Biofuels

A viable approach to carbon reduction?

RSC

Cambridge

December 11, 2008

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www.cred-uk.org

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CRed carbon reduction

local action for a global challenge

CRed is a catalyst to stimulate new thinking and action that might not otherwise happen.

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CRed Renewable Transport fuels Activities

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CiViTAS

Cleaner and better transport in cities

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What are biofuels?

First generation primarily from food crops

Increasing interest in non-food sources - lignocellulose, algae

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Bioethanol: fermentation of glucose in starch

Sugar cane in Brazil, Corn (maize) in USA, Sugar Beet or Wheat in Europe

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$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$$

A dilute solution of alcohol is purified by energy intensive distillation.

British Sugar bioethanol plant, Wissington

Substitutes to 5% for gasoline in all cars or E85 in flex-fuel vehicles

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Biodiesel: transesterified plant oils

Rape in Europe, Soya in Brazil and USA, Palm oil in Asia, Jatropha in many hot countries

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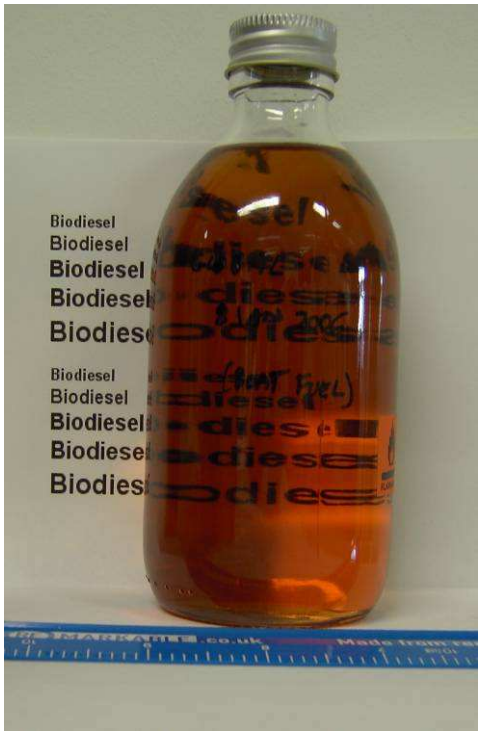
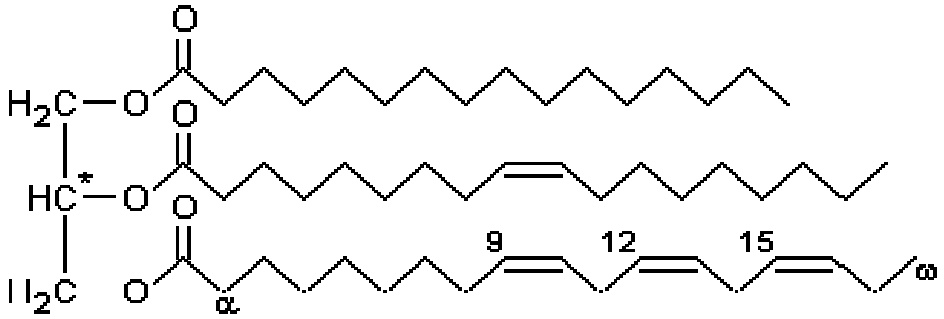


A sample of biodiesel from UEA's collection built up during work on the EU Civitas project



Substitutes to 5% in any diesel vehicle and up to 100% in many vehicles.

Loading B100 into a EuroIV Scania bus

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Bimethane from anaerobic digestion

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The product gas is roughly equal proportions of methane (CH_4) and carbon dioxide (CO_2) which can easily be separated by cooling prior to sequestration of the CO_2.

Picture from "Methane to Markets", Andrew Needham, Biogen

CH_4 for power

CO_2 to store?

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Unlike most renewable energies, liquid biofuels come with baggage

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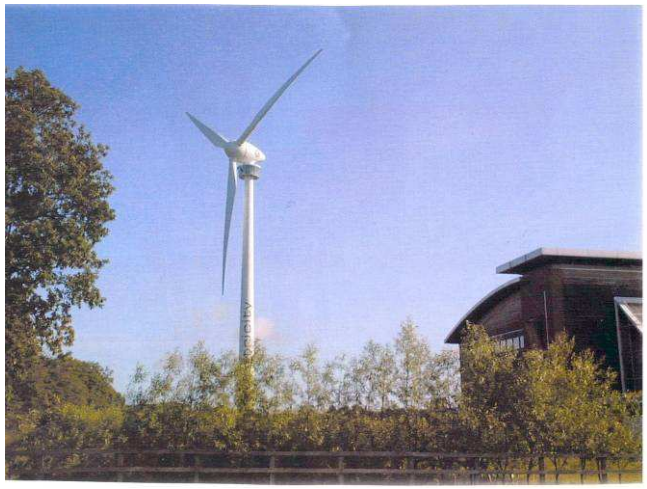

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There are exciting prospects but significant dangers and massive complexities

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- Food
- Fuel
- Agriculture
- Forests
- Climate change
- Politics
- Accounting

As with so much energy and climate change policy the focus is on supply not demand

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Long-term targets inadequate: Need rapid reduction in demand very soon

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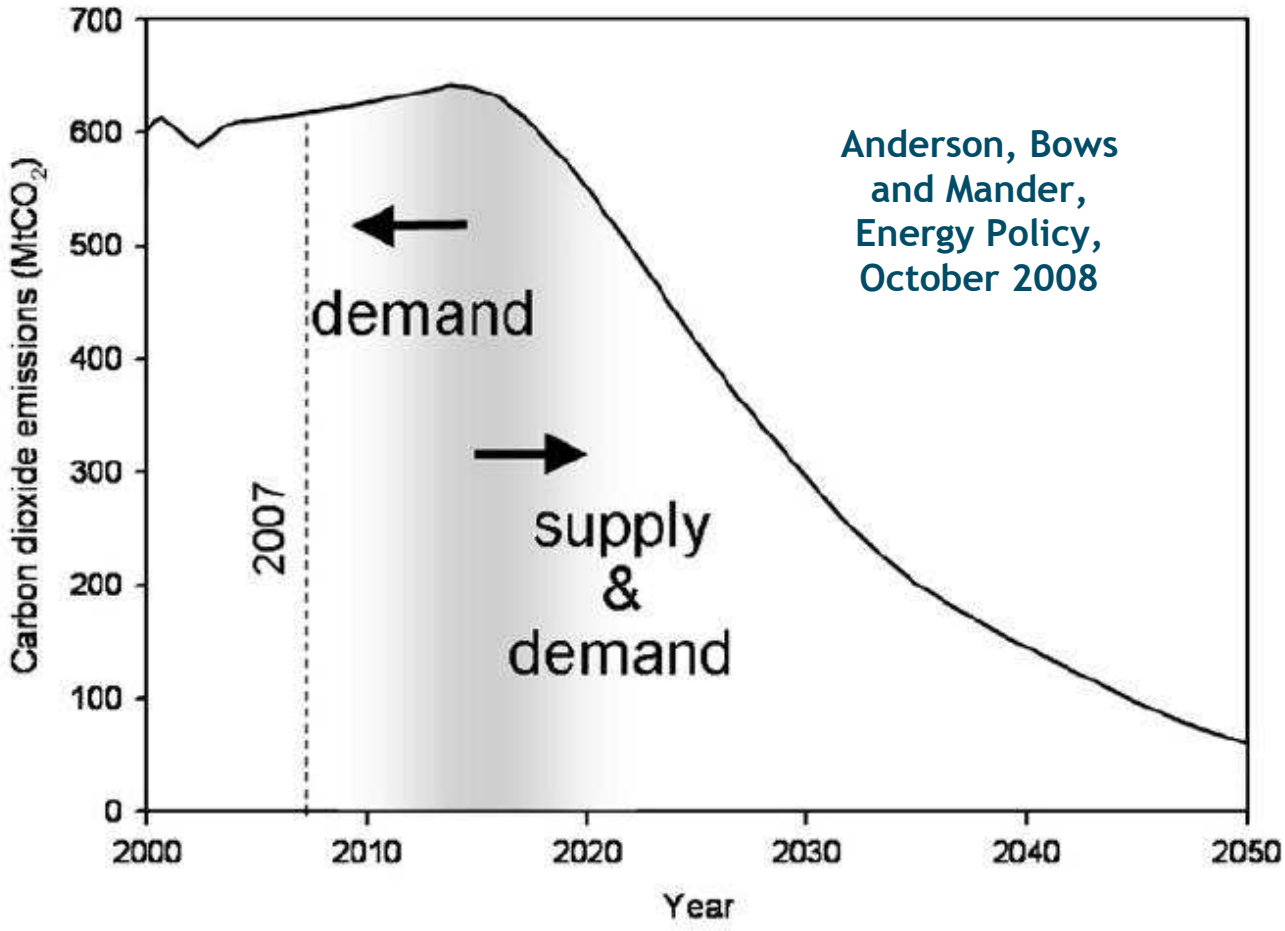
"In the short term there's no other game in town other than demand": Kevin Anderson, Tyndall Centre



Anderson, Bows and Mander, Energy Policy, October 2008

Fig. 3. Schematic representing the importance of cumulative emissions and messages for policy makers.

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Need to go beyond Climate Change Bill and long-term targets and focus on impact of cumulative emissions

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"By continuing to stress long-term carbon mitigation targets, the UK Government is relinquishing opportunities for meaningful and timely reductions in energy demand, and consequently is forgoing urgently needed reductions in CO_2 emissions. ... Consequently, if the UK is to demonstrate effective leadership on climate change and actively pursue a 450ppmv pathway, it is incumbent on the Government to redress the balance of its policy agenda in favour of an early transition to a lower energy-consuming society."

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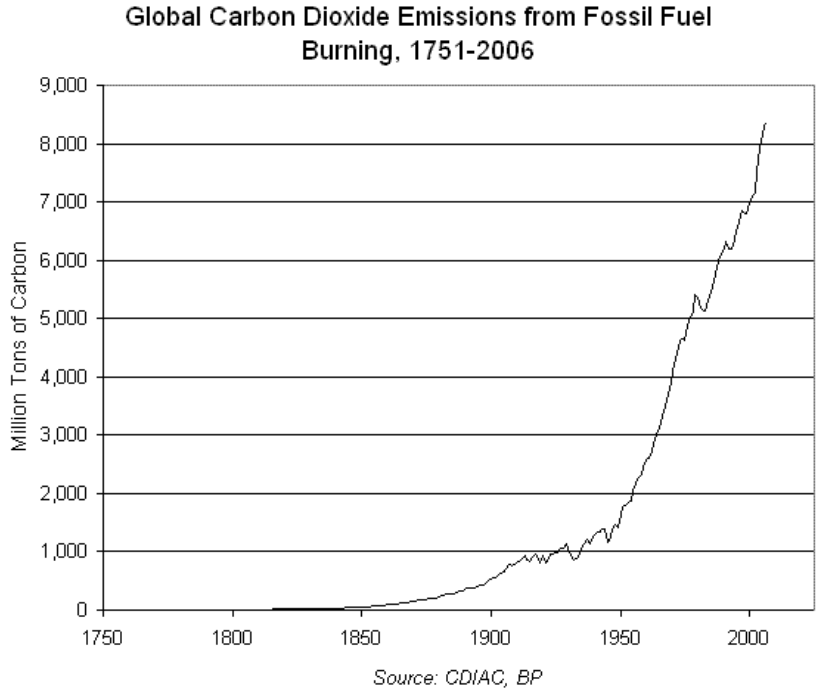
Anderson, Bows and Mander, Energy Policy, October 2008

Fossil fuel emissions are accelerating



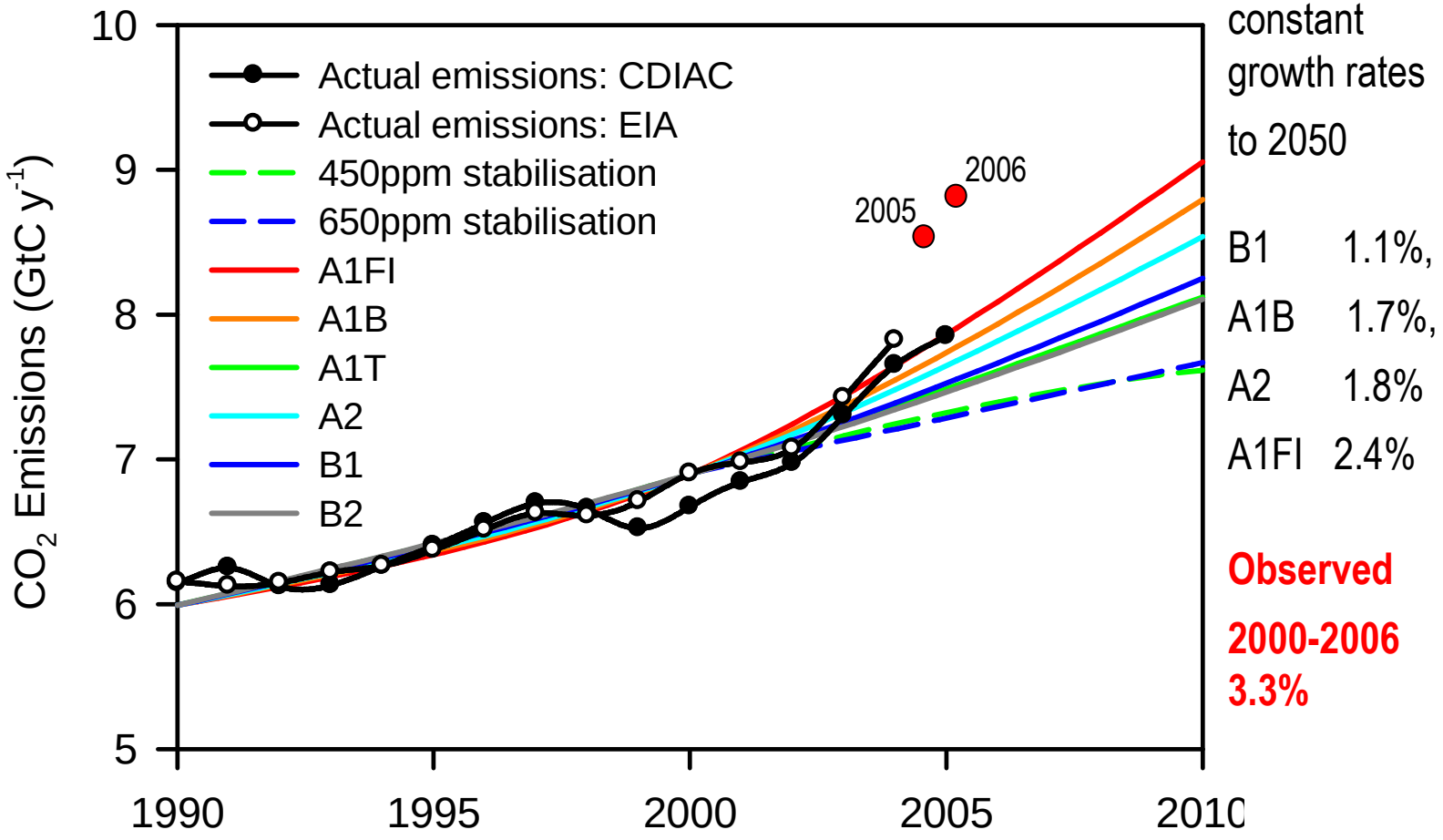
Annual increase:

2.7% over last 100 years

3.3% over last five years

Approx 300 GT C from fossil fuels and approx 150 GT C from land-use change since 1850

