The Climate Change Challenge and Place of Asia and the Pacific

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Pilot Sustainable Asia Leadership Program
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ADB

Presentation Outline

- Climate change as the preeminent sustainability challenge
- Human-induced climate change: factual observations
- What science tells us to expect
- Asia's special position
- Challenges and actions needed

2011 Significant Climate Anomalies and Events

Preeminence of Addressing Climate Change in Measures to Enhance Sustainability

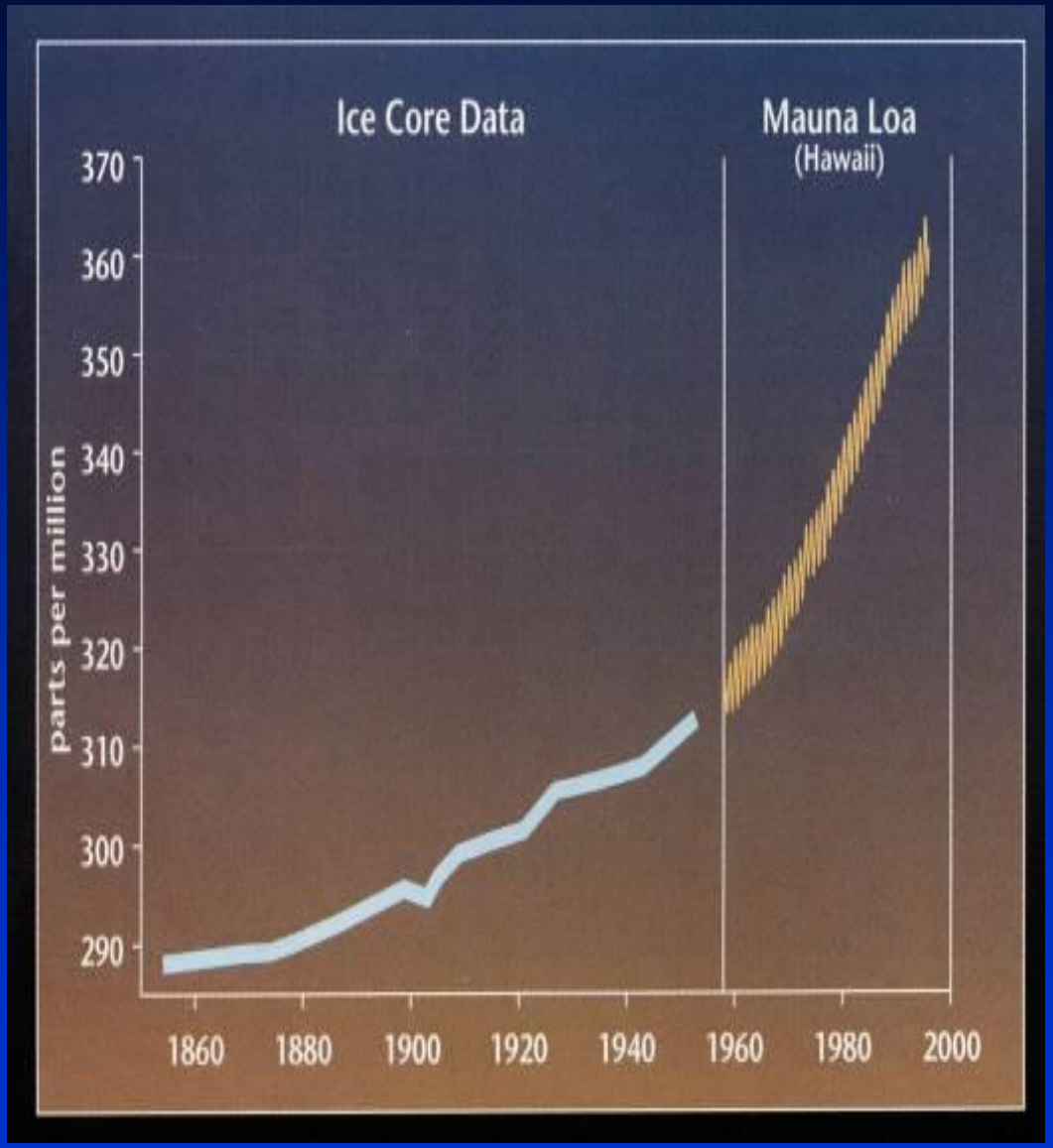
Promoting transitions to environmentally sustainable infrastructure

Improving natural resources management and maintaining ecosystem integrity

Enhancing environmental governance and management capacities

Impacts of Climate Change Will Dominate All

Fact: Atmospheric Concentration of CO_2



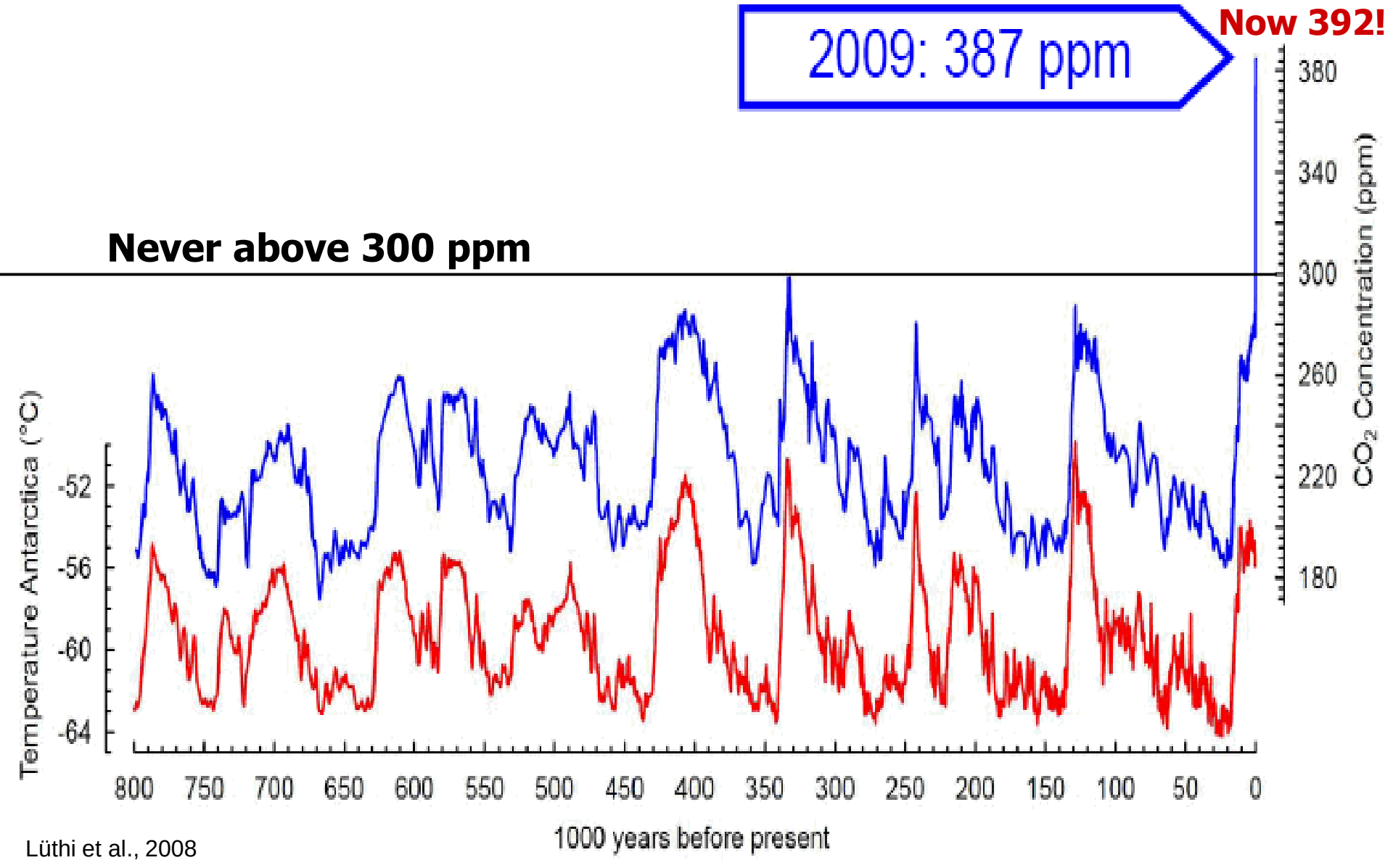
CO2 concentrations up by about 31% since 1750
75% due to fossil fuel burning, rest to land use change, primarily deforestation

Other GHGs on the rise too:

CH4 up by 151% since 1750, 50% from human activity (fossil fuel production, animal husbandry, rice, landfills)

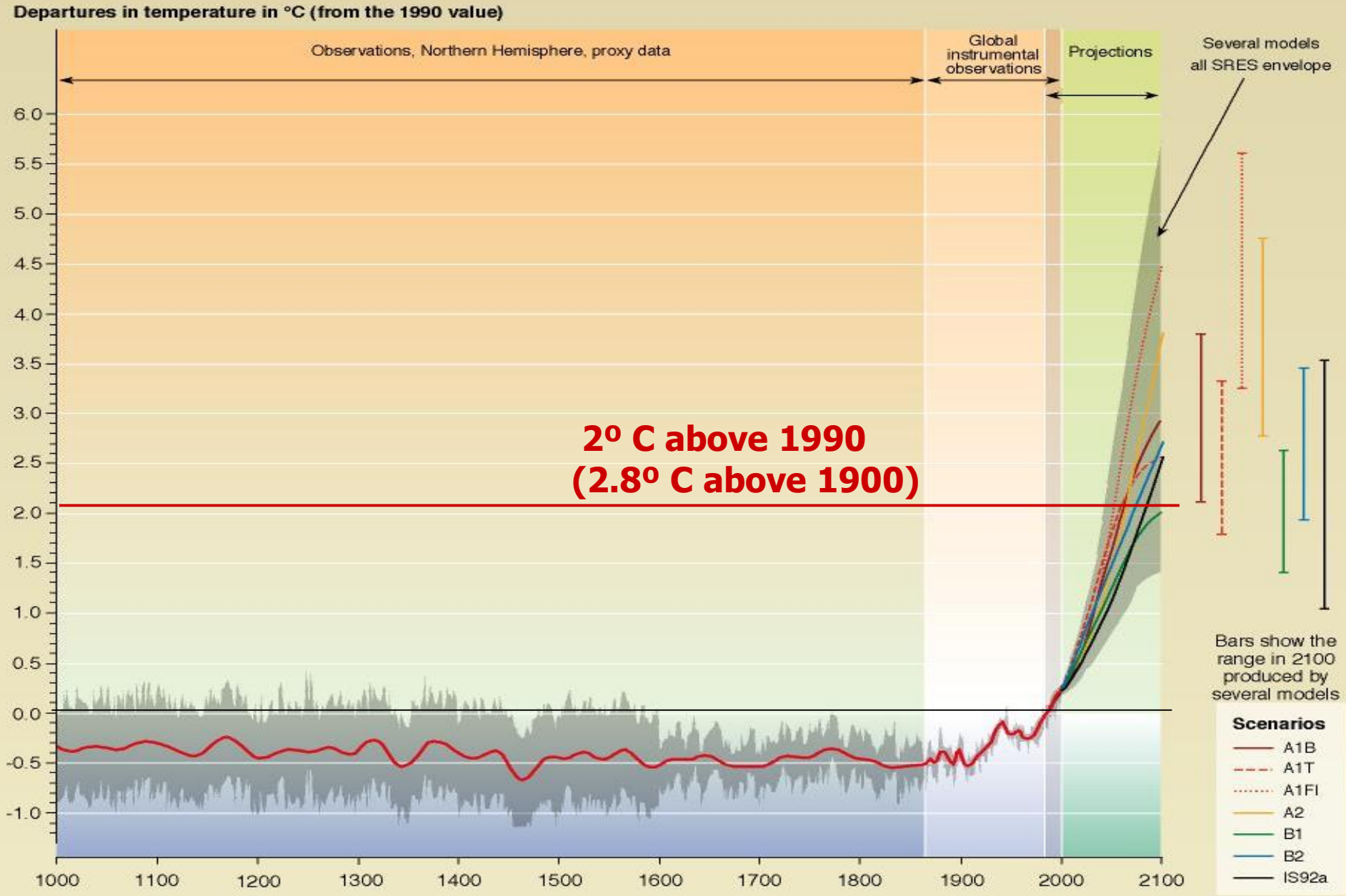
N2O up by 17% since 1750, 33% due to human activity (agriculture, industry)

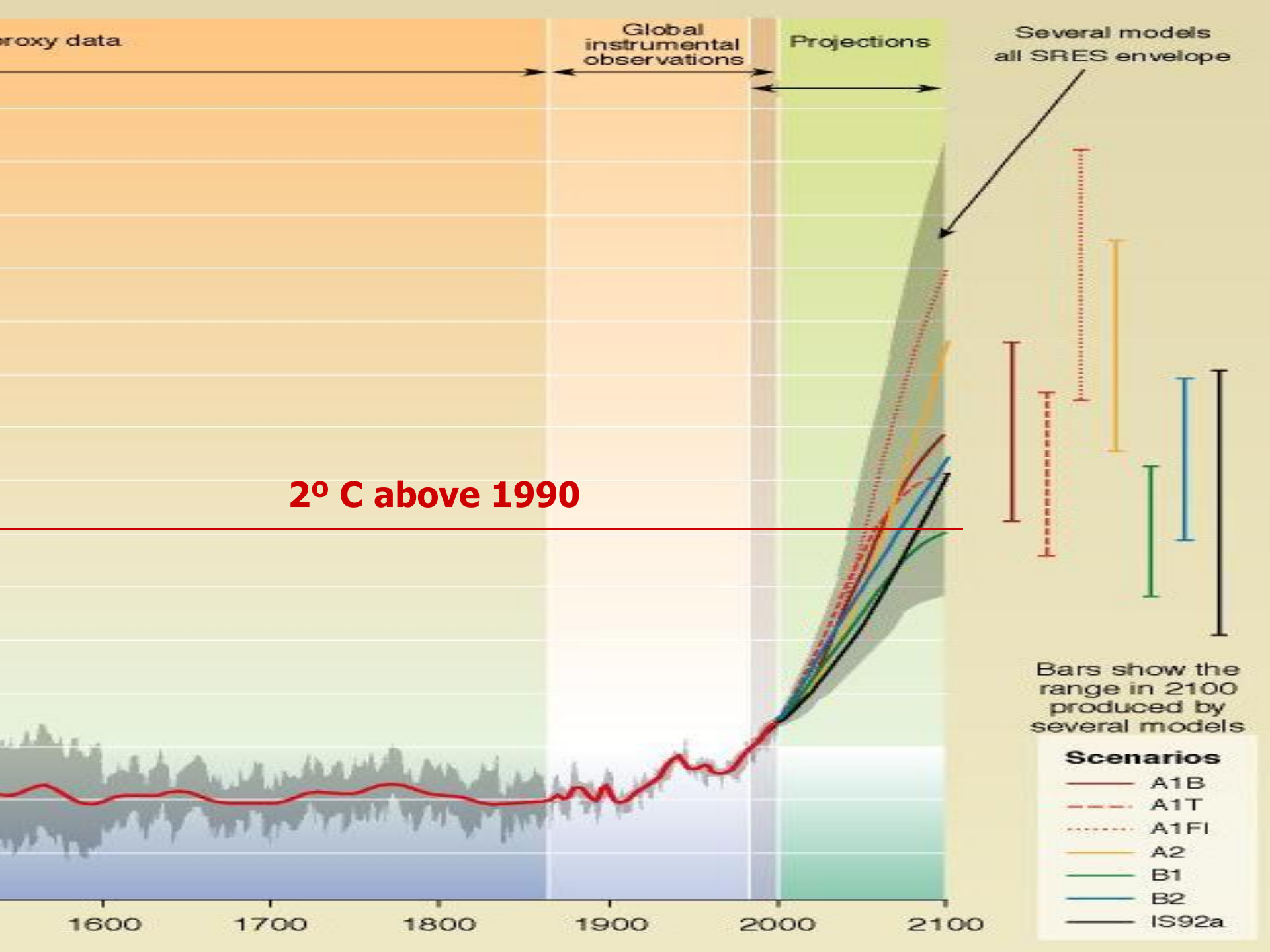
Fact: Strong correlation between CO_2 and temperature for past 800,000 years



Lüthi et al., 2008

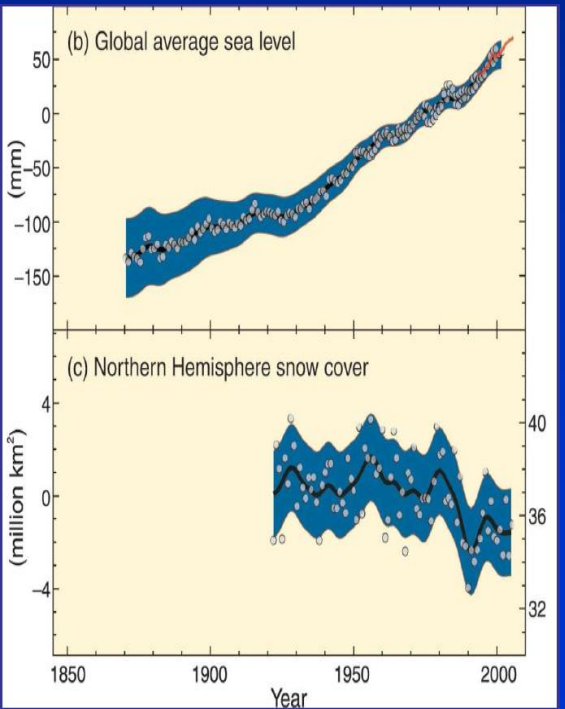
Variations of the Earth's surface temperature: 1000 to 2100




roxy data
Global instrumental observations
Projections
Several models all SRES envelope
2º C above 1990
Bars show the range in 2100 produced by several models
Scenarios
A1B
A1T
A1FI
A2
B1
B2
IS92a
1600
1700
1800
1900
2000
2100

IPCC 4th Assessment Report, 2007 (AR4)

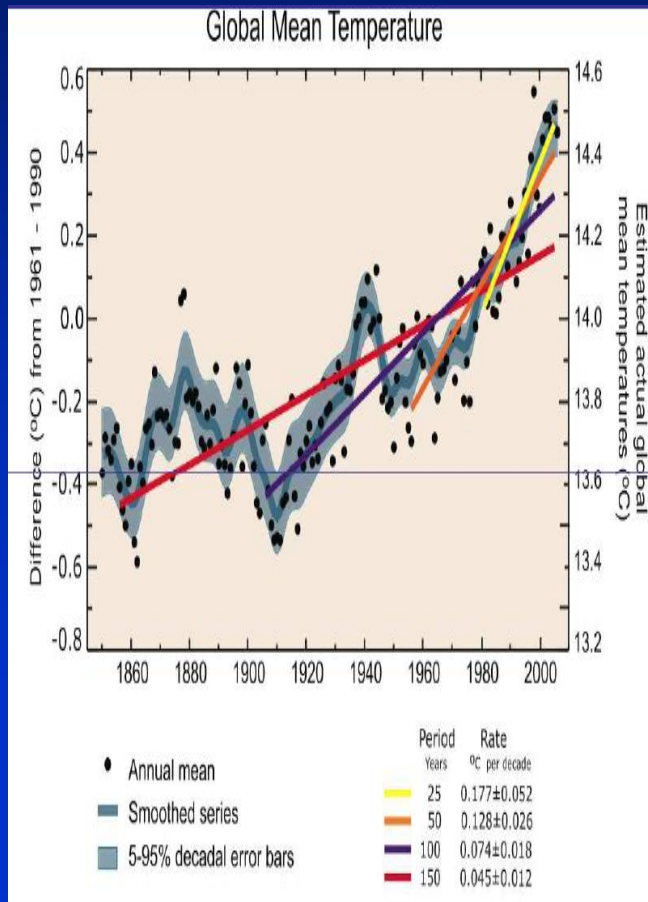
- *Warming of the climate system is unequivocal*
- *>90% sure that most warming since 1950s due to increase in GHG emissions from human activities*



