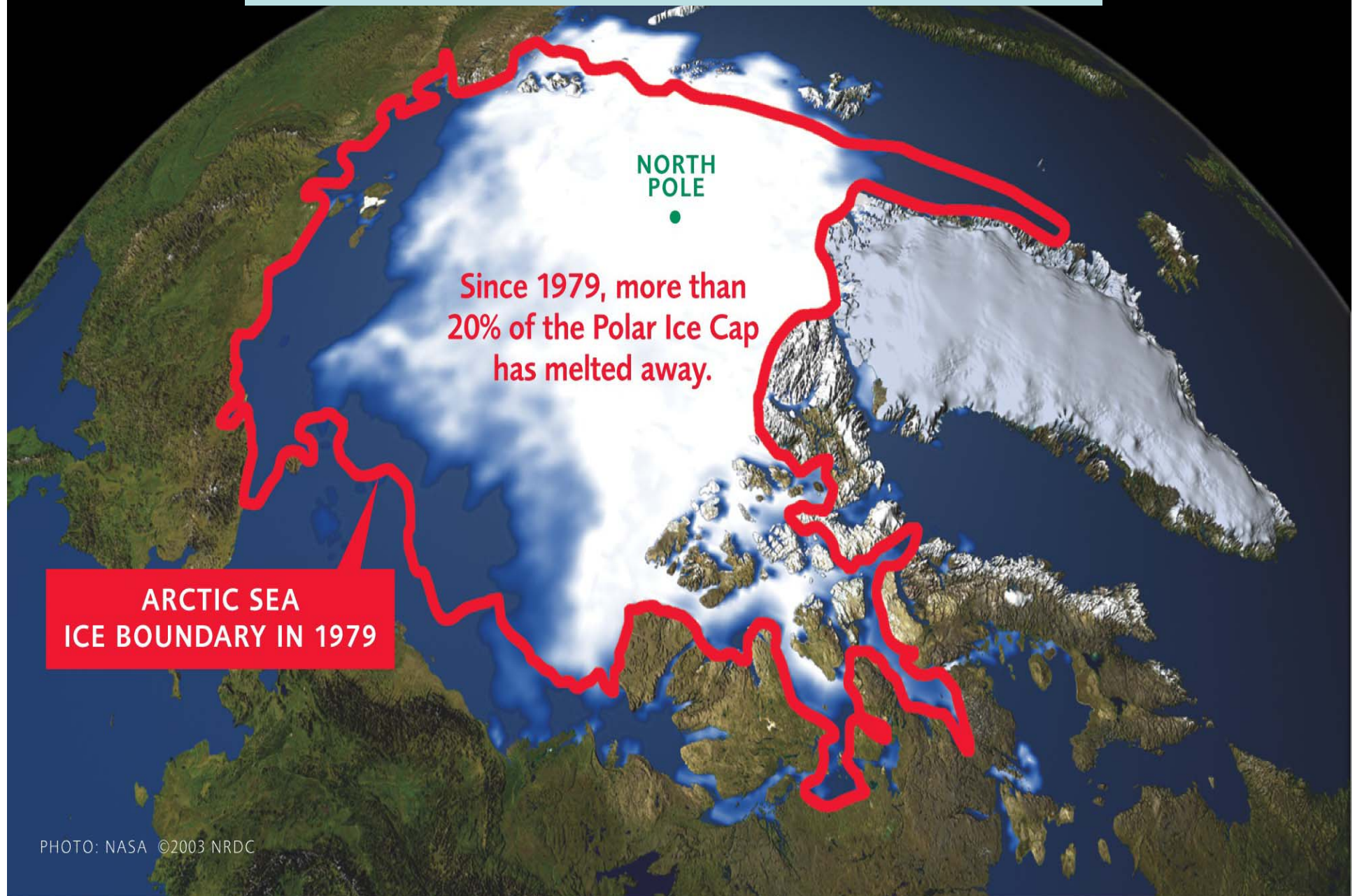


<http://www.cru.uea.ac.uk/cru/info/warming/>

... lead to loss of Arctic sea ice ..



