FONDATION POUR LES ÉTUDES
ET RECHERCHES
SUR LE DÉVELOPPEMENT
INTERNATIONAL

Challenges in Setting up a Workable and Effective Climate Regime

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Capitalism in the 21st. C.: Stagnation versus Growth in Europe

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Presentation draws on Scott Barrett, Carlo Carraro, Jaime de Melo eds. (here)

Outline

1. Background
   - Climate science and economic challenges
   - E-book objectives
2. Architecture and Governance
   - Legal Instruments
   - Monitoring, Reporting and Verification (MRV)
   - Building bloc and other strategies
   - Greening the GATT
3. Policy and technology options
   - Regulatory Approach
   - Pricing carbon and associated leakage
   - Renewables, Carbon capture & storage, geoengineering
   - Cities
4. Burden sharing and finance
   - Natural disasters, vulnerability, CBDR
   - REDD+, curbing carbon
   - Raising Climate Funds
5. Key reinforcing measures

Background: The Science

Objectives: Control climate changes related to anthropogenic activities (article 1.2 of the UNFCCC)

The 3 pillars of the Science:

1. CO_2 emissions have increased and stay up in the troposphere (for 100 years or more?). 2 GTCo2 in 1900 to 5 GT in 1950 and 32 Gt in 2013 (we have accurate measurement since 1970) (here)

2. Temperatures have increased throughout the XXth- century

3. Greenhouse gas (GHG) effect: Tyndall, Fourier, and Arrhenius. (but if none trapped, temperatures would be -15^0 to -20^0 cooler)

Background: The science

Evidence and projections

- ⇨CO2 emission increases decompositions: 1970-2010 (here)
- ⇨Predicted multiple damages to increase according to CO2 emissions (BAU) path= CO2 emissions continue growing at ≈ 2% a year (here)
- ⇨Mutliple objectives (art. 1.2) tightens considerably the carbon budget below (750-1400 GtCO2 over the 1850-2100 period) (here)
- ⇨Cumulated energy from trapped GHG in oceans (here)
- ⇨Too much known fossil fuels in ground (here) and (here)
- ⇨Time is running out (here)
- ⇨Climate- change- migration-conflict (here)

The collective action policy challenge

Difficult to close gap between

- top-down 'ideal' (i.e. efficient) but unreachable and
- bottom-up 'achievable' (but insufficient) approach.

Result is a gap between the 2 approaches

⇨ Challenge: limit CO2 emissions further for the sake of their collective interests (how to fill the gap)

Example: Pricing fossil fuel consumption for externality gives national benefits (3.7 millions deaths estimated from outdoor pollution) and collective benefits (less global warming).

- Adding up co-benefits for top 20 emitters reduce global CO2 emissions by 11%.

Objectives of e-book

⇨ Hints, guidelines, and policy recommendations what we need for a workable and effective climate regime rather than

- workable and insufficiently effective (Paris?) or
- effective if implemented but politically unacceptable (an 'ideal' top down approach)

Architecture and Governance (1)

- Legal Instruments Chp (11)
  - KP was 'legally binding' so less participation and withdrawal
  - No evidence that legally binding treaty has more effect on state behavior than non-legally binding
  - More important is ability of treaty to enforce participation

- Metrics (chp 12)
  - Are aggregate pledges getting us on the $+2^0C$ path?
  - Are similar countries making similar pledges? (difficult to answer as pledges expressed differently-see metrics for EU and US (here)

- Monitoring, Reporting and Verification (MRV) (chp.13)
  - Effective MRV needed. Can help build confidence

Architecture and Governance (2)

- Building blocs and other strategies
  - Help governments and critical players determine what is feasible by trial & error to build confidence (chp. 14)
  - « Experimental governance » (XG) could move MRV to more coordinated and effective effort
  - Get all actors (NGOs, IOs, firms) to form clubs, institutional linkages in a « building bloc » strategy (chp. 15)

- Greening the GATT (chp. 16)
  - Different CO2 prices →carbon leakage and climate and trade policies on a collision course → border tax adjustments
  - Labelling of energy-efficient technologies, remove fossil fuel subsidies
  - GATT to move from 'negative' to 'positive' contract = trade rules allowing punishments for non-observance of climate policies.

Policy and technology options (1)

- Clean Power Plan (CPP) by the EPA, the US approach (Chap. 17)
  - Has been effective to meet 2009 pledge made to reduce emissions (by 17% in 2020 relative to 2005) contributing so far half of observed reductions until 2013.
  - Flexibility in implementation for the regulated entities
  - Reinforces bottom-up leadership (laboratory for new regime)

- Pricing carbon (chp. 18)
- Tax carbon →to lower energy intensity of GDP. Emission intensities still very different across countries (here)
- Sweden has a $130 t/CO2 …but world average over 40 [20] national [subnational] jurisdictions is only $15 t/co2 (here)
- Discussion of political economy of 4 alternatives (chp. 18)
  - Remove fossil fuel subsidies
  - Fuel taxation (here)
  - Cap and trade and direct regulation (here)
  - Promote renewable energy (e.g. Germany)

Policy and technology options (2)

- Carbon leakage (Chp. 21)
  - Need for a greater transparency in price-setting
  - Without coordination leakage will inevitably occur
  - Three channels of leakage identified: Energy market, competitiveness channel and innovation channel
  - Suppose that OECD applies carbon tax to reduce CO2 emissions by 30%⇨Leakage rate about 15% that is cut in half by border tax adjustment (here)
  - Options against leakage: border carbon adjustments, output-based rebating, exemptions and sectoral treaties
- Renewable energies (chp. 22, 23)
  - Solar and wind must be scaled up
  - Will not be sufficient to limit climate change alone
  - Will not remove CO2 already present in the atmosphere

Policy and technology options (3)

- Carbon Capture & Storage (CCS) (chp 24)
  - Add-on cost that needs financing through carbon tax
  - Technology (to scale) not yet implemented
  - High cost facing falling price of natural gas and objections to store CO2 near power plants (close to where people live)
  - ..but ensures reductions are at home and so avoids leakage abroad discussed below
- Solar Geo-engineering(ch. 25)
  - Controls mean global temperature at very low cost, but can affect climate in other (unknown) ways
  - Does not modify *(improve)* atmosphere and ocean composition
  - …but needs a global governance

Comparing options for limiting climate Change

Options	Objective	Costs	Risks	Unknowns	Collective action
Unconstrained climate change	Not an intended outcome, but a consequence of failure to limit emissions	Low	High	Many	Not achieved
Substantial emission reductions	Reduce the flow of CO_2 into the atmosphere.	High	Low	None	Difficult
Carbon geoengineering	Reduce the concentration of CO_2 in the atmosphere	Very High	Moderate	Few	Coalition of the willing
Solar geoengineering	Limit solar radiation reaching the lower atmosphere	Low	High	Many	Easy, apart from governance

Policy and technology options (4)

- Cities (chp 30)
  - Count for 54% of world population but for 70% of CO2 emissions
  - 2.3 out of 2.5 billion extra people heading towards cities
  - Construction is for 70 to 100 years
  - Taking average Carbon Replacement Value (CRV) for key materials (aliminium,steel, cement) for all new cities in developing countries will take 1/3 of remaining carbon budget for 21st. C (40% already used over 2000-11). See (here)
  - Cities in developed countries could be part of building bloc strategy and experimental governance mentioned earlier. Ambitious de-carbonization plans in some cities . See C-40 and (here)

Incidence and Burden sharing (1)

- Natural disasters and vulnerability (chp. 26)
- Poorest have contributed least (here)
- Poorest are hardest hit by climate shocks (the most vulnerable and least resilient) (here). Econometric evidence: Over past 50 years, 1^0 deviation from trend is estimated to reduce per capita GDP by 1.4% (but only in poor countries).
  - Projections: SSA and SA will be most exposed around 2050 (here)
  - Poorest projected to incur additional health damage (here)

Burden sharing. Common but Differentiated Responsibilities (CBDR) is key role in the UNFCCC (technology mechanism + green climate fund (=$100 billion by 2020) key to breakdown of wall between Annex I and II (discussion on compensation for past damages and financing needed for future adaptation continues to be acrimonious).
CO2 reduction scenarios (egalitarian, responsability, income)(here)
…or taxing the rich in high-income countries (here) and (here)

Burden sharing : Two suggestions(2)

- REDD+ (chp. 28)
  - Account for 11% of CO2 emissions. At $5t/CO2), reducing deforestation by half would cost around $20 billion per year (here)
  - …so REDD+ is potentially low cost of implementation and satisfies MRV via satellite technology and largely avoids political process
  - but flawed process reflected by lack of ownership at the national level and processes are run at international level.
- Curbing carbon (chp. 29)
  - Remove coal (most inefficient fossil energy) only produced by a few from energy production firstly in high-income countries (Australia, US, Germany) then move down the ladder (MIC, LIC)
  - Harness the moral energy generated by popular concerns to curb the supply side (easier than demand side).
  - Avoids the political process to transfer funds to developing countries but requires huge cooperation (no increase in production by countries further down the ladder….)

Raising Climate funds

- The macroeconomics of finance needs (chp. 32)
  - $0.6 trillion per year til 2030 (i.e. 0.75 of world GDP)
  - A CO2 tax (for OECD countries) consistent with $+2^0$ C by 2100 would generate up to $1.3 trîllion per year equivalent to 1.2% of OECD GDP. Non-OECD countries might need $50 billion per year to finance transition
- Climate finance: Regulatory framework, (chp 33)
  - So far ¾ of climate finance is spent domestically
  - Alternative source for raising funds (green bond market, taxes on int'l transport, on financial transactions) disappointing
- Kicking-off the transition (chp. 34)
  - World awash in finance since 2008 crisis
  - Gov't backed 'climate remediation assets' could give the needed guarantee for low-carbon energy.
  - Allocate according to vulnerability to climate changes

Key reinforcing measures

1) Finance energy R&DD (both public and private) by scaling up dramatically. Cooperation with developing countries on energy R&D and technology transfers is also essential.

2) Encourage carbon pricing. Will substitute away from fossil fuels + adoption of technologies & CCS. Raises revenues. Double dividend.

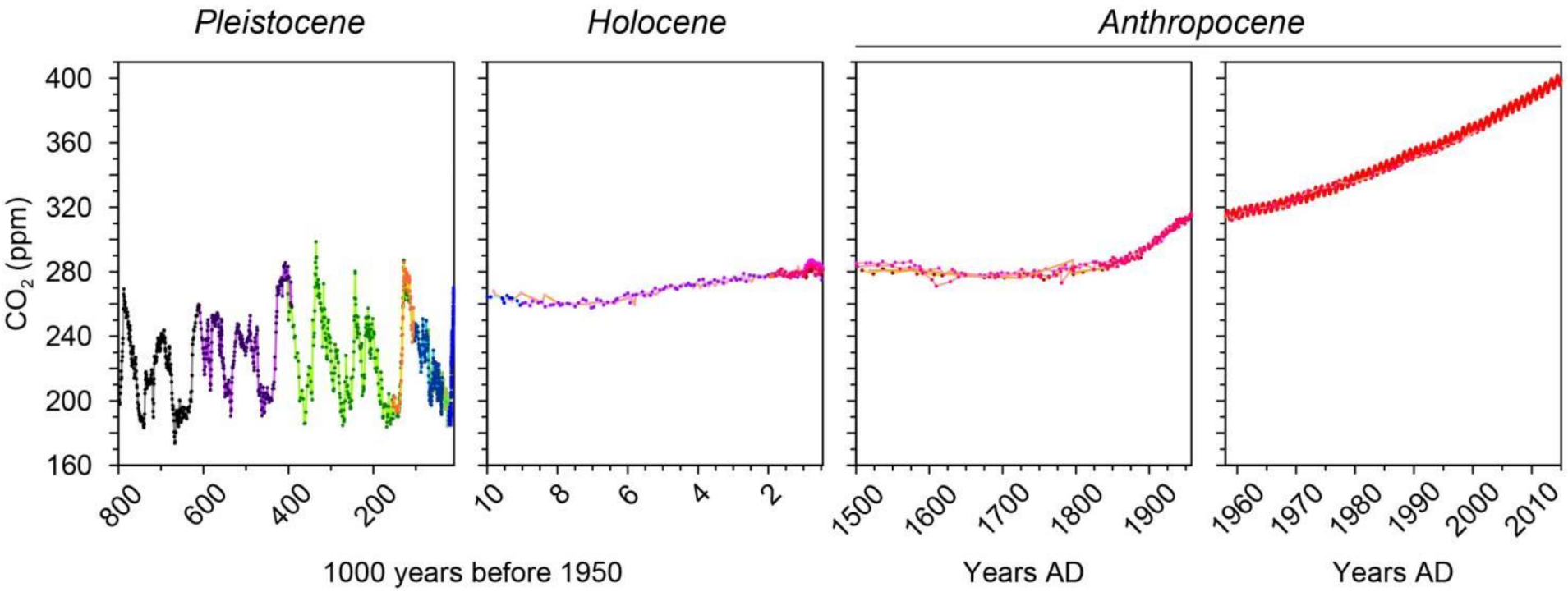
3) Finance adaptation for the poorest (LDCs). Calls again for adequate funding, but also better governance and risk assessment and clever way to "dissimulate" required transfer (CAT, REDD+ , closing coal).

4) building bloc strategies and experimental governance extending beyond public authority to achieve collective governance

5) Overcome free rider incentives with a robust system for MRV supplemented by additional measures ("building blocks", resilient cities, measures to enforce agreed reductions in emissions).

