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Getting to 2° C: Global Goals and Realistic Responses

Workshop on the Role of Nuclear Power in a Carbon Constrained World

September 22, 2015

CO_2 concentrations over time

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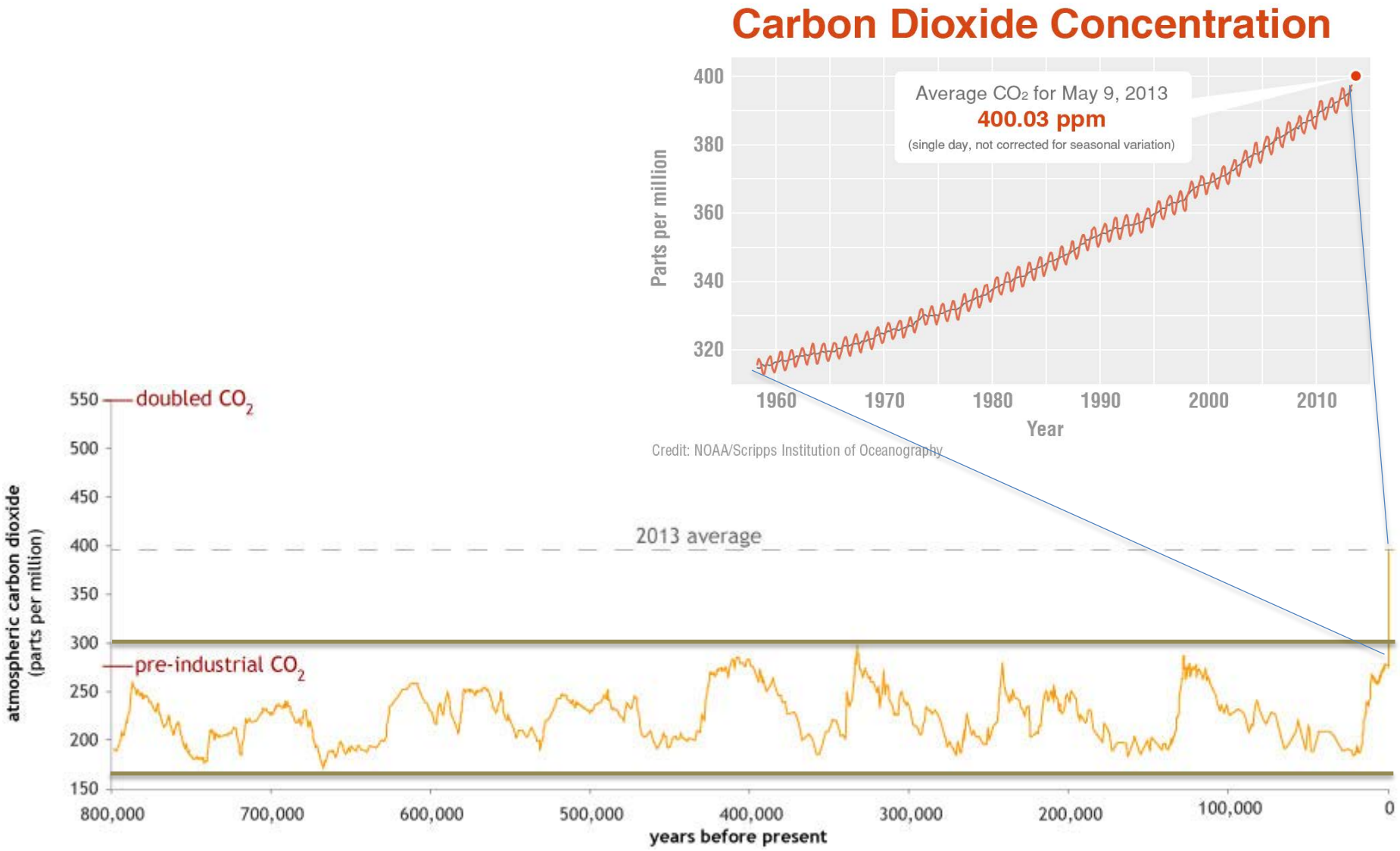

Source: https://www.climate.gov/news-features/climate-qa/how-much-will-earth-warm-if-carbon-dioxide-doubles-pre-industrial-levels

TOTAL equivalent CO_2 emissions are expected to rise despite improvements in technology

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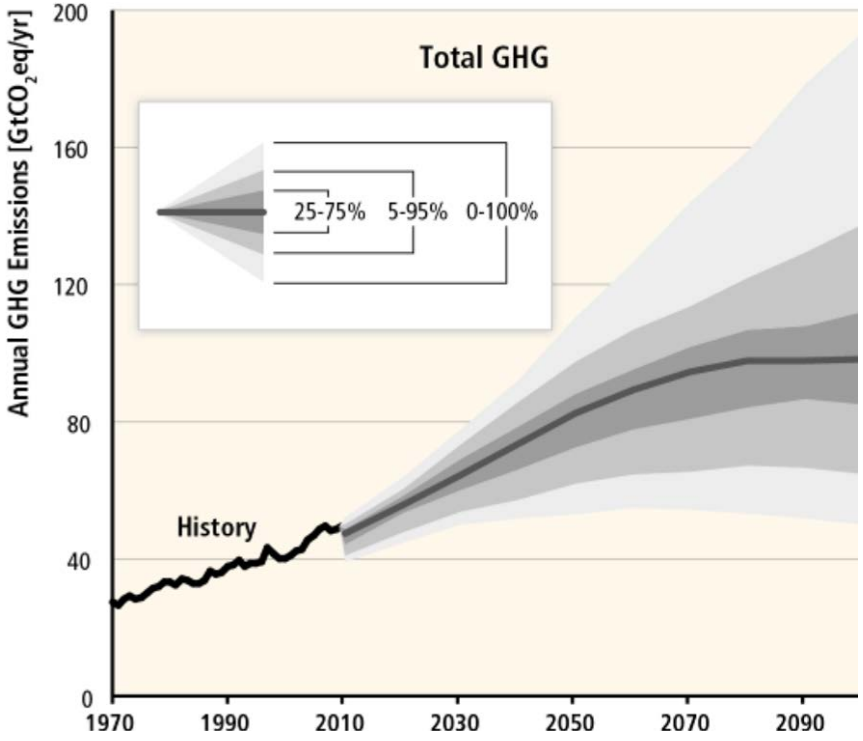
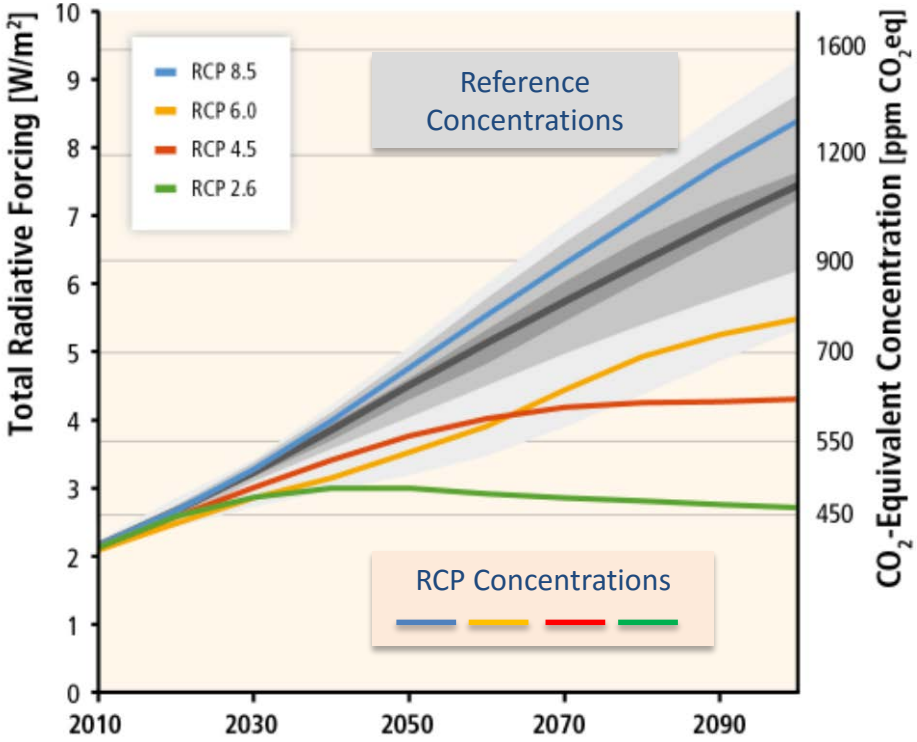
Baseline scenarios result in global mean surface temperature increases in 2100 from 3.7 to 4.8°C compared to pre-industrial levels (median values; the range is 2.5°C to 7.8°C when including climate uncertainty)

