DECARBONIZING **DIRECT AIR CAPTURE** WITH **SOLAR POWER**

Enric Prats-Salvado, Nipun Jagtap, Nathalie Monnerie, Christian Sattler

Institute of Future Fuels – German Aerospace Center (DLR)

DLR

What is direct air capture of CO_2?

Carbon Capture & Storage (CCS):

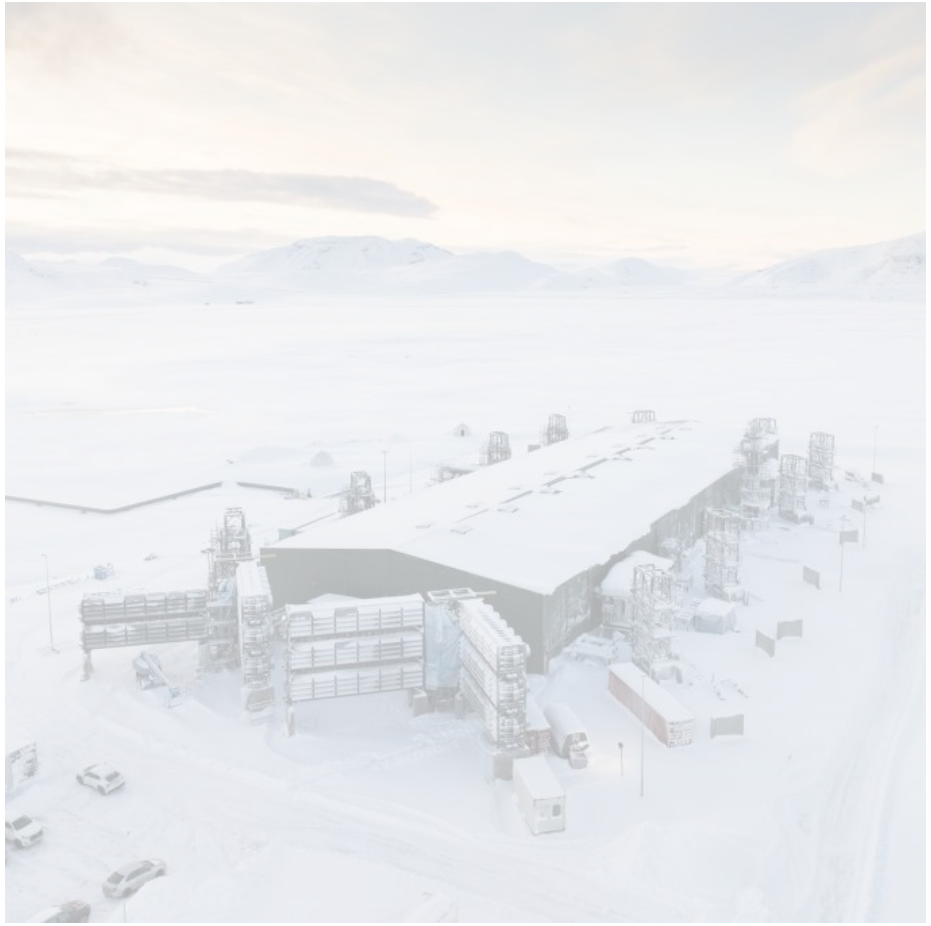
Reverse emissions

Carbon Capture & Utilization (CCU):

Main solution for hard-to-abate sectors

How does direct air capture work?

Solid Direct Air Capture (S-DAC)



