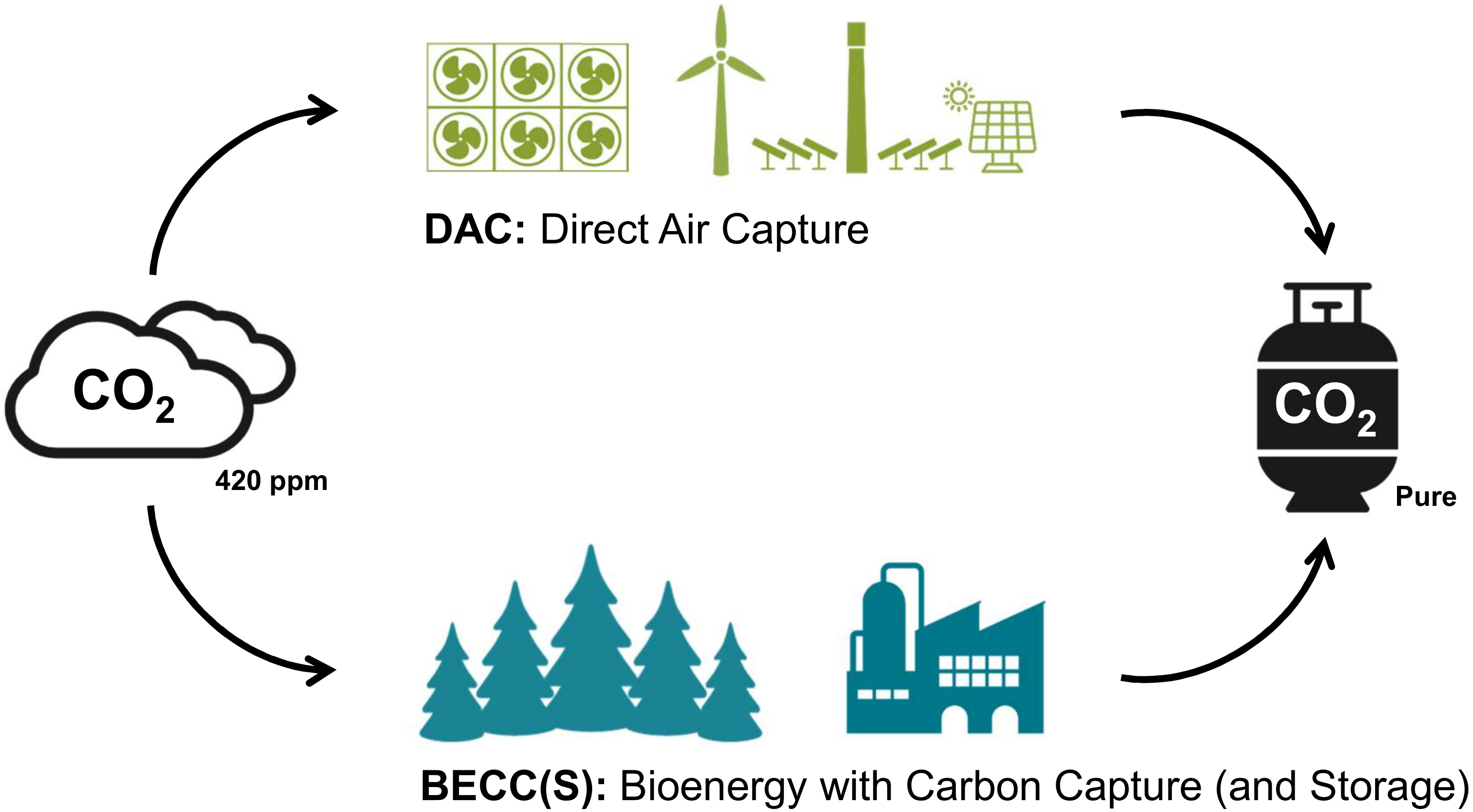
SOLAR DIRECT AIR CAPTURE

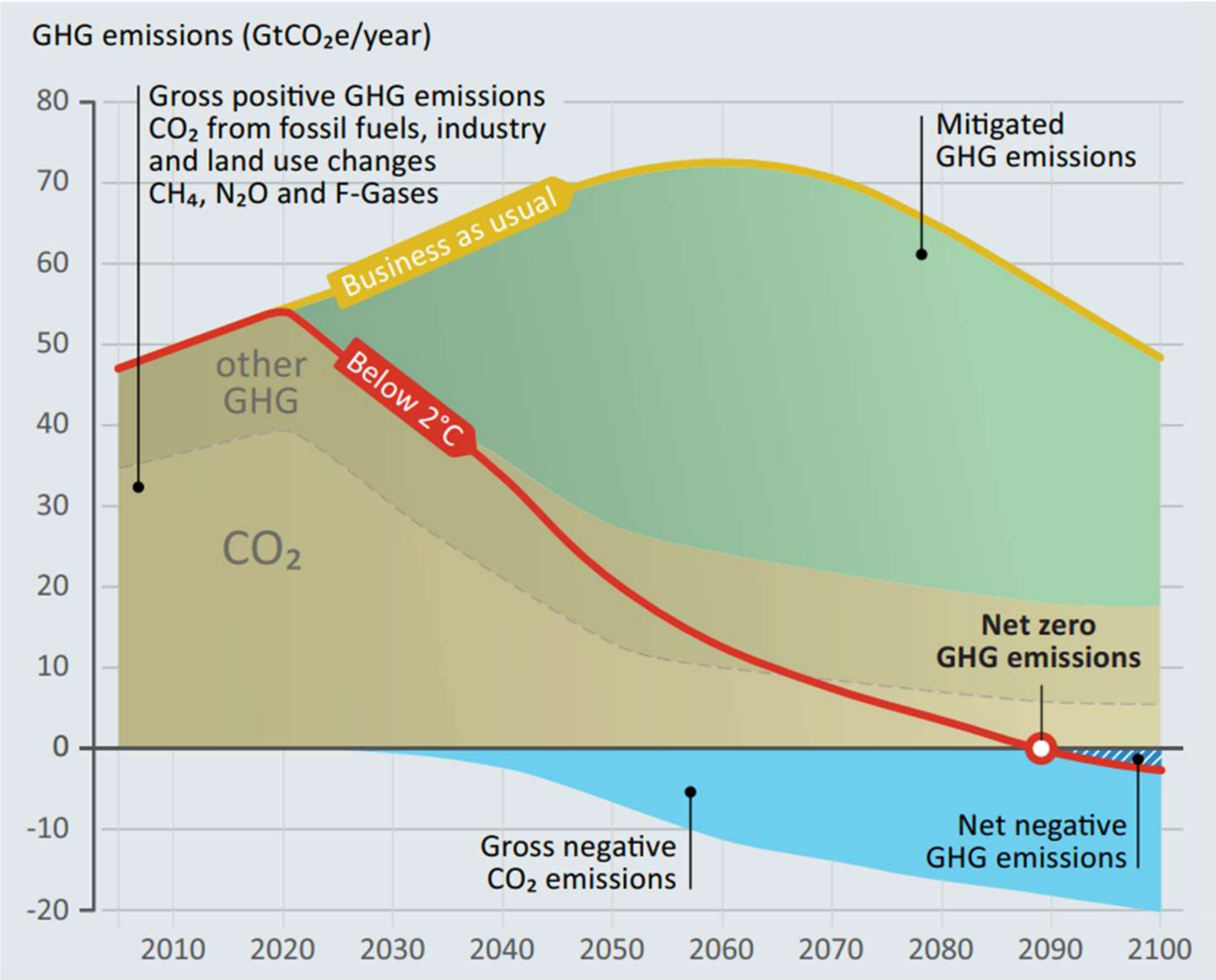
Enric Prats-Salvado – Conference on CO_2-based Fuels and Chemicals 2023

DLR

What is direct air capture of CO_2?



Why do we need direct air capture?



Carbon Capture & Utilization (CCU):

