From Concept to Current

The Impact of DACCS on the Energy Landscape

CIGRE UK, Technical Webinar, 19th March 2025

DACCS = Direct Air Carbon Capture & Storage

Your presenters today

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Siemens Energy is a

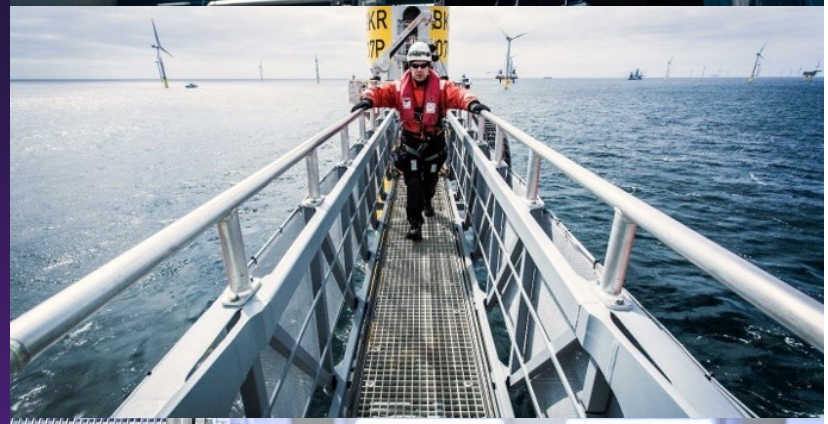
global leader in energy technology

~1/6
of global electricity generation is based on our technology.

100,000
employees work as a team to energize society.[1]

We are present in
>90 countries.

We invest around
€1.2bn annually in research and development.

