

LNG distribution around the Baltic Sea

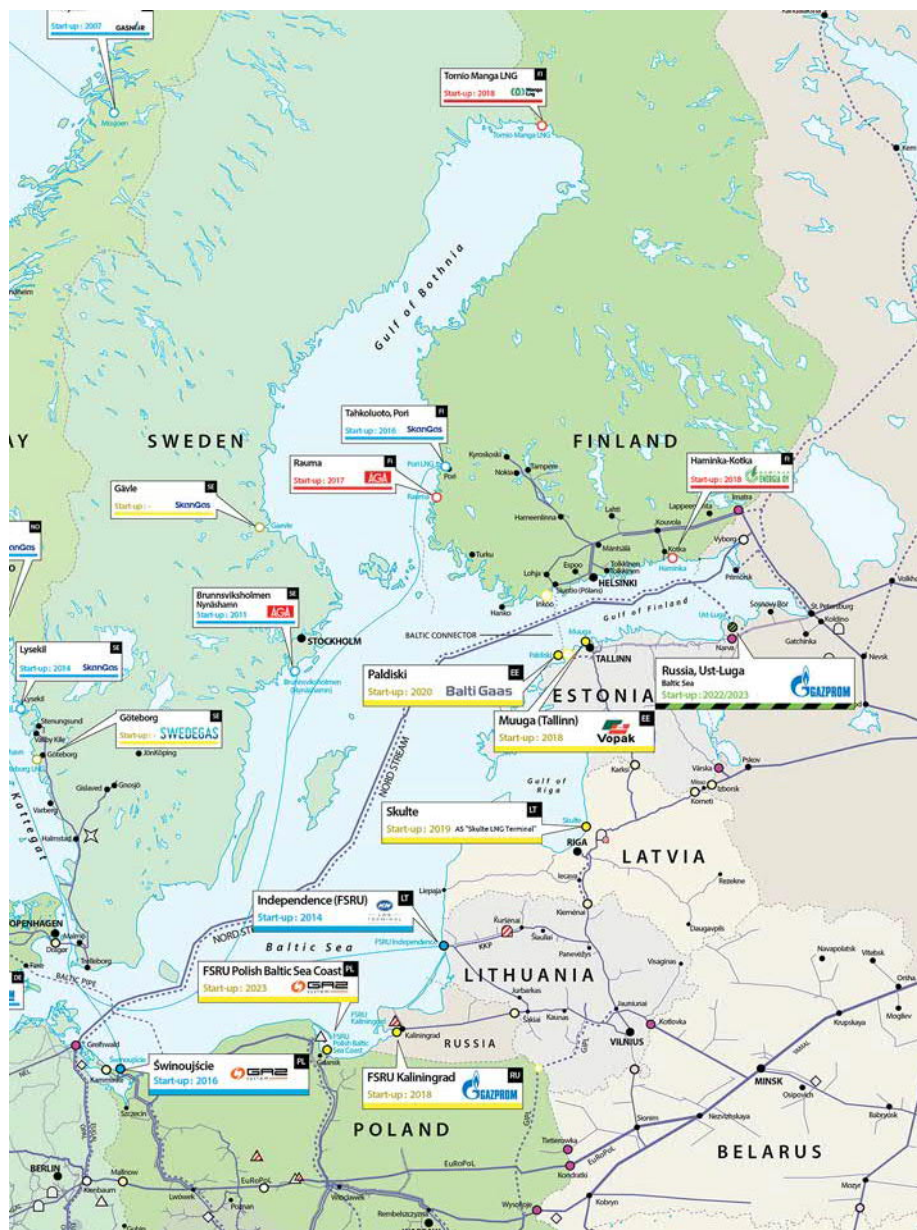
From 2005 onwards, the Baltic Sea has been subject to ever stricter environmental regulations as part of it being designated as an Emission Control Area (ECA). By using liquefied natural gas (LNG) as fuel in vessels the ECA regulations are fulfilled and even surpassed. One of the challenges is the availability of LNG, but the situation is rapidly improving.

Naval Architect Joakim Konsin has been following closely the situation with new LNG investments around the world and especially in the Baltic Sea area. “There are currently a huge number of activities taking place led by several parties,” Konsin says. “Shipowners are investing in new vessels which use LNG as fuel, natural gas is being delivered to new liquefaction plants, energy companies are investing in terminals and bunkering vessels to store and distribute LNG, and governments are supporting investments in clean technology and infrastructure necessary for the distribution.”

