



5th Oil and Gas Security Network Forum
Sendai, Japan

2-2 Small-scale LNG in Asia Pacific

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April 10 2019



About APEC and APERC



Asia-Pacific Economic Cooperation

- Multi-lateral organization of 21 Pacific Rim economies, founded in 1989.
- Mission: to promote sustainable economic growth and prosperity.
- APEC economies collectively account for about 60% of the world's energy demand.



- Established in July 1996 in Tokyo following the directive of APEC Economic Leaders in the Osaka Action Agenda.
- The primary objectives are to foster understanding among APEC members of regional energy outlook, market developments and policy through:
 - Research, especially on analysis of energy supply and demand in the APEC Region;
 - Cooperative programs to promote energy efficiency and low-carbon energy.
- Funded by the Japanese government and based in Tokyo.
- Currently has 25 research staff, including 16 visiting researchers from APEC economies.

Small-scale LNG in Asia Pacific

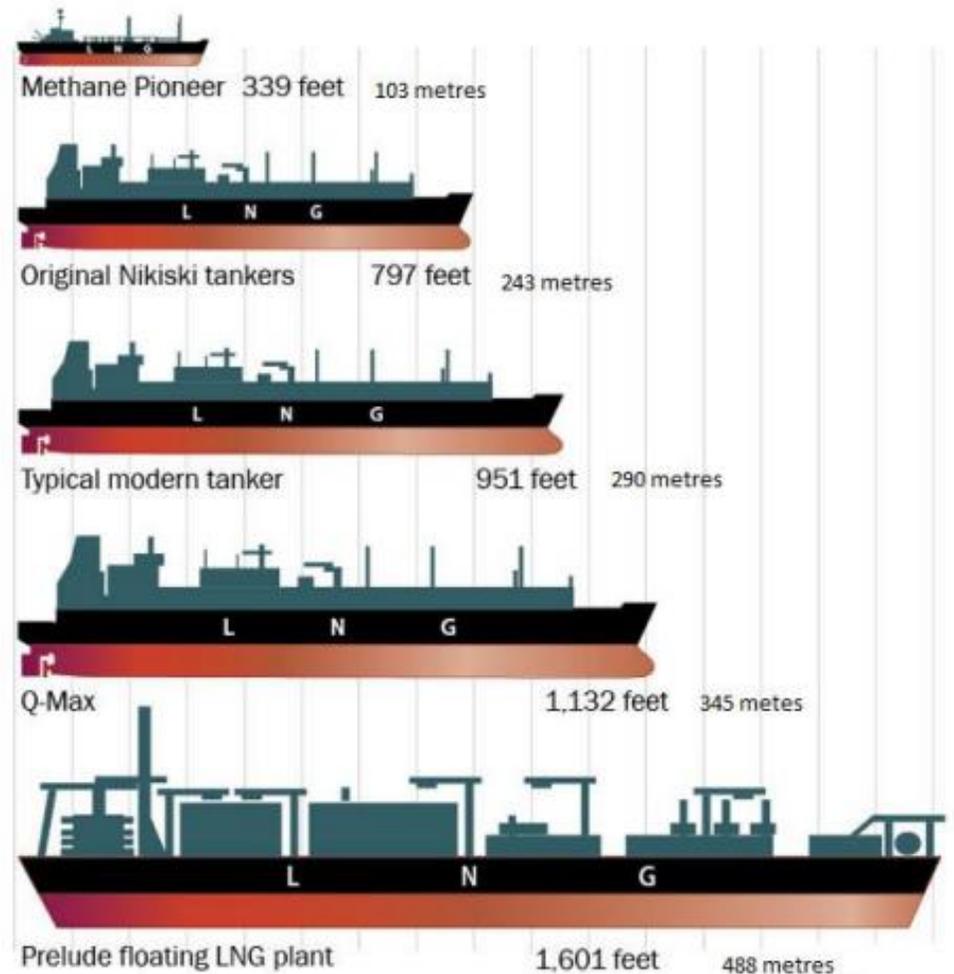
- A joint-research paper between IEEJ and APERC.
- The structure of the paper:
 1. What is small-scale LNG?
 2. Small-scale LNG (SSLNG) uses
 3. Model of the economics of SSLNG
 4. Case Studies
 - A. China
 - B. Southeast Asia
 - C. North and Northwestern Europe
 5. Conclusions