Since pre-industrial times (1850-99) global surface temperature has increased about 0.8ºC

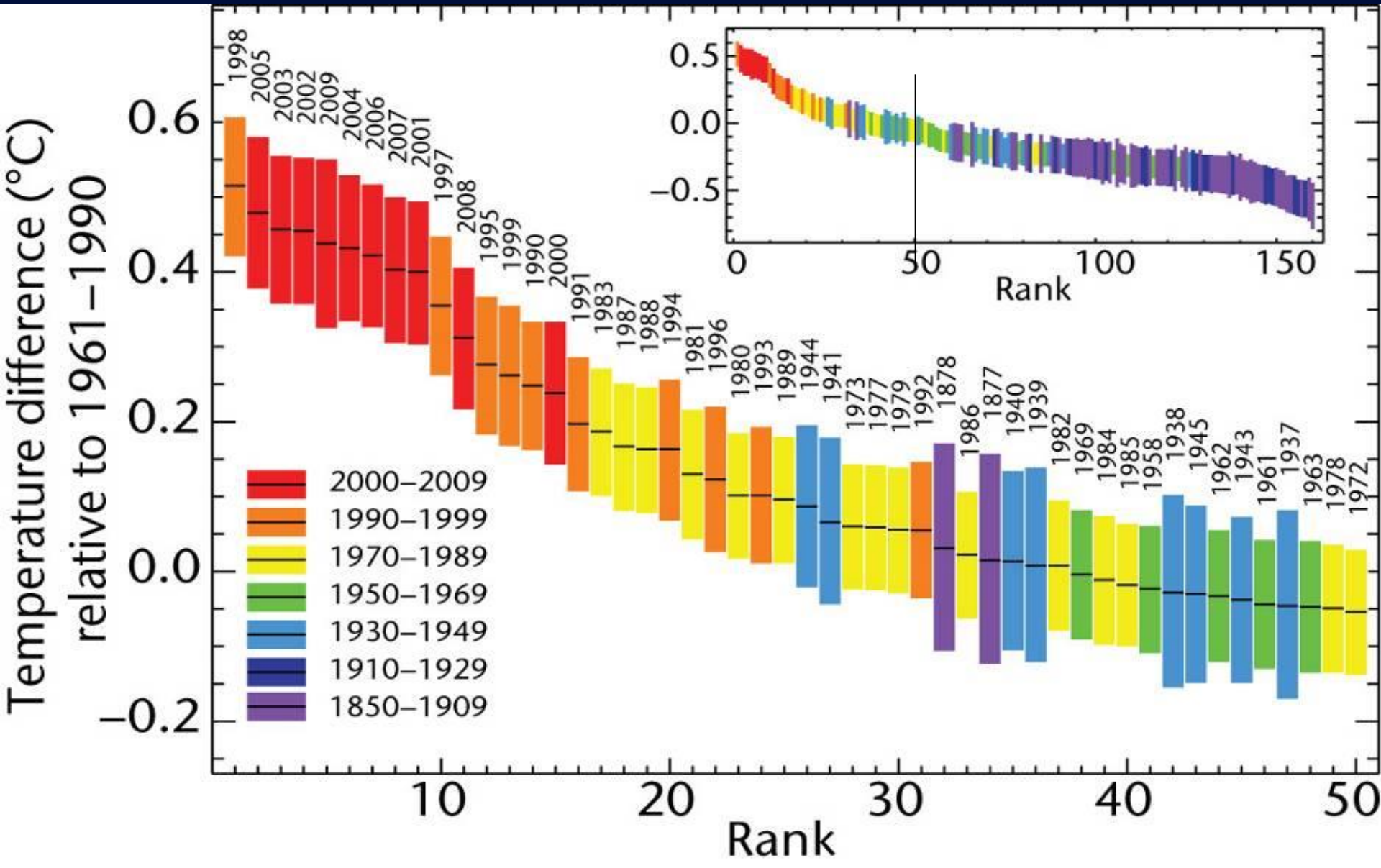
Sea level rise since 1961 :1.8 mm/yr

Arctic sea ice extent shrunk by 2.7% per decade since 1978



Reinforced by Post-AR 4 Observations

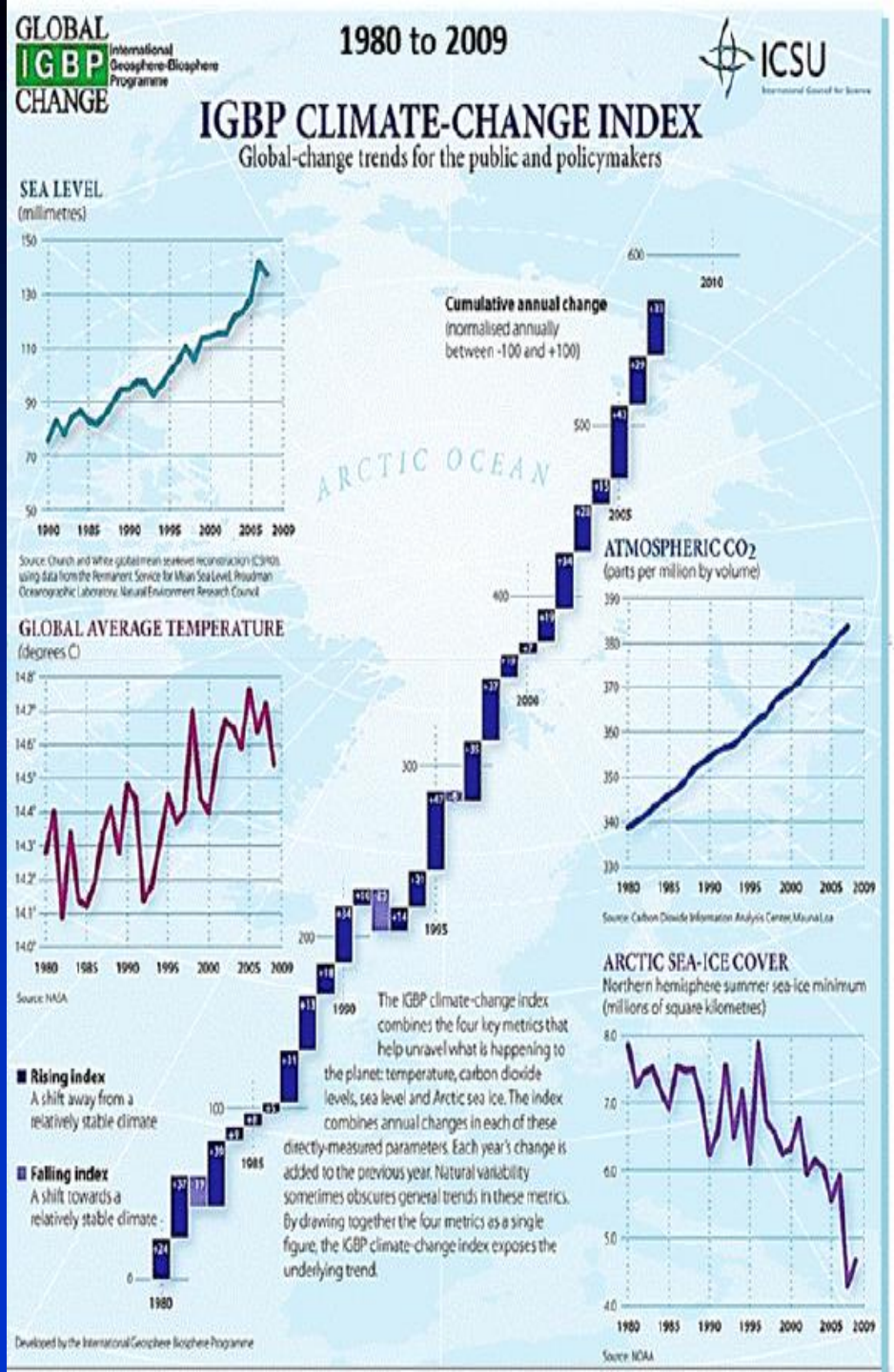
2000-2010: Warmest decade in last 160 years; 2010 warmest year on record



Many consistent observations:

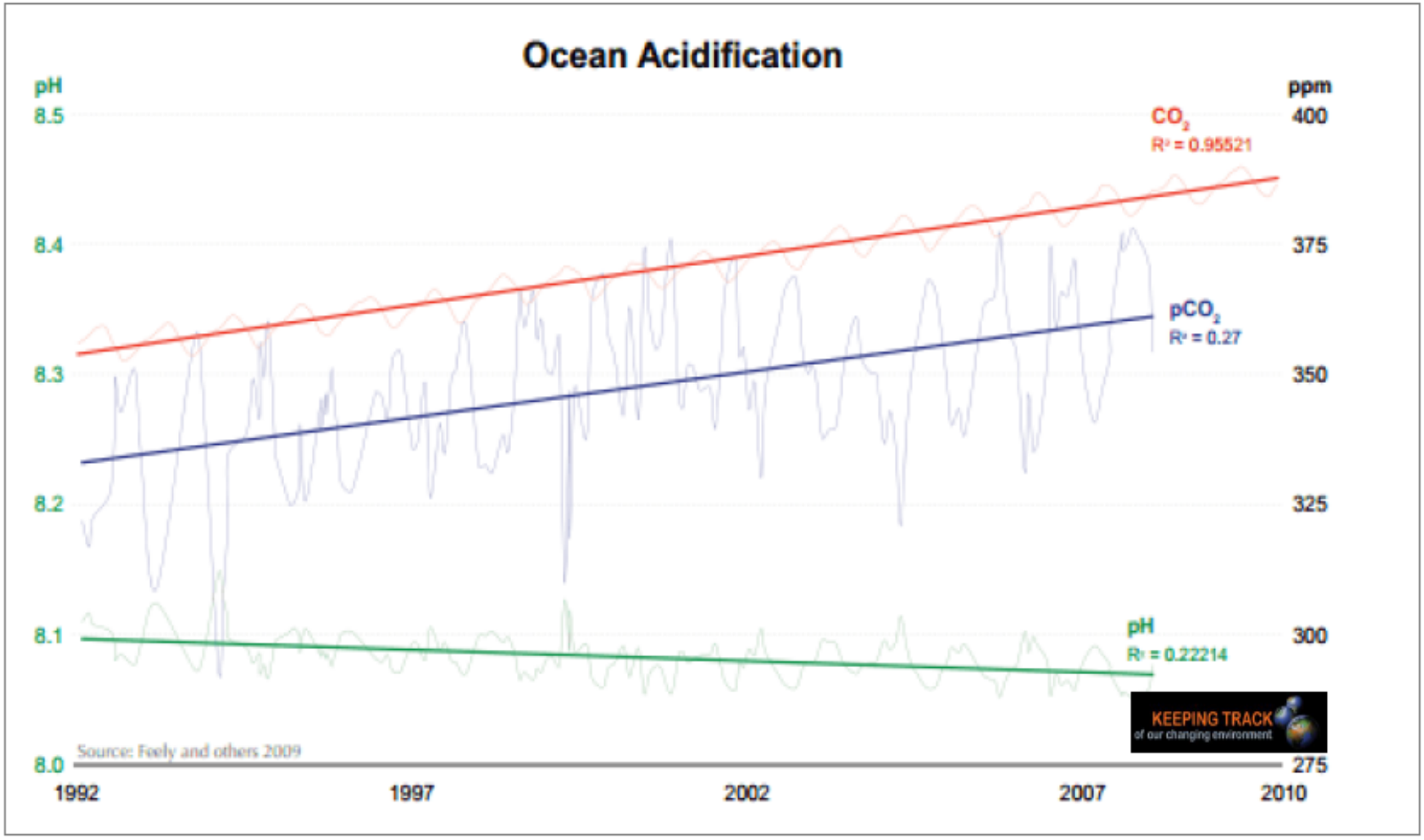
- A discernable increase in **air temperature** observed **above** both the **land** and **sea**.
- Increases in **water temperature** at the **sea-surface down to hundreds of metres below the surface**.
- An increase in **humidity** (warmer atmosphere holds more moisture).
- Increases in **sea level** (warmer waters expand, and melting land-based ice adds to volume) - and **sea acidity**, not in this index.
- Shrinking of Arctic **sea ice, glaciers**, and Northern Hemisphere spring **snow cover**.

Source: Met Office, Hadley Centre



Oceans are becoming more acidic, with negative implications for corals and other marine life

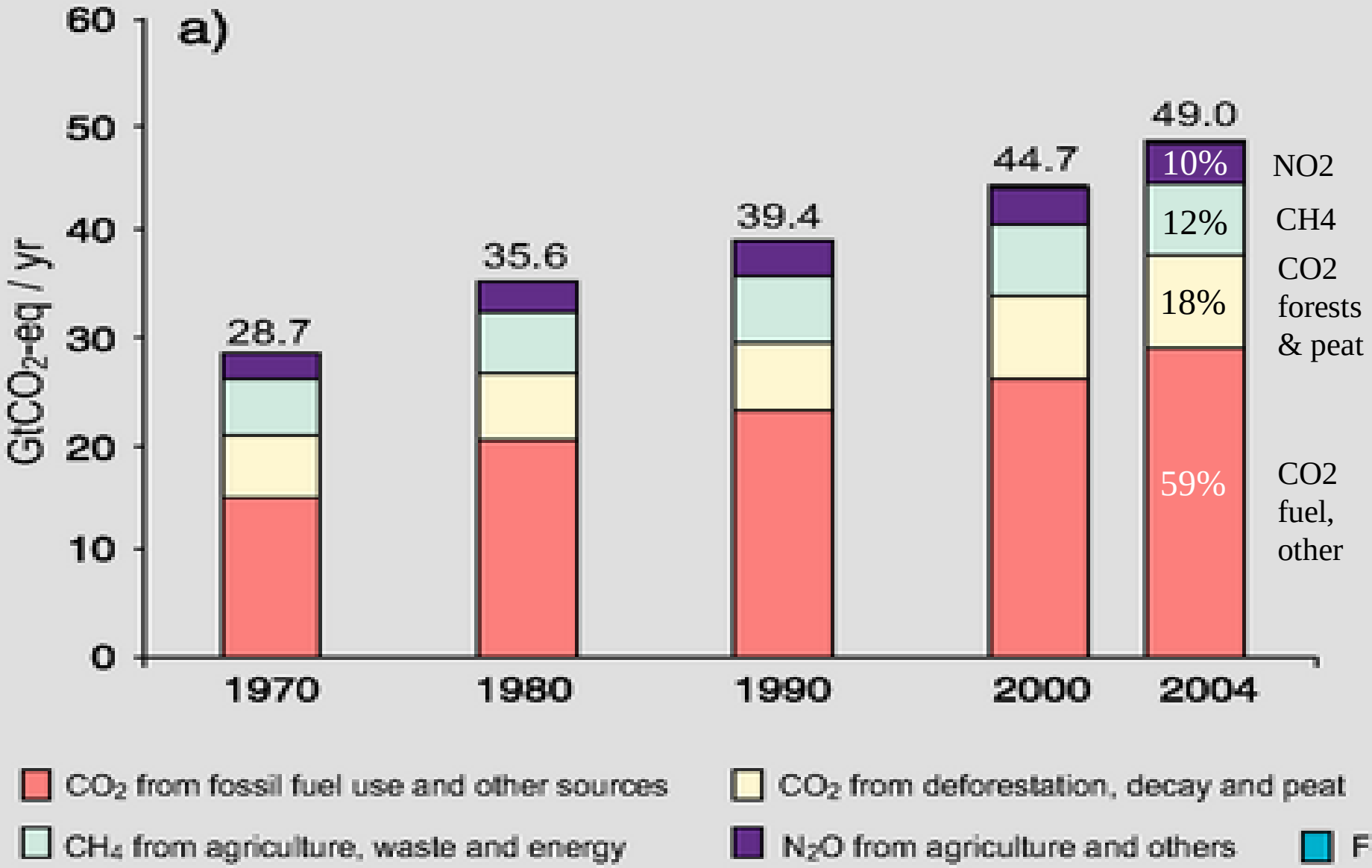
This is the highest rate of ocean acidification in the past 300 million years (B. Honisch Science 2012).



Ways to Look at Emission Sources

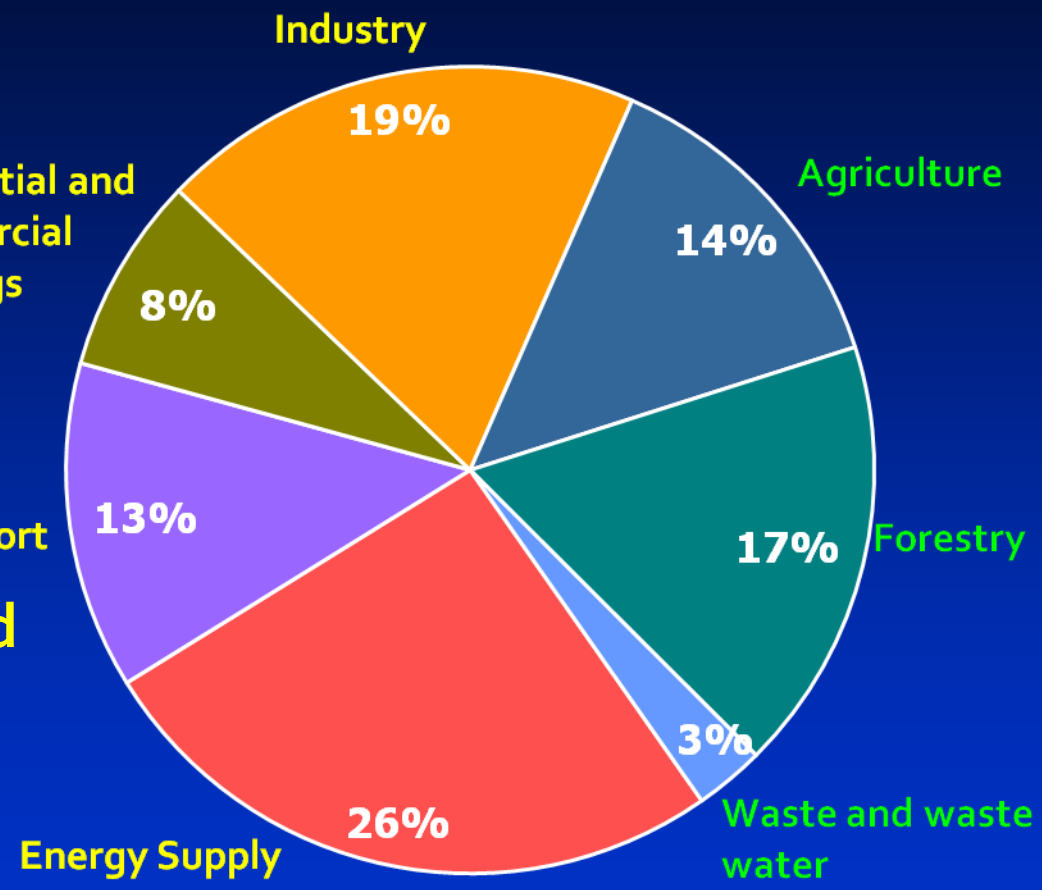
- By Economic Activity
  - Type of GHG and source
  - Sector producing the emission
  - Energy sector fuel types
- By Country, Country Groups, Region
  - Fuel combustion
  - Gross and per capita

