

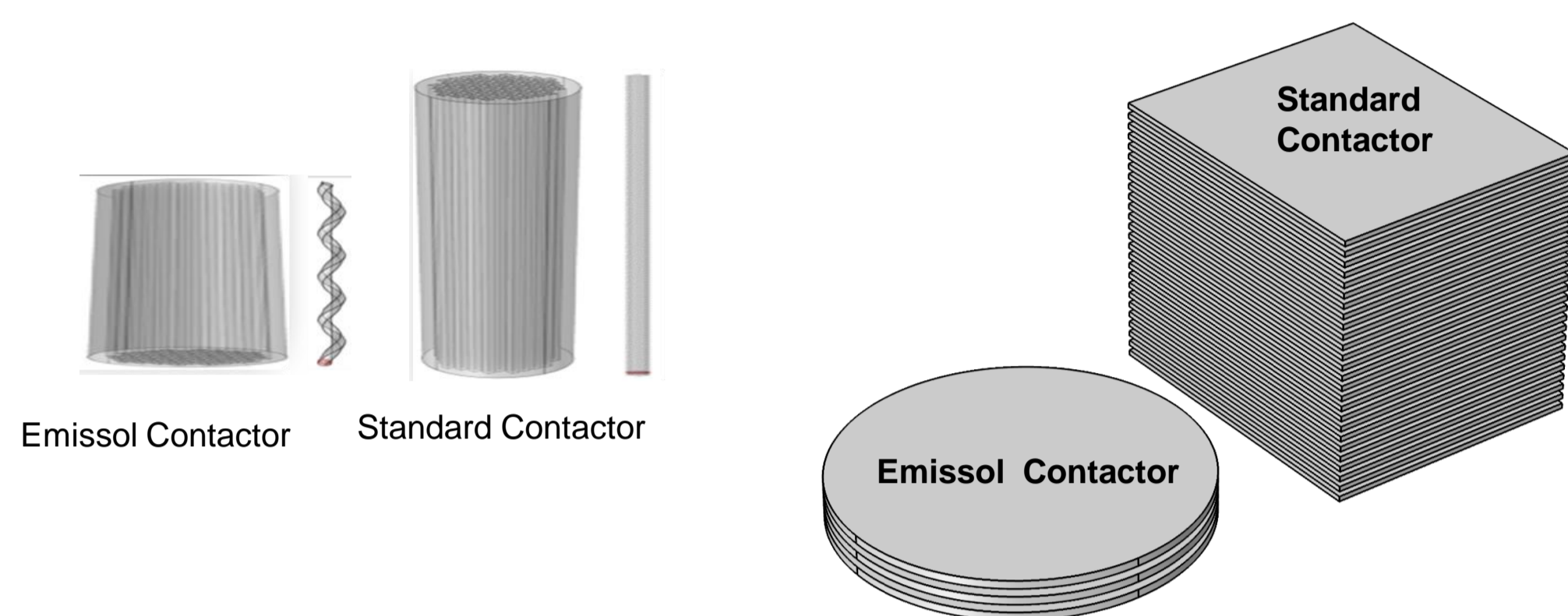
Optimized Techno-Economics for Future DAC Plants



