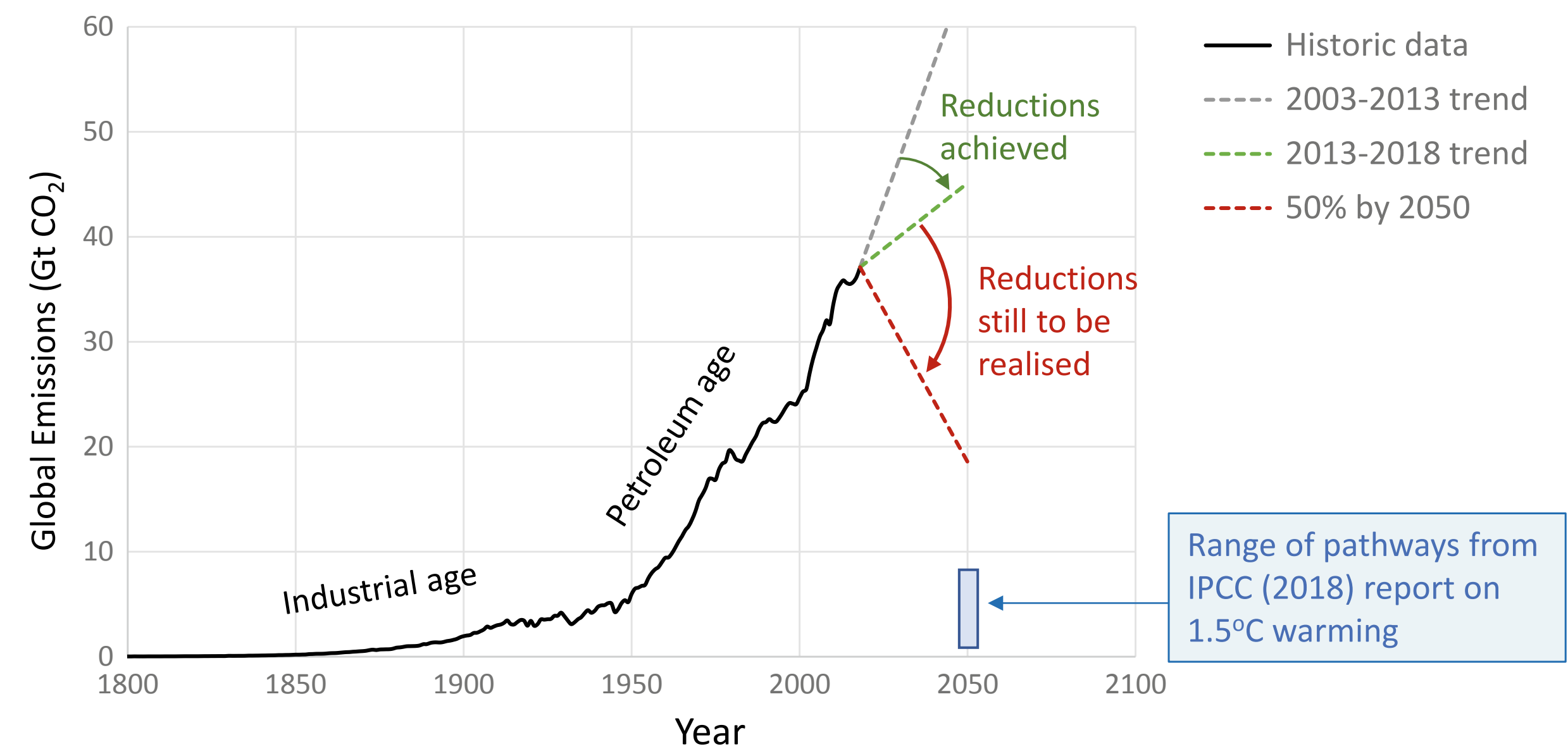


# History fossil fuels

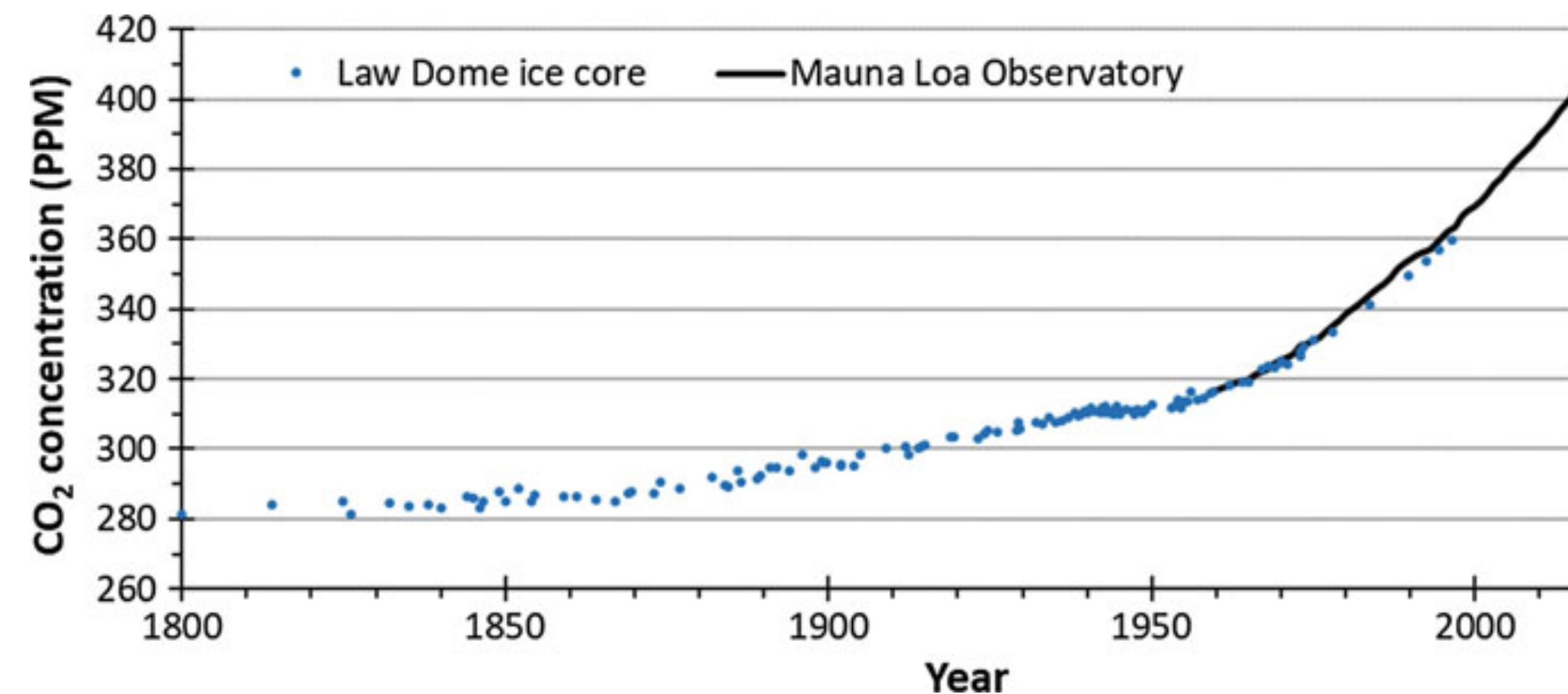
- ▶ during industrial revolution society more & more dependent on fossil fuels
- ▶ acceleration of CO<sub>2</sub> in atmosphere
- ▶ widespread agreement rapidly reduce rate of emissions
- ▶ find balance anthropogenic emission & sinks
- ▶ reduction 50% needed by 2050 to avoid warming by 1.5°C
- ▶ ‘energy transition’ towards low-carbon energy
- ▶ change behavior & adapt new technologies
- ▶ extremely complex problem



**Fig. 1.1** Historical record of global CO<sub>2</sub> 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](http://www.wri.org)). Figure modified from Stephenson et al. (2019)

# History greenhouse gas

- ▶ importance CO<sub>2</sub> as greenhouse gas recognized in '50's
- ▶ significant change in CO<sub>2</sub> concentration due to anthropogenic emission
- ▶ increase of 50% in CO<sub>2</sub>
- ▶ 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<sub>2</sub> 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](http://www.esrl.noaa.gov/gmd/ccgg/trends/data.html)