Figures

Atmospheric CO2 concentrations (past 800 000 years)



«Accurate» measurements since ≈1950 at Mount Mauna Loa (Hawaï)
CO_2 ppm (280 in 1850 to 400 ppm in 2014).
Previously data from glaciers, tree trunks, grape harvests…

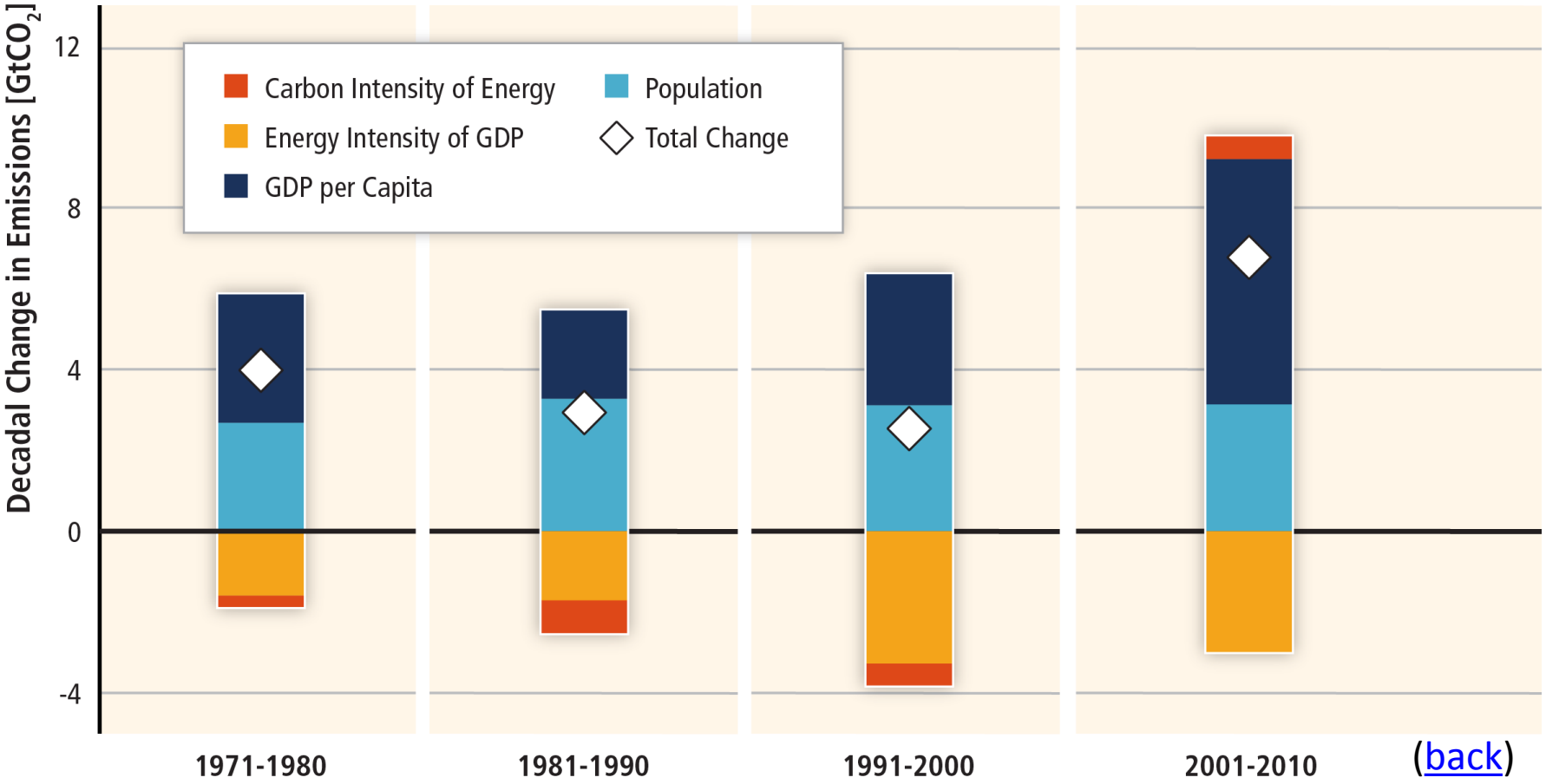
Chap 2, Fig 1

(back)

Decomposing CO2 emissions growth (1970-2010)

GHG emissions rise with population and with GDP per capita but energy intensity of GDP usually falls .

Bad news: carbon intensity of energy on the rise over 2001-2010.



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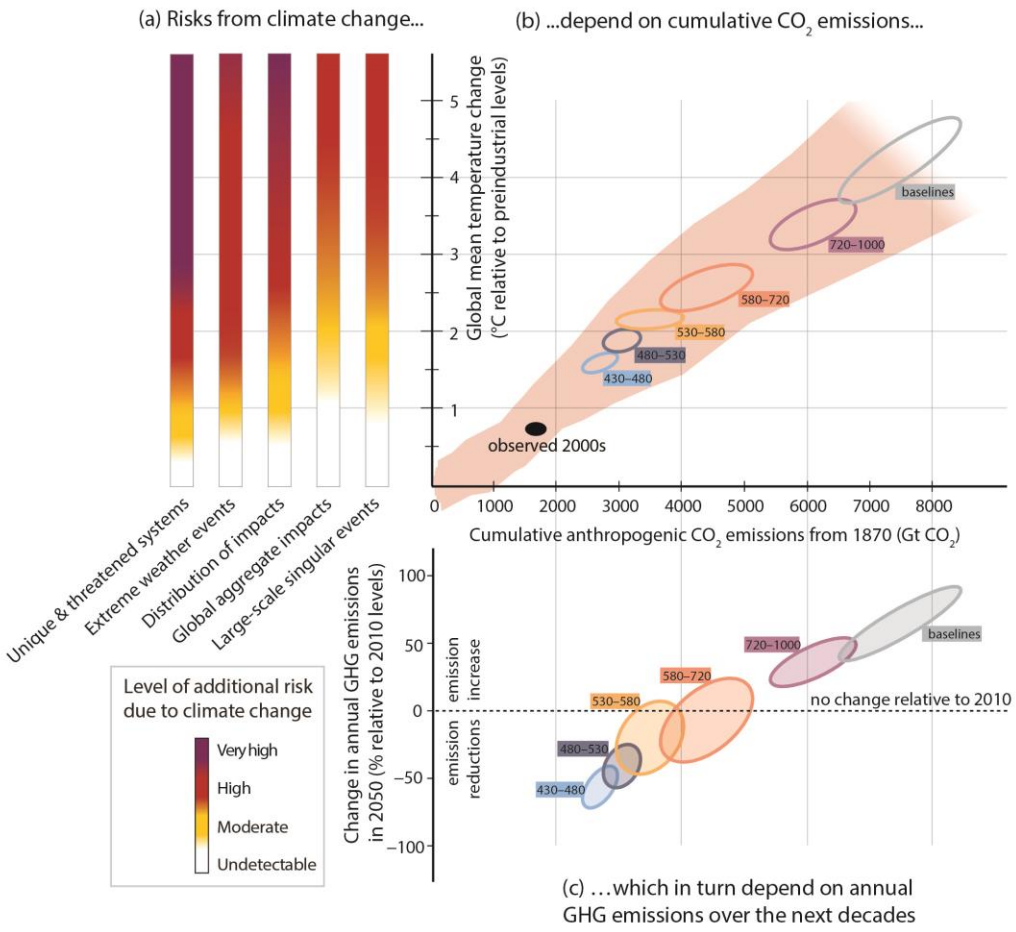
Basics: Risks and multiple damages depend on cumulative GHG emissions



A Simplistic view of temperature

$T = a + b\,CO_2$

$\Delta T = b \Delta CO_2$

From 1850 to 1990 $\Delta T = +0.7^0$ and ΔCO_2 (280ppm to 370 ppm $\rightarrow$ b=0.008)

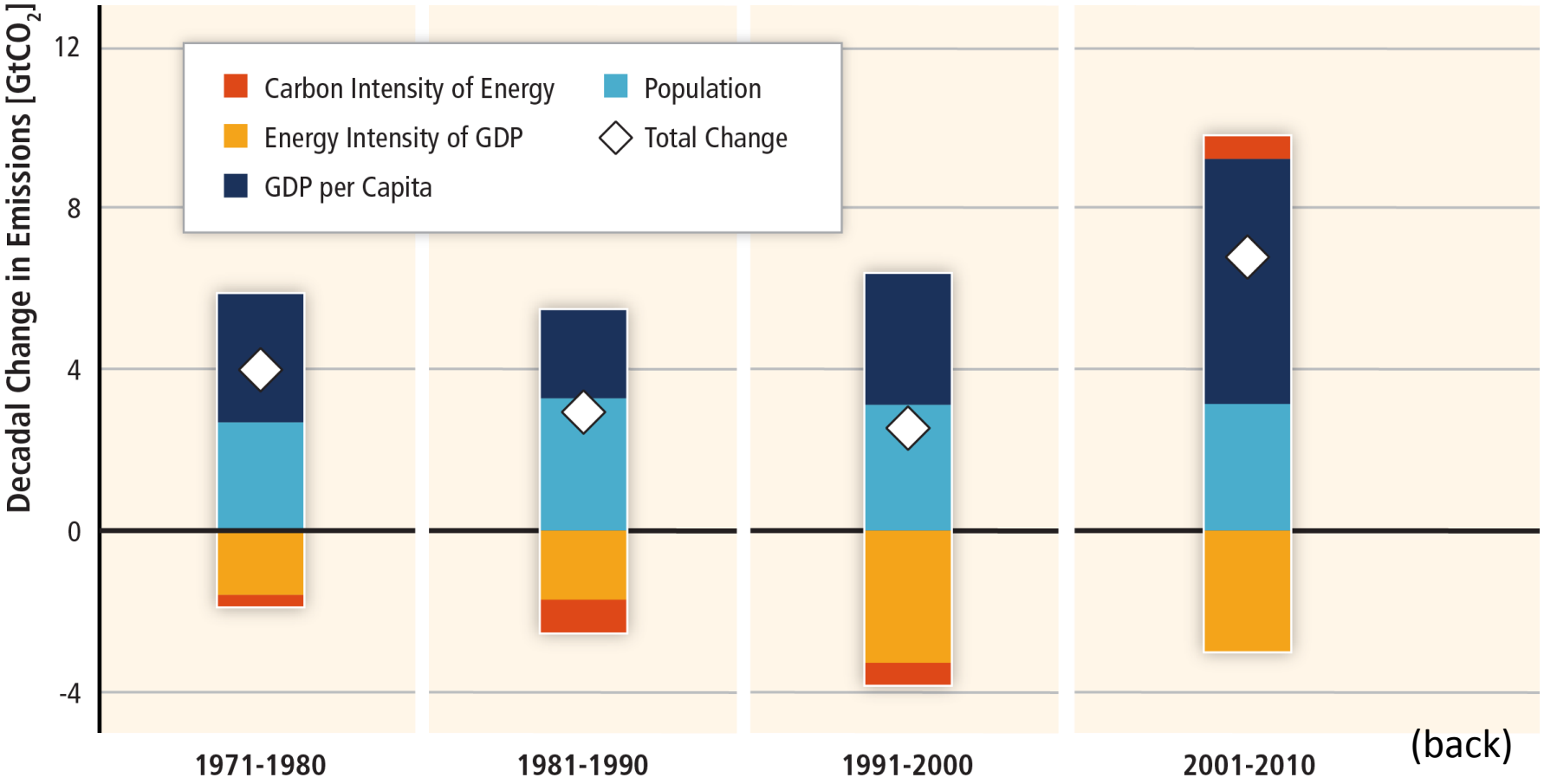
Wedge and ellipses show range of uncertainty of different scenarios of CO2 cumulative emissions reductions by 2050 to have 66% chance of $\Delta T < +2^0$).

Chap 2, fig 4 (back)

Decomposing CO2 emissions growth (1970-2010)

GHG emissions rise with population and with GDP per capita but energy intensity of GDP falls . (see annex)

Bad news: carbon intensity of GDP on the rise over 2001-2010.



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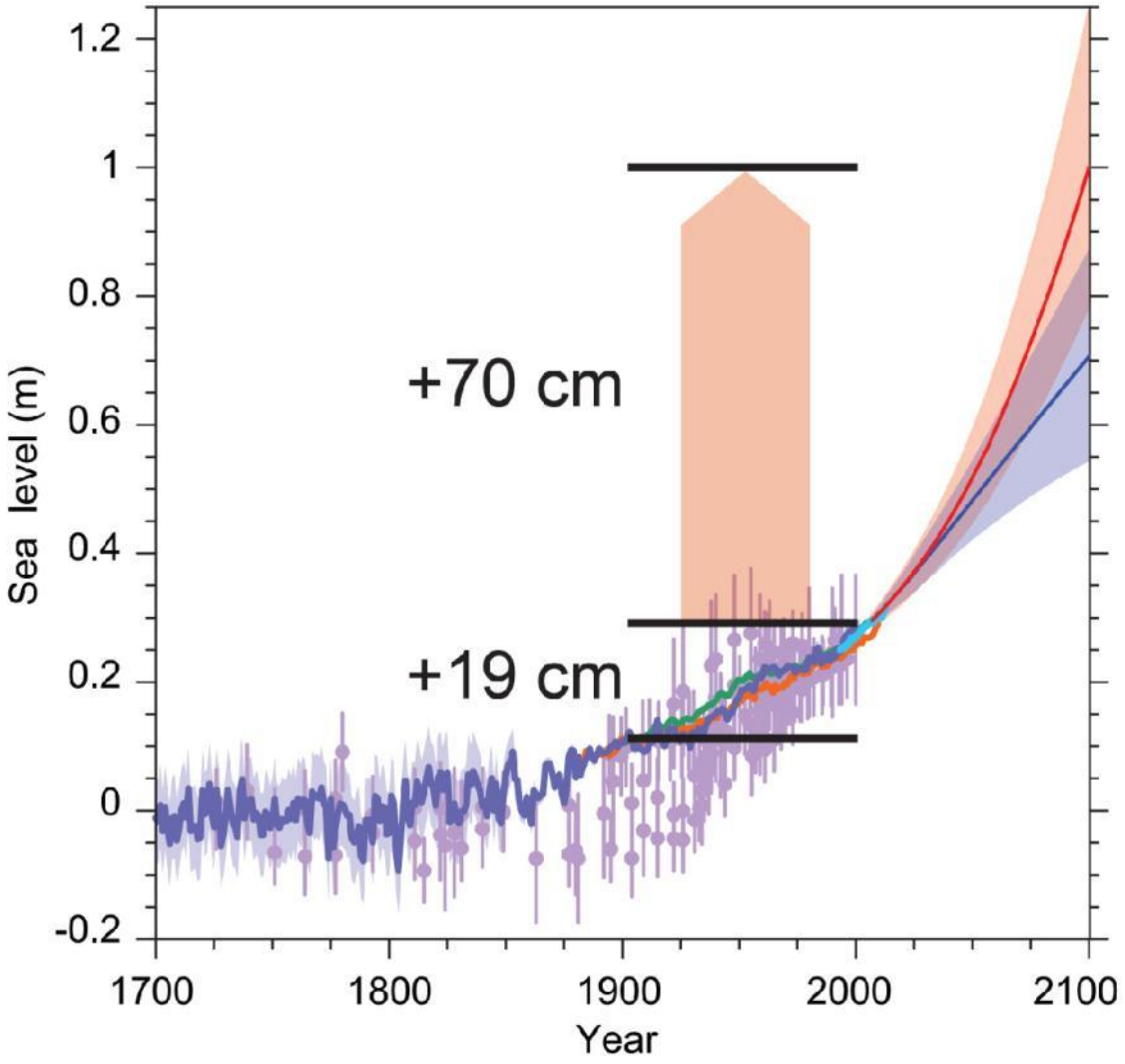
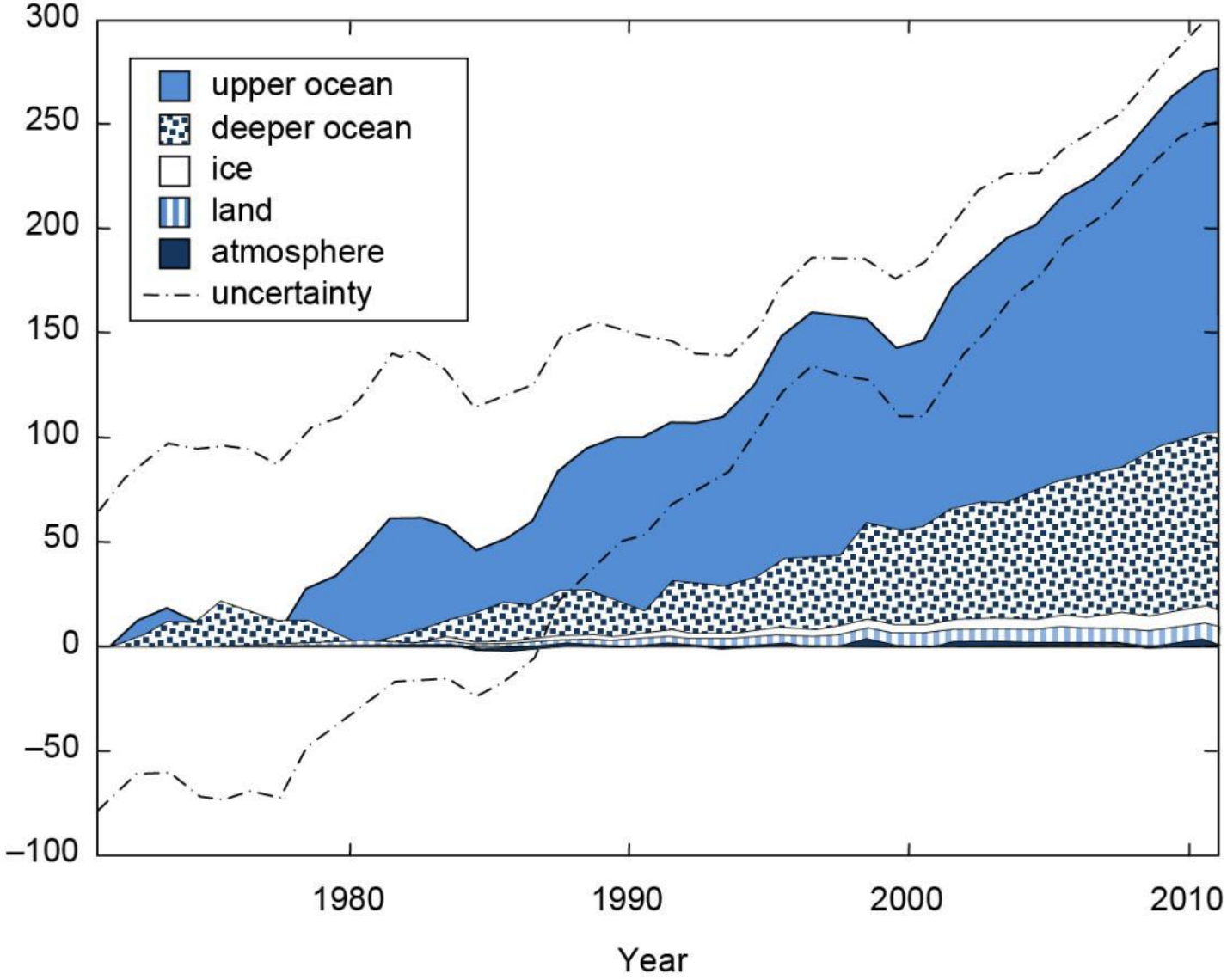
The scale of committed adaptation to sea level rise (+ 19cm since 1850 and projected (+ 70cm more by 2100)



