



WORLD CARBON CAPTURE  
UTILISATION AND STORAGE  
CONFERENCE




# The global Carbon Capture Project: How's it going?

 **NTNU**  
Norwegian University of  
Science and Technology

 **NTVA**  
NORGES TEKNISKE  
VITENSKAPSAKADEMI

**Philip Ringrose, NTNU / NTVA**

 31 02-09-2025

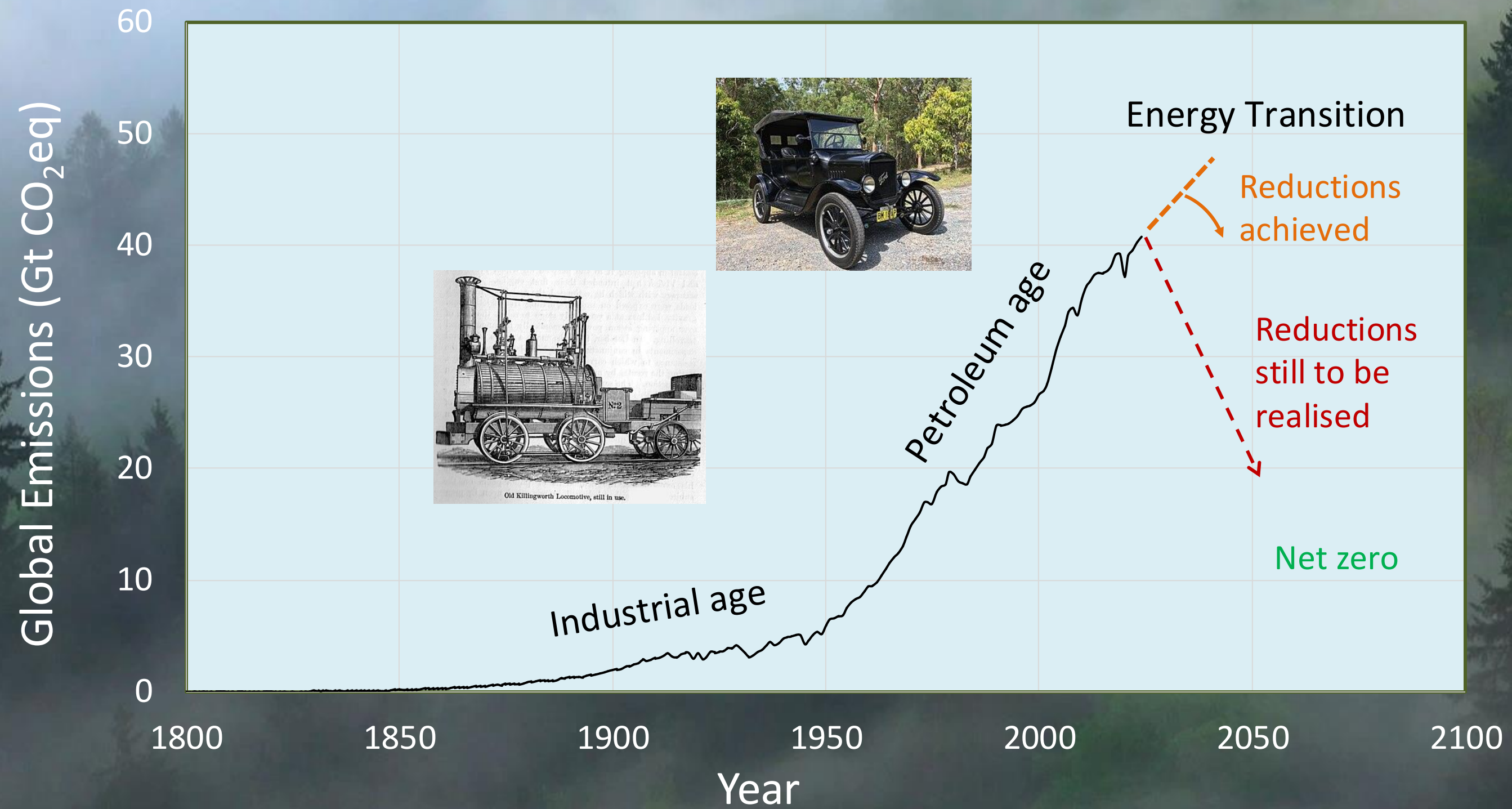
 09:05

 Peer Gynt-salen

# Looking at CCUS from a societal and global perspective



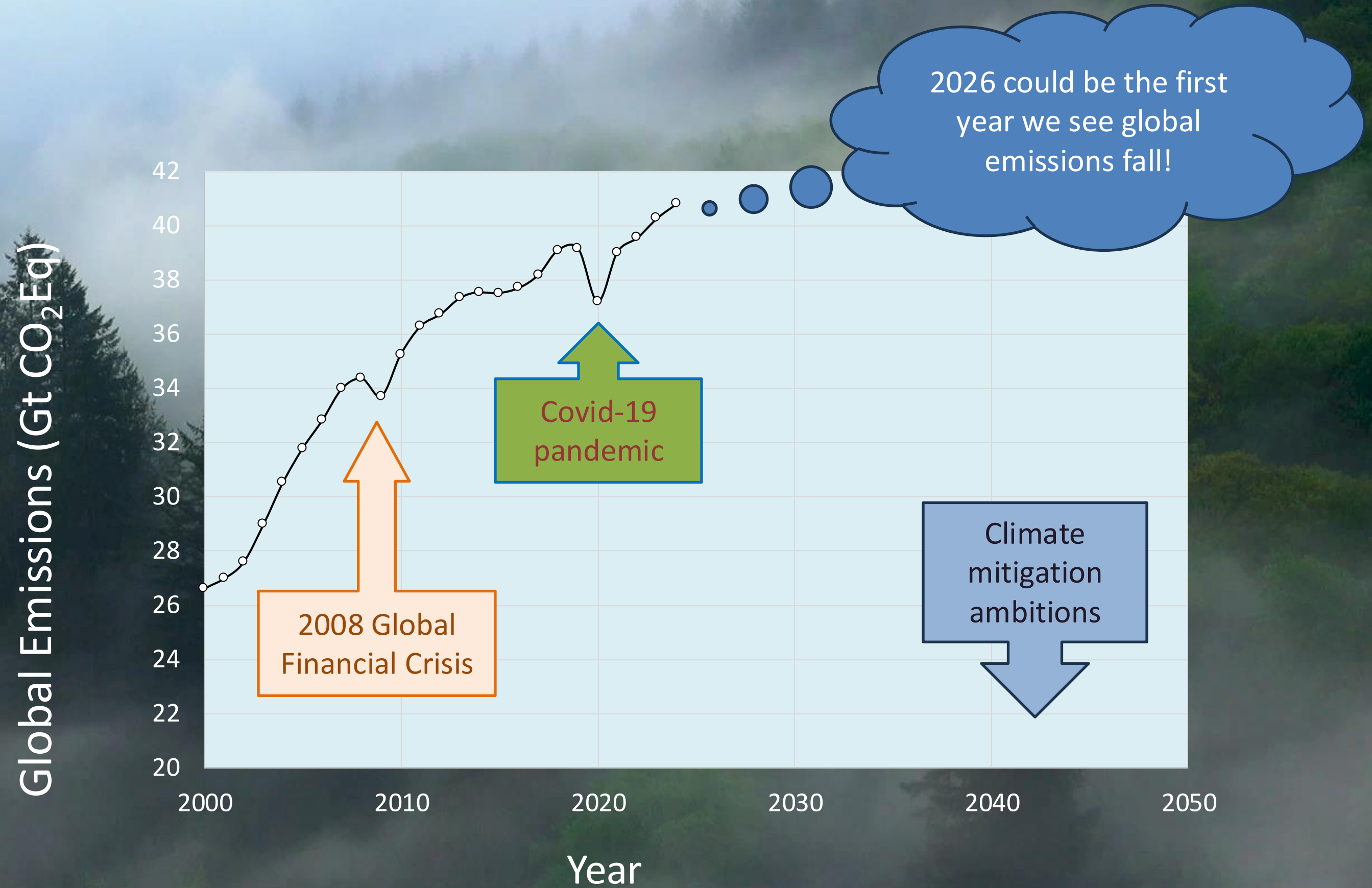
# The challenge



# So far, only global crises have reduced global emissions

We need economically viable pathways to rapidly and significantly reduce emissions

China has 'turned the corner' on emissions as growth in clean-energy has helped China's CO<sub>2</sub> emissions to fall during the first half of 2025  
CarbonBrief newsletter



# Our Earth – ecosystems

The oceans and terrestrial ecosystems absorb about half of anthropogenic CO<sub>2</sub> emissions ...

