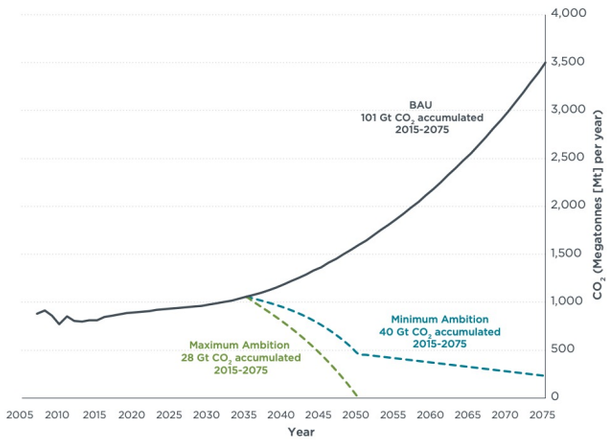
CARBON CAPTURE

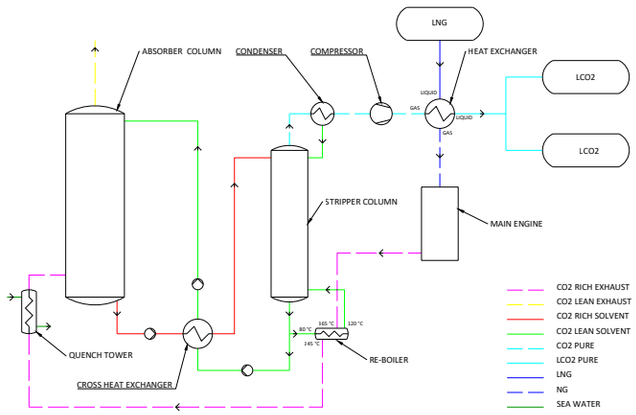
A Techno-Environmental Design Study on the Implementation of a Carbon Capture Plant into a Fitting Marine Vessel

1 Background & Introduction



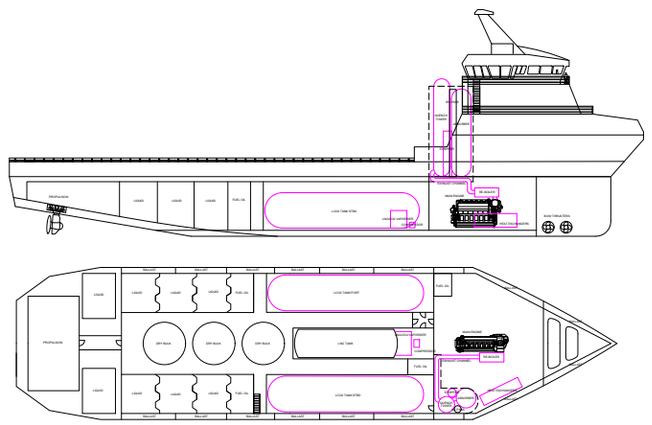
- Excessive anthropogenic emission of CO_{2e} is rising global surface temperatures at a rate of 0.2˚C per decade.
- The maritime industry contributes 2.89% of this total emissions amount.
- The ambition for the maritime industry is to reduce emissions by at least 50% of 2008 levels by the year 2050, with a further pursuit for zero carbon.
- Transitional abatement methods are needed to facilitate this shift to a carbon free future.
- Carbon capture is a promising solution – successful implementation is dependant on the level of system harmonisation of capture plant with vessel.

2 System Design



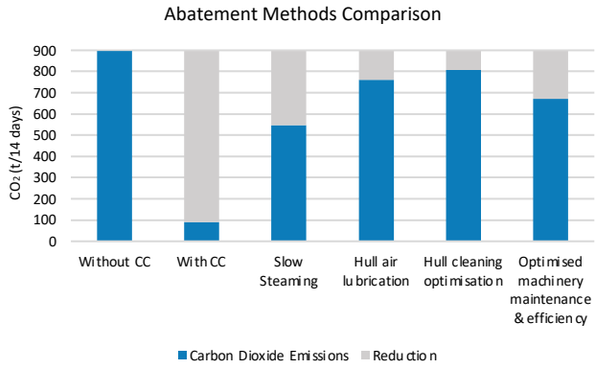
- Weighted decision matrix against PDS resulted with offshore service vessels (OSV) supporting the implementation of a solvent-based carbon capture system most suitable.
- OSV with LNG/MGO fueled engine emits 896.84 t of CO_2 over a 14-day case study journey.
- Chemical engineering and scaling principles deduced a carbon capture plant that matches with the capacity of the engine delivering the exhaust.
- Heat duty for system operation is taken from exhaust waste heat, saving 2695 kW_{th}. LNG is used as the heat sink for the liquification cooling duty of the captured CO_2, saving 227.9 kJ.
- Capture plant weighs 210.32 t and requires 337 kW of extra energy for operation.

3 Implementation & Response



- The positioning of tanks and components carefully considered to maintain ideal proximity to machinery while upholding stability aspects.
- Tanks placed midship on the wings, main plant components situated starboard side of the vessel.
- Placement induced a list and trim on the vessel, although conformance to intact stability regulations was upheld. Fluctuating masses as fuel was consumed and CO_2 was taken on posed no stability problems.
- Extra weight and operation of the plant compared to the reference case resulted in a greater fuel consumption of 4.236 kg/NM or 29.28 kg/tonnage weight added – Proportional increase of CO_2 emittance resulted.

4 Evaluation & Conclusion



- Design synthesis of all technical aspects ensured capture plant is adequately sized to the vessel, and the implementation of the plant induced a true to life response from the vessel – Technical harmonisation is achievable and meets project objectives.
- Capture plant saves 807.1 t of CO_2 through the 14-day concept voyage.
- Offshore and service vessels as a fleet with capture plant installed will contribute sufficiently to achieving 1.5 ˚C temperature reduction target.
- Carbon capture plant sufficient as a transitional solution to achieve zero carbon, however not as a long term substitute.
- Further work to look at economic and environmental life cycle elements.

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