Emissions de gaz à effet de serre dans le contexte d'un réchauffement à 2°C

Philippe Ciais

LSCE

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GLOBAL CARBON PROJECT

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Freidlingstein et al. 2014, Raupach et al. 2014 & Fuss et al. 2014 (not already mentioned above)
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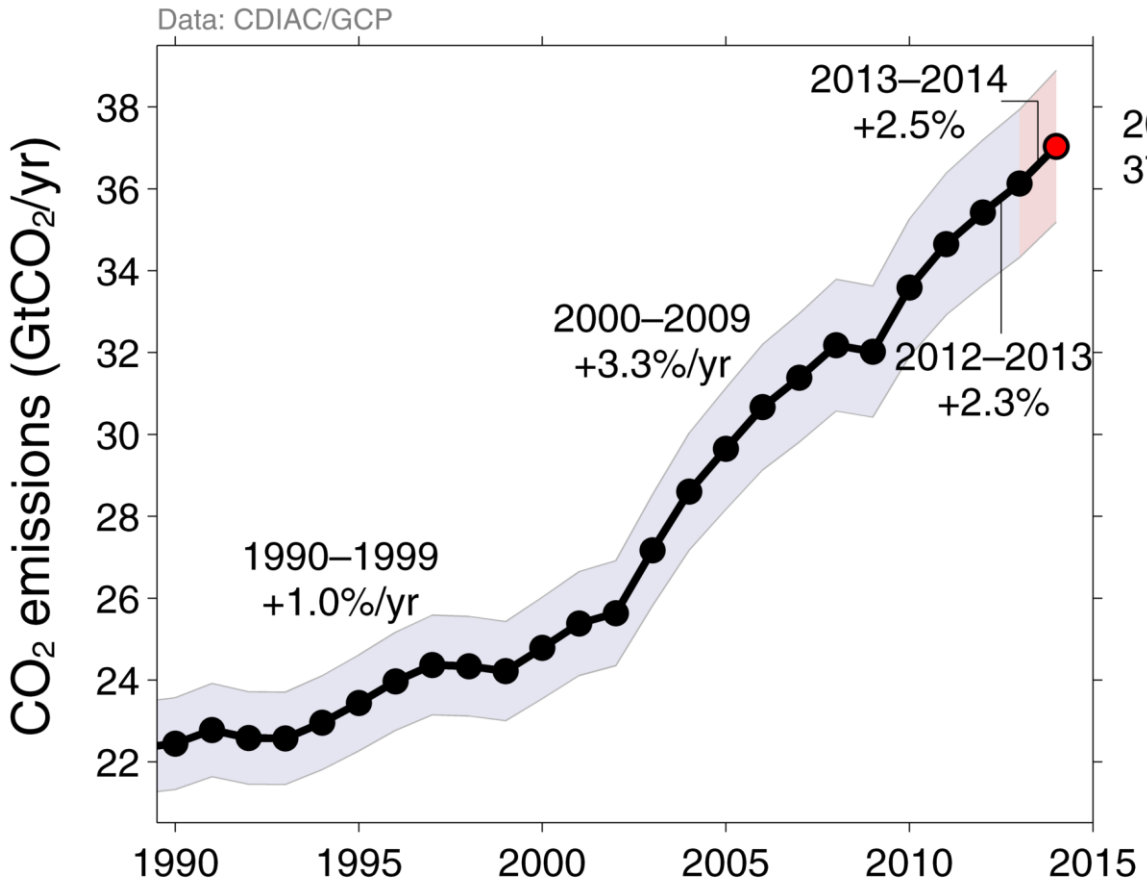
Fossil Fuel and Cement Emissions

Global fossil fuel and cement emissions: 36.1 ± 1.8 $GtCO_2$ in 2013, 61% over 1990

● Projection for 2014 : 37.0 ± 1.9 $GtCO_2$, 65% over 1990



Uncertainty is ±5% for one standard deviation (IPCC "likely" range)

Estimates for 2011, 2012, and 2013 are preliminary

Source: CDIAC; Le Quéré et al 2014; Global Carbon Budget 2014

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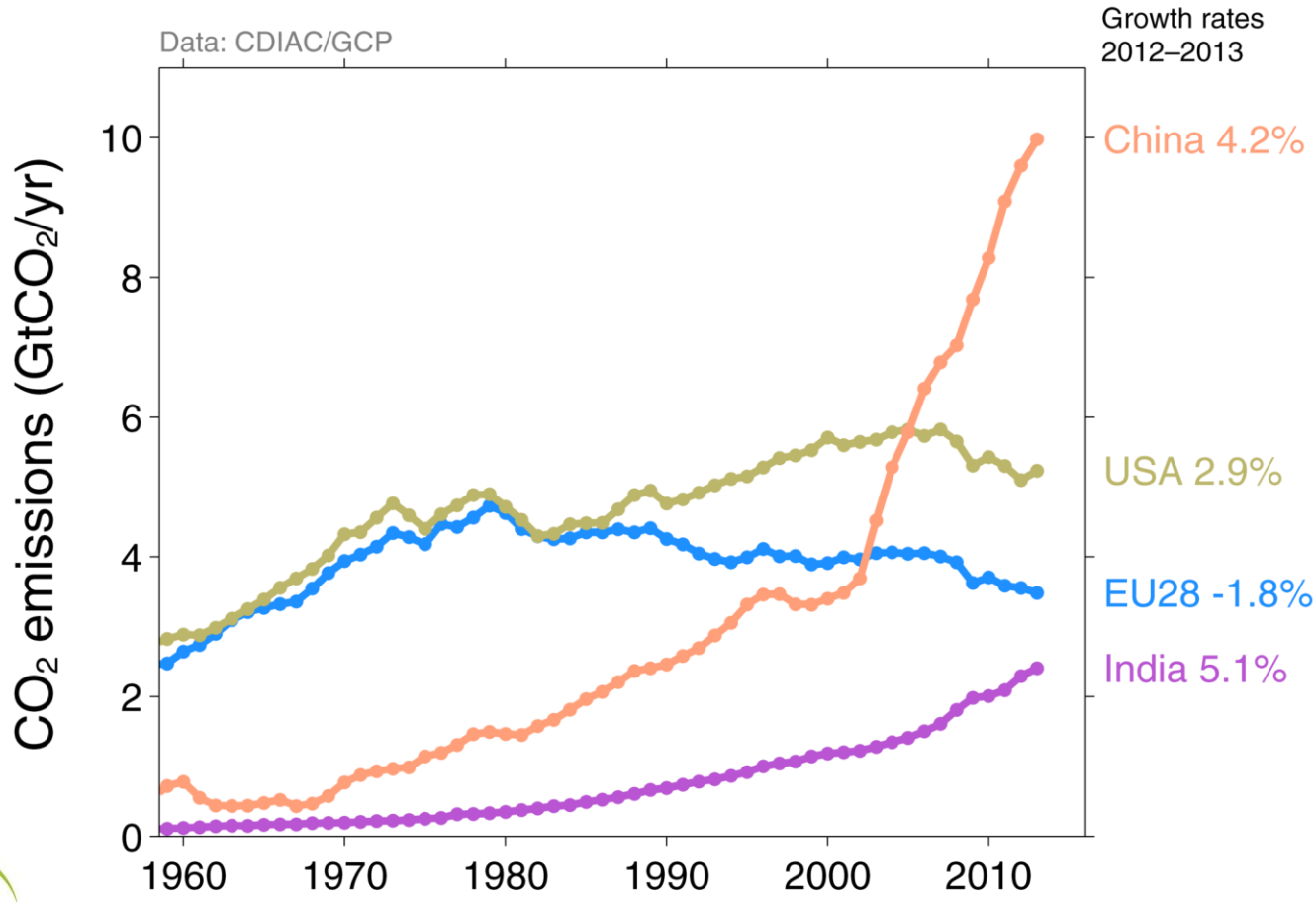
Top Fossil Fuel Emitters (Absolute)

The top four emitters in 2013 covered 58% of global emissions
China (28%), United States (14%), EU28 (10%), India (7%)

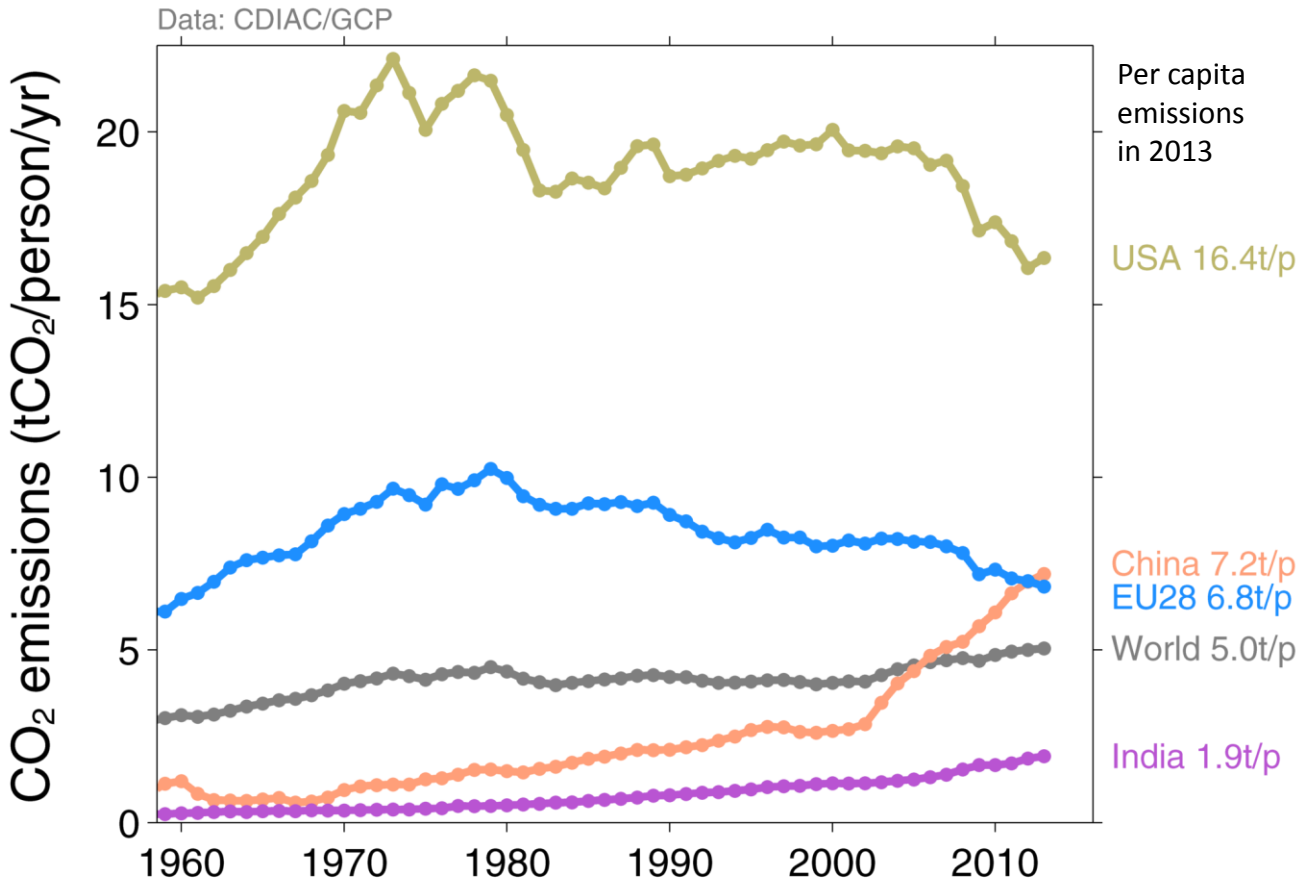


GLOBAL CARBON PROJECT

Bunkers fuel used for international transport is 3% of global emissions
Statistical differences between the global estimates and sum of national totals is 3% of global emissions
Source: CDIAC; Le Quéré et al 2014; Global Carbon Budget 2014

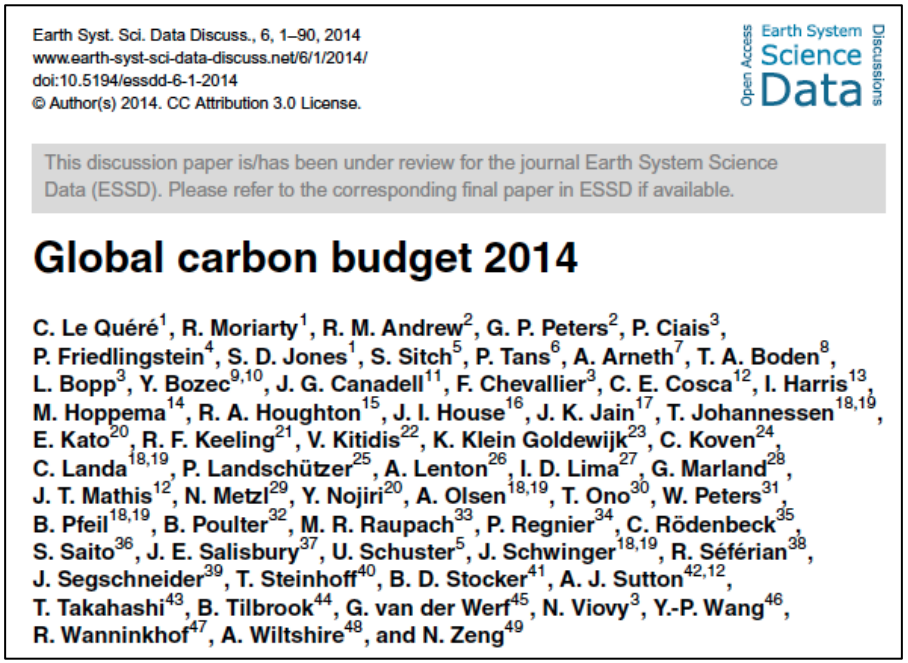
Top Fossil Fuel Emitters (Per Capita)

China's per capita emissions have passed the EU28 and are 45% above the global average



GLOBAL CARBON PROJECT

Source: CDIAC; Le Quéré et al 2014; Global Carbon Budget 2014



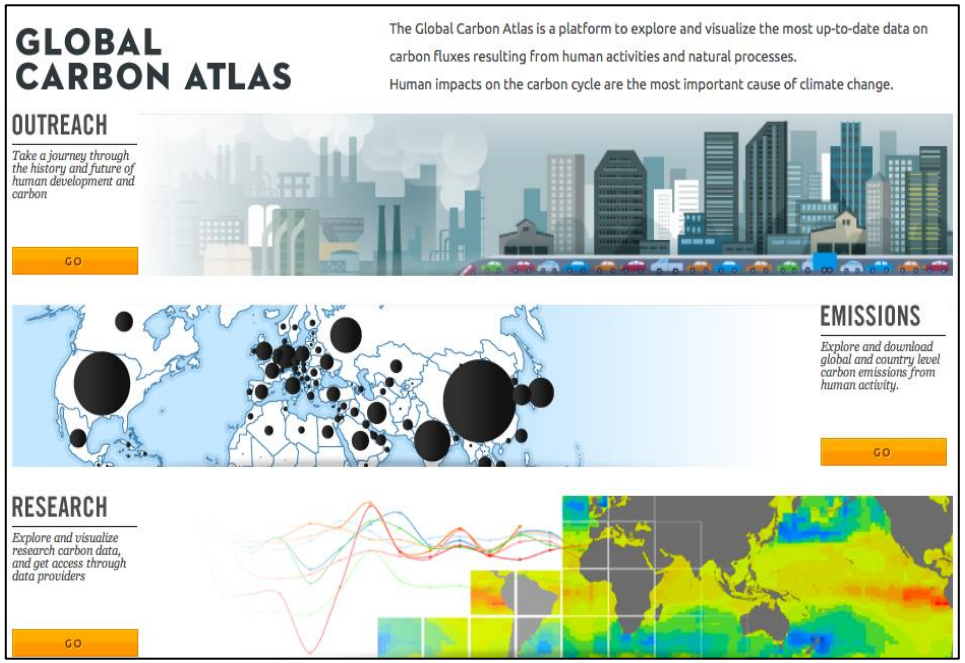
Earth Syst. Sci. Data Discuss., 6, 1–90, 2014
www.earth-syst-sci-data-discuss.net/6/1/2014/
doi:10.5194/essdd-6-1-2014

Open Access Earth System Science Data Discussions

This discussion paper is/has been under review for the journal Earth System Science Data (ESSD). Please refer to the corresponding final paper in ESSD if available.