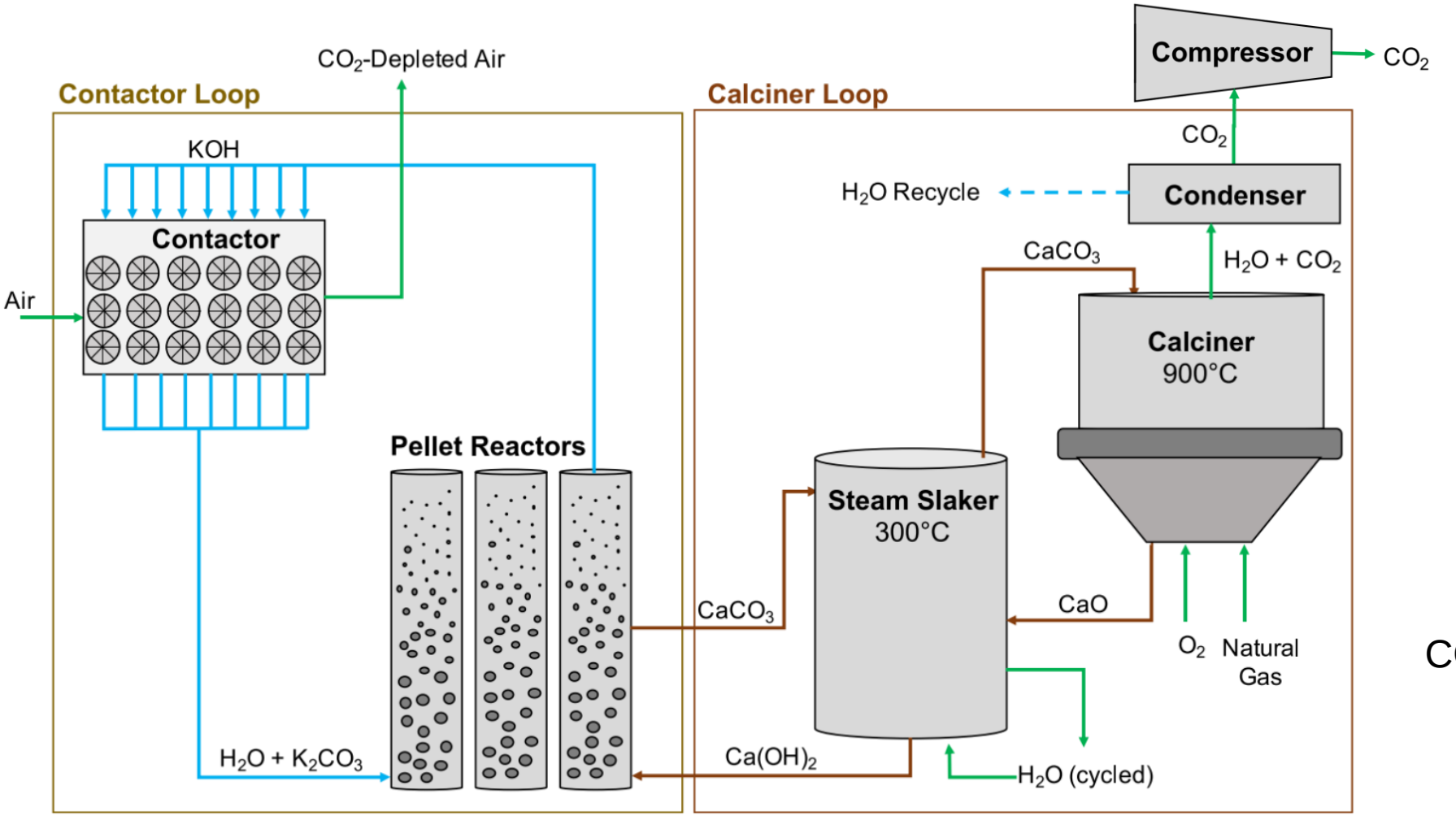
Climeworks (2024, 36 kt CO_2/y, Iceland)

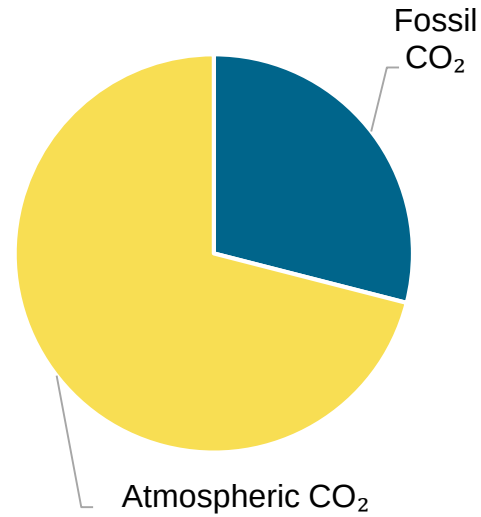
Liquid Direct Air Capture (L-DAC)

Carbon Engineering (2025, 500 kt CO_2/y, US)

Sources: climeworks.com; iea.org

How can we use solar energy in L-DAC?

