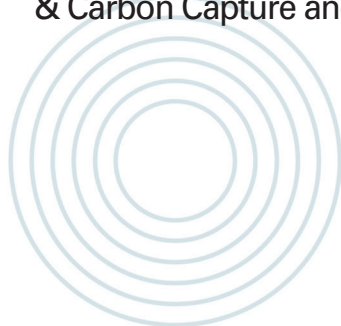
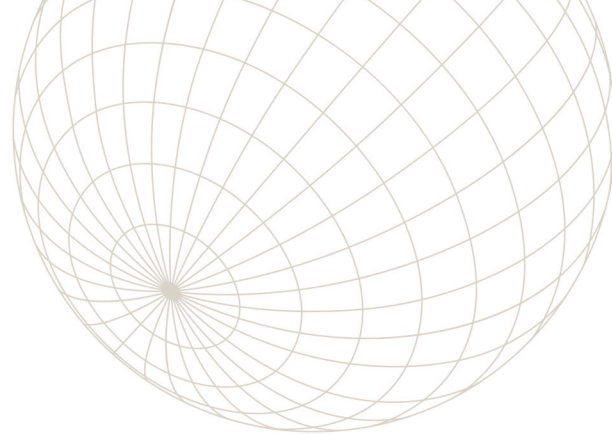


Carbon Neutral Solution

Hydrogen Generation System
& Carbon Capture and Storage System



ENG

PANASIA

Panasia: We are heading to the future with eco-friendly solutions

PANASIA is a green energy solution provider that leads the way in building a future in which humans and nature coexist.

At PANASIA, we are continuously working to take risks and develop technologies powered by nature based on the standards of nature across various areas, from the air environment to the water environment, and to our hydrogen business.

We offer high-quality ICT-based products by adopting our unique "SMART PANASIA" system, which encompasses all processes from product planning to design, production, and to services, and allows our technologies to learn and evolve on their own.

With its core technologies and years of experience, PANASIA has become a global leader that uses its technology to respond to demands in various environmental areas.



Water Quality Environment



Water treatment system



Measurement control system

Air Quality Environment



De-SOx system (Scrubber)



De-NOx system (SCR)



