

The science and impacts of climate change

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Weather vs climate

Weather = short term (daily or hourly) changes in precipitation (rain & snow), wind and cloud cover.

Climate = long term patterns (30 year averages) in e.g. temperature or winter rain in one specific place.



Pre-Industrial Greenhouse Effect

The sun's **radiation** travels towards the **earth**

About half is reflected into space or absorbed by **clouds** and the **atmosphere**

The rest reaches the earth, where it is absorbed by **oceans** and **land**

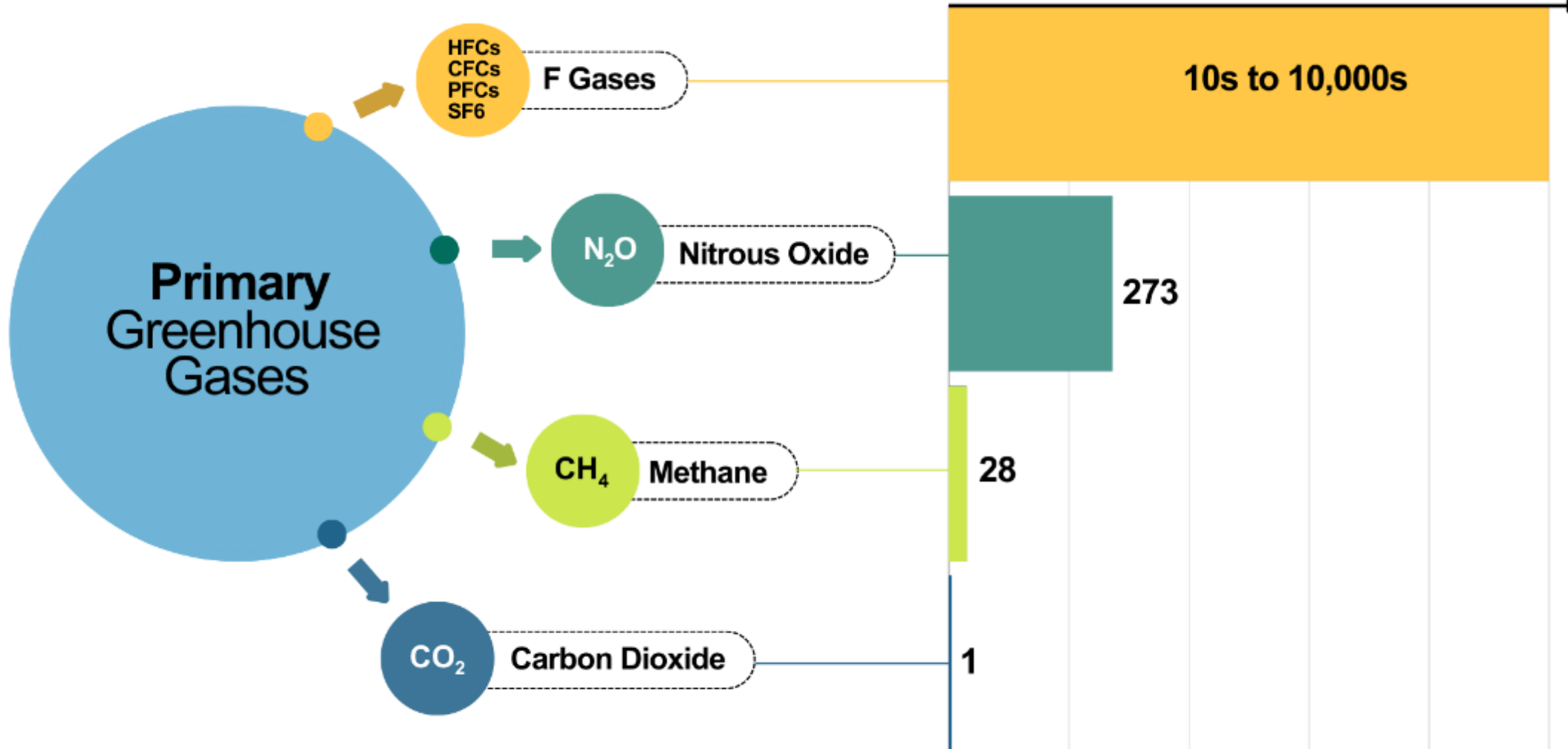
Human-Enhanced Greenhouse Effect

The earth also emits **heat** back toward space

Some of this heat passes directly through the **atmosphere**

But **most** of it is captured and retained by the **greenhouse gases**





CO₂e is a conversion of all greenhouse gases to a carbon dioxide equivalent.