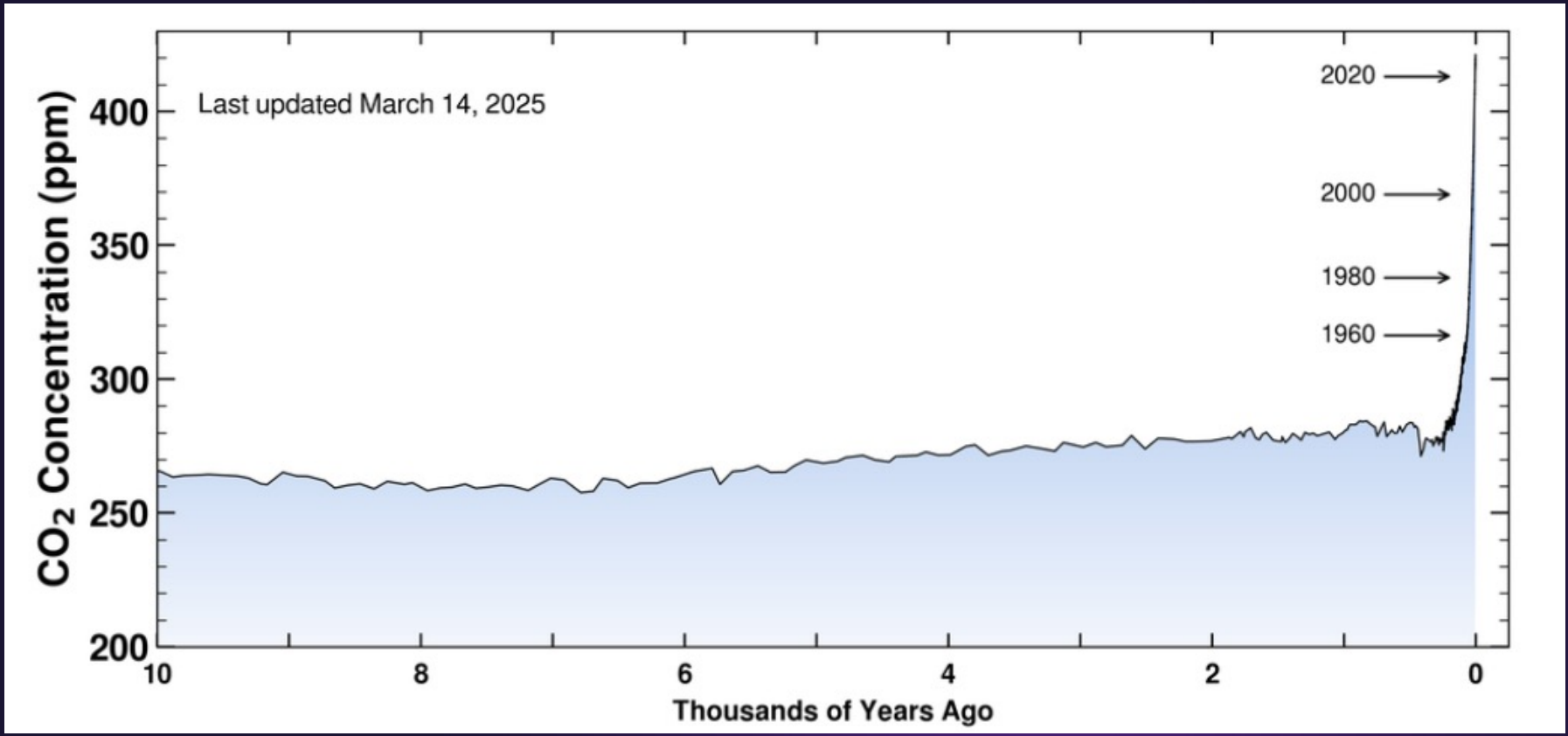


1 Number of employees as of December 31, 2024

What we are going to cover today

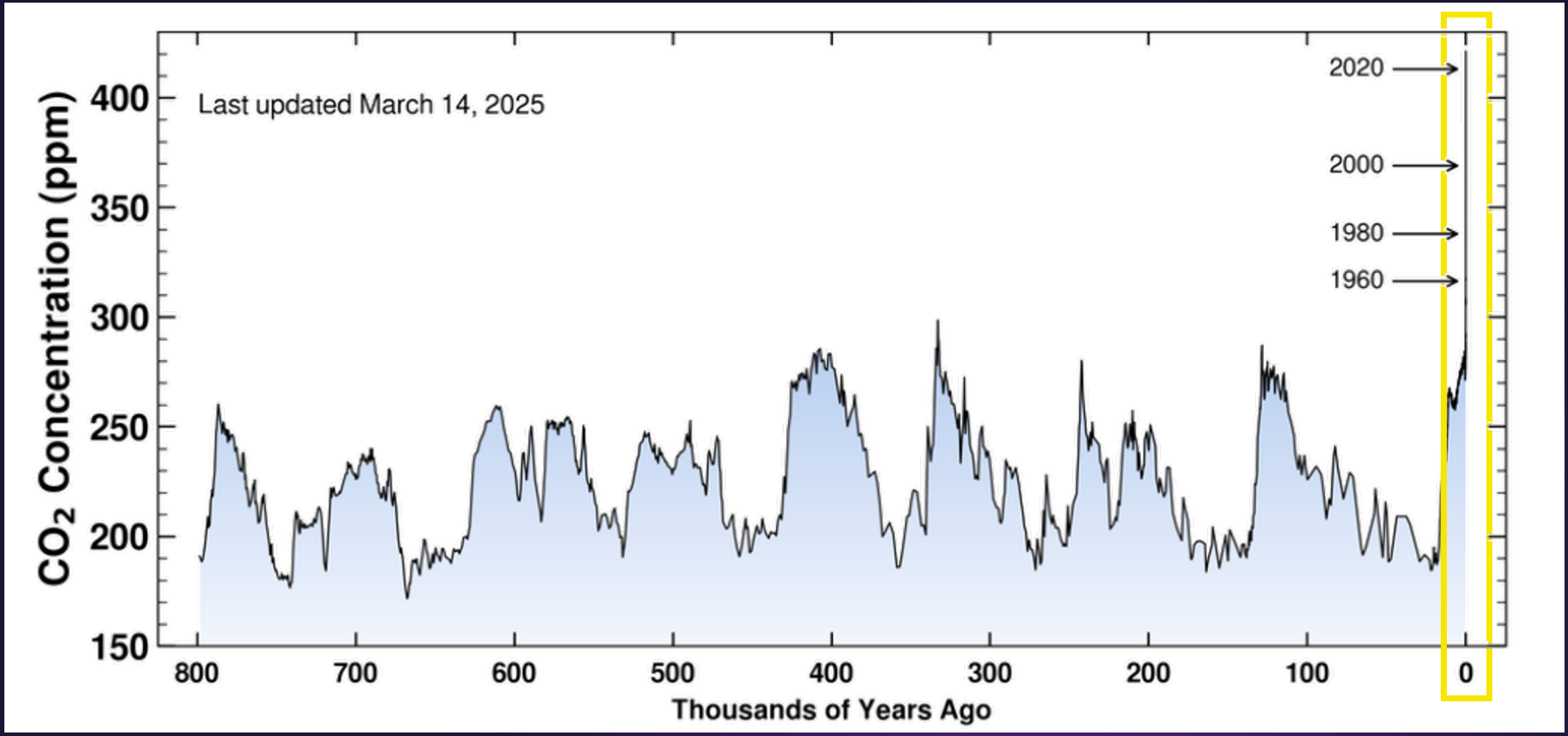
1. Global Context
2. What is DAC?
3. Power System Implications
4. Policy Implications
5. Summary & Q&A

