

Aim & Scope of the Analysis:

- What are the trends in LNG production (esp. Russian Arctic)?
- What are the developments in the Asian LNG receiving markets?
- What are the specifics and prospects of Arctic shipping?

Impacts of an Ice-Free Northeast Passage on LNG Markets

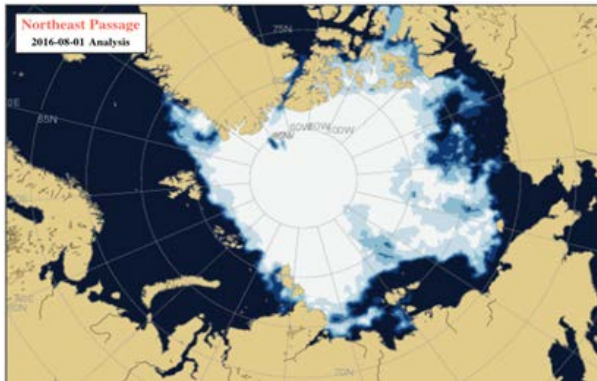
Prof. Dr. Reinhard Madlener, Michael Schach

Energy Transition 2018, Trondheim, Norway
Statoil Natural Gas Workshop, February 26, 2018

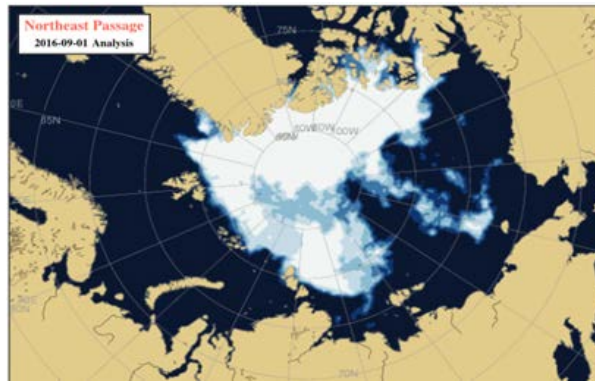
Shipping along the NEP

The Northeast Passage

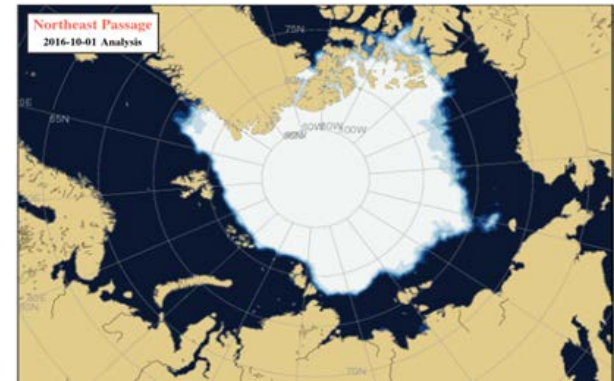
- First transition of NEP in 1878/79 by the Swedish explorer Adolf Erik Nordenskiöld
- First shipment of LNG from Hammerfest, Norway to Tobata, Japan in 10 days
- 3 m/yr the NEP is ice-free, 6 m/yr shipping with ice-reinforced vessels is possible



August 2016



September 2016



October 2016

- Unpredictability of ice makes just-in-time deliveries (container shipping) impossible
- NEP strategic corridor and shipping route (bulk: hydrocarbons, minerals) for Russia and Asian Economies

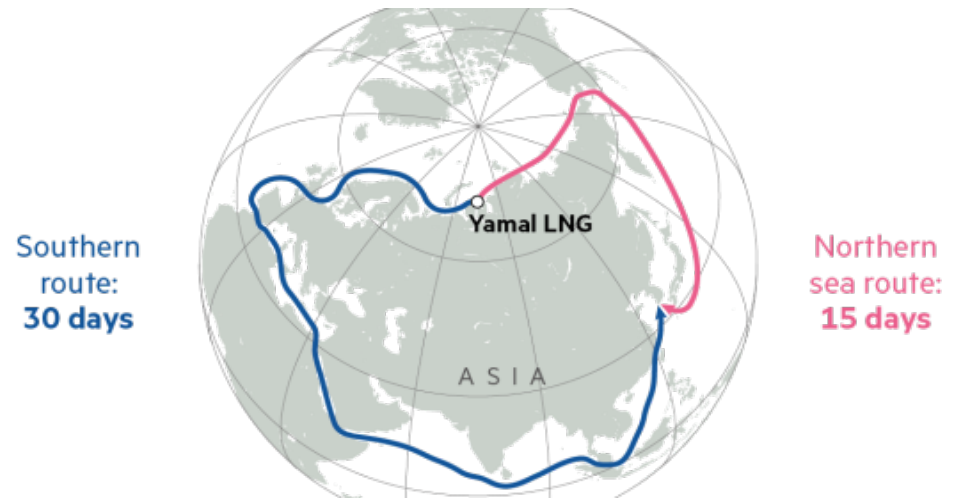
Natural Gas Production in the Russian Arctic

The next global hotspot for hydrocarbons?