Annual Global Emissions of GHGs



Source: IPCC, Summary for Policymakers, AR-4, 2007

Sources by Sector: Global GHG Emissions



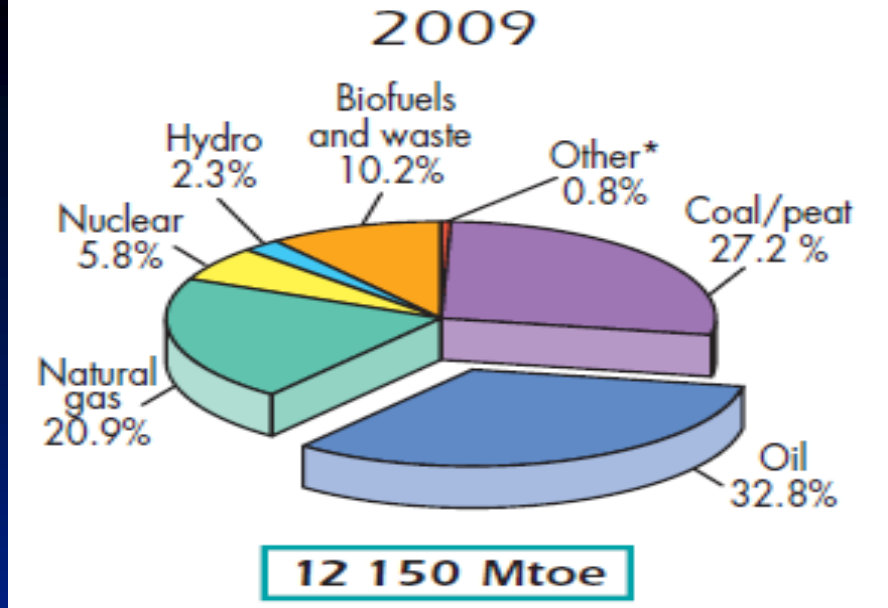
Agriculture and Forest Sectors >30% of total

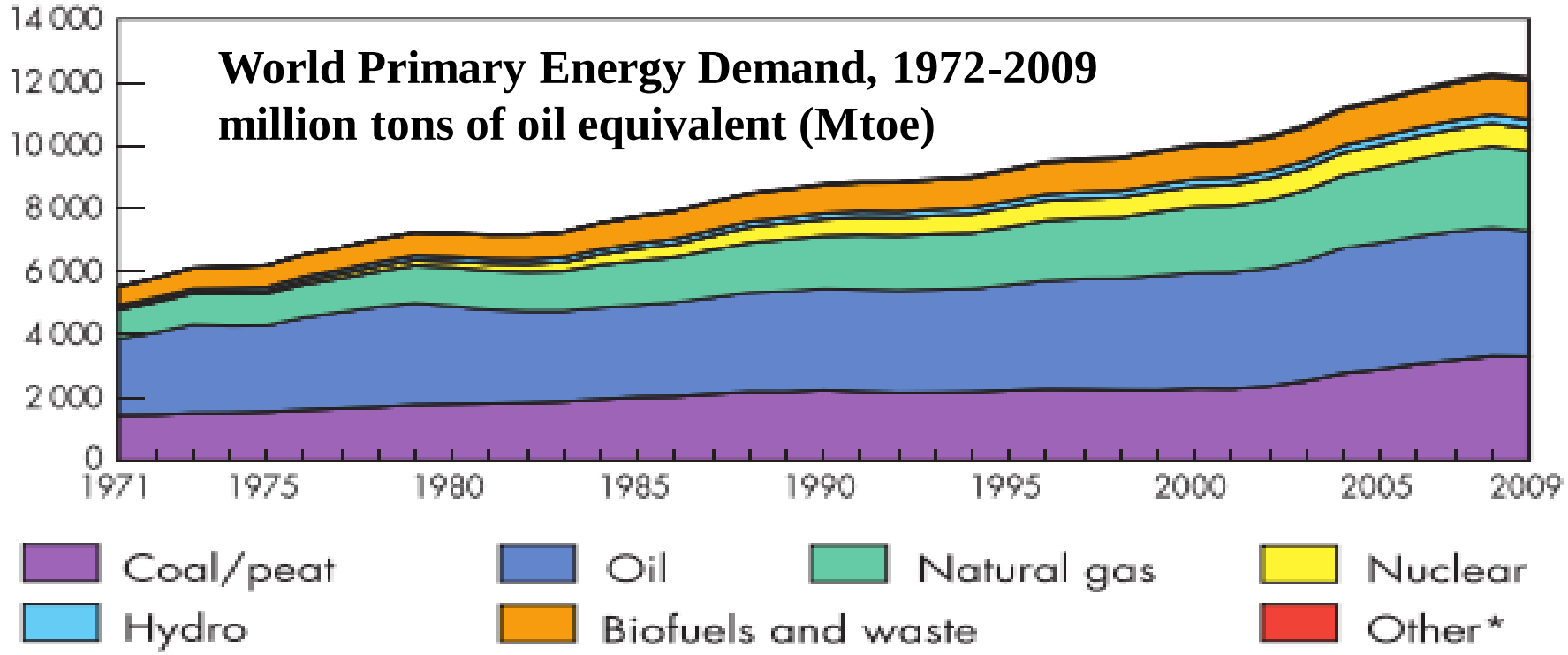
Energy-Related >60% of total

Total Global GHG Emissions: 49 Giga tons CO2e, 2004 figures

Source: IPCC (2007). Summary for Policymakers, 4th Assessment Synthesis Report

Burning of fossil fuels dominates the global energy system:





Source: IEA Key World Energy Statistics, 2011

Top 10 Electricity Generators from Fossil Fuels by Type (IEA, 2009)

Coal/peat	TWh
People's Rep. of China	2 913
United States	1 893
India	617
Japan	279
Germany	257
South Africa	232
Korea	209
Australia	203
Russian Federation	164
Poland	135
Rest of the world	1 217
World	8 119

Oil	TWh
Saudi Arabia	120
Japan	92
Islamic Rep. of Iran	52
United States	50
Mexico	46
Iraq	43
Kuwait	38
Pakistan	36
Indonesia	35
Egypt	30
Rest of the world	485
World	1 027

Natural gas	TWh
United States	950
Russian Federation	469
Japan	285
United Kingdom	165
Italy	147
Islamic Rep. of Iran	143
Mexico	138
India	111
Spain	107
Thailand	105
Rest of the world	1 681
World	4 301

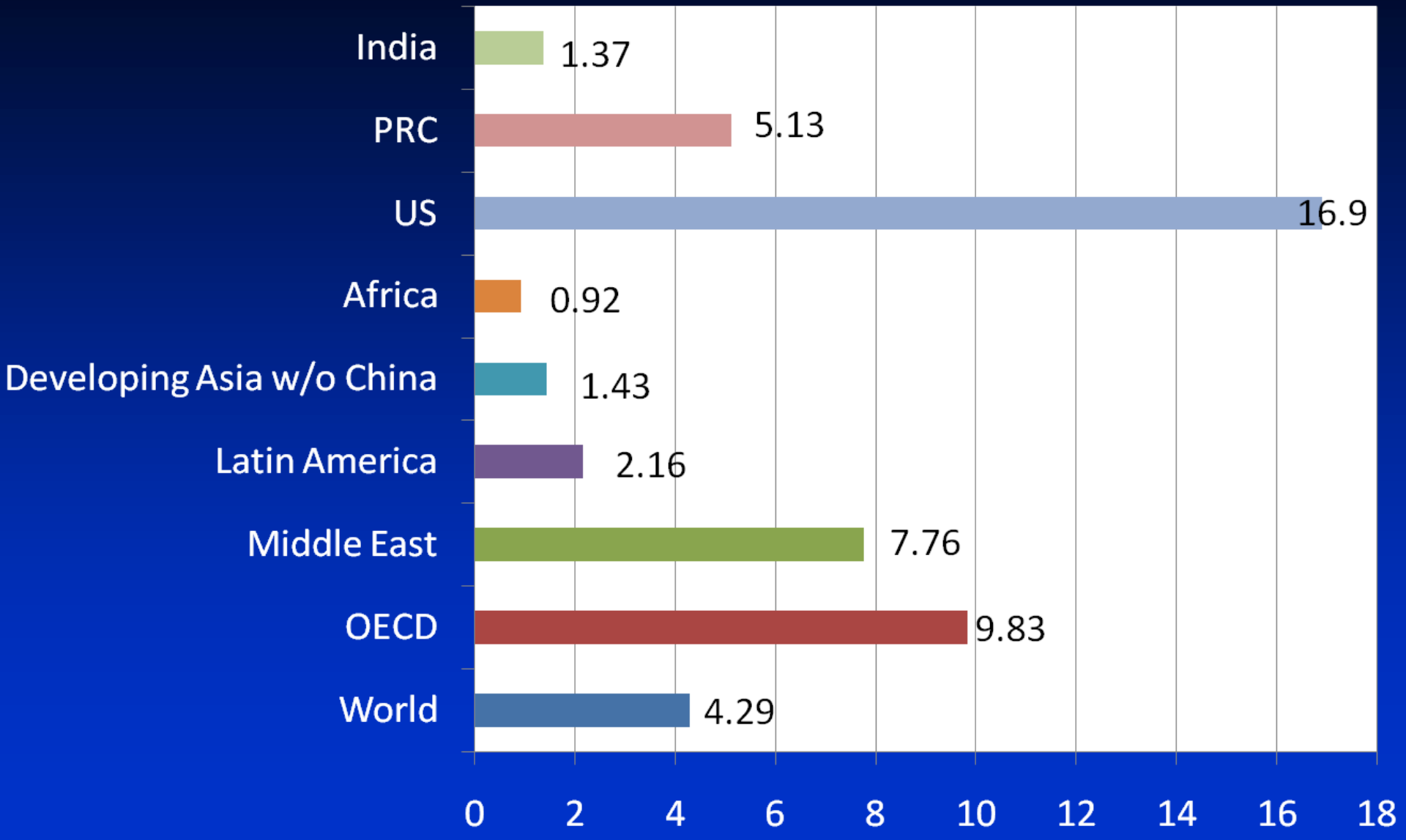
Top CO_2-burning/emitting Countries in 2009

	Country	CO_2 Emissions from Fuel Combustion Mt of CO_2	Share in Total	CO_2 Emissions/ Population t CO_2
1	**People's Rep. of China**	**6,832**	**23.6%**	**5.13**
2	United States	5,195	17.9%	16.90
3	**India**	**1,586**	**5.5%**	**1.37**
4	Russian Federation	1,533	5.3%	10.80
5	**Japan**	**1,093**	**3.8%**	**8.58**
6	Germany	750	2.6%	9.16
7	Islamic Rep. of Iran	533	1.8%	7.31
8	Canada	521	1.8%	15.43
9	**Repubic of Korea**	**515**	**1.8%**	**10.57**
10	United Kingdom	466	1.6%	7.54
11	Saudi Arabia	410	1.4%	16.17
12	Mexico	400	1.4%	3.72
13	**Australia**	**395**	**1.4%**	**17.87**
14	Italy	389	1.3%	6.47
15	**Indonesia**	**376**	**1.3%**	**1.64**

Total 2009 CO_2 emissions from these sources: ~ 29 Gt

Data Source: IEA World Energy Outlook, 2011

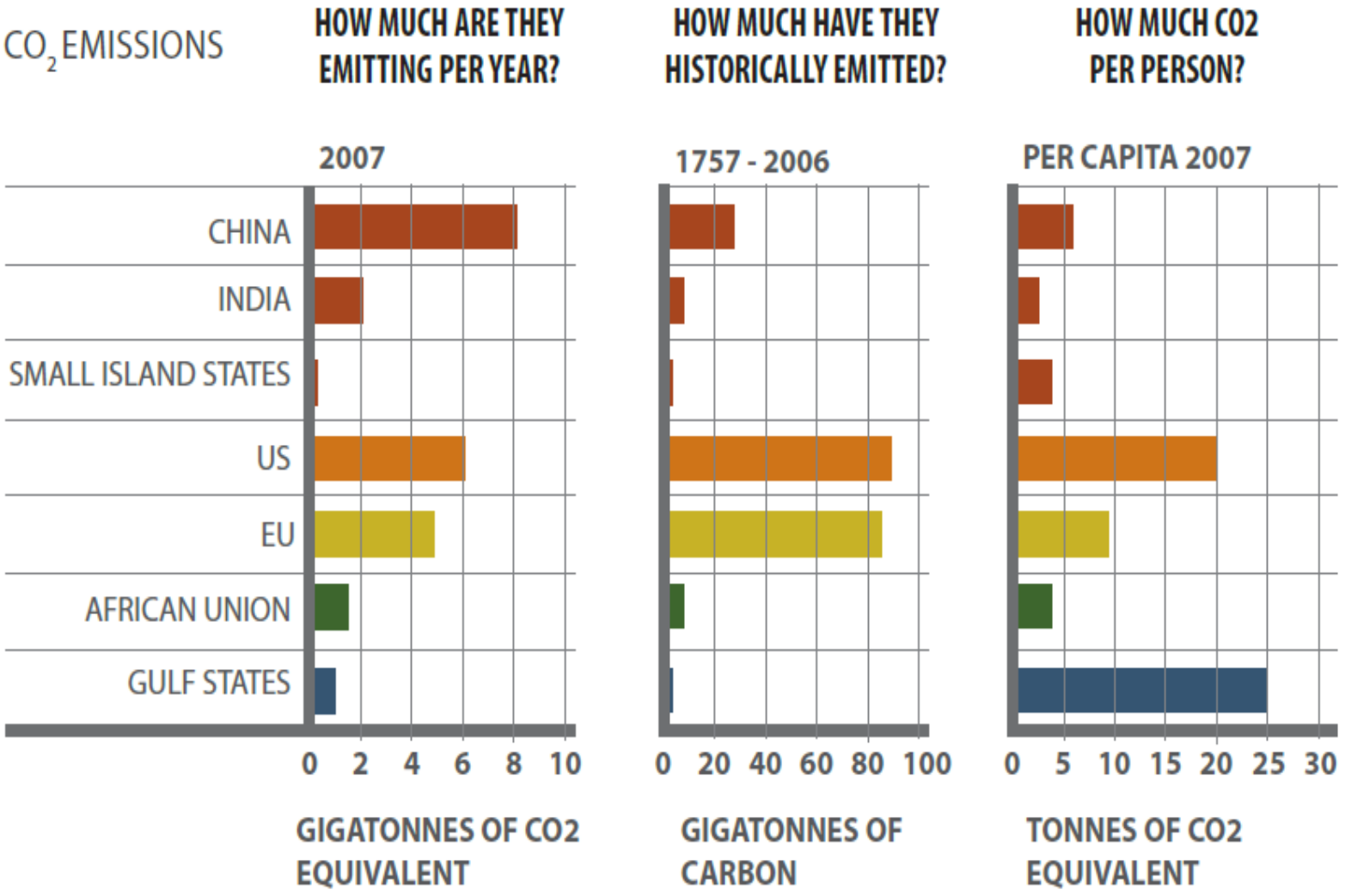
2009 Energy-based CO_2 Emissions / capita



Data Source: IEA Key Energy Statistics , 2011

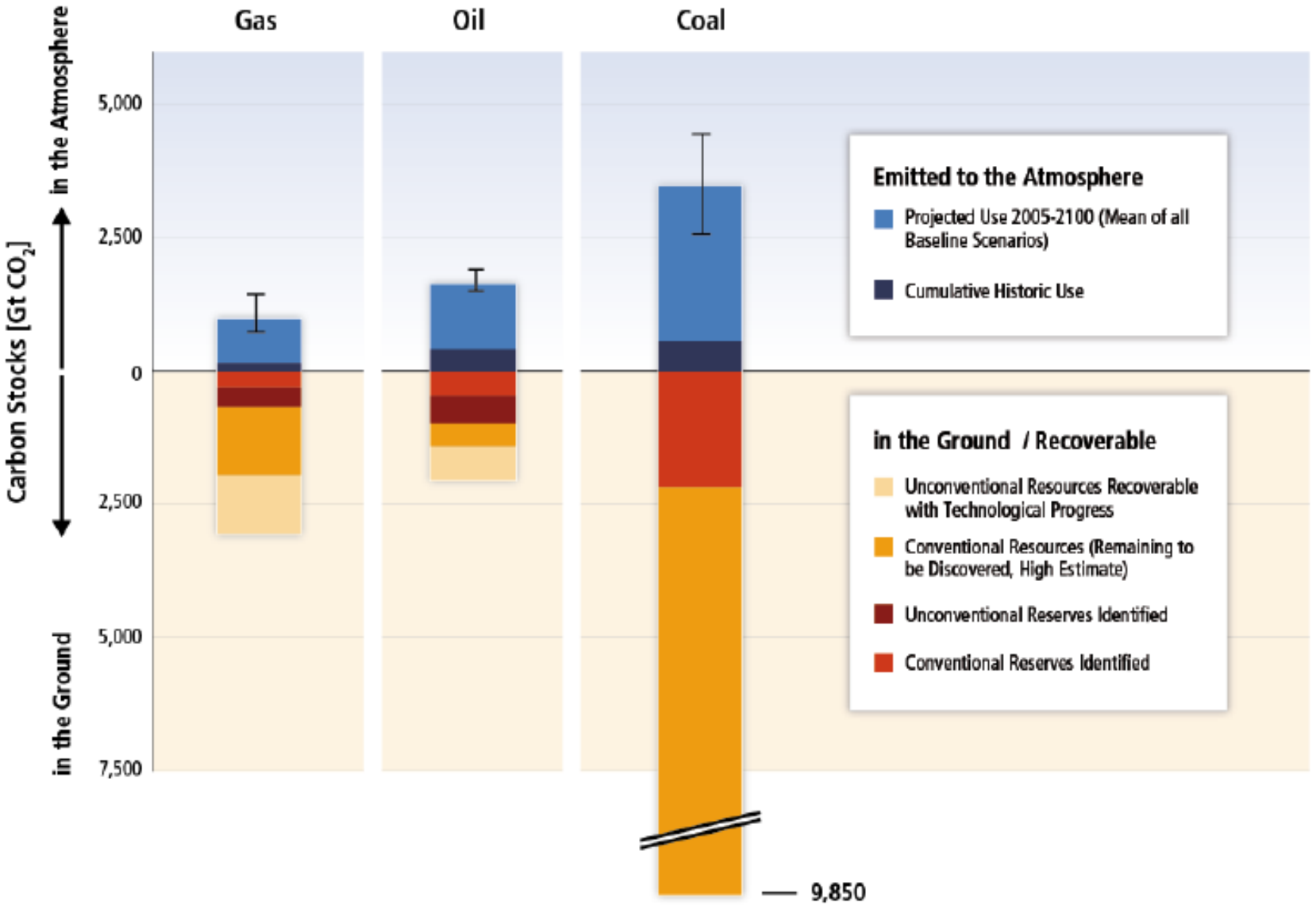
Comparing CO_2 Emissions

(Carbon Dioxide Information Analysis Center)



