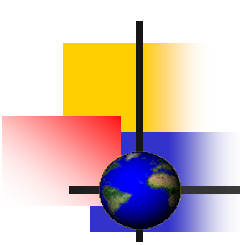


LNG Bunkering Business prospection and strategy

2014. 11. 28

Youngsam Oh

Korea Gas Corporation R&D Division



Contents

- ✓ Why energy trends is changing to LNG
- ✓ What is the value chain of LNG bunkering
- ✓ LNG bunkering activity in China and Korea
- ✓ LNG Bunkering Business model and Conclusion

Fuel cost outlook

Environmental issue = Increasing in needs of Clean Fuel

LNG Price Competitiveness

\$3 ~ \$15 per mmBtu

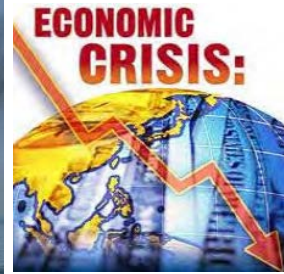
- ▶ Increase LNG Production
- ▶ Shale gas in U.S.A

Vs.

Oil Price Competitiveness

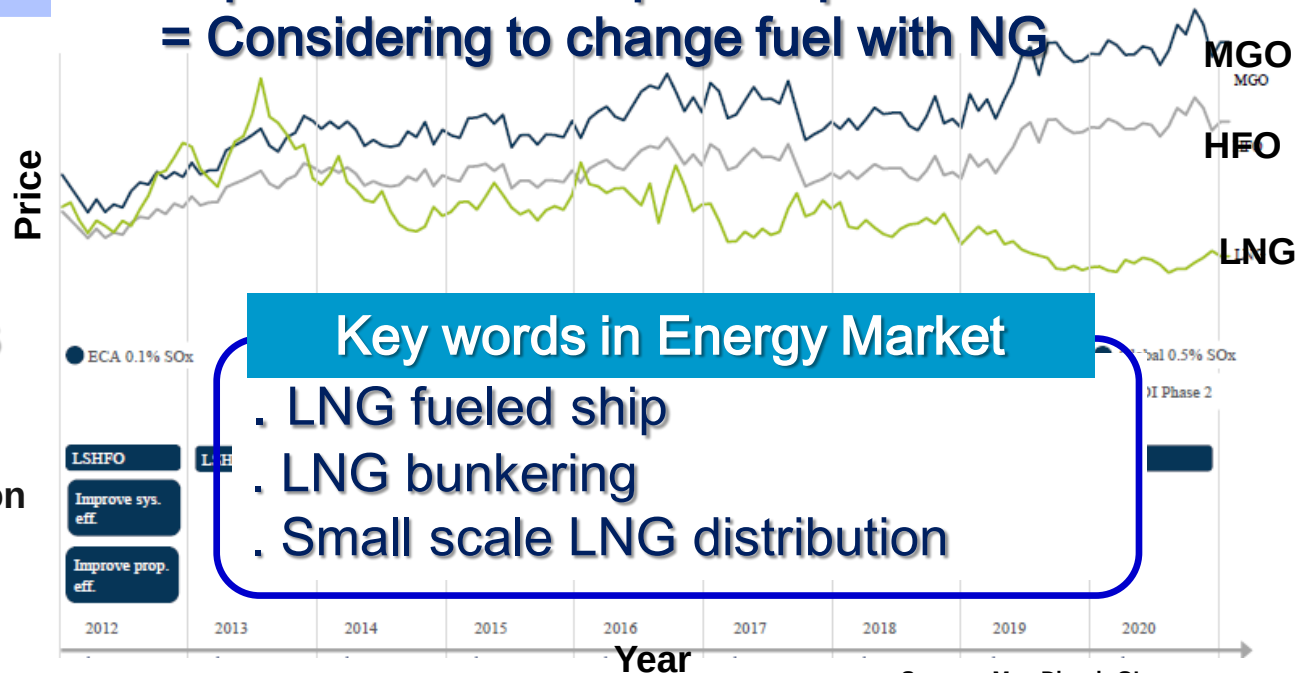
\$13 ~ \$22 per mmBtu

- ▶ Decrease in Oil Production
- ▶ Instability of Oil market



■ LNG will be more economy than oil after 2016 according to DNV' s report.

Expectation of cheaper NG price
= Considering to change fuel with NG



Trend change in Marine Fuel

Environmental Regulation
Economic crisis
High Oil price

Green ship

Eco ship

Exhaust gas cleaning
Engine fuel efficiency ↑

Fuel Change
Operating Cost ↓

Shale Gas

ECA

LNG

Operation : 50
Under construction: 69
(source : DNV, 2014)

Small Ferry
✓ Gluta
✓ PSV
✓ Tug boat

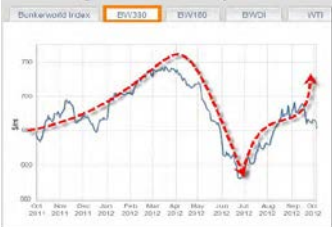
Big Cargo ship
✓ Ro-PAX
✓ General Cargo
✓ Ro-Ro ship