Main solution for hard-to-abate sectors

Accelerate transition in other sectors

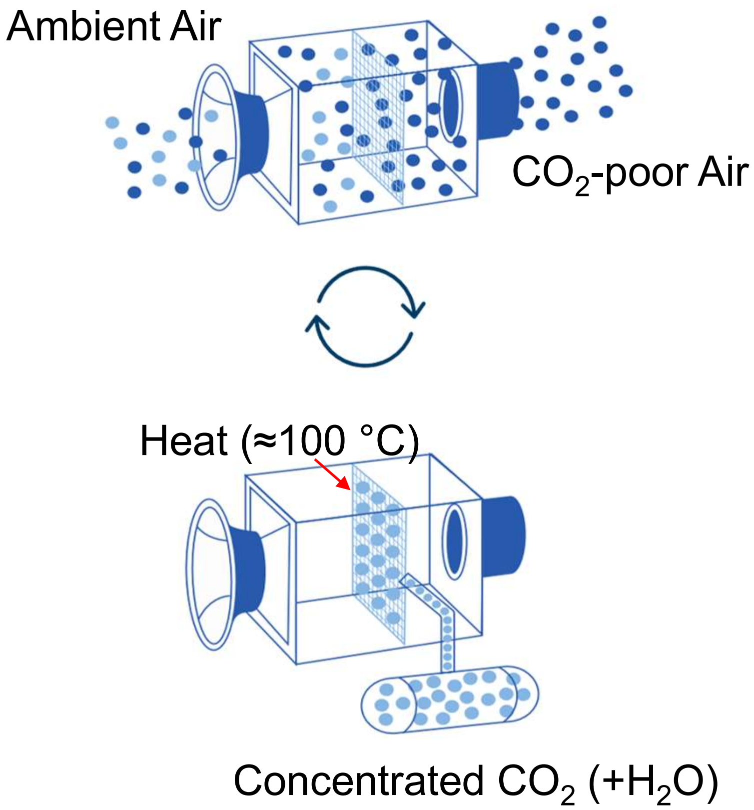
Carbon Capture & Storage (CCS):

Reverse emissions

Source: UNEP Emissions Gap Report 2017

How does direct air capture work?

Solid Direct Air Capture (S-DAC)