Global carbon budget 2014

C. Le Quéré[1], R. Moriarty[1], R. M. Andrew[2], G. P. Peters[2], P. Ciais[3], P. Friedlingstein[4], S. D. Jones[1], S. Sitch[5], P. Tans[6], A. Arneth[7], T. A. Boden[8], L. Bopp[3], Y. Bozec[9,10], J. G. Canadell[11], F. Chevallier[3], C. E. Cosca[12], I. Harris[13], M. Hoppema[14], R. A. Houghton[15], J. I. House[16], J. K. Jain[17], T. Johannessen[18,19], E. Kato[20], R. F. Keeling[21], V. Kitidis[22], K. Klein Goldewijk[23], C. Koven[24], C. Landa[18,19], P. Landschützer[25], A. Lenton[26], I. D. Lima[27], G. Marland[28], J. T. Mathis[12], N. Metzl[29], Y. Nojiri[20], A. Olsen[18,19], T. Ono[30], W. Peters[31], B. Pfeil[18,19], B. Poulter[32], M. R. Raupach[33], P. Regnier[34], C. Rödenbeck[35], S. Saito[36], J. E. Salisbury[37], U. Schuster[5], J. Schwinger[18,19], R. Séférian[38], J. Segschneider[39], T. Steinhoff[40], B. D. Stocker[41], A. J. Sutton[42,12], T. Takahashi[43], B. Tilbrook[44], G. van der Werf[45], N. Viovy[3], Y.-P. Wang[46], R. Wanninkhof[47], A. Wiltshire[48], and N. Zeng[49]



More information, data sources and data files:
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More information, data sources and data files:
www.globalcarbonatlas.org
Contact: philippe.ciais@lsce.ipsl.fr

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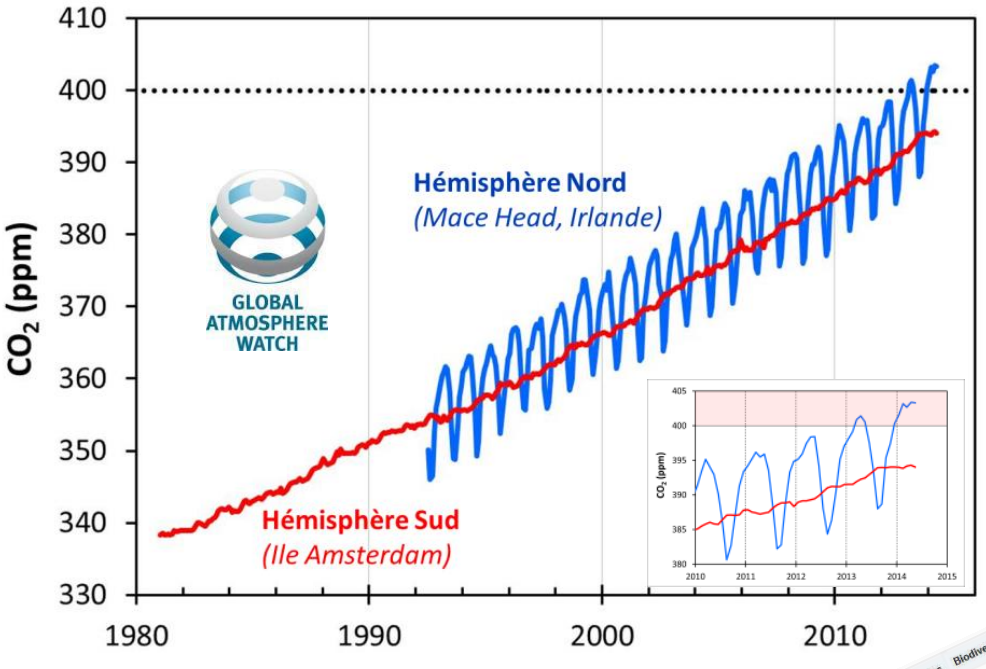
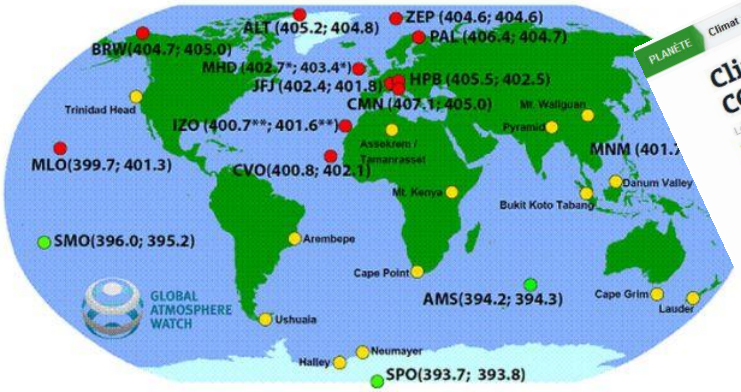
400 ppm de CO_2 pendant plus d'un mois la station de Mace Head



Observatoire de Mace Head, Irlande

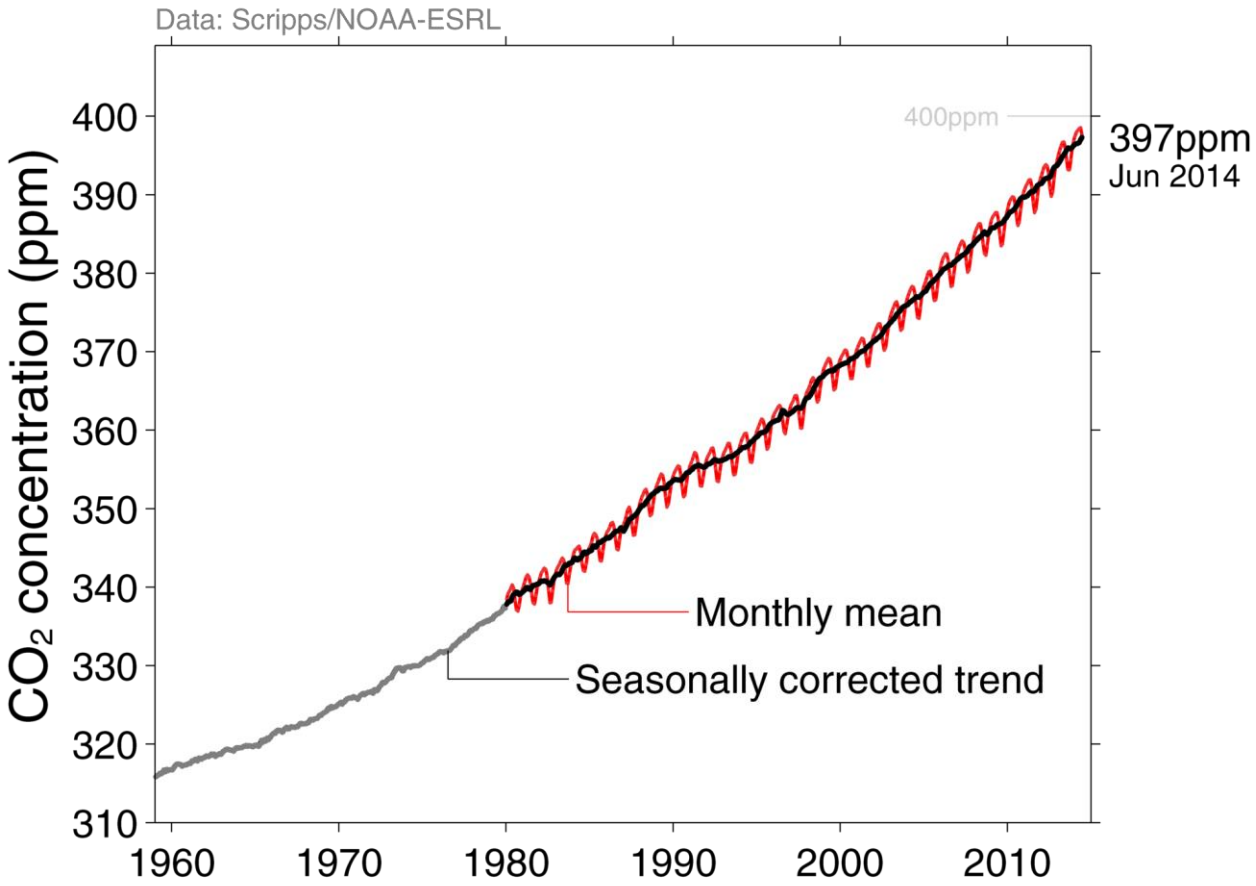
LSCE

Observatoire de l'Ile Amsterdam, TAAF



400 ppm de CO2 atteint à Mauna Loa pendant plusieurs jours

The global CO_2 concentration increased from ~277ppm in 1750 to 395ppm in 2013 (up 43%)
Mauna Loa registered the first daily measurements above 400pm in May 2013



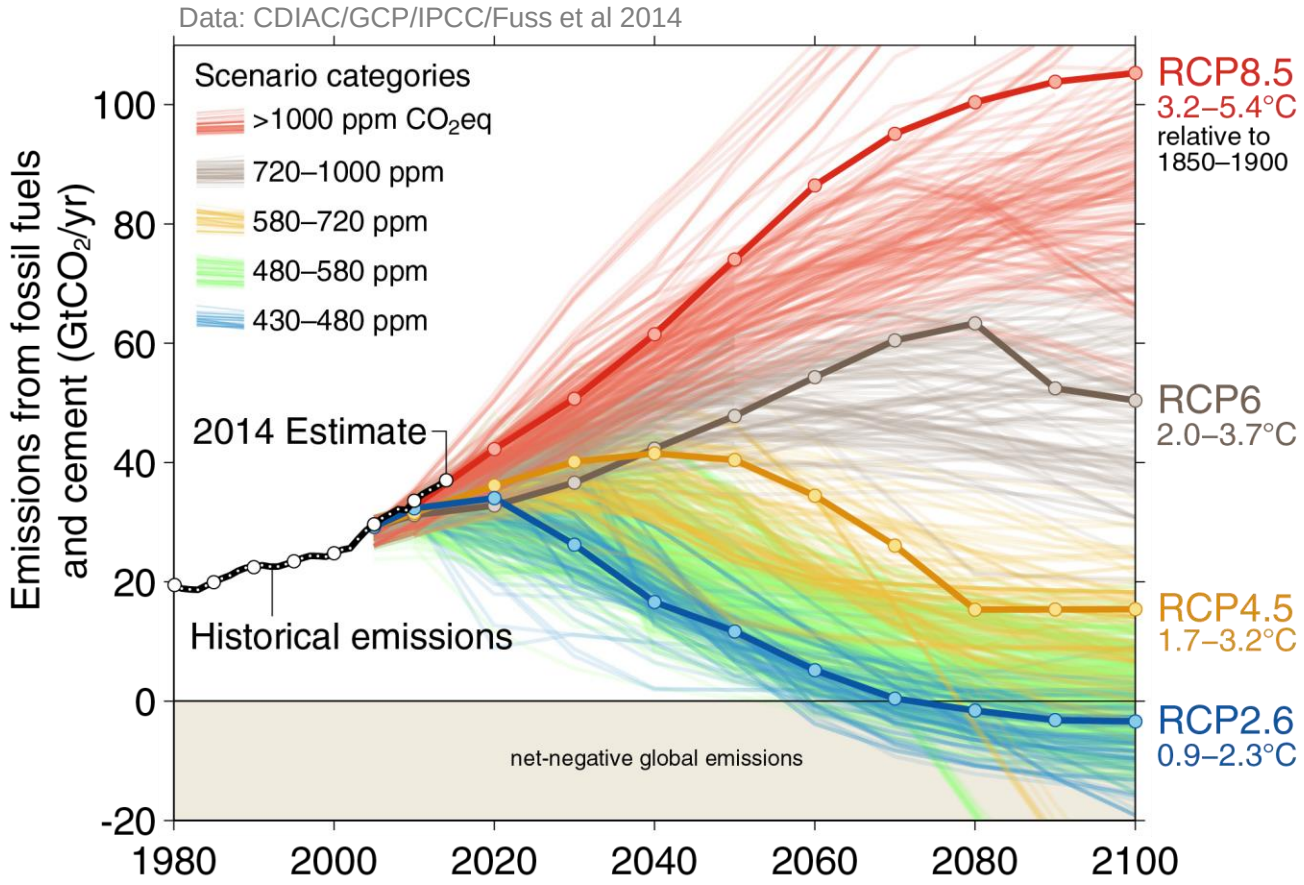
Globally averaged surface atmospheric CO_2 concentration

Data from: NOAA-ESRL after 1980; the Scripps Institution of Oceanography before 1980 (harmonised to recent data by adding 0.542ppm)

Source: NOAA-ESRL; Scripps Institution of Oceanography; Global Carbon Budget 2014

Observed Emissions and Emissions Scenarios

Emissions are on track for 3.2–5.4ºC "likely" increase in temperature above pre-industrial
Large and sustained mitigation is required to keep below 2ºC



Over 1000 scenarios from the IPCC Fifth Assessment Report are shown

Source: Fuss et al 2014; CDIAC; Global Carbon Budget 2014

GLOBAL CARBON PROJECT

Remaining CO_2 emission quota

nature geoscience

REVIEW ARTICLE

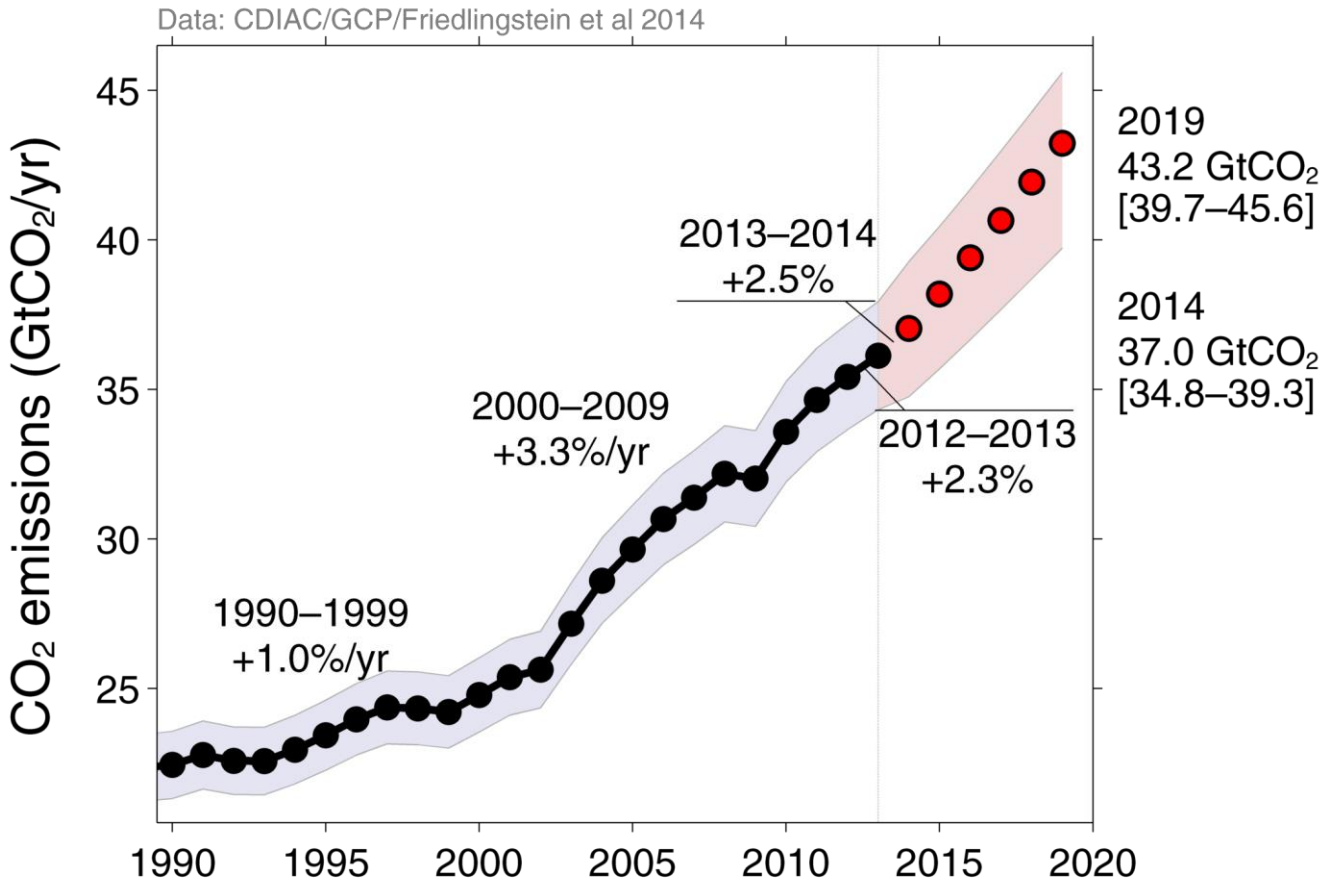
PUBLISHED ONLINE: 21 SEPTEMBER 2014 | DOI: 10.1038/NGEO2248

