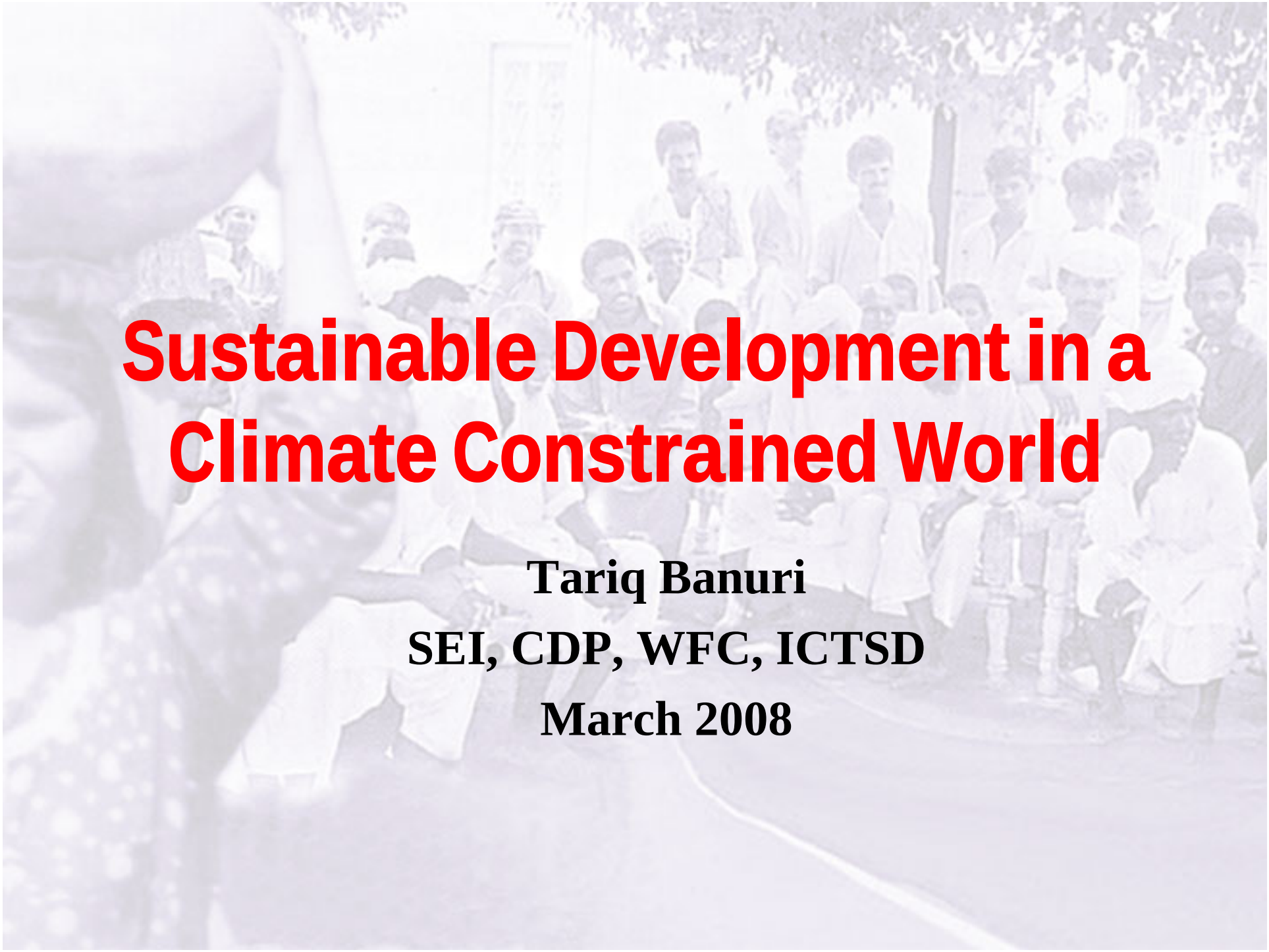

Sustainable Development in a Climate Constrained World

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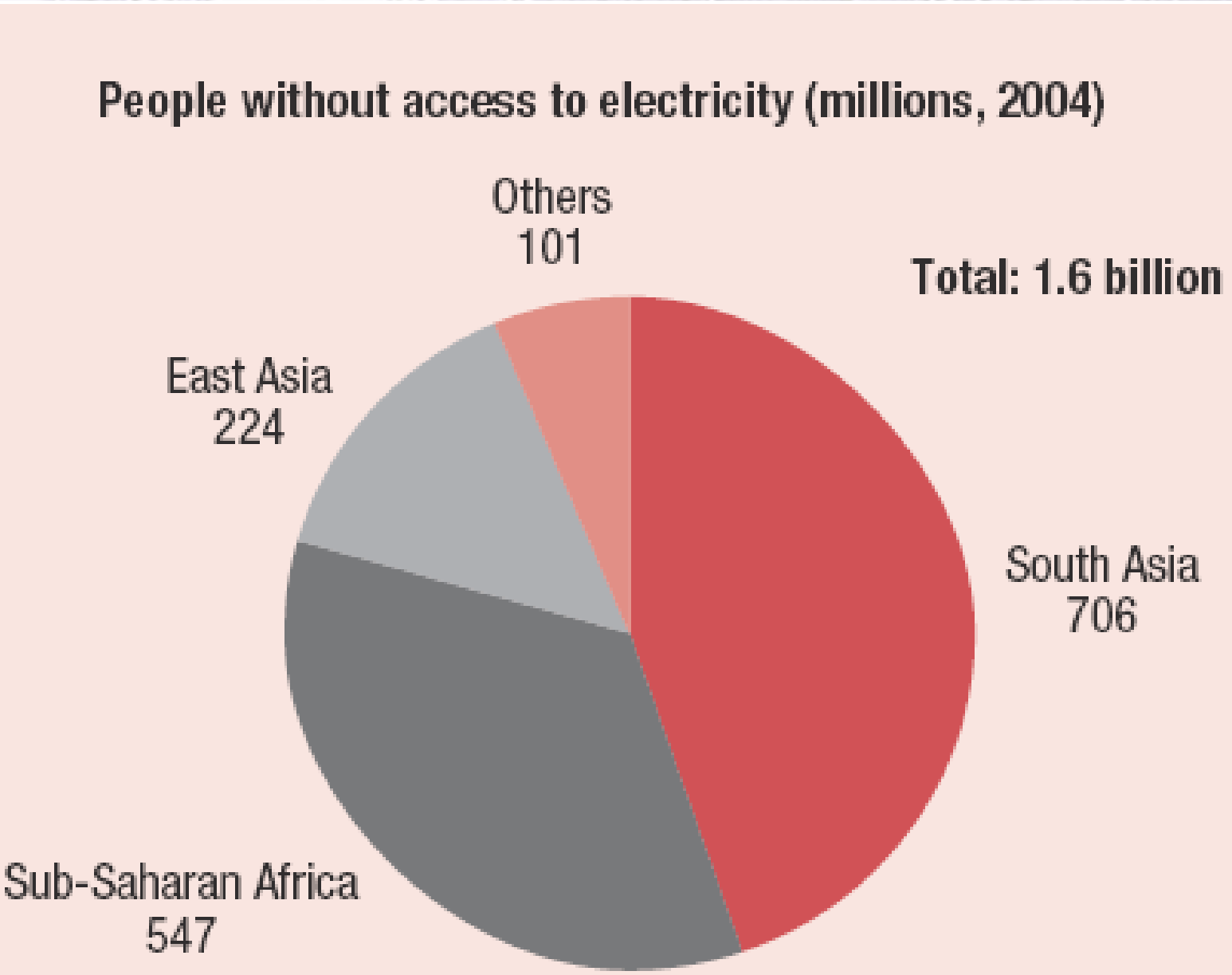
March 2008

The Plu-Perfect Storm

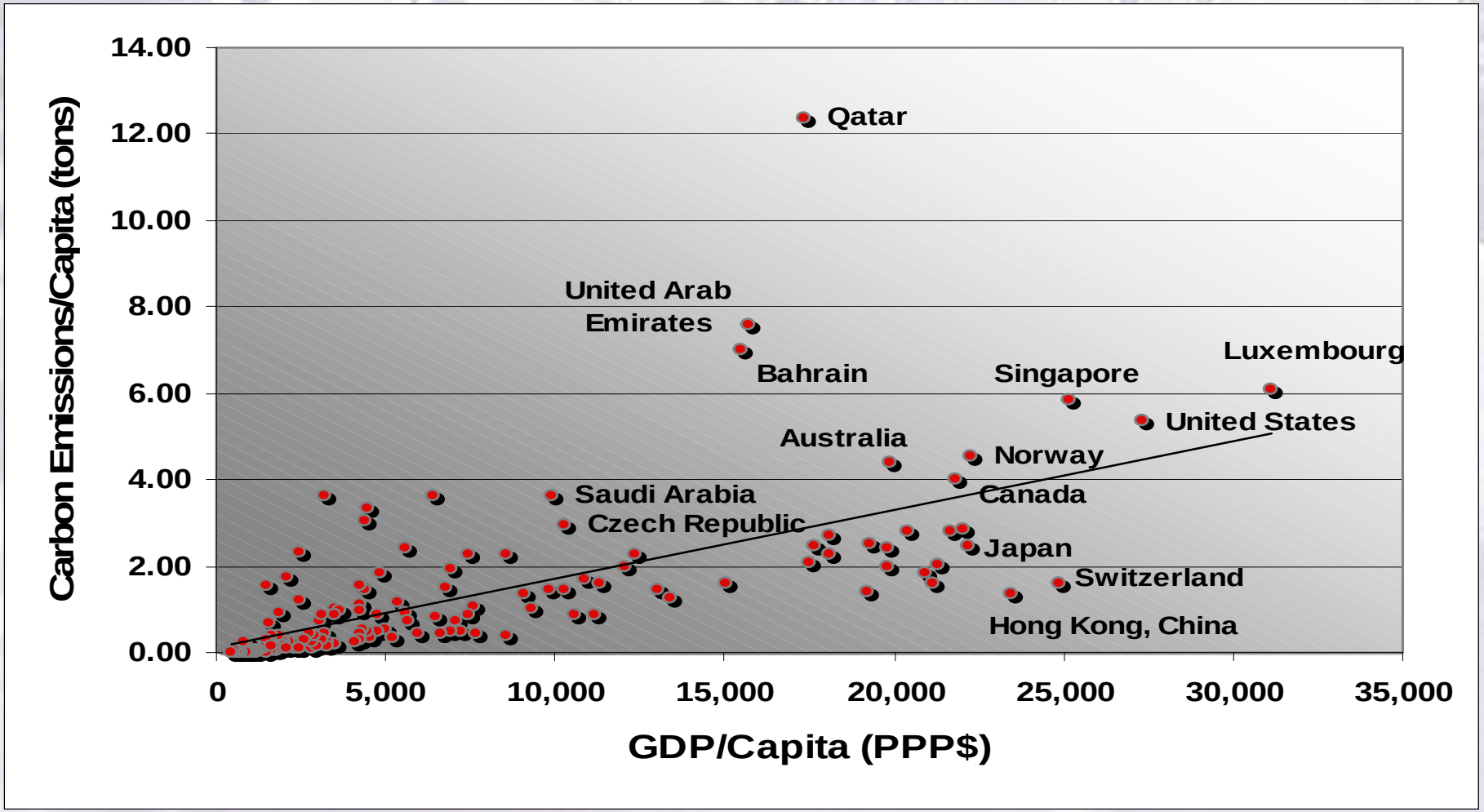
- The unfinished agenda of sustainable development (including MDGs)
- The impact of climate change
- Future climate strategies by Annex I
  - Recession, non-oil commodity decline
  - Increased carbon/ energy prices
- The impact of mitigation actions in developing countries