Trajectory of Global Fossil Fuel Emissions



Raupach et al. 2007, PNAS

Rate of increase of atmospheric CO_2 doubled since Mauna Loa measurements began

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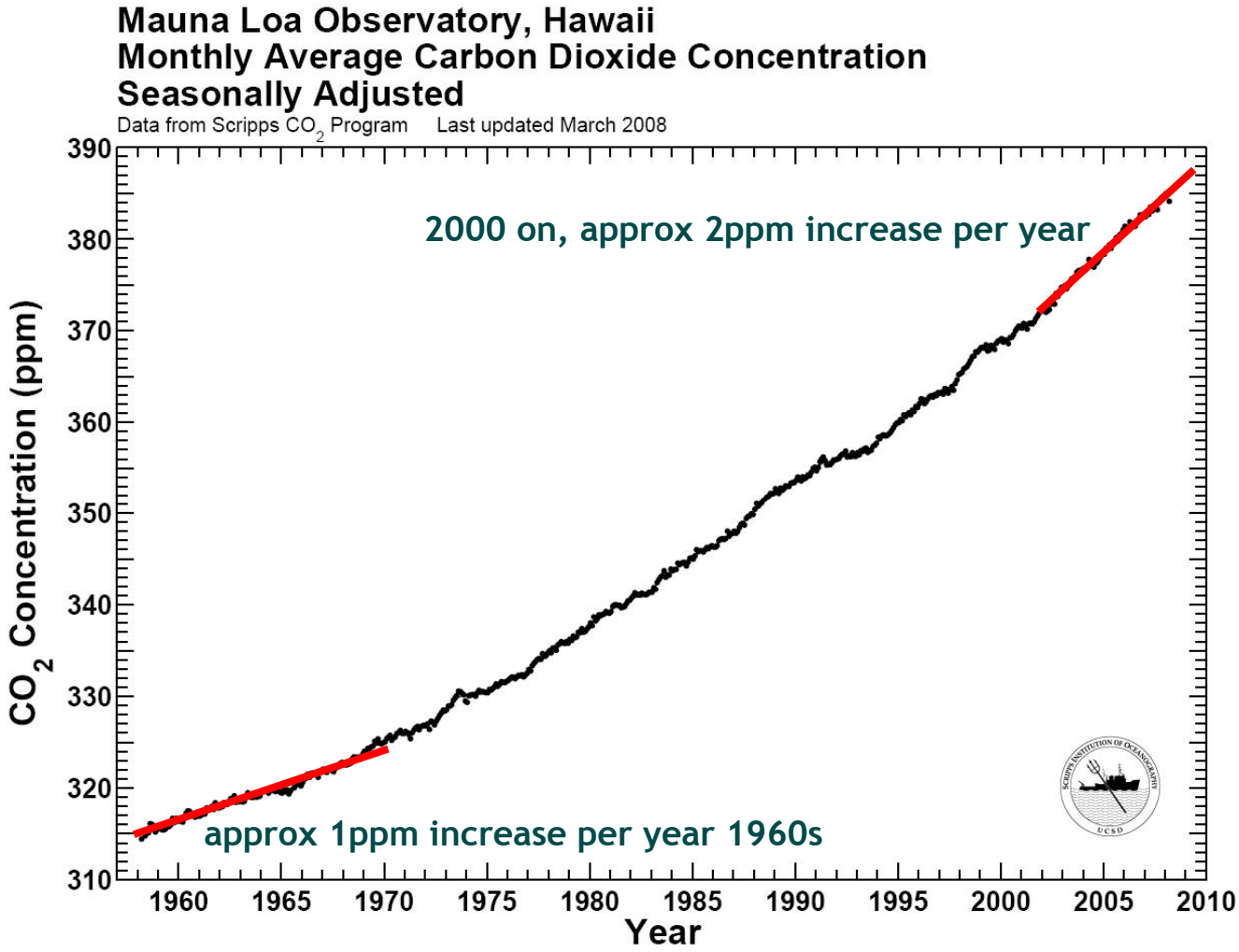

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Large stores of carbon locked up in permafrost peatlands and biomass under increasing risk

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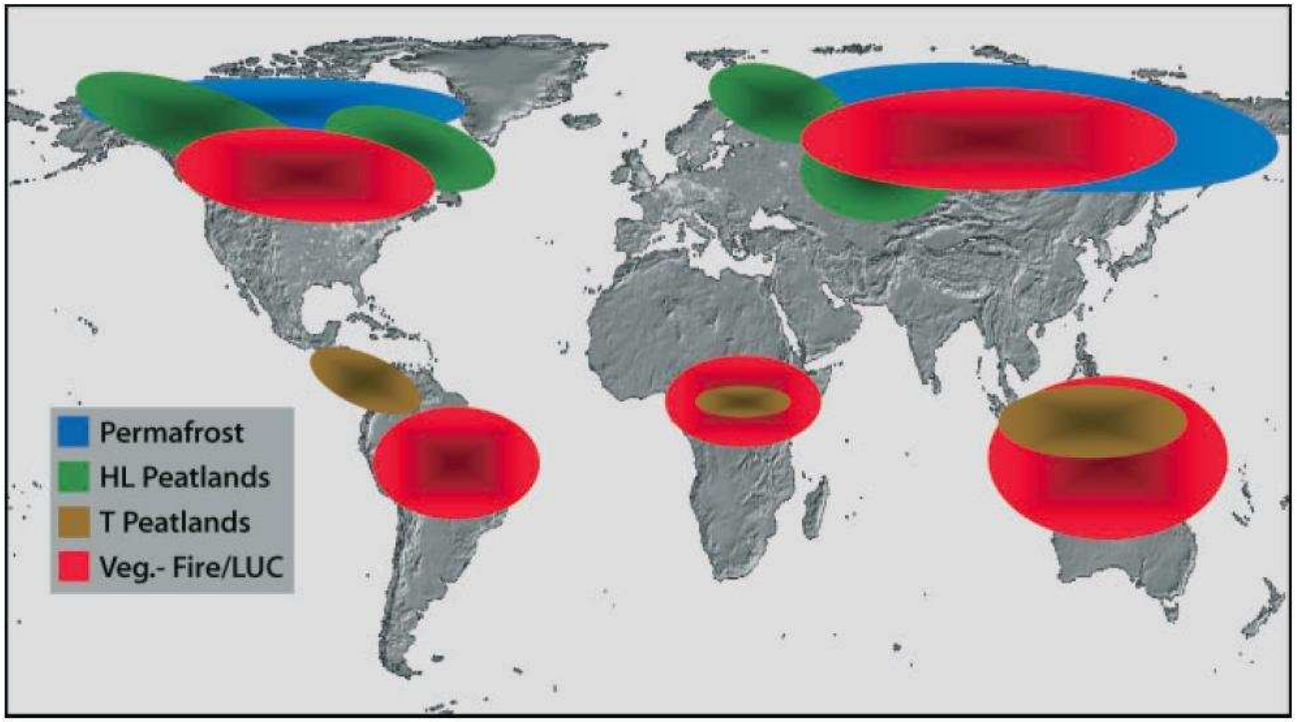
Fig. 6.8.
C pools vulnerable to global warming and land-use change. They include: *(i)* frozen ground, *(ii)* tropical and high-latitude peatlands, and *(iii)* vegetation susceptible to land use and fire



"Saturation of the Terrestrial Carbon Sink"
Josep G. Canadell et al, 2007

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Global warming impacts already apparent
Glaciers retreating around the world

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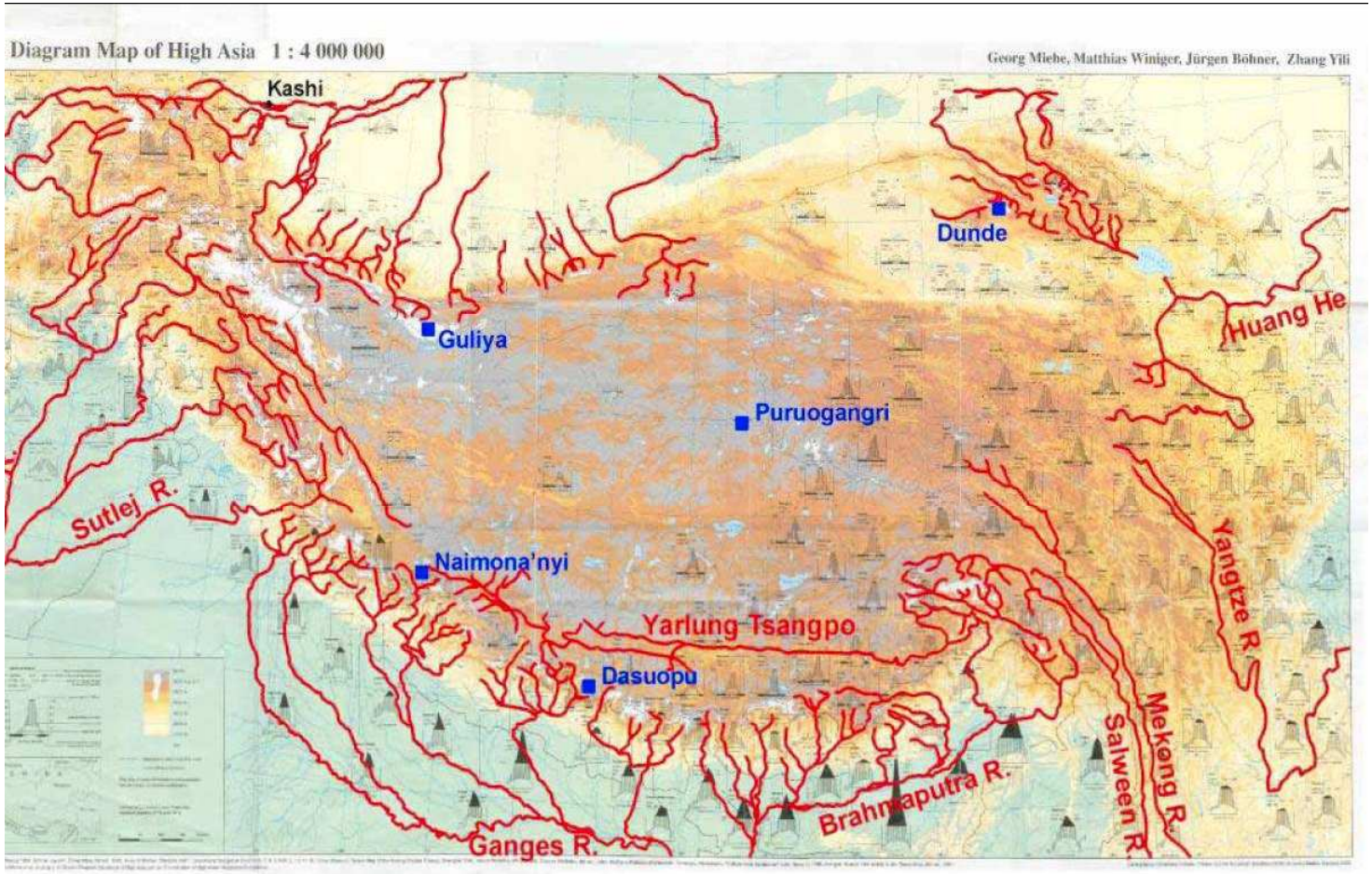

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Himalayan glaciers store about 12,000 cubic kilometers of freshwater in ~15,000 glaciers and are the lifeline for millions of people (IPCC, 2007)

"Glaciers in most parts of the world are rapidly melting and their loss will affect 2 to 3 billion people"

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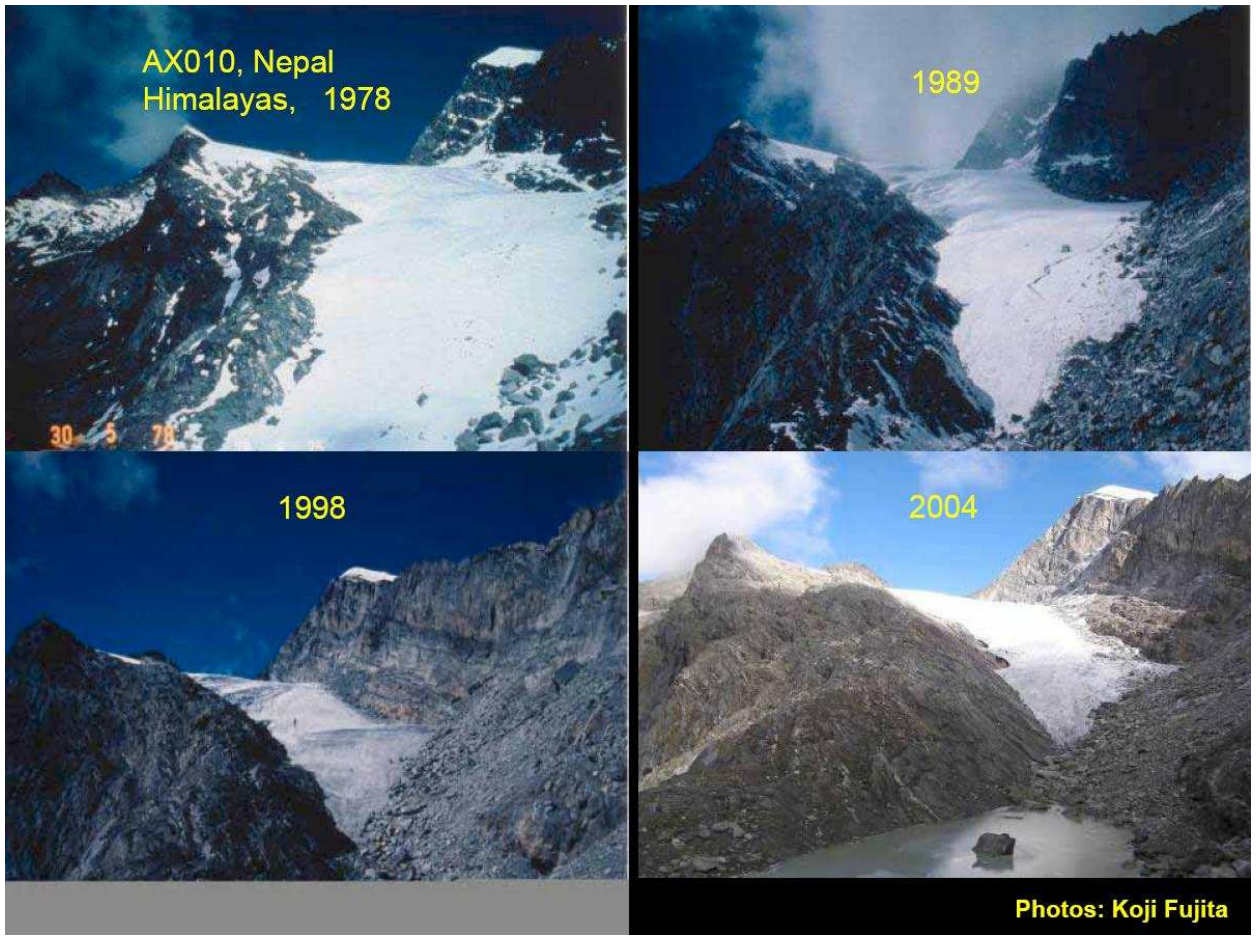
From:
"Retreating Glaciers"
Lonnie G Thompson,
Leverhulme Symposium, 2008



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September 2007: dramatic impact of global warming; Arctic sea ice extent was a record low of 4.3m square kilometres.

