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Negative greenhouse gas emissions for shipping

The shipping sector is a key element to the global supply chain, and about 3% of the total greenhouse gas emission comes from this sector. Currently, the rate of emission reduction is not sufficient to meet the targets to enhance the sector's sustainability, and net negative carbon dioxide emissions are required to accelerate decarbonisation and for balancing the residual emissions (i.e., methane, nitrous oxide, etc.). To limit greenhouse gas emissions from shipping, the present fossil-based marine fuels should be replaced by renewable fuels or by using carbon abatement technology. Renewable fuels may be produced from biomass (biofuels) or renewable electricity (e-fuels). Bioenergy with carbon capture and storage, and direct air capture carbon capture storage have received wide interest recently. This project analyses the potential of onboard carbon capture technology for carbon-based e-fuels and biofuels to achieve GHG emission reduction, while also presenting a cost analysis of these options. To assess the climate change impact and cost, prospective life cycle assessment and environmental life cycle costing methods are used. Key performance indicators for the climate impact performance are identified and investigated, such as renewable electricity mix requirement for fuel production, and carbon capture rate for onboard carbon capture. The advantage of using the carbon-based renewable fuel is its relative ease to store, handle and transport compared to renewable hydrogen, and onboard carbon capture is less energy intensive and can operate using heat from the engine.