# Development of Small Scale LNG Fueling Station for Yard Tractor

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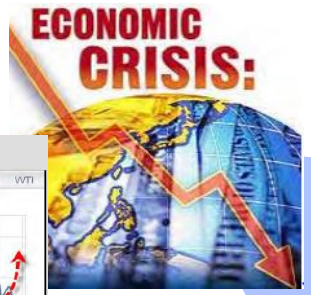
- What is the new concept of LNG fueling station ?

- Future  small scale LNG business concept

- Conclusion

# Change in Energy Trends

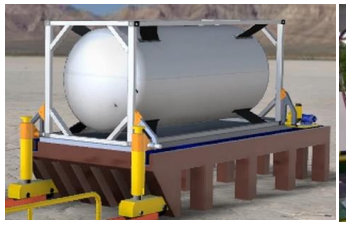

GAS

- ✓ **Climate Change** from environmental pollution
- ✓ Expectation of **stable NG price** because of Shale gas
- ✓ Needs for **New business** to overcome Economic Crisis

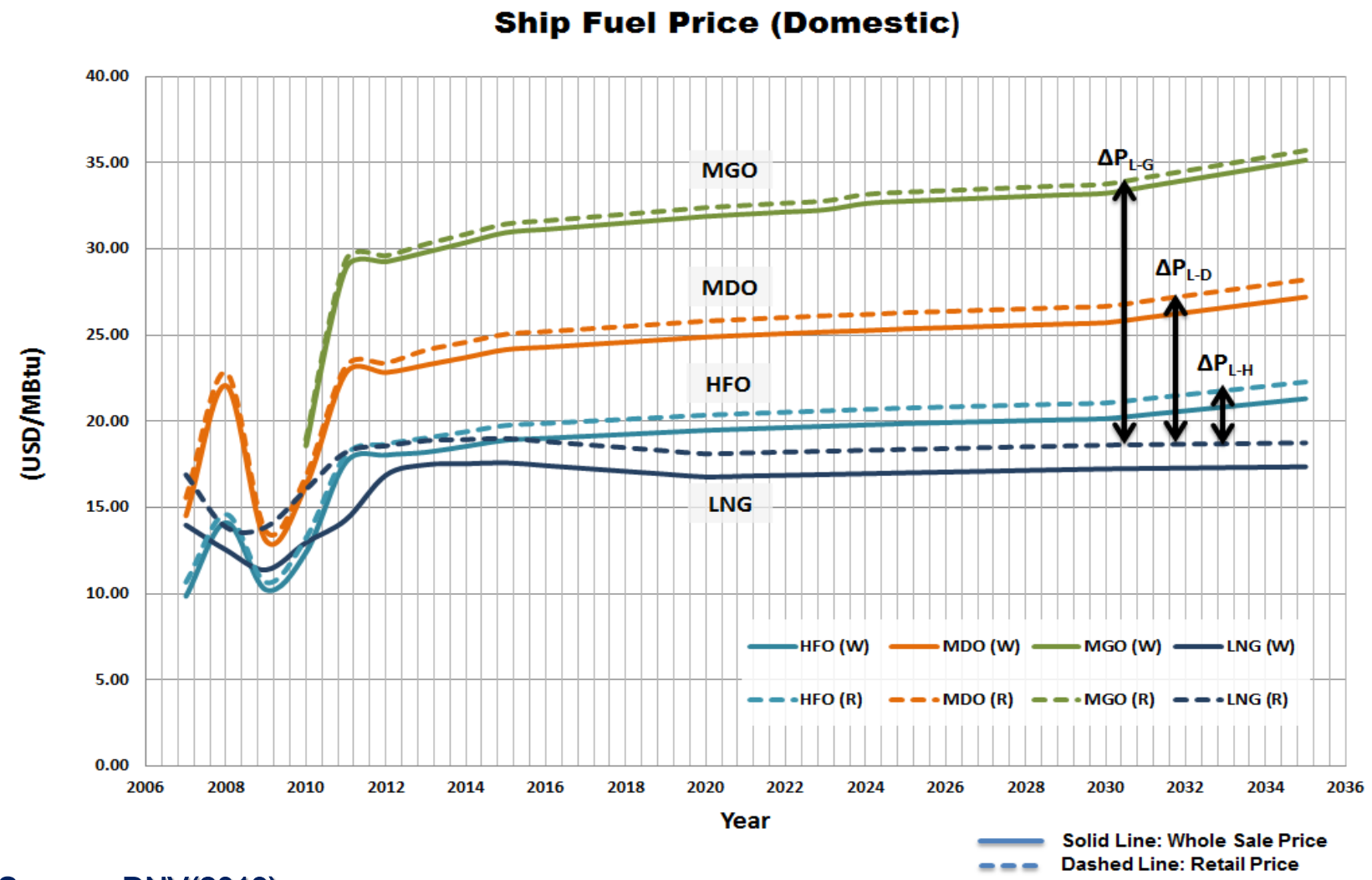
OIL

**Key words in Energy Market**

. LNG fueled ship
. LNG bunkering
. Small scale LNG distribution



# LNG Bunkering Price Expectation

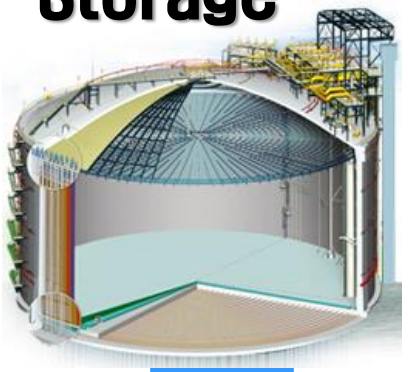



Source : DNV(2013)