... but they can't keep up with the rate of human emissions

High probability of triggering climate tipping points under current climate policies

Deutloff, Held, and Lenton, 2025.

*Earth System Dynamics*, 16(2), pp.565-583.

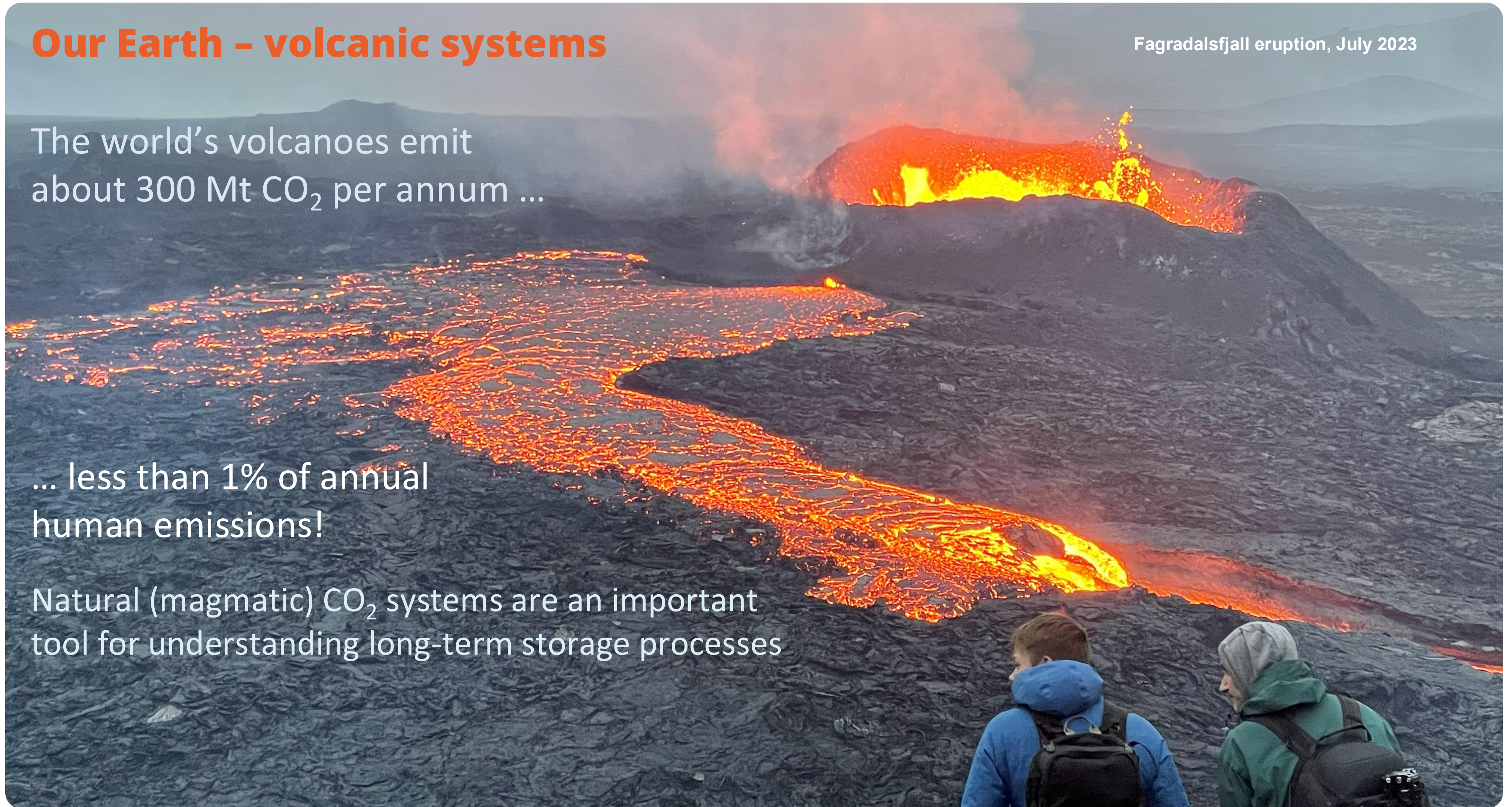
# Our Earth – volcanic systems

Fagradalsfjall eruption, July 2023

The world's volcanoes emit about 300 Mt CO<sub>2</sub> per annum ...

... less than 1% of annual human emissions!

Natural (magmatic) CO<sub>2</sub> systems are an important tool for understanding long-term storage processes



# **Our Earth – the atmospheric system**

**The role of greenhouse gases in our atmosphere is a matter of basic physics**



# Our Earth – the atmospheric system

The role of greenhouse gases in our atmosphere is a matter of basic physics

## Physics ‘fun fact’

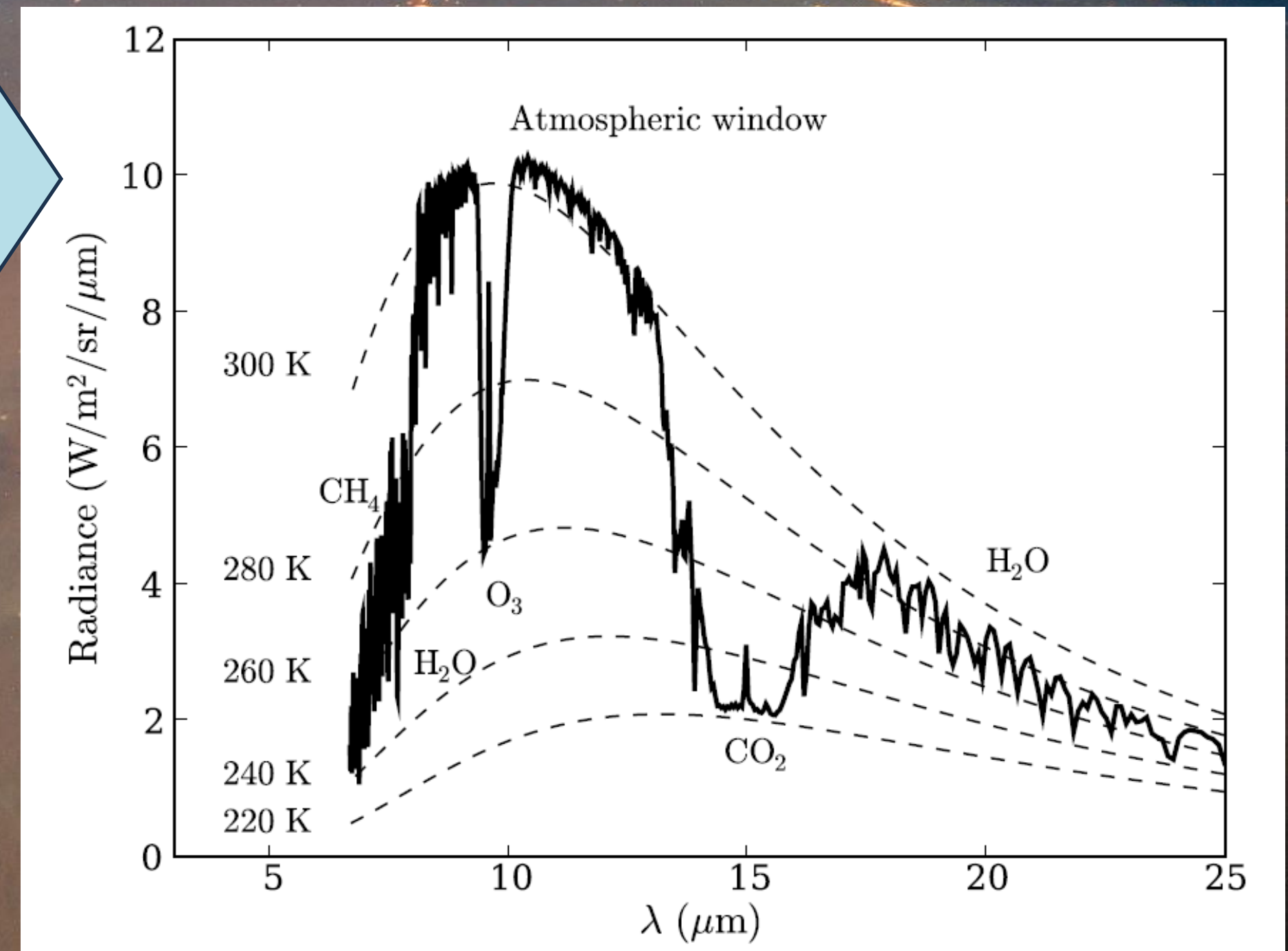
“The mean distance travelled by a photon (from Earth’s IR radiation) before being absorbed by a random CO<sub>2</sub> molecule in the atmosphere is between ~2600m and ~4000m.”

