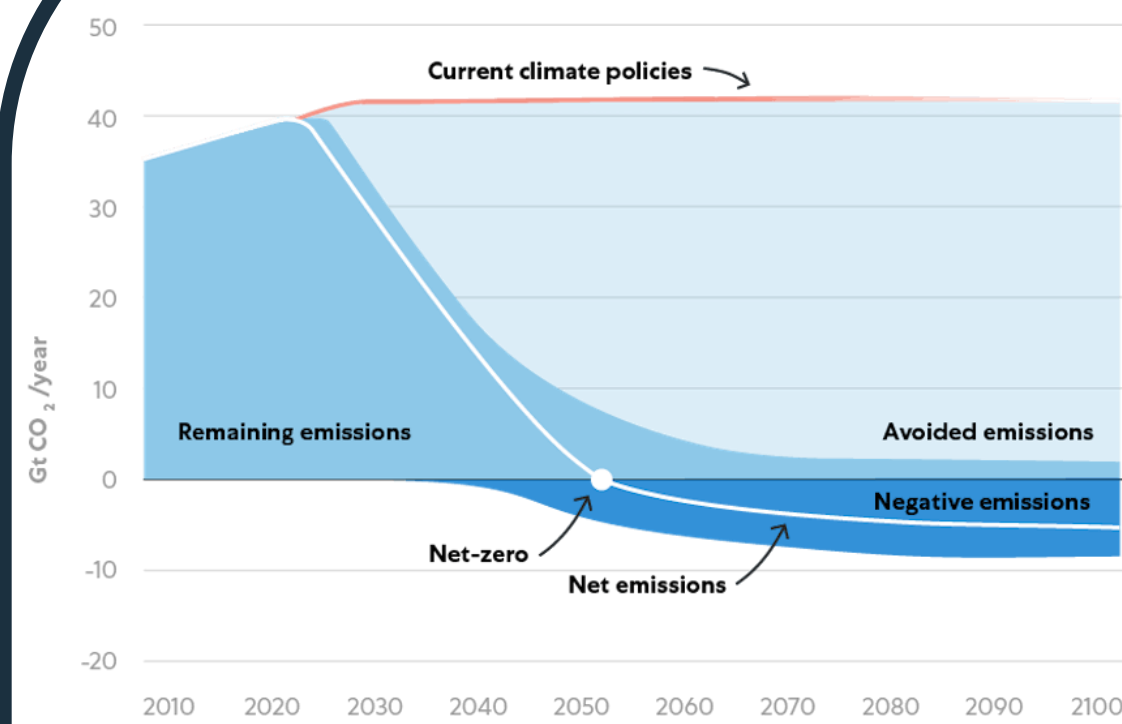
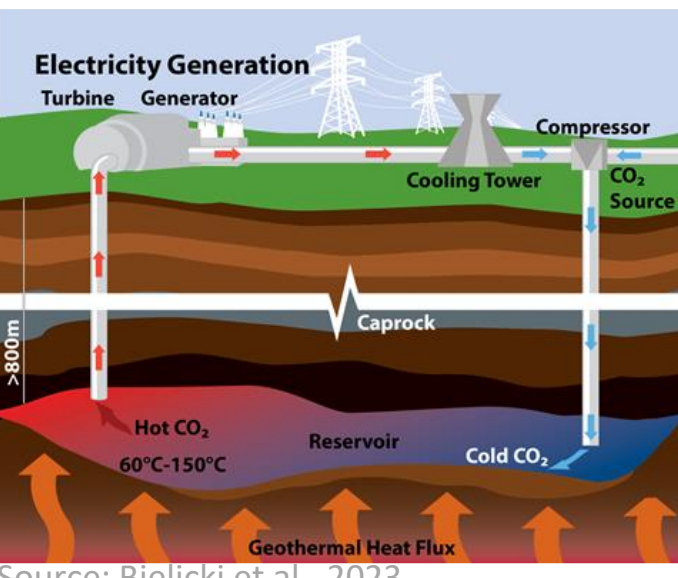