# Traditional LNG Value Chain

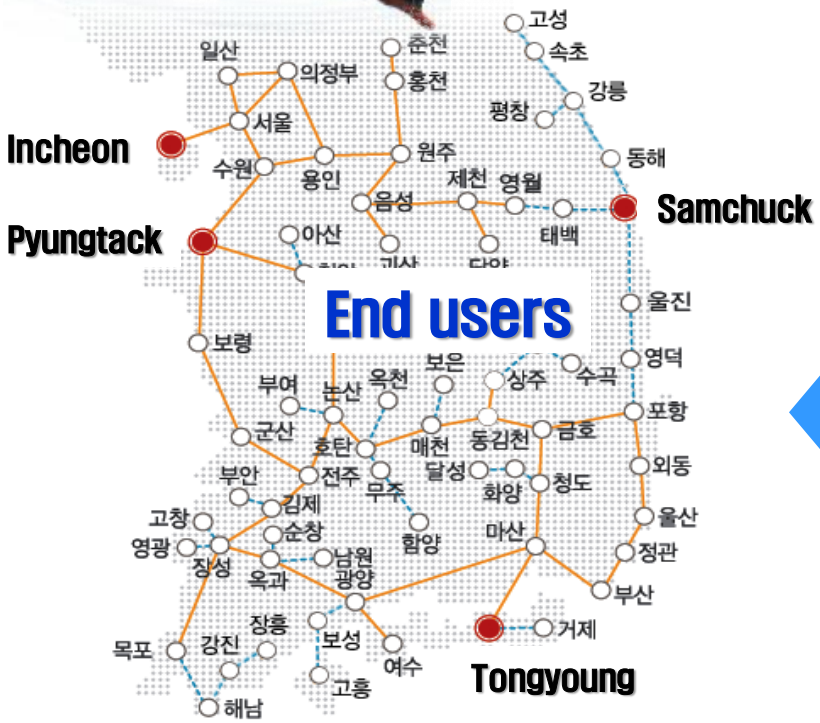

LNG Terminal

Storage



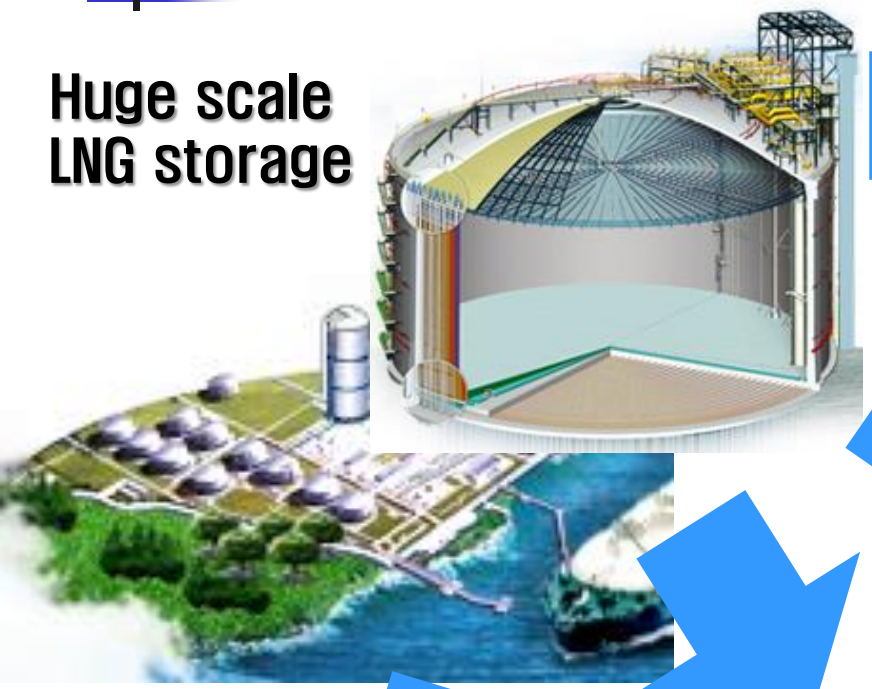
High Pressure Pipeline

Supply



# Paradigm Change in LNG Storage

Huge scale
LNG storage





Medium scale
Storage

Small scale Storage

FSRU

# Change in NG Demands

## Traditional Demands

Power Plant
Industry
City gas

Natural Gas

Islands

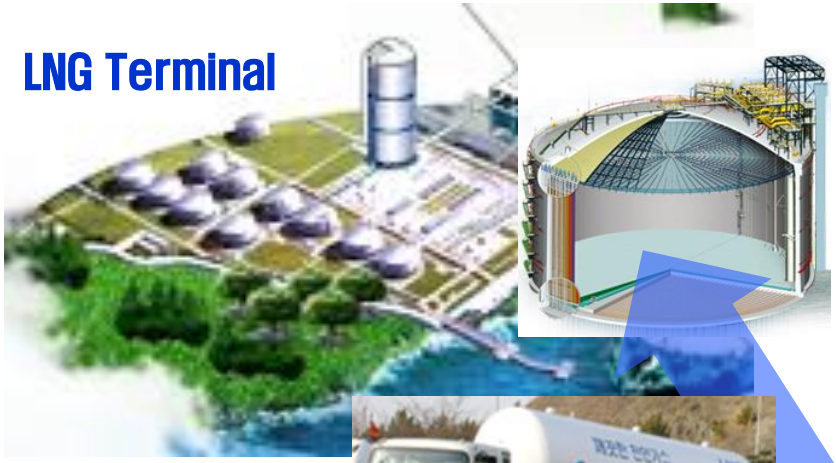
Fueling Station


LNG fueled Ship


Remote area

# Small Scale LNG Supply Chain

LNG Terminal



Power plant

LNG vehicle

LNG Fueled ship

Satellite LNG Station

Industries

Remote Place

# Busan Green Port Plan

## "Busan Green Port Plan" (2011)

**Logistics Competitiveness**

- Cost reduction
- Increment in Trade

**Marin Air Environment**

- Satisfaction of International standards
- Green Port

**LNG Infrastructure**

- Boost LNG technology Development of related Industry


***The most pollutant emitting equipment in Port !!***

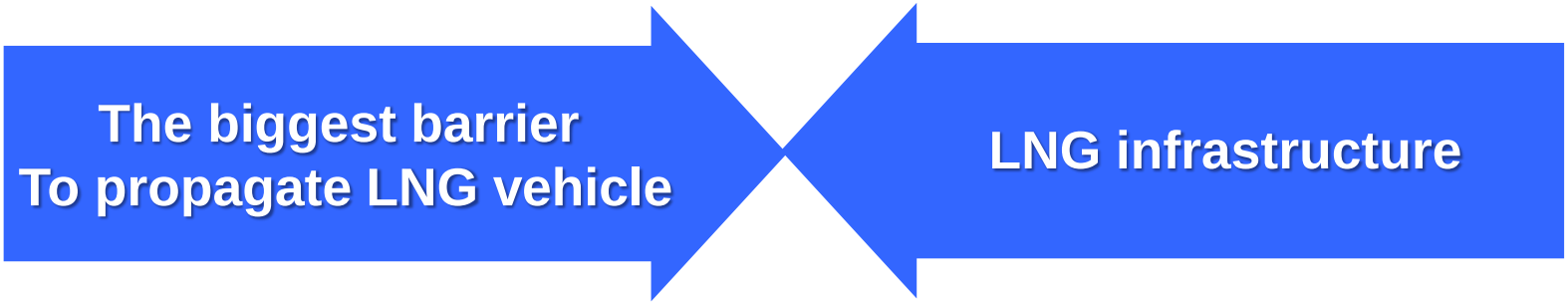
| | Pollutant emission (g/km) | | | | |
|---|---|---|---|---|---|
| | CO | NOx | HC | CO2 | PM |
| NG | 0.0562 | 7.1228 | 0.5088 | 580 | – |
| Diessel | 0.5113 | 7.2135 | 0.5553 | 667 | 0.0492 |
| Saving(%) | 89.0 | 1.3 | 8.4 | 13.1 | 100 |

## Yard Tractor Dissemination Plan in Ports of Korea

| | | New Busan | N Busan | Kangyang | Incheon | Ulsan | Pohang | Pyungtack | Masan | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| YT | 2013 | 387 | 290 | 110 | 50 | 18 | 15 | 25 | 15 | 910 |
