Tackling the Challenge of Climate Change
A Near-Term Actionable Agenda

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Former Chair of IPCC

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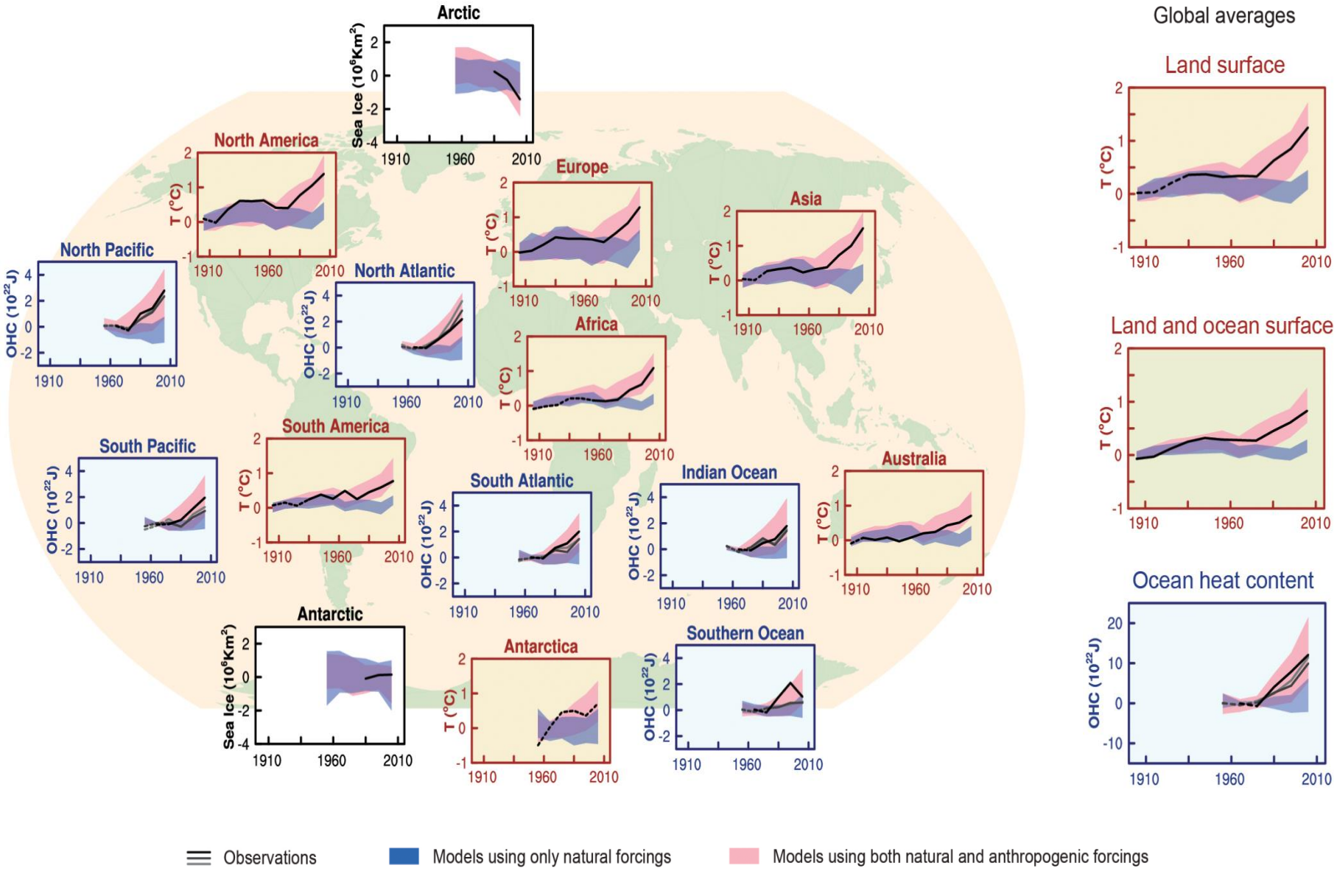
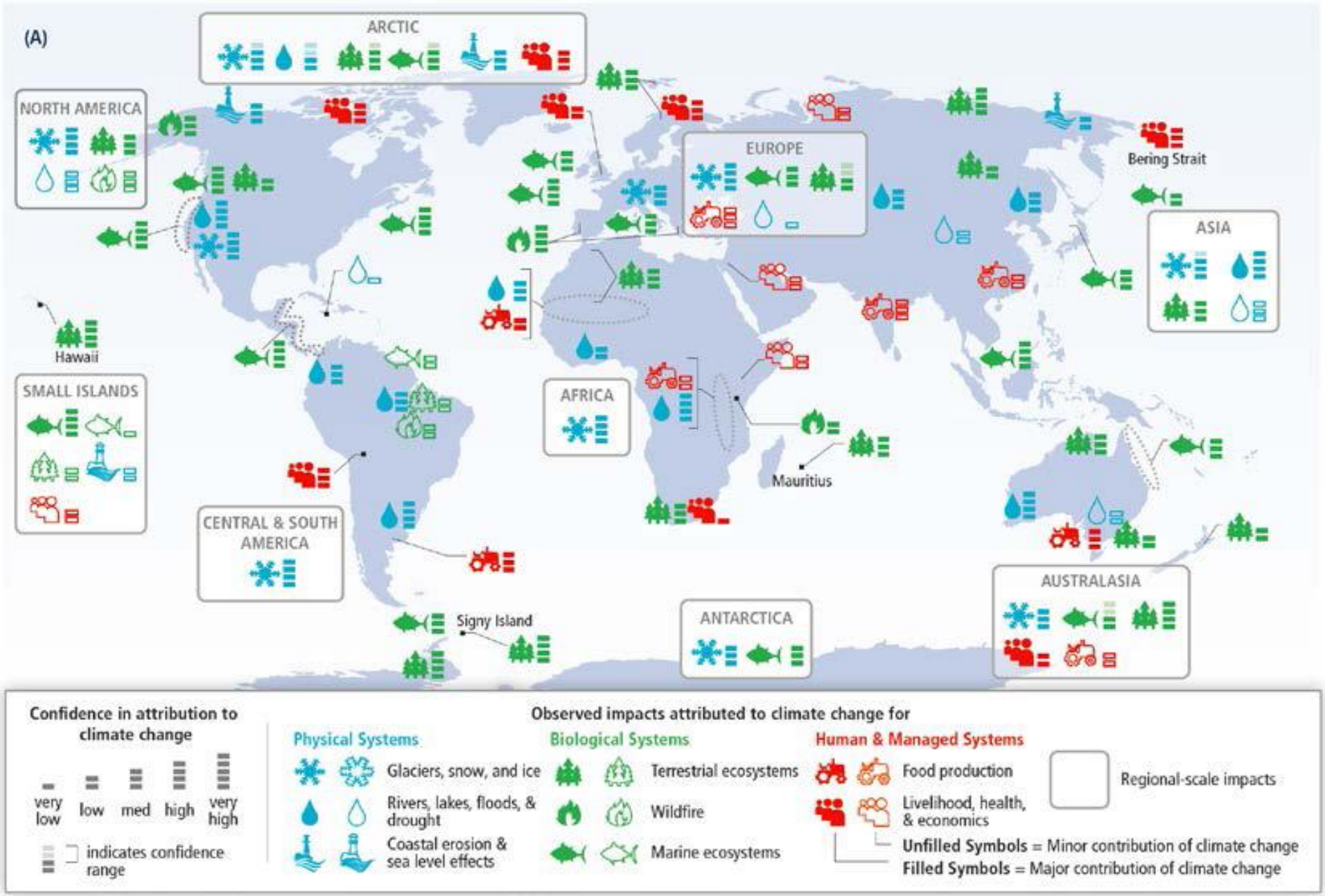
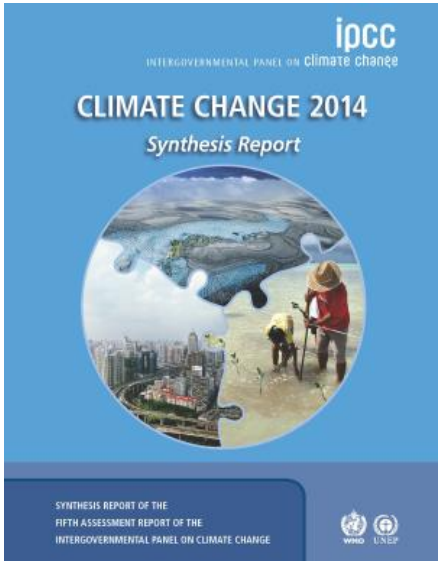
4 May 2016

Observed and Simulated Trends in Temperature



Observed Impacts Due to Climate Change

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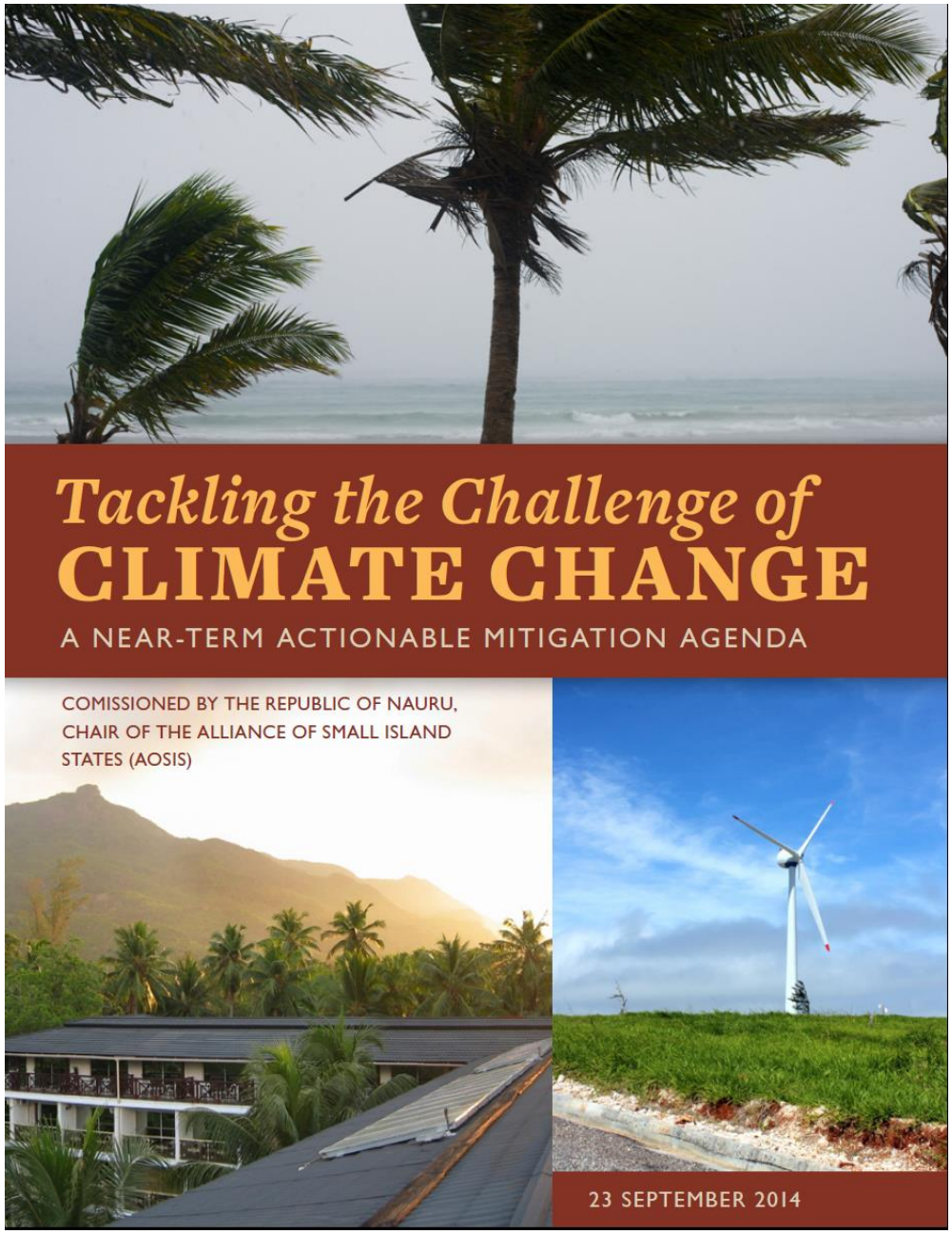
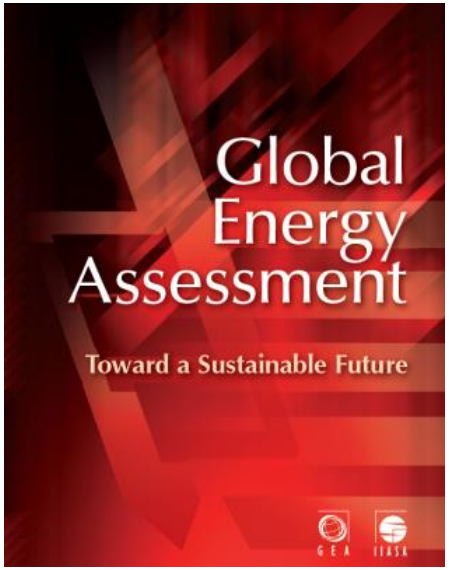
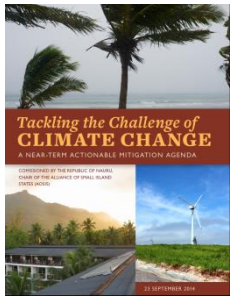
INTERGOVERNMENTAL PANEL ON climate change
CLIMATE CHANGE 2014
Synthesis Report
SYNTHESIS REPORT OF THE
FIFTH ASSESSMENT REPORT OF THE
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
WMO UNEP


Tackling the Challenge of
CLIMATE CHANGE
A NEAR-TERM ACTIONABLE MITIGATION AGENDA
COMISSIONED BY THE REPUBLIC OF NAURU,
CHAIR OF THE ALLIANCE OF SMALL ISLAND
STATES (AOSIS)
23 SEPTEMBER 2014


Global
Energy
Assessment
Toward a Sustainable Future
GEA
IIASA

The scale of the challenge is beyond anything we have yet considered.