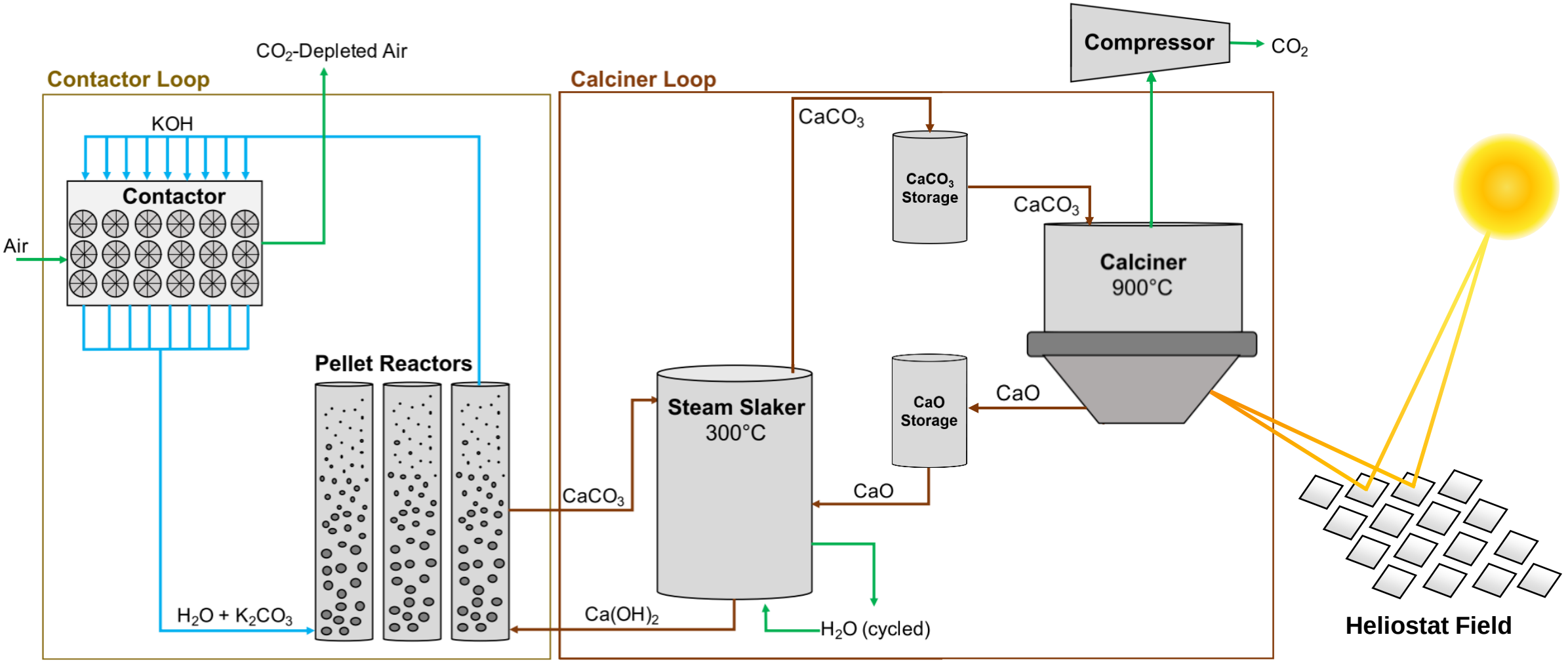




CO_2 mostly limited to CCS

Source: McQueen et al. 2021

How can we use solar energy in L-DAC?