(Ringrose, Amundsen & Landrø, 2024, First Break)

## Spectrum of terrestrial infrared radiation

(from Sportisse, 2010, Ch. 2, Fundamentals in Air Pollution)

- As measured by a sensor at an altitude of 70 km
- Planck (blackbody emission) distributions are given for 220, 240, 260, 280 and 300 Kelvin.
- The corresponding greenhouse gases are indicated near the absorption peaks.



# Europe has been quite successful at cutting emissions

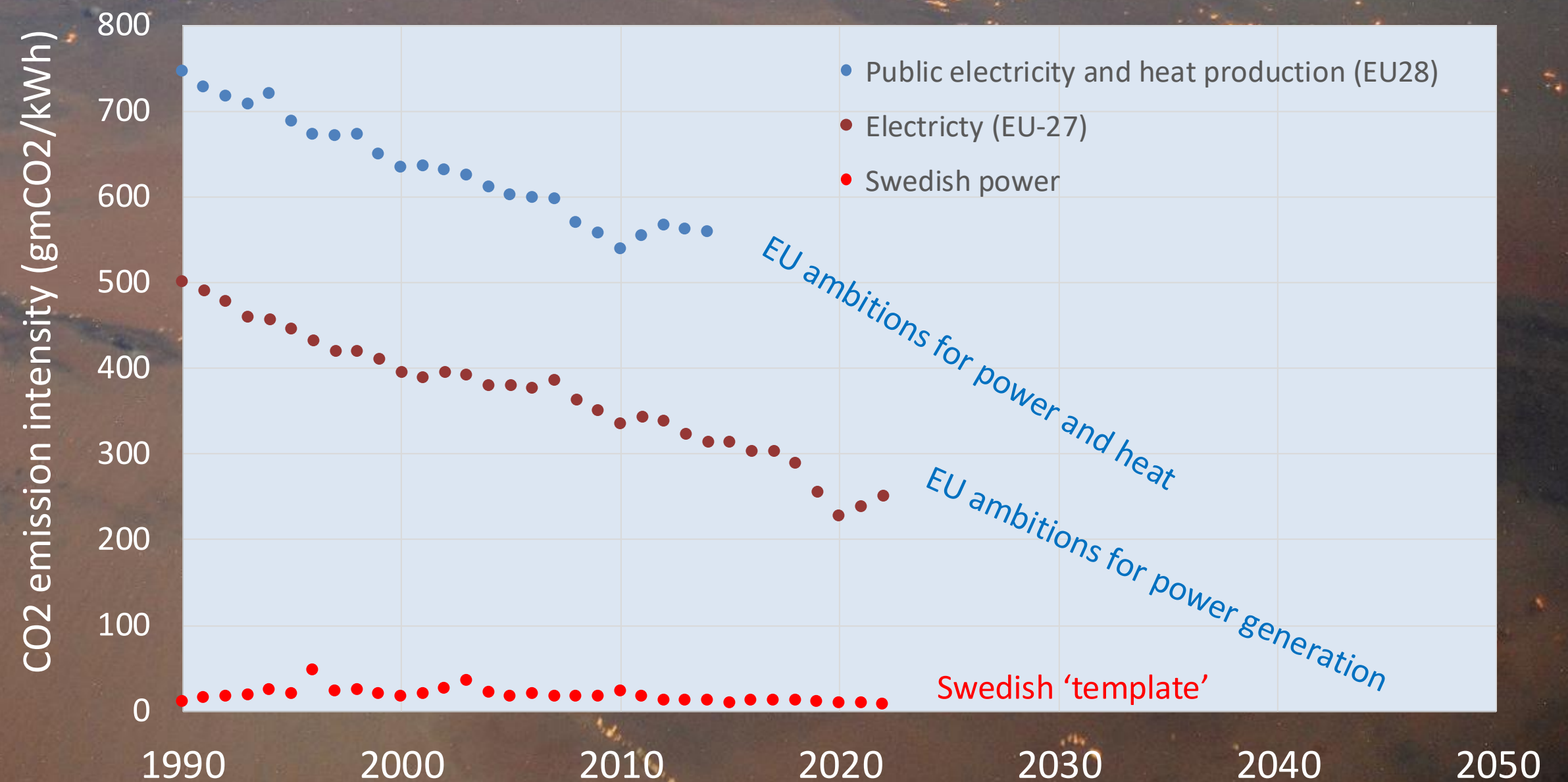
The EU's net emissions in 2024 were 37% lower than in 1990

UK's net emissions in 2024 were 54% lower than in 1990 (mainly due to switching from coal to gas and RE)

