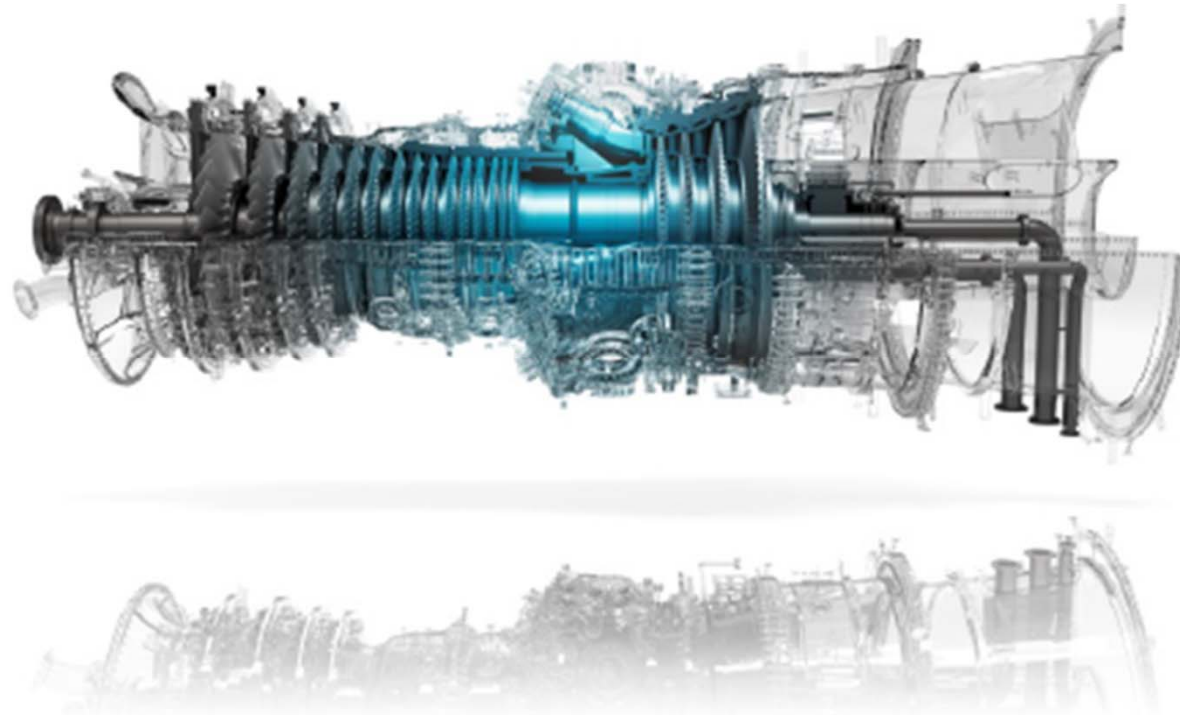


EU-Japan Energy Business Seminar
24th April 2019, Tokyo, Japan

H2 Gas Turbine for Hydrogen Society



Satoshi Tanimura

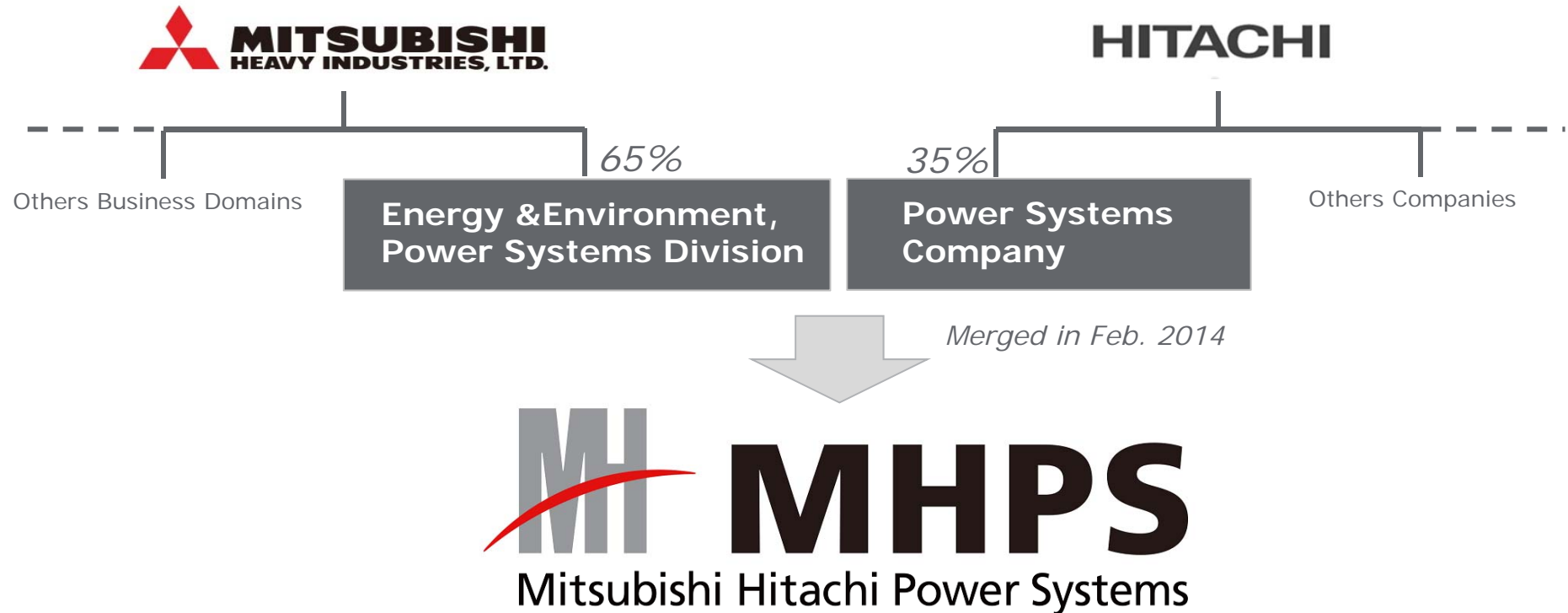