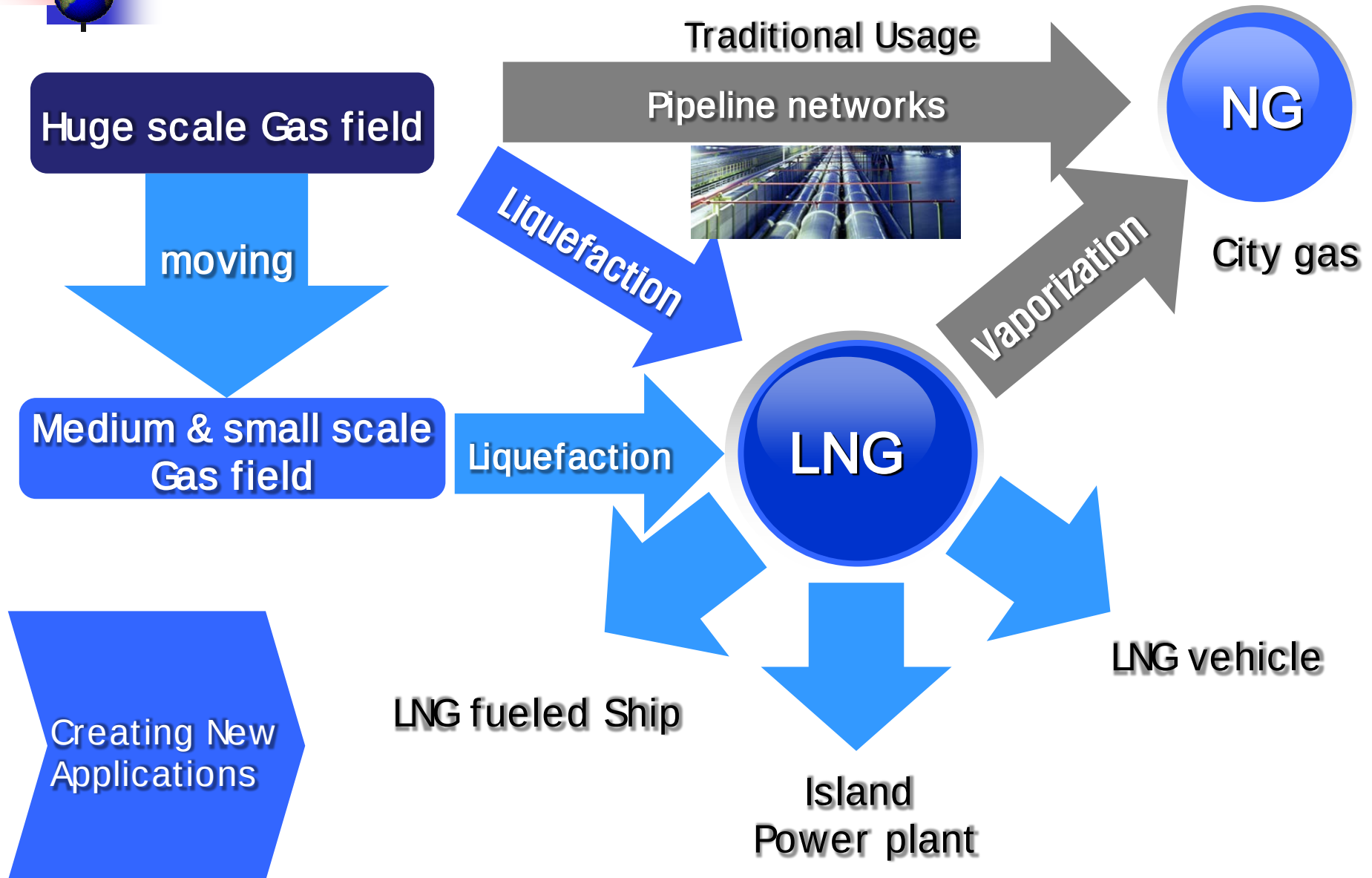
ECONOMIC CRISIS:



Higher bunker price

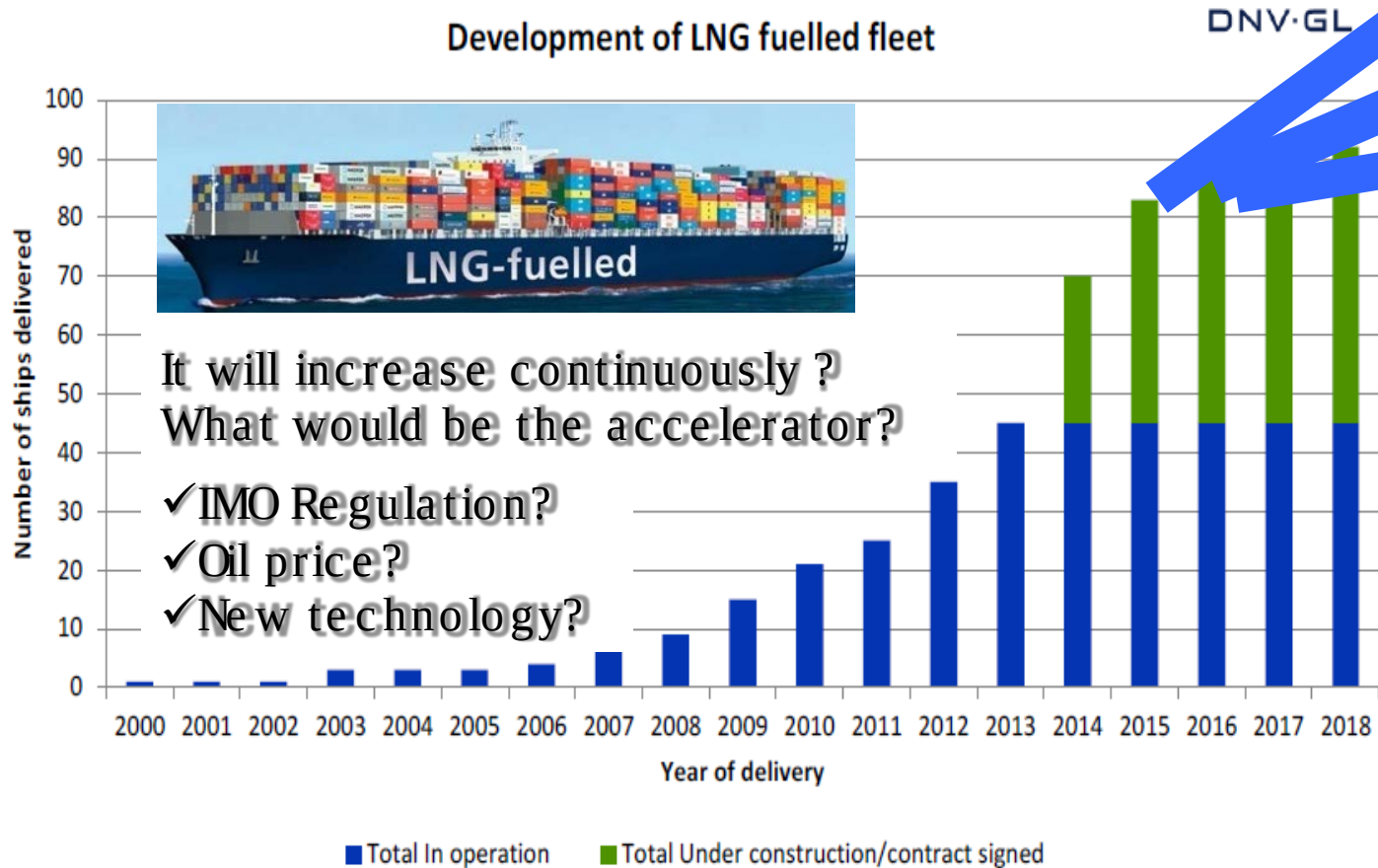


Paradigm Change in NG Supply

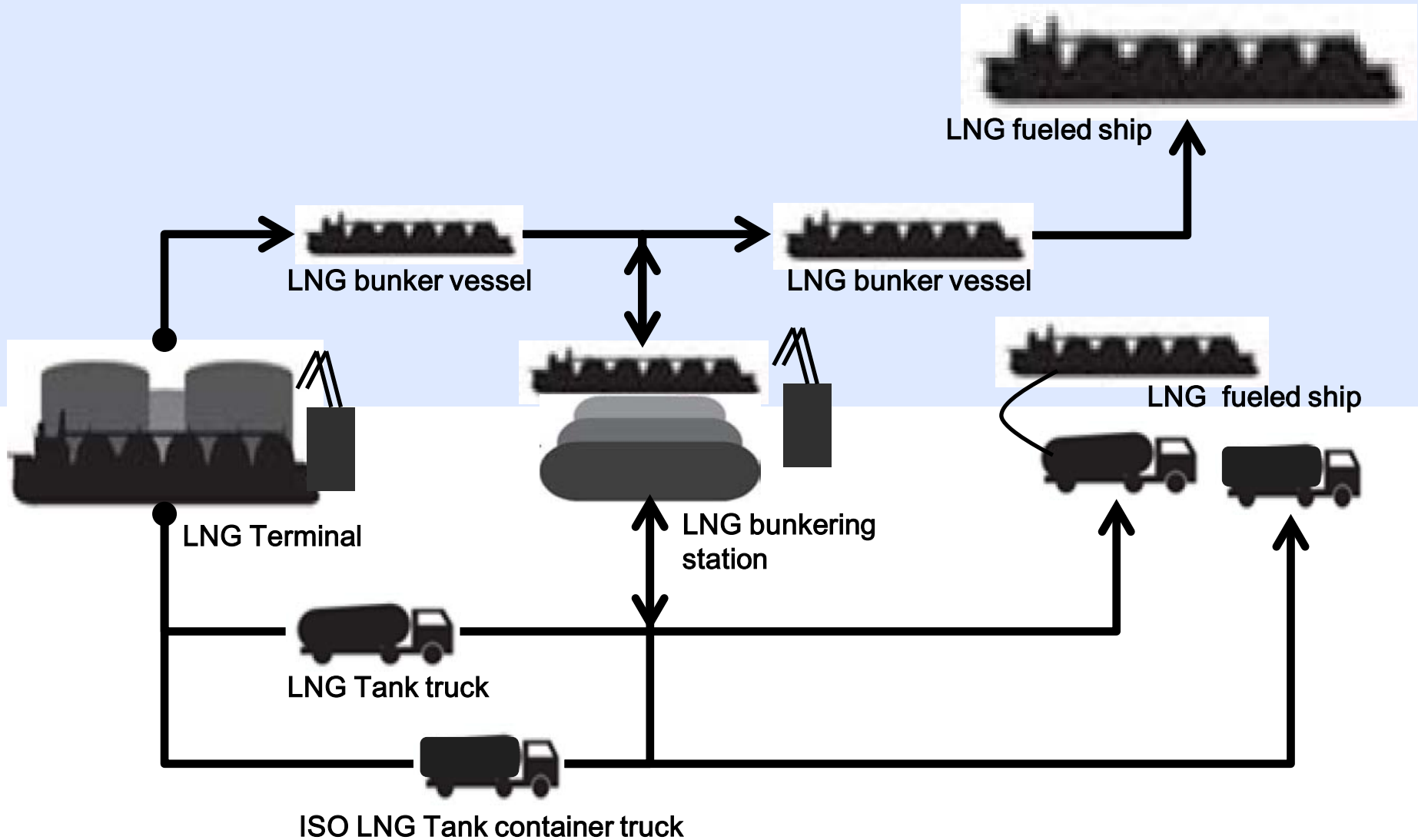


Trends in LNG fueled ship

The No. of LNG fueled ship has been increased steadily until now



Value Chain in LNG Bunkering



Scenario in LNG Bunkering

LNG Tank Lorry to Ship



LNG bunkering at LNG Terminal



LNG
Tank lorry

Bunkering
Shuttle



Ship to Ship



Onshore LNG bunkering Station

Which one should go first?

LNG Fueled Ship



LNG Bunkering Facility



We need a breakthrough !!

Ship to ship



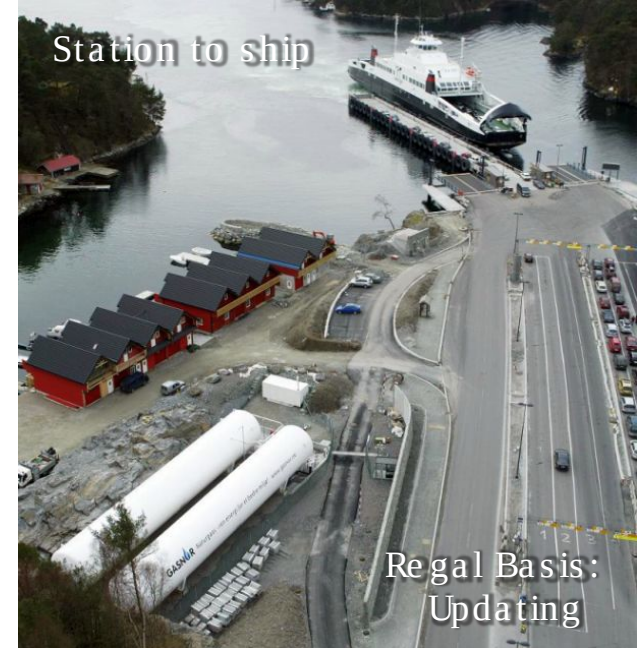
Regal Basis :
Preparing

Truck to ship



Regal Basis :
Prepared

Station to ship



Regal Basis :
Updating

LNG Bunkering strategy in China

- As a First step : Policy based approach
 - ✓ Yangtze river LNG bunkering program
 - ✓ propagation of LNG bunkering to the sea