| | 2017 (predict) | 600 | 340 | 180 | 220 | 40 | 40 | 40 | 25 | 1,485 |
| CT | 2013 | 20,000 | 13,000 | | | | | | | 33,000 |

# Needs for LNG Yard Tractor

- ✓ Burden for high Fuel Cost and air pollution problem in Port
- ✓ Many references in saving operation cost (20~40%) and the strong points of LNG YT in environmental aspect and working condition
- ✓ Issue for the Green Port and energy management in logistics




- ✓ Yard had a good condition for LNG station

  . Yard tractor is just moving in the yard area

- ✓ Possibility to connect to the LNG Bunkering business for LNG fueled ship in the future

# Domestic LNG Fueling station

DaeJeon LCNG Station


Pohang LCNG Station

Guangyang LCNG Station

Donghae LCNG Station

No. of LNG Vehicle in Korea

| Year | 2008 | 2009 | 2010 | 2011 | 2012~2013 | Total |
|---|---|---|---|---|---|---|
| No. of Vehicle | 12 | 33 | 72 | 92 | 18 | 227 |

- ✓No. of LNG Fueling station = 10 stations (LCNG 6, LNG 4)
- ✓Giving-up operation of LNG fueling station for Airport limousine bus
- ✓Obstacles in propagation of LNG vehicle
  - . Lack of LNG fueling infrastructure
  - . High alternation cost of vehicle and delay In development of parts
  - . Law economic condition in the beginning stage because of BOG

# Strategy for LNG Fueling Station

## Which one should go first?

LNG Yard Tractor

Priority?