Global GHG Emissions



Global GHG Concentrations



Future projections of energy use and CO_2 emissions assume significant technological progress in their no-climate-policy, business-as-usual cases

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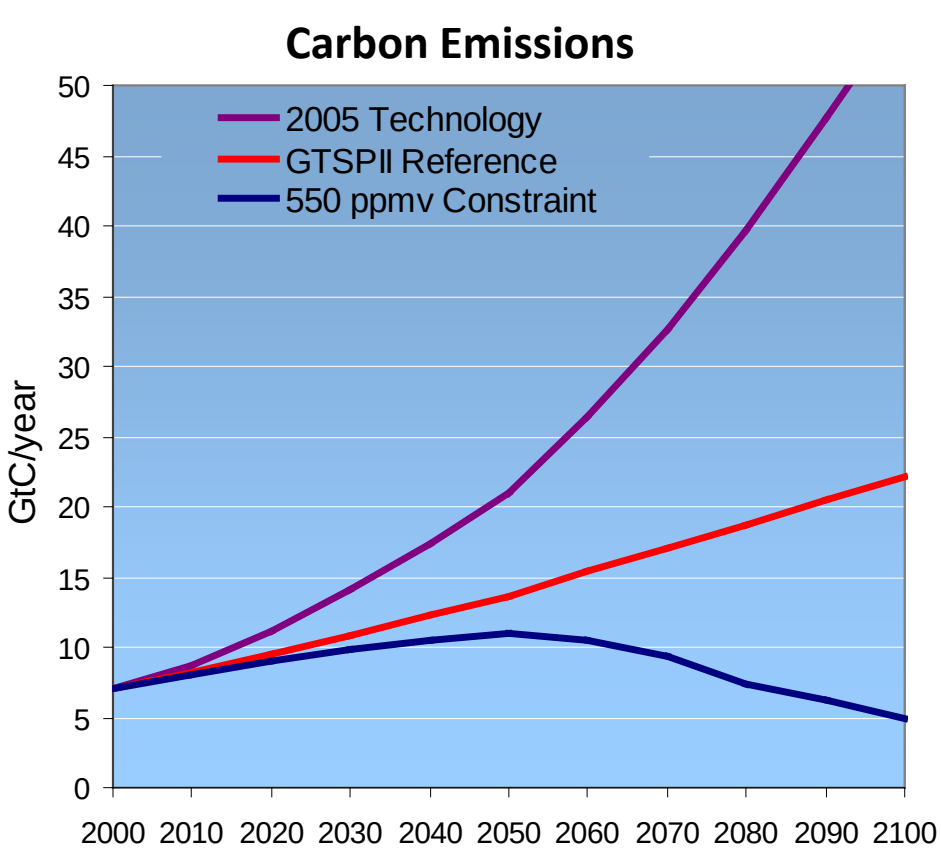
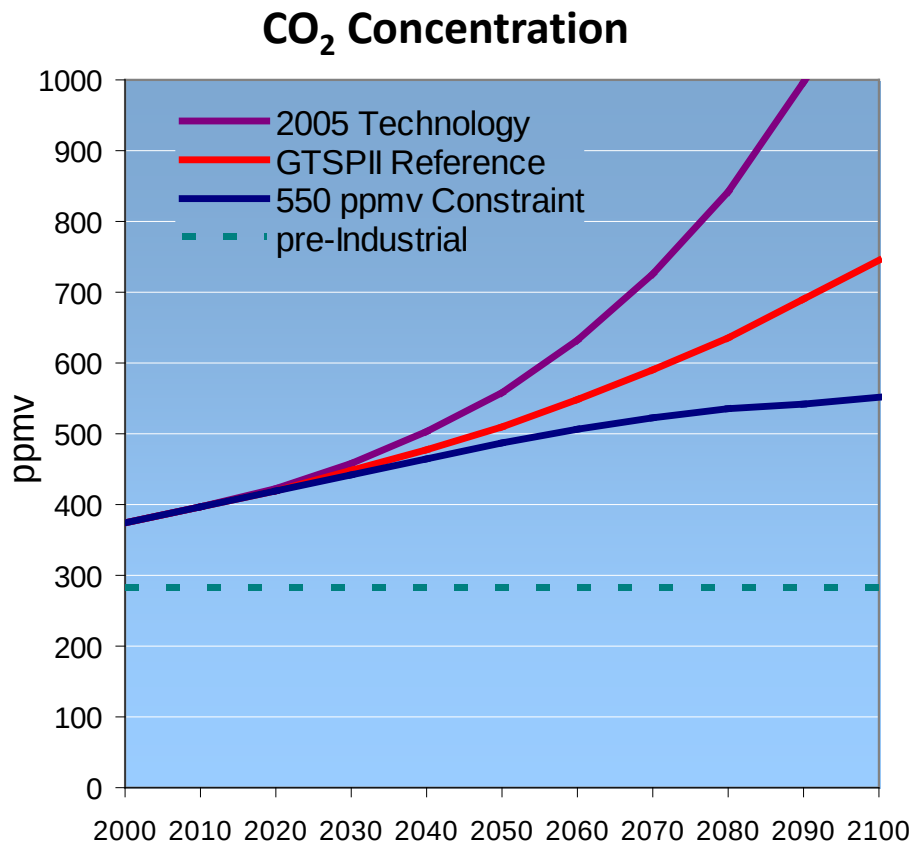
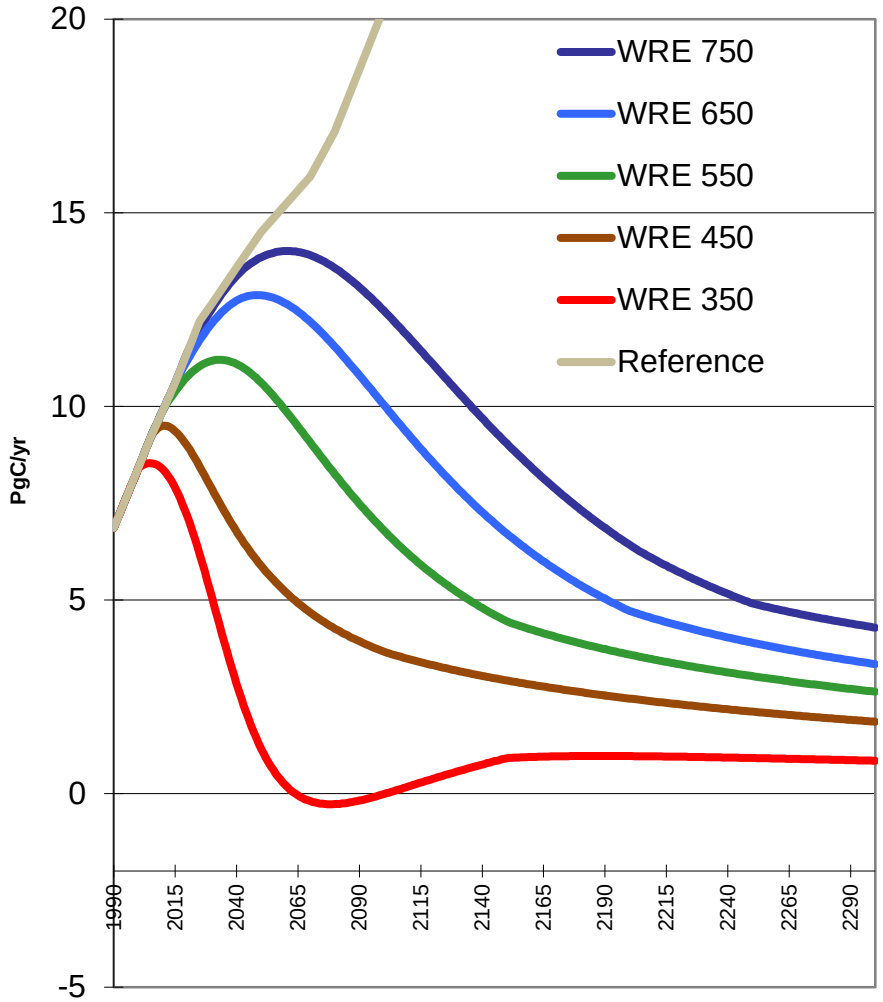