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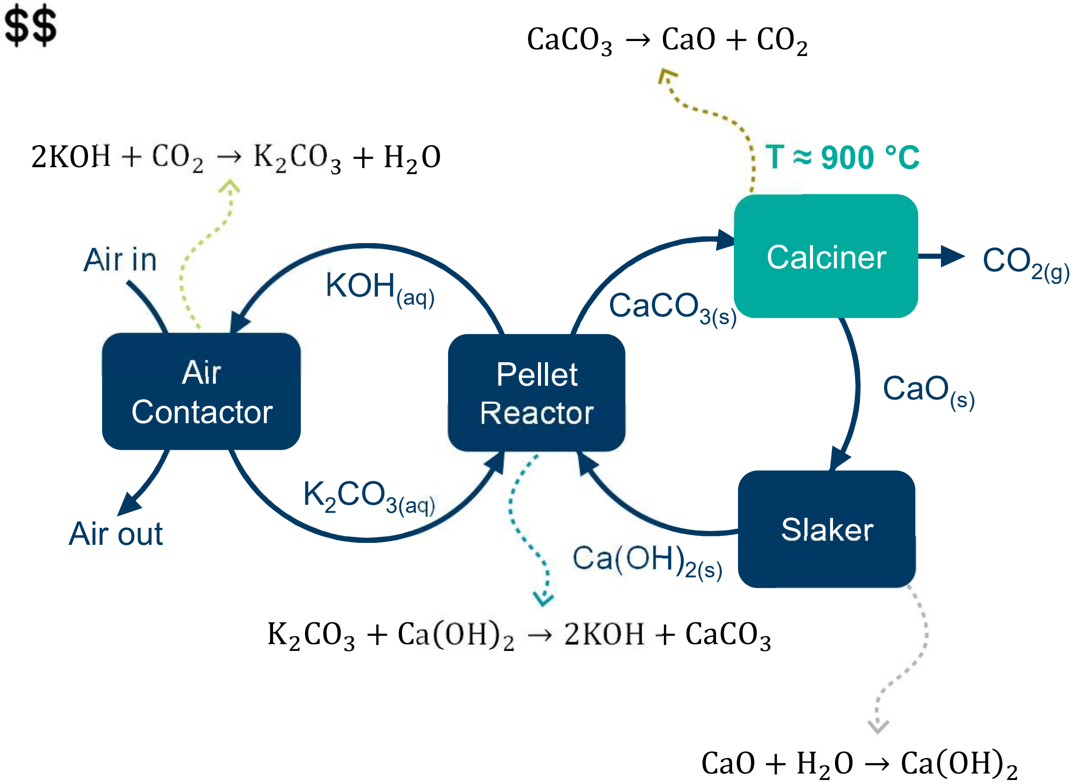
Liquid Direct Air Capture (L-DAC)



Source: Deutz and Bardow 2021

How does direct air capture work?

Solid Direct Air Capture (S-DAC)

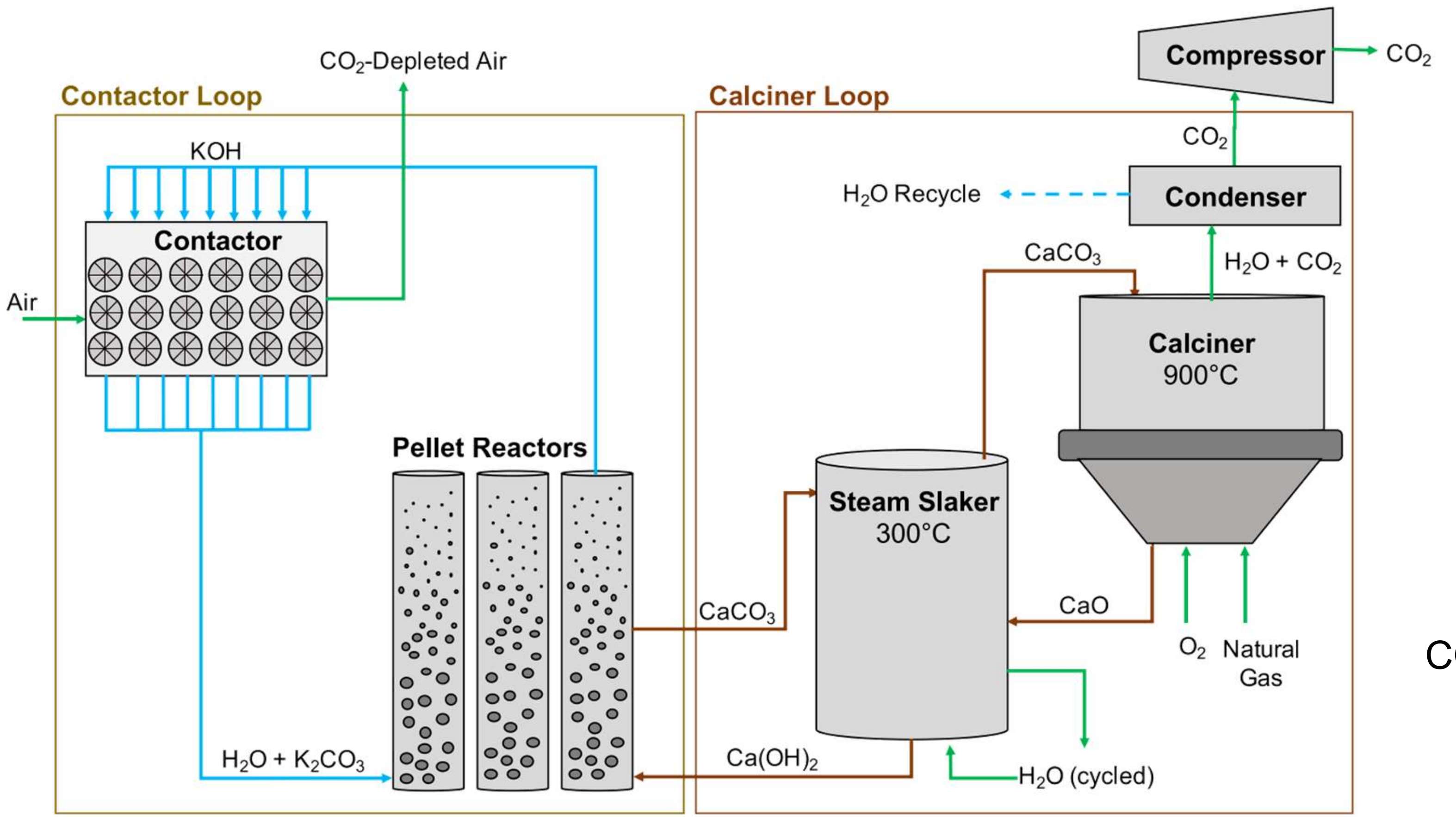
Climeworks (2021, 4 kt CO_2/y, Iceland)