LNG Fueling Facility

Demonstration project

Initiation of LNG Market

# Needs for small scale LNG station

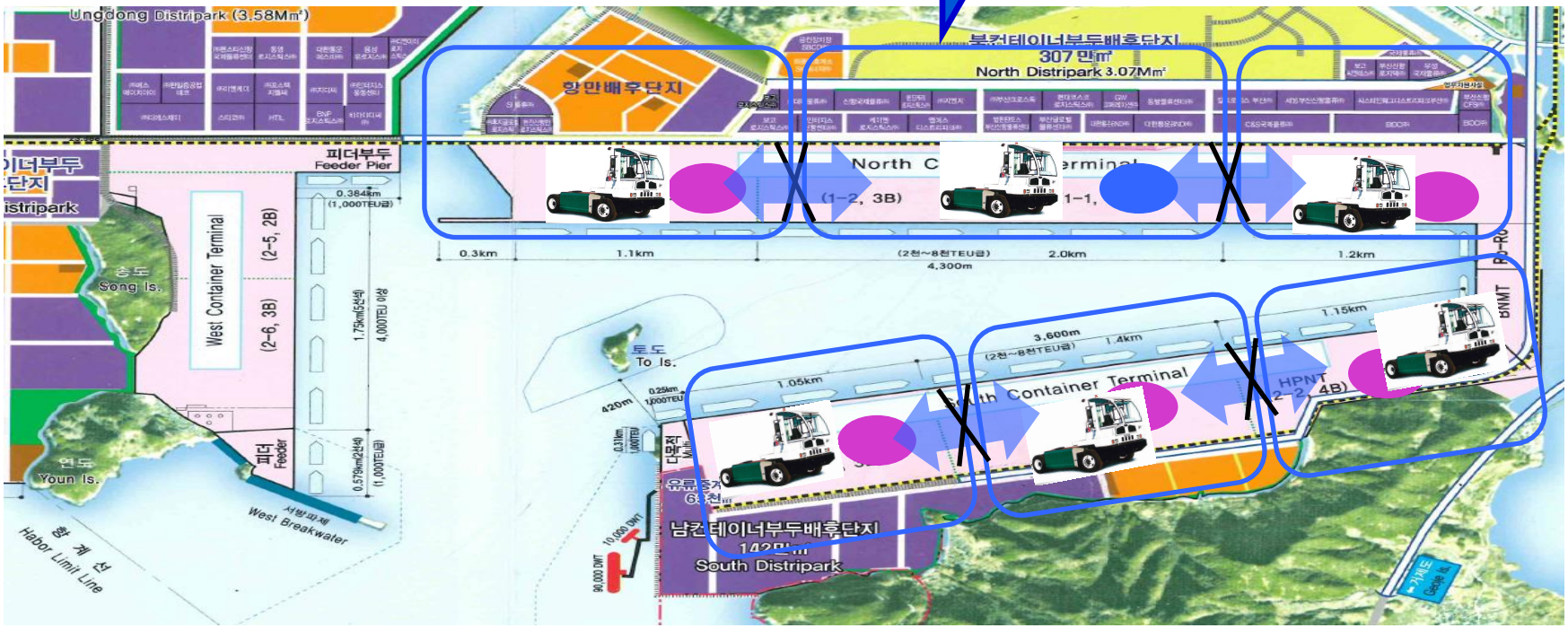
Needs for LNG station

Fixed Tank type LNG fueling Station?

Restricted condition to move between terminals