First LNG-fuelled Ship in China



- LNG fuelled ship bunkering station
 - ✓ River : 7 station operation
- About 200 vessels is waiting for converting to LNG fuelled Ship
- Still ~150,000 vessels can be converted to LNG fuelled ship

2010



River Cruises

2012



River BC

2013



River Dug

LNG Bunkering Activity in China

ENN is leading LNG Bunkering Business in China

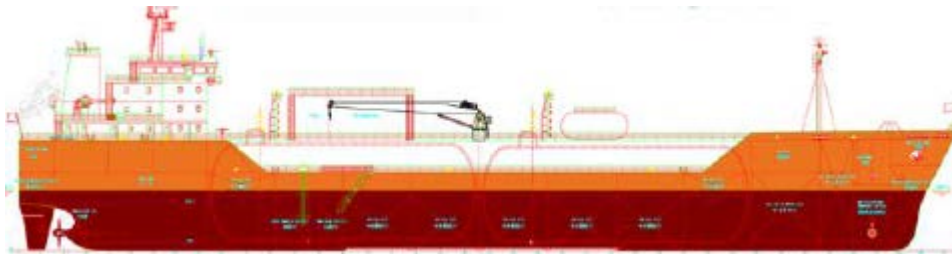
- Lorry bunkering is currently main stream
- Fst LNG bunkering vessel is under construction
 - ✓ 240 m³ LNG volume, river LNG bunkering,



2014

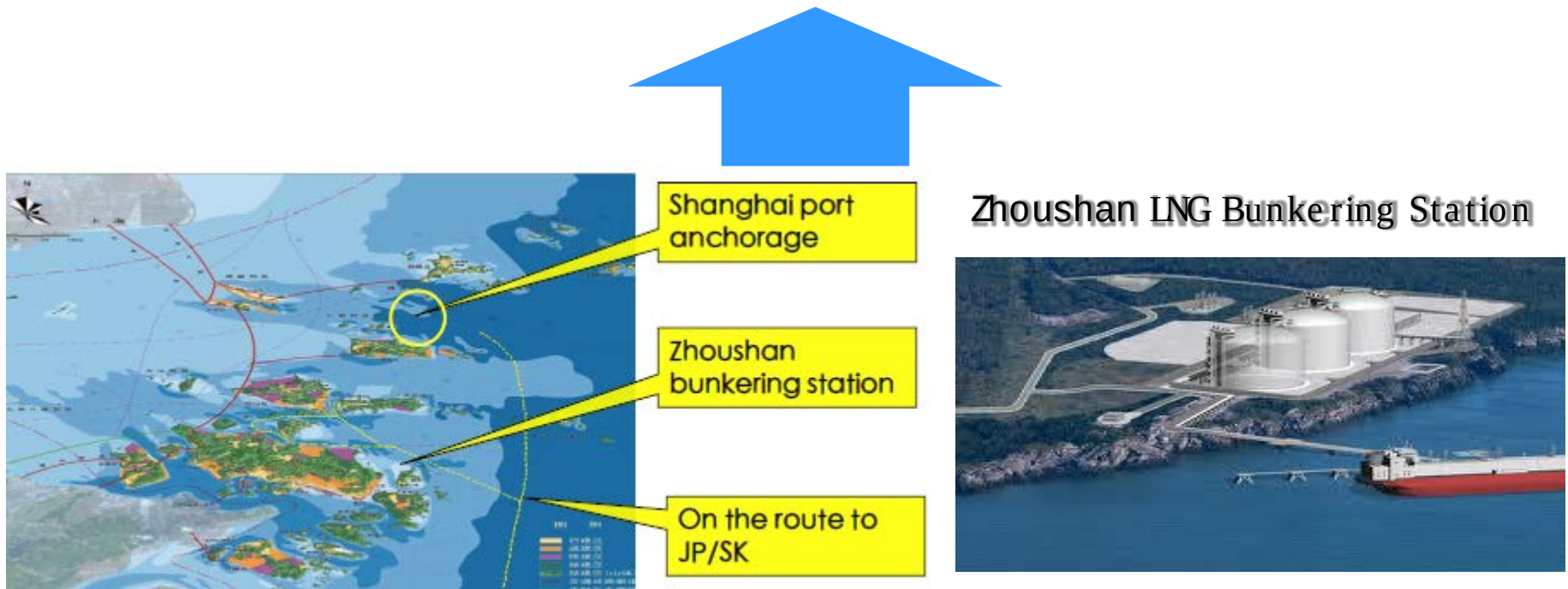


- Multi gas carrier (Anthony Vender) is under construction
- 8500 m³ LNG bunkering shuttle is under design (2016 Operation)



First LNG Bunkering terminal in China

Energy Gateway for the eastern China, Zhoushan



- ✓ Building LNG bunkering terminal with 160,000 m³ Tanks to start up in 2016
- ✓ LNG supply in 2016 : 5 million ton/year
- ✓ Future stage : 10 million ton/year

LNG Bunkering Activities in Korea

LNG Bunkering Association

- . 22 participants including Ship builder, Energy co. city gas co.

First LNG Fueled ship, Econuri

- . To demonstrate for LNG fueled ship

LNG Supply to Island power generation

- . To demonstrate to supply LNG to islands



Floating LNG Bunkering Terminal Project

- . To develop LNG equipment, ship design etc.



Next Step ?

