CCS

- a new solution
or
- a new problem?

NOAH
Friends of the Earth Denmark

JOACC
Aalborg
9 June 2009

Palle Bendsen

NOAH
Friends of the Earth Denmark

The first modern environmental organisation in Denmark

Founded 1969 - holistic view all the way

Member of

Friends of the Earth International

Friends of the Earth Europe

INFORSE-EUROPE
International Network for Sustainable Energy - Europe

Affiliated with

T&E
European Federation for TRANSPORT and ENVIRONMENT

CJN!
Climate Justice Network

Energy and Climate group

Energy and Climate Group since 1994

Sustainable Europe 1994
- 31 Friends of the Earth Groups
- Wuppertal Institute

- Environmental space
- Ecological debt

Danish energy policies

Climate & energy paths

Energy & climate plan
- Growth paradigm
- Behavioural changes

EU energy & climate policies

Nuclear
Euratom
Barsebäck
ESS

Campaigns
- now: The Big Ask /Klima SOS
- www.klima-sos.dk
- Climate scenario (SEI)

Educational materials
- like www.global-klima.org

Informational materials
- like www.ccs-info.dk
  (to be published soon)
- English version later this summer:
  www.ccs-info.org

CCS - issues

Timing

- climate mitigations
  - Energy efficiency
  - Mitigation potential

Environment

Energy future

Climate justice

- CCS in CDM?

Security

Liability

Economics

Financing

Public debate?

CCS in ETS

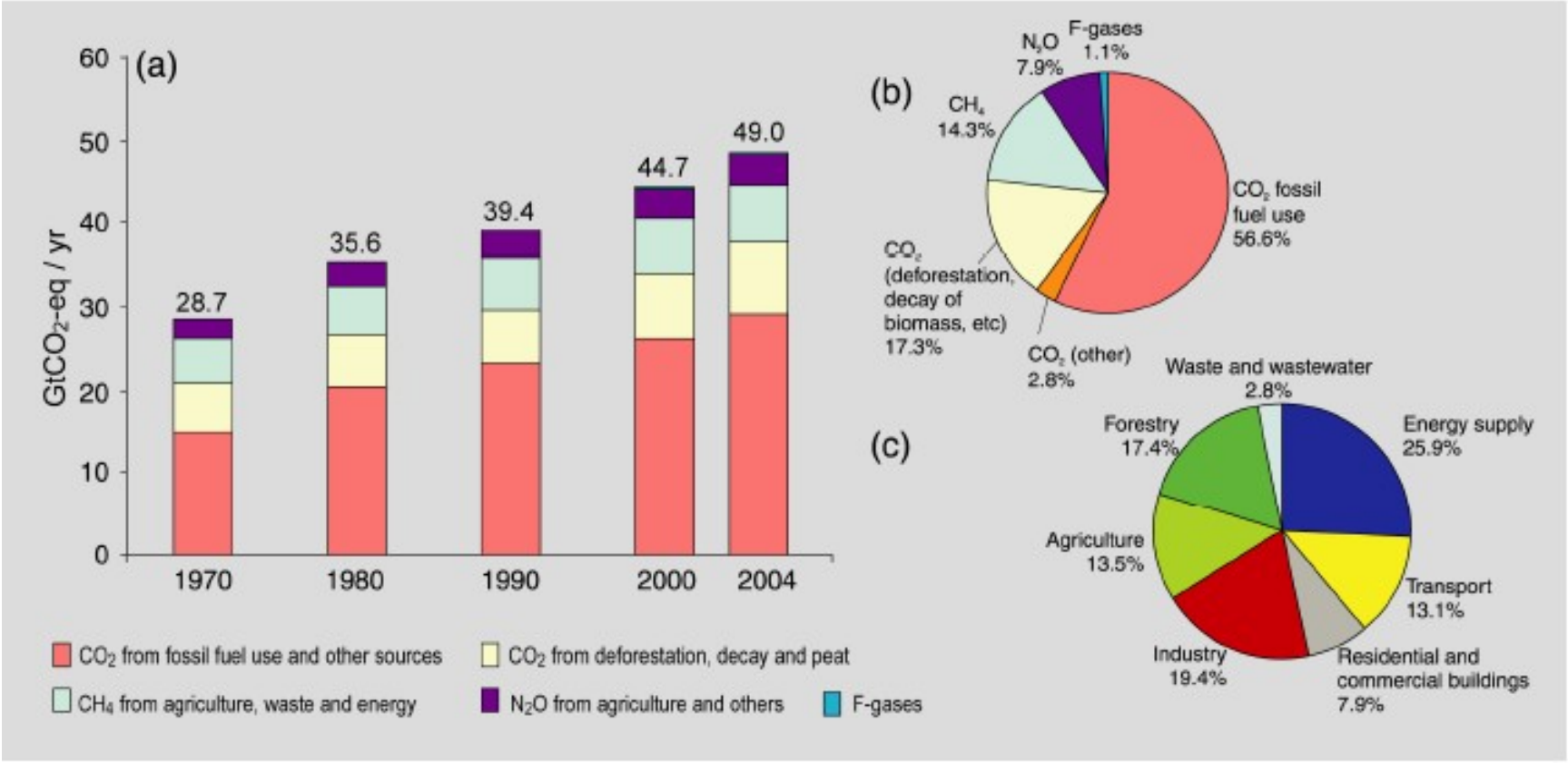
CCS – cui bono?