Why DACCS?



Source: The Keeling Curve (maintained by Scripps Institution of Oceanography at UC San Diego)

Why DACCS?

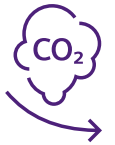


Source: The Keeling Curve (maintained by Scripps Institution of Oceanography at UC San Diego)

The Problem:

450 ppm CO_2 in the atmosphere is
too much for the climate,
but not enough to make
Direct Air Capture easy or affordable.

Why DACCS?



Achieving Net Zero Targets

Offset emissions from hard-to-abate sectors

Flexible demand

Reduce curtailment by up to 30TWh by 2050

Minimal Land & Water Usage

Less resource required compared to other carbon removal methods

How to use DACCS:

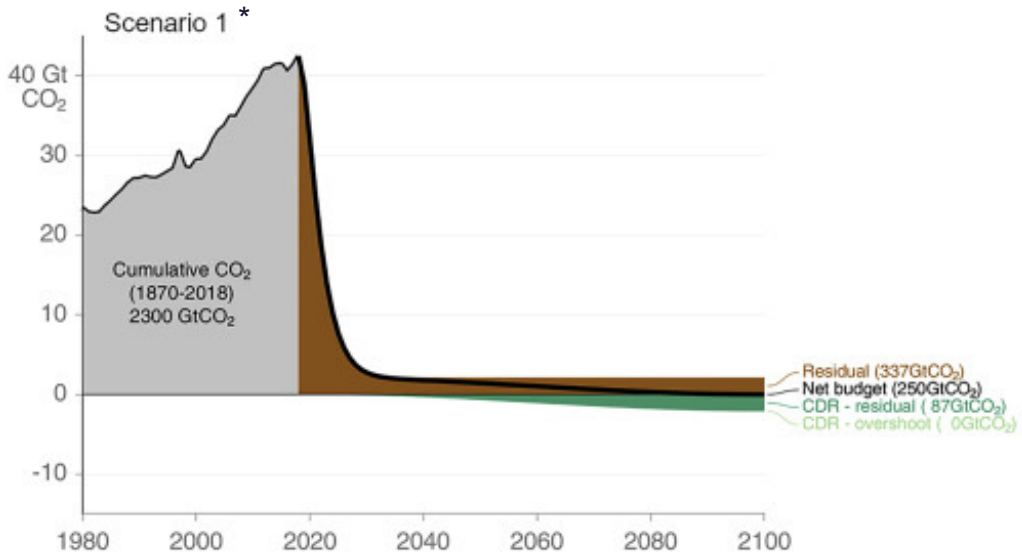
In tandem with other technologies.

Not in place of other efforts.

Net Zero?

