GLOBAL CARBON PROJECT

Global Carbon Budget

2019

The GCP is a Global Research Project of futureearth Research. Innovation. Sustainability. and a Research Partner of WCRP World Climate Research Programme

Published on 4 December 2019

PowerPoint version 1.0 (released 4 December 2019)

Acknowledgements

The work presented here has been possible thanks to the enormous observational and modelling efforts of the institutions and networks below

Atmospheric CO_2 datasets
NOAA/ESRL (Dlugokencky and Tans 2019)
Scripps (Keeling et al. 1976)

Fossil Fuels and Industry
CDIAC (Gilfillan et al. 2019)
Andrew, 2019
UNFCCC, 2019
BP, 2019

Consumption Emissions
Peters et al. 2011
GTAP (Narayanan et al. 2015)

Land-Use Change
Houghton and Nassikas 2017
BLUE (Hansis et al. 2015)
GFED4 (van der Werf et al. 2017)
FAO-FRA and FAOSTAT
HYDE (Klein Goldewijk et al. 2017)
LUH2 (Hurtt et al. in prep)

Atmospheric inversions
CarbonTracker Europe (van der Laan-Luijkx et al. 2017)
Jena CarboScope (Rödenbeck et al. 2003)
CAMS (Chevallier et al. 2005)

Land models
CABLE-POP | CLASS-CTEM | CLM5.0 | DLEM | ISAM | ISBA-CTRIP | JSBACH | JULES-ES | LPJ-GUESS | LPJ | LPX-Bern | OCN | ORCHIDEE-Trunk | ORCHIDEE-CNP | SDGVM | VISIT
CRU (Harris et al. 2014) JRA-55

Ocean models
CESM-ETHZ | CSIRO | MICOM-HAMOCC (NorESM-OC) | MITgem-REcoM2 | MOM6-COBALT (Princeton) | MPIOM-HAMOCC6 | NEMO3.6-PISCESv2-gas (CNRM) | NEMO-PISCES (IPSL) | NEMO-PlankTOM5

pCO_2-based ocean flux products
Jena-MLS | MPI-SOMFFN | CMEMS
SOCATv2019

Full references provided in Friedlingstein et al 2019

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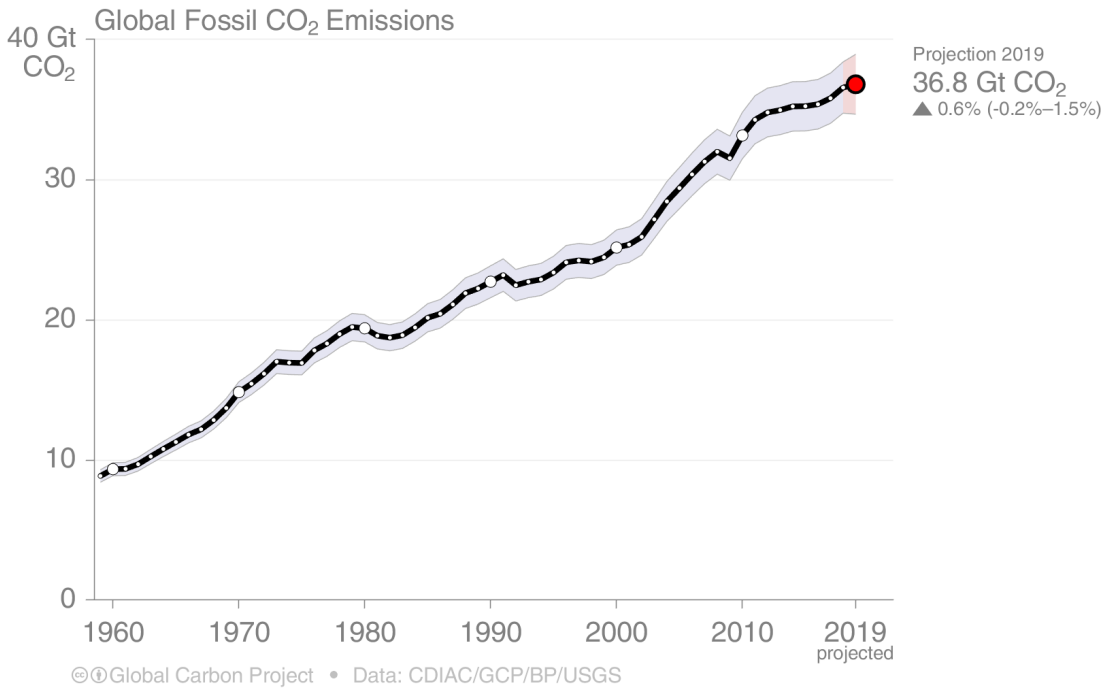
Fossil CO_2 Emissions

from fossil fuel use and industry

Global Fossil CO_2 Emissions

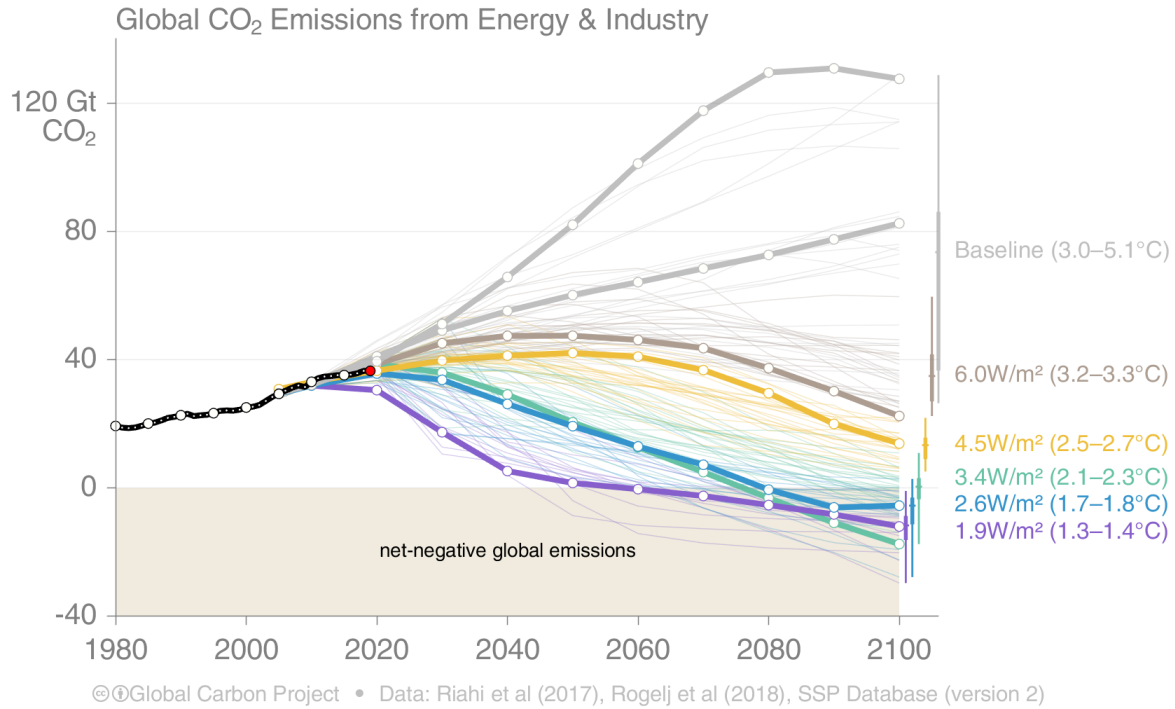
Global fossil CO_2 emissions have risen steadily over the last decades & show no sign of peaking
Fossil CO_2 emissions will likely be 62% higher in 2019 than the year of the 1st IPCC report in 1990