LNG bunkering shuttle Project

- . To design of LNG bunkering shuttle

LNG Yard tractor Project

- . To propagate LNG usage and connect to LNG bunkering to ship

LNG Bunkering in Korea

LNG Terminal



LNG Satellite Station

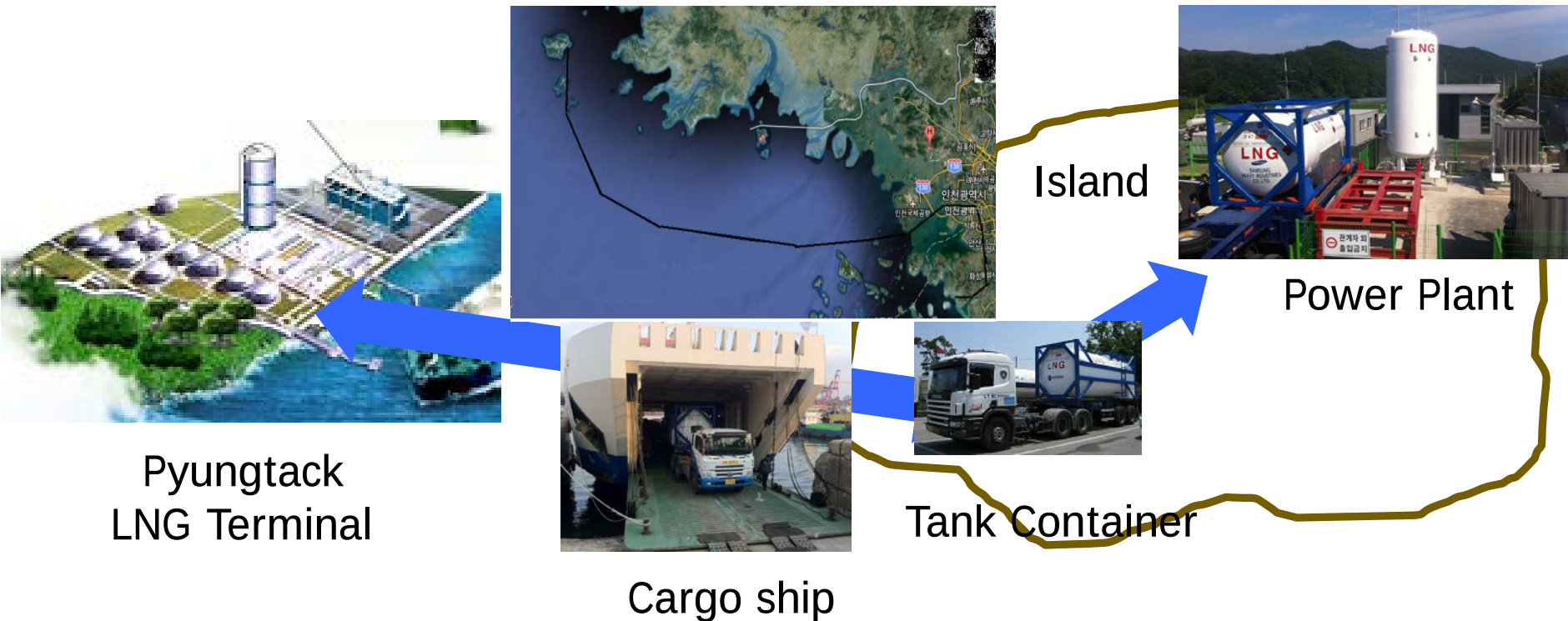
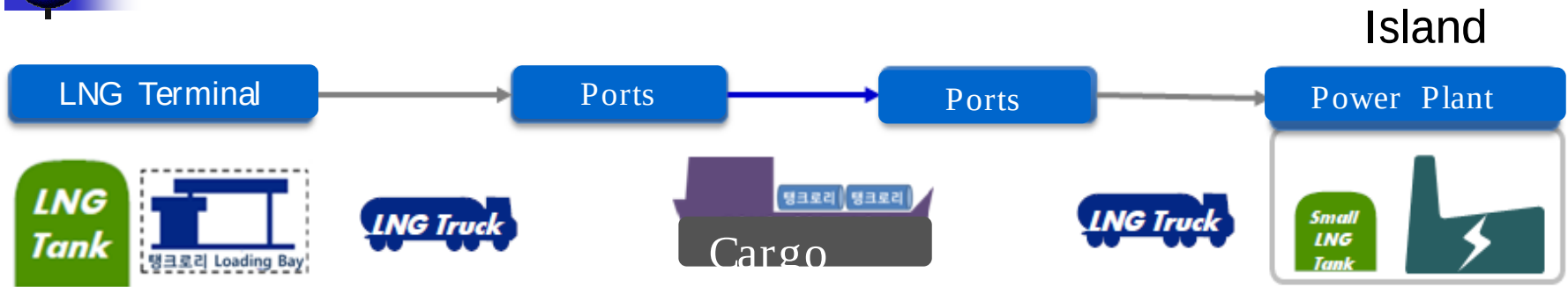