**Solution**

**Small Scale LNG Stations In each sector**



# Types of LNG Fueling Facility

Fixed Tank Type

Package Type

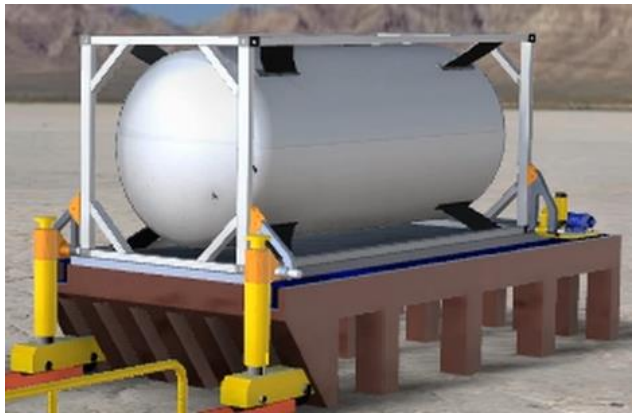

Mobile Type

Skid Mounted Type

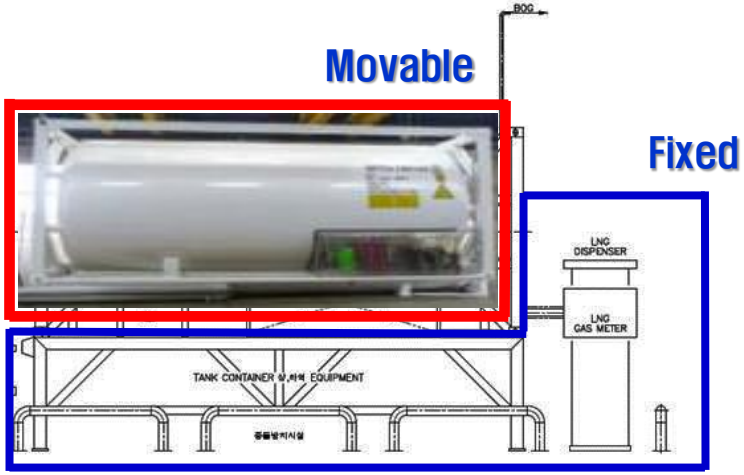
ISO Tank Container type

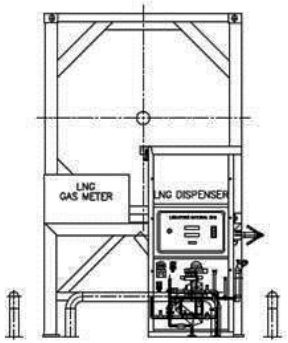
Next ?