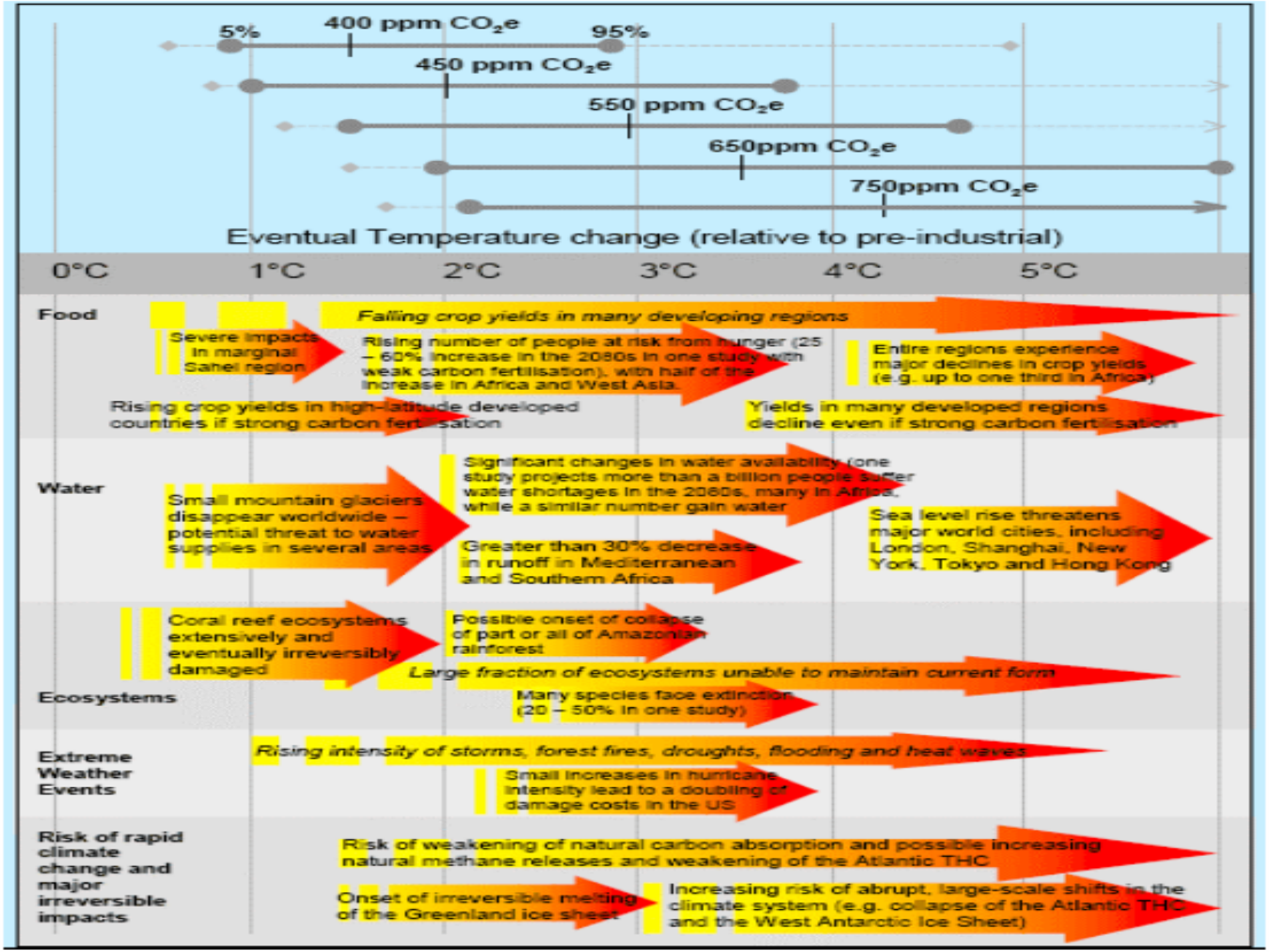
Unequal Primary Energy (btoe)

	2000	2005	2030
OECD	~5.1	~5.6	~6.9
EIT	~1.0	~1.1	~1.8
Developing Countries	~3.6	4.7	~9
World	~9.7	11.4	17.7