2013



LNG fueled ship

Demonstration of LNG Supply to Island



LNG supply with Tank container



First Step



LNG Yard Tractor



Remote Demands

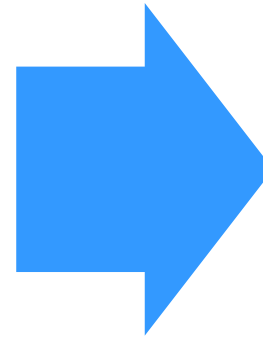


LNG fueled ship Bunkering

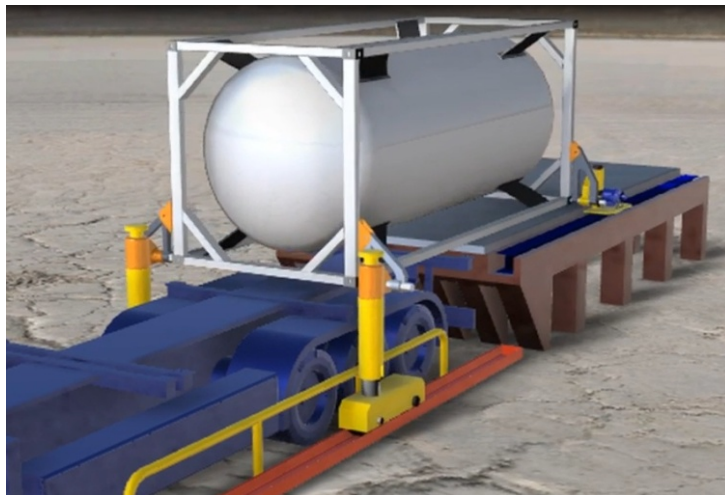
Features

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

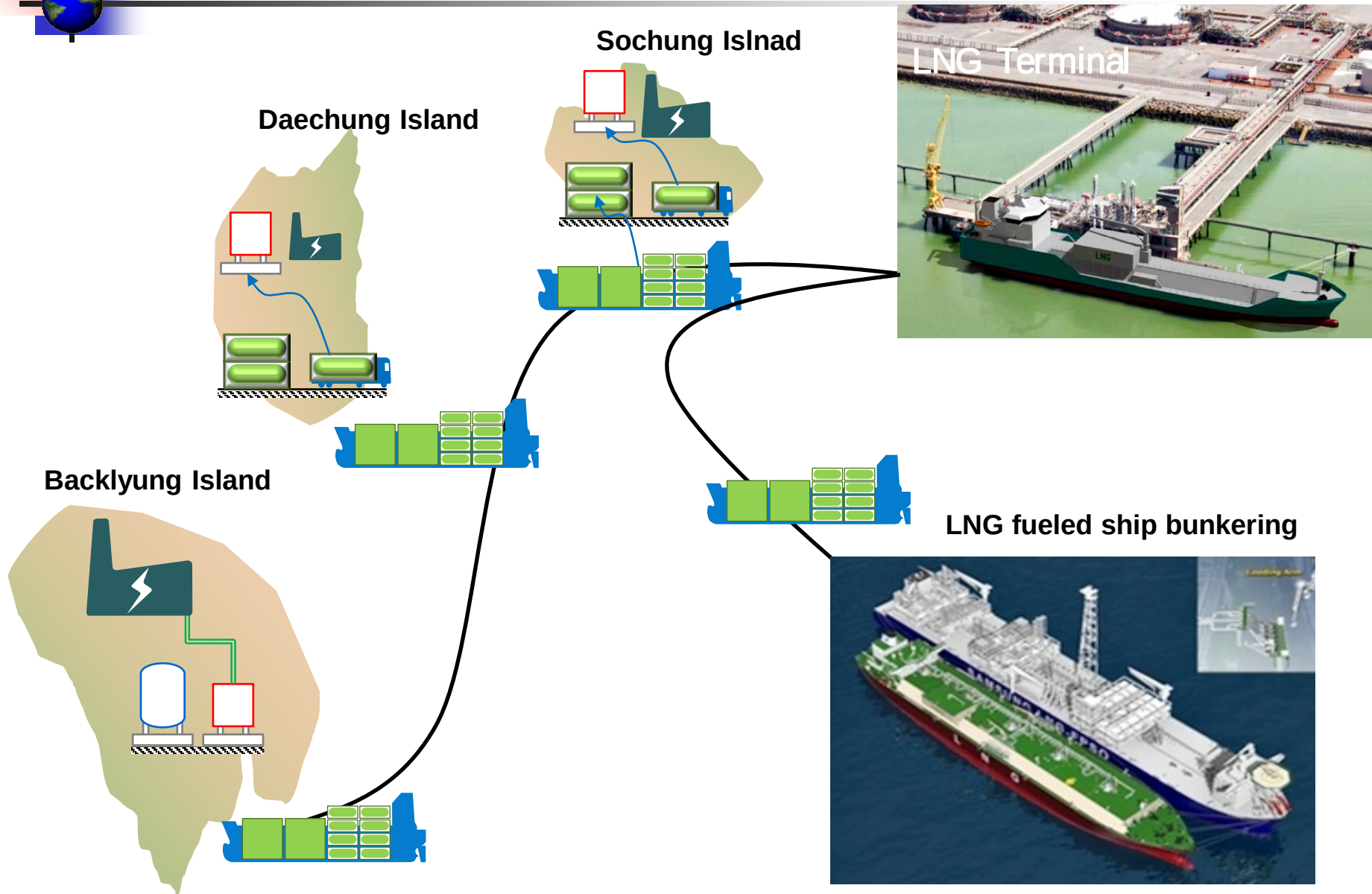
Tank container Type LNG Station



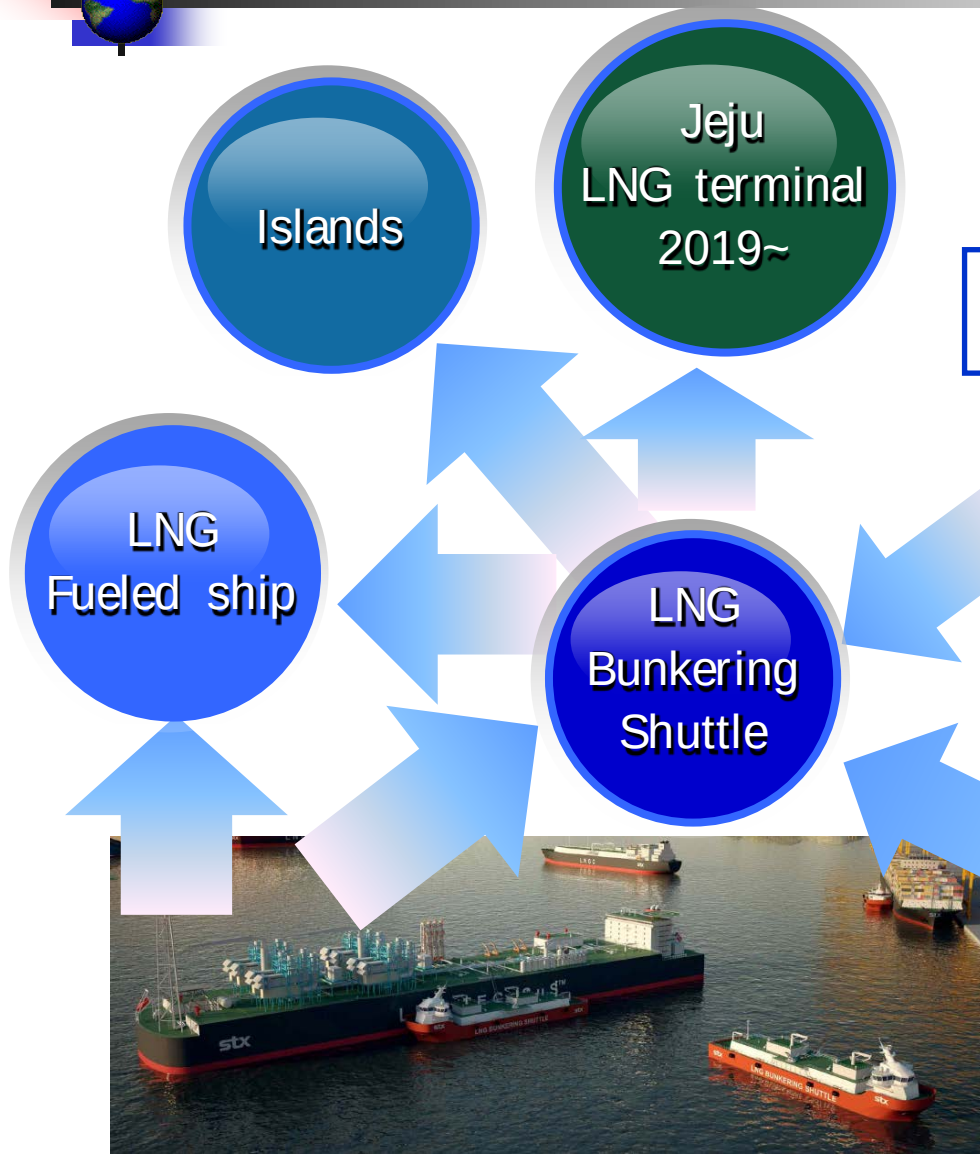
Tank Container Type LNG Station



Concept of LNG Shuttle Operation



Future of LNG Bunkering in Korea

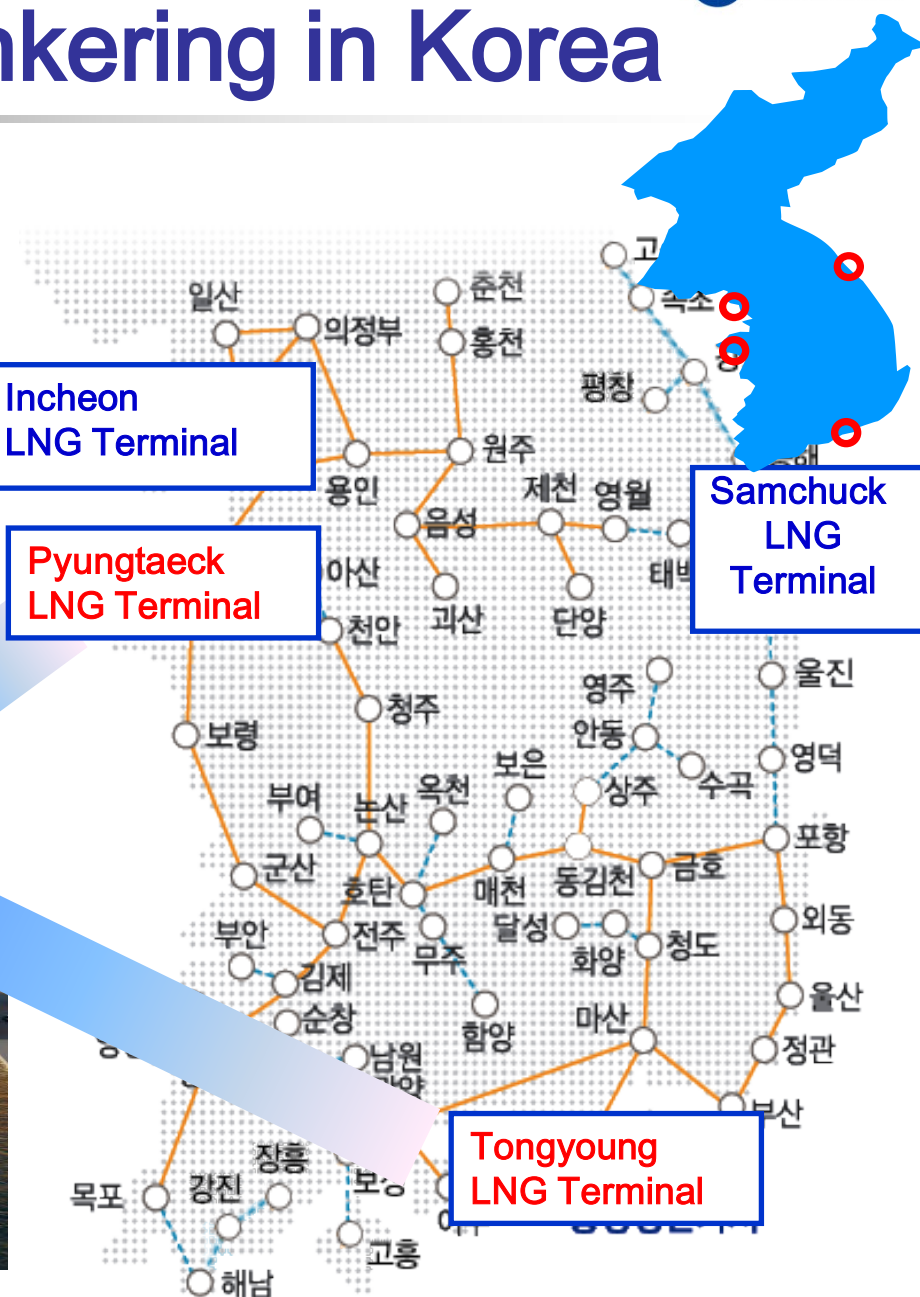


Incheon
LNG Terminal

Pyungtaeck
