

Carbon 2 Chem®

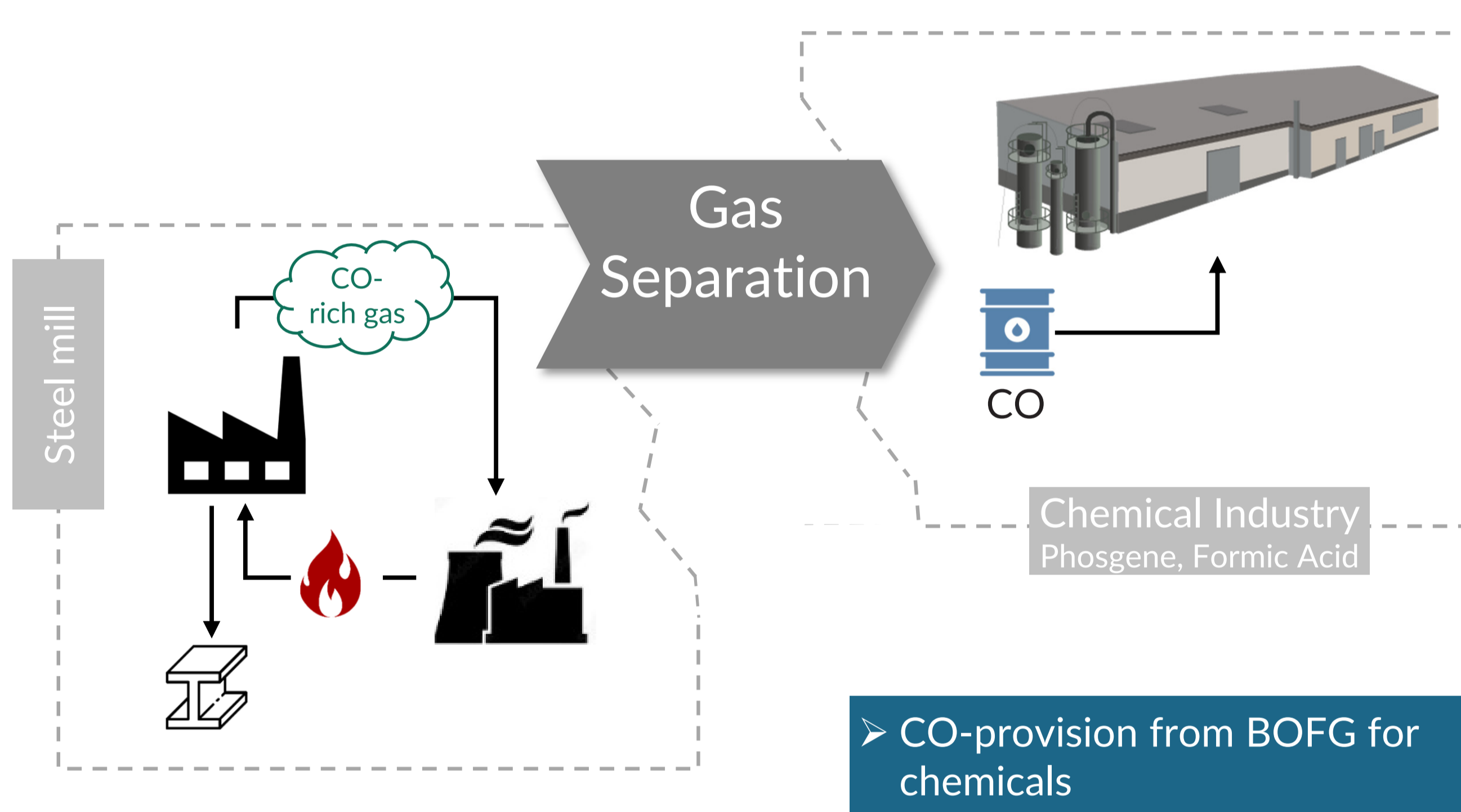
L-V | From Pollutant to Raw Material: Sustainable Polycarbonate from BOFG

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In subproject L-V, two process concepts for recovering CO from BOFG for polycarbonate production via phosgene were presented: a) direct separation of pure CO by vacuum pressure swing adsorption (VPSA) and b) CO₂ separation by amine gas scrubbing to recover a CO/N₂ mixture using monoethanolamine (MEA) as absorption solvent. While the VPSA process was already assessed, this study aims for an economic and ecological evaluation of the amine gas scrubbing. To assess the amine gas scrubbing process, we combine process modelling and optimization with life cycle assessment.