Persistent growth of CO_2 emissions and implications for reaching climate targets

P. Friedlingstein[1]*, R. M. Andrew[2], J. Rogelj[3,4], G. P. Peters[2], J. G. Canadell[5], R. Knutti[3], G. Luderer[6], M. R. Raupach[7], M. Schaeffer[8,9], D. P. van Vuuren[10,11] and C. Le Quéré[12]

Persistent Growth – Global

Assuming emissions follow projected GDP growth and accounting for improvement in carbon intensity, we project fossil fuel and cement emissions to grow 3.1%/yr to reach 43.2 $GtCO_2$/yr by 2019



Economic growth based on IMF projections, fossil fuel intensity based on 10-year trend

Source: CDIAC; Friedlingstein et al 2014

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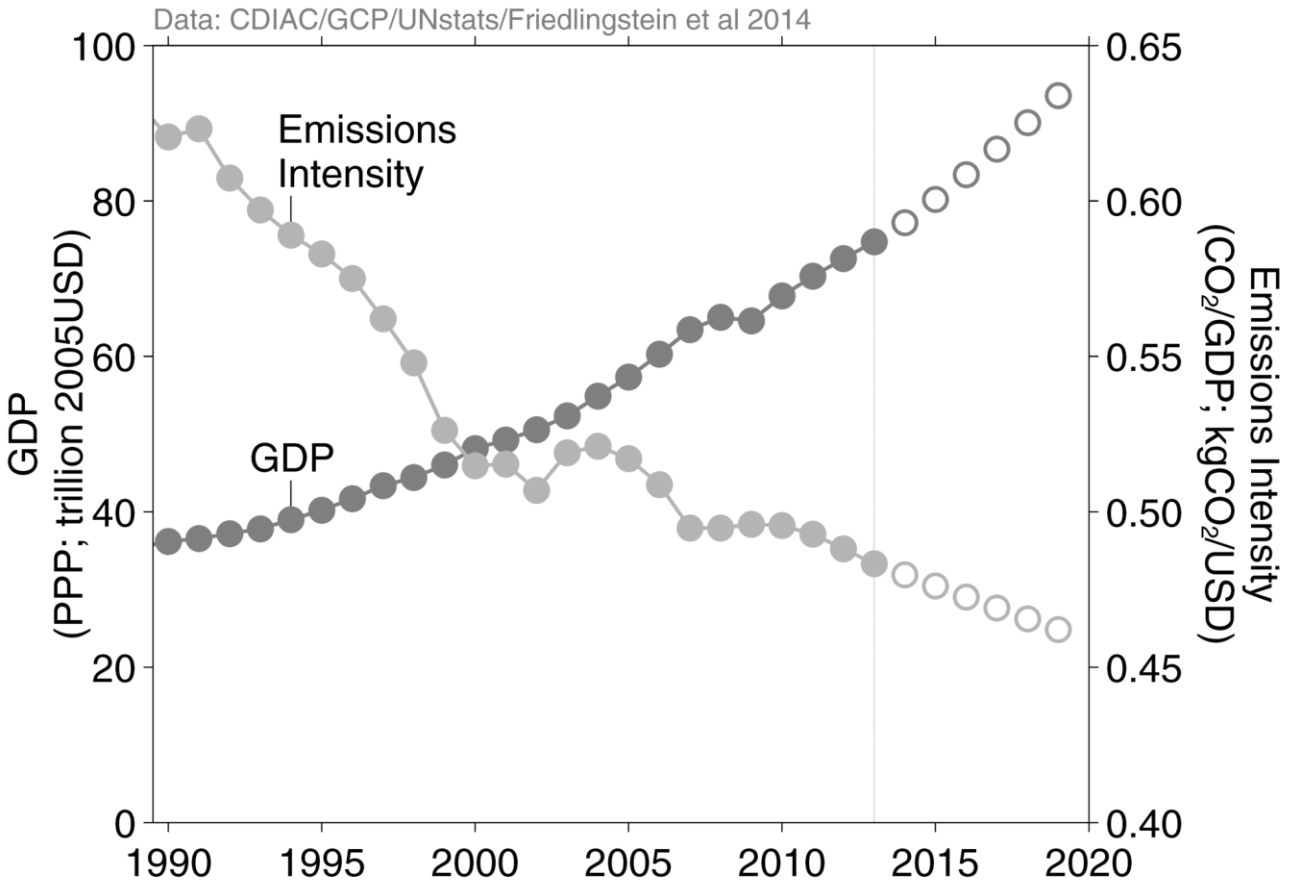
Carbon Intensity of Economic Activity – Global

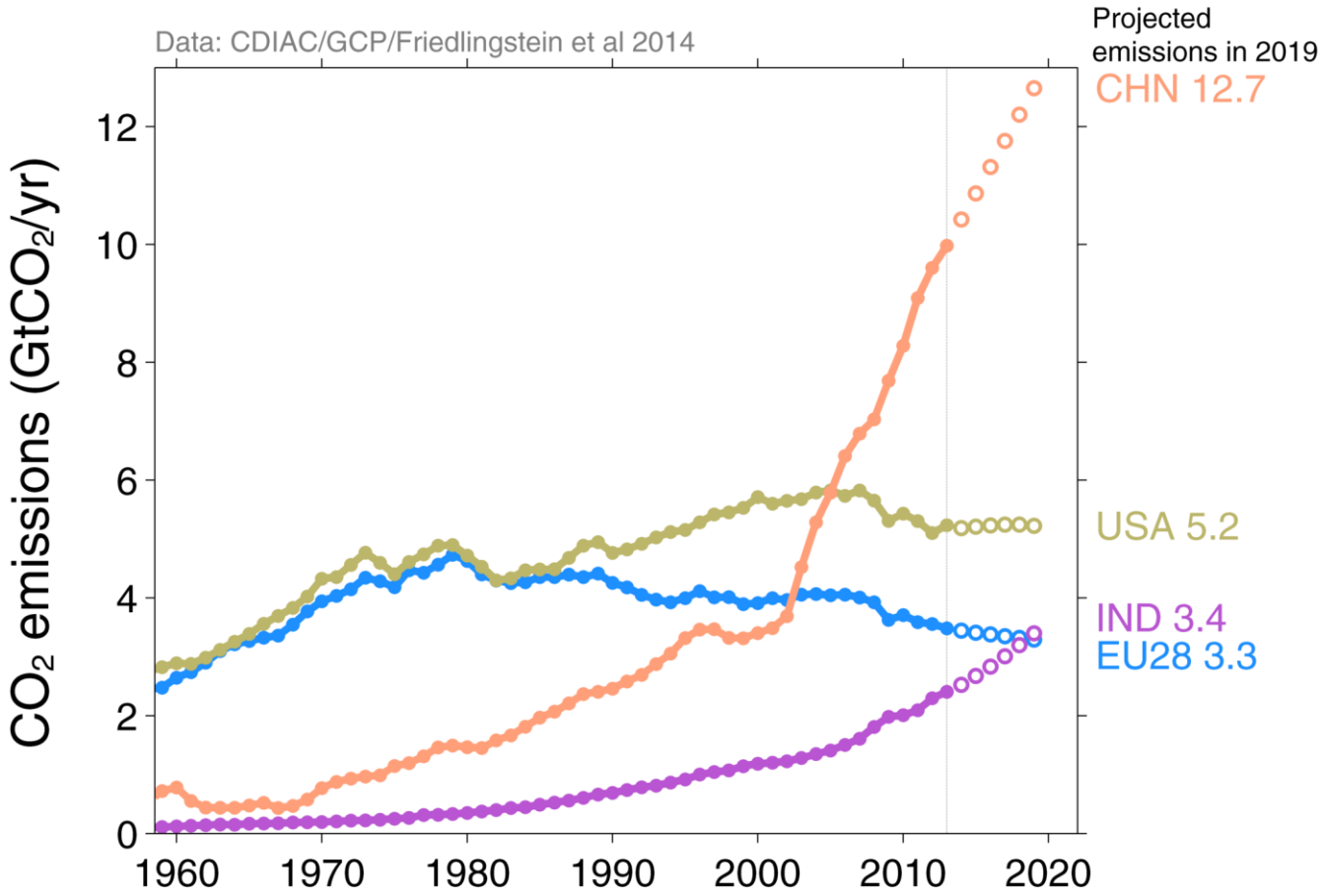
GDP and carbon intensity trends are relatively stable over time, leading to stable emission growth
Step changes in emission intensity are required for emission trends to change for a given GDP



Economic growth based on IMF projections, fossil fuel intensity based on 10-year trend
Source: CDIAC; Friedlingstein et al 2014

Persistent Growth – Regional

Continued trends suggest that by 2019 China's emissions could exceed the USA, EU28 and India combined, and India could emit more than the EU28

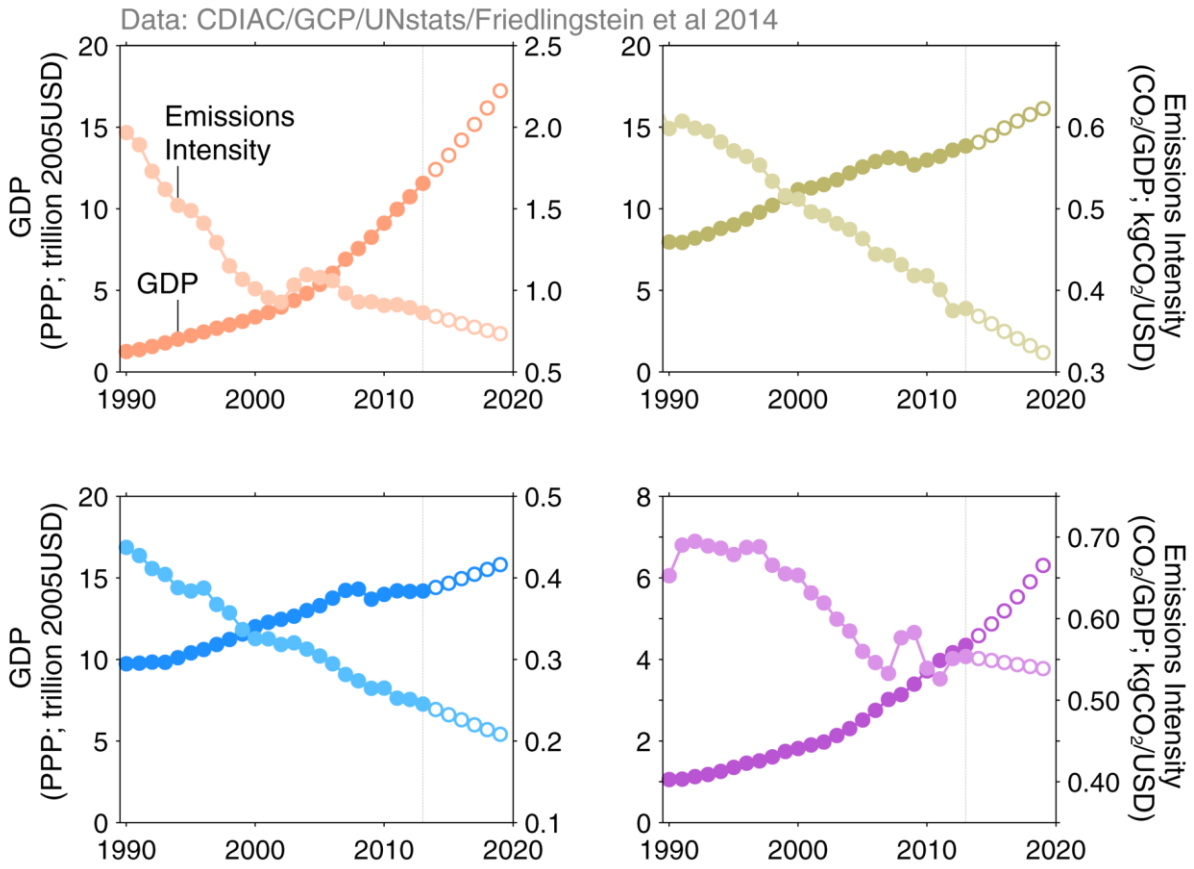


Economic growth based on IMF projections, fossil fuel intensity based on 10-year trend

Source: CDIAC; Friedlingstein et al 2014

Carbon Intensity of Economic Activity – Regional

GDP in China and India is growing faster than improvements in carbon intensity of GDP, with the opposite in the USA and EU



omic growth based on IMF projections, fossil fuel intensity based on 10-year trend

Source: CDIAC; Friedlingstein et al 2014

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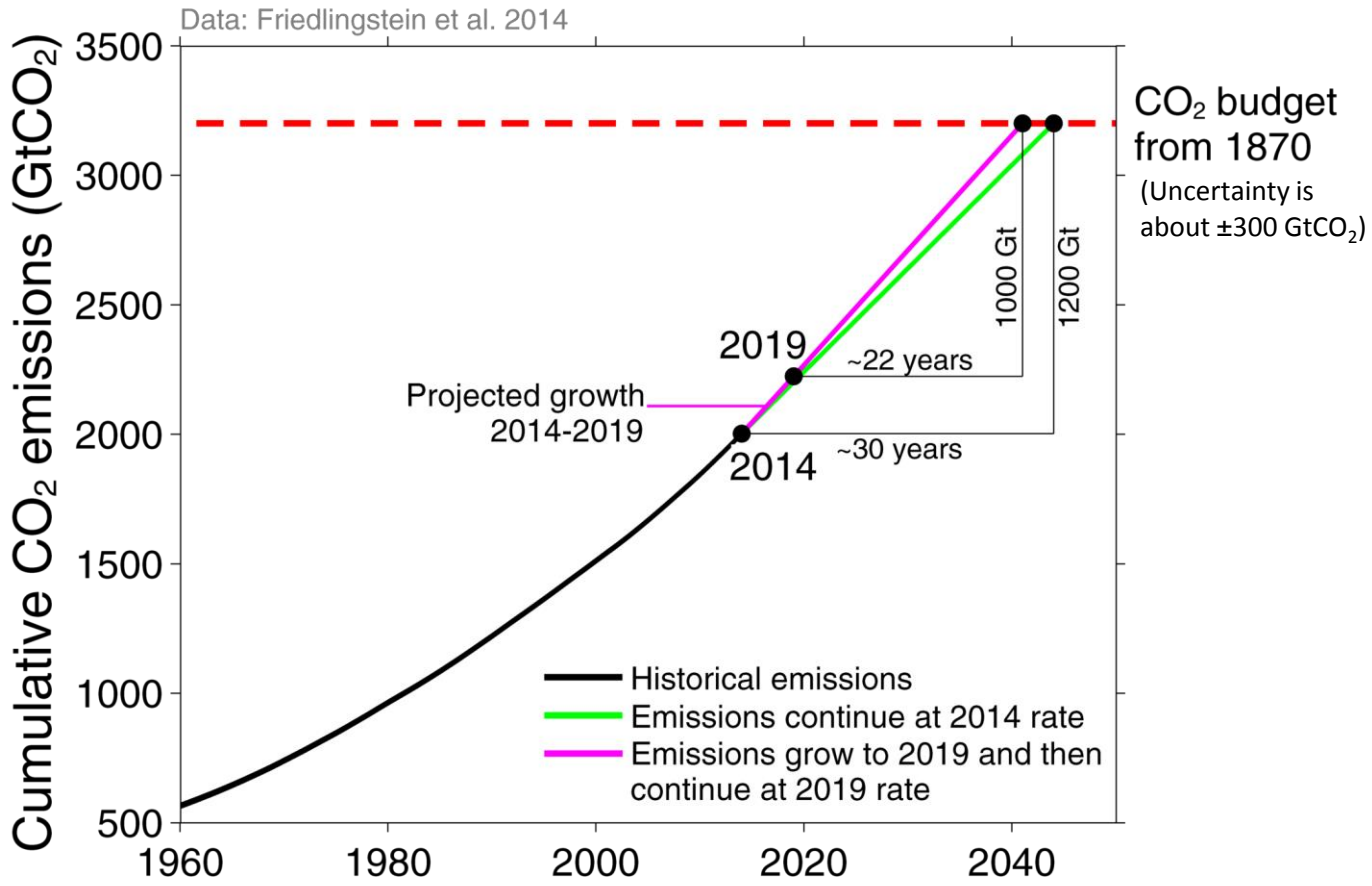
Remaining emissions budget