Carbon Capture and Storage (CCS) system

Energy Solution



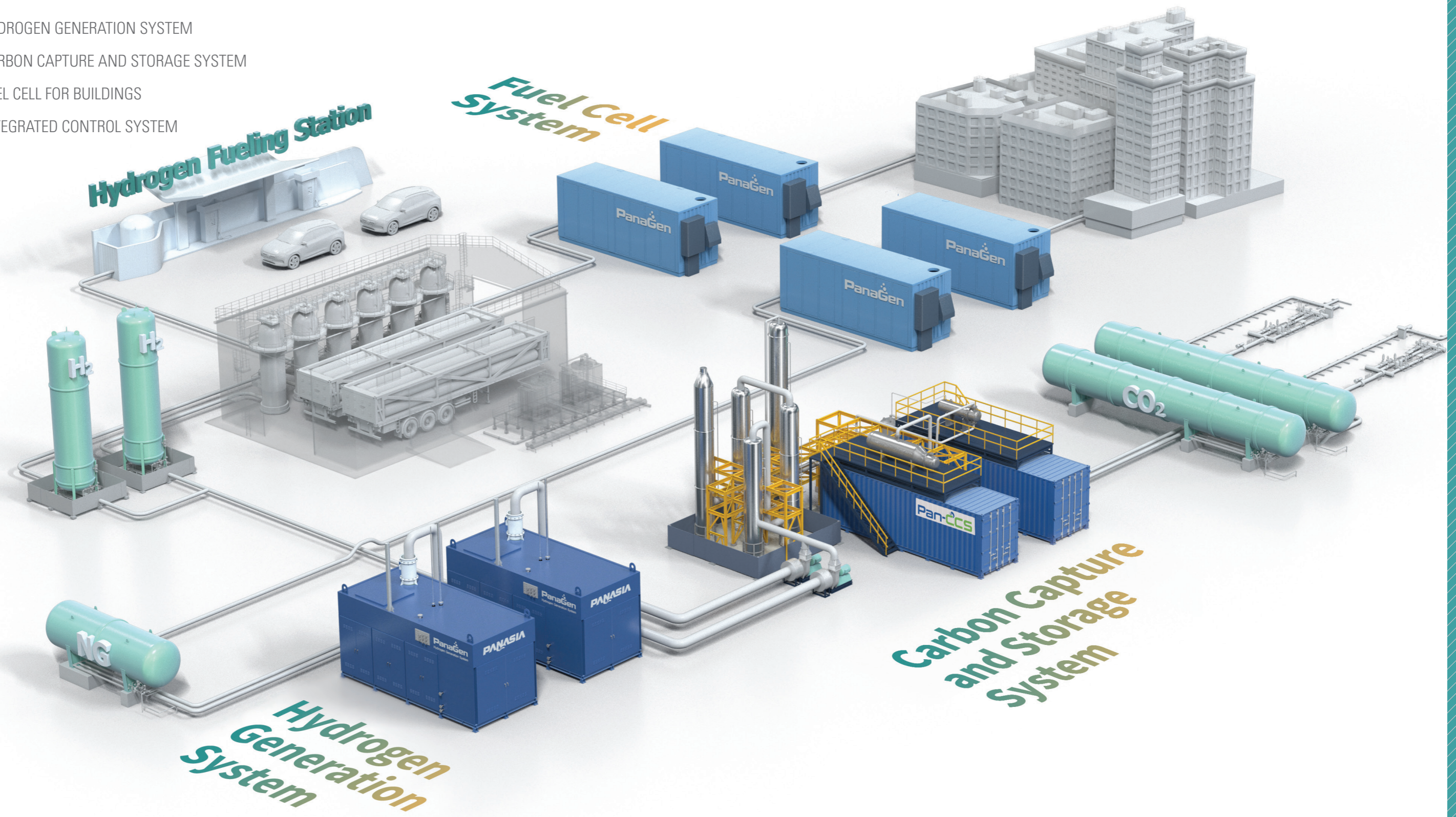
Hydrogen generation system



CARBON-NEUTRAL SOLUTION CATEGORY

Hydrogen Generation System
& Carbon Capture and Storage System

- HYDROGEN GENERATION SYSTEM
- CARBON CAPTURE AND STORAGE SYSTEM
- FUEL CELL FOR BUILDINGS
- INTEGRATED CONTROL SYSTEM



Hydrogen Generation System



PANASIA's hydrogen generation system, PanaGen™ is a renewable energy solution designed to generate hydrogen and achieve carbon neutrality in the hydrogen energy industry.

PanaGen™ generates hydrogen through cracking ammonia and reforming LNG or biogas on-site to utilize for household, construction, and industrial plants.

— Features



Ultra-high purity
(99.999%)



Fully automatic with
fail-safe control



Fully skidded, modular
design for low cost
installation



Low life cycle cost
for catalyst



Fast initial and warm
start up



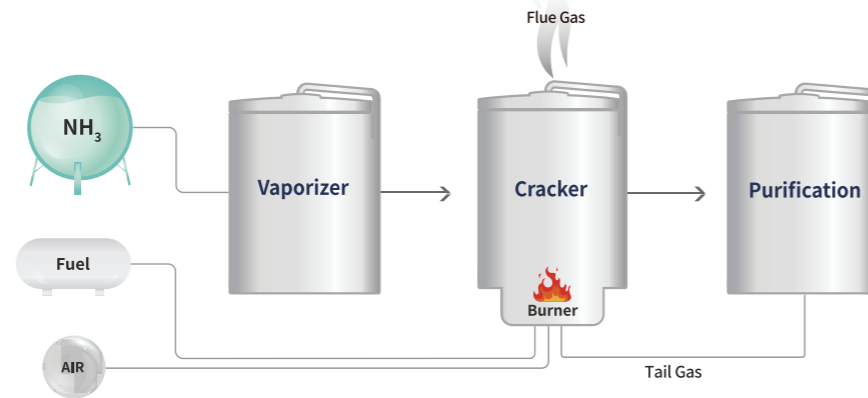
Real time monitoring &
control through "Smart
Control Center"