Small changes have a big impact

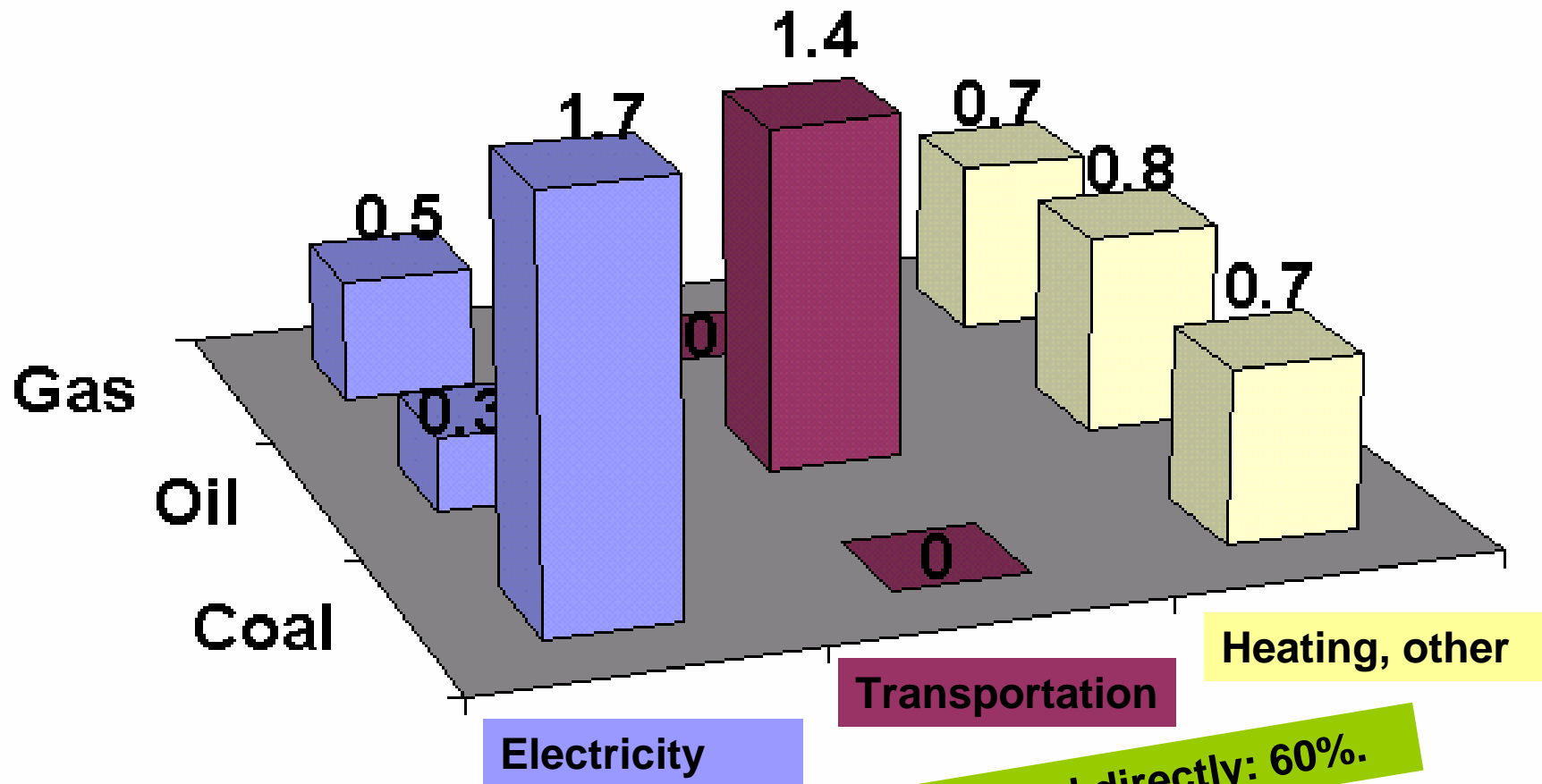


Since 1979, more than
20% of the Polar Ice Cap
has melted away.