Global Warming Potentials over a 100 year period



Key sources of Greenhouse Gases

HFCs
CFCs
PFCs
SF6

F Gases



N₂O

Nitrous Oxide



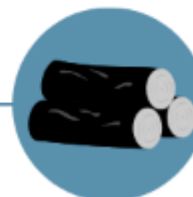
CH₄

Methane

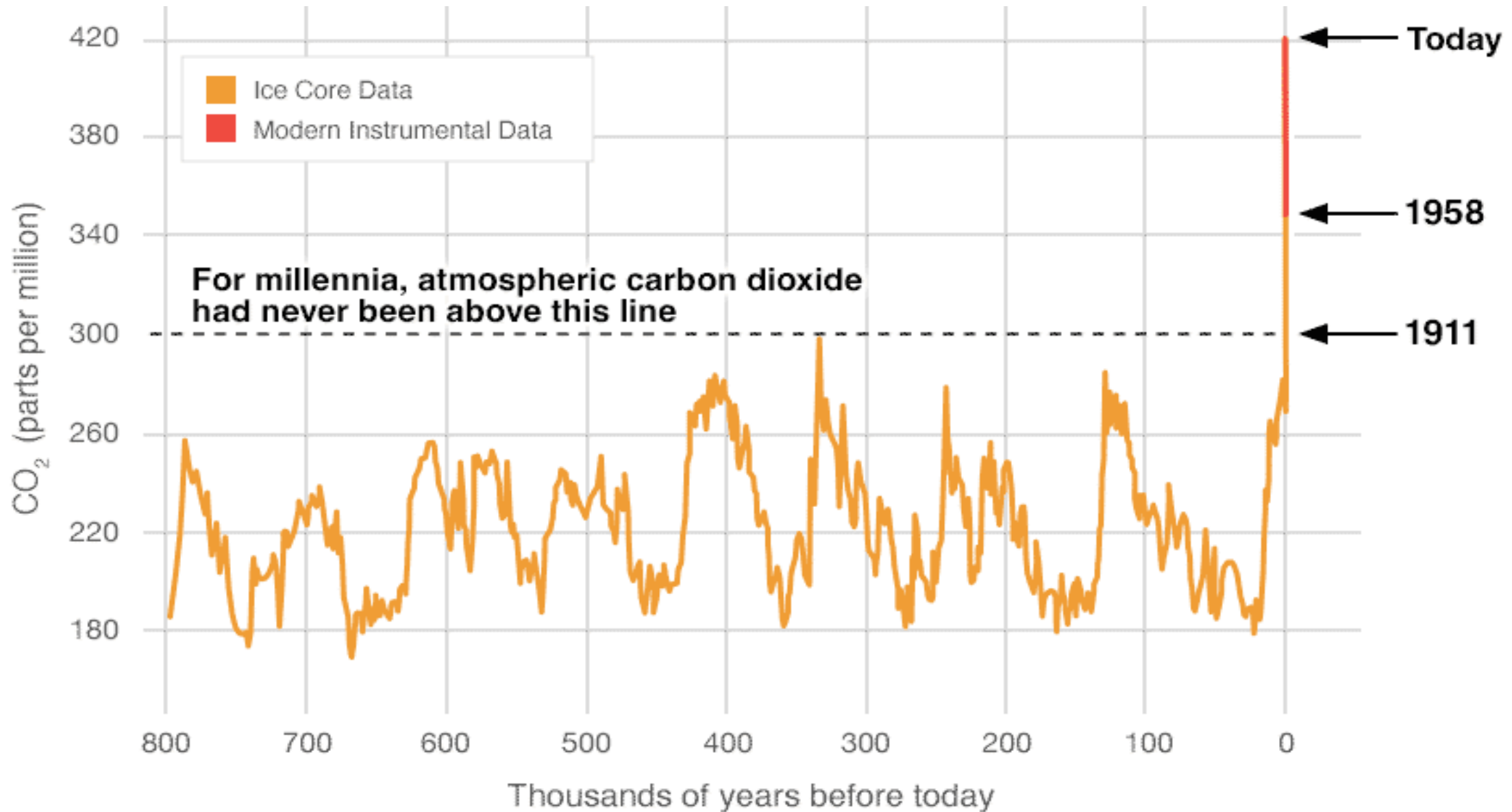


CO₂

Carbon Dioxide

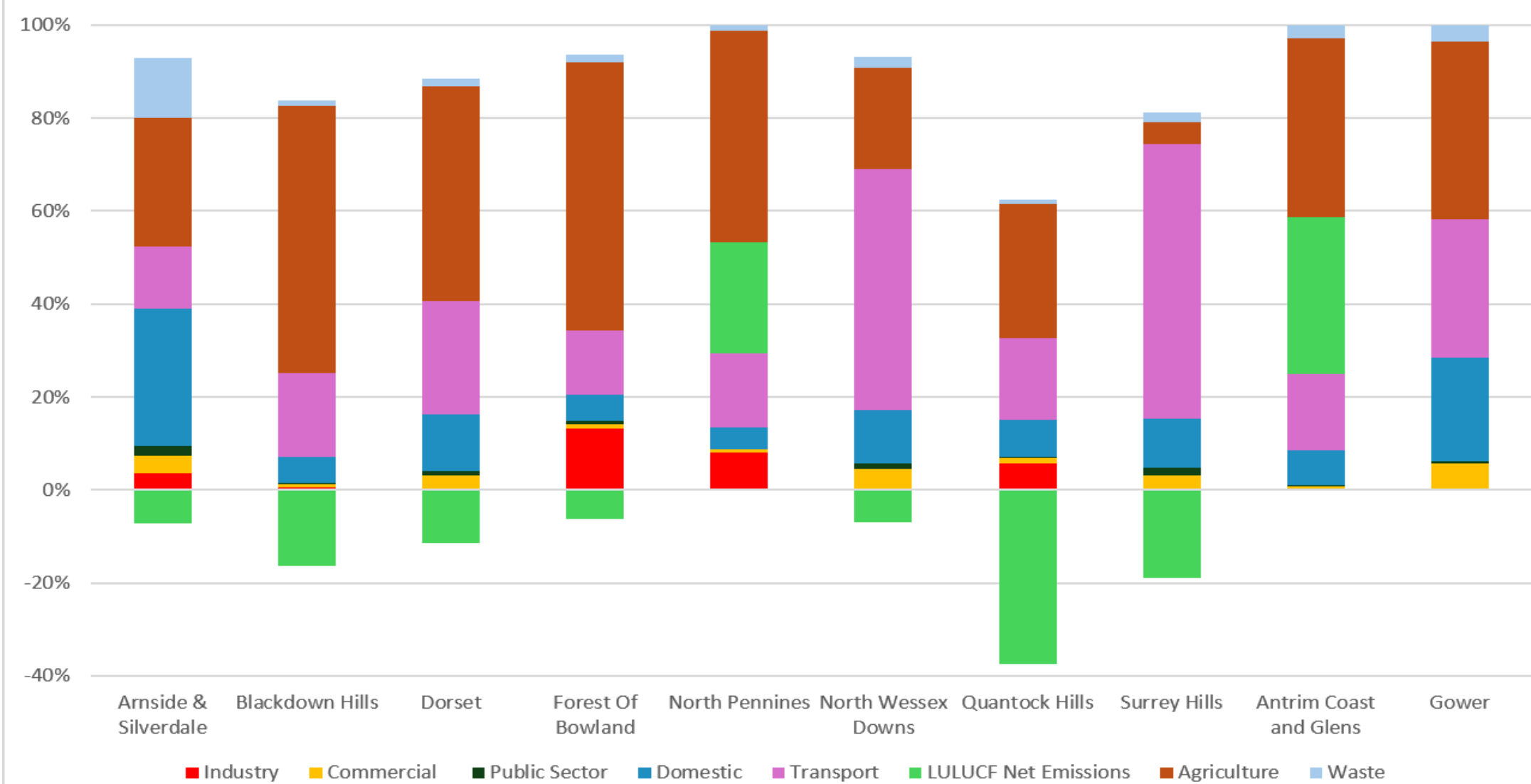


Level of CO₂ over 800,000 years



Sample of National Landscapes