Chap 2, fig3

(back)

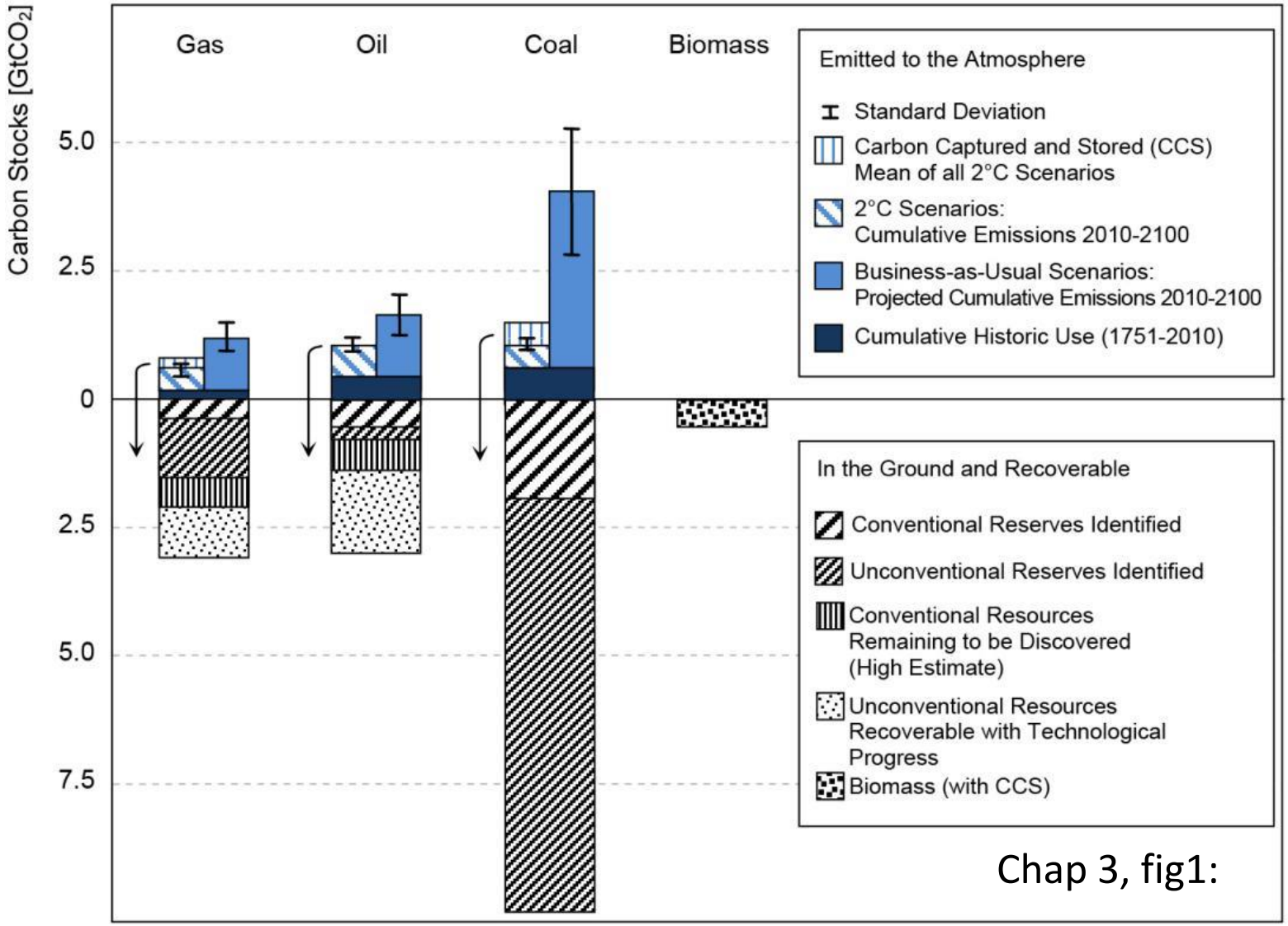
Change in the energy content of Earth System since 1970 almost all in oceans →ocean acidification



Chap 2, fig 2

(back)

Too much known fossil fuels reserves in the ground for a 2°C limit goal

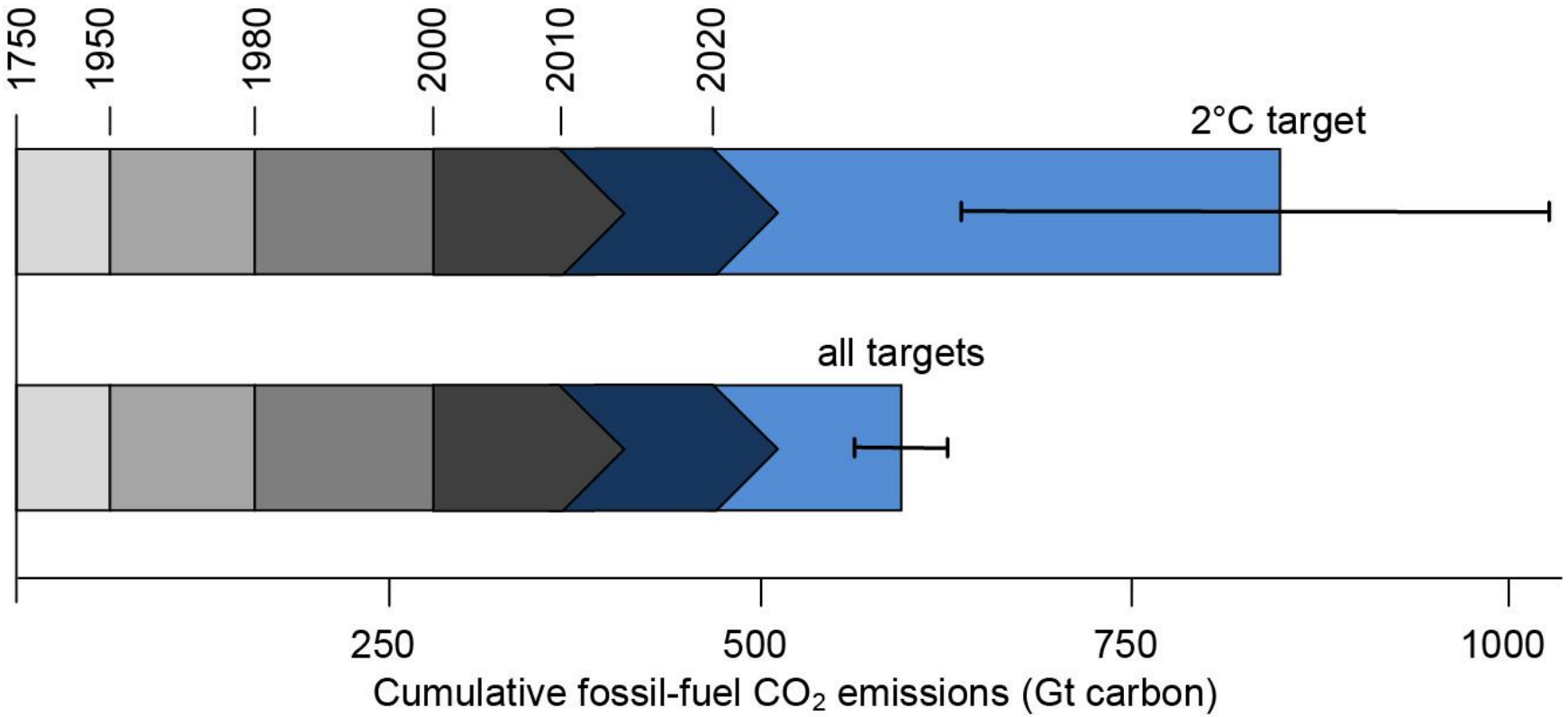


Chap 3, fig1:

(back)

Carbon budget (750-1400 GtCO2)

Allowable cumulative emissions with multiple climate targets (limits to ocean acidification, sea level rise, loss of biodiversity)
[past and future land use changes excluded]



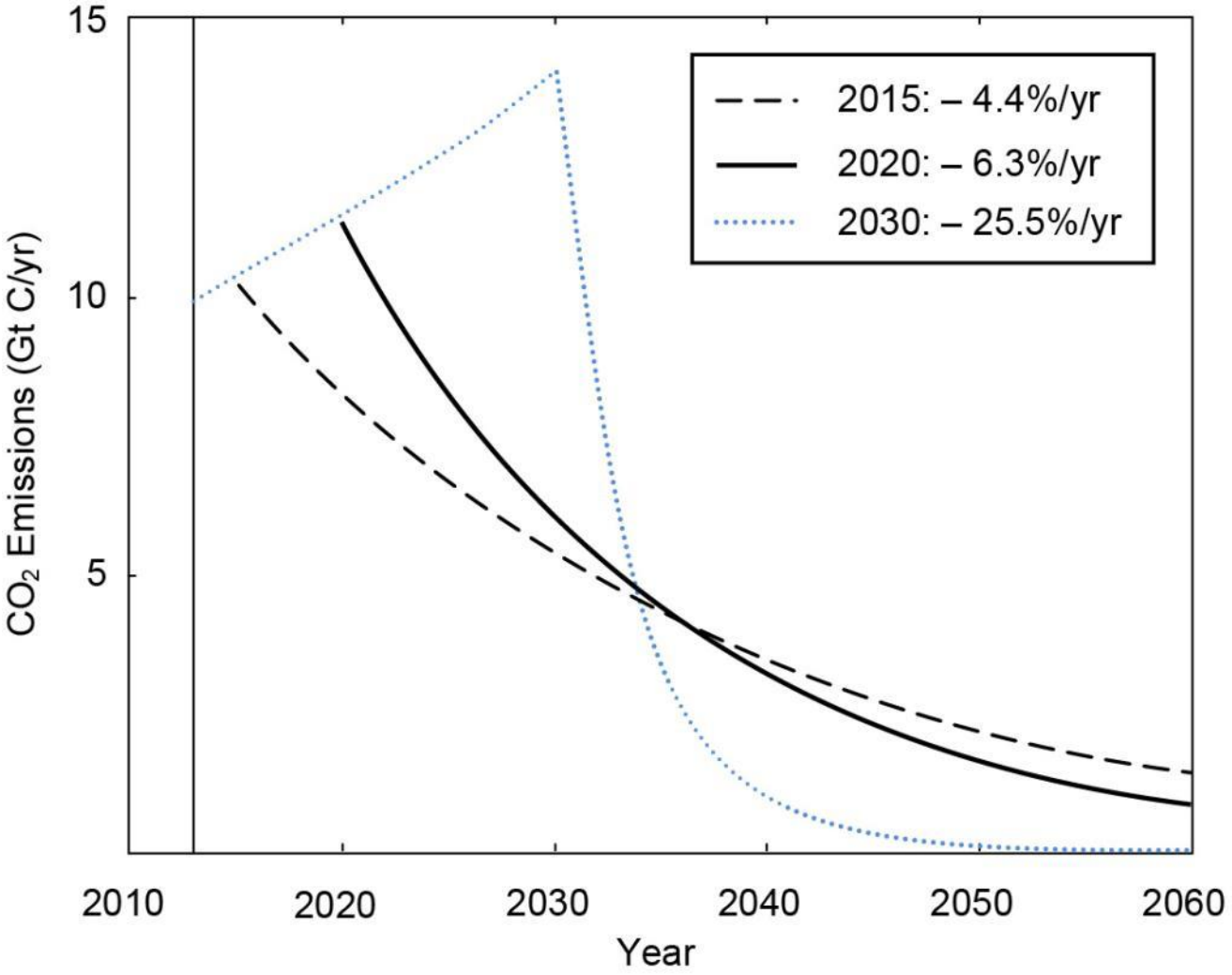
Cumulative carbon budget for a 2^0 target (uncertainty bars show 66% probabilistic estimate)