The availability of LNG has been a challenge that has been resolved in various ways. Some vessels have been fuelled at the quayside by LNG-trucks or from local small storage tanks while some vessels have bunkered elsewhere, e.g. in Rotterdam before sailing into the Baltic Sea. As we can see from the table on page 12, the situation will improve soon. Two terminals are already operating in Poland and Lithuania, another is almost ready in Kaliningrad and one more is planned in Poland for 2023. The bunkering vessel *Kairos* is additionally operating from the port of Klaipeda in Lithuania. Finland, Sweden, Estonia, Latvia and Russia all have new facilities planned.

Storage vessels instead of tanks

Some of the terminals are using or planning to use existing LNG carriers, which are to be converted into floating storage units (FSUs) or floating storage and regasification units (FSRUs). A regasification plant may be mounted onboard or on land for supplying gas to a pipeline. For example, the port of Klaipėda in Lithuania is using a bunkering vessel as an addition to their FSRU, *Independence*. The bunkering



Overview map of the Baltic Sea.
(Source: Gas Infrastructure Europe)

vessel *Kairos* can also deliver LNG fuel to vessels in other ports. At present it is the largest bunkering vessel in the world with a tank capacity of 7500 m³.

"A reasonable sized LNG storage capacity should be provided to serve the regasification plant. The easiest and most cost-efficient way is to use an existing LNG carrier and convert it into a floating storage unit," Konsin adds. "Such a storage vessel can act also as bunker storage for other ships that can be moored alongside for bunkering."

To convert an existing LNG carrier into a floating LNG storage unit is also recognized as an attractive alternative for LNG transportation. The vessel can, for example, be stationary moored in a harbour or it can be moored further offshore.

Aker Arctic has made studies for the winter marine operations required when applying converted LNG carriers for LNG transportation. "In the first phase of such projects, Aker Arctic typically evaluates the ice conditions and

LNG facilities in Baltic ports

	Start of operations	Type of facility	Storage capacity of tanks, m ³	Operator
Świnoujście, Poland	2016	Land-based tank	2 x 160 000	Polskie LNG S.A.
Klaipėda, Lithuania	2014	FSRU <i>Independence</i> in Klaipėda harbour	170000	Klaipėdos Nafta
Polish Baltic Sea Coast	2023	FSRU	Unknown	Polskie LNG S.A.
Kaliningrad, Russia	2019	Underground storage + FSRU <i>Marshal Vasilevskiy</i>	174000	Gazprom
Gävle, Sweden	Planned	Land-based tank	30000	Gasum
Nynäshamn, Sweden	2011	Land-based tank	20000	AGA
Oxelösund, Sweden	Planned for 2020	Land-based tank	500	The Port of Oxelösund
Paldiski, Estonia	2020	Land-based tank	160000	Alexela
Muuga, Estonia	Planned for 2018	Land-based tank	4000	Vopak
Skulte, Latvia	Planned for 2019	FRU + connection to the Inčukalns underground gas storage	No storage in port	No investor yet
Baltic LNG, Ust-Luga, Russia	2023	Large export terminal	Unknown	Gazprom
Portovaya	Planned for 2019	FSU	138000	Gazprom
Vysotsk LNG, Russia	Planned for 2018	Land-based tank	42000	CryoGAS-Vysotsk
Tornio, Finland	2019	Land-based tank	50000	Manga LNG
Pori, Finland	2016	Land-based tank	30000	Gasum
Hamina, Finland	2020	Land-based tank	30000	Hamina Energia Oy and Alexela



The port of Klaipėda in Lithuania is using bunkering vessel Kairos as an addition to their FSRU, *Independence*.

anticipated shipping activities in the intended operation area around the LNG terminal,” says Project Manager Sami Saarinen. “The number of assisting tugs / icebreakers, their duties and their optimised ice performance requirements are then determined accordingly, so that the assisting operations at the terminal can be performed adequately and cost effectively throughout different winters.” Sometimes it may even be possible to suggest modifications for the terminal layouts and arrangements. This is an important benefit for the clients, because even small modifications to existing terminal designs may significantly ease and decrease operational costs of winter operations in the terminal.

Finally, some ice strengthening of the converted LNG carrier is typically required. Aker Arctic has made such analyses and “conversion plans” for the clients so that the converted LNG Carrier

has capacity to withstand external ice loadings during winter season.

Urgent need for a distribution system
Recent vessel acquisitions for the Baltic Sea have all looked towards the future and opted for LNG as fuel. They are waiting eagerly for the new distribution terminals to start operation.

