



[WWW.CHEMSHEETS.CO.UK](http://www.chemsheets.co.uk)

BURNING FOSSIL FUELS

Substance formed	How it is formed	Potential problems	Ways to reduce the problem
Carbon dioxide CO₂	Complete combustion (reaction with oxygen) of C in fuel	Greenhouse gas causing global warming	Burn less fossil fuels
Carbon monoxide CO	Incomplete combustion (reaction with oxygen) of C in fuel	Toxic	Ensure there is a good supply of air/oxygen when burned
Carbon (soot) C	Incomplete combustion (reaction with oxygen) of C in fuel	Blackens buildings Global dimming	Ensure there is a good supply of air/oxygen when burned
Sulfur dioxide SO₂	Combustion of S (reaction with oxygen) in fuel	Acid rain	Remove S from fuel before burning; or remove SO ₂ from fumes after burning (flue gas desulfurization)
Nitrogen oxides NO & NO₂	Reaction of N ₂ in air with O ₂ in air at very high temperatures (often in engines or furnaces)	Acid rain	For engines use a catalytic converter
Unburned fuel	Not all fuel burns	Wastes fuel, harmful & a greenhouse gas	Ensure correct fuel:air mixture when fuel is burned

ACID RAIN

Damages plants





**Branches from a tree in Germany's Black Forest show
needle loss and yellowed boughs caused by acid rain**

Kills fish





1908



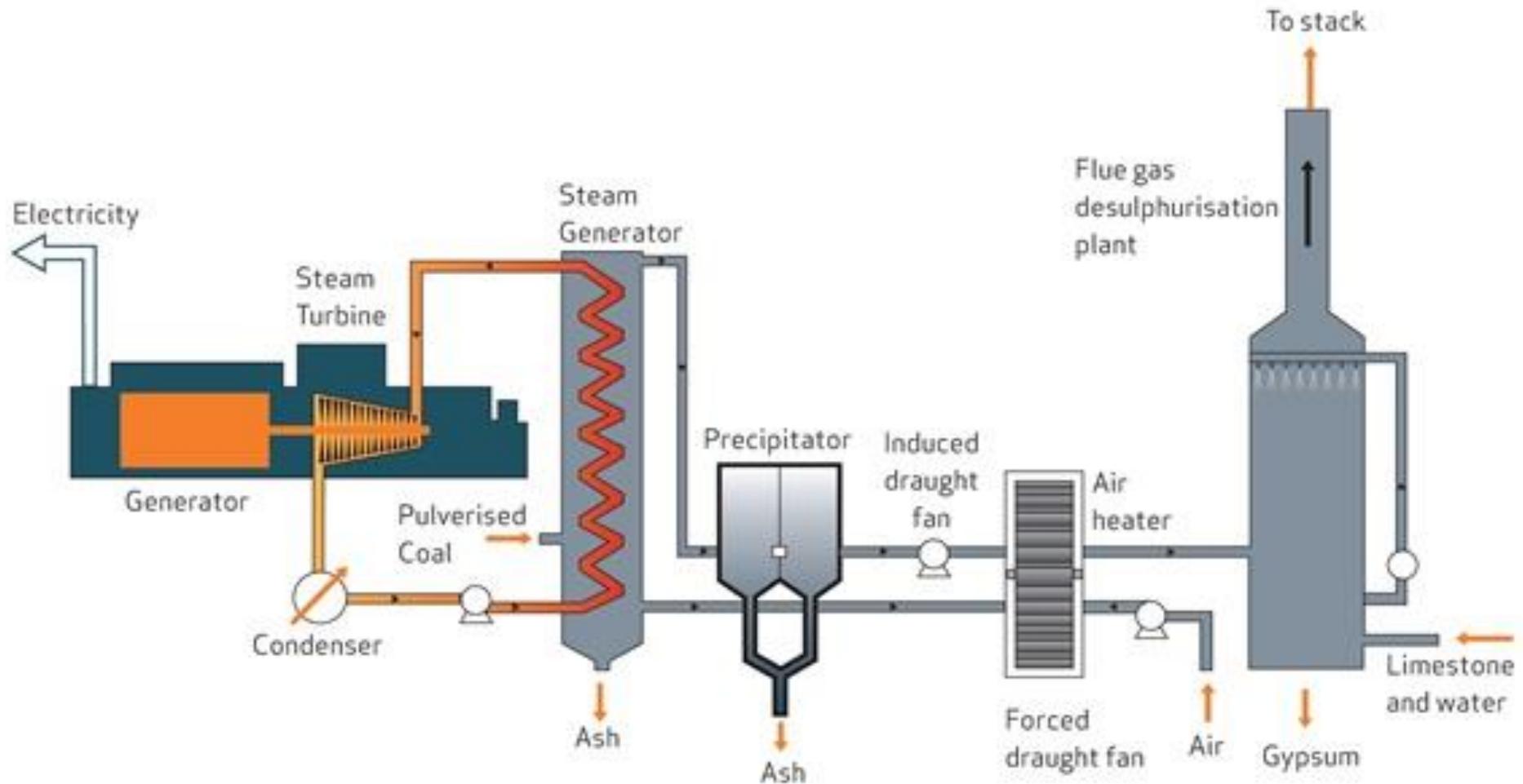
1968

Damages some stones (e.g. limestone)