ARCTIC SEA
ICE BOUNDARY IN 1979

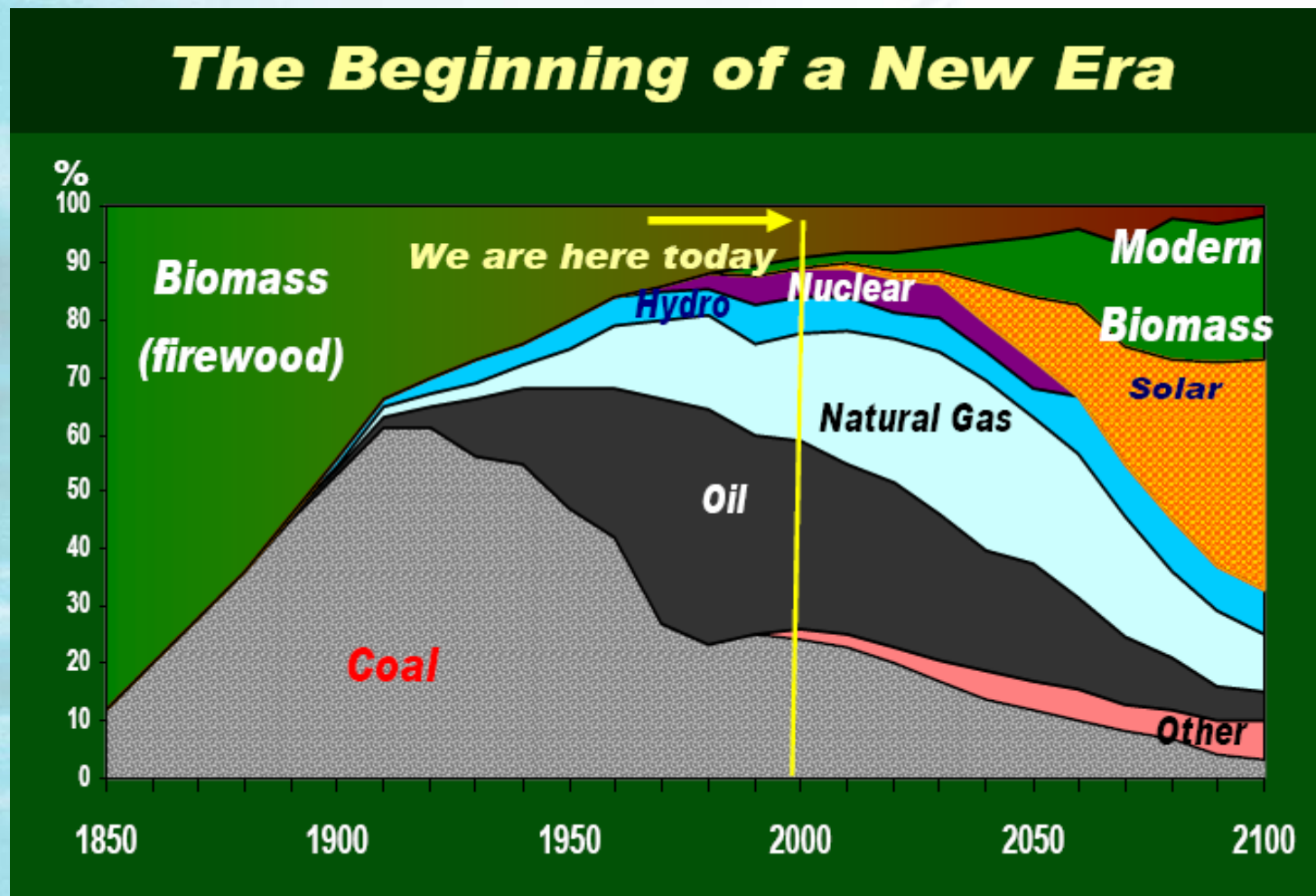
CO₂ emissions by sector and fuel

Allocation of 6.2 GtC/yr 2000 global CO₂ emissions



Electricity: 40%; fuels used directly: 60%.

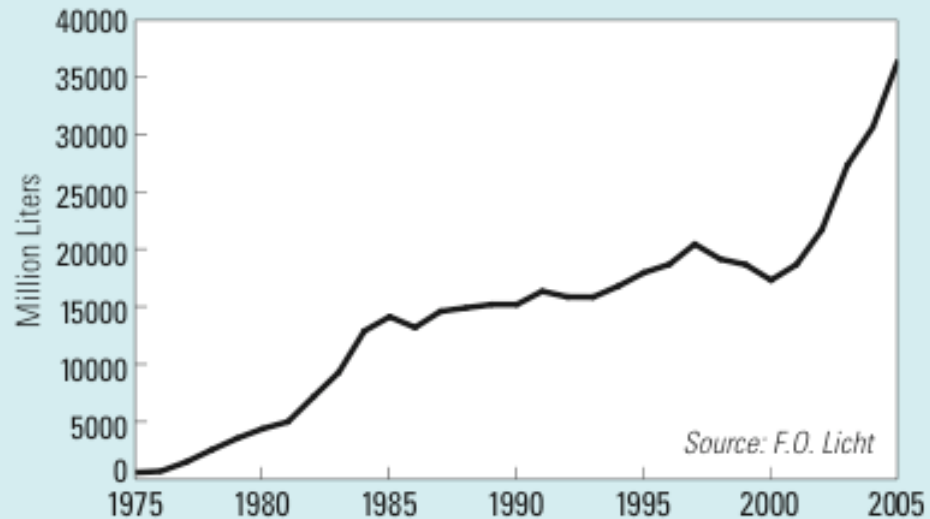
The beginning of a new era?



