Costs and benefits of LNG economic development in the Baltic and Arctic Regions

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Outline

- Introduction (including a few geographic details);
- Brief discussion on ice coverage trend;
- Explaining the “Arctic Routes”;
- The Polar Code and why opting for LNG;
- LNG in Baltic Sea Ports
- Economic benefits

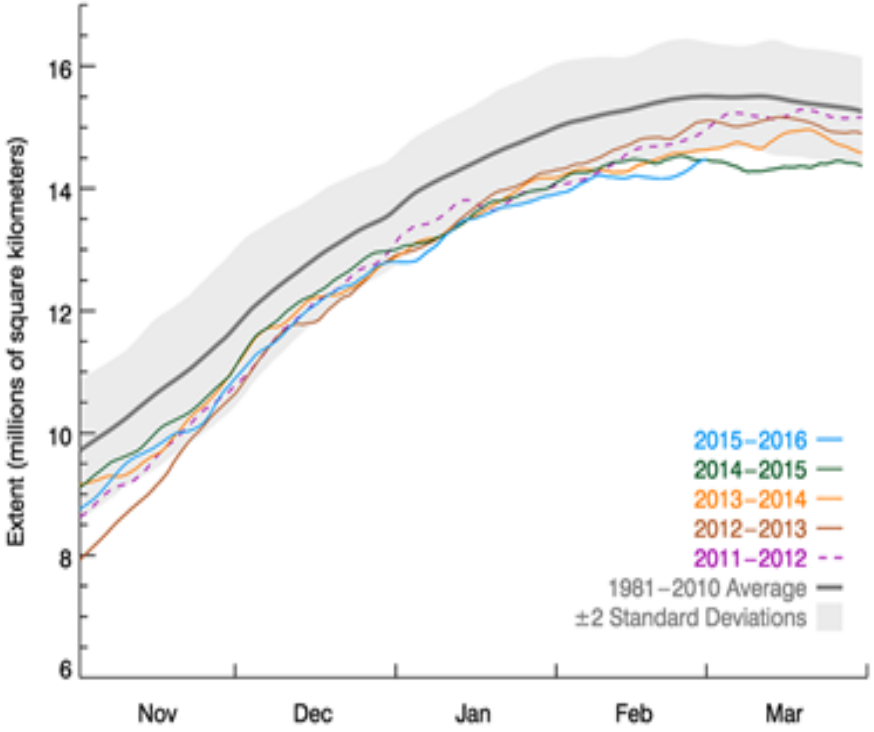
Defining the Arctic

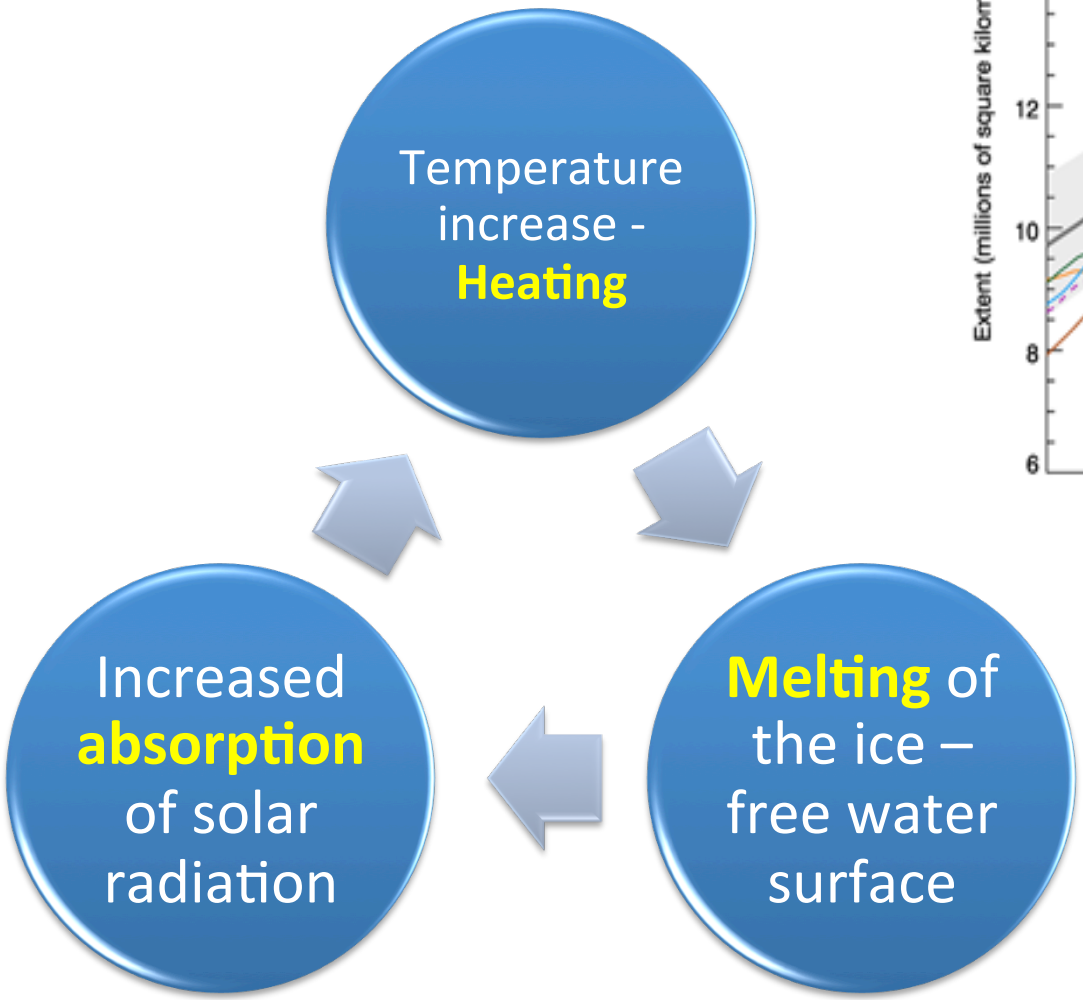
- "Above" the Arctic circle;
- Harsh environmental conditions;
- Inadequate infrastructure & communications;
- Sparsely populated…

Latest developments in the Arctic

- Global warming is becoming increasingly evident!
- Maritime routes that were previously covered with ice-pacts are becoming available for shipping…
- On going debate in relation to the extraction of the available natural resources in the wider region!
- The International Maritime Organization (IMO) has already established the Polar Code…

Ice coverage?





