CEECC TALK

Department of Environmental Economics

Centre for Environmental Economics
&
Climate Change (CEECC)
Pakistan Institute of Development Economics (PIDE)

Please join us in the seminar organized by Centre for Environmental Economics & Climate Change (CEECC) on "NEXUS BETWEEN CLIMATE CHANGE AND ENERGY"

KEYNOTE SPEAKER

Dr. TARIQ BANURI

Date: March 29, 2018 Time: 11:00 AM-12: 30 PM

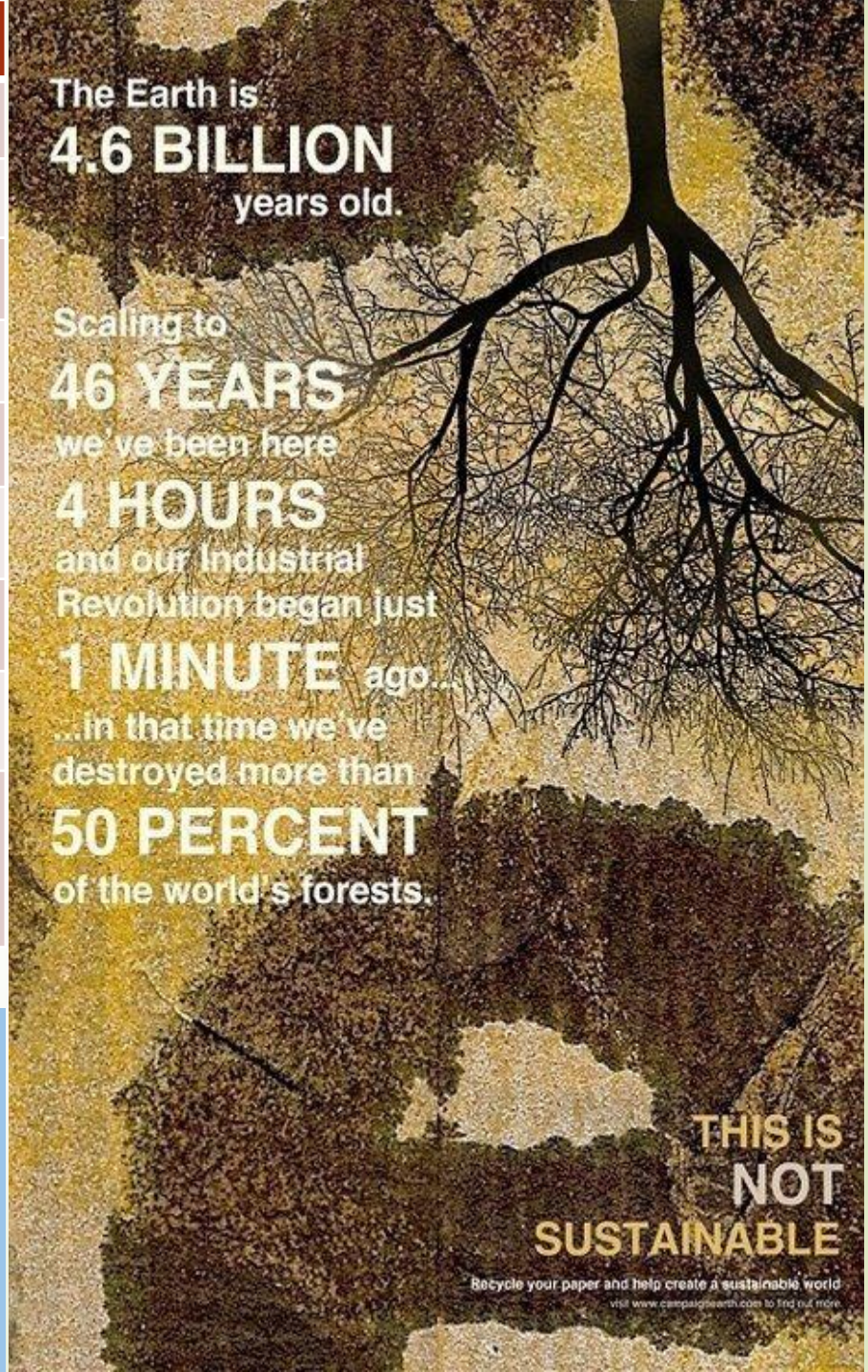
VENUE: AR KAMAL CONFERENCE HALL, PIDE ISLAMABAD

Pakistan Institute of Development Economics

http://www.pide.org.pk @ceecc-pide @ceeccpide

Year	Event
29.3.1972	Earth is formed
29.3.1975	First life on Earth
29.3.1980	Photosynthesis starts
29.3.1992	Atmospheric oxygen
29.3.2009	Cambrian explosion
29.3.2011	Vertebrate land animals
2016-17	Dinosaurs
Today	**4 hours ago: First Humans**
Today	**I minute ago: Industrial Revolution begins**

Climate, Energy, and Pakistan



Climate Change

The Science

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(1) It is real, (2) it is here, (3) it is here to stay (for a bit), (4) we caused it, (5) we are sure, (6) we know how to fix it, (7) but only if we cooperate, (8) and the window is short, and closing fast, (9) there will be pain nevertheless, (10) we will have to adapt, (11) we also have to learn to prosper in a world defined by climate change, (12) developing countries will need help in adaptation, mitigation, and the pursuit of prosperity.

The Role of Atmospheric CO_2

- Atmospheric CO_2 is now higher than it has been in at least 800,000 years, possibly as long as 20 million years. CO2 is rising because we're burning fossil fuels. It has carbon that's been buried underground for millions of years, but now we're digging it up and burning it, which results in CO2 that gets dumped in the easiest and cheapest way possible: in the atmosphere.

Sources and Sinks

Where humanity's CO2 comes from

91% 33.4 billion metric tonnes

Fossil Fuels & Cement 2010

9% 3.3 billion metric tonnes

Land Use Change 2010

Where humanity's CO2 goes

50% 18.4 billion metric tonnes

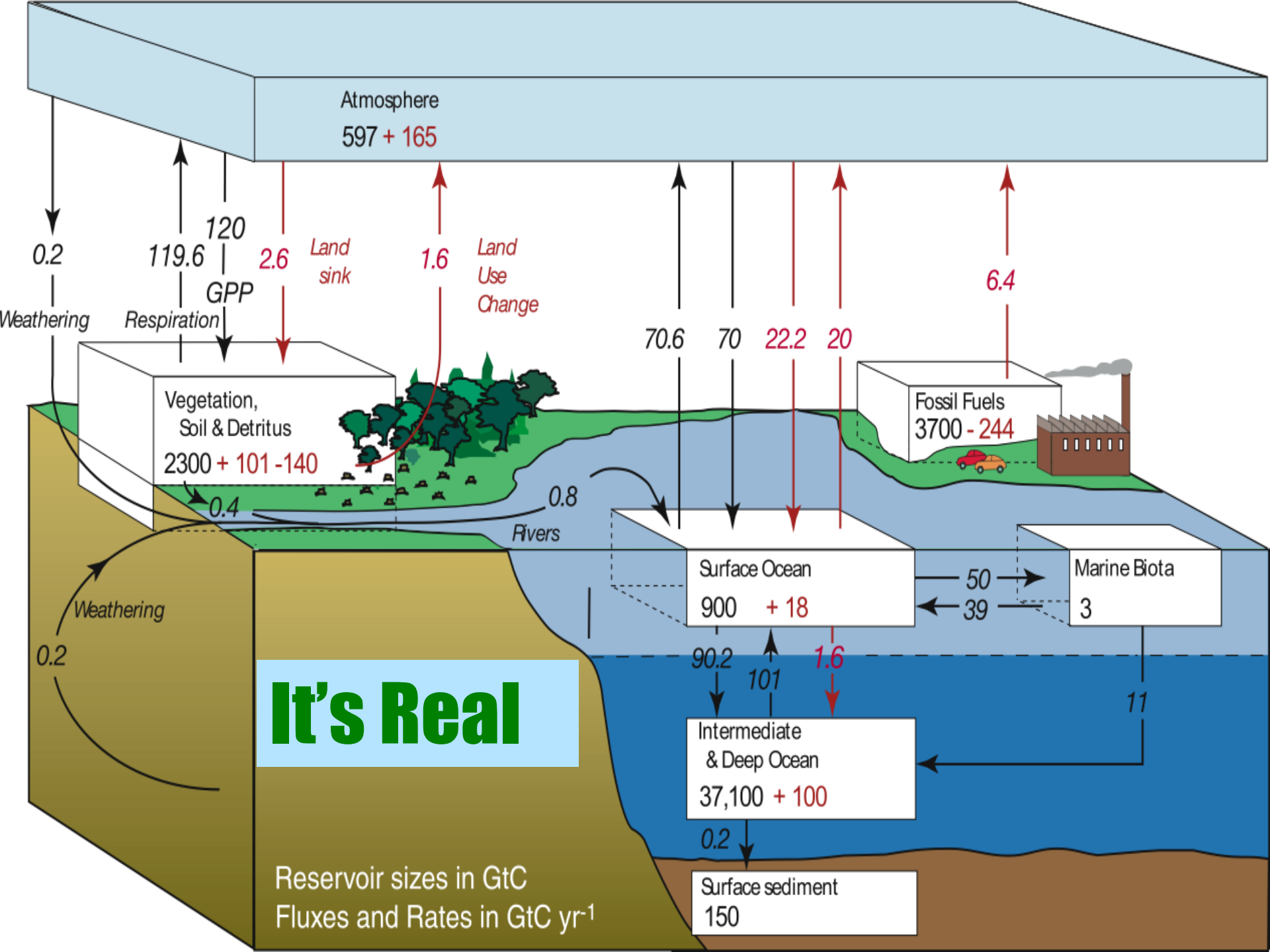
Atmosphere 2010

26% 9.5 billion metric tonnes

Land 2010

24% 8.8 billion metric tonnes

Oceans 2010


Atmosphere
597 + 165
0.2
119.6
120
GPP
2.6
Land sink
1.6
Land Use Change
6.4
Weathering
Respiration
70.6
70
22.2
20
Vegetation, Soil & Detritus
2300 + 101 -140
Fossil Fuels
3700 - 244
0.4
0.8
Rivers
Surface Ocean
900 + 18
50
39
Marine Biota
3
Weathering
0.2
90.2
101
1.6
11
It's Real
Intermediate & Deep Ocean
37,100 + 100
0.2
Surface sediment
150
Reservoir sizes in GtC
Fluxes and Rates in GtC yr-1

It's Here!

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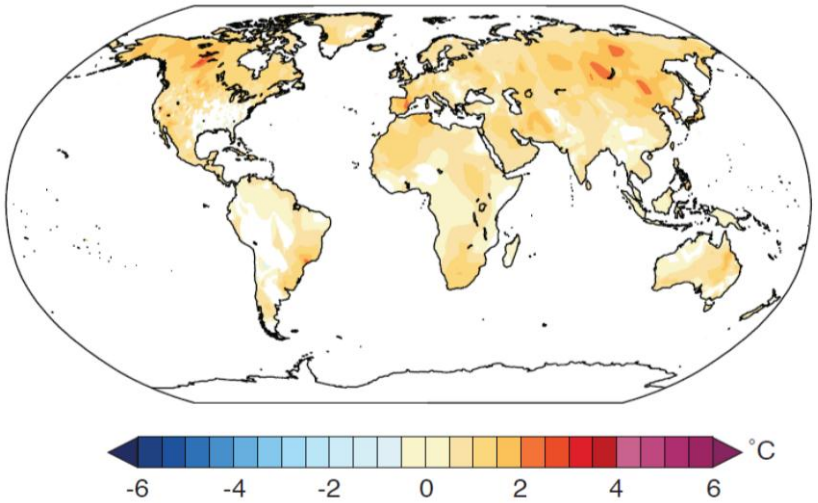
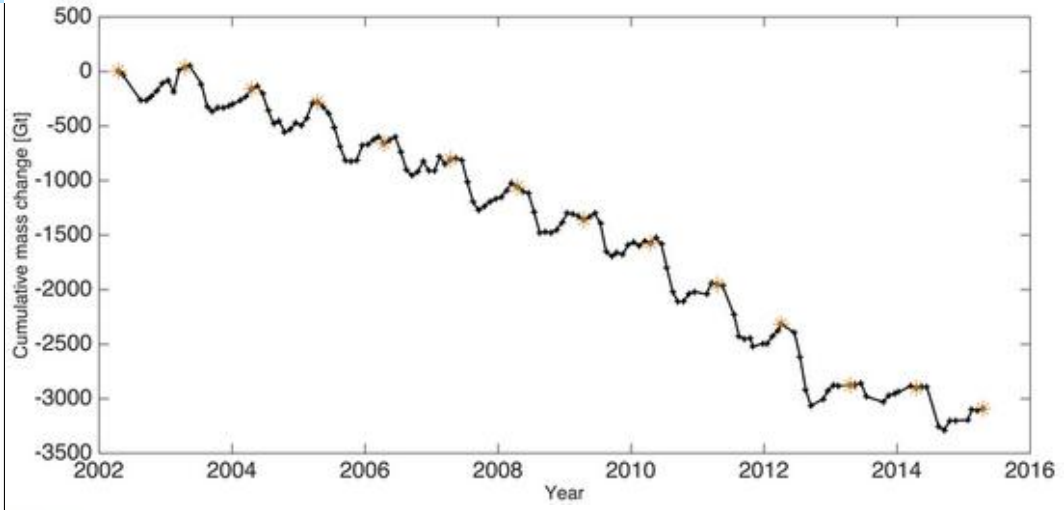
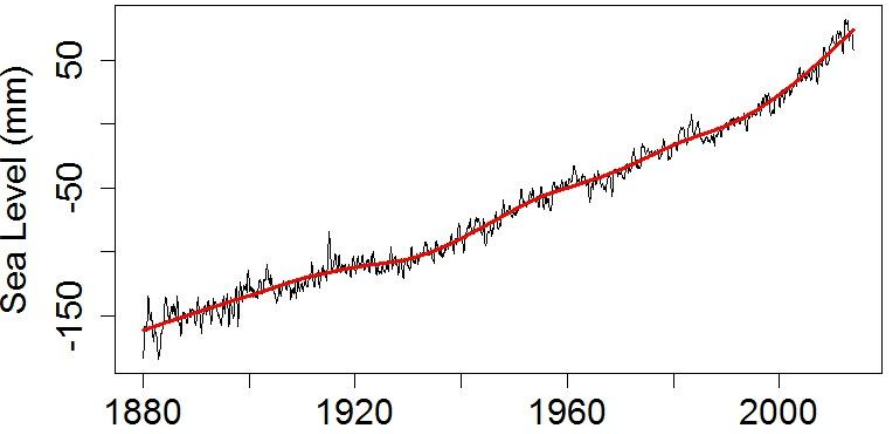
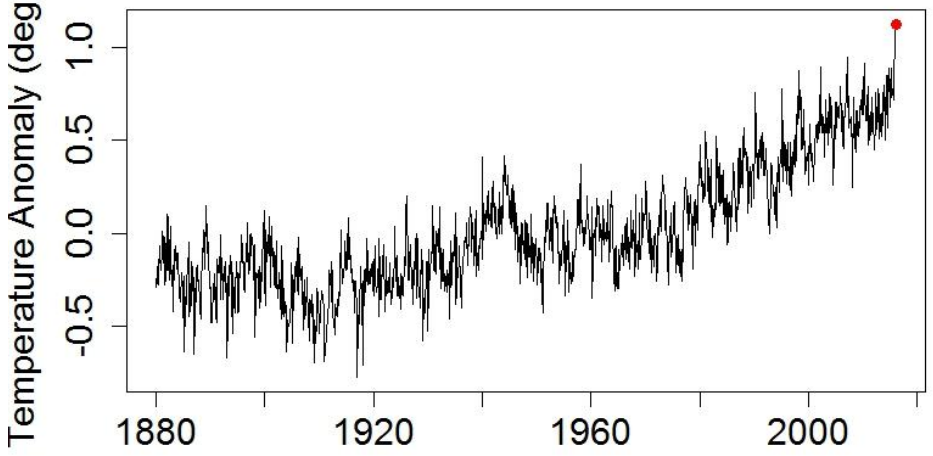