TECHNOLOGY

Ammonia Cracking Hydrogen Generation System

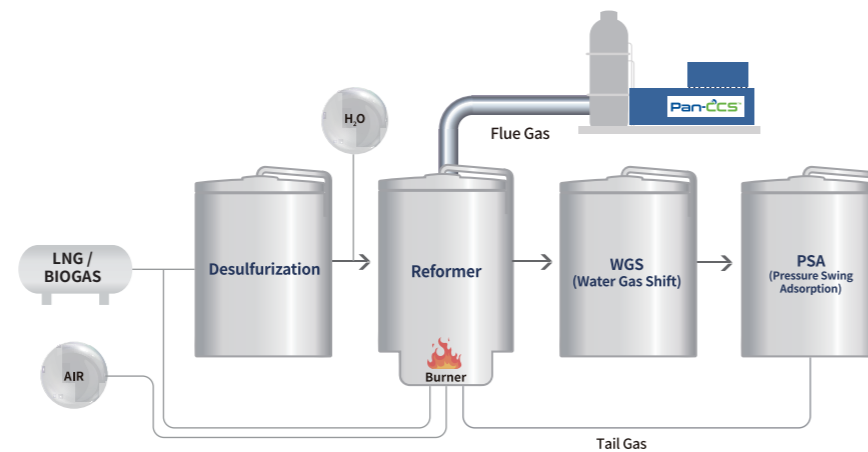
Ammonia Cracking Hydrogen Generation System is an eco-friendly green hydrogen solution that decomposes green ammonia and converts it to hydrogen. It doesn't emit any carbon dioxide.



LNG·Biogas Reforming Hydrogen Generation System

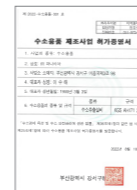
Hydrogen generation system that produces hydrogen by reforming natural gas and biogas.

Carbon dioxide generated by natural gas reforming can be captured through CCS.



PanaGen™ is the first to obtain manufacturing certificate from government

- KGS AH 171 (Based on facilities, technology, and inspection of hydrogen generation system manufacturing)



Smart Integrated Control System

Safety management

Real-time operating status monitoring and prevention of problems

Efficient management

Providing the consumables replacement notification service through big data analysis
 ➔ Keeping operating losses to a minimum

Product diagnosis

Fault Diagnosis and Analysis



SPECIFICATIONS

| Line up | | PanaGen™-30 | PanaGen™-100 | PanaGen™-250 | PanaGen™-500 |
|-------------------------------|---------------------|---|--------------|-----------------|----------------|
| Output(product) | | | | | |
| Product(H ₂) Flow | Nm ³ /hr | ~30 | ~100 | ~250 | ~500 |
| | kg/day | ~60 | ~200 | ~500 | ~1000 |
| Purity | %vol | ~99.999 | | | |
| Pressure | bar.g | ~6.5 | ~6.5 | ~6.5 | ~6.5 |
| General Specifications | | | | | |
| Feed NG flow | Nm ³ /hr | ~15 | ~50 | ~130 | ~260 |
| Feed NG Pressure | bar.g | 8.9~9.5 | | | |
| DI Water | L/hr | ~33 | ~110 | ~275 | ~550 |
| Water Quality(Feed/DI) | uS/cm | Feed Water : <650, Deionized Water : <1 | | | |
| Comp. Air Quality | | ISO 8573-1 Class 3/3/4 | | | |
| Operating Amb. Temp. | °C | -20 ~ 40 | | | |
| Electricals | | | | | |
| Power Source | | 380VAC 3phase 60Hz | | | |
| Electricity | kWh | ~14 | ~30 | ~60 | ~150 |
| Dimensions | | | | | |
| Size(WxDxH) | Meter | 6.2 x 2.4 x 3.4 | 6 x 3 x 3.5 | 8.5 x 3.0 x 3.5 | 14 x 3.2 x 3.8 |
| | | H : Vent stack height excluded | | | |

- Utility area such as feed NG compressor, cooling tower, control room are excluded.
- At ambient temperatures higher than 30°C, system efficiency can be decreased due to PSA efficiency.
- Intake air should be delivered from safety[Non hazardous] area.
- Actual values can be different depending on various conditions and feedstock characteristics.
- If clients need other specification not mentioned in the table above, please contact us.