Cumulative CO_2 emissions should remain below about 3200 Gt for a 66% chance of staying below 2°C
At present emissions rates the remaining budget would be used up in about 30 years



If emissions continue to grow as projected to 2019 and then continue at the 2019 rate, the remaining budget would be used up about 22 years from 2019

Source: Friedlingstein et al 2014

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Sharing the CO_2 emission quota

nature climate change

PERSPECTIVE

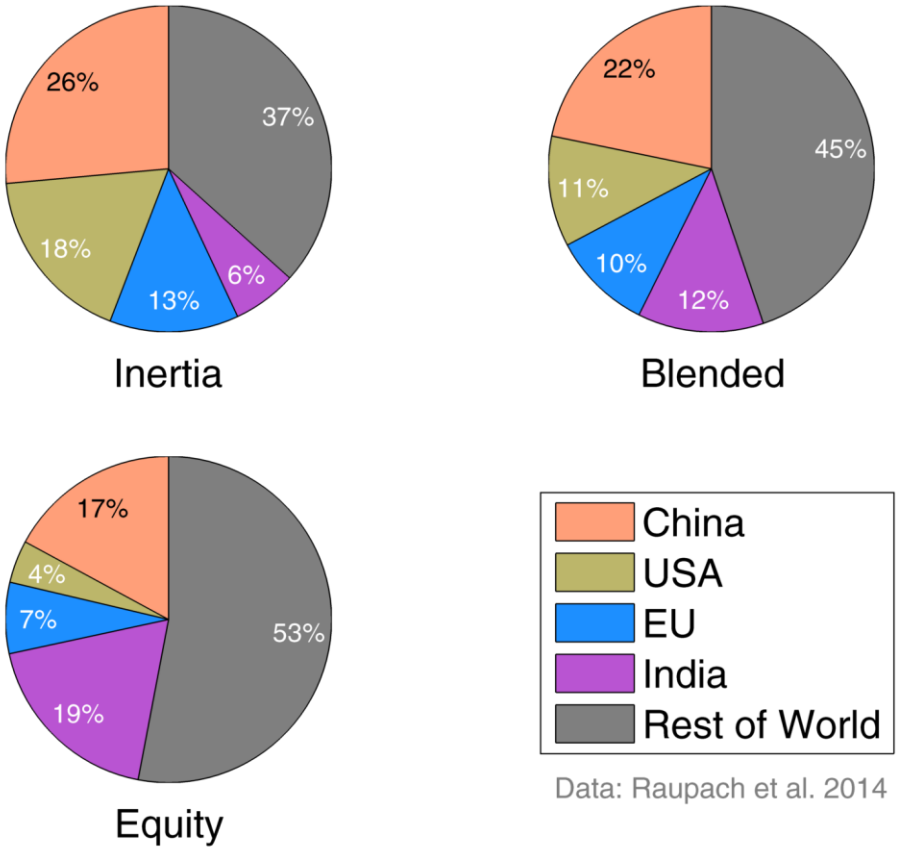
PUBLISHED ONLINE: 21 SEPTEMBER 2014 | DOI: 10.1038/NCLIMATE2384

Sharing a quota on cumulative carbon emissions

Michael R. Raupach[1*], Steven J. Davis[2], Glen P. Peters[3], Robbie M. Andrew[3], Josep G. Canadell[4], Philippe Ciais[5], Pierre Friedlingstein[6], Frank Jotzo[7], Detlef P. van Vuuren[8,9] and Corinne Le Quéré[10]

Sharing the CO_2 emission quota

The share of an available CO_2 emission quota allocated to countries
A 'blended' option gives more feasible mitigation rates, without penalising developing regions

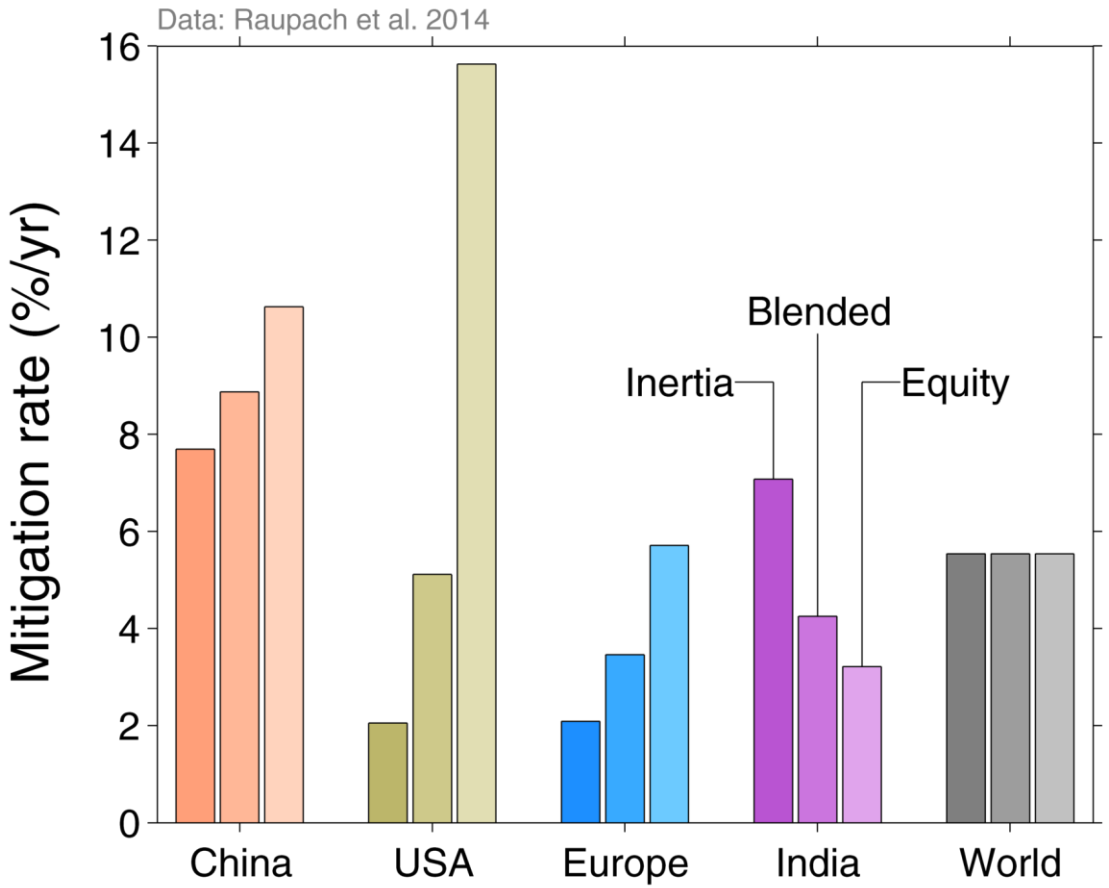


Inertia (current emissions), equity (population), blended (50-50 split)
Emissions trading would allow additional sharing of the quota, together with financial transfers

Source: Raupach et al 2014

Mitigation rates become infeasible under some schemes

The necessary mitigation rates can change significantly for some countries
'Blended' effort sharing can strike a balance between fairness and feasibility



For comparison, the nuclear transitions in some European countries led to ~4%/yr reductions for 10-year periods

Source: Raupach et al 2014

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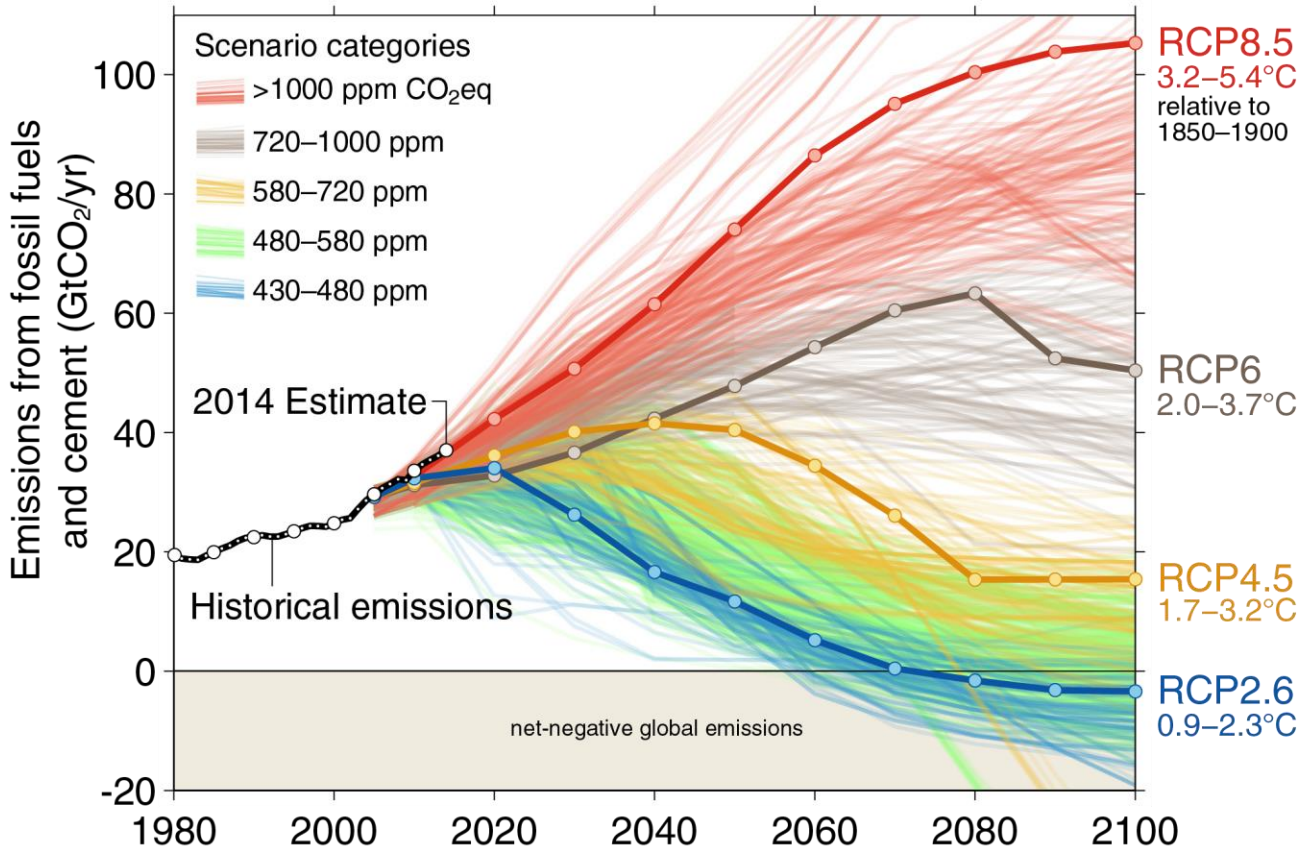
Betting on Negative Emissions

COMMENTARY:

Betting on negative emissions

Sabine Fuss, Josep G. Canadell, Glen P. Peters, Massimo Tavoni, Robbie M. Andrew, Philippe Ciais, Robert B. Jackson, Chris D. Jones, Florian Kraxner, Nebosja Nakicenovic, Corinne Le Quéré, Michael R. Raupach, Ayyoob Sharifi, Pete Smith and Yoshiki Yamagata

Net negative emissions are present in nearly all 2°C scenarios



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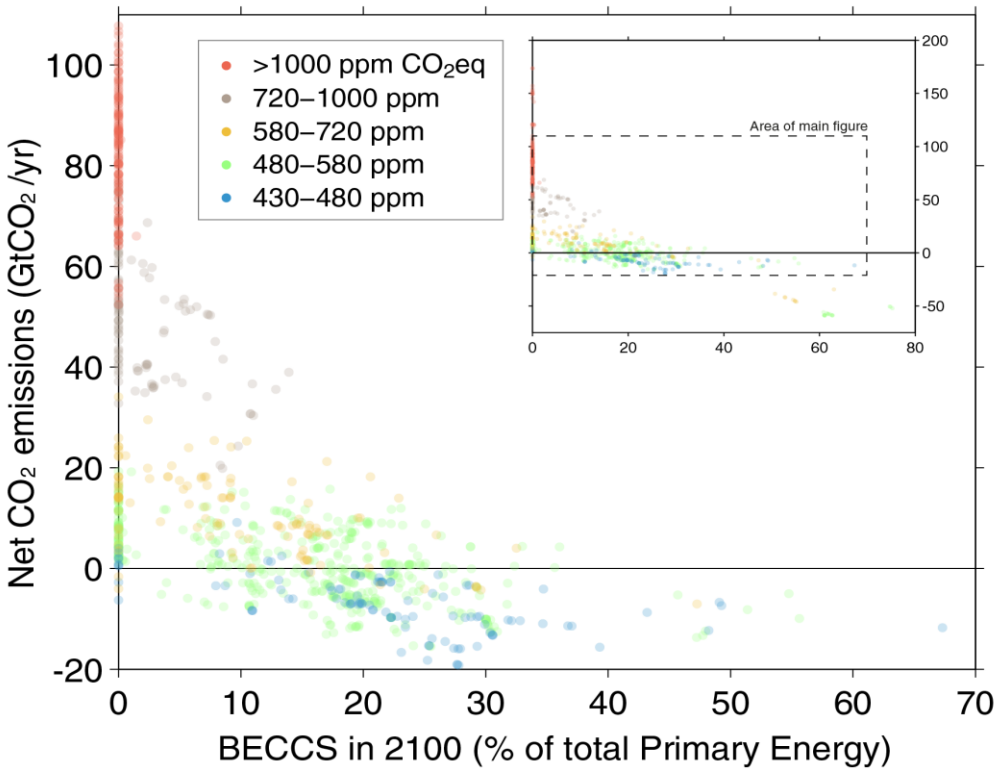
BECCS : biomass energy capture and sequestration

BECCS is necessary, but not sufficient for 2ºC

BECCS is used in over half of scenarios, but ~40% have net positive emissions in 2100
~90% of 2ºC and ~35% of other mitigation scenarios have net negative emissions in 2100

Data: Fuss et al 2014/IPCC

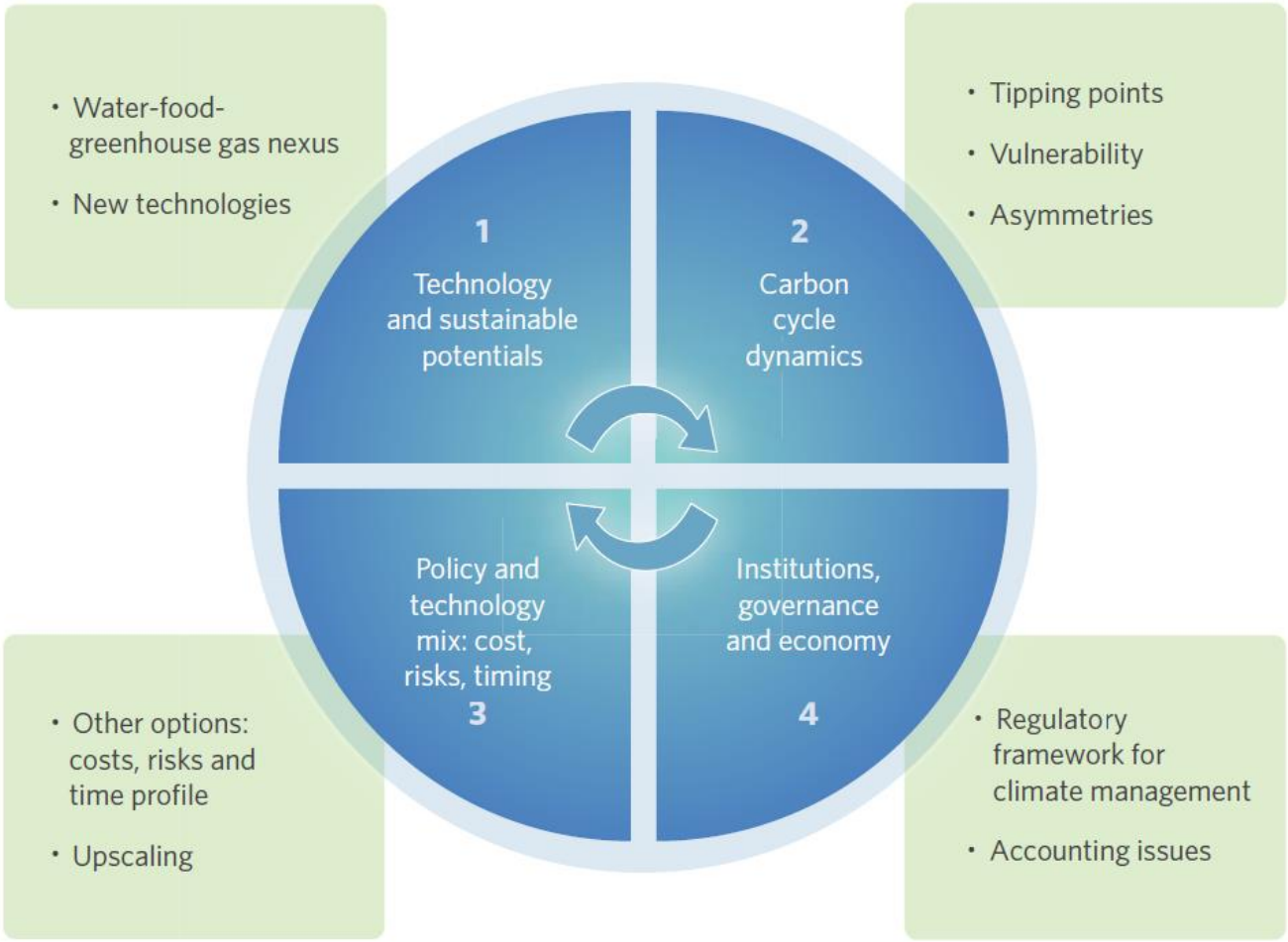


BECCS = Bioenergy with Carbon Capture and Storage; Scenarios from IPCC Fifth Assessment Report