By 2030, the EU (& Norway) aim to cut emissions by >55 % compared to 1990

While UK is targeting a 68% reduction by 2030

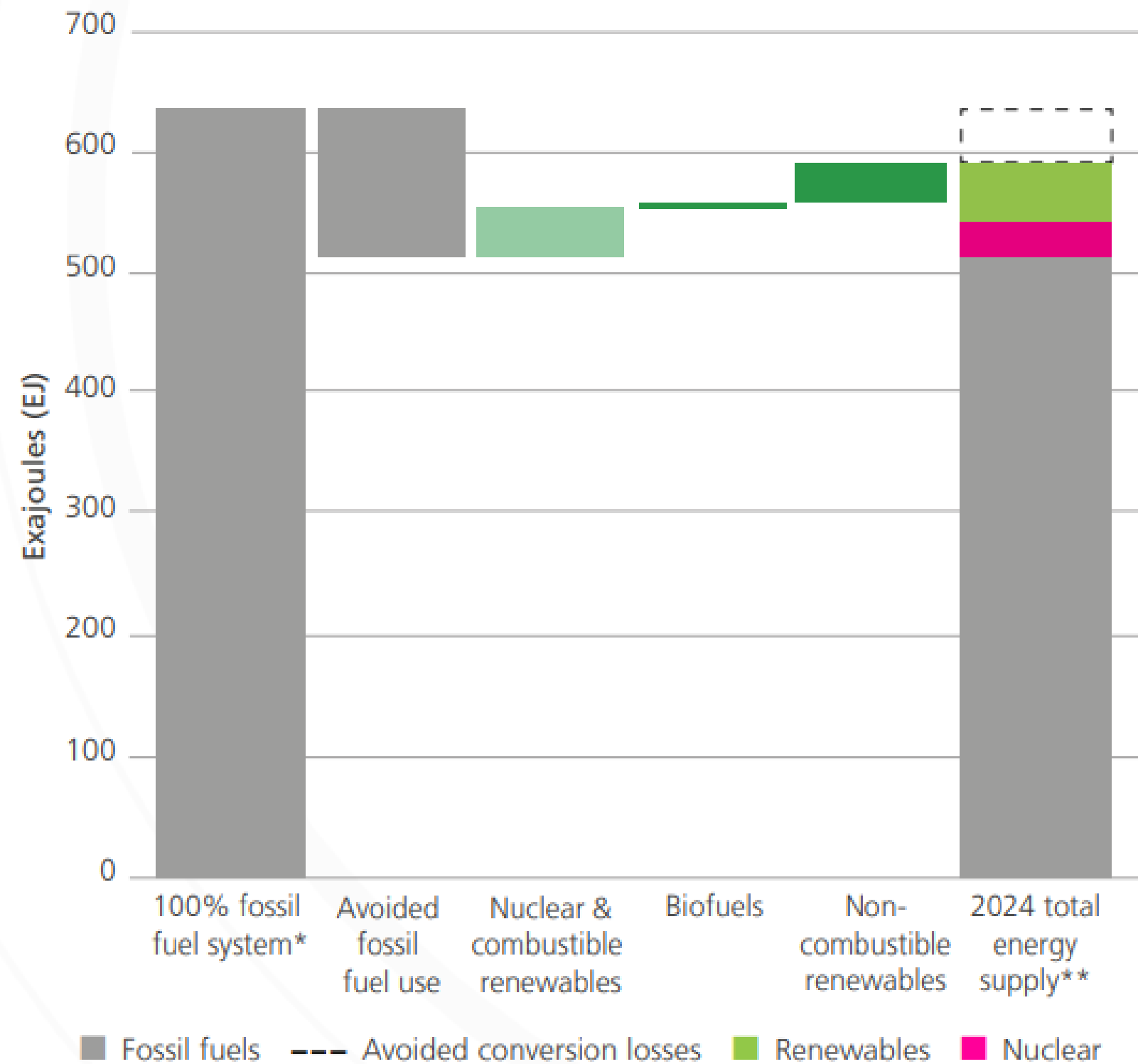
GHG emissions from Electrical power and heating in Europe



# Avoided fossil fuels, nuclear and RE are having an impact globally

Energy Institute Statistical Review of World Energy 2025

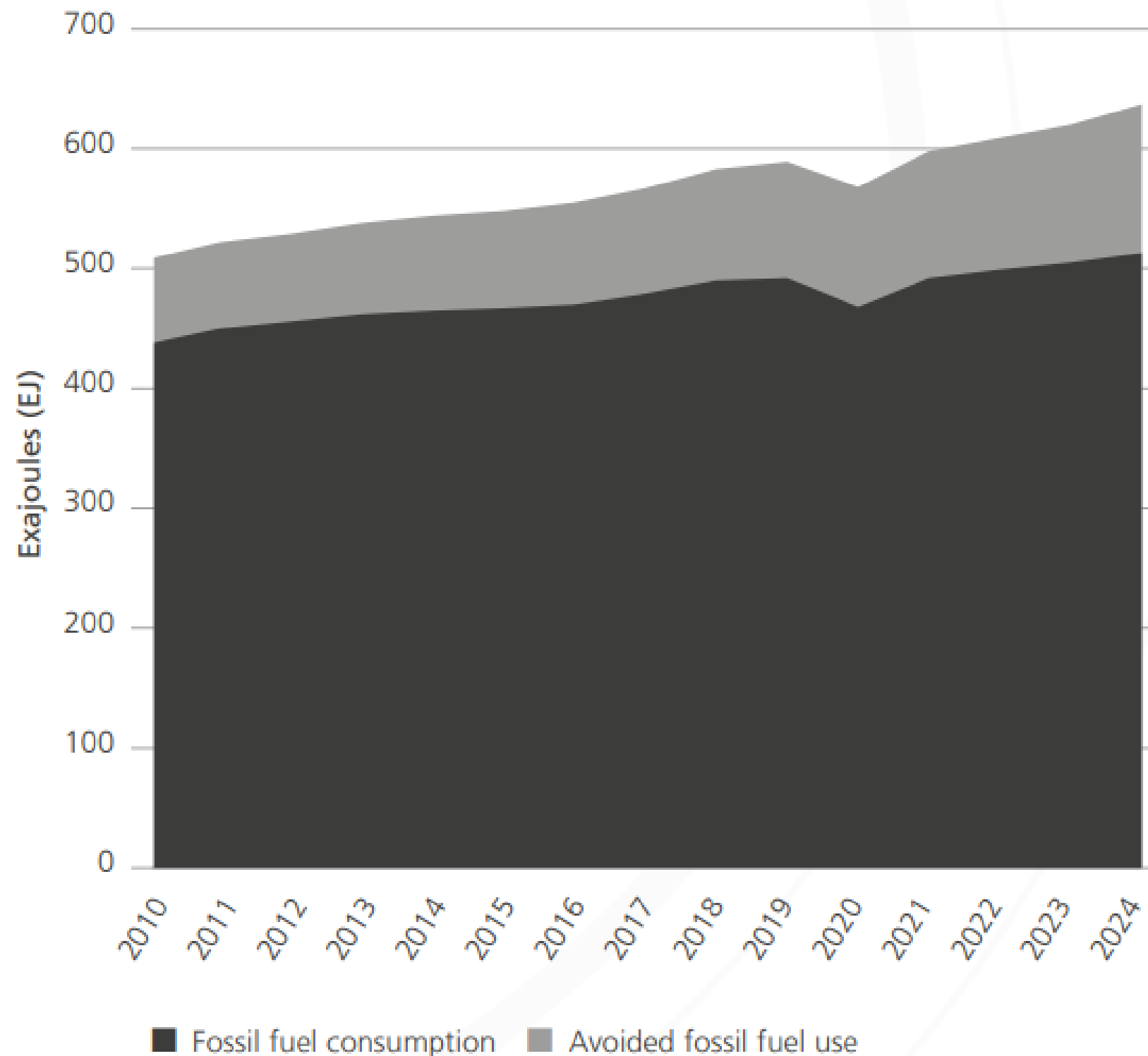
### Renewables and nuclear reduce fossil fuel dependency and increase energy system efficiency in 2024