LNG Terminal

Samchuck
LNG
Terminal

Tongyoung
LNG Terminal

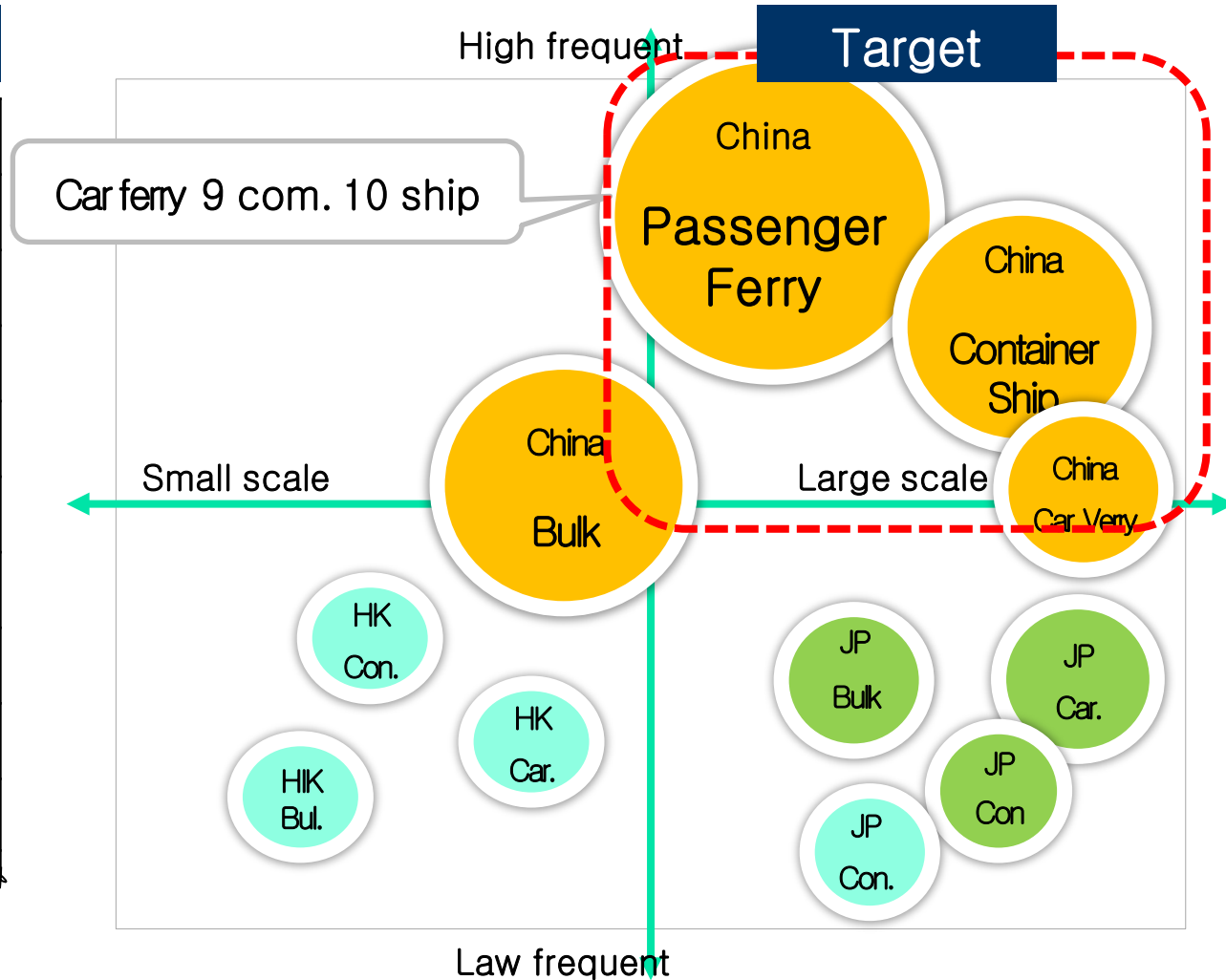


Off shore LNG Terminal

Current Shipping with China

Segmentation

	Nat.	Type	Portion
1	China	Passenger	31.0%
2	China	Bulk	10.0%
3	China	Container	9.0%
4	China	Car ferry	4.0%
5	Japan	Car ferry	3.0%
6	Japan	Bulk	2.0%
7	Japan	container	1.5%
8	HK	container	1.4%
9	:	:	:
	...		



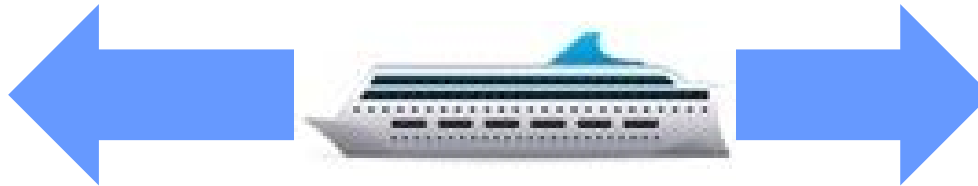
Conclusion

China

<Korea-China Joint Project>
Co-Operation of LNG fueled Ferry

Korea

Bunkering
Facility



Bunkering
Facility

Ship building

Ship building

Development
Of related
technology