Mitsubishi Hitachi Power Systems, LTD.

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1. Company introduction

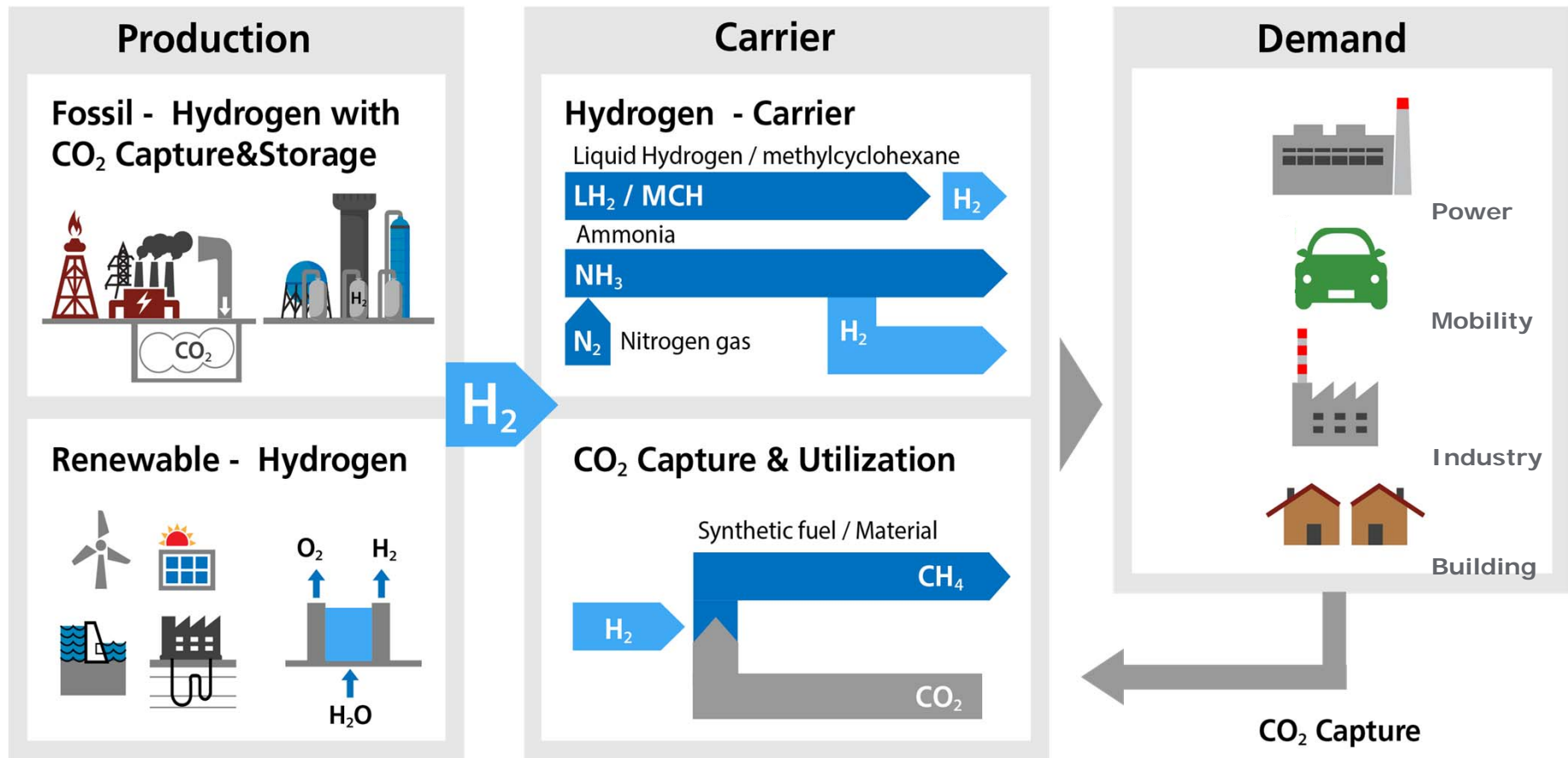
MHPS is a company for the thermal power generation system
in MHI group