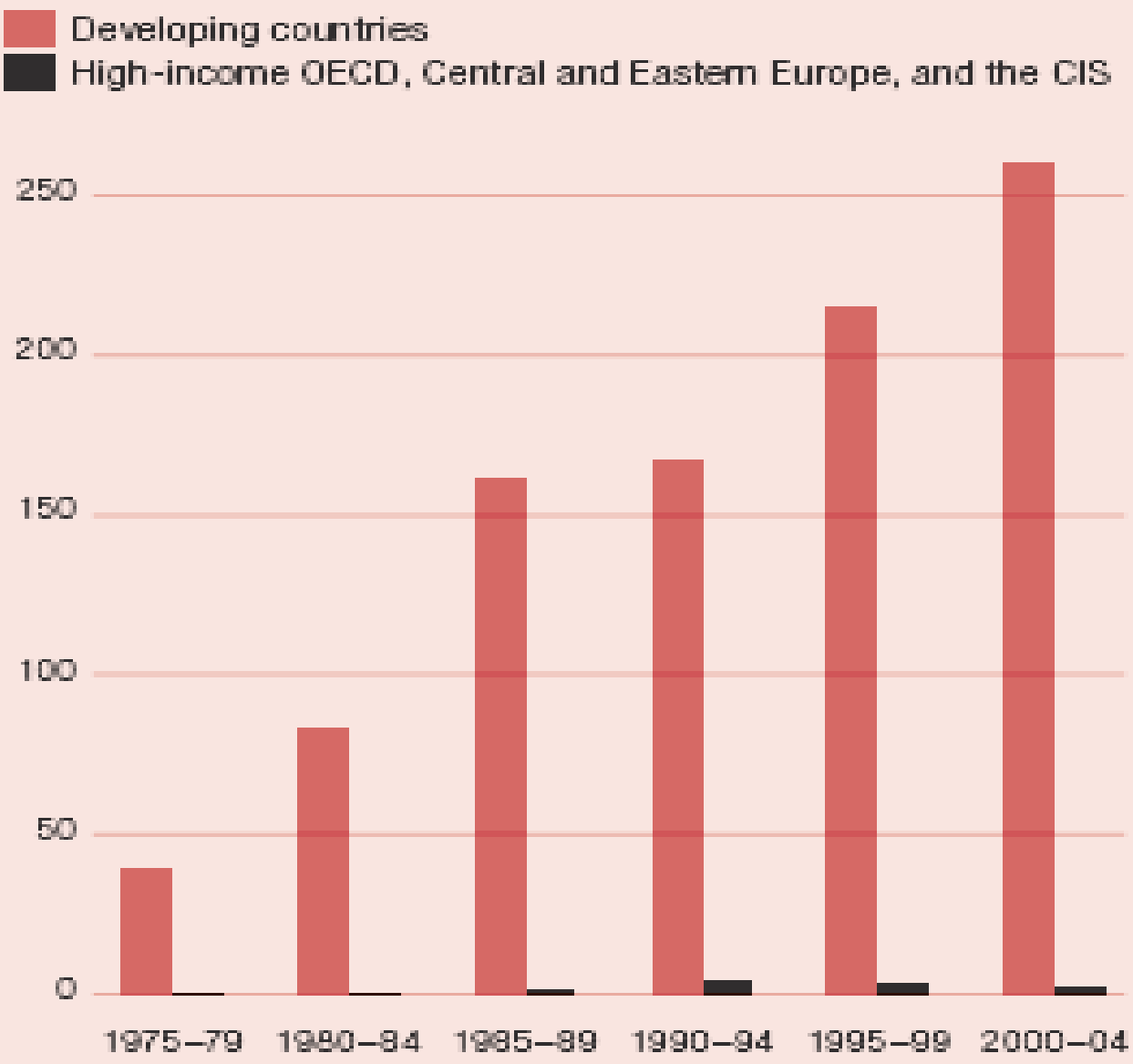

People without access to electricity (millions, 2004)
Others
101
Total: 1.6 billion
East Asia
224
South Asia
706
Sub-Saharan Africa
547
Source: IEA 2006c.

The Unsustainable Trajectory




5%
400 ppm CO_2e
95%
450 ppm CO_2e
550 ppm CO_2e
650ppm CO_2e
750ppm CO_2e
Eventual Temperature change (relative to pre-industrial)
0°C
1°C
2°C
3°C
4°C
5°C
Food
Falling crop yields in many developing regions
Severe impacts in marginal Sahel region
Rising number of people at risk from hunger (25 – 60% increase in the 2080s in one study with weak carbon fertilisation), with half of the increase in Africa and West Asia.
Entire regions experience major declines in crop yields (e.g. up to one third in Africa)
Rising crop yields in high-latitude developed countries if strong carbon fertilisation
Yields in many developed regions decline even if strong carbon fertilisation
Water
Significant changes in water availability (one study projects more than a billion people suffer water shortages in the 2080s, many in Africa, while a similar number gain water
Small mountain glaciers disappear worldwide – potential threat to water supplies in several areas
Greater than 30% decrease in runoff in Mediterranean and Southern Africa
Sea level rise threatens major world cities, including London, Shanghai, New York, Tokyo and Hong Kong
Ecosystems
Coral reef ecosystems extensively and eventually irreversibly damaged
Possible onset of collapse of part or all of Amazonian rainforest
Large fraction of ecosystems unable to maintain current form
Many species face extinction (20 – 50% in one study)
Extreme Weather Events
Rising intensity of storms, forest fires, droughts, flooding and heat waves
Small increases in hurricane intensity lead to a doubling of damage costs in the US
Risk of rapid climate change and major irreversible impacts
Risk of weakening of natural carbon absorption and possible increasing natural methane releases and weakening of the Atlantic THC
Onset of irreversible melting of the Greenland ice sheet
Increasing risk of abrupt, large-scale shifts in the climate system (e.g. collapse of the Atlantic THC and the West Antarctic Ice Sheet)

People affected by hydrometeorological disaster (millions per year)



Source: HDRO calculations based on OFDA and CRED 2007.