The 2019 projection is based on preliminary data and modelling.
Source: CDIAC; Friedlingstein et al 2019; Global Carbon Budget 2019

Shared Socioeconomic Pathways (SSPs)

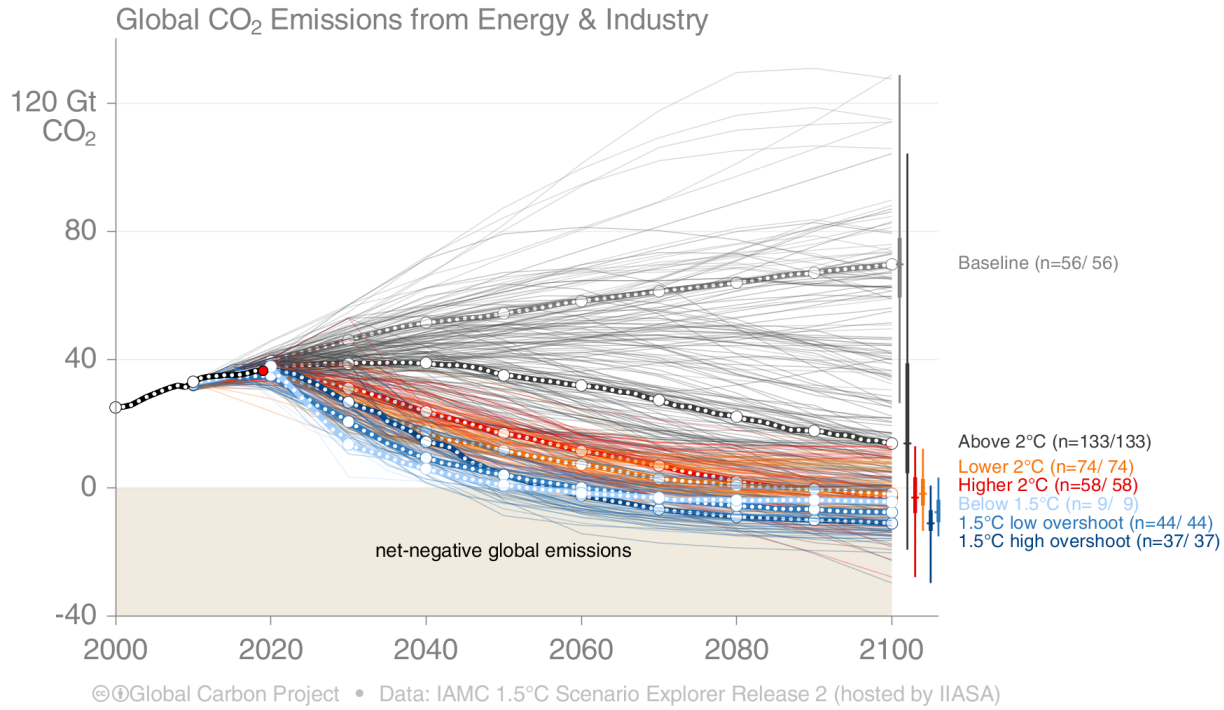
The SSPs lead to a broad range in baselines (grey), with more aggressive mitigation leading to lower temperature outcomes. The bold lines are scenarios that will be analysed in CMIP6 and the results assessed in the IPCC AR6 process.



This set of quantified SSPs are based on the output of six Integrated Assessment Models (AIM/CGE, GCAM, IMAGE, MESSAGE, REMIND, WITCH). Net emissions include those from land-use change and bioenergy with CCS.
Source: Riahi et al. 2016; Rogelj et al. 2018; IIASA SSP Database; IAMC; Global Carbon Budget 2019

The IPCC Special Report on "Global Warming of 1.5°C"

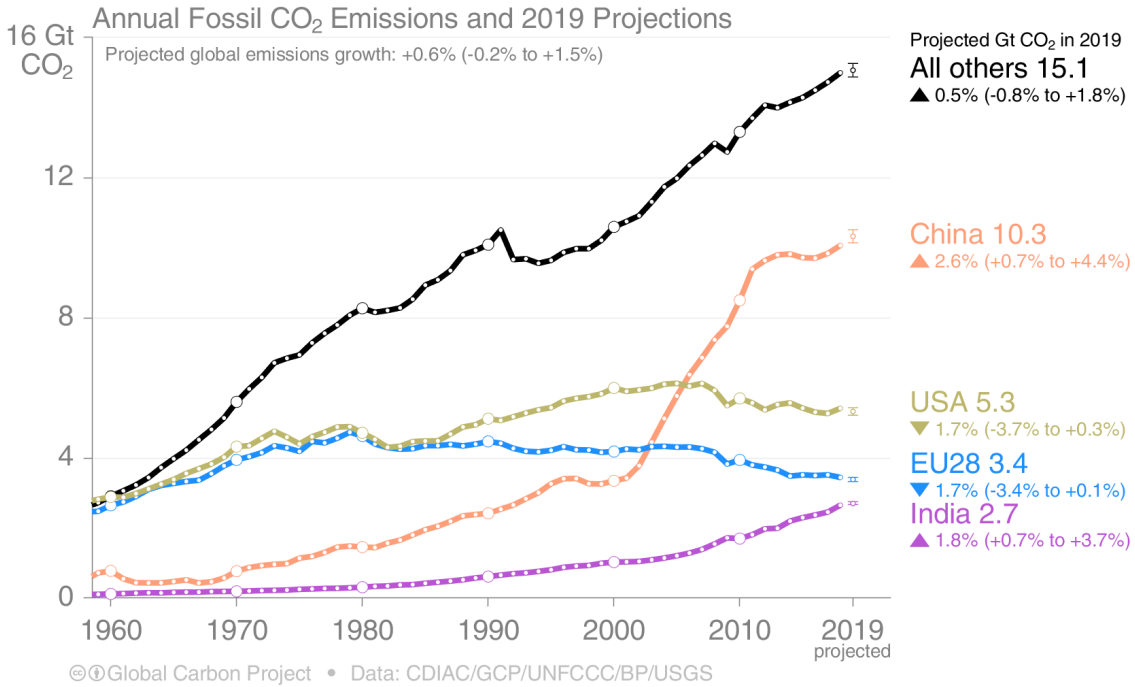
The IPCC Special Report on "Global Warming of 1.5°C" presented new scenarios:
1.5°C scenarios generally require halving emissions by ~2030, net-zero by ~2050, and negative thereafter