2. H2 related technologies in MHI group

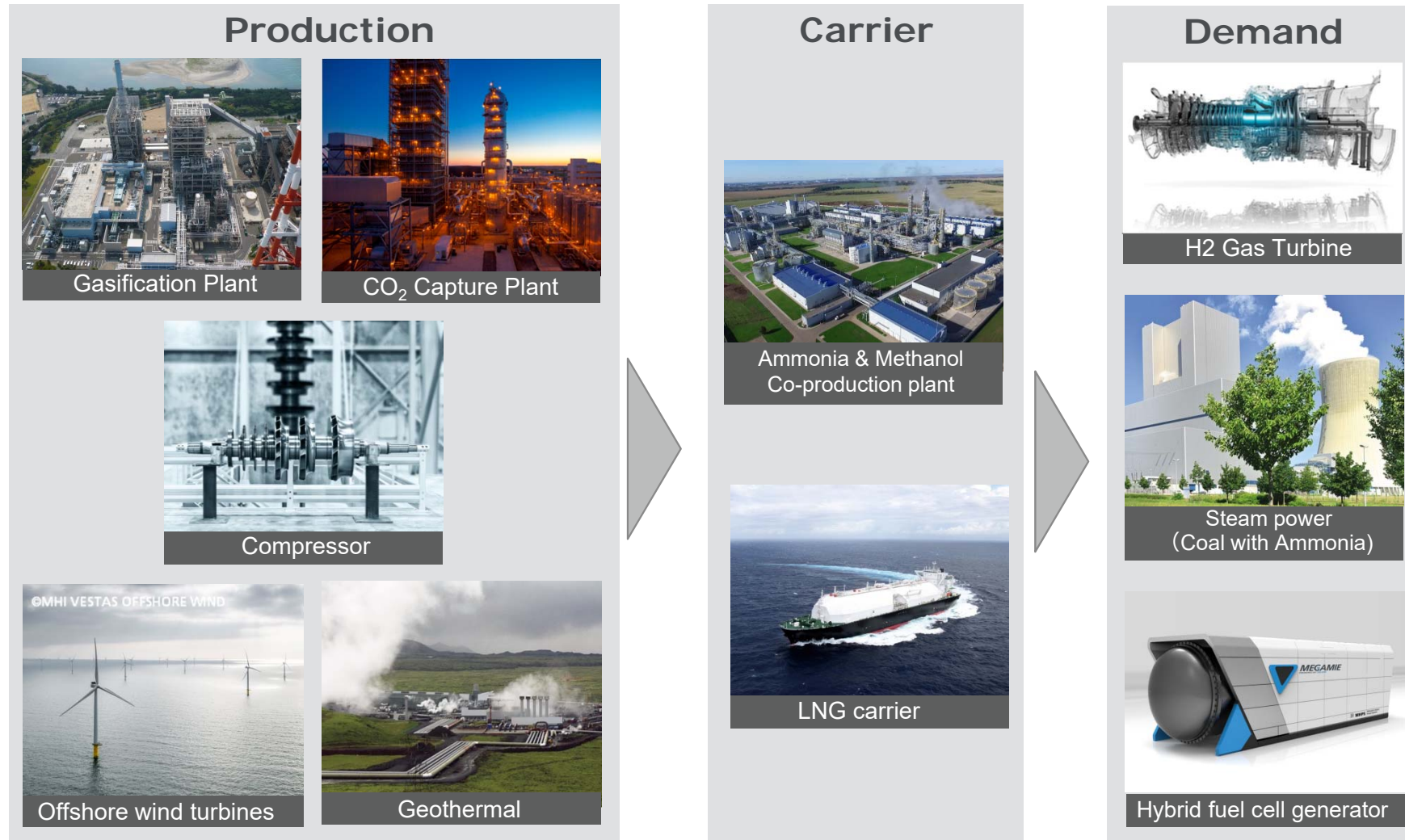
All 3 stages (Production/Carrier/Demand) are the key to realize hydrogen society