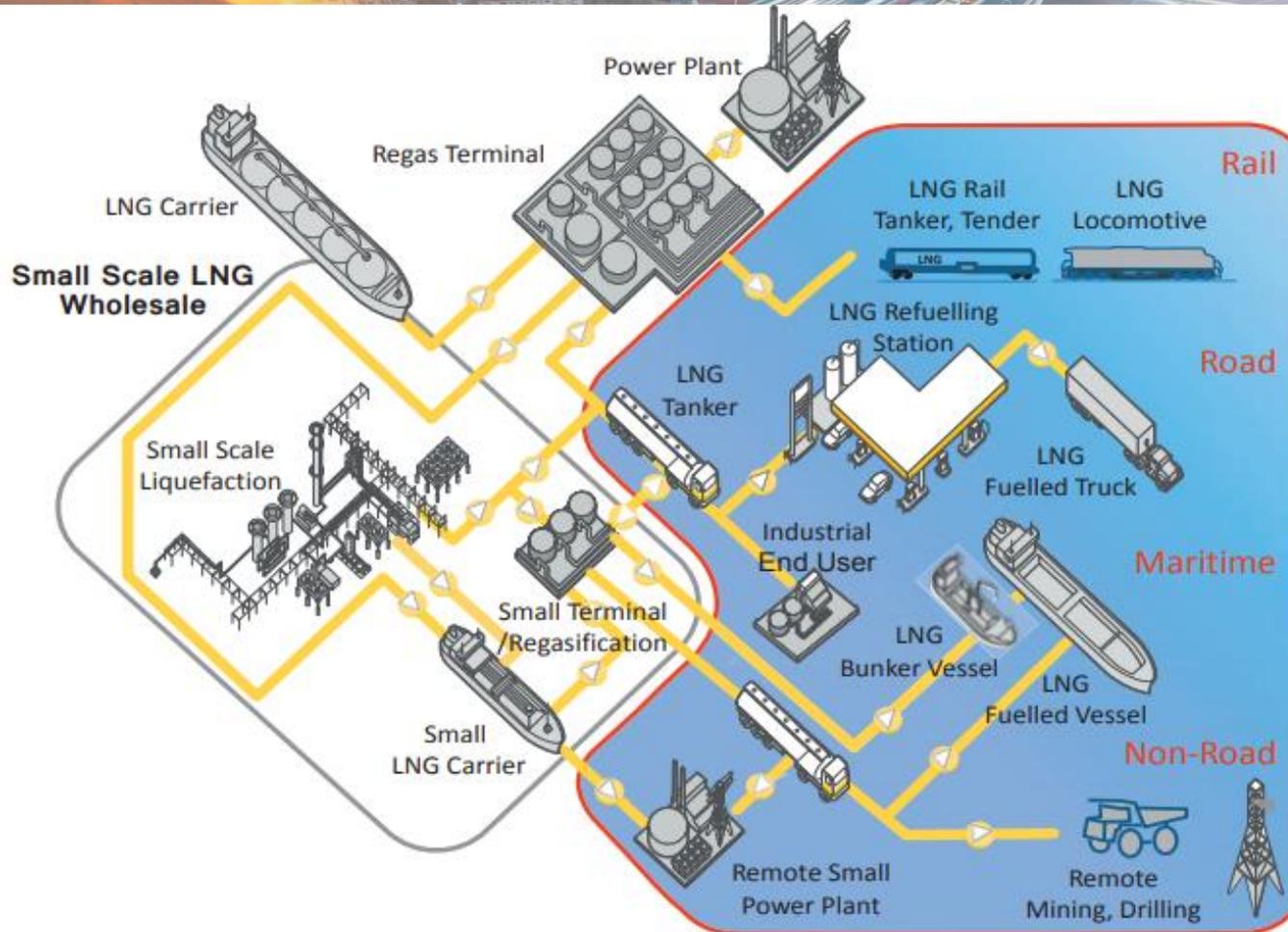
1- What is small-scale LNG?