- **We can and must act boldly now to reduce greenhouse gas emissions to keep the political goal of 1.5–2°C goal within reach,**
- **avoid increased costs of mitigation and adaptation and technological lock-in,**
- **provide universal access to modern energy, and**
- **realize multiple health and development co-benefits.**

Elements of the 2015 Paris Agreement

Article 2: Limit the global temperature increase to below 2 degrees C, and pursue efforts to limit the temperature increase to 1.5 degrees C above pre-industrial levels.

Article 4: Global emissions of greenhouse gases should peak as soon as possible, and anthropogenic emissions by sources and removal by sinks should balance by the second half of this century

Article 4.2: Each Party must prepare Nationally Determined Contributions (NDCs)

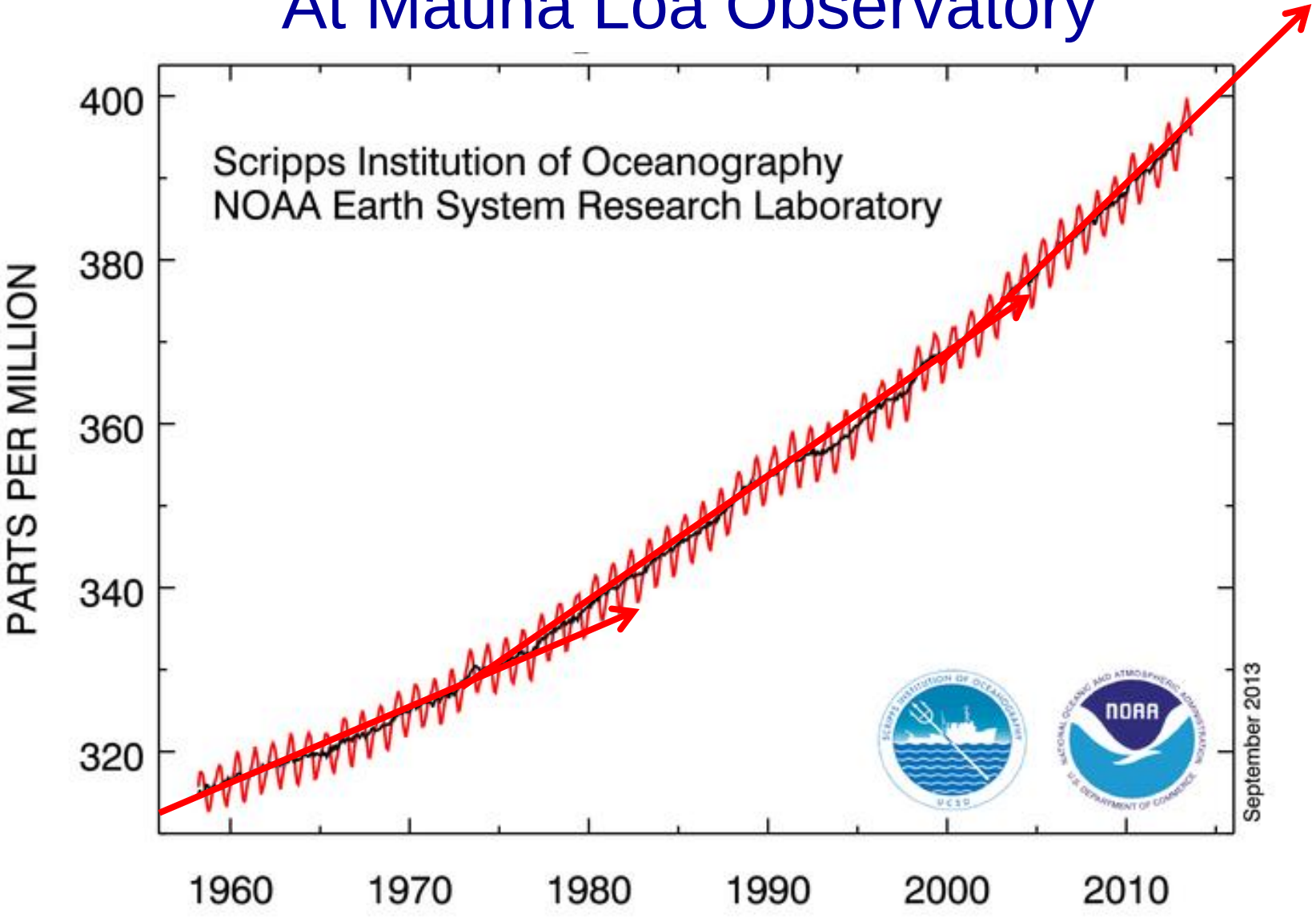
Article 7: A recognition that there is a significant need for adaptation

Article 9: Developed countries will provide financial resources to assist developing countries with respect to mitigation and adaptation, with a floor of US$100B per year

Articles 4.9/14: A global stock take will take place every 5 years, starting in 2023