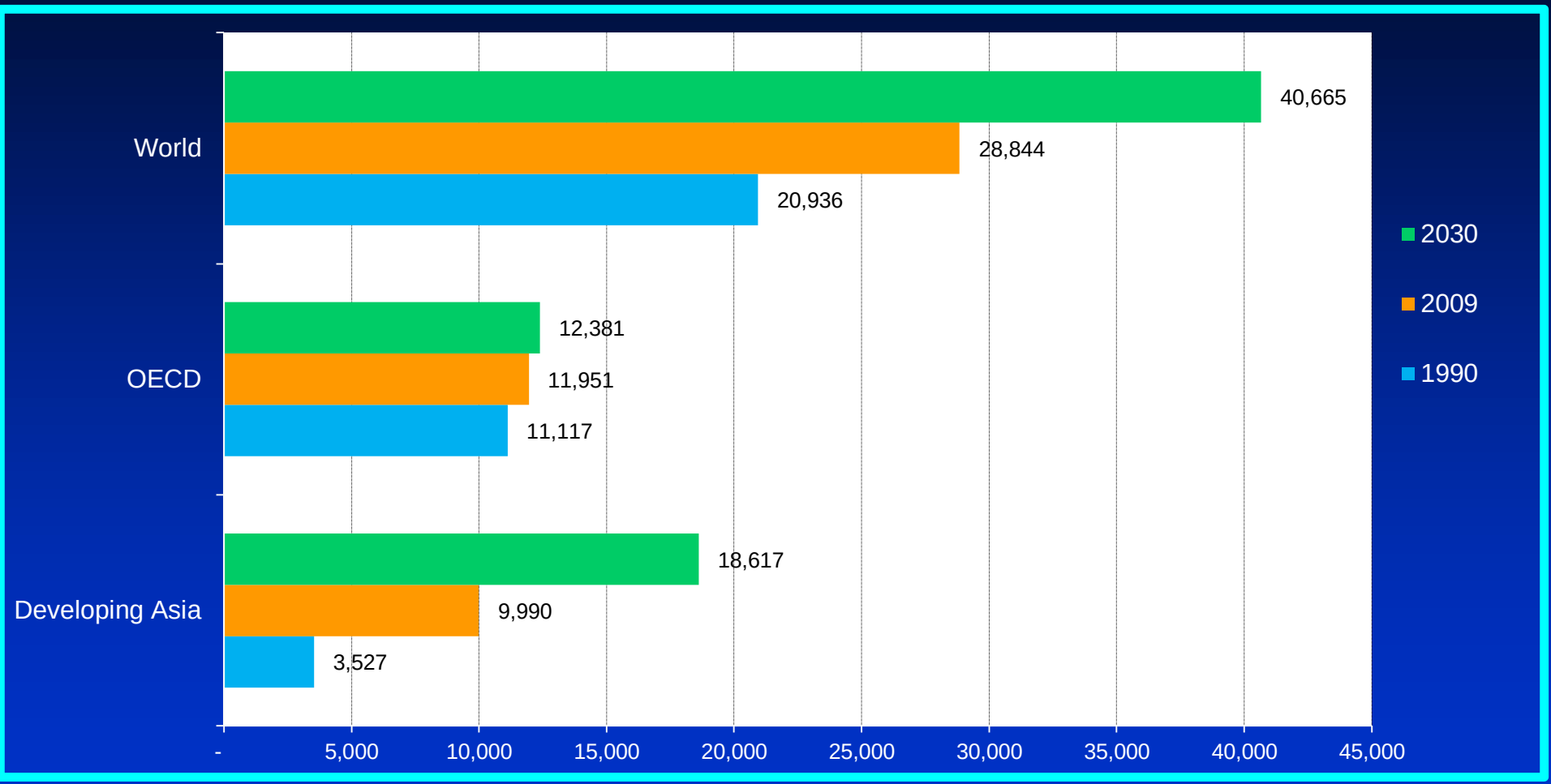
Looking Ahead

IPCC: “Potential emissions from remaining fossil fuels could result in GHG concentration levels far above 600ppm”



Source: IPCC Special Report on Renewable Energy and Climate Change Mitigation, 2011

Rising Share of Developing Asia in Global Energy-related CO_2 Emissions, million tons

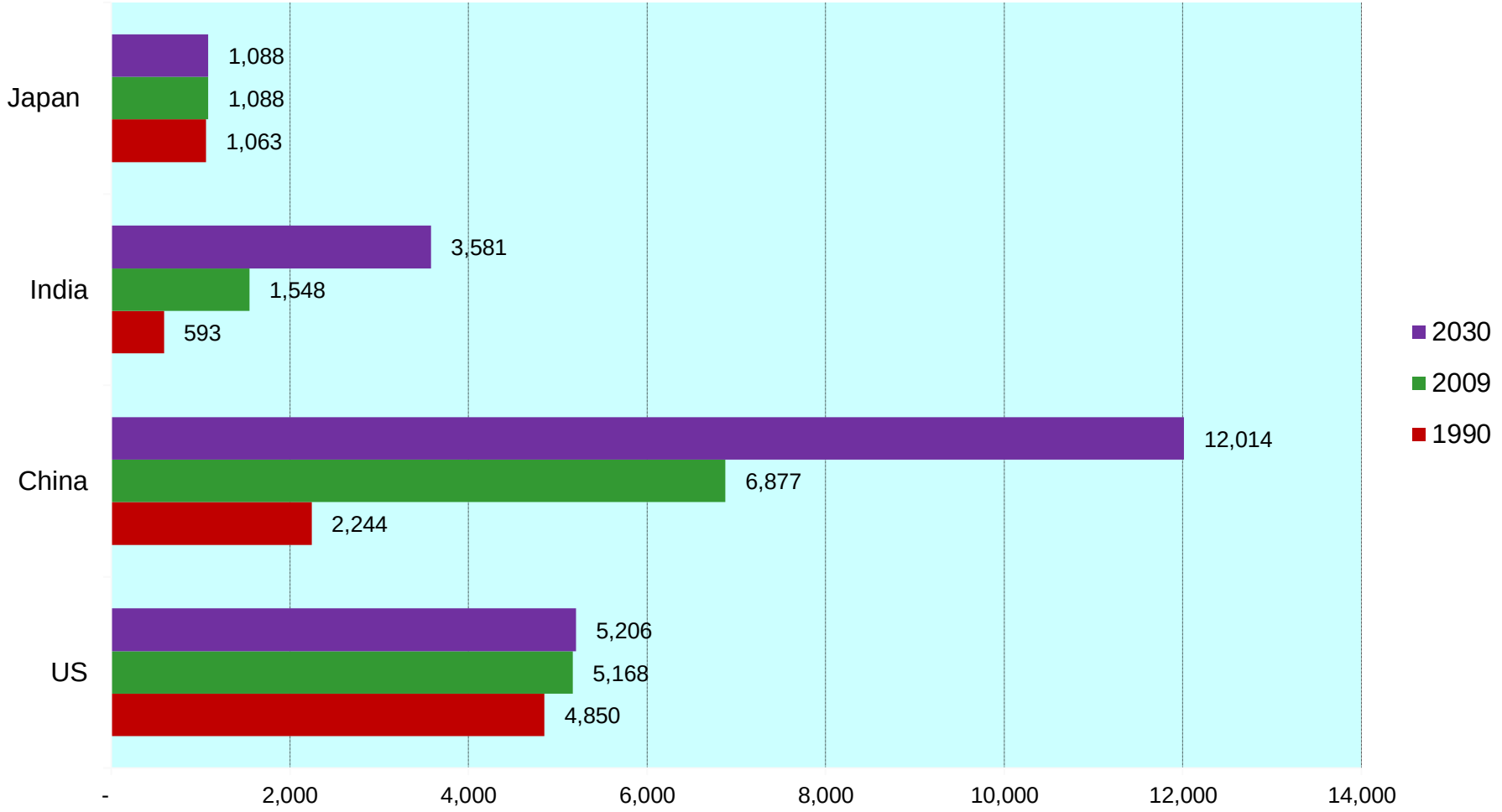


Share	1990	2009	2030
Developing Asia	**17%**	**35%**	**46%**
OECD	53%	41%	30%

2030 based on Current Policies Scenario

Data Source: IEA World Energy Outlook , 2011

Energy-related CO_2 Emissions, Selected Countries, million tons

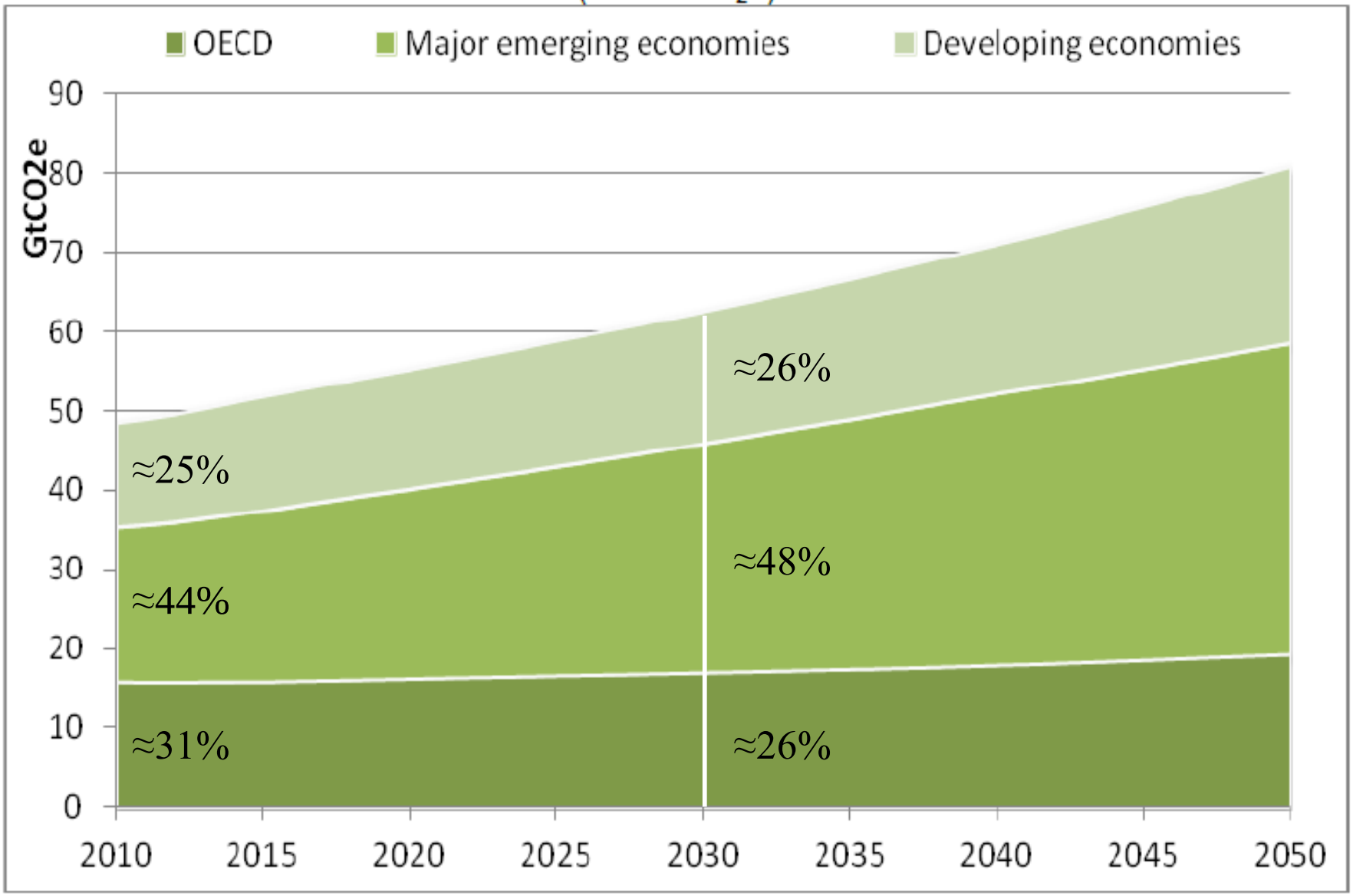


2030 based on Current Policies Scenario

Data Source: IEA Key Energy Statistics , 2011

Figure 2.2. Business as usual GHG emissions 2010-2050

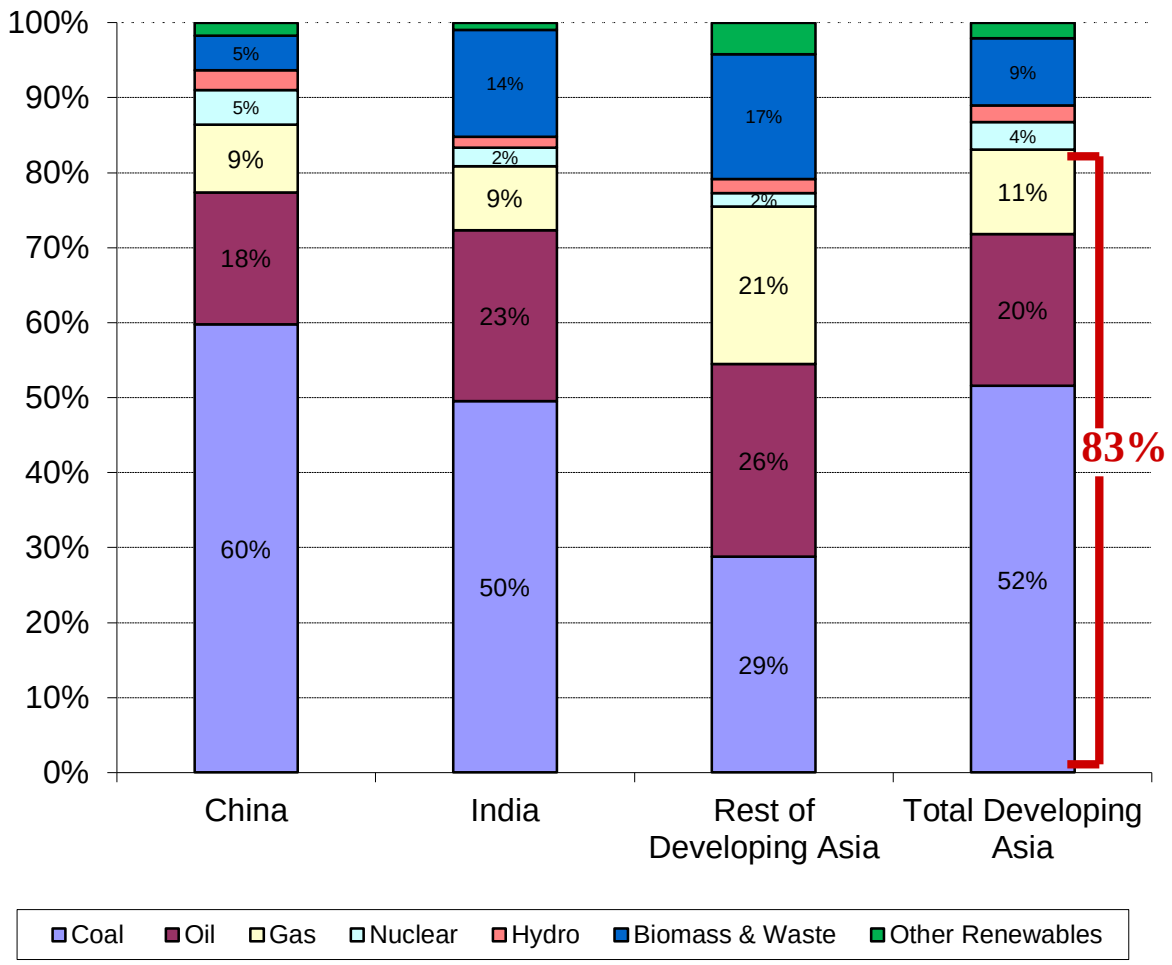
(unit: $GtCO_2e$)



Note: $GtCO_2e$ = Giga tonnes of CO_2 equivalent

Source: OECD (2012), *Environmental Outlook to 2050*, OECD, Paris.

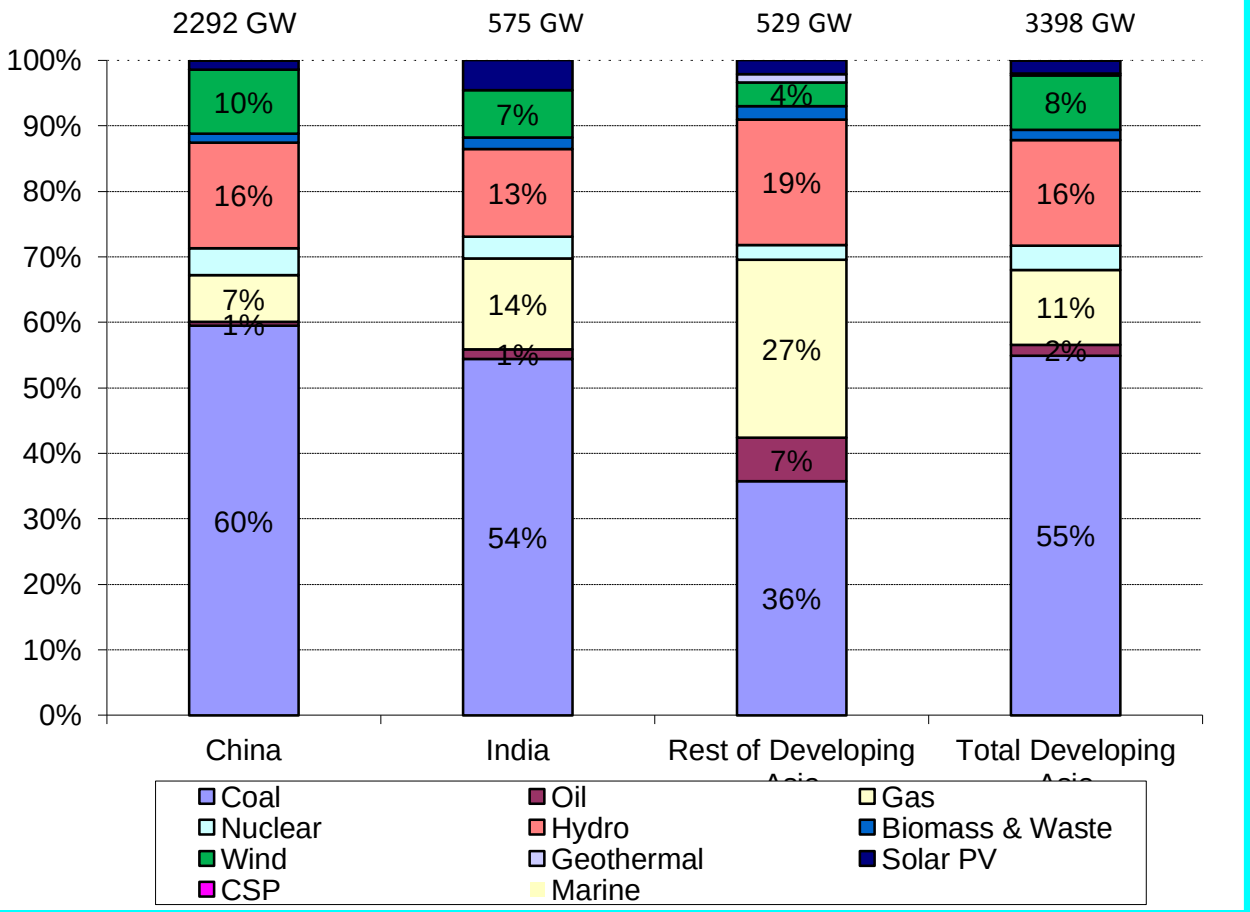
Projected 2030 Energy Mix for Developing Asia under Business as Usual Scenario (current policies)



Developing Asia, Energy Mix			
	1990	2009	2030
Coal	44%	52%	52%
Oil	20%	21%	20%
Gas	4%	8%	11%
Nuclear	1%	1%	4%
Hydro	2%	2%	2%
Biomass and Waste	30%	15%	9%
Other Renewables	0%	1%	2%
Total	100%	100%	100%
Total, million toe	1591	3724	6784

Data Source: IEA World Energy Outlook , 2011

Projected 2030 Electrical Generation Capacity for Developing Asia Under Business as Usual Scenario (current policies)

