SETAC Europe 36th Annual Meeting

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Quantifying Life-Cycle Burden-Shifting Intensity in Global Warming Potential

Induced by Post-Combustion Carbon Capture and Storage for Decarbonizing Energy-Intensive Industries

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INTRODUCTION

Accounting for approximately 60% of global greenhouse gas emissions, the energy sector is pivotal in the transition to carbon neutrality. Post-combustion carbon capture and storage (PCCS) has emerged as a crucial decarbonisation strategy for energy-intensive industries, favoured for its technological maturity, adaptability to existing plants, and modularity.

However, current industry evaluations predominantly focus on the CO_2 recovery rate of PCCS units, often **overlooking the secondary greenhouse gas emissions** generated by the system's own energy and material demands.

Taking plants without PCCS as the baseline, this work **quantifies the life-cycle burden transfer intensity of global warming potential (GWP)** for plants with PCCS systems installed.

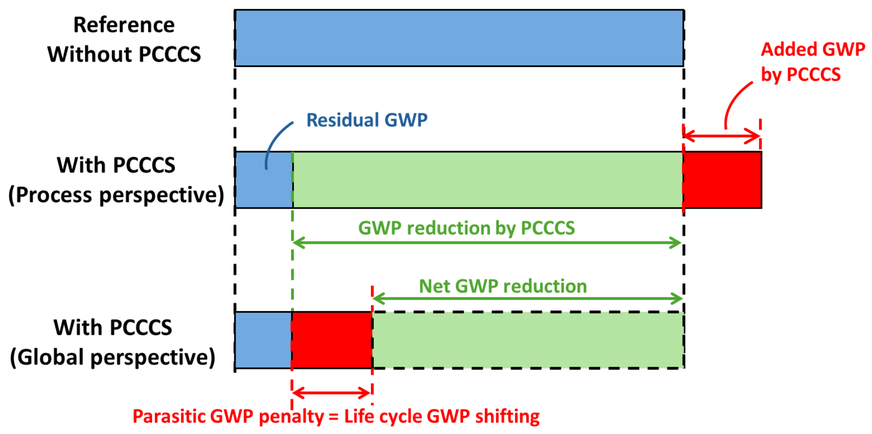
METHOD

Principle: The graphical method is as follows:

Equation: *Life cycle GWP shifting rate = Parasitic GWP penalty rate*

$$= \frac{GWP_{CO_2\ in\ stack} \times CO_2\ capture\ rate}{GWP_{GHGs\ in\ life\ cycle}} - Net\ GWP\ reduction\ rate$$