We Will Have to Adapt

- People are experiencing costs due to climate impacts already, vulnerabilities and coping strategies are emerging
- Need to engage local people and grassroots groups
  - How are climate risks perceived, which strategies would be most effective, e.g., water

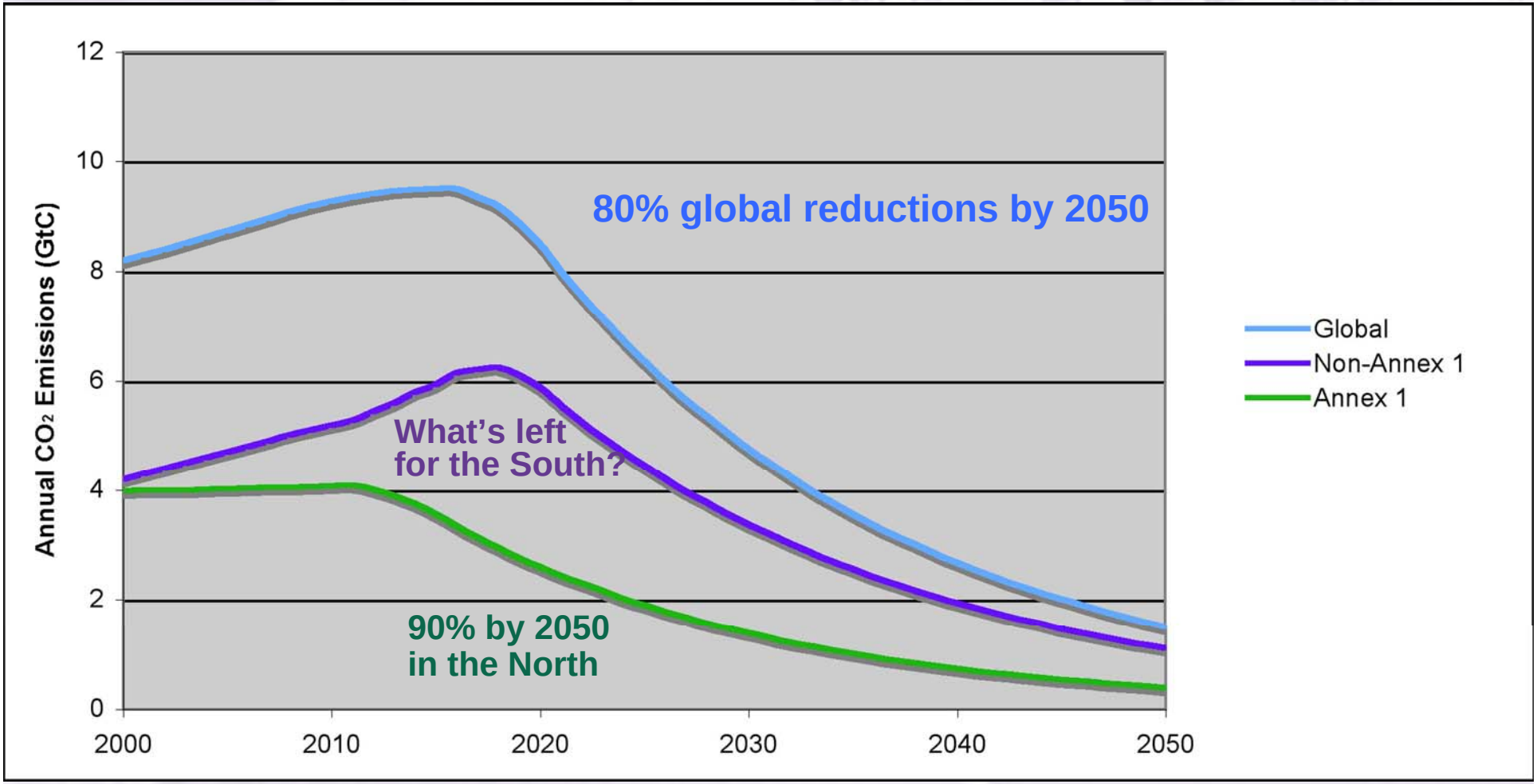
The Research and Policy Agenda

- Reliable uncertainty estimates of place-based climate risks are urgently required
- Planetary / continental scale climate and impact assessments are not useful for place-based adaptation, due to a mis-match of time and spatial scales
- Funds, tools and technology to manage current climate risks and potential ones from near term climate change are required to enhance developing countries' long term adaptation ability