Viking Grace, which was the first large LNG-fuelled passenger ship in the world has, since entry into service in 2013, received her gas fuel from an LNG bunkering vessel *Seagas* that is supplied by LNG trucks. The drawback with the present fuel gas supply chain is its complexity, as significant number of trucks are required to provide the fuel.

Polaris, the newest Finnish icebreaker, and the patrol vessel *Turva* have both been fuelled by LNG trucks, but are also now beginning to refuel in dedicated Finnish harbours.

Tallink's *Megastar* is currently fuelled by LNG trucks but Eesti Gas Tallink has opted to invest in their own LNG bunkering vessel that will be operating in Tallinn and start operation in 2020. The bunkering vessel will also serve their new LNG-fuelled ro-pax ferry entering into service in 2021.

Containerships plc has invested in four smaller LNG-fuelled container vessels due to commence operations later this year. They will initially receive LNG fuel in Rotterdam as the LNG infrastructure in the Baltic Sea still is limited.

ESL Shipping has invested in two large bulk carriers (M/S *Haaga*, M/S *Viikki*) which are already sailing in the Baltic Sea. They are the most environmentally friendly bulk carriers in the world and refuel from the bunkering vessel *Kairos*.

Sovcomflot has ordered eight LNG-fuelled Aframax tankers as well as three smaller LNG-fuelled vessels for Baltic Sea traffic. Additionally, there are two passenger ferries on order intended for traffic between Gotland and mainland Sweden.

“There are over 8,000 unique vessels sailing in the Baltic Sea annually and so far, only a small portion using LNG as fuel today,” Konsin adds. “However, if we look at the newbuilding order book, most of the new vessels will be using LNG.”

Jack Sharples of the Oxford Research Institute for Energy Studies recently published a research paper, about LNG supply chains and development of shipping fuel in Northern Europe. He estimates that the demand for LNG is likely to grow even more quickly given the increasing size of LNG-fuelled vessels. Further restrictions on global SOx emission from next year and limitations on NOx emissions in the ECA areas will add more vessels using LNG to the order book.

Designing LNG vessels

In recent years Aker Arctic has been deeply involved in various LNG-fuelled vessels for the Baltic as well as LNG transportation in the Arctic. An entire transportation system was developed for Yamal LNG, including support during the initial planning, studies for alternative hull forms and machinery concepts, fleet studies, ice management studies for the harbour, shipping infrastructure investigations in addition to involvement with the design of the port fleet and the

Arctic LNG carriers. Successful LNG-fuelled icebreaker *Polaris* and coast guard patrol vessel *Turva* are operating on the Baltic Sea. A number of powerful icebreakers using LNG as fuel are being designed. Recently the keel was laid of the LNG-powered, icebreaking, luxury cruise ship, *Le Commandant Charcot*, for Ponant

"Designing vessels for ice infested waters is not only about strengthening the vessel to withstand the ice loads. The total operation profile of the vessel has to

be evaluated to optimize the hull form between open water performance and ice performance," says Sales Manager Arto Uuskallio. "Aker Arctic takes a holistic approach to the design work, which also includes planning for possible risks in advance. Ice going vessels, icebreakers, assisting tugs for harbours and mooring, ice management studies and optimal harbour designs are all part of our services."



Photo: Meyer Turku Shipyard

Current LNG vessels
Polaris, Turva and Viking Grace.

Cooperation agreement between Aker Arctic and Eranti Engineering Oy

Aker Arctic and Eranti Engineering have signed a cooperation agreement for designing fixed arctic offshore and coastal structures together.

"Harbours which encounter ice need to be planned as a holistic entity including the layout, the geometry, the mooring places, the piers and evaluating the cargo vessel operation with possible assisting tugs. Ice management is an essential part of designing harbours," says Sales Manager Arto Uuskallio. "Through our cooperation with Eranti Engineering, we can offer more complete design packages to our customers."

"Backed by superior ice and arctic engineering know-how, the design solutions aim to provide significant cost savings for our clients," says Dr. Esa Eranti.



Arctic harbour design may include layout, planning of ship and icebreaker operations, brash ice control system and ice barrier design.

Meet Joakim Konsin



Joakim joined Aker Arctic two years ago and works with designing ice-going cargo ships, especially focusing on LNG vessels. He works closely with Mauri Lindholm, the Aker Arctic LNG expert, and divides his time between Turku and Helsinki offices. Before joining Aker Arctic, Joakim worked for 14 years in various companies in the shipbuilding industry, both in Finland and Switzerland. He graduated as a Naval Architect from Aalto University in Espoo and has recently moved back to his home town together with his three sons. Joakim enjoys sailing and playing basketball.