Source: Nakícenovic, Grübler and McDonald, 1998

World ethanol production

Figure 1. World Ethanol Production, 1975–2005



Main producers 2005:

US 16.2 Gl

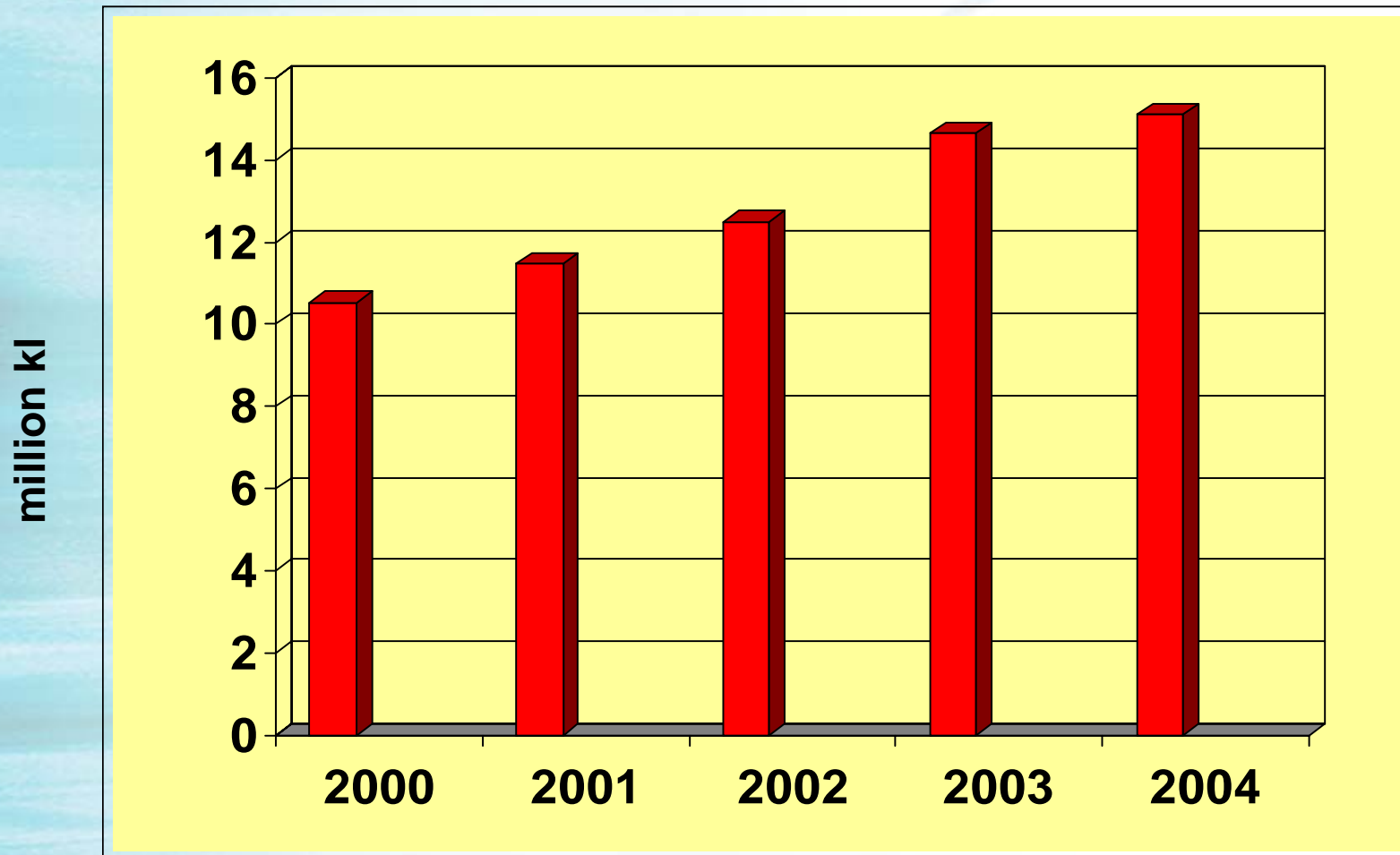
Brazil 16.1 Gl

China 3.8 Gl

India 1.7 Gl

Australia?