Motivation/Challenge



VPSA vs. MEA Scrubbing

LCA reveals potential to reduce system-wide environmental impacts using VPSA to recover CO^[1]

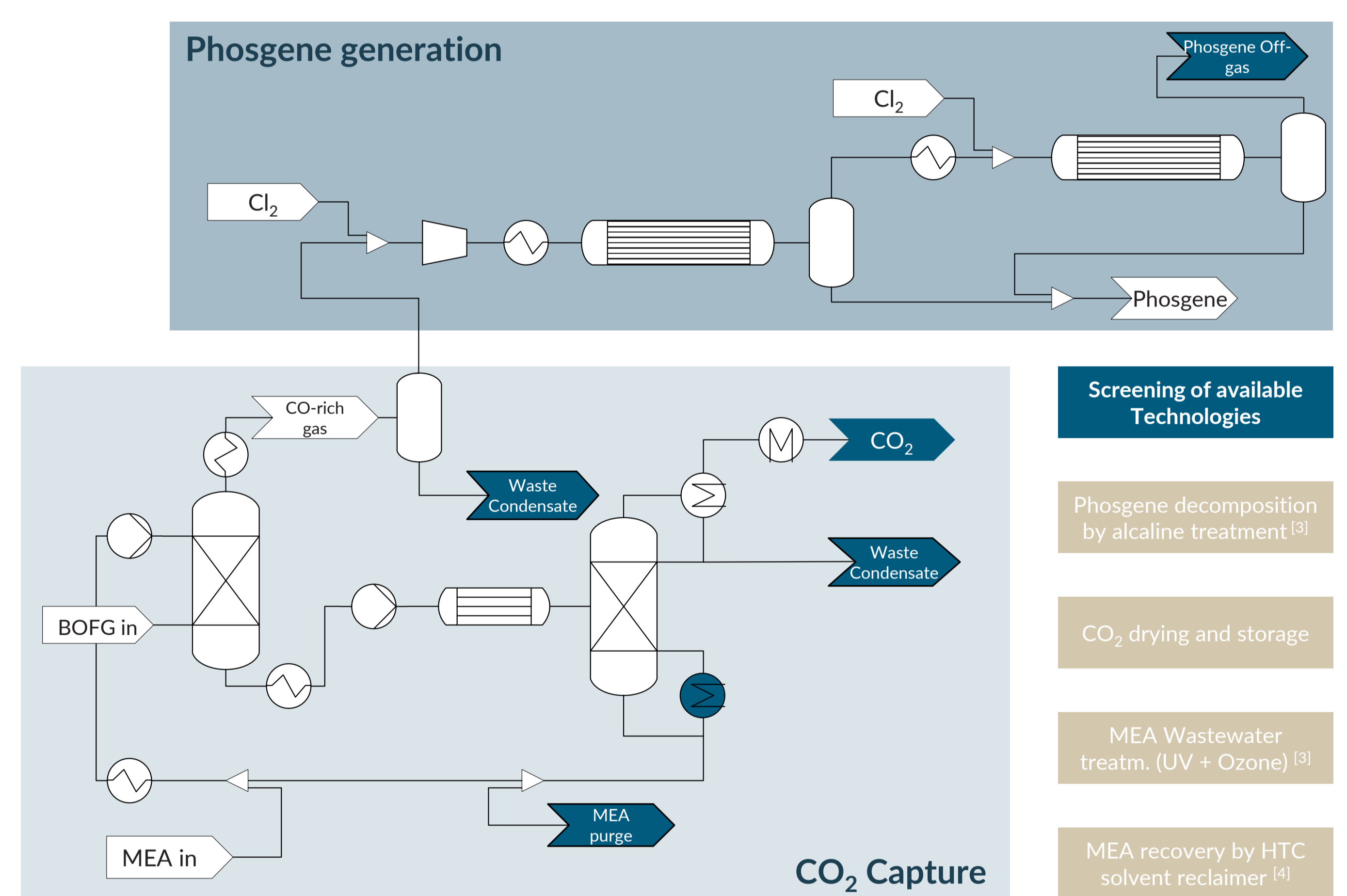
> BUT: VPSA is highly sensitive towards impurities

MEA scrubbing is a well-proven technology and allows for additional CO₂ capture to further reduce emissions