Source: McQueen et al. 2021

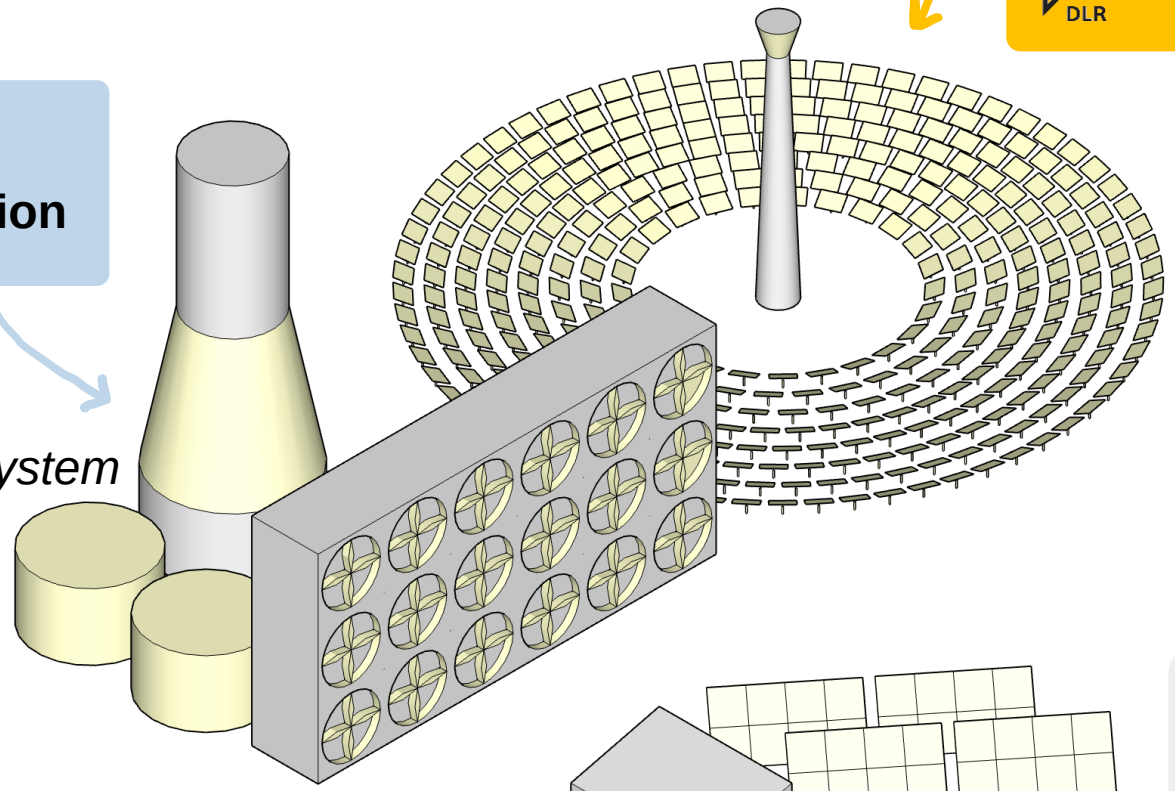
Methodology

meteonorm **Meteorological data**

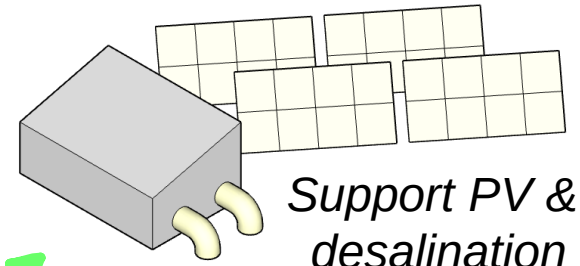
HFLCAL **Solar field model**

Solar field

L-DAC Simulation



L-DAC system



Support PV & desalination

Desalination energy needs

and

meteonorm **Meteorological data**

DLR greenius **PV + battery model**

ecoinvent **Equipment & chemicals LCI**

L-DAC equipment LCI