Ethanol Production in Brazil

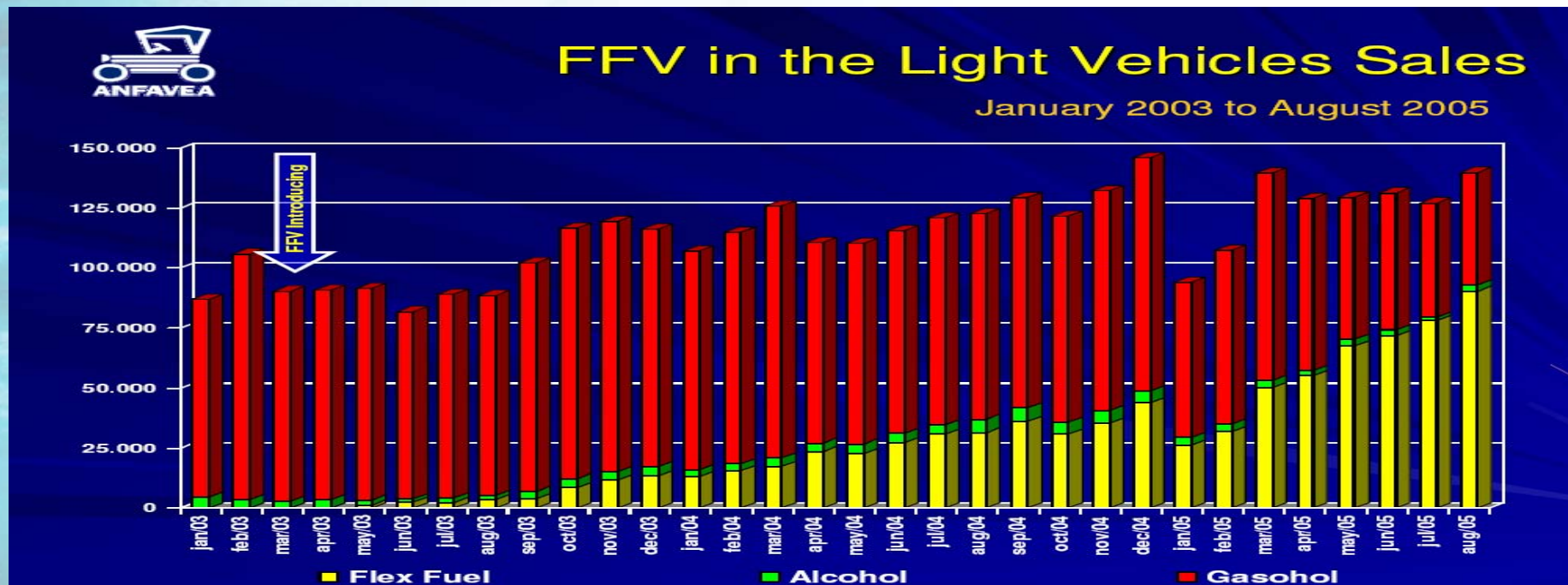


Source: Ministry of Agriculture, Livestock and Food Supply

2000s: Demand side revival:

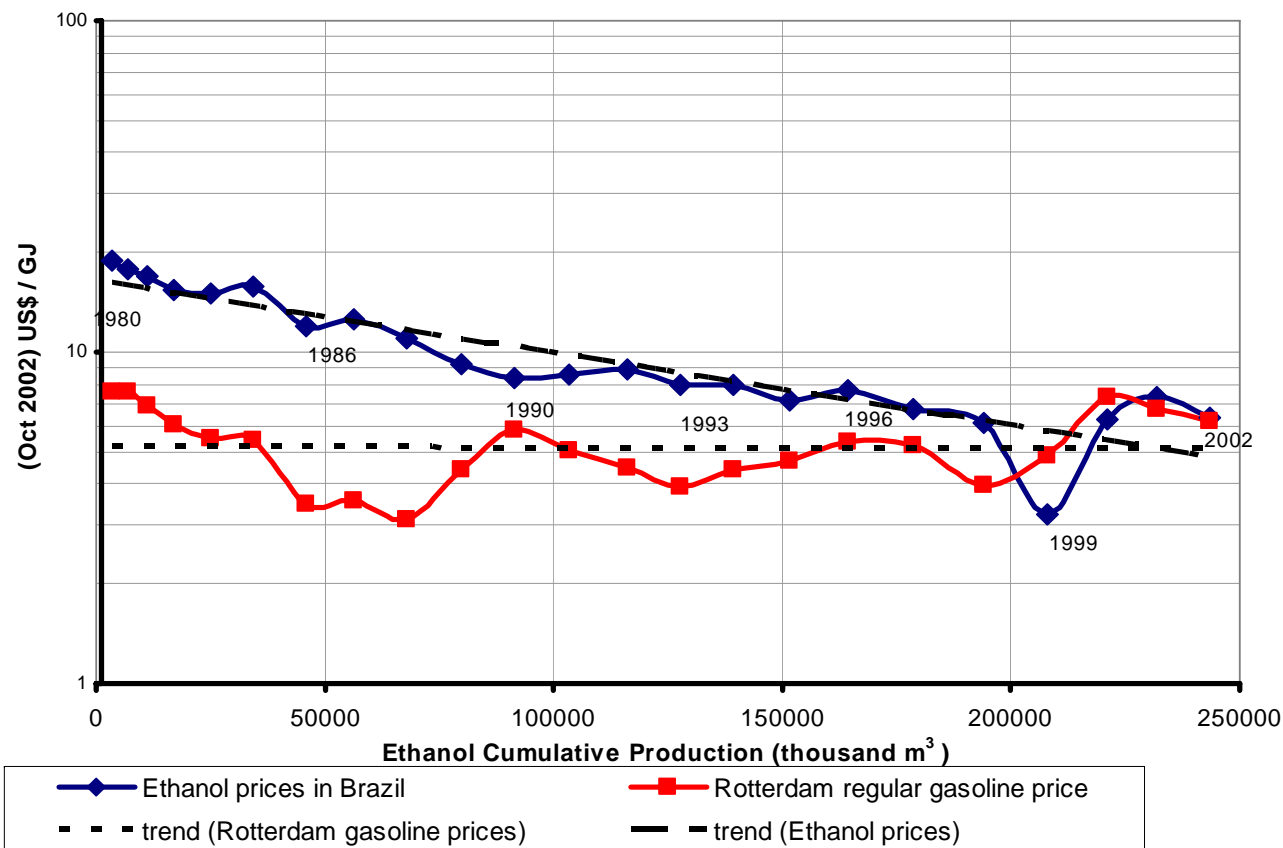
The flex-fuel technology

- 2003: a new generation of alcohol-powered cars entered production
- Flex-fuel cars can use pure alcohol, pure petrol or any blend of the two
- Volkswagen introduced the first flexible fuel car in 2003: the Gol 1.6 Total Flex
- Since the end of 2005, Chevrolet, Peugeot, Volkswagen, Ford, Fiat and Renault produce a total of 23 FFV models for the Brazilian market