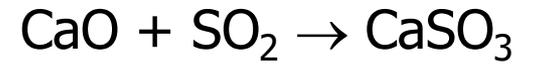
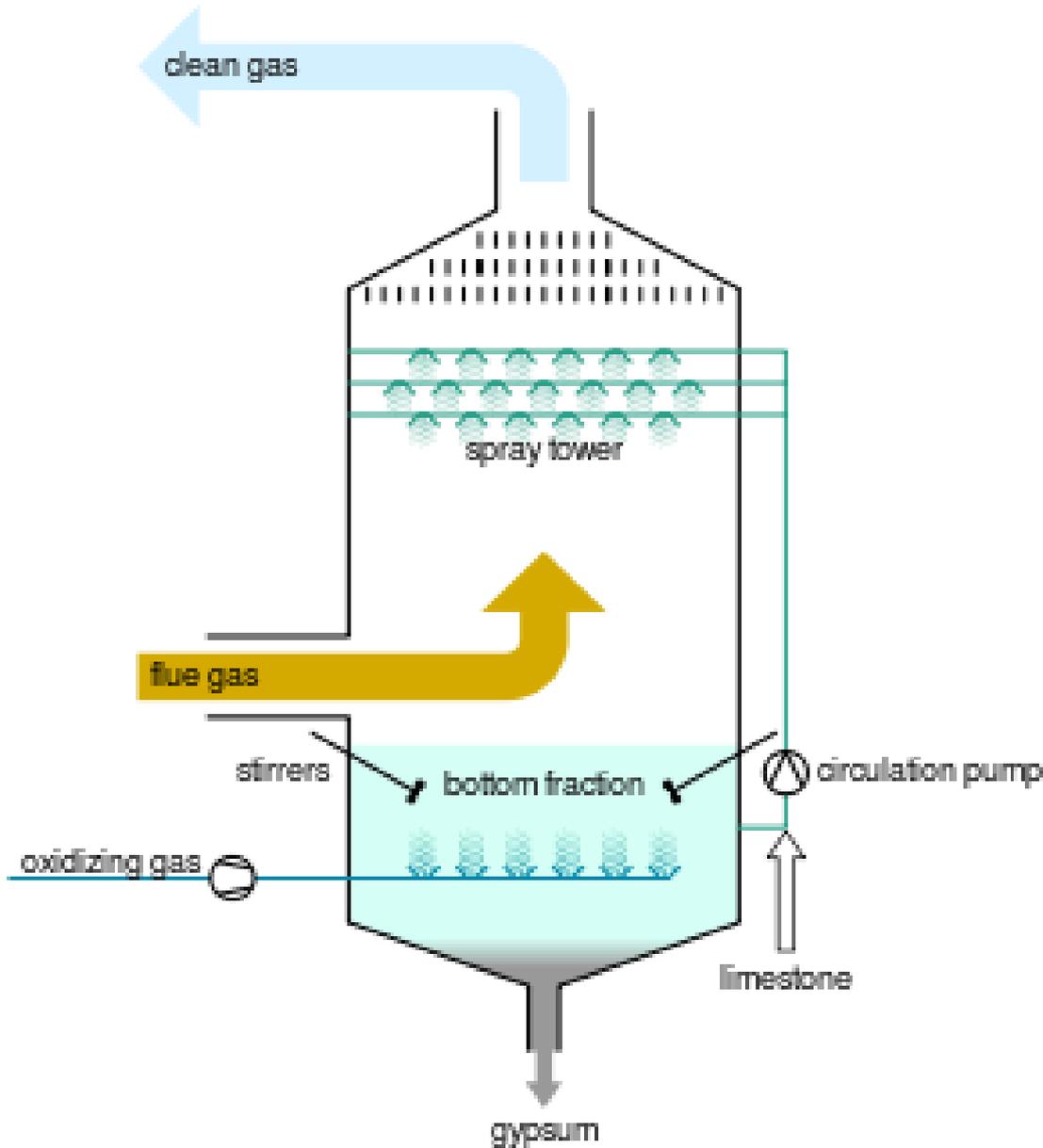
Much SO₂ from power stations