- Small-scale LNG refers in general to LNG-related facilities (receiving terminals, storage units, vessels, etc.) of similar characteristic but with a lower magnitude when compared with conventional LNG infrastructure.
- Not yet a clear and commonly accepted definition of SSLNG.
- This study follows the International Gas Union (IGU) criteria:
 - Liquefaction and regasification capacity <1.0 million tonnes per annum (mtpa)
 - Vessels with a <60 000 m³ capacity (vs 170 000 m³)

LNG tanker sizes



1- Why is SSLNG relevant?



SSLNG advantages

- Lower initial investment and faster construction
- Better accessibility and operational flexibility

SSLNG disadvantages

- Greater supply chain complexity
- Greater exposure to price uncertainty

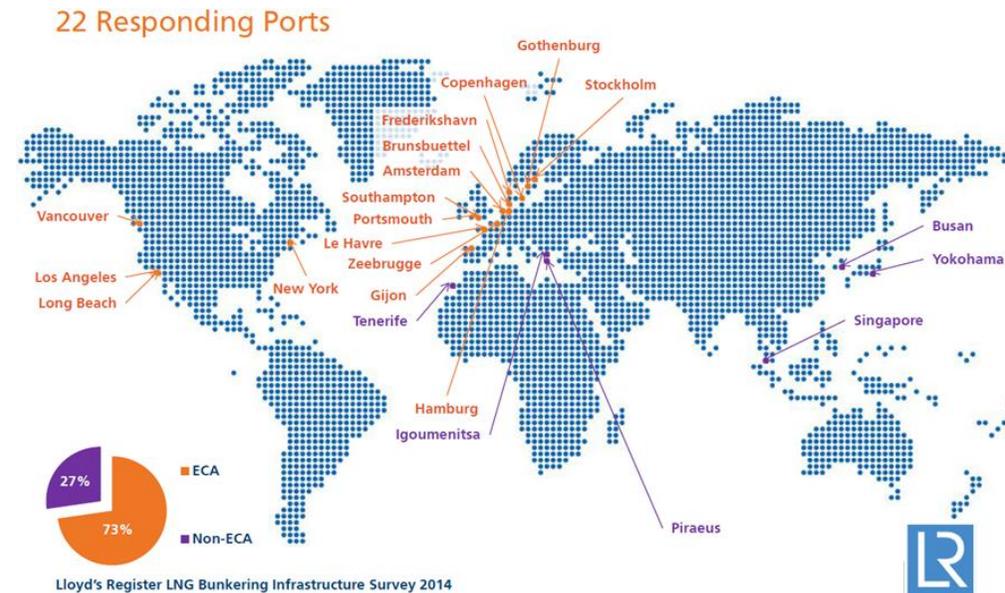
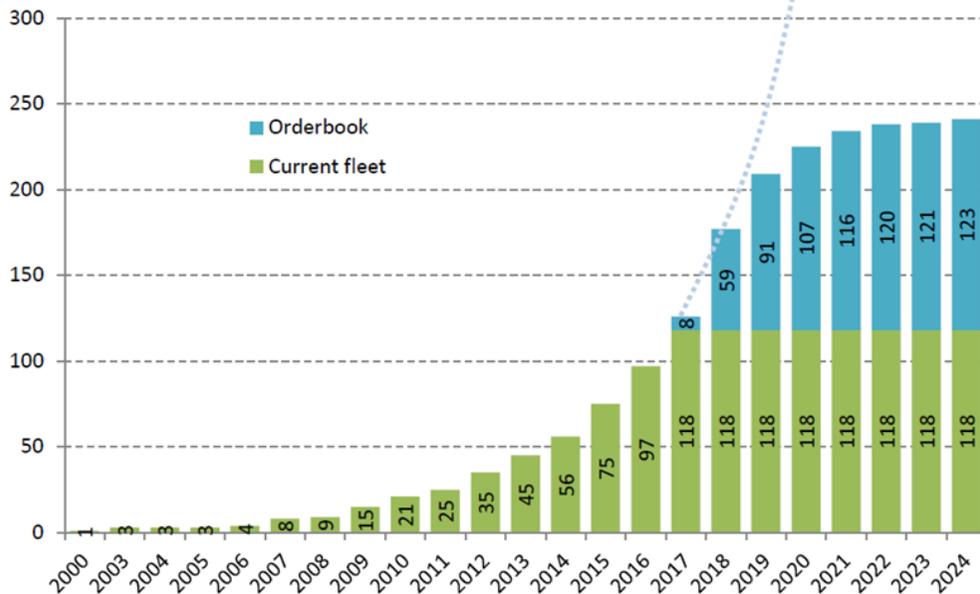
2- SSLNG currently and its uses