- National Grid definition: “the **balance** between the amount of greenhouse gas (GHG) that's **produced** and the amount that's **removed** from the atmosphere”
- “can be achieved through a **combination of emission reduction and emission removal**”

Global Net Zero Targets



* Negative emissions offset residual (positive) emissions, resulting in little Carbon Dioxide Removal (CDR) and drastic and immediate emission reductions

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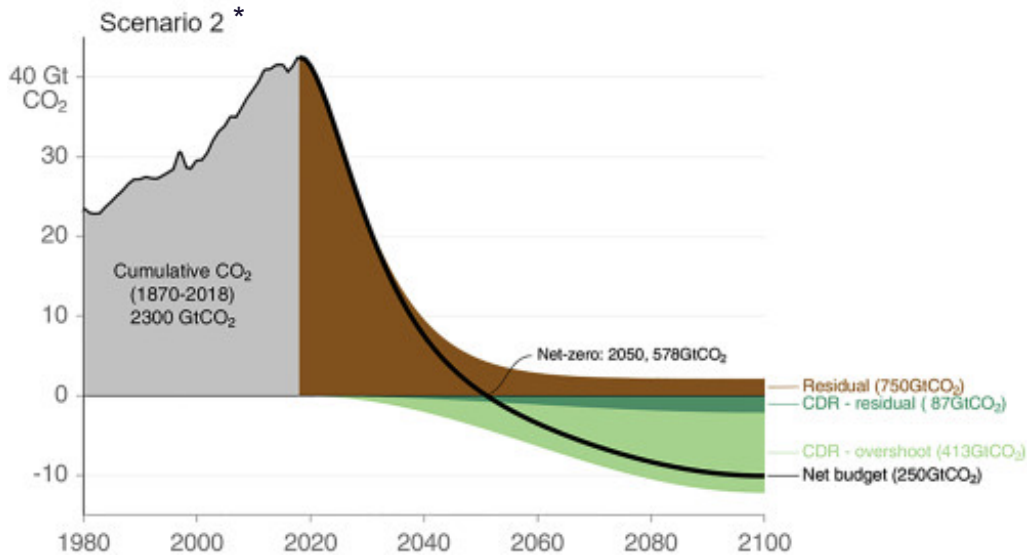
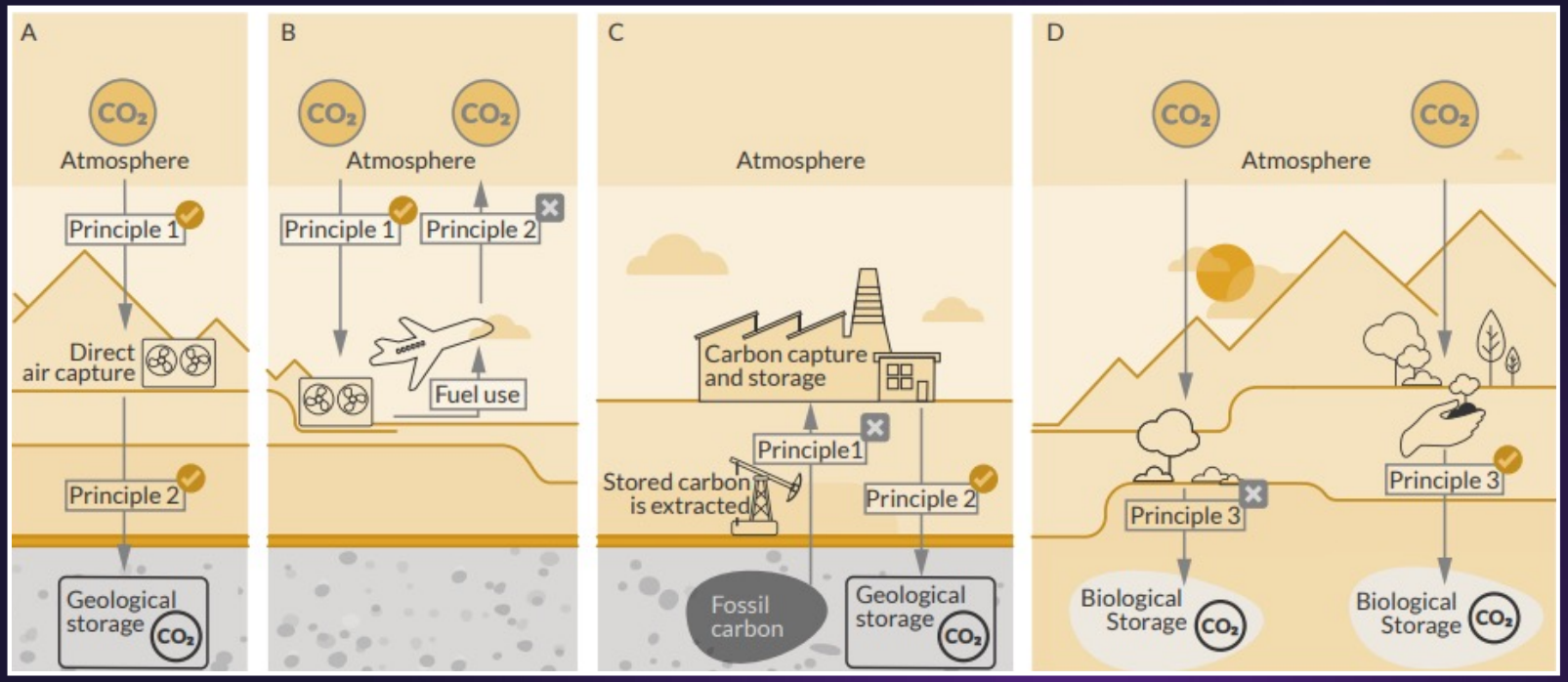
Global Net Zero Targets