Introduction



Direct Air CO₂ Capture (DACC)

- Captures the CO₂ from the atmosphere
- DACC requires **process heat** and **electricity**



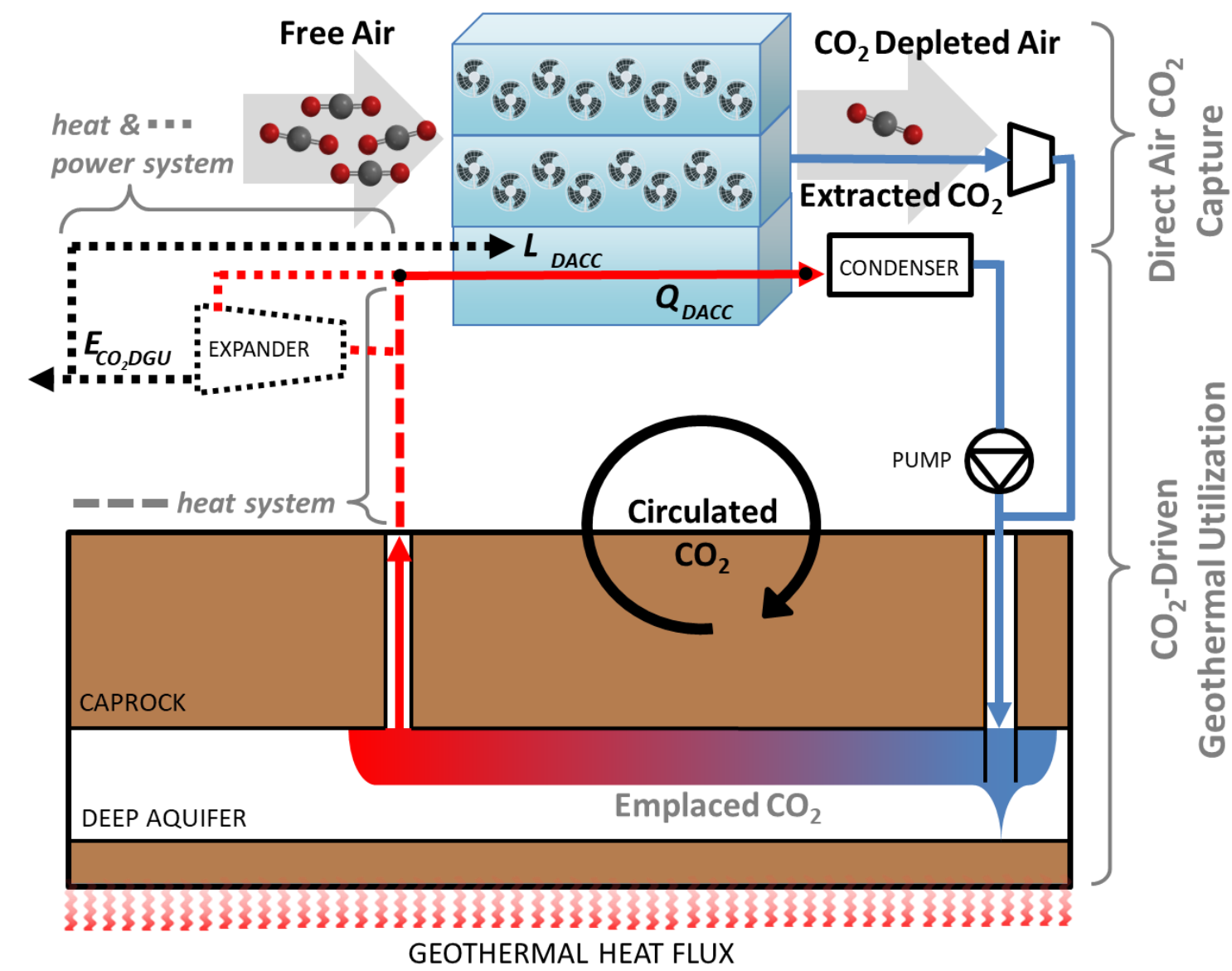
CO₂-driven Geothermal Utilization (CO₂DGU): Geologically stored CO₂ can be circulated to **extract geothermal heat** from a sedimentary basin geothermal resource (Randolph and Saar, 2011).