OPENLCA **LCA**

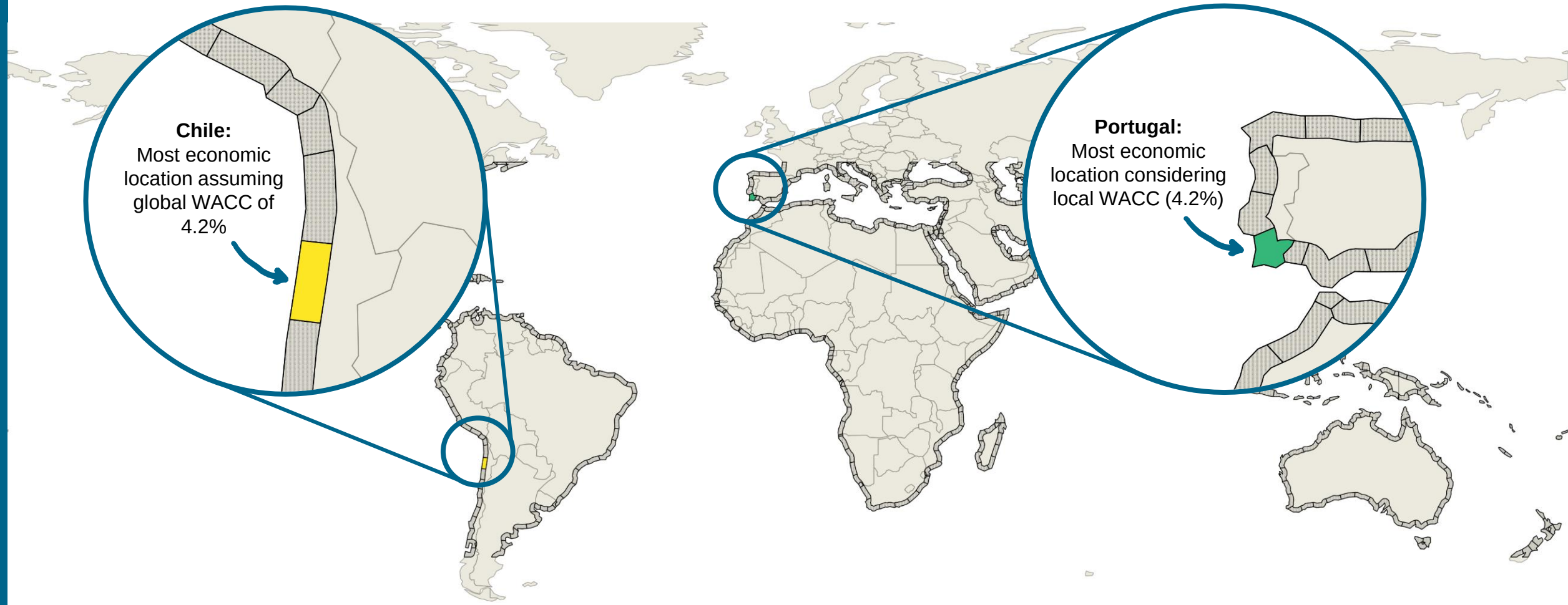
and

Cost estimation

Source: Prats-Salvado et al. 2024

Is there a suitable location for solar L-DAC?

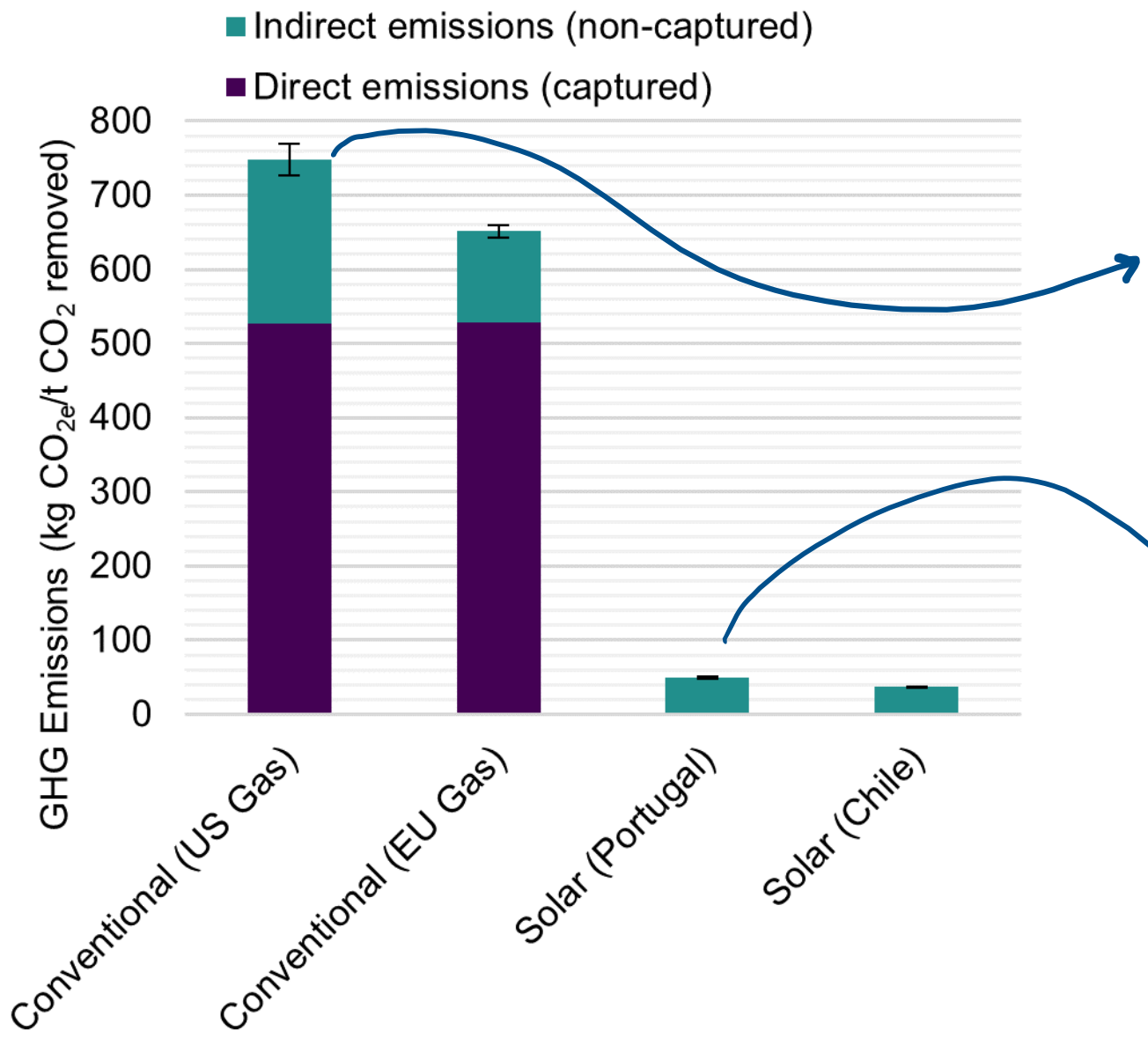
1) Access to desalinated water → ≈100 km from the ocean
2) Economically feasible solar field → Between ±45° latitude
3) Available land → ≥500 km^2 of unprotected, flat and of low environmental and economic interest

