16 Appendix B – Additional results

This appendix present additional results supporting the main LCA analysis, including engine-level emission indicators and supplementary sensitivity analysis.

16.1 Engine-level NOx emissions

Figure B1 shows the NOx emissions (g/kWh) for MGO and HOEF blends, together with the regulatory limits defined under IMO MARPOL Annex VI. The results indicate that MGO exhibits the highest NOx emissions, reaching approximately 9 g/kWh. This value remains within the IMO Tier I limit (9.8 g/kWh), which applies to marine engines installed on vessels built between 2000 and 2010, but exceeds the stricter Tier II limit (7.7 g/kWh) applicable to engines installed on ships built after 2011. The introduction of HOEF blends leads to a reduction in NOx emissions. In particular, HOEF I blends show a significant decrease in NOx emissions, with both tested blends falling below the Tier II limit. In contrast, HOEF II blends exhibit NOx emissions closer to those of MGO and remain around or above the Tier II threshold.

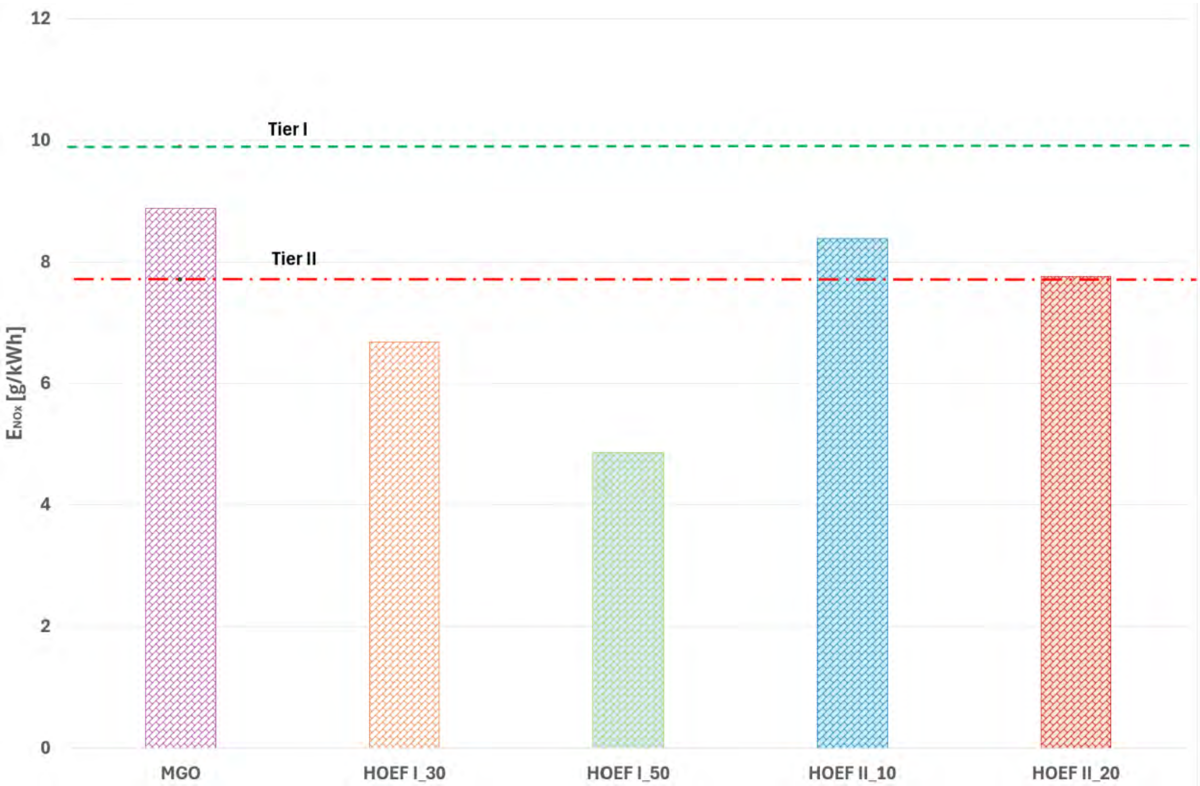

Figure B1. Comparison of NOx emissions (g/kWh) for MGO and HOEF blends relative to IMO Tier I and Tier II emission limits

16.2 Sensitivity analysis-electricity mix

Additional sensitivity analysis results for the ferry, trawler and purse seiner case studies are also presented in this appendix (Figure -Figure). The results confirm trends observed in the main text, with higher impacts associated with carbon-intensive electricity mixes, such as PL, and lower impacts for low carbon scenarios (RE, NO, FR). The influence of electricity mix becomes more pronounced with increasing HOEF share.

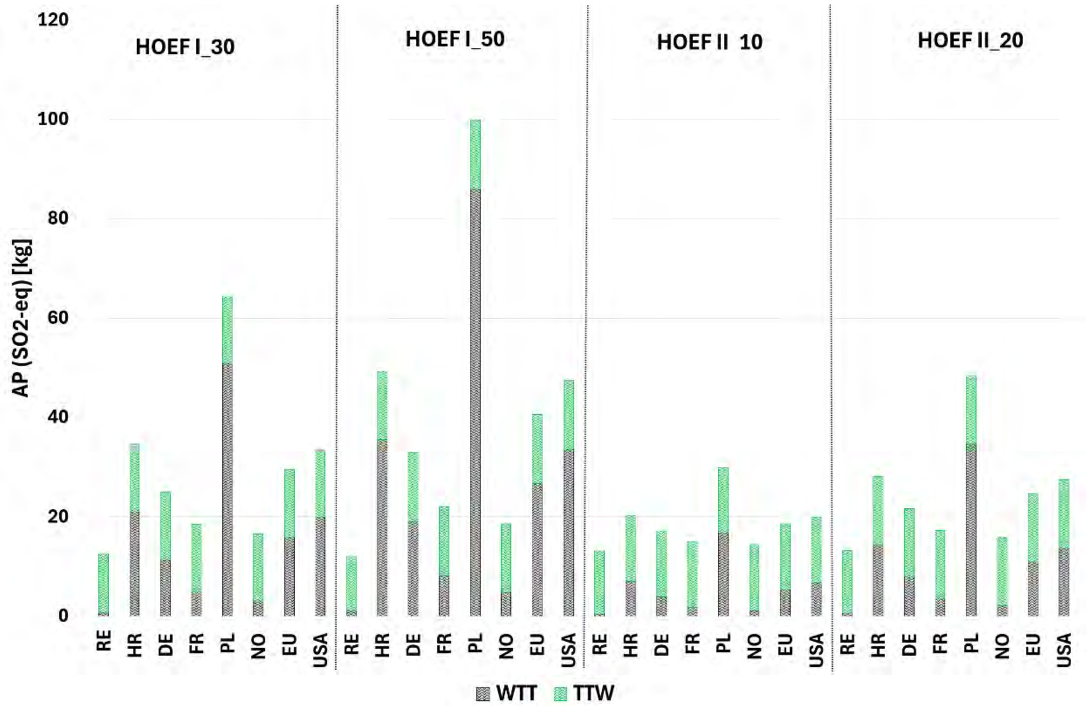

Figure B2. Sensitivity of AP indicator to different electricity mix scenarios for analysed HOEF blends (the ferry case study).

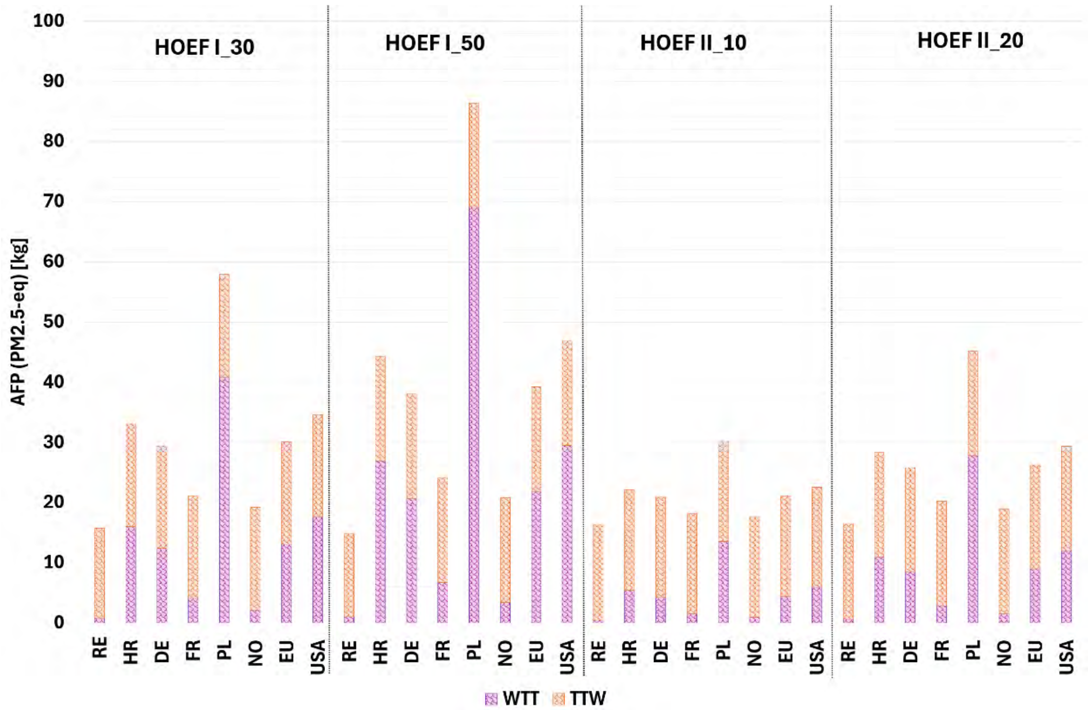

Figure B3. Sensitivity of AFP indicator to different electricity mix scenarios for analysed HOEF blends (the ferry case study).

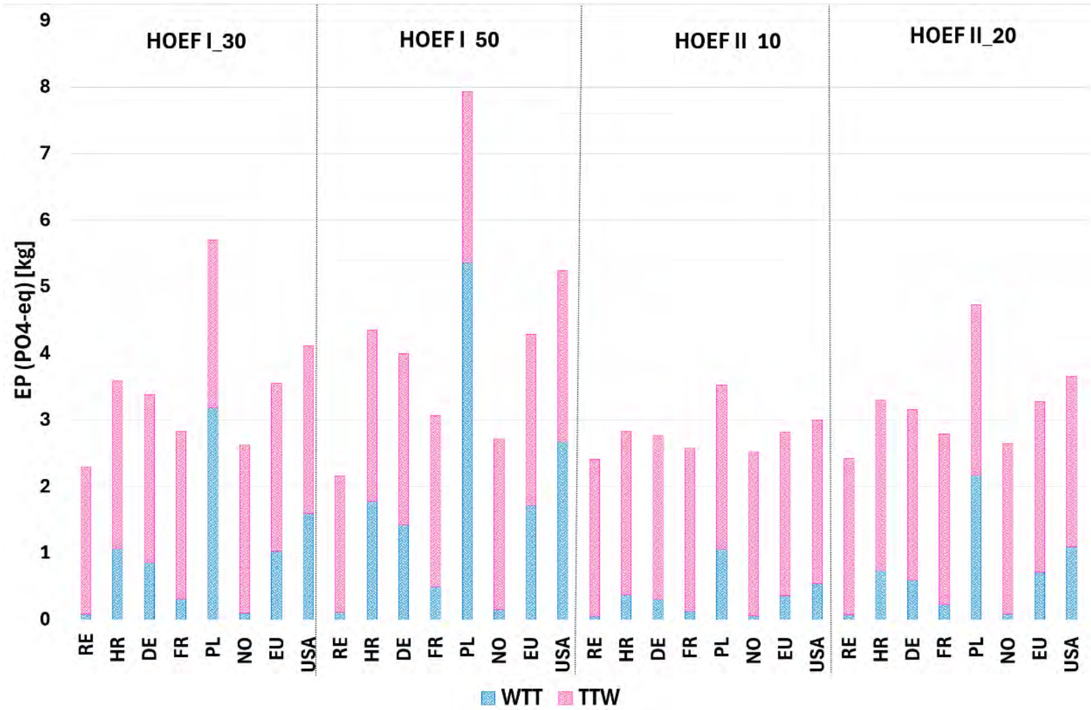

Figure B4. Sensitivity of EP indicator to different electricity mix scenarios for analysed HOEF blends (the ferry case study).