The hot produced CO₂ can be used directly or converted to **electricity** (Adams et al., 2015).

What if We can Use the CO₂ that is Extracted from the Atmosphere to Provide Process Needs to Improve the Efficiency of Removing CO₂ from the Atmosphere?

Research Highlights

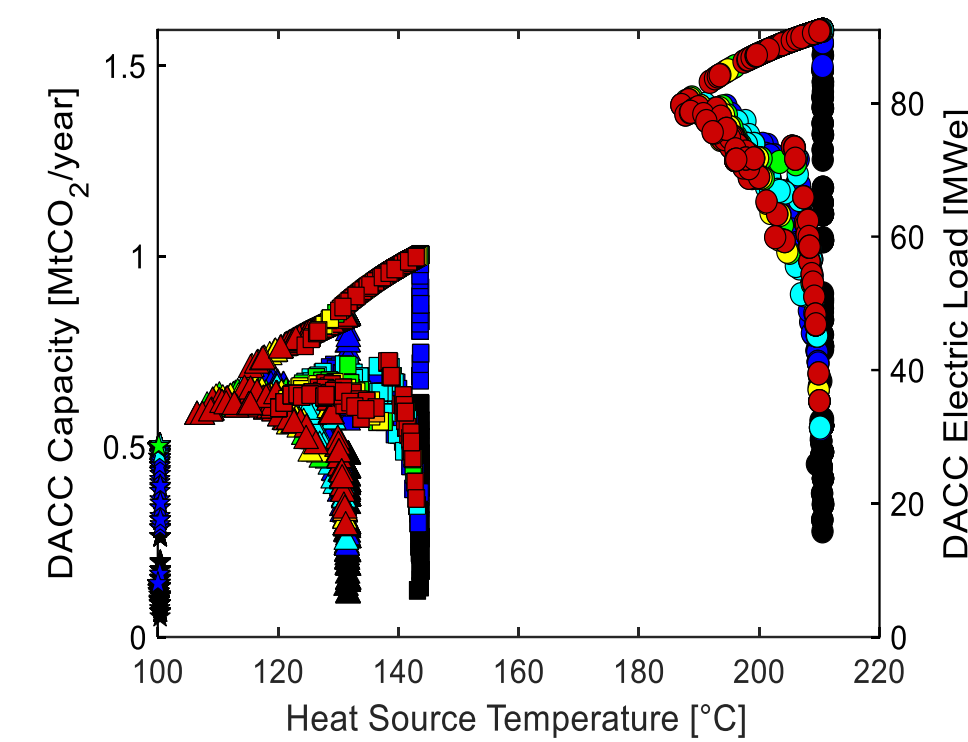
Direct Air CO₂ Capture, Utilization, and Storage (DACCUS)