Product Line-up

Small-capacity Hydrogen generation system (for houses and general buildings)

Capacity 1~10 Nm³/hr
 Purity 75% H₂
 Type SMR / Membrane
 Purification method PrOx / Membrane



Mid-sized or small-sized Hydrogen generation system (for industrial use)

Capacity 30/100/150/300 Nm³/hr
 Purity 99.999% H₂
 Type SMR
 Purification method PSA



Mid-sized or large-sized Hydrogen generation system (for industrial plants)

Capacity 500/1,000/10,000 Nm³/hr
 Purity 99.999% H₂
 Type SMR / Membrane
 Purification method PSA / Membrane



Hydrogen generation system for ships

Capacity 100/150/300 Nm³/hr
 Purity 99.999% H₂
 Type SMR / Membrane
 Purification method PSA / Membrane



Small Capacity Hydrogen Generation System & Fuel Cell System



Panasia's small-capacity hydrogen generation system produces hydrogen on-site through gas reforming.

The biggest advantage of fuel cell system for use in buildings is that it can be operated at all times regardless of the season, weather, and location.

Also, it has a small installation area, which is advantageous in terms of space efficiency.

— Features



User-friendly interface & autonomous driving



Prompt operating time



Secure high durability under thermal shock resistance design



Easy maintenance & exchangeable catalyst module



Simple installation & construction



Defect analysis or fault diagnosis prediction of catalyst deactivation

SPECIFICATIONS

Hydrogen Generation System for Use in Buildings

| Line Up | | PanaGen-1A | PanaGen-5A | PanaGen-10A | PanaGen-25A |
|-------------------------------|---------------------|--------------|--------------|--------------|--------------|
| Output(product) | | | | | |
| Product(H ₂) Flow | Nm ³ /hr | ~0.9 | ~4.5 | ~9.0 | ~22.5 |
| Purity | %vol | ~76 | | | |
| General Specifications | | | | | |
| Type | Indoor | | | | |
| Feed Gas | NG | | | | |
| Feed NG flow | Nm ³ /hr | 0.245 | 1.225 | 2.450 | 6.125 |
| Feed NG Pressure | bar.g | 0.1~0.3 | | | |
| Efficiency(LHV) | % | 78 | | | |
| Start-up Time | Min. | ~ 50 | | | |
| Operating Amb. Temp. | °C | 1~40 | | | |
| Electricals | | | | | |
| Power Source | 220VAC 1phase 60Hz | | | | |
| Dimensions | | | | | |
| Size(WxDxH) | Millimeter | 450x450x1000 | 600x600x1400 | 700x700x1700 | 100x800x1900 |

Fuel Cell System

| Line Up | | PanaGen-1KF | PanaGen-5KF | PanaGen-10KF | PanaGen-25KF |
|-------------------------|---|--------------|--------------|---------------|----------------|
| Output(product) | | | | | |
| Power Generation | kWh | 1 | 5 | 10 | 25 |
| Efficiency(Electricity) | % | >35 | | | |
| Efficiency(Total) | % | >90 | | | |
| General Specifications | | | | | |
| Type | Indoor | | | | |
| Feed Gas | NG | | | | |
| Feed NG flow | Nm ³ /hr | 0.245 | 1.225 | 2.450 | 6.125 |
| Feed NG Pressure | bar.g | 0.1~0.3 | 0.1~0.3 | 0.1~0.3 | 0.1~0.3 |
| Start-up Time | Min. | ~ 50 | | | |
| Operating Amb. Temp. | °C | 1~40 | | | |
| Electricals | | | | | |
| Power Source | 220VAC 1phase 60Hz / 380VAC 3phase 60Hz | | | | |
| Dimensions | | | | | |
| Size(WxDxH) | Millimeter | 600x600x1400 | 950x650x1400 | 1300x700x1700 | 1500x1000x1900 |