Stabilizing CO2 concentrations require emissions to eventually fall to zero



- WRE--Wigley, Thomas ML, Richard Richels, and Jae Edmonds. "Economic and environmental choices in the stabilization of atmospheric CO2 concentrations." (1996): 240-243.

Which emissions pathways maintain temperature change below different levels?

Some quick notes on units

Preindustrial CO_2 = 280 ppm
Current CO_2 = 400 ppm

Radiative Forcing (Wm^{-2})	CO_2 (ppm equivalent)
2.6	450
3.0	490
3.7	550
4.5	650
5.3	750
6.0	850
8.5	1350

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Often taken to be equivalent to 2 degrees, but that's too simple

Temperature implications are ambiguous because of climate uncertainty and different definitions temperature goals.

or, (2) likelihood of remaining below a particular level.

CO_2-eq Concentrations in 2100 (CO_2-eq) [f] Category label	Subcategories	Relative position of the RCPs[d]	Change in CO_2-eq emissions compared to 2010 (in %)[c]		Likelihood of staying below a specific temperature level over the 21st century (relative to 1850-1900)[d,e]			
			2050	2100	1.5°C	2°C	3°C	4°C
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(720 - 1000)[b]	Total range	RCP6.0	18 to 54	-7 to 72	*Unlikely*[h]		*More unlikely than likely*	
> 1000[b]	Total range	RCP8.5	52 to 95	74 to 178		*Unlikely*[h]	*Unlikely*	*More unlikely than likely*

Temperature goals can be expressed in terms of (1) long-term equilibrium temperature….

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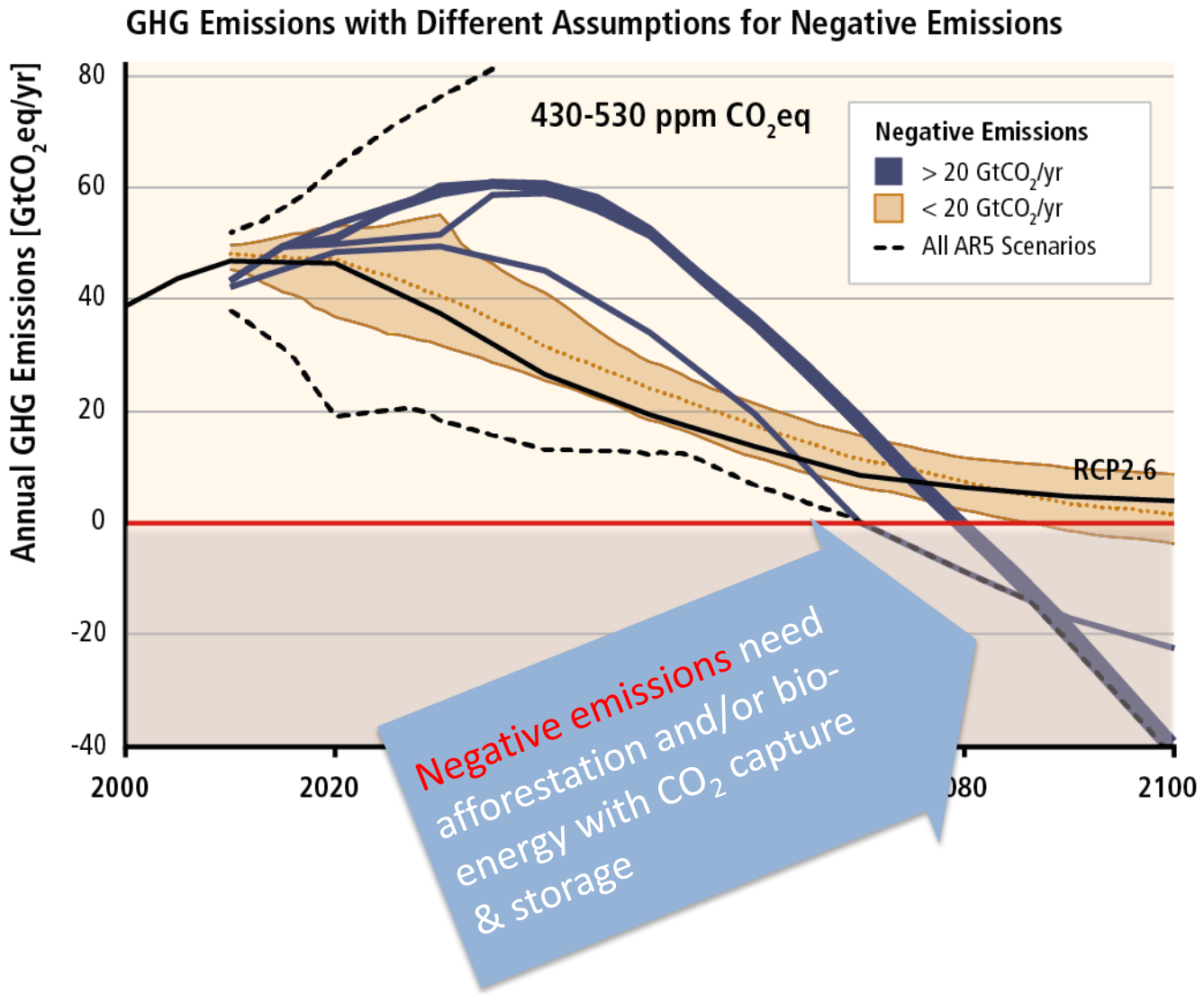
What is required to meet different concentration goals?