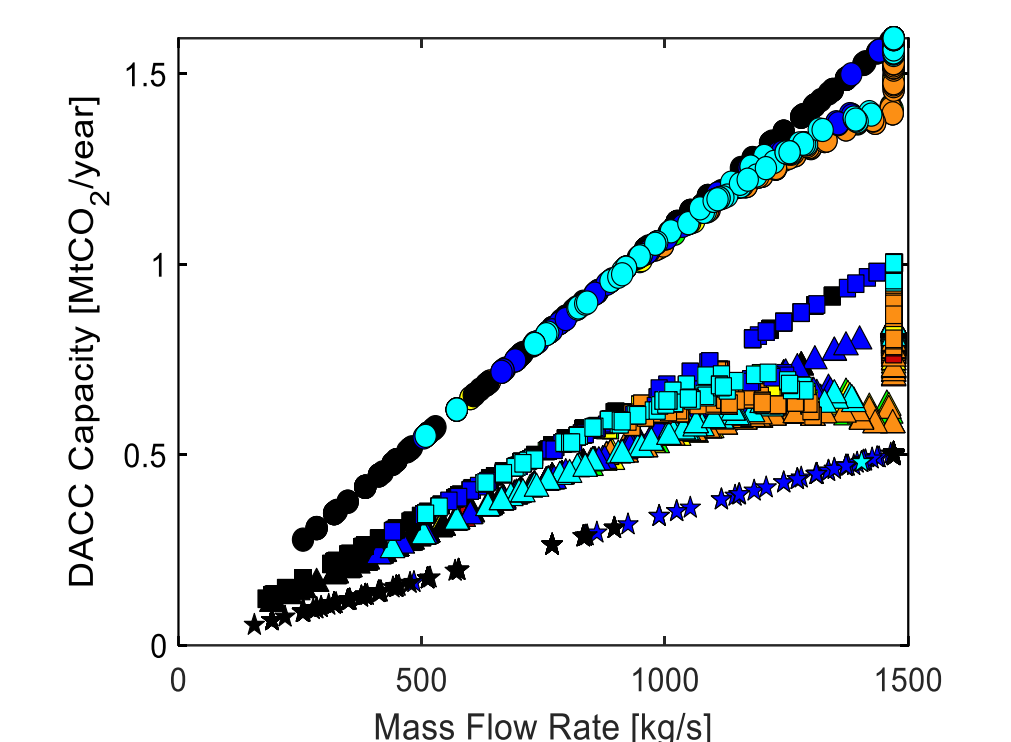
DACCUS uses the CO₂ that has been extracted from, or would be emitted to the atmosphere to provide process heat and electricity to extract more CO₂ from the atmosphere

- Reservoir Heat Source**
- ☆ 50°C/km, 2500 m
 - △ 35°C/km, 5000 m
 - 50°C/km, 3500 m
 - 50°C/km, 5000 m
- Permeability (m²)**
- 1x10⁻¹⁵
 - 5x10⁻¹⁵
 - 5x10⁻¹⁴
 - 1x10⁻¹⁴
 - 1x10⁻¹³
 - 1x10⁻¹²
 - 1x10⁻¹¹