From Tide Gauges



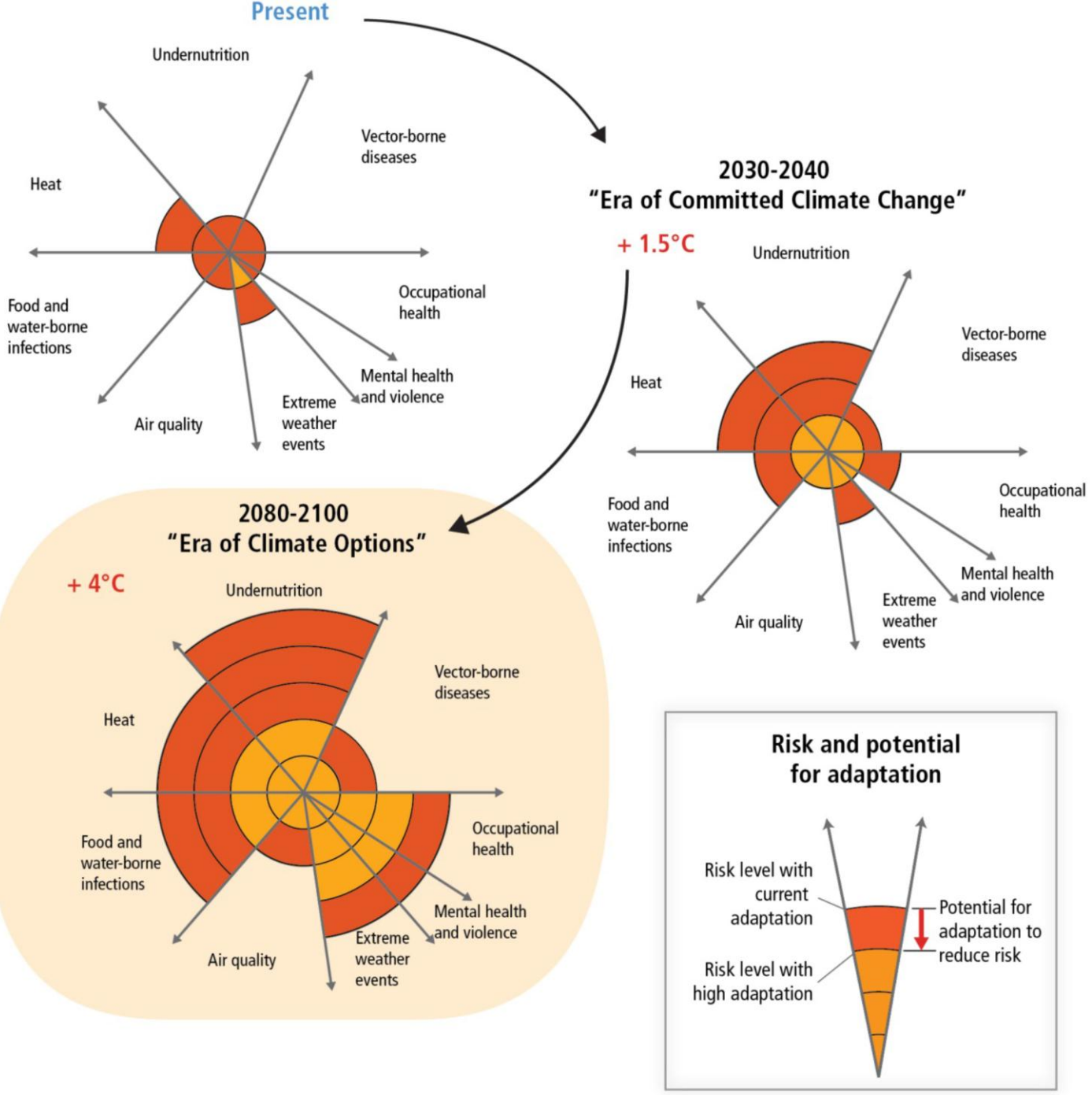
NASA



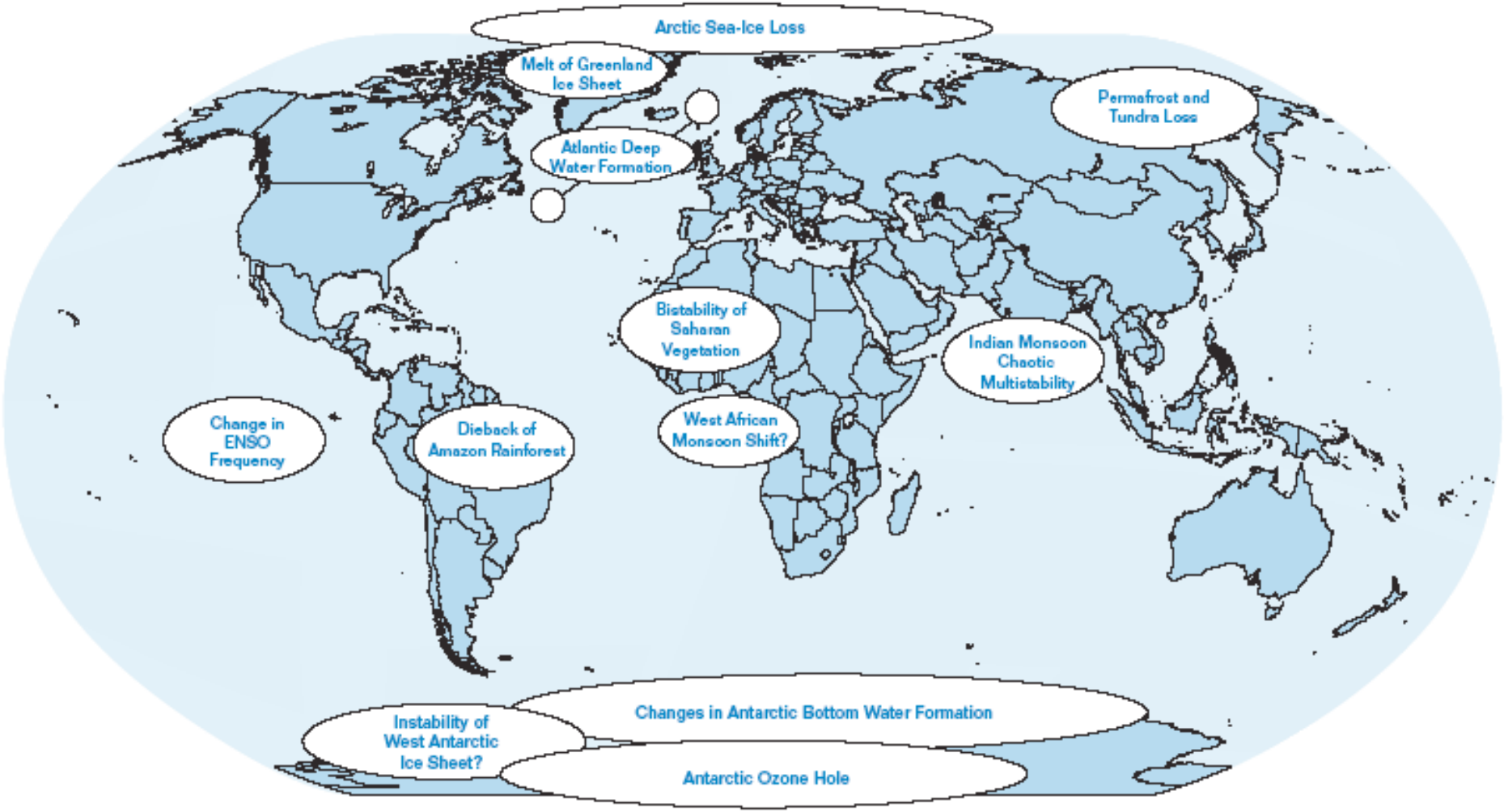
Other Changes

- Species are migrating to higher latitudes and elevations because areas that used to be the right temperature for them, are no longer.
- Plants are blooming earlier than before.
- Heat waves have increased dramatically in some regions, too often exacting a heavy death toll.
- Some places have become more prone to severe drought, while others are more prone to severe flooding.
- Etc.

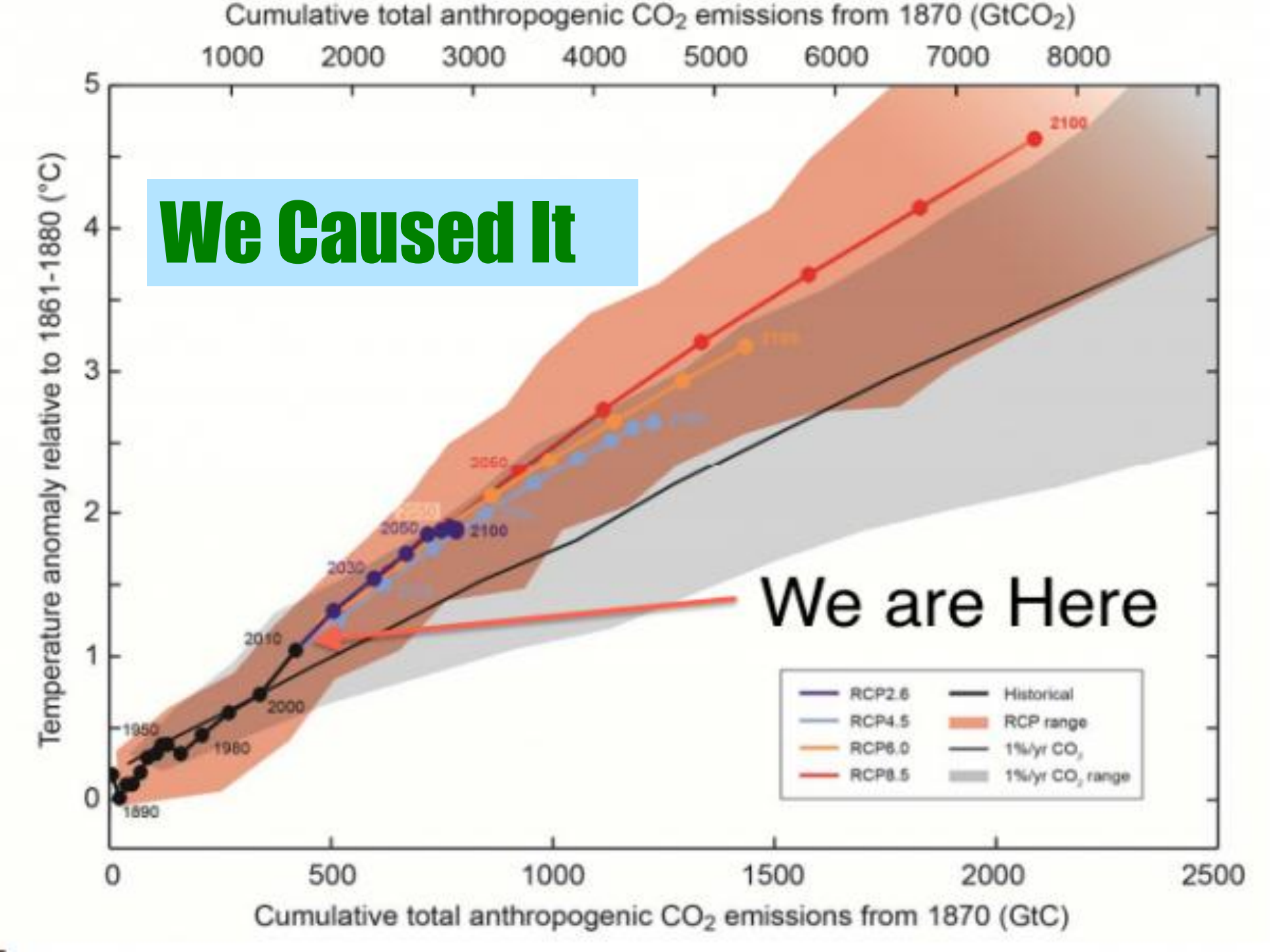
Here to Stay!


Present
Undernutrition
Vector-borne diseases
Heat
Occupational health
Food and water-borne infections
Mental health and violence
Air quality
Extreme weather events
2030-2040
"Era of Committed Climate Change"
+ 1.5°C
Undernutrition
Vector-borne diseases
Heat
Occupational health
Food and water-borne infections
Mental health and violence
Air quality
Extreme weather events
2080-2100
"Era of Climate Options"
+ 4°C
Undernutrition
Vector-borne diseases
Heat
Occupational health
Food and water-borne infections
Mental health and violence
Air quality
Extreme weather events
Risk and potential for adaptation
Risk level with current adaptation
Potential for adaptation to reduce risk
Risk level with high adaptation

Tipping Points



The Earth's "Tipping Points"


Cumulative total anthropogenic CO_2 emissions from 1870 ($GtCO_2$)
1000
2000
3000
4000
5000
6000
7000
8000
We Caused It
Temperature anomaly relative to 1861-1880 (°C)
0
1
2
3
4
5
1890
1950
1980
2000
2010
2030
2050
2100
We are Here
RCP2.6
RCP4.5
RCP6.0
RCP8.5
Historical
RCP range
1%/yr CO_2
1%/yr CO_2 range
0
500
1000
1500
2000
2500
Cumulative total anthropogenic CO_2 emissions from 1870 (GtC)