Conclusion and alternatives

Setting the frame:
Timing the mitigations

Timing the mitigation

Global emissions



Timing the mitigation

IPCC assessed scenarios

Table SPM.6. Characteristics of post-TAR stabilisation scenarios and resulting long-term equilibrium global average temperature and the sea level rise component from thermal expansion only. {Table 5.1}[a]

Category	CO_2 concentration at stabilization (2005 = 379 ppm) [b]	CO_2-equivalent Concentration at stabilization including GHGs and aerosols (2005 = 375 ppm) [b]	Peaking year for CO_2 emissions [a, c]	Change in global CO_2 emissions in 2050 (% of 2000 emissions) [a, c]	Global average temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity [d], [e]	Global average sea level rise above pre-industrial at equilibrium from thermal expansion only [f]	Number of assessed scenarios
	ppm	ppm	Year	Percent	°C	metres	
I	350 – 400	445 – 490	2000 – 2015	-85 to -50	2.0 – 2.4	0.4 – 1.4	6
II	400 – 440	490 – 535	2000 – 2020	-60 to -30	2.4 – 2.8	0.5 – 1.7	18
III	440 – 485	535 – 590	2010 – 2030	-30 to +5	2.8 – 3.2	0.6 – 1.9	21
IV	485 – 570	590 – 710	2020 – 2060	+10 to +60	3.2 – 4.0	0.6 – 2.4	118
V	570 – 660	710 – 855	2050 – 2080	+25 to +85	4.0 – 4.9	0.8 – 2.9	9
VI	660 – 790	855 – 1130	2060 – 2090	+90 to +140	4.9 – 6.1	1.0 – 3.7	5

Meinshausen, 2009: Emission pathways to achieve a 2°C target

Bringing economics and energy-system analysis into the picture (IPCC WG3): "For the lowest mitigation scenario category assessed, emissions would need to peak by 2015".

Table 3.1 – Stabilisation scenario classes and their 21st century characteristics adapted from IPCC AR4 WGIII SPM 5 and Fig.3.18. Emission scenarios within category I and the lower end of II are consistent with a 2°C target, if the probabilities of staying below 2°C shall be 50% or higher [9].

IPCC Category	CO_2 conc.	CO_2-eq conc.	Peaking year for CO_2 emissions	Year in which emissions decrease below 2000 levels	Cumulative CO_2 emissions 2000-2100	Change in global emissions in 2050 (% of 1990 emissions)[10]
WGIII Source	SPM.5	SPM.5	SPM.5	Fig. 3.19	Fig.3.18	SPM.5
	ppm	ppm	Year	Year	$GtCO_2$	%
I	350-400	445-490	2000-2015	2000-2030	800-1500	-83.5 to -40
II	400-440	490-535	2000-2020	2000-2040	1000-1800	-56 to -23

2°C paper, Tab 3.1, IPCC SYR SPM, Footnote 20

It's about the carbon budget

Emissions must peak no later than 2015

Otherwise the reduction path becomes technologically and politically infeasible

Cumulative emissions 2000 – 2100:
800 GT CO2

Emissions 2000 – 2009 ~ 340 GT CO2

Remaining budget: 460 GT CO2

Questions regarding timing

Emissions must peak no later than 2015

Will CCS be able to deliver in time?