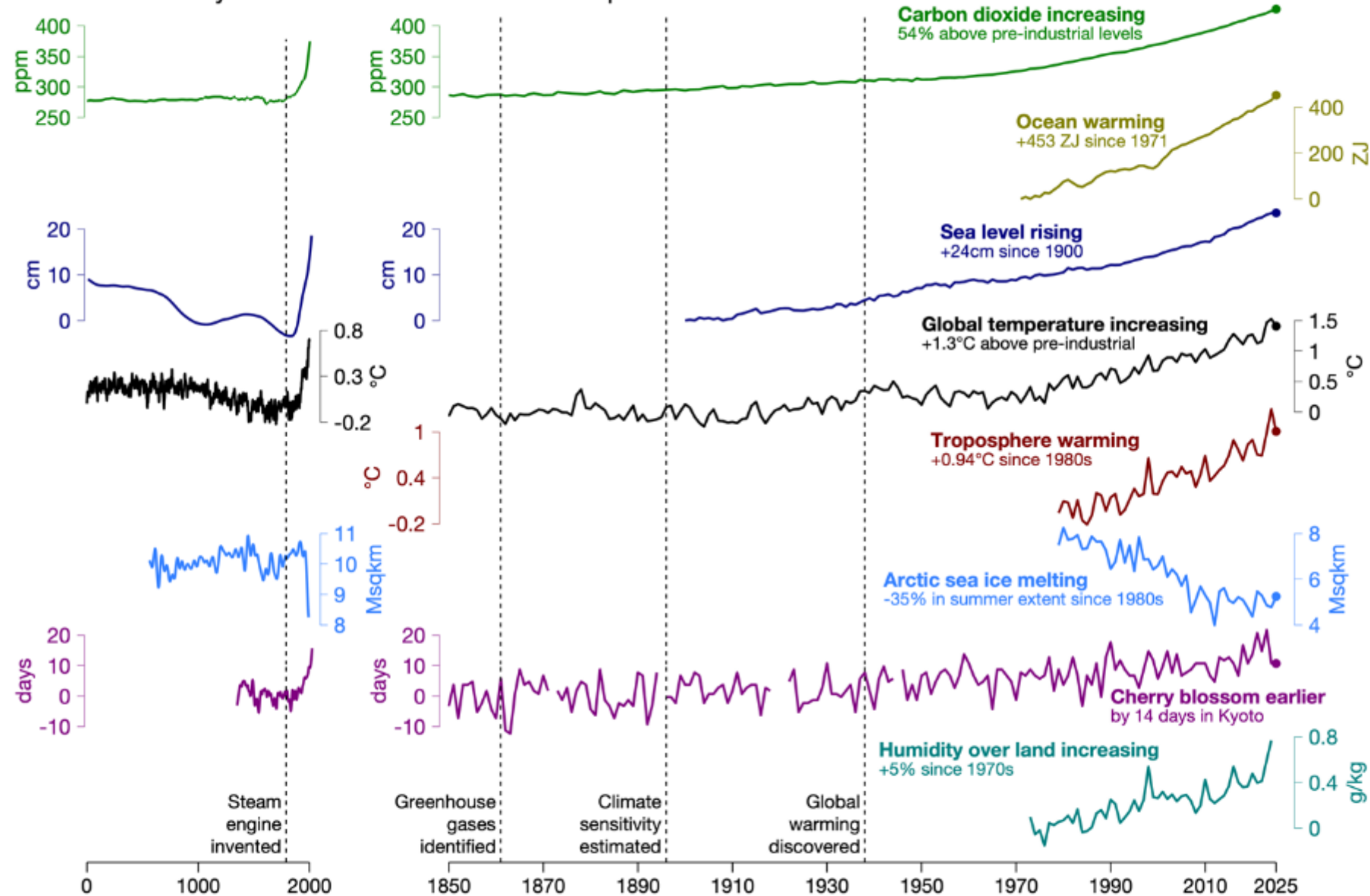
GHG Emissions estimates by sector 2024



Changes emerging across the climate system

Last 2000 years

Instrumental period



Prof. Ed Hawkins (National Centre for Atmospheric Science, University of Reading)



National
Landscapes
Association



News Headlines – impacts from last 12 m

More than 2,700 people are thought to have died from heat-related causes during the May and June heatwaves in England and Wales

Harvest 2026 is on track to be the worst harvest on record (Yields are below the 10-year average for wheat, spring barley and oats)

Burnham brings in military and bans disposable barbecues in 'tinderbox' Britain (37 wildfires across Britain)