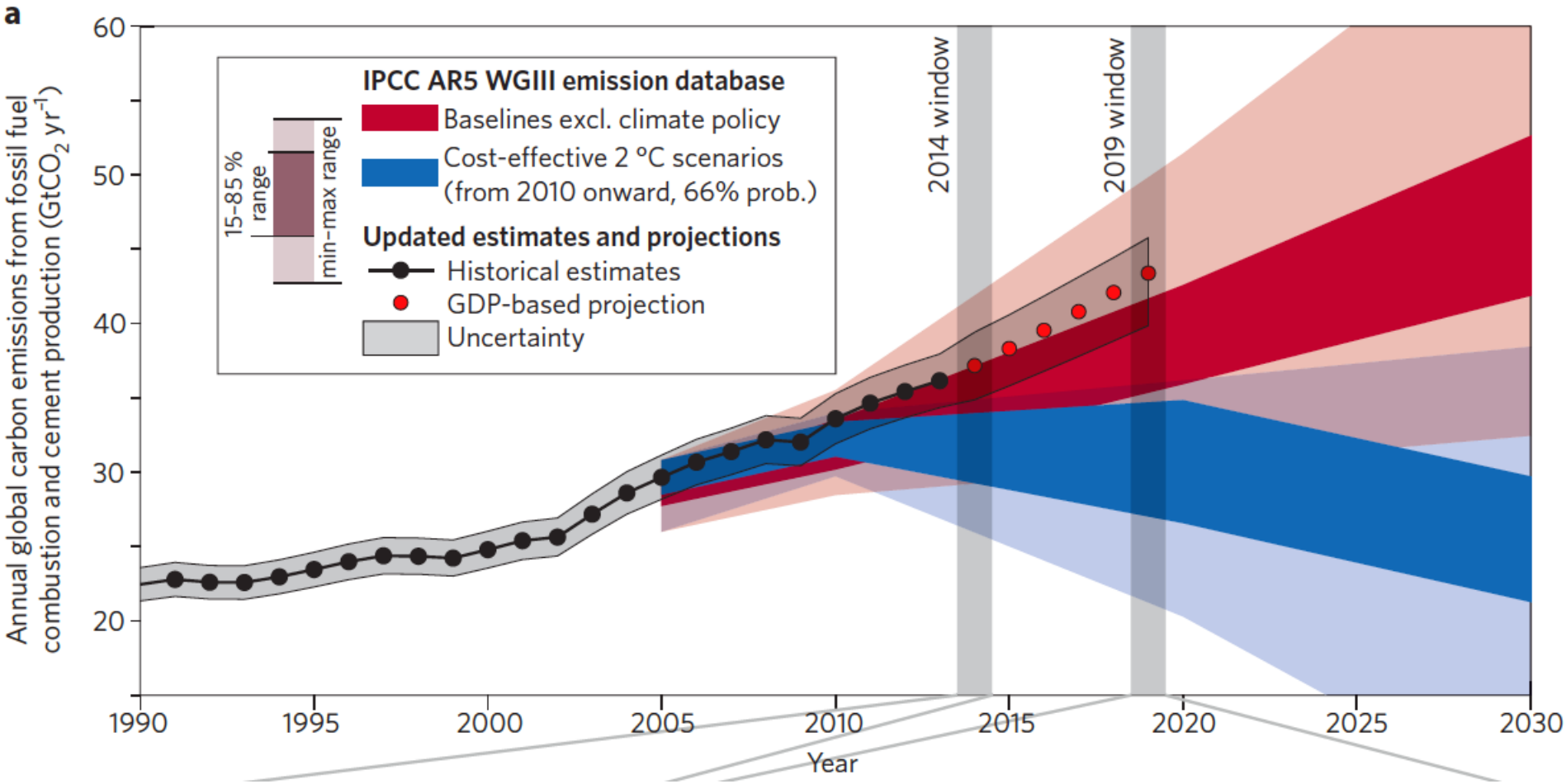
CO_2 Concentrations

At Mauna Loa Observatory



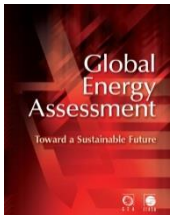
Source: NOAA, 2013 and IPCC WGI, 2013

Current global emissions are following the IPCC high scenario



Friedlingstein

Global CO_2 Emissions



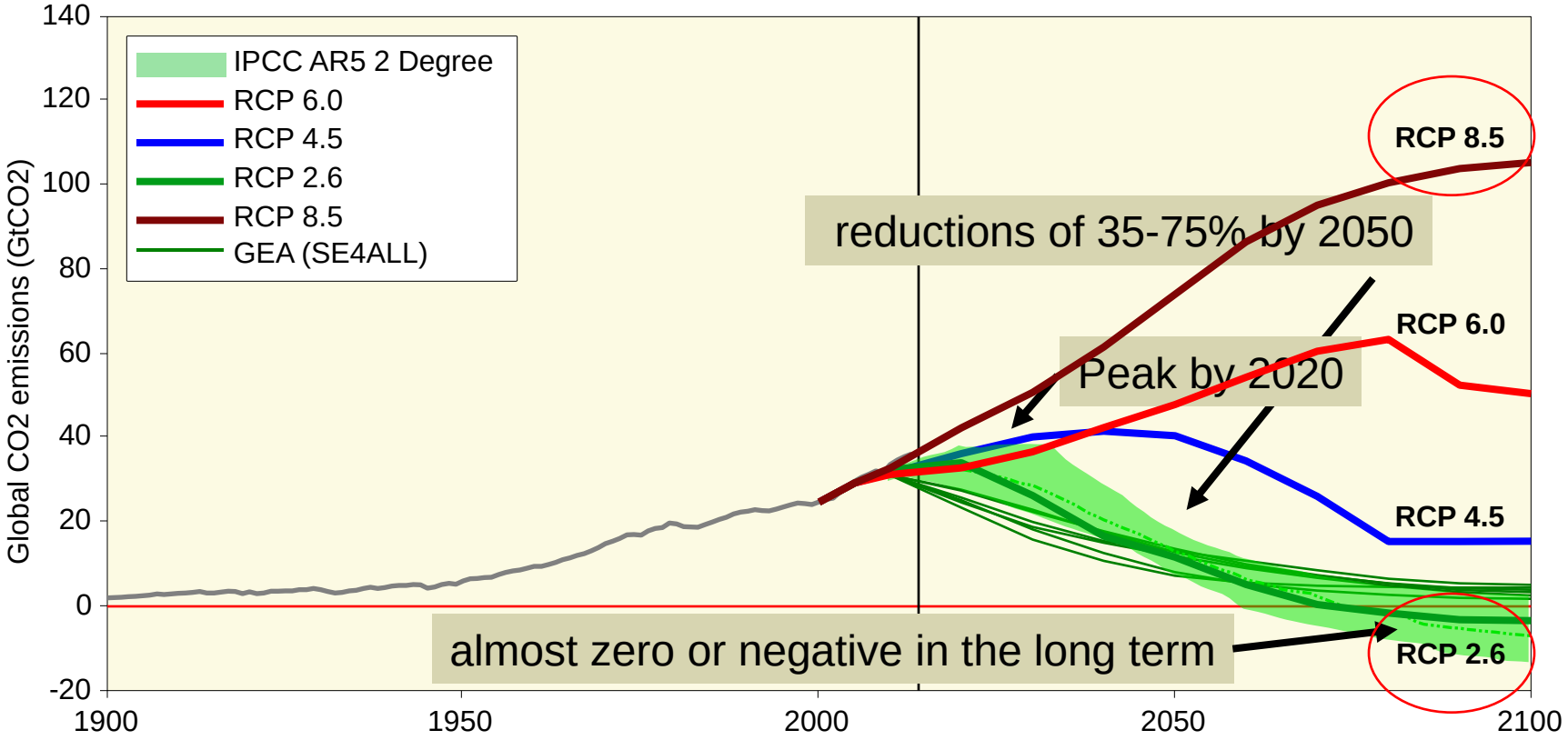
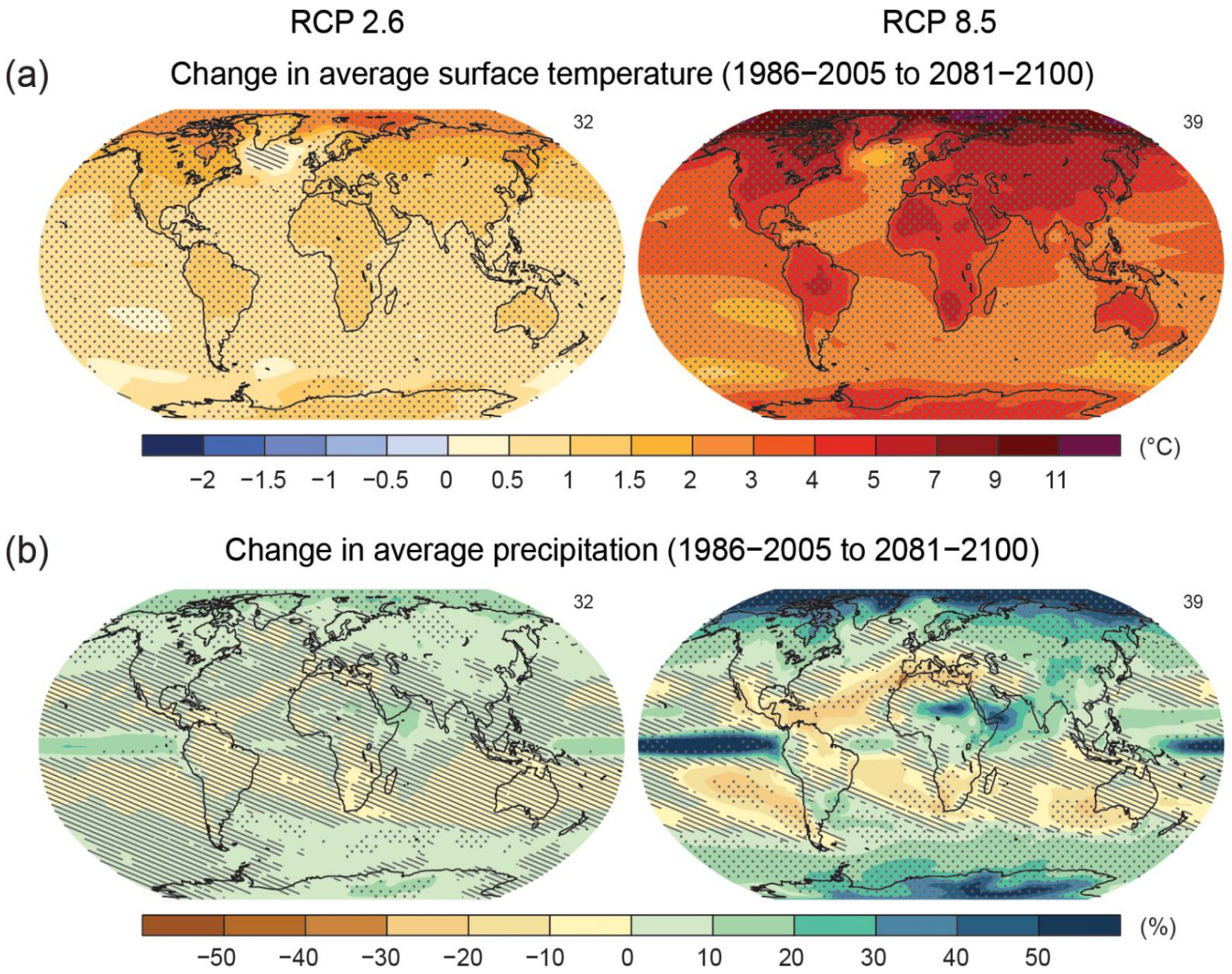
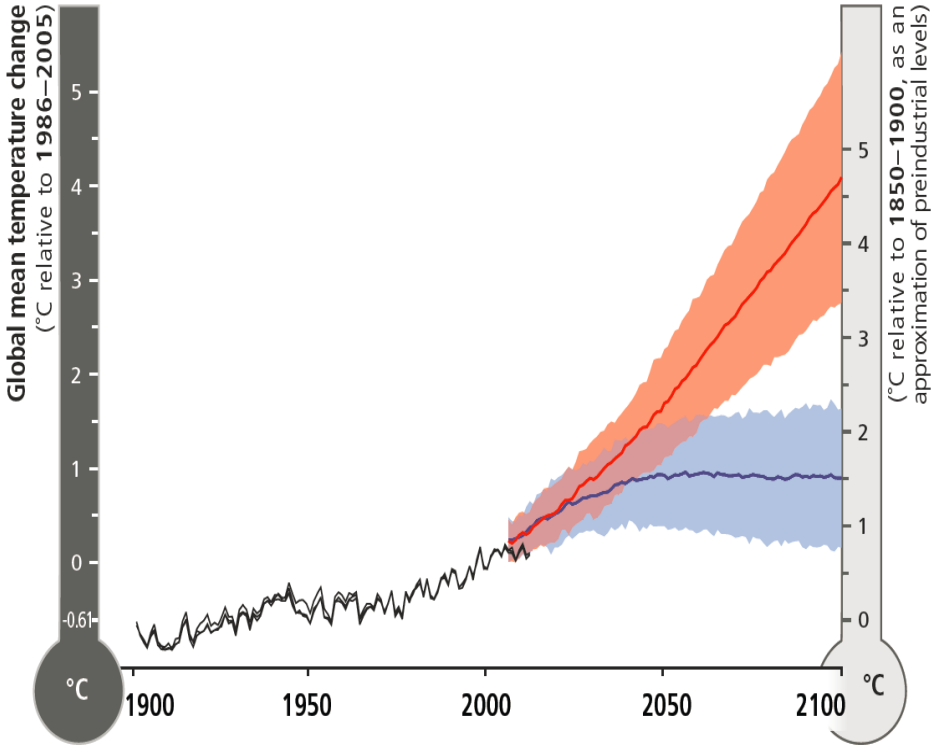
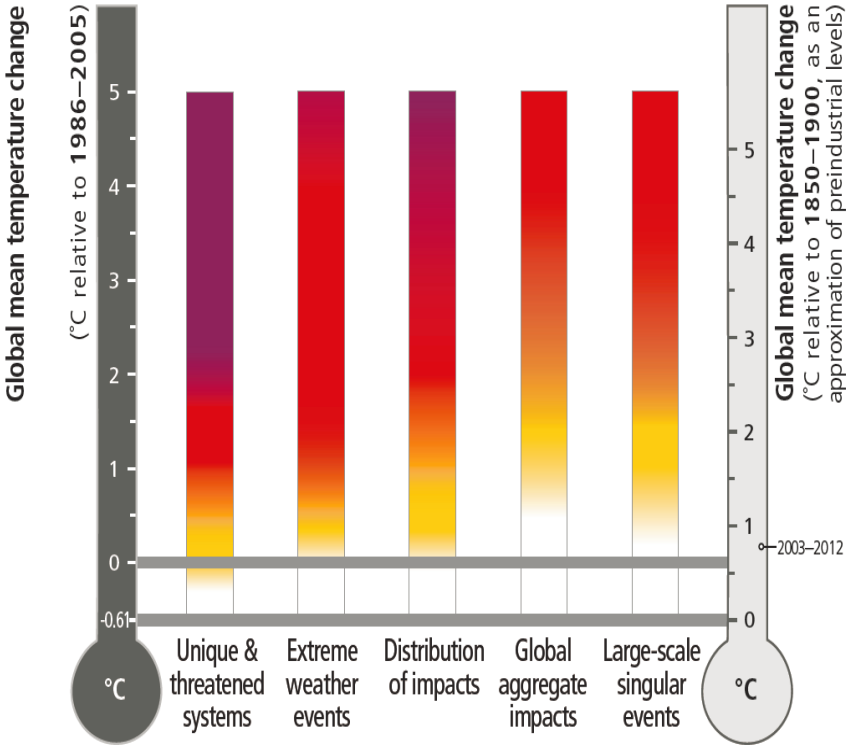


Figure SPM.8a,b

Maps of CMIP5 multi-model mean results







Observed
RCP8.5 (a high-emission scenario)
Overlap
RCP2.6 (a low-emission mitigation scenario)

Level of additional risk due to climate change

Undetectable | Moderate | High | Very high

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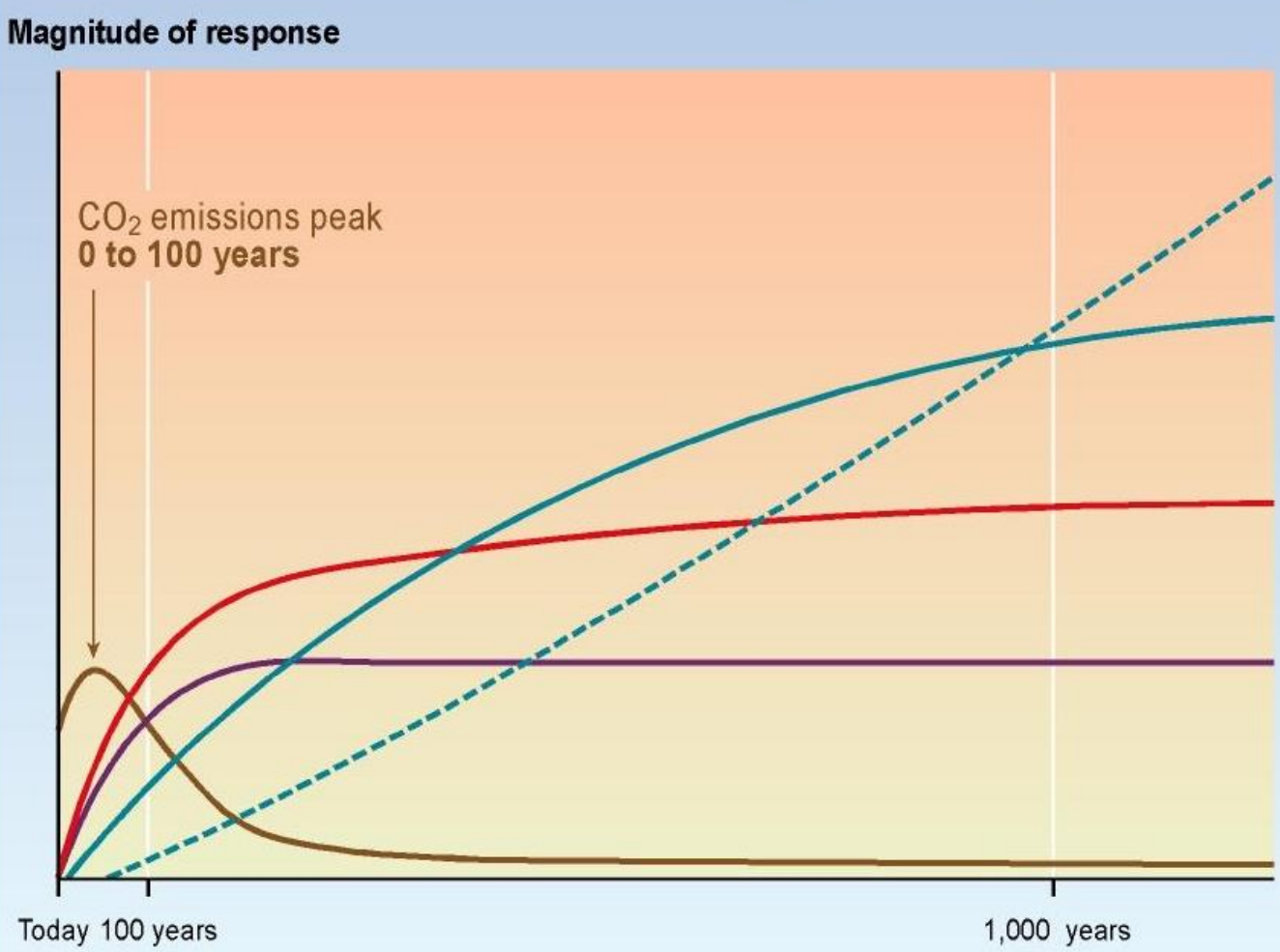
INTERGOVERNMENTAL PANEL ON climate change

