

Carbon Capture and Utilization

CO₂ – From Pollutant to Product

Dr. Florian Möllenbruck (f_moellenbruck@eu.mhps.com)

Productmanager CCS/U

New Business

Mitsubishi Power Europe GmbH

Company Overview

Mitsubishi Power is the thermal power generation company within the MHI Group

**MITSUBISHI
HEAVY
INDUSTRIES
GROUP**

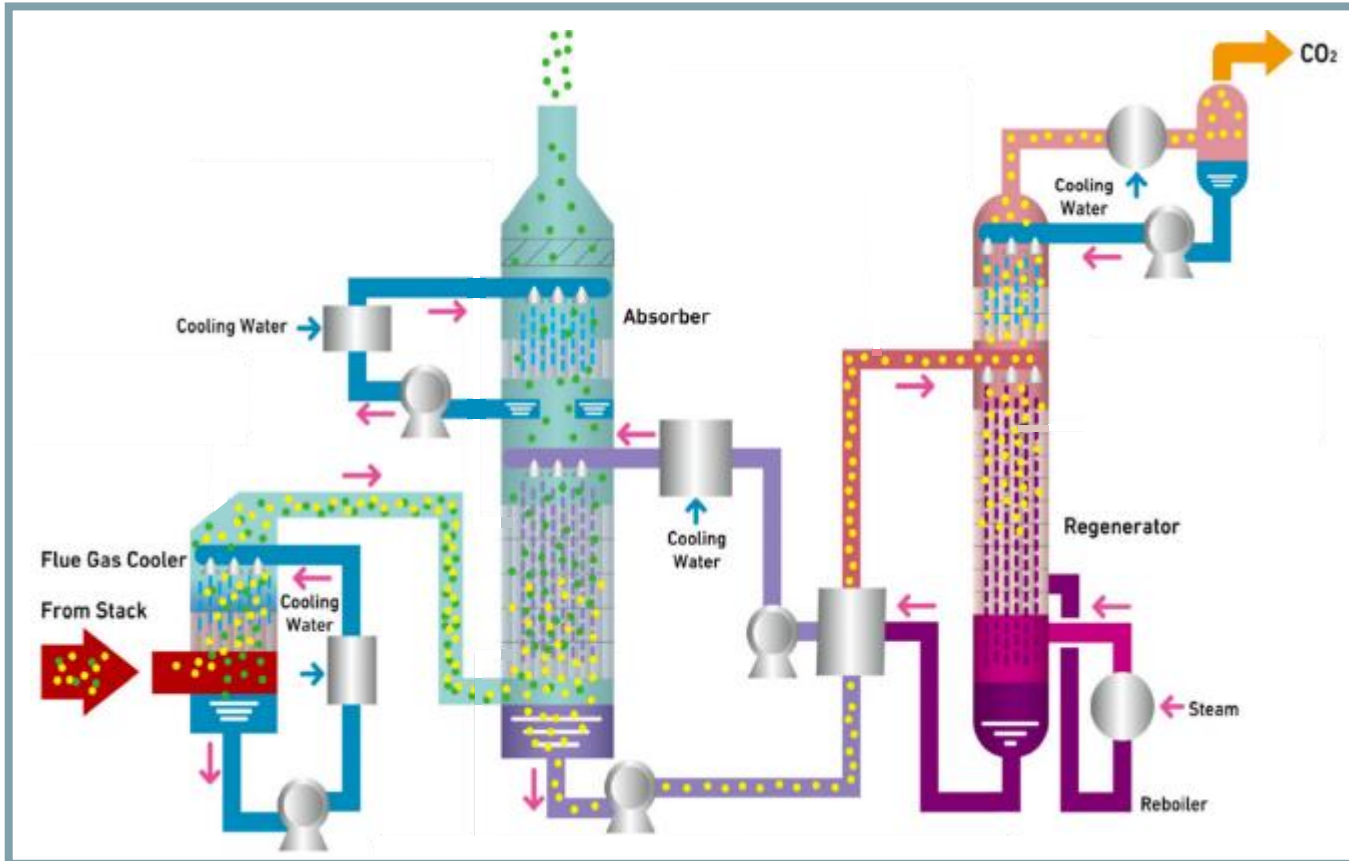
100 %



- HQ Location: Yokohama, Japan
- Number of group companies: 69 companies
- Total workforce: approx. 18,300
- Major operations / businesses:
 - Thermal Power Generation Systems
 - Geothermal Power Generation Systems
 - Environmental Systems
 - Fuel Cells
- Capital: ¥100b / \$892m (USD/JPY: 112)

** This table is not exhaustive. It lists only companies and products related to hydrogen business*

Research & Innovation Centre		
Energy Systems	Plants and Infrastructure	Integrated Defense and Space Systems
		