N.B. UNFCCC Article 2 here (Legally binding engagement to stabilize anthropogenic emissions so that ecosystems survive and development takes place---but no quantitative targets are specified…)

Chap 2, Fig 5 (back)

Time is running out to get started…

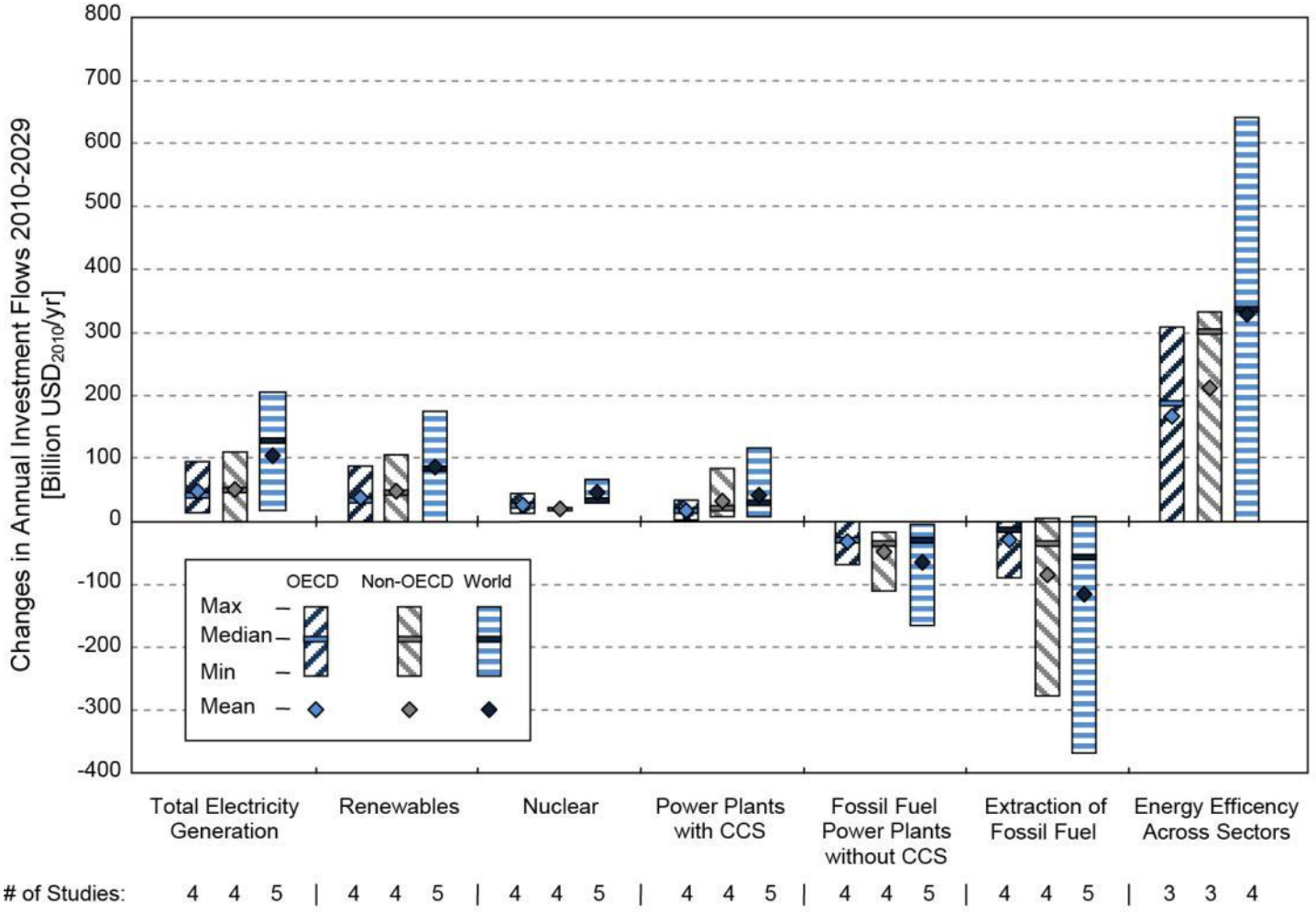
(constant rates of emission reduction starting from current GHG yearly 2% growth)



Chap 2, Fig 6:

(back)

Investment redirections for (<2^{0}C) (average across models)

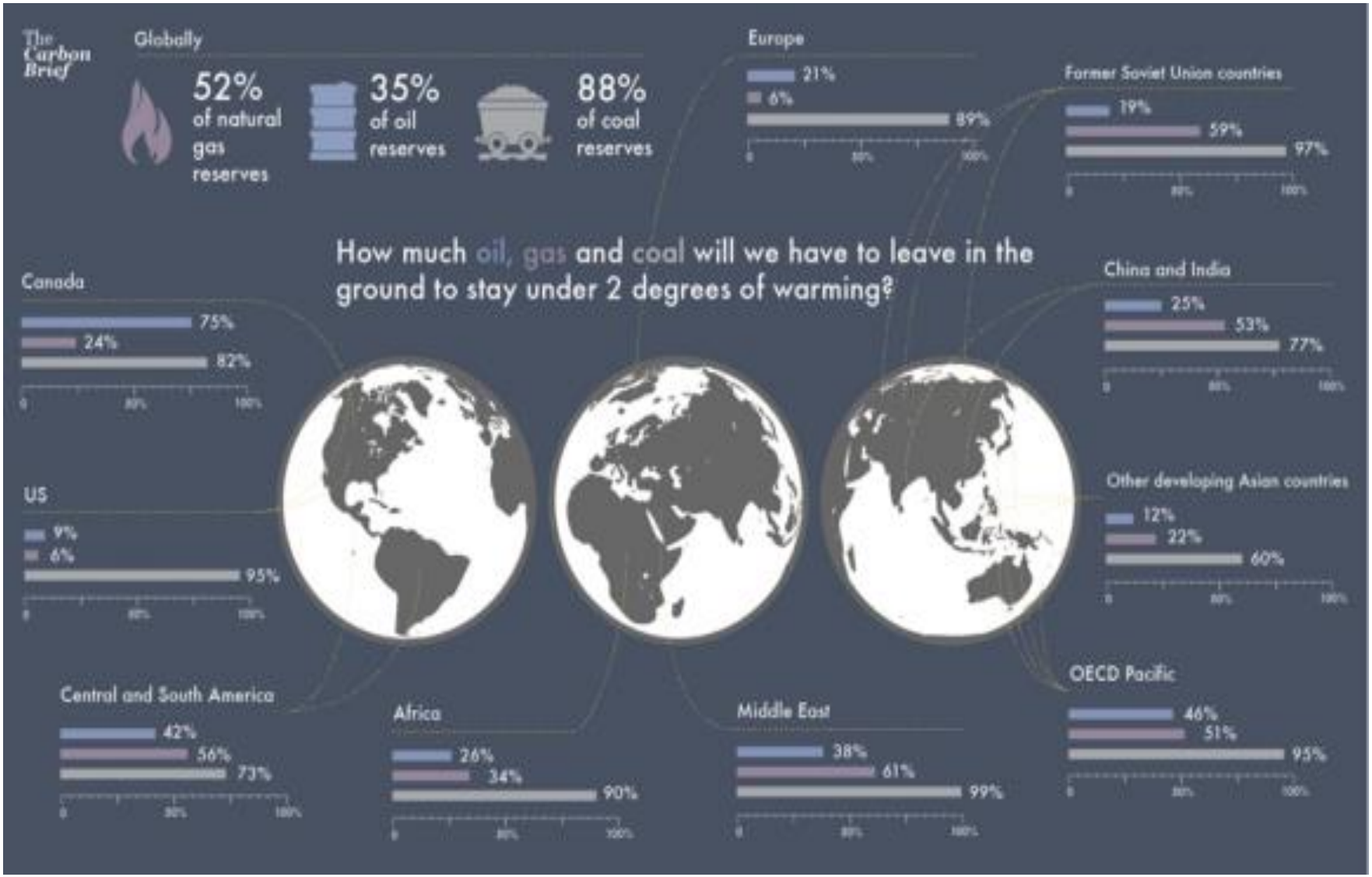


Change in annual energy sector investment flows from BAU to low-carbon energy technologies in mitigation scenarios (2010-2029)(≈ 50% probability)

Chap 3,Fig 4

(back)

Our Stranded Assets: How much to leave in the ground



65% of our carbon budget compatible with +2^0 already burned
60-80% of publicly listed companies' current reserves cannot be burnt wo CCS or CCU. Unburnable assets til 2050 ~ 100 trillion until 2050

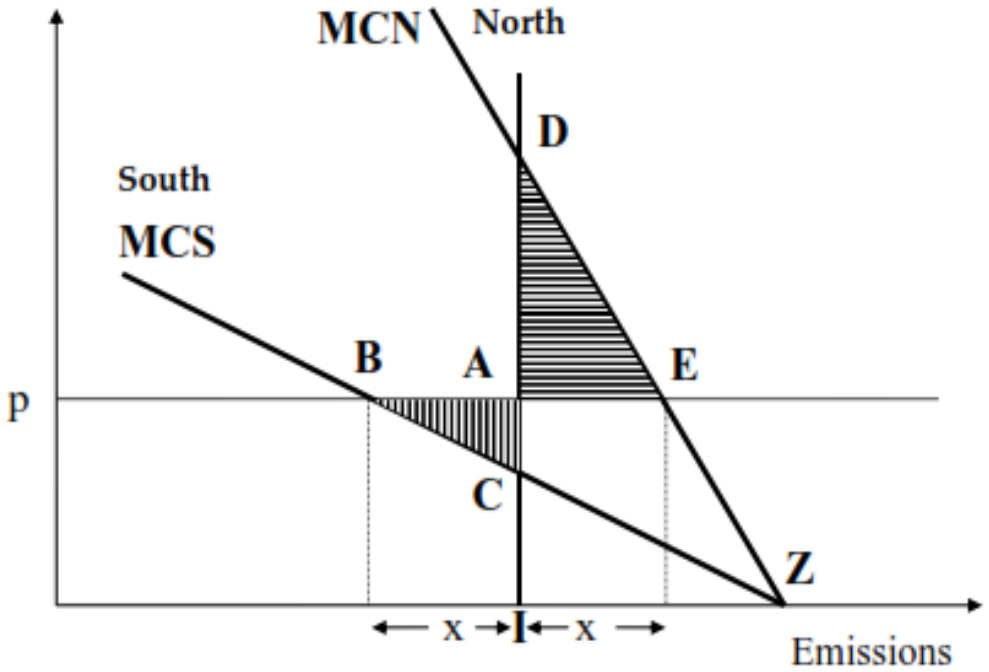
(back)

Metrics for the EU and US INDCs

	US[1]	EU[2]
Announced target	-26 to -28% relative to 2005 in 2025	-40% relative to 1990 in 2030
GHG emissions		
Target in tonnes ($MMTCO_2e$)	5252	3364
Relative to 1990 [%]	-17	-40
Relative to 2005 [%]	-27	-35
Relative to 2025 BAU [%]	-25	-9
Relative to 2030 BAU [%}	-25	-25
GHG/GDP[2]		
2015 $kgCO_2e$/US$(2005)	0.45	0.35
Target 2025	0.28	0.25
Target 2030	0.25	0.20
Δ(GHG/GDP)		
2015-2025 (%/year)	-4.9	-3.4
2015-2030 (%/year)	-4.1	-3.7
Electricity Price 2025	<requires modelling>	<requires modelling>
Gasoline / Diesel Fuel Price 2025	<requires modelling>	<requires modelling>
Natural Gas Price 2025	<requires modelling>	<requires modelling>
Marginal abatement costs [US$/$tCO_2e$]	<requires modelling>	<requires modelling>
Mitigation costs per GDP [%]	<requires modelling>	<requires modelling>

Chp 12, table 2: (back)

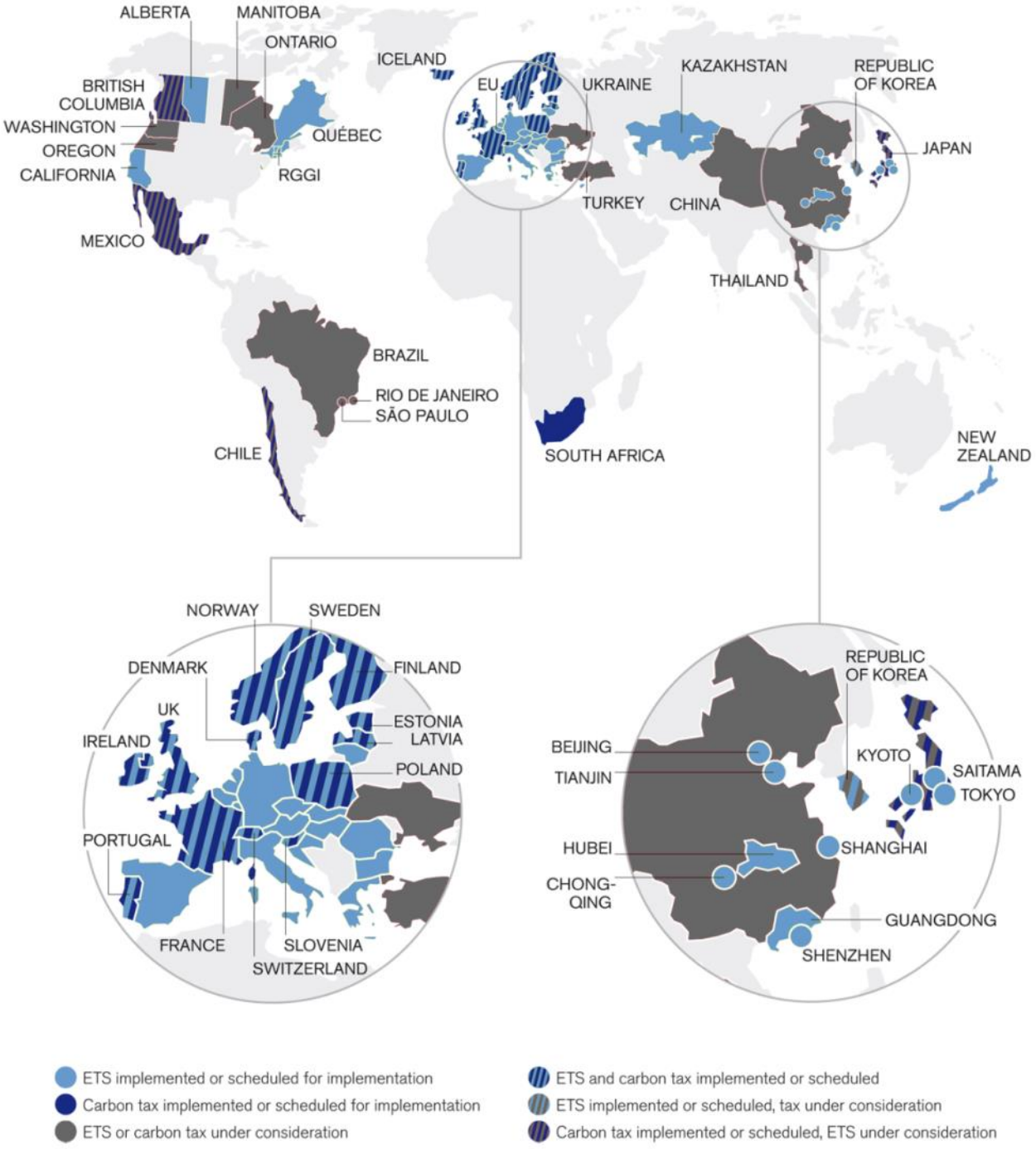
Cap and Trade



Assumes North and South have a cap (total for both is OZ). Allowing trading will lead North to purchase emissions rights from South. Efficiency gains equal to sum of triangles