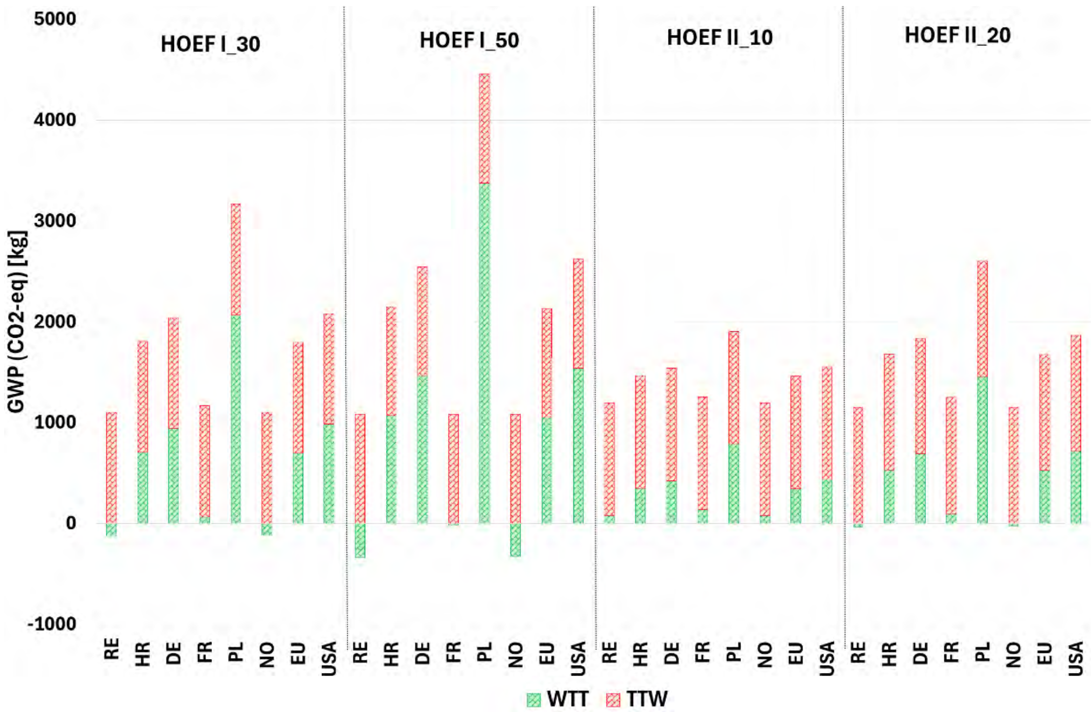

Figure B5. Sensitivity of GWP indicator to different electricity mix scenarios for analysed HOEF blends (the trawler case study).

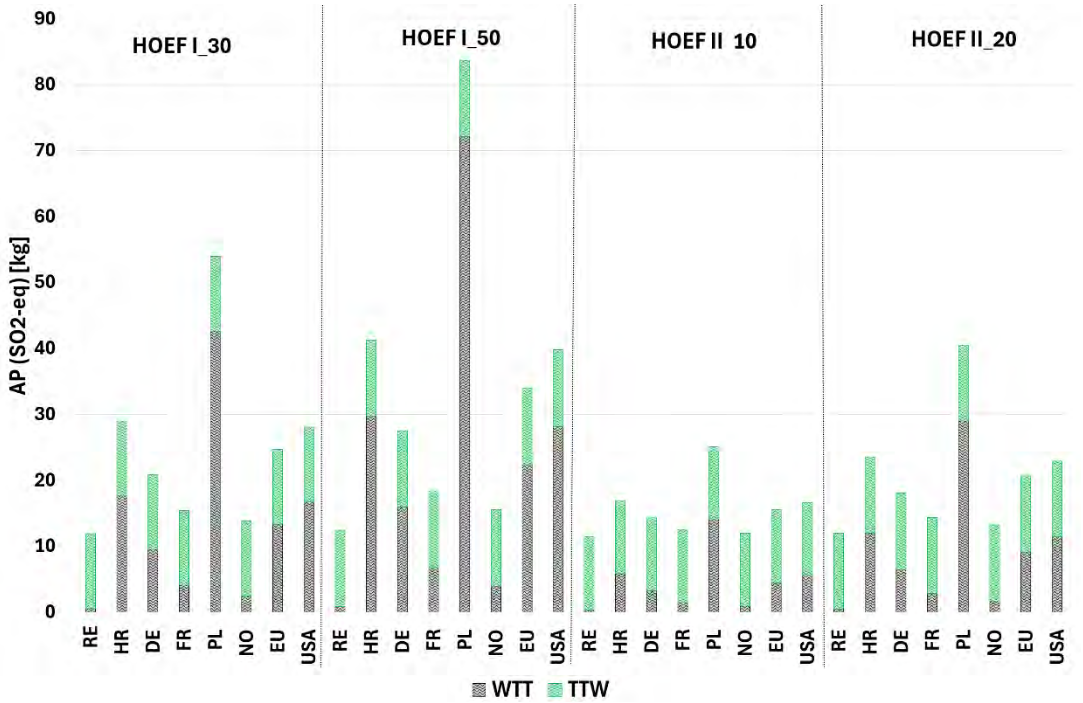

Figure B6. Sensitivity of AP indicator to different electricity mix scenarios for analysed HOEF blends (the trawler case study)

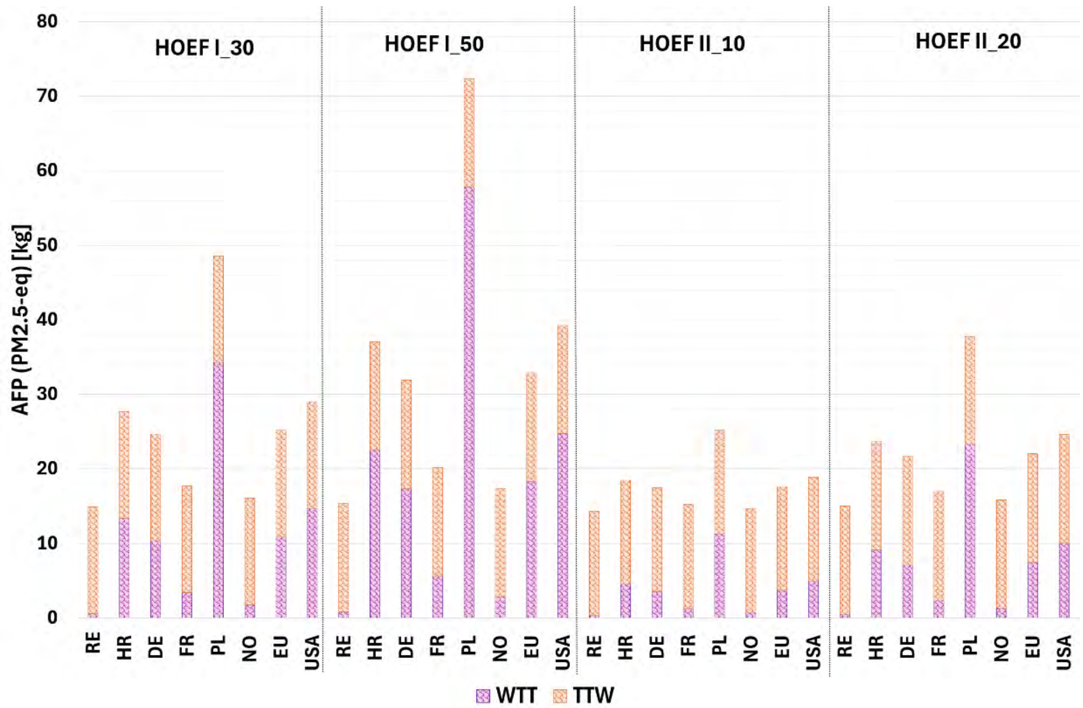

Figure B7. Sensitivity of AFP indicator to different electricity mix scenarios for analysed HOEF blends (the trawler case study)

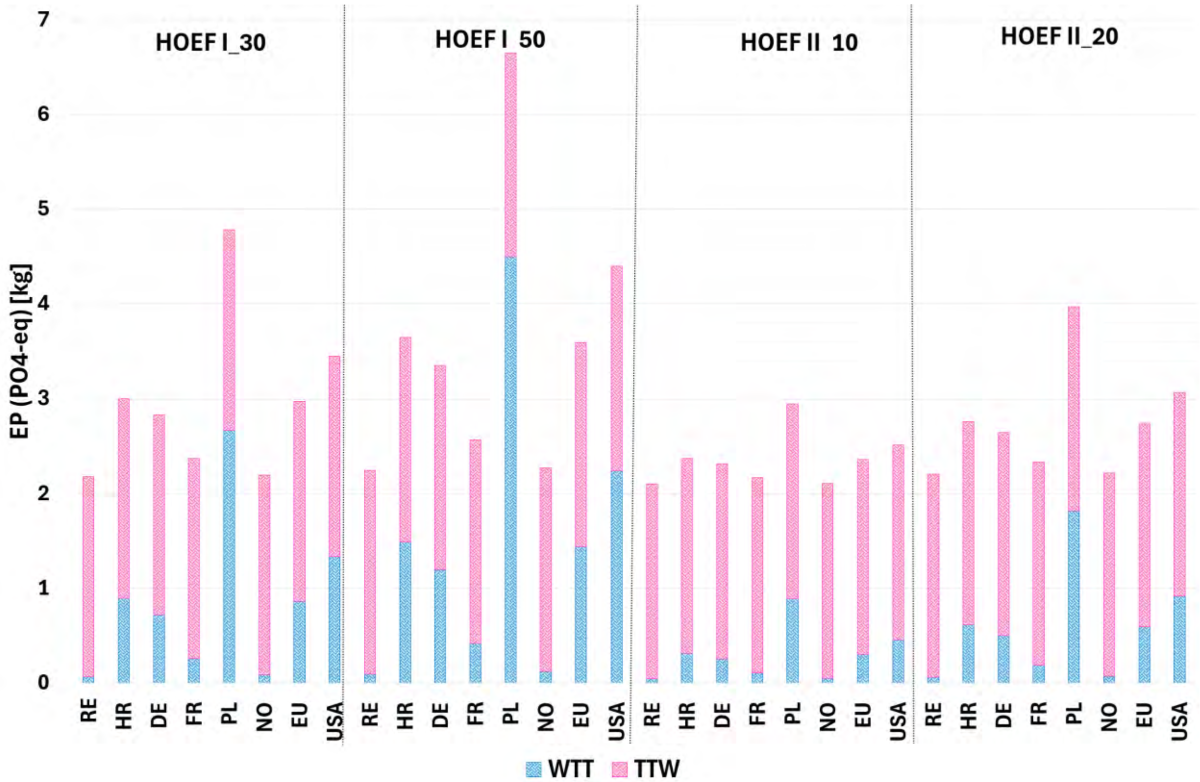

Figure B8. Sensitivity of EP indicator to different electricity mix scenarios for analysed HOEF blends (the trawler case study)

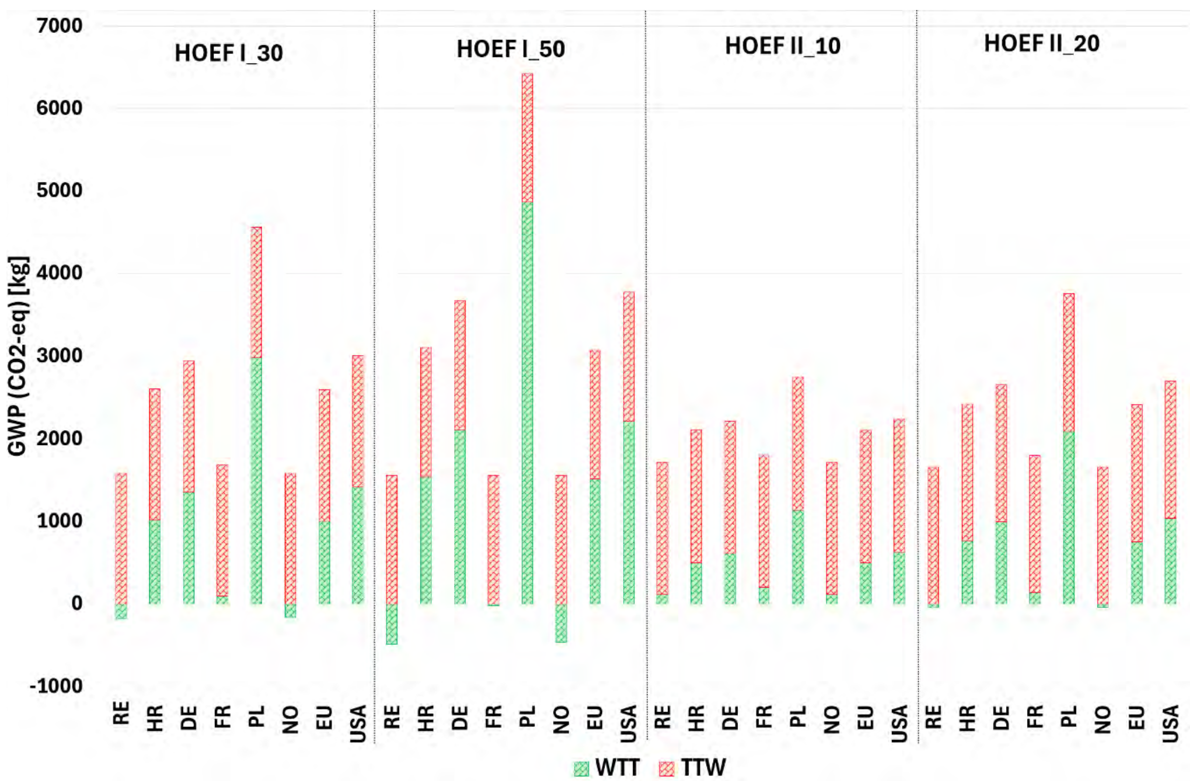

Figure B9. Sensitivity of GWP indicator to different electricity mix scenarios for analysed HOEF blends (the purse seiner case study)

