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Energy requirements for CO_2 capture from ambient air (DAC) competitive with capture from flue-gas (PCC)[1] CHRISTOPH MEINRENKEN, Columbia University — Capture of CO_2, whether from a flue gas source (PCC) or from distributed sources via ambient air (DAC), is a key enabling technology to provide carbon for sustainable synthetic energy carriers such as solar fuels. Based on thermodynamic minimum considerations, DAC is often expected to require about 3 times more energy (per ton CO_2 captured) than PCC because CO_2 in ambient air is more dilute. Here, we calculate the energy required for a humidity swing-based DAC installation that uses an anionic exchange resin as sorbent. The calculation uses recently measured equilibrium CO_2 loadings of the sorbent as function of partial CO_2 pressure, temperature, and humidity. We calculate the installation's electricity consumption to be about 45 kJ per mole of pure CO_2 at 1 bar (scenario-dependent). Furthermore, we estimate the amount of heat provided by ambient air and thus provide context of the overall energy and entropy balance and thermodynamic minimum views. The electricity consumption is competitive with typical parasitic loads of PCC-equipped coal-fired power plants (40-50 kJ per mole at same pressure) and significantly lower than predicted for other DAC installations such as Na(OH) sorbent-based systems. Our analyses elucidate why DAC is not always more energy-intensive that PCC, thus alleviating often cited concerns of significant cost impediments.

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