How will the non-captured part influence the budget?

- regarding timing

EU's CCS-Directive:

7 million tonnes of CO2 stored by 2020
160 million tonnes by 2030

- accounting for "some 15 % of the reductions required in the Union."

"... provided that CCS obtains private, national and Community support and proves to be an environmentally safe technology..."

Climate
Energy penalty

Estimates

DOE/NETL	15 - 30 %
IPCC	24 - 40 %
IEA	39 %
PC retrofit*	50 - 80 %
Precombustion**	
w. 90 % capture	40 %

NOAH FoE Dk has chosen 40 %

* House, Harvey, Aziz and Schrag, Jan 2009

** Dennis and Klein, May 2007

CCS mitigation potential

Credit

- Capture ≈ 79 %

95 kg CO_2 emitted per GJ produced

40 % added coal

85 % capture efficiency

Total ≈ 79 %

Debit *(guesstimates)*

- Mining ≈ 3 %
- Transport ≈ 2 %
- Plant ≈ 1 %
- Infrastructure/ transp./inject. ≈ 1 %
- Leakage ≈ 2 %

Total ≈ 9%

Net CO_2 eff. ≈ 70 %

Environment

Environment

Effects pertaining to increase in mining of coal and operation of CCS-plant

- Emissions of NOx, SOx, HC, VOC, particulates, heavy metals
- Increased use of energy and raw materials
- Impact on surface and groundwater
- Destruction of villages, nature, habitats, landscapes,
- Noise and aesthetic effects
- **Increased use of water**

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Czech Republic:

81 villages and towns have disappeared since 1945

due to coal mining

Coal mining – open pit

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India

Increased use of water due to CCS

Table ES-1. Water consumption and cooling duty factors for thermoelectric power plants[i]

	Without CO_2 Capture	With CO_2 Capture	% Change With CO_2 Capture
*Water Consumption Factors (gallons per MWh net power)**			
Nuclear	720	--	
Subcritical PC	520	990	+90%
Supercritical PC	450	840	+90%
IGCC, slurry-fed	310	450	+50%
NGCC	190	340	+80%
Cooling Duty Factors (MMBtu per MWh net power)			
Subcritical PC	4.7	11	+130%
Supercritical PC	4.1	9.3	+130%
IGCC, slurry-fed	3.0	3.7	+20%
NGCC	2.0	4.2	+110%

** Based on a cooling water system utilizing wet recirculating cooling towers*

Source: **Water Requirements for Existing and Emerging Thermoelectric Plant Technologies** **DOE/NETL-402/080108**

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Vestas expects that the installed wind power capacity on average will experience an annual growth rate of about 20 per cent in the coming ten years

mainly due to the fact that wind power neither uses water nor emit CO2 when generating electricity.

http://www.vestas.com/files//Filer/EN/Investor/Company_announcements/2009/090211-CA_UK-04.pdf