Dataset: 80 cases from 2015-2025 by meta-review

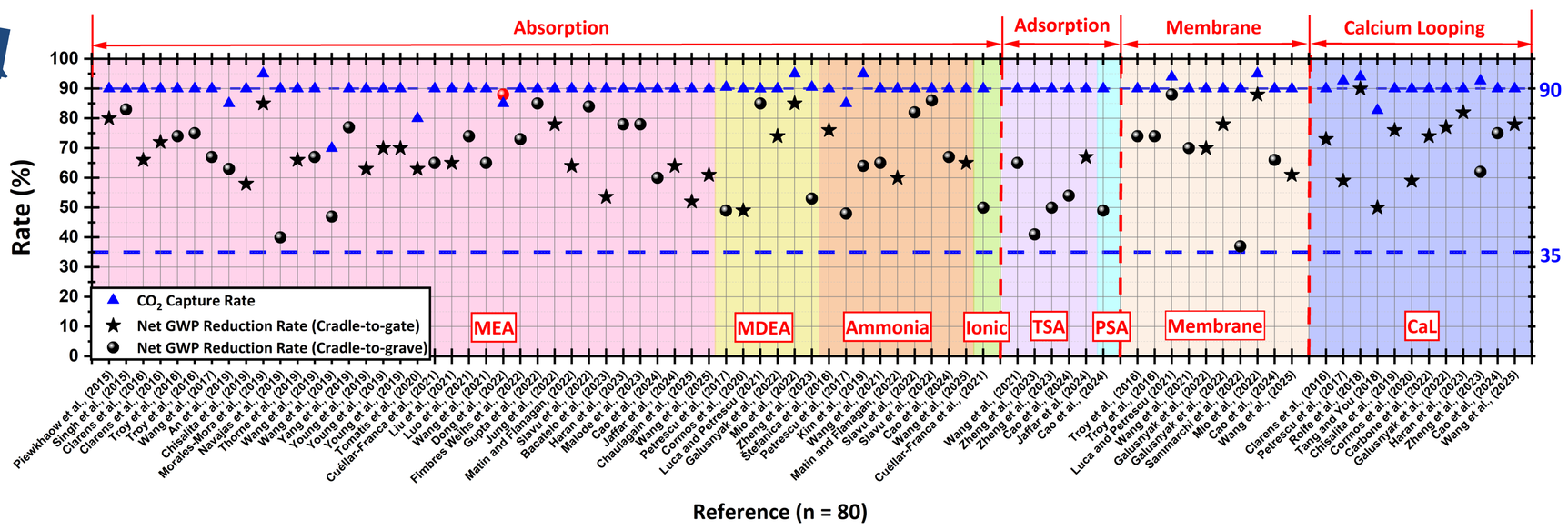


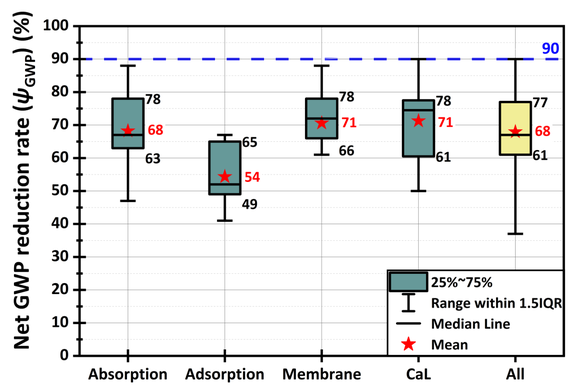
RESULTATS AND CONDLUSIONS

1) CO_2 capture efficiencies cluster around 90%;

2) Net GWP reduction rate varies from 35% to 90%; the interquartile range of 61–77% and mean about 68%;

3) Obviously gap between process-level CO_2 capture efficiency and realised net GWP reduction rate;

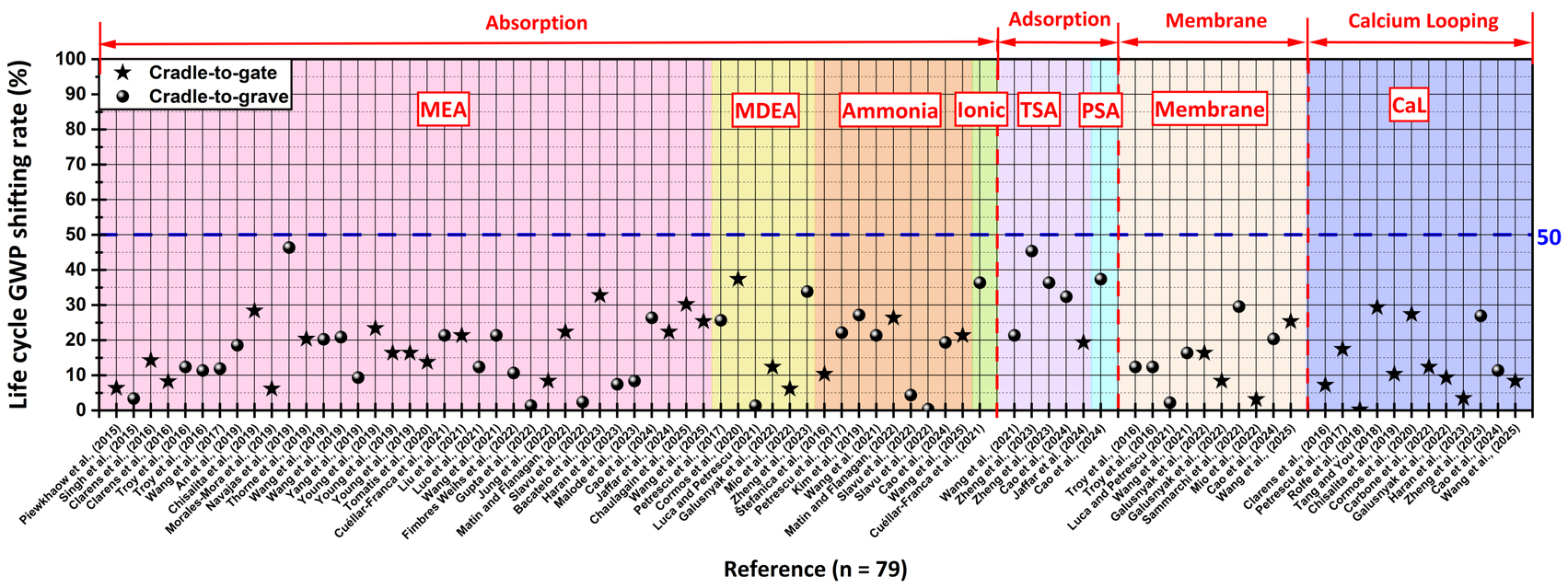


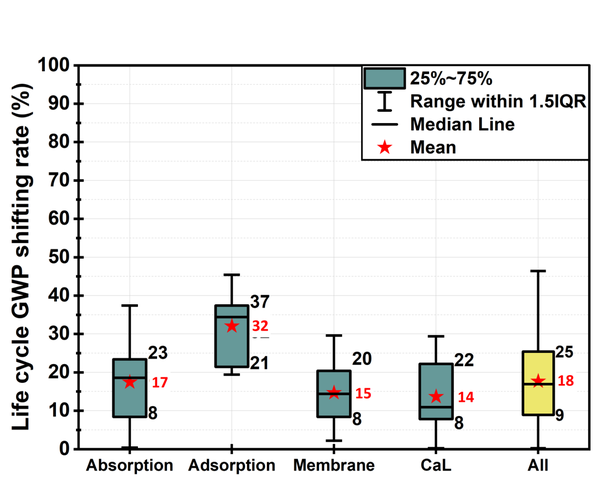


1) Life cycle GWP shifting rate varies from 0% to 50%;

2) All capture tech, the interquartile range of 9–25% and mean about 18%;

3) The ranking of mean of life cycle GWP shifting rate : Adsorption > absorption > membrane ≈ Calcium looping





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