Flooding Across England and Wales Ahead of Christmas 2025 (many rainfall events close together)



The scientific consensus

13,950 peer-reviewed climate
articles 1991-2012

Only 24 rejected global warming

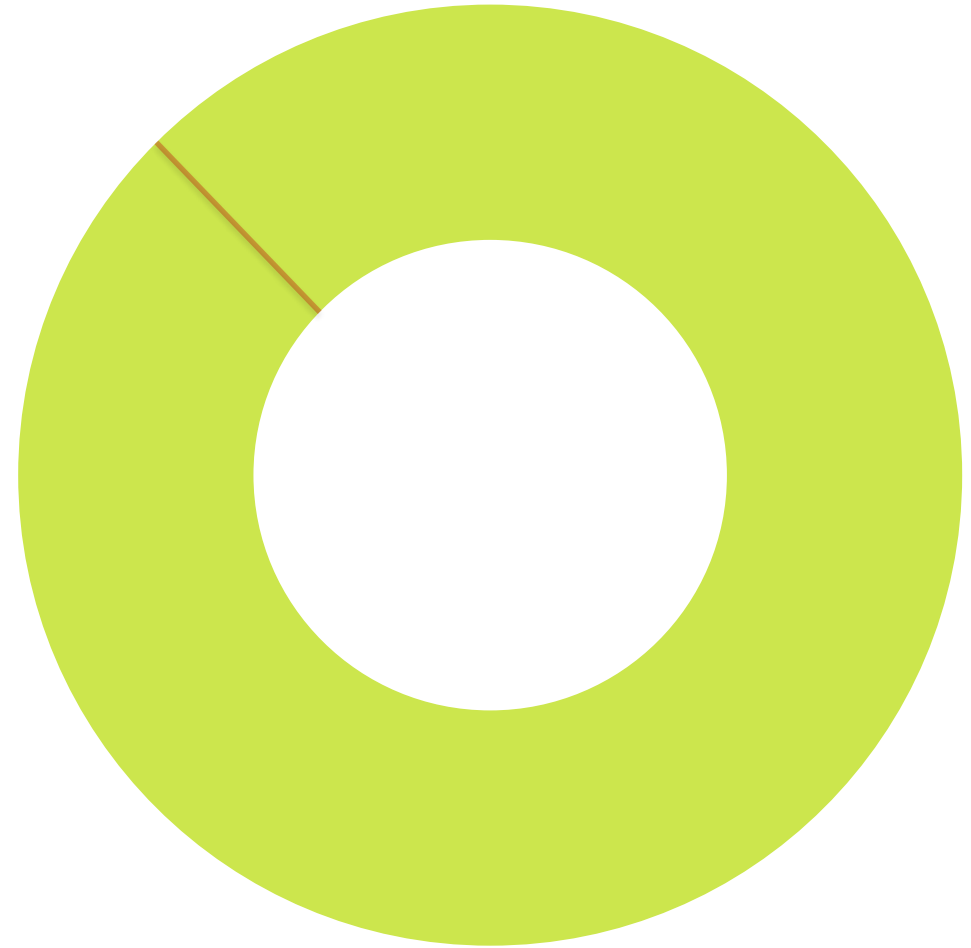
If 13,950 highway engineers told you
that a bridge wasn't safe to cross, but
24 told you it was fine, would you still
cross the bridge?