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Energy (& Climate) Future

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Energy (& Climate) Future

Following the CCS-track will lock us in with the environmental hazards of coal

Nightmare: Power Plant and CCS-plant take turns in becoming obsolete

There are always other options

Energy (& Climate) Future

World Coal Consumption

2006 **5737 MT Coal**

2030 **8559 MT Coal**

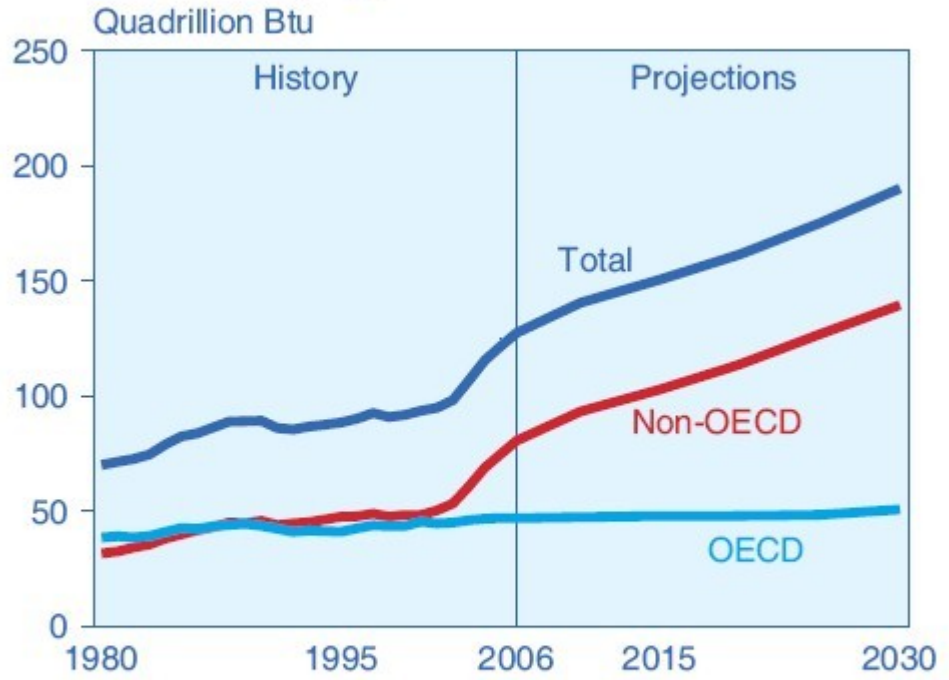

Figure 42. World Coal Consumption by Country Grouping, 1980-2030