\* Calculated using fossil fuel equivalent method

\*\* Calculated using physical energy content method

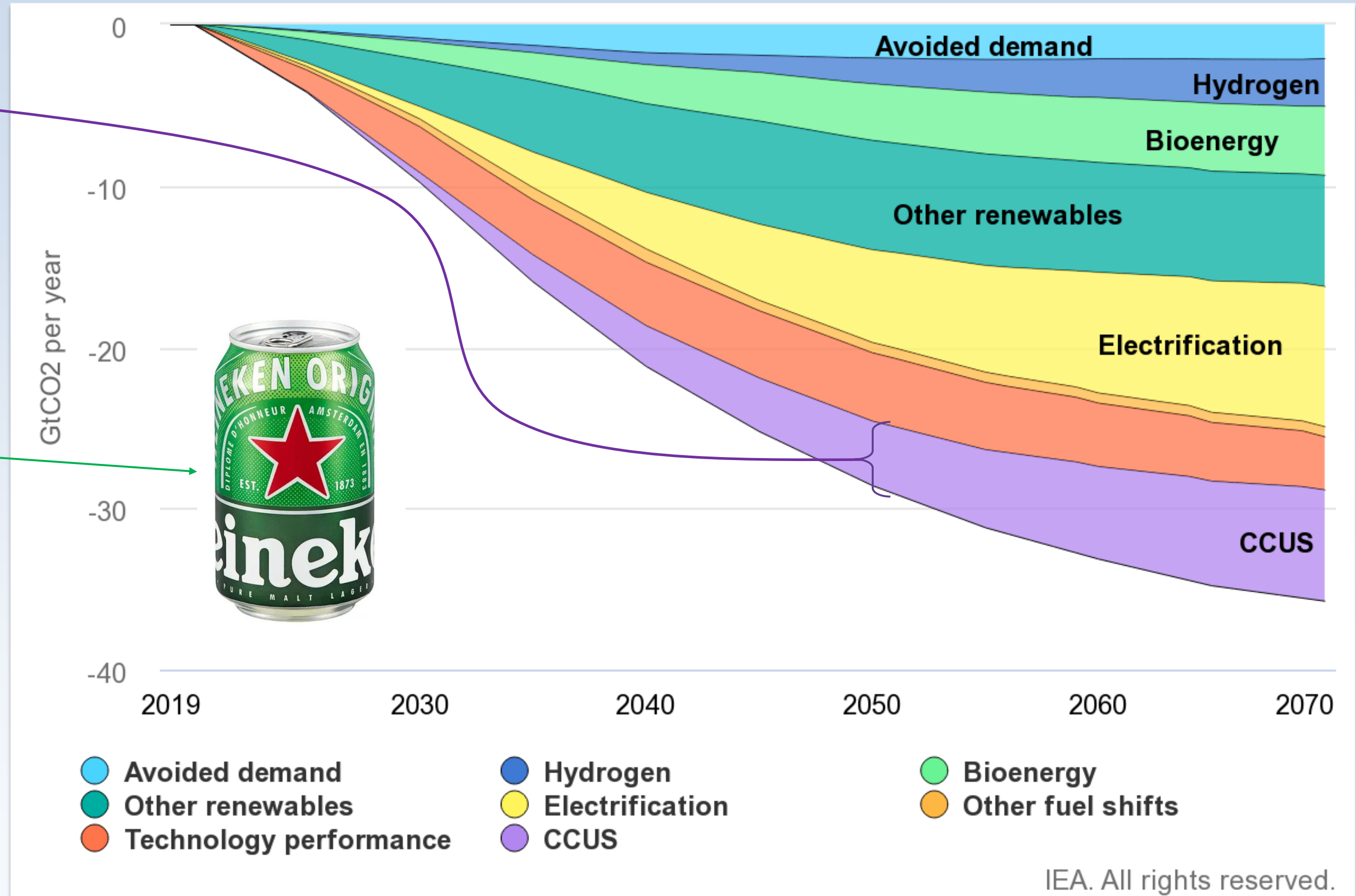
### Avoided fossil fuels use by renewables and nuclear



# IEA Sustainable Development Scenario

CCS only needs to cover about 14% of emissions reductions by 2050

However, CCS is vital for handling difficult things ...  
... it refreshes the parts that other beers don't reach!



Cumulative CO<sub>2</sub> emissions reductions in the energy sector in the **IEA Sustainable Development Scenario** relative to the Stated Policies Scenario. From IEA (2020)