Adaptation Cost Estimates

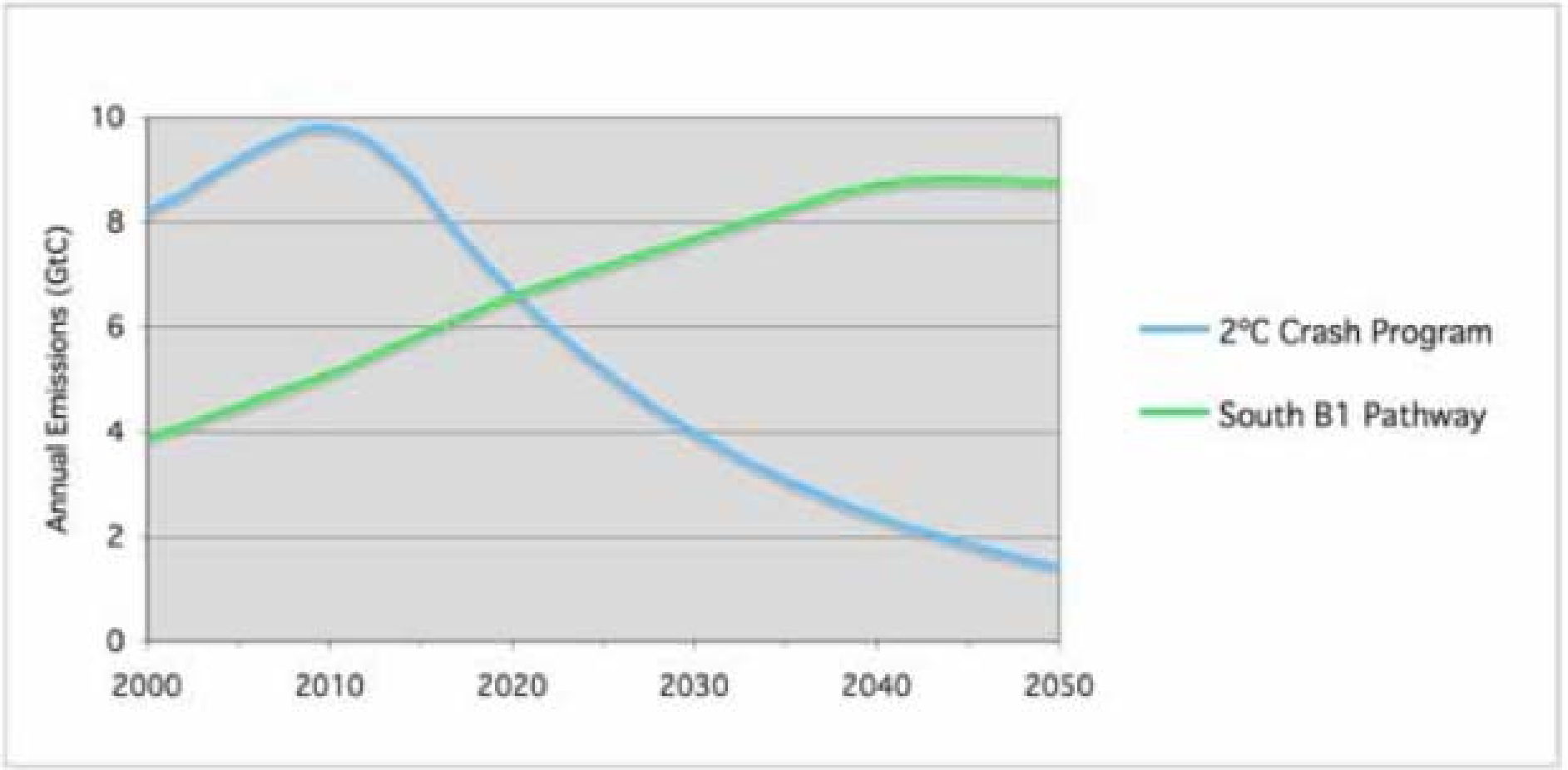
- Stern: OECD $15-150b (.05-.5% of GDP), developing countries tens of billions of dollars
- WB (2006) additional costs $4-37 per year.
  - Only includes cost of tailoring new investment to protect it from climate-change risks.
- UNFCCC: In 2030, $28-67b needed in non-Annex I parties, $50-171b globally
- Oxfam (2007): developing countries *at least* $50b per year (or roughly 0.5% of GDP) under 2-3^0 rise; NAPA-based costs: $2.2b for LDCs and $14.4b for all developing countries

Kartha et al's Formulation



What kind of climate regime can make this possible?

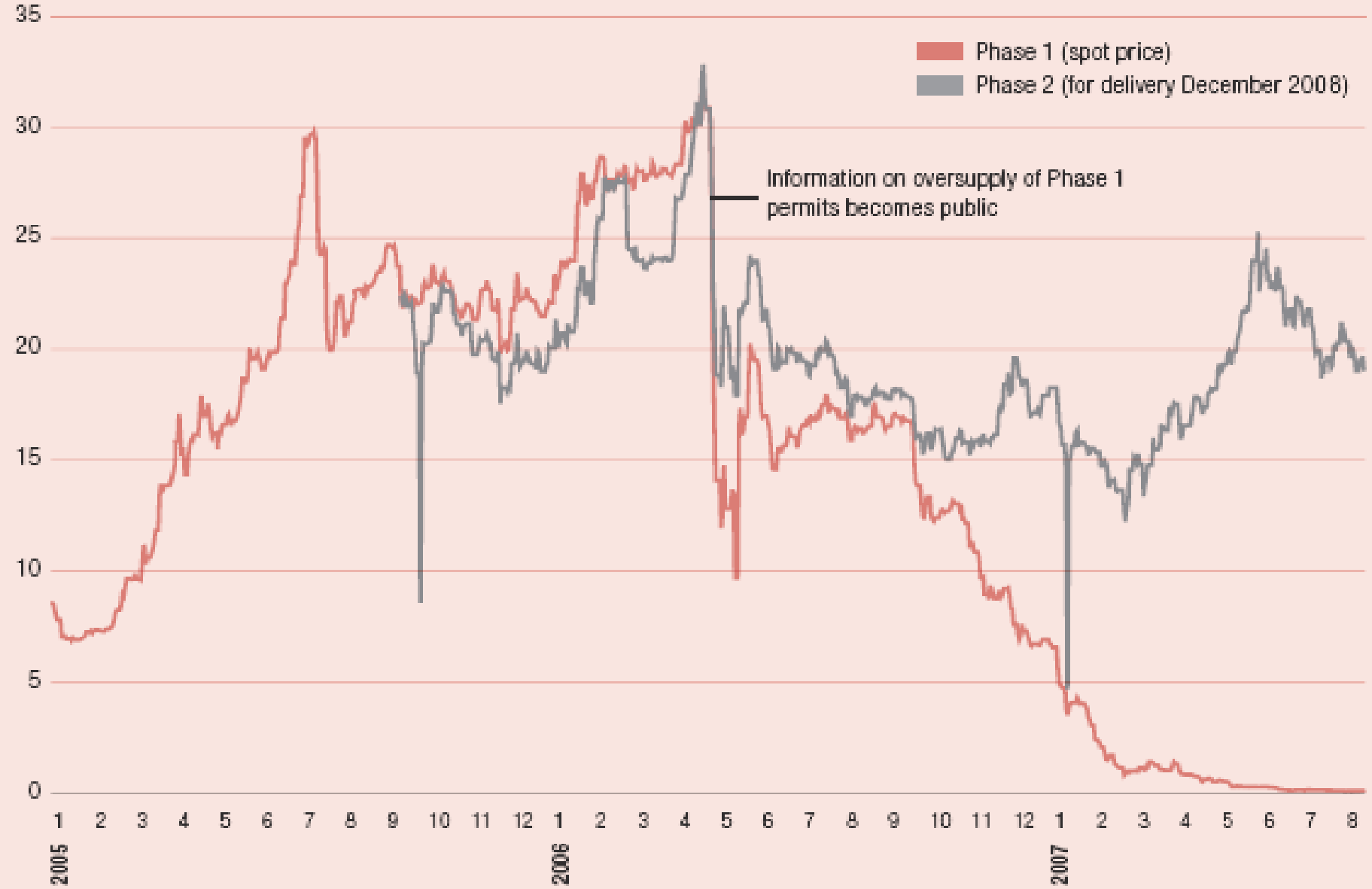
The time for simple emission rights has gone