Source: Fuss et al 2014

Four components of consistent negative emissions narratives

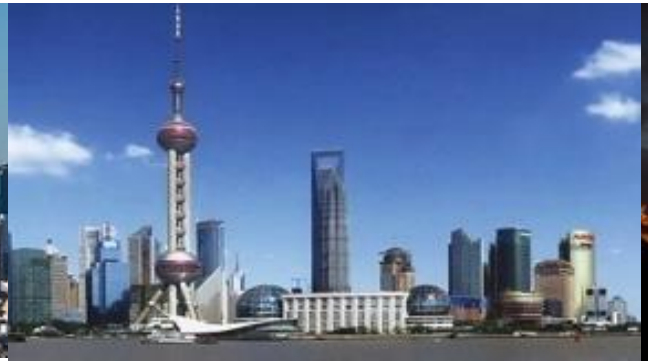
The viability of BECCS as a climate change mitigation option is unproven and its widespread use in climate stabilization scenarios might become a dangerous distraction



Source: Fuss et al 2014



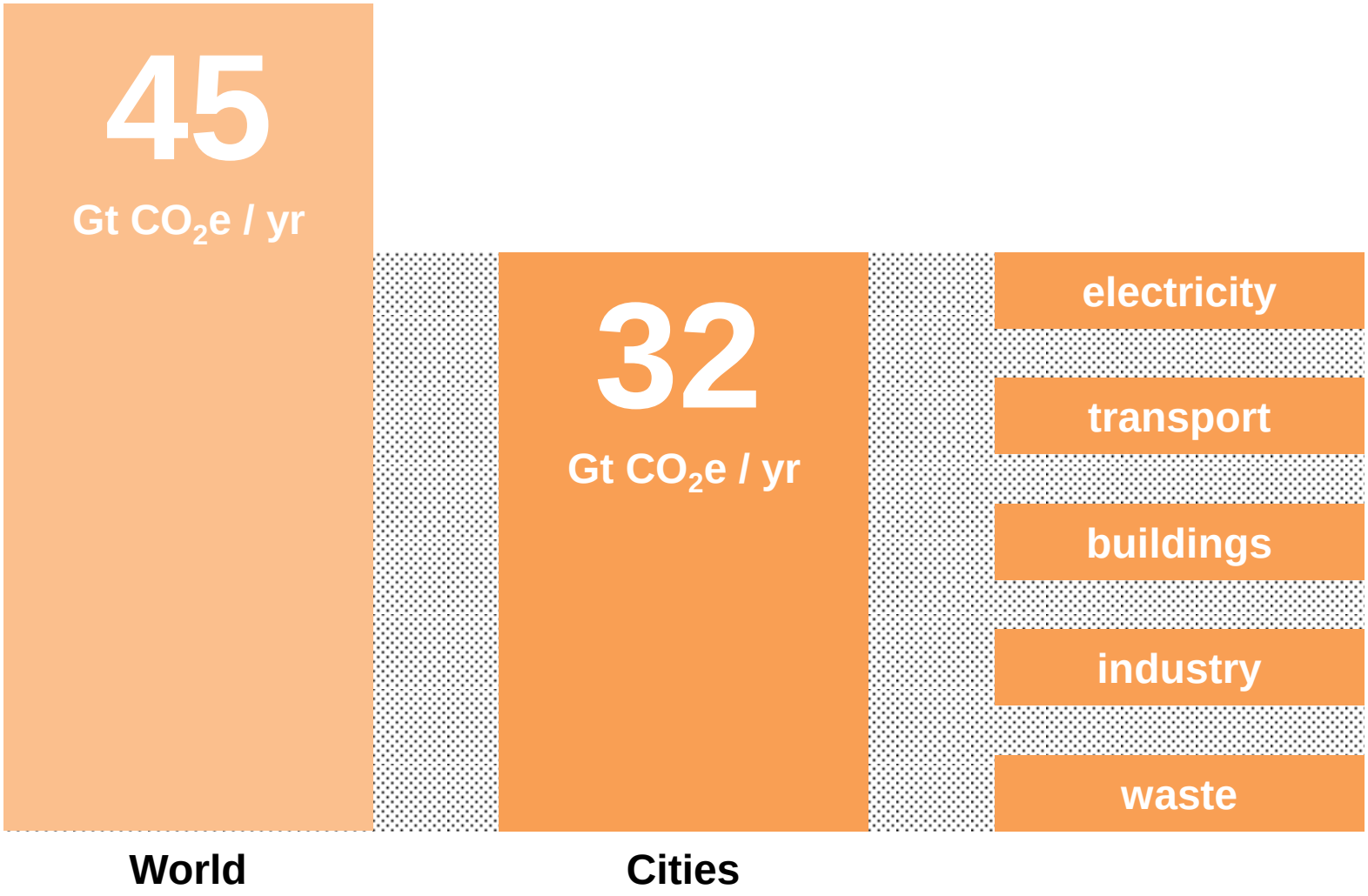
Urban areas are responsible for 75% of the global energy consumption and 70% of the emissions of heat trapping greenhouse gases


While they cover only 2% of the land area

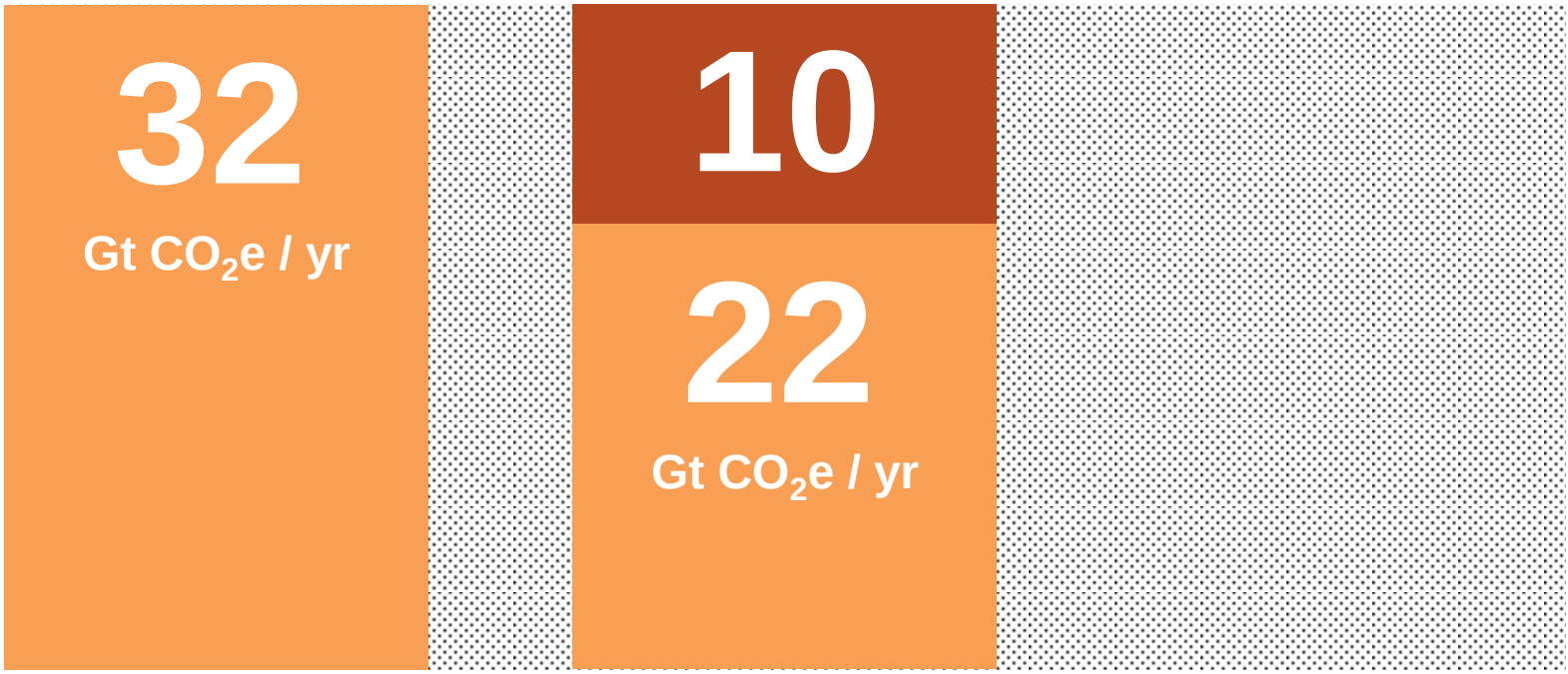


Urban areas account for 70% of man-made emissions of greenhouse gases

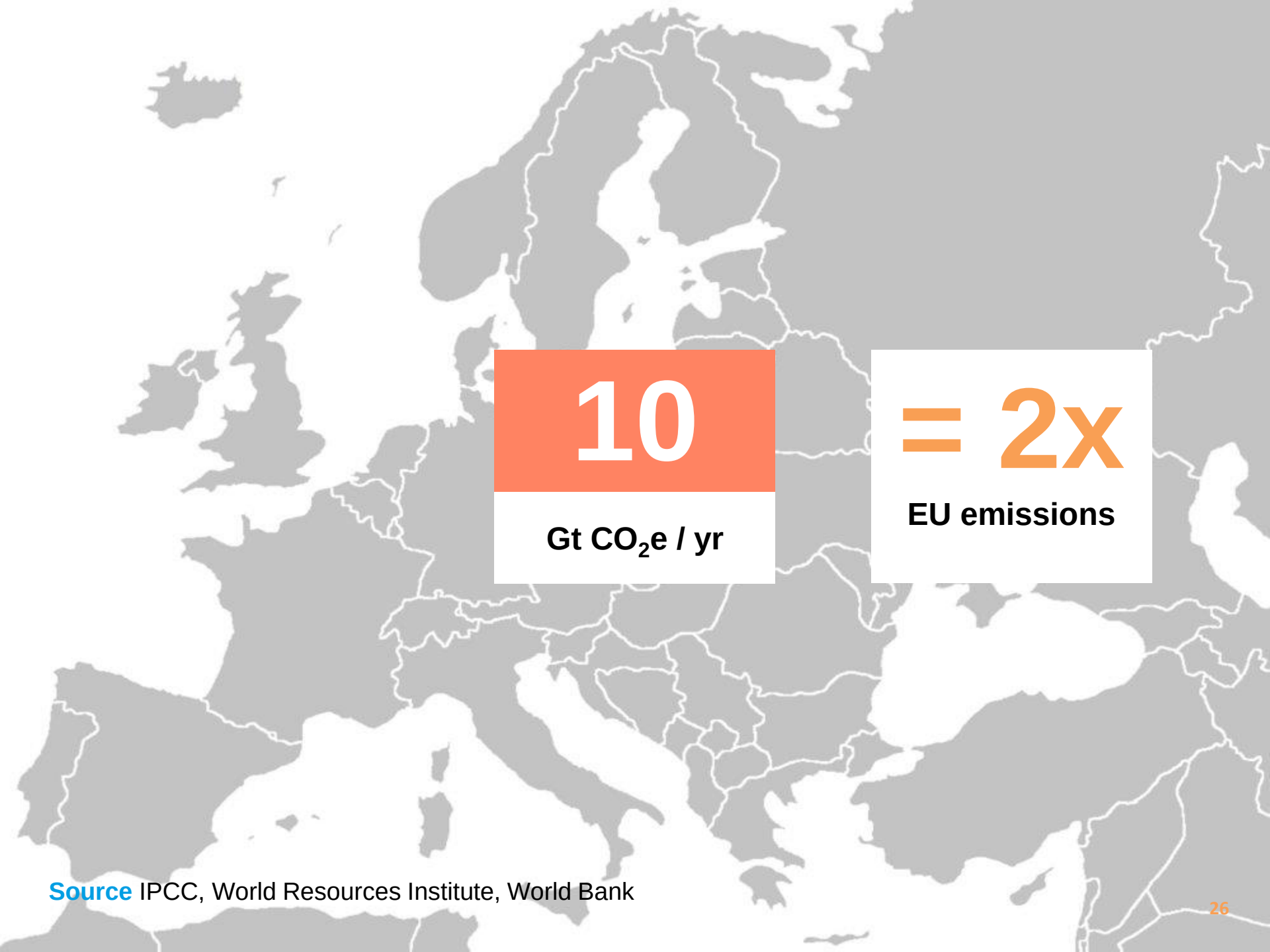


Source IPCC, World Resources Institute, World Bank

Cities have a huge climate mitigation potential

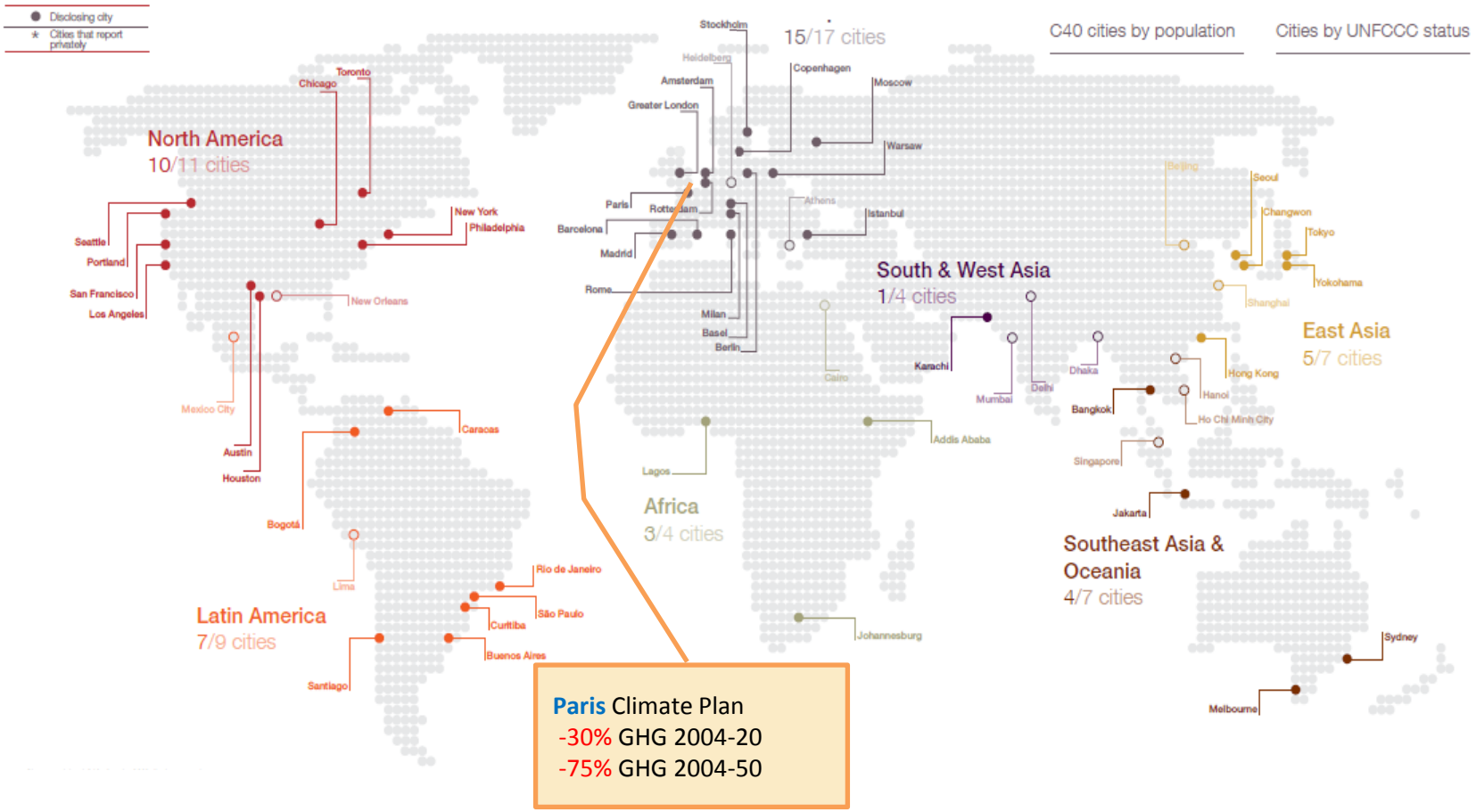


Source IPCC, World Resources Institute, World Bank



Source IPCC, World Resources Institute, World Bank

Cities engaged on ambitious voluntary reduction targets



Need reliable data to measure the effectiveness of city mitigation policy

32

Gt CO_2e / yr

Cities

10

22

Gt CO_2e / yr

Low carbon cities

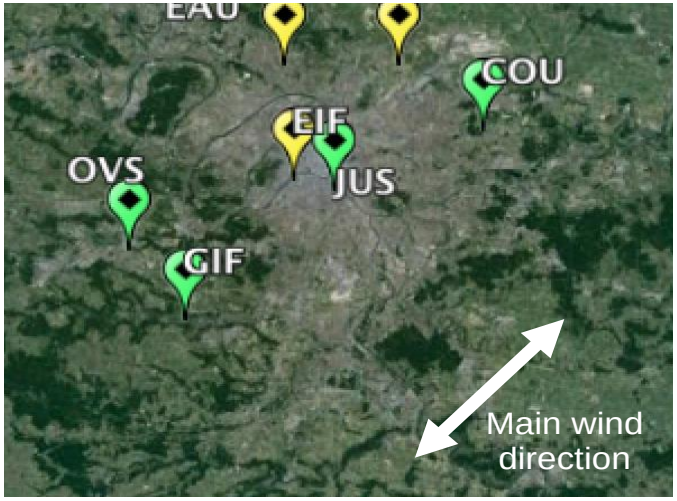
92%

of cities are not on track!

