

LNG supply chain in the SBSR

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Abstract

The paper presents the LNG-related supply chain in the South Baltic Sea Region which was specified as a result of the MarTech LNG Project. First part of the paper presents specification of technologies and technical solutions. Then it turns to the LNG-related stakeholders, i.e. all actors involved into LNG supply, delivery as well as end-user technologies. Aspects of LNG-related infrastructure accomplish the presentation of the SBSR supply chains. The paper is concluded by structural delineation of the supply chains in the SBSR.

Introduction

The MarTech LNG Project aims at transferring tested and proven LNG knowledge and technology to implement into the South Baltic countries. LNG building and operation knowledge will allow the local maritime industries to benefit from the investments and support the development of new products and services that are demanded in the global market thus strengthening the Baltic maritime Sector. Furthermore, the creation of a Baltic supply chain will establish cooperation between regional maritime industries and scientific institutions locally, nationally and internationally, and support the creation of cluster development, able to respond to international tenders in the future. Presented paper describes the LNG-related supply chain in the South Baltic Sea Region which was specified as a one of the results of the MarTech LNG Project.

Technological capabilities

Technological capabilities of the SBSR are presented by the overview of the key current LNG-related devices and inventions:

- Biggest LNG ferries (129.9 m long, 19.2 m wide with capacity for 242 passenger cars and 600 passengers, gas-electric system with 3 large LNG gas motors and alternators, thus enabling a speed of approx. 20 knots) [1];
- Terminal LNG cargo tanks made by using a slip-form construction method [2];
- Methods of regasification (evaporators heated by fuel itself – Submersible Combustion Vaporizer (SCV) and Evaporators heated by air or sea – Open Rack Vaporizer (ORV)) [3];
- Pilot navigation and docking system for LNG carriers to increase of safety of berthing ships by the construction and implementation of innovative information and telecommunication system [4];
- LNG-powered ships, i.e. cruise ferries with engine compartments enable to run them on LNG [5];
- WS1 LNG / FO Bunker vessel with a 1400 DWT, equipped with flexible cargo configuration (3 configurations possible) combining traditional HFO and MDO fuels with LNG and possessing a capacity for LNG between 700–1400 m³ [6];
- LNG Hybrid Barge as electricity supplier to the AIDA cruise ships with year-round utilization of the system by feeding the produced energy in the cruise-off season into the municipal grid, thus supplying electricity and heat to approx. 11,000 households [7];
- LNG Hybrid Ferries Watten Link for use in the North Sea equipped with 3 proven LNG Gen sets, 2 electrical drive motors and 1 hybrid

- battery pack with LNG (only one fuel on board) supply for ferry service up to 4 days [8];
- LNG fuel tank containers [9];
- New generation passenger and car ferry powered by LNG – Viking Grace [10];
- Cruise ferries run by LNG [11];
- Focus on investments into smaller ships with reduced emissions as a result.

LNG-related stakeholders and players

Potential stakeholders and players located in the SBSR, can be found among companies, associations, authorities, consultants, classification societies, ports, producers, distributors, ship-owners, storage and bunkering companies, system operators, end-user technologies, as well as further organisations and institutions. On the basis of the data gathered following stakeholders and players portfolio for the SBSR was generated (Fig. 1). It is noteworthy that only key stakeholders and players are listed here. Stakeholders and players presented in the portfolio refer to the following main categories:

- bunkering;
- shipbuilding & repair;
- ports;
- shipping;
- end-user technologies.

Beyond this, for the purpose of this study, it has been decided to incorporate such stakeholders and players groups as regulators (including authorities, classification societies and other relevant organisations and associations), storage stakeholders, distributing stakeholders and consultants.

Taking into account this breakdown of all relevant stakeholders across the SBSR, it is first important to accentuate stakeholders that are already equipped with LNG technological solutions, products and services, or do record LNG-related young or mature existing activities that have been mapped in the maritime industry discourses. In this respect, the table below presents key stakeholders that due

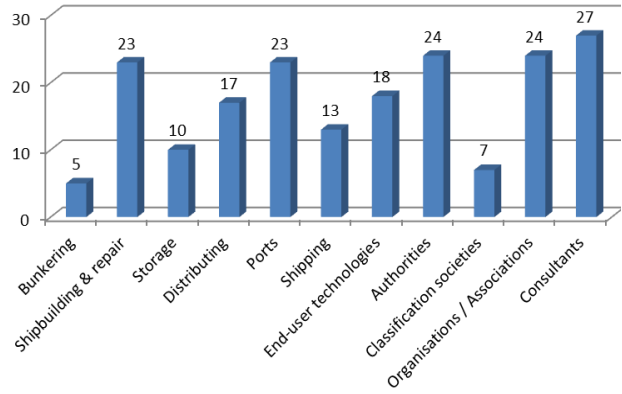


Fig. 1. Profile of stakeholders in the SBSR

to their activities can be referred to as LNG stakeholders (Table 1).