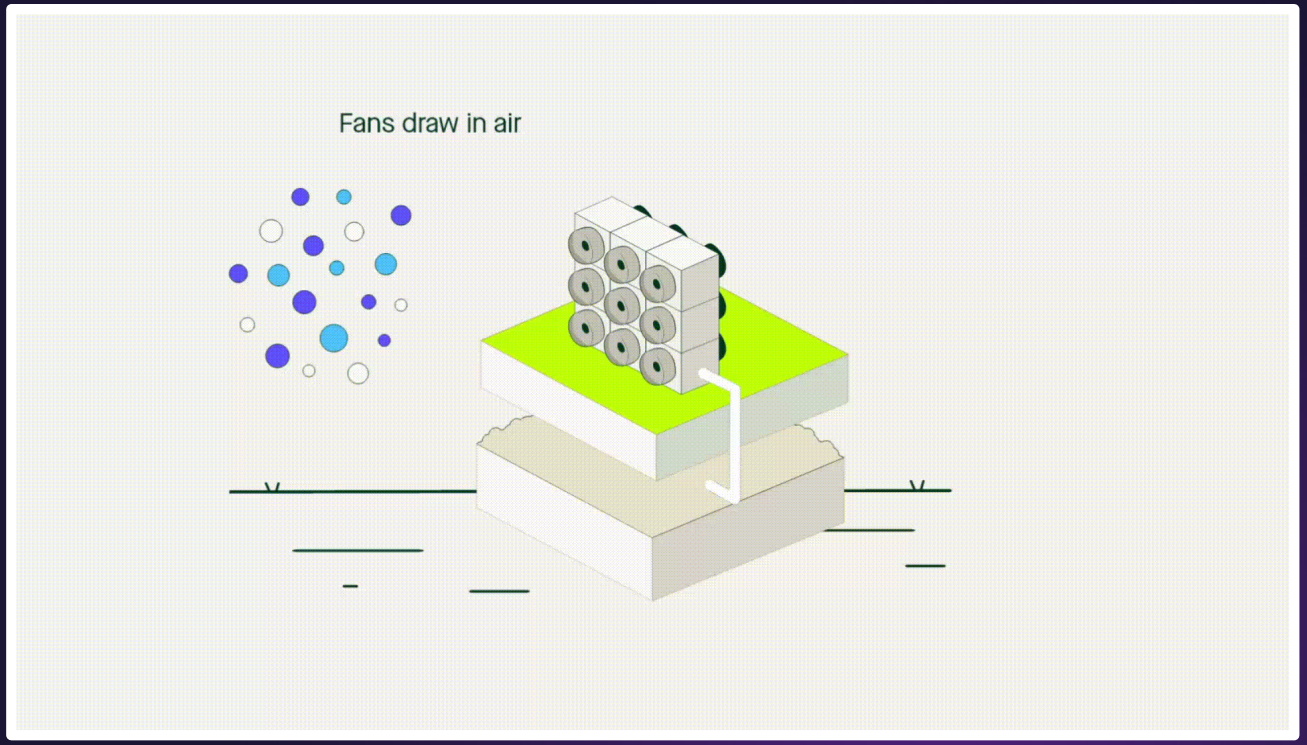


* Greater (positive) emissions result in larger Carbon Dioxide Removal (CDR) and higher overshoot before the temperature increase declines to 1.3°C–1.4°C in 2100, still with drastic CO2 emission reductions in the next two decades