- USGC: 22% of undiscovered, recoverable oil and gas resources within the Arctic Circle (Yamal Region, Kara Sea, East Barents Basin, Alaskan Arctic)

Yamal LNG:

- First LNG shipment in Nov 2018
- Output of 16.5 MTPA in 2019
- Shipping along NEP is 2.5 times less expensive than along SCR
- MOU for follow-up projects signed



Our empirical (algorithm-based) study shows: LNG production in the Russian Arctic and shipping along the NEP is indeed feasible and cost-competitive

Three decisive aspects on the consumer side:

1. Objectives of national Japan's LNG strategy, LNG: 27% of energy mix in 2030

- Creation of an LNG trading hub in Japan (expansion of tradability, spot trading)
- Change of market structure (supply & demand-based pricing)
- Fostering liquidity and flexibility (refusal of LTCs, open and sufficient infrastructure)



Significant impacts on traditional financing and sales model of E&P projects

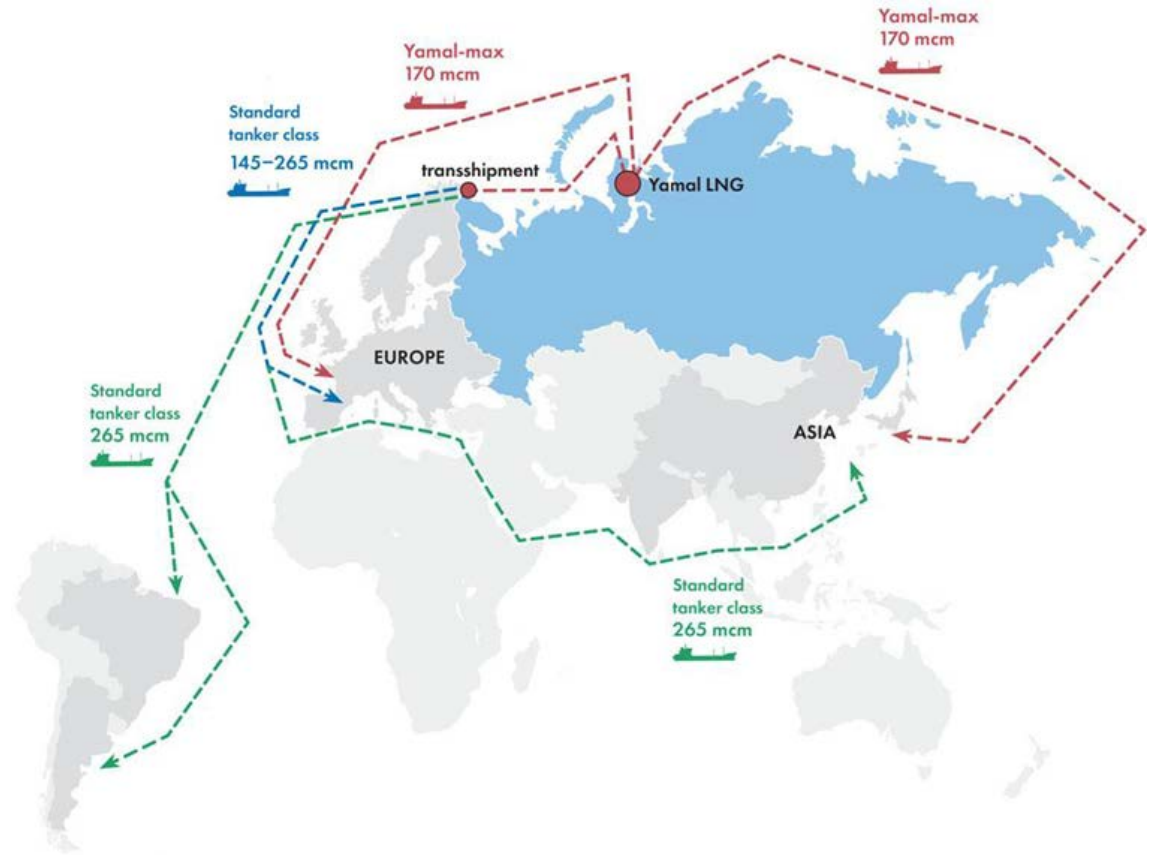
2. Significance of renewables in South Korea's future energy mix:

- Strategic interest in Arctic and NEP, but plans to build up renewables to reduce imports, replace coal

3. The sustainability of China's environmental policy:

- China introduced an energy policy to limit pollution, replacing coal with natural gas (pipelines from Turkmenistan and Russia, LNG)

Thank you for your kind attention. Any Questions?



References:

Schach M., Madlener R. (2017a). Impacts of an Ice-Free Northeast Passage on LNG Markets and Geopolitics, *FCN Working Paper No. 4/2017*, Institute for Future Energy Consumer Needs and Behavior, RWTH Aachen University, April.

Schach M., Madlener R. (2017b). Impacts of an Ice-Free Northeast Passage on LNG Trading: Transport Routes and Optimal Capacity Planning, *FCN Working Paper No. 12/2017*, Institute for Future Energy Consumer Needs and Behavior, RWTH Aachen University, September.