….and if sum of distributed emission rights exceed OZ, then no abatement (and/or low carbon price as in EU ETS)

(back)



Existing, emerging, and potential regional, national and subnational carbon pricing

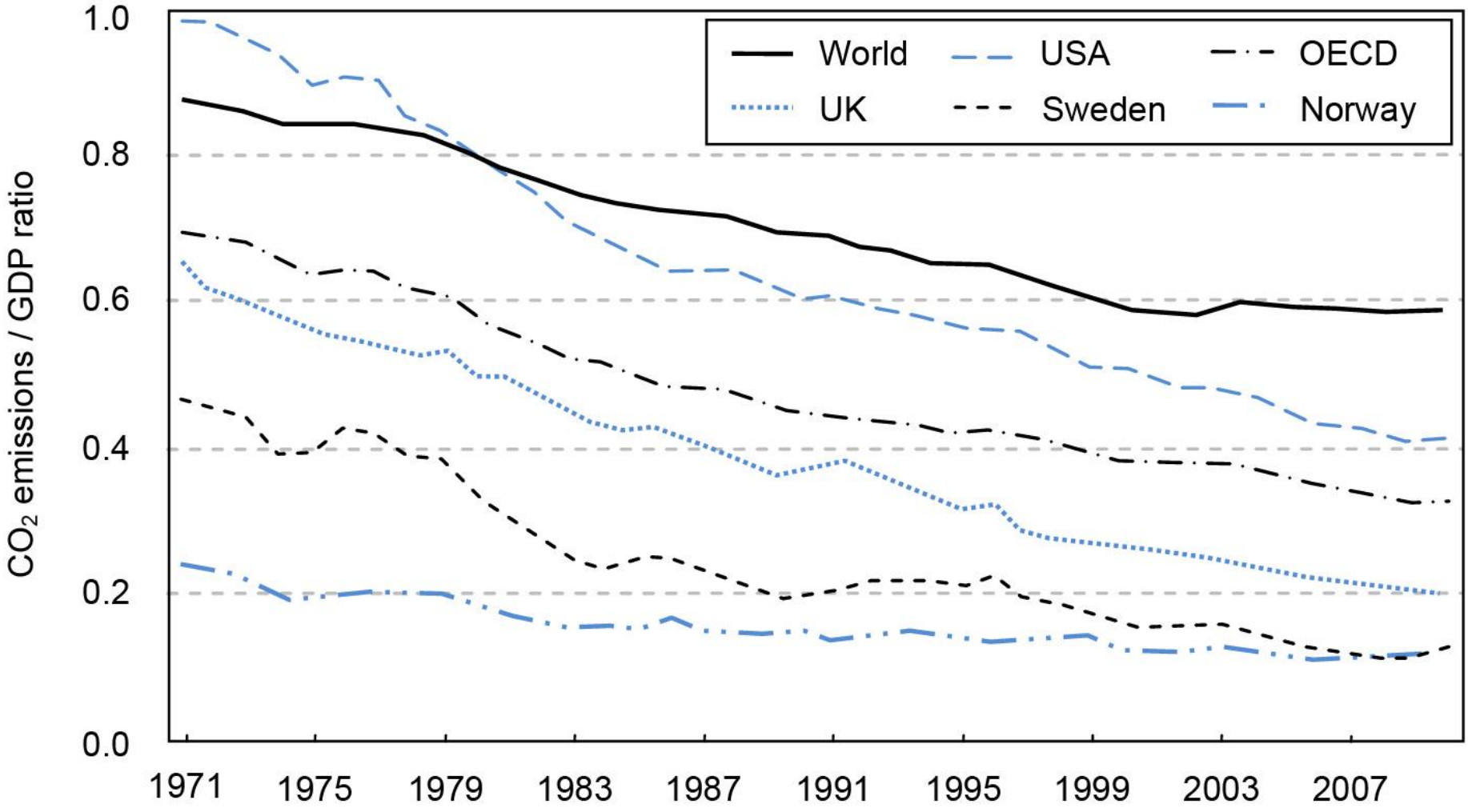
ETS= Emissions Trading system

Average worldwide CO2 price per ton ≈$15
(Sweden ≈$130)

Chap 19, fig 1:

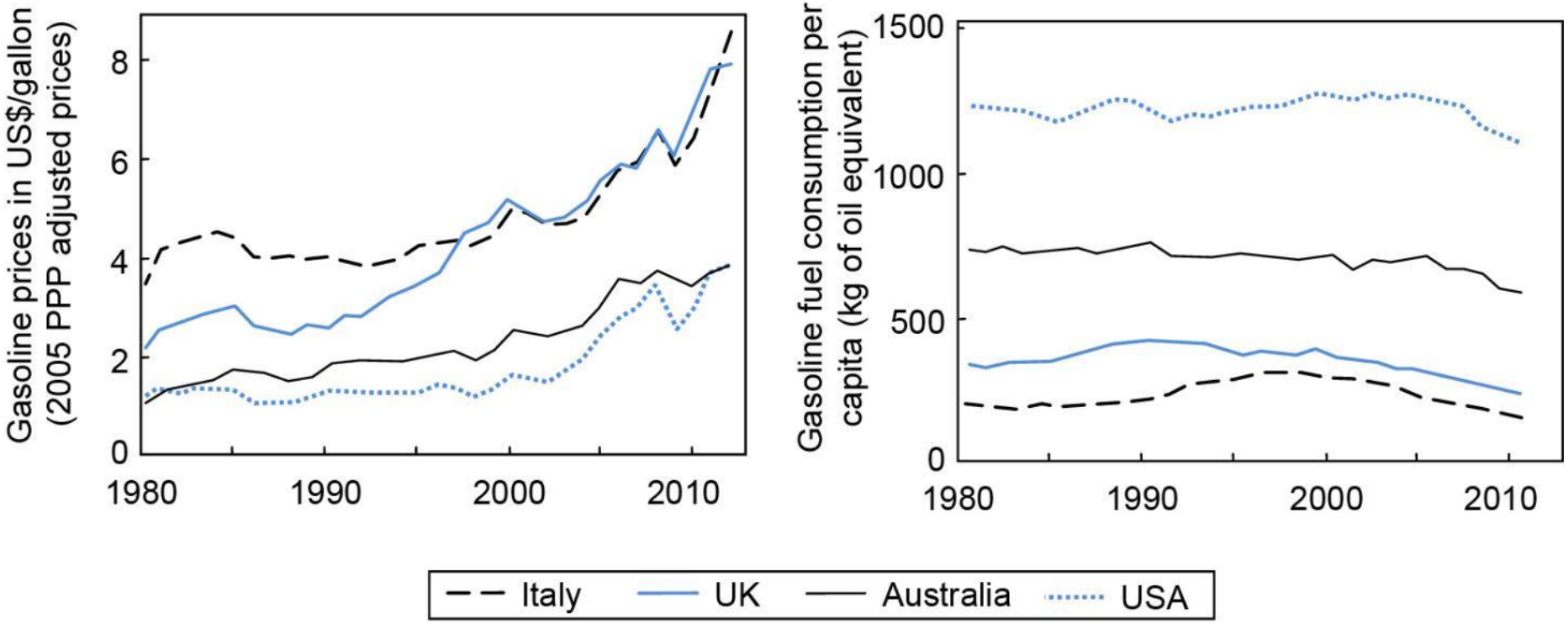
(back)

Decoupling of carbon and economic growth



Chap 18, fig1 (back)

Gasoline prices and gasoline fuel consumption per capita

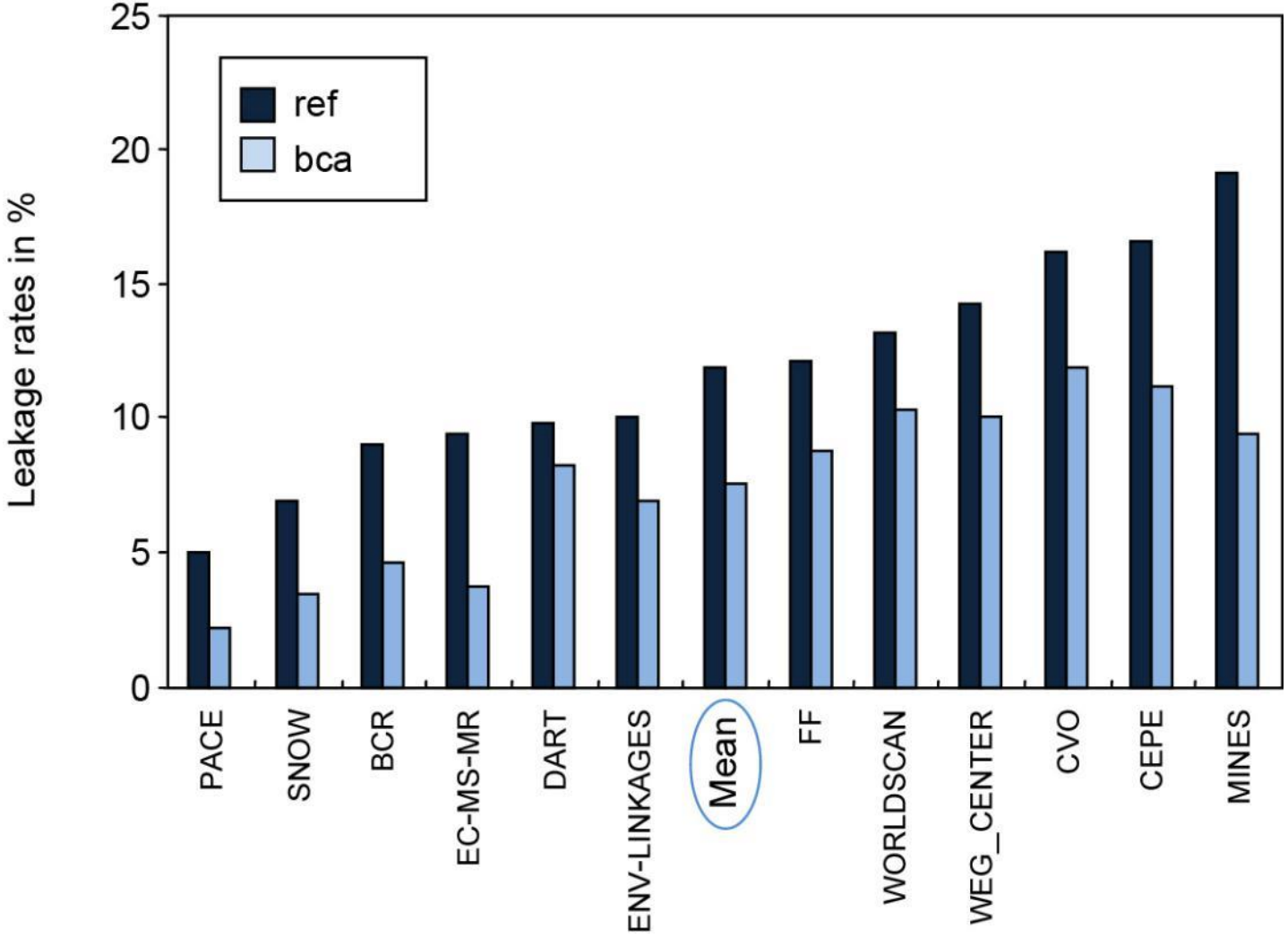


Per capita fuel consumption is lower in countries with higher fuel prices (does not control for country size and urban sprawl)

Chap 18, Fig 2

(back)

Carbon leakage rates (light blue) from OECD coalition to reduce emissions by 20% from BAU



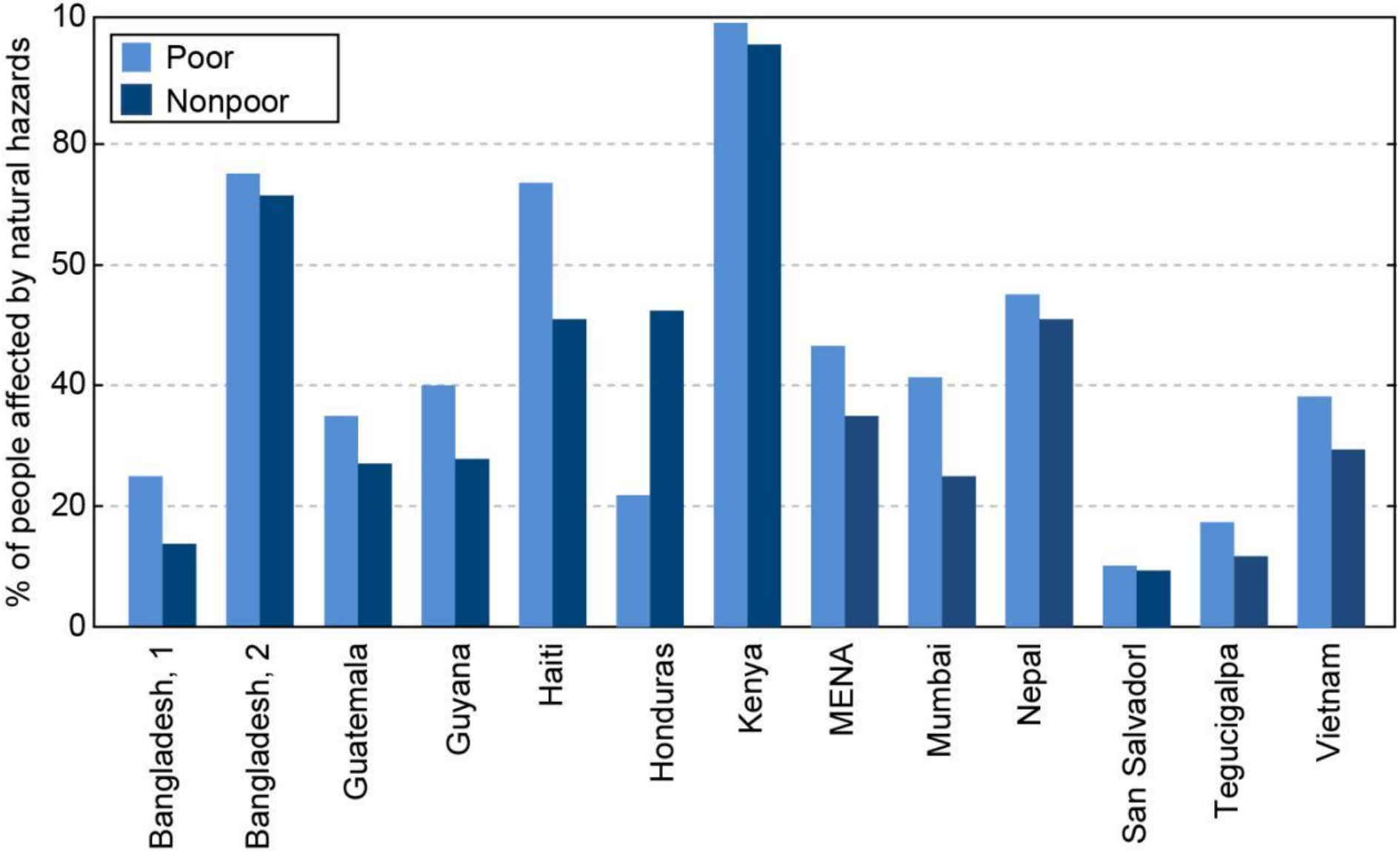
Leakage rate estimates of ≈15%

Border carbon adjustment (bca) for energy-intensive trade-exposed sectors (aluminium, steel, cement,…) cuts leakage rate from emissions pricing in OECD by about half