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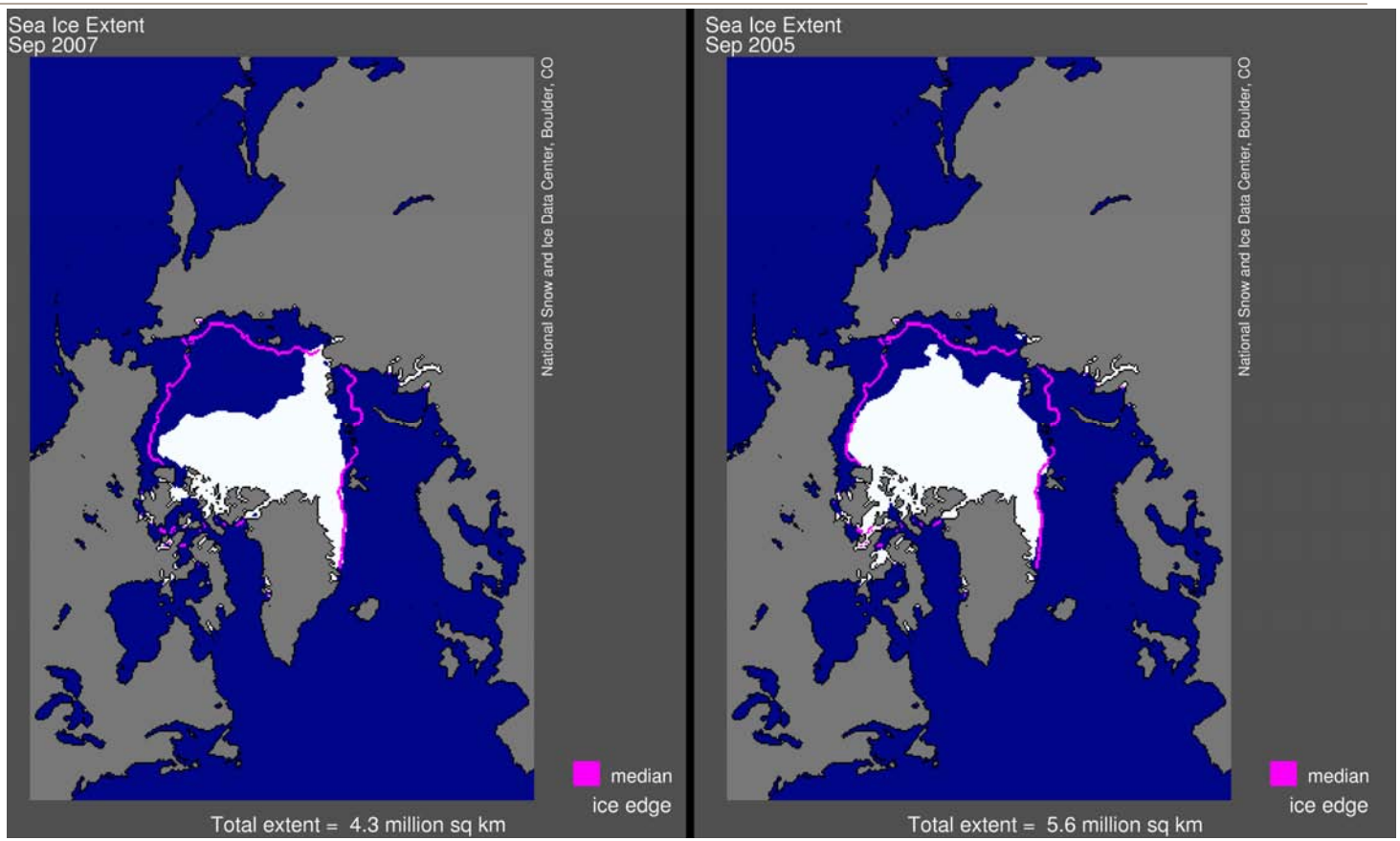
Previous record low: 5.6m square kilometres, September 2005

2007 shows nearly a 25 per cent reduction in ice extent in just two years



The North-West passage was open for the first time in living memory

Source: US National Snow and Ice Data Center, Colorado Univ, www.nsidc.org, 1 October, 2007

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Exceeding critical atmospheric CO2 levels may lead to irreversible and possibly rapid change back eventually to a ten degree warmer world

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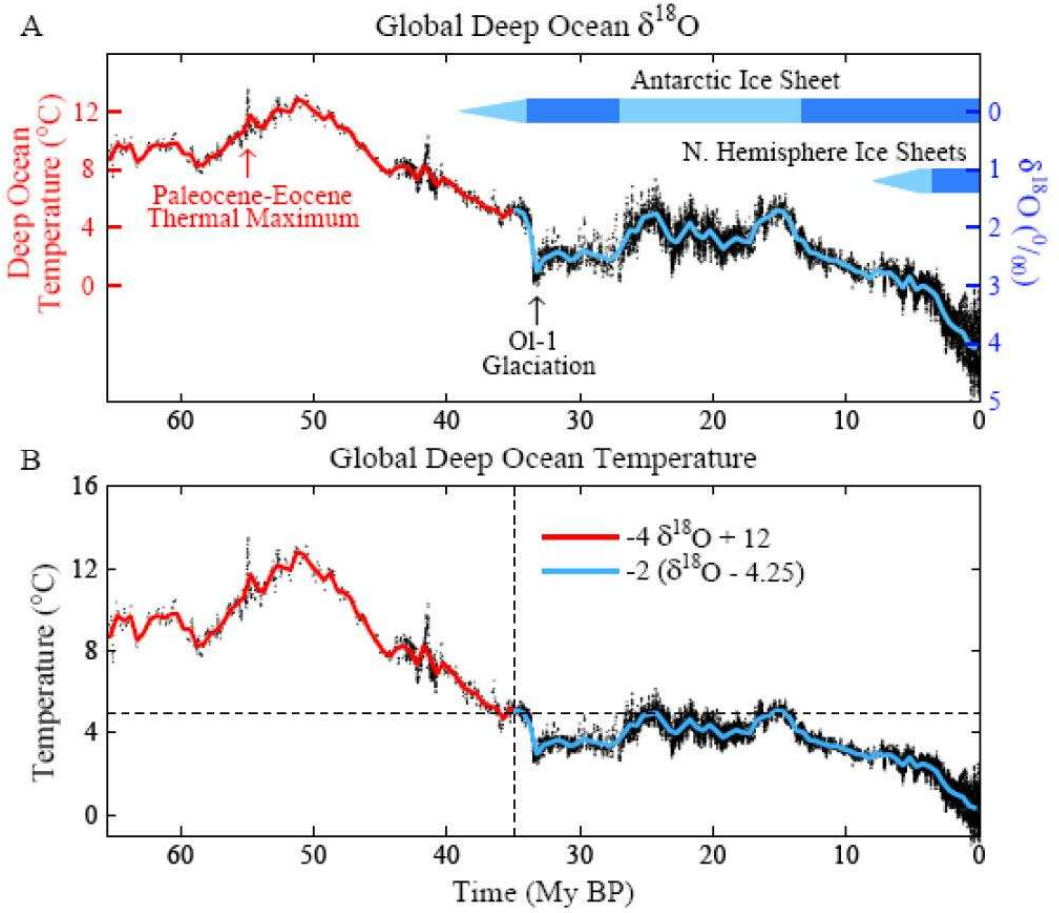

Fig. 3. Global deep ocean (A) $\delta^{18}O$ (22) and (B) temperature. Black curve is 5-point running mean of $\delta^{18}O$ original temporal resolution, while red and blue curves have 500 ky resolution.

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"Target Atmospheric CO2: Where Should Humanity Aim?"
James Hansen et al, March, 2008

The Earth has been cooling for 50 million years

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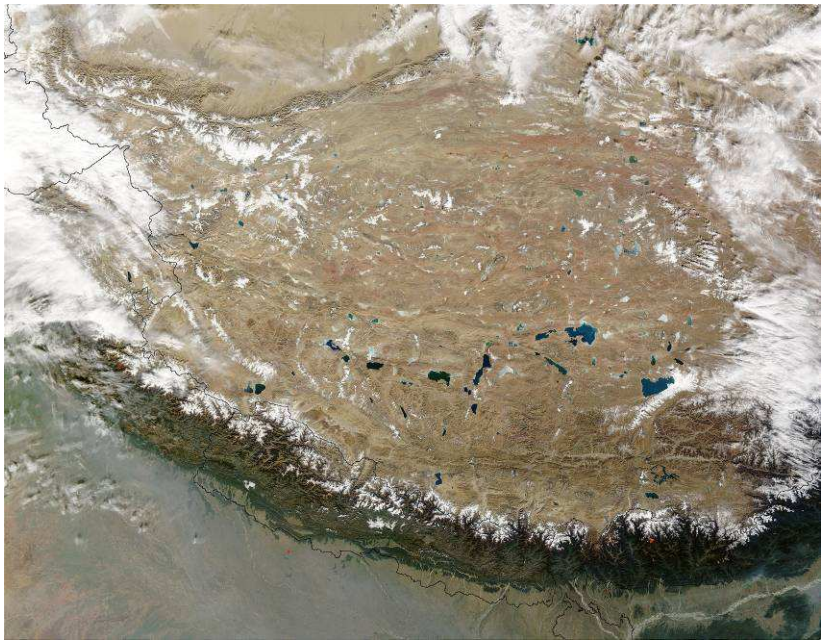
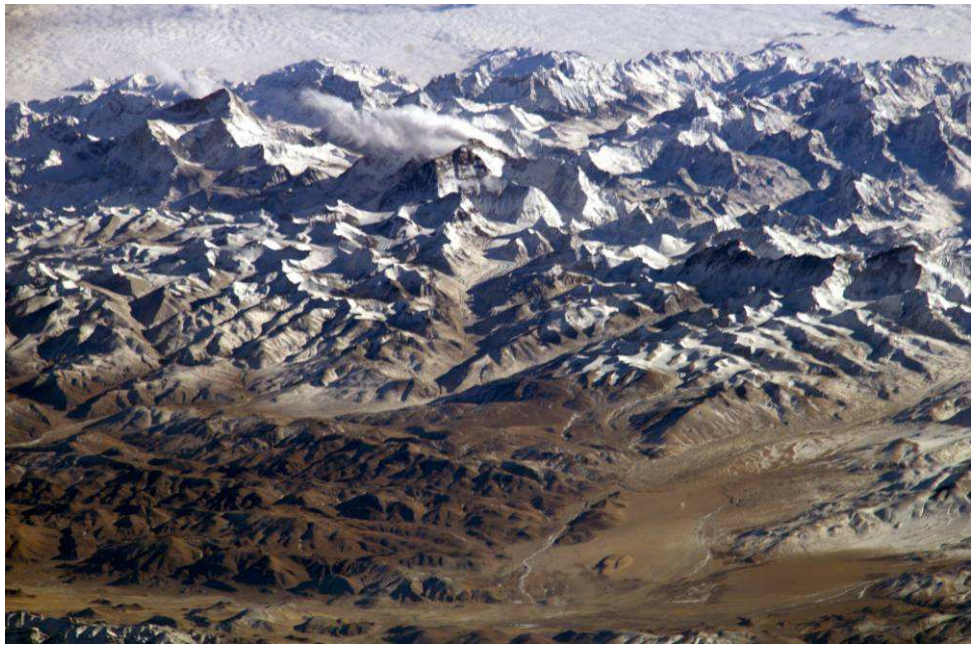


Tibetan plateau



Himalayas

from space; pictures courtesy of NASA

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Are we close to the ghg levels where ice may eventually disappear?

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Decreasing CO2 was the main cause of a cooling trend that began 50 million years ago, large scale glaciation occurring when CO2 fell to 425±75 ppm, a level that will be exceeded within decades, barring prompt policy changes. If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO2 will need to be reduced from its current 385 ppm to at most 350 ppm.... An initial 350 ppm CO2 target may be achievable by phasing out coal use except where CO2 is captured and adopting agricultural and forestry practices that sequester carbon. If the present overshoot of this target CO2 is not brief, there is a possibility of seeding irreversible catastrophic effects.

"Target Atmospheric CO2: Where Should Humanity Aim?"
James Hansen et al, March, 2008

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Liquid biofuels contrast to biomass

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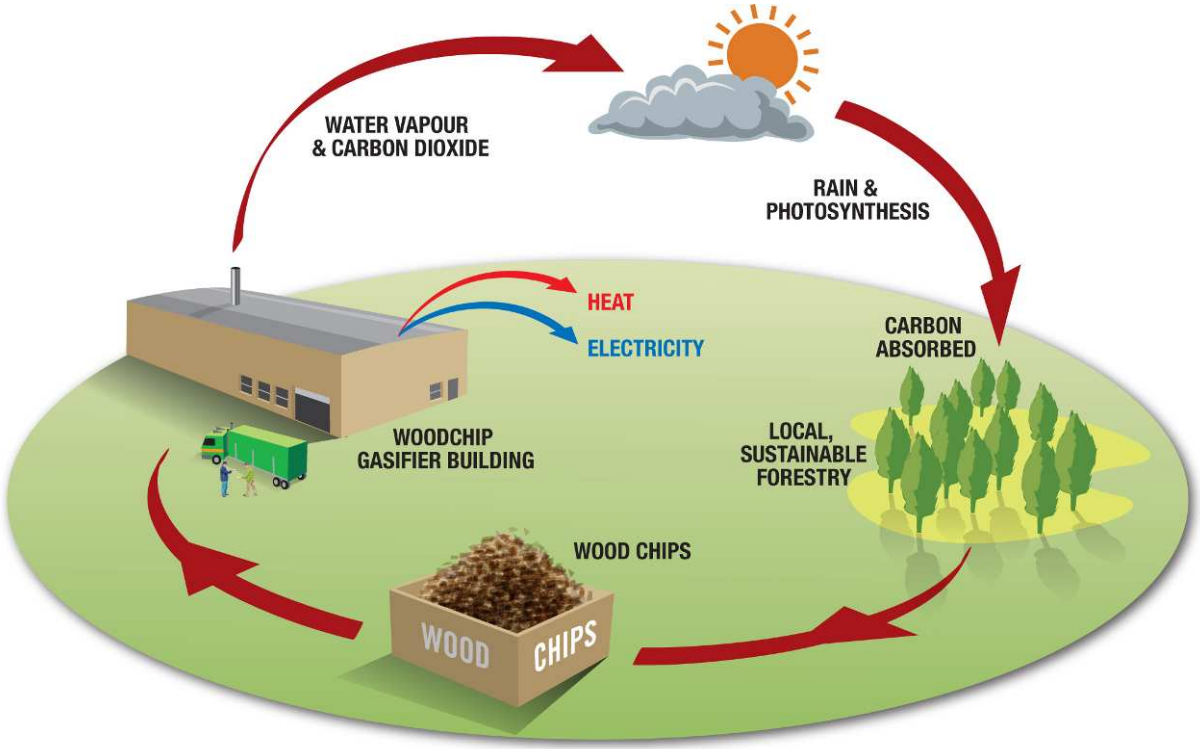
UEA's biomass gasifier



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UEA's biomass gasifier under construction

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Biomass gasifier – first in England

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1.4MWe, 2MWh

- Reduces UEA carbon footprint by 35 per cent
- 1990 to 2006: 239 per cent increase in student numbers
- 10 per cent increase in CO_2 emissions
- 53 per cent reduction in CO_2 emissions per student
- Biomass gasifier will reduce absolute CO_2 by 2009 by approx 25 per cent from 1990

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Politics 1:
Martin Wolf: The Financial Times

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"Energy security and climate change are two of the most significant challenges confronting humanity. What we see, in response, is the familiar capture of policymaking by well-organised special interests. A superb example is the flood of subsidies for biofuels. These are farm programmes masquerading as answers to energy insecurity and climate change. Not surprisingly, they have the depressing characteristics of such programmes: high protection, open-ended support to producers, and indifference to economic rationality."