Net emissions include those from bioenergy with carbon capture and storage (BECCS).
Source: Huppmann et al 2018; IAMC 1.5C Scenario Database; IPCC SR15; Global Carbon Budget 2019

Emissions Projections for 2019

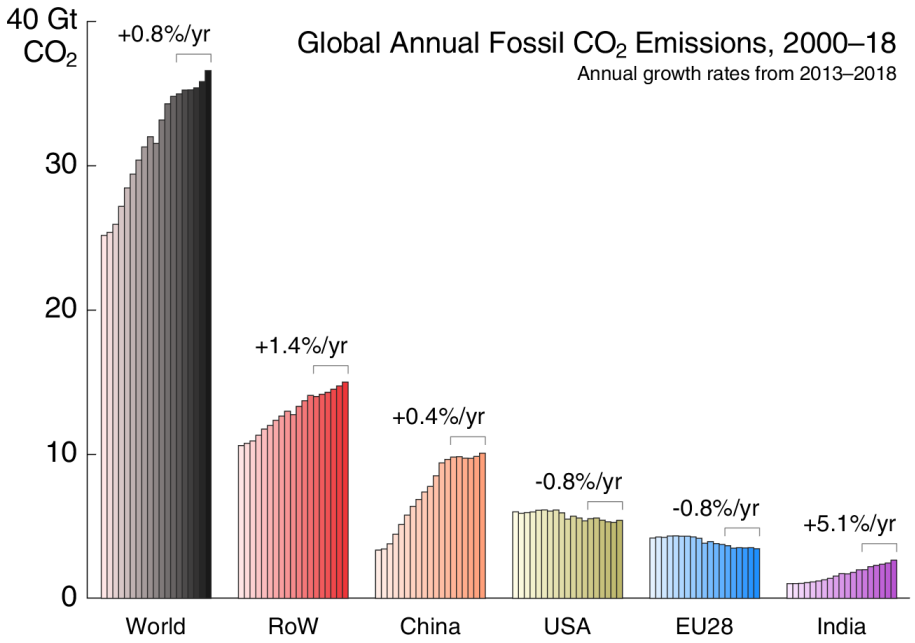
Global fossil CO_2 emissions are projected to rise by 0.6% in 2019 [range: -0.2% to +1.5%]
The global growth is driven by the underlying changes at the country level.



Source: CDIAC; Peters et al 2019; Friedlingstein et al 2019; Global Carbon Budget 2019

Top emitters: Fossil CO_2 Emissions

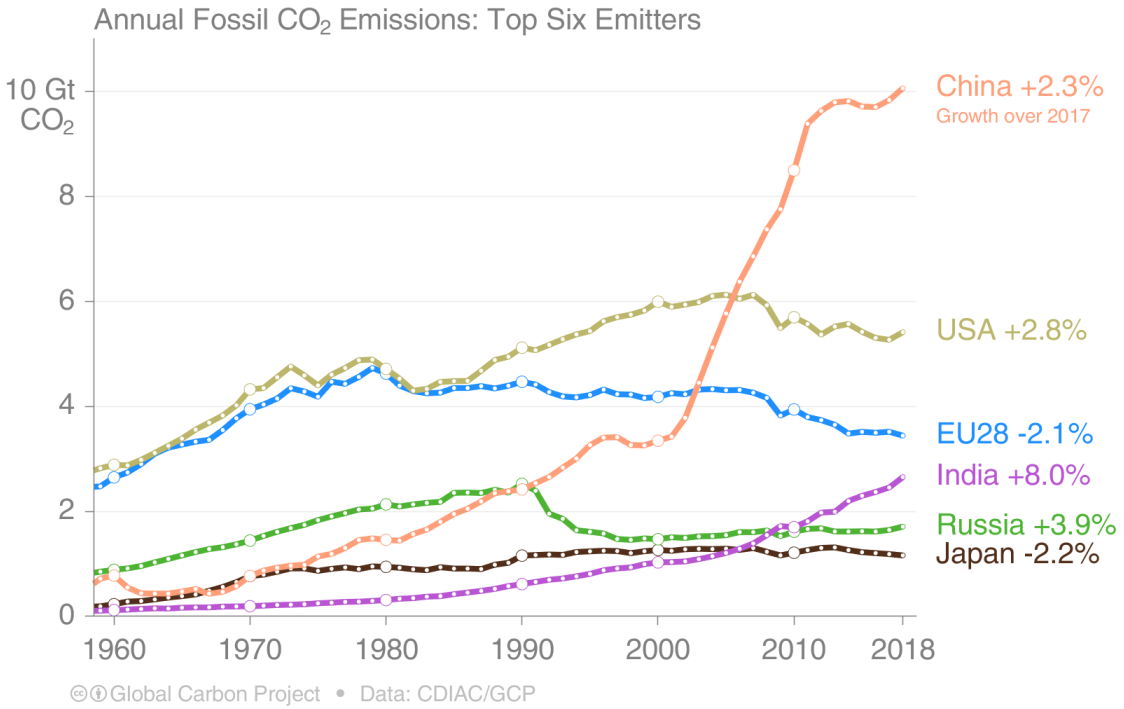
Emissions by country from 2000 to 2018, with the growth rates indicated for the more recent period of 2013 to 2018