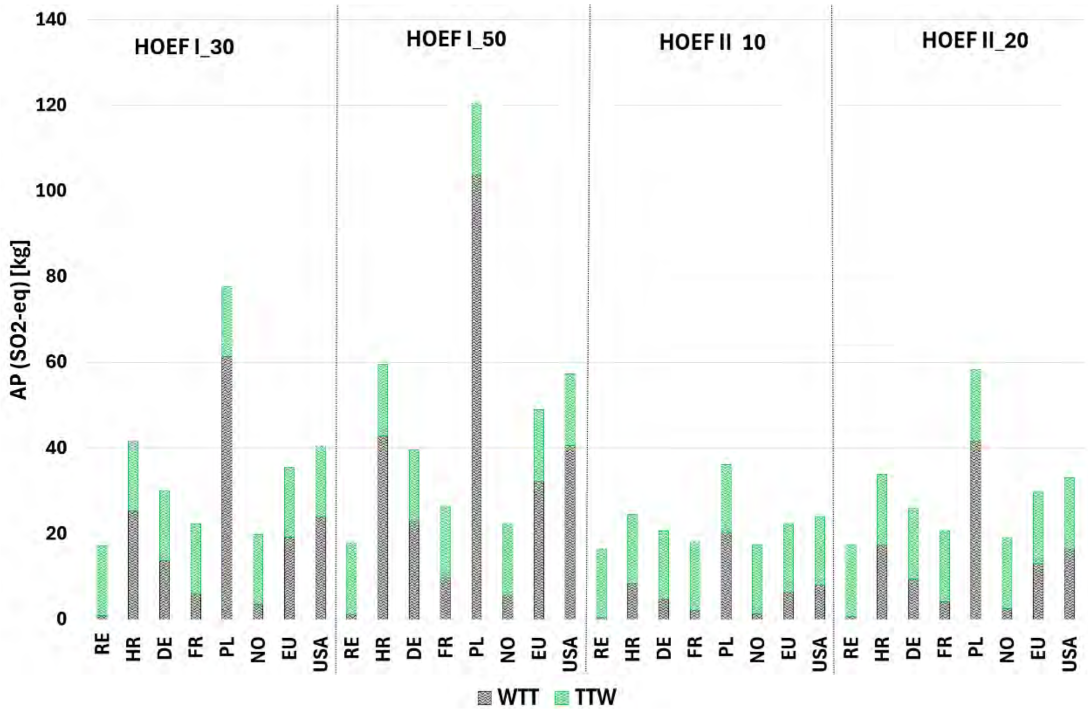

Figure B10. Sensitivity of AP indicator to different electricity mix scenarios for analysed HOEF blends (the purse seiner case study)

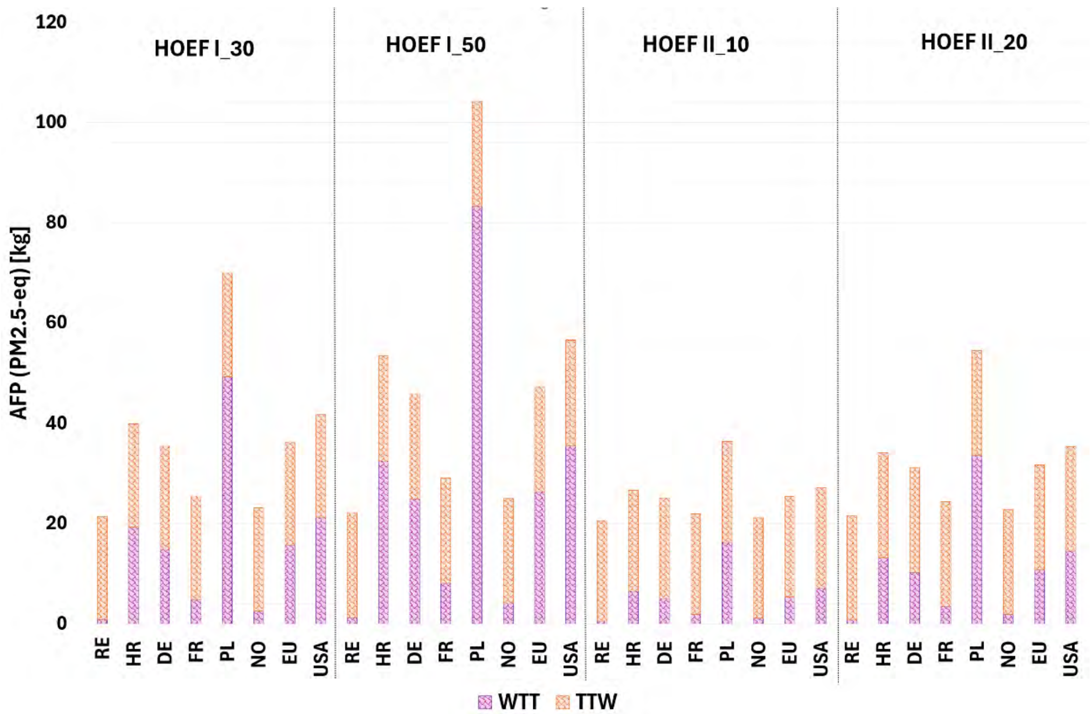

Figure B11. Sensitivity of AFP indicator to different electricity mix scenarios for analysed HOEF blends (the purse seiner case study)

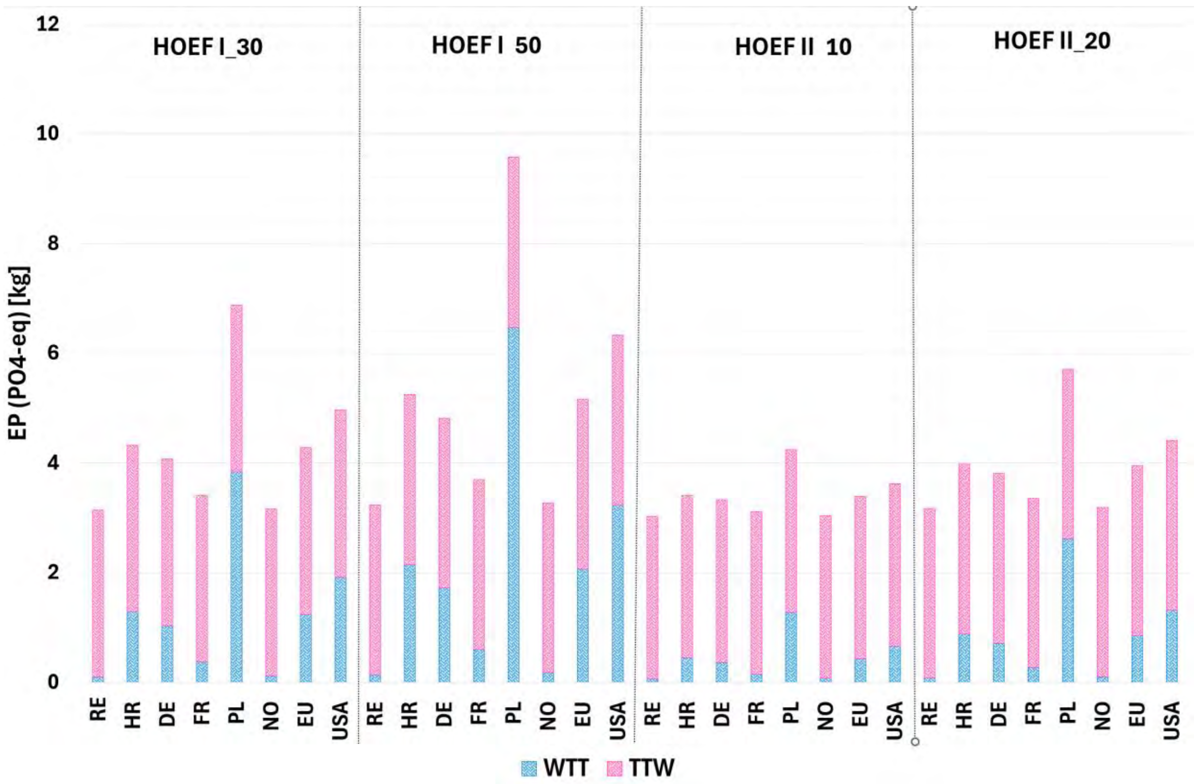

Figure B12. Sensitivity of EP indicator to different electricity mix scenarios for analysed HOEF blends (the purse seiner case study)

16.3 Sensitivity to vessel speed

Results of the sensitivity analysis to vessel speed for ferry, bulk carrier, and cruise case study are shown in Figure B13- B21.

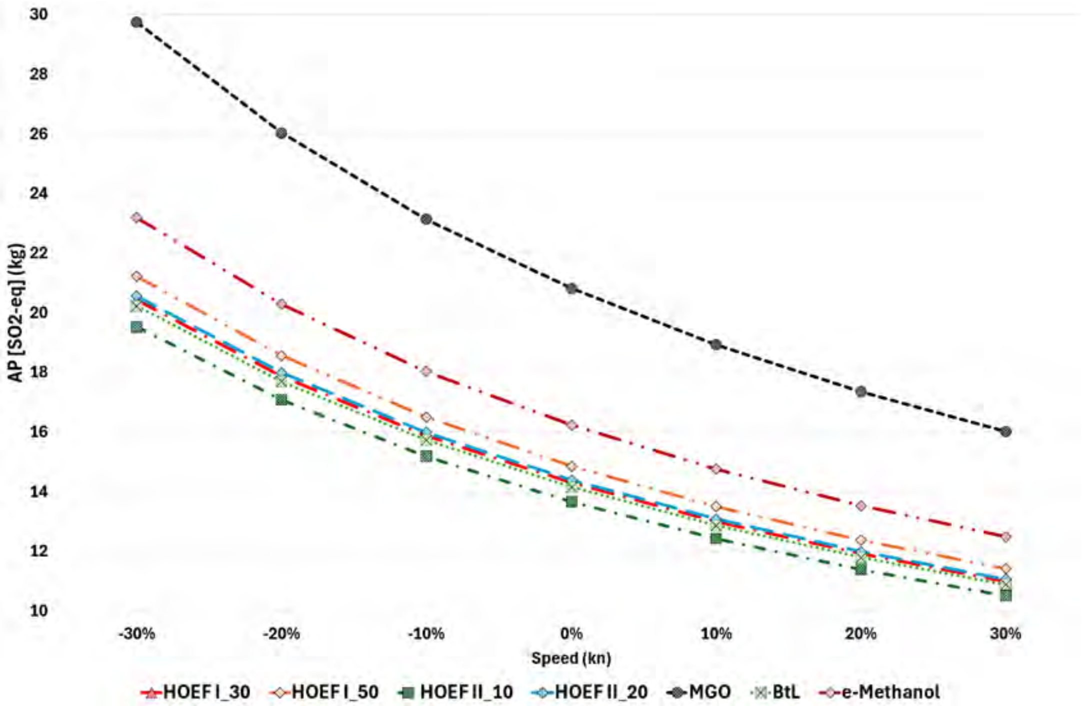

Figure B13. Sensitivity of AP indicator to different operational vessel speeds for analysed fuels (the ferry case study).