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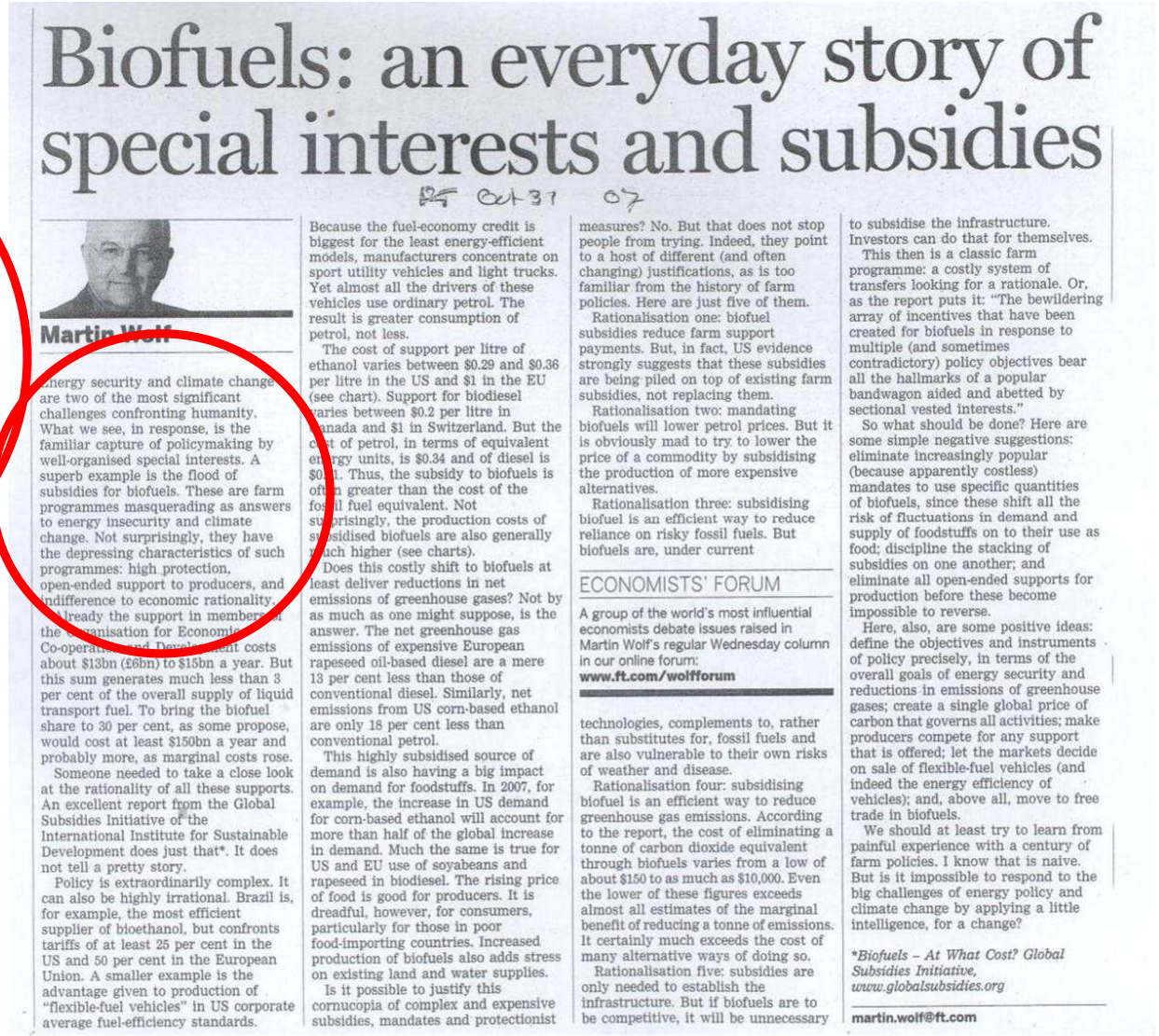

Biofuels: an everyday story of special interests and subsidies

Martin Wolf

Energy security and climate change are two of the most significant challenges confronting humanity. What we see, in response, is the familiar capture of policymaking by well-organised special interests. A superb example is the flood of subsidies for biofuels. These are farm programmes masquerading as answers to energy insecurity and climate change. Not surprisingly, they have the depressing characteristics of such programmes: high protection, open-ended support to producers, and indifference to economic rationality. Already the support in members of the Organisation for Economic Co-operation and Development costs about $13bn (£6bn) to $15bn a year. But this sum generates much less than 3 per cent of the overall supply of liquid transport fuel. To bring the biofuel share to 30 per cent, as some propose, would cost at least $150bn a year and probably more, as marginal costs rose.

Someone needed to take a close look at the rationality of all these supports. An excellent report from the Global Subsidies Initiative of the International Institute for Sustainable Development does just that*. It does not tell a pretty story.

Policy is extraordinarily complex. It can also be highly irrational. Brazil is, for example, the most efficient supplier of bioethanol, but confronts tariffs of at least 25 per cent in the US and 50 per cent in the European Union. A smaller example is the advantage given to production of "flexible-fuel vehicles" in US corporate average fuel-efficiency standards. Because the fuel-economy credit is biggest for the least energy-efficient models, manufacturers concentrate on sport utility vehicles and light trucks. Yet almost all the drivers of these vehicles use ordinary petrol. The result is greater consumption of petrol, not less.

The cost of support per litre of ethanol varies between $0.29 and $0.36 per litre in the US and $1 in the EU (see chart). Support for biodiesel varies between $0.2 per litre in Canada and $1 in Switzerland. But the cost of petrol, in terms of equivalent energy units, is $0.34 and of diesel is $0.41. Thus, the subsidy to biofuels is often greater than the cost of the fossil fuel equivalent. Not surprisingly, the production costs of subsidised biofuels are also generally much higher (see charts).

Does this costly shift to biofuels at least deliver reductions in net emissions of greenhouse gases? Not by as much as one might suppose, is the answer. The net greenhouse gas emissions of expensive European rapeseed oil-based diesel are a mere 13 per cent less than those of conventional diesel. Similarly, net emissions from US corn-based ethanol are only 18 per cent less than conventional petrol.

This highly subsidised source of demand is also having a big impact on demand for foodstuffs. In 2007, for example, the increase in US demand for corn-based ethanol will account for more than half of the global increase in demand. Much the same is true for US and EU use of soyabeans and rapeseed in biodiesel. The rising price of food is good for producers. It is dreadful, however, for consumers, particularly for those in poor food-importing countries. Increased production of biofuels also adds stress on existing land and water supplies.

Is it possible to justify this cornucopia of complex and expensive subsidies, mandates and protectionist measures? No. But that does not stop people from trying. Indeed, they point to a host of different (and often changing) justifications, as is too familiar from the history of farm policies. Here are just five of them.

Rationalisation one: biofuel subsidies reduce farm support payments. But, in fact, US evidence strongly suggests that these subsidies are being piled on top of existing farm subsidies, not replacing them.

Rationalisation two: mandating biofuels will lower petrol prices. But it is obviously mad to try to lower the price of a commodity by subsidising the production of more expensive alternatives.

Rationalisation three: subsidising biofuel is an efficient way to reduce reliance on risky fossil fuels. But biofuels are, under current technologies, complements to, rather than substitutes for, fossil fuels and are also vulnerable to their own risks of weather and disease.

Rationalisation four: subsidising biofuel is an efficient way to reduce greenhouse gas emissions. According to the report, the cost of eliminating a tonne of carbon dioxide equivalent through biofuels varies from a low of about $150 to as much as $10,000. Even the lower of these figures exceeds almost all estimates of the marginal benefit of reducing a tonne of emissions. It certainly much exceeds the cost of many alternative ways of doing so.

Rationalisation five: subsidies are only needed to establish the infrastructure. But if biofuels are to be competitive, it will be unnecessary to subsidise the infrastructure. Investors can do that for themselves.

This then is a classic farm programme: a costly system of transfers looking for a rationale. Or, as the report puts it: "The bewildering array of incentives that have been created for biofuels in response to multiple (and sometimes contradictory) policy objectives bear all the hallmarks of a popular bandwagon aided and abetted by sectional vested interests."

So what should be done? Here are some simple negative suggestions: eliminate increasingly popular (because apparently costless) mandates to use specific quantities of biofuels, since these shift all the risk of fluctuations in demand and supply of foodstuffs on to their use as food; discipline the stacking of subsidies on one another; and eliminate all open-ended supports for production before these become impossible to reverse.

Here, also, are some positive ideas: define the objectives and instruments of policy precisely, in terms of the overall goals of energy security and reductions in emissions of greenhouse gases; create a single global price of carbon that governs all activities; make producers compete for any support that is offered; let the markets decide on sale of flexible-fuel vehicles (and indeed the energy efficiency of vehicles); and, above all, move to free trade in biofuels.

We should at least try to learn from painful experience with a century of farm policies. I know that is naive. But is it impossible to respond to the big challenges of energy policy and climate change by applying a little intelligence, for a change?

Biofuels – At What Cost? Global Subsidies Initiative, www.globalsubsidies.org

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ECONOMISTS' FORUM

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www.ft.com/wolfforum

Politics 2:
subsidies for fossil fuels are massive and distort behaviour

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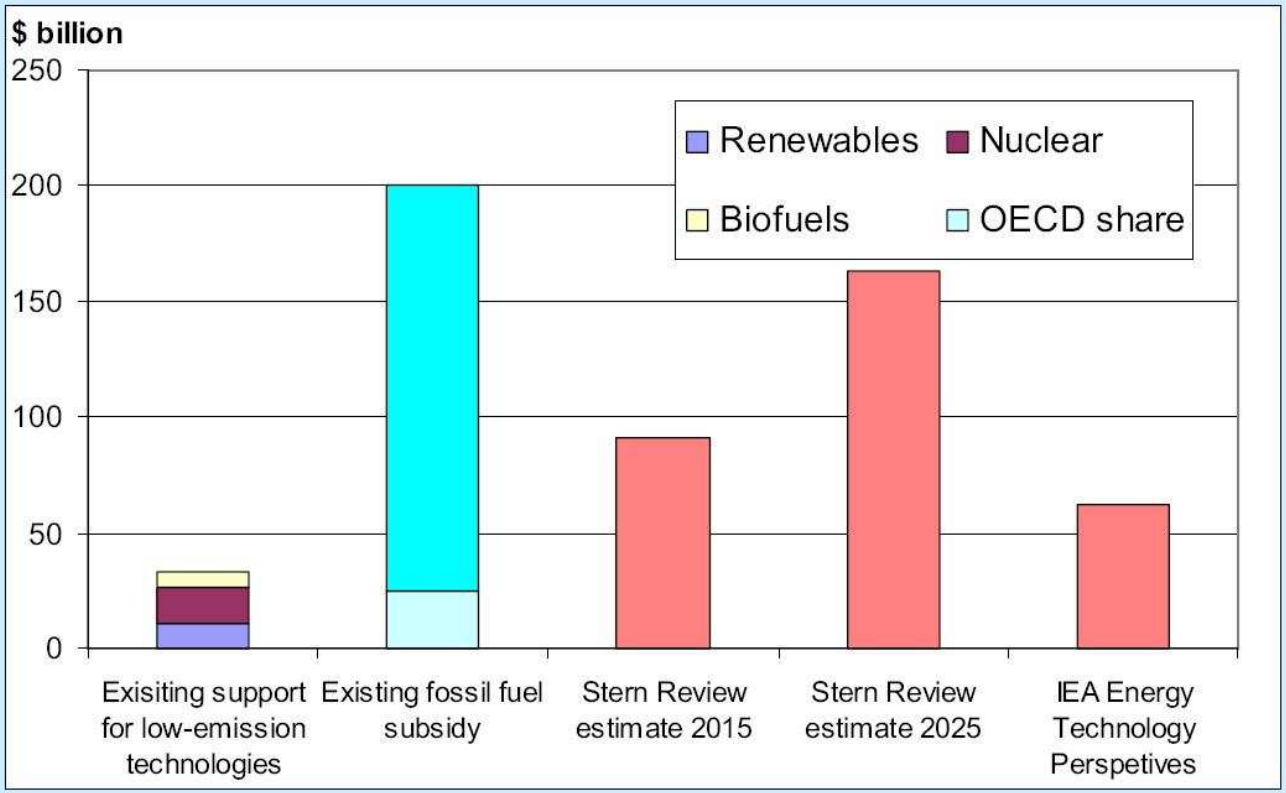
Stern, p422;
The fossil fuel subsidy level may be underestimated

Figure 16.7 Estimated scale of current and necessary global deployment support



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In *"Lives per gallon"*, Terry Tamminen, 2006, estimates annual US federal tax breaks and other direct subsidies for oil to be in the range $65billion to $113billion, close to $1 per gallon

Politics 3:
subsidies for biofuels are similarly massive and similarly distorting - in the United States

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"Current subsidies to biofuels in the United States are large, between $5.5 and $7.3 billion per year."

"Biofuels subsidies continue to grow rapidly in scope and scale, expected to soon reach $8–11 billion per year."

"Under optimistic projections, it costs some $500 in federal and state subsidies to reduce one metric ton of CO2-equivalent through the production and use of corn-based ethanol."

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"Biofuels: At What Cost?"
Government Support for Ethanol and Biodiesel in the United States
Doug Koplow
Oct 06, www.globalsubsidies.org

Politics 4:
- and in Europe as well

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The cost of obtaining a unit of CO2-equivalent reduction through subsidies to biofuels is very high, especially for biofuels produced from virgin materials. We calculate that subsidies per tonne of CO2-equivalent avoided are between € 575 and € 800 for ethanol made from sugarbeet, and around € 215 for biodiesel made from used cooking oil, and over € 600 for biodiesel made from rapeseed. Hence, even with best-case scenario assumptions for GHG reductions from biofuels, one could achieve far more reductions for the same amount of money by simply purchasing the reductions in the marketplace.


BIOFUELS - AT WHAT COST?

Government support for ethanol and biodiesel in the European Union

One of a series of reports addressing subsidies for biofuels in selected OECD countries

October 2007

Prepared by:
Géraldine Kutas, Carina Lindberg and Ronald Steenblik

Prepared for:
The Global Subsidies Initiative (GSI)

GSI Global Subsidies Initiative

The GSI is a programme of iisd International Institute for Sustainable Development / Institut international du développement durable

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Politics 5: EU and UK mandates

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Stem from the EU Biofuels Directive, 2003

Now part of EU and UK Renewable Energy Strategy

EU: 10 per cent of transport fuel consumption by 2020

UK Renewable Transport Fuel Obligation (RTFO) to be slowed to reach 5% in 2013-14 rather than in 2010-11.

A further £6 million to research being conducted by the Carbon Trust to accelerate the development of advanced sustainable biofuels technologies.

CONCERN WITH INDIRECT EFFECTS

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The technical fix myth

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- With biofuels (nuclear power…) we can fix our ghg problem and carry on behaving as before without major change.
- This model is wrong: a sustainable Earth is resource limited.
- Biofuels are not a technical fix and cannot create fuel security.
- They become valid only as one part of a comprehensive strategy to tackle transport emissions - including vehicles and travel patterns.
- Biofuels have been promoted without attention to the other essentials.
- In future we will need to obtain food, and fuel, and many other products from crops - this will be a massive challenge.