We're Sure

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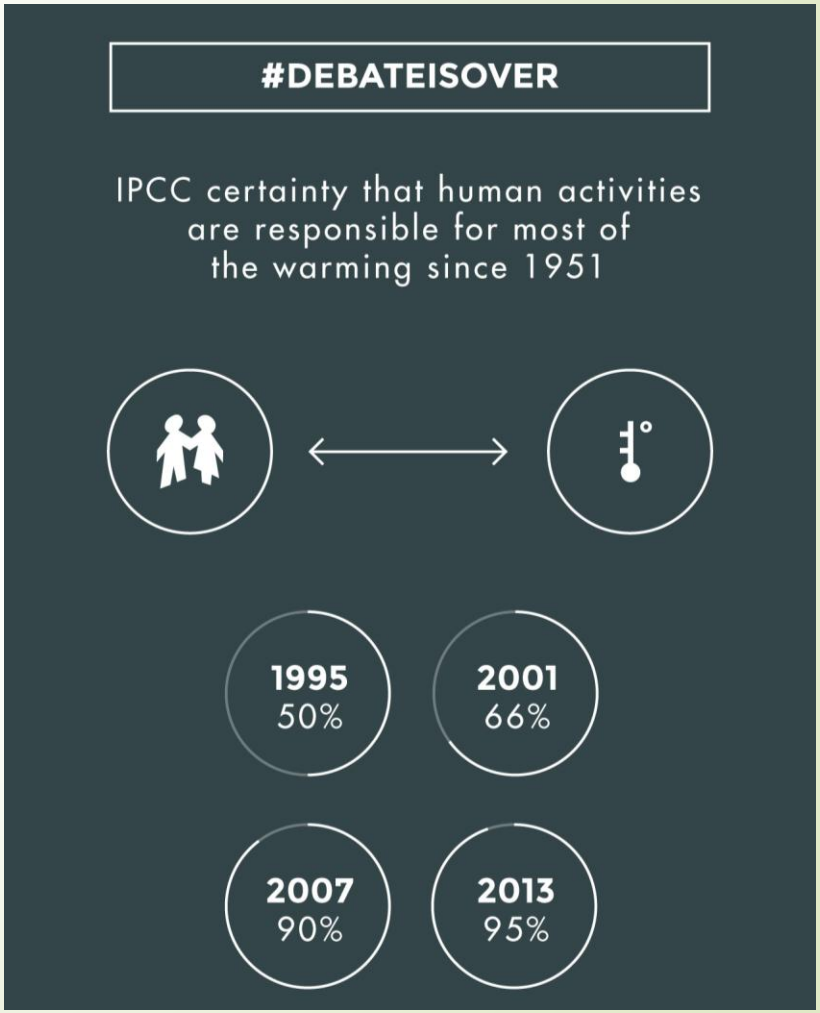
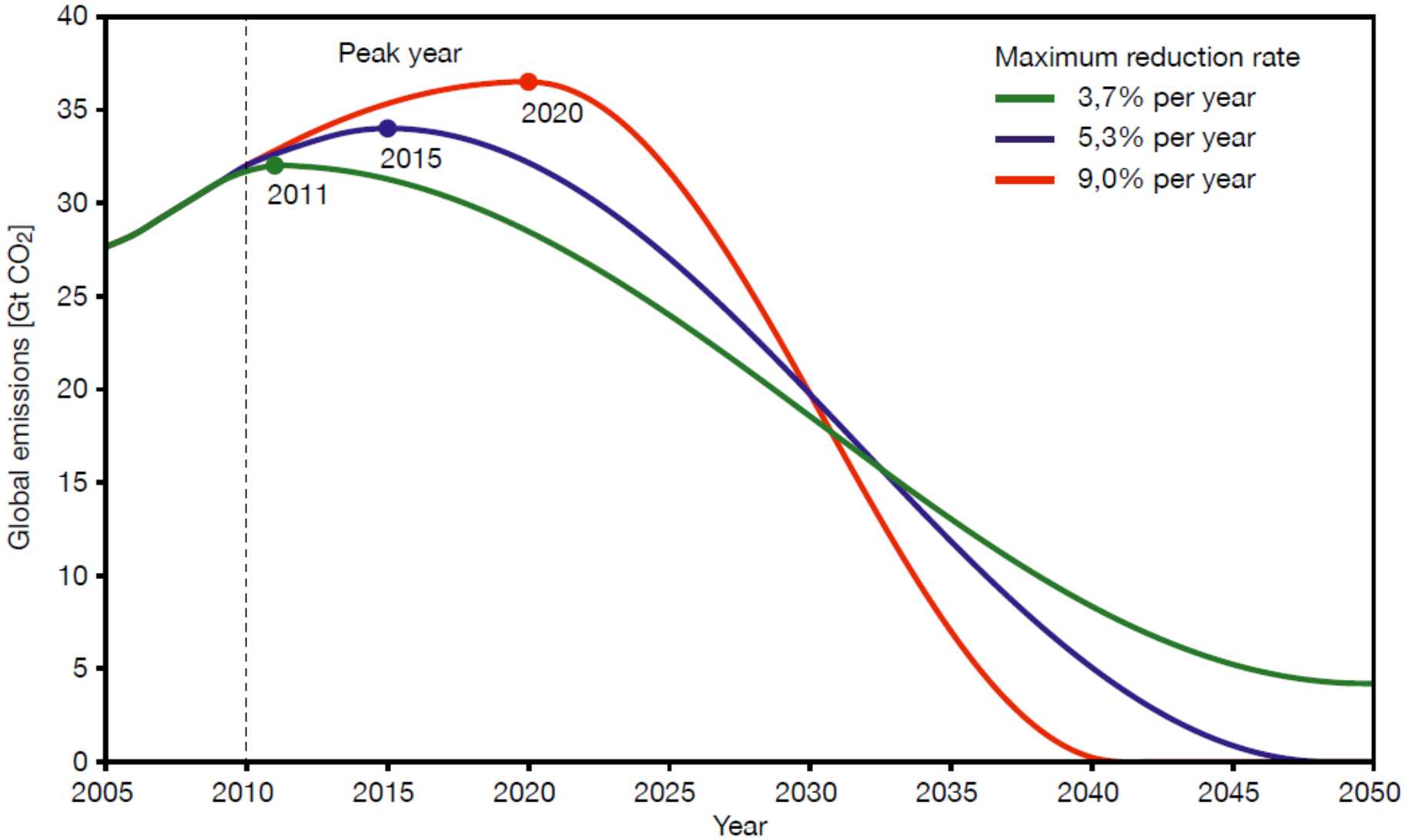
- Recent findings don't reveal something new, but confirm earlier ones (higher confidence, both qualitative and quantitative, and higher likelihoods), show acceleration, and provide more regional and thematic detail.
- There *is* some good news, but ambiguous, and will need investment to be realized: increase in water availability in some places (but probably w floods), lower risks of eutrophication or algae blooms, more effective wastewater treatment.

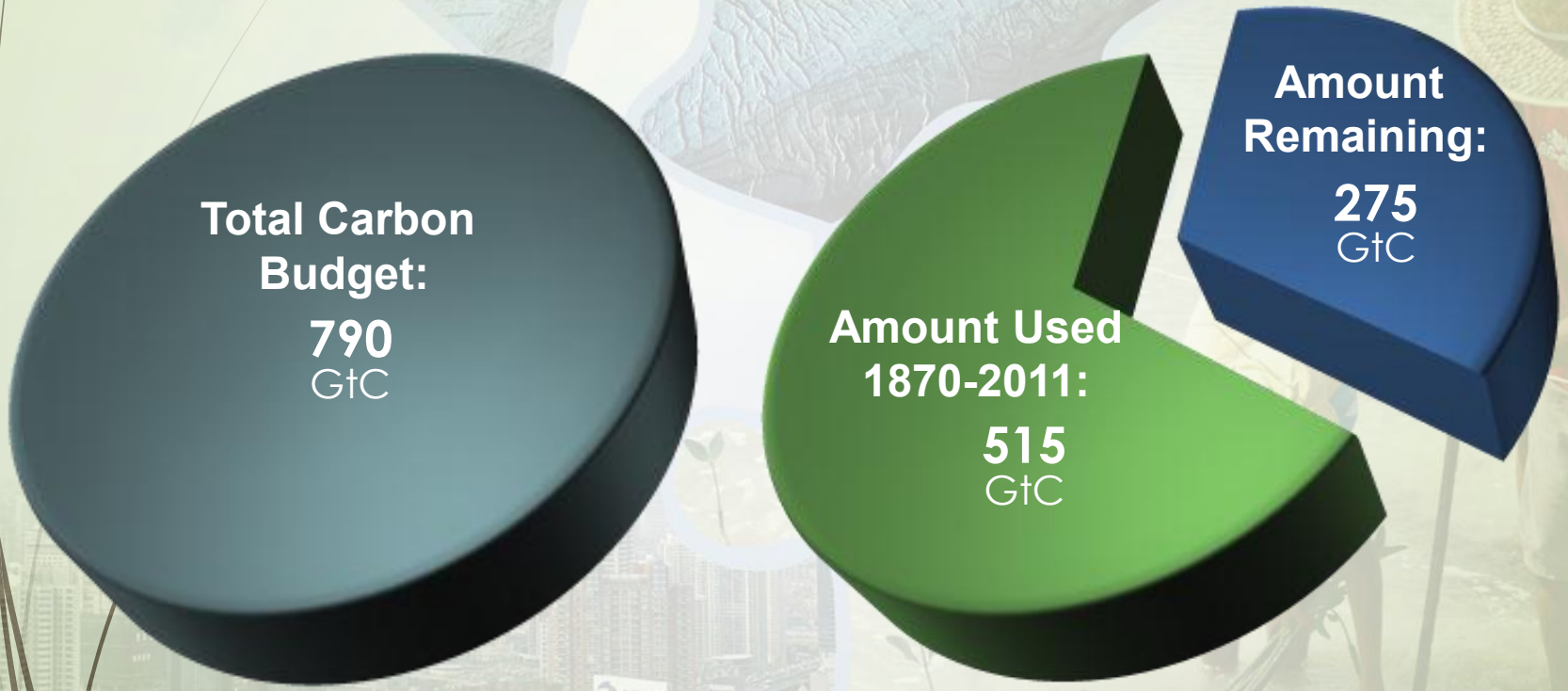


We Can Fix it!


Peak year
2011
2015
2020
Maximum reduction rate
3,7% per year
5,3% per year
9,0% per year
Global emissions [Gt CO_2]
Year
0
5
10
15
20
25
30
35
40
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050

But the window for action is closing rapidly

65% of our carbon budget compatible with a 2°C goal already used



AR5 WGI SPM

ipcc
INTERGOVERNMENTAL PANEL ON climate change
WMO UNEP

Potential Climate Change Impacts

Climate Changes

Temperature

Precipitation

Sea Level Rise

Health Impacts

Weather-related Mortality
Infectious Diseases
Air Quality-Respiratory Illnesses

Agriculture Impacts

Crop yields
Irrigation demands

Forest Impacts

Change in forest composition
Shift geographic range of forests
Forest Health and Productivity

Water Resource Impacts

Changes in water supply
Water quality
Increased Competition for water

Impacts on Coastal Areas

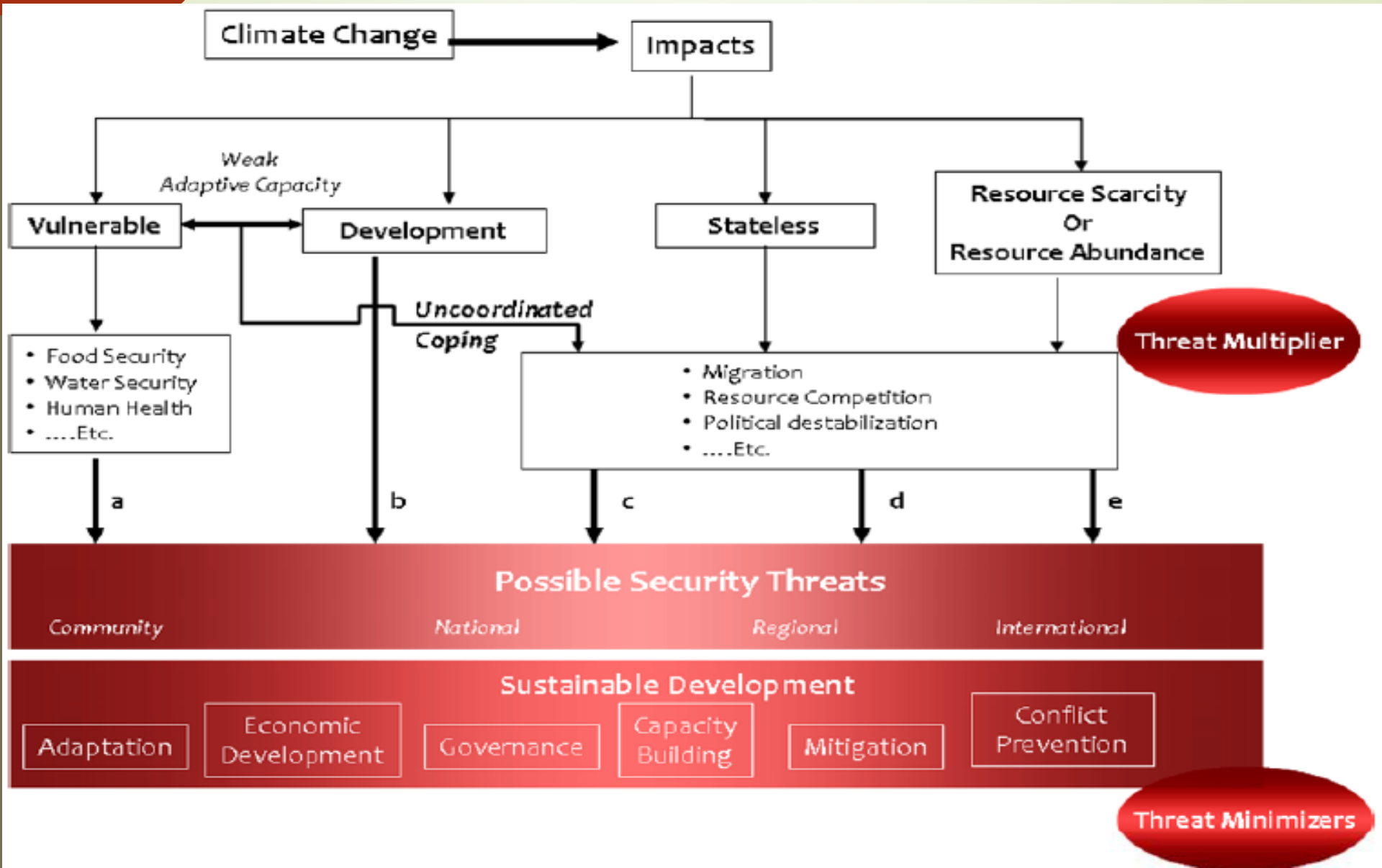
Erosion of beaches
Inundate coastal lands
Costs to defend coastal communities