CO_2 concentration, temperature, and sea level continue to rise long after emissions are reduced



Time taken to reach equilibrium

Sea-level rise due to ice melting:
several millennia

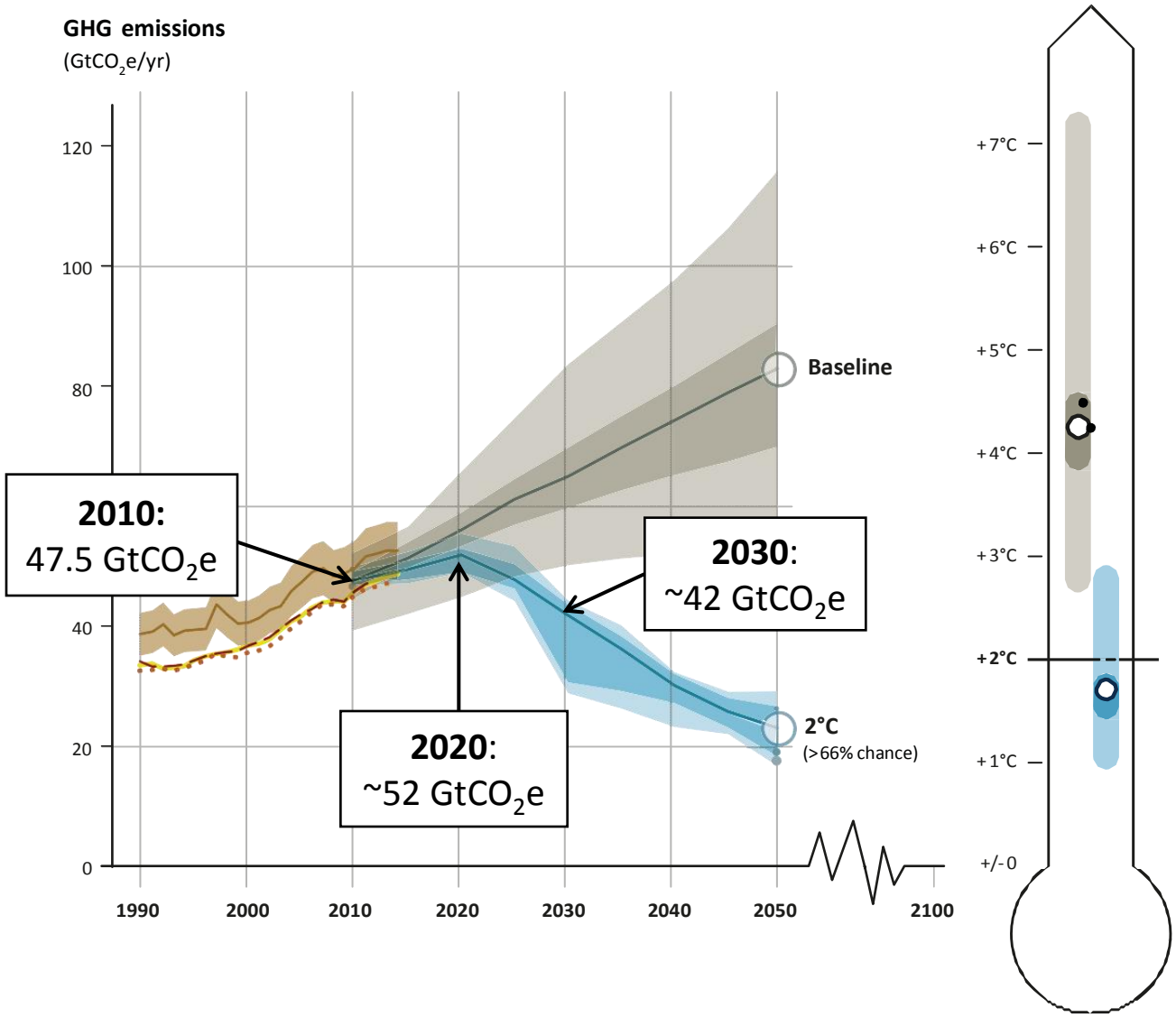
Sea-level rise due to thermal expansion:
centuries to millennia

Temperature stabilization:
a few centuries

CO_2 stabilization:
100 to 300 years

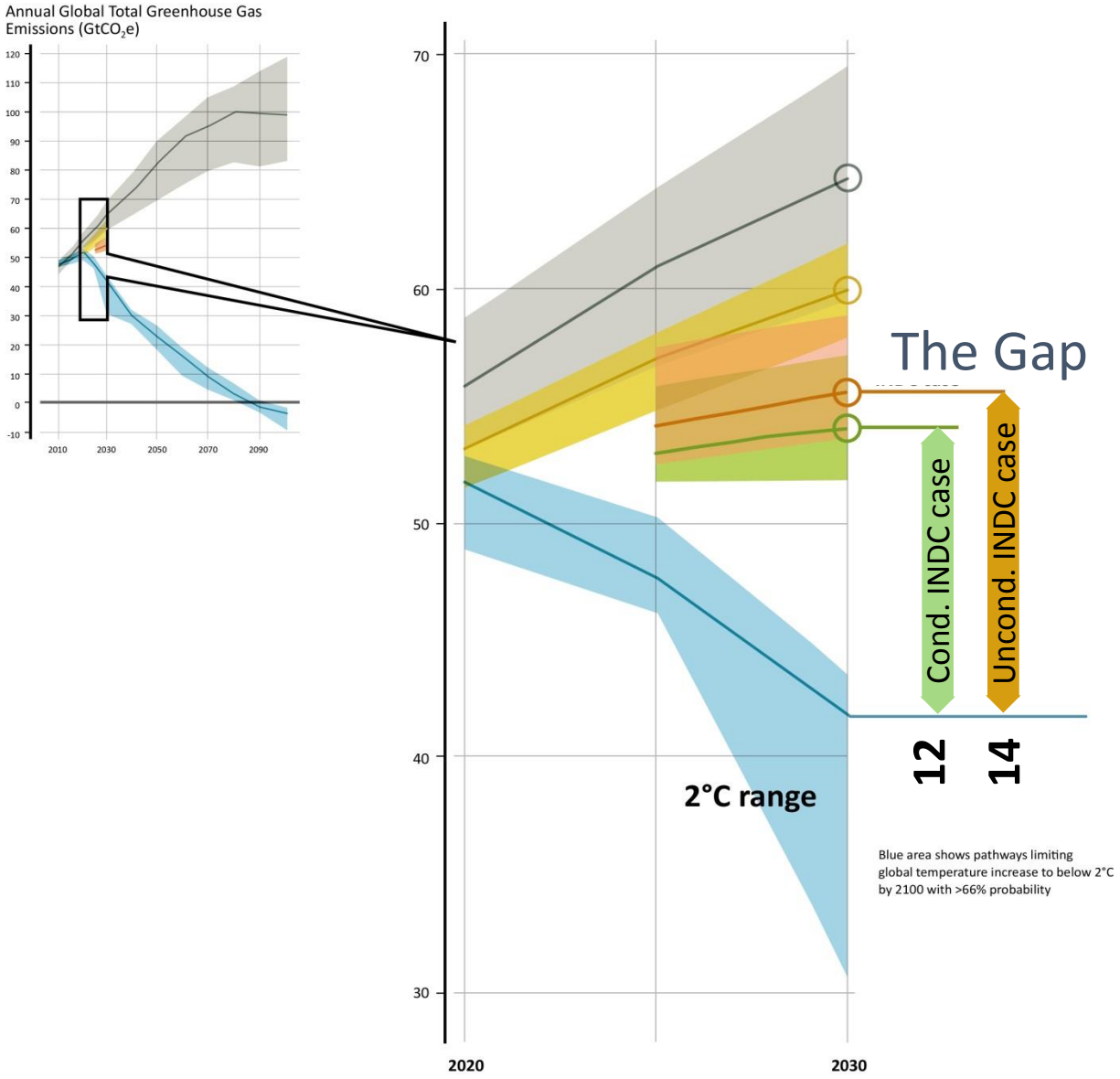
CO_2 emissions

Staying within the 2°C target



Credit: UNEP, 2015 https://www.dropbox.com/sh/vk018yr6h5xulnc/AAB-ISJFv_Xv7BFF4uBKIUVWa?dl=0

INDC contributions and the emissions gap



Unconditional INDC case
Gap= 14 $GtCO_2e$

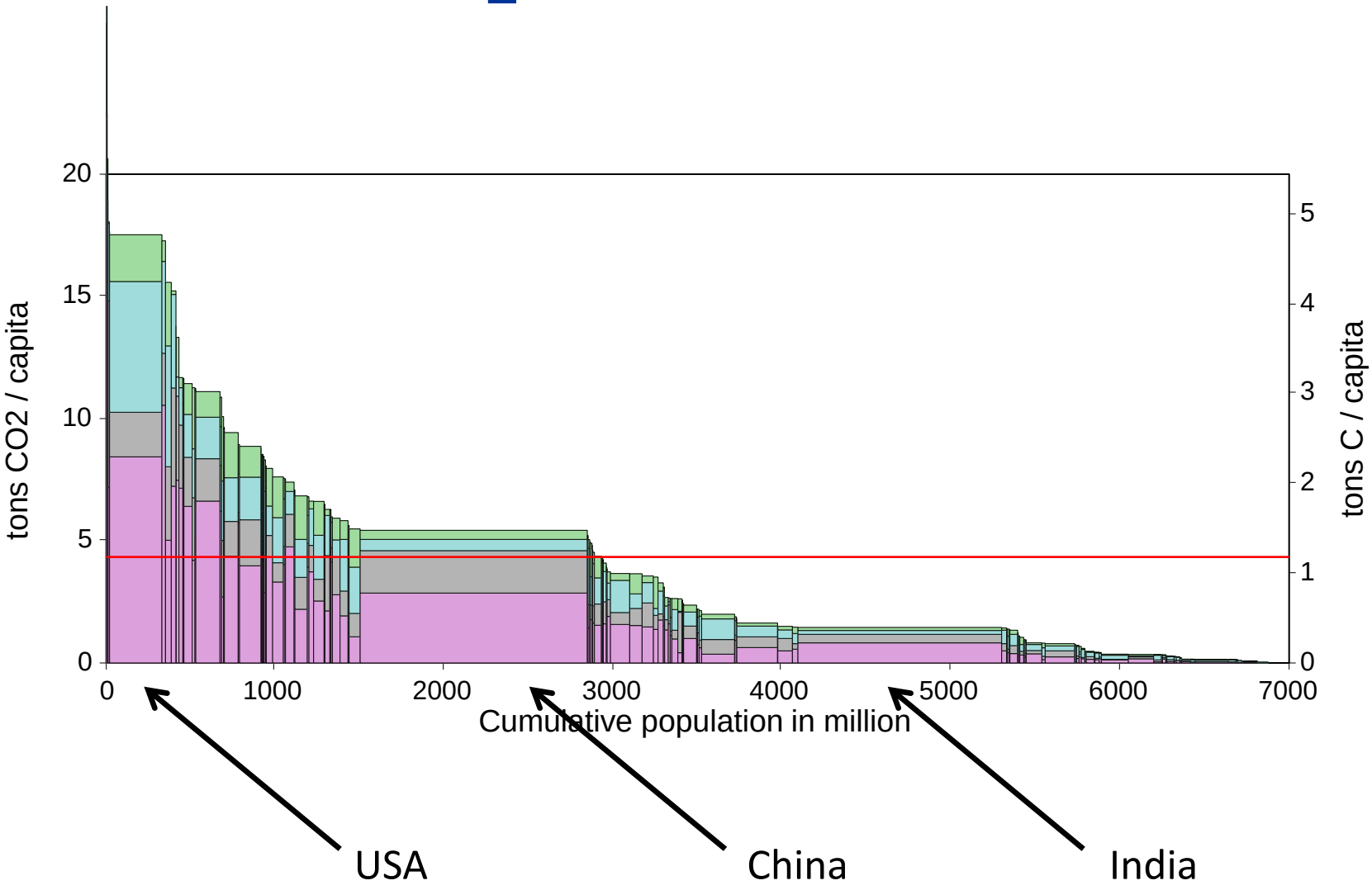
Conditional INDC case
Gap= 12 $GtCO_2e$

The INDCs present a real increase in the ambition level compared to a projection of current policies.