Ice-coverage is clearly declining…

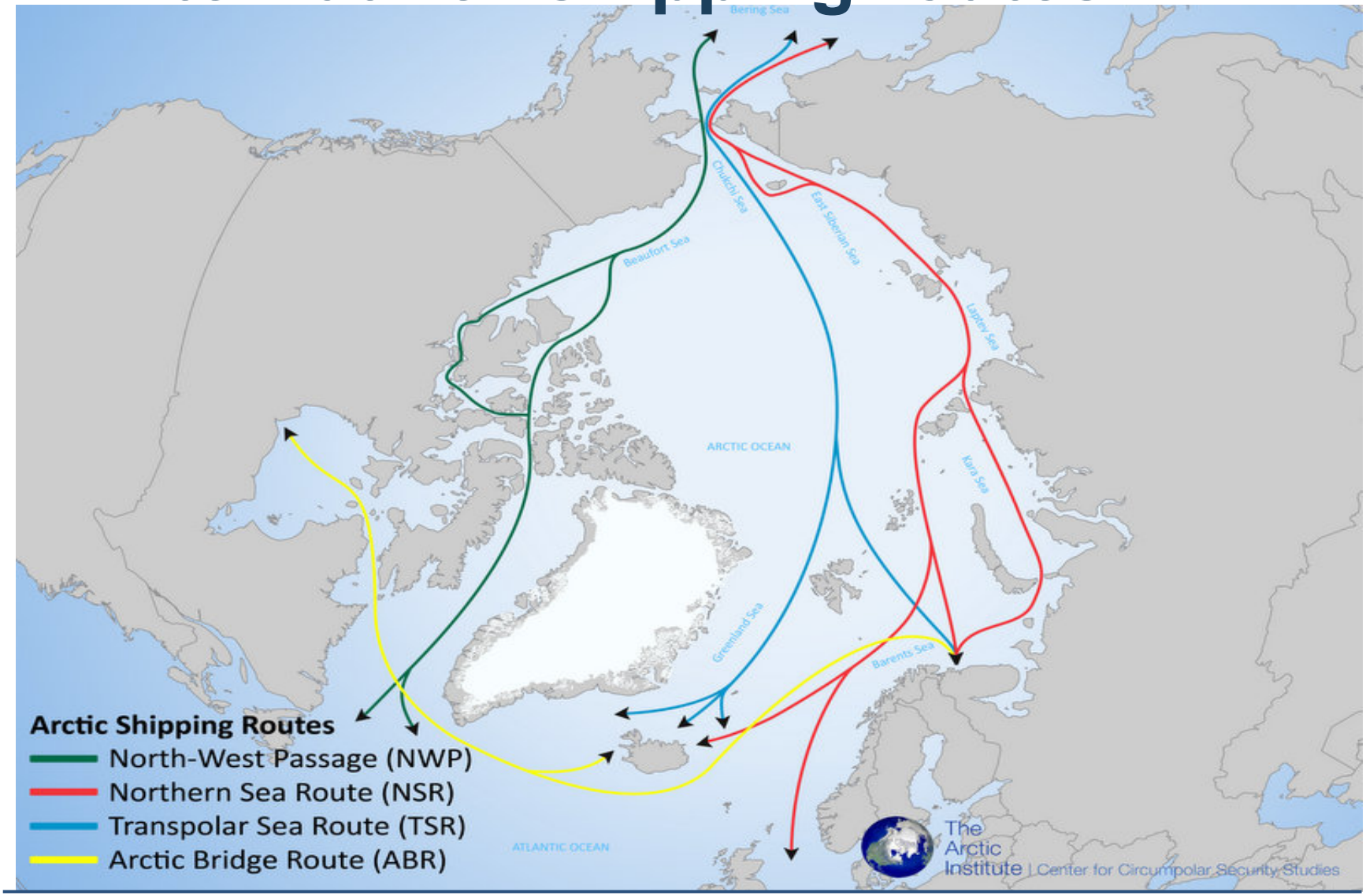
Latest developments in the Arctic

- The Arctic is a new and enticing field for profit!

- Shipping is increasing: More on Arctic Passages to follow, but keep in mind that the question of their economic viability remains unanswered…

- It is true that these passages represent a rather limited share of the global maritime traffic, but further traffic increase is predicted:
  - Need for pre-emptive regulation → The Polar Code