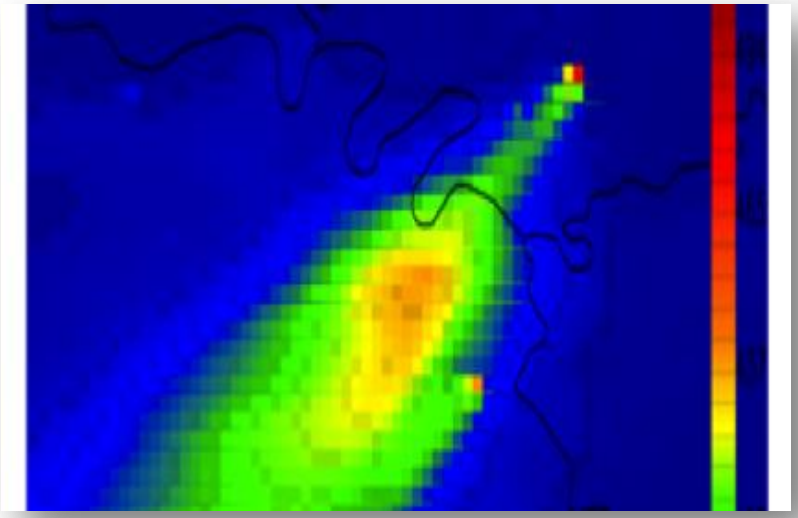
Source ICLEI, carbon Registry

Using atmospheric measurements to monitor CO_2 emissions from the Paris urban area

A spatially explicit inventory exists over Paris, but its updates lag 2-3 years behind the current year.



Paris network of CO2 stations



Simulated plume of CO2 emissions

Near real time emissions will be provided during the COP21

Thank you for your attention

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Global Carbon Budget (2014) More information, data sources and data files at http://www.globalcarbonproject.org/carbonbudget/

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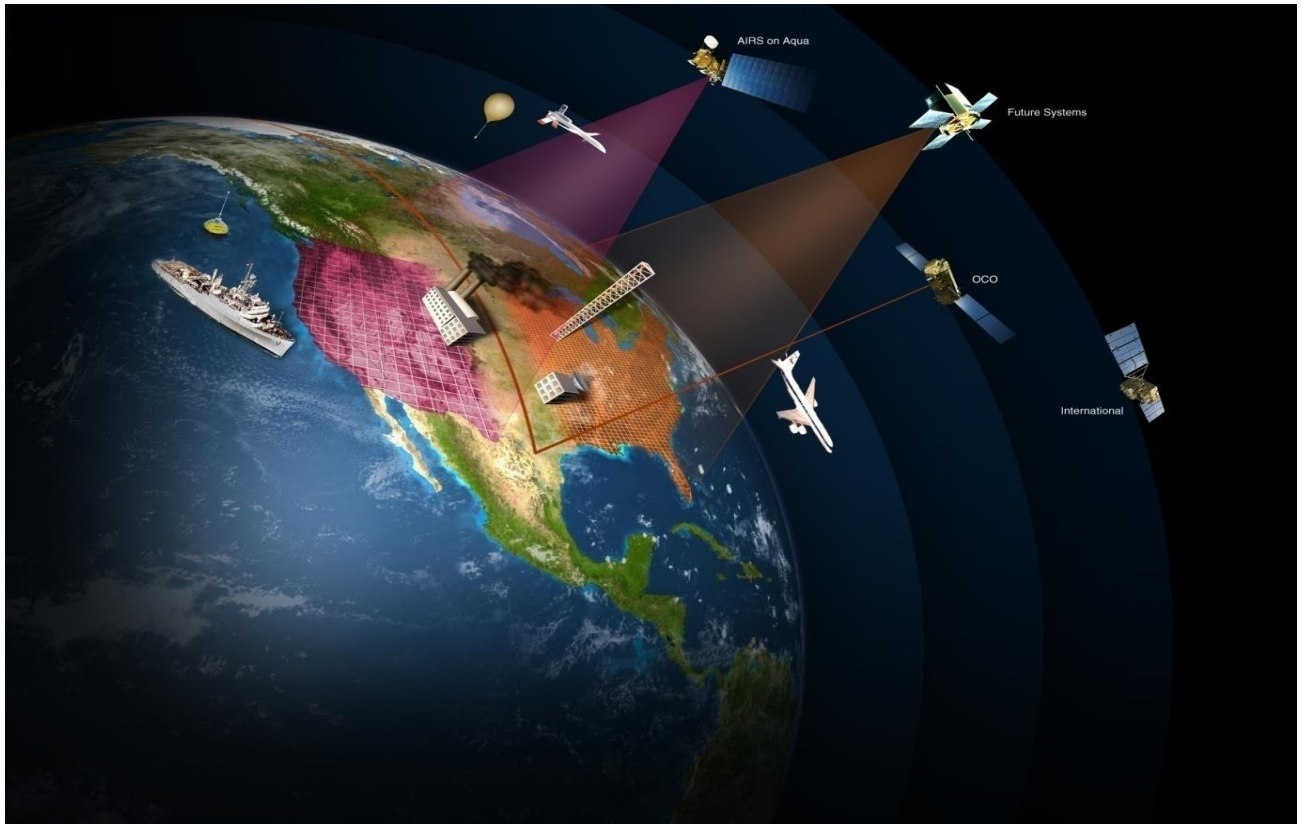
AIRS on Aqua
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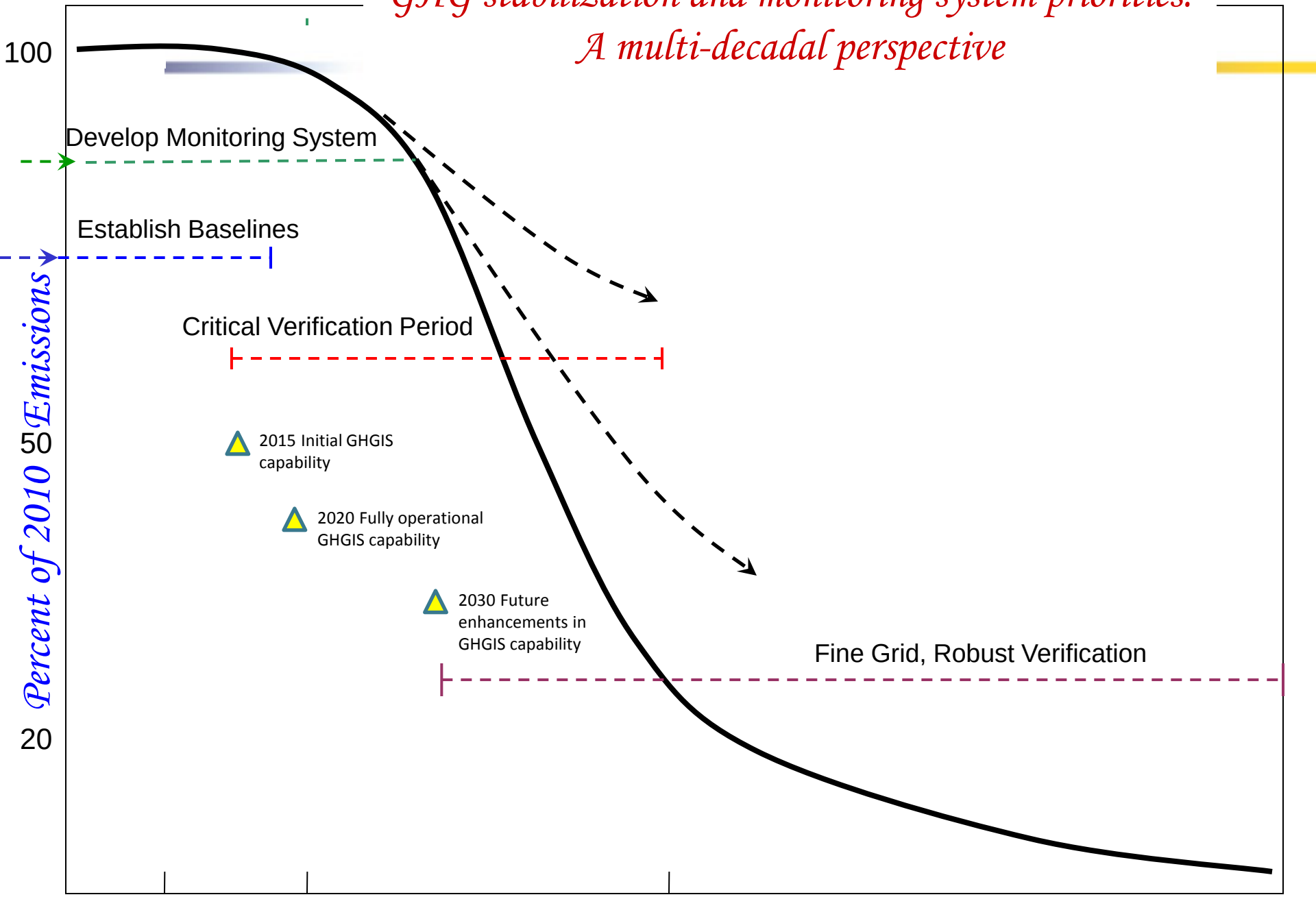
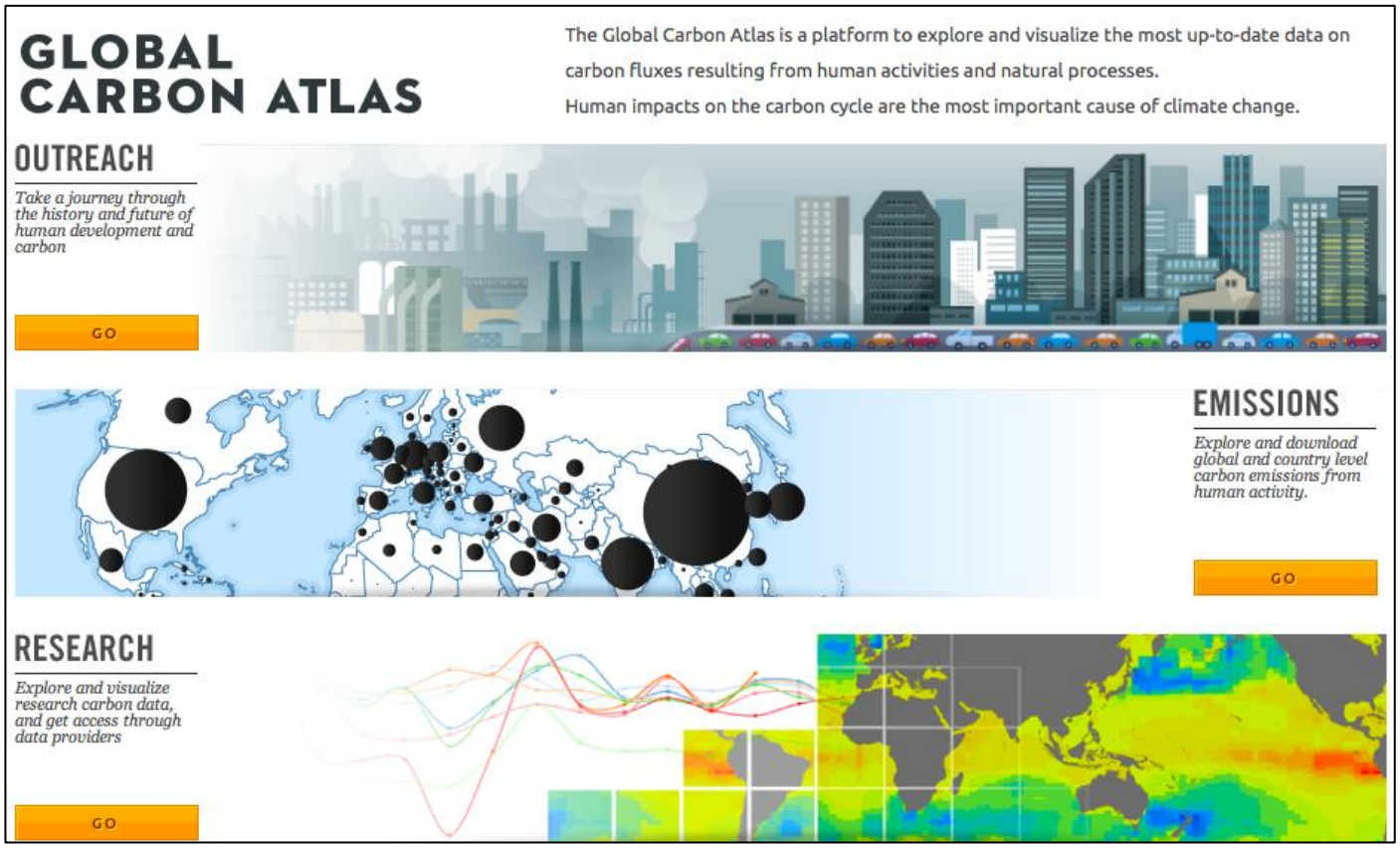
International

GHG stabilization and monitoring system priorities: A multi-decadal perspective



Global Carbon Atlas

Explore CO_2 emissions at the global and country levels, compare among countries, visualize, and download data and illustrations ("Emissions" application). Also explore "Outreach" and "Research".