# Tank container Type LNG Station




Tank Container Type LNG Station



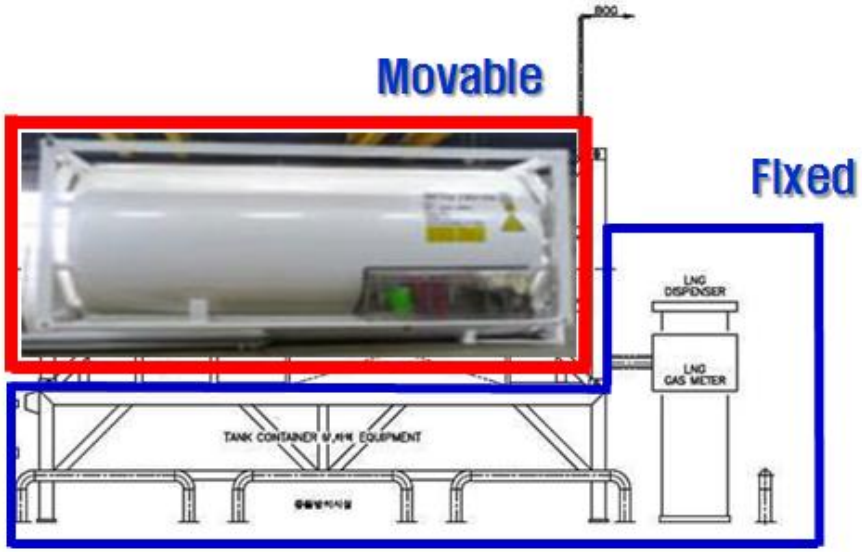



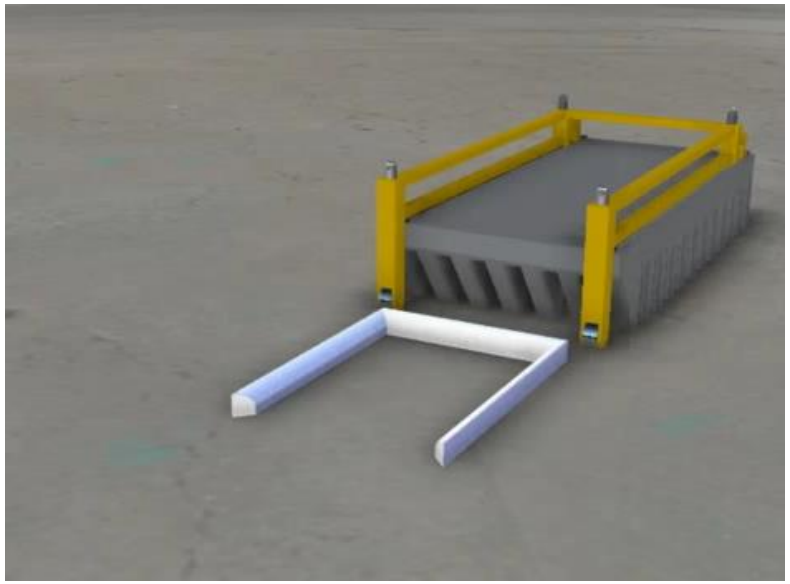

# Unloading Methods

Crain

Reach Stacker

Special Forklift



# Fixed Tank vs. Tank Container

## Fixed Tank + Lorry

## ISO Tank Container

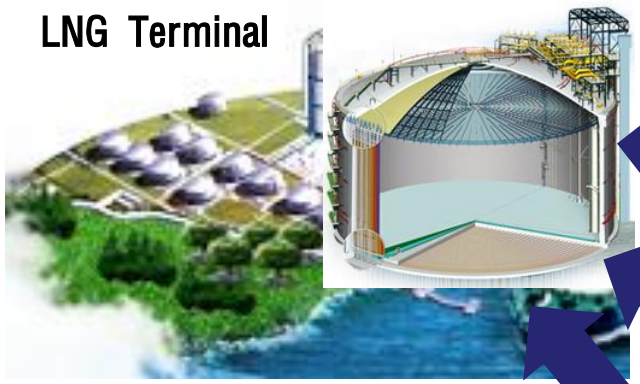

- ✓ On site fixed LNG Tank
- ✓ Transferring LNG
- ✓ Time for transferring LNG
- ✓ Treatment of BOG
- ✓ Good for large demands