One of the largest group of stakeholders behind the regulation and framework conditions providing stakeholders such as authorities, classification societies can be located in the shipbuilding-related industry. In this context, naval architects should be also allocated to this group of stakeholders, since they are involved into design, construction and repair of marine onshore and offshore infrastructure and related structures. The following shipbuilding and repair industry-related stakeholders are present in the SBSR (Table 2).

When taking into account shipping companies and related stakeholders, in some cases it is hard to allocate them distinctly to the shipping stakeholders category. In fact, these can be in some cases placed either in shipbuilding & repair or shipping-related group. Nevertheless, this study made an attempt to identify key shipping stakeholders in the SBSR (Table 3).

Turning towards stakeholders capable to distribute or storage gas, especially with the focus on LNG, there are located over 20 companies able to provide demanded services currently and in the future. As a result of the data, the following constellation of the distributing and storage companies has been generated (Table 4).

Table 1. LNG stakeholders

Company	Activity
Fjord Line AS	Cruise ferries powered by LNG (DK)
Man Diesel & Turbo	LNG fuelled two-stroke engines (DK)
Rolls Royce Marine AS	LNG carriers (DK)
Wärtsilä	LNG systems (DK)
Viking Line	LNG ferry Viking Grace (SE)
White Smoke Shipping	LNG Bunkering solutions & STS Bunkering (SE)
Cryo AB	LNG bunker tanks and systems (SE)
Nordic Yards GmbH	LNG tank systems for arctic use (DE)
Marine Sevice GmbH	LNG fuel tank container (DE)
KAEFER	Marine & Offshore Cryogenic insulation solutions for LNG tank and cargo systems (DE)

Table 2. Shipbuilding and repair industry-related stakeholders

Company	Company
Søby Yard (DK)	Muehlhan Rostock GmbH (DE)
Marstal Yard (DK)	R & M Ship Technologies GmbH (DE)
Fayard Yard (DK)	KAEFER Marine & Offshore (DE)
Man Diesel & Turbo (DK)	Neptun Ship Design GmbH Rostock (DE)
RollsRoyce Marine AS (DK)	IMAVIS Maritime Wirtschafts- und Schiffbauforschung GmbH (DE)
Wartsila (DK)	BaltiCo GmbH bei Rostock (DE)
ABB (DK)	Marine- und Automatisierungstechnik GmbH Rostock-Warnemünde (DE)
OSK Ship-Tech (DK)	SDC SHIP Design & Consult GmbH (DE)
Schottel GmbH Wismar (DE)	SC "Western Shipyard" (LT)
Nordic Yards GmbH (DE)	Gdansk Shiprepair Yard Remontowa (PL)
Becker Marine Systems Hamburg (DE)	White Smoke Shipping (SE)
Frauenhofer Anwendungszentrum Rostock (DE)	Cryo AB (SE)
Ingenieurtechnik und Maschinenbau GmbH (DE)	

Table 3. Shipping stakeholders

Company	Company
Lauritzen Kosan (DK)	Rederiet færgen (DK)
Mærsk LNG (DK)	Nordic Yards GmbH (DE)
Evergas (DK)	SDC SHIP Design & Consult GmbH (DE)
Clipper Group (DK)	DFDS Seaways (LT)
Fjord Line Denmark AS (DK)	Swedish Marine Forum (SE)
Mærsk Line Ltd (DK)	Stena (SE)
Mols linien AS (DK)	

Table 4. Distributing and storage stakeholders

Company	Company
Dong gas Distribution / Dong Storage (DK)	PL Energia (PL)
EnergiDK (DK)	Polskie LNG (PL)
Energinet DK Gaslager (DK)	PGNiG (PL)
Aalborg gasforsyning (DK)	Swedish Gas Association (SE)
Naturgas fyn (DK)	Stockholm liquefied methane gas station (SE)
HNM Naturgas (DK)	Enagas SA (SE)
EON (DE)	EON (SE)
Klaipėdos Nafta (LT)	Marine Service GmbH Hamburg (DE)
Gaz-System (PL)	JSC Klaipėdos Nafta (LT)