Source: CDIAC; Jackson et al 2019; Friedlingstein et al 2019; Global Carbon Budget 2019

Top emitters: Fossil CO_2 Emissions

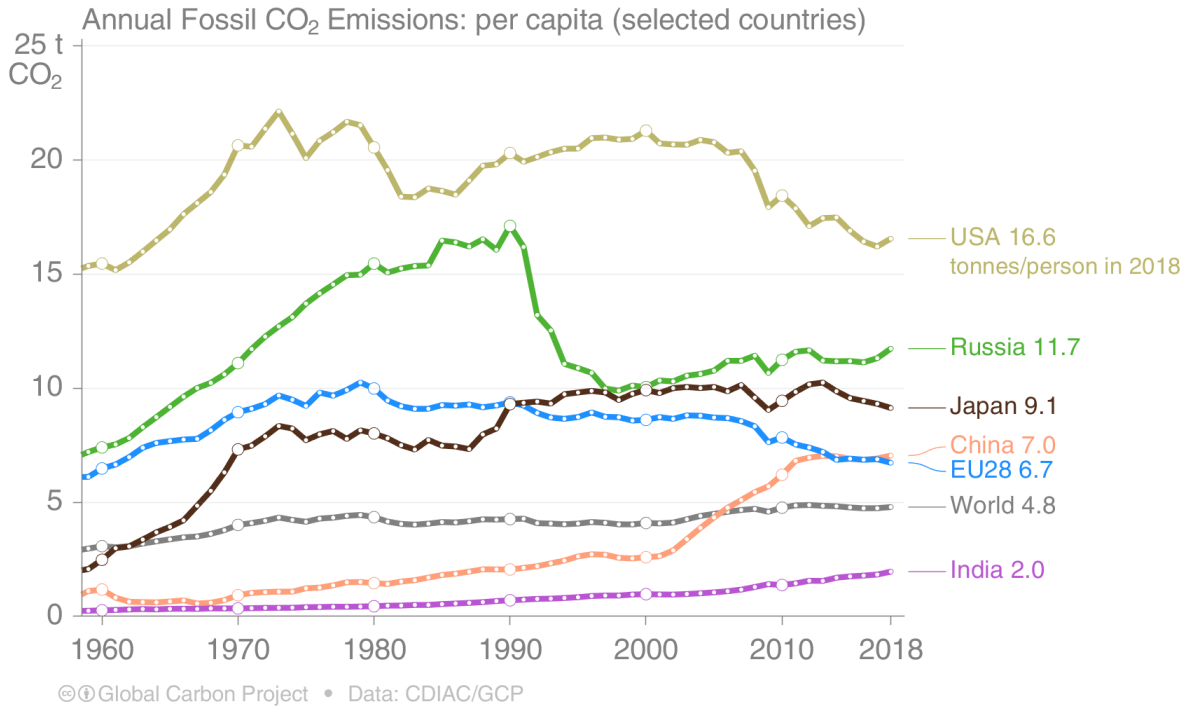
The top six emitters in 2018 covered 67% of global emissions
China 28%, United States 15%, EU28 9%, India 7%, Russia 5%, and Japan 3%



Bunker fuels, used for international transport, are 3.4% of global emissions.
Source: CDIAC; Peters et al 2019; Friedlingstein et al 2019; Global Carbon Budget 2019

Top emitters: Fossil CO_2 Emissions per capita

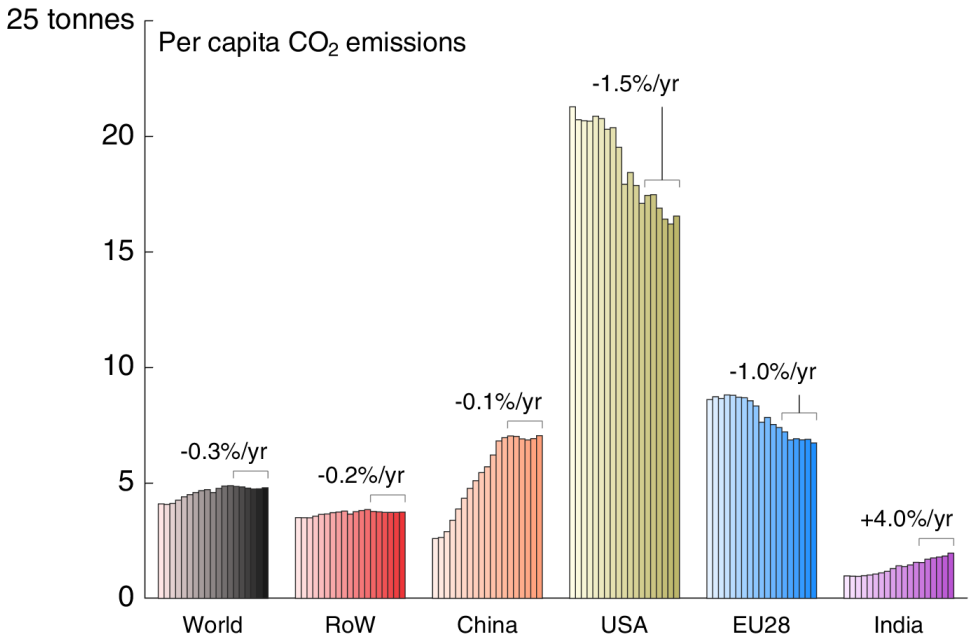
Countries have a broad range of per capita emissions reflecting their national circumstances