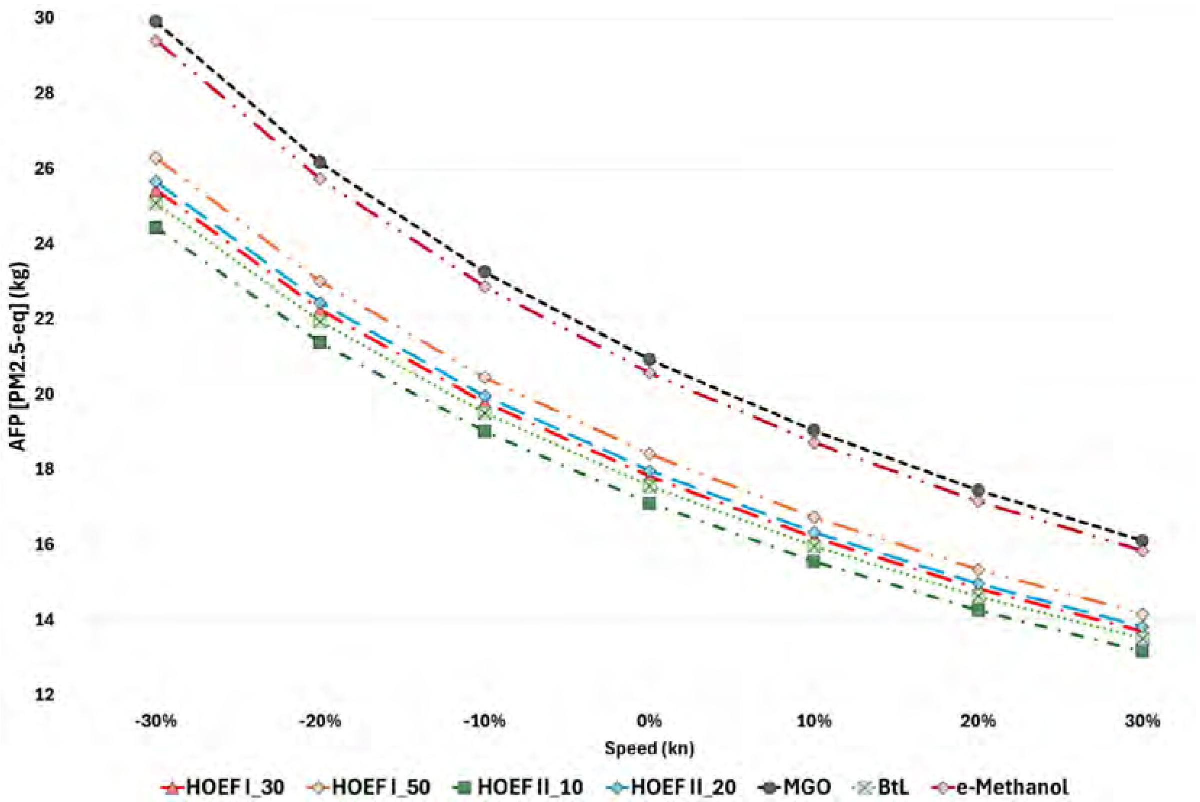

Figure B14. Sensitivity of AFP indicator to different operational vessel speeds for analysed fuels (the ferry case study).

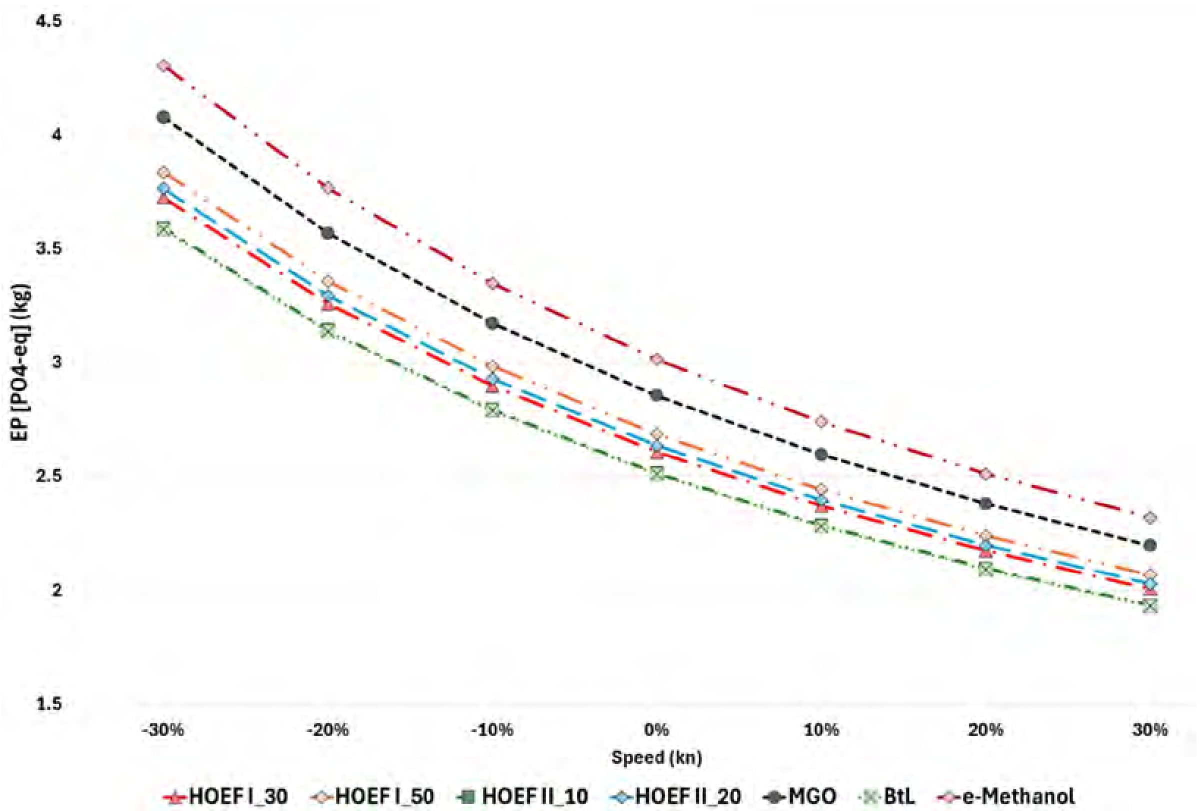

Figure B15. Sensitivity of EP indicator to different operational vessel speeds for analysed fuels (the ferry case study).

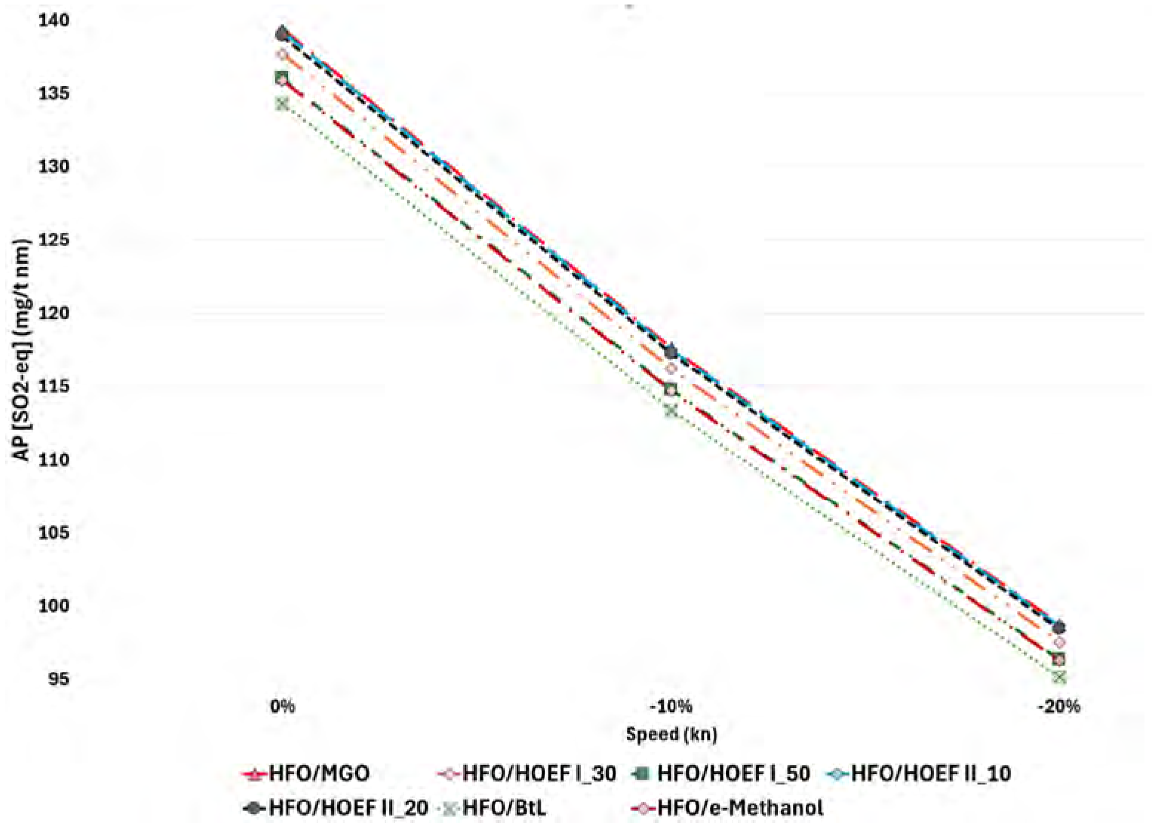

Figure B16. Sensitivity of AP indicator to different operational vessel speeds for analysed fuels (the bulk carrier case study)

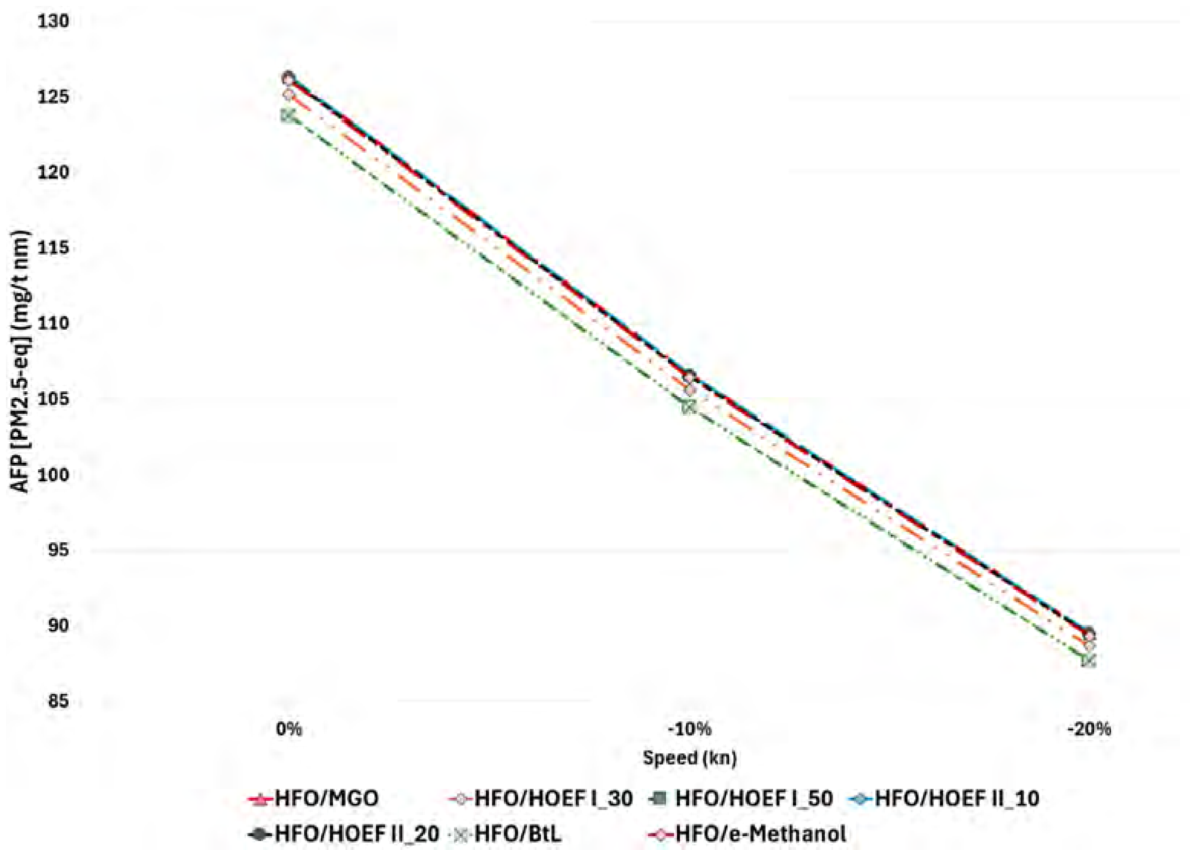

Figure B17. Sensitivity of AFP indicator to different operational vessel speeds for analysed fuels (the bulk carrier case study).