Chap 21, fig2

(back)

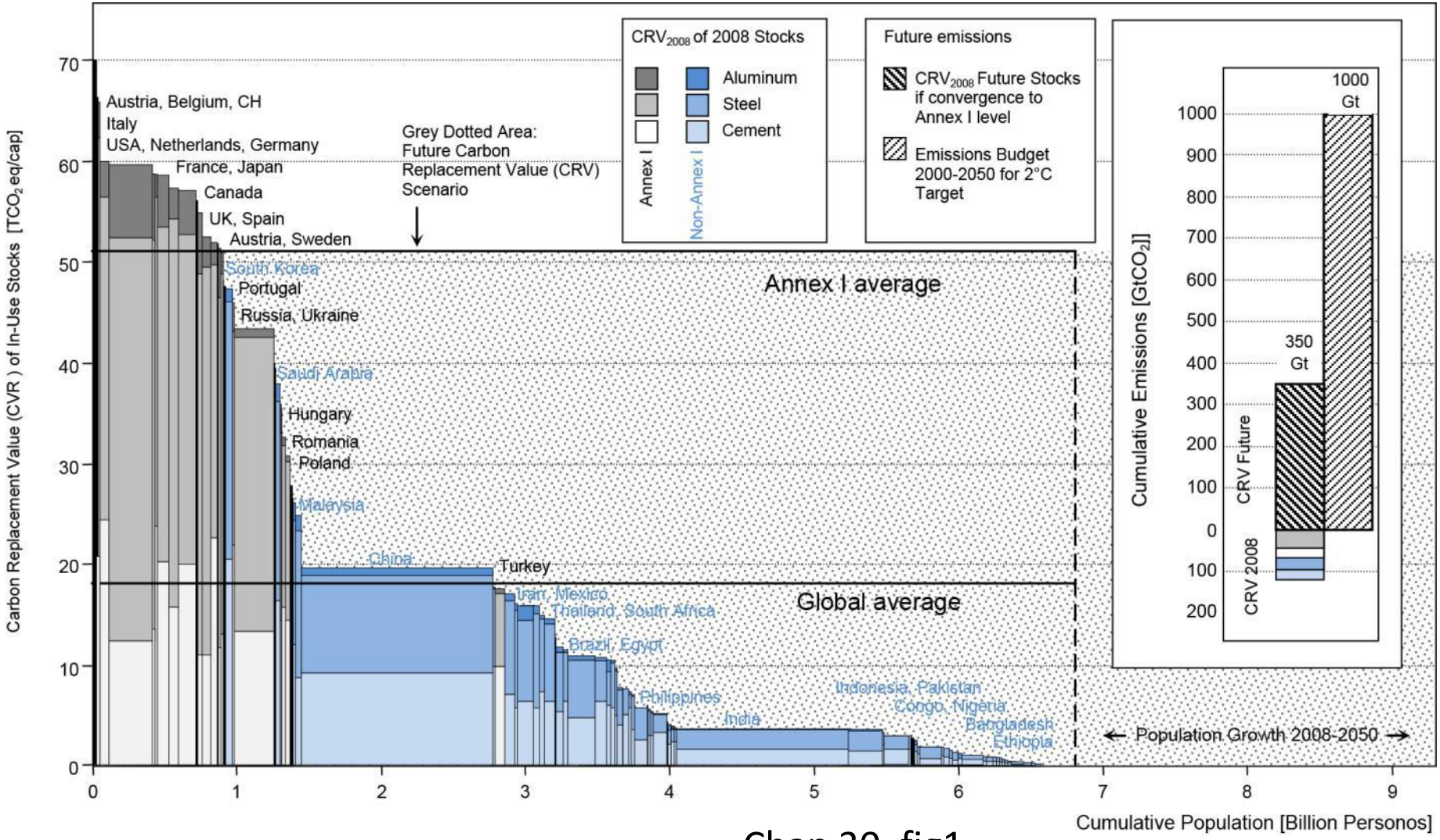
Poor people are more exposed to natural hazards than non-poor (except Honduras)



Chap 26, fig1

(back)

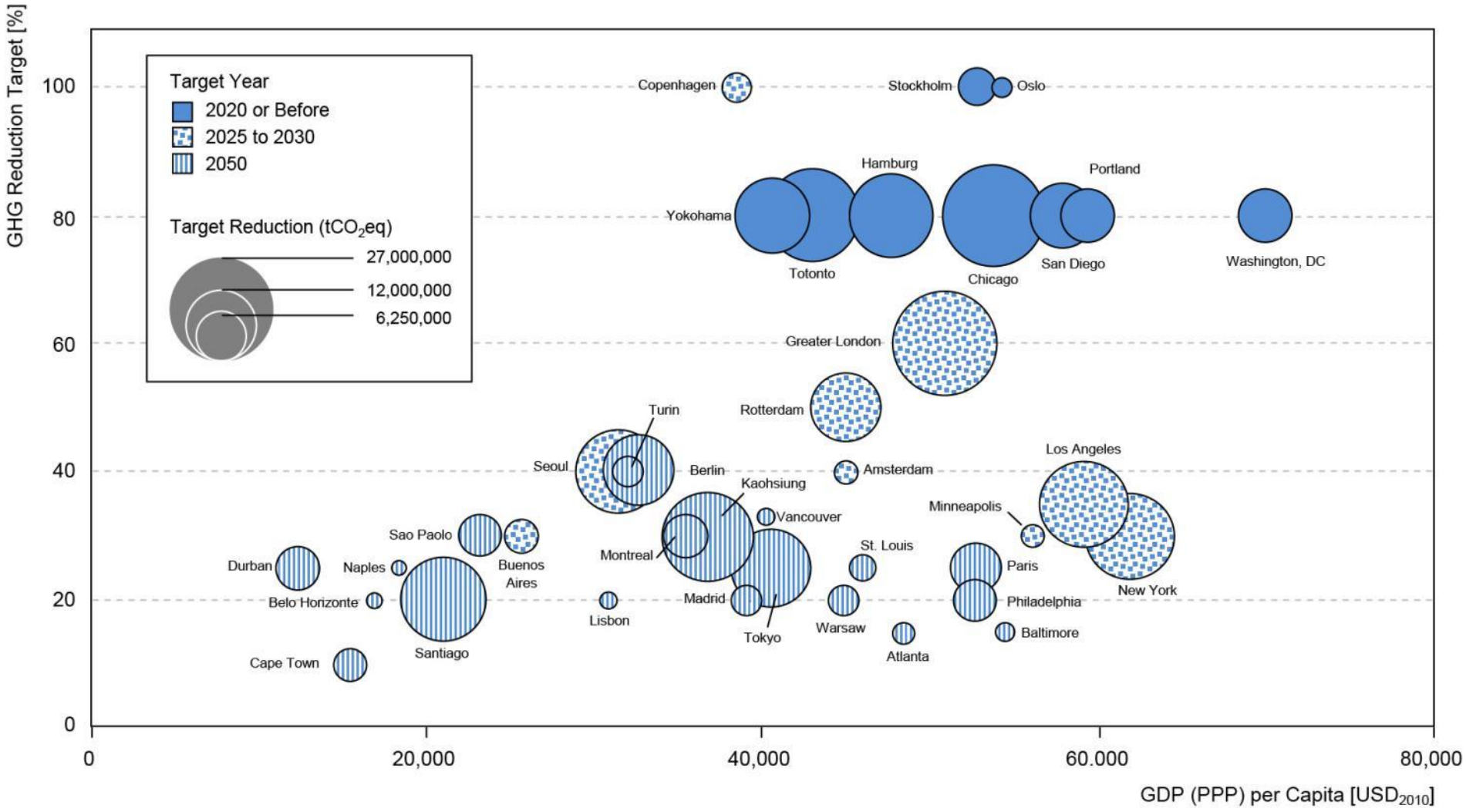
Carbon replacement value (CRV) per capita of existing stocks by country and as yet unbuilt stocks if developing countries converge on the current Annex I level CRV



Chap 30, fig1

(back)

Mitigation targets for 42 cities



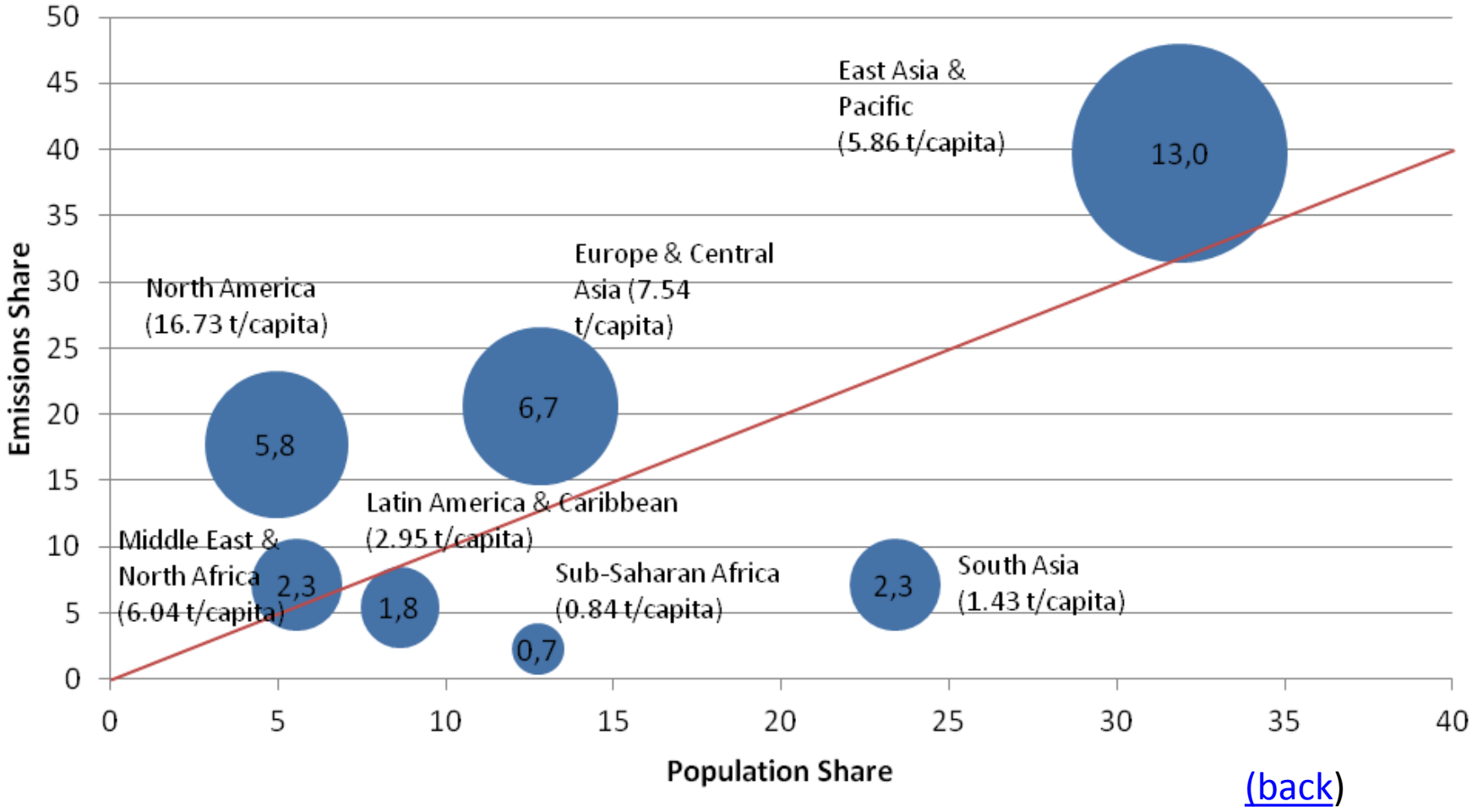
Chap 30, fig 2

(back)