Source: CDIAC; Friedlingstein et al 2019; Global Carbon Budget 2019

Per capita CO_2 emissions

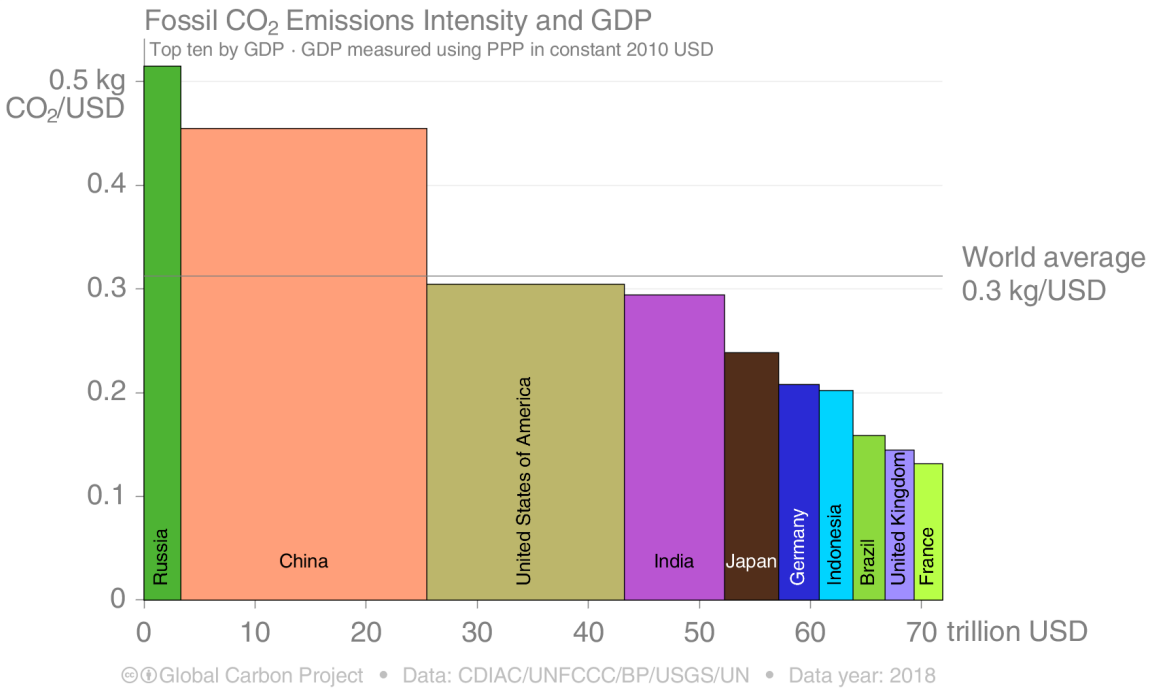
The US has high per capita emissions, but this has been declining steadily. China's per capita emissions have levelled out and is now the same as the EU. India's emissions are low per capita.



Source: Jackson et al 2019; Global Carbon Budget 2019

Fossil CO_2 emission intensity

The 10 largest economies have a wide range of emission intensity of economic activity

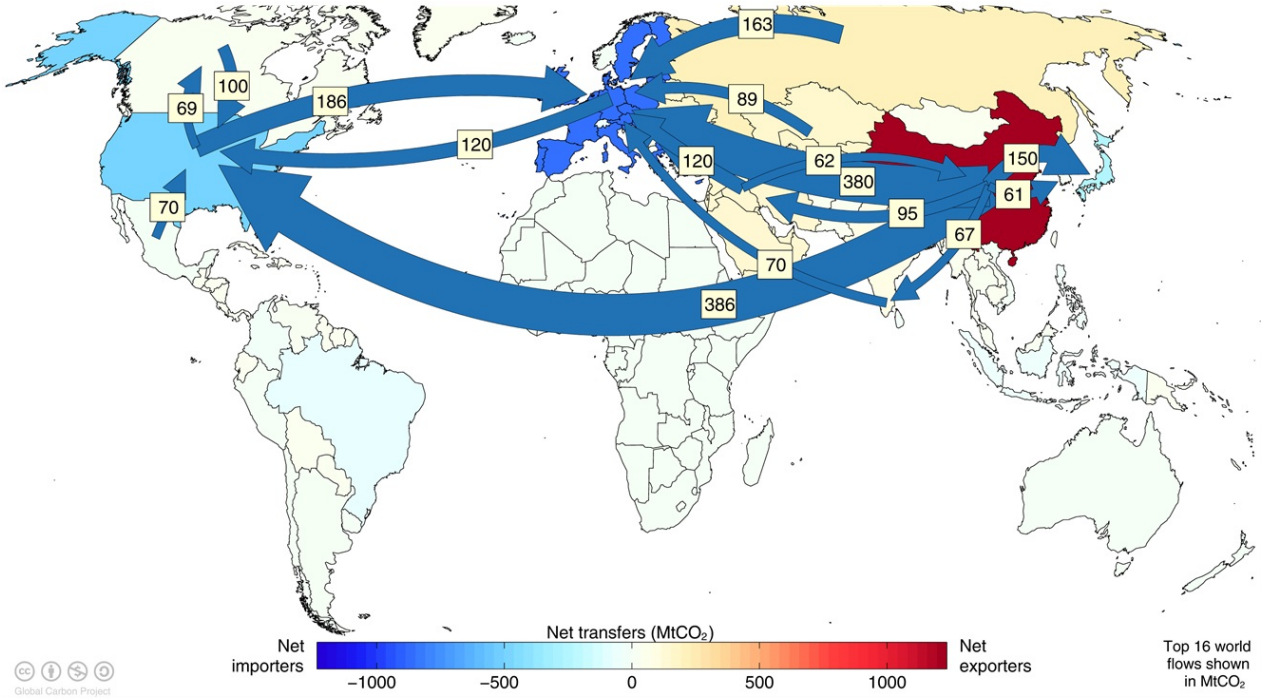


Emission intensity: Fossil CO_2 emissions divided by Gross Domestic Product (GDP)

Source: Global Carbon Budget 2019

Major flows from production to consumption

Flows from location of generation of emissions to location of consumption of goods and services



