Carbon Neutral Solution for Marine

Hydrogen Generation System
& Carbon Capture, Utilization and Storage

ENG

PANASIA

GMC Marine Partner

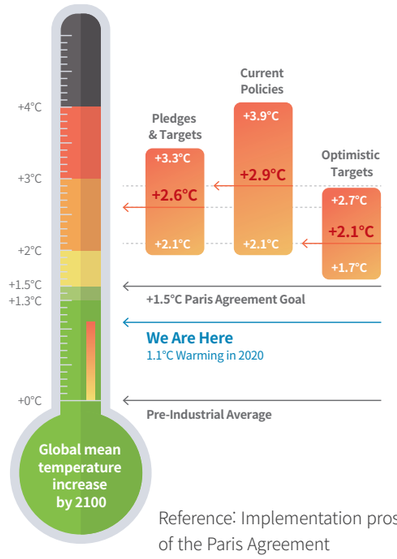
Carbon Capture, Utilization and Storage(CCUS) System

PANASIA's Pan-CCUS™

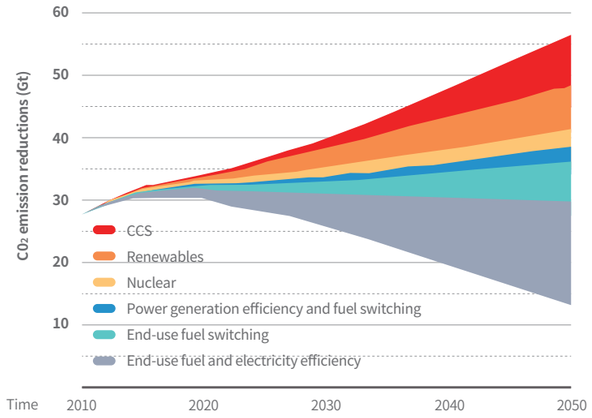
The Carbon Capture, Utilization and Storage system for ships is a system that captures and utilizes carbon dioxide generated during combustion of fossil fuel used to propel and generate power for ships and reforming to produce hydrogen, in order to reduce the amount of CO_2 released into the air.

The aim of the Paris Agreement is to reduce the impacts of climate change by keeping the global temperature rise below 2°C above pre-industrial levels. To that end, the agreement requires a rapid reduction of greenhouse gas emissions.

The aim of Carbon Capture, Utilization and Storage (CCUS) is to limit the impacts of climate change by capturing carbon dioxide, and the captured CO_2 is used for commercial applications.



Reference: Implementation prospects of the Paris Agreement



Reference: Predictions for greenhouse gas emissions mitigation measures

CCUS is predicted to contribute to 19% of the total CO_2 emission reductions globally by 2050. Without CCUS, the cost of reducing emissions would increase by more than 70%. In other words, CCUS will play a pivotal role in reducing CO_2 emissions.

PANASIA's Pan-CCUS™ will lead the way to a carbon-neutral world.

Features

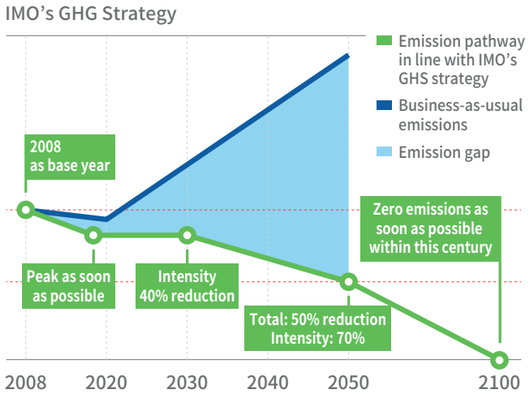
- High purity of product CO_2
- Compact size of tower and configurations
- Low energy consumption
- Simple and reliable operation
- Full automation

REGULATION

EEDI (Energy Efficiency Design Index) & EEXI (Energy Efficiency Existing ship Index)

- Setting targets to reduce CO_2 emissions per transport work by the nth year below the 2008 peak
- CO_2 emissions generated by a ship when transporting 1 ton of cargo 1 nautical mile; for 13 types of ships with gross tonnage more than 400 tons, the EEDI must be calculated for each new ship
- The EEDI applies to ships built since 2015, targeting a 30% reduction of greenhouse gas emissions by 2025 (with the base year of 2013)

phase 2 **20%** 2020~ — phase 3 **30%** 2025~ — phase 4 **40%** 2030~ — phase 5 **50%** 2050



CII (Carbon Intensity Indicator)

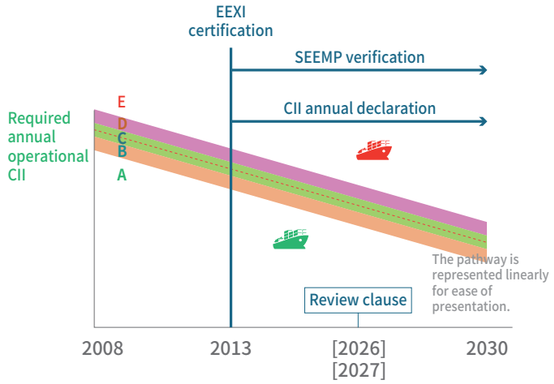
Carbon Intensity Indicator (CII)

- The Carbon Intensity Rating scheme is applicable to existing ships operating internationally above 5,000 GT.
- The Carbon Intensity Indicator (CII) is a measure of how efficiently a ship operates based on vessel traffic data.
- Each ship will be given an annual rating ranging from A to E, based on the annual CII rating achieved by the ship against the annual CII requirement.