Sources: **History:** Energy Information Administration (EIA), *International Energy Annual 2006* (June-December 2008), web site www.eia.doe.gov/iea. **Projections:** EIA, World Energy Projections Plus (2009).

- if this is allowed to happen we'll be roasted with or without CCS ...

Energy (and Climate) Future

The non-captured part in itself will weigh in with ?? GT CO2 in the budget

&

The promise of future CCS will keep old power plants going, and new ones will be built "capture ready" (??)

&

Coal will become no. 1 source of energy

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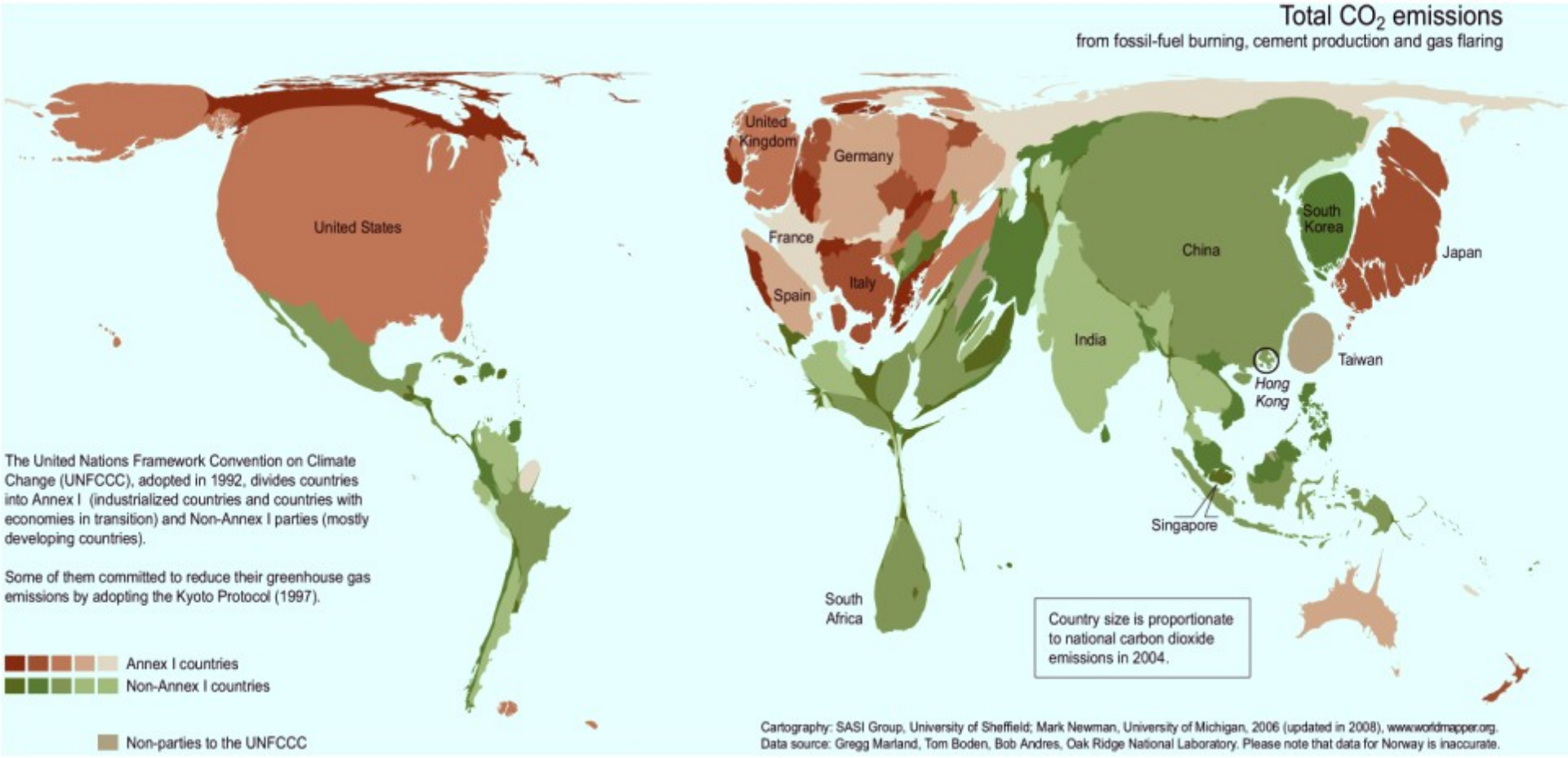
Climate justice