Values for 2011. EU is treated as one region. Units: $MtCO_2$

Source: Peters et al 2012

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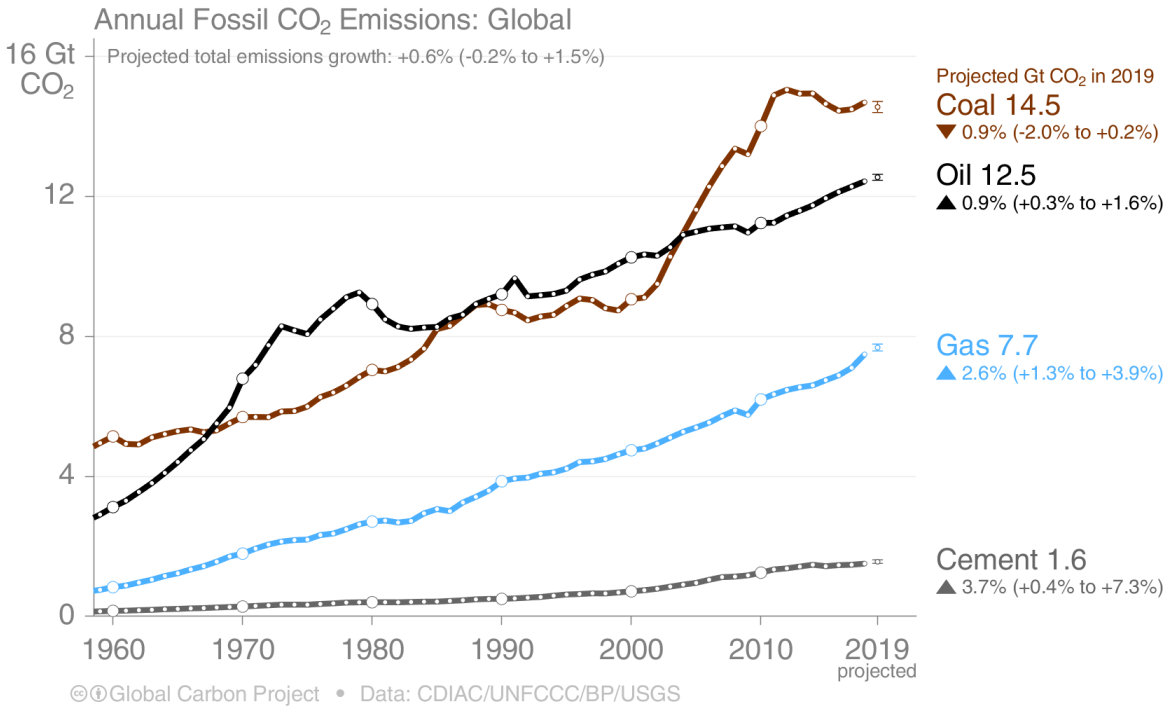
Fossil CO_2 Emissions by source

from fossil fuel use and industry

Fossil CO_2 Emissions by source

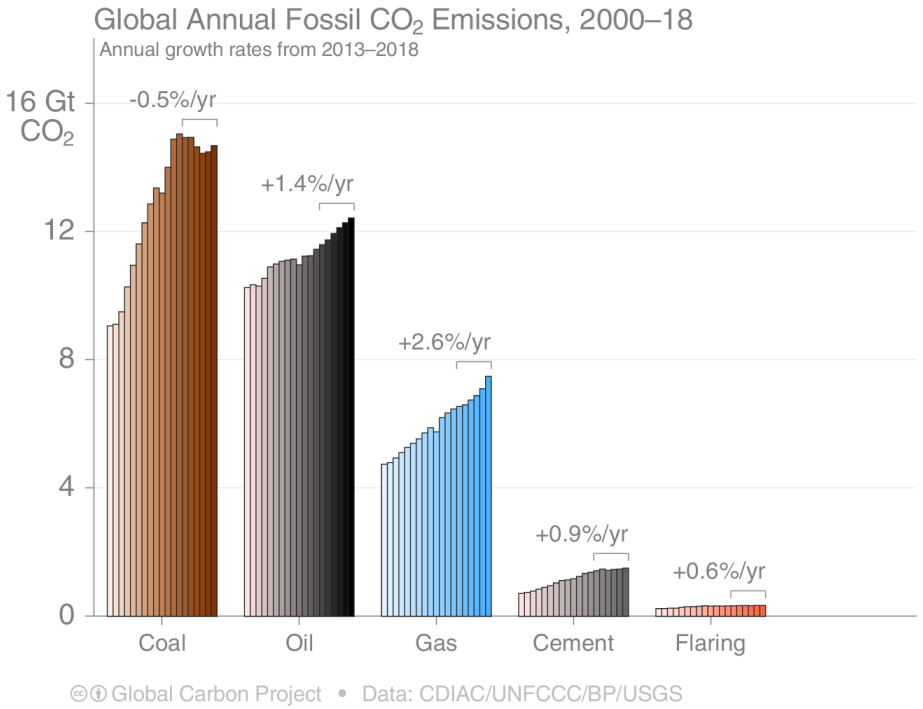
Share of global fossil CO_2 emissions in 2018:
coal (40%), oil (34%), gas (20%), cement (4%), flaring (1%, not shown)



Source: CDIAC; Peters et al 2019; Friedlingstein et al 2019; Global Carbon Budget 2019

Fossil CO_2 Emissions by source

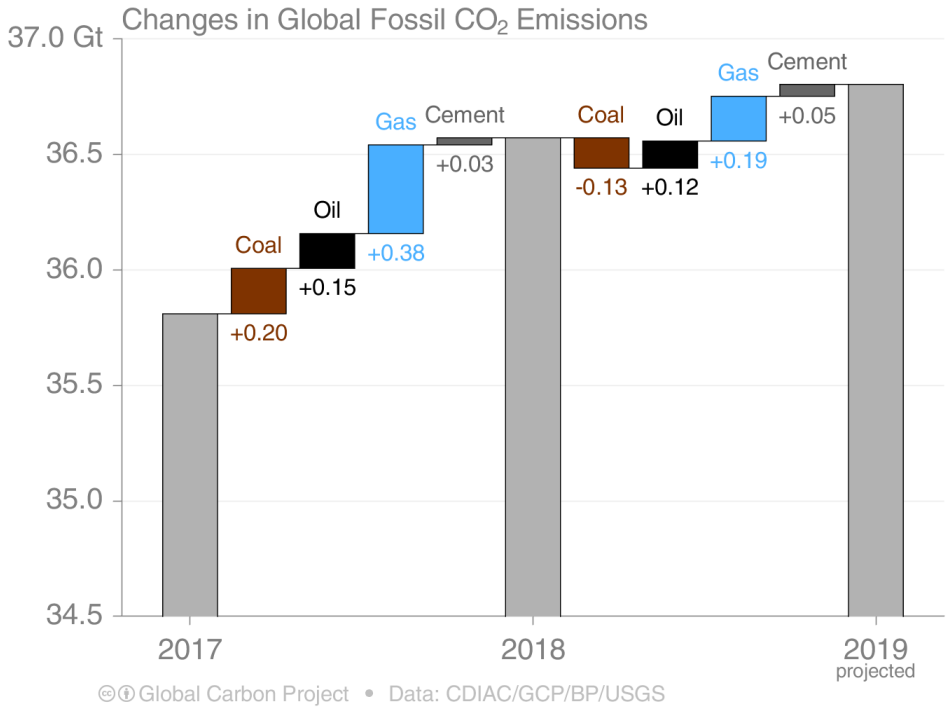
Emissions by category from 2000 to 2018, with growth rates indicated for the more recent period of 2013 to 2018



