History fossil fuels

- during industrial revolution society more & more dependent on fossil fuels
- acceleration of CO2 in atmosphere
- widespread agreement rapidly reduce rate of emissions
- find balance anthropogenic emission & sinks
- reduction 50% needed by 2050 to avoid warming by 1.5^{o}C
- ‘energy transition’ towards low-carbon energy
- change behavior & adapt new technologies
- extremely complex problem

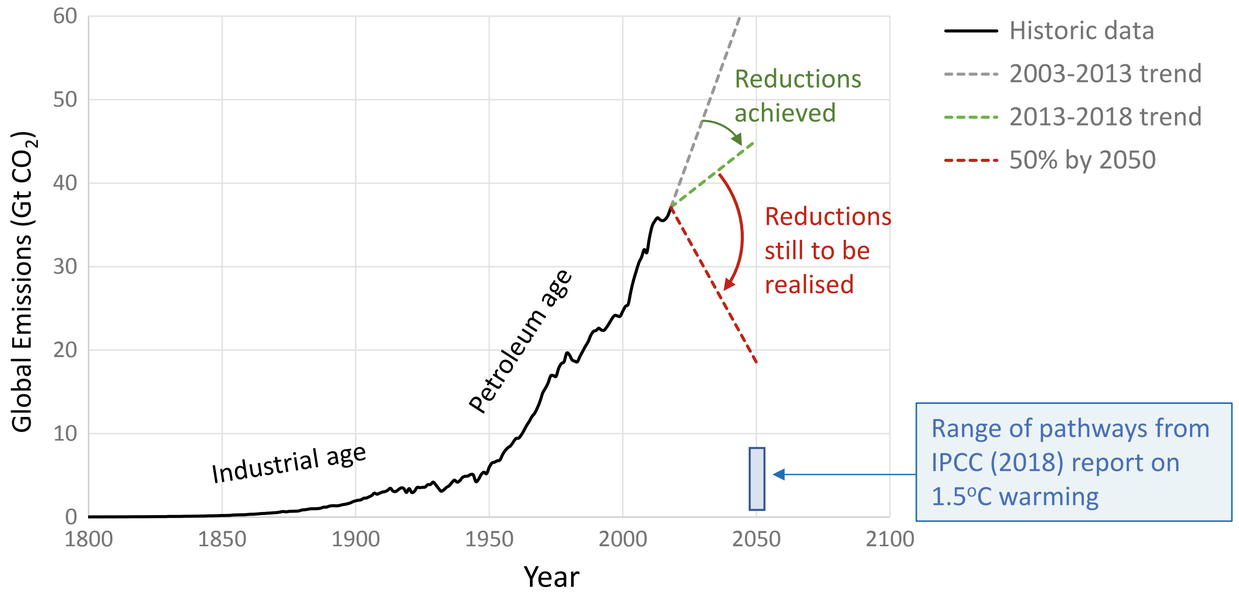

Fig. 1.1 Historical record of global CO_2 emissions compared with various projections (data sources: carbon emissions data up to 2013 from https://cdiac.ess-dive.lbl.gov/ with 2014–2018 years estimates from www.wri.org). Figure modified from Stephenson et al. (2019)

from Philip Ringrose

History greenhouse gas

- importance CO2 as greenhouse gas recognized in ’50’s
- significant change in CO2 concentration due to anthropogenic emission
- increase of 50% in CO2
- need to achieve low-carbon energy transition

1. understanding atmosphere can not be taken for granted
2. realize consequences of cheap fossil fuels
3. need to avoid effects man-made climate change

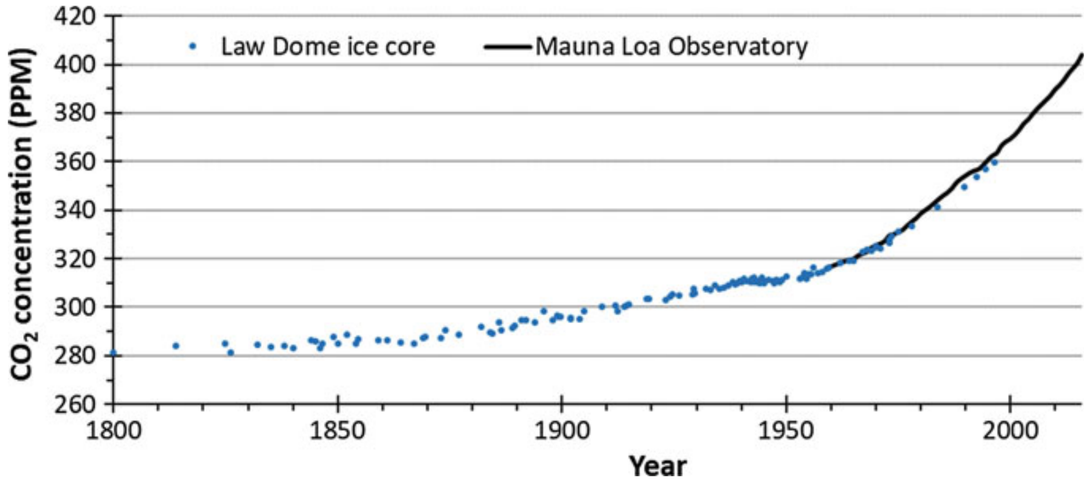

Fig. 1.2 Mean annual CO_2 concentration in the atmosphere from two sources: The Law Dome ice-core dataset (Etheridge et al. 1996; MacFarling Meure et al. 2006); Mauna Loa Observatory measurements from the Earth System Research Laboratory. *Source* www.esrl.noaa.gov/gmd/ccgg/trends/data.html