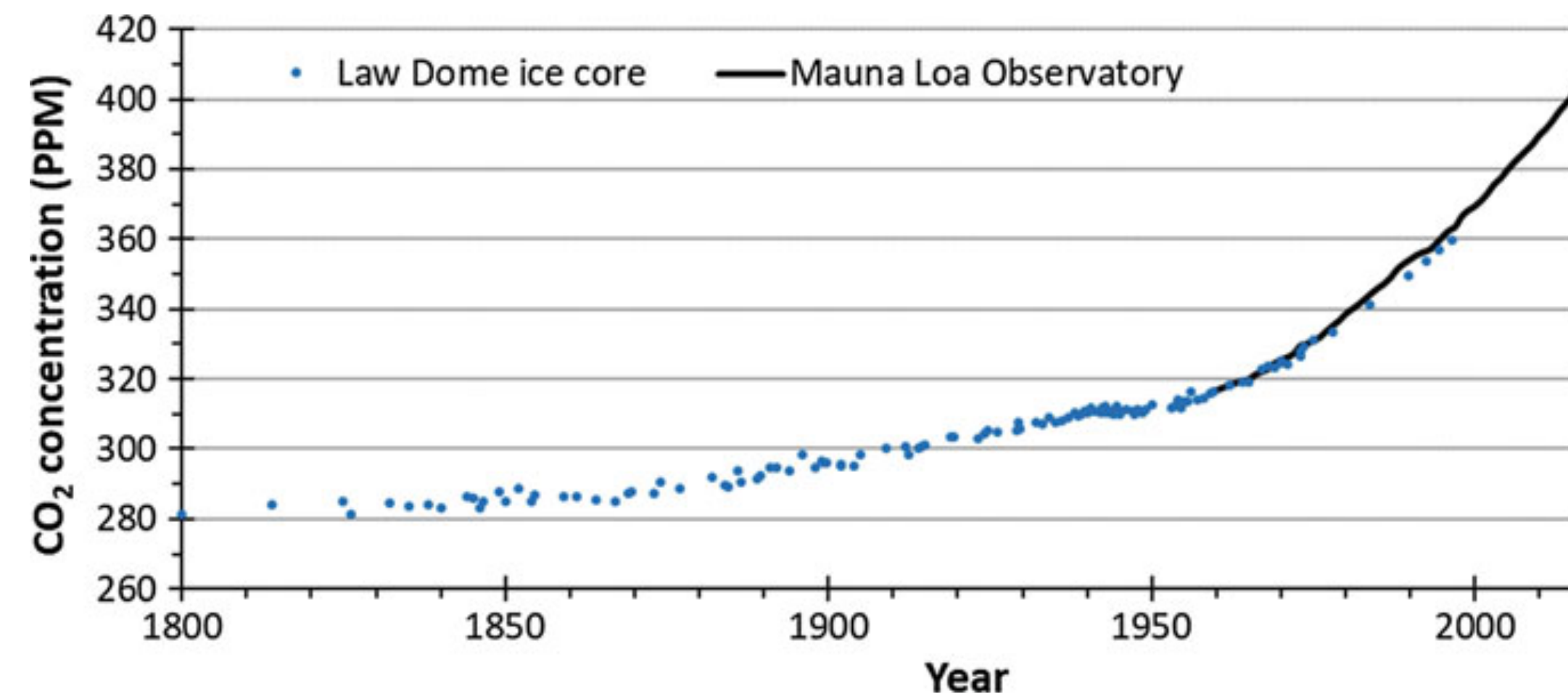


# History greenhouse gas

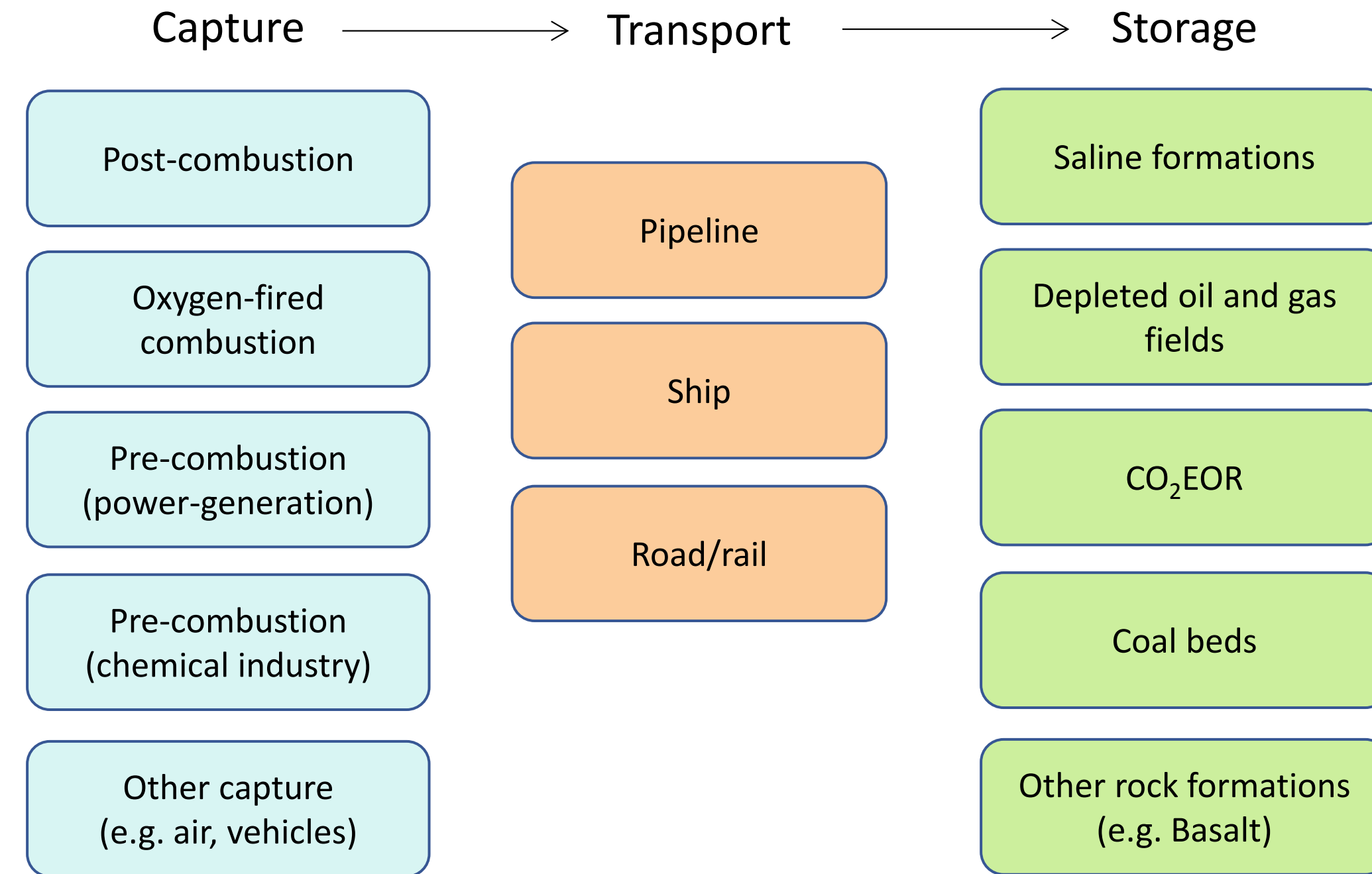
- ▶ importance CO<sub>2</sub> as greenhouse gas recognized in '50's
- ▶ significant change in CO<sub>2</sub> concentration due to anthropogenic emission
- ▶ increase of 50% in CO<sub>2</sub>
- ▶ need to achieve low-carbon energy transition
  1. understanding atmosphere can not be taken for granted
  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)

# Why CCS?

- ▶ can't stop using fossil fuels over night
- ▶ renewable energy needed for long-term near net-zero
- ▶ 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 CO<sub>2</sub> power generation & industry
- faster energy transition
- need 10X increase by 2030 compared to current plans to meet Paris agreement

Needs to isolate CO<sub>2</sub> from atmosphere for few thousand years

Permanent storage difficult to ensure