articles *rejecting* global warming

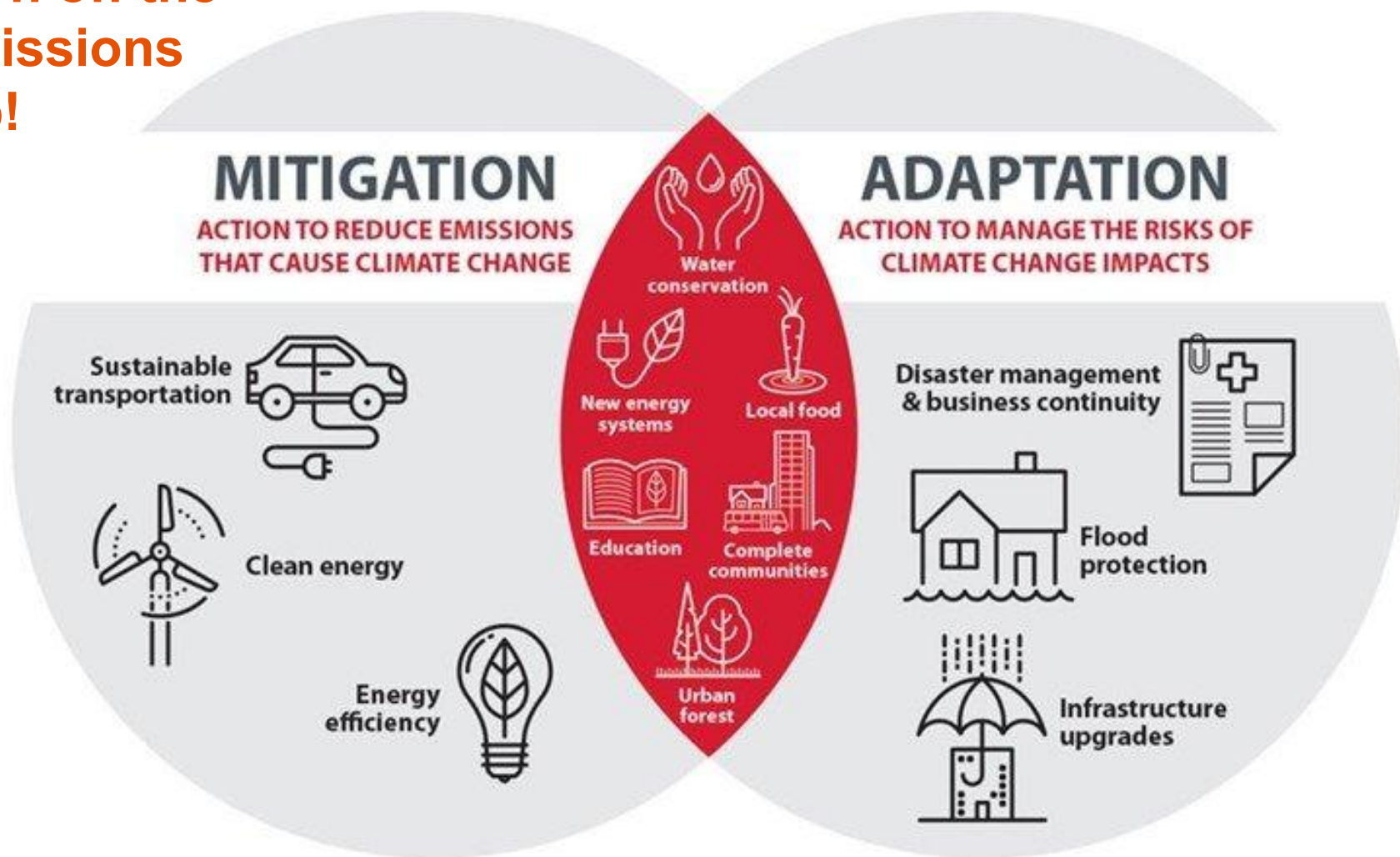


articles *accepting* global warming



What can we do to reduce the impacts?

Turn off the
emissions
tap!



Prepare for
effects now
and in the
future



Species adapt to a warming climate in 2 ways:

1. Changes in the timing of life-cycle events (e.g. spring bud-burst & frogspawn)
2. Species are shifting their geographical ranges by moving to:

- **higher elevations** and

(N America median rate 0.011 kilometers per decade)