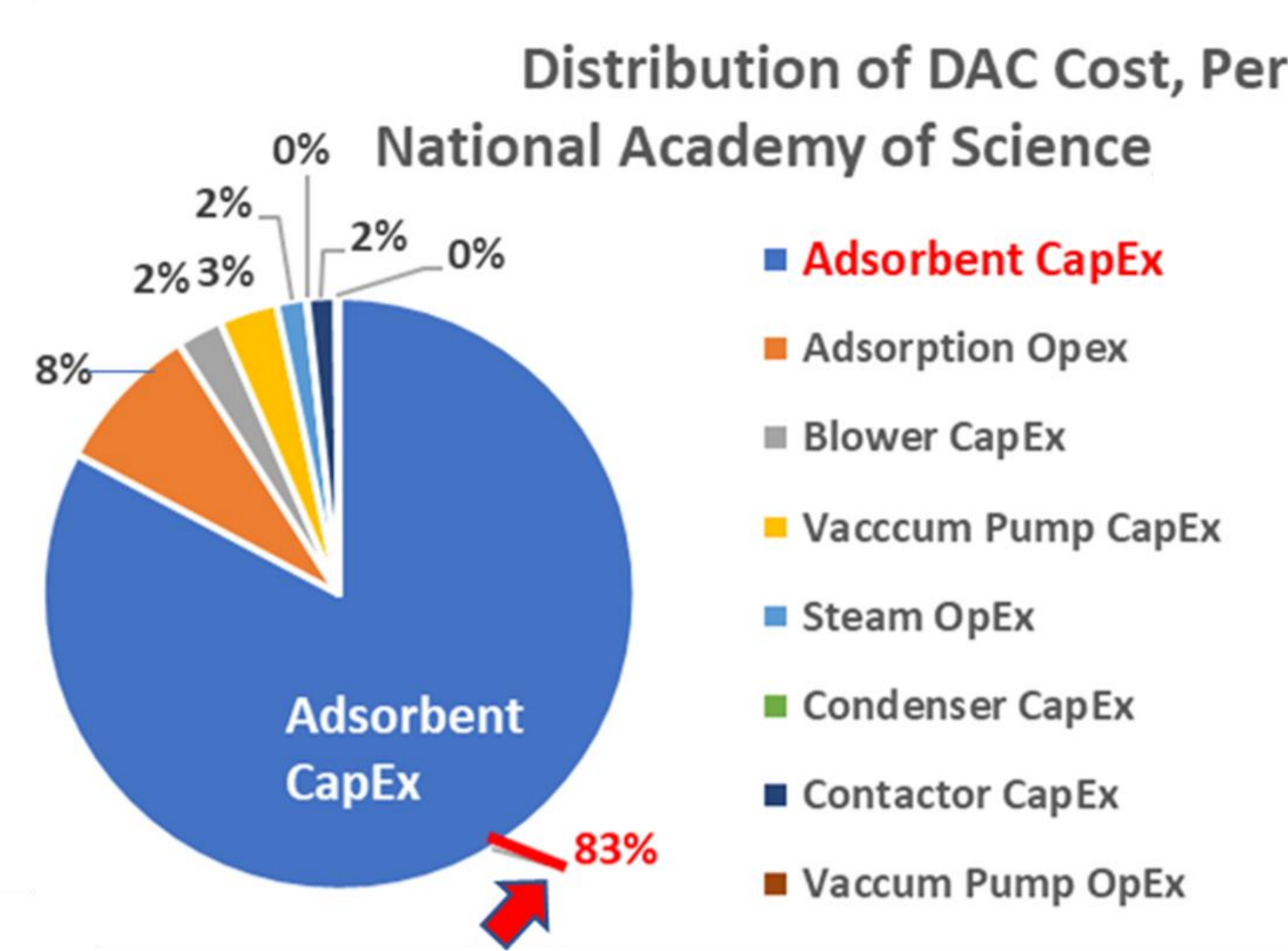
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Summary:

- The greatest obstacle in commercializing direct CO₂ capture from air is known to be its cost. In this study, we have evaluated techno-economics of typical industrial DAC plants and sought ways to reduce their costs. Specifically, and amongst other metrics, we propose a fast-capture, highly efficient contactor for CO₂ removal, analyzing its substantial impact on DAC cost reduction.



* Variety of designs are available and can be customized per plant needs.



Annual Costs, Solid Sorbent System, 1 Mt/yr. Ref.[NAS]	Standard Contactor Cost (\$)	Emissol Contactor Cost (\$)	
Adsorbent CapEx	\$ 122	\$ 77	40%↓
Adsorption OpEx	\$ 12	\$ 14	
Blower CapEx	\$ 3.70	\$ 3.70	
Vacuum Pump CapEx	\$ 4.70	\$ 4.70	
Steam OpEx	\$ 2.40	\$ 2.40	
Condenser CapEx	\$ 0.08	\$ 0.08	
Contactor CapEx	\$ 2.30	\$ 2.30	
Vacuum Pump OpEx	\$ 0.20	\$ 0.20	
TOTAL	\$147.38	\$ 105.25	30%↓

=> Total DAC Cost Reduction by 30%

Figure 1. Lowering DAC cost using Emissol high efficiency contactor. Emissol contactor reduces sorbent use by about 40%, the total DAC cost by about 30%. (Benchmark DAC cost is from Ref. (1).)

Cost Optimization of DAC processes:

Case Study I: DAC Cost Reduction - Plant A (currently operational in the US)