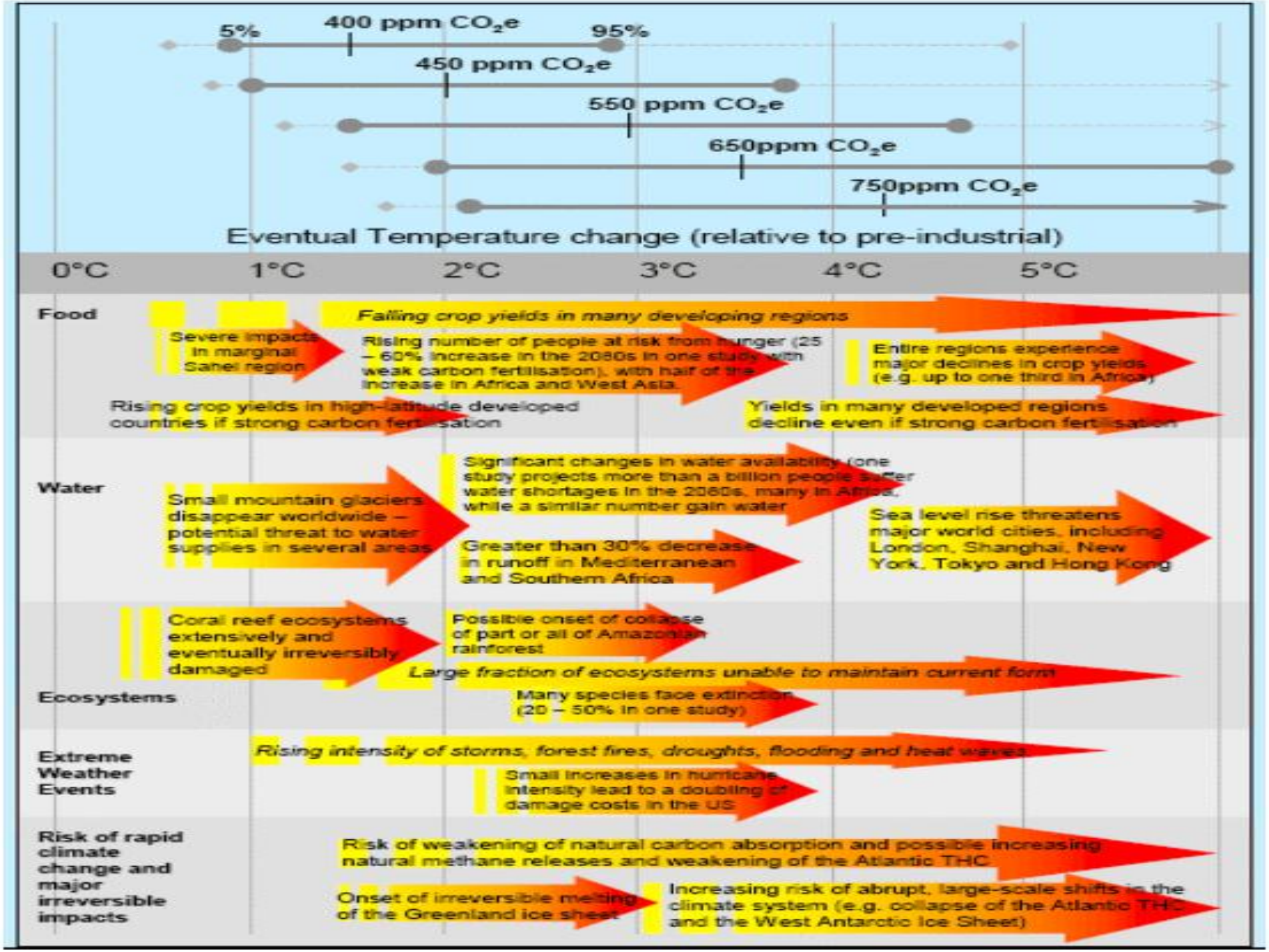
Species and Natural Areas

Shift in ecological zones
Loss of habitat and species

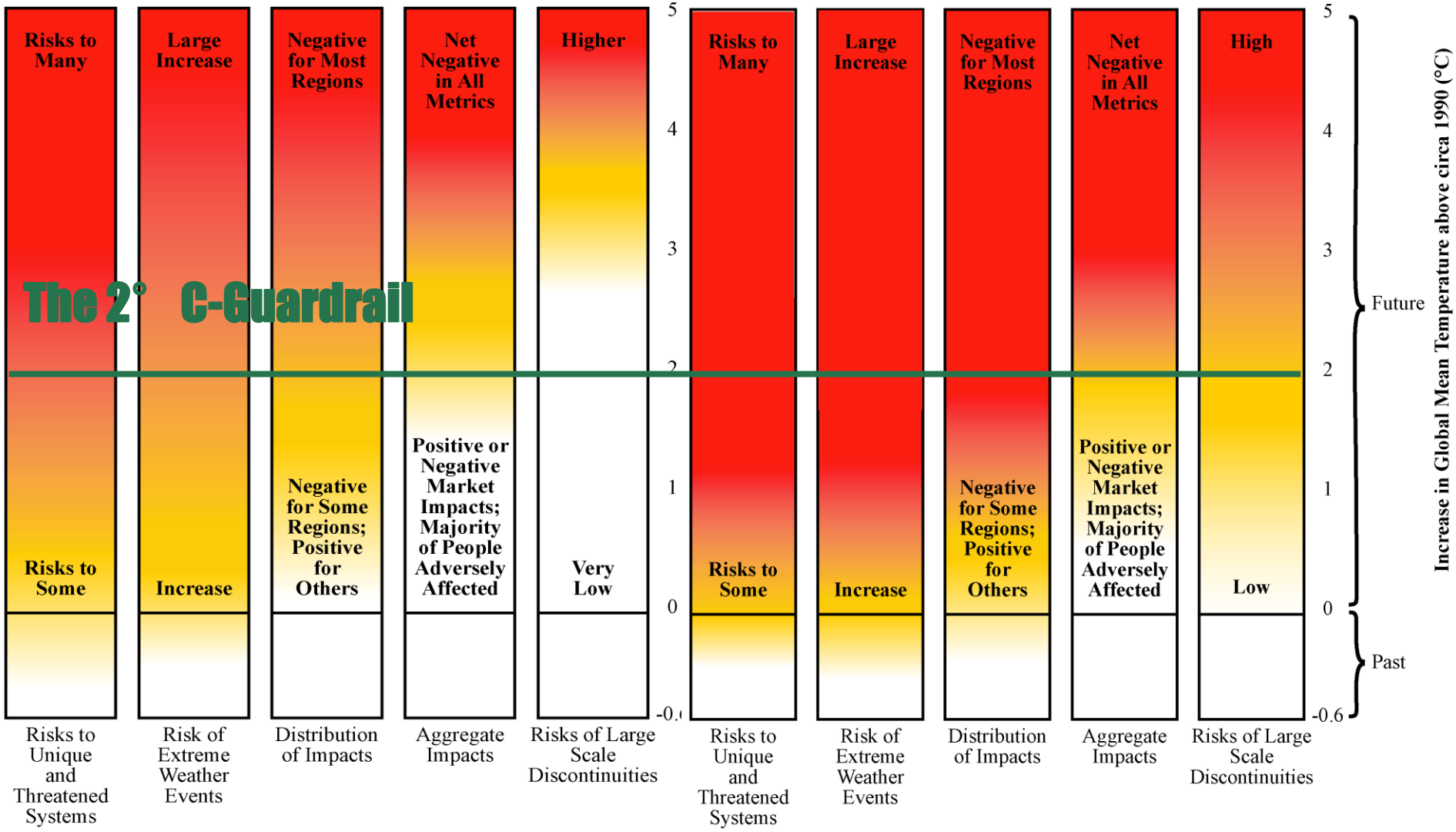
EPA

Security implications




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
Small mountain glaciers disappear worldwide – potential threat to water supplies in several areas
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
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)

The 2 degree line



Impact on Pakistan

What is the Future for Pakistan?

"Remember how I said I was happiest when we had nothing?"

- Pakistan has three climate-related goals:
  - Save Lives and property
  - Pursue sustainable development
  - Honor international commitments
- Is this possible?

Objectives

National Objective	Climate Impact
Development	Energy, finance, markets
Poverty	Growth, indigenous knowledge, food insecurity
Security	Water scarcity, food insecurity, forced migration
Sovereignty	Famines, forced migration

HEAT

SNOWFALL

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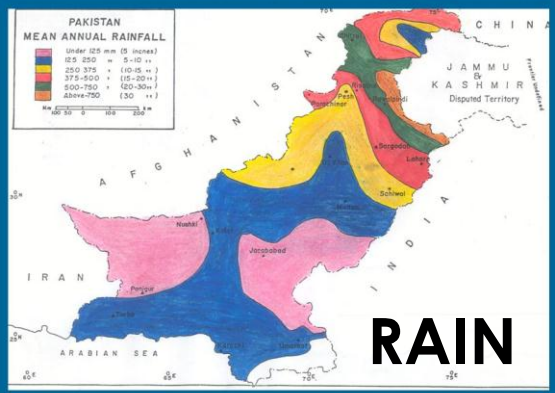
GLACIERS

RAINFALL PATTERN OVER PAKISTAN



RAIN

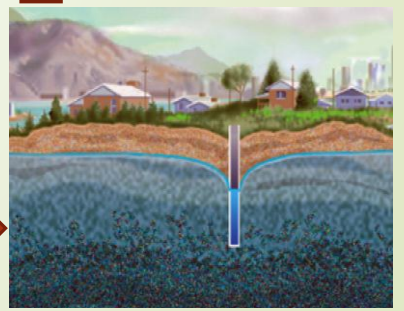
Average annual rainfall over Pakistan is 291 mm (11.4"). Nearly two third of rainfall is received in Kharif (summer) while balance is received in Rabi (winter).

140MAF

50MAF

STORAGE

RIVERS



GROUNDWATER

PK Impacts

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- 0.6 °C increase in average temperature over Pakistan during 20th century (conforms with global increase)
- For 21st century, projected temperature rise over Pakistan is higher than global average by about 1 °C (globally projected temperature change is 1.4 °C – 4.6 °C under different scenarios)
- Future projected temperature increase higher in northern parts of Pakistan as compared to southern parts
- Significant increase in frequency and intensity of extreme events (floods, droughts, heatwaves, cyclones) especially in last two decades, increased monsoon variability and SLR
- Pakistan rated among top 10 countries most affected by climate change (Global Climate Risk Index 2017 by German Watch)

Asia Findings

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- High Confidence: Warming trends, high temperature extremes, high stress on coastal systems, adaptive changes observed in terrestrial ecosystem, threat exacerbation due to CC, high risk of extreme events, inadequate research on observed changes and their impacts.
- Medium Confidence: Water scarcity threat (due to population, economic, and management variables), variable impacts on food security, .

Regional Findings

- Evolution in the treatment of regional aspects of climate change from a patchwork of case examples towards broader ranging information, and more coherent, though not comprehensive, future projections (with associated uncertainties).
- Regional variations in observations and projections are both because the impacts themselves vary, and because of unequal research attention to causes and adaptation processes, contested approaches, especially towards hot spots, insufficient quantification of uncertainty.

Water/ Glaciers

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	Issue	Research
Extreme events	More frequent/intense hydrological extremes/disasters (GLOFs, floods, drought),	Assess past changes in HKH glaciers, monitor HKH snow cover and glacier behavior, data issues
Surface water	Falling per capita water availability	Analyze historical data for past trends and future flows in the IBS
Ground water	Deteriorating groundwater quality and quantity	Study impact of climate change on ground water
Coastal zone	Sea level rise	Study impacts of sea level rise on coastal areas
Adaptive capacity	Weak capacity to cope with floods	Analyze adaptation measures and capacity
Regional	Relation between IWT and climate change	Study climate impact on trans-boundary water issues

Agriculture

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Crop	Yield Changes
WHEAT	**Projected**
Semi-arid areas: FSD and SKP	-3.4 to -12.5%
Arid Areas: BDN and HYD	-3.9 to -13.4%
RICE	**Projected**
2020	-10.4 to -11.4%
2050	-15.8 to -16.5%
2080	-17.8 to -21.5%

Year	GHG Emissions
1994	71.63
2008	120.29
2012	165.30
2016	174.56
Sources of emissions	Manure, enteric fermentation, crop residue burning, flooding rice, agricultural soils
Response options	Changes in sowing windows, planting techniques, fertilizer application, seed rate, irrigation method

Mitigation Efforts

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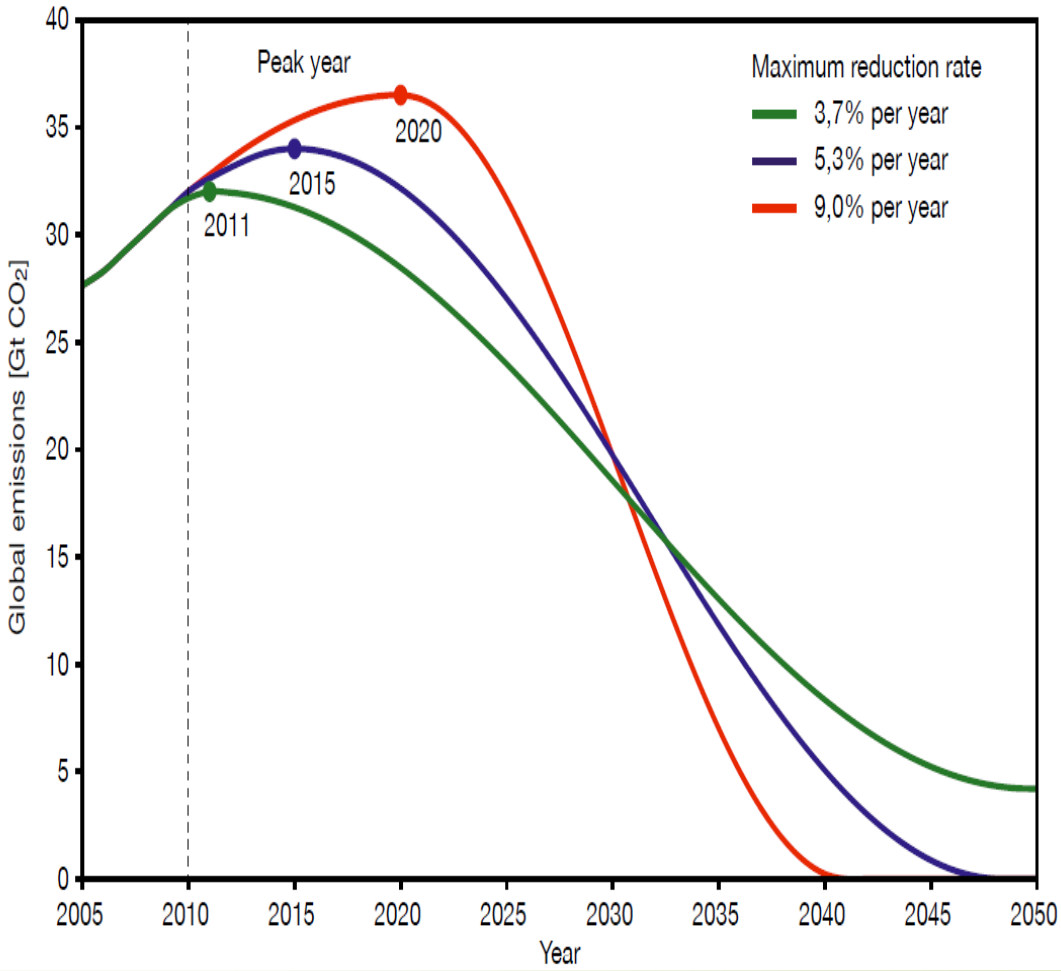
- Pakistan emits 408.1 million tones of carbon dioxide equivalent ($MtCO_2e$), which is 0.83 per cent of the global total of 48.892 billion tons ($GtCO_2e$). Future GHG emissions are projected to grow at 9 per cent per year, to reach 1,603 $MtCO_2e$ in 2030.
- Pak-NDCs document, submitted in 2016, commits the country to a 20% reduction in projected emissions provided$40 billion funding is available to cover incremental costs. However, Pakistan can take credit for abatement efforts undertaken on their own.

Pakistan's Mitigation Efforts

Sector	Brief Description of Recent Policies	SR	LR
		Savings $MtCO_2/yr$	
Renewable Energy	RE Policy 2006, amended in 2013 to include biomass/waste, and provided with financial support in 2016. From zero generation in 2012, RE contributed 1,549 GWh in 2016.	0.84	4.4++
LNG	Policy to import LNG, construction of first LNG terminal, and conversion of Nandipur power plant to LNG. Plans are to increase imports to 30 million tonnes.	0.93	7.5+
Euro II Standards	Shift to higher quality and more efficient fuels lowers fuel consumption in 2016.	0.62	2.0+
Nuclear Energy	340 MW CHASNUPP-4 commissioned in 2017. Another 4,200 MW planned until 2022.	1.48	21.0+
Hydropower	6 hydro plants added 243 MW in 2016-17, and another 31 under construction will add 9,000 in the next decade.	0.59	23.0+
Afforestation	The billion-tree tsunami and the Green Pakistan program will add 1.1 billion trees.	..	12.1++
Total		**4.46**	**70.0+**