Available Southern emissions budget under the 2°C Crash Program, plotted against the South's SRES B1 pathway emissions. Note that Northern emissions are assumed to magically drop to zero in 2020 – the South's budget reflects the *entire* global emissions budget.

	Kyoto targets [a] (2008–2012)	Post-Kyoto	
European Union [b]	8%	20% (individually) or 30% (with international agreement)	60–80% (with international agreements)
France	0%	–	75%
Germany	21%	40%	–
Italy	6.5%	–	–
Sweden	4% increase (4% reduction national target) (by 2010)	25%	–
United Kingdom	12.5% (20% national target)	26–32%	60%
Australia [c]	8% increase	–	–
Canada	6%	20% relative to 2006	60–70% relative to 2006
Japan	6%	–	50%
Norway	1% increase (10% reduction national target)	30% (by 2030)	100%
United States [c]	7%	–	–
Selected United States state-level proposals			
Arizona	–	2000 levels	50% below 2000 (by 2040)
California	2000 levels (by 2010)	1990 levels	80% below 1990 levels
New Mexico	2000 levels (by 2012)	10% below 2000 levels	75% below 2000 levels
New York	5% below 1990 (by 2010)	10% below 1990 levels	–
Regional Greenhouse Gas Initiative (RGGI) [d]	Stabilization at 2002–2004 levels (by 2015)	10% below 2002–2004 levels (by 2019)	–
Selected United States Congress proposals			
Climate Stewardship and Innovation Act	2004 levels (by 2012)	1990 levels	60% below 1990 levels
Global Warming Pollution Reduction Act	–	2% per year reduction from 2010–2020	80% below 1990 levels
Climate Stewardship Act	2006 level (by 2012)	1990 levels	70% below 1990 levels
Safe Climate Act of 2007	2009 level (by 2010)	2% per year reduction from 2011–2020	80% below 1990 levels
United States non-governmental proposals			
United States Climate Action Partnership	0–5% increase of current level (by 2012)	0–10% below "current level" (by 2017)	60–80% below "current level"

EU Emission Trading Scheme (ETS) permit prices (€/t CO_2)



Source: Point Carbon 2007.

Table 1: Recent Estimates of Levelised Costs for New Plant in the Period 2005-15

	Gas (combined cycle)	**Coal (pulver-ised fuel)**	**Coal-IGCC with CCS**	**Nuclear**	**Wind--onshore**	**Wind--offshore**
Capital cost, £/kW	400	800	1600	1770	800 b/	1330 b/
Plant life, years	30	40	25	40	25	20
Fixed operating costs, £/kW/year	12	40	80	105	28	48
Variable operating costs p/kWh	0	0.6	0.9	0	0	0
Thermal Efficiency, %	50	45	35	a/	-	-
Plant factor, %	90	90	85	85	30	35
Fuel input costs, p/kWh	1.4	0.5	0.5	a/	0.25 c/	0.25 c/
Levelised costs, p/kWh	**3.6**	**2.6**	**4.8**	**3.9**	**4.4**	**6.8**
Uncertainty ranges:						
-- capital costs	± 15%	± 15%	± 25%	± 30%	± 20%	± 30%
-- fuel costs	± 50%	± 30%	± 30%	-	-	-
--levelised cost as % levelised cost of marker d/	-	-	67 ± 30%	50 ± 50%	62 ± 35%	120 ± 60%

Source: Data for the Stern Report, reviewed by DTI the Carbon Trust and others. Stern (2007). The gas fuel costs correspond to £4/GJ and the costs of coal to £35/ton. The discount rate is 10%.

a/ Fuel costs and assumptions as to the effects of efficiency are included in the fixed operating costs.

b/ Includes allowance for backup costs = 20% of installed capacity with open cycle GT as backup.

c/ Balancing costs per kWh.

d/ The 'marker' is the fossil fuel technology offering the lowest cost of generation; it can be coal or gas, depending on coal or gas prices (the range of which is shown in the table).

UNDP HDRO 2007

- *Mitigation:* Sustainable carbon budgeting:
  - *Emissions (2050)*: Global 50%, developed countries 80% (20-30% by 2020), developing countries 20%
  - *Portfolio (2020)*: 20% of energy needs met by renewable sources
  - *Policies*: carbon taxation and/or cap-and-trade (carbon price up to \$60-100/t CO_2) plus regulatory systems, public-private partnerships, energy reforms in developing countries, backed by financial and technical transfers, co-operation (and possibly market incentives) to stop deforestation.
  - Financing: Climate Change Mitigation Facility at \$25-50b per annum.
- *Adaptation*: \$86b per annum in new and additional funds by 2016, half for climate proofing and rest for social security and poverty reduction.

Mitigation Cost Estimates (UNFCC)

- Extra investment $200-210 b/yr needed in 2030 for mitigation in order to return GHG emissions to current levels.
- Share for developing countries to grow from the current 20-25% to much higher.
- In 2030, 46% of global total investment in developing countries would generate 68% reduction in global emissions.