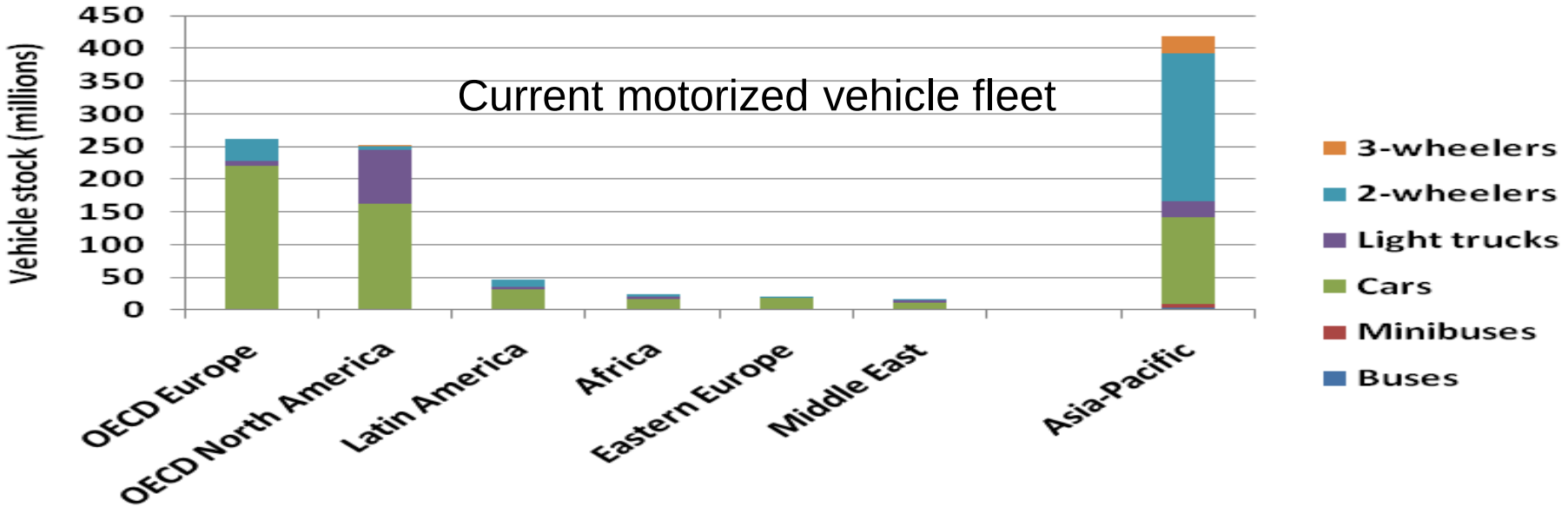


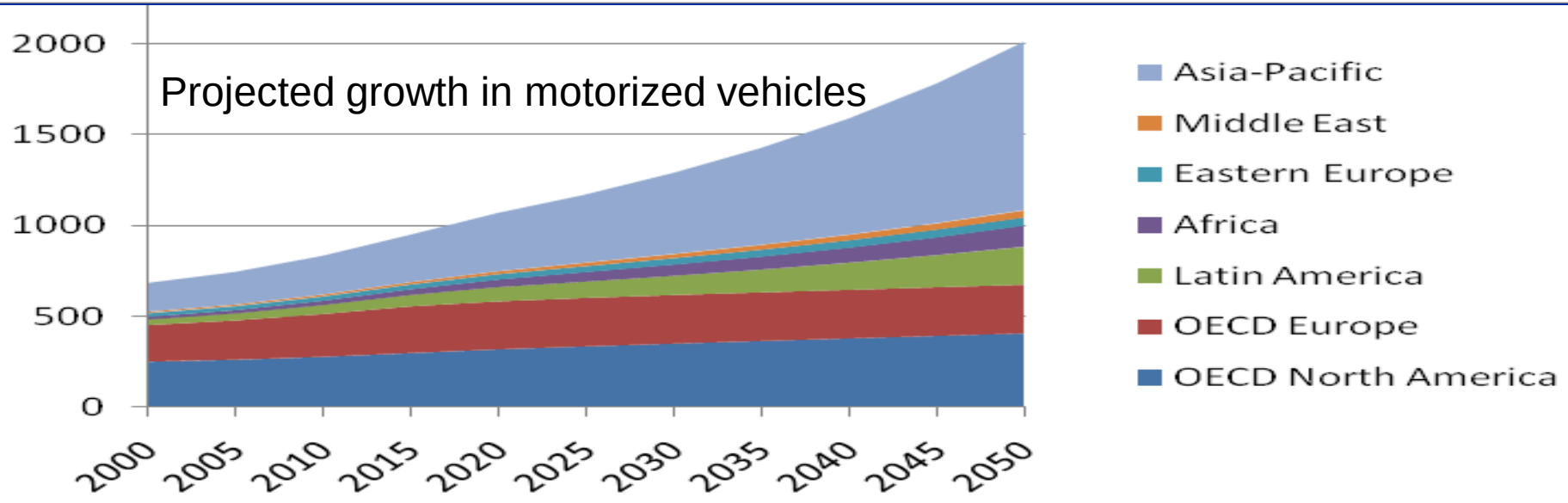
Developing Asia Electrical Generation Capacity	2009	2030
Coal	58%	55%
Oil	5%	2%
Gas	11%	11%
Nuclear	1%	4%
Hydro	21%	16%
Biomass and Waste	0%	2%
Wind	3%	8%
Geothermal	0%	0%
Solar PV	0%	2%
CSP	0%	0%
Marine	0%	0%
Total	100%	100%
Total, GW	1360	3397

Data Source: IEA World Energy Outlook , 2011

Growth in Motorized Transport

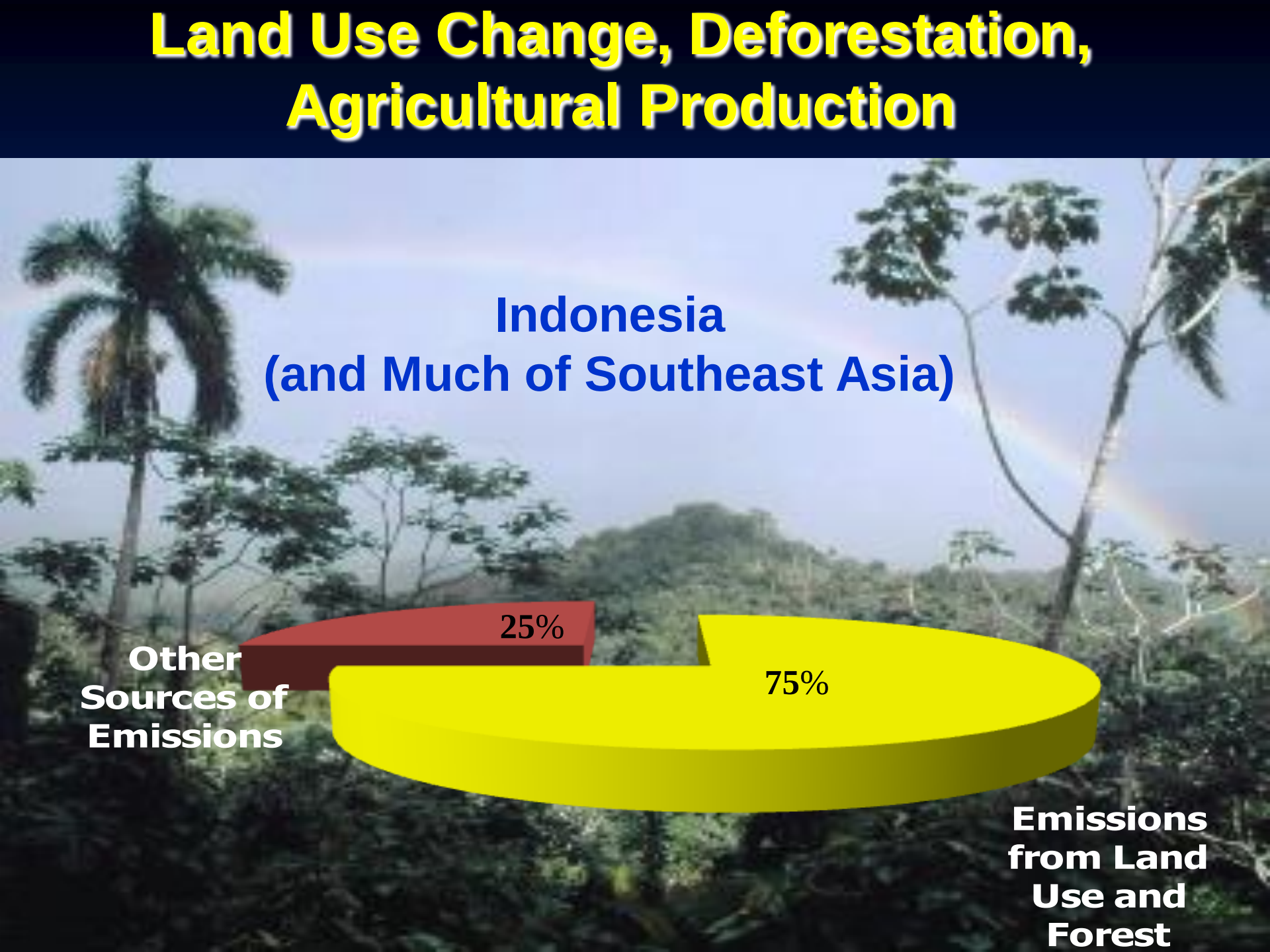
Source: IEA, Mobility Model, 2010





Land Use Change, Deforestation, Agricultural Production

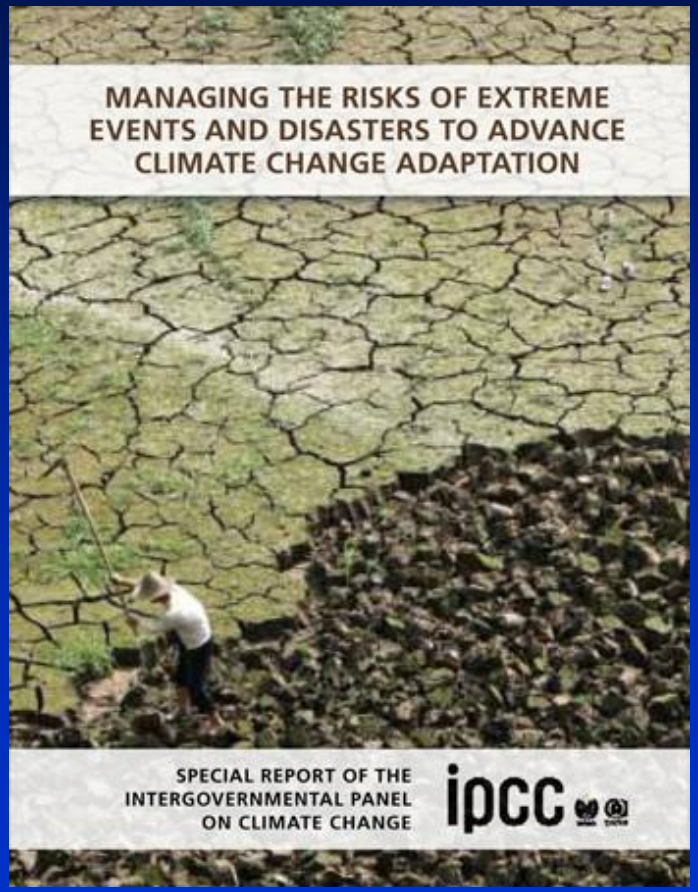
Indonesia
(and Much of Southeast Asia)



Climate Change Impacts: Key Characteristics

- Impacts are not evenly distributed; the poorest countries will suffer earliest and most
- World is already "locked in" to significant level of climate change – adaptation effort is a must
- Many impacts still can be reduced or delayed by timely GHG emissions mitigation efforts
- Scientists point to increasing risks of serious, irreversible impacts and tipping points

Observed Changes in Climate Extremes (since 1950)



- Increase in number of heavy precipitation events in some regions (likely)
- Increase in extreme coastal high water due to rising mean sea level (likely)
- Decrease in number of cold days/nights and increased warm days/nights (likely)
- Increase in length or number of warm spells or heat waves in many regions (medium)
- More intense and longer droughts in some regions (medium)
- Warming trend in daily temperature in Asia (medium)

Source: IPCC SREX 2012

Projections: By end of the 21st century…

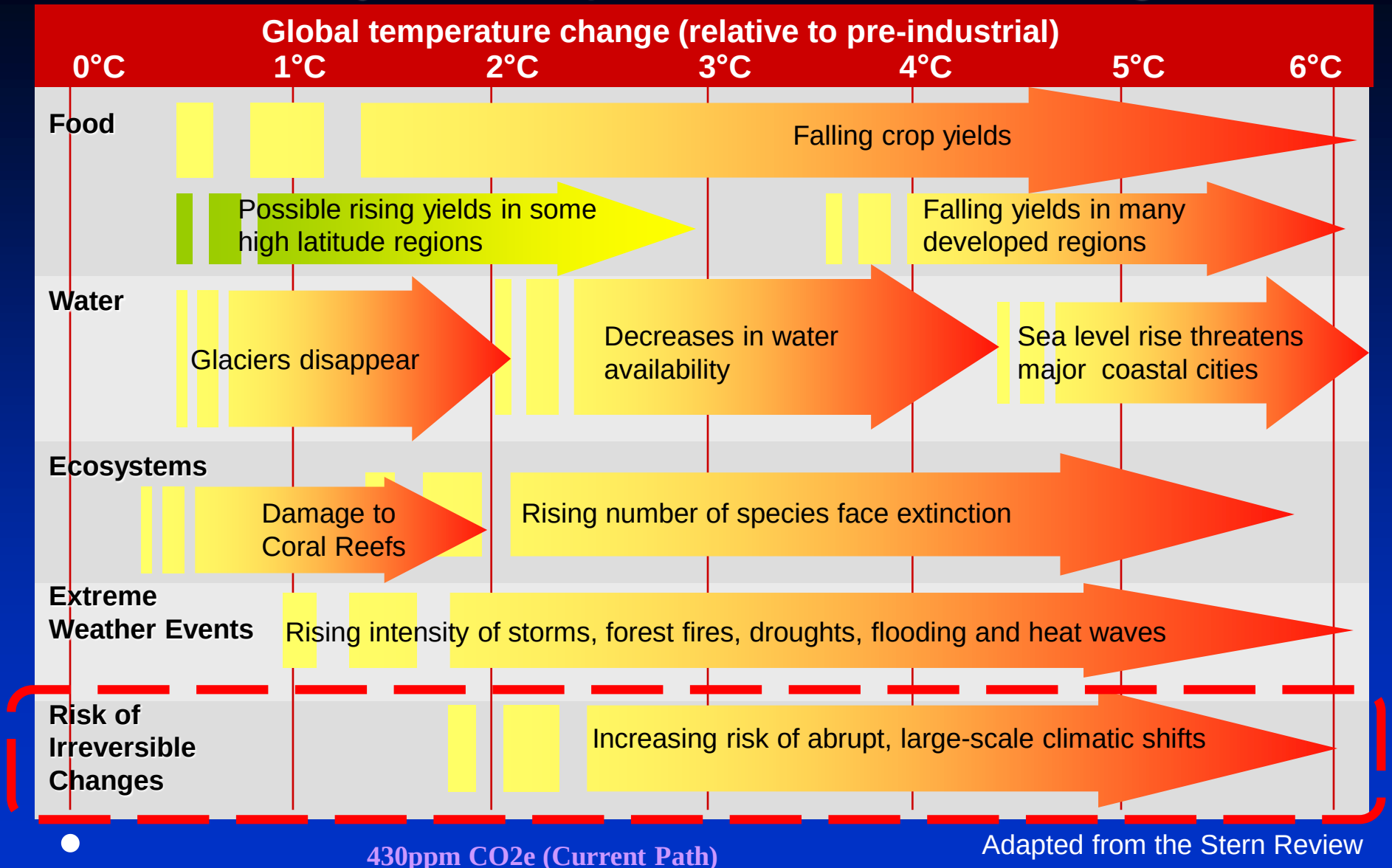
- 1-in-20 year hottest day *likely* to become a 1-in-2 to 1-in-5 year event in most regions

- 1-in-20 year annual maximum daily precipitation amount is *likely* to become a 1-in-5 to 1-in-15 year event in many regions

- Drought will intensify in some seasons and regions

IPCC (2012), Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

Projected Impacts of Climate Change



Committed global temperature increases by 2100

Due to climate science 2.5°C

Due to climate policy 4.4°C

NB. without zero carbon emissions target warming and ocean acidification are unlimited

Upper probability risk by 2100 from today's global emissions scenario And from policy commitment >7°

Today's emissions scenario by 2100 UK Met Office A1F1 5.5°

Policy commitment by combined national UN pledges Climate Interactive 4.4°

Policy increase 4.4C°C

Air pollution aerosol cooling factor +0.4°C 2.5°

Ocean heat lag by 2100 IPCC 0.5°C 2.1°

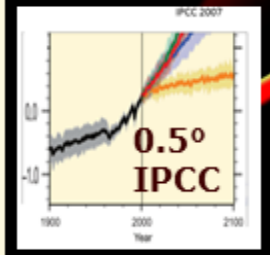
Rapid emissions cut to stable atmospheric CO2: 40 years +0.8°C 1.6°

Today 0.8°

Science cumulative increase 2.5°C

°C	°F
9	16.2
8	14.4
7	12.6
6	10.8
5	9
4	7.2
3	5.4
2	3.6
1	1.8

3C: all crop all regions declined below today's yields (according to crop models that don't include many adverse factors e.g. prolonged drought).



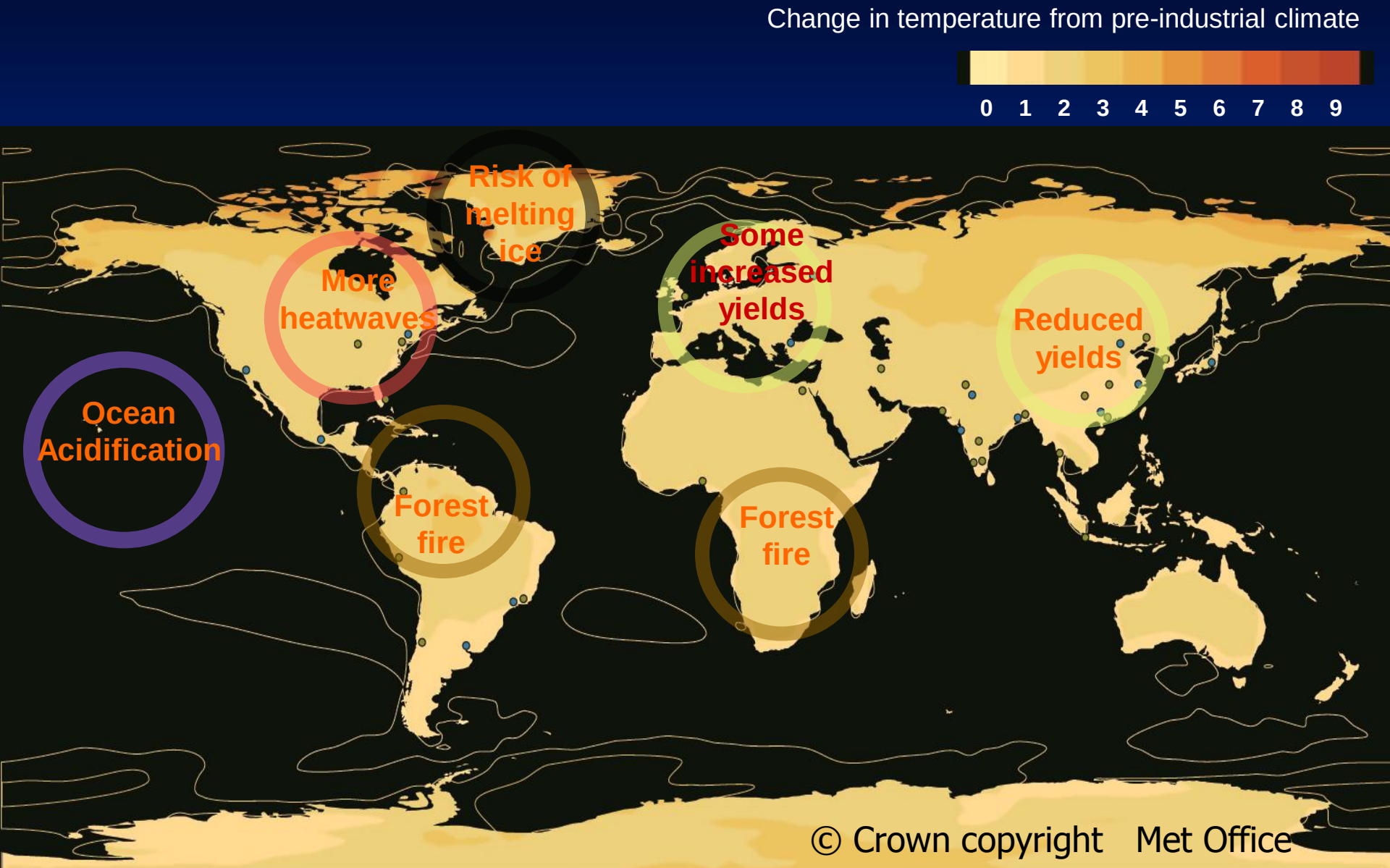
3C does not include higher rate of NH crops losses due to rapid loss of Arctic cooling albedo, nor accelerated global warming from Arctic methane feedback.