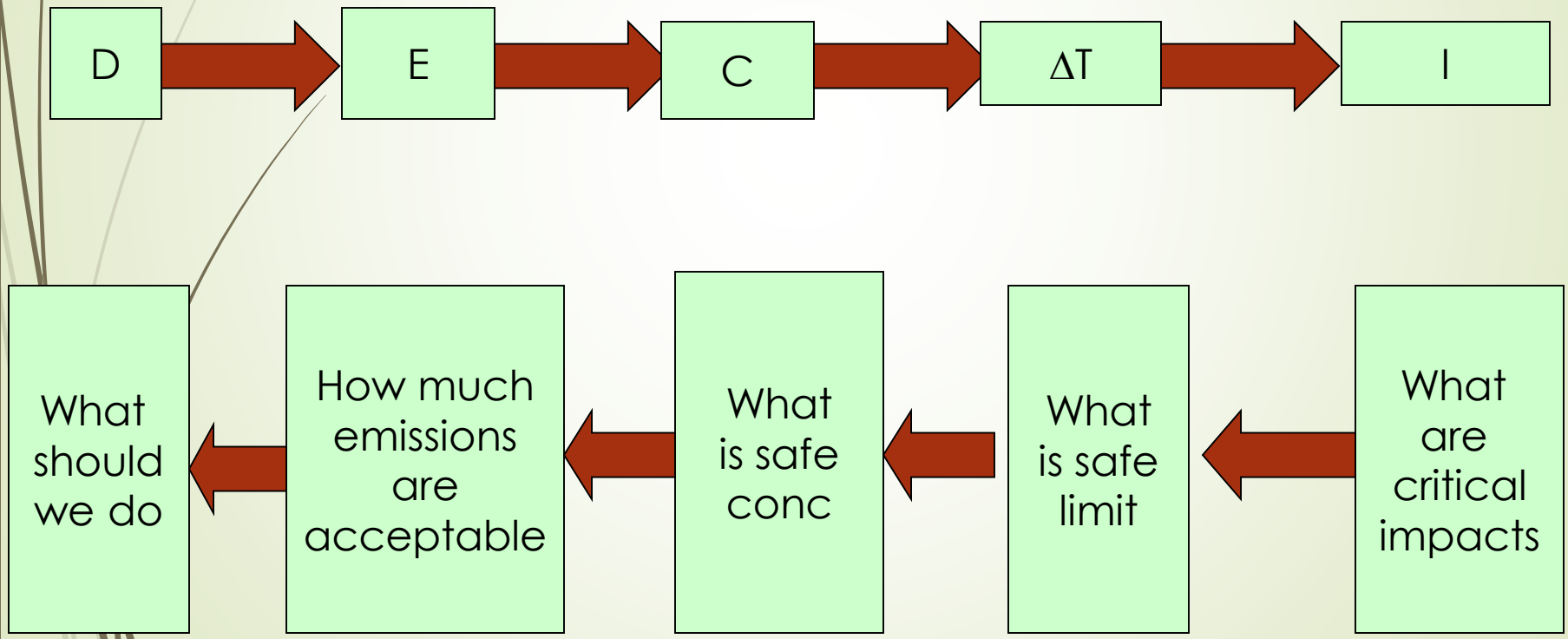
The Paris Agreement

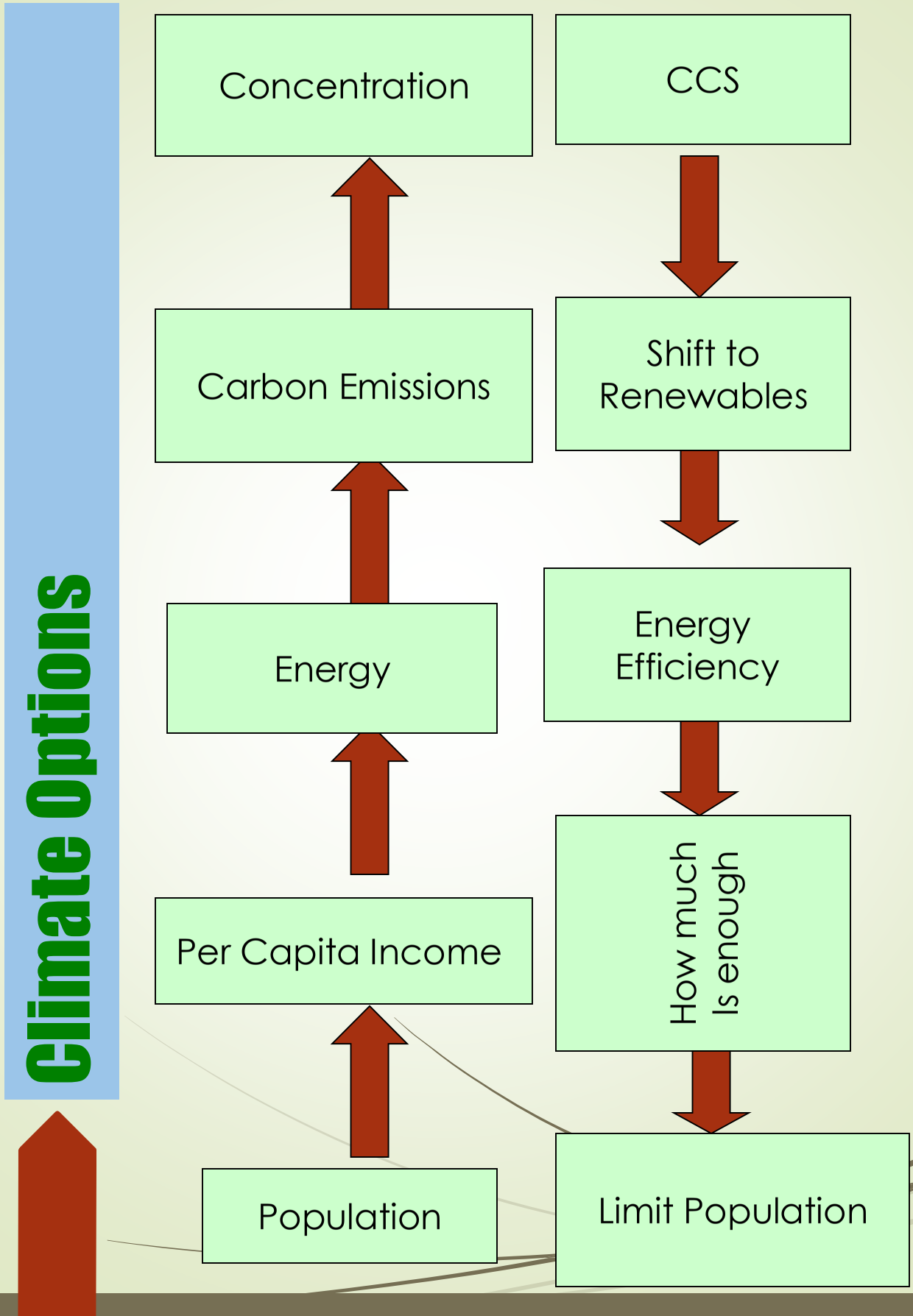
The Zero-Sum Box



Emission pathways for at least 67% probability of staying under 2 °C warming. The total "emissions budget" for 2010-50 is 750 Gt.

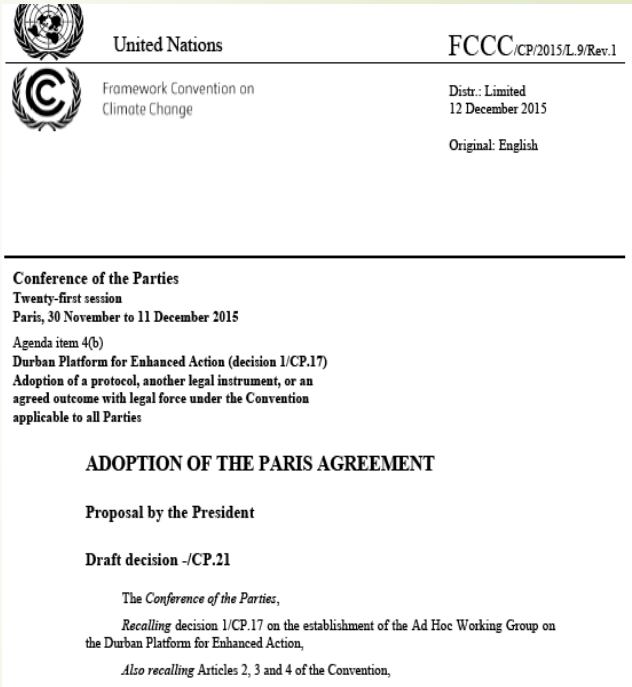
From Science to Policy




Climate Options
Concentration
Carbon Emissions
Energy
Per Capita Income
Population
CCS
Shift to Renewables
Energy Efficiency
How much Is enough
Limit Population

Key features

- 20 pp decision
  - Workplan for putting flesh to the bones of the Paris Agreement in the next years
  - Pre-2020 action
- 12 pp Paris Agreement as annex (!)
  - This allows US President to approve the agreement without obtaining Congressional ratification (which would be very unlikely)
  - Governance by Conference of Parties to the agreement (CMA)



United Nations

Framework Convention on Climate Change

FCCC/CP/2015/L.9/Rev.1

Distr.: Limited
12 December 2015

Original: English

Conference of the Parties
Twenty-first session
Paris, 30 November to 11 December 2015

Agenda item 4(b)
Durban Platform for Enhanced Action (decision 1/CP.17)
Adoption of a protocol, another legal instrument, or an agreed outcome with legal force under the Convention applicable to all Parties

ADOPTION OF THE PARIS AGREEMENT

Proposal by the President

Draft decision -/CP.21

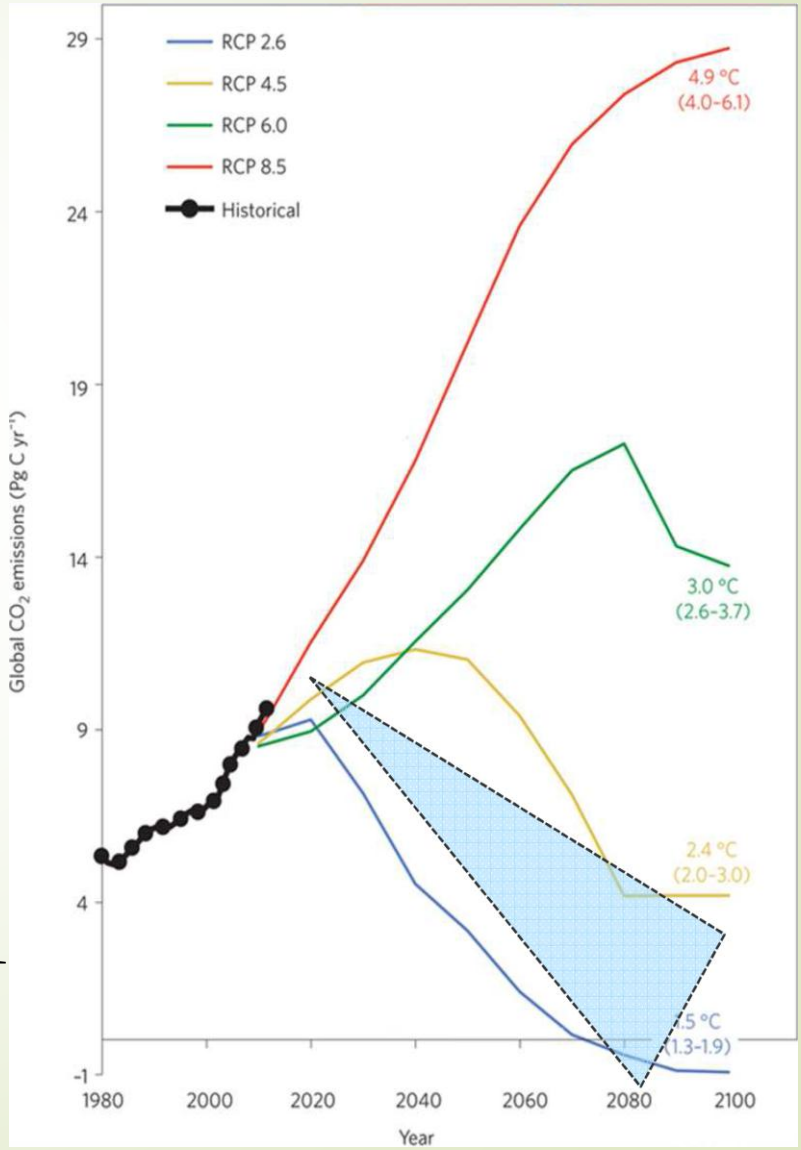
The *Conference of the Parties*,

Recalling decision 1/CP.17 on the establishment of the Ad Hoc Working Group on the Durban Platform for Enhanced Action,

Also recalling Articles 2, 3 and 4 of the Convention,

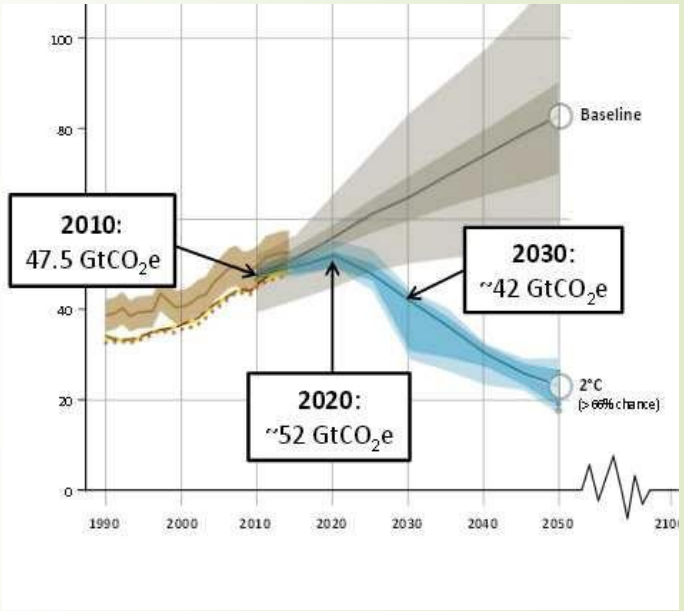
The Ambitious Goal

- Global goal: between 2° and 1.5° C (Art. 2)
- Global peaking "ASAP" (Art. 4.1)
- Balance of emissions and sinks by second half of century (Art. 4.1)
  - Excludes solar radiation management
- Global stocktake every 5 years from 2023 (Art. 14.1 and 2)



Mitigation by everyone

- All countries participate by NDCs (Art. 4.2), to be ratcheted upwards every 5 years (Art. 4.3, 4.9)
- Industrialized countries "should" have absolute targets (Art. 4.4)
- Developing countries should "move over time" towards "economy-wide reduction/ limitation targets (Art. 4.4)



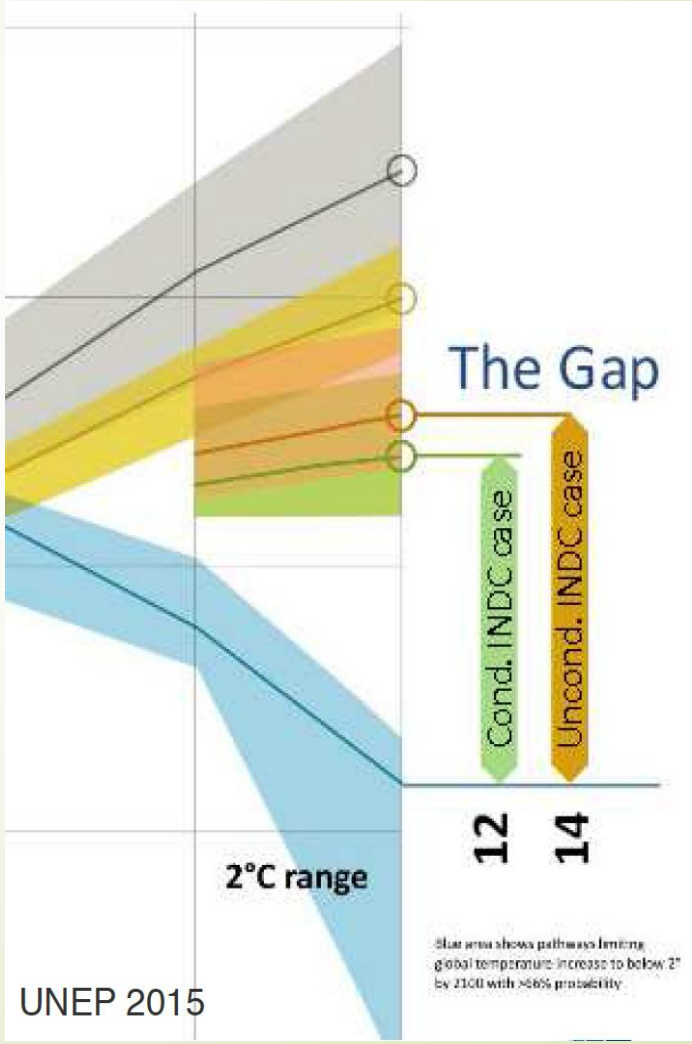
pushed through by the US at the last minute instead of stronger "shall"

The Collective Action Challenge

"No one is making you do anything you don't want. I'm just saying we're all headed for Dodge City and we think you should come along."

Mitigation by everyone

- All countries to account for emissions (Art. 4.13)
  - Environmental integrity, transparency, accuracy, completeness, comparability and consistency of inventories
- Joint NDCs possible (Art. 4.16-18)
- REDD+: “encourage” results-based payments (Art. 5.2)
  - Link to market mechanisms unclear



Market mechanisms (Art.6)

- All countries can use a market mechanism (called SDM?) that combines features of CDM and JI (Art. 6.4)
  - Supervised by body (~EB), payment of adaptation tax (Art. 6.6)
  - Authorization of public and private entities by Party (Art. 6.4b)
  - Allocation of credits to buyer and seller countries to prevent double counting (Art. 6.4c, 6.5)
  - "Overall mitigation" of global emissions (Art. 6.4d)
  - Rules to be developed by CMA based on the following principles
    - Real, measurable and long term reductions (38b dec.)
    - Definition of scopes of activities (38c dec.)
    - Additionality (38d dec.)
    - Verification and certification by DOEs (38e dec.)
    - Apply experience from Kyoto Mechanisms (38f dec.)

Market mechanisms (Art.6)

- "Cooperative approaches" (CAs) possible, but not defined (Art. 6.2 and 6.3)
  - "Internationally transferred mitigation outcomes" (ITMOs)
    - Already possible to use before 2020 (108 dec.)
  - Environmental integrity, transparency
  - Guidance by CMA, but no specific governing body
- Possible inroad for bilateral mechanisms and direct emissions trading, linking of ETS
- This is an open flank and requires a lot of thinking and further political decisions
- Explicit mention of non-market approaches to appease opponents (Art. 6.8 and 6.9)

CDM guidance paves the way

- Encourages further uses of the CDM and financing CDM activities through climate finance institutions including GCF
- Requests EB to develop stand-alone CDM PoA guidance
- Digitization of documents to reduce transaction costs
- Expand the scope of work of the Regional Collaboration Centers beyond “pure CDM work”

… as well as JI guidance

- Focus is on lessons learnt for designing the new mechanisms
  - \
- Reinforce synergies with other mechanisms
  - Allowing CDM DOEs to perform JI audits
  - Aim for coherence, avoid double-counting, share infrastructure, technical arrangements, tools, governance, and processes

Transparency (Art.13)

- Both for action and support (Art. 13.1)
  - NDC: Clarity and progress (Art. 13.5), achievement (Art.13.12)
  - Mandatory inventory as per IPCC good practice guidance (13.7a)
  - Support provided - finance, TT and CB (Art. 13.9)
- Build on UNFCCC approaches used to date (Art. 13.4)
- Very weak principles
  - Non-intrusive, non-punitive, national sovereignty (Art. 13.3)
  - Technical expert review, not defined in detail (Art. 13.11)
- Flexibility for developing countries (Art. 13.2)
  - In light of their capacities – difficult to operationalize
  - Alleviations for LDCS and SIDS (Art. 13.3)

➨ Many open flanks remain!