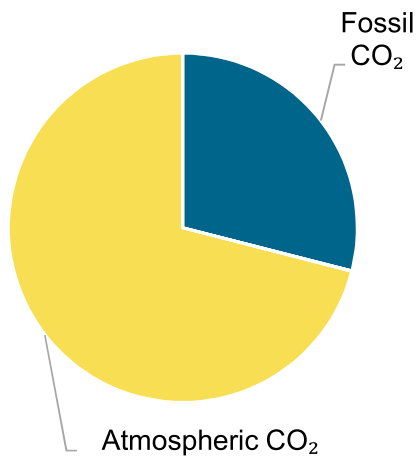
Liquid Direct Air Capture (L-DAC)

Carbon Engineering (2024, 0.5 Mt CO_2/y, US)

Sources: climeworks.com; iea.org

How can we use solar energy in L-DAC?



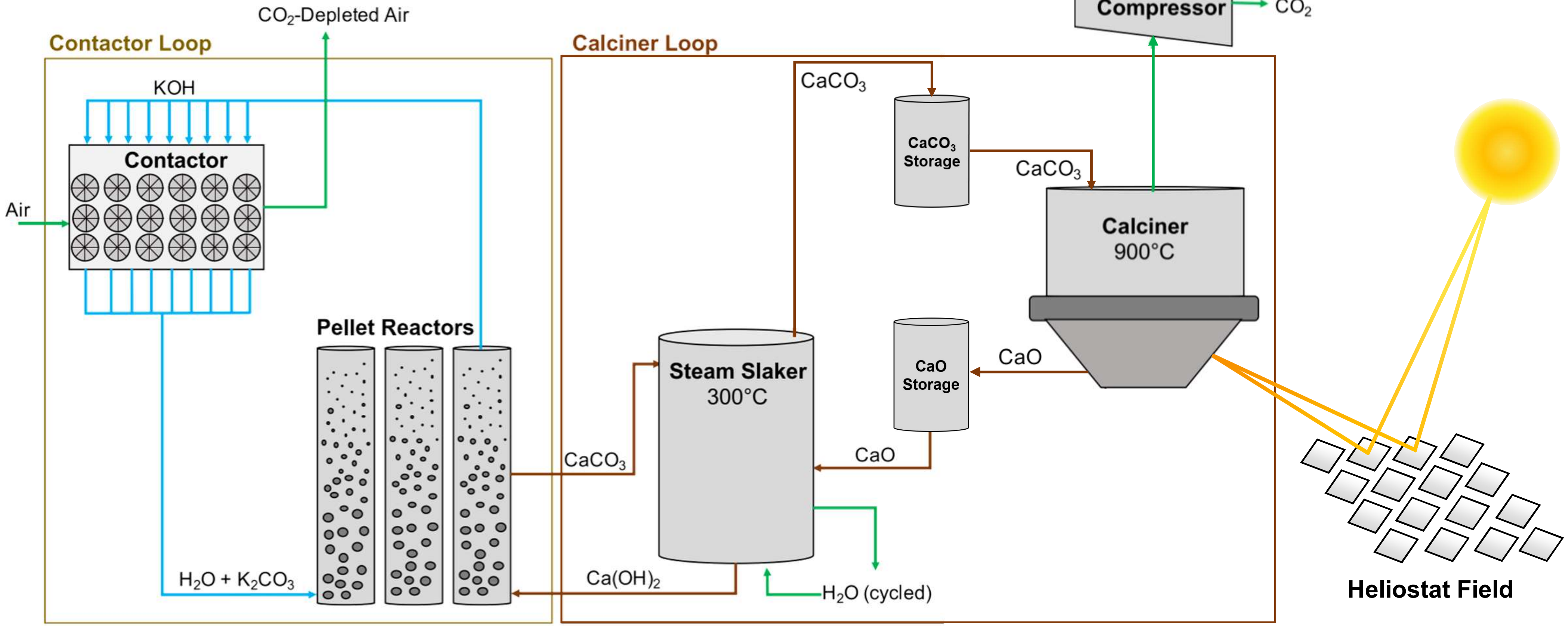


CO_2 mostly limited to CCS

Sources: Fasihi 2019, McQueen et al. 2021

How can we use solar energy in L-DAC?

Water losses?
Carbon removal efficiency?



Sources: Fasihi 2019, McQueen et al. 2021

Is there a suitable location for solar L-DAC?