Global Hydrogen Supply Chain



2. H2 related technologies in MHI group

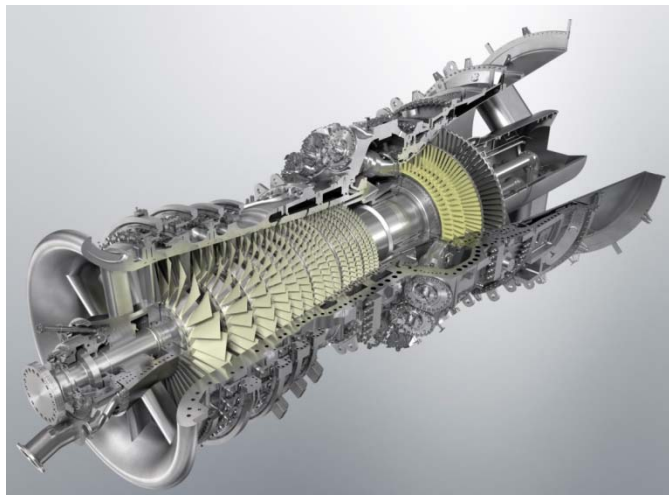
As MHI group, we can contribute in each stage of global hydrogen supply chain



3. MHPS H2 Gas Turbine development

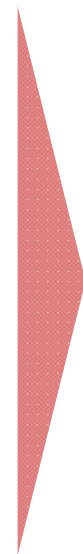
Existing Gas Turbine can run with hydrogen
by limited modifications to combustion parts

Advanced Technology

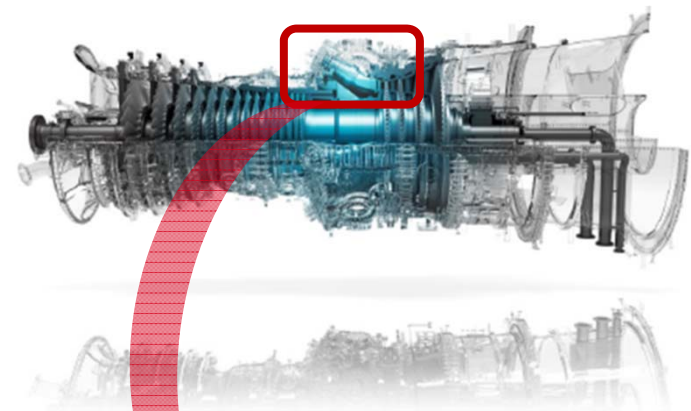


MHPS's "JAC"
Super High Efficiency GTCC

Efficiency : ~65%
Availability: 99.5%






H2 Gas Turbine



Limited modification
to combustion parts

3. MHPS H2 Gas Turbine development

H2 Gas Turbine combustion technology development

Type	Low NOx tech.	Turbine Inlet Temp.	H2 density	Schedule	
Ready	Diffusion 	N2 dilution, Water/Steam injection	1200 ~ 1400°C	~ 100%	<p>1970</p> <p>2025</p> <p>Cogen/IGCC (31 units, > 3 mil hours experience)</p> <p>Magnum H2 conversion</p>
	Pre-mix 	Dry	1600°C	~ 30%	<p>DLN</p> <p>30% co-firing test completed (NEDO PJ)</p>
Under development	Multi-Cluster 	Dry	1650°C	~ 100% (target)	<p>target ~2024</p> <p>Under development (NEDO PJ)</p>

*This presentation is based on results obtained from a project commissioned by NEDO.