Flue Gas Desulphurisation System



Remove SO₂ by flue gas desulphurisation

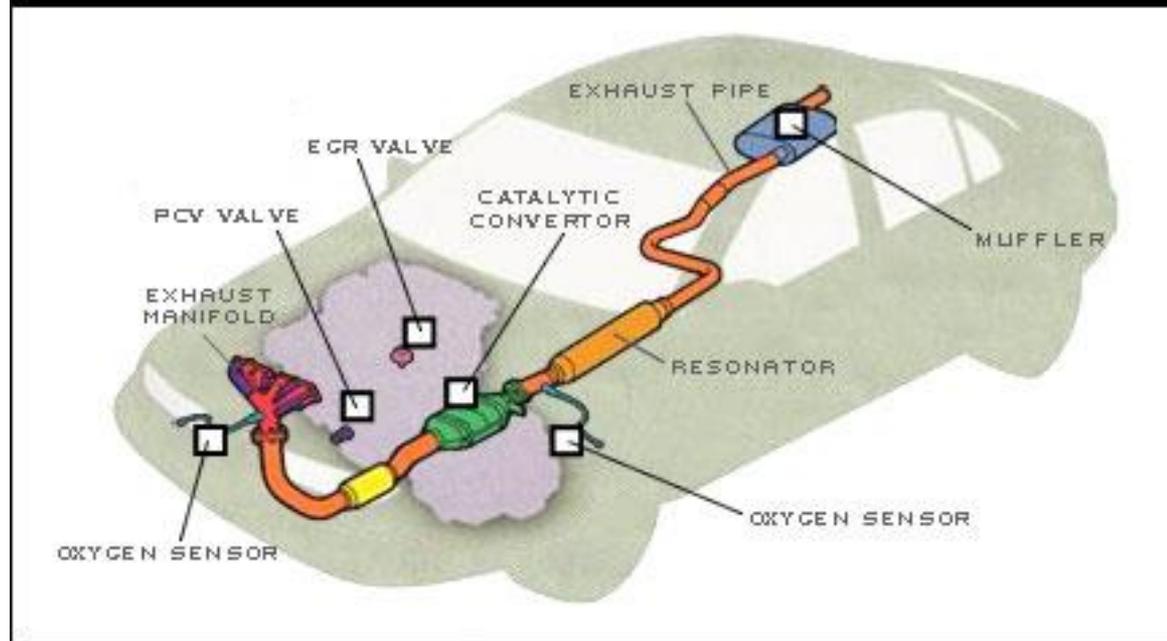


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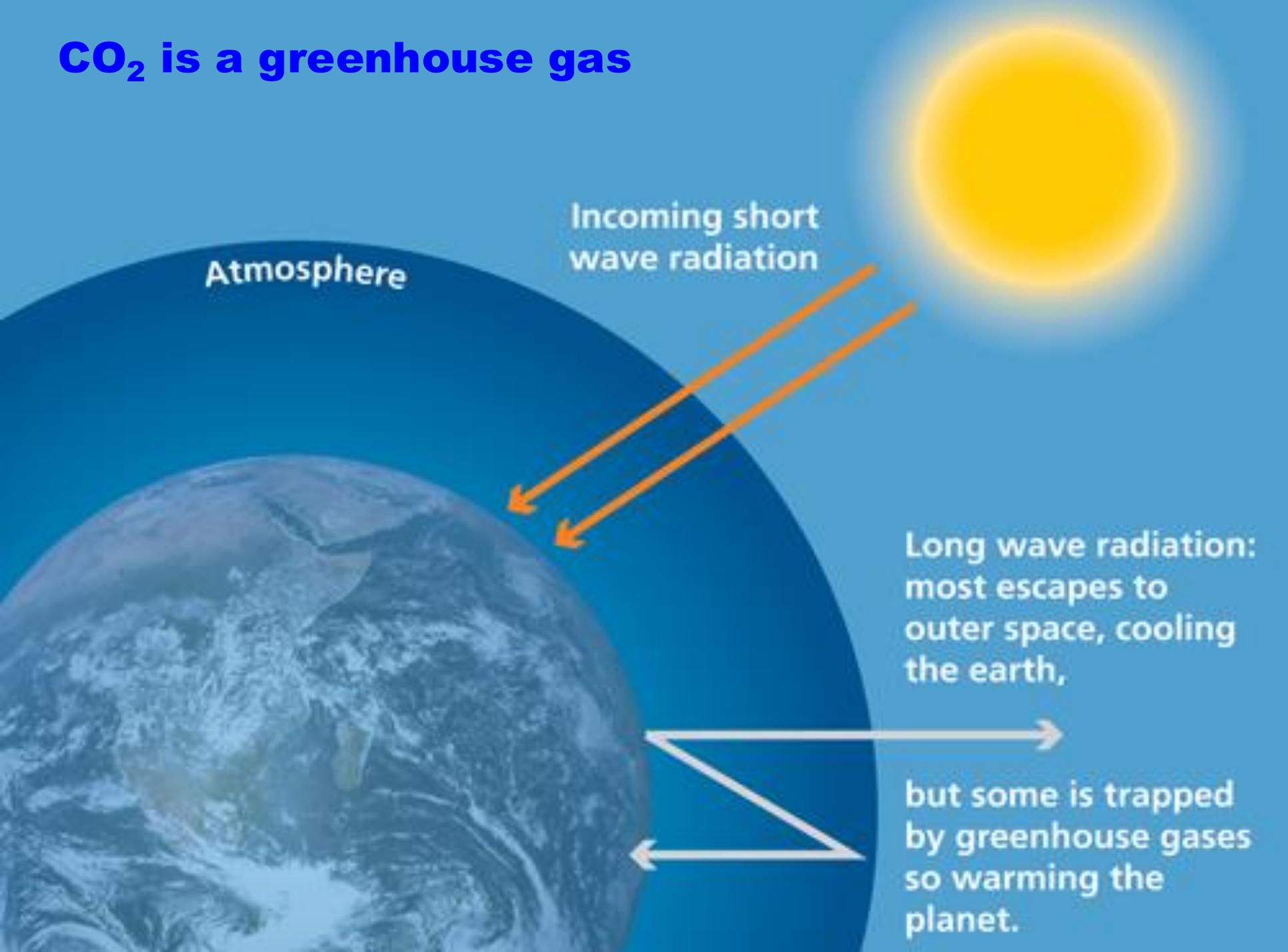
Remove SO₂ by flue gas desulphurisation