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US bioethanol production has increased five fold since 2000 - could double again
Nearly one-third of corn crop

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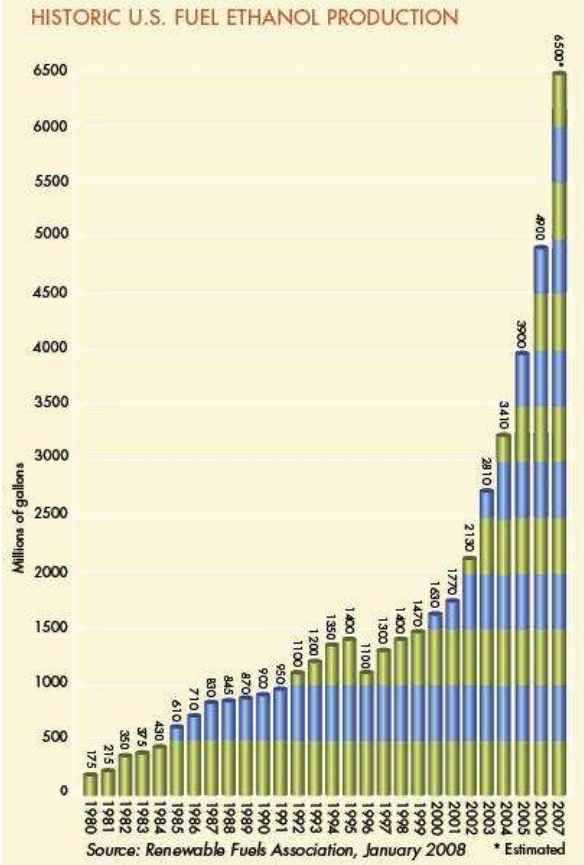
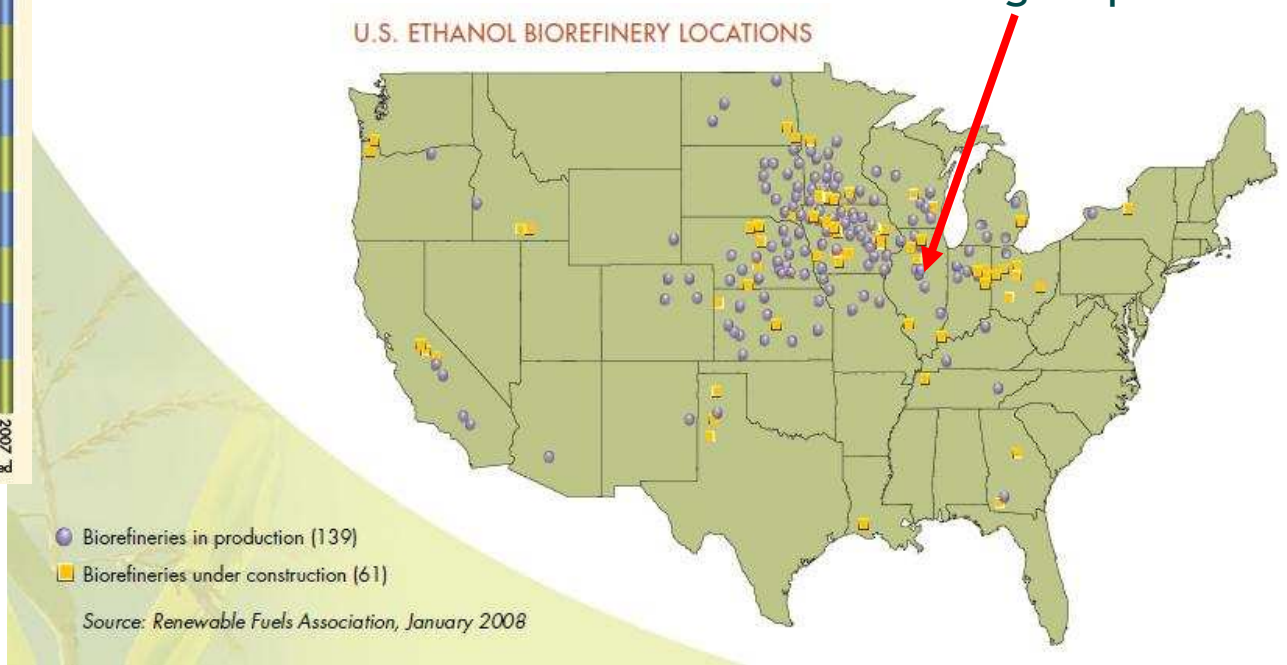


"Once all of the new construction currently underway is complete, the U.S. ethanol industry will be able to supply more than 13 billion gallons of ethanol, representing nearly 10% of the nation's gasoline demand."

Illinois is third largest producer



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Ethanol accounts for nearly a third of US corn use – but still only five per cent of overall gasoline use

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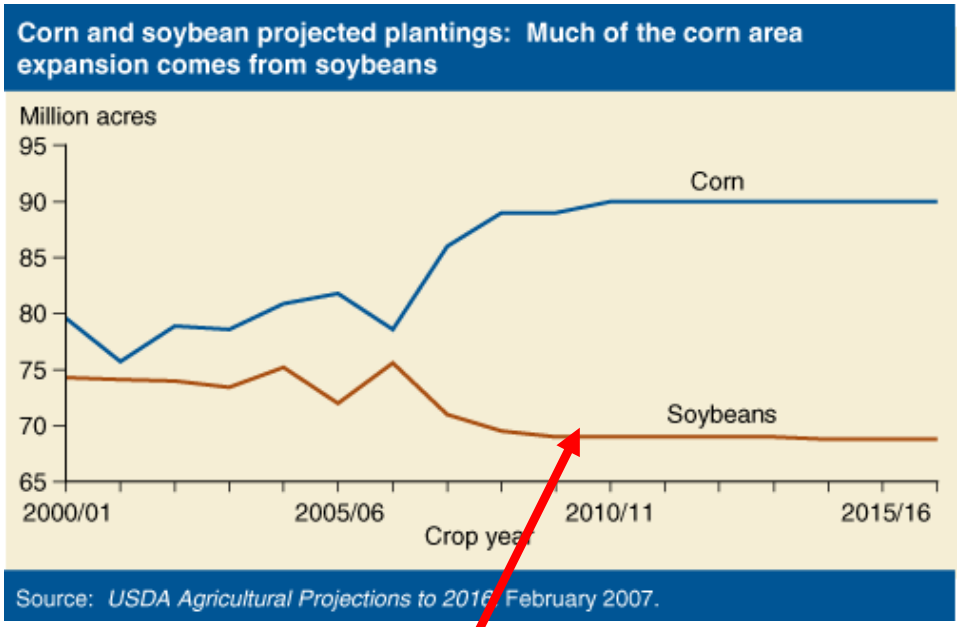

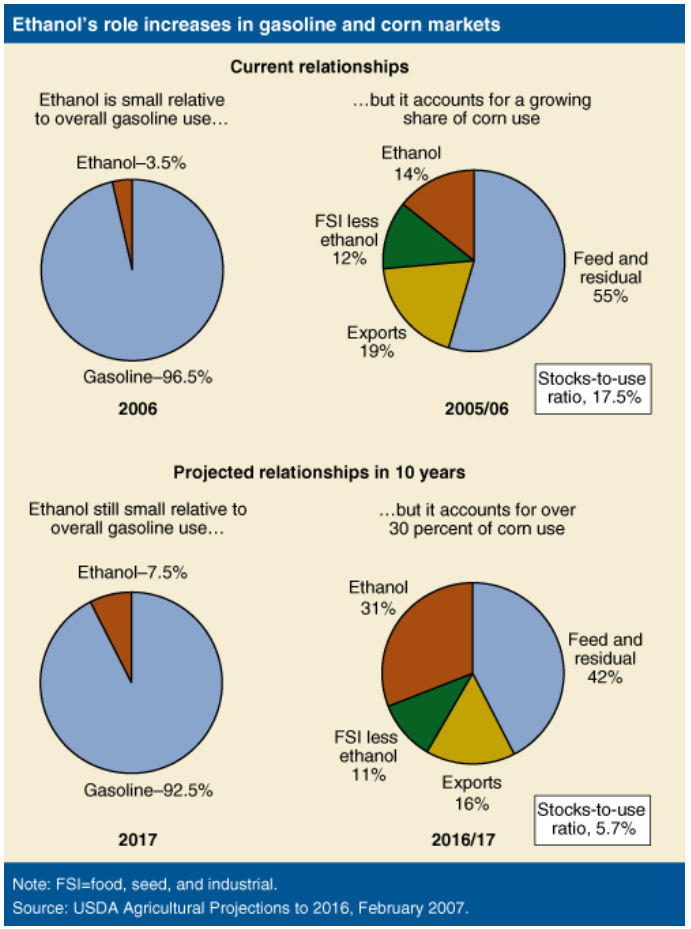

But a major impact is to reduce soya planting and also to plough up virgin prairie for corn – direct and indirect land-use change

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Source: *"U.S. Ethanol Expansion Driving Changes Throughout the Agricultural Sector"*, Paul C. Westcott, United States Department of Agriculture Economic Research Service, September 2007

Indirect effects:
Nepstad and colleagues show the link between more US corn and Amazon deforestation

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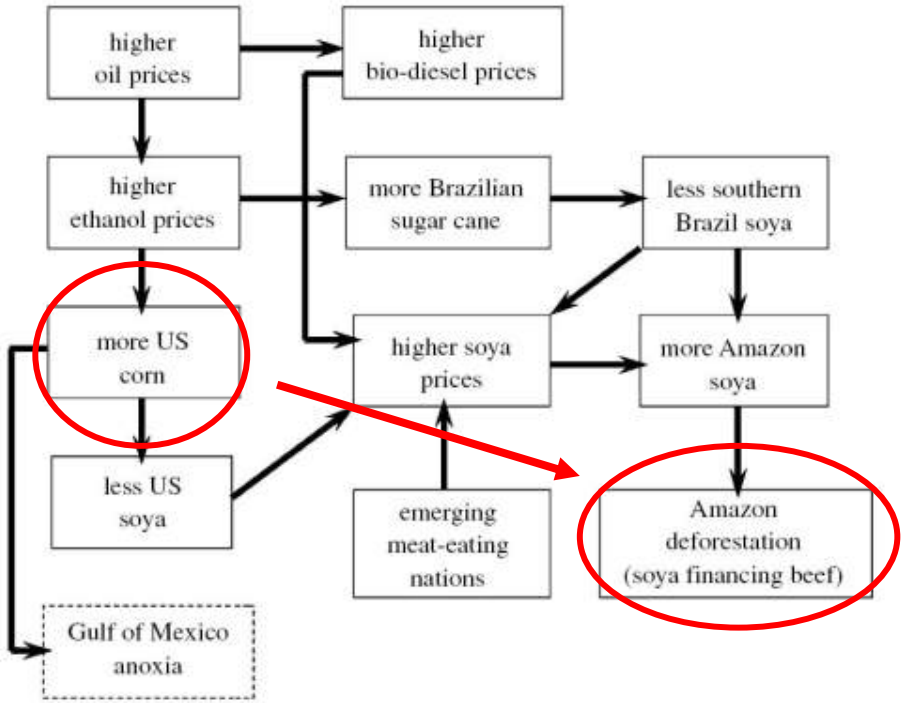

Figure 1. Economic teleconnections between US investments in corn-based ethanol production, Brazilian investments in sugar cane-based ethanol production and Amazon deforestation.

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Source: *"Interactions among Amazon land use, forests and climate: prospects for a near-term forest tipping point"*, Daniel C Nepstad et al, Phil Trans Roy Soc B Biol Sci, Feb 2008

The chain is largely indirect through deforestation by cattle ranchers
Not just biofuels but animal feed especially

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"Rising worldwide demands for biofuel and meat are creating powerful new incentives for agro-industrial expansion into Amazon forest regions."

"The prospect of reducing global warming and keeping global average temperatures from rising no more than 2°C will be very difficult if emissions of carbon from tropical forests worldwide, and the Amazon in particular, are not curtailed sharply in the coming years."

"Growing global demands for biofuel and animal ration provide new incentives to clear forest that are already colliding with a decade-long expansion of the Amazon cattle herd. Although some soya expansion takes place through the direct conversion of forest to soya, most of the expansion is onto areas that were previously cattle pasture, pushing up land prices in the process and capitalizing ranchers who can move on to acquire land holdings deeper into the Amazon forest region. This is particularly important given the prevalence of cattle ranching as a land use and as a driver of deforestation in the region."

Source: *"Interactions among Amazon land use, forests and climate: prospects for a near-term forest tipping point"*, Daniel C Nepstad et al, Phil Trans Roy Soc B Biol Sci, Feb 2008

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The Cerrado and other areas of Brazil are equally affected but less protected

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"The Amazon and the Cerrado are particularly vulnerable. Interacting with climate change and land use, the upcoming stage of cellulosic energy could result in a collapse of the new frontier into vast degraded pasture."

"There is now two or three times as much annual deforestation in the Cerrado as the Amazon."

"There is no monitoring of deforestation outside the Amazon."