Vague Wording on Finance (Art.9)

- Industrialized countries shall provide finance (Art. 9.1)
  - Biennial communication of volumes and forecasts (Art. 9.5 and 7)
  - GCF, LDCF, SCCF, GEF as entities (59 dec.), AF maybe (60 dec.)
- Developing countries can voluntarily provide (Art. 9.2) and report on climate finance (Art. 9.5)
- Simplified project approvals for LDCs and SIDS (Art. 9.9)
- Generally vague wording!
  - "Significant" role of public funds (Art. 9.3)
  - Industrialized countries should "continue to take the lead", progression beyond current efforts (Art. 9.3), intend to continue 100 billion $, to be increased from 2025 (54 dec.)
  - "Should aim for" balance of mitigation and adaptation (Art 9.4)
  - Finance flows to be consistent with pathway towards low GHG, emissions and climate-resilient development (Art. 2.1c)

Why so Vague?

"Not now, Matthew. This is Daddy's quiet-desperation time."

Other vagueness

- Adaptation (Art. 7)
  - Global goal, very fluffy (Art. 7.1)
  - Formal recognition of developing country efforts (Art. 7.3)
  - Cooperation (Art. 7.7), effectiveness/durability (Art. 7.7e)
  - Adaptation plans (Art. 7.9) with prioritization (Art. 7.9c), to be communicated periodically (Art. 7.10 and 11)
- Loss & Damage (Art. 8): Warsaw Mechanism continues (Art. 8.2)
- Technology (Art. 10): framework (Art. 10.4)
- Capacity Building (Art. 11): on finance access (Art. 11.1)

Role of non-state actors

- "Invited" cities, corporations, regions, and investors to provide input to NAZCA portal (135 dec.)
  - Platform for exchange of experiences (136 dec)
  - Key role of incentives such as carbon pricing (137 dec.)
  - How much mitigation do these initiatives actually achieve?

Workplan

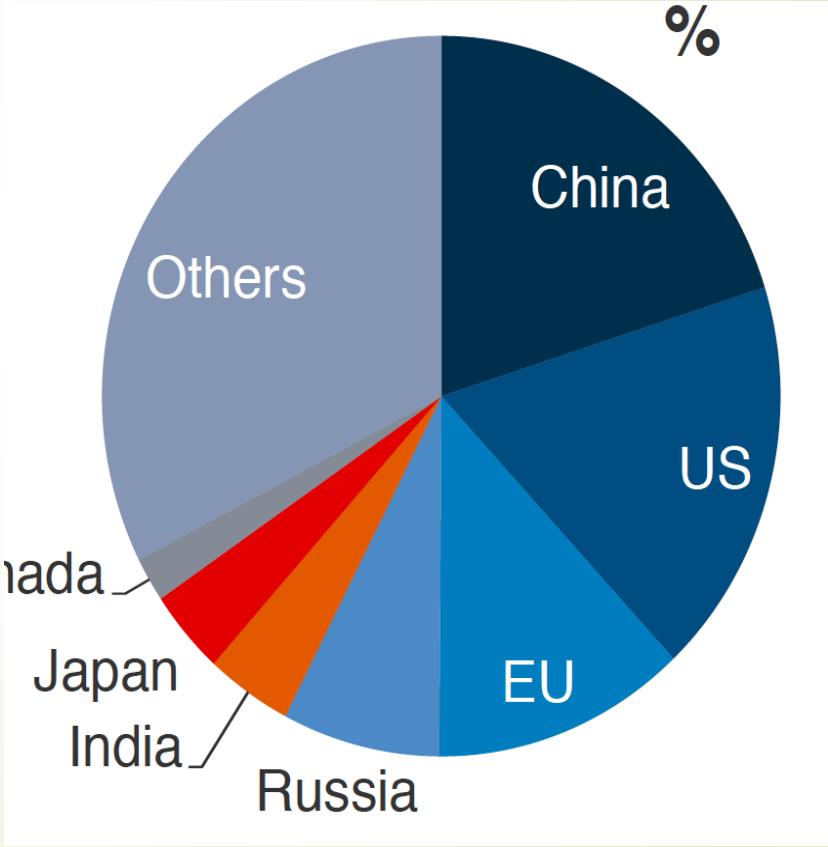
- Ad-Hoc Working Group on Paris Agreement (APA) set up
- Ambition: Special IPCC report on impacts of 1.5° and its paths by 2018
- NDCs
  - Updated INDC synthesis by Secretariat 2 May 2016, cutoff of information 4 April 2016
  - INDCs can be converted to NDCs immediately upon signature of PA or newly submitted (22)
  - INDCs with 2025 target replaced by new NDC by 2020 (23)
  - APA to develop rules for NDC features and info (26, 28)
  - NDC registry at UNFCCC from 2016

Workplan II

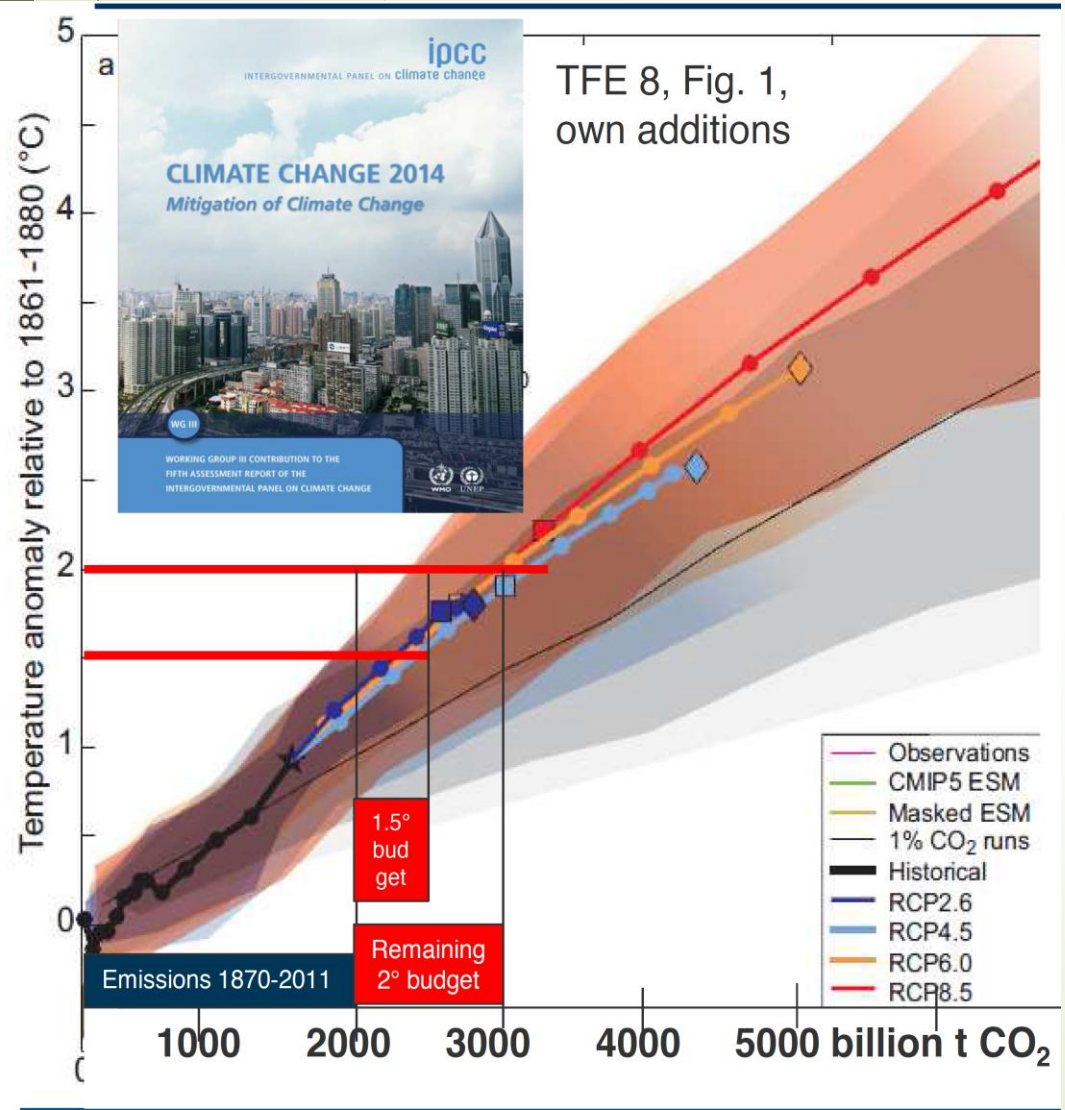
- Accounting
  - APA to develop rules (31) applicable from second NDC (32)
  - Common methodologies assessed by IPCC (31a)
  - Methodological consistency, including on baselines (31b)
  - Once category is in NDC it needs to remain there (31c)
  - Explanation on reasons for exclusion of categories required (31d)
  - Double counting avoidance (35)
- Mid-century LEDS can be communicated by 2020 (36)
- Framework for non-market approaches (40)
- Adaptation
  - Methodologies for assessing adaptation needs (43b)
  - Methodologies for adequacy and effectiveness of adaptation (46b)

Operational issues

- Compliance (Art. 15)
  - Compliance committee (Art. 15.1)
  - Non-adversarial, non-punitive (Art. 15.2)
  - No sanctions
- Legally binding nature (Art. 20)
  - Ratification, acceptance, approval (Art. 20.1)
- Entry into force (Art. 21)
  - 55 parties, with 55% of global emissions as per their latest inventories (Art. 21.2)
- Withdrawal (Art. 28)
  - Possible with one year notice (Art. 28.2)

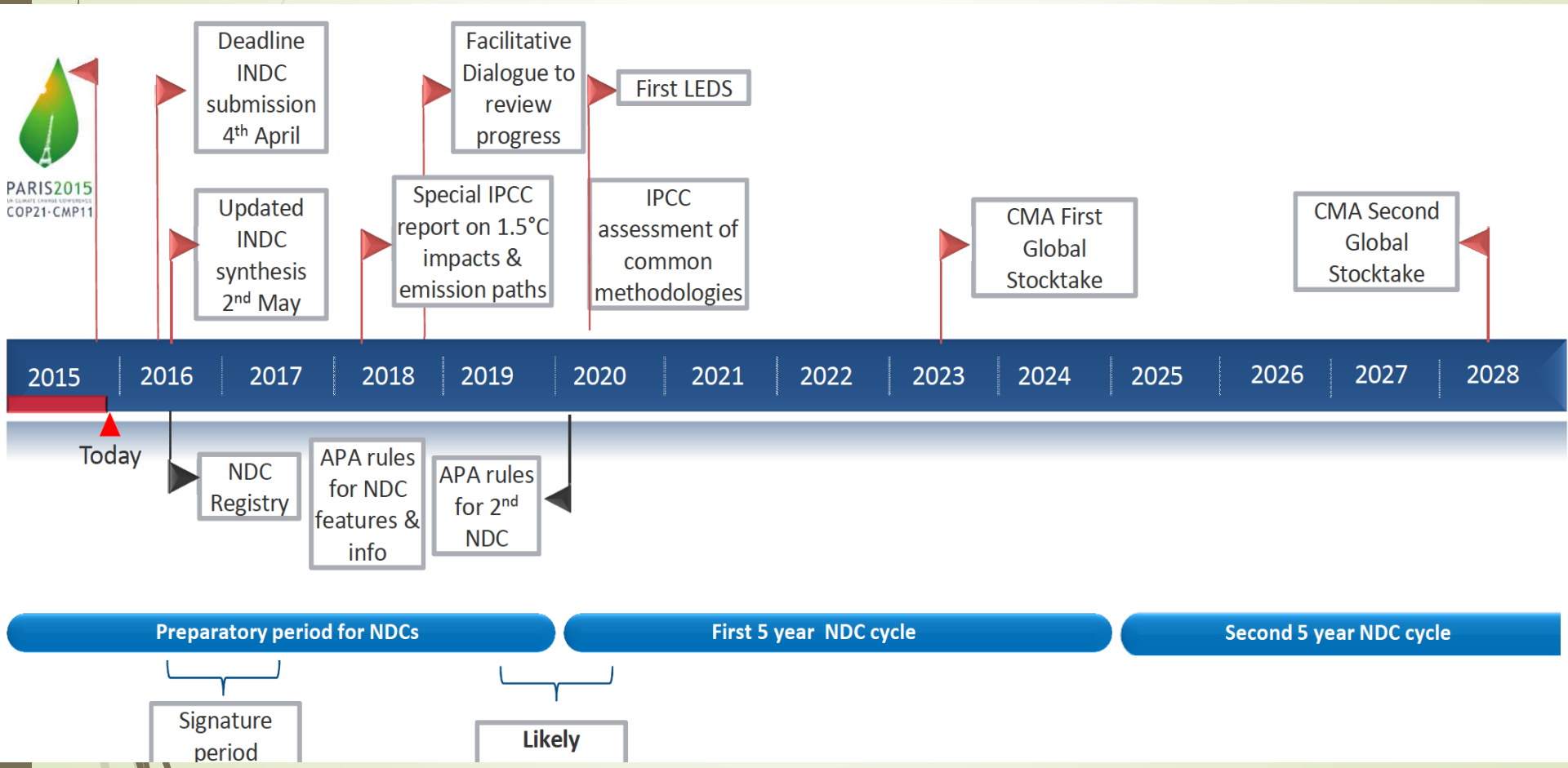


The mitigation challenge



- Remaining emissions budget:
  - 2°C: 1000-1200 $GtCO_2$
  - 1.5°C: 500-600 $GtCO_2$
- Current annual global emissions ~ 50 $GtCO_2$
- Only 20-25 years left at current rate for 2°C, a decade for 1.5°C!
- Massive challenge for de-carbonization

Timelines


PARIS2015
COP21·CMP11
Deadline INDC submission 4th April
Updated INDC synthesis 2nd May
Facilitative Dialogue to review progress
First LEDS
Special IPCC report on 1.5°C impacts & emission paths
IPCC assessment of common methodologies
CMA First Global Stocktake
CMA Second Global Stocktake
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025
2026
2027
2028
Today
NDC Registry
APA rules for NDC features & info
APA rules for 2nd NDC
Preparatory period for NDCs
First 5 year NDC cycle
Second 5 year NDC cycle
Signature period
Likely

Key messages

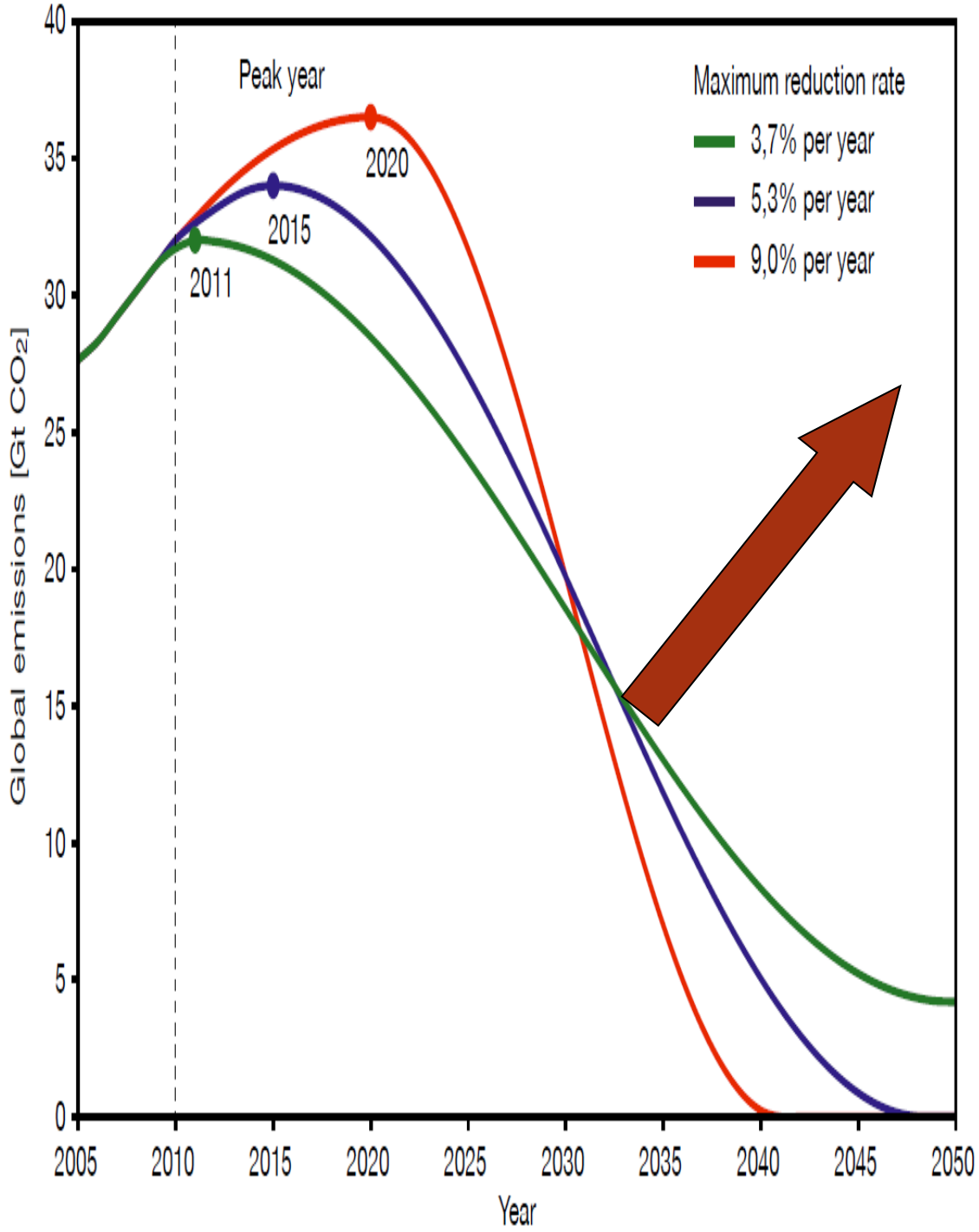
- PA is not everything we need, but it is a step forward, combining bottom-up pledges with a soft international regulatory architecture
- Market mechanisms are reinstated as key instrument
- Much work is needed in the next years to put flesh on the bones

The Research Challenge

"I'll be happy to give you innovative thinking. What are the guidelines?"