- The market size for small-scale LNG is estimated to be at least **20 million tons**.
- Compared with conventional LNG, small-scale LNG is used in a wide range of fields:
 - fuel for power generation;
 - land and marine transportation;
 - residential and industrial uses in remote areas.
- Natural gas is a less polluting alternative to oil for power generation and industrial uses in remote areas and on outlying islands.
- Supply can come online in a relatively shorter period
- Accessibility to remote places with no access to pipelines or large-scale LNG
- Logistics and operational flexibility



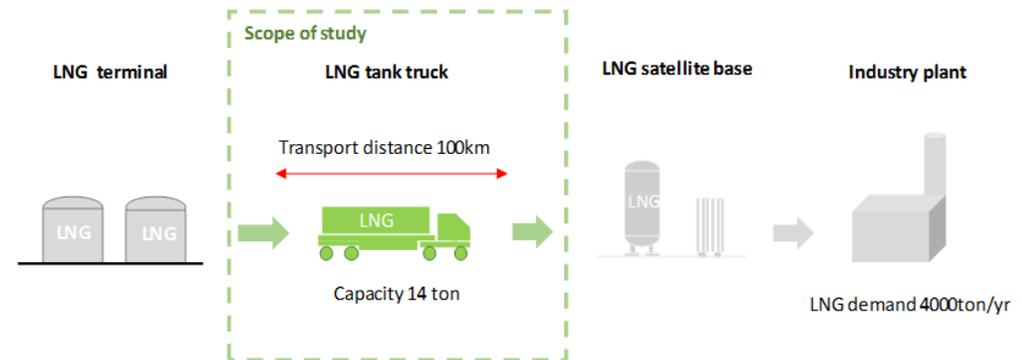
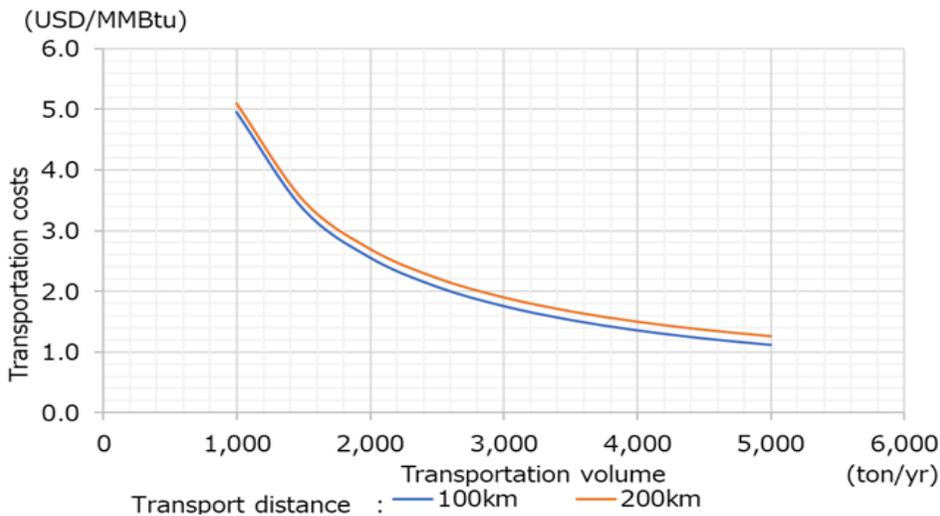
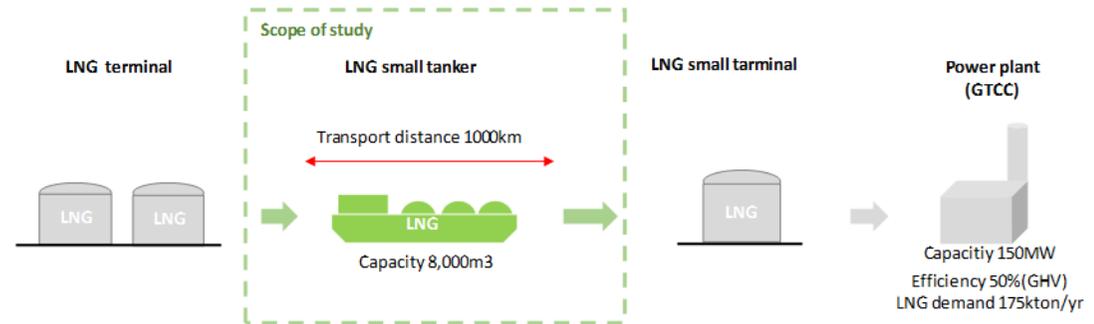
2- SSLNG and LNG as a bunkering fuel