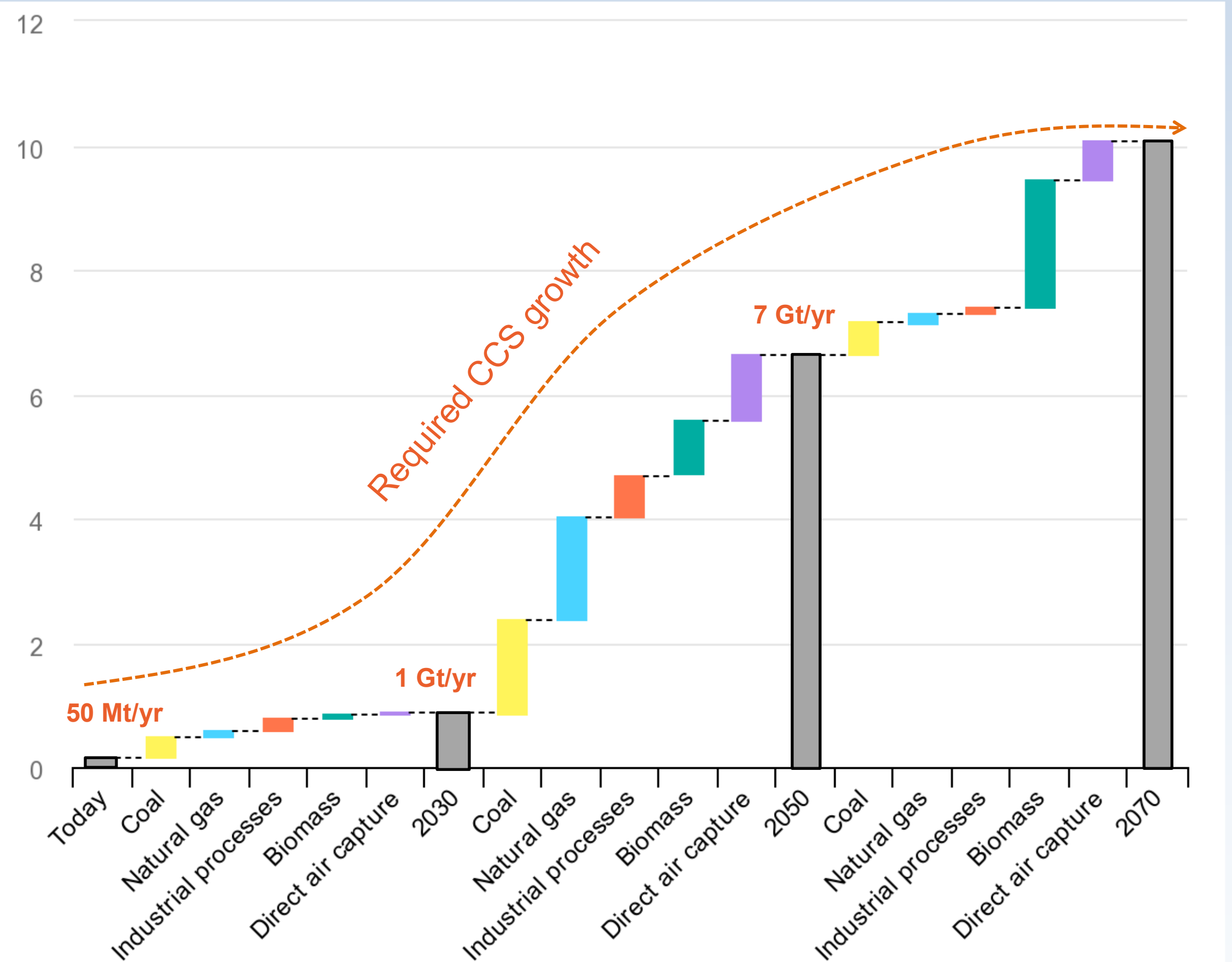
# IEA Sustainable Development Scenario

CCS is initially mainly needed for decarbonising coal, natural gas and industry

But CCS for negative emissions has to accelerate and eventually dominate

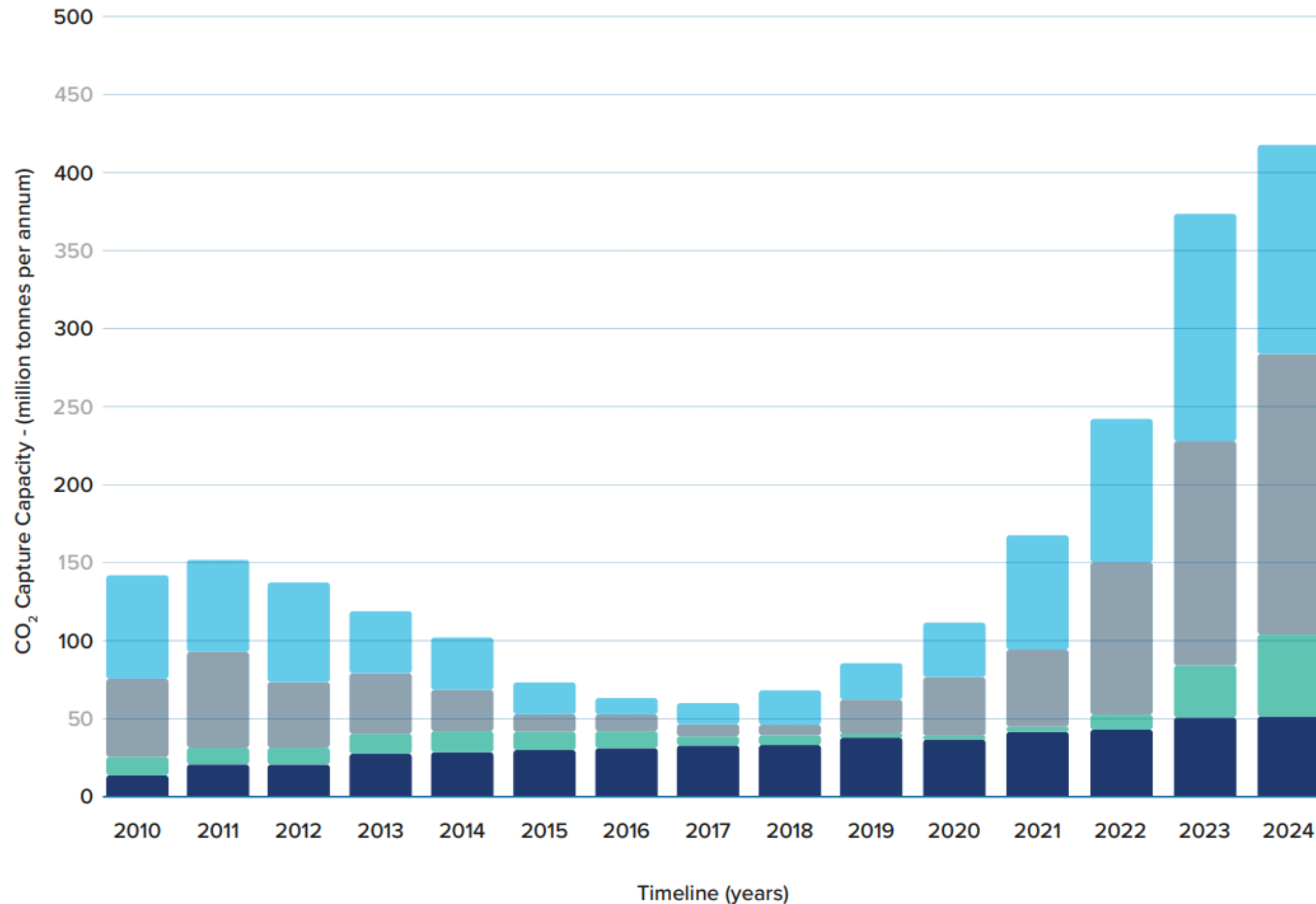
The European Commission has recently increased their CCS ambition to 450 Mt/yr by 2050

Growth in world CO<sub>2</sub> capture by source and period in the IEA Sustainable Development Scenario, 2020-2070.  
From IEA (2020)



# Global deployment of CCUS

CO<sub>2</sub> capture capacity of commercial CCS facilities since 2010 – GCCSI Global status of CCS report 2024



## Key

- Early Development
- Advanced Development
- In Construction
- Operational

0.5Gt/yr

What could we achieve by 2030?