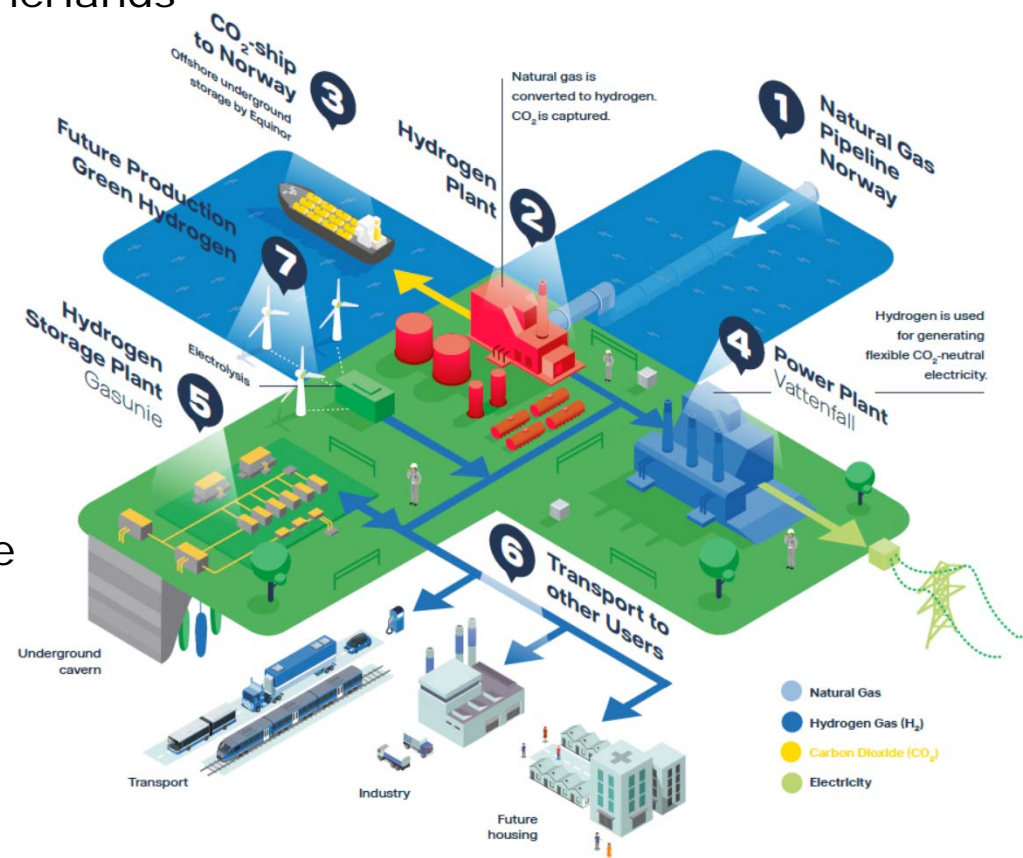
4. EU-Japan collaborative project

H2M (Hydrogen to Magnum) project: a first step in the development of a low-carbon H2 economy

- Goal: 1 Magnum CCGT (M701F) on blue hydrogen by 2025
- Location H₂ plant: Eemshaven, the Netherlands
- Supply to other users
(Transport/Industry/Housing)
- Gradual transition to green hydrogen



- Kick-start H₂ economy:
 - Realisation of hydrogen infrastructure
 - Development of hydrogen demand
- CO₂ emission reduction: up to 2 Mt/yr



Source and courtesy Vattenfall

5. Summary (1/2)

(1) MHPS H2 Gas Turbine will contribute to Hydrogen Society



H2 Gas Turbine

Fuels H2 infrastructure development

- Large H2 demand for power generation
- Straightforward repurposing of existing assets
- Gas Turbine can be fueled by H2 transported by Ammonia / MCH / LH2