Requirements:

1) L-DAC is water-intensive and must be scalable → Desalination water → ≈100 km from sea
2) Solar equipment is a significant part of the CAPEX → Between ±45° Latitude

Location screening (Local WACC & 0.1 Mt_{CO2}/y)

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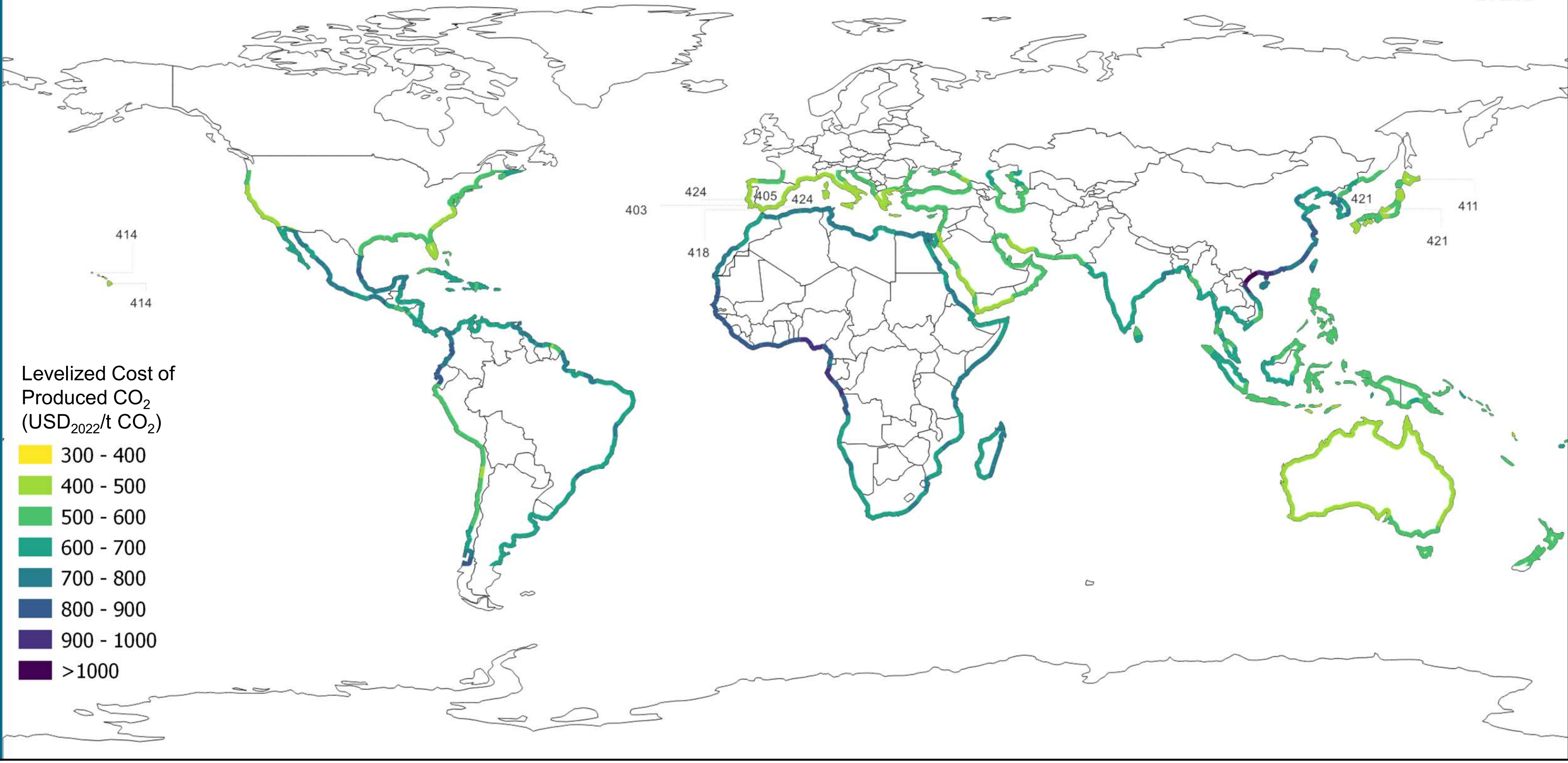
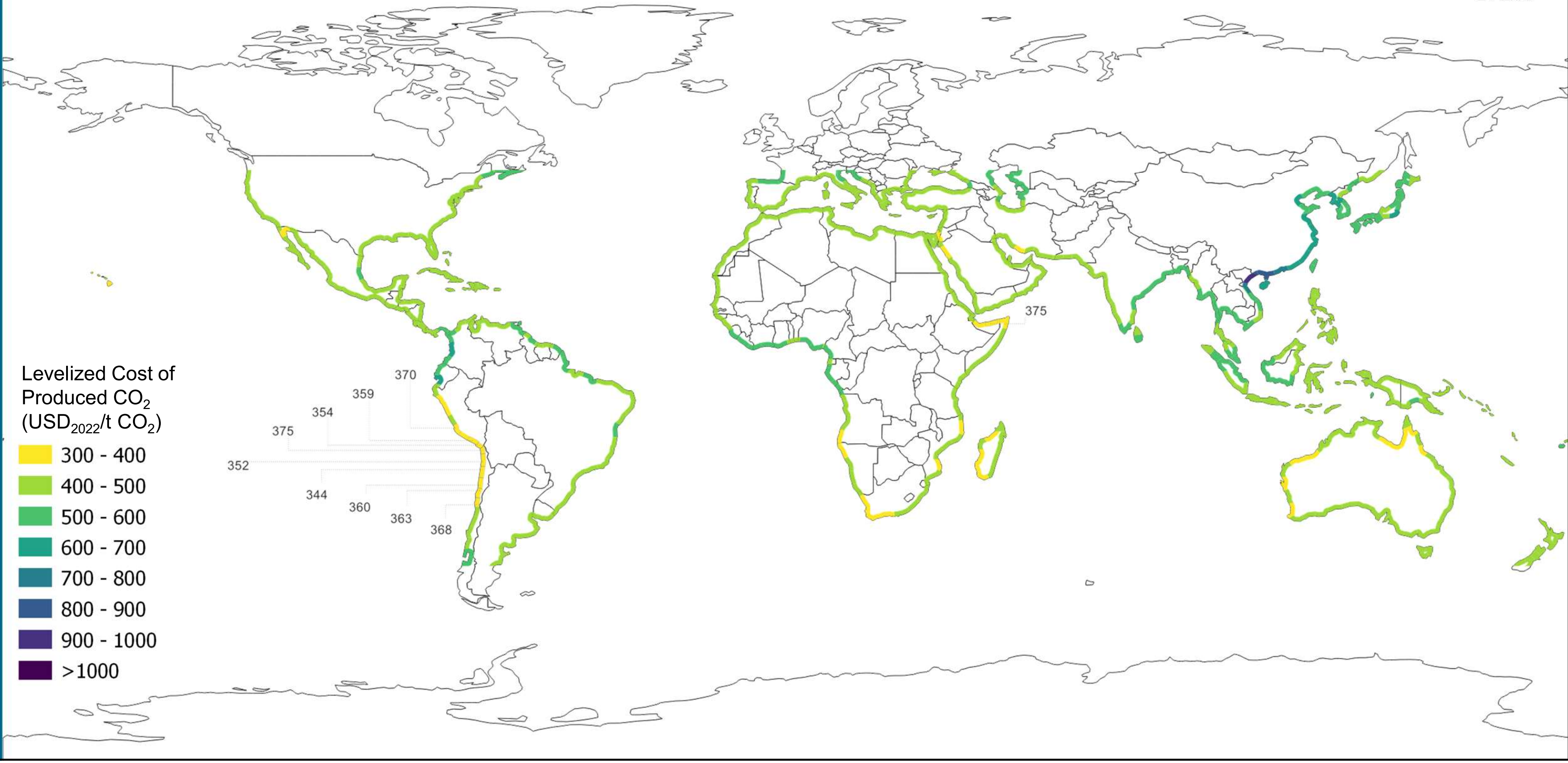
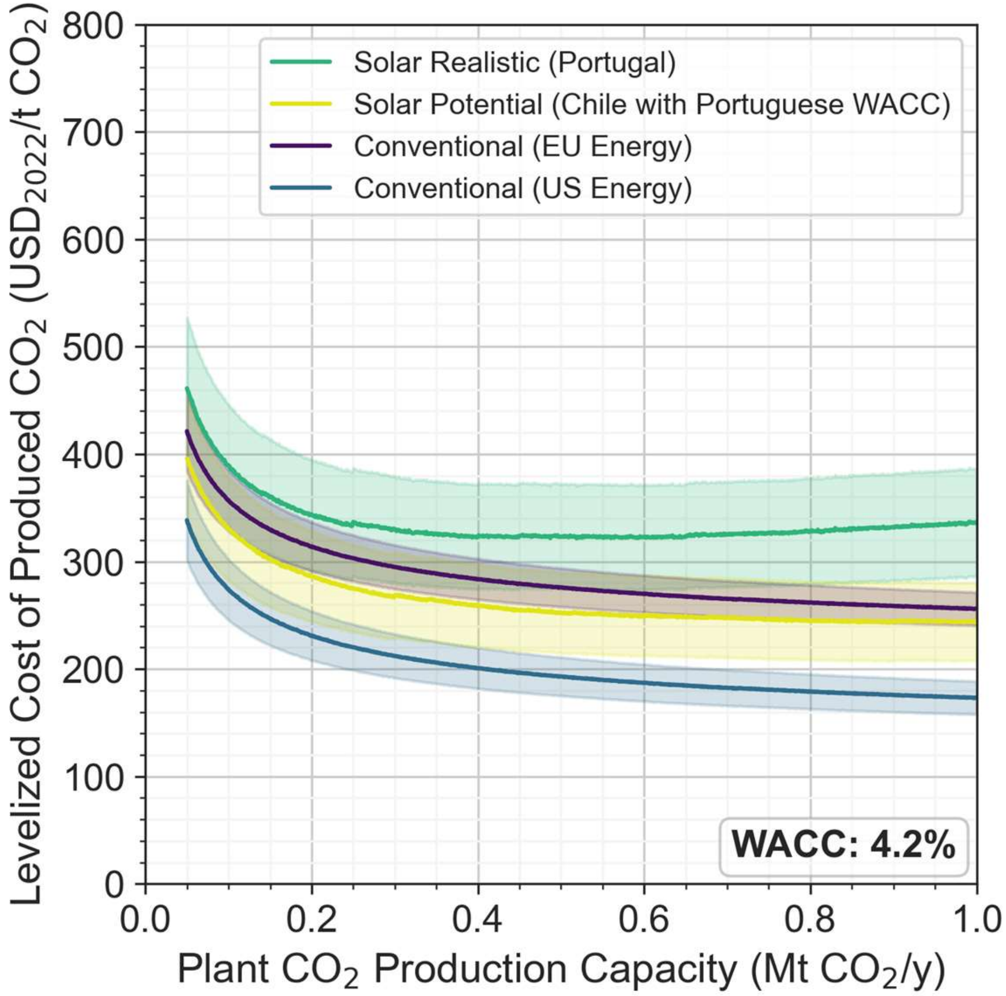