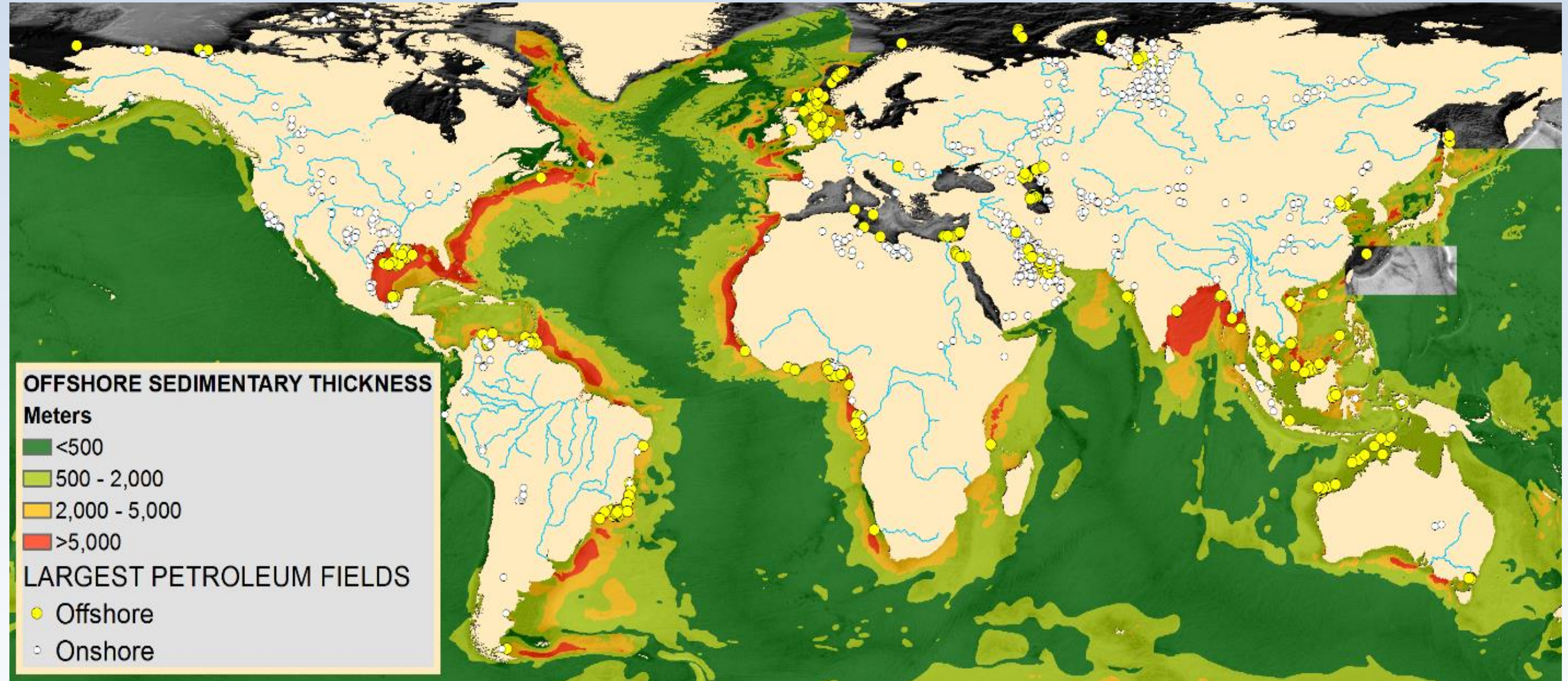
50Mtpa more in construction

50Mtpa in operation



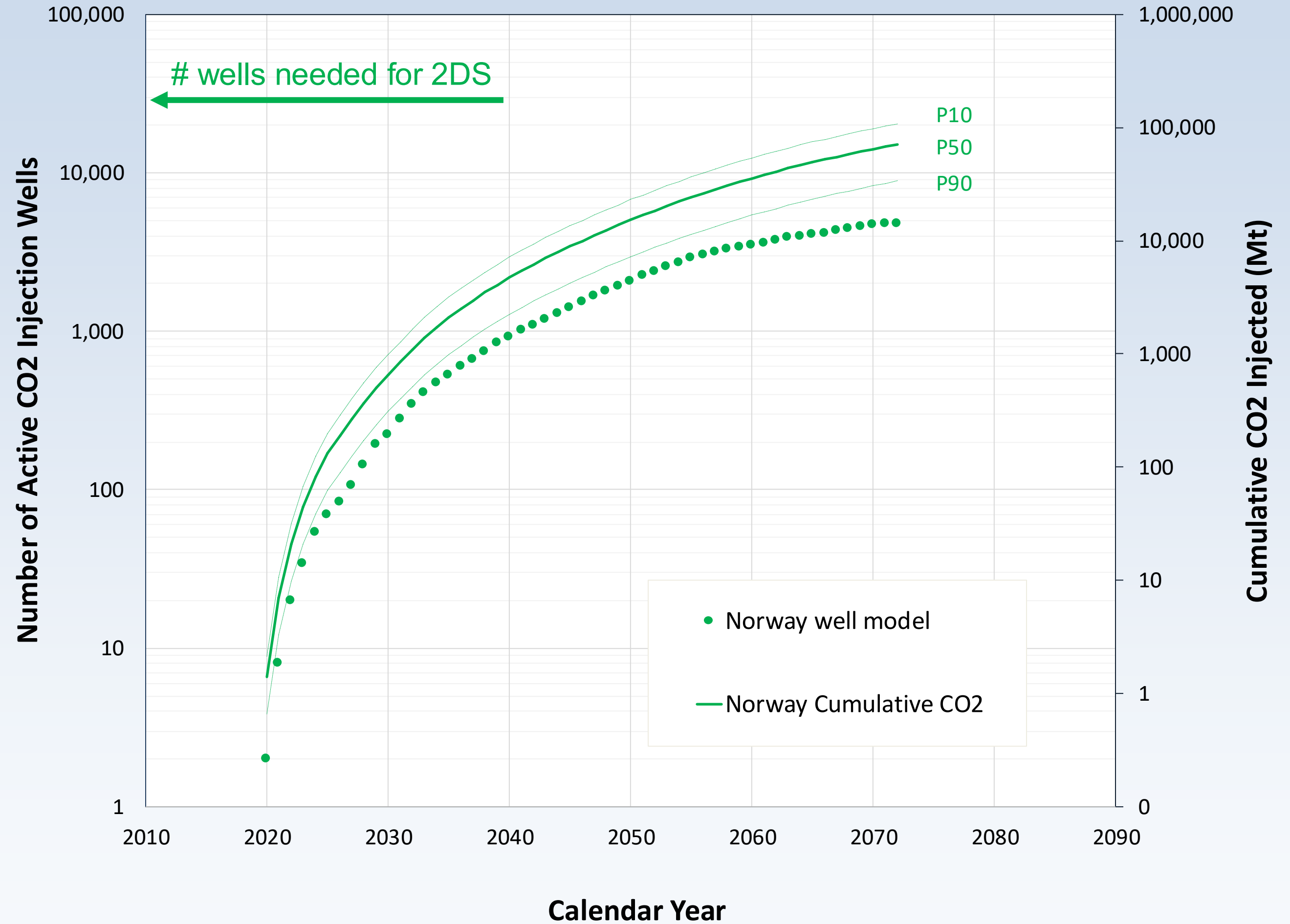
# Storage resources are overwhelmingly available

Global distribution and thickness of sediment accumulations on continental margins, with largest oilfields and main river systems (Ringrose & Meckel, 2019)



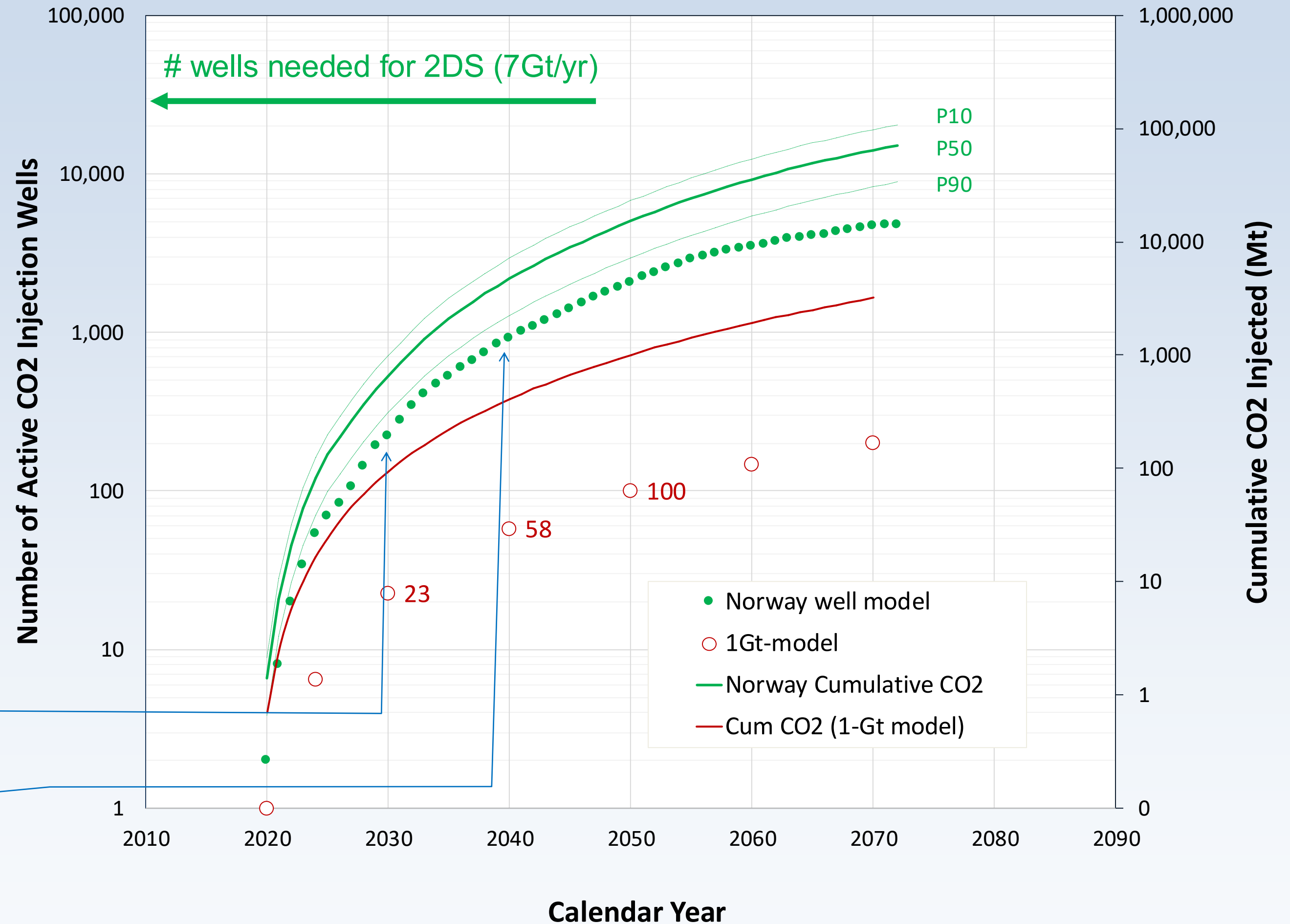
# How do we exploit these resources?