Applications



— Detached house / Townhouse



— Collective building



— Medium / Large building

※ All buildings that can use gas lines are applicable

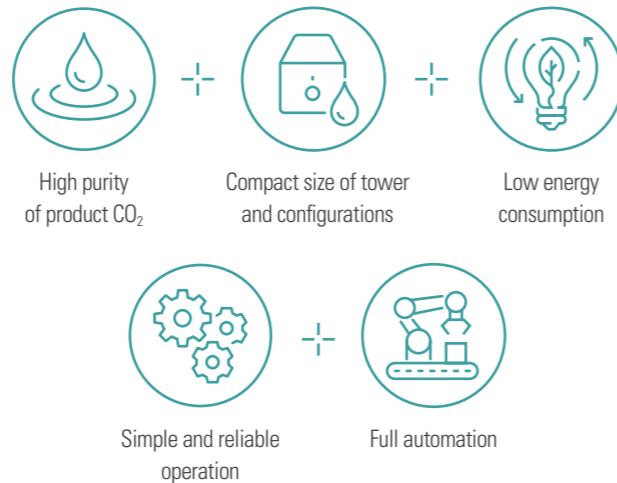
Carbon Capture and Storage(CCS) System



PANASIA's Pan-CCS™

The Carbon Capture and Storage(CCS) is a system that captures and utilizes carbon dioxide generated during combustion of fossil fuel used to generate power and produce hydrogen, in order to reduce the amount of CO₂ released into the air ultimately.

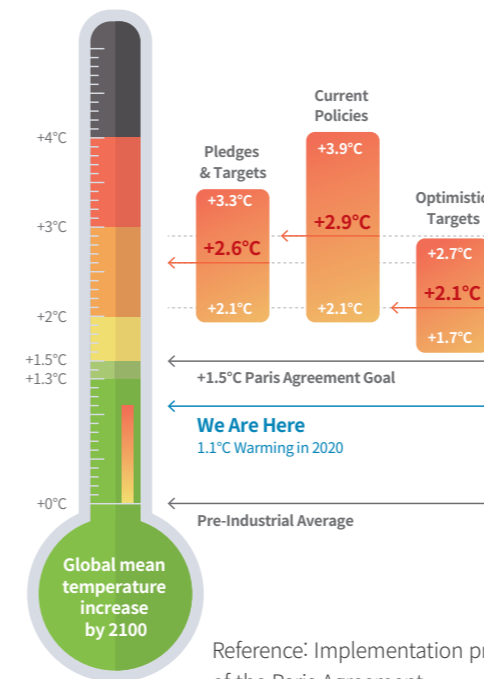
— Features



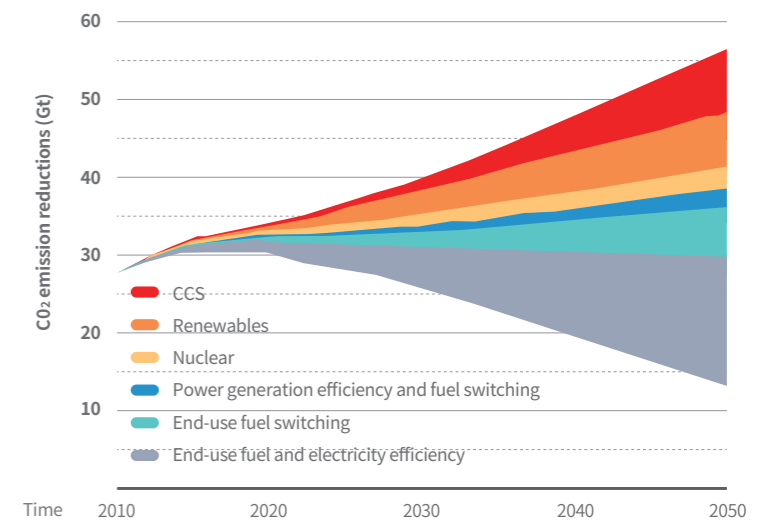
Challenges against climate change with Flue Gas CO₂ Capture

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 and Storage(CCS) System is to limit the impacts of climate change by capturing carbon dioxide, and the captured CO₂ is used for commercial applications.