Source: CDIAC; Jackson et al 2019; Global Carbon Budget 2019

Fossil CO_2 emissions growth: 2017–2019

Natural gas is contributing the most to global emissions growth, followed by oil, while coal emissions are more variable
Since the potential peak in coal emissions in 2012, natural gas is responsible for more than half global emissions growth



Source: CDIAC; Friedlingstein et al 2019; Global Carbon Budget 2019

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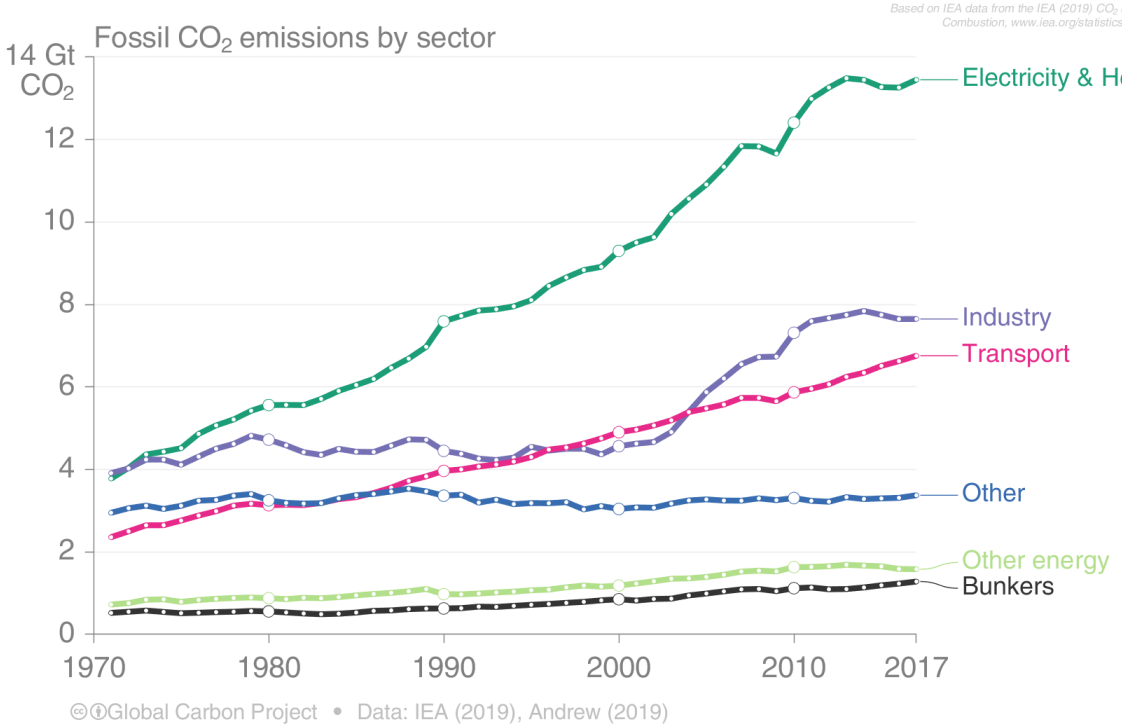
Fossil CO_2 Emissions by sectors

from fossil fuel use and industry

Fossil CO_2 Emissions by Sector

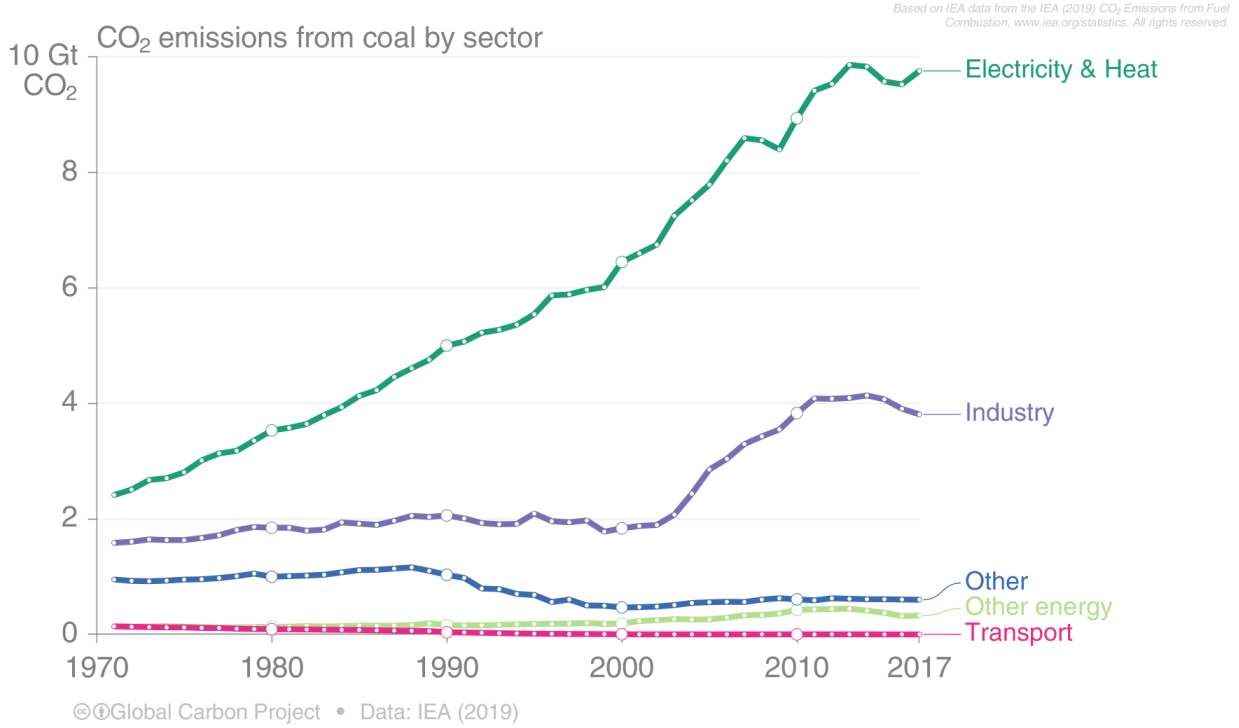
Global fossil CO_2 emissions are dominated by electricity, heat, & energy (45%), industry (23%), & national transport (19%). International aviation and marine bunkers are 3.5% & remaining sectors 10%.