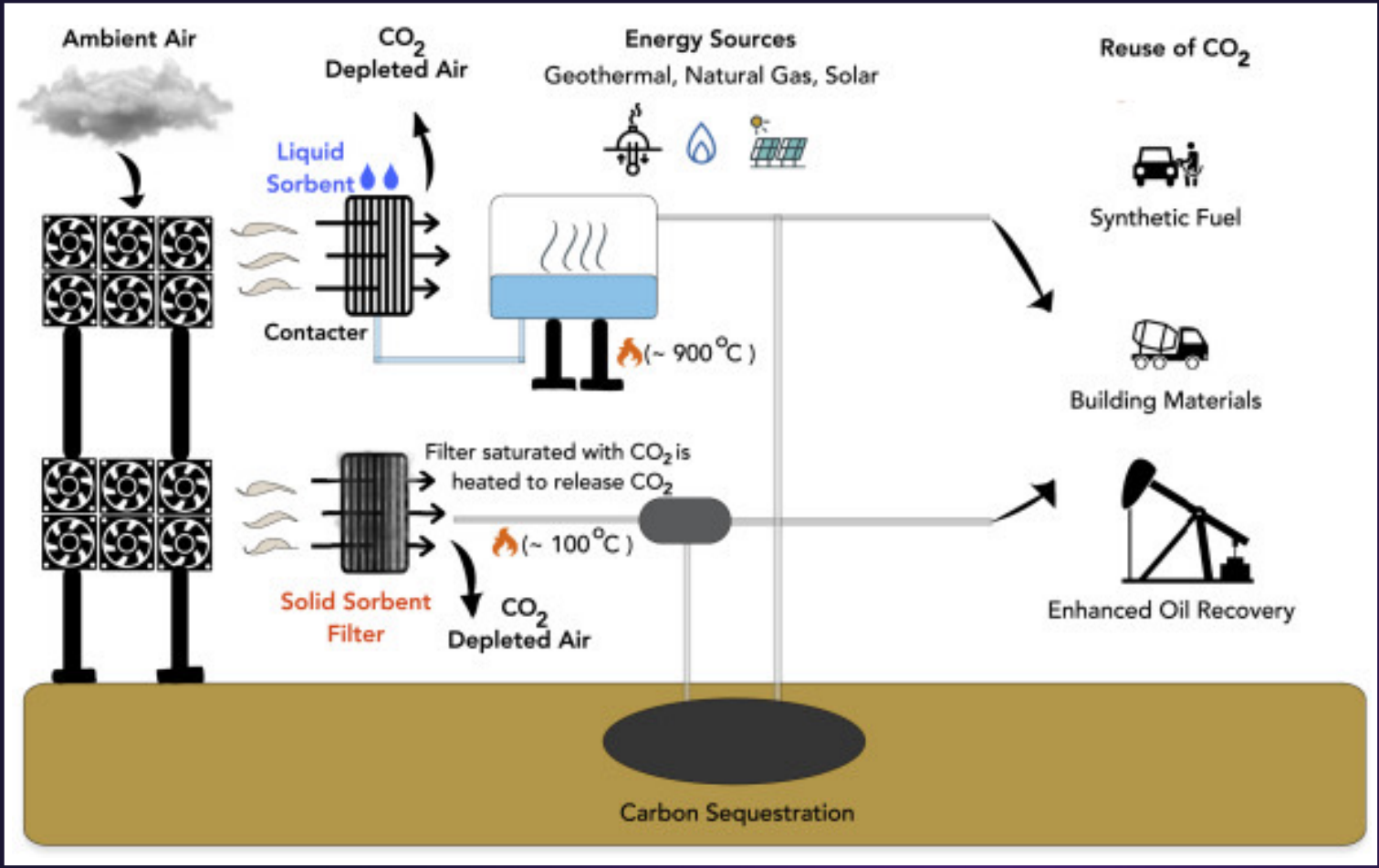
Carbon Dioxide Removal



Direct Air Capture 101



Direct Air Capture 101



DACCS Energy Intensity

- ~2,000kWh/tCO_2 removed
- 2 DAC Technologies
  - Thermal-based
    - 80% Thermal
    - 20% Electrical
  - Electrified
    - 100% Electrical