- In the transportation sector, compressed natural gas (CNG) is currently used in a variety of places across the globe, while LNG as a transportation fuel has grown in recent years in China and the United States, mainly for long-haul trucks.
- LNG is a potential fuel for marine vessels given the impact of the 2020 International Maritime Organization's (IMO) SOx emission regulations. The implementation of these regulations may further boost LNG's use as bunkering fuel.



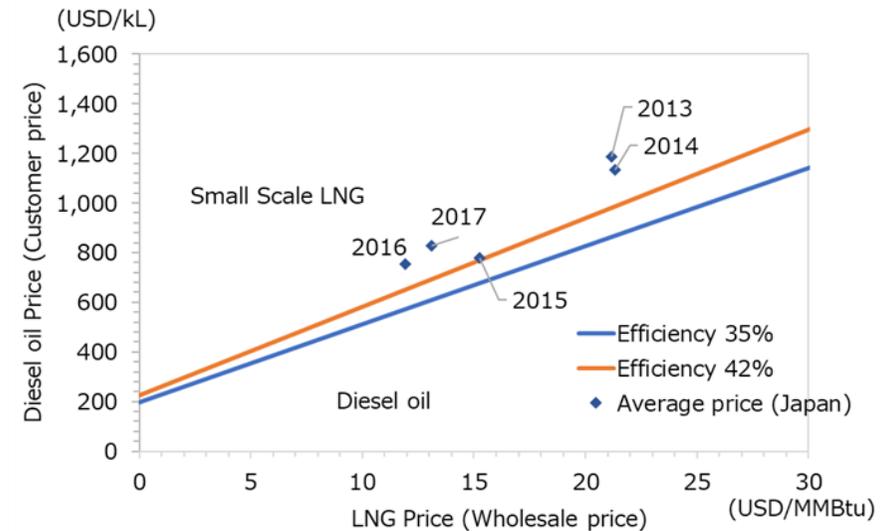
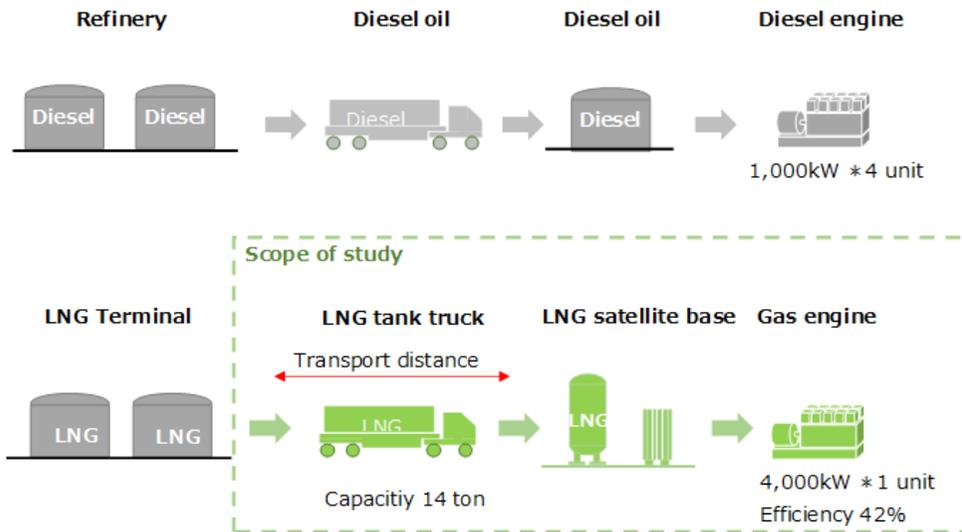
3- Economic case for SSLNG (Japan)

- The transportation cost of SSLNG using an 8,000 m³ vessel was estimated to be about USD 10 million annually (67% CAPEX), with a transport unit price of \$0.81/MMBtu.
- Transport cost using a 14 tonne truck was estimated to be about USD 0.28 million annually (67% CAPEX), with a transport unit price of \$1.35/MMBtu.