Many scenarios reaching 450 or 500 ppmv CO2e rely on net negative global emissions



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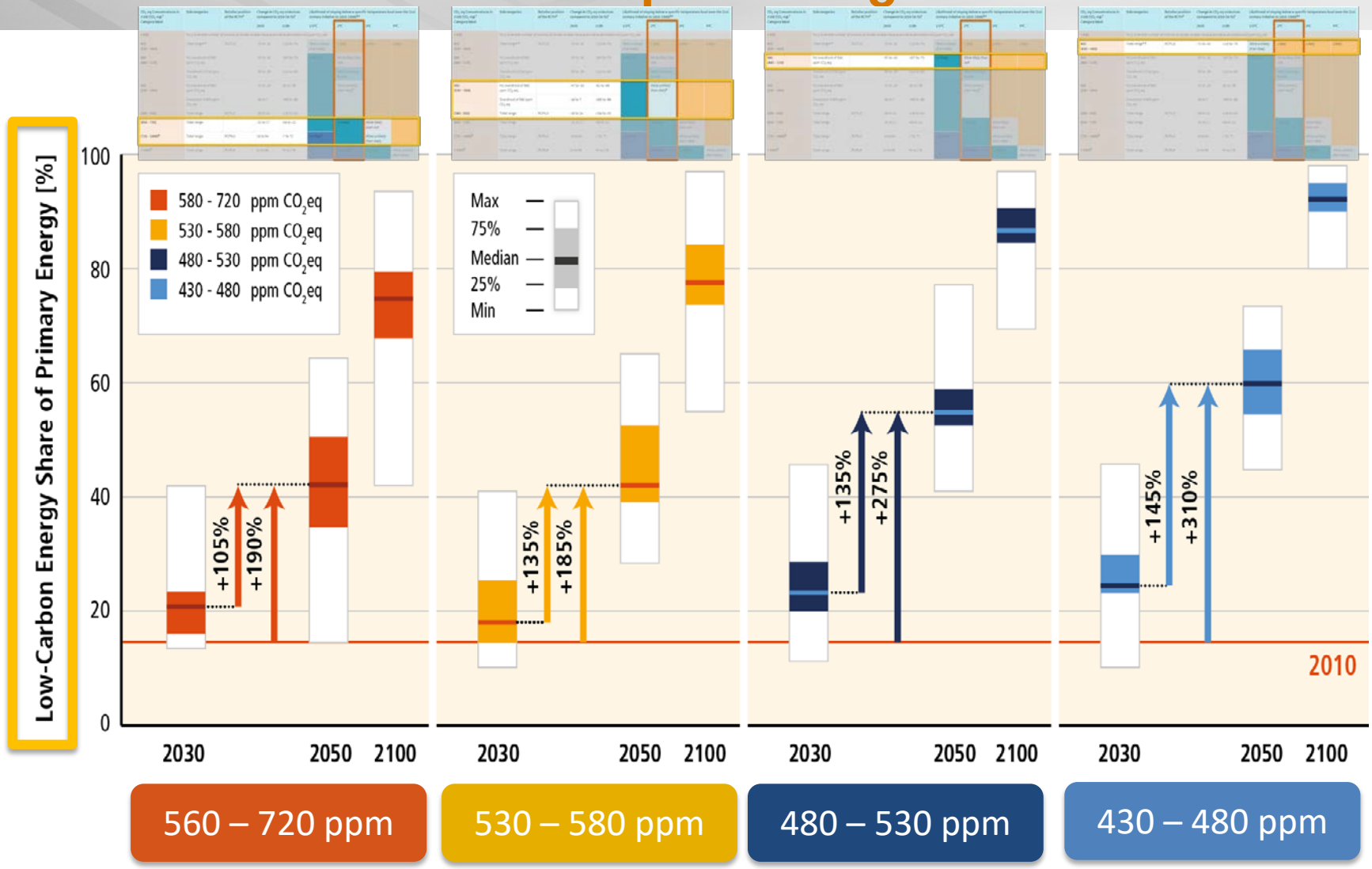

Note: Only scenarios that apply the full, unconstrained mitigation technology portfolio of the underlying models (default technology assumption) are shown. Scenarios with exogenous carbon price assumptions are excluded.

