

Climate change by the numbers -

Numbers to help you understand climate change

Yinon Bar-On, Sarah Sclarsic, Daniel Segre,, Rob Phillips, Ron Milo

Common units:

1 Pg=1 Gt=10¹² kg

Conversion of mass of C to CO₂: ≈ x4

1 part per million (ppm) CO₂ in atmosphere ≈ 2 Gt carbon (GtC) ≈ 8 Gt CO₂ ≈ 16 Gt CO₂ emissions (see airborne fraction)

Temperature rise so far: Global: 1 °C; Over land: 2 °C; Arctic: 4 °C; Global rate: 0.2 °C/decade; RCP8.5 scenario currently unfolding: 4 °C

Sea level rise so far: 20 cm;

Sea level rise rate: 3 cm/decade

People in places to be flooded by 2050: 100 million.

Expected rise by end of century 1 m (without tipping point); rise if all of Greenland and Antarctica melt: 60 m

CO₂ emission 10 GtC with sources:

electricity generation, transportation, Land use change, food+agriculture

CO₂ emissions remaining in atmosphere (airborne fraction), ocean, land: 50%, 25%, 25%.

Global natural CO₂ cycling via net primary productivity: 100 GtC, half terrestrial and half oceanic
Accumulated human induced emissions: 1500 GtCO₂
Carbon in the earth system: Most is in rock-forming (solid) minerals. DIC in ocean about 40,000 GtC; ≈800 GtC in atmosphere; ≈600 GtC in biomass; ≈2000 GtC in soil

Brief mass history of humanity on earth: we evolved in a world with 2tT biomass, we burned 1tT, we excavated 1tT of fossil fuels and used them to produce 1tT of human made objects.

Ocean acidification: ≈0.1 pH unit

Residence times in atmosphere:

CH₄ 10 years; Ozone 1 year; N₂O 100 years; CO₂ 1000+ years (with 10-15% lingering >100k years)

Greenhouse gases, forcing potential:

CO_{2,e20} (CO₂ by definition =1): CH₄ 70

CO_{2,e100} (CO₂ by definition =1): CH₄ 20

Eq. forcing due to 2x[CO₂] ≈2 W/m²

Eq. temp. due to 2x[CO₂] ≈2-4 °C

Forced heat flux stored by oceans:

current ≈50%; accumulated so far ≈90%

Methane emissions: 550Mt CH₄/year (60% human; 40% natural); 10Mt CH₄/year remaining in atmosphere.

Human sources: Enteric fermentation 30%; Gas & oil 20%; Rice + Ag. 20%; Wastewater 10%; Landfills 10%; Coal:6%

Greenhouse gases accumulation:

Pre-industrial CO₂ level: 270 ppm; Current CO₂ levels: 410 ppm; CO₂ levels rise rate: +2 ppm/year

Current methane levels: 2 ppm; rate of increase: 0.1 ppm/decade.

Total current forcing: 2.6 W/m²

Composed of: 1.8 W/m² due to CO₂ followed by methane, halocarbons, ozone, N₂O, black carbon etc.

Future (2100) forcing: RCP 8.5 W/m² scenario currently unfolding;

Average solar flux: 300 W/m²

Carbon tax:

\$10-100/ton; Value of total emissions based on tax: \$300-3000 B/year

Permafrost inventory: 1000-2000 GtC

Characteristic albedo: ocean 0.05-0.1; forest 0.1; crops 0.2; desert 0.3; ice 0.4; snow 0.4-0.9; clouds 0.4-0.7;