Adaptation Cost Estimates

- Stern: OECD $15-150b (.05-.5% of GDP), developing countries tens of billions of dollars
- WB (2006) additional costs $4-37 per year.
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Current Flows

- GEF
  - 1991-06, $3b grants (to leverage $14 b+ co-financing) in 160+ countries.
  - Pledges 2006: $3.13b for 4 yrs by 32 countries
- CDM
  - CERs: 191m regd; 1,160m? by end-2012
  - Finance: $5.2b in projects regd in 2006
  - Critiques: Northern oriented, unequally distributed (75% BICM, 2% Afr), uncertain, moral hazard

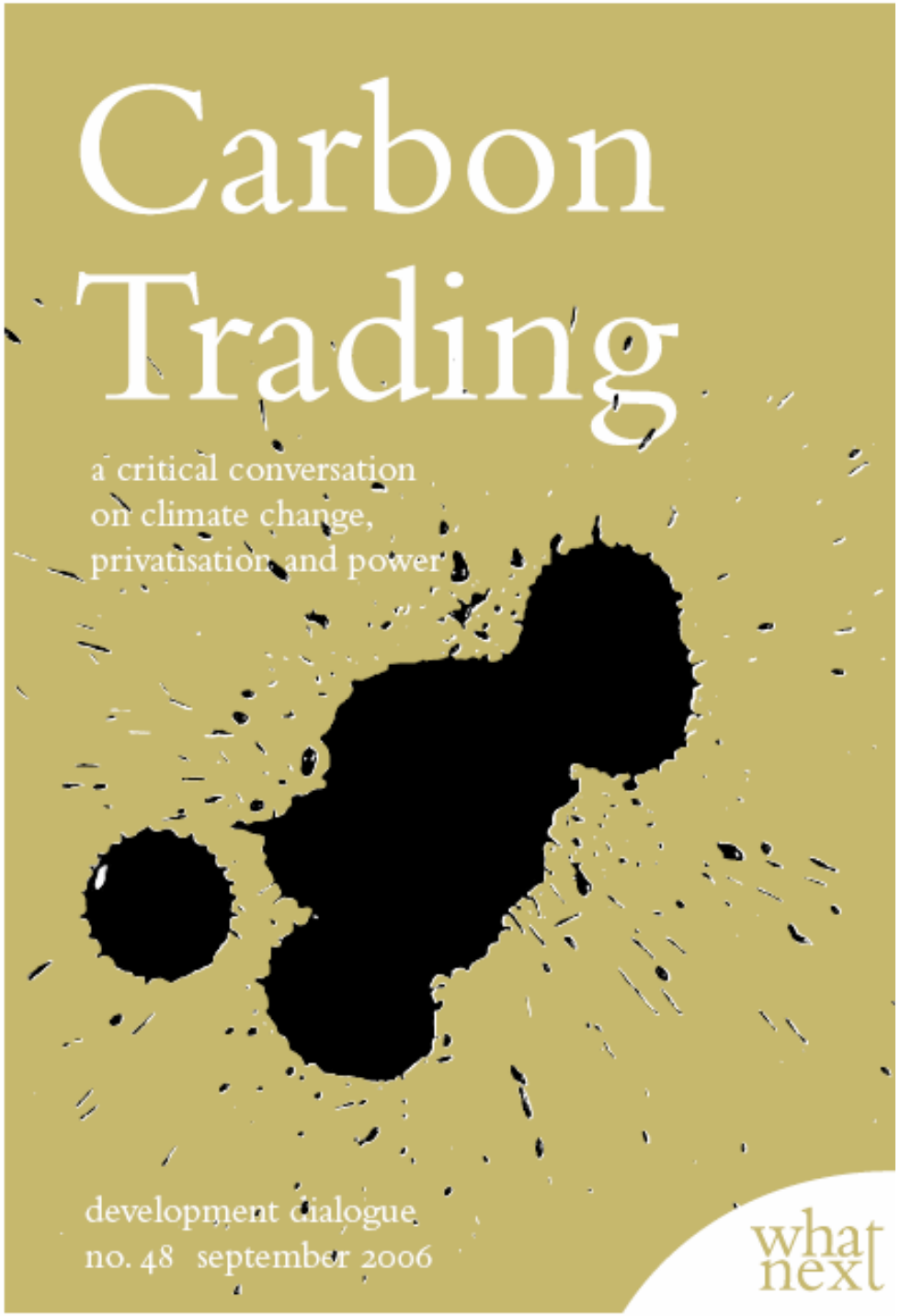
Market Envy

"Mommy, where do carbon offsets come from"?

"Well, you see, honey, when a polluter and a consultant love money very, very much, they come together in a very special way to produce an extremely long piece of paper".

Gar Lipow, Systems Analyst and Peace Activist, 2006

Cited in *Carbon Trading, p. 61*



Regime Models

Cap and Trade: But with possible variations, e.g., (a) national targets versus emission rights (aggregate or per capita); or (b) greenhouse development rights

Carbon Tax: Carbon-tax (comparable to targets)

Regulation: Direct reduction of fossil fuels

Investment: Global public investment program

Cross Cutting issue: Comprehensive solution or rolling regimes?

Criteria for Regime Choice

- **Development:** What will happen to development: in fast growing countries, in other countries?
- **Human Development**: MDGs
- **Policy consistency:** Can we bind future governments? Should the private sector believe it?
- **Simplicity:** transparency, directness, need for ancillary measures, experience of use in the South
- **Nature of North-South interaction:** Aid? Conditionality? Partnership?

The Investment Approach

Mitigation Fund: e.g., from HDR, or a global fund 1 per cent of world GNP for climate transition allocated mainly for energy modernization

Financing: progressive source by income rather than country.

Technology Transfer: Support inter-locking institutions for extension, research, education, policy, inputs, credit, marketing.

Focus: Sustainable Energy

Policy: Feed-in-Tariffs