www.globalcarbonatlas.org

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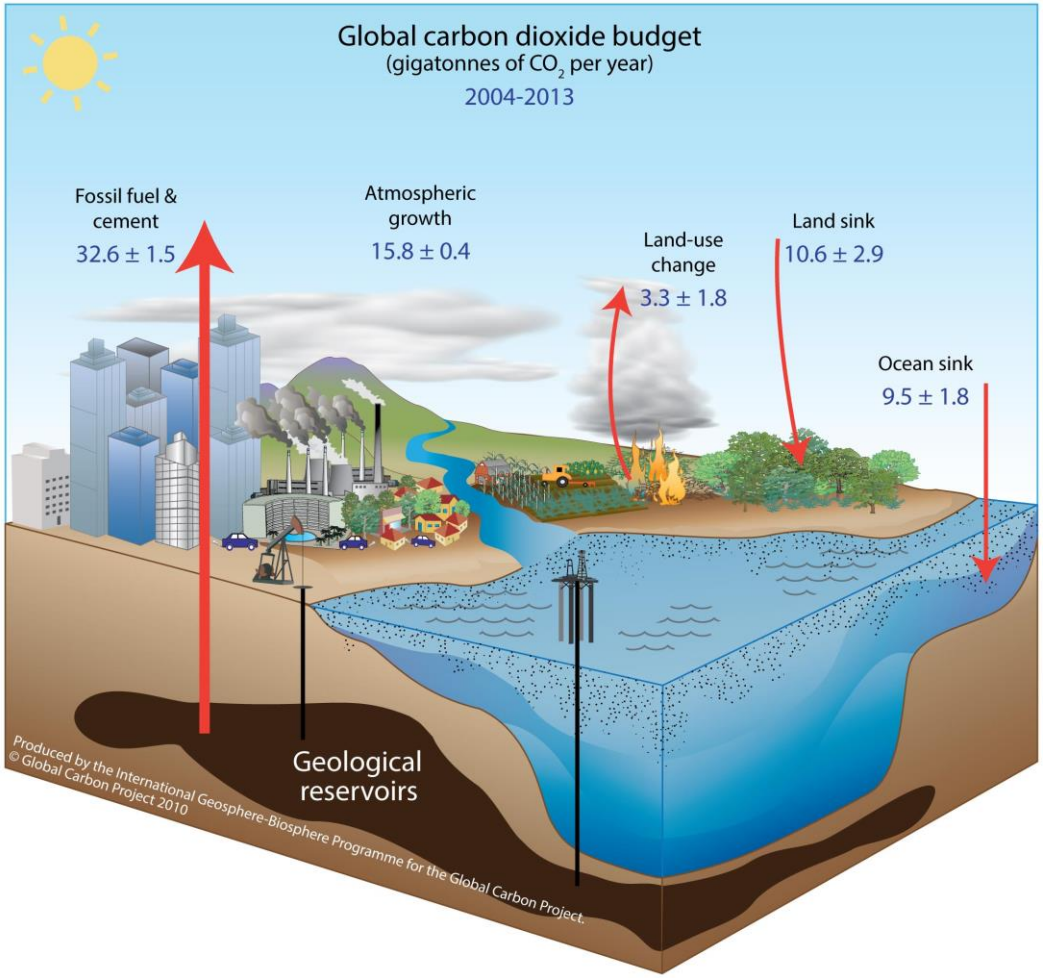
Anthropogenic Perturbation of the Global Carbon Cycle

Perturbation of the global carbon cycle caused by anthropogenic activities, averaged globally for the decade 2004–2013 ($GtCO_2$/yr)

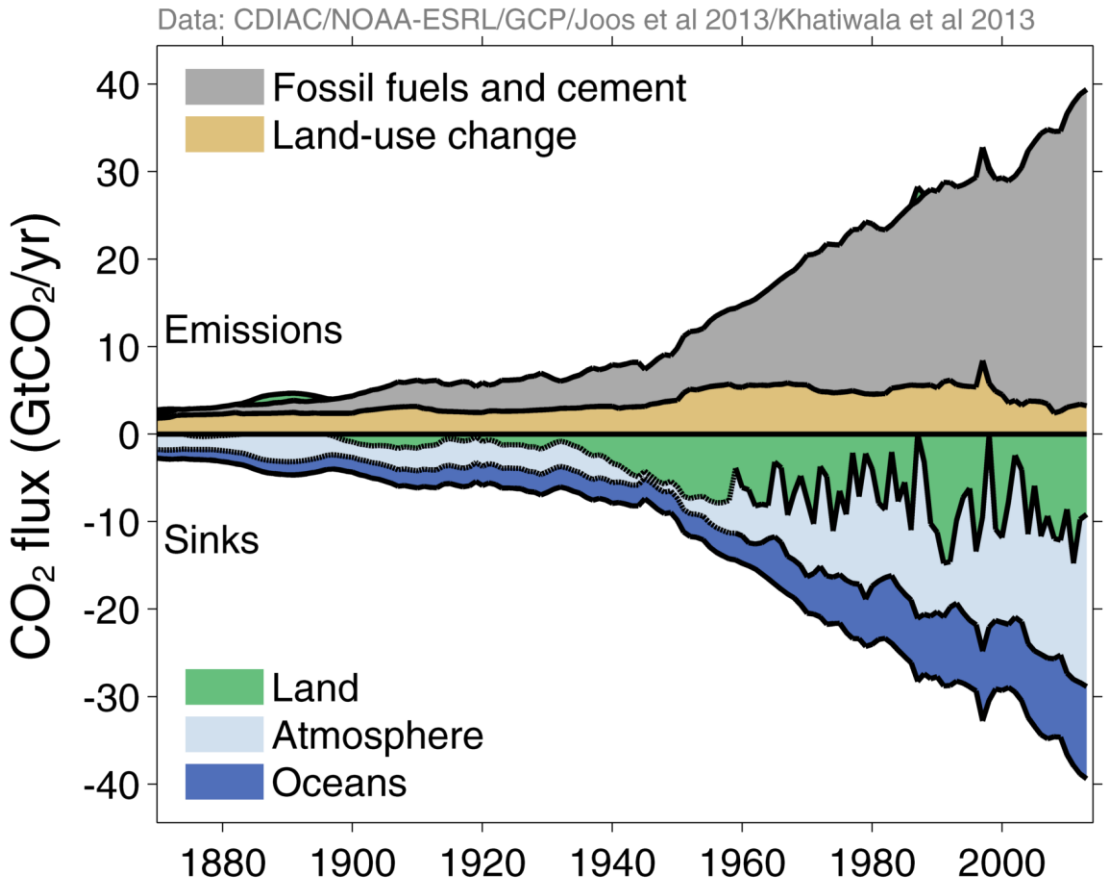
Data: CDIAC/NOAA-ESRL/GCP



Source: CDIAC; NOAA-ESRL; Le Quéré et al 2014; Global Carbon Budget 2014

Global Carbon Budget

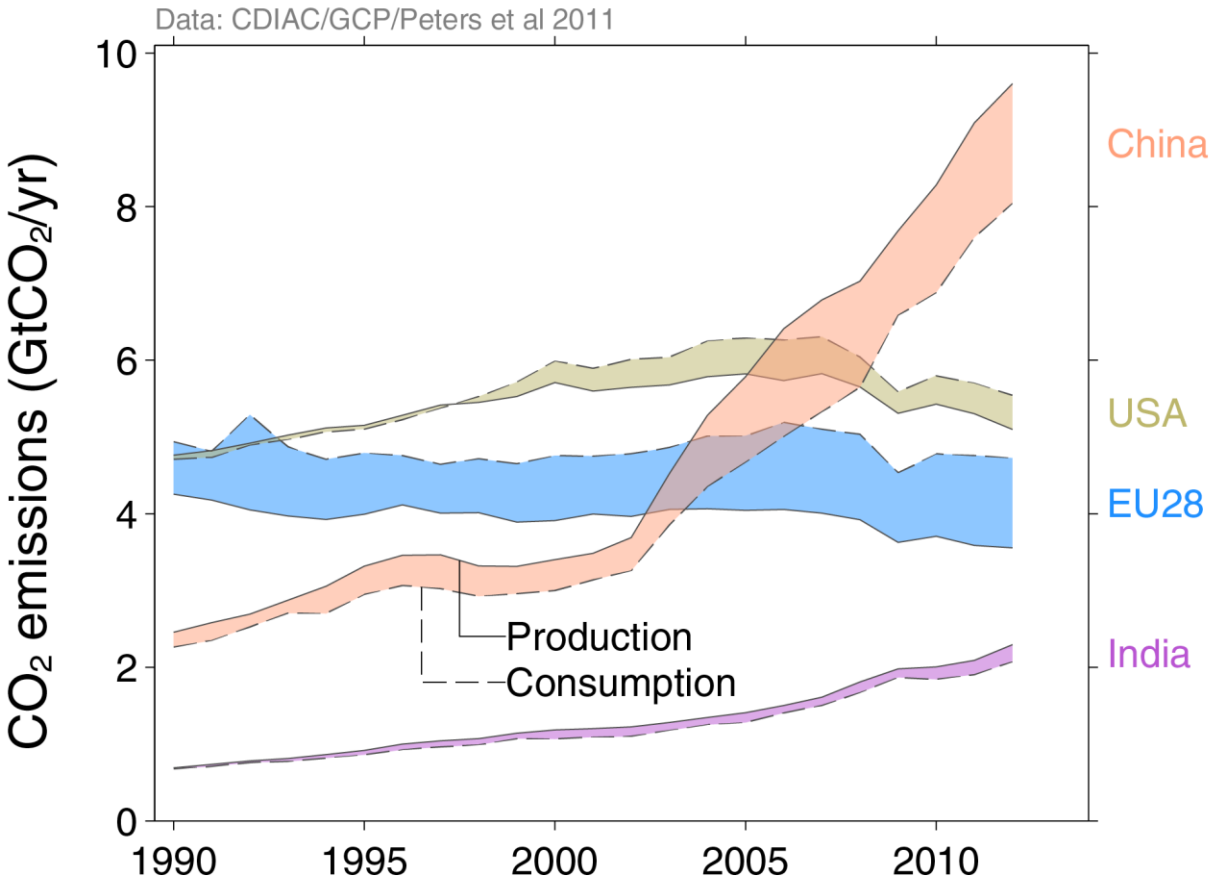
Emissions are partitioned between the atmosphere, land, and ocean



Source: CDIAC; NOAA-ESRL; Houghton et al 2012; Giglio et al 2013; Joos et al 2013; Khatiwala et al 2013; Le Quéré et al 2014; Global Carbon Budget 2014

Consumption-based emissions (carbon footprint)

Allocating emissions to the consumption of goods and services provides an alternative perspective on emission drivers

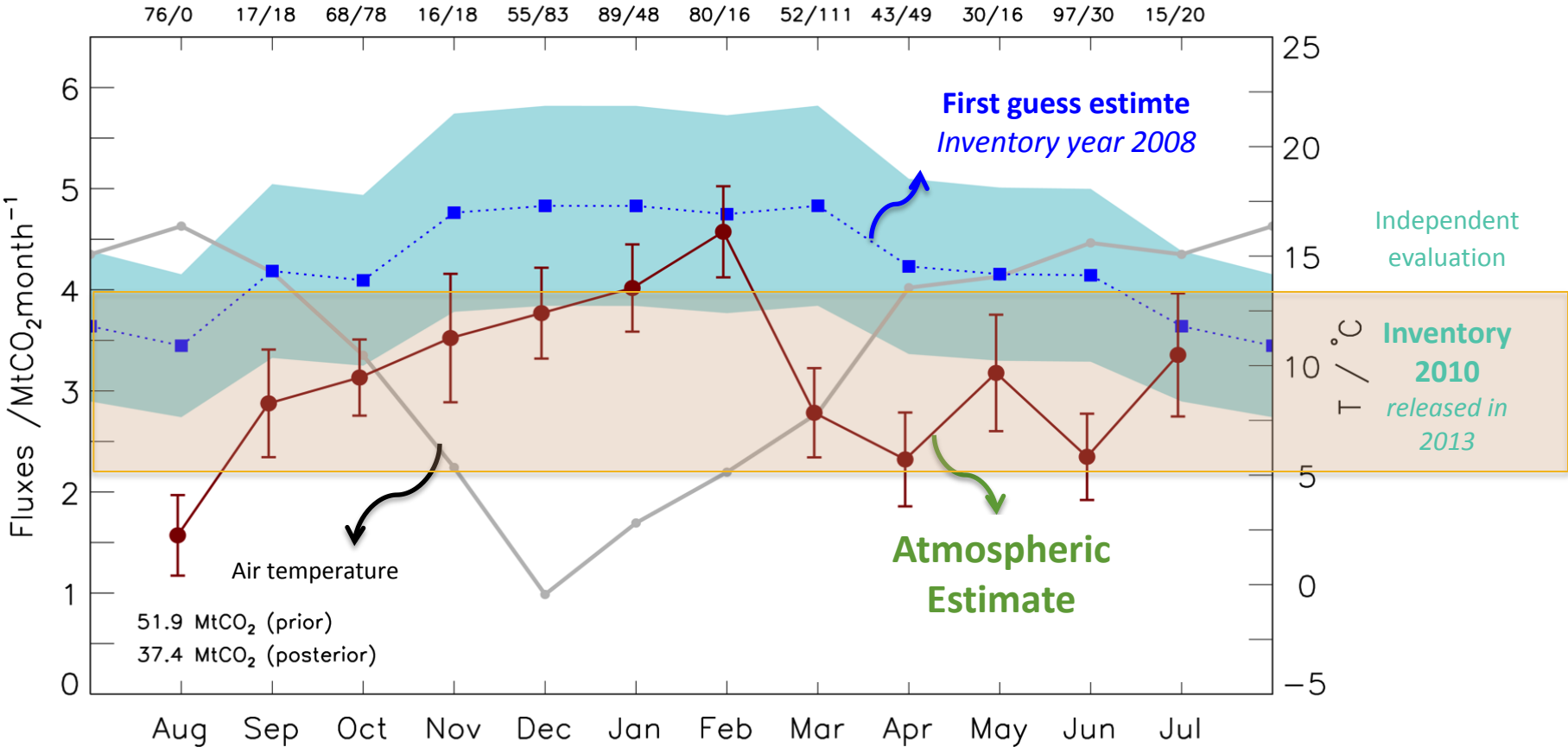


Consumption-based emissions are calculated by adjusting the standard production-based emissions to account for international trade

Source: Le Quéré et al 2014; Peters et al 2011;Global Carbon Project 2014

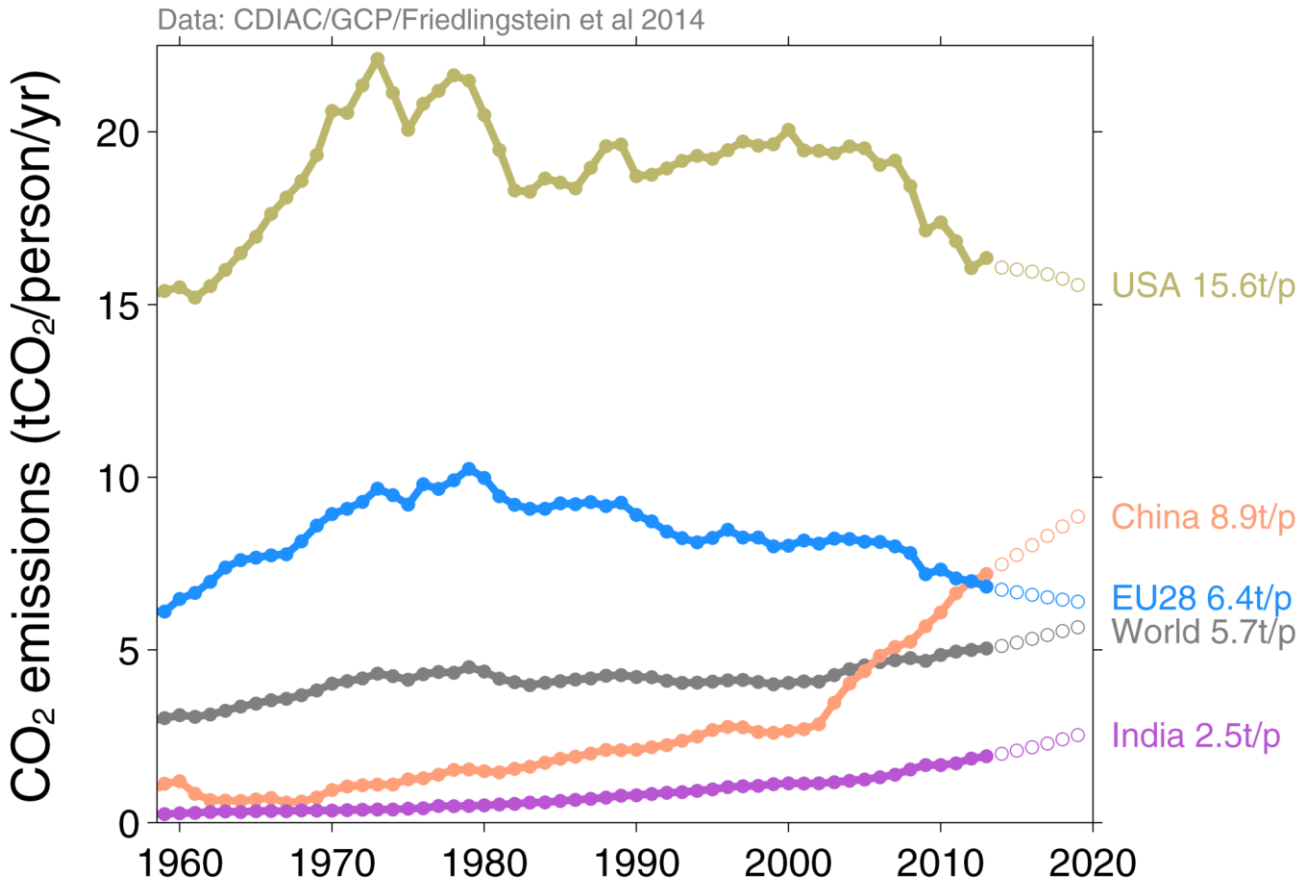
Optimized emissions and improved inventory using 4 stations for year 2010