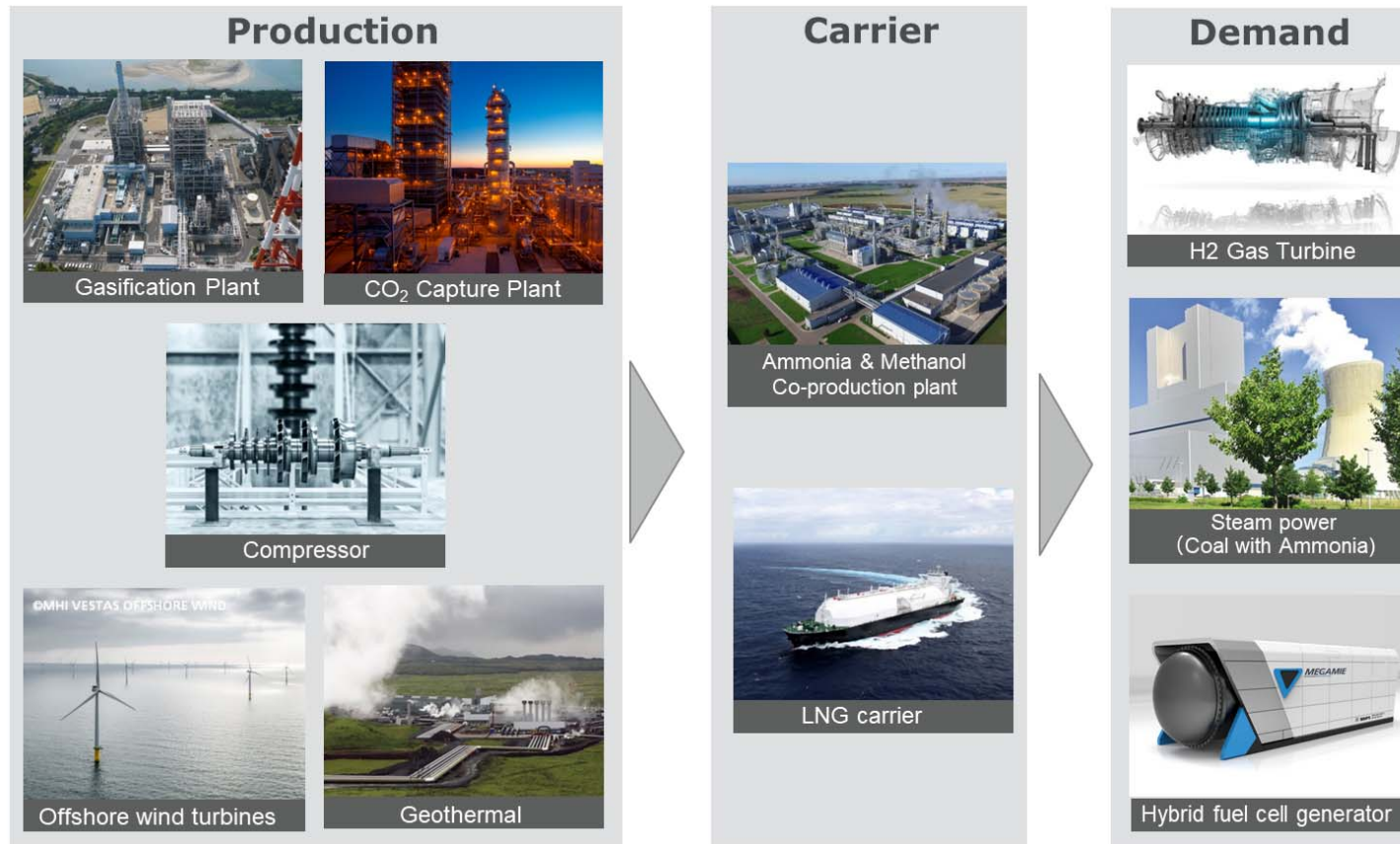
Reduce CO2 at large scale

- Large CO2 reduction
(1 CCGT (440MW) \doteq 2,000,000 FCV)

Hydrogen Society

5. Summary (2/2)

(2) MHI group can contribute to realize global H2 supply chain



(3) Public-Private Partnerships are essential to realize the technology roll-out

Power for a Brighter Future