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

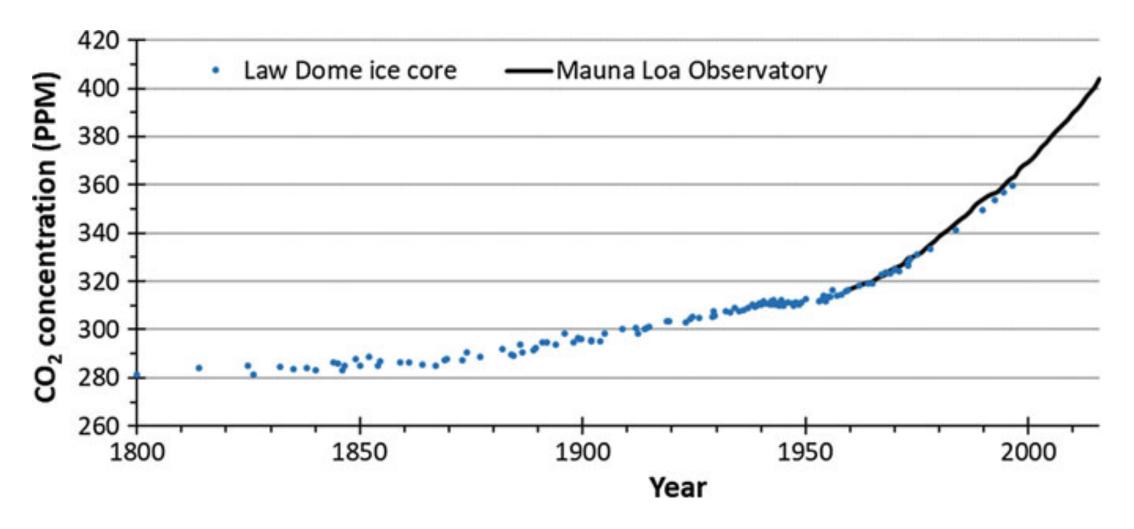
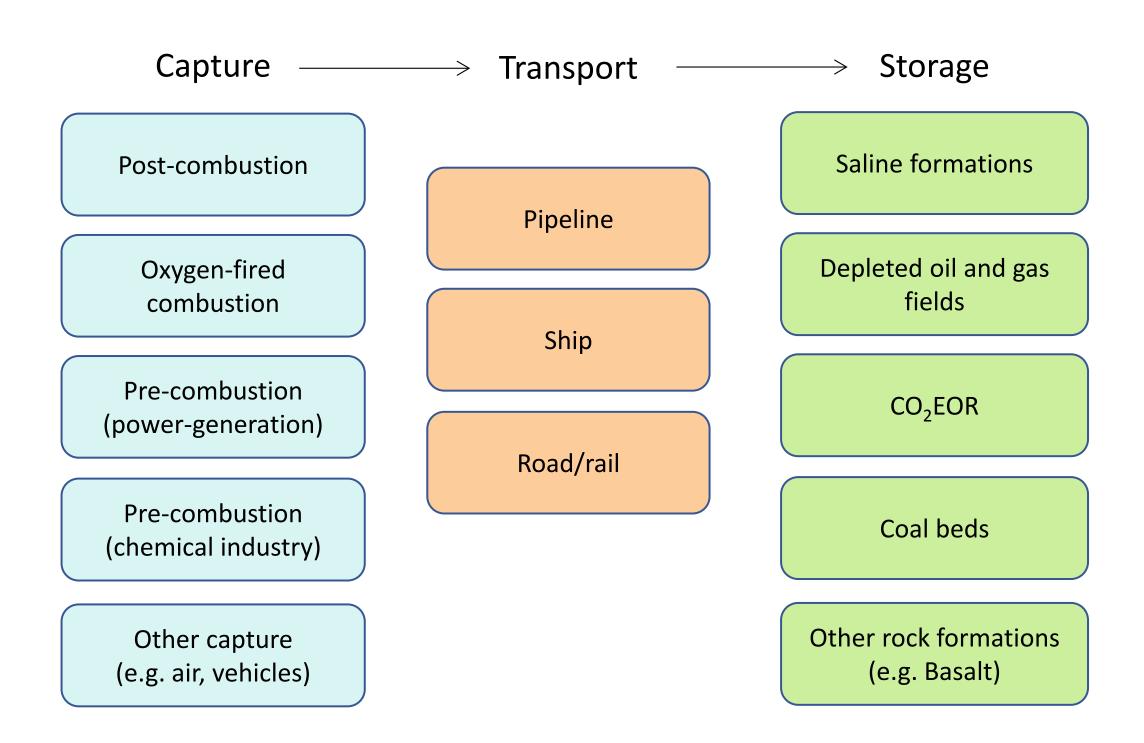


Fig. 1.2 Mean annual CO₂ concentration in the atmosphere from two sources: The Law Dome ice-core dataset (Etheridge et al. 1996; MacFarling Meure et al. 2006); Mauna Loa Observatory measurements from the Earth System Research Laboratory. *Source* www.esrl.noaa.gov/gmd/ccgg/trends/data.html



Why CCS?

- can't stop using fossil fuels over night
- renewable energy needed for long-term near netzero
- ▶ 80% current energy is from fossil
- renewable energy is intermittent
- need pragmatic approach
 - 1. improved efficiency
 - 2. new renewables
 - 3. switch from coal to natural gas
 - 4. add nuclear to the mix
 - 5. deploy CCS



Arguments why CCS is vital

- reduce CO2 power generation & industry
- faster energy transition
- need 10X increase by 2030 compared to current plans to meet Paris agreement

Needs to isolate CO2 from atmosphere for few thousand years

Permanent storage difficult to ensure