EXHAUST & EMISSIONS SYSTEM



**Catalytic converters
in cars remove NO_x**

CO₂ is a greenhouse gas



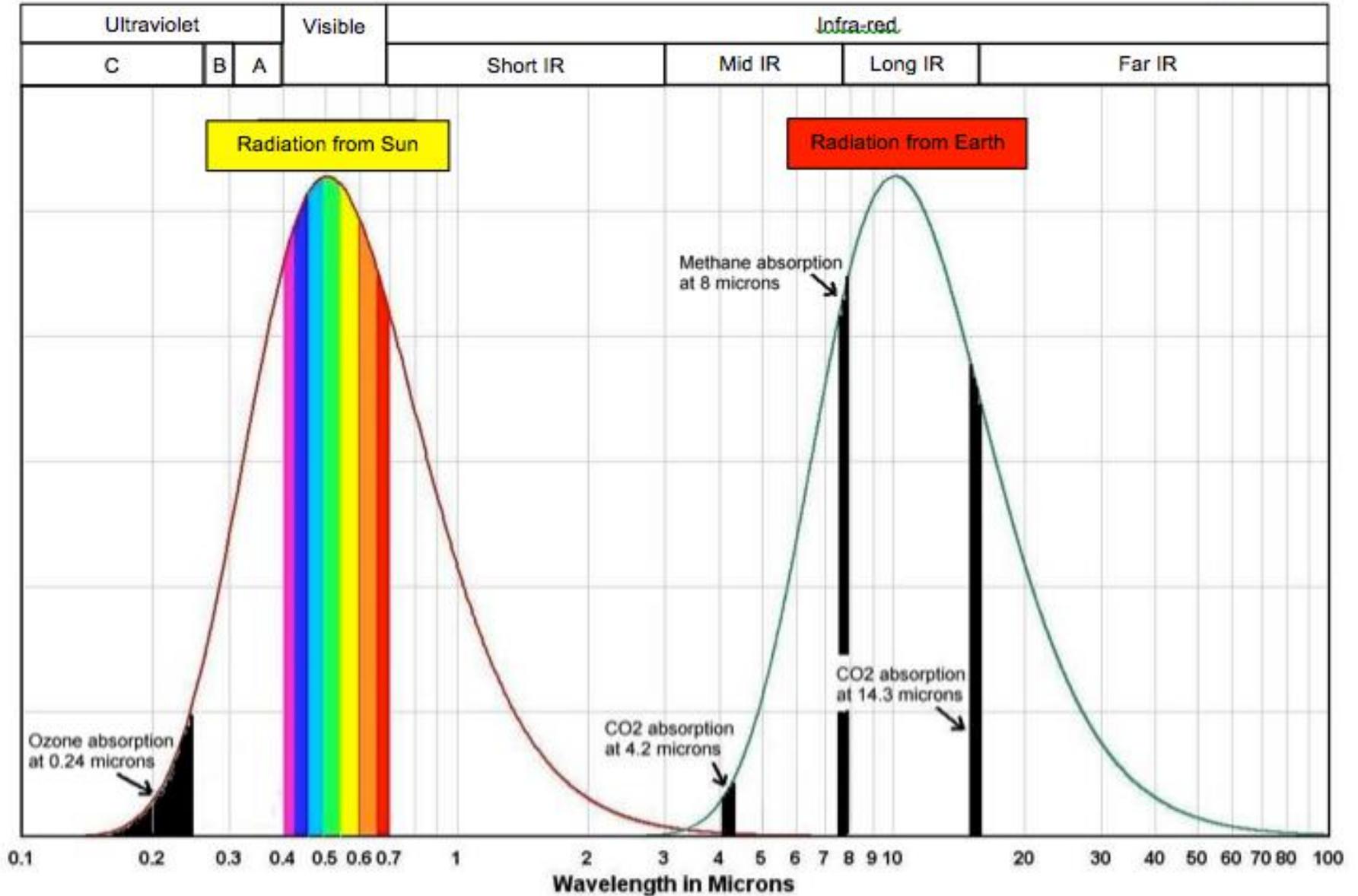
Atmosphere

Incoming short
wave radiation

Long wave radiation:
most escapes to
outer space, cooling
the earth,

but some is trapped
by greenhouse gases
so warming the
planet.