“Alternative" shipping routes…



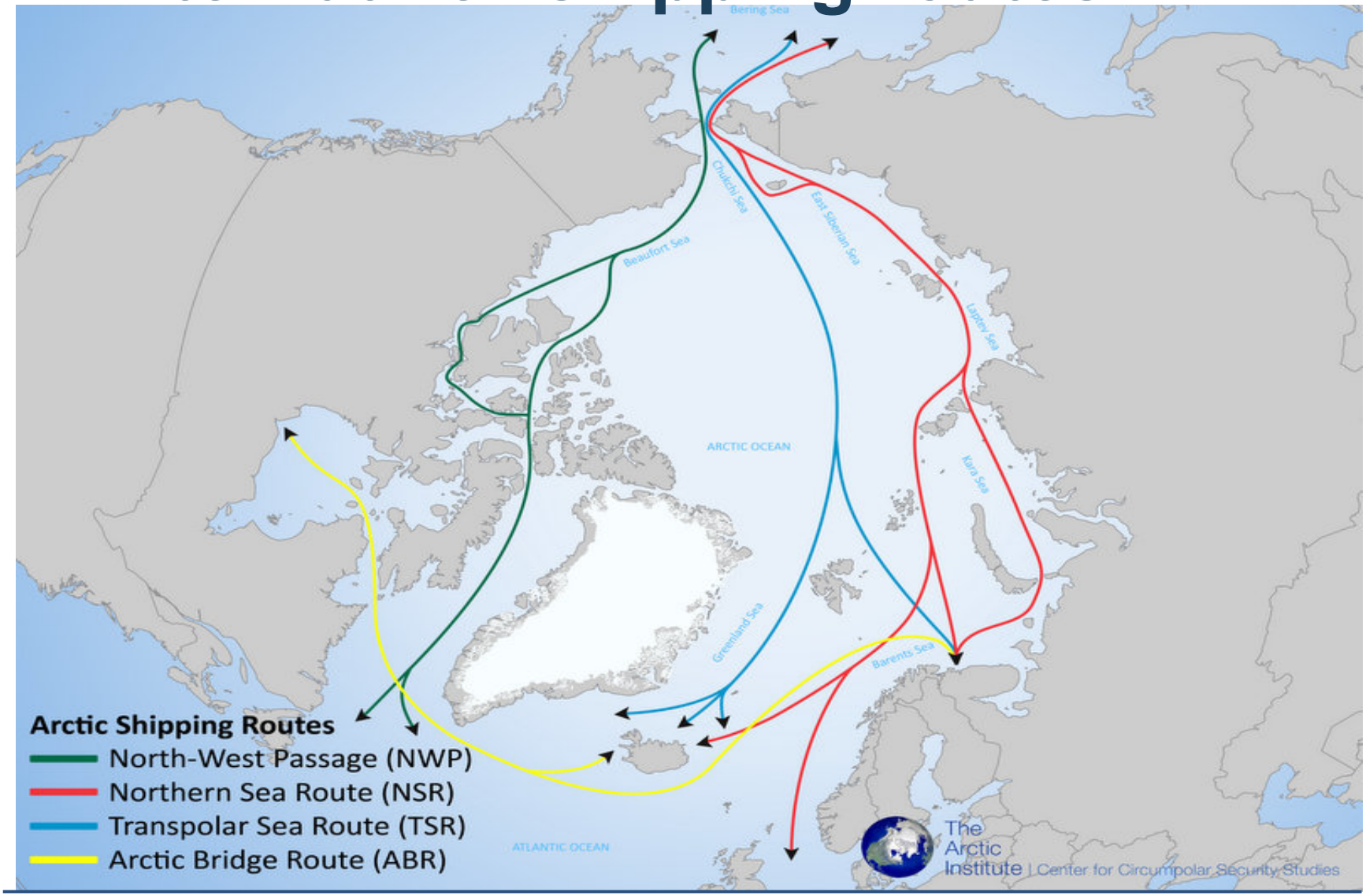
“Alternative" shipping routes…

- Up until recently: rather limited access/traffic in the Arctic Ocean;

- But, navigation season is predicted to increase! (70 → 125 days by 2050 → 160 days by 2100)

- Strongest interest towards two (2) passages:
  - North-West passage (NWP), complete transit 2007.
  - Northern Sea Route (NSR), complete transit 2009.
  - Both are intercontinental maritime alternatives.

“Alternative" shipping routes…



Why is there a need for ice-breakers?

The Polar Code

- In any case, the need for preemptive measures was timely realized by the International Maritime Organization (IMO);

- Establishment of the International Code for Ships Operating in Polar Waters (Polar Code-PCD):
  - safety (Part I-A)
  - pollution prevention (Part II-A)
  - recommended provisions for both (Parts I-B & II-B respectively)

WHAT DOES THE POLAR CODE MEAN FOR SHIP SAFETY?