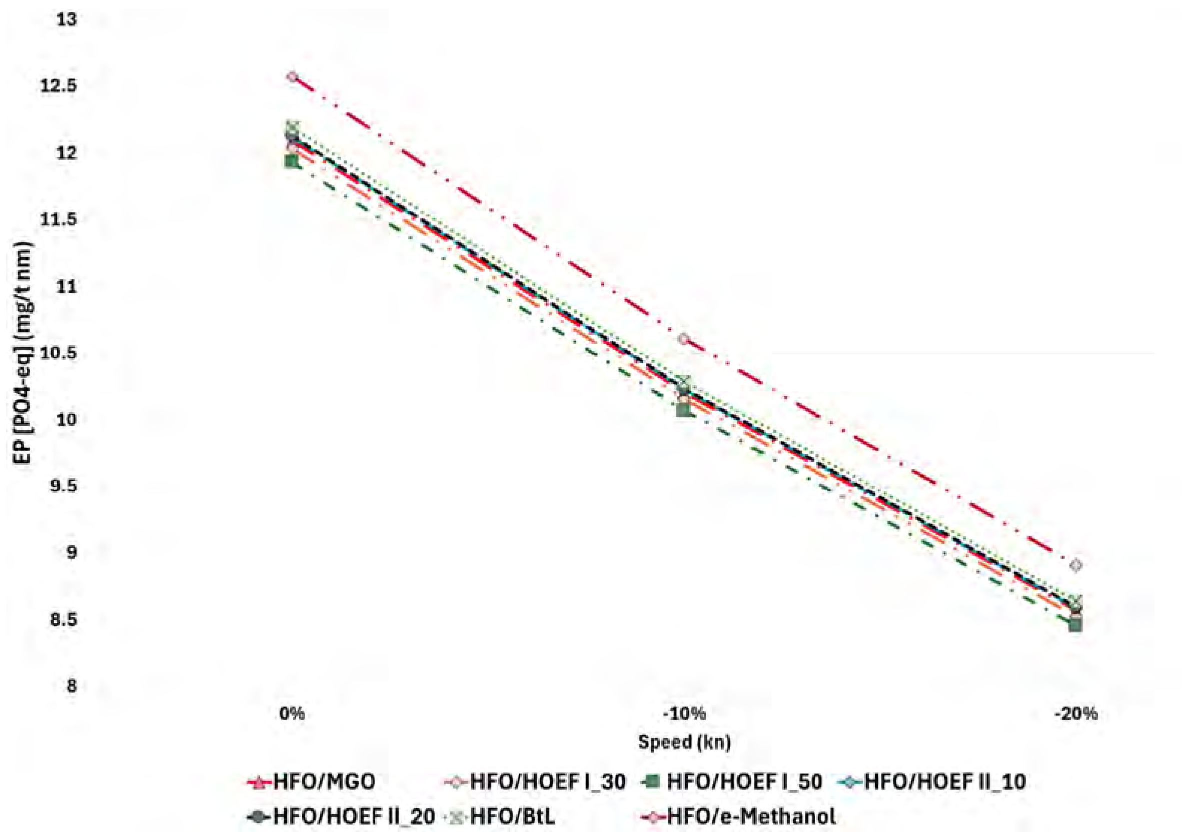

Figure B18. Sensitivity of EP indicator to different operational vessel speeds for analysed fuels (the bulk carrier case study).

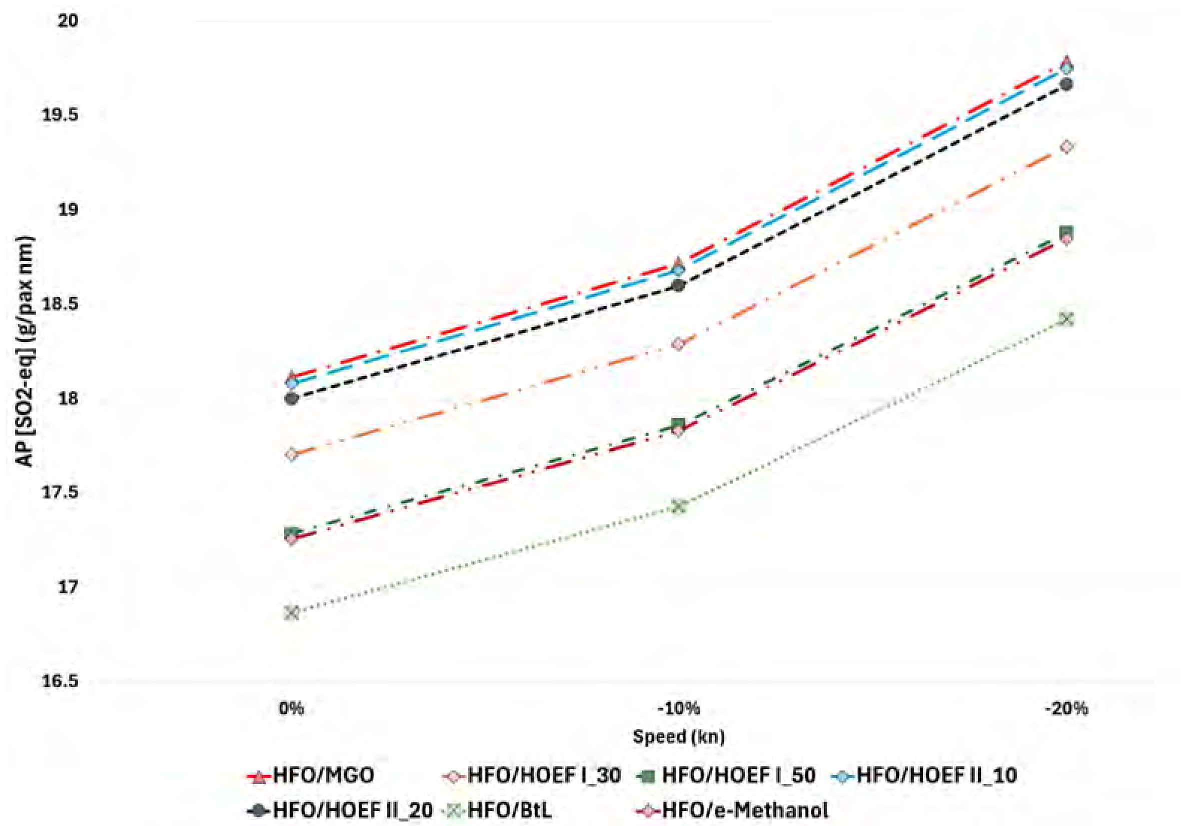

Figure B19. Sensitivity of AP indicator to different operational vessel speeds for analysed fuels (the cruise ship case study).

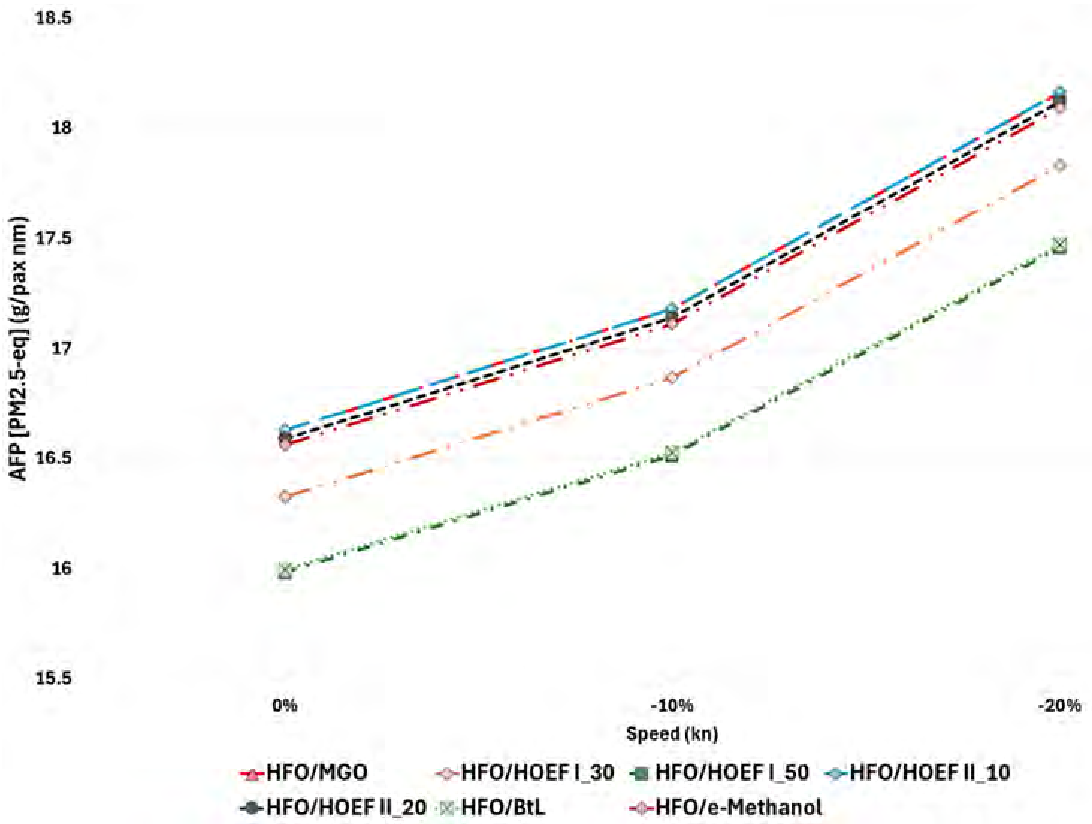

Figure B20. Sensitivity of AFP indicator to different operational vessel speeds for analysed fuels (the cruise ship case study).

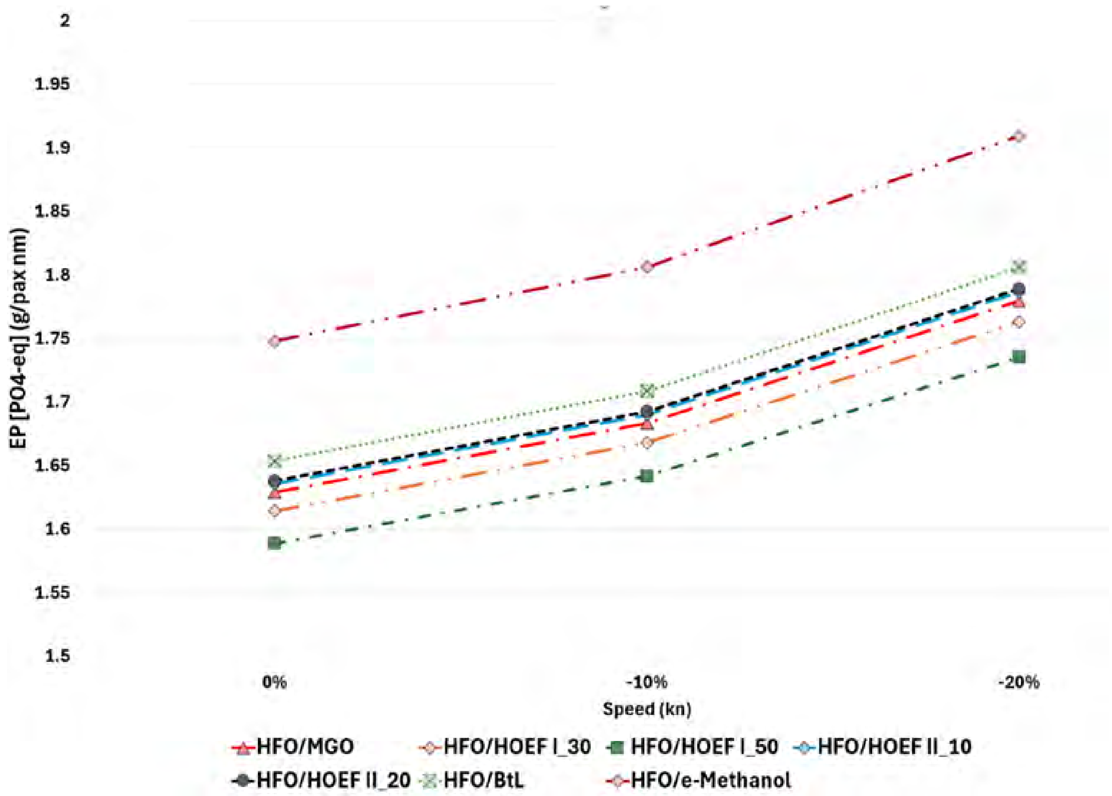

Figure B21. Sensitivity of EP indicator to different operational vessel speeds for analysed fuels (the cruise ship case study)

16.4 Sensitivity to ECA share

Results of the sensitivity analysis to ECA share for bulk carrier and cruise case study are shown in Figure 8.