The Broader Context: Energy

Focus on Energy

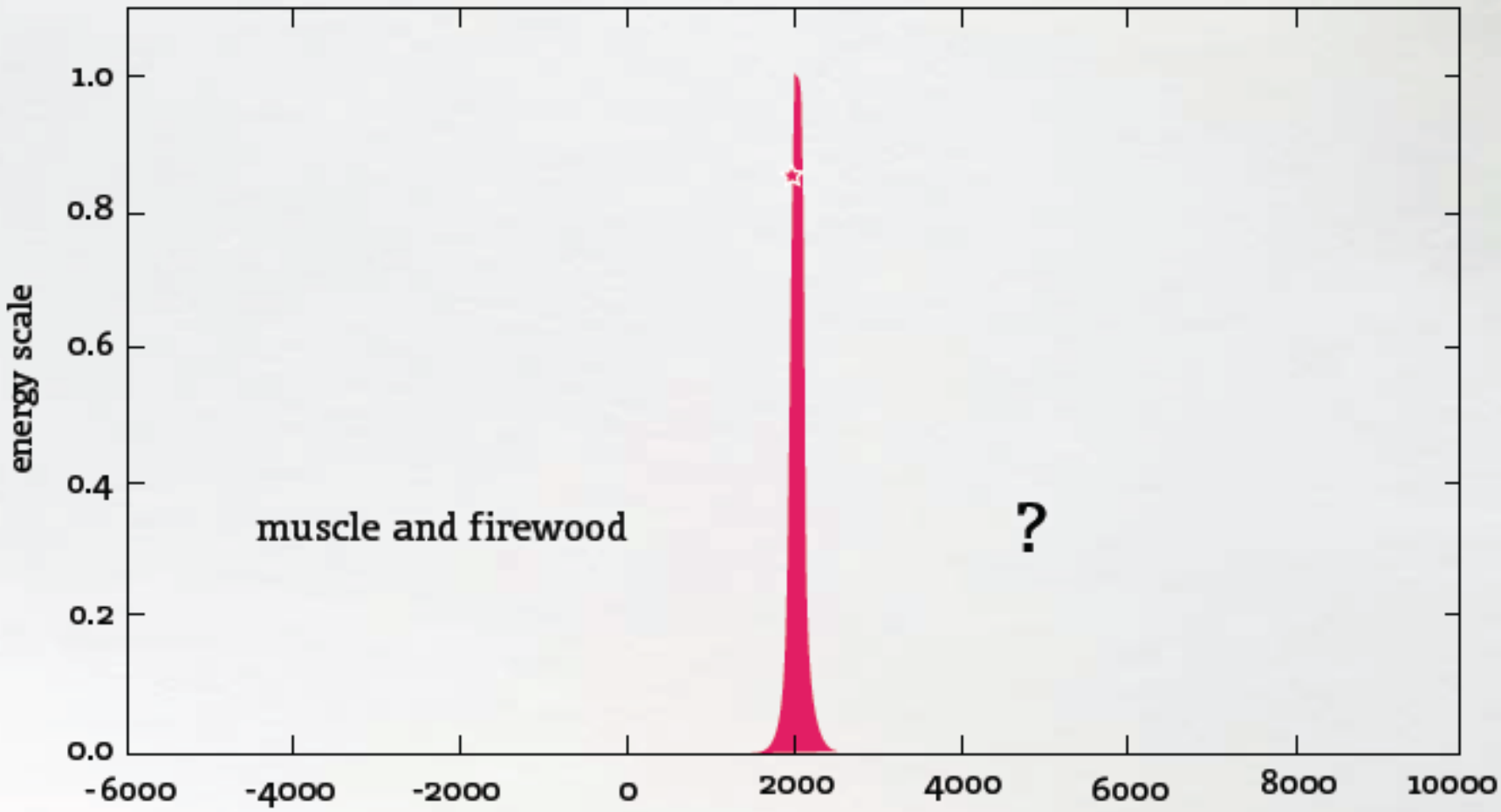


"I'm right there in the room, and no one even acknowledges me."

Energy is the Key

- Energy drives economic growth, helps achieve basic needs and human development, and is necessary for recycling, reduction, reuse
- Energy is responsible directly for over 75% (and rising) of GHGs
- Energy is even more unequally distributed than income, within and between countries; and developing countries need 3-4 times more energy, which is both affordable and sustainable.
- Social and environmental limits manifest themselves in the form of energy shocks.

But the Age of Growth is over...

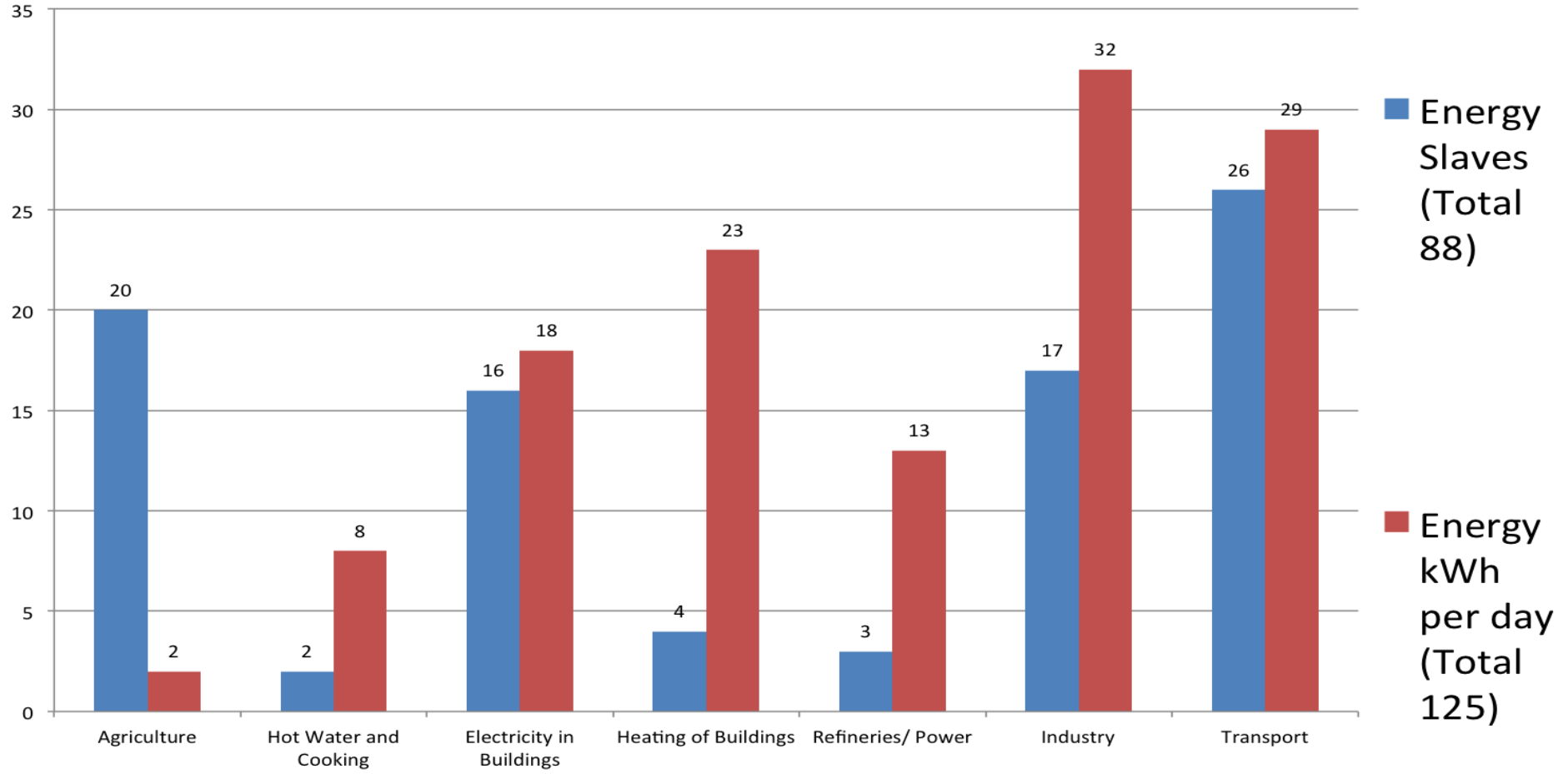


Energy Bonanza–Economic Impact

	1800	2000	Δf	2050	Δf
Population (billion)	1	6	x6	10	x1.6
GDP (trillion 1990 $)	0.3	30	x100	85-110	<x3-x4
Primary energy (EJ)	13	420	x30	600-1,040	x1.5-x2.5
CO_2 emissions (GtC)	0.3	6.4	x20	5-15	<x1-x3
Mobility (km/person/day)	0.04	40	x1,000	120-160	x3-x4

World Energy Council, 2004

Energy Slaves (France Example)



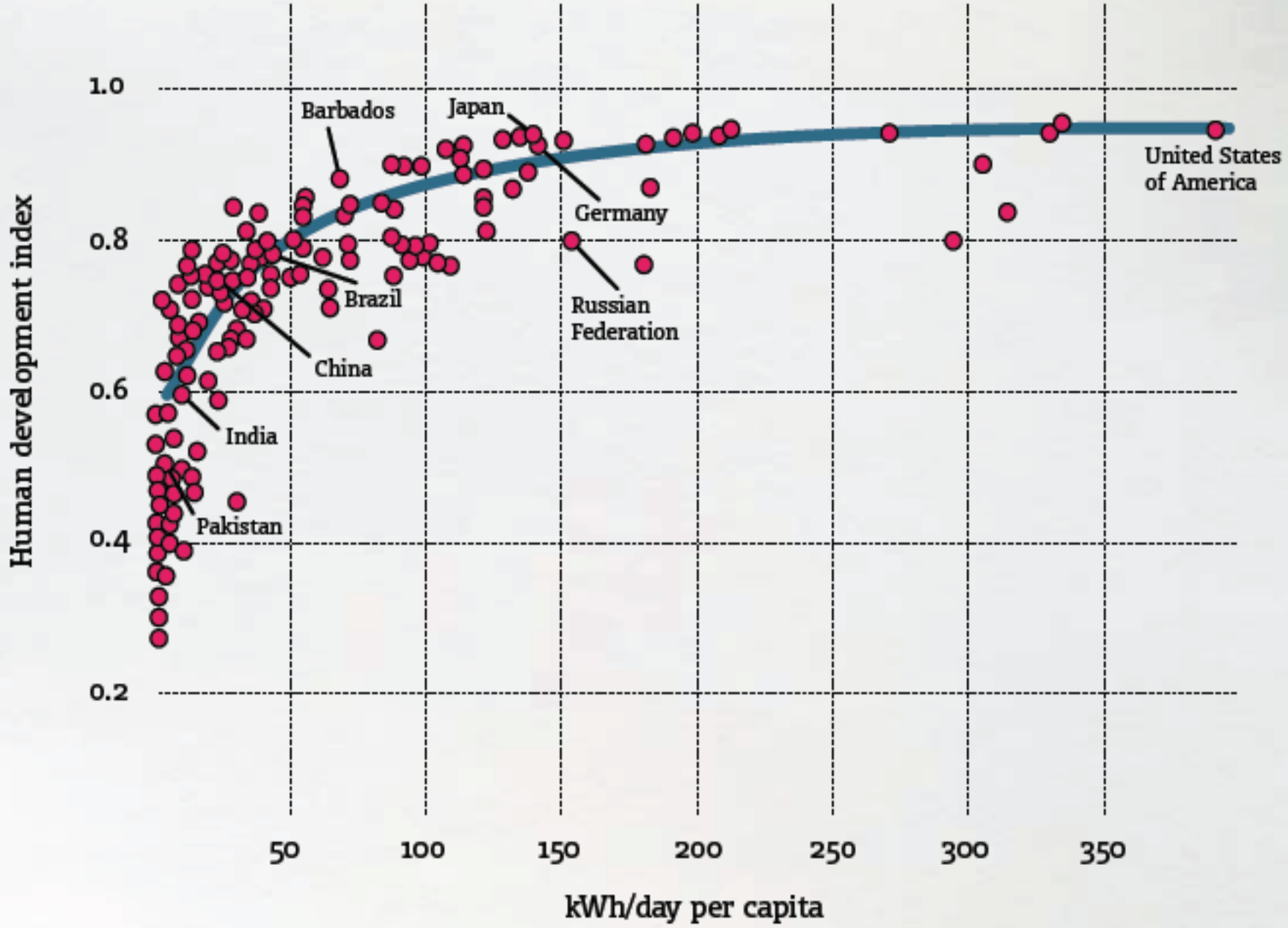
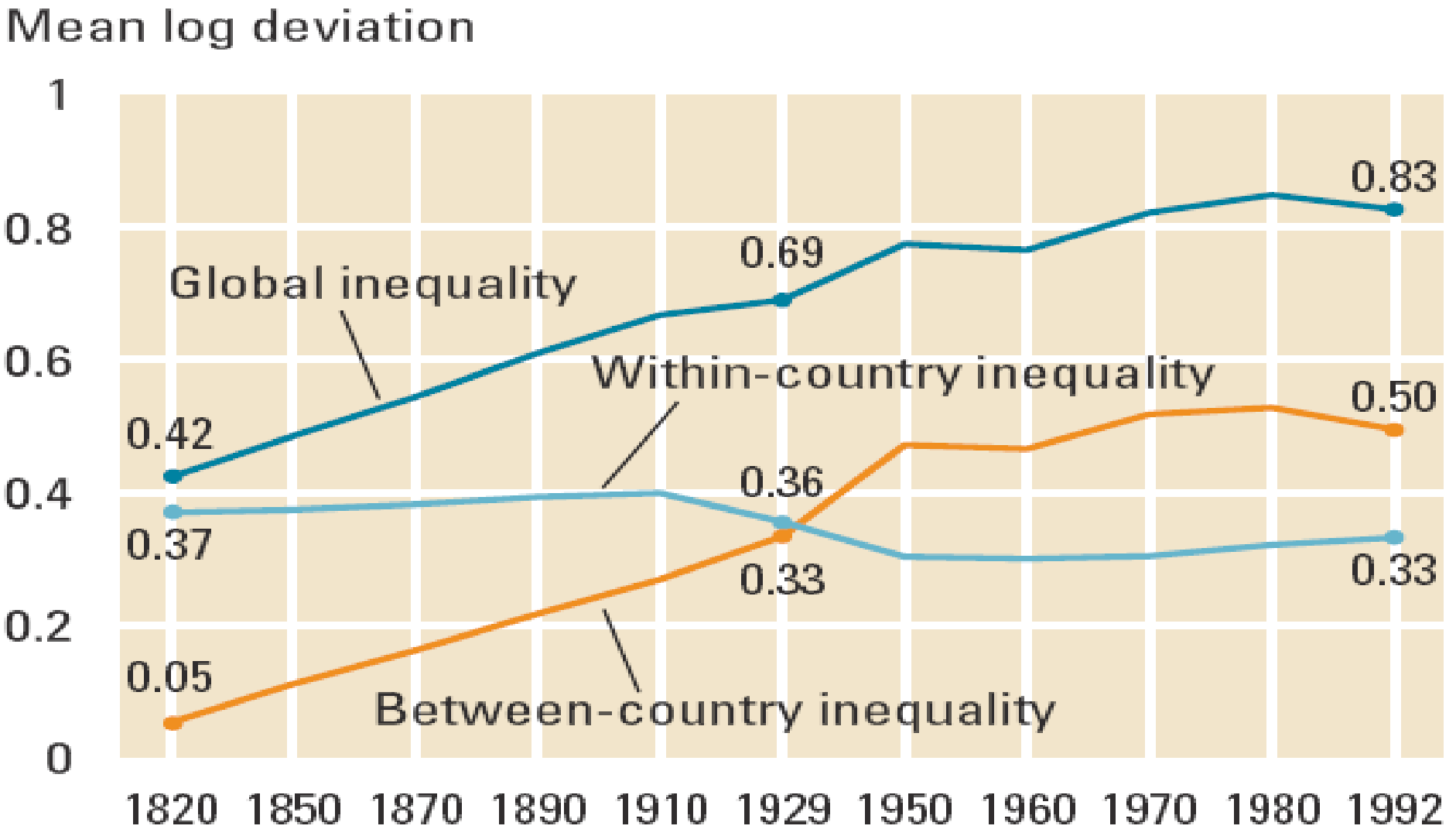

Human development index
1.0
0.8
0.6
0.4
0.2
Barbados
Japan
Germany
United States of America
Brazil
Russian Federation
China
India
Pakistan
50
100
150
200
250
300
350
kWh/day per capita

Figure 3.10 Inequality between countries became much more important over the long run



Source: Authors' manipulation of data from Bourguignon and Morrisson (2002).