**Features**

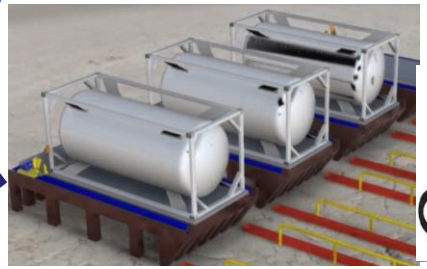
- ✓ No on site fixed LNG tanks
- ✓ No Transfer & No BOG
- ✓ Quick Ready to supply
- ✓ Good for small demands

# Small Scale LNG supply concept

LNG Terminal



First Step



LNG Yard Tractor

Remote Demands

Features

- ✓ Easy to install
- ✓ Easy to response to the demands
- ✓ Low Installation cost
- ✓ Quick installation
- ✓ Easy to scale up
- ✓ Variety in application

LNG fueled ship Bunkering

# Test results of LNG YT

## Engine Specification

### Diesel Yard Tractor


| Cummins QSB6.7 | Items | Hyundai G-CNG |
|---|---|---|
| 215hp/2500rpm | HP | 228hp/2500rpm |
| 77kgf.m | Torque | 65kgf.m |
| In line, 6 cylinder | Type | I6, OHC, 4V/V |
| 95×115 | Bore × Stroke (mm) | 107×118 |
| 6,700cc | Displacement | 6,798cc |
| 17.2 : 1 | Compression ratio | 10.5 : 1 |
| 475kg | Weight | 606kg |
| 1059/725/960 | Size(L/W/H) | 1080/974/904 |

### LNG Yard Tractor


| Items | Diesel Engine | NG Engine | Reduction |
|---|---|---|---|
| CO2 (g/kwh) | 1,036 | 597 | 42.4 % |
| PM (g/kwh) | 0.181 | 0.000 | 100 % |
| Noise (dB) | 82.8 | 65.8 | 20 % |
| Vibration | High | Medium | |
| Fuel Efficiency | 1.29 km/L | 1.59 km/kg (1.27 km/Nm3) | |

# Future of Busan port




Small scale
LNG station



Middle scale
LNG station

On shore
LNG Bunkering Station


Small scale
LNG station

# Small Scale LNG Business Model

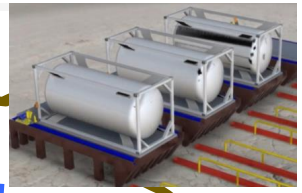
LNG Terminal

Bunker shuttle

Container shuttle

Island

Container Trailer



LNG station

On Shore satellite Station

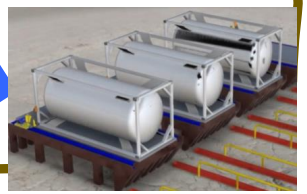
Tank Lorry

Island

LNG station

Tank trailer

Container Terminal



# Future LNG Business in Korea

Off Shore LNG Terminal

Incheon
LNG Terminal

Pyountack
LNG Terminal

Samchuck
LNG Terminal

Tongyoung
LNG Terminal

LNG fueled
Ship

Island
Power
Generation

LNG
Bunkering
Shuttle

Jeju
LNG Terminal
2018~

LNG
Yard Tractor

# Conclusion

✓LNG Yard Tractor is the solution for reducing air pollution and Green port strategy

; Basement for propagation of LNG Yard tractor to other ports

✓ ISO LNG Tank container type of LNG fueling station can be the best option at the beginning and for small demands

; Need to renewal Law and proffer equipments

✓ LNG fuel can increase the logistics competitiveness

; Need to connect to other applications such as LNG fueled ship and LNG train as well as LNG tractor

✓ The Small scale LNG distribution model can be connected to new business applications especially in the country where there is no pipeline networks

# Thank you !!

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