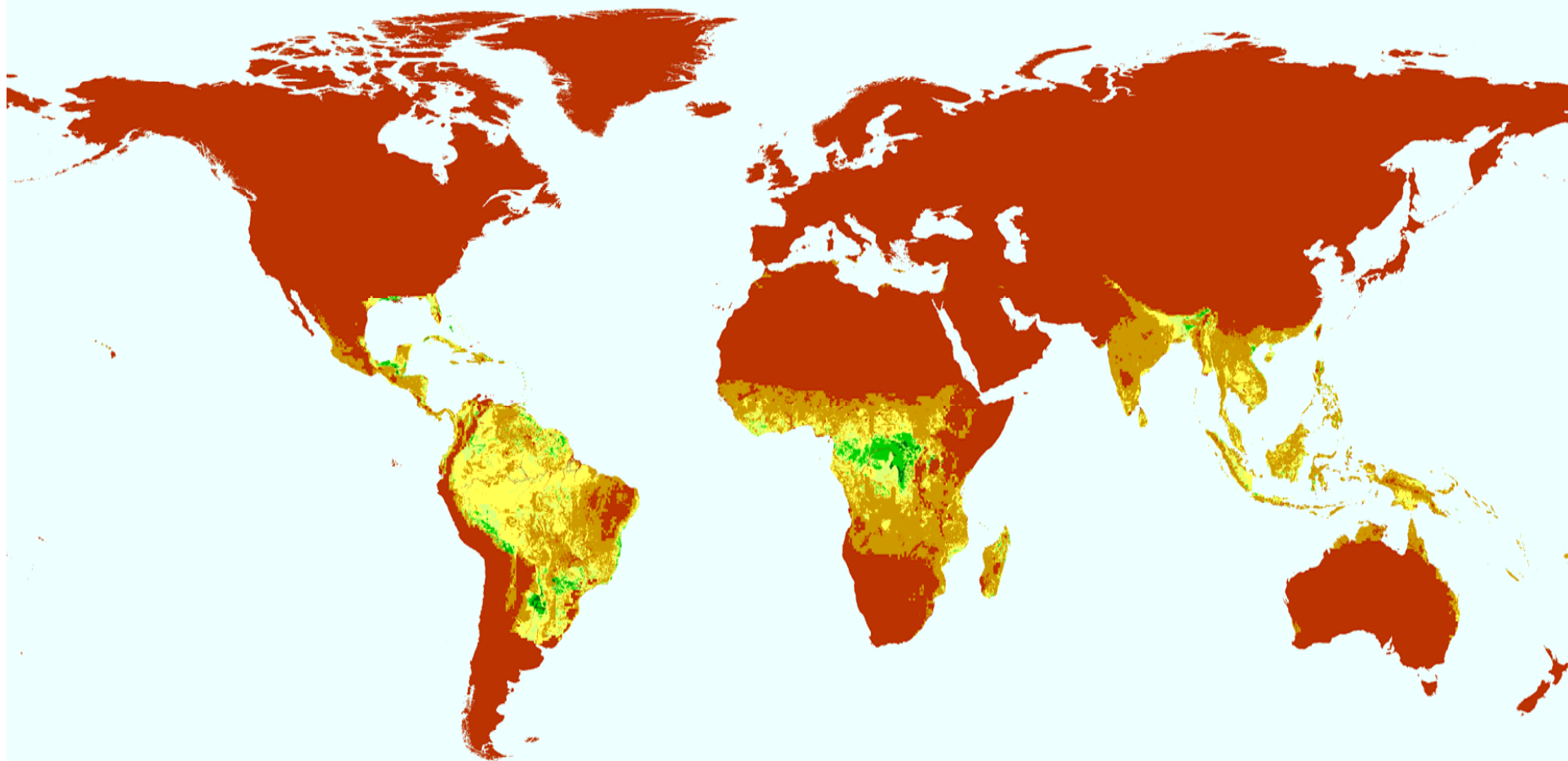


The Brazilian ethanol learning curve

Source: Goldemberg, J., et al 2004



Land suitable for rainfed sugar cane



Source: FAO Terrastat

R&D in the South

- Brazil building world's first hybrid ethanol-biodiesel plant
- Barralcool plant in Mato Grosso state, built by Brazilian equipment supplier Dedini
- \$12.5 million investment, with cogeneration of electricity
- The latecomer effect: latest technology plus lowest costs



Energy Ratios and Productivity in Ethanol Making

Feedstock	Energy Output/Fossil Input
Wheat	1.2
Corn	1.3-1.8
Sugar beets	1.9
Sugar cane, Brazilian	8.3
Gasoline from Crude Oil	0.8

Feedstock	Yield t/ha	Feedstock kg/l EtOH	EtOH l/ha
Sugar cane, Brazil	85	12	7,000
Corn, US	10	2.8	3,500