Location screening (Global 4.2% WACC & 0.1 Mt_{CO2}/y)

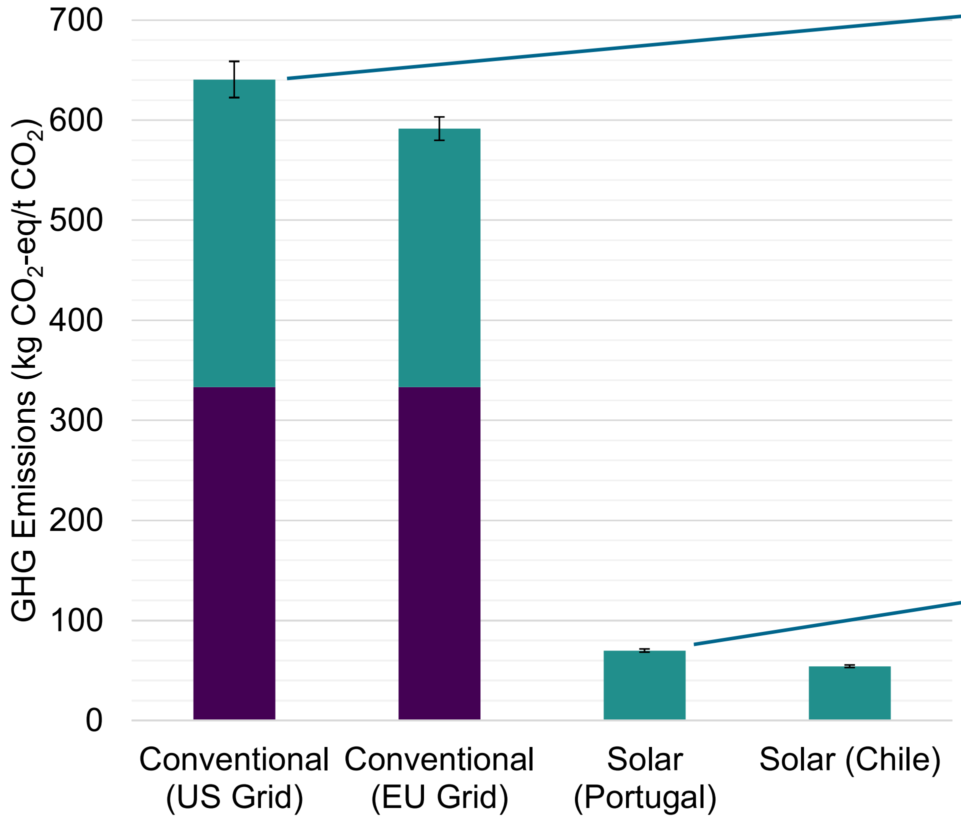


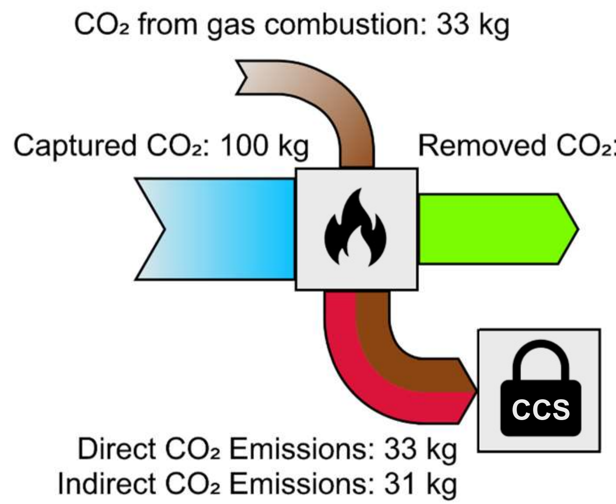
Impact of scale

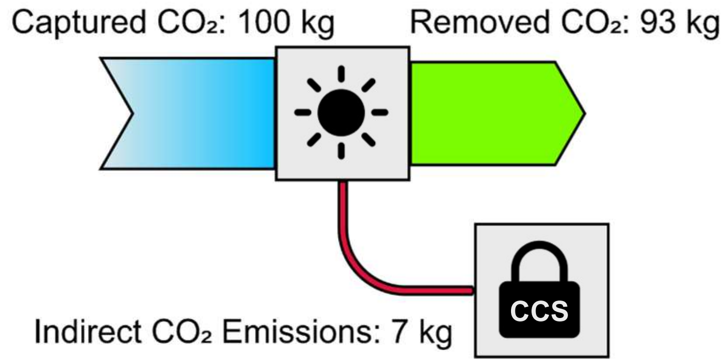


Impact of associated emissions

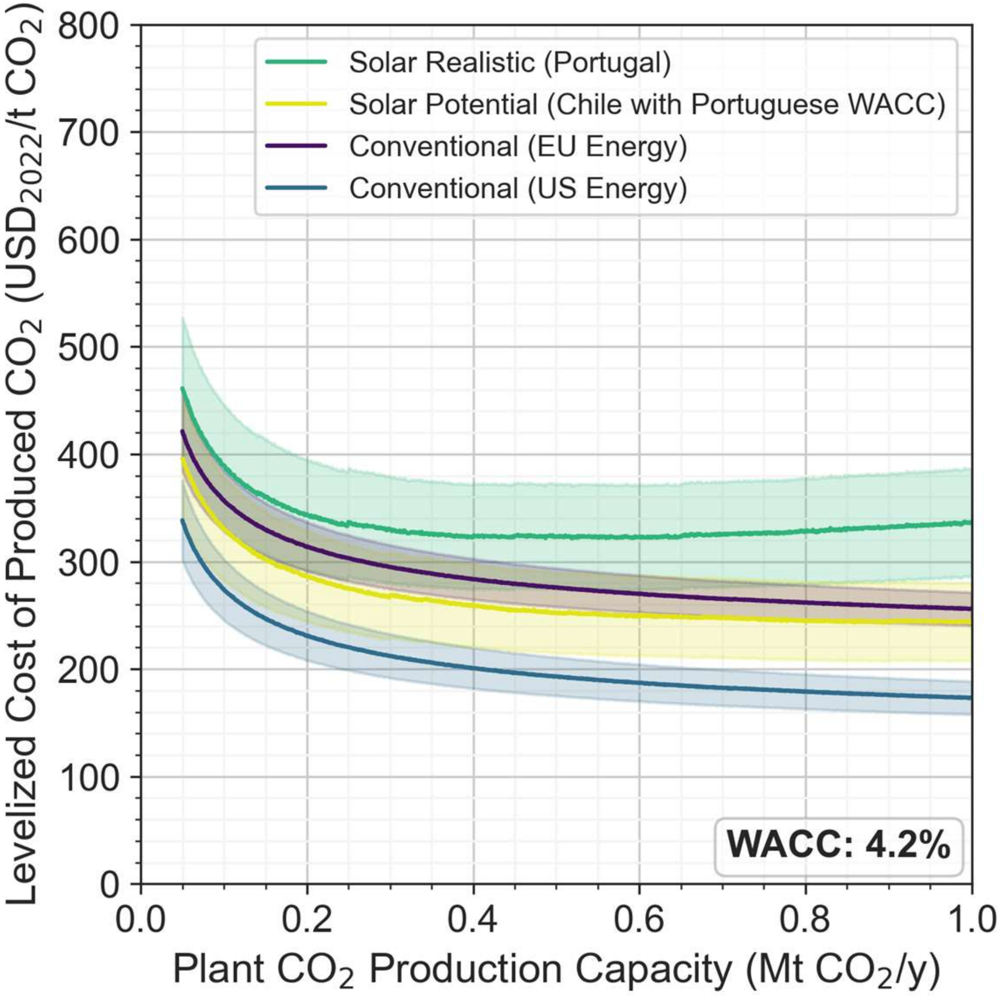
Life cycle assessment (LCA):
Climate Change Impact Category

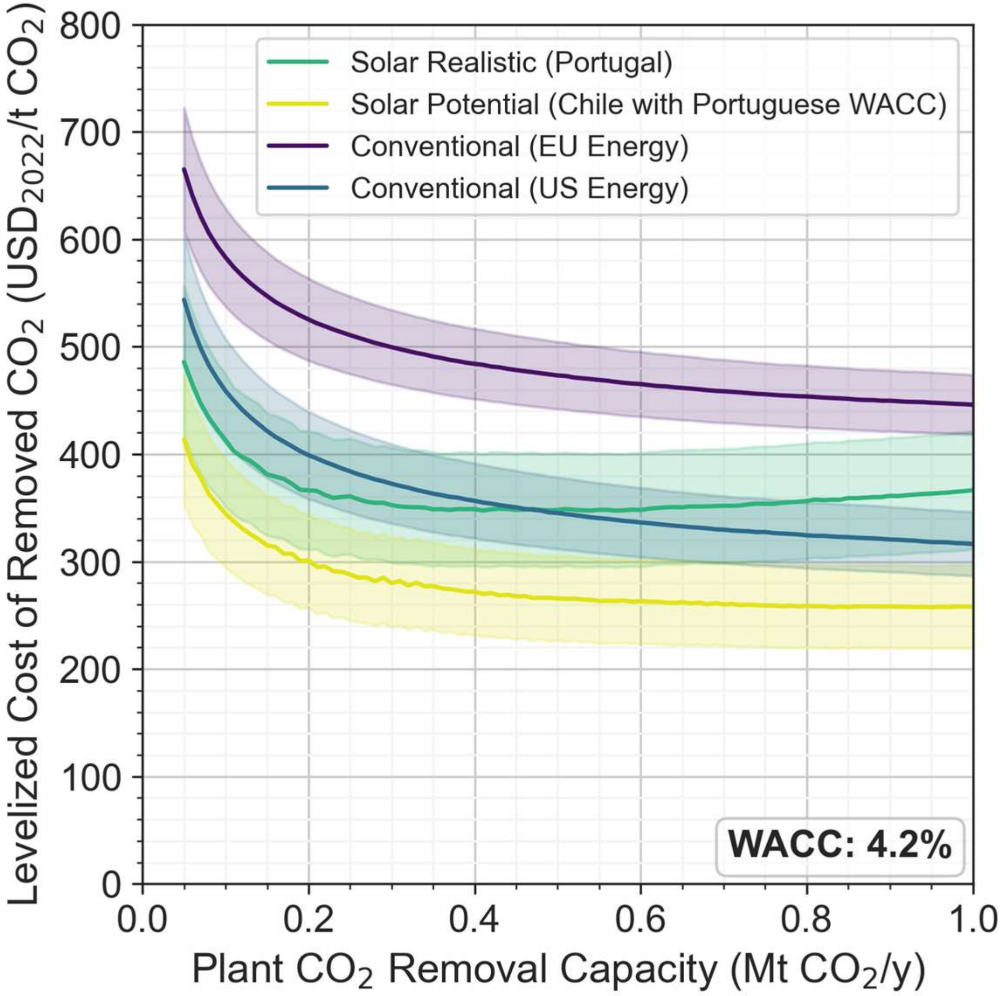






Impact of associated emissions





Take home messages

DAC: Enabling the energy transition

Solar energy & DAC: Synergies in specific locations

Solar thermal energy: Cost-effective solution for decarbonization

Thanks for your attention!

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LinkedIn

References

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