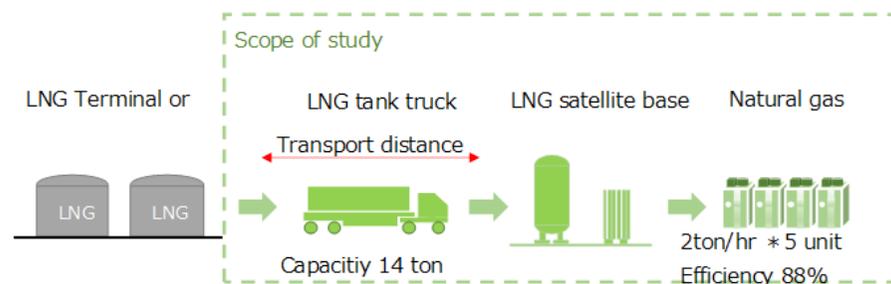
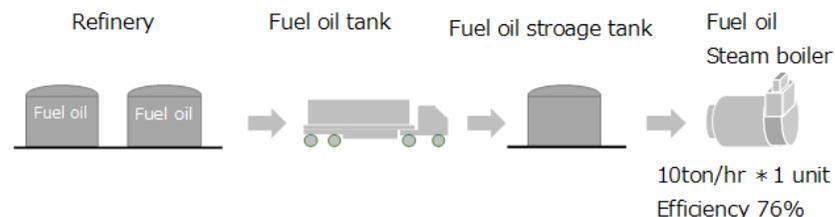
3- Economic case for SSLNG (power generation)

- This model estimated an annual cost savings of about \$1.6 million by introducing small-scale LNG for a hypothetical 4 MW power plant.
- SSLNG significantly reduce costs by replacing oil in power generation, but this highly depends on international LNG prices.



3-Economic case for SSLNG (industry and residential)

- In the industrial uses, the annual cost reduction amounted to \$240,000.



- For residential use, the transportation cost of supplying SSLNG is about 1.8 times higher.
- Very challenging to develop SSLNG where there is no base demand from power generation and industrial use.

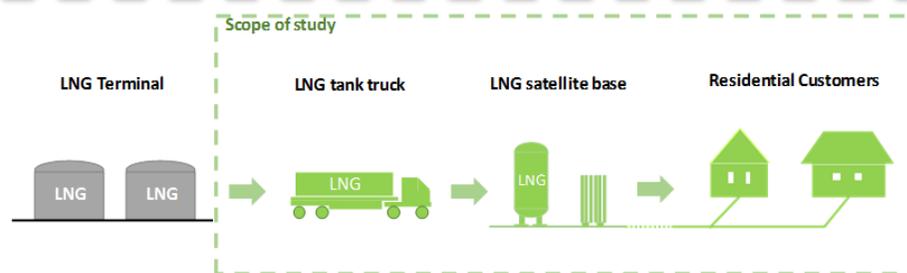


Table 3-8 Average operator gas production cost*1 (FY2016)

(1) Top 10 companies in city gas sales volumes*2	\$9.3/MMBtu
(2) Small-scale LNG operators	\$16.6/MMBtu

