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Life cycle environmental impact of humidity-swing direct air carbon capture using desalinated seawater CHRISTOPH MEINRENKEN, Columbia University, COEN VAN DER GIESEN, JARA SCHULZ, RENE KLEIJN, Leiden University — IPCC's last report re-emphasized interest in carbon mitigating or even carbon negative energy technologies. CO2 capture such as post-combustion capture (PCC) or direct air capture (DAC) are of interest, however their added energy and material requirements raise questions not only for costs: While these technologies decrease GHG emissions, they invariably add other environmental impacts ("problem shift"). In a previous study, we have shown that, for humidity-swing air capture (HDAC) and avoiding the same net CO2, this problem shift is ˜30% higher than for PCC, but ˜60% lower when HDAC is powered by photovoltaics in a distributed approach, away from CO2 point sources (average shift in 9 environmental impacts). While this is promising, HDAC's high consumption of fresh water (10-20m3 per net avoided metric ton CO2) may be prohibitive vis-à-vis water scarcity. Here, we extend the previous study by investigating the impacts of adding reverse osmosis to the envisioned HDAC installation (adding a further 2-5kWh electricity per m3 water and required infrastructure to the life cycle assessment). We find that the problem shift is still ˜55% lower than in the PCC case (HDAC and desalination powered by photovoltaics). This shows that the incremental energy and infrastructure requirements for desalination are moderate compared to the capture technology itself, offering a route for HDAC without undue competition for fresh water resources.

Christoph Meinrenken
Columbia University

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