- Using historical drilling data, Ringrose & Meckel (2019) showed how around 12,000 CO<sub>2</sub> injection wells will be needed by 2050 (globally)



# How do we exploit these resources?

- Using historical drilling data, Ringrose & Meckel (2019) showed how around 12,000 CO<sub>2</sub> injection wells will be needed by 2050 (globally)
- The 'Norway well model' indicates the build rate for a 'continental' CCS cluster
- Also shown are the wells needed to deliver 1 Gt cumulative of CO<sub>2</sub> storage by 2050



Next 5 years: about 200 wells per continent

By 2040: about 1000 wells per continent

# News from Norway - June 2025

“The CCS Longship has taken it’s first voyage with cement capture volumes to storage”



# News from Norway - June 2025

Longship complete, first offloading and a royal visit

## First CO<sub>2</sub> on board

Our first custom-built ship, Northern Pioneer, has started commissioning and carried out its first CO<sub>2</sub> loading and offloading from Heidelberg Materials in Brevik.

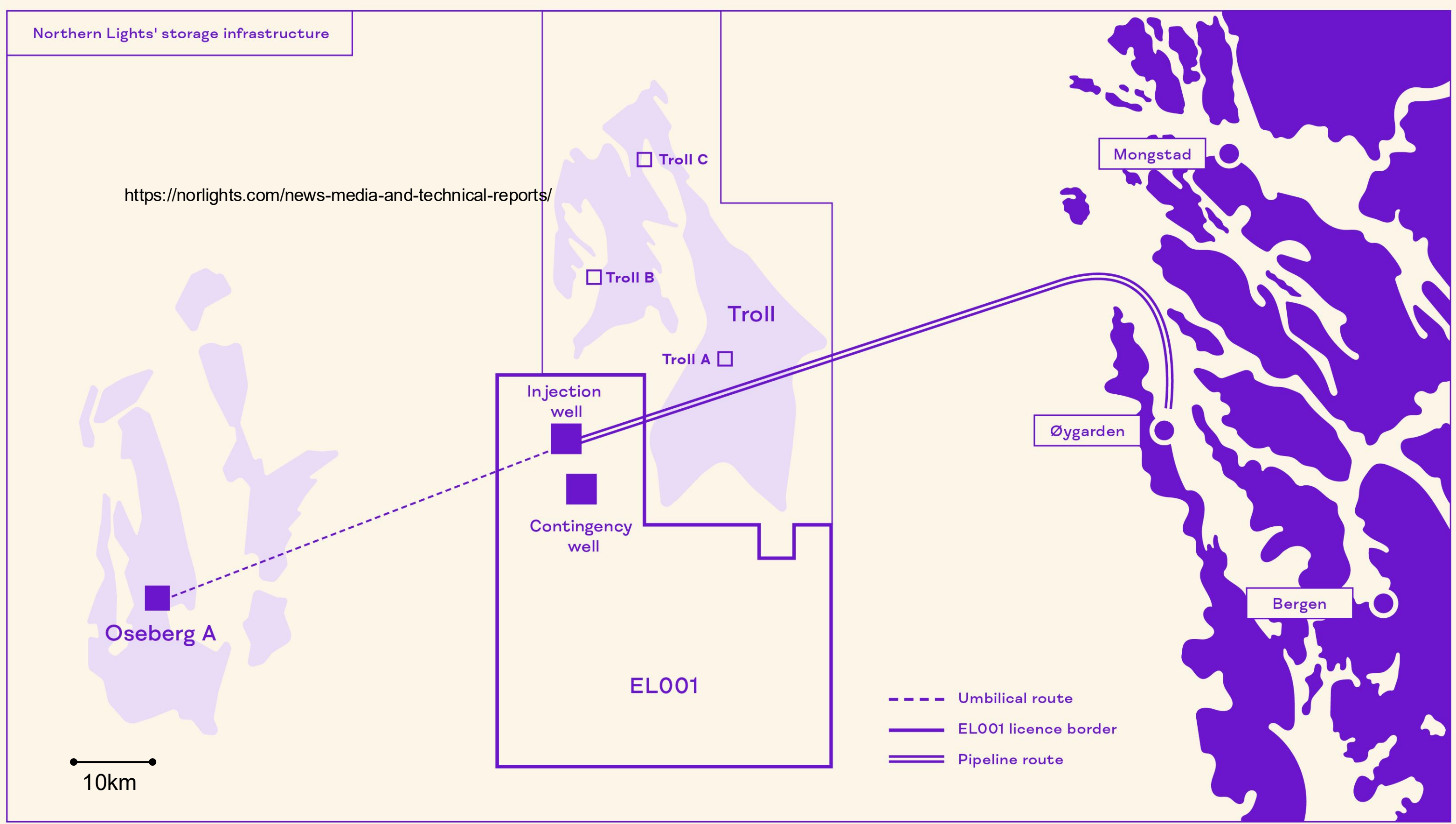
<https://norlights.com/news-media-and-technical-reports/>

Crown Prince Haakon attended the opening of the Longship project's carbon capture facility at Heidelberg Materials' cement plant in Brevik, Norway.



# News from Norway - August 2025

“First CO<sub>2</sub> volumes have now been injected and successfully stored at the Northern Lights project”



<https://norlights.com/news-media-and-technical-reports/>



# The global Carbon Capture Project – how's it going?

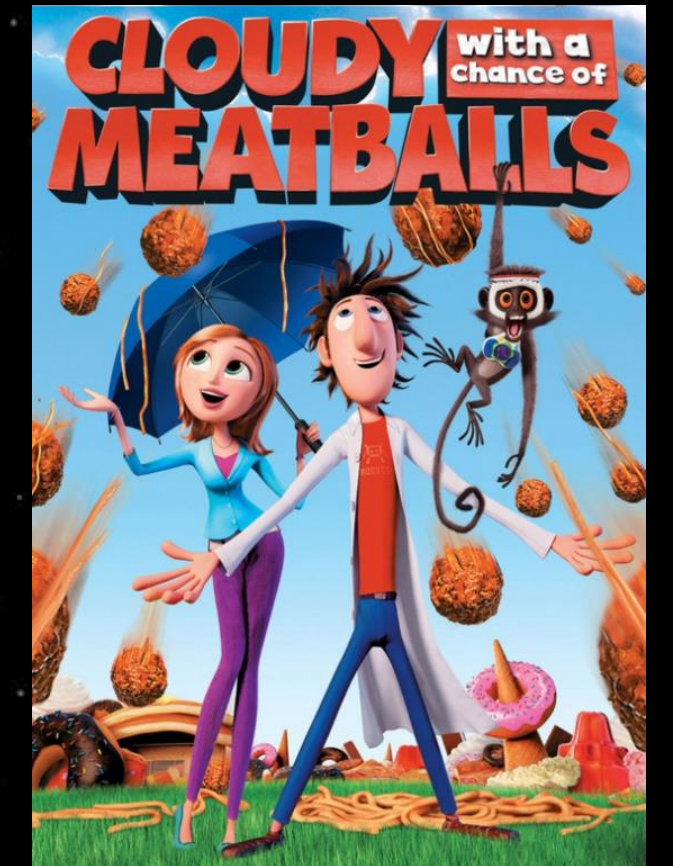
Not too bad actually ...  
Many projects underway  
or in construction

But more speed and  
momentum is needed

Business models and  
financial incentives are  
very uncertain



## CCS Outlook?



"Cloudy with  
a chance of  
reaching the 2DS  
climate goals"



---

**WORLD CARBON CAPTURE  
UTILISATION AND STORAGE**

---

CONFERENCE

---

Date and location

**1-4 SEPTEMBER 2025  
BERGEN, NORWAY**

**WCCUS.ORG**