<p>Jet Engines (Mitsubishi Heavy Industries Aero Engines, Ltd.)</p> <p>Offshore Wind Turbines (MHI Vestas Offshore Wind A/S)</p> <p>Compressor (Mitsubishi Heavy Industries Compressor Corp.)</p> 	<p>Iron Making (Primetals Technologies, Ltd.)</p> <p>Ammonia & Methanol Co-Production Plants CO2 Capture Plants (Mitsubishi Heavy Industries Engineering, Ltd.)</p> <p>Gas Carriers (Mitsubishi Shipbuilding Co., Ltd.)</p>	<p>Aircraft (Mitsubishi Aircraft Corporation)</p> <p>H-IIA Rocket</p>



- Automatic load adjustment control (ALAC)
- Amine filtration and purification systems
- Proven tower design for even gas / liquid distribution

KM CDR Process™ = Kansai Mitsubishi Carbon Dioxide Recovery Process

- Amine-based technology
- Capable of capturing ~90% CO₂ from combustion gas sources, up to 99.5% possible
- Purity of CO₂ > 99.9%
- Carbon Capture from Flue Gases with 3% of CO₂ or more
- 1–1.2 tons of saturated 3 bar(a) steam per ton of CO₂
- 55-65 kWh electrical power per ton of CO₂