The Cerrado is the richest savannah in the world

Source: *"Climate change, biofuels and eco-social impacts in the Brazilian Amazon and Cerrado"*, Donald Sawyer, Phil Trans Roy Soc B Biol Sci, Feb 2008

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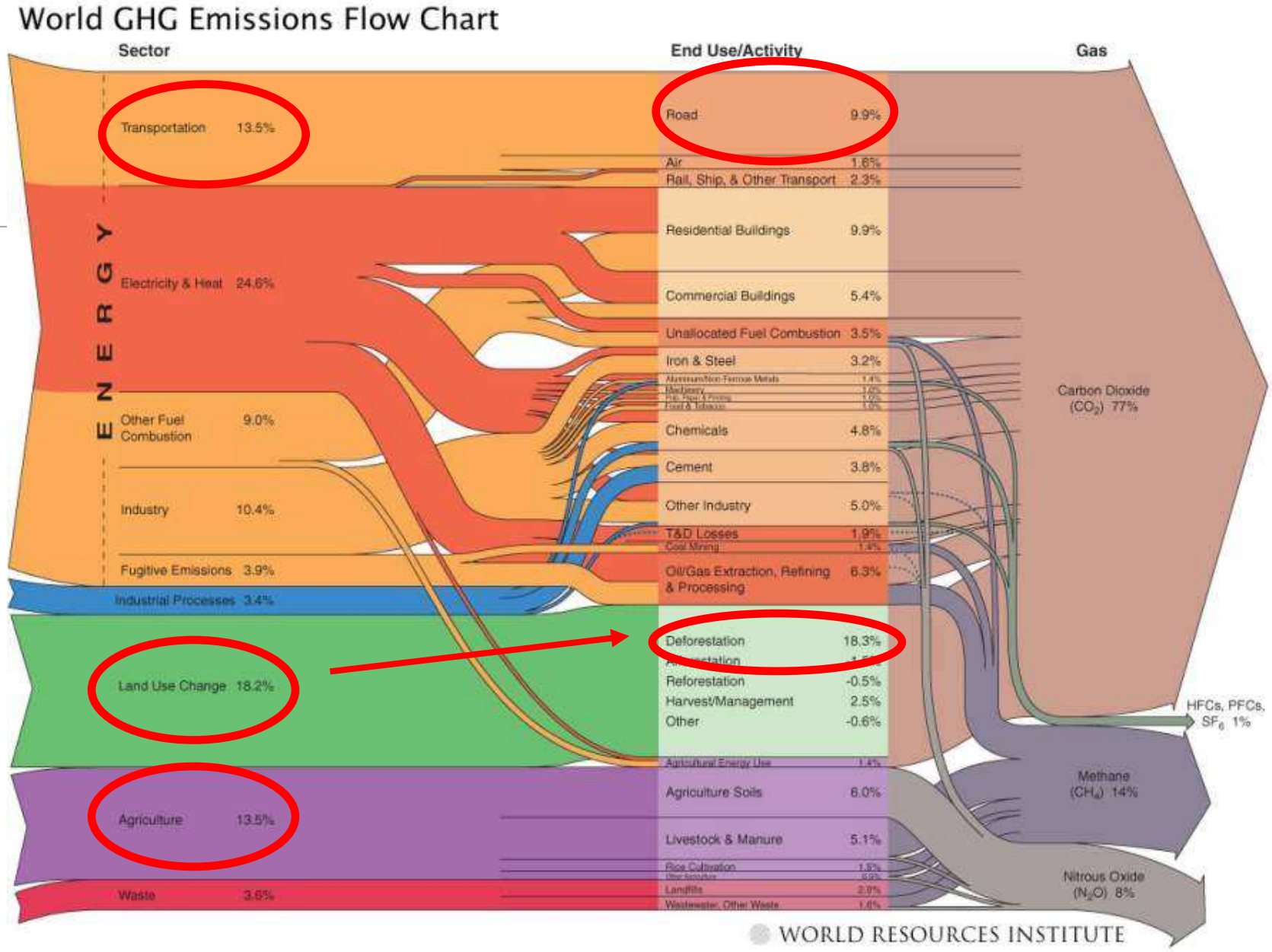
Global ghg emissions



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Stern, Fig B, p199
Data for 2000

Land use change and agriculture emissions are over two times transport emissions

Indirect effects especially severe in wetland rainforest

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"The draining of wetlands to produce any type of biofuel would produce a loss of stored carbon that would take hundreds of years to make up through the biofuels' annual greenhouse gas savings."
EU Biofuels Progress Report, January 2007

Indonesia, 2007
Emily Fitzherbert
UEA Student

Copyright
Sinclair Stammers

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GOOD? **OR BAD?**

EU mandates can drive demand for palm oil for biofuels

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Schematic of Neste proposed 800,000 tonne biofuel plant in Singapore - which will be the world's largest

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On current protocols, some companies are achieving reasonable ghg savings But there is acknowledgement that we need to understand indirect effects

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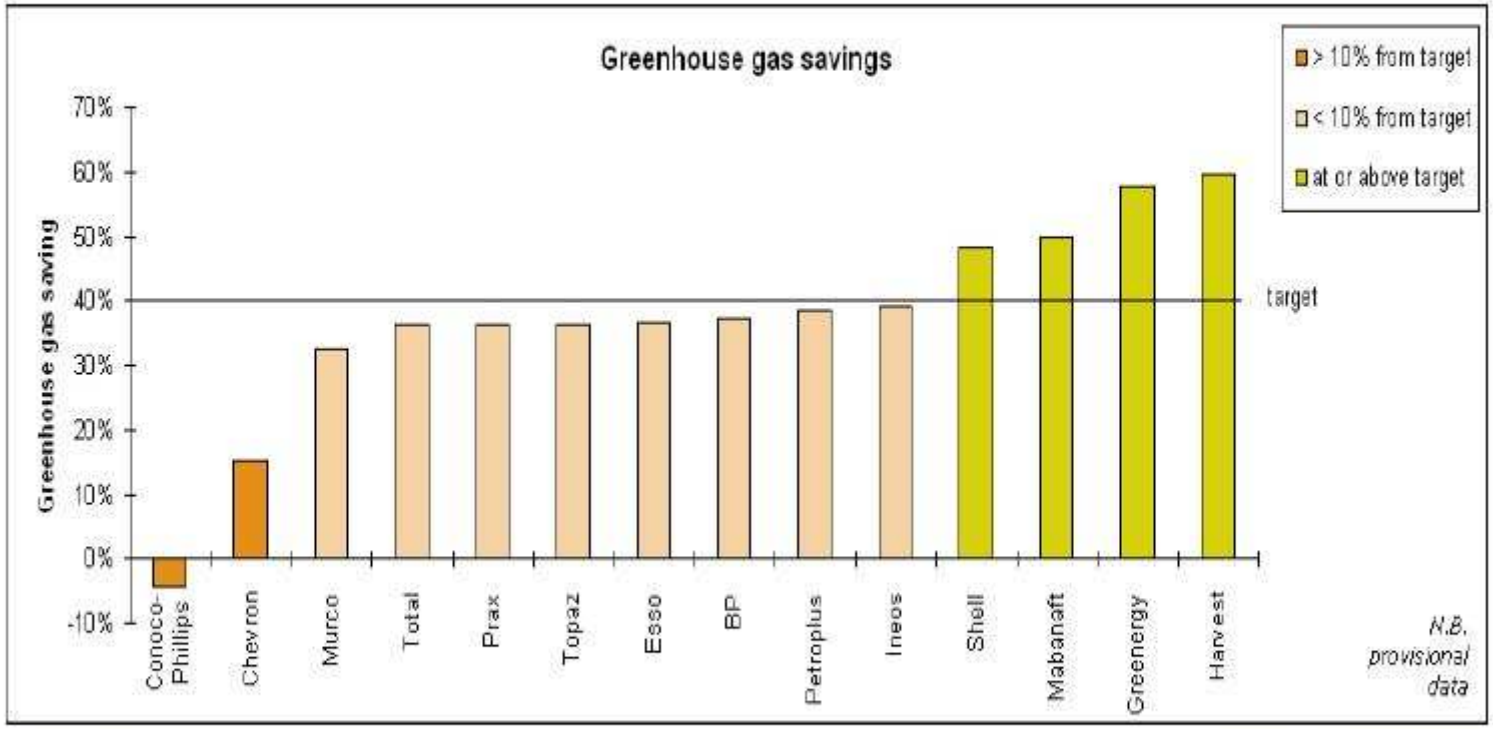
Early experience – company performance



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*Data for April to July 2008

The “carbon debts” (in years) from land-use change caused by biofuels planting have recently been estimated

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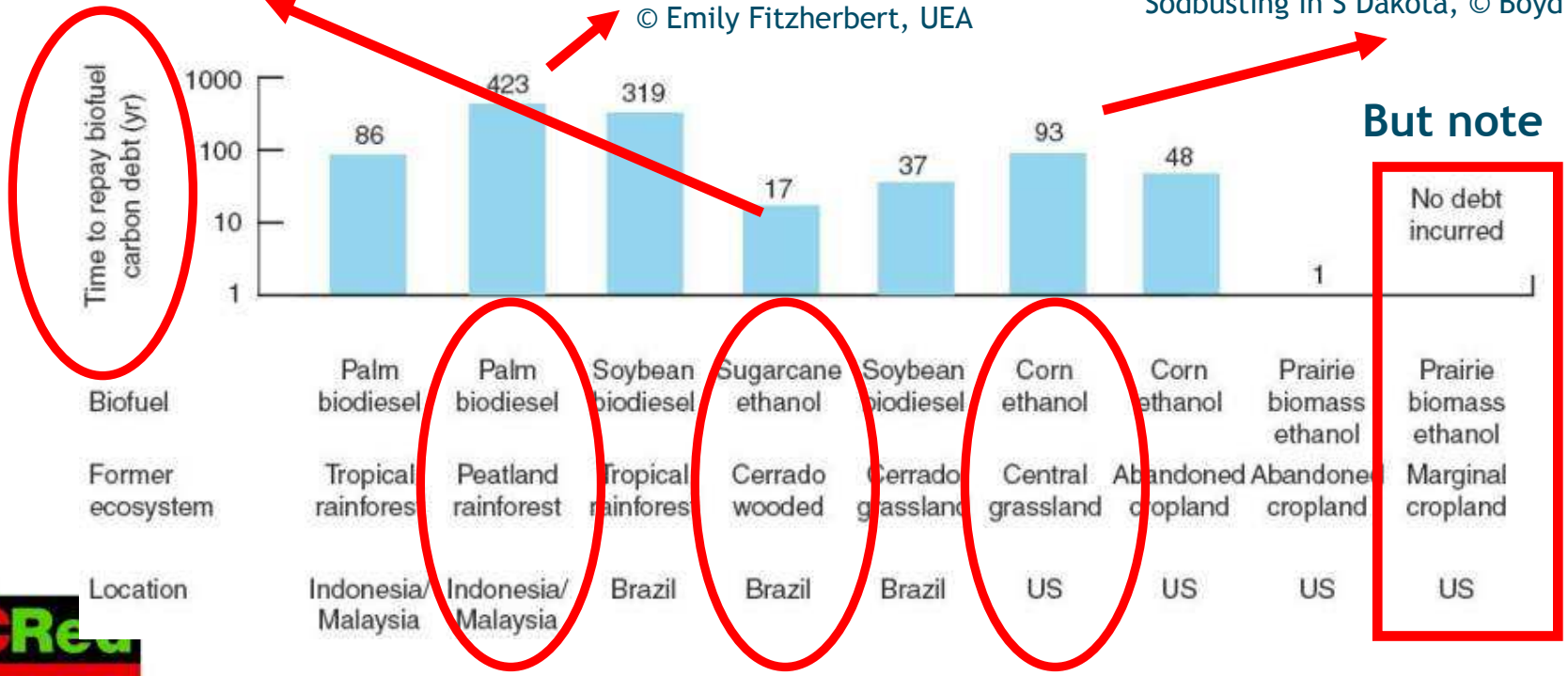
Burning forest in Indonesia
© Emily Fitzherbert, UEA

Sodbusting in S Dakota, © Boyd Schulz



But note

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Land Clearing and the Biofuel Carbon Debt, Fargione, Hill, Tilman, et al Science Express, 7 February 2008

And also the impact on food prices - still higher than two years ago

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World News

FT Jan 18 08

Soaring soyabean price stirs anger among poor

NEWS ANALYSIS

A mass protest in Indonesia's capital highlights growing regional tension, say **Raphael Minder, John Aglionby and Song Jung-a**

During the ancient Zhou dynasty, soyabeans were among China's five sacred grains.

Thousands of years later, soyabeans maintain their importance to the Chinese and most other Asians, although they have recently triggered much more down-to-earth preoccupations.

On Monday, 50,000 Indonesians demonstrated outside the presidential palace in Jakarta after soyabean prices soared more than 50 per cent in the past month and 125 per cent over the past year, leaving huge shortages in many markets. And while the social unrest has not yet spread to other Asian nations, consumer frustrations are mounting.

From tofu in China to miso, or soyabean paste, in Japan, soya products are an essential ingredient in Asian cuisine as well as staple food for the region's poor.

For many Indonesians, a piece of tempeh, or fermented soyabean cake, is often their only source of protein, and last year soya products accounted for 22 per cent of Indonesians' protein intake, excluding rice, according to government data.

"It's probably double that for poor people, who make up almost half the population, because it's the cheapest protein source," says Harbeindrejit Dillon, an agriculture analyst.

"The crisis shows how low the government has sunk. The public's attitude is that if it can't even take care of [soyabean] producers, then who can it do?"

World soyabean prices ...

> 'It's finally a trade-off between filling stomachs and filling diesel tanks in cars and trucks'

... climbed to a record this week, partly because farmers in the US and Asia have instead been growing corn, palm oil and other crops to supply the biofuel industry. Bad harvests in Latin America and rising Chinese demand have added to the price pressure.

"It's finally a trade-off between filling stomachs and filling diesel tanks in cars and trucks," says Shenggen Fan at the International Food Policy Research Institute.

The Indonesian government is now taking tentative steps to address the price surge, but their impact could prove limited. Mustafa Abubakar, the head of Indonesia's government logistics agency, said yesterday that Jakarta would import lower-quality soyabeans than previously from the US to help contain the price surge.

Authorities in other countries are also starting to act. In South Korea, the national agency handling imports, Korea Agro-Fisheries Trade Corporation, is poised to increase soyabean imports to contain prices, while the Korean agricultural ministry has formed a taskforce to deal with the worries over ...

... meanwhile, food producers have been quick to pass on higher costs to consumers. In Japan, miso companies recently announced rises of 10 to ... per cent.

In South Korea, soyabean prices increased by 30.7 per cent in December alone, translating this month into retail price rises of up to 30 per cent for soya milk, snacks and some other soya goods.

In Hong Kong, tofu sellers at the city's Graham Street market have raised prices for the first time in at least ... years.

"Our costs have gone up because the tofu factories have increased their prices twice since last October," says Ng Chou, 73, whose family's To Kei tofu store has been in existence since 1949.

A slab of tofu from Mr Ng that cost HK$4 (50 US cents) last October now costs HK$5.

An essential problem for Asia is its dependency on imports.

Japan imports 86 per cent of the roughly 4m tonnes of soyabeans consumed there each year, with three-quarters of the total coming from the US. Casting its ever larger shadow over world prices is China, already the world's largest importer.

Chinese demand has been surging, particularly for soyabeans used as feedstock as a more affluent society raises its meat consumption. Chinese pork prices have climbed about 90 per cent over the past year – a much bigger source of ... for Britain.

... the coming decade, Chinese import demand is set to "dwarf all other countries" and account for more than three-quarters of the projected gain in world soyabean trade by fiscal 2017, according to the US Department of Agriculture.

"China is the biggest swing factor for the soyabean market. Period," says Dong Tao, a regional economist at Credit Suisse in Hong Kong.

"Chinese soyabean imports are very volatile ... import supplement ... domestic pressures ... and the swings can be hard to explain."

Additional reporting by Robin Kwong in Hong Kong, Jonathan Soble in Tokyo, Geoff Dyer in Shanghai and Taufan Hidayat in Jakarta

UN poised to ration food aid as prices soar

FT 25 Feb 08

WFP sees 'new area of hunger' as costs spiral

Poor countries pay 35% more for cereal imports

By Javier Blas in Washington and Gillian Tett in London

The UN's agency responsible for relieving hunger is drawing up plans to ration food aid in response to the spiralling cost of agricultural commodities.

The World Food Programme is holding crisis talks to decide what aid to halt if new donations do not arrive in the short term.

Josette Sheeran, WFP executive director, told the Financial Times that the agency would look at "cutting the food rations or even the number of people reached" if donors did not provide more money.

"Our ability to reach people is going down just as the needs go up," she said.

WFP officials hope the cuts can be avoided, but warned that the agency's budget requirements were rising by several million dollars a week because of climbing food prices.

The WFP crisis talks come as the body sees the emergence of a "new area of hunger" in developing countries where even middle class, urban people are being "priced out of the food market" because of rising food prices.

"The warning suggests that the price jump in agricultural commodities – such as wheat, corn, rice and soyabeans – is having a wider impact than thought, hitting countries that ... previously largely escaped hunger.

"We are seeing a new face of hunger in which people are being priced out of the food market," said Ms Sheeran. Hunger is now "affecting a wide range of countries", she said, pointing to Indonesia, Yemen and Mexico.

"Situations that were previously not urgent – they are now."

The main focus of the WFP has been to provide aid in areas where food was unavailable. But the programme now faces having to help countries where the price of food, rather than shortages, is the problem.

Ms Sheeran said that in response to rising food costs, families in developing countries were moving in some cases from three meals a day to just one, or relying on one staple food.