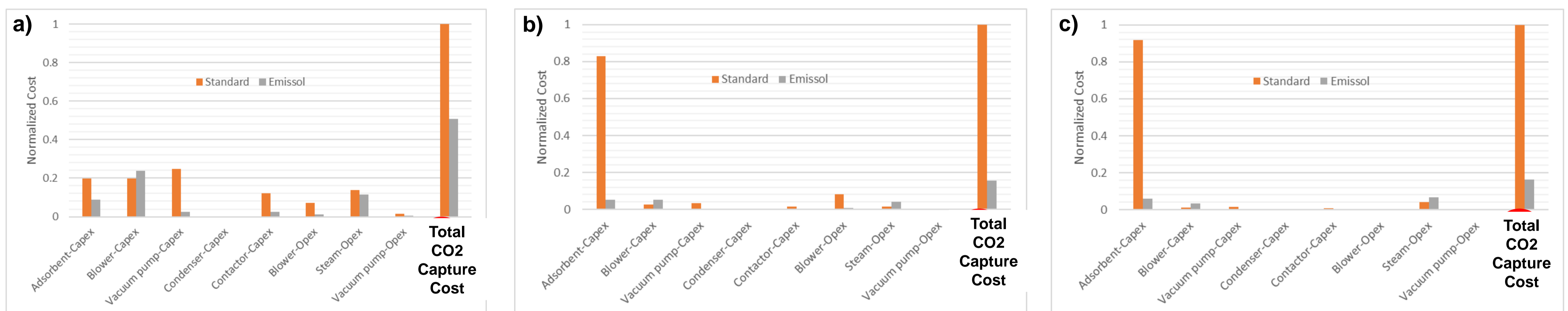


Figure 2. Reducing the DAC cost: CapEx and OpEx components of a standard DAC plat (baseline^(1,2)) compared with same when equipped with Emissol contactor: (a) best case, (b) middle case, and (c) worst case cost scenarios ⁽¹⁾.

Case Study II: DAC Cost Reduction - Plant B (currently operational in the EU)

- Remarkable DAC cost saving can be achieved when utilizing Emissol contactors. See Figure 3.
- Emissol contactors provide increased CO₂ capture rate, need substantially less sorbent, and markedly lower the total DAC cost.

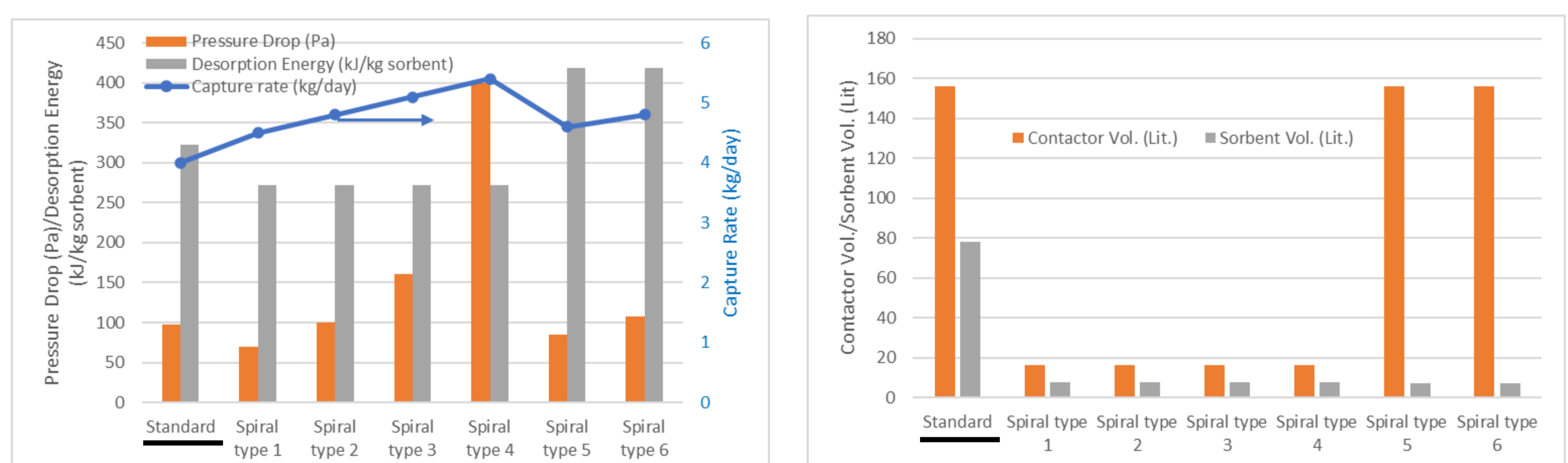


Figure 3. Superior performance of Emissol contactors compared to standard ones in an existing DAC plant B (currently operational in the EU).

Future Works:

- Cost estimation for Emissol DAC plant using equipment design analysis.
- Further optimization of Emissol contactors through novel designs (in progress).
- Developing a unique process tailored to superior performance of our rapid-capture contactor.
- Further cost reduction in total DAC costs through developing new sorbents uniquely suited to our process (patent pending).

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(1) National Academies of Sciences Engineering, Medicine, Negative Emissions Technologies and Reliable Sequestration: A Research Agenda, The National Academies Press, Washington, DC, 2019.
 (2) A. Sinha, L.A. Darunte, C.W. Jones, M.J. Realf, and Y. Kawajiri. Industrial & Engineering Chemistry Research 56, no. 3 (2017): 750-764.