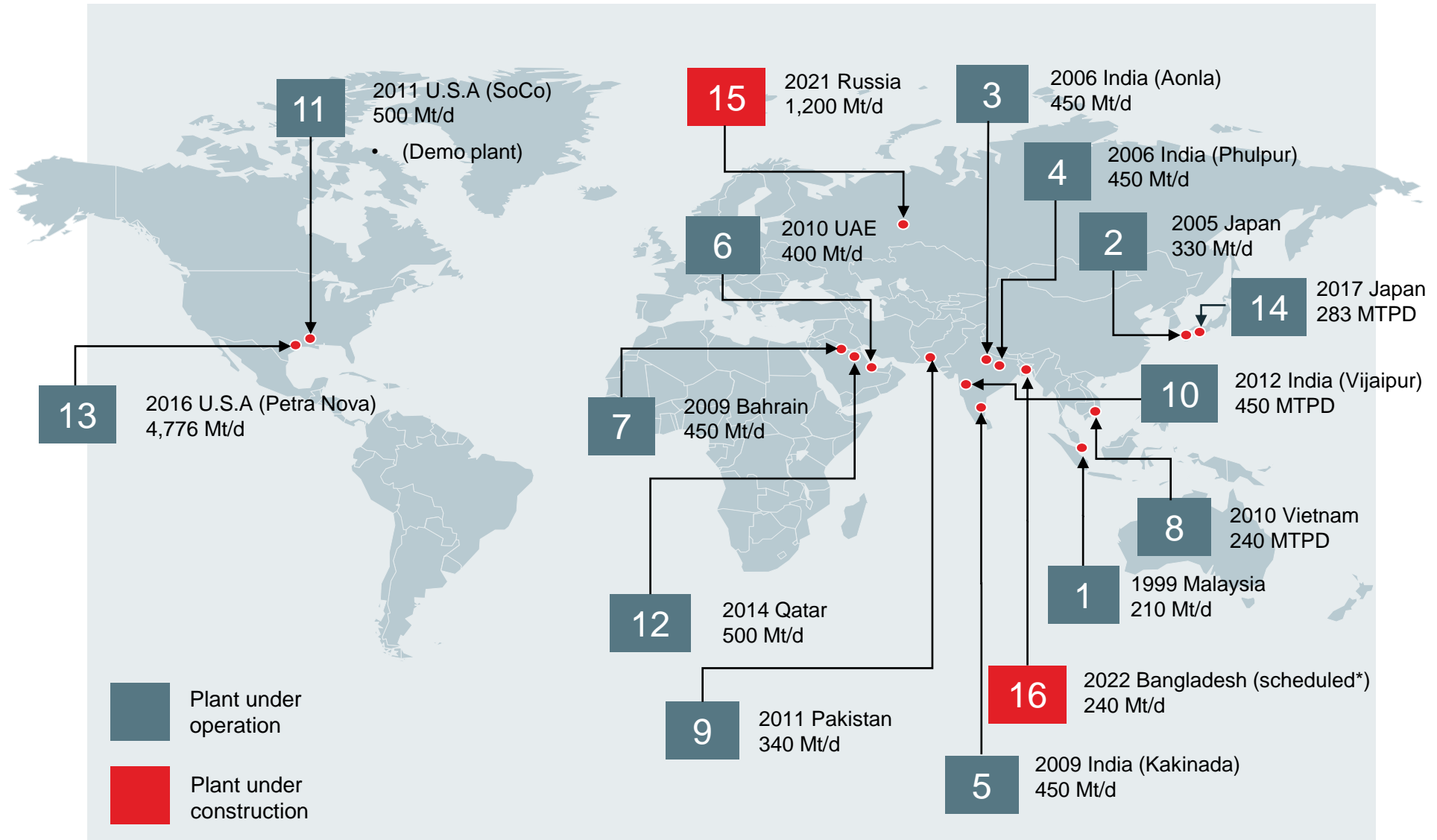
Typical Layout of a Carbon Capture Plant

- 1: Flue Gas Duct
- 2: Flue Gas Quencher
- 3: Absorber
- 4: Regenerator
- 5: Cooling Tower
- 6: Dehydration and CO₂ Compressor
- 7: Reboilers



KM CDR Process™ – Worldwide Commercial Experience

MHI's experienced global KM CDR Process™ team stands ready to meet customer requirements for commercial CO₂ capture plants on natural gas and coal exhaust from conceptual design through detailed engineering and project delivery.



- *Signed a contract for fertilizer plant construction on Oct 2018, subject to finance close.

The world's largest CO₂ capture plant: Petra Nova

- The world's largest CO₂ capture plant (4,760 tons/day) on coal-fired flue gas has been under commercial operation since December 2016. Petra Nova is a partnership between NRG Energy and JX Nippon Oil & Gas
- Supported by DOE (U.S. Department of Energy) grant program* (CCPI Round 3) and Japanese government finance (JBIC / NEXI)



Petra Nova – Facts	
Plant location	NRG WA Parish Power Plant (Thompsons, TX)
Project owner	Petra Nova – partnership between NRG Energy and JX Nippon Oil & Gas
Plant scale	240 MW _{eq}
CO₂ capacity	4,776 TPD (1.4 MMtonne/year)
CO₂ conc.	11.5 mol%-wet
CO₂ removal	90%



CO ₂ Used for CO ₂ -EOR	
Pipeline	12 in diameter, ~81 miles
Injection Site	West Ranch Oil Field

* U.S. Department of Energy "W.A. Parish Post-Combustion CO₂ Capture and Sequestration Project Final Environmental Impact Statement Volume I" (Feb, 2013), DOE/EIS-0473



<https://www.youtube.com/watch?v=9PtnuRWOQAY>



MOVE THE WORLD FORWARD

**MITSUBISHI
HEAVY
INDUSTRIES
GROUP**