EQUIPMENT

WINDOWS ON BRIDGE
Means to clear melted ice, freezing rain, snow, mist, spray and condensation

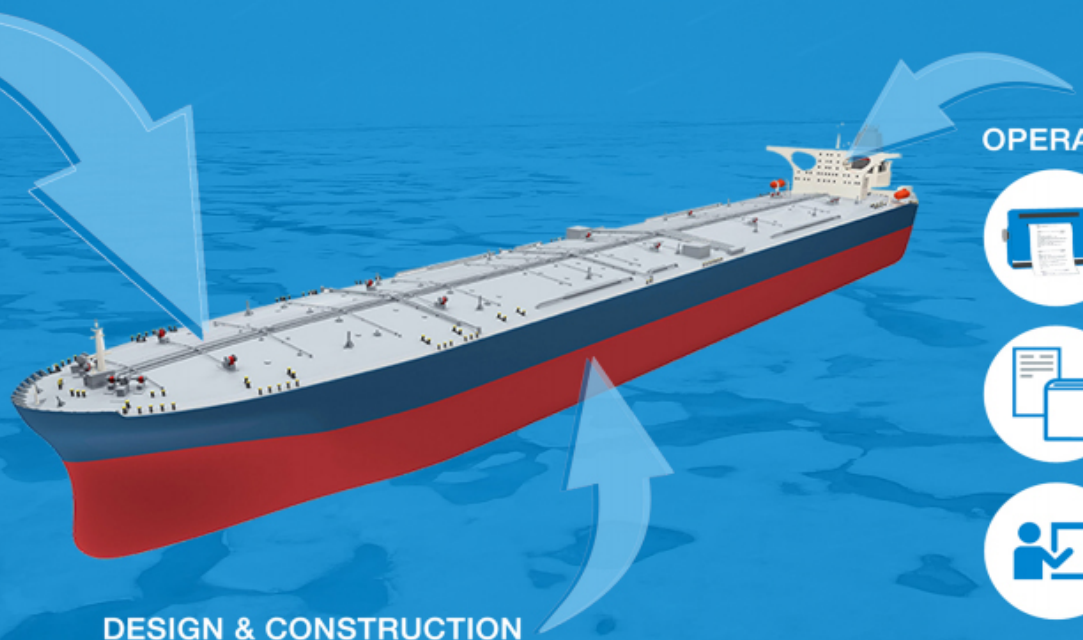
LIFEBOATS
All lifeboats to be partially or totally enclosed type

CLOTHING I
Adequate thermal protection for all persons on board

CLOTHING II
On passenger ships, an immersion suit or a thermal protective aid for each person on board

ICE REMOVAL
Special equipment for ice removal: such as electrical and pneumatic devices, special tools such as axes or wooden clubs

FIRE SAFETY
Extinguishing equipment operable in cold temperatures; protect from ice; suitable for persons wearing bulky and cumbersome cold weather gear



DESIGN & CONSTRUCTION

SHIP CATEGORIES
Three categories of ship which may operate in Polar Waters, based on:
A) medium first-year ice
B) thin first-year ice
C) open waters/ice conditions less severe than A and B

INTACT STABILITY
Sufficient stability in intact condition when subject to ice accretion and the stability calculations must take into account the icing allowance

MATERIALS
Ships intended to operate in low air temperature must be constructed with materials suitable for operation at the ships polar service temperature

STRUCTURE
In ice strengthened ships, the structure of the ship must be able to resist both global and local structural loads

OPERATIONS & MANNING

NAVIGATION
Receive information about ice conditions

CERTIFICATE & MANUAL
Required to have on board a Polar Ship Certificate and the ship's Polar Water Operational Manual

TRAINING
Masters, chief mates and officers in charge of a navigational watch must have completed appropriate basic training (for open-water operations), and advanced training for other waters, including ice