Development
Of related
technology

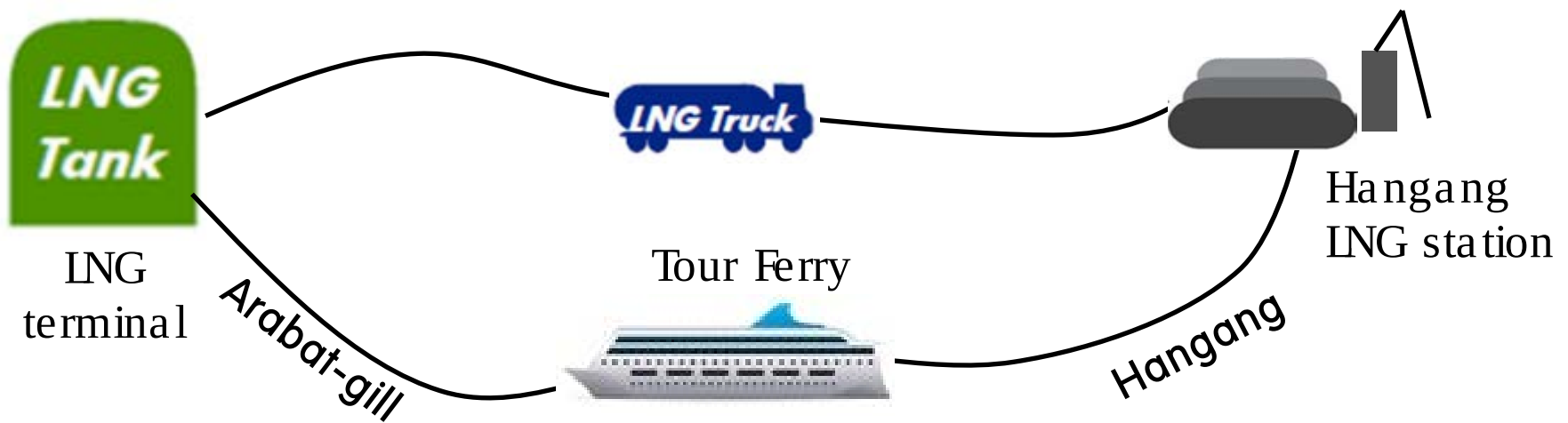
Co-responding
to ECA regulation

Co-responding
to ECA regulation

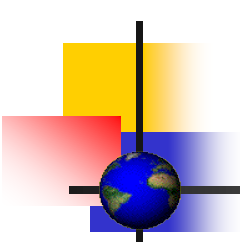


Suggestion

<Domestic LNG bunkering Project> HanGang LNG fueled Tour ferry Project



- To initiate Domestic LNG Bunkering industry
 - ✓ Chance to build new LNG fueled ship
 - ✓ Chance to build LNG bunkering station
 - ✓ Chance to have an experience of LNG Bunkering
 - ✓ To get competitiveness in LNG bunkering
 - ✓ To create New sightseeing business



Thanks for yor attentions

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