Increasing wavelength

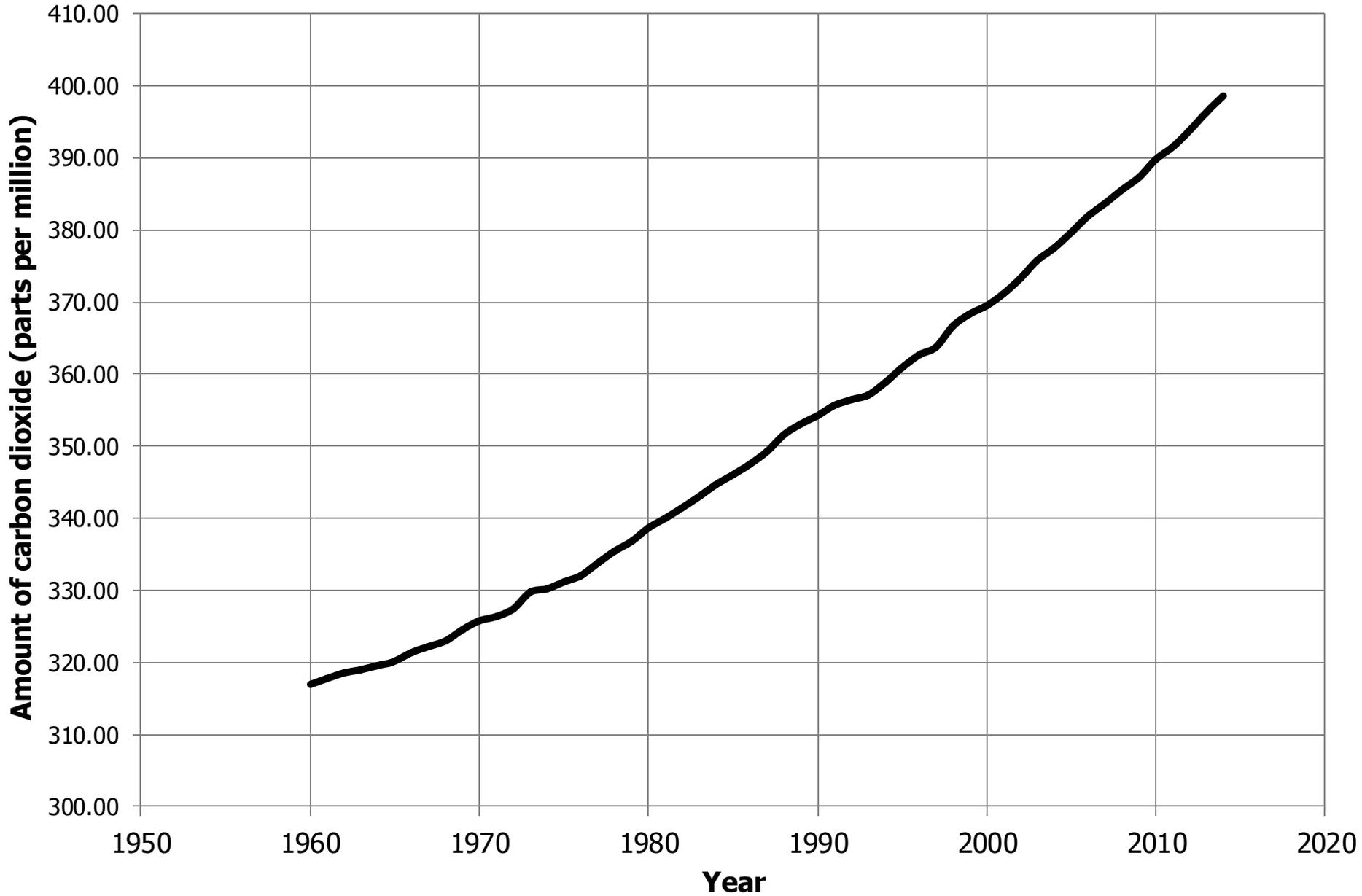


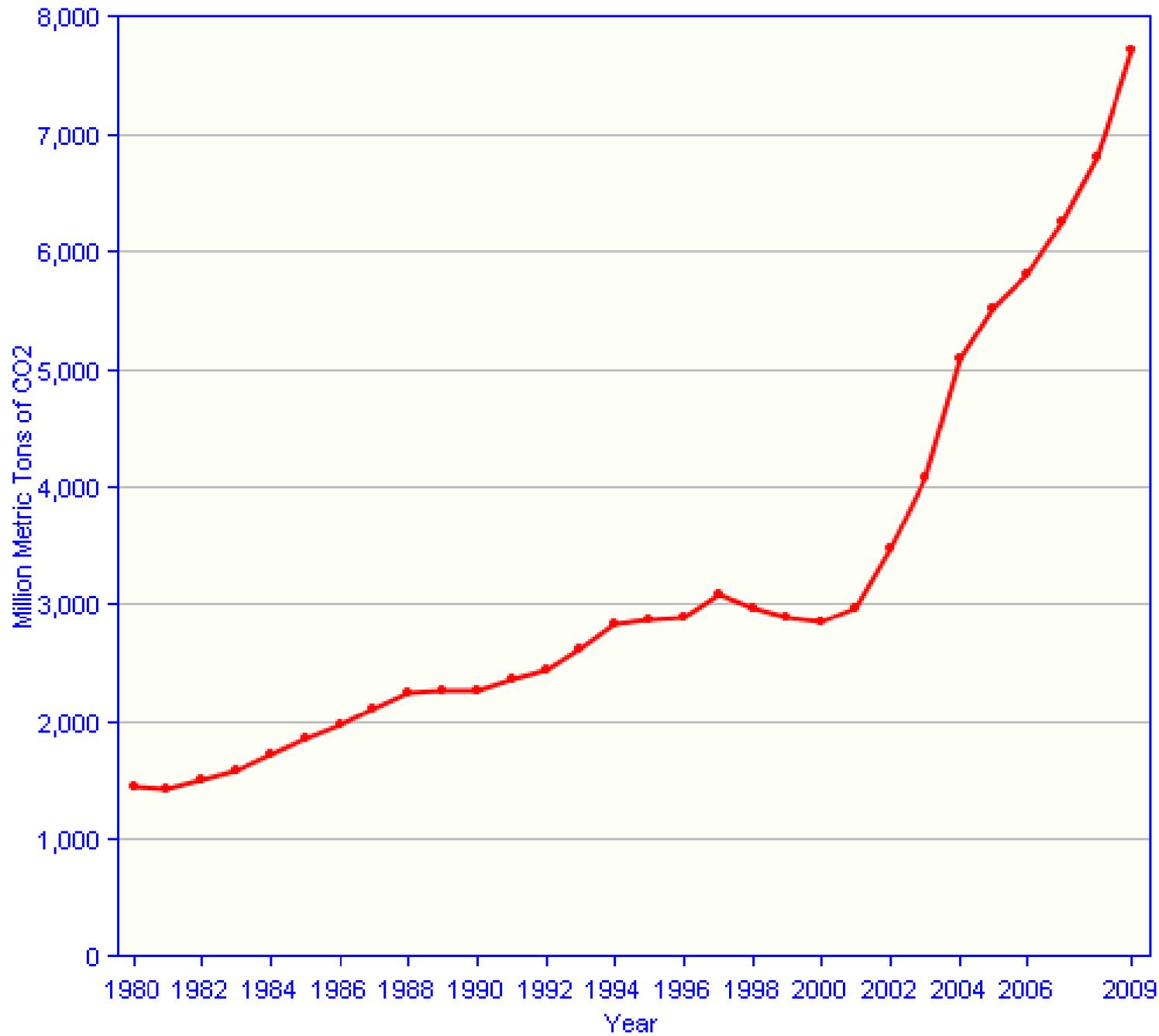
Adapted from www.planetforlife.com & Hodder AQA GCSE Chemistry (2016) (Grime & Henry)