Limiting emissions to 450ppm

Emissions by sector with and without CO_2 capture and storage (CCS)

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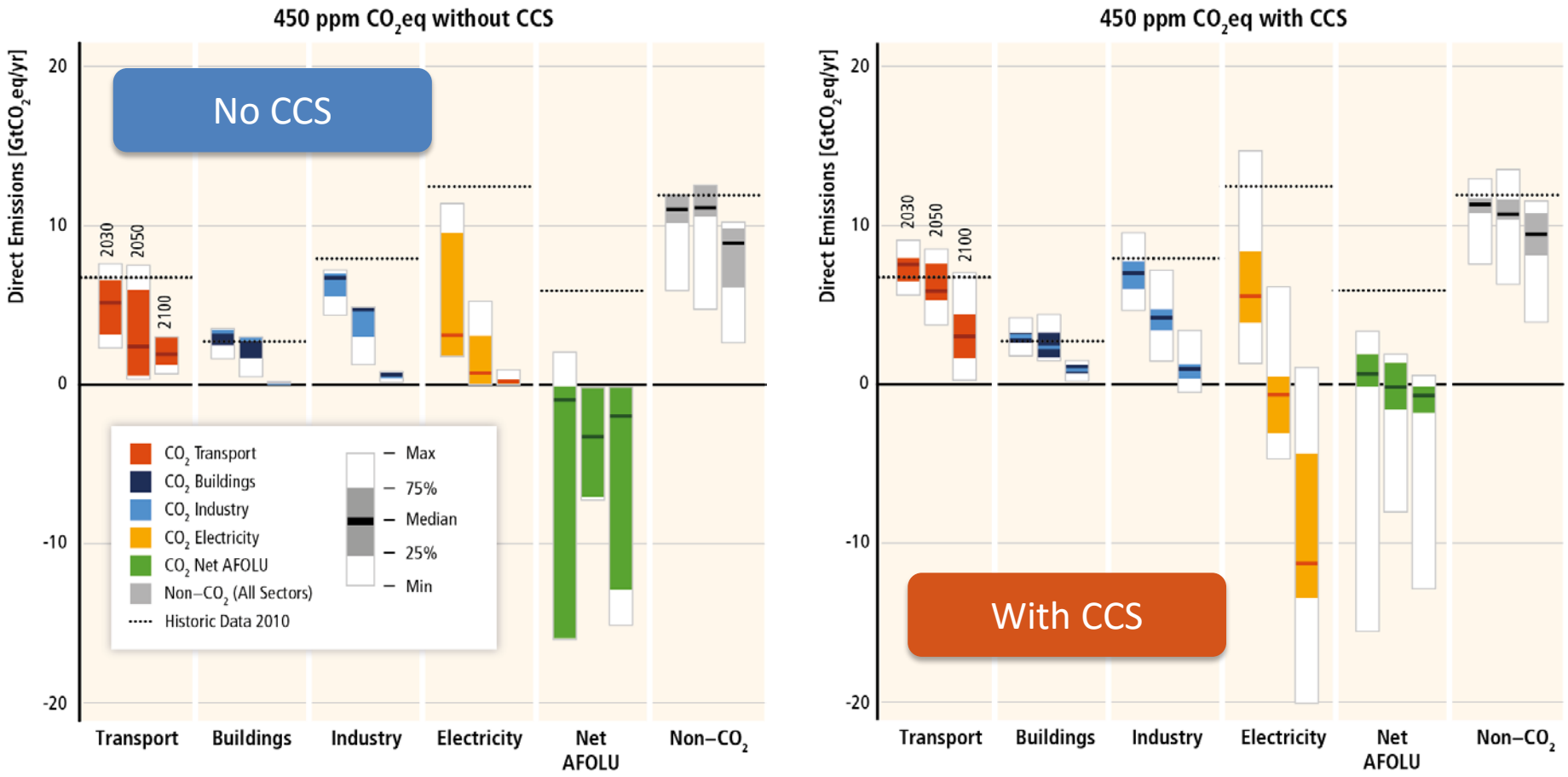
Change in Global Direct Emissions across Sectors: 450 ppm CO2e scenarios



Electricity Generation

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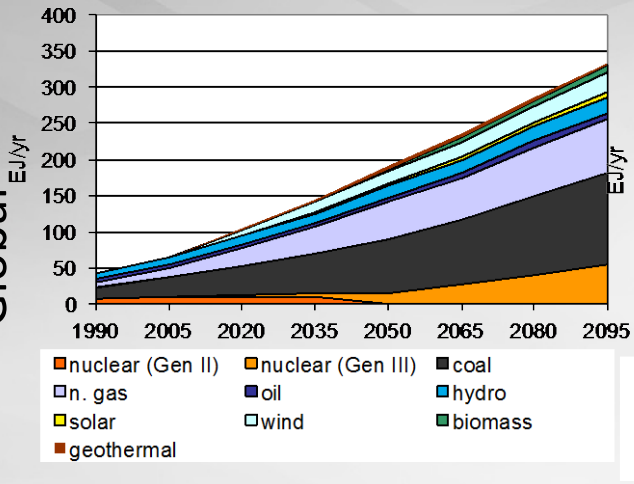
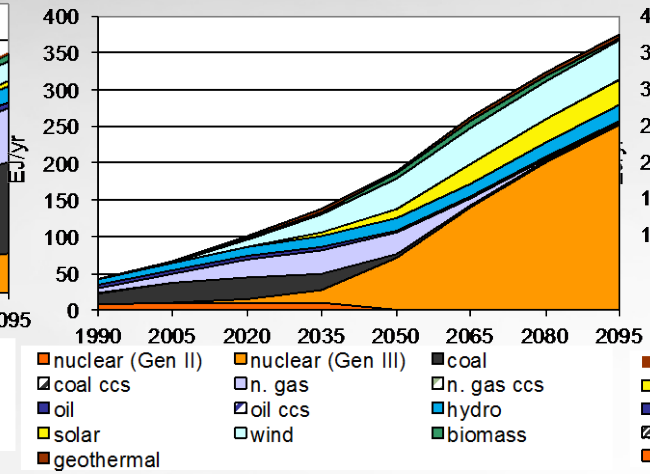
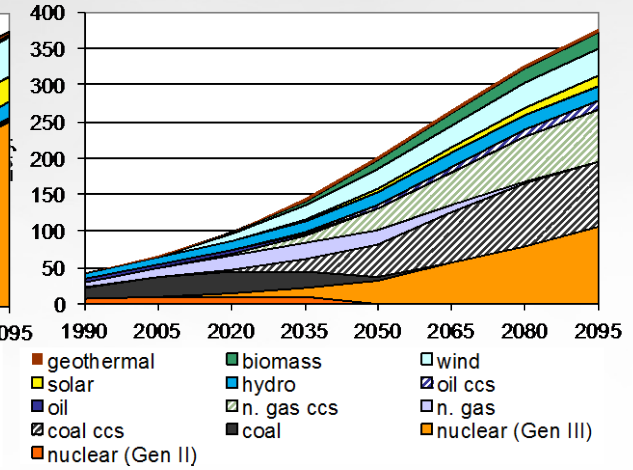
Ref | 450 ppm w/o CCS | 450 ppm w/ CCS