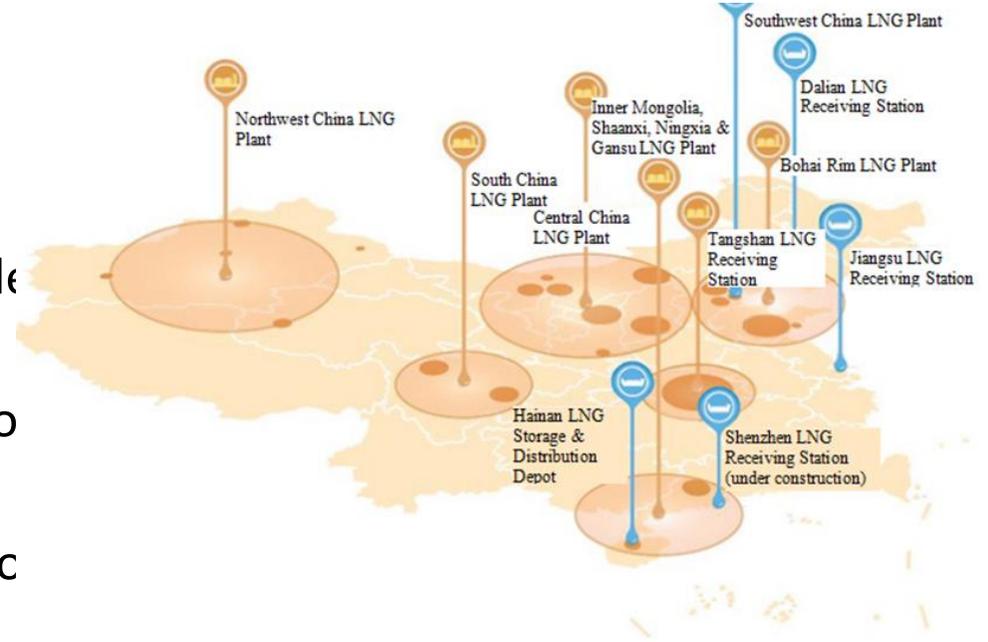
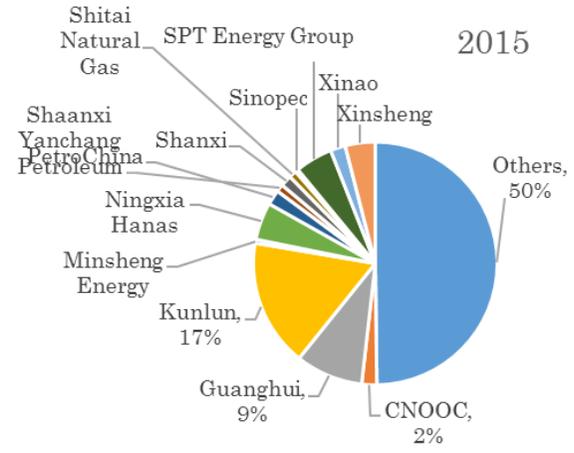
4- Case studies on the use of SSLNG across regions

- This paper includes three study cases of the use of SSLNG with some patterns in common but with clear different divers, uses and magnitude:
 1. China
 2. Northern Europe (Netherlands, Belgium, Norway, Finland and Sweden)
 3. Southeast Asia (Singapore and Indonesia)



4-1 SSLNG in China

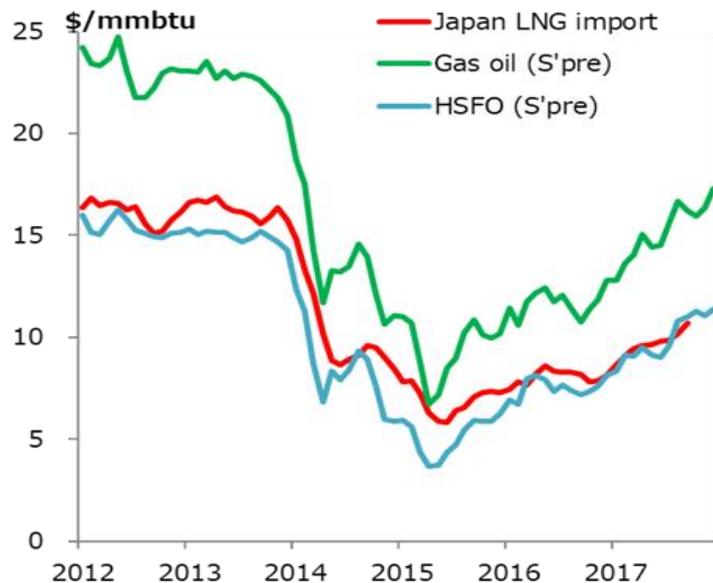
- China leads SSLNG capacity with around 15 mtpa in over 200 SS liquefaction facilities.
- China's gas supply includes domestic production and imports by pipeline and via LNG.
- However, most small-scale liquefaction plants are found in major gas and coal producing areas of the northwestern and central provinces.
- SSLNG is an alternative for inland consumers and regions with no access to gas pipelines.
- The transportation sector has the largest potential for SSLNG. The number of LNG-fueled trucks is rapidly increasing.
- Demand is also increasing for LNG as a fuel for marine vessels.
- More than 40 LNG-bunkering terminals are to be built in China by 2020.