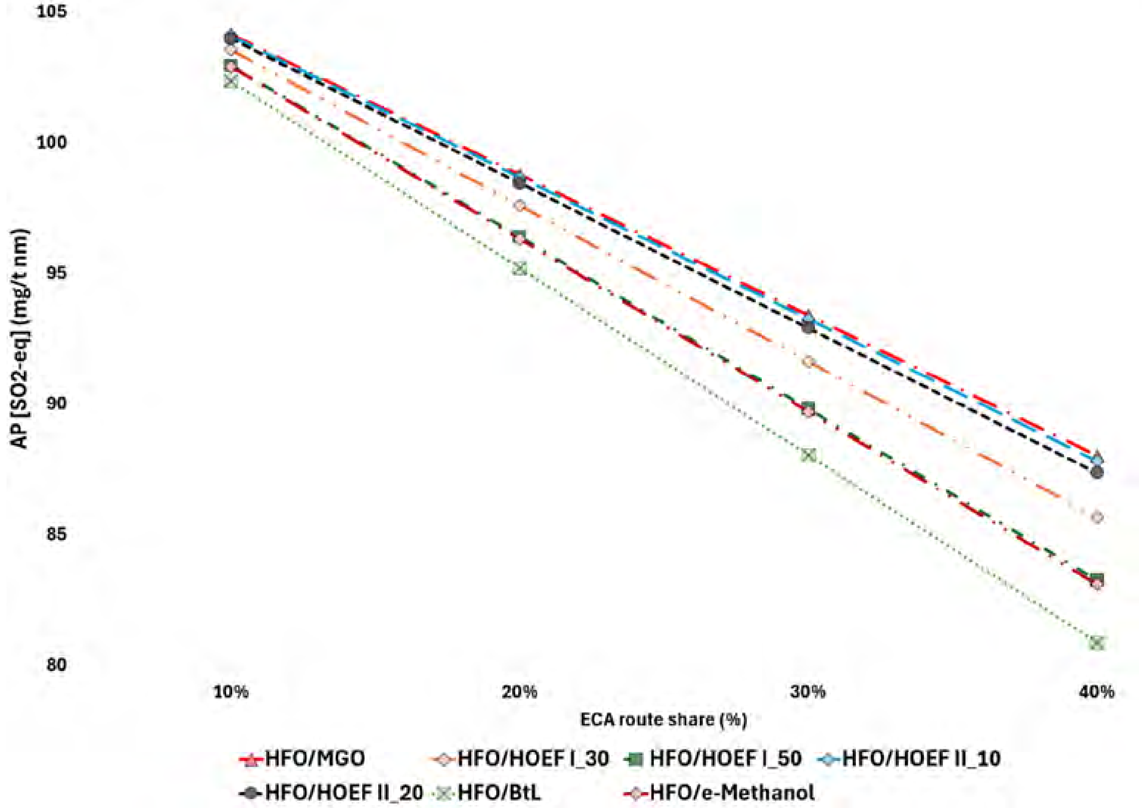

Figure B22. Sensitivity of AP indicator to variations in ECA share.

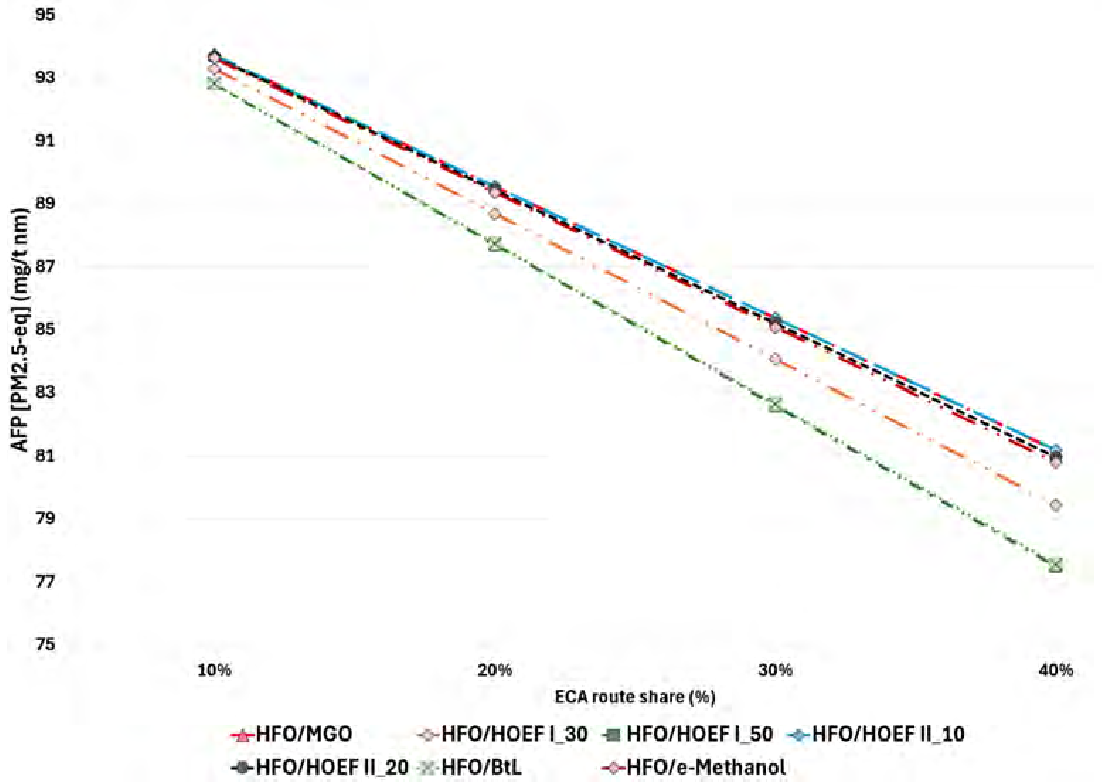

Figure B23. Sensitivity of AFP indicator to variations in ECA share.

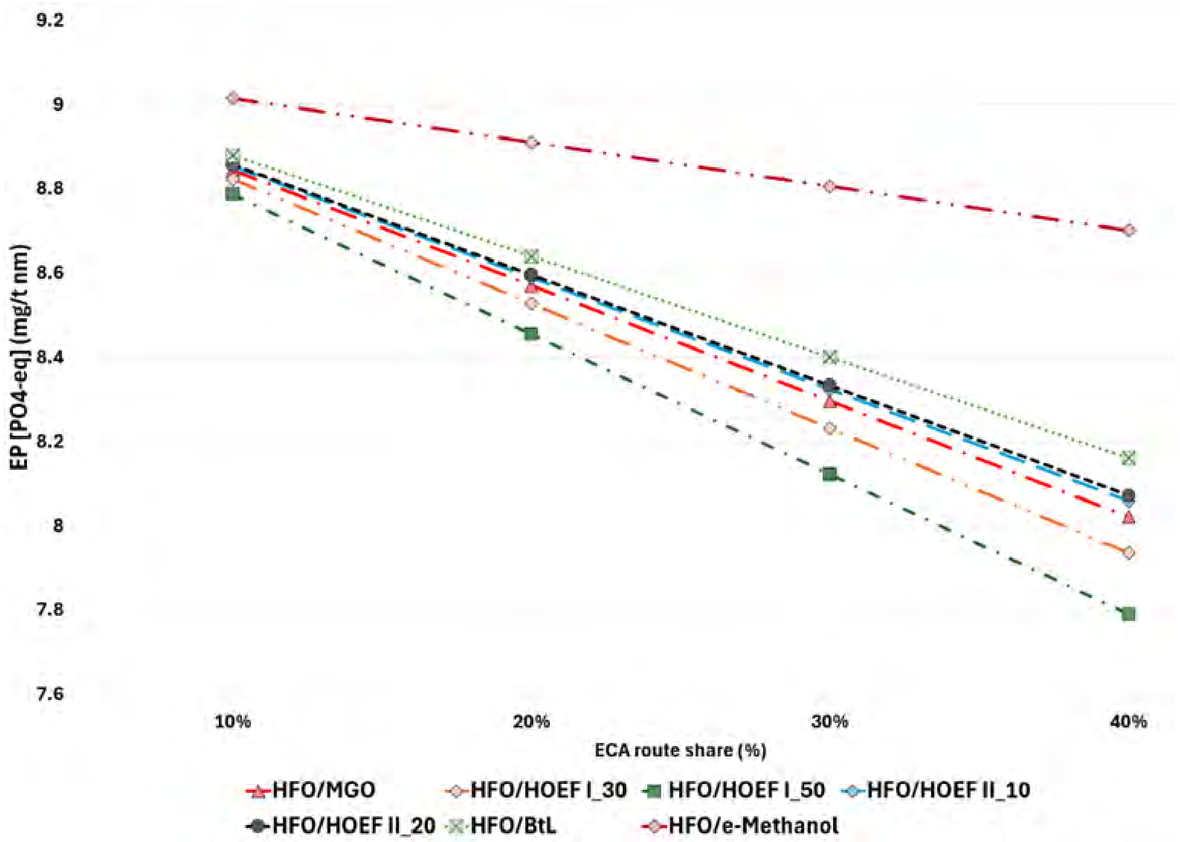

Figure B24. Sensitivity of EP indicator to variations in ECA share.