Current A1F1 worst case emissions scenario

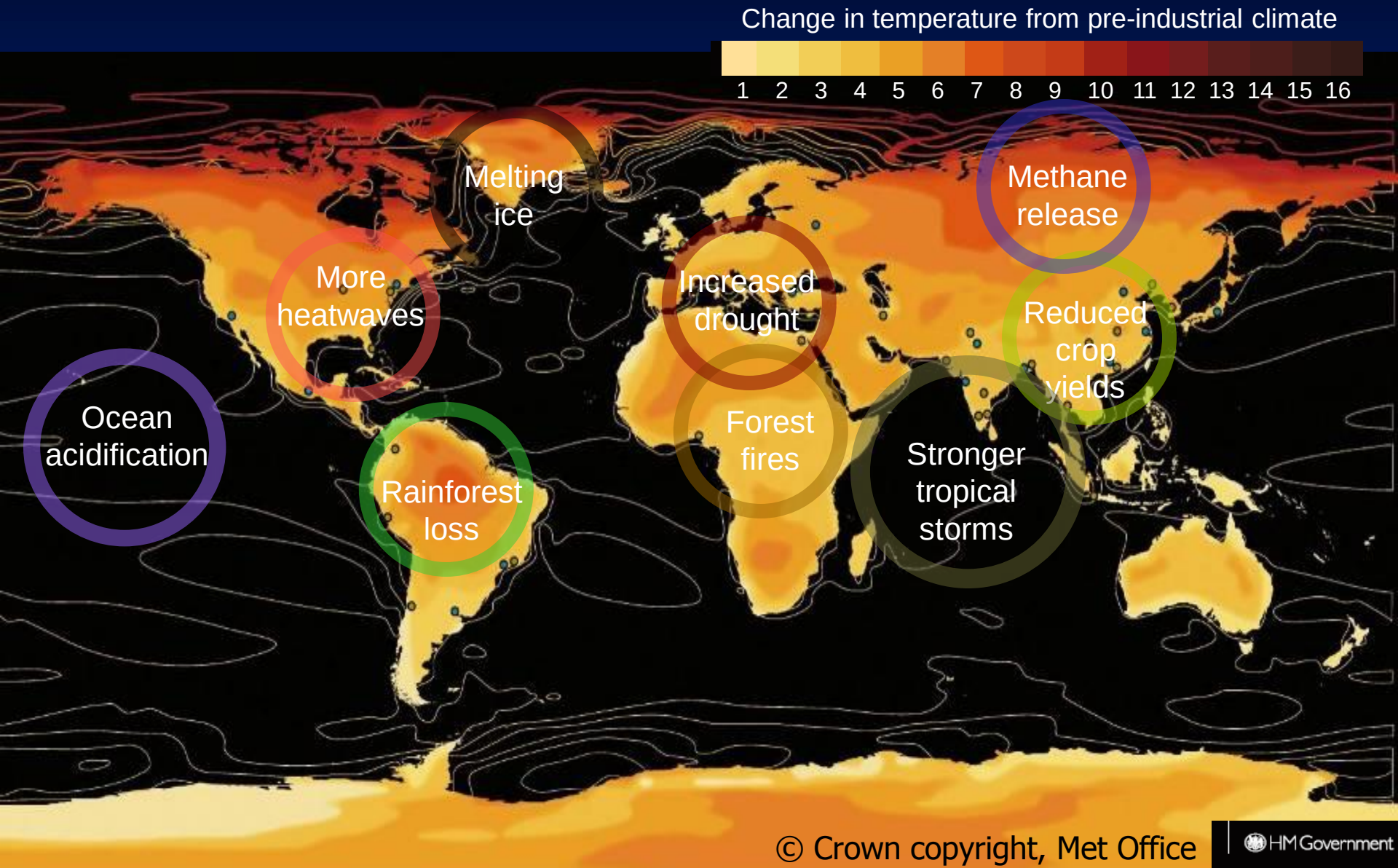
2000 2020 2040 2060 2080 2100

Global temperature increase °C from preindustrial

Impacts of a global temperature rise of 2º C



Impacts of a global temperature rise of 4º C



Vulnerability of Asian & Pacific Countries to Climate Change

- **High Exposure:** drought, flood, tropical storms, sea level rise, loss of snowpack/ glacial storage
- **High Sensitivity:** reliance on natural resources; drought-, flood-prone and coastal agriculture
- **Low Adaptive Capacity:** economic resources, infrastructure, technology, education & skills, health, institutions

Climate Change Impacts in Asia & Pacific

- **Loss of development gains through reduced GDP**

  India and Southeast Asia could lose on average 2-3% of GDP, and as much as 9-13% (95th percentile) of GDP by 2100.

- **Declines in agricultural crop yields from changing rainfall patterns, increased drought and flood risk**

  Strong impact on Western Asia, where yields of the predominant crops may fall by 15 – 35% once temperatures reach 3-4 °C

- **Agricultural losses and other risks from melting glaciers and loss of mountain snow**

  Increased risk of floods and intense bursts. Shorter irrigation period, threatening crop rotations, affecting close to 1 billion people on the Indian sub-continent and in PR China

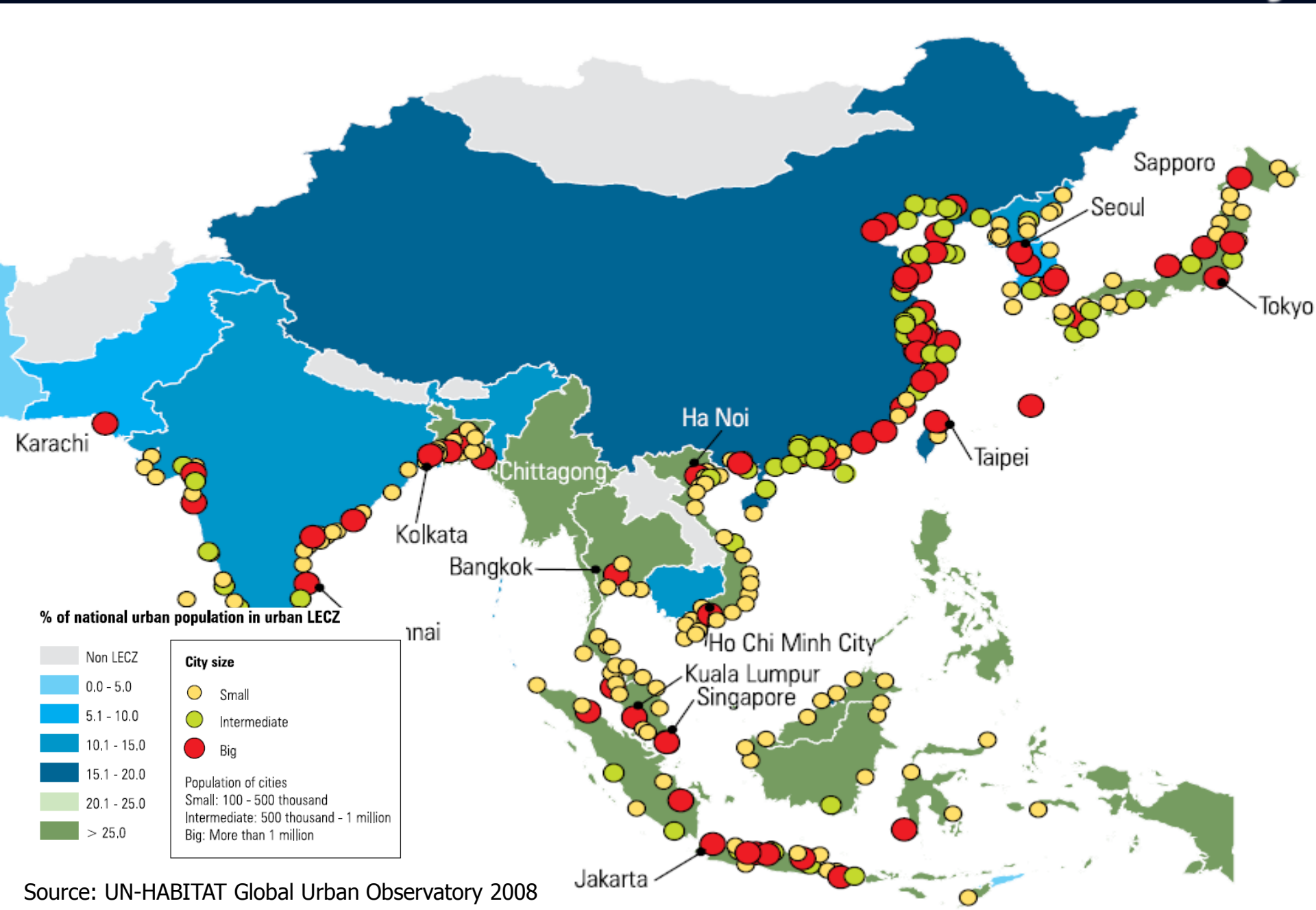
- **Coastal degradation from rise in sea levels, temperature and acidity**

  South and East Asia could lose 15% of their land area by 2100. Small island states in the Indian and Pacific Oceans are acutely threatened with their very survival. Fisheries threatened.

- **Damage to critical ecosystems from climate shifts**

  Reduced productivity of terrestrial, coastal and marine ecosystems from increased temperature, precipitation extremes, other shifts in climate

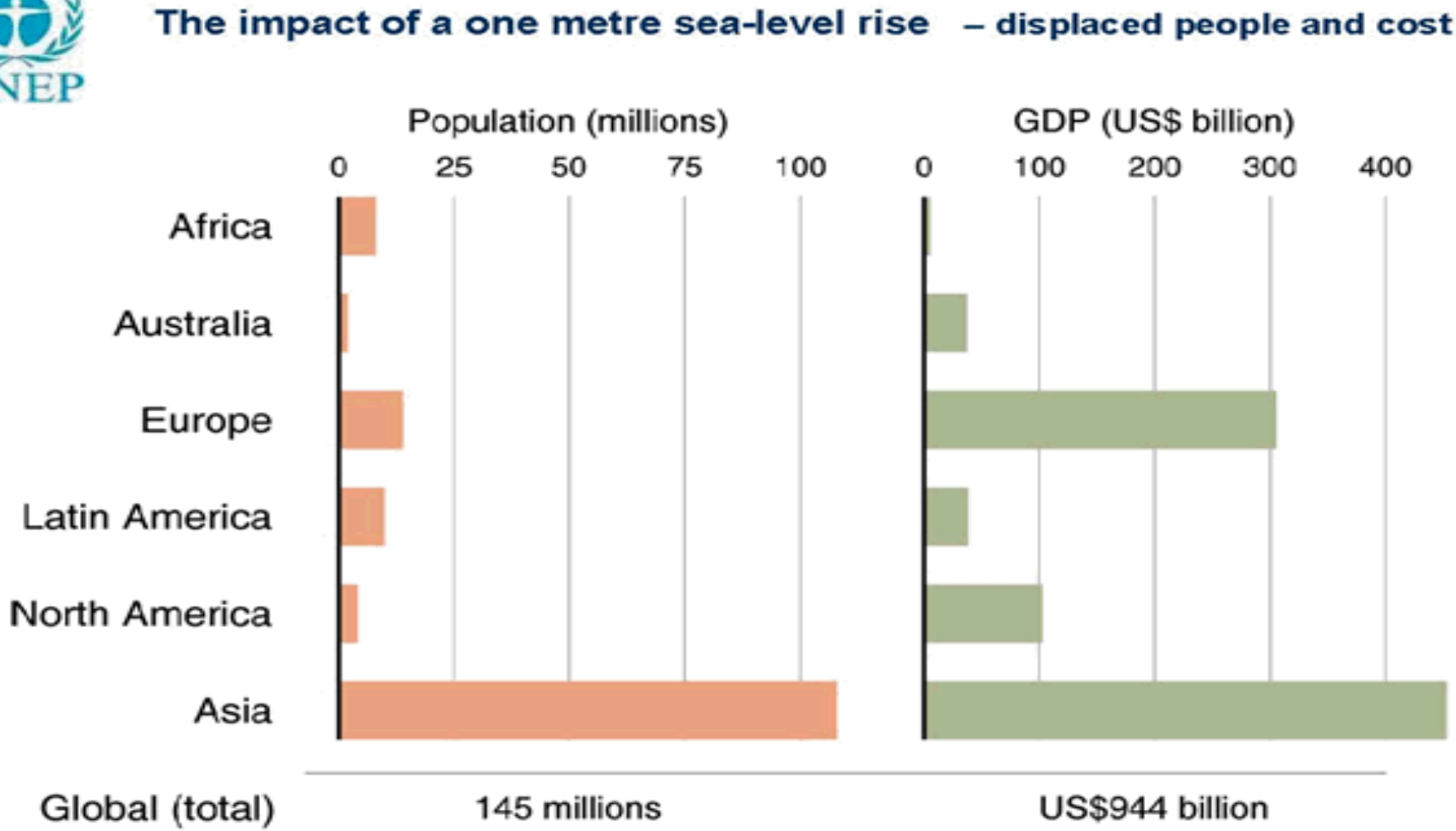
Asian Coastal Cities Sea Level Rise Vulnerability



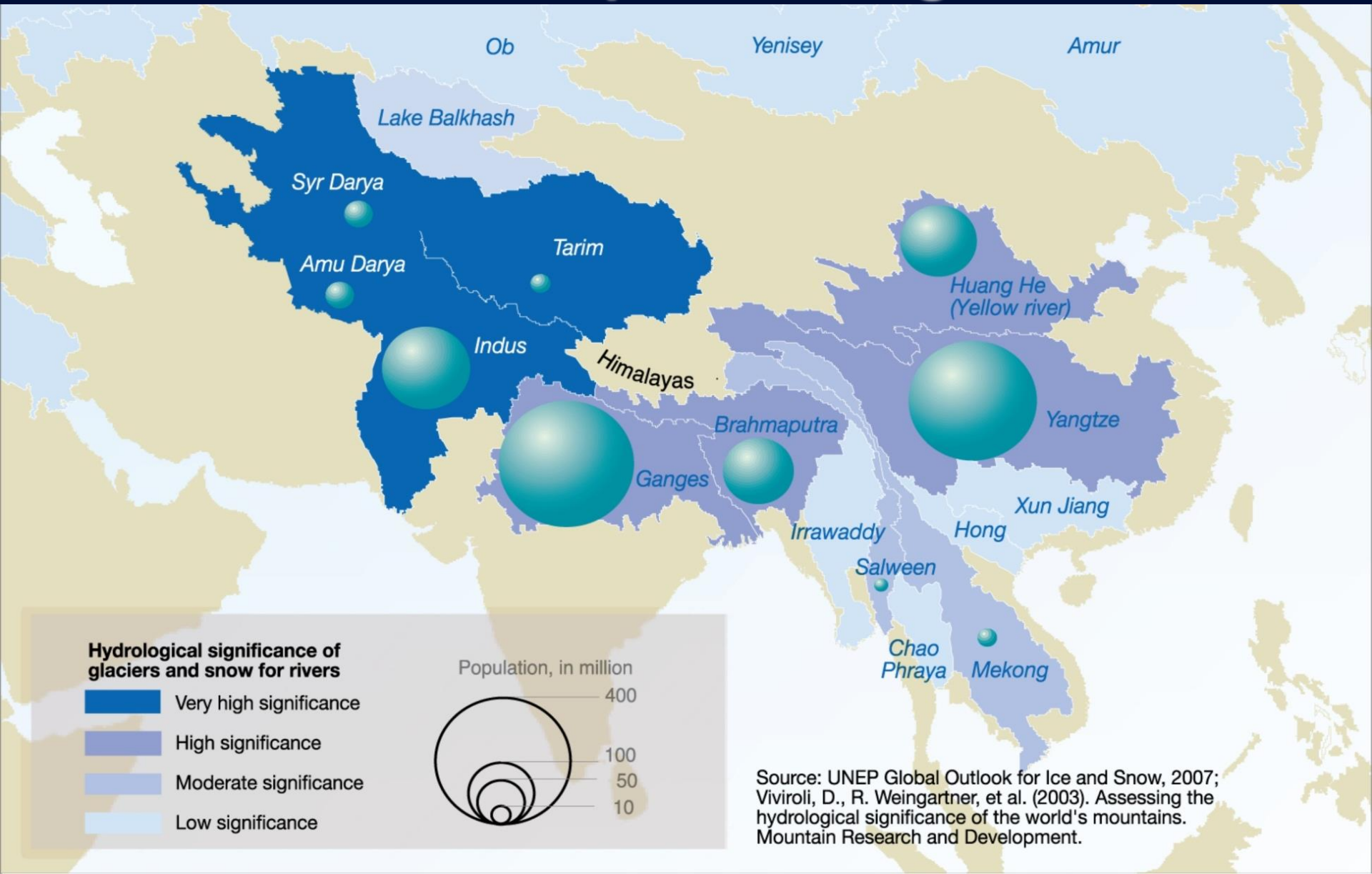
Source: UN-HABITAT Global Urban Observatory 2008

Which will result in large-scale displacement at great cost

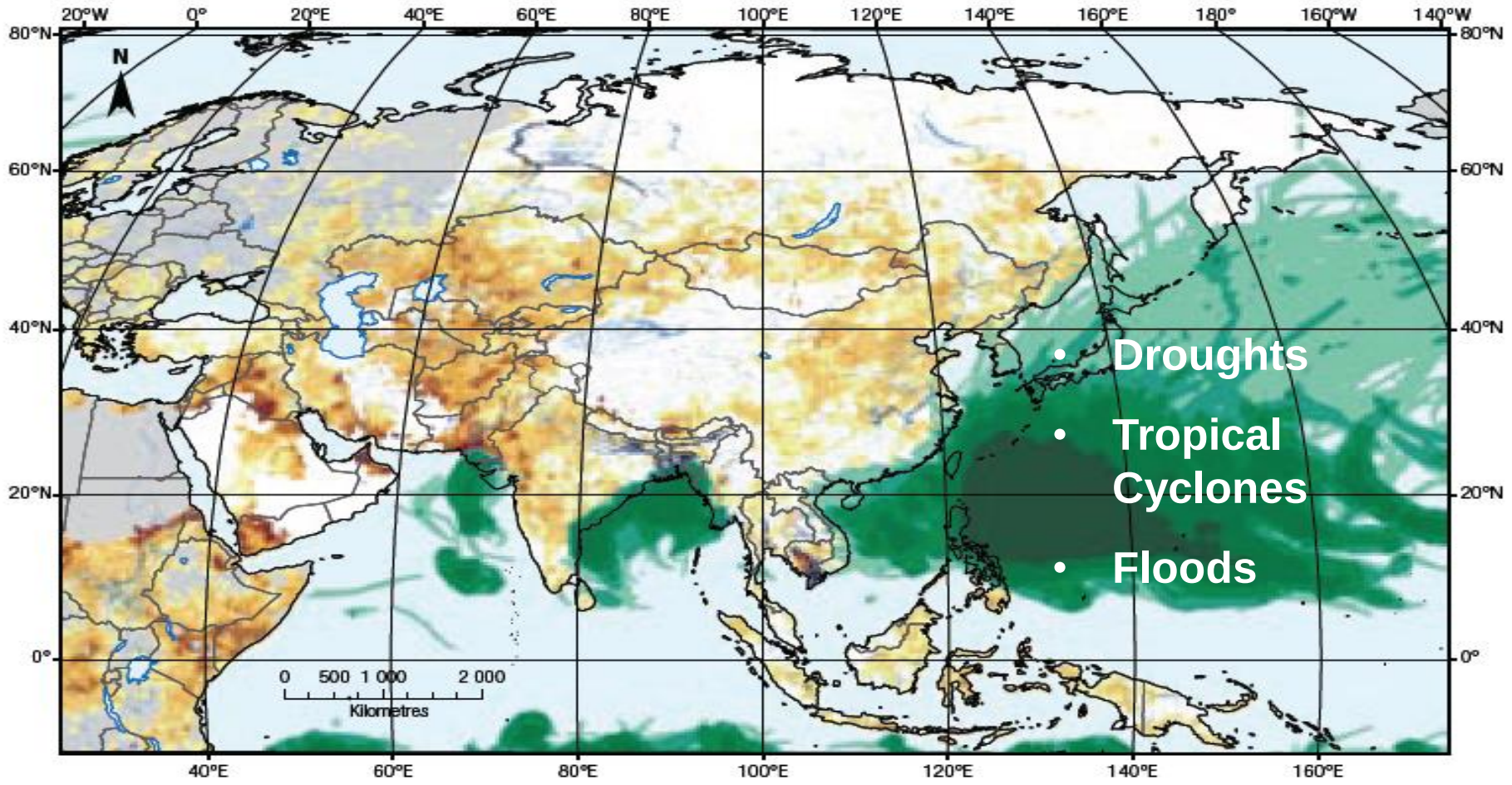
UNEP



Asia is Uniquely Vulnerable to Loss of Glacial and Snowpack Storage …



And to weather-related hazards …



Weather-related hazards

Droughts index
(frequency and intensity)
- Very high
- High
- Moderate high
- Moderate low
- Low