Reference: Implementation prospects of the Paris Agreement



Reference: Predictions for greenhouse gas emissions mitigation measures

CCS is predicted to contribute to 19% of the total CO₂ emission reductions globally by 2050. Without CCS, the cost of reducing emissions would increase by more than 70%. In other words, CCS will play a pivotal role in reducing CO₂ emissions.

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

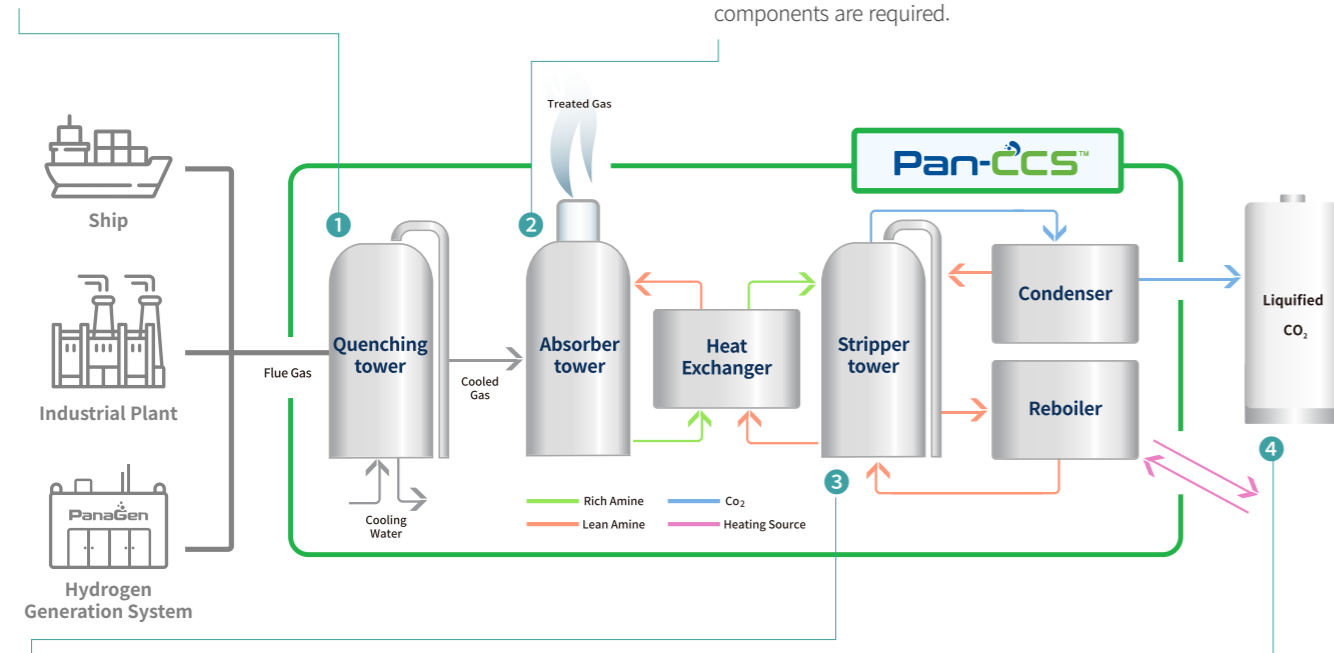


1 Pre-treatment of flue gas

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.

2 CO₂ absorption

Once cooled, the gas comes into contact with the chemical solvent in the absorber, and CO₂ 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.



