MHI Floating Power Plant : MFPP® & Small LNG Distribution

Mitsubishi Heavy Industries, LTD.

November 2018
Natural Gas demand growth

Natural gas demand by region in 2017 and 2040 (%)

- North America: 26% in 2017, 21% in 2040
- Asia Pacific: 14% in 2017, 13% in 2040
- Middle East: 26% in 2017, 16% in 2040
- Eurasia: 11% in 2017, 15% in 2040
- Europe: 5% in 2017, 4% in 2040
- Latin America: 5% in 2017, 4% in 2040
- Africa: 5% in 2017, 5% in 2040

Source: The Gas Exporting Countries Forum (GECF) in 7th LNG Producer–Consumer Conference 2018

Natural Gas demand is expected to grow especially in Asia Pacific region.

We understand, however, there are some obstacles to realize this scenario:

- Rapid & smooth installation of gas fired power plants to meet the demand
- Provision of small scale LNG distribution in remote demand sites economically
LNG Distribution Network for Power Generation

Power Generation / Storage & Re-gas / Distribution, as Integrated One Stop Solution

**Economical**
Bulk Purchasing & Storage at the Hub site with middle scale MFPP® & Global LNG carrier size FSU/FSRU.

**Scalable & Flexible**
Small scale distribution network for each end demand site with mini-shuttle/TAG & small MFPP®

**Optimization**
Optimized Purchasing & Distribution Management by Demand Monitoring
What is a **MFPP®**?

Summarized feature of the MHI Floating Power Plant (MFPP®), meeting the nationwide challenges:

- **Rapid electrification**
- **Minimum land expropriation**
- **Economical electricity**
- **Cleaner power generation**
- **Development of remote area**

Floating Power & LNG Distribution

- LNG Storage Tank (IMO Type-C 8,000m³ × 4)
- LNG Loading Unit
- Re-Gasification Unit
- 32K Tank Type (8K IMO Type-C × 4)
- GTCC/GT
- Tank Less Type
- Re-Gasification Unit
MHI provides a best solution in consideration of “Usage”, “Output”, “Operation Date”, “Fuel Types”, “Fuel Storage”, “Fuel Supply Method” and other requirements under our “One Stop Solution policy”
Gas to Power Solution Image

Gas to power solution value chain

Liquefaction → Global Distribution → Local Distribution HUB → Local Distribution → Local Storage & Re-Gasification → Power Gen

Global LNG Carrier → FSRU/FSU (150k~260km³) → Small LNG Carrier → FSRU

Hub

Large Plant

Gas Liquefaction

Local LNG Terminal

Small LNG Shuttle

FSRU

Onshore Power Plant
Case 1: MFPP® with Large FSU

- Existing Gas Network
- Subsea Gas P/L
- Submarine cable
- FSU
- GTCC

Case 2: MFPP® with Large FSRU

- Existing Gas Network
- Subsea Gas P/L
- Submarine cable
- FSRU
- GTCC
- Mooring Dolphin
Small and/or Remote demand

Gas Engine Generator

Gas Turbine Generator

LNG Shuttle to Supply LNG

Substation

Electric Cable

Grid

Floating Storage and Power Plant

Gas P/L (City Gas Distribution)

Lorry Station

LNG

Storm surge barrier

Small scale LNG & Power Supply Chain with Floating Storage, Re-Gas and Power Generation Plant
Vision for LNG Network

- Hub and Supply
- Power & Gas
- To City
- Power Supply
- for Mine
- Power Supply
- for Resort Development
- Adjustment Power with Renewable
- Substitute Power for Geothermal
Gas advantage compared to coal power

1. Low Carbon Technology

- **CO₂ Emission (g/1kWh)**
  - Fuel: Coal = 868, Oil = 780, Gas = 698
  - Facility: Coal = 88, Oil = 38, Gas = 36

2. Faster start up for flexible operation

- Power Supply
  - Demand Curve
  - Thermal
  - Nuclear
  - Hydro (Run-of-river type)
  - Hydro (Pumper Storage/Reservoir type)

3. Higher efficiency as GT Combined Cycle

- More than 50% steam turbine efficiency

4. Utilization with Renewable & Smart Grid

- Renewable Energy:
  - Wind/Solar
  - Gas Turbine/Engine (NG/Oil)
- Smart Grid Control Center
- Storage/Discharge:
  - Lithium-Ion Battery
  - EV

© 2018 MITSUBISHI HEAVY INDUSTRIES, LTD. All Rights Reserved.
Future vision

Positive Spiral Development through creation of Energy Demand

Improvement of quality of Life

Gas Infrastructure in City

Source: Shizuoka Gas

Sustainable Growth

Industry Development

Water / Cool & Cold Chain / Waste / Transportation, etc.

Lower COE

Lower Gas Cost

Improvement of quality of Life

Gas Infrastructure in City

MHI’s Solution

MFPP®

FsRU

Mini LNG Shuttle

GAS
Thank you very much.