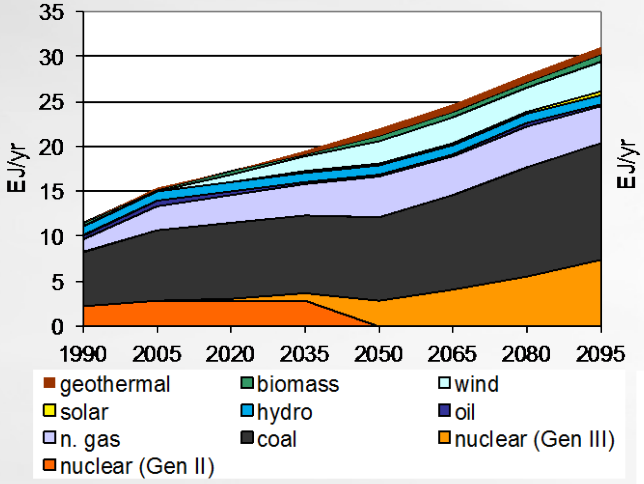
Global

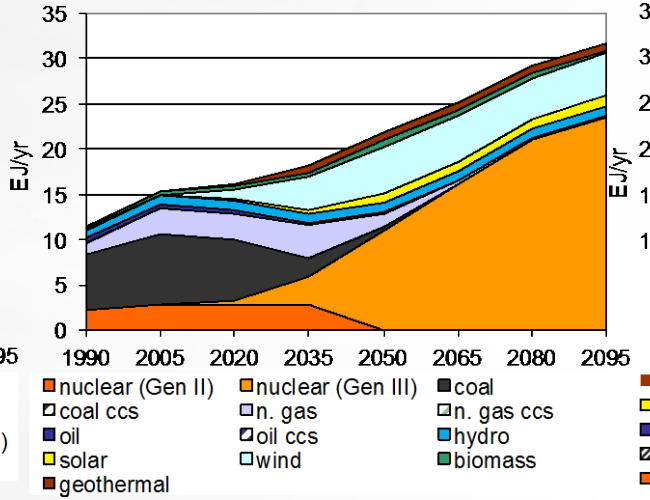


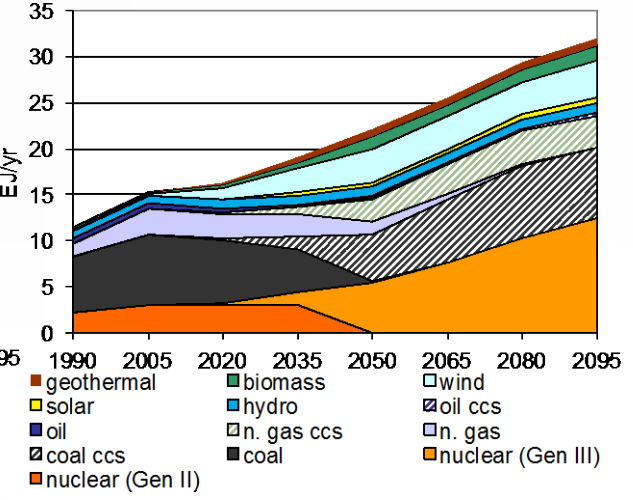




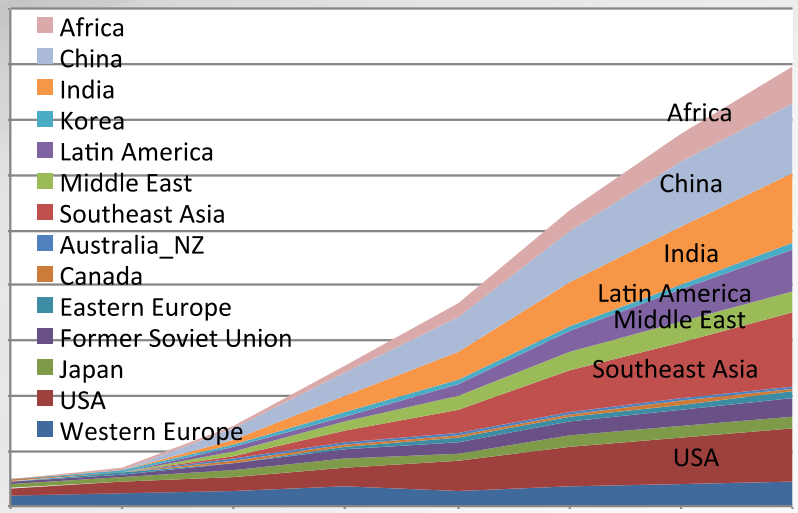
US

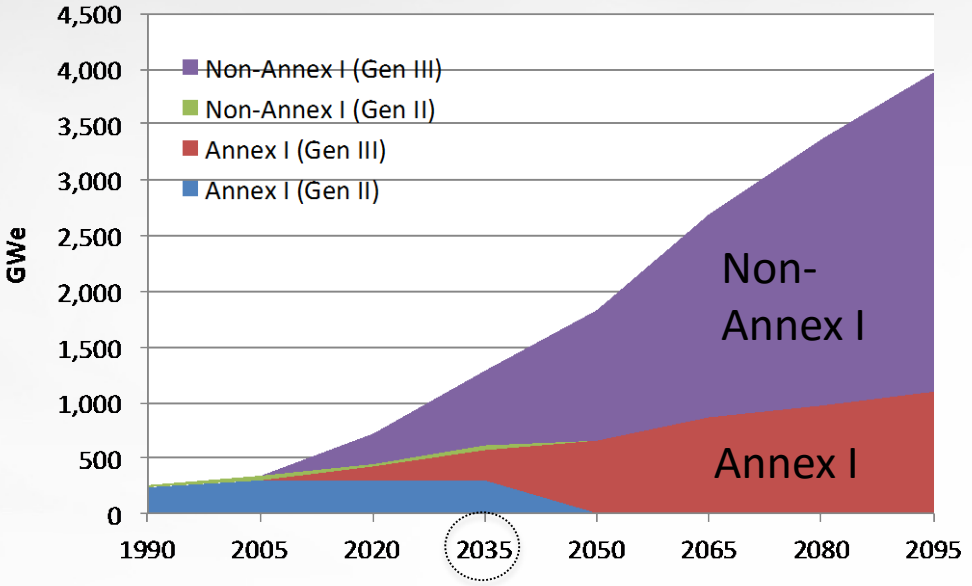






Nuclear Generation Capacity by Region
Climate Mitigation Scenario
450 ppm w/ CCS





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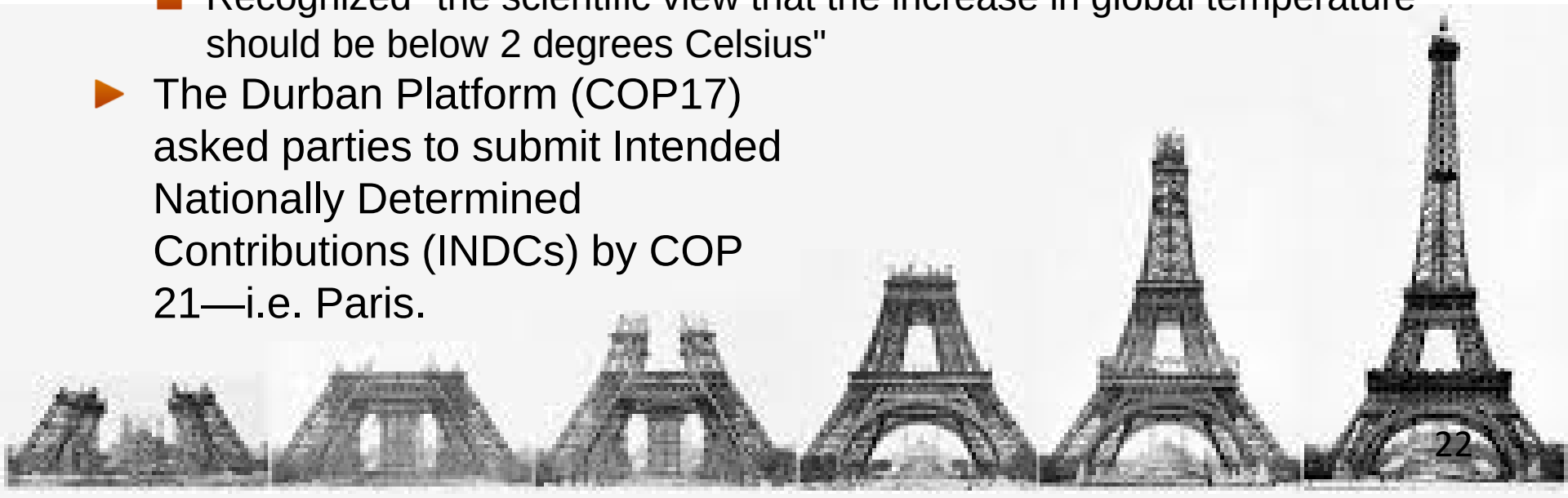
PARIS

And Beyond

Paris is coming

COP 21 will be held in Paris in December 2015

- Part of the UNFCCC, originally negotiated and opened for ratification in 1992, entered into force 1994 (196 parties).
- Set the goal of avoiding “dangerous anthropogenic interference with the climate” (Article 2),
- The Kyoto Protocol COP3 (1997) established the first international emissions limitation program.
- The 2009 Copenhagen Accord that emerged from COP15
  - Established a new international approach to emissions limitation,