CO2 emissions (fossil fuel combustion + cement)
Gt et t/capita in 2011

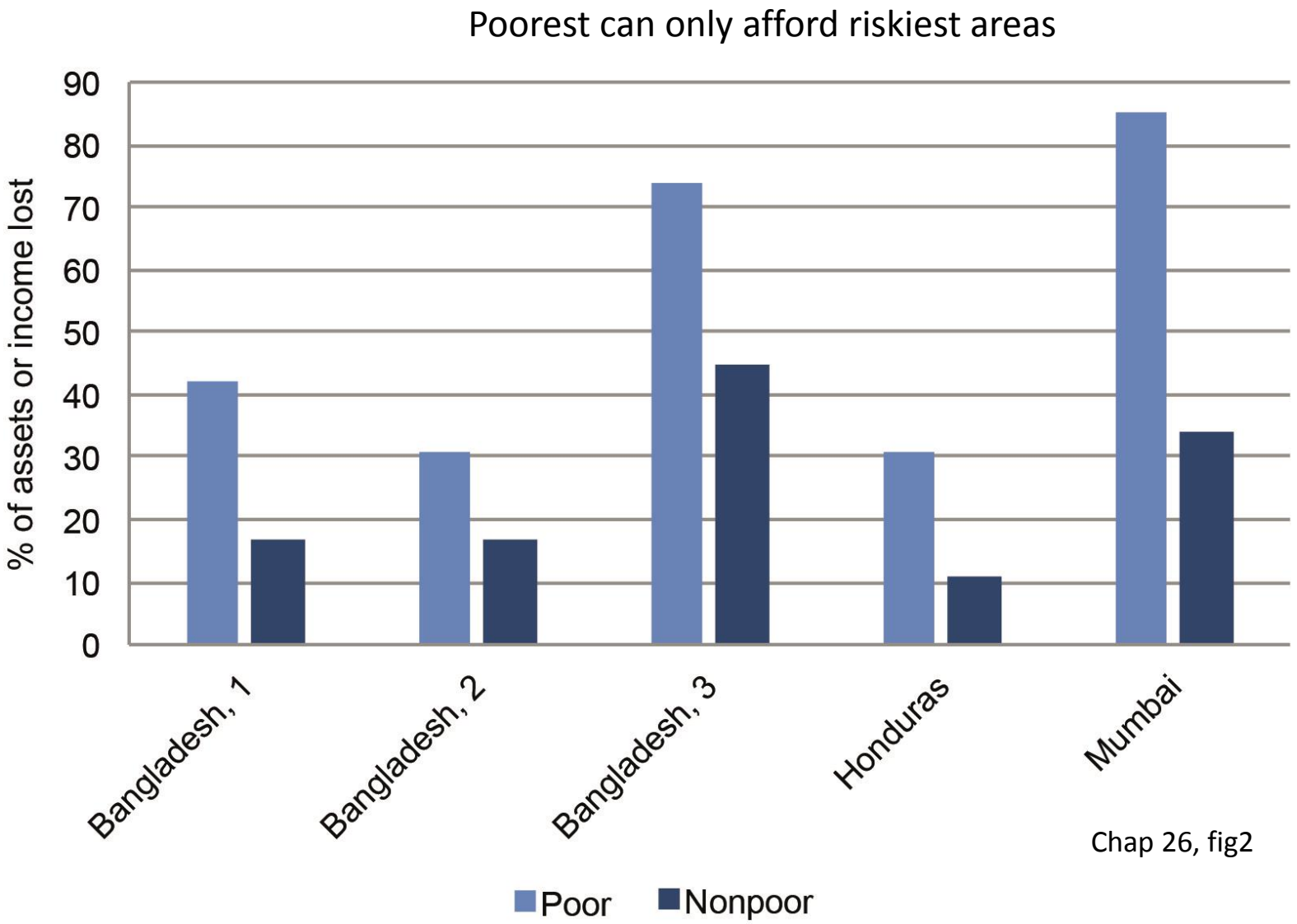
Countries above 45^0 line have an above-average emission. Size of bubble is proportional to total emissions by the country/region

⇨ SSA: small absolute contribution and per capita(=little leverage for SSA and SA)



(back)

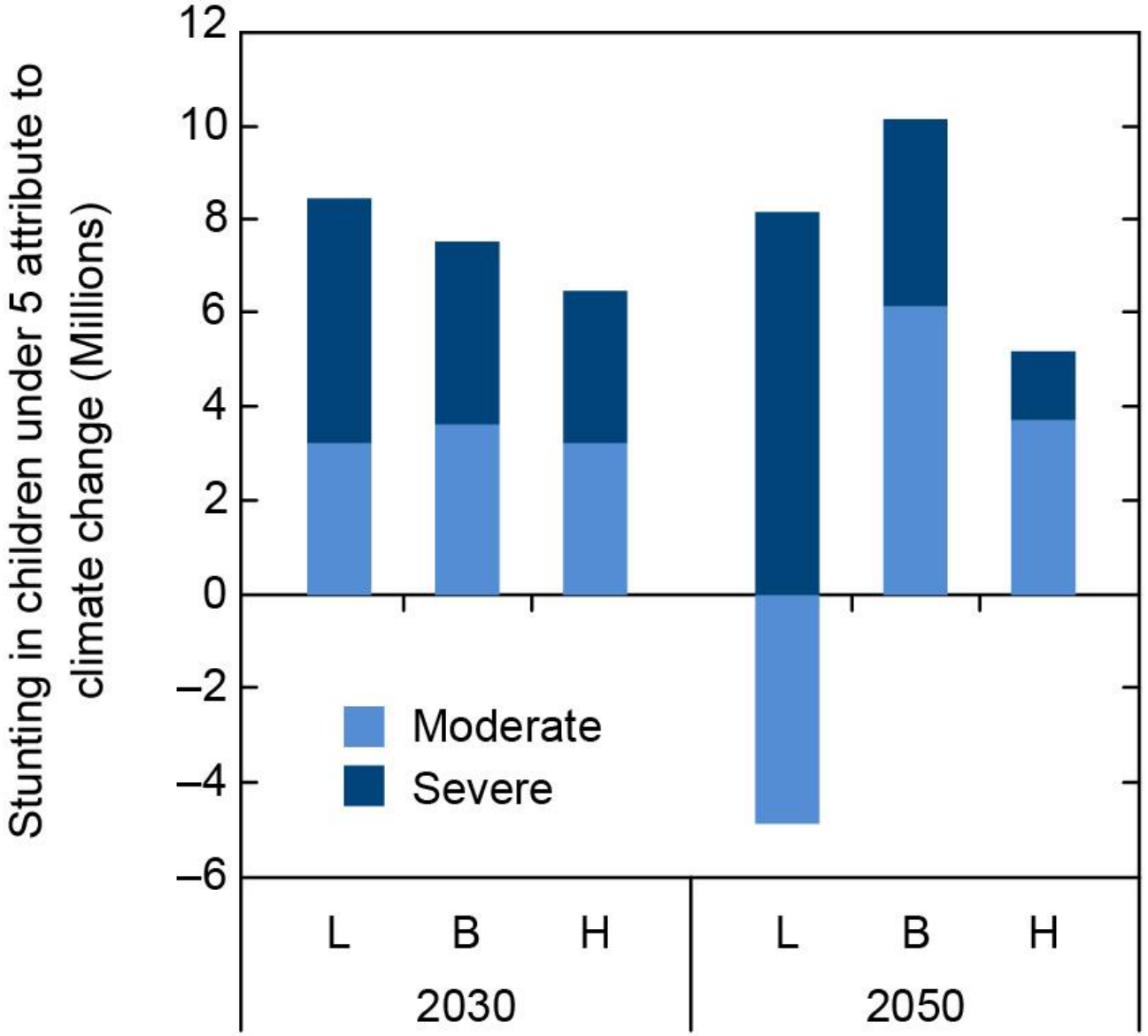
Poor people lose a larger percentage of assets or income after floods and storms



Chap 26, fig2

(back)

Additional Stunting for under 5 children due to climate change



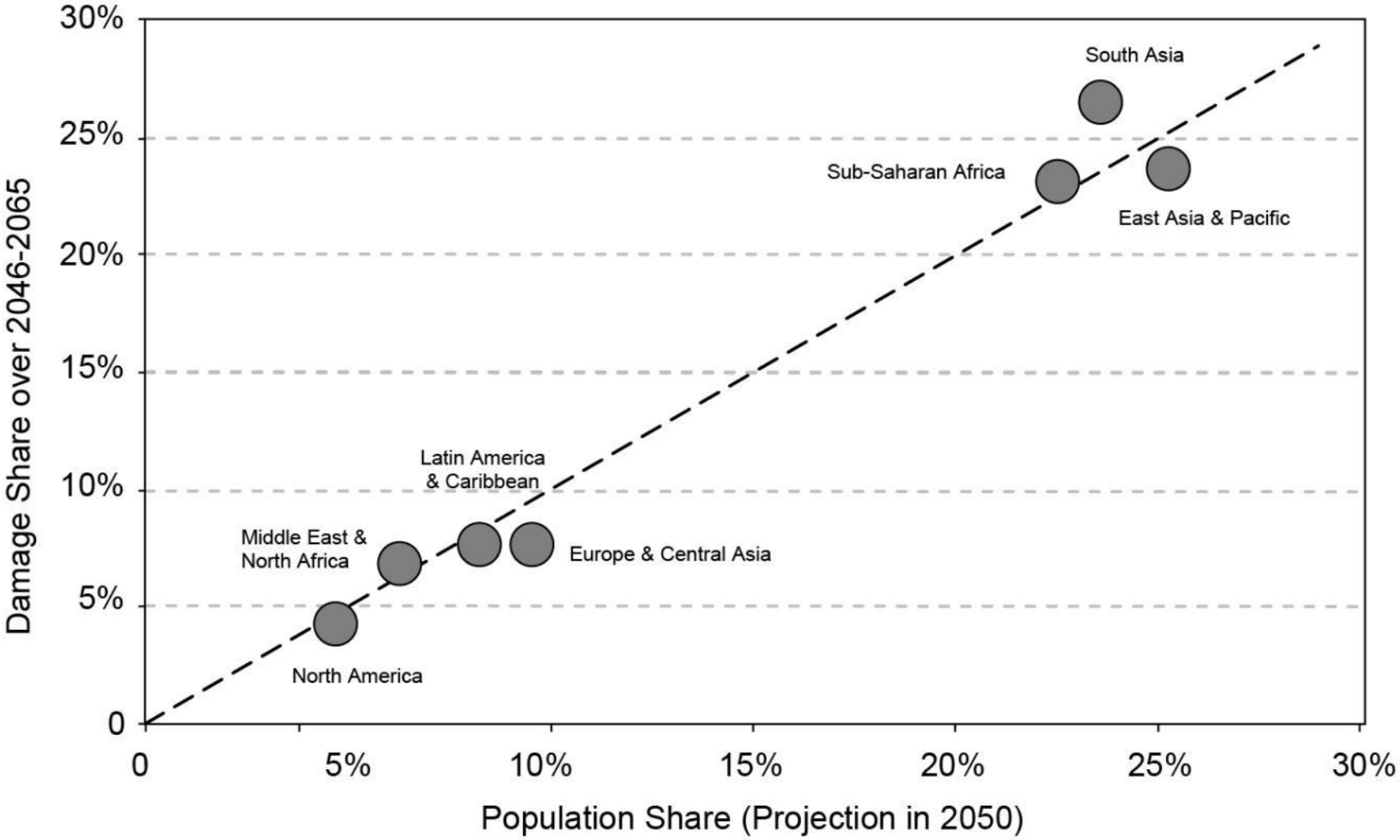
socioeconomic scenarios

L=low growth
B=base care
H= high growth

Chap 26, fig4

(back)

Potential damage share and population projections in 2050 by region



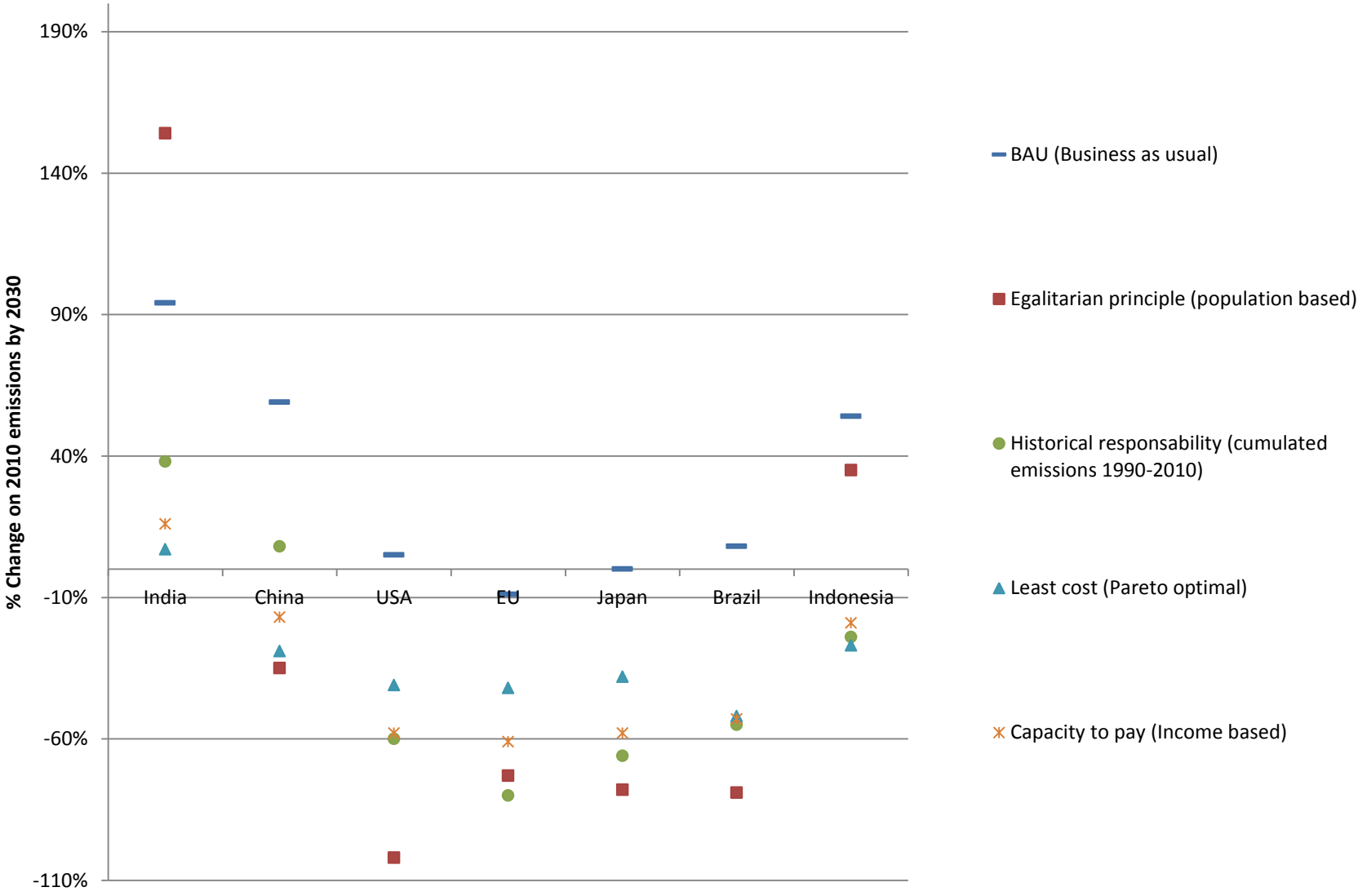
SSA and South Asia would be the hardest hit by projected temperature increases

Chap5, fig2 (back)

Alternative burden sharing formulae

(back)