BACKGROUND INFO

- THE INTERNATIONAL CODE FOR SHIPS OPERATING IN POLAR WATERS WAS ADOPTED NOVEMBER 2014 BY THE IMO MARITIME SAFETY COMMITTEE
- IT APPLIES TO SHIPS OPERATING IN ARCTIC AND ANTARCTIC WATERS
- THE AIM IS TO PROVIDE FOR SAFE SHIP OPERATION AND THE PROTECTION OF THE POLAR ENVIRONMENT BY ADDRESSING RISKS PRESENT IN POLAR WATERS AND NOT ADEQUATELY MITIGATED BY OTHER INSTRUMENTS

IMO INTERNATIONAL MARITIME ORGANIZATION

WMU WORLD MARITIME UNIVERSITY

The Polar Code

- Into force: 1.1.2017;

- All ships intending to operate in polar region will apply for a Polar Ship Certificate:
  - Category A ship (medium first-year ice, which may include old ice inclusions
  - Category B ship (not included in category A, thin first-year ice, which may include old ice inclusions)
  - Category C ship (open water or less severe ice conditions than A & B)

The Polar Code

- Assessment is required in order to be awarded withy the necessary certificate

- Apart from the Polar Code, amendments are also made in:
  - International Convention for the Safety of Life at Sea (SOLAS)
  - International Convention for the Prevention of Pollution from Ships (MARPOL)
  - Standards of Training, Certification and Watch-keeping (STCW)

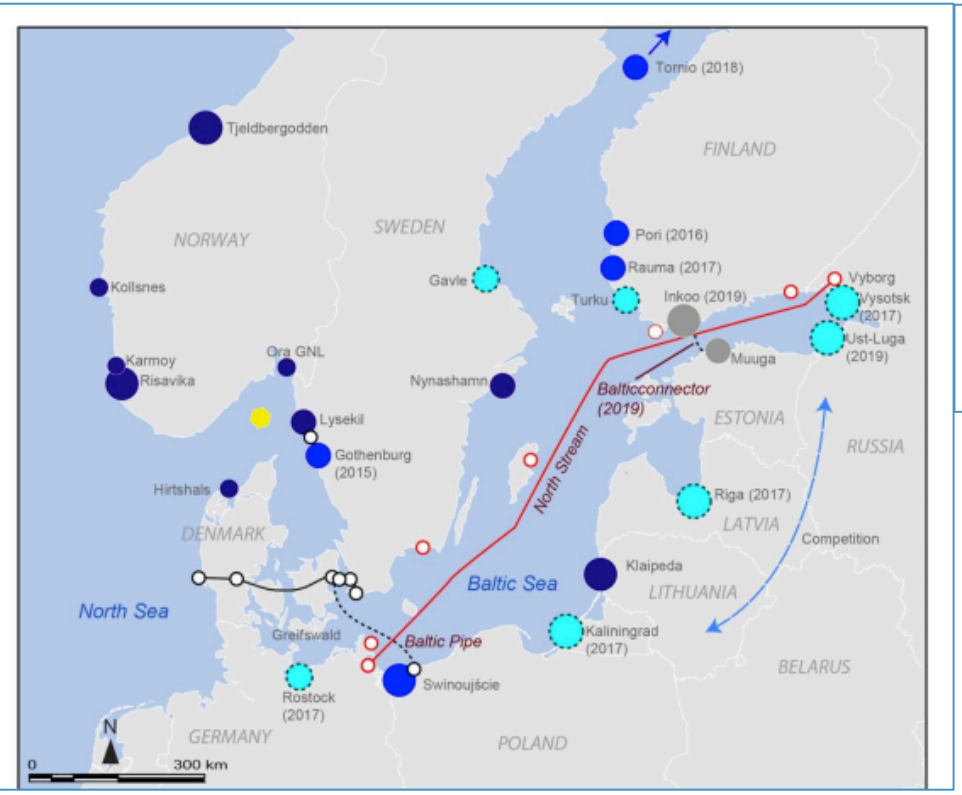
Why opting for LNG in the Arctic?

- LNG as a maritime fuel continues to grow globally as the primary or (in many cases a) dual-fuel for vessels.