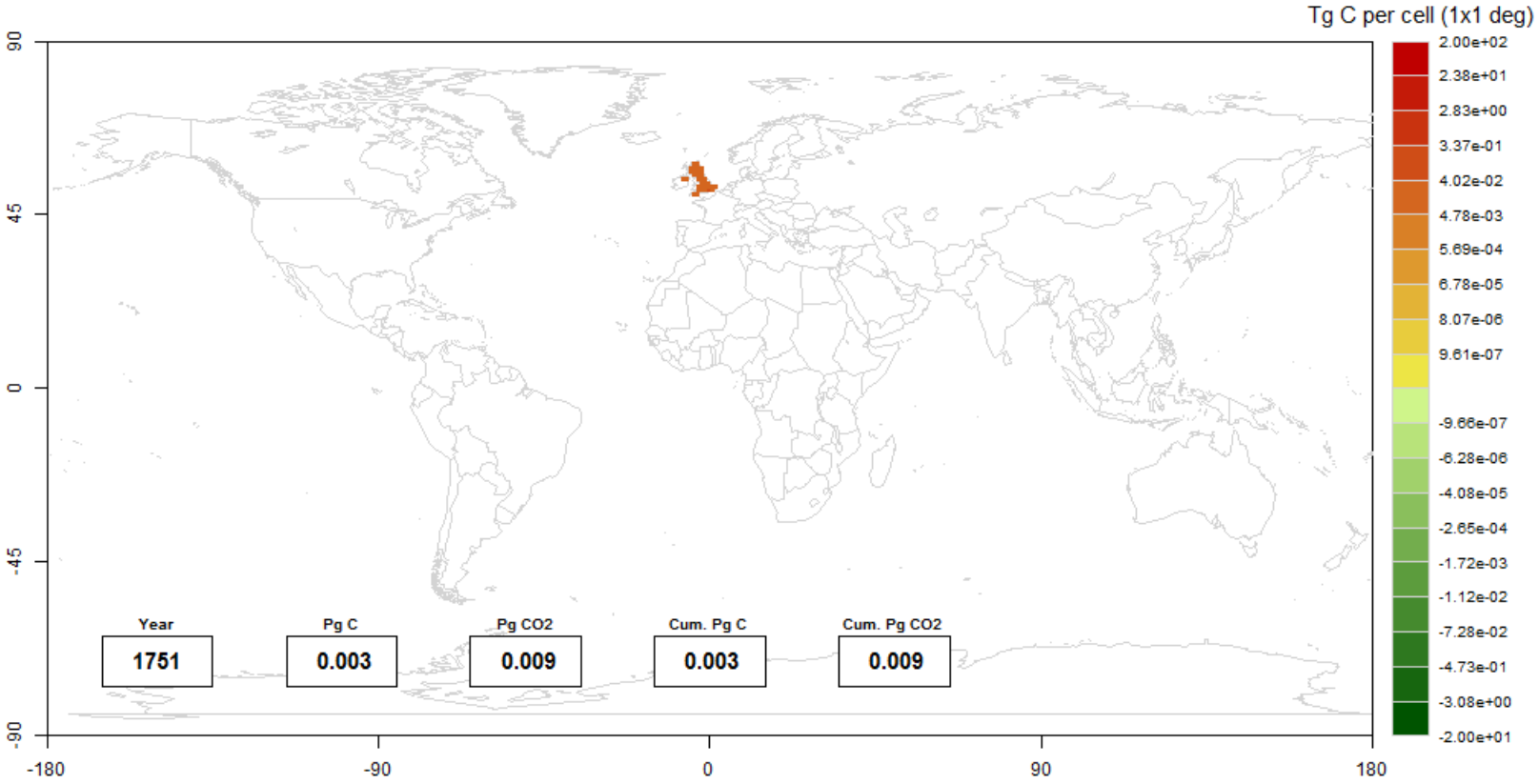
The emissions gap in both 2025 and 2030 will be very significant and ambitions will need to be enhanced urgently.

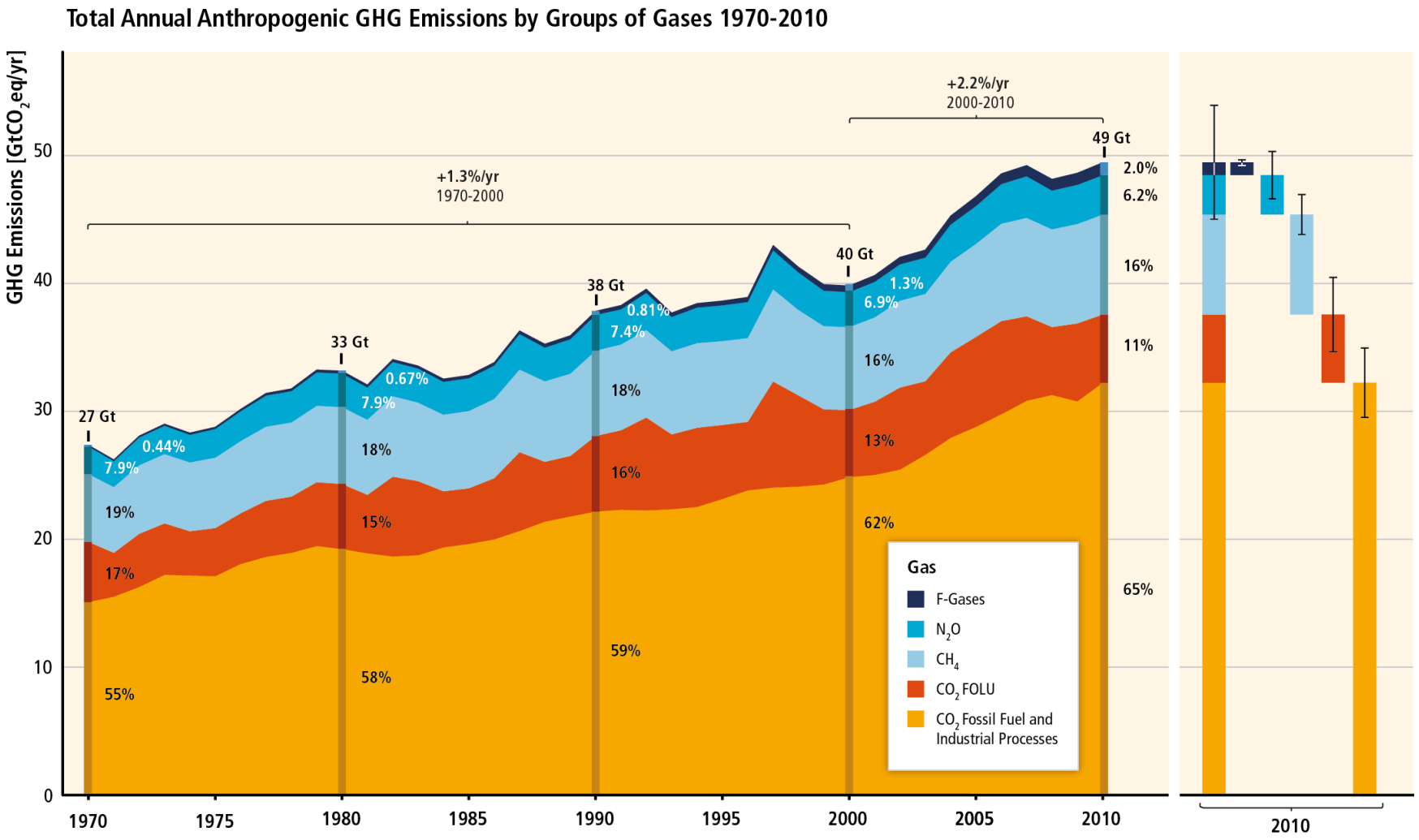
Credit: UNEP, 2015

Annual CO_2 per Capita Emissions

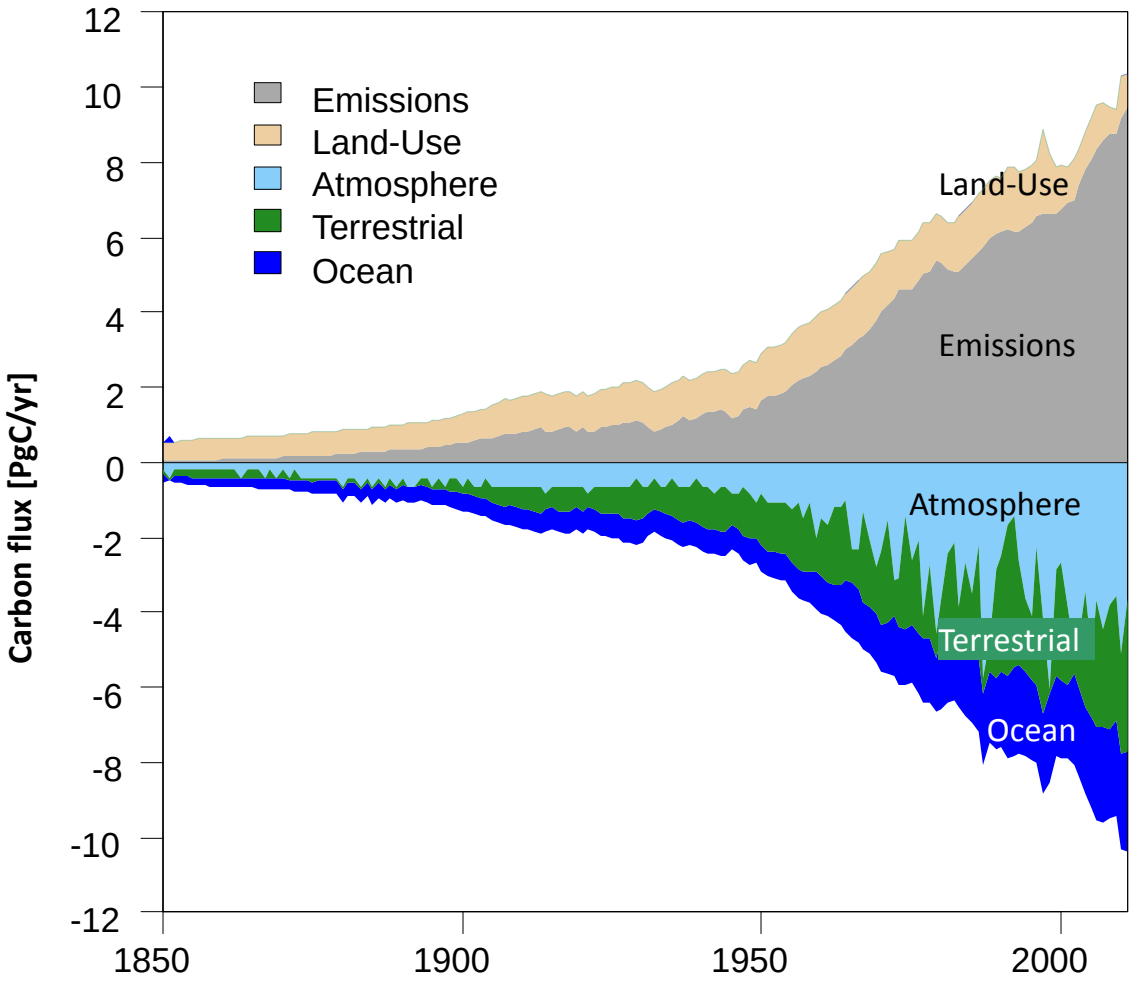


Global CO_2 Emissions




Total Annual Anthropogenic GHG Emissions by Groups of Gases 1970-2010
GHG Emissions [GtCO2eq/yr]
+1.3%/yr
1970-2000
+2.2%/yr
2000-2010
27 Gt
33 Gt
38 Gt
40 Gt
49 Gt
0.44%
0.67%
0.81%
1.3%
7.9%
7.9%
7.4%
6.9%
19%
18%
18%
16%
17%
15%
16%
13%
55%
58%
59%
62%
2.0%
6.2%
16%
11%
65%
Gas
F-Gases
N2O
CH4
CO2 FOLU
CO2 Fossil Fuel and Industrial Processes
0
10
20
30
40
50
1970
1975
1980
1985
1990
1995
2000
2005
2010
2010