Greenhouse gases

- molecules with polar bonds absorb IR radiation to make bonds vibrate
 - H_2O , CO_2 and CH_4 (C-H is slightly polar)
- greenhouse gases do not absorb the sun's higher frequency UV/visible radiation
 - O_2 and N_2 do NOT have polar bonds so are NOT greenhouse gases

CO₂ in the air (data from Mauna Lao)





CO₂ emissions

From Wikipedia

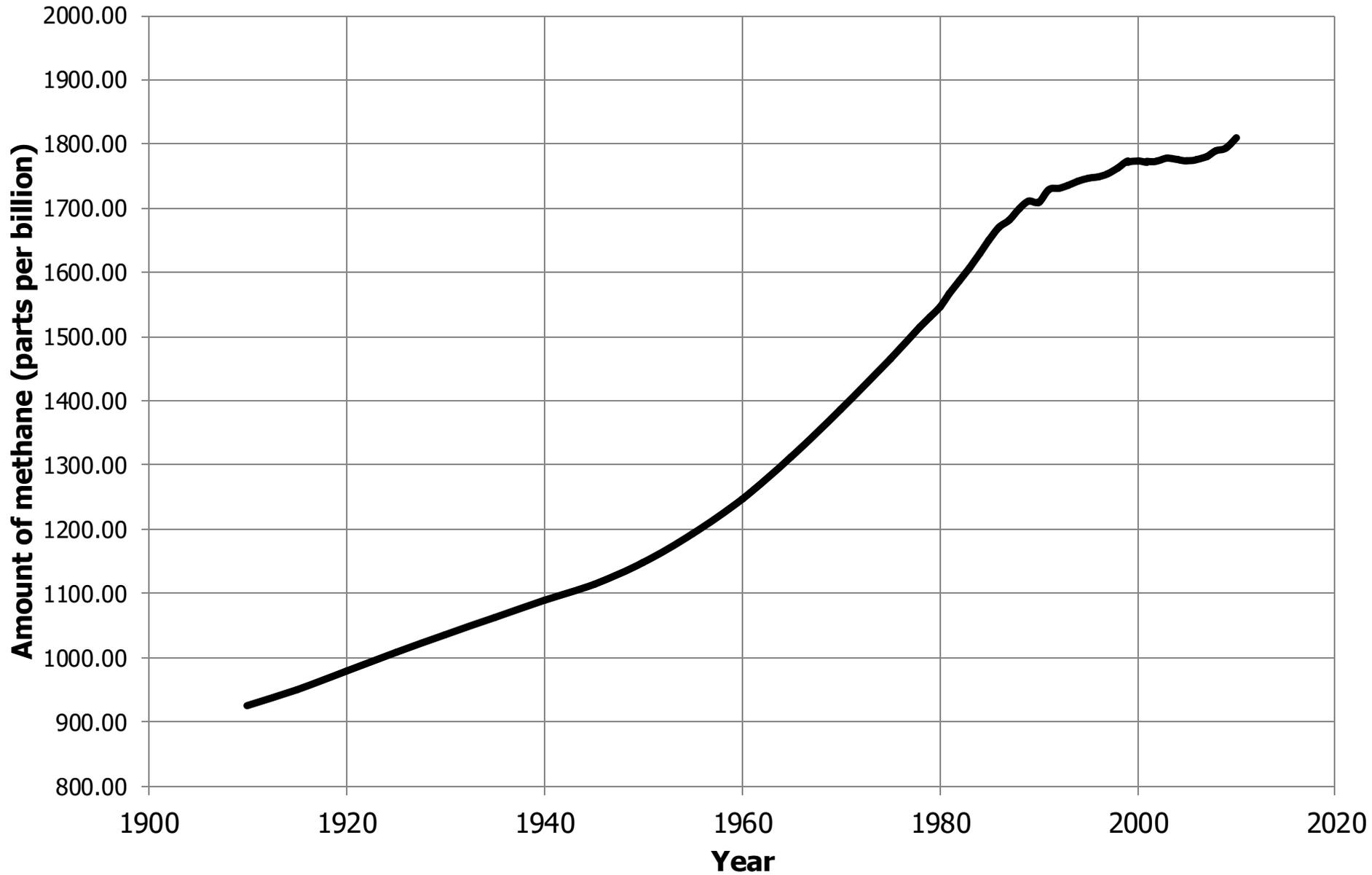


Carbon dioxide CO₂ emissions



Images from Wikipedia

Methane in the air



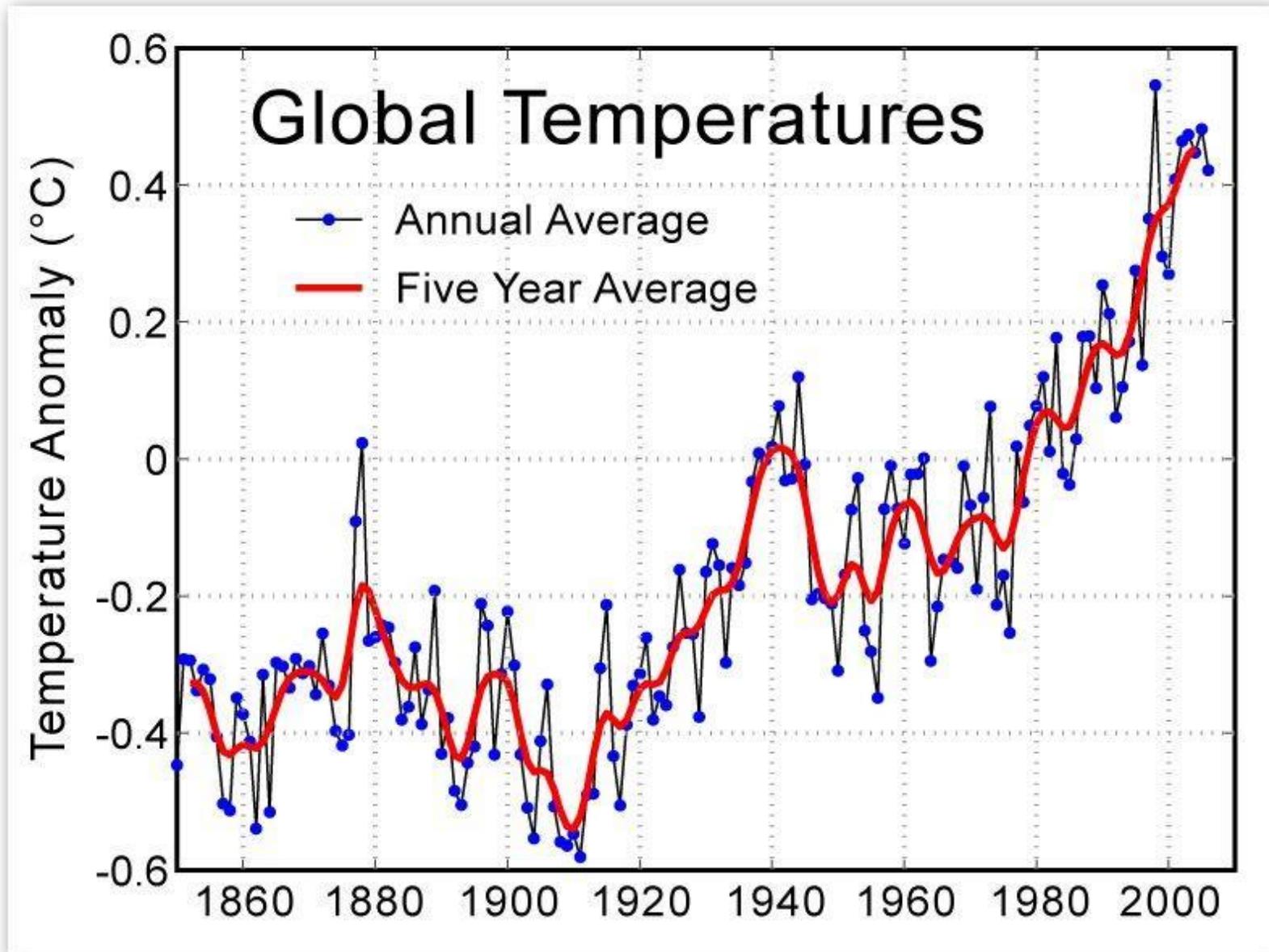


Methane CH_4 emissions



Images from Wikipedia & modernfarmer.com,

The Earth is getting warmer

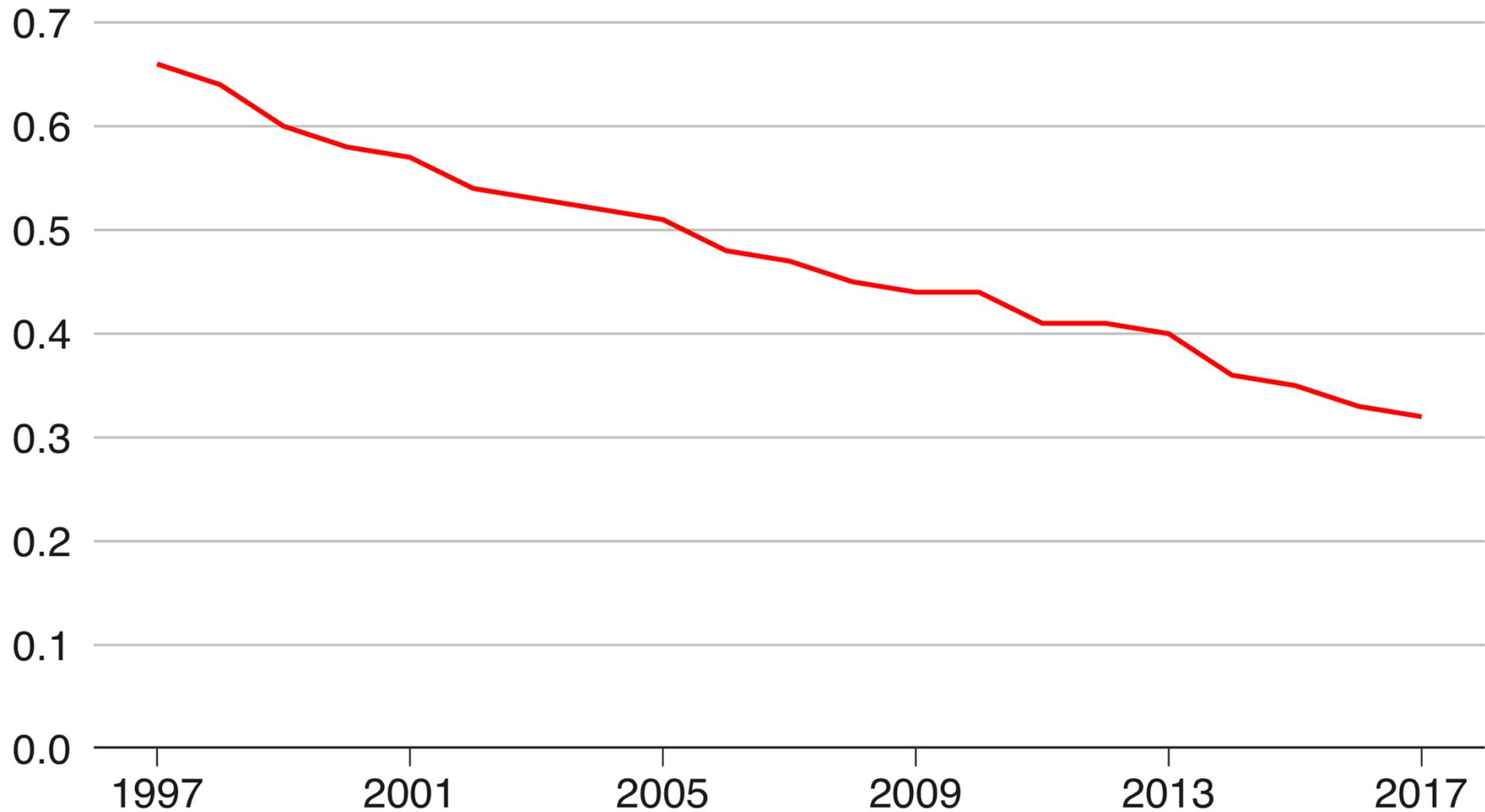


Sea levels are rising



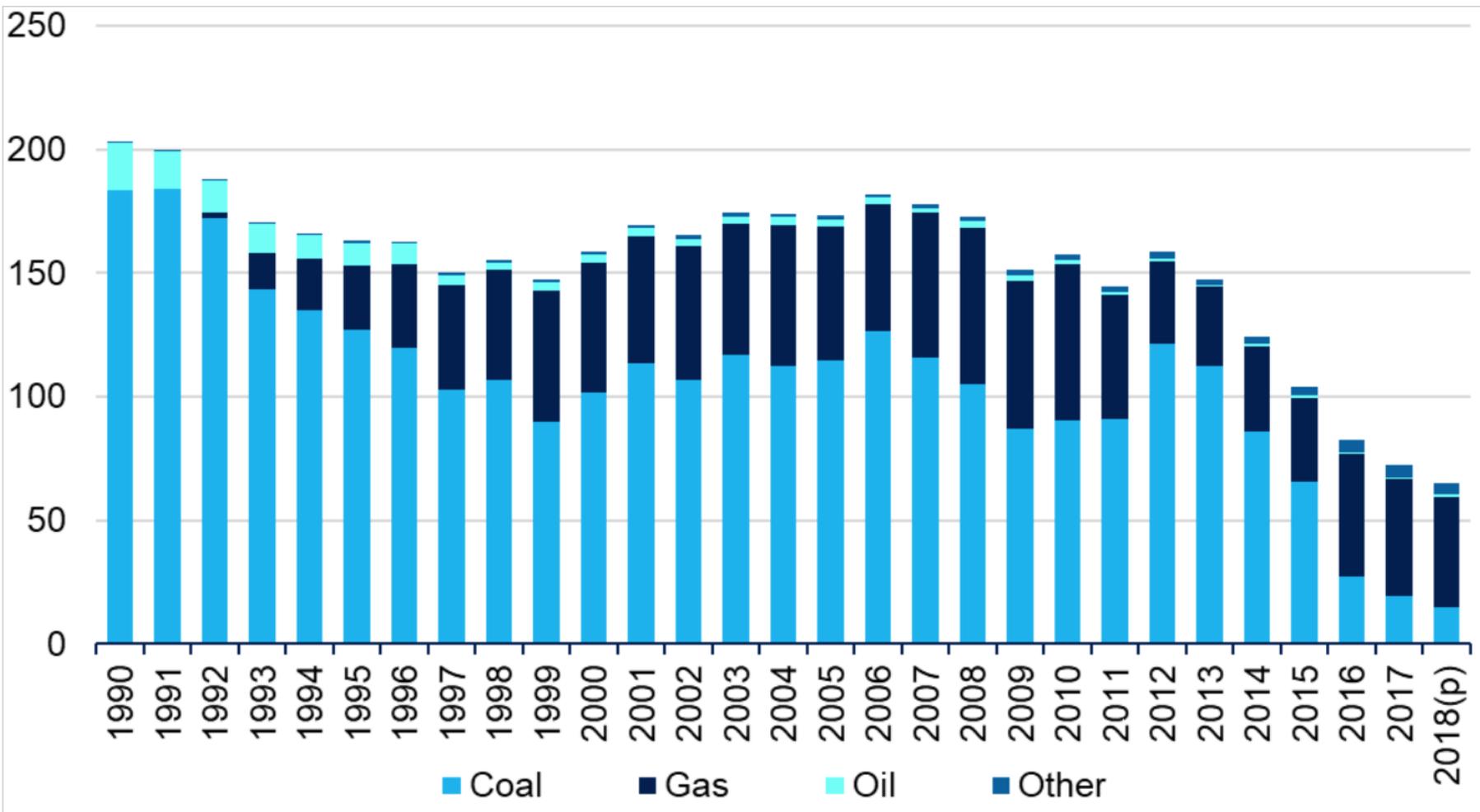
From thesilenteath.com

UK greenhouse gas emissions have dropped



Source: Department for Business. 2017 figures provisional.

Figure 4: Carbon dioxide emissions from electricity generation, UK, 1990-2018 (MtCO₂)



Source: Tables 1 & 2, Provisional UK greenhouse gas emissions national statistics 1990-2018 Excel data tables

Note: (p) 2018 estimates are provisional.