  - Recognized "the scientific view that the increase in global temperature should be below 2 degrees Celsius"
- The Durban Platform (COP17) asked parties to submit Intended Nationally Determined Contributions (INDCs) by COP 21—i.e. Paris.

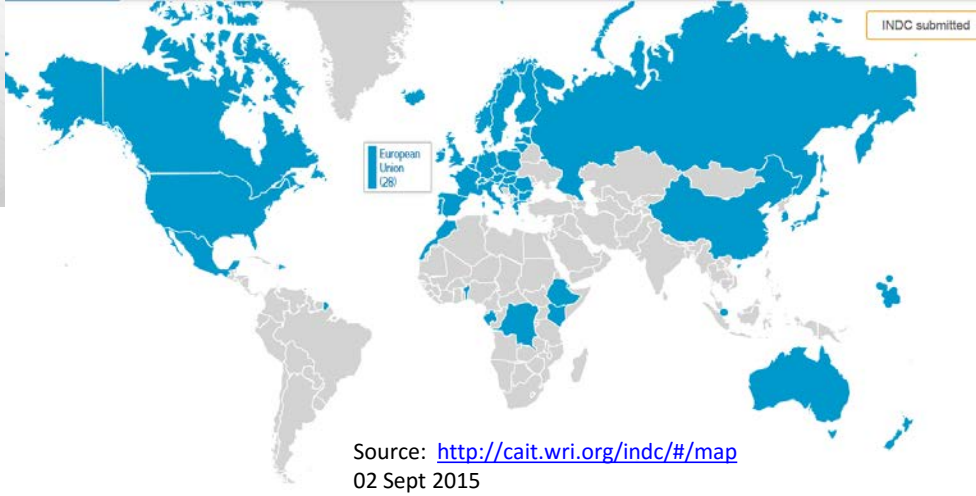


The INDCs

- The new international architecture that will emerge from Paris will be substantially different than the architecture created by the Kyoto Protocol.
  - Based on cap and trade
  - Capped emissions in Annex I parties
  - Included non-Annex I parties only through CDM

- The heart of the new international emissions limitation architecture is the **INDC (Intended Nationally Determined Commitment).**
- As of 02 September 2015
  - **29 submissions** representing **57 parties** (28 EU members in 1 submission)
  - Covering ~65% of emissions (http://cait.wri.org/indc/)

Who's Committed to What?



