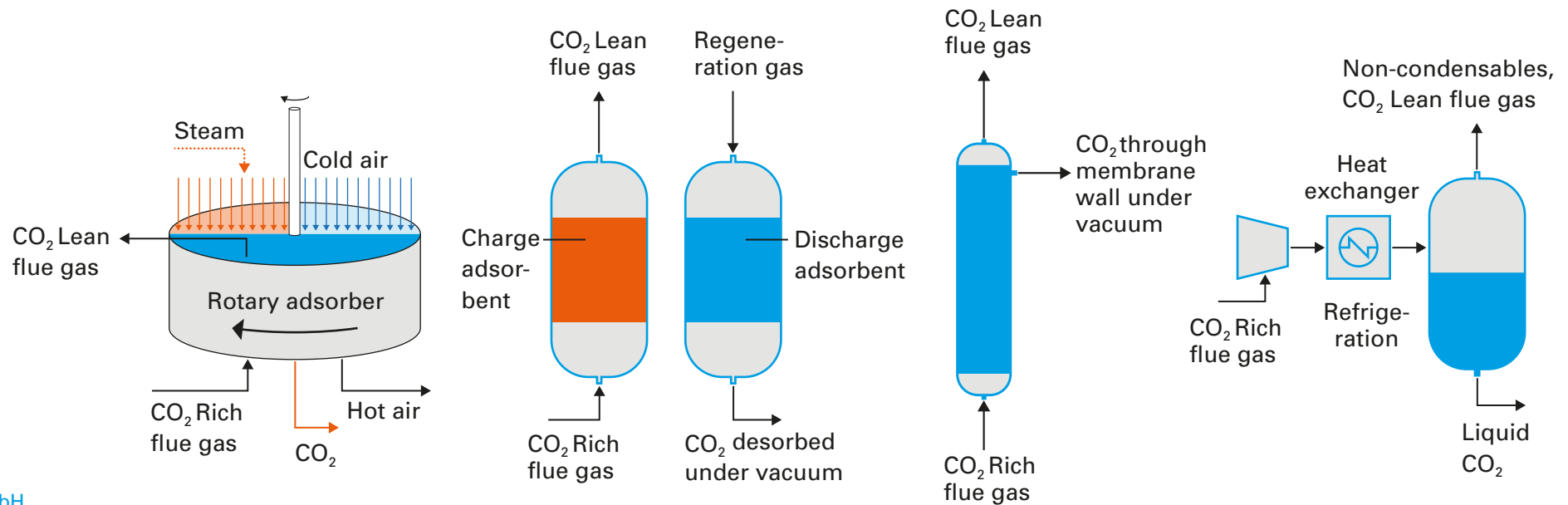


CCUS technologies – Adsorption based & others



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	TSA – temperature swing adsorption and desorption	VSA – vacuum swing adsorption and desorption	Selective membrane separation	Cryogenic CO ₂ liquefaction
Separation principle	Adsorption	Adsorption	Membrane	Physical (phase separation)
Specific energy demand	1.5 GJ/t _{CO2} (mostly waste heat)	1.7 GJ/t _{CO2} (mostly power)	1.20 GJ/t _{CO2} (mostly power)	n.a. (mostly power)
Typical temperature	40-60°C	<40°C	30-50°C	-50°C
Typical pressure	Ambient	Cycling between moderate pressure and vacuum	Moderate pressure flue gas, CO ₂ under vacuum	20-50 bar _g
Typical CO ₂ removal	90% (target)	<90%	<80%	>99% (with CO ₂ feed >50%)
Typical CO ₂ purity	95% (target)	<95%	95%	>99% (with CO ₂ feed >50%)
Typically combined with	Standalone	Cryogenic Liquefaction	Amine wash, Cryogenic Liquefaction	VSA, Membrane (eg Cryocap)
Typical plant size (tonnes per year CO ₂ removal)	200 – 2,000,000	1,000 – 500,000	10,000 – 1,000,000	> 100,000
Technology maturity level	Pilot / Commercial, eg Husky Energy SK, Lafarge Holcim Cement, BC	Demonstration / Commercial, eg Air Products Port Arthur SMRs, USA	Demonstration / Commercial	Demonstration / Commercial, eg Air Liquide Cryocap at Port-Jérôme SMR, France