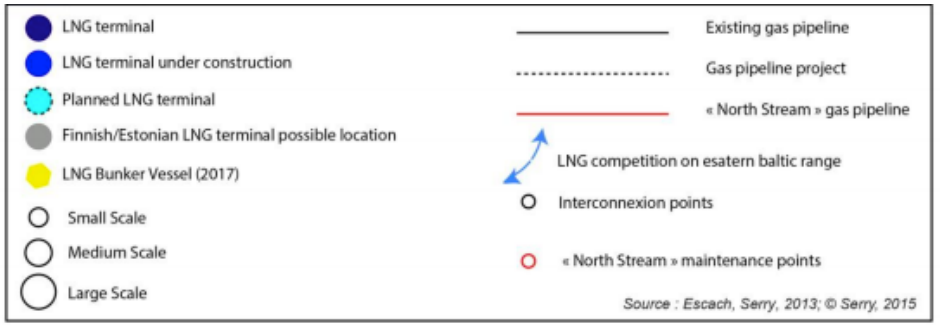
- This includes both new build and converted vessels and barges.

- Related IMO advisories and regulations are already influencing mariners everyday life.

LNG facilities development in the Baltic ports



- Currently (as of January 2015) thecoverage of LNG infrastructure is rather poor, but by 2020 a wide availability of LNG in theBSR can be expected.
- A growing number of medium- and small-scale LNG facilities is drivenby LNG end-use markets with rapidly growing potential and supportive of LNG uptake formaritime use (Jankowski et al., 2014).
- Three large-scale import terminals (Ust Luga in Russia, Swinoujscie in Poland and Inkoo in Finland) announced readiness to build a separate bunkering facility.



Source: Daria Gritsenko, Arnaud Serry, LNG Facility Development in Baltic Seaports

LNG facilities development in the Baltic ports

Existing and planned terminal projects in the Baltic Sea Region

Terminal	Type[2]	Capacity	Operator	Status	Comment
Fredriksstad/Øra, Norway	Closed	6 400	Skangas	In operation	Local gas grid and redistribution by truck
Nynäshamn, Sweden	Closed	20 000	AGA	In operation	Redistribution by truck and pipeline
Lysekil/ Brofjorden, Sweden	Closed	30 000	Skangas	In operation	Local gas delivery to refinery and redistribution by truck. Maritime redistribution by bunker barge. In operation since 2014.
Świnoujście, Poland	Open	320 000	Polskie LNG	Under construction	European gas grid and redistribution by truck. Maritime and rail based redistribution and bunkering is under discussion. Planned operational start was December 2014 but has been delayed.
Klaipeda, Lithuania	TBD	170 000	Klaipeda's Nafta	In operation	FSRU unit designed to connect to the local gas grid. In operational since December 2014.
Regional terminal, Gulf of Finland	TBD	180 000	Gasum	Under discussion	Regional terminal for the Baltic energy market area located in either Finland (Inkoo) or Estonia (Paldiski). Planned operation by 2021.
Tallin Muuga, Estonia	Open	180 000	Vopak /Elering	Under discussion	Local gas hub in the first phase, regional open access hub in the second phase. Planned operation by 2018.
Pori, Finland	TBD	30 000	Skangas	Under production	Regional terminal dedicated to the Finnish gas market with planned truck distribution. Planned operation in 2016.
Turku, Pansio Port, Finland	TBD	30 000	Gasum/ Skangas	Under discussion	Terminal with pipeline distribution in the Turku area, truck loading facilities and loading/unloading via existing jetty. Planned to be in operation by 2017.
Tornio, Finland	Closed	50 000	ManGa LNG	Under production	Terminal mainly for industrial use. Unloading to trucks and vessels is under discussion. Planned operation by 2018.
Gävle, Sweden	TBD	30 000	Skangas	Under discussion	Terminal with loading and unloading of LNG to vessels as well as to LNG trucks is discussed. For the future, train unloading is discussed. Planned operation by 2017.
Gävle Norrsundet, Sweden	TBD	15 000	Swedegas	Under discussion	Terminal in Gävle, potentially with a connected gas pipeline infrastructure. Planned operation by 2018.
Sundsvall, Sweden	TBD	5 000	TBD	Under discussion	Terminal dedicated to industrial purposes and transportation. Planned loading to trucks and rail distribution. Planned operation by 2020.
Gothenburg, Sweden	Open	30 000	Swedegas	Under discussion	Redistribution by truck and through a connection to Swe/Dan gas grid as well as bunkering. Planned construction starting 2016.
Malmö/Copenhagen, Sweden/ Denmark	TBD	10 000	TBD	Under discussion	Redistribution by truck and train and through the Swe/Dan gas grid as well as bunkering is under discussion.
Aarhus, Denmark	TBD	<10 000	TBD	Under discussion	Terminal for marine purposes. Possible loading of trucks.
Helsingborg, Sweden	TBD	<15 000	TBD	Under discussion	Redistribution by truck, train, maritime and through local gas grid as well as bunkering is under discussion.
Trelleborg, Sweden	TBD	<5 000	TBD	Under discussion	LNG supply for maritime purposes, possible loading of trucks
Hirtshals, Denmark	TBD	500	HMN Naturgas	In operation	Small LNG tank for bunkering of ferries, in operation since 2015.
Rauma, Finland	TBD	10 000	AGA	Under discussion	Bunkering of ships from trucks and land. Planned operation by 2017.
HaminaKotka, Finland	TBD	30 000	Hamninan Energia	Under discussion	Terminal with distribution to industries, shipping and trucks. Planned operation by 2018.
Fjusö/Ingå Helsinki, Finland	TBD	TBD	Gasum	Under discussion	Floating storage facility is planned for maritime use. Planned operation by 2021.
Riga, Latvia	TBD	180 000	Latvenergo	Under discussion	Large scale terminal. Planned operation by 2016.
Rostock, Germany	TBD	360 000	Gazprom	Under discussion	Planned operation not yet decided.
Vaasa, Finland	TBD	TBD	TBD	Under discussion	Terminal for industrial and maritime use. Planned operation not yet decided.
Vysotsk	Closed	1 500 000[3]	Gazprom-bank	Under discussion	LNG production plant