Sources: Ministry of Agriculture, Brazil and Isaias Macedo, 2005

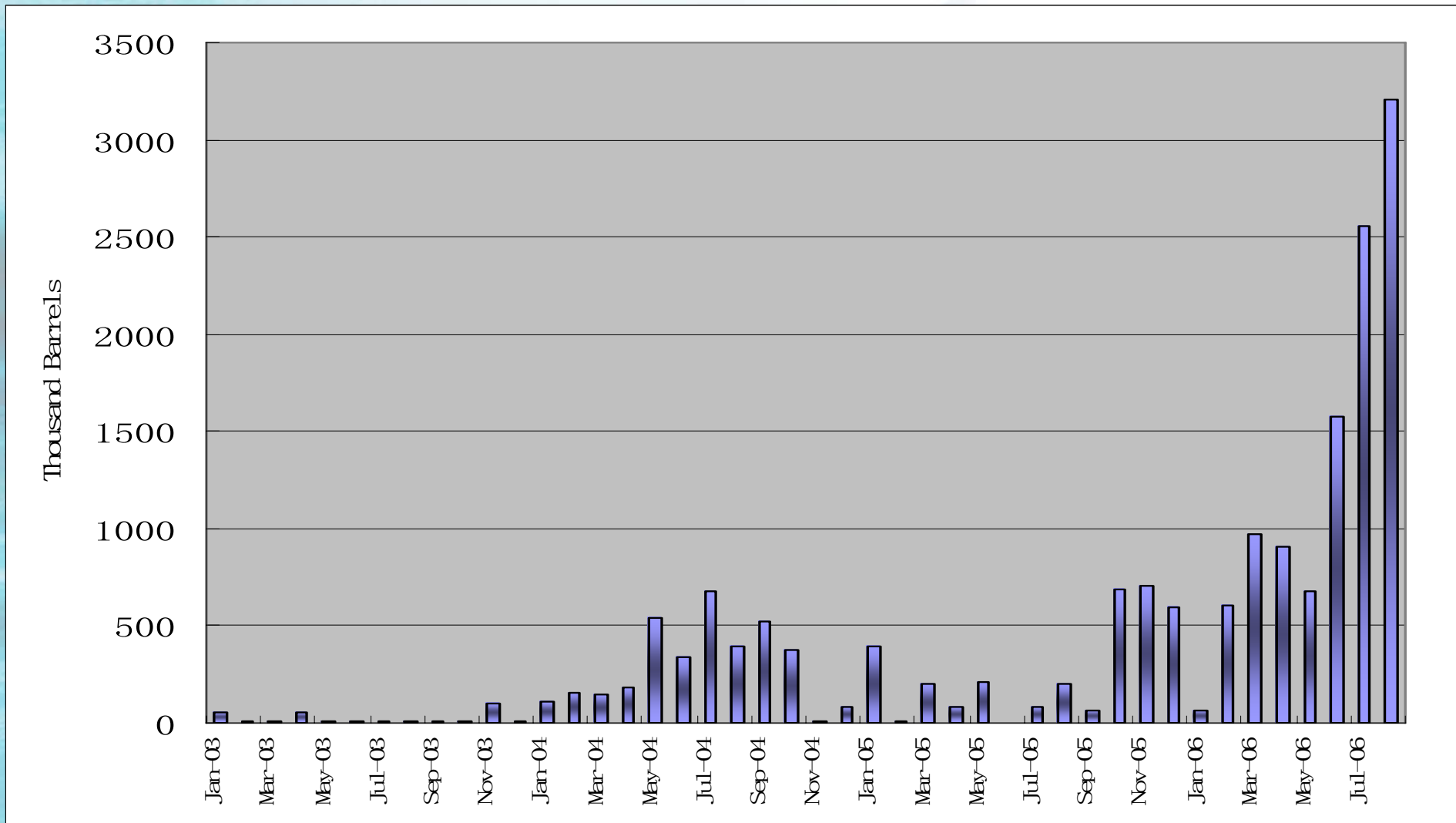
Claude Mandil on biofuels

In *La Tribune*, Claude Mandil argues that ethanol is currently made from three main feedstocks: corn in the United States and Europe, sugar beet in Europe and sugar cane in the developing world, most notably in Brazil and India.

"The first two methods are the worst imaginable", says Mandil, because they are only commercially viable with permanent subsidies and trade barriers, and their production requires a large amount of fossil fuel inputs, which is not the case for sugar cane and other tropical crops.

According to Mandil, "ethanol produced in Brazil, even when it is imported by Europe [taking into account the energy needed to transport the fuel across the Atlantic] makes sense. If the United States and Europe are serious about biofuels, they must turn to the South for their supplies".

Imports of ethanol into the US are rising, 2004-05



Source of primary data: Form 819, US EIA

North to lead the way in second generation biofuels



- Austria building world's first biogas-based biorefinery
- Pilot plant being built in city of Utzenach will use grass as feedstock
- Will produce biogas to generate green electricity
- Sludge used as organic fertilizer for the grass, closing cycle

We live in interesting times (2)

Bioenergy Europe 2006, Hanover Nov 2006

Deutsche Bank and BP:
21st century will be the century of bioenergy

Dr. Norbert Walter, Chief Economist of Deutsche Bank

Dr. Uwe Franke, Head of BP Germany

DB and BP forecast that bioenergy, and supporting biomass production, will determine the future of energy on a global scale.

Bioenergy is set to be the leading industry of the 21st century.



Biofuels to be treated as fuels

- Take biofuels out of ‘food’ category with its culture of subsidies
- Put on a par with petrofuels
- Dismantling of existing tariff barriers by the US and EU
- WTO to devise new rules for global trade in biofuels



Business opportunities for Australian companies

- Biofuels
 - Ethanol e.g. Global Technex; Dalby Biorefinery; Global Ethanol Holdings
 - Biodiesel e.g. Australian Natural Fuels; Australian Biodiesel Group
 - Cellulosic ethanol e.g. Microbiogen
- Wind energy e.g. Roaring Forties-CPG
- Solar energy e.g. CSG innovation at UNSW
- Geothermal e.g. Geothermal Resources Ltd
- Energy conservation e.g. Energy & Water Solutions
- Green automotive industry e.g. fuel cell technology
- Green services e.g. carbon footprint analysis

Energy-hungry economies: China, India, Japan et al

A new world?