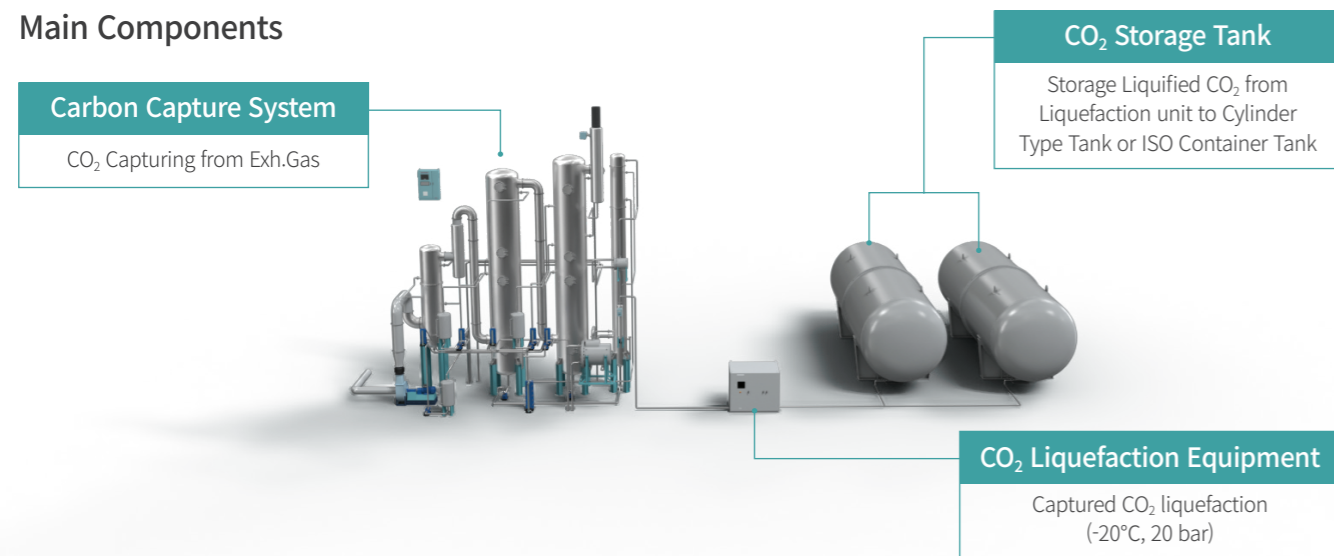
3 Regeneration

A solvent that has absorbed CO₂ is transferred to the stripper tower. The high-temperature vapor in the reboiler causes CO₂ to be removed from the solvent. In the cooling tower, it breaks down into water and CO₂. Then, the water is recovered and sent to the stripper while CO₂ is transferred to the liquefaction process.

4 Liquefaction & storage

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

Main Components



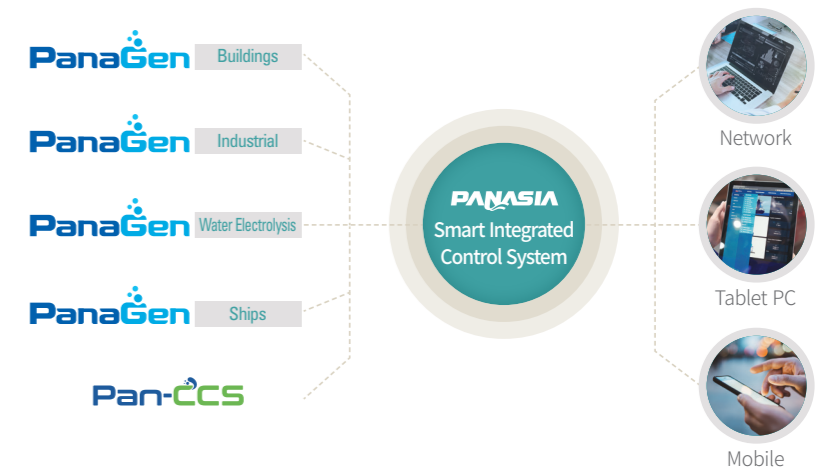
Integrated Control System

PANASIA's integrated control system is a customized ICT-based service available 24/7, which collects product data in real time and checks the system status remotely to provide customers with prompt and accurate solutions anytime, anywhere.



At PANASIA, we offer unique services aimed at increasing customer convenience.

This customized ICT-based service, which is available 24/7, collects product data in real time and checks the system status remotely to provide customers with prompt and accurate solutions anytime, anywhere. It also provides early diagnosis of problems using accumulated data to assist customers in system control to help their systems run at their optimal performance.



Safety control

- Safety controls for issues including hydrogen leakage
- Real-time checking and issuing alert notifications
- Advance prediction and prevention of problems

Product diagnosis

- Real-time monitoring of output, amount of power generated, efficiency, etc.
- Fault diagnosis and analysis

Efficient management

- Supporting online remote updates
- Big data-based maintenance and control
- Spare parts replacement notifications
- Keeping operational losses to a minimum

PANASIA

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