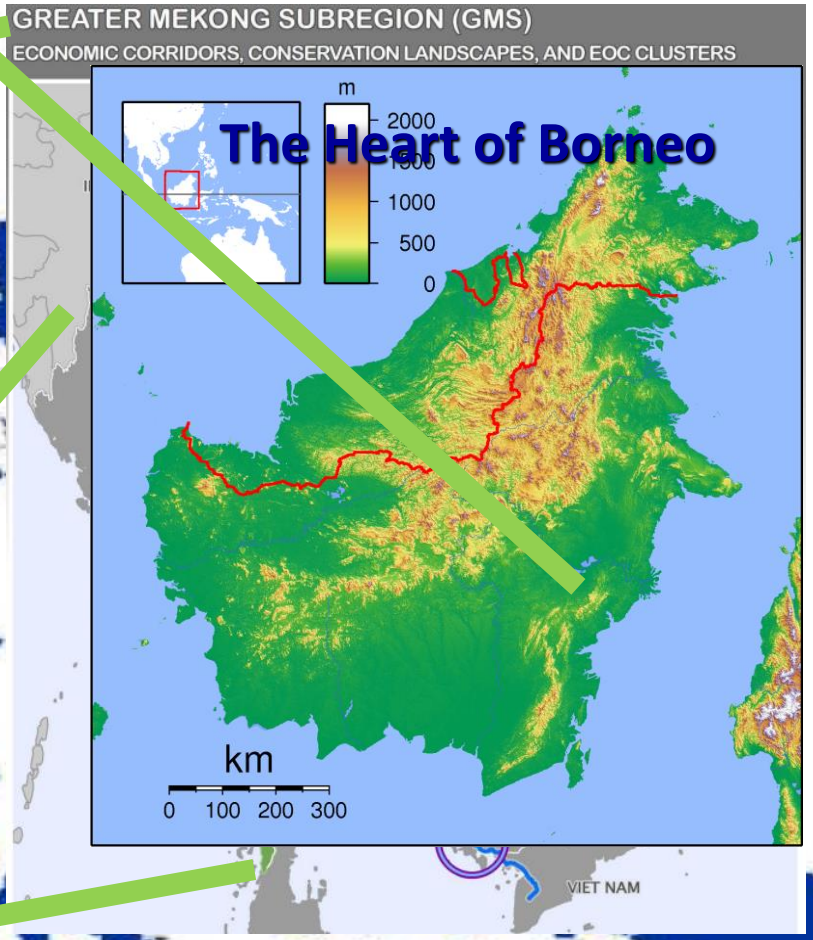
Tropical cyclones
(sum of winds in km/year)
- 100 000–426 510
- 30 000–100 000
- 10 000–30 000
- 3 000–10 000
- <3 000

Floods
(average annual frequency)
- >50
- 20–50
- <20

- Lakes and oceans
- Regional extent
- Other regions

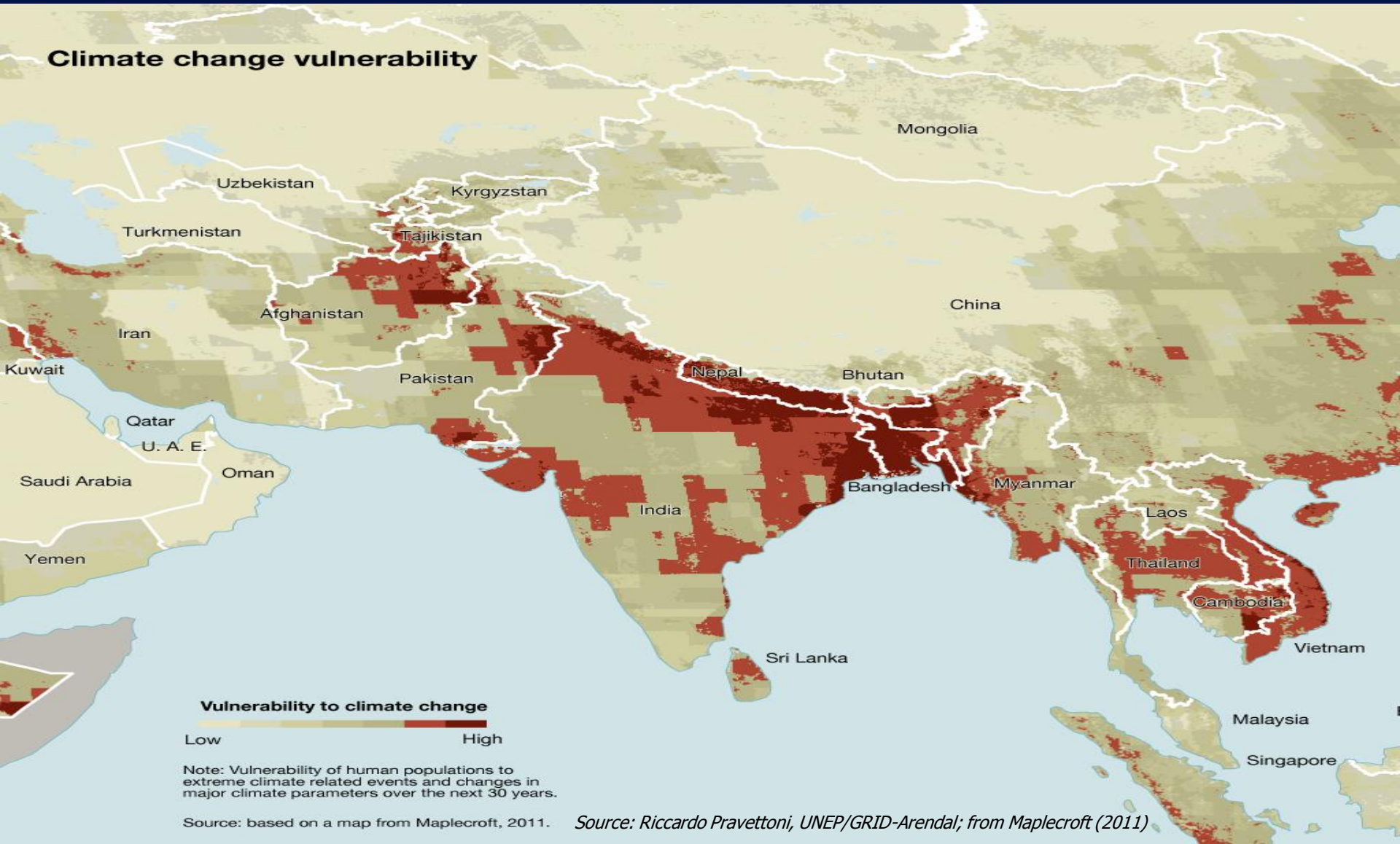
Source: UNISDR (2009) Chapter 2, Figure 2.2 p. 23

Risk of Irreversible Threats to Vital Ecosystems in Asia



Vulnerability Location-Specific

Need climate impact info at finer scales than is currently available



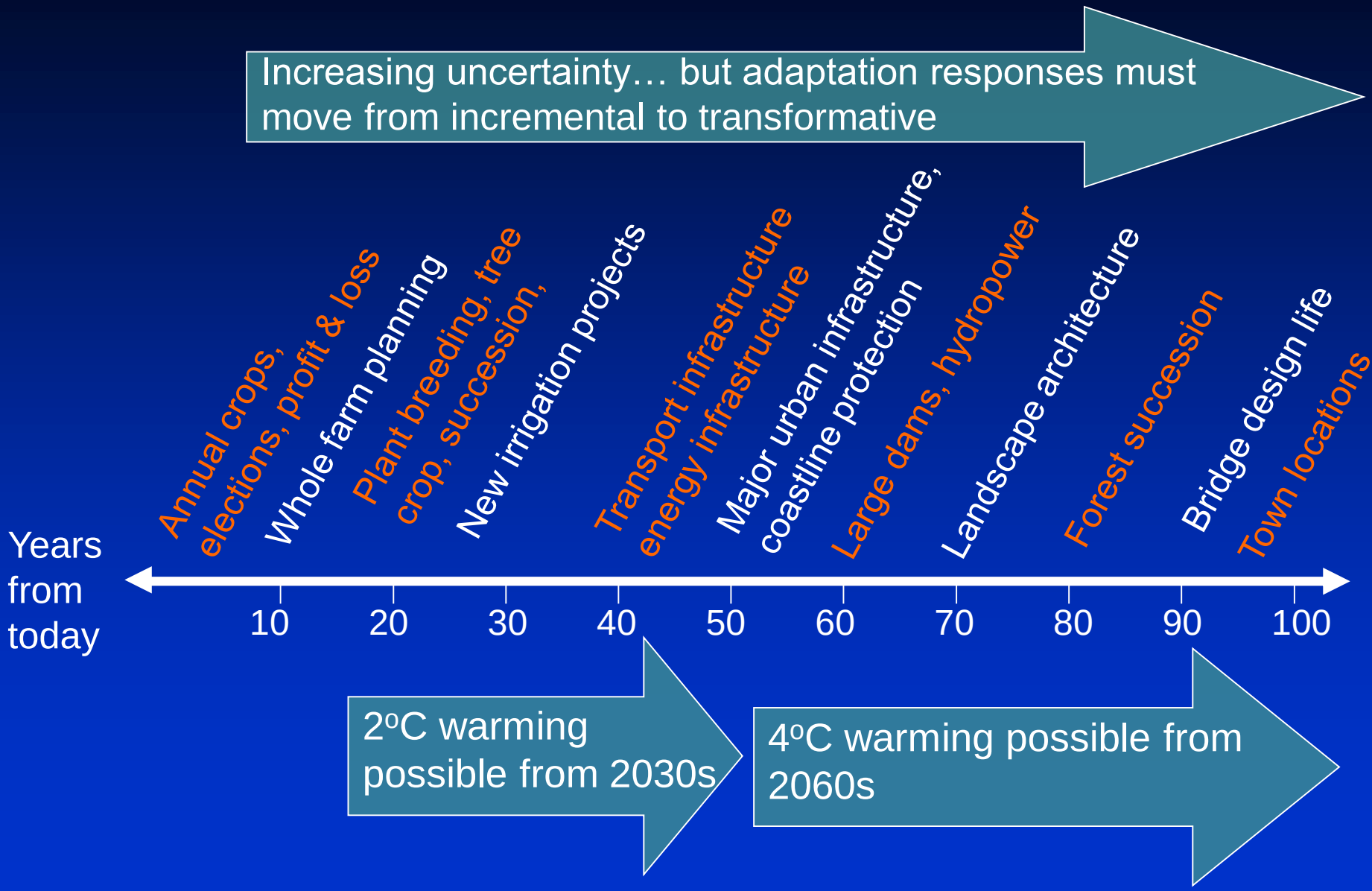
Source: Riccardo Pravettoni, UNEP/GRID-Arendal; from Maplecroft (2011)

5 Climate Threats: Countries at Most Risk

	Drought	Flooding	Storms	Sea Level Rise (1m)	Agriculture
1	Malawi	Bangladesh	Philippines	All low-lying Island states	Sudan
2	Ethiopia	China	Bangladesh	Vietnam	Senegal
3	Zimbabwe	India	Madagascar	Egypt	Zimbabwe
4	India	Cambodia	Vietnam	Tunisia	Mali
5	Mozambique	Mozambique	Moldova	Indonesia	Zambia
6	Niger	Laos	Mongolia	Mauritania	Morocco
7	Mauritania	Pakistan	Haiti	China	Niger
8	Eritrea	Sri Lanka	Samoa	Mexico	India
9	Sudan	Thailand	Tonga	Myanmar	Malawi
10	Chad	Vietnam	China	Bangladesh	Algeria

Source: World Bank (2009). *Convenient Solutions to an Inconvenient Truth: Ecosystem-based Approaches to Climate Change*, Environment Department.

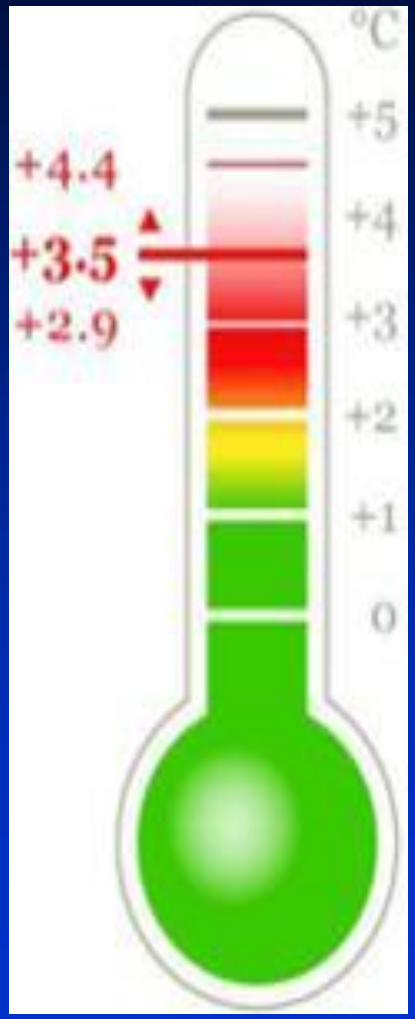
Investment Life and Adaptation Decisions



Source: Mark Stafford Smith et al, 2010

The 2^0 C Maximum Temp Increase Target

- Refers to maximum increase in global mean temperature from pre-industrial level to avoid dangerous climate change
- Recognized in Cancun Agreement (COP 16, 2010)
- Global mean warming would reach about 3.5°C by 2100 with the emission reduction proposals currently in Cancun and Durban Agreements, much more after…
- If no additional action taken before 2020, the risk of exceeding 2°C remains high



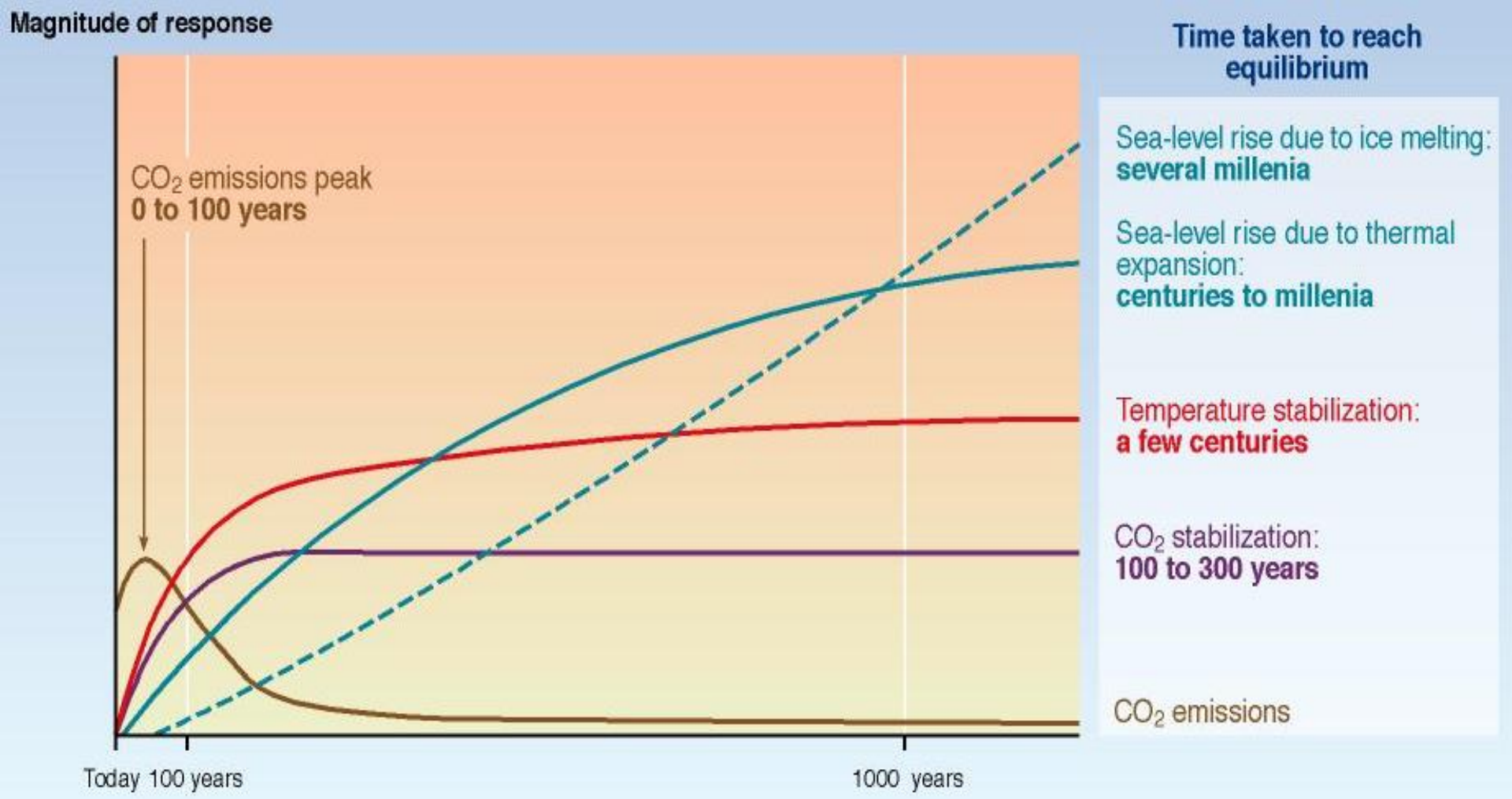
Source: Climate Action Tracker, 2011

The 2^0 C Target: Key Questions

- Why 2^0 C? What about 1.5^0 C called for by Small Island States?
- Is it realistic and achievable, given that full implementation of global action pledges would lead to a 3.5^0 C increase?
- [And noting that business as usual means about 5.5^0 C!]
- Key variables in pathways to stabilization:
  - Year of peak emissions
  - Rate of pre-peak emission increase
  - Rate of post-peak emission reduction
  - Long-term emission floor

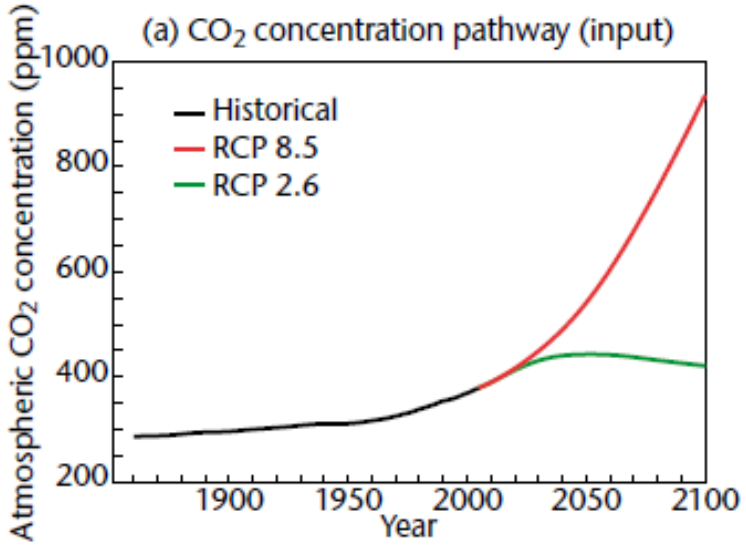
CO_2 Concentrations, Temperature, Sea Level – Continue to rise long after emissions are reduced

To stabilize at 550 ppm requires global emissions to peak between 2020 and 2030 at about 9 Gt C/year – current emissions = 50 Gt C/year !!