In response to increasing food prices, Egypt has widened its food rationing system for the first time in two decades while Pakistan has reintroduced a ration card system that was abandoned in the mid-1980s.

Food prices are rising on a mix of strong demand from developing countries; a rising global population; more frequent floods and droughts; and the biofuel industry's appetite for grains, analysts say. Soybean prices on Friday hit an all-time high of $14.23 a bushel while corn prices jumped to a fresh ... year high of $5.25 a bushel.

... world's poor countries will have to pay 35 per cent more this year for their cereals imports, taking the total cost to a record $33.1bn (£16.8bn) (in the year to July 2008), even as their food purchases fall 3 per cent, according to the UN's Food and Agriculture Organisation.

The US Department of Agriculture warned last week that ... agricultural commodities ... would continue ... over the next two to three years.

Food prices, Page 6
www.ft.com/foodprices

Wheat in biggest one-day rise as price soars 25% to record high

FT Feb 26 08

Kazakh export tariffs aimed at curbing sales

By Javier Blas in London and Isabel Gorst in Moscow

Prices of top-quality wheat jumped 25.25 per cent yesterday, the biggest one-day increase ever, to a record high as Kazakhstan, one of the world's largest exporters of the grain, said it would impose export tariffs to curb sales.

The move, which follows similar export restrictions in Russia and Argentina, is likely to put further pressure on already tight global wheat supplies, analysts said.

Akhmetzhan Yesimov, Kazakhstan's minister of agriculture, said the government wanted to limit exports as it battled against rising domestic inflation of nearly 20 per cent. "Whatever happens, we will soon limit exports," Mr Yesimov said.

Kazakh grain is similar to some of the scarce top-quality North American crops that jumped in price yesterday.

Spring wheat at the Minneapolis Grain Exchange surged to a record $4.75 to a record high of $24 a bushel as consumers scrambled to secure supplies and speculators poured fresh money into the agriculture market.

The price of spring wheat has more than doubled since January and has risen fourfold in the past year, contributing to a rise in global food inflation.

Gavin Maguire, of Iowa Grain in Chicago, said consumers such as mills and bakers, who needed wheat, were "panicking".

"Historical references are useless. We are breaking all the rules," he said.

... and Turkey said they were planning substantial wheat purchases to replenish inventories and analysts said China could be forced to follow because of drought damage to its next crop.

Global supplies of wheat are scarce after extreme weather damaged crops in Australia, Canada and the European Union. As a result, the US is experiencing record demand and its inventories are set to drop to the lowest level in 60 years.

... signs emerged in the bond market yesterday that investors have higher expectations for inflation. The difference between yields on 10-year inflation-protected securities and conventional government bonds rose ... basis points to 2.41 per cent yesterday, up from a January low of 2.04 per cent, a sign that bond investors are nervous that interest rate cuts from the Federal Reserve may stoke inflation.

Additional reporting by Saskia Scholtes in New York

Editorial Comment, Page 12
ABF passes on rise, Page 17
Cost hit producers, Page 19
Commodities, Page 38
www.ft.com/foodprices

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Population growth, poverty reduction, and the impacts of climate change will all increase pressure on food supplies

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"It is very hard to imagine how we can see a world growing enough crops to produce renewable energy and at the same time meet the enormous increase in the demand for food which is quite properly going to happen as we alleviate poverty."

Professor John Beddington, UK Government Chief Scientific Advisor, March 6, 2008

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“Bread and Roses – the Politics of Food”

University of East Anglia

“Global food production will need to double by the middle of the century just to meet demand. We have the knowledge and the technology to do this, as things stand, but the perfect storm of climate change, environmental degradation and water and oil scarcity, threatens our ability to succeed.”

Rt Hon Hilary Benn, Fabian Society Lecture, December 10, 2008

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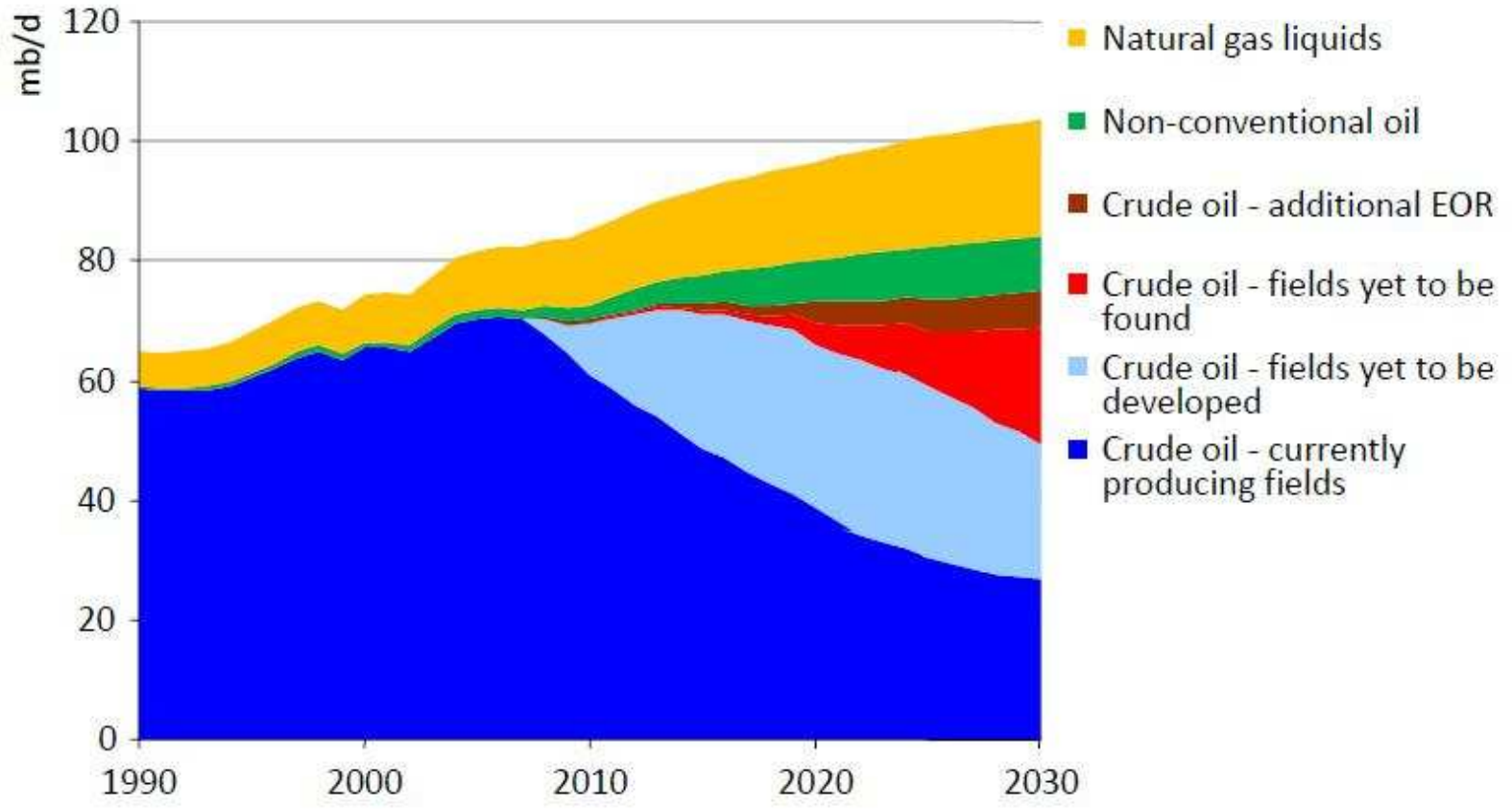
Peak oil already?
IEA World Outlook, November 2008

University of East Anglia



Flat oil demand requires four Saudi Arabias to be introduced
Impact on fuel prices, fertilizer prices…?
Coal to liquids if we don't reduce demand…?

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How will we cope with increasing global demand for transport fuels?

University of East Anglia

2005: 84 mbpd; 2050: 169 mbpd
Goldman Sachs Global Economic Paper, No 118, 2004

The increase will be driven by increasing prosperity in the developing world and by the production of ultra-cheap cars such as the $2500 Tata Nano

The Tata Nano launched 10 January 2008

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Solution: Reduce demand before addressing supply

1. Reduce waste – cut demand

2. Use more efficient equipment

3. Switch to renewable energy

Change behaviour
and innovate!

Demand reduction should be key

University of East Anglia

"The attempt to solve one problem--growing U.S. dependence on imported oil--is creating another far more serious problem. Fortunately this can be avoided. ***The 3 percent of U.S. automotive fuel supplies now coming from ethanol could be achieved, several times over and at a fraction of the cost, by raising automobile fuel-efficiency standards by 20 percent."***

EXPLODING U.S. GRAIN DEMAND FOR AUTOMOTIVE FUEL THREATENS WORLD FOOD SECURITY AND POLITICAL STABILITY
Lester Brown, November, 2006
http://www.earth-policy.org/Updates/2006/Update60.htm

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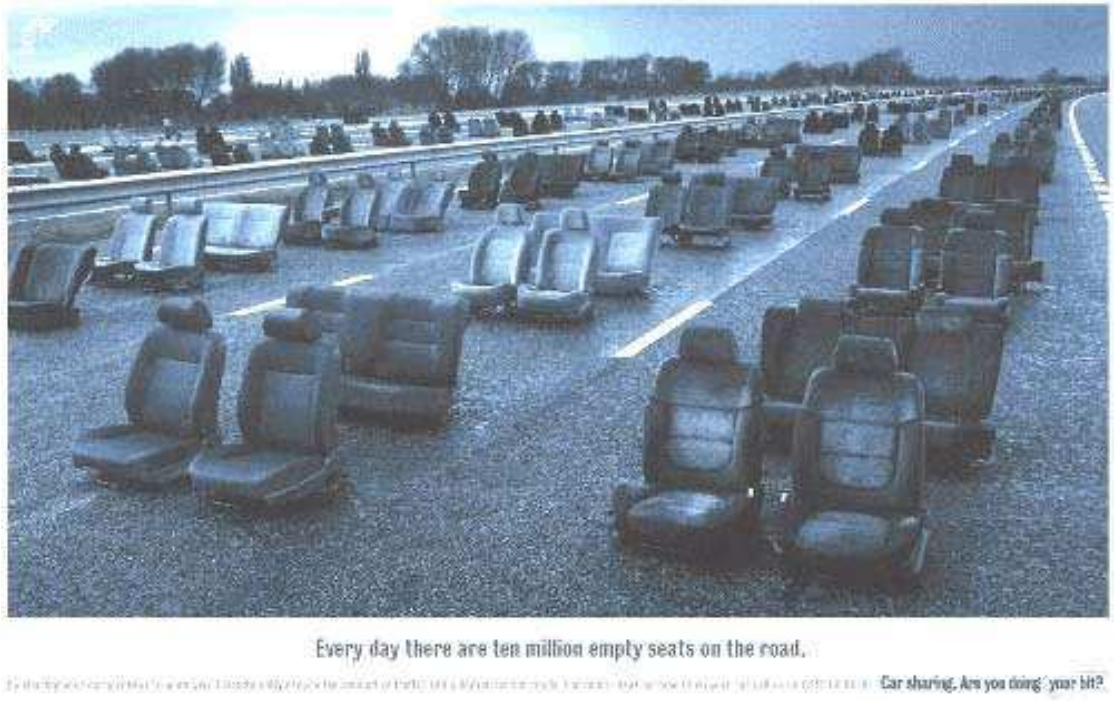
Reduce waste – car share: the cheapest way of cutting transport emissions

University of East Anglia

Every day there are 10 million empty seats on UK roads

Radical initiatives can fill many of these



Getting average UK car occupancy back to the early 1960s level of 2 per car would save about 9 m tonnes CO2 – or about three times the saving (before land-use emissions factored in) that will come from the RTFO (Renewable Transport Fuels Obligation) for 5 per cent biofuels in 2010

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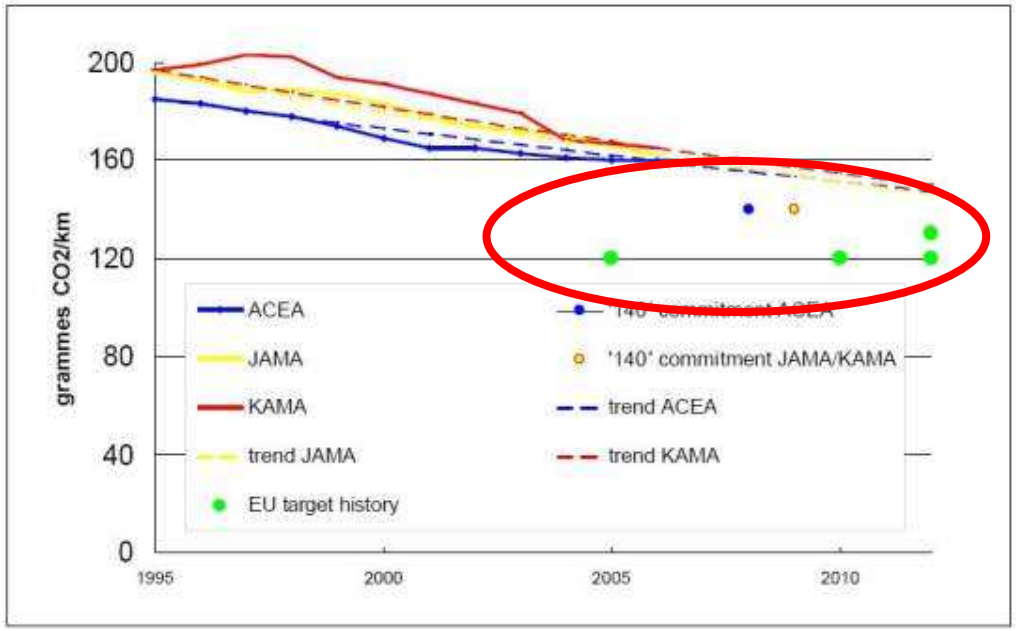
More efficient equipment: innovate to create truly low CO2 emission vehicles

University of East Anglia

- The vehicle industry in Europe has repeatedly resisted reducing average fleet emissions to 120g CO_2/km.
- Even for 2012, the target has been relaxed because 'biofuels' and 'soft measures' can take up the slack.
- This is appalling and promotes additional ghg emissions in two unnecessary ways.
- **The industry should aim for a maximum of 80g CO2/km (half today's EU fleet average) by 2020 with further reduction thereafter.**

Graph: progress over time in the CO_2 commitment of the three car manufacturing associations, and distance to target if historic rate of improvement is not changed: EU 15 figures.