Mean annual value is spot-on the inventory update of 2010 emissions
Larger seasonal contrast in the atmospheric approach



Top Fossil Fuel Emitters (Per Capita)

The divergence between EU28 and Chinese per capita emissions is likely to continue
USA continues with high and India with low per capita emissions



Economic growth based on IMF projections, fossil fuel intensity based on 10-year trend

Source: CDIAC; Friedlingstein et al 2014

Global Carbon Budget

The cumulative contributions to the Global Carbon Budget from 1870
Contributions are shown in parts per million (ppm)

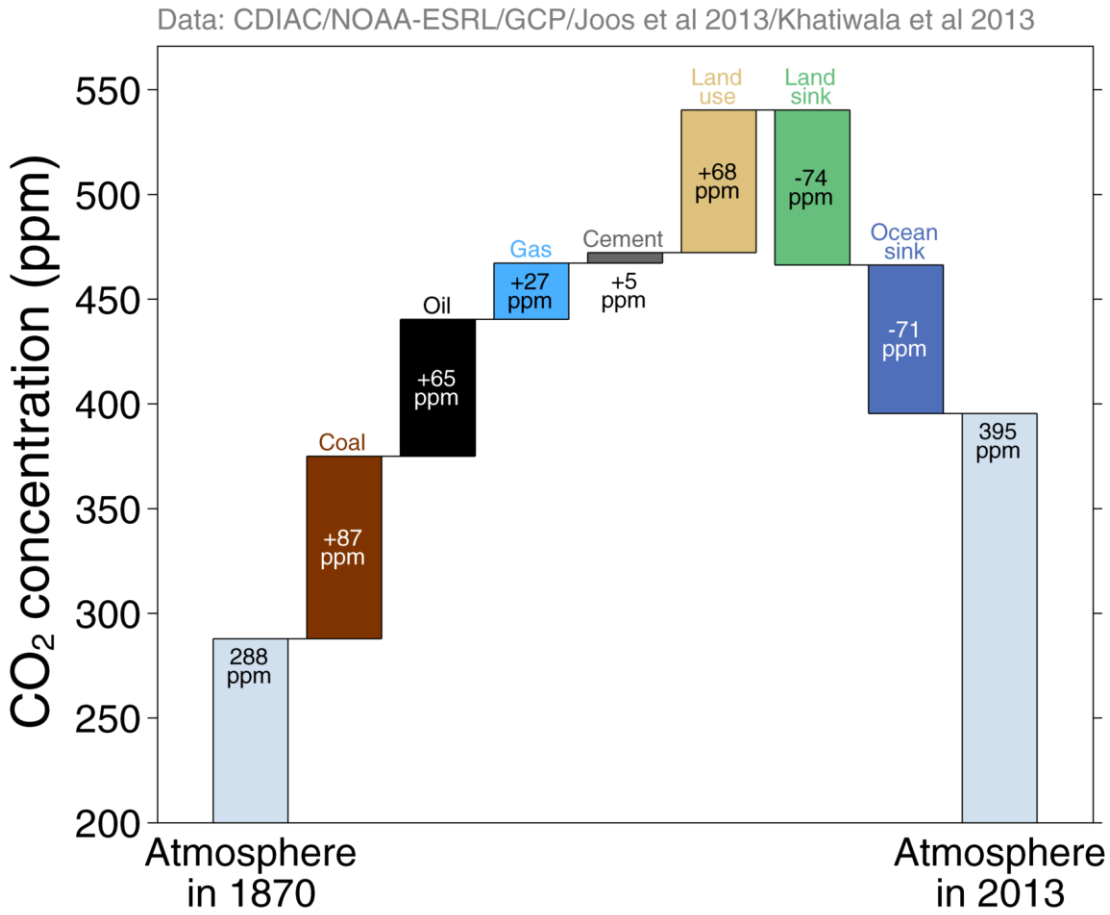
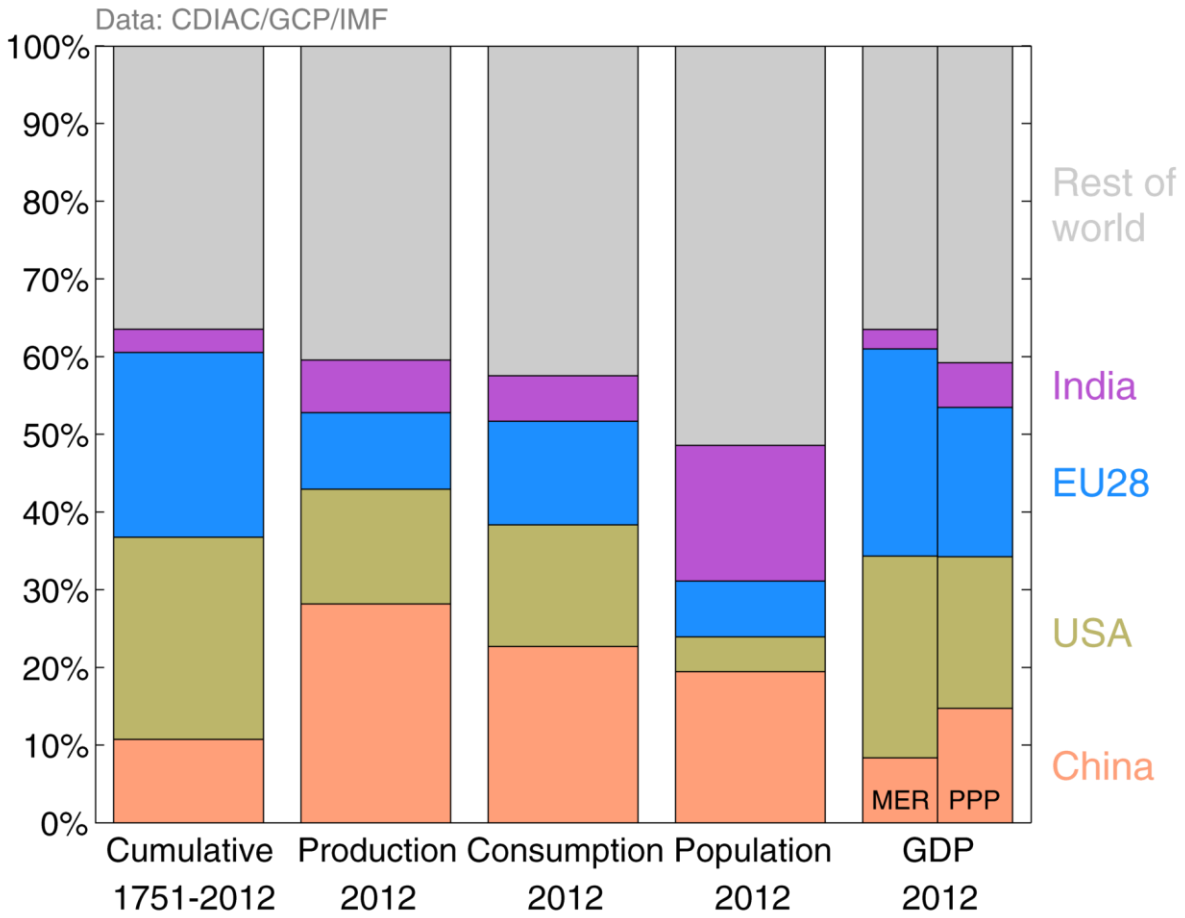


Figure concept from Shrink That Footprint

Source: CDIAC; NOAA-ESRL; Houghton et al 2012; Giglio et al 2013; Joos et al 2013; Khatiwala et al 2013; Le Quéré et al 2014; Global Carbon Budget 2014

Alternative Ranking of Countries

Depending on perspective, the significance of individual countries changes

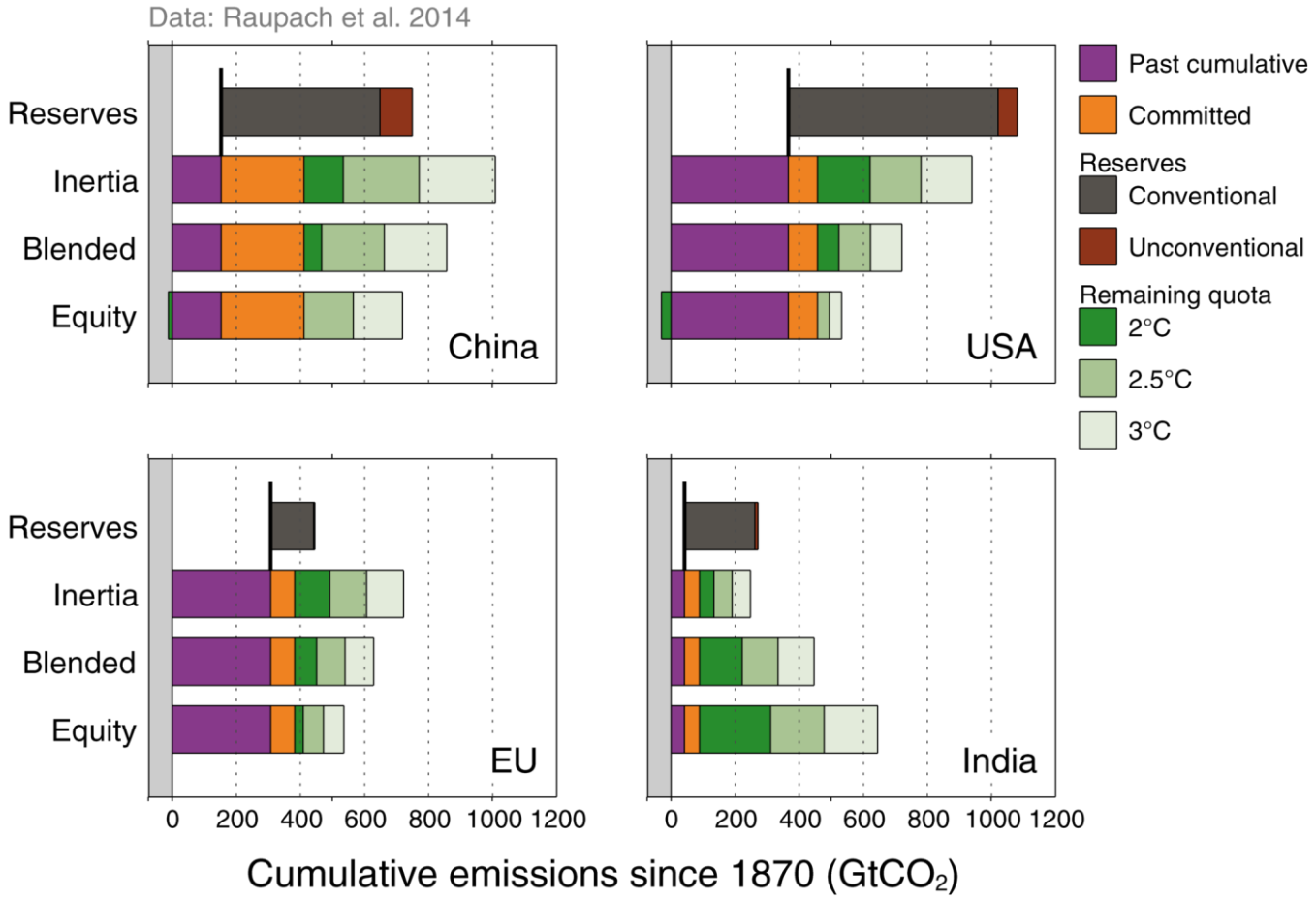


GDP: Gross Domestic Product in Market Exchange Rates (MER) and Purchasing Power Parity (PPP)

Source: CDIAC; United Nations; Le Quéré et al 2014; Global Carbon Budget 2014

Regional Quotas, Committed Emissions, Fossil-Fuel Reserves

With population-based (equity) sharing & committed emissions,
the USA and China have already exceeded their 2°C quotas



Trade in fossil fuels redistributes the emissions from fossil-fuel reserves amongst nations

Source: Raupach et al 2014

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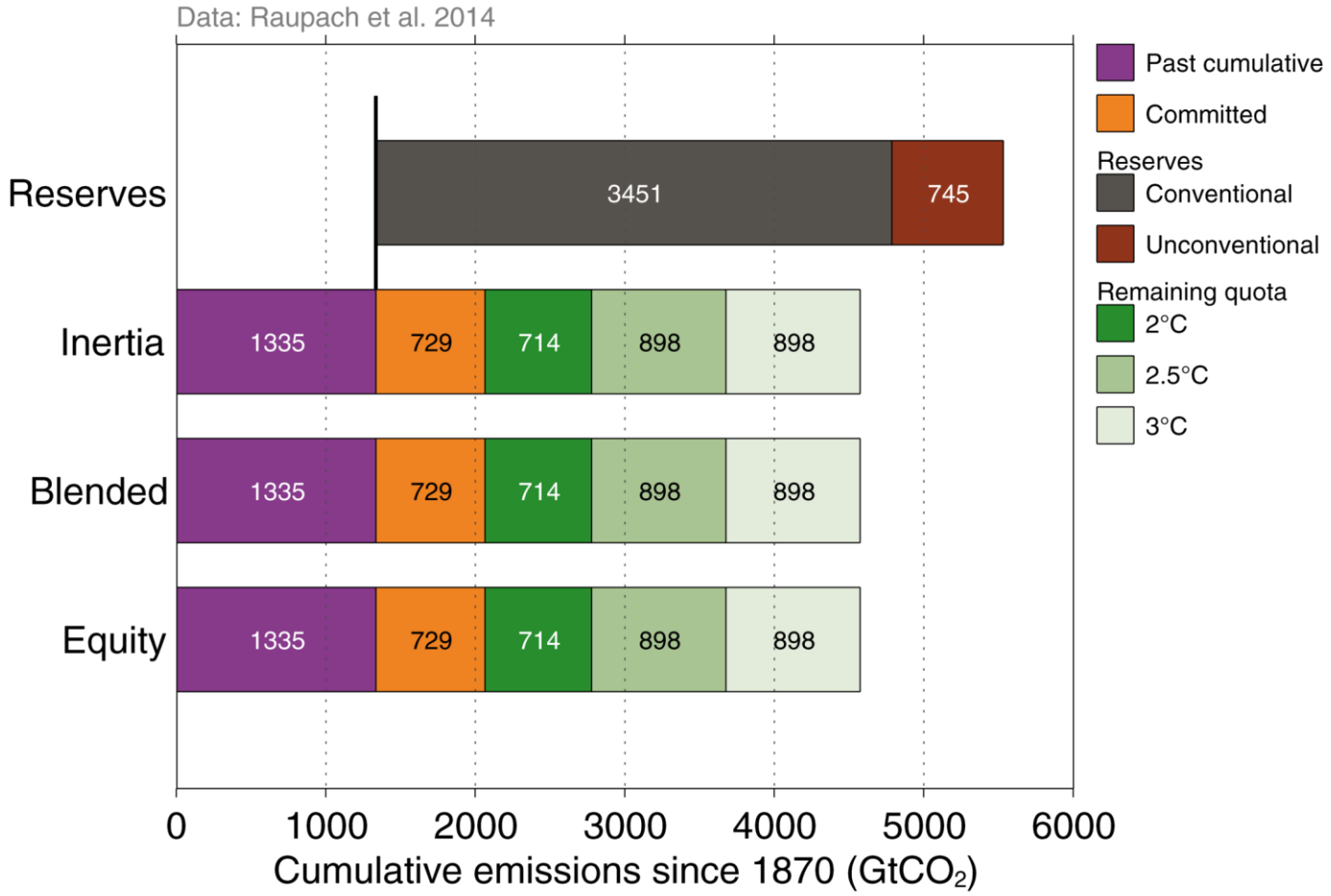
Global Quotas, Committed Emissions, Fossil-Fuel Reserves

To keep temperatures below 2°C requires two-thirds of fossil fuels to remain in the ground*
Committed emissions in existing infrastructure represents 50% of the remaining quota*



*Assuming a 50% chance to stay below 2°C and no carbon-capture and storage

Source: Raupach et al 2014