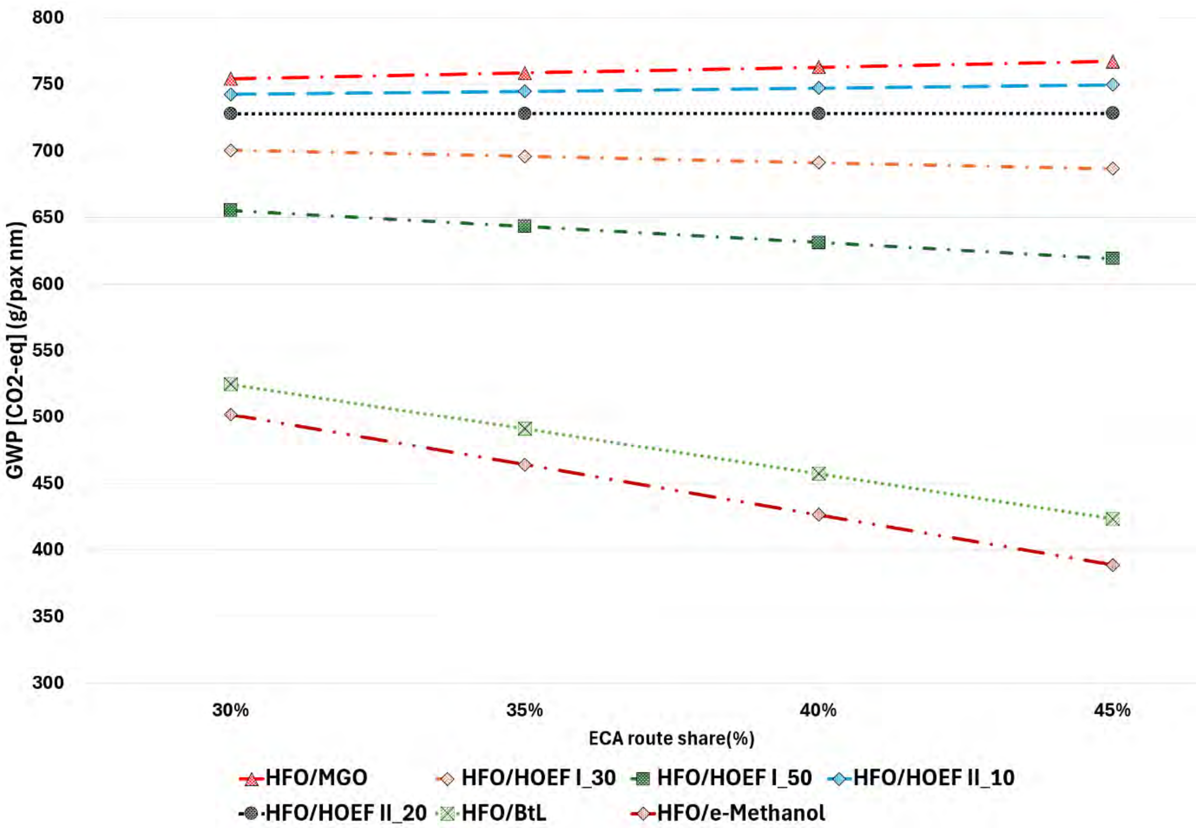

Figure B25. Sensitivity of GWP indicator to variations in ECA share

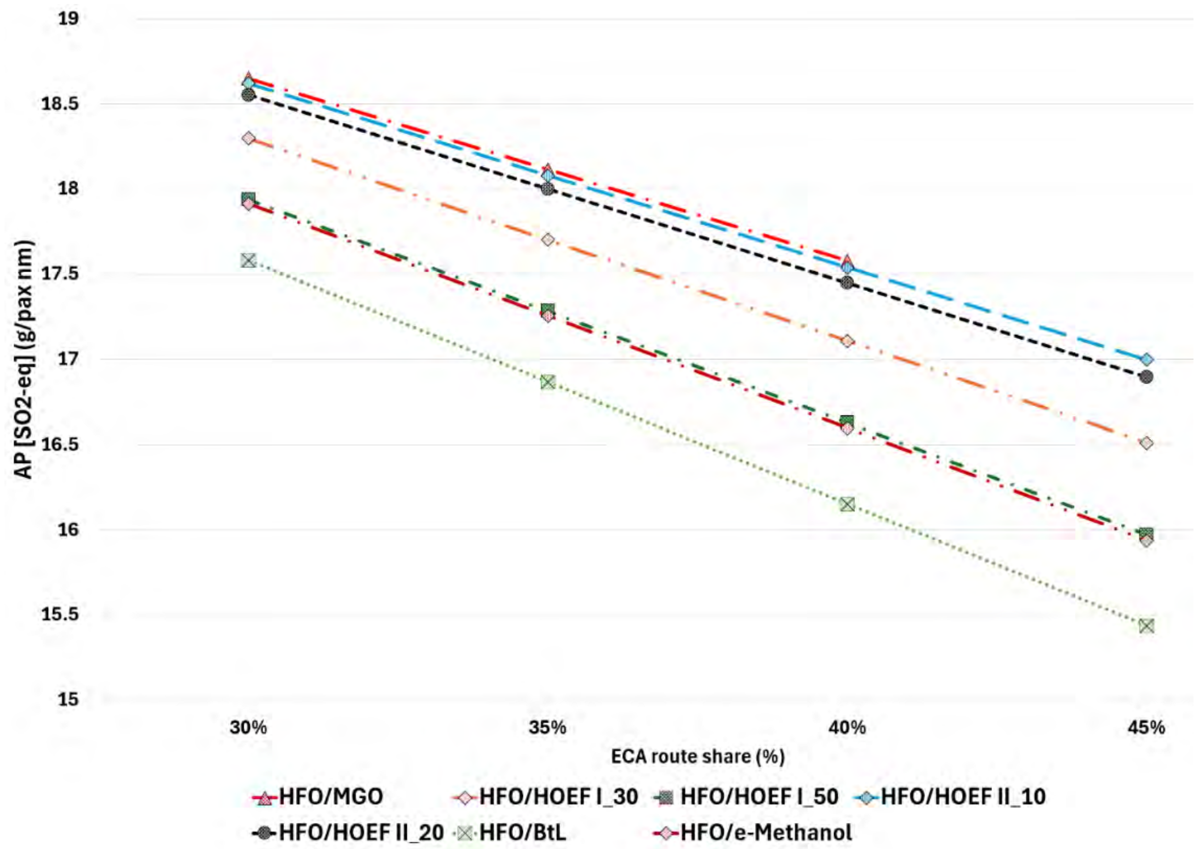

Figure B26. Sensitivity of AP indicator to variations in ECA share

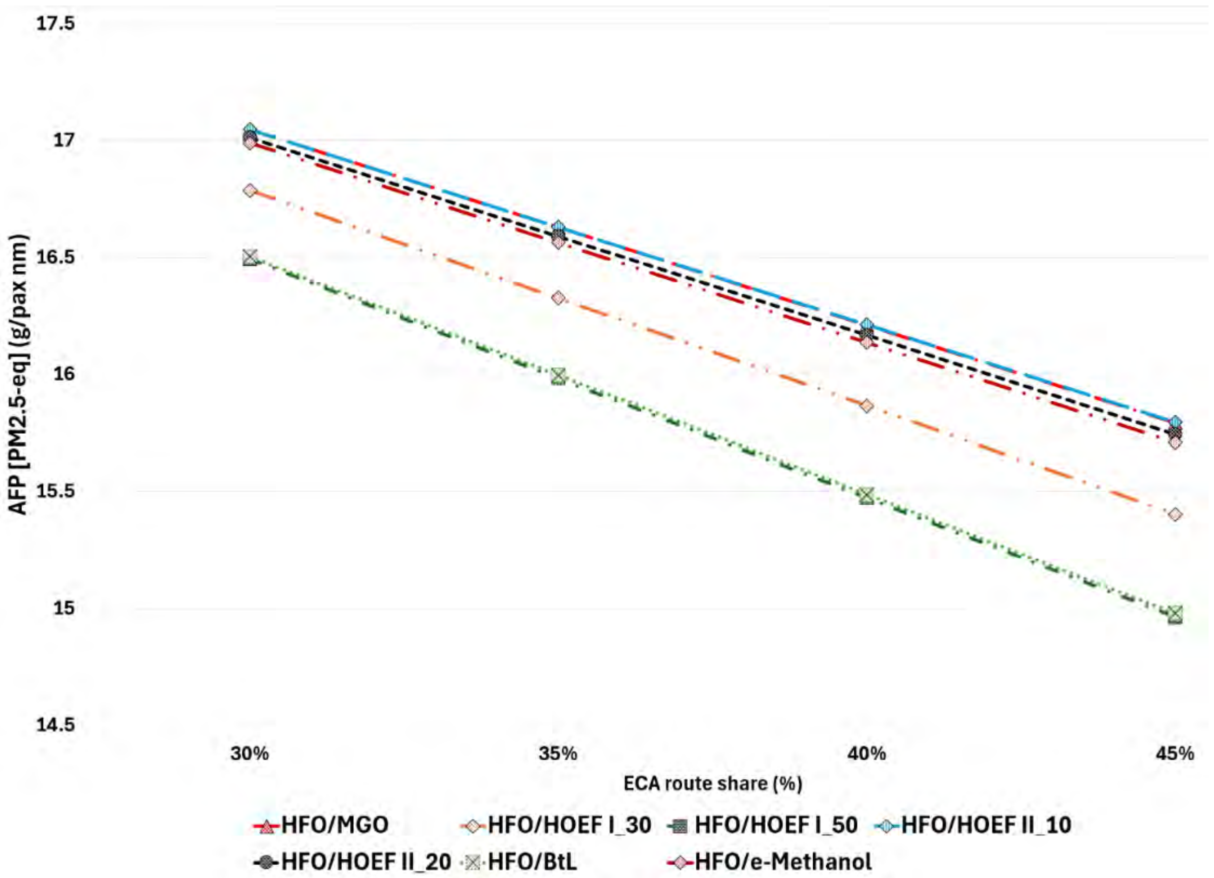

Figure B27. Sensitivity of AFP indicator to variations in ECA share

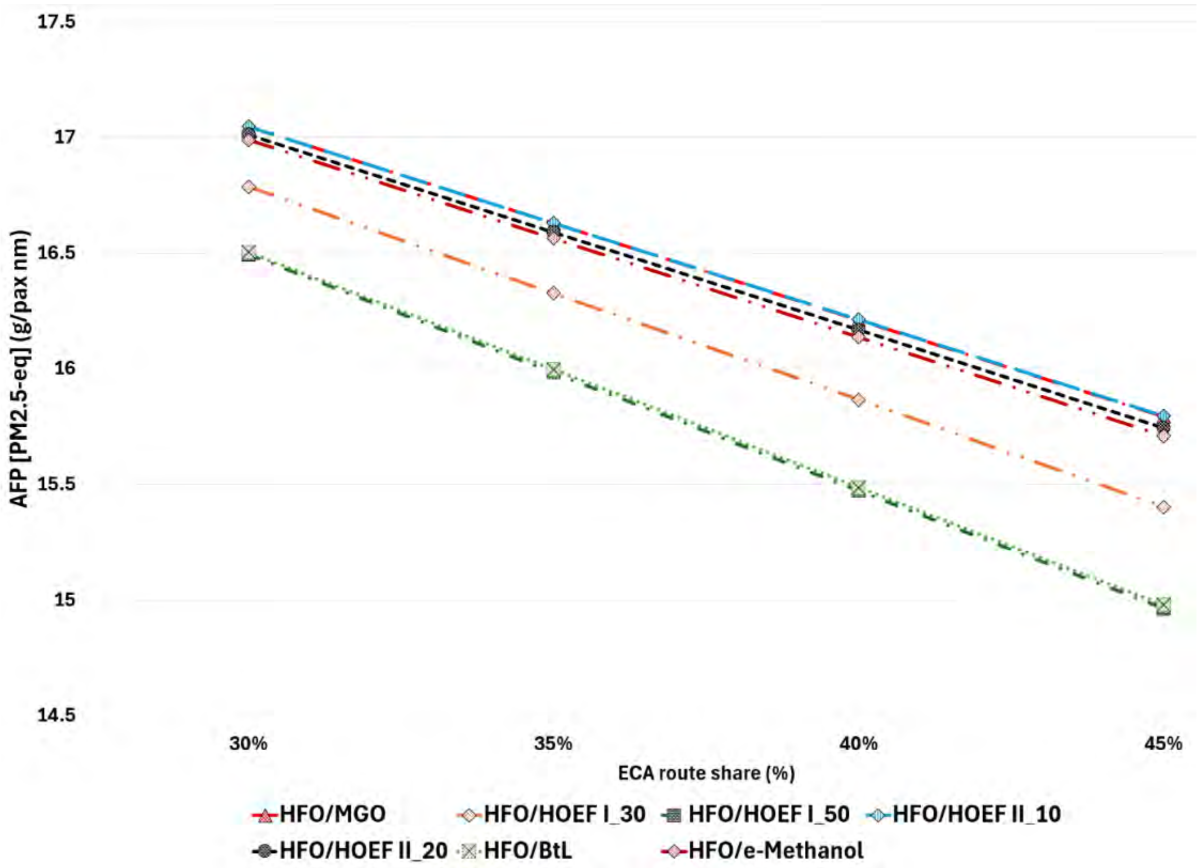

Figure B28. Sensitivity of EP indicator to variations in ECA share

16.5 Sensitivity to fuel blend

Figure B29. WTW acidification potential (AP, SO2-eq) for the ferry case study with pure HOEF I and HOEF II.

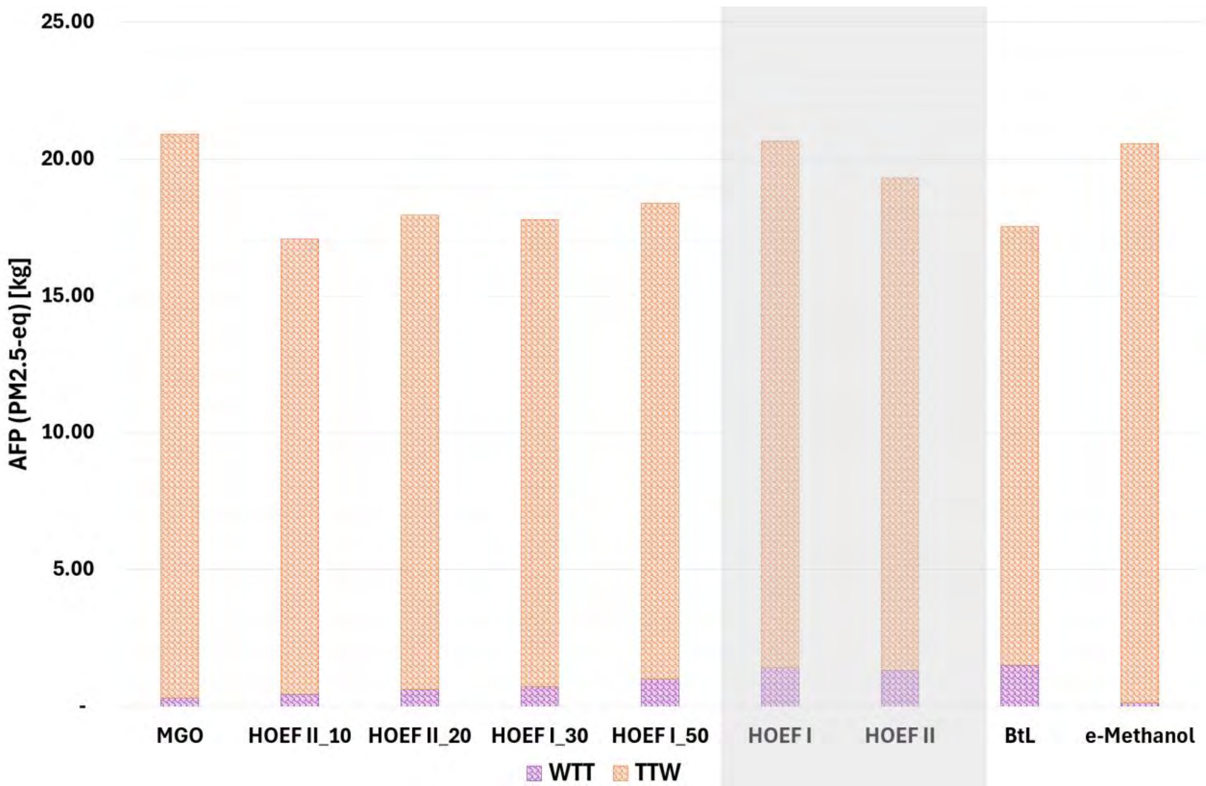

Figure B30. WTW particulate matter formation (AFP, PM2.5-eq) for the ferry case study with pure HOEF I and HOEF II.