Need quick emissions reductions to 50% of current levels by 2050 to stay within 2°C

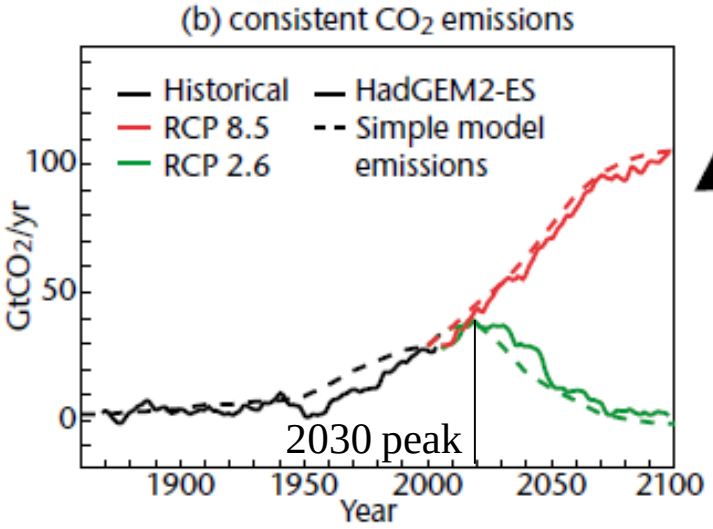
Met Office Hadley Centre (2010)
RCP = Representative Concentration Pathway

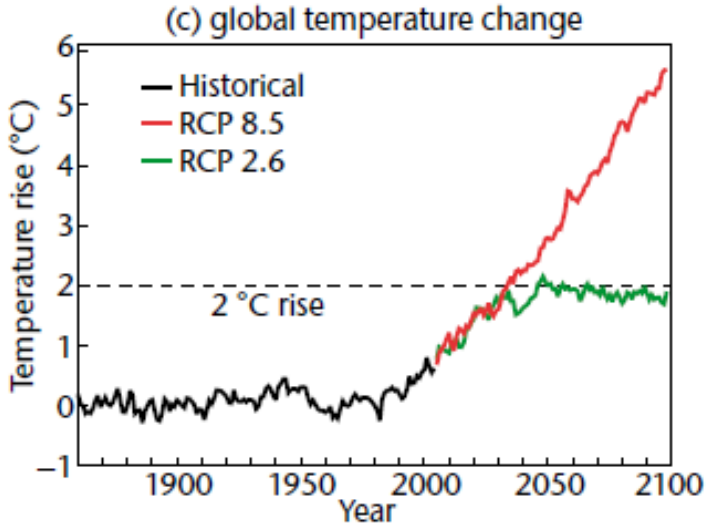


RCP 8.5 = BAU mitigation, approx. 1300 ppm by 2100

RCP 2.6 = strong mitigation, approx. 500 ppm by 2050 (peak of 2.1^{0}C), reducing to about 475 ppm by 2100 (1.5^{0}C)

HadGEM2-ES model





Likely Range of Atmospheric Concentrations Associated with Various Decrees of Warming

Stabilization CO_2-equivalent concentration (ppmv): range and best estimate			Equilibrium global average warming (°C)
320	← 340 →	380	1
370	← 430 →	540	2
440	← 540 →	760	3
530	← 670 →	1060	4
620	← 840 →	1490	5

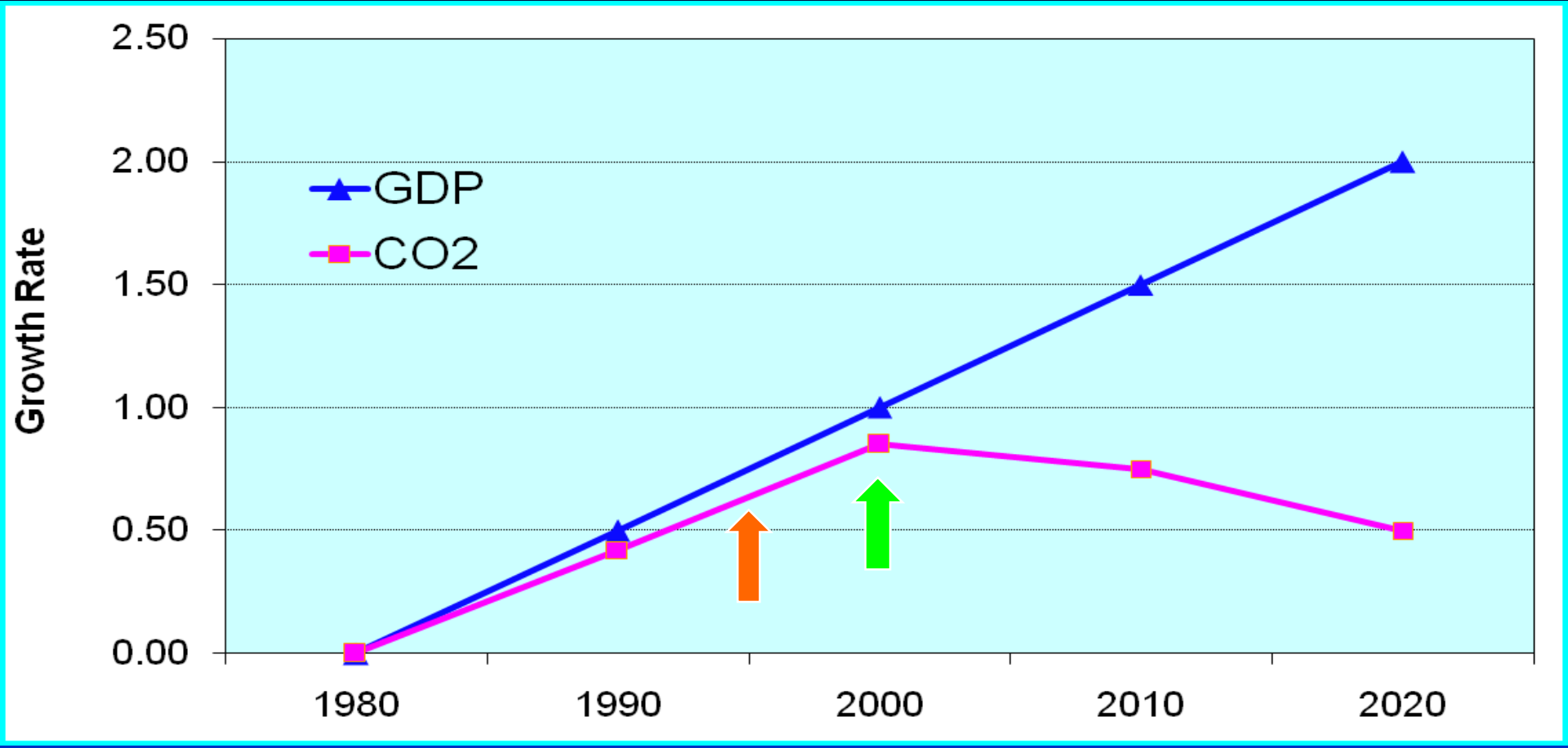
Note: Green and red numbers represent low and high ends of ranges, respectively; **black bolded** numbers represent best estimates.

US National Academy of Sciences (2010)

What Needs to be Done to Achieve the 2^0 C Maximum Temp Increase Target?

- Developed countries – rapid absolute decreases in GHG emissions
- Developing countries – relative decoupling of emissions from growth
- Global problem –> global solution
- Actions taken at regional, national, sub-national, and individual levels (with or without a global compact)

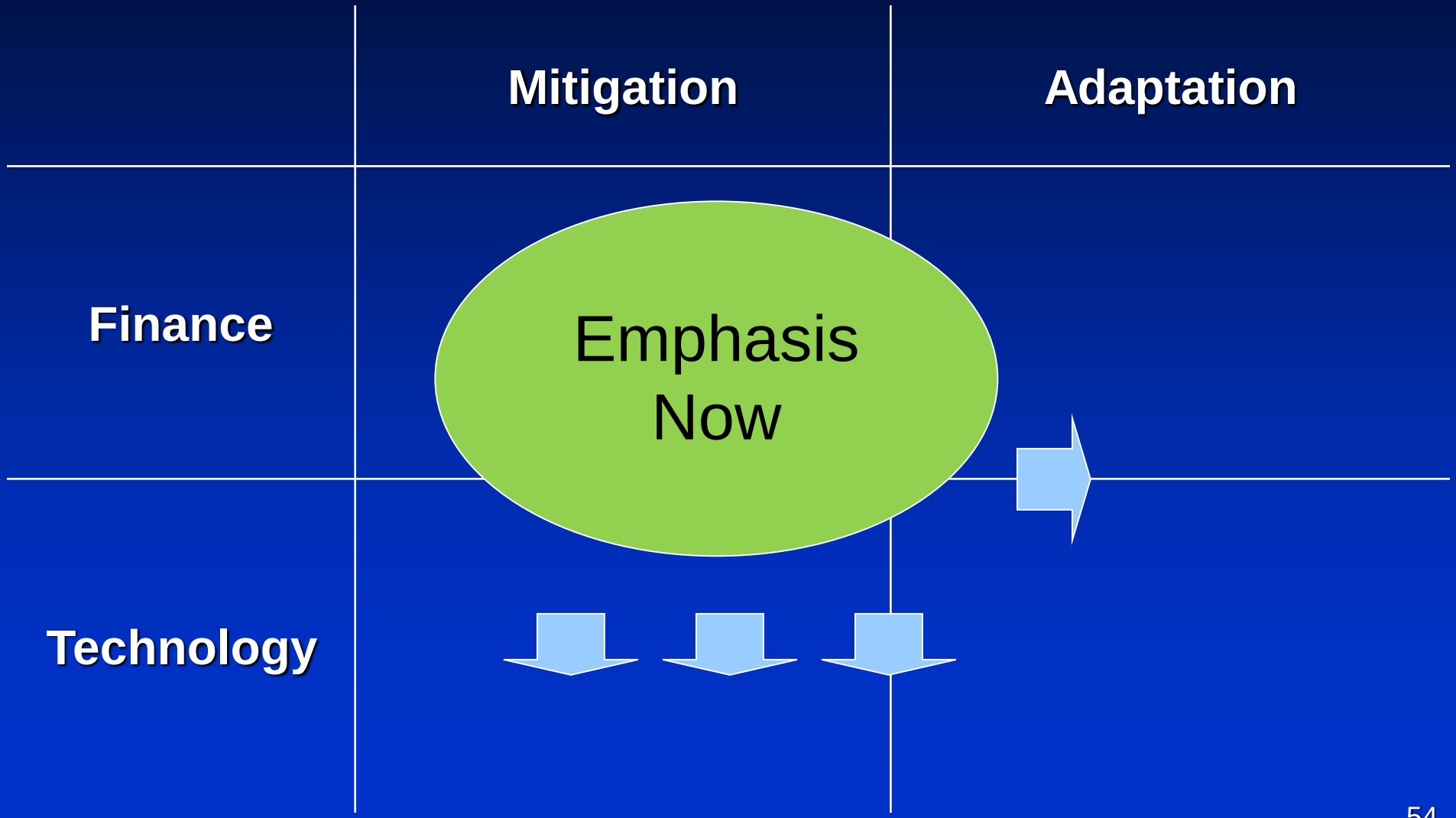
Biggest Challenge: Decoupling Economic Growth and GHG Emissions



Relative decoupling: emissions grow at a slower rate than economic growth

Absolute decoupling: emissions decline while economy grows

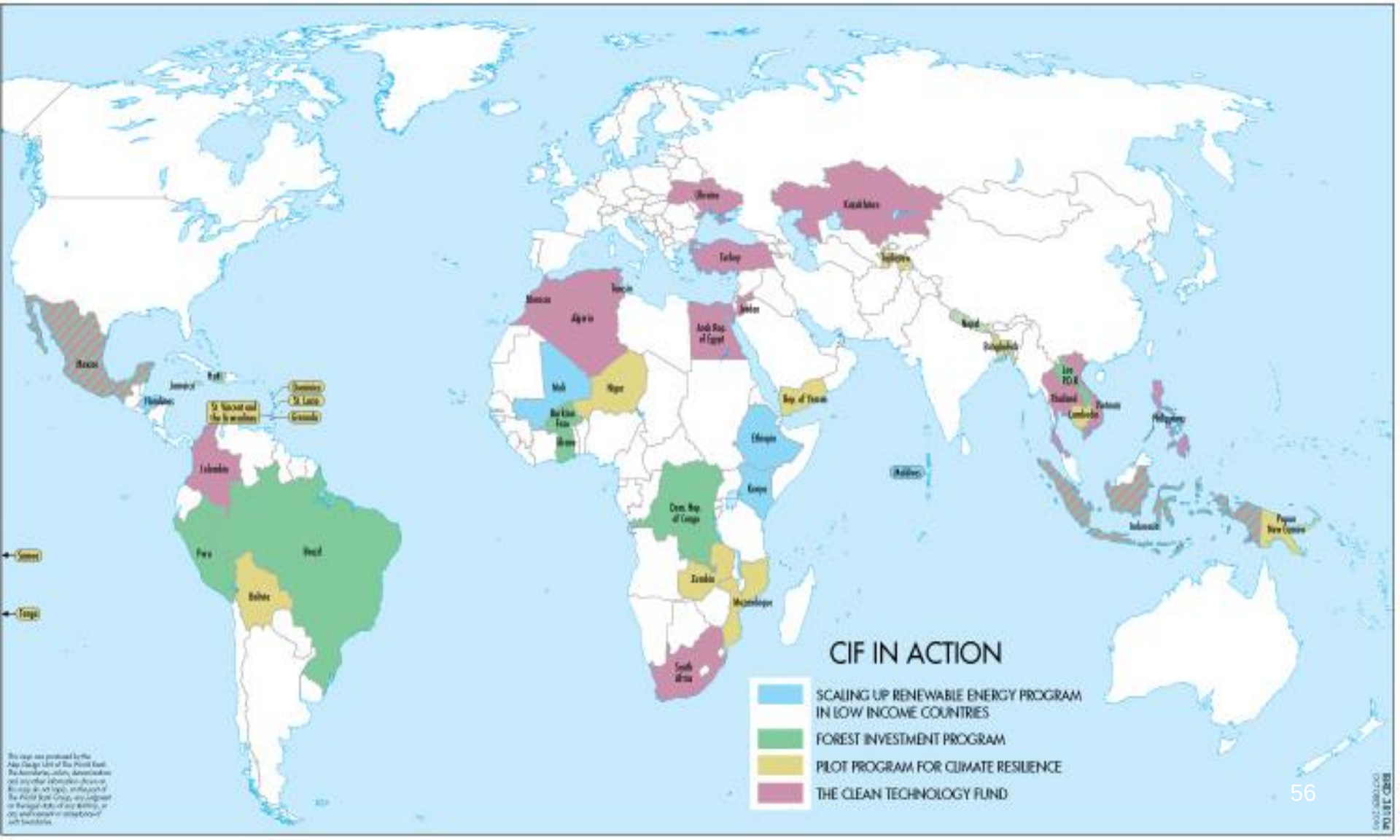
Bali Action Plan "Building Blocks" and Future Attention



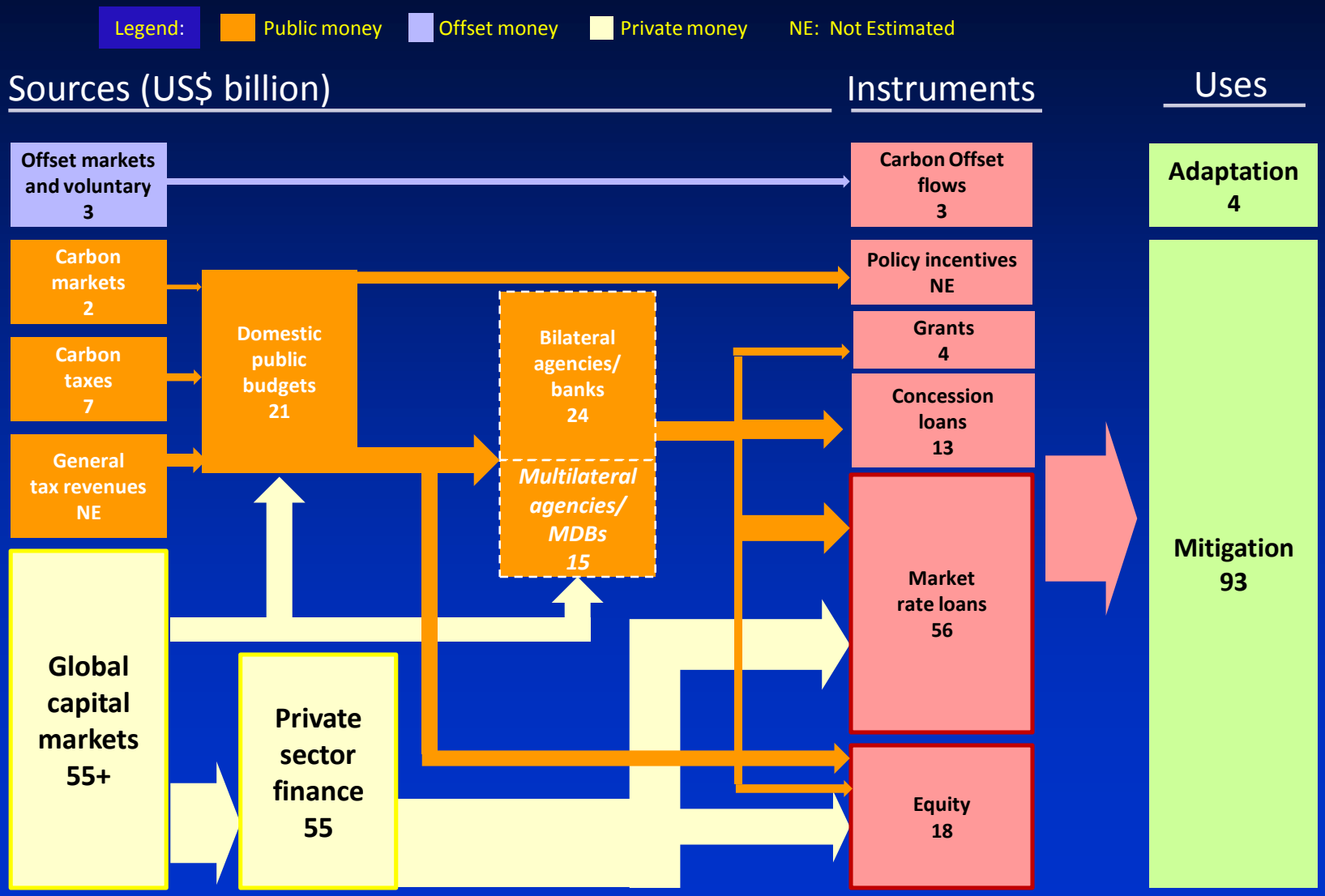
Categories of Pledged GHG Emission Reduction Actions for Selected Asian Countries

Project-level Activities	**Sector-level Activities**	**Economy-wide Targets**			
		Intensity Targets (GHG or CO2 / GDP)	Absolute Targets		
			Compared to Base Year	Compared to Business as Usual	Carbon Neutrality
Mongolia	Cambodia	PRC, India	Marshall Islands	Indonesia	Bhutan, Maldives

Climate Investment Funds:
45 Countries, $7.2 billion -> $45 billion



2010 Climate Financing for Developing Countries: $55b of $97b from the Private Sector



Source: Climate Policy Insitute, 2010 - Boxes and flows not drawn to scale

Conclusions

- **Climate change part of green economy** picture, but **dominates discussions for good reason**
- **Global problem needs global solution**, but **action is at lower levels** and not dependent on global compact
- **Asia and Pacific unique:** both the most vulnerable and largest source of new emissions
- **Inaction will lead to fundamental change** – affecting the very underpinnings of civilization
- **Political will must be found** to transform the global economy, especially energy sector – and quickly !!
- **Financing and technology** lie at the heart of solution, but **adaptation essential** to already inevitable impacts