Source: European Federation for Transport and Environment

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The VW “One litre car”: 283mpg
30g CO_2/km

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There’s a huge way to go in down-powering future cars to dramatically reduce CO_2 emissions

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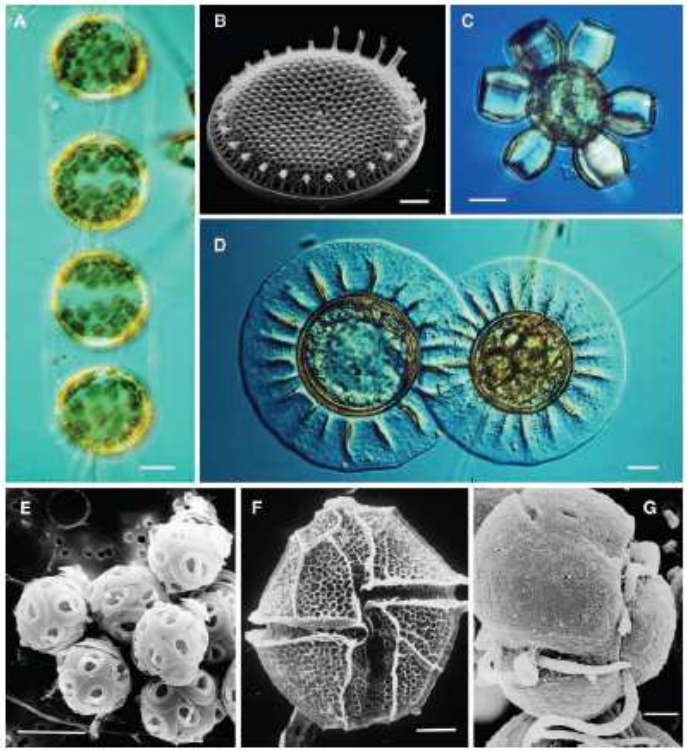
Biofuels from algae?

University of East Anglia

Phytoplankton:

1% of Earth's photosynthetic biomass
but +/-45% of annual primary production



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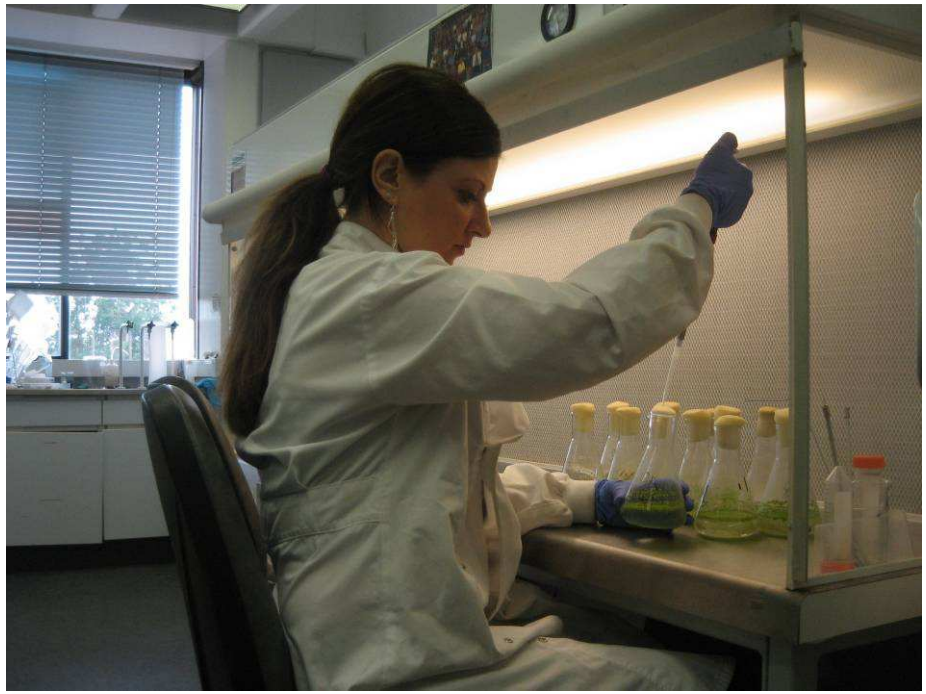
Micro-plants grow very quickly

University of East Anglia

Yields up to 100x conventional crops



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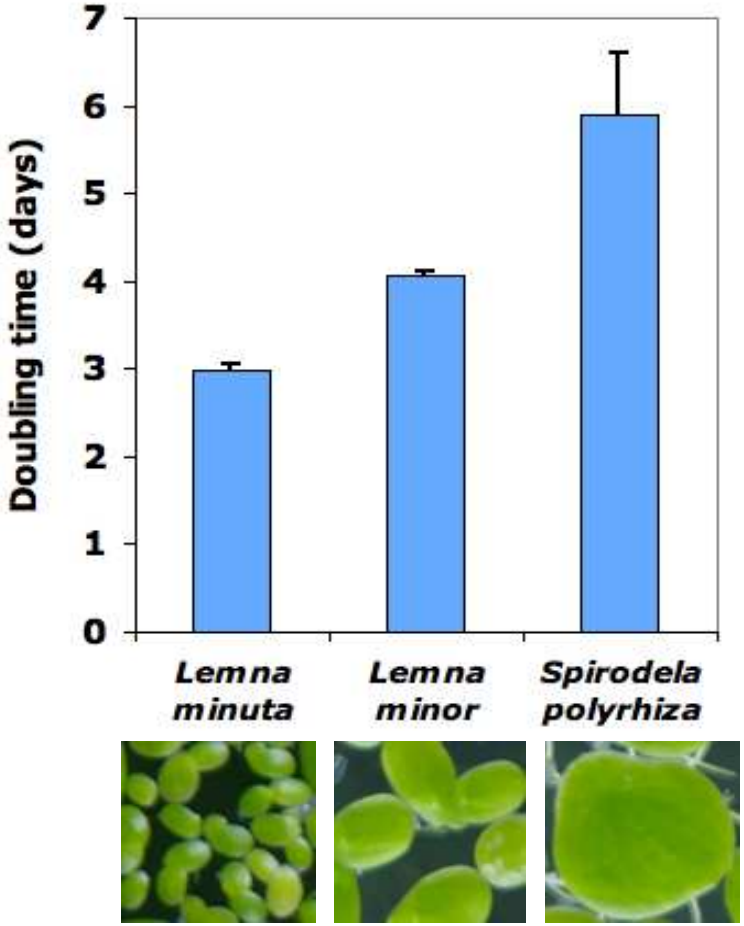

Biofuel from Duckweed

University of East Anglia

Input:
waste water
(nutrients)

Output:
protein

Output
Bioalcohol
from
fermentation
of cell wall
sugars

Duckweed
biomass

Input
Sunlight

Input:
CO_2

Output:
'Clean' water

Biogas for transport

University of East Anglia

One of the most exciting sources of renewable fuel is biowaste which can be converted to biogas through anaerobic digestion. Biogas contains about sixty per cent biomethane which can be up-graded and tankered to a fuel depot or inserted into the natural gas grid.

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Probably 10 per cent of UK road transport fuel needs could be sourced by biomethane from waste - one-third of HGVs

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Biomethane can save in favourable cases well over 100 per cent of fossil fuel CO_2 emissions.

Natural gas technology is in use today and can save over 20 per cent CO_2 emissions. CNG and ultimately biomethane is an ideal low emission fuel for long distance and urban fleets.

A Hardstaff dual-fuel 44 tonne truck at UEA, April 2007

CRed carbon reduction

Natural gas technology can morph seamlessly to biogas when this becomes available: Hardstaff in UK about to run first vehicles on biogas

Malmo and other Swedish cities have success with gas-powered and now biogas-powered fleets

University of East Anglia

Solar energy to reduce transport emissions: Renewable power for hybrid/electric vehicles

University of East Anglia

Solar collectors can harvest ten times more energy per unit area than plants. Solar concentrating power plants in hot, desert areas offer huge potential to provide renewable electricity for hybrid and electric vehicles.

Biofuels must only be made in innovative ways that do not conflict with food production and do not make greenhouse gas emissions worse. If vehicle emissions drop sharply then biofuels can play a valuable role in getting towards zero-carbon transport.

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Support Trans-Mediterranean Renewable Energy Co-operation, TREC, a future source of renewable electricity

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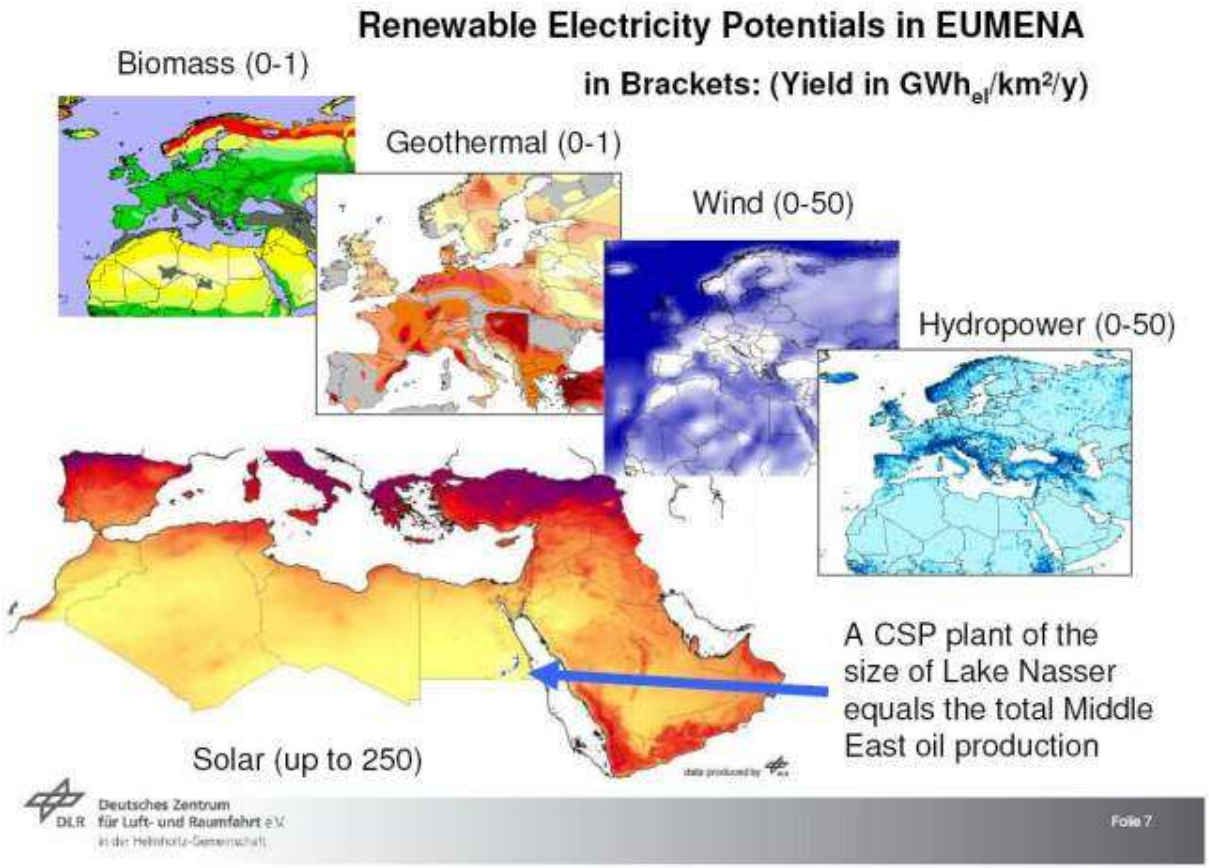
EUMENA is Europe, Middle East and North Africa

64MW Nevada Solar One solar concentrating power plant in USA; picture from www.german-renewable-energy.com.



CRed carbon reduction

From: *"Concentrating solar power for Europe, Middle East and North Africa – a roadmap to 2050"*, Dr Franz Trieb, April 2007

Can HVDC of solar power from Africa provide renewable electricity for vehicle power? Perhaps with multinational vision and will

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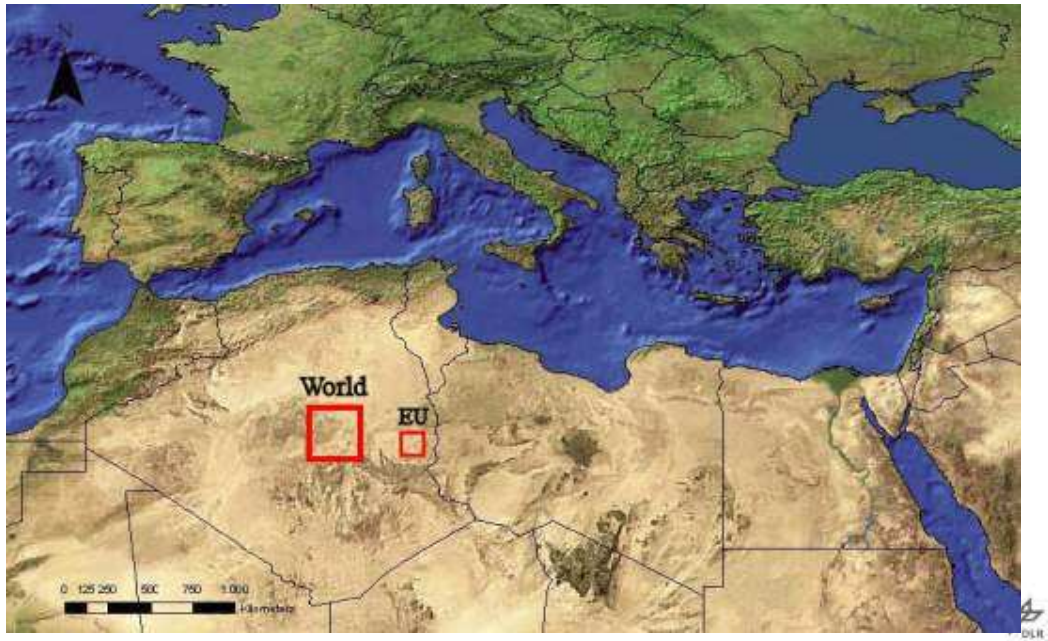
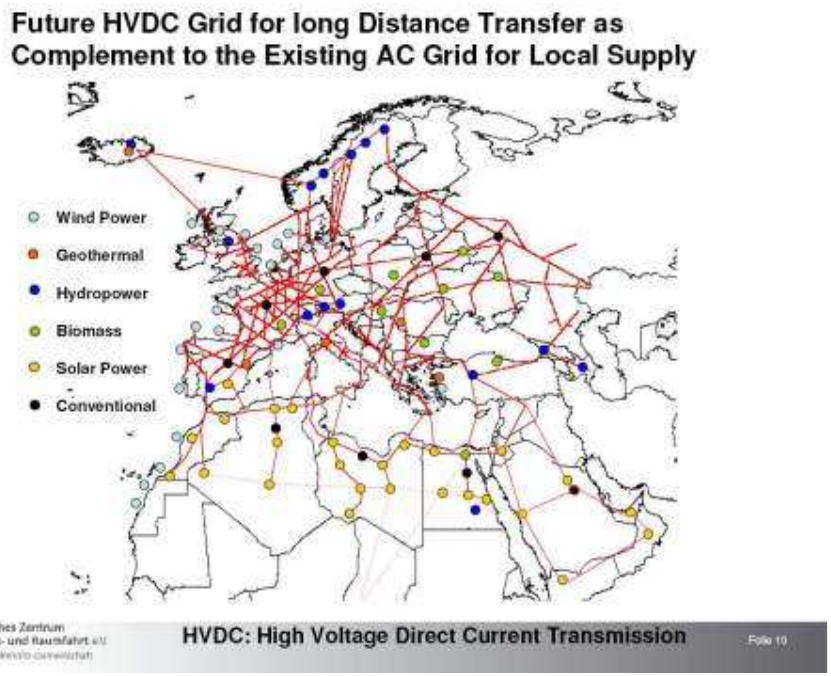


Areas of desert that could produce all the world's and all the EU's electricity



From: *"Concentrating solar power for Europe, Middle East and North Africa – a roadmap to 2050"*, Dr Franz Trieb, April 2007

"The sun-belt and the technology belt can become very powerful when they begin to understand themselves as a community: a community of energy, water and climate security; a community for their common future."
H.R.H. Prince El Hassan Bin Talal of Jordan, Former President, The Club of Rome

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