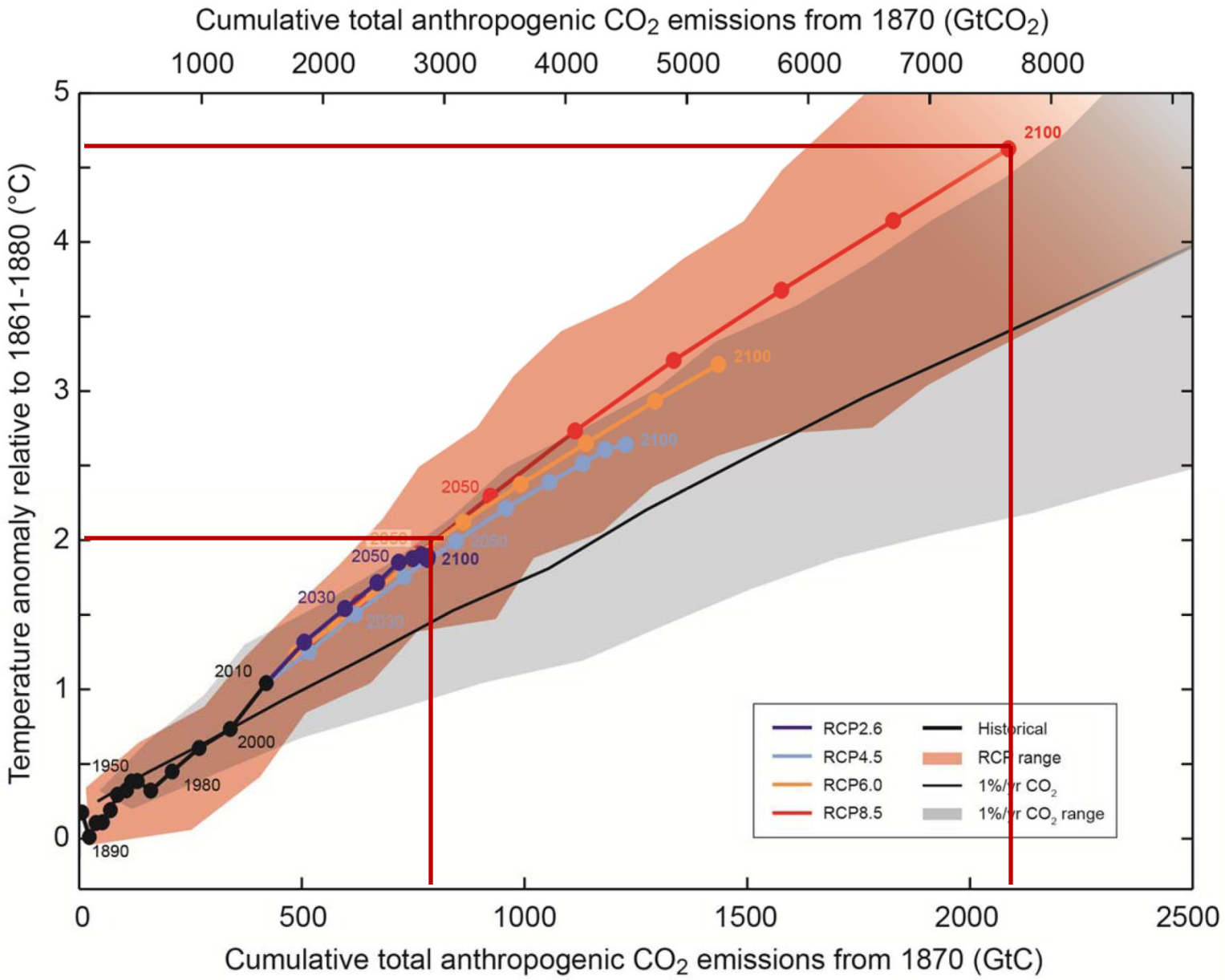
Human Perturbation of the Global Carbon Budget



2000-2010 (PgC /yr)	
Land-Use	1.0 ± 0.7
Emissions	7.9 ± 0.5
Atmosphere	4.1 ± 0.2
Terrestrial	2.5 ± 1.0 (Residual)
Ocean	2.3 ± 0.5 (5 models)

Global Carbon Project 2011; Le Quéré et al. 2009 & 2012, Nature G; Canadell et al. 2007, PNAS