The Gift of Fossil Fuels

- The present prosperity is, in truth, the gift of fossil fuels.
- Fossil fuels provided massive increases in energy availability, and thus in the human capacity for manipulating Nature to its advantage. This capacity grew by several orders of magnitude since the pre-industrial age.
- Today, the continued use of fossil fuels is threatened on the one hand by climate change and on the other hand by potential depletion of resources. To quote the Bhagavad Gita, “Now I have become death, the destroyer of the worlds”.

Growth has finessed many problems

- **Communism** aspired to become the universal creed of the 20th century, but a more flexible and seductive religion succeeded instead: **the Quest for Economic Growth**. Capitalists, nationalists, Catholics, Protestants, Jews, Muslims, LDS, Hindus, and Buddhists, as well as communists—worshipped at this same altar.
- **Growth disguised a multitude of sins:** corruption, surveillance states, social inequities, or [despotism]. Indeed, adherents to the faith proposed that **only growth could resolve such ills**.
- The growth religion, on balance was quite useful in an empty world. But today it has created a crowded and stressed one, **and shows no inclination to adapt to the change**. Yet, it is an **Iron law of Nature** that if humans do not choose wisely, Nature will choose efficiently.
  - J. R. McNeill (2000) *Something New Under the Sun*

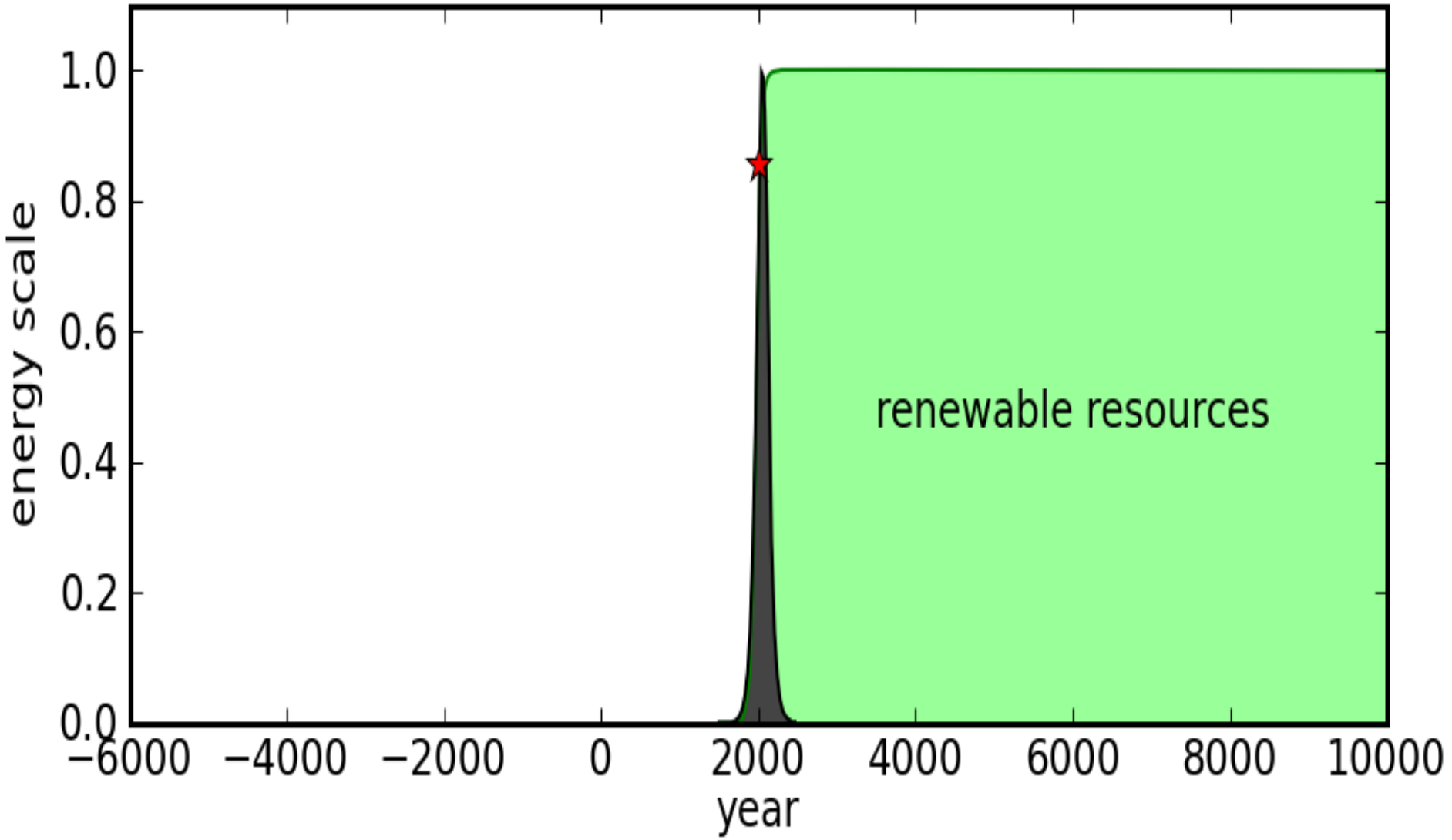
Where do we go now?

If we could first know where we are and whither we are tending, we could then judge better what to do and how to do it.

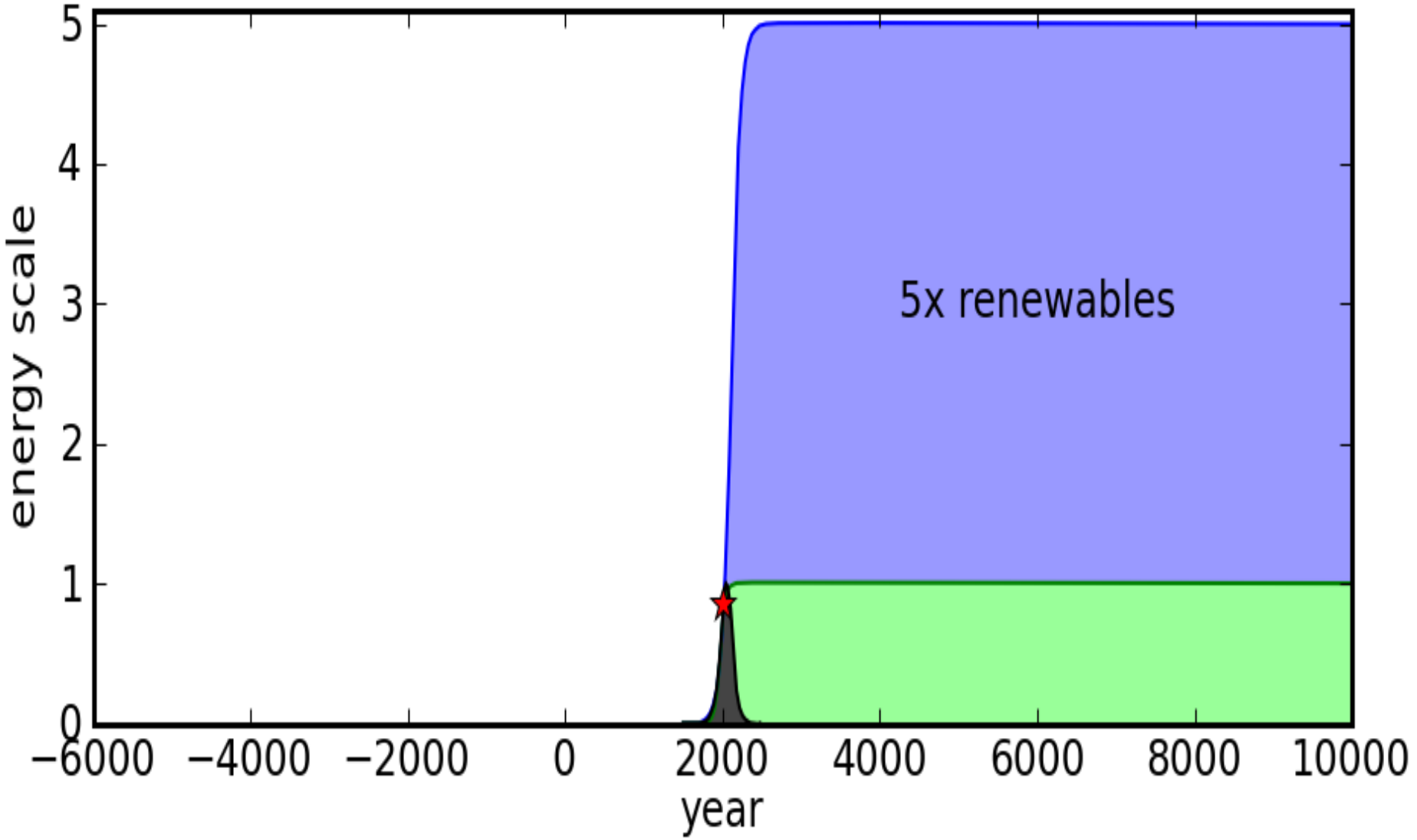
Abraham Lincoln, 1858

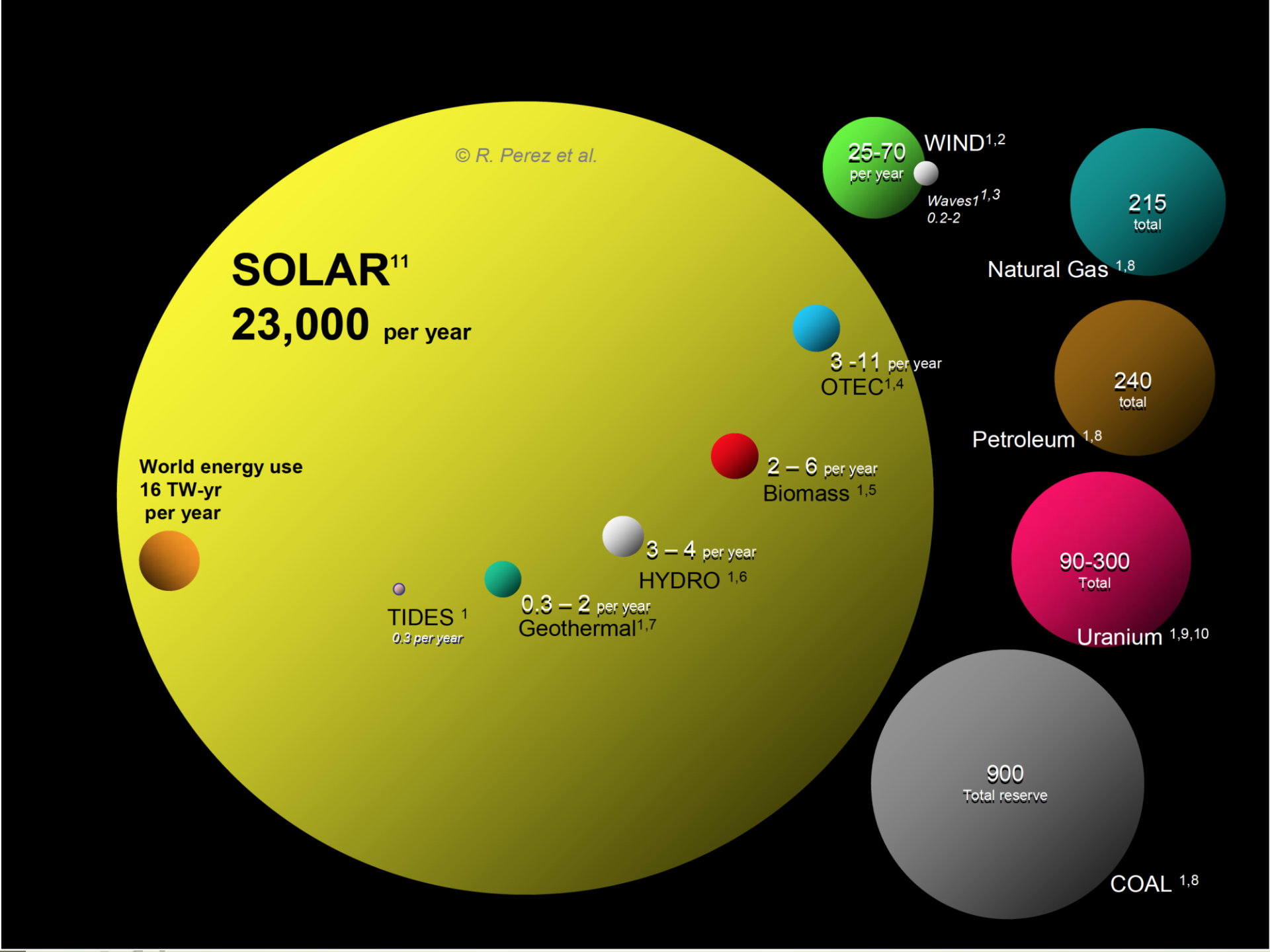
The "House Divided" Speech

What Does this Tell Us?



The Real Challenge




© R. Perez et al.
SOLAR[11]
23,000 per year
World energy use
16 TW-yr
per year
TIDES [1]
0.3 per year
0.3 – 2 per year
Geothermal[1,7]
3 – 4 per year
HYDRO [1,6]
2 – 6 per year
Biomass [1,5]
3 -11 per year
OTEC[1,4]
25-70
per year
WIND[1,2]
Waves1[1,3]
0.2-2
215
total
Natural Gas [1,8]
240
total
Petroleum [1,8]
90-300
Total
Uranium [1,9,10]
900
Total reserve
COAL [1,8]

QUESTION: Can Pakistan Develop?

- Learn from development experience
- Natural constraints do not determine development
- Agricultural Involution example

Pakistan's Options

- Approach from Development Angle
- Trade, infant industry, Aid, China Example

"Enough storyboarding. Let's shoot something."

Make Climate History

- The age of unsustained growth is gone
- Can we make it stay until we don't need it anymore? Buy a little more time for the human race to grow up?
- Collaboration:
  - Rights of the weak and the vulnerable: SDGs 1-5
  - Rights of and to Nature: SDGs 6, 7, 12-15
  - Right to overcome gross forms of inequality and vulnerability: SDGs 8-11