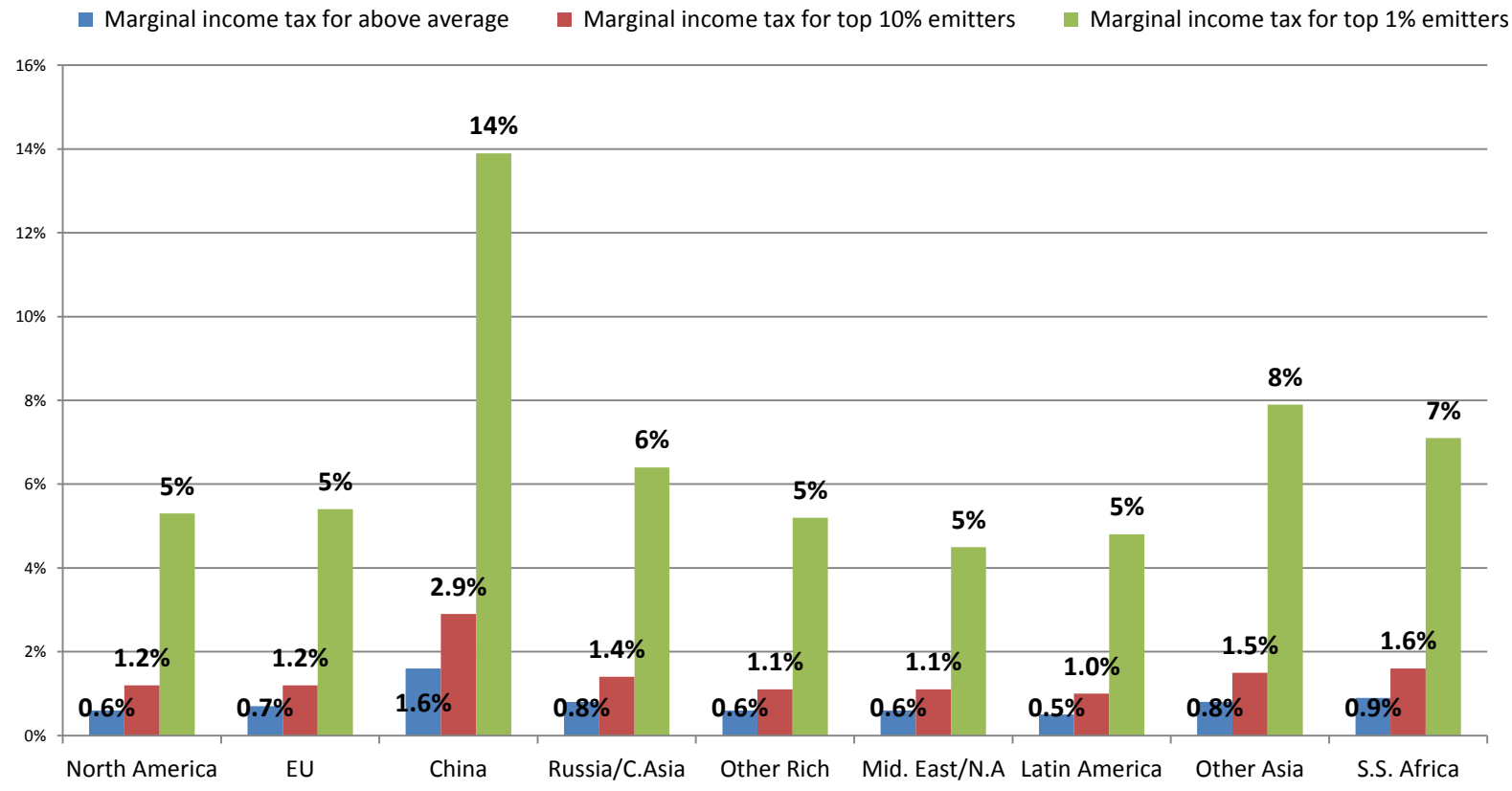
Simulations of allocation of CO2 reductions by 2030 relative to 2010



Financing Adapation: Raising a tax

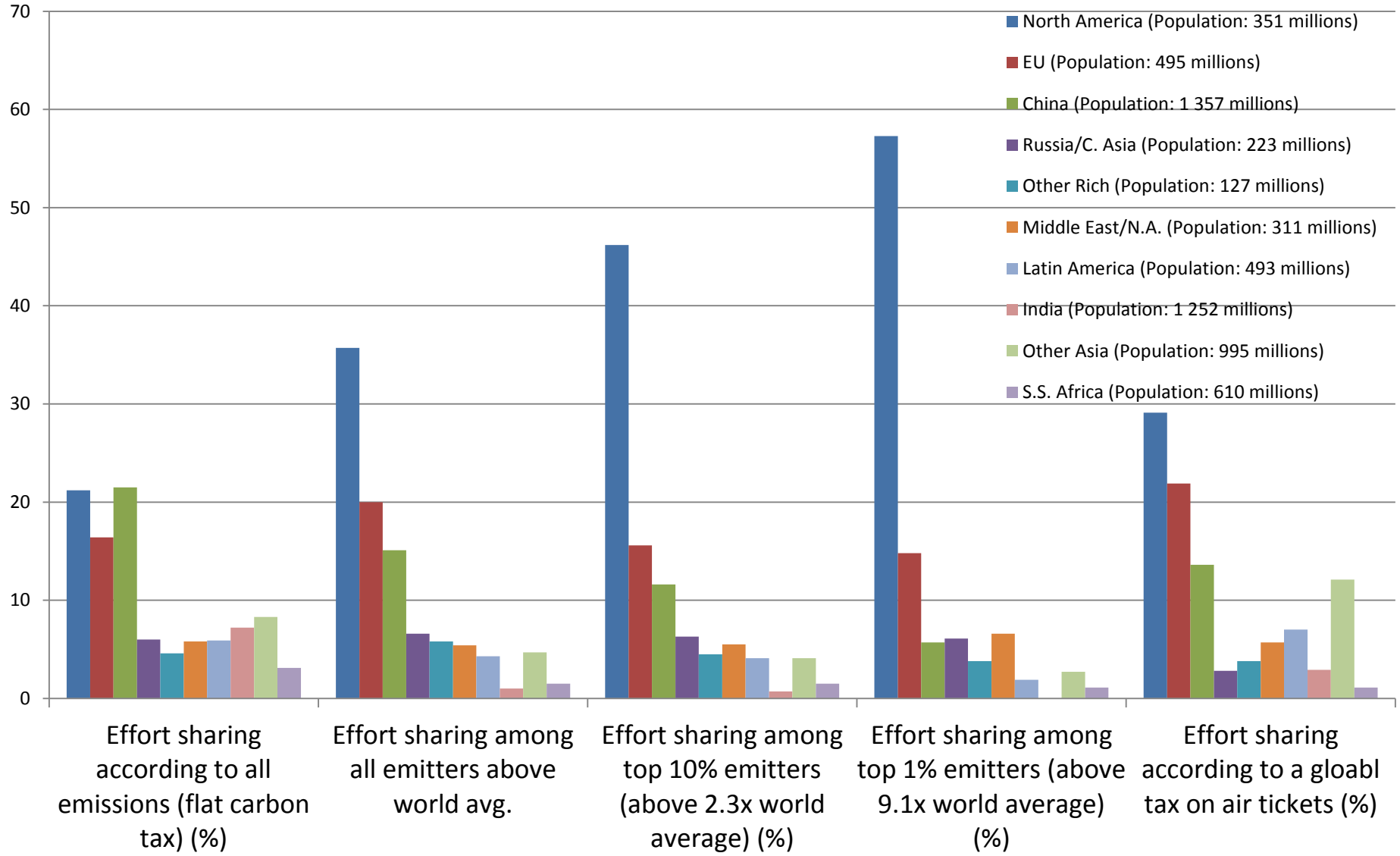
(0.2% world GDP ≈$ 150 billion annually (3X annual amounts in green fund)

Marginal income tax for those that are taxed (3 alternatives: all above average-emitters; to 10% emitters; top 1% emitters)



Source: « Carbon and Inequality: from Kyoto to Paris » Chancel and Piketty (here)

Fiscal Burden sharing by region

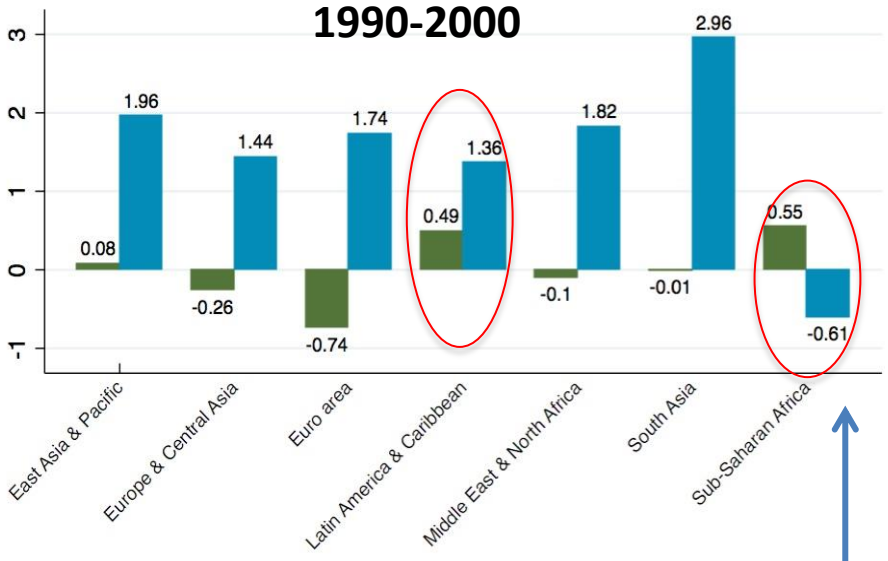


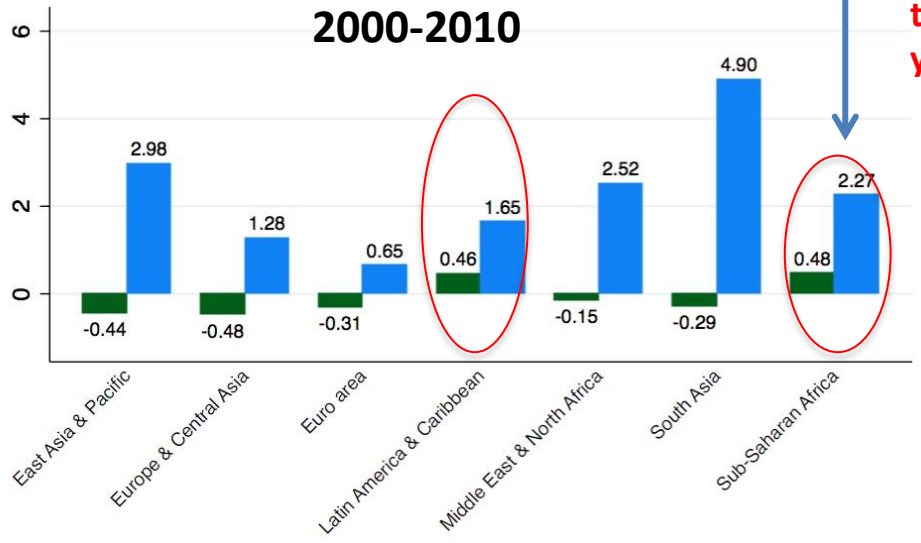
Source: « Carbon and Inequality: from Kyoto to Paris » Chancel and Piketty

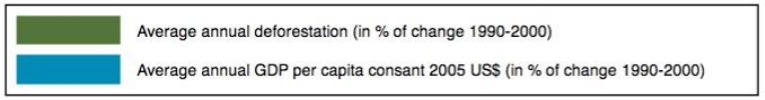
(back)

Regional Forest depletion and GDP growth

(Decadal growth rates)



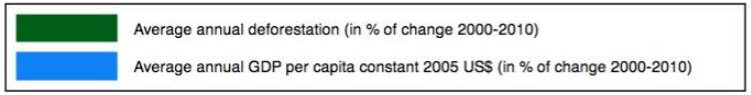




SDG goal 15: **halve deforestation in 2020** and **end iit by 2030**.

Forests countries **emitted 5.4 gigatons** a year from 2008 to 2012 **larger than the emissions from the entire European Union in 2011**.

⇨ With carbon price set at $5 per ton of CO_2 (price of the Amazon Fund, Guyana-Norway agreement), for less than $2 billion a year, global CO2 emissions could be cut **by more than the amount emitted by the United Kingdom each year** when reducing deforestation….



Source: Author's calculation
Deforestation from FAO, Global Forest Resources Assessment
GDP per capita (constant 2005 US$) from World Bank.
Carbon calculation from Jens Engelmann (CGDEV)

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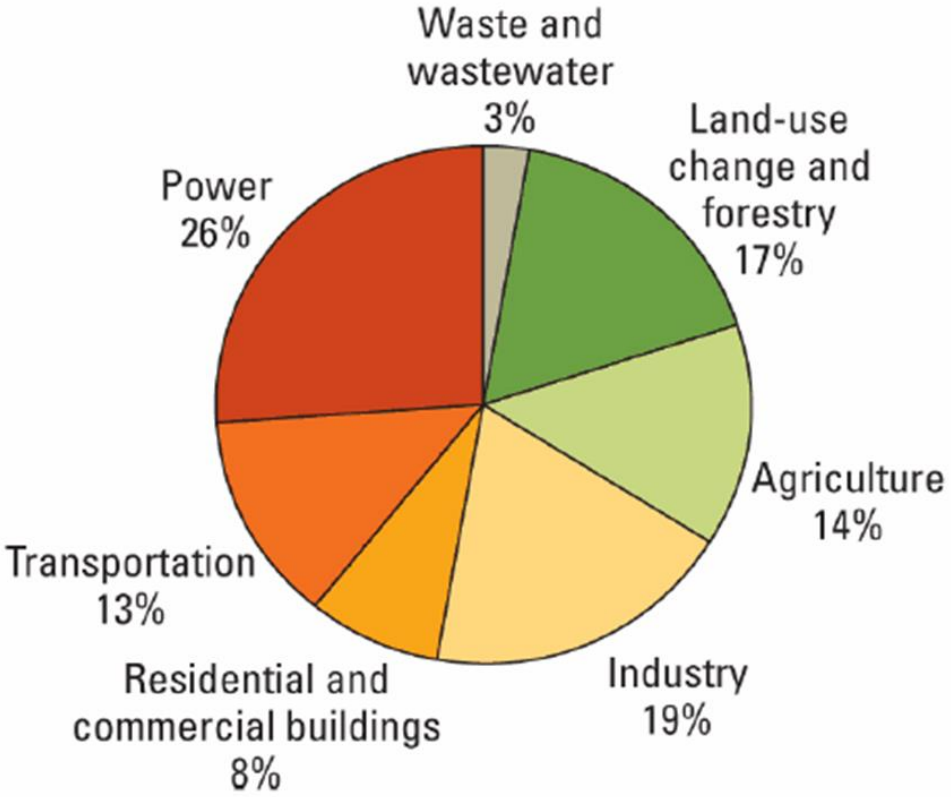
Annex

Major Sources of GHG Emissions

Figure 3: Major Sources of GHG Emissions



Source: IPCC 2007a, figure 2.1.

Note: Share of anthropogenic (human-caused) greenhouse gas emissions in 2004 in CO_2e. Greenhouse gas emissions include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and high-global-warming-potential gases (F-gases). All are expressed in terms of CO_2 equivalent (CO_2e)—the quantity of CO_2 that would cause the same amount of warming. Emissions associated with land use and land-use change, such as agricultural fertilizers, livestock, deforestation, and burning, account for about 30 percent of total greenhouse gas emissions. And uptakes of carbon into forests and other vegetation and soils constitute an important carbon sink, so improved land-use management is essential in efforts to reduce greenhouse gases in the atmosphere.

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