- **higher latitudes**

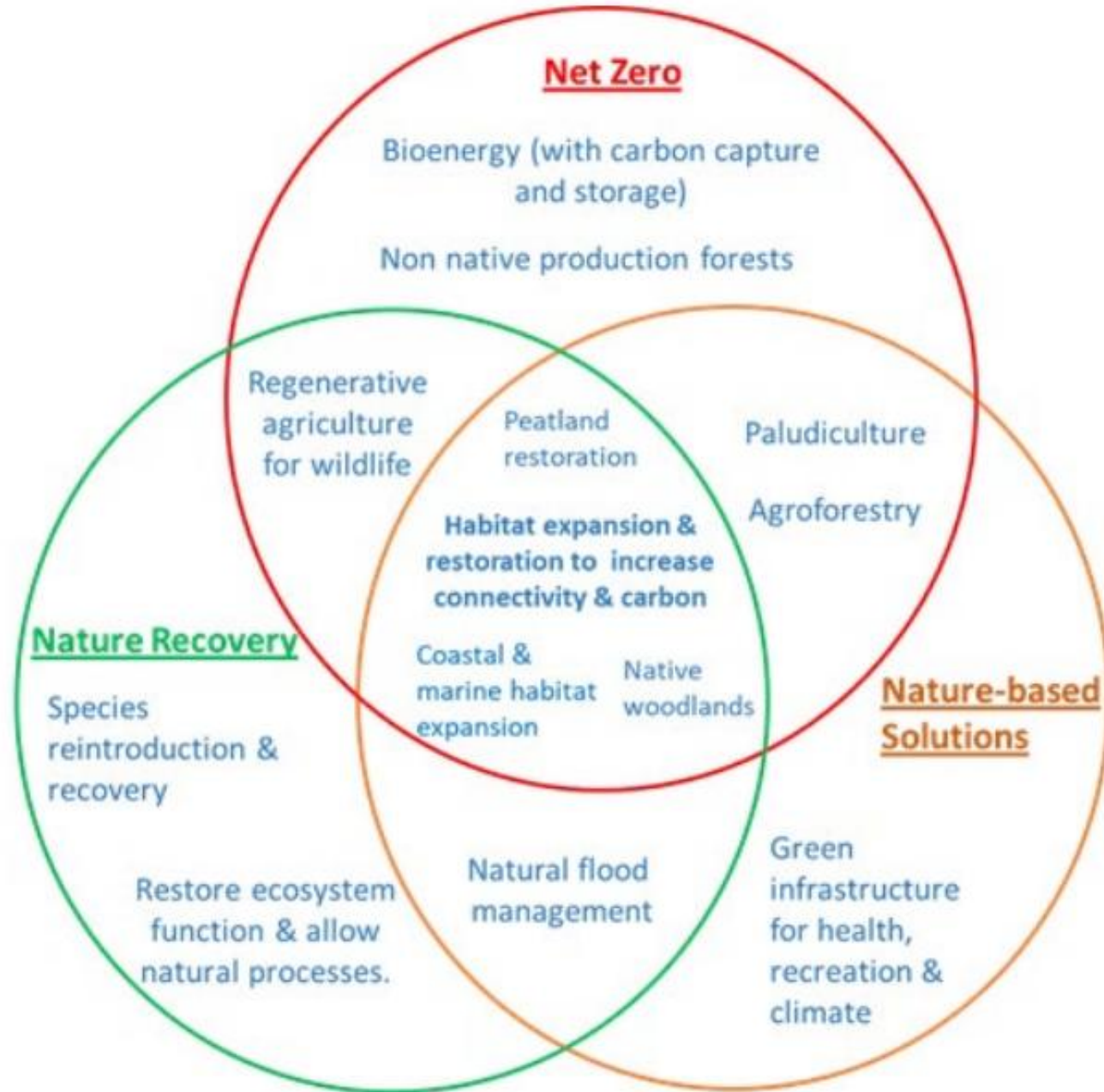
(median rate of 16.9 kilometers per decade, Chen et al. 2011)

Current rates of climate change will likely exceed the ability of many species to adjust to new conditions, leading to (Loarie et al. 2009).

- **higher extinction rates**



Relationships between Nature-Based Solutions (NBS), nature recovery and net zero



Benefit-cost ratios - directly avoided damages of CC from adaptation measure + quantified co-benefits

Table 2
A selection of UK-based benefit-cost ratios for adaptation actions

Hazard	Adaptation actions	Benefit-cost ratios
Flooding	Natural flood management.	3:1–5:1
	Property flood resilience measures.	5:1
	Flood and coastal erosion risk management.	5:1
Warming	Active cooling measures with some passive cooling (for example, loft insulation, shutters).	3:1 ^[2]
	Heatwave plans.	10:1–30:1 (for the 2040s)
Drought	Demand-side water efficiency measures.	1.8:1
	Rainwater harvesting and storage.	2:1 (property level), 3:1 (community-level)
	Supplying water via transfers and storage infrastructure.	11:1 (range 7:1–15:1 across England sub-regions)
Multiple hazards	Proactive maintenance of existing infrastructure.	5:1–10:1
	Emergency response, prevention, and protection by UK Fire and Rescue Services.	6:1
	Embedding climate resilience into new infrastructure.	4:1



1. It's warming
2. It's us
3. We're sure
4. It's bad
5. We can fix it.