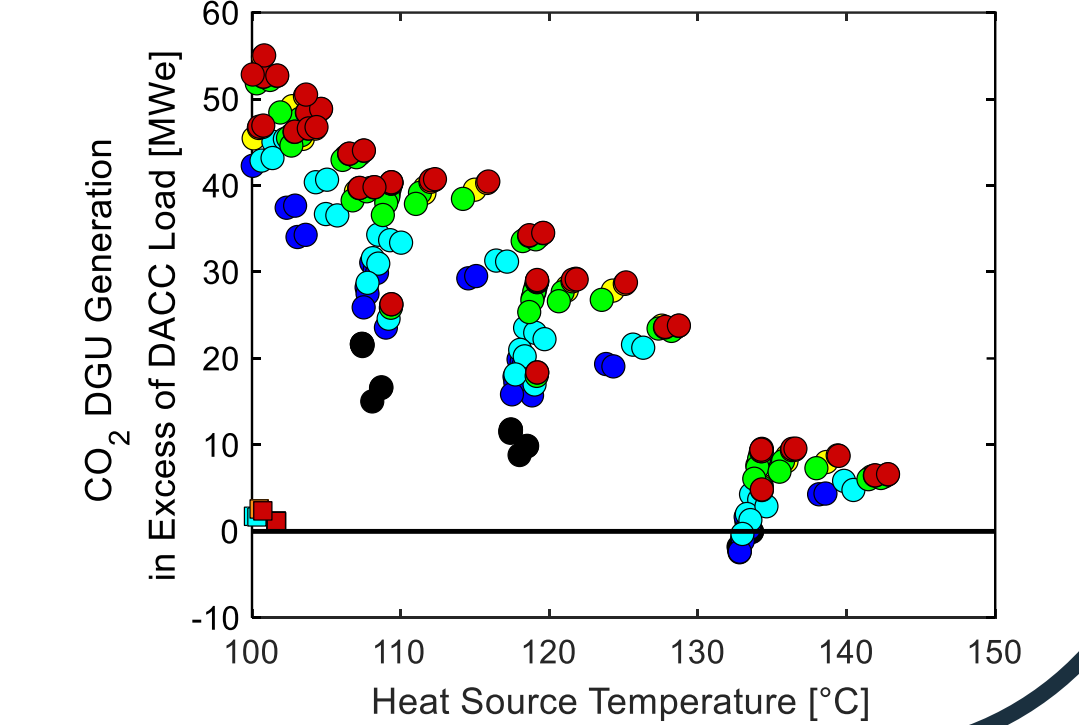
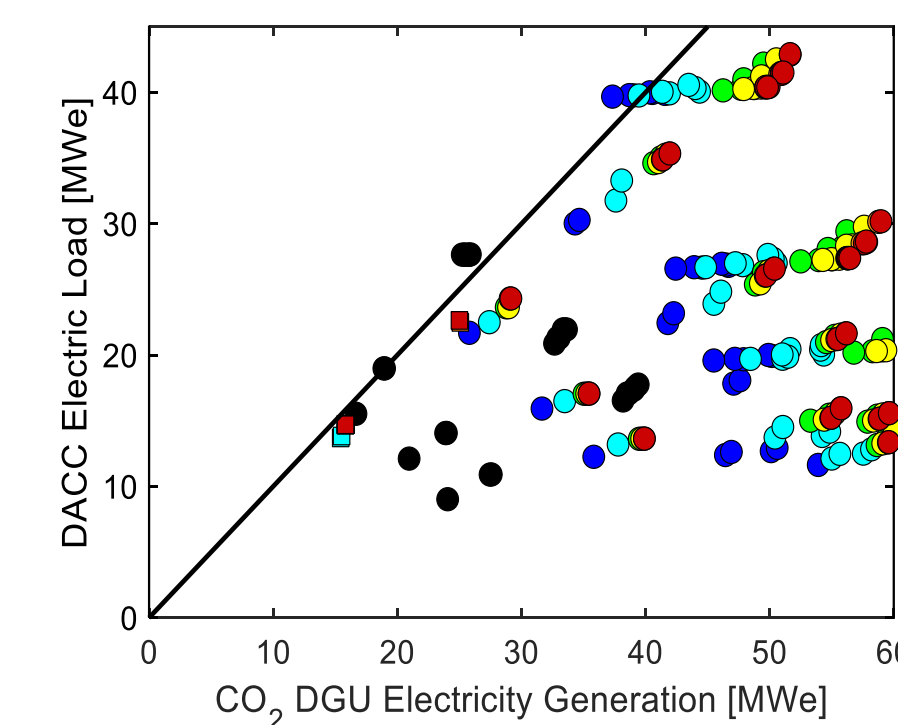
DACC Capacity and Electricity Load for DACCUS Heat System



Results



DACC Electric Load, CO₂DGU Electricity Generation, and CO₂DGU Electricity Generation in Excess of DACC Electric Load for DACCUS Heat and Power System