Source: http://cait.wri.org/indc/#/map
02 Sept 2015

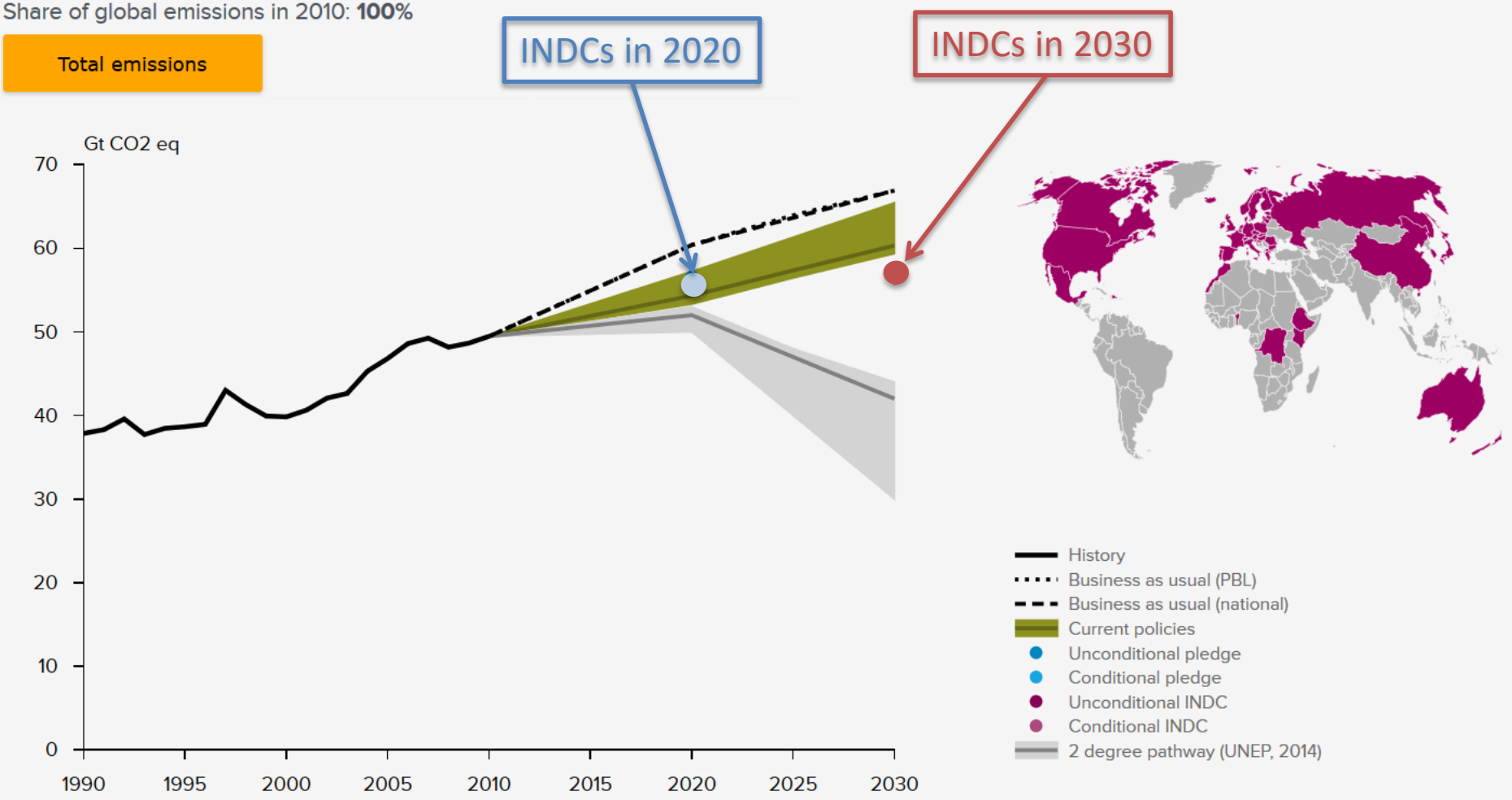
- **China** commits to
  - Peaking of carbon dioxide emissions around 2030 with best efforts to peak early;
  - Lower carbon dioxide emissions per unit of GDP by 60% to 65% from the 2005 level;
  - Increase the share of non-fossil fuels in primary energy consumption to around 20%; and
  - Increase the forest stock volume by around 4.5 billion cubic meters on the 2005 level.
- **EU** commits to a binding target of an at least 40 percent domestic reduction in greenhouse gas emissions by 2030 compared to 1990 to be fulfilled jointly.
- **Japan** commits to reduce GHG emissions in 2030 to 26.0% emission in 2013
- **United States** commits to reduce its greenhouse gas emissions by 26-28 percent below its 2005 level in 2025 and to make best efforts to reduce its emissions by 28 percent.

PBL analysis of INDCs and paths to 2 degrees

Global

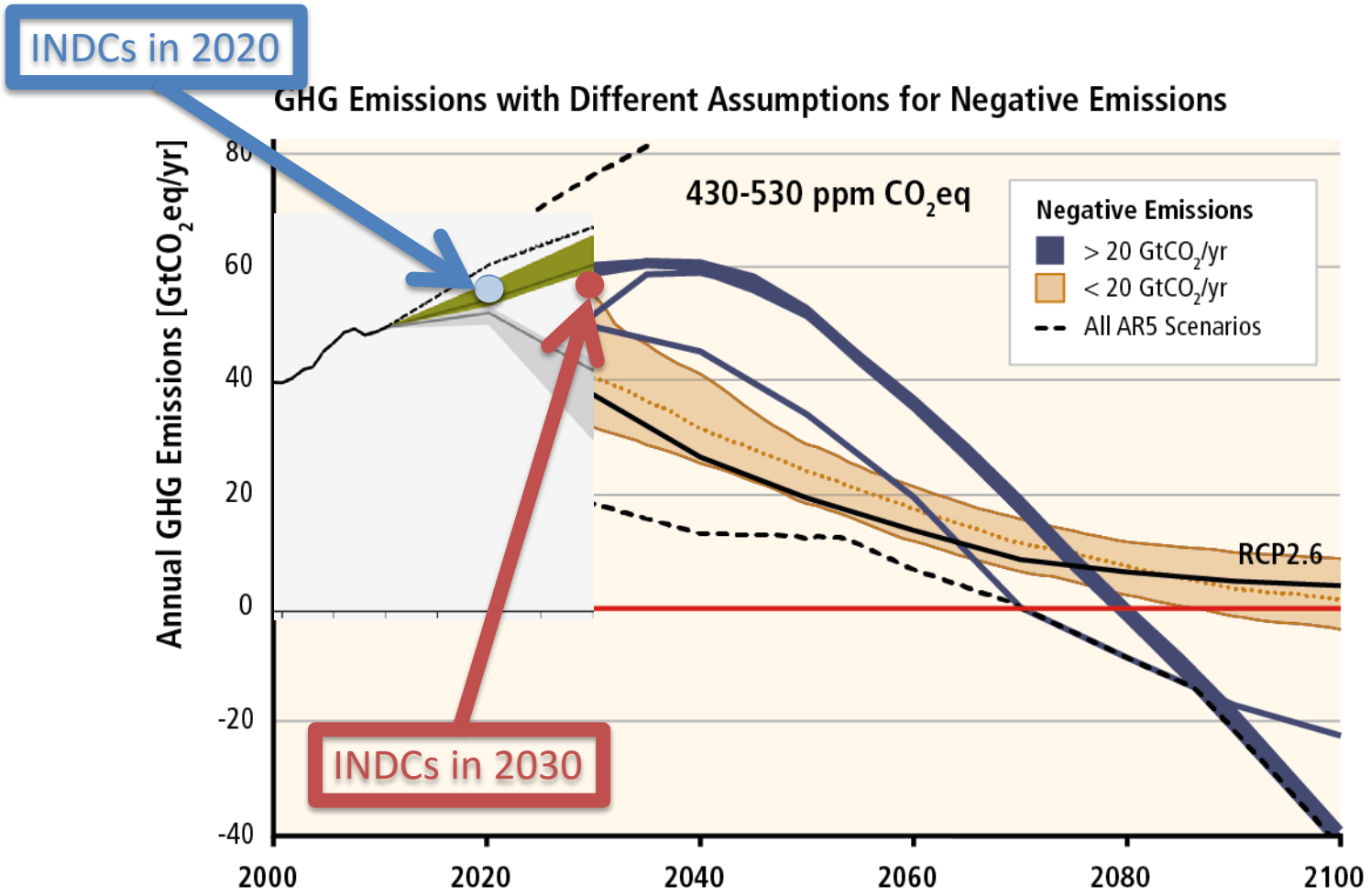
Share of global emissions in 2010: **100%**

Total emissions



Source: http://infographics.pbl.nl/indc/

The INDCs are the beginning—not the end—of a much longer process



INDCs are not on the main path, BUT if subsequently strengthened, preserve the option of a significant probability of staying below 2 degrees

DISCUSSION