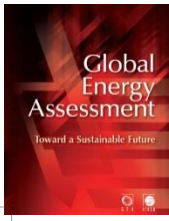
Cumulative Emissions & Temperature

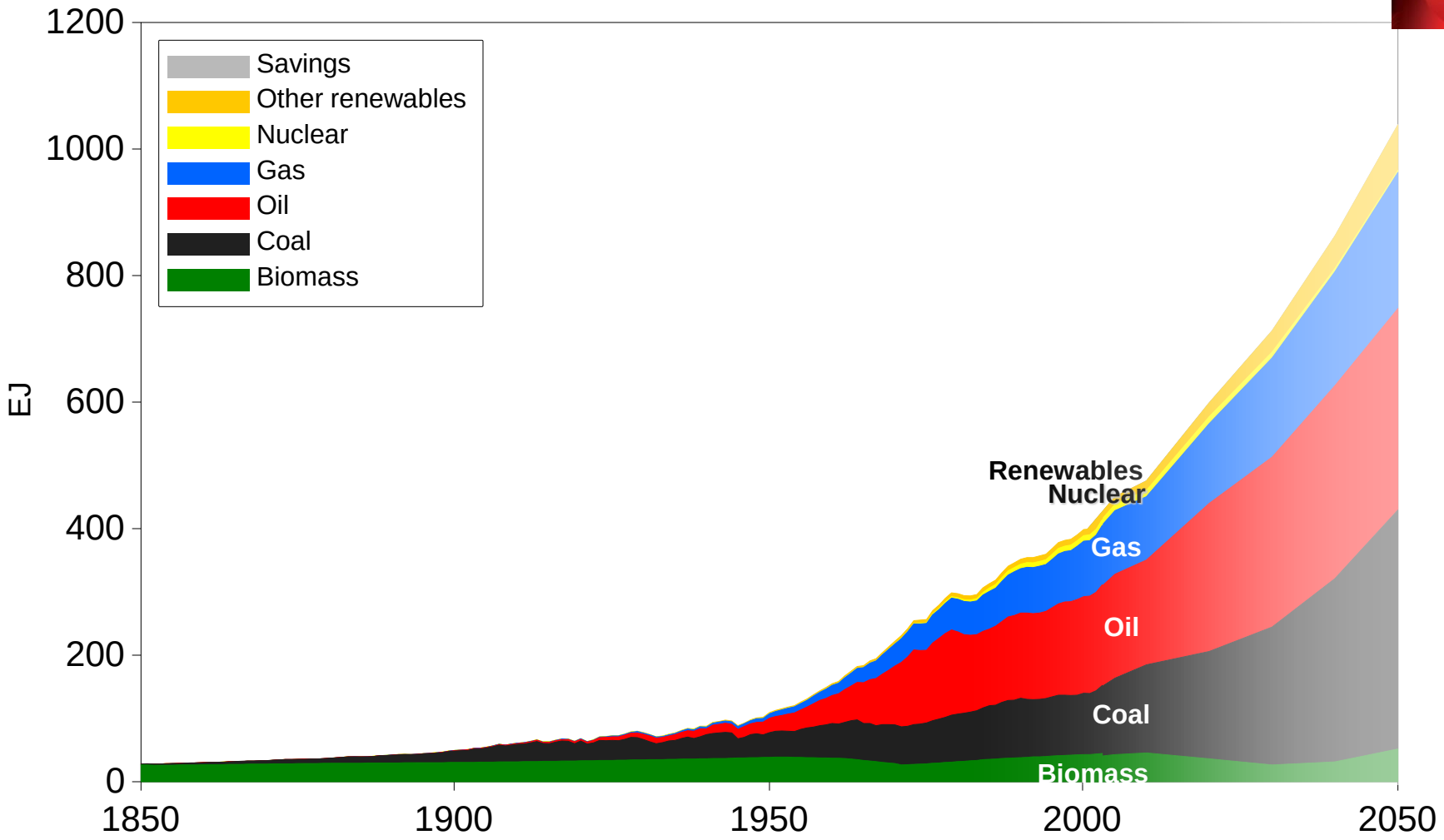


Source: IPCC WGI, 2013

Global Primary Energy

RCP 8.5 Pathway

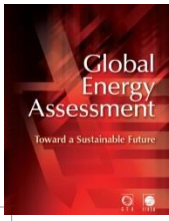


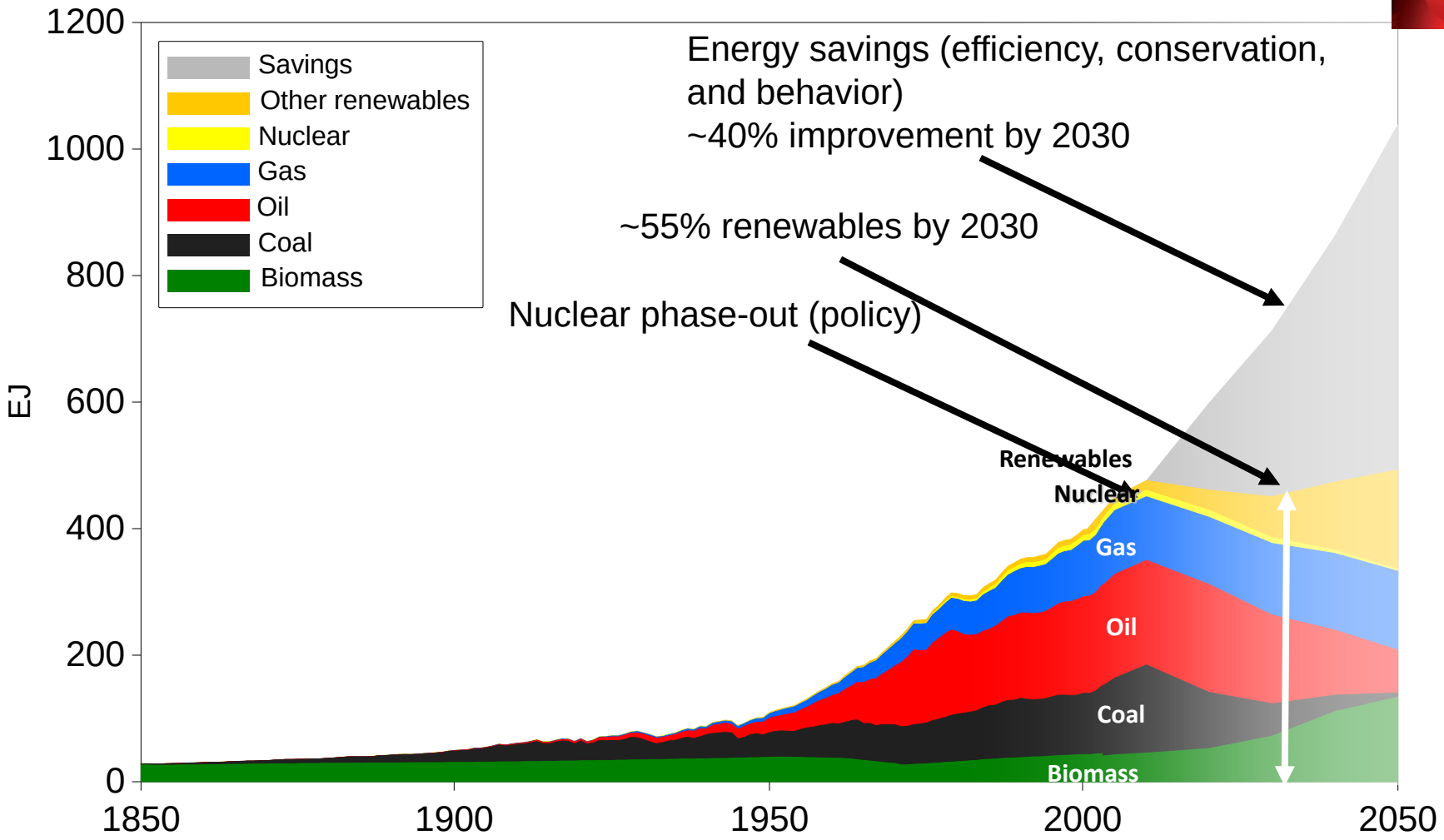


Source: Riahi et al, 2012

Global Primary Energy

RCP 2.6 variant: no CCS

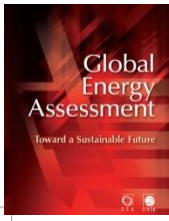


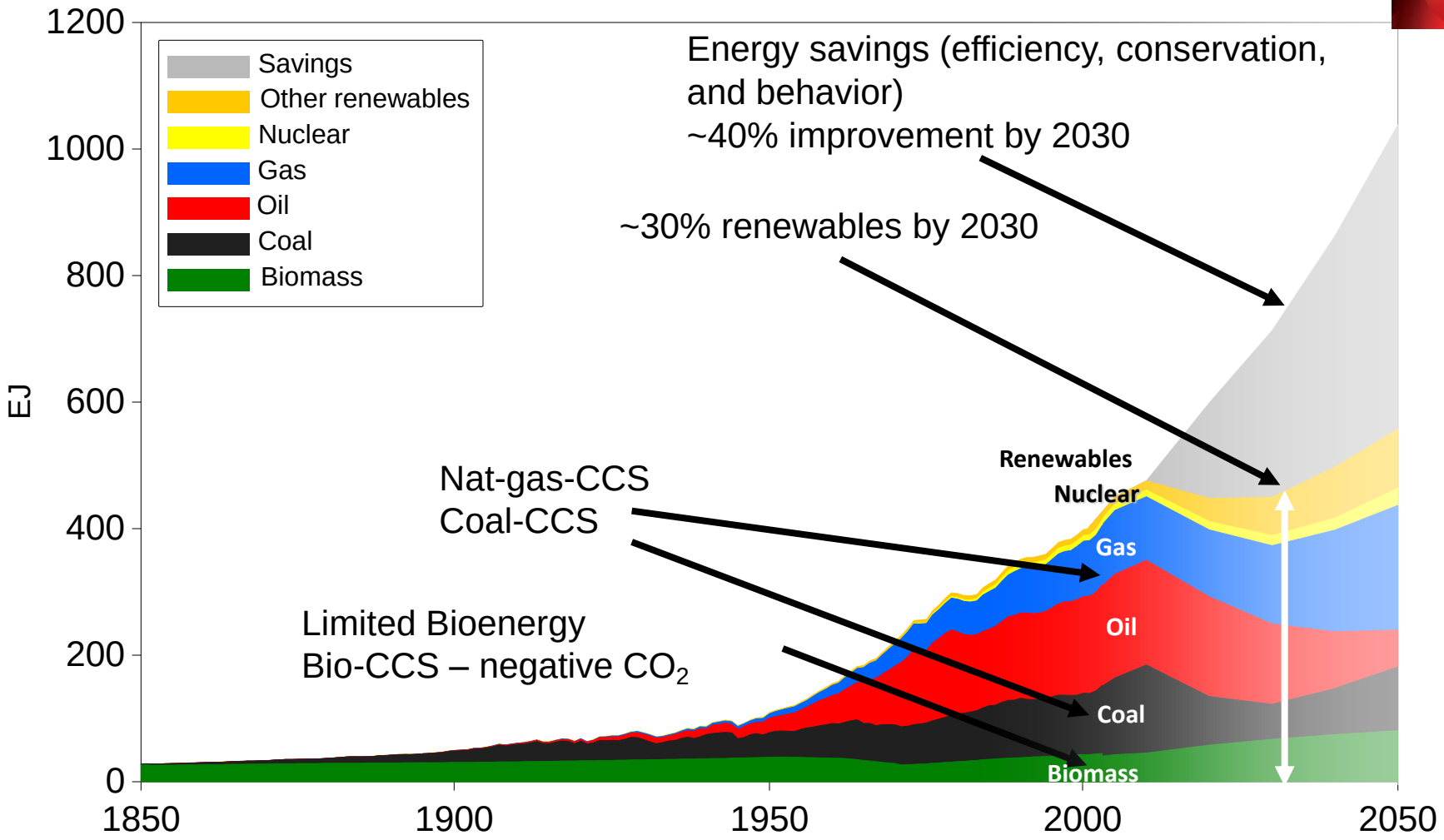


Source: Riahi et al, 2012

Global Primary Energy

RCP 2.6 variant: limited REN

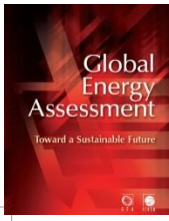


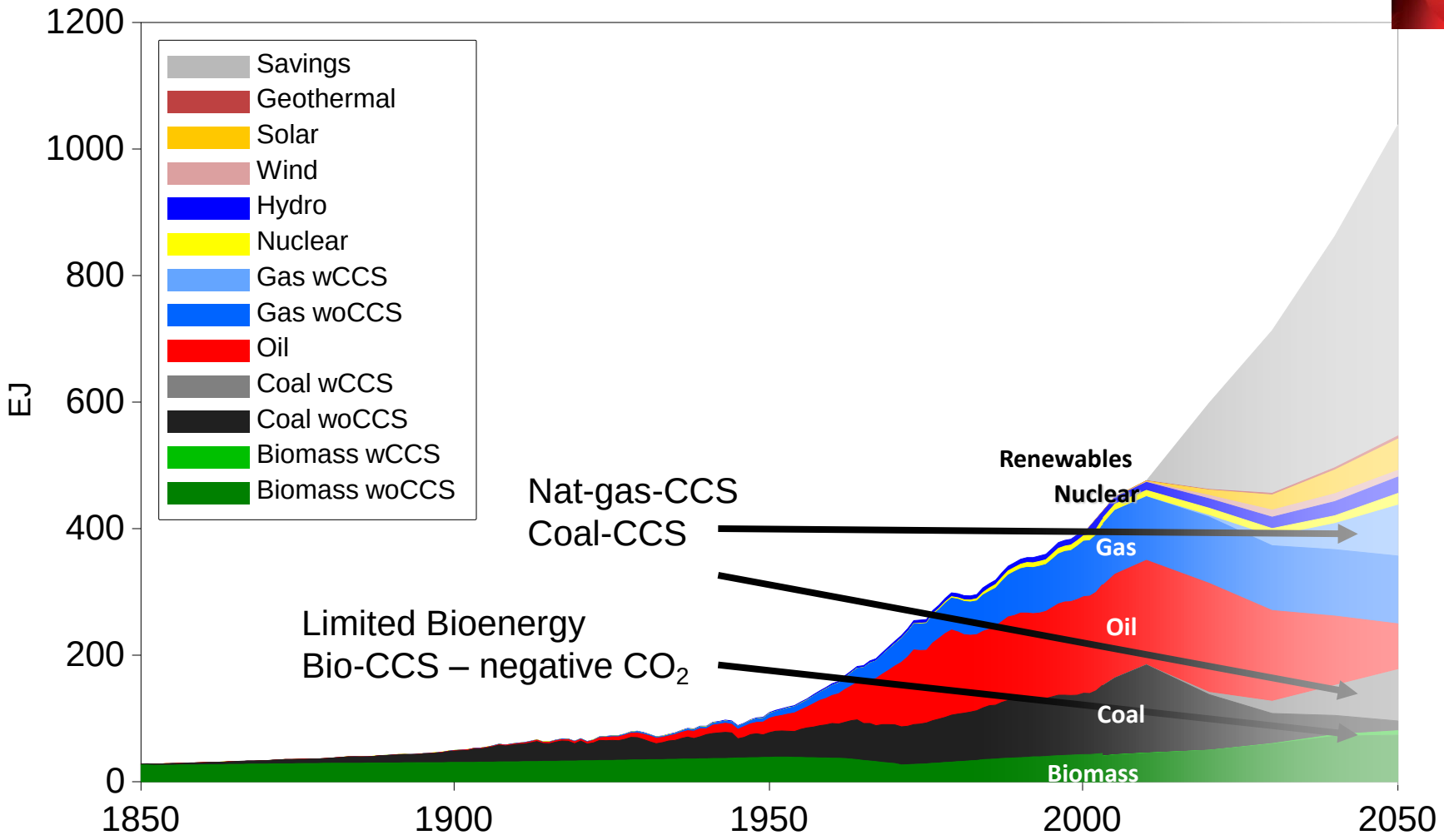


Source: Riahi et al, 2012

Global Primary Energy

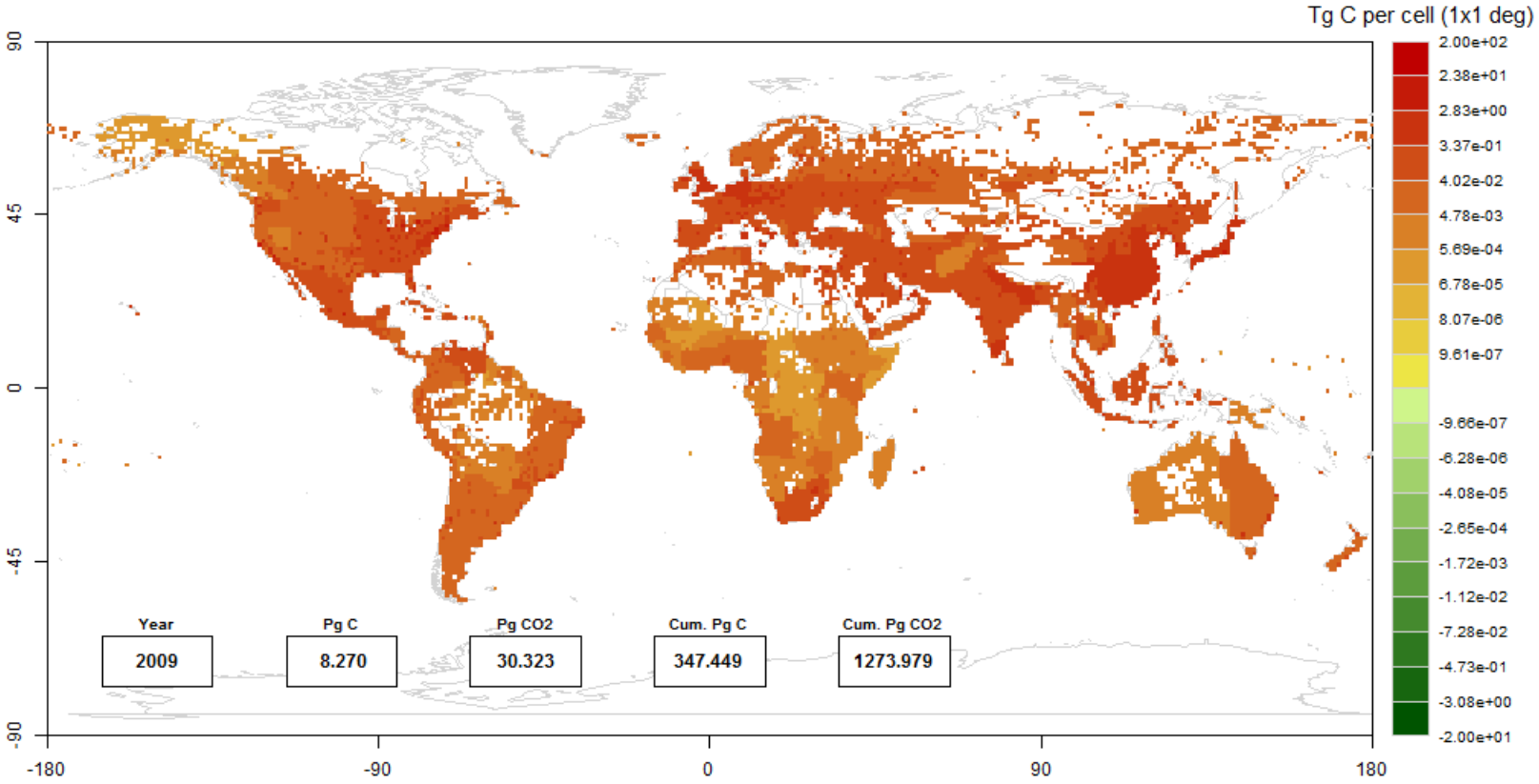
RCP 2.6 variant: limited REN





Source: Riahi et al, 2012

Global CO_2 Emissions

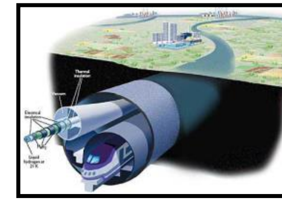


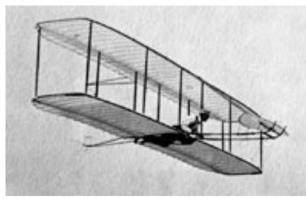
But first, a reminder… about technology

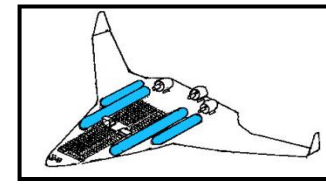
1850 | 1900 | 1950 | 2000 | 2050









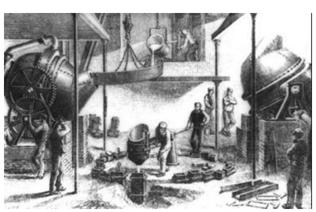











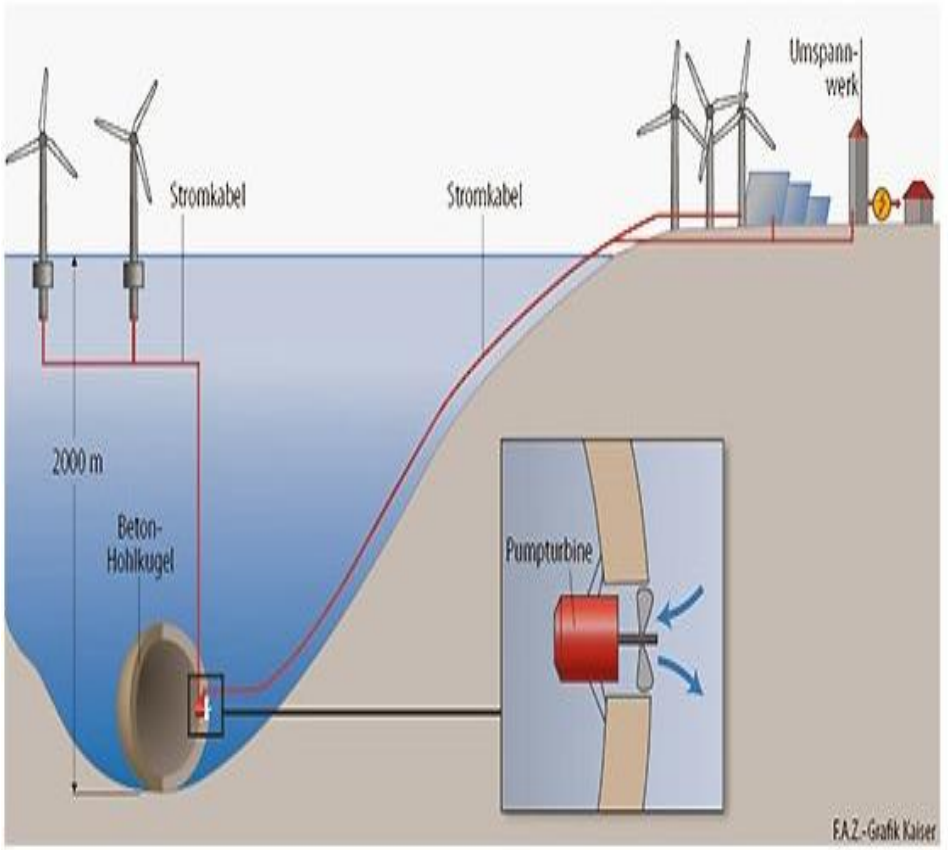





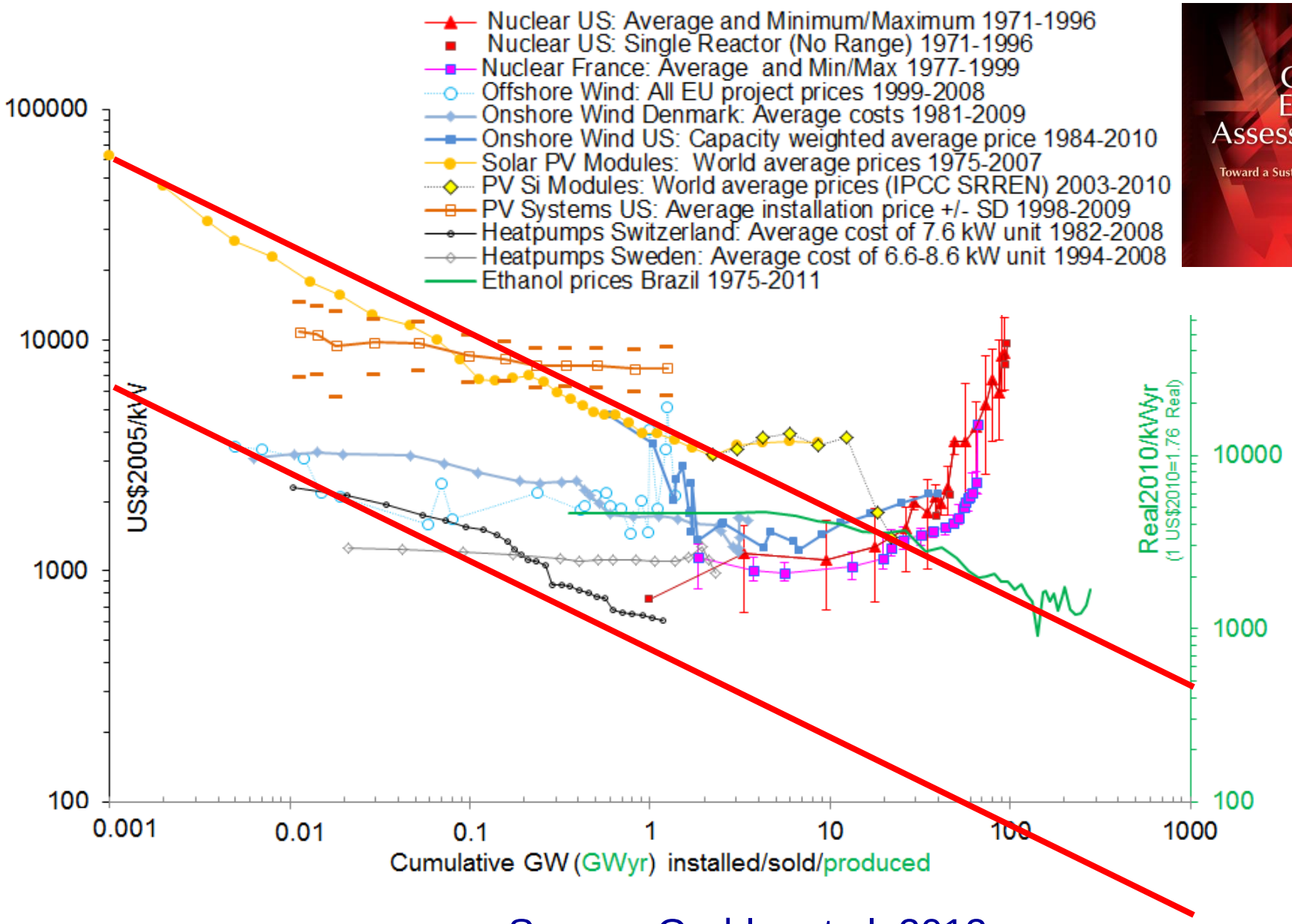
Sources: www.the-ashpit.com; www.railroad.net; wikepededia commons; www.virtualtourist.com; airandspace.si.edu; www.rwf2000.com; www.islandregister.com; www.islandregister.com

Source: After Granger Morgan, 2012

An Example of a possible transformational technology

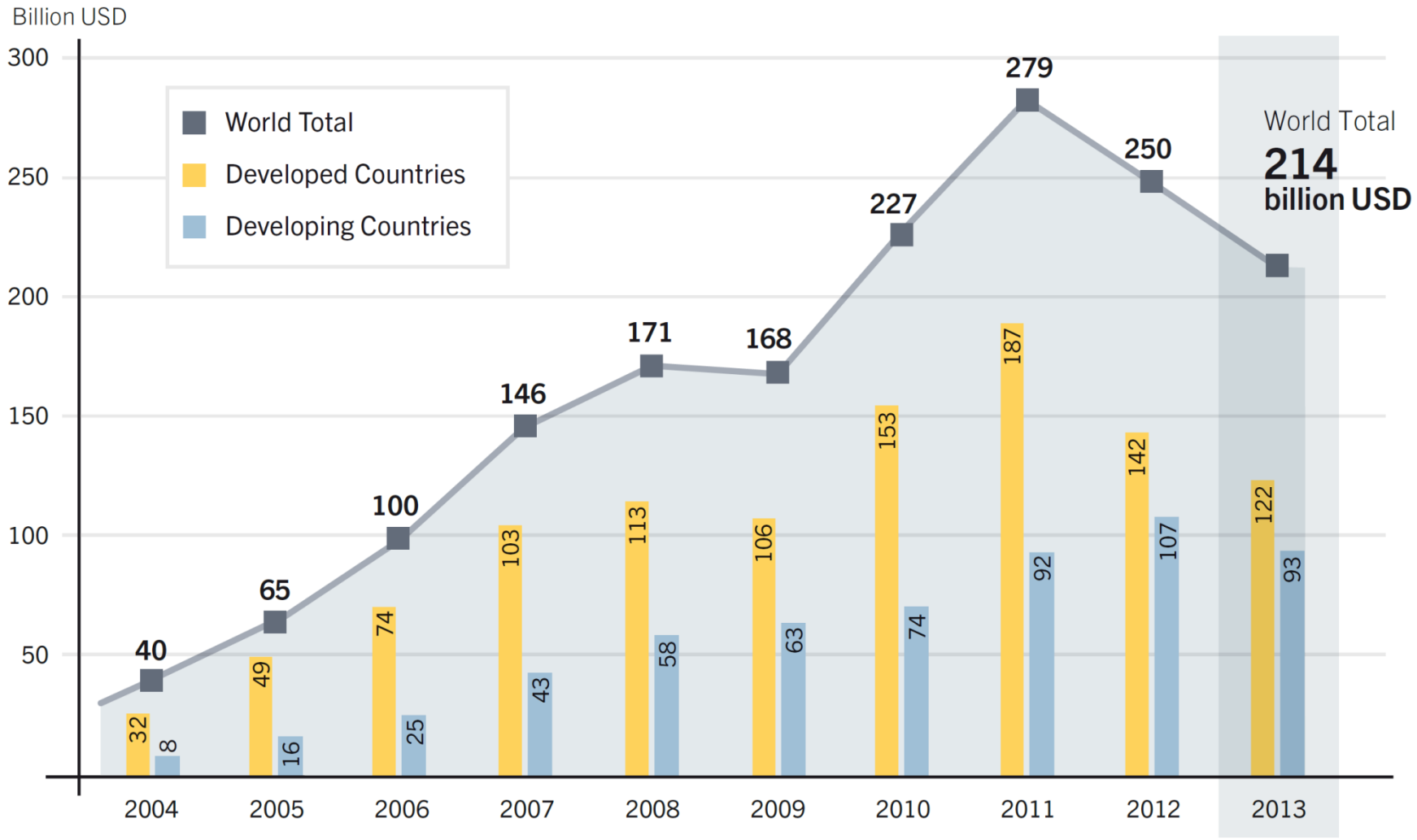


Supply Technologies Cost Trends



Source: Grubler et al, 2012

Annual Investments in Renwables



Source: REN 21, 2014

Estimates for mitigation costs vary widely

- **Reaching 450ppm CO_2eq entails consumption losses of 1.7% (1%-4%) by 2030, 3.4% (2% to 6%) by 2050 and 4.8% (3%-11%) by 2100 relative to baseline (which grows between 300% to 900% over the course of the century).**

- **This is equivalent to a reduction in consumption growth over the 21st century by about 0.06 (0.04-0.14) percentage points a year (relative to annualized consumption growth that is between 1.6% and 3% per year).**

- **Cost estimates exlude benefits of mitigation (reduced impacts from climate change). They also exclude other benefits (e.g. improvements for local air quality).**

- **Cost estimates are based on a series of assumptions.**

Limiting Temperature Increase to 2˚C

Measures exist to achieve the substantial emission reductions required to limit likely warming to 2°C (40-70% reduction in GHGs globally by 2050 and near zero or below emissions levels in 2100)