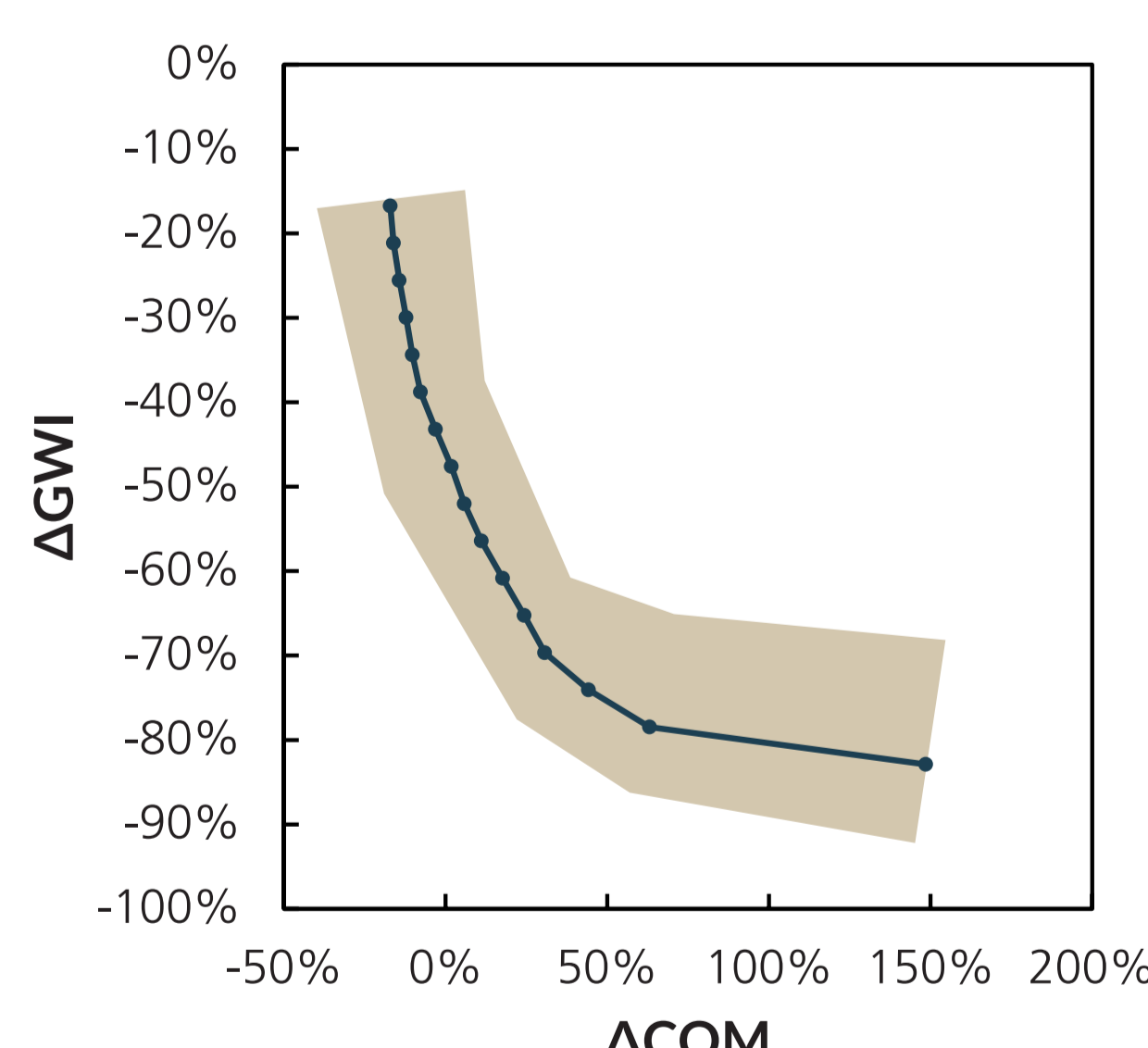
> Techno-economical analysis (TEA) reveals comparable specific costs of manufacturing (COM) of phosgene based on CO enriched by MEA scrubbing and by VPSA

Process simulation

- > High TRL for CO₂ capture absorption process
- > BUT: Sidestreams significantly impacting the LCA and economics:
 - Condensate- and purgestreams containing MEA
 - MEA degradation and consumption
 - Off-gas contaminated with phosgene
 - CO₂ purity for capture and storage vs. reboiler duty of stripping column
- > Phosgene purity requirements for polycarbonate production



Pareto optimization



Open questions

- > Pareto optimization: Impact of additional process steps on LCA and TEA?
 - MEA recovery and recycling (HTC) + MEA treatment (UV + Ozone)
 - CO₂ drying and compression for storage
 - Phosgene off-gas treatment
- > How does CO₂ price impact TEA?

[1] J. Hense, M. Bachmann, L. Polte, N. v.d. Aßen, A. Jupke, Chem. Ing. Tech. 2022.
[2] G. Duembgen, E. Voelkl, G. Pforr, BASF AG, 1981, EP0019160B1, European Patent Office.
[3] Y. Yoon, M. Kwon, B.-C. Lee, J.-W. Kang, Journ. of Adv. Ox. Tech. 2012, 15 (2), 301-309.
[4] W. ElMoudir, J. Fairchild, A. Aboudheir, Energy Procedia. 2014, 63, 6156-6165.

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