Methods

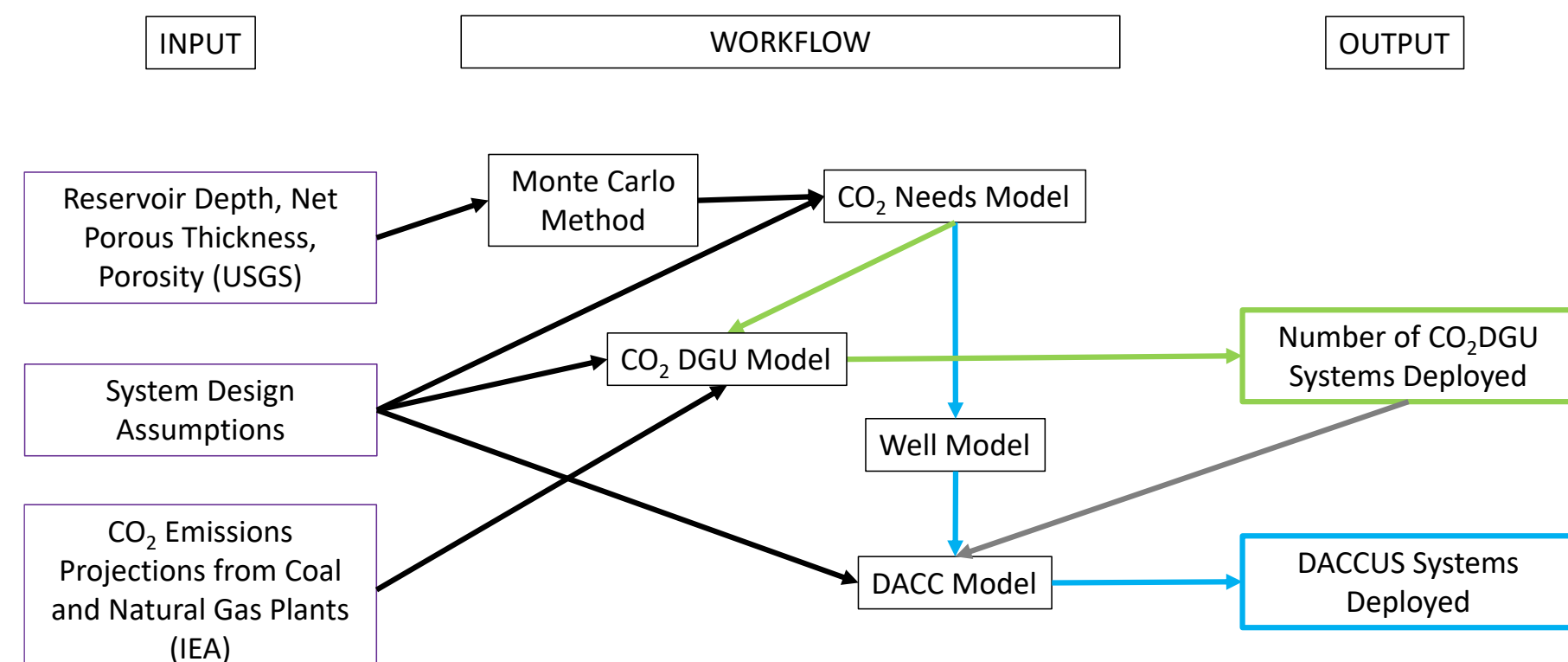
Two DACCUS configurations are investigated:

- 1) Heat System: CO₂DGU provides the heat to regenerate the solid sorbent;
- 2) Heat and Power System: The heat extracted by CO₂DGU is used to generate electricity, and the excess sensible heat is used to regenerate the solid sorbent.

The heat provided by the CO₂DGU system is

$$Q_{HS} = \dot{m}_{HS} \cdot (h_{HS,in} - h_{HS,out})$$

where \dot{m}_{HS} is the mass flowrate of the heat source (i.e., CO₂ circulating through the CO₂DGU system) and $h_{HS,out}$ is the enthalpy of the heat source out of the DACC system.



The annual capacity of DACC is

$$C_{DACC} = \eta_q \cdot \left(\frac{Q_{HS}}{\theta_{reg}} \right) \cdot t_h$$

where η_q is the heat exchange efficiency between the heat source and the DACC facility, θ_{reg} is the specific thermal load to regenerate the solid sorbent, and t_h is the operating hours per year.

1. DACCUS can satisfy the electric load of the DACC facility in over 90% of the relevant reservoir characteristics we examined.
2. This integration could improve efficiency, reduce costs, and increase the net reductions in atmospheric CO₂ and the broader system that provides the inputs DACC requires
3. DACCUS can be deployed in formations with thicknesses lower than 100 meters because the CO₂ need of these reservoirs is such that they can be primed in 5 years or less.

References

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 Leveni M., under revision, Potential for Climate Benign Direct CO₂ Capture with CO₂-Driven Geothermal Utilization (DACCUS). *Environ. Res. Lett.*