Notes: The covering area is in direct proportion to the production capacity of plants and receiving and unloading capacity of receiving stations.

4-2 SSLNG in southeast Asia

- **Singapore** willing to become a major hub for LNG bunkering.
- Subsidy for LNG-fueled ships construction and cooperation with other ports and ship-owners to promote LNG as a bunker fuel.
- LNG already cheap but shipping companies unlikely to convert to LNG.
- How many newly built ships will be LNG-fueled?

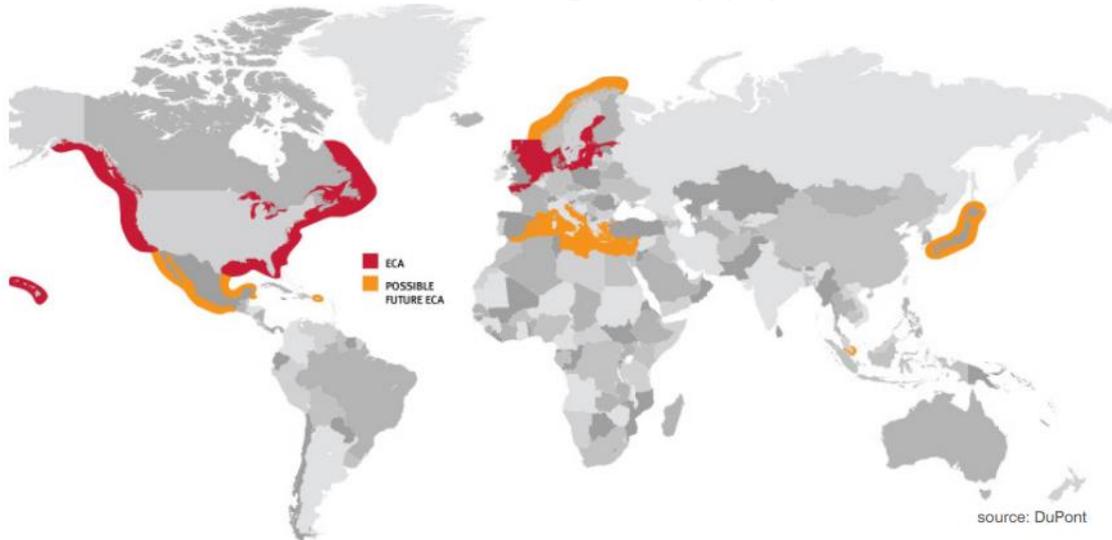


- In **Indonesia**, SSLNG may be a substitute for aging oil-fired power generation on islands.
- In Bali, an SSLNG facility and a gas-fired power plant, is already in operation.
- Unless enough demand is secured, no price competitiveness in Indonesian island.
- Cost reductions through optimizing logistics and modularizing equipment?



4-3 SSLNG in Europe

- Small-scale LNG is mainly used in Netherlands, Belgium, Norway, Finland and Sweden.
- In the Netherlands and Belgium, SSLNG is driven by:
 - Lower than expected use of conventional LNG terminals
 - Environmental restrictions, Emission Control Area (ECA)
 - Gas demand for industries and power generation in remote areas
- In Northern Europe, despite having natural gas resources and production, some demand for areas without access to natural gas pipelines.
- SSLNG as an alternative gas supply for remote towns or peninsulas.



Conclusions

- One of the main challenges of expanding small-scale LNG in the Asia-Pacific region will be the relative **price competitiveness** of LNG versus petroleum products.
- LNG pricing structure in Asia mostly determined by crude oil's price.
- Saving **costs on the infrastructure development** of SSLNG is a key factor for its competitiveness (standardization, modularization, etc.).
- **Optimizing logistics** such as associated infrastructure for SSLNG receiving terminals, pipeline networks, satellite terminals, roads quality, safety, etc
- **Coordination** among multiple stakeholders:
 - Governments
 - LNG companies
 - End-users (power generators, industries, etc.)
 - Local authorities



Thank you

<http://aperc.ieej.or.jp/>

[https://www.igu.org/sites/default/files/node-document-field file/IGU LNG 2018 0.pdf](https://www.igu.org/sites/default/files/node-document-field%20file/IGU%20LNG%202018%200.pdf)

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