Calculation of annual CII :

$$CII = \frac{\text{Annual fuel consumption} \cdot CO_2 \text{ factor}}{\text{Annual distance travelled} \cdot \text{Capacity}} \cdot \text{Correction factors}$$

To be developed



Source: GHG-INF.2/1/1

Solution

Classification	Area	Green ship technologies
Propulsion and hull	Hull form / Lightweight construction	Wave-making resistance / frictional resistance / air resistance / Lightweight hull construction using advanced materials and composites
	Auxiliary power	Auxiliary propulsion using solar and wind power
	Hull coating / Hull decontamination / Propeller polishing	Coatings made of advanced materials applied to reduce hull resistance / Hull surface decontamination / Propeller decontamination to improve propulsion efficiency
Energy efficiency improvement	Shaft generator	Technology of generating power from the main engine
	Waste heat recovery system	Recovering heat energy from exhaust gas and converting it into electricity
	Hydrogen fuel cell system	Generating electricity using hydrogen fuel cells
Greenhouse gas emissions reduction	CO_2 capture system	Combustion gas after-treatment, CO_2 capture and storage
Alternative fuel	Ammonia	Propulsion technology using ammonia

※ CCUS has a significant capacity to reduce GHG emissions and can be applied directly.

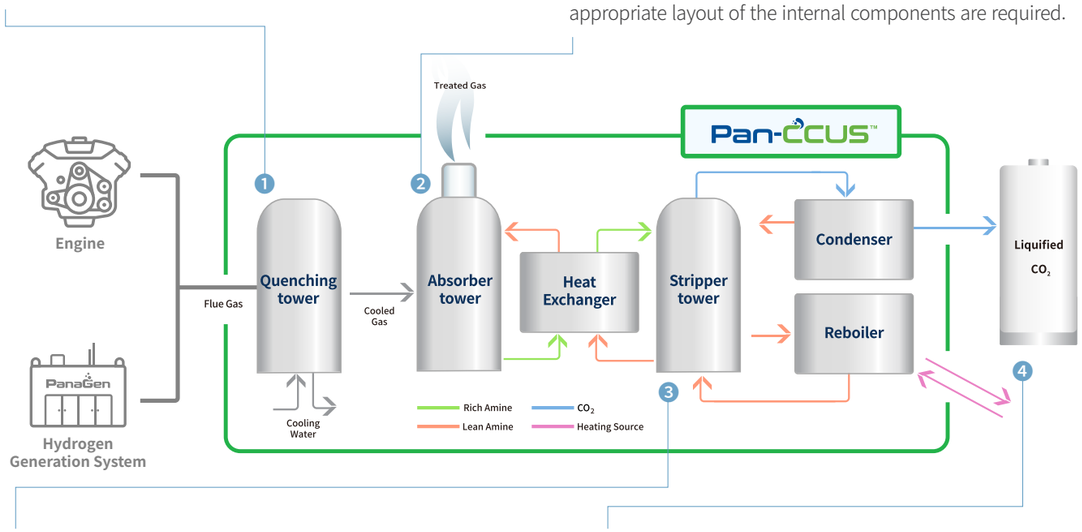
TECHNOLOGY

❶ Pre-treatment of Flue Gas

Flue gas is cooled in the quenching tower. When the particles and sulfur oxide are removed, the gas is pressurized by the intake fan and transferred to the absorber tower.

❷ CO_2 Absorption

Once cooled, the gas comes into contact with the chemical solvent in the absorber, and CO_2 is selectively absorbed. To ensure efficient delivery of the substance and keep the tower size to a minimum, high-performance packing and an appropriate layout of the internal components are required.



❸ Regeneration

A solvent that has absorbed CO_2 is transferred to the stripper tower. The high-temperature vapor in the reboiler causes CO_2 to be removed from the solvent. In the cooling tower, it breaks down into water and CO_2. Then, the water is recovered and sent to the stripper while CO_2 is transferred to the liquefaction process.

❹ Liquefaction & Storage

Adding pressure and cooling for liquefaction purposes to meet the needs of storage containers and buyers.

Applications

for Hydrogen Generation System

Capacity 80 / 200 / 400 CO_2 kg/h
Purity 99.9% CO_2
Feature High concentration of CO_2
Modular design
High purity of CO_2

for Ship

Capacity 1 / 2 / 3 CO_2 ton/h ~
Purity 99.9% CO_2
Feature Changing concentration of CO_2
Space limitation
CCS for marine condition
Load change of engine

for Industrial Plant

Capacity 5 / 10 /15 CO_2 ton/h ~
Purity 99.9% CO_2
Feature Large scale of CCS
Long-term Stability
Cost efficient