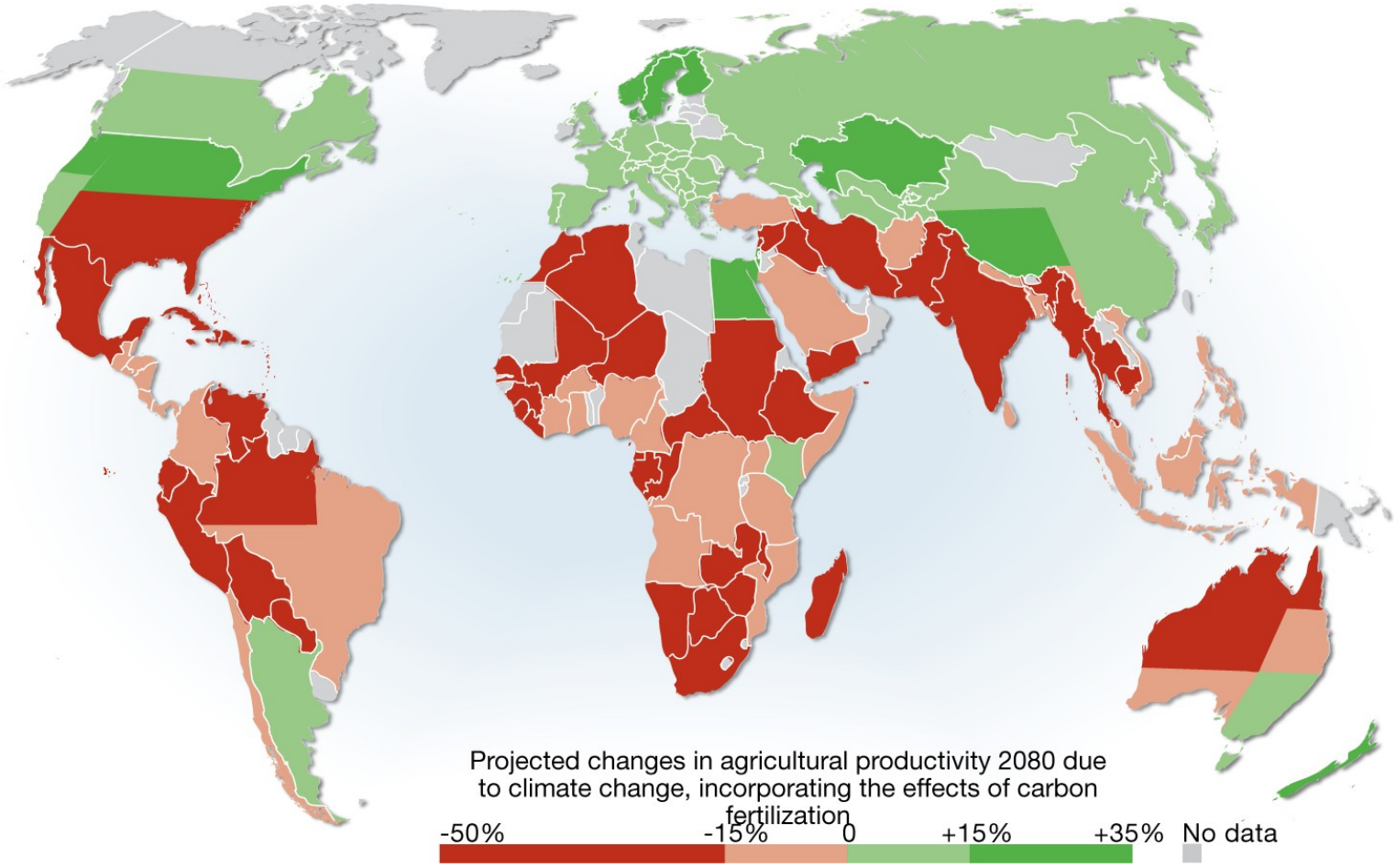
Climate justice - facts



Total CO2 emissions from fossil-fuel burning, cement production and gas flaring. (2009).
In *UNEP/GRID-Arendal Maps and Graphics Library*.
http://maps.grida.no/go/graphic/total-co2-emissions-from-fossil-fuel-burning-cement-production-and-gas-flaring