A combination of adaptation and substantial, sustained reductions in greenhouse gas emissions can limit climate change risks

Implementing reductions in greenhouse gas emissions poses substantial technological, economic, social, and institutional challenges

Ambitious mitigation is affordable and translates into delayed but not foregone growth (economic growth reduced by ~ 0.06% / BAU growth 1.6-3%). Estimated costs do not account for the benefits of reduced climate change

But delaying mitigation will substantially increase the challenges associated with limiting warming to 2°C

IPCC AR5 Synthesis Report

ipcc INTERGOVERNMENTAL PANEL ON climate change

WMO UNEP

AR5 WGI SPM, AR5 WGII SPM,AR5 WGIII SPM

Climate Change and Equity

- Issues of equity, justice, and fairness arise with respect to mitigation and adaptation:

- Different past and future contributions to the accumulation of GHGs in the atmosphere

- Varying challenges and circumstances

- Different capacities to address mitigation and adaptation.

- Options for equitable burden-sharing can reduce the potential for the costs of climate action to constrain development.

Conclusions

- **We can and must act boldly to reduce GHG emissions to keep the agreed 1.5 – 2 degree C goal within reach**
- **The scale of the challenge is beyond anything we have yet considered**
- **Success is only achievable if we tackle the technological, institutional, financial and political inertia now. Our current pathway will not achieve the deep decarbonization we need**
- **There is major cost-effective potential to rapidly increase efficency in all sectors with existing commercially available technologies and use of best practices, given appropriate policy support**
- **There is significant scope for early deployment at scale of renewable energy technologies, if supported with policies (affordable capital, feed-in tariffs, elimination of fossil fuel subsidies) and increased financing**
- **An effective price on carbon (to reflect the costs of emissions) would send the right price signal to drive investments in clean technologies**
- **A systems-wide transformation towards a low-carbon economy requires policies to catalyze societal behavioural changes**
- **No more coal-fired power plants should be built without Carbon Capture and Storage**