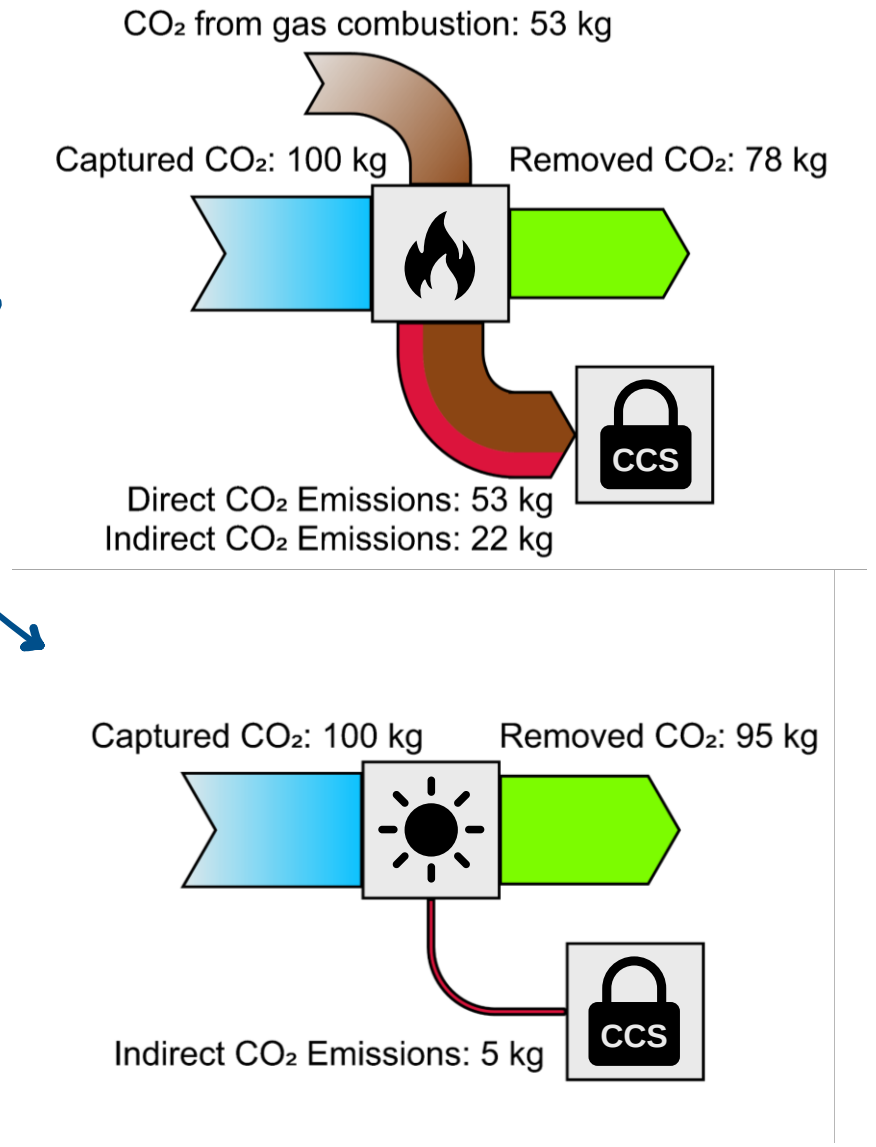


*WACC: weighted average cost of capital

Source: Prats-Salvado et al. 2024

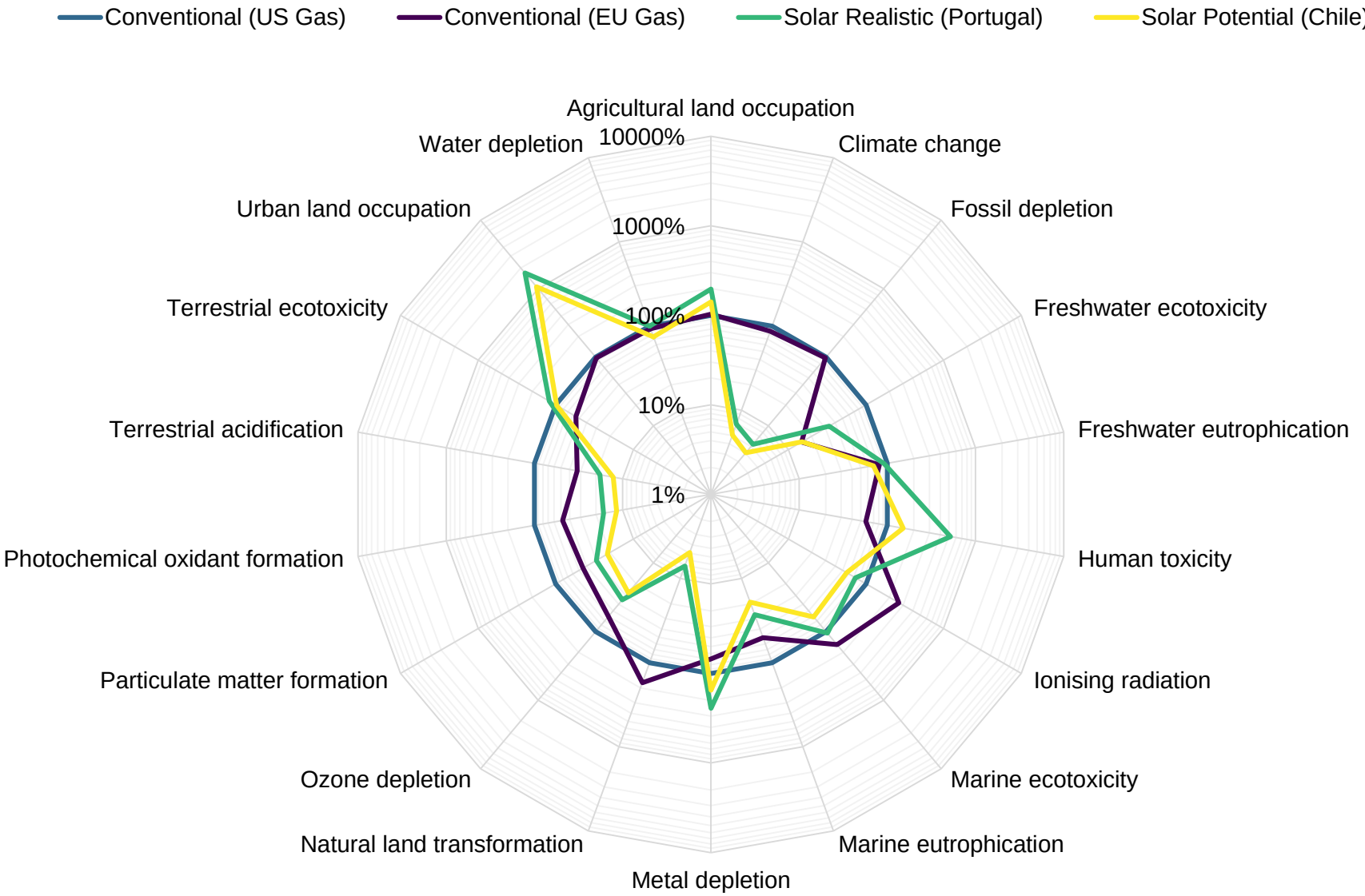
LCA results: global warming





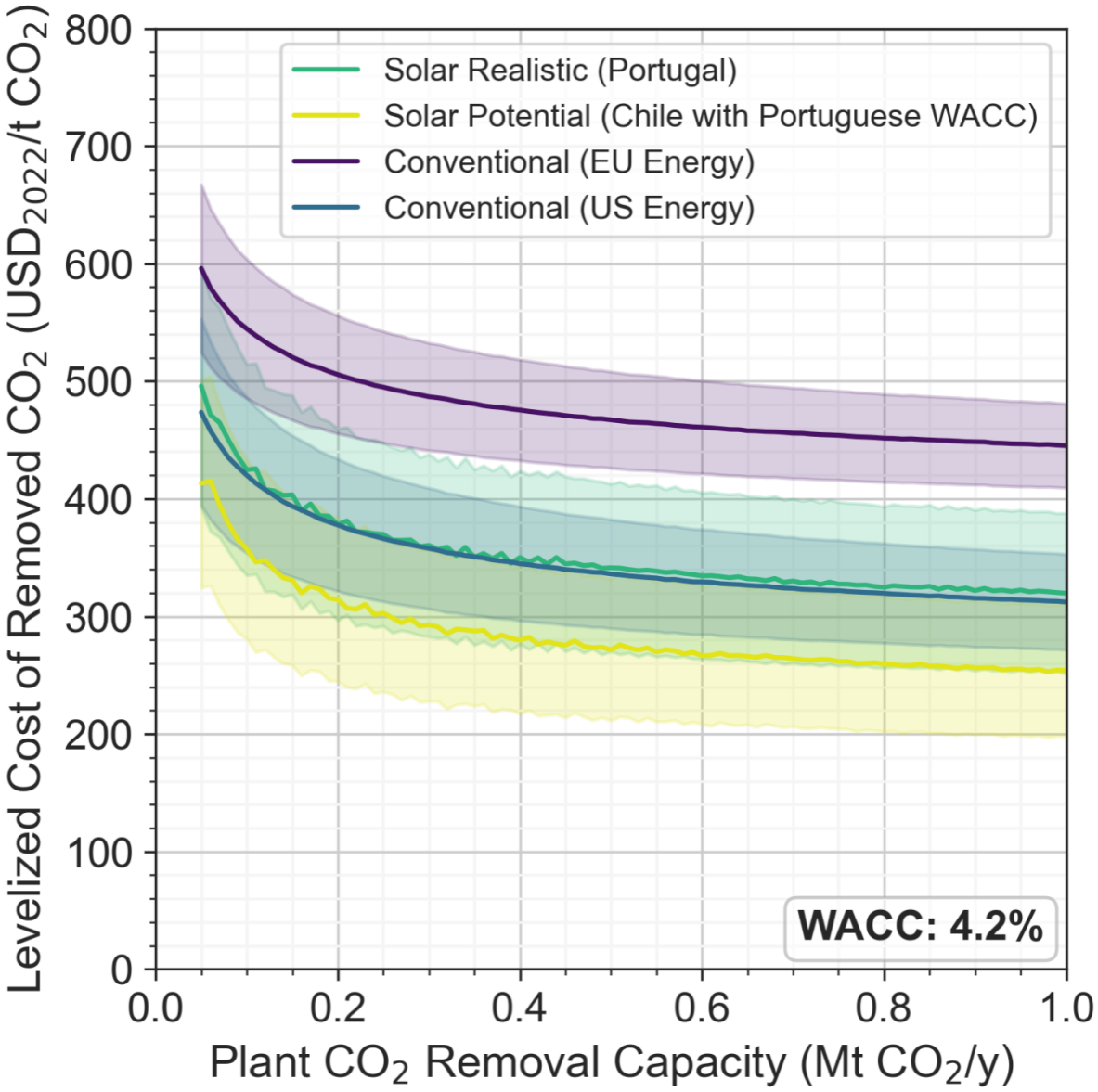
Source: Prats-Salvado et al. 2024

LCA results: burden shifting



Source: Prats-Salvado et al. 2024

Impact of associated emissions



Source: Prats-Salvado et al. 2024

Take home messages

DAC: Enabling the energy transition

Solar energy & DAC: Synergies in specific locations

Solar thermal energy: Feasible solution for decarbonization

Thanks for your attention!

Enric Prats-Salvado
Institute of Future Fuels (DLR)

The authors of this work gratefully acknowledge the funding of the **HI-CAM** project by the **German Helmholtz Gemeinschaft**, as well as the financial support from **DLR's basic funding** for the **SOLHYKO** project.