0.3 TWh/yr

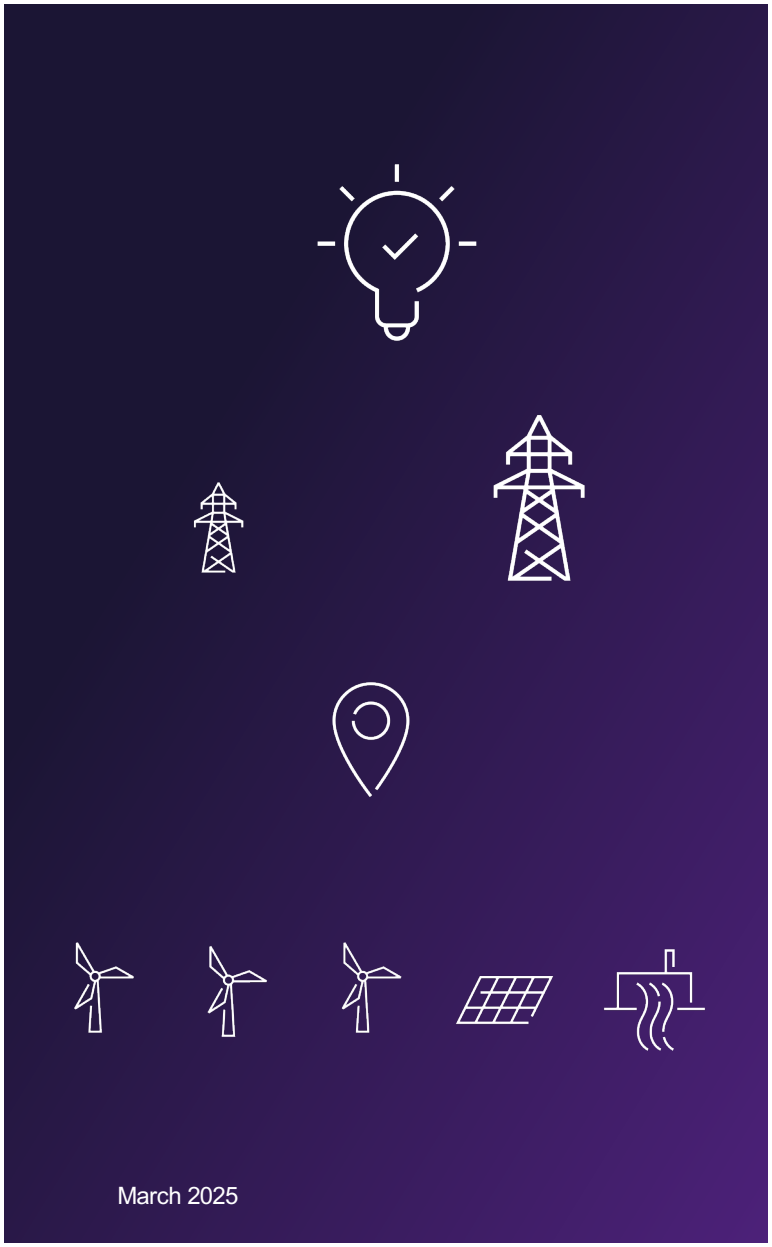
By 2035

10-30 TWh/yr

By 2050

UK DACCS Demand

- Various by organization / scenario constraints
- NESO Future Energy Scenarios (FES)
  - 5-15 $MtCO_2e$ by 2050
- UK Climate Change Committee (Balanced Pathway – CDR not feedstocks)
  - 0.15 $MtCO_2e$ by 2035
  - 8 $MtCO_2e$ by 2050



What does DAC mean for Electricity Grids?

~1 to 3GW installed capacity
to meet projected CO_2 removal by 2050 in the UK

Distribution connected plants, to kick off the industry

Other aspects

- Land availability,
- Environmental planning
- Grid connection

Huge potential

- Co-locate with renewable energy projects facing grid constraints
- Demand side response
- Business case - future?