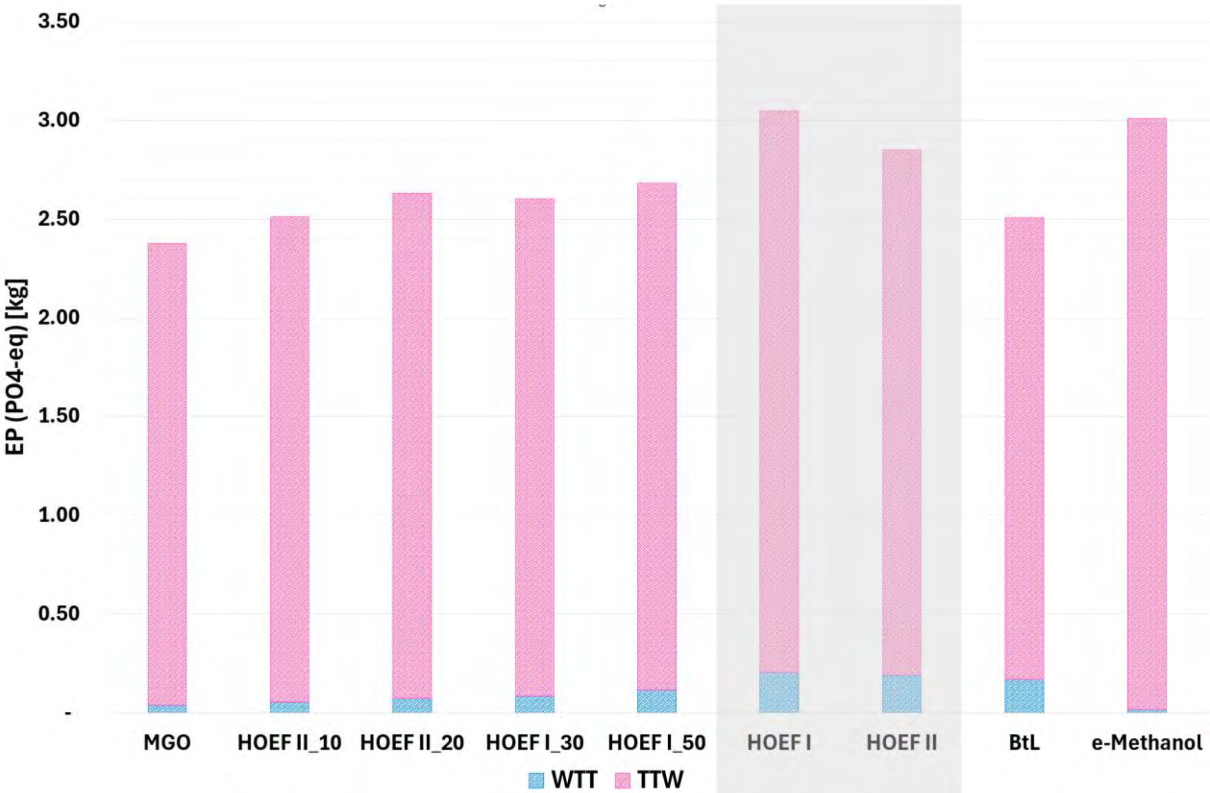

Figure B31. WTW eutrophication potential (EP, PO4 3--eq) for the ferry case study with pure HOEF I and HOEF II.

16.6 Sensitivity to inclusion of paraffinic co-products

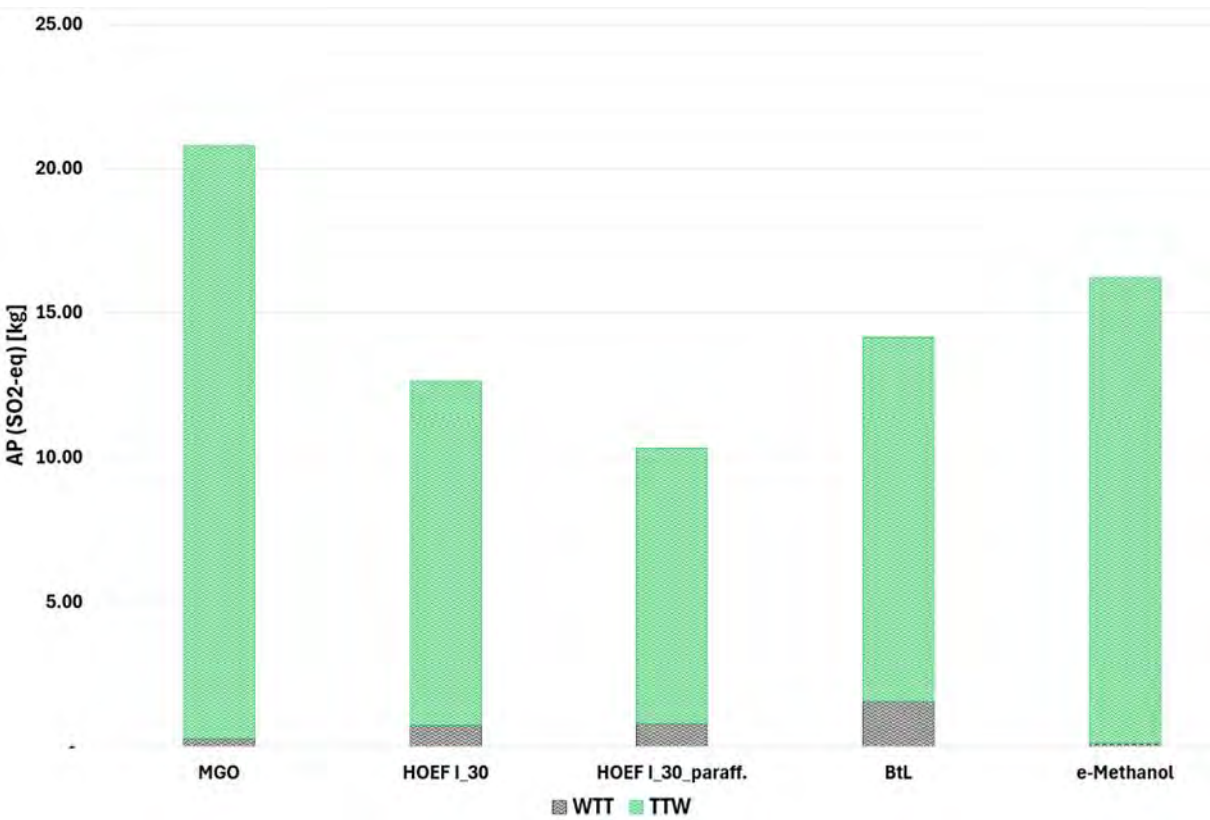

Figure B32. Sensitivity of WTW acidification potential (AP, SO_2-eq) to inclusion of paraffinic co-products for the HOEF I_30 blend (ferry case study).

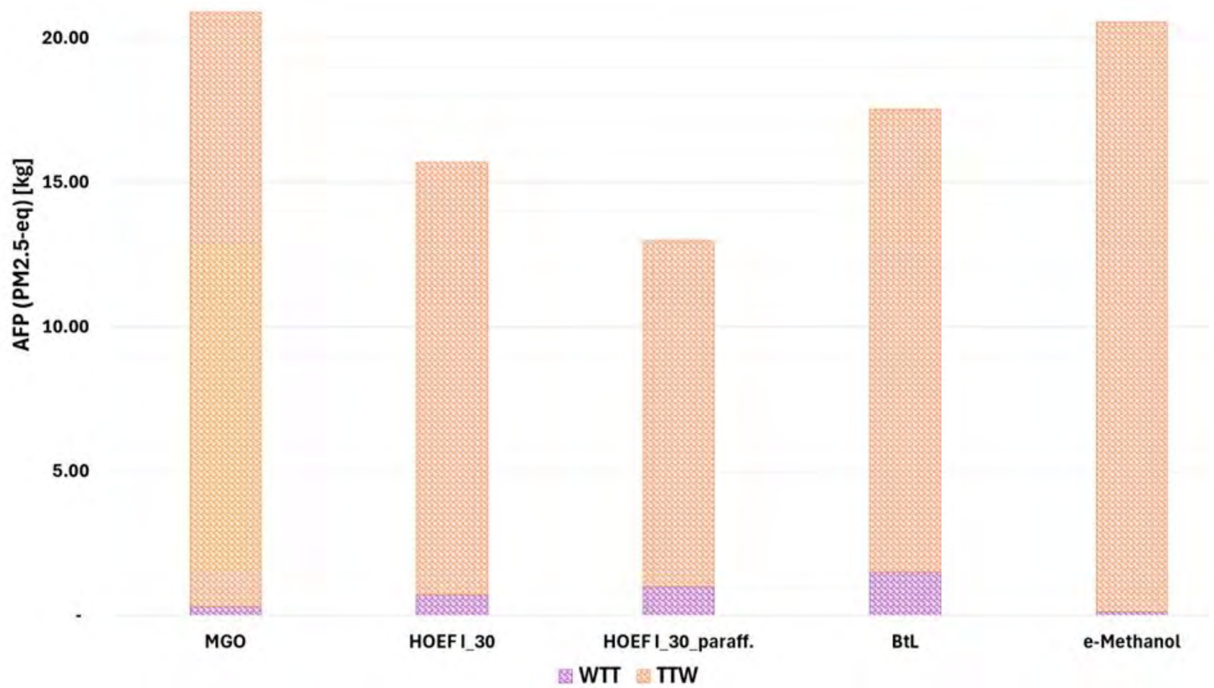

Figure B33. Sensitivity of WTW particulate matter formation potential (AFP, $PM_{2.5}$-eq) to inclusion of paraffinic co-products for the HOEF I_30 blend (ferry case study).

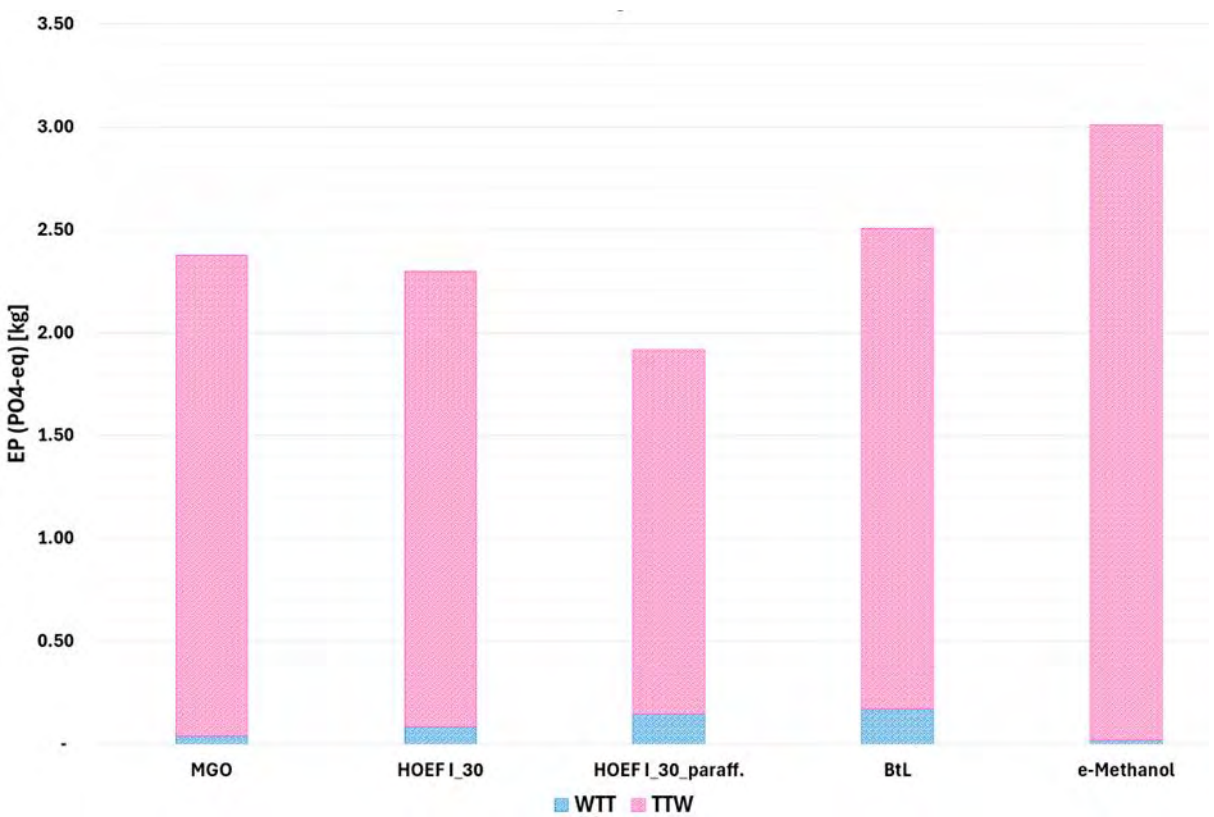

Figure B34. Sensitivity of WTW eutrophication potential (EP, PO_4^{3-}-eq) to inclusion of paraffinic co-products for the HOEF I_30 blend (ferry case study).