Climate Justice

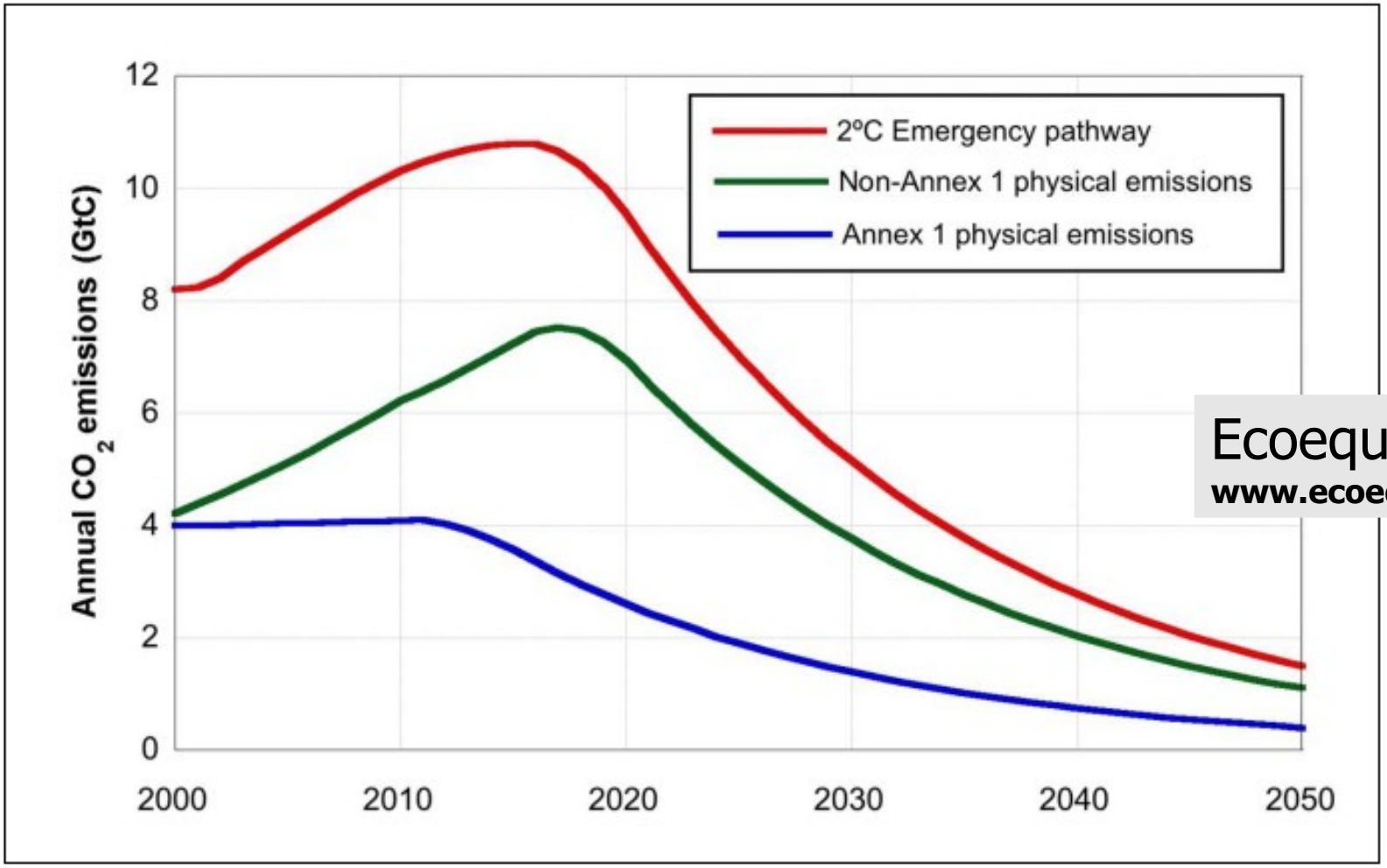
– agriculture projections



Projected agriculture in 2080 due to climate change. (2008).
In *UNEP/GRID-Arendal Maps and Graphics Library*.
http://maps.grida.no/go/graphic/projected-agriculture-in-2080-due-to-climate-change.

Climate justice

– The South's dilemma



Ecoequity
www.ecoequity.org

Figure ES1. The South's Dilemma. Red line shows the 2°C **Emergency pathway**, in which CO_2 emissions peak in 2015 and fall to 80 percent below 1990 levels in 2050. Blue line shows Annex 1 emissions declining to 90 percent below 1990 levels in 2050. Green line shows, by subtraction, the emissions space that would remain for the developing countries.

CCS in CDM

Developing countries:

Lock-in energy future to centralisation

- Coal with all its pathology
- Big technologies – big money
- replacing sustainable energy supply systems

Annex 1:

Substitute for domestic action

In CDM: - technologies supposed to be "Environmental sound"

What about China?

"China is one of the largest coal producers, exporters, and consumers in the world.

Abundant natural coal reserves have fueled China's booming economic development;

- **however,** pollution problems both from burning and mining coal have created serious environment and public health problems, which may nullify much of China's GDP growth."

A China Environmental Health Project Research Brief

Coal Mining and Environmental Health in China

Yang Yang

April 02, 2007

Environment & economics
What could China do?

- upgrade its old mining industry and old power plants

or

- opt for energy efficiency and renewables rather than build a coal fuelled power plant a week

But it seems unlikely that China would buy into CCS when it requires 40 % more coal

CCS conclusion

– a technical fix for a defective development

- Timing ... too late
- Climate
  - Energy efficiency ... too poor
  - Mitigation potential ... too small
- Environmental effects ... too big
- Energy future ... lock-in centralised system - unsustainable - coal
- Climate Justice ... does not deliver

CCS conclusion

– a technical fix for a defective development

- Financing ... not without public money
- Economics... unsustainable
- CCS in CDM ... destructive, no offsetting
- Security ... risks
- Liability ... hit-and-run
- Public debate?.... belated if at all

What are the alternatives?

Equity and sustainability

Environmental space – dematerialization Factor 10

1. Demand side

Energy savings

Energy efficiency

Recycling

Cradle-to-cradle

Less meat

Stop deforestation

2. Supply side

Renewables

- Wind
- Solar PV
- Solar heat
- Solar CSP
- Wave
- Hydro (existing or small scale)

Equity and sustainability

Environmental space

Carbon uptake in soil

Reform of land-use

Reform of agriculture

Afforestation