Financial Incentives

Project support, e.g. guaranteed pricing mechanisms, tax credits; first-of-a-kind support; emissions accounting standards

Regulatory Frameworks

Streamlining the approval process for DACCS projects to reduce delays and uncertainties

Infrastructure Development

Strategic planning of CCS infrastructure & reduction of delivery times

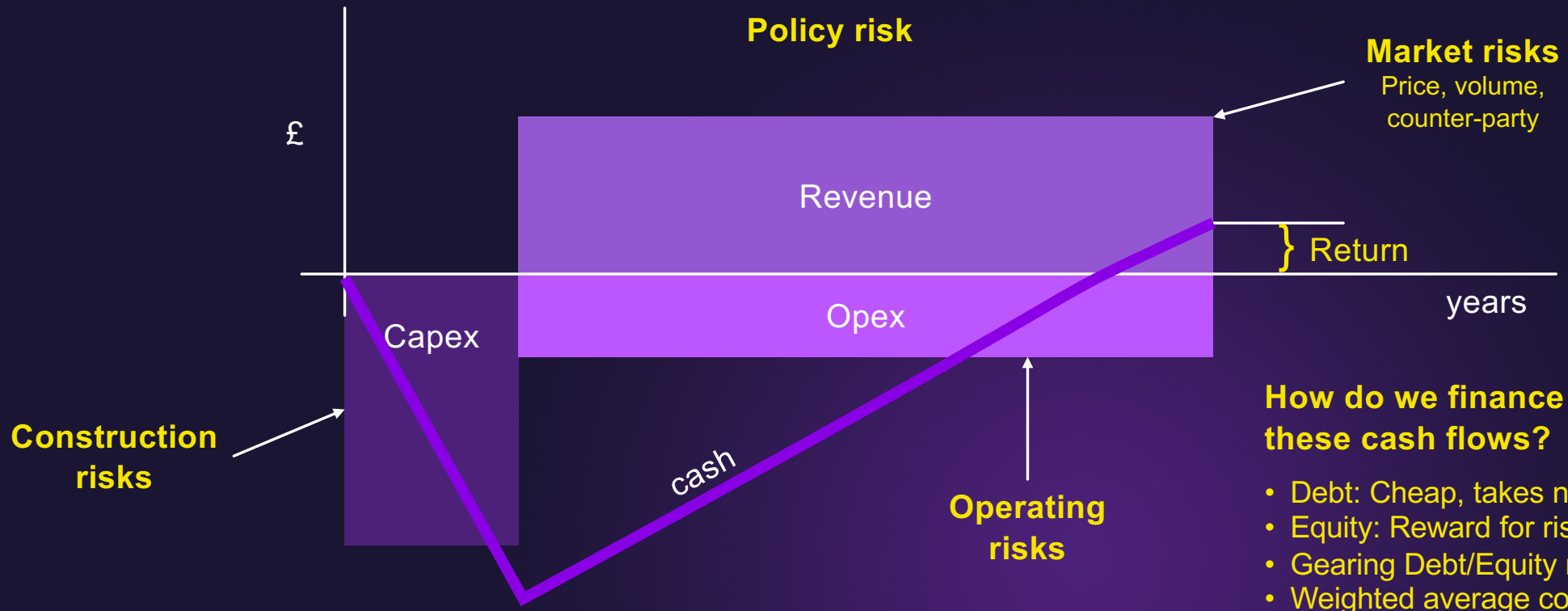
Research & Development

Dedicated funding for R&D to drive innovation and cost reductions

International Cooperation

Standardize DACCS practices & accelerate deployment

Raising the money for energy infrastructure



How do we finance these cash flows?

- Debt: Cheap, takes no risk
- Equity: Reward for risk
- Gearing Debt/Equity ratio
- Weighted average cost of capital (WACC)
- Refinancing

Summary

DAC in a nutshell

- **~2,000kWh** / tCO_2 removed
- **5-15MtCO_2** / yr by 2050 in UK; 980MtCO_2 / yr globally
- **10-30TWh** needed from electricity by 2050 (UK, electrified DAC)

Grid implications

- **Distribution connected** to kick off
- Huge potential to **co-locate with renewable energy** projects facing grid constraints
- Can be useful for **demand side response**

Policy environment

- DAC viability depends on **making the economics work**
- Support for **first-of-a-kind** projects & **rapid scaling**
- **Negative emissions have value**: Robust carbon pricing mechanisms & accounting standards

Thank you
for your attention!