LNG and benefit

Safety benefits

LNG has been used as fuel for decades. Safe storage, safe transportation and safe usage are the mandated requirements for any fuel and LNG continues to demonstrate a long track record of safety in all these three areas.

Environmental Benefits In comparison to diesel, typical emissions savings associated with natural gas are:

- Well-to-Wheel greenhouse gas reduction of between 11% and 20%
- NOx emissions reduced by 80%
- Particulate emissions reduced by 75%

Economic benefits

As energy costs continue to grow, it is more and more necessary to find alternative fuels. Using LNG not only brings many environmental benefits, but also substantial economic savings. The technical innovation in the production of LNG has helped to position LNG as one of the least expensive transportable fuels.

Financial aspects

There are still some financial issues that need to be solved before any larger development of LNG terminals will take place:

- Pay-back time for investments, it is necessary to find financial schemes that are positive for investors
- Investment vs operational costs
- Finding investors/partners often crucial for ports
- Safety distances affecting other activities, makes the project costly
- Additional structures are expensive
- Permit process takes time and money, and as the experience and knowledge within this area grows, the permit process can be expected to be shorter and less costly

Recommendations

There are still some financial issues that need to be solved before any larger development of LNG terminals will take place:

1. Technical feasibility study: First, a thorough feasibility study regarding the market potential for LNG supply in a port and its hinterlands should be made to determine needed volumes and from that different set-ups for LNG storage and sourcing can be suggested.
2. Financial overview is suggested to establish the maturity of the project.
3. Identify the relevant laws and regulations that apply for the permit process, and in parallel to this a permit process should be initiated to accommodate for any needed alterations and ensure a smooth process.
4. Commence a dialogue with the relevant authorities at an early stage. This could be both on local and on national level.
5. During the design phase, involve stakeholders and possible financers of the terminal.

Thank you very much for your attention!