Source: IEA 2019; Peters et al 2019; Global Carbon Budget 2019

Coal CO_2 Emissions by Sector

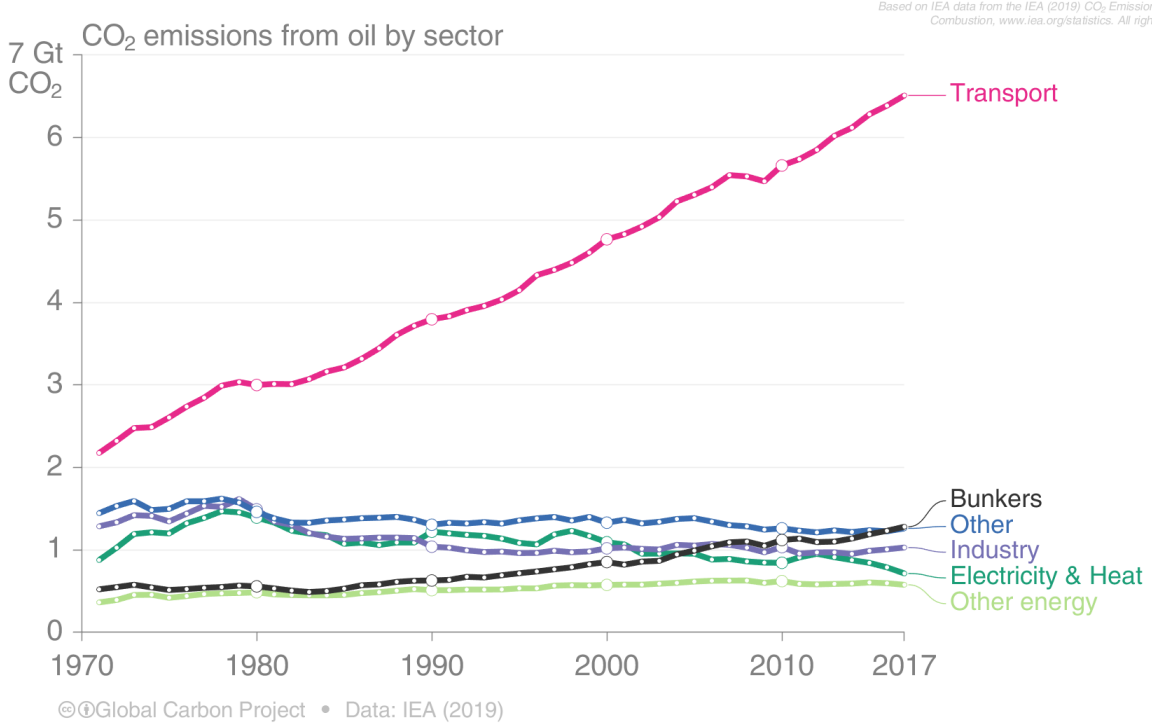
Coal CO_2 emissions are dominated by electricity, heat, and industry,
with both showing significantly lower growth & even declines in the last few years



Source: IEA 2019; Peters et al 2019; Global Carbon Budget 2019

Oil CO_2 Emissions by Sector

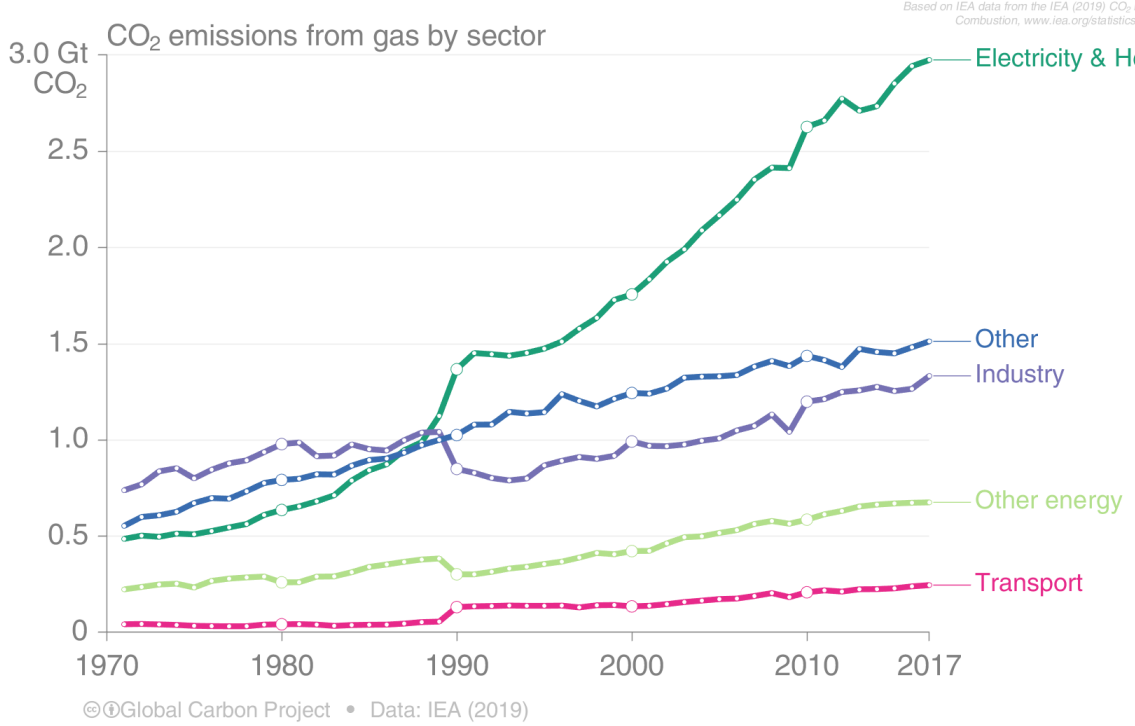
Oil CO_2 emissions are dominated by national transport with almost linear growth over five decades
Road transport is half the total growing at 1.9% while national & international aviation is 8% growing at 3% per year



Source: IEA 2019; Peters et al 2019; Global Carbon Budget 2019

Gas CO_2 Emissions by Sector

Gas CO_2 emissions are dominated by electricity & heat, industry, and other commercial & residential sectors
Gas CO_2 emissions are growing rapidly in most countries and sectors, dominating growth in CO_2 emissions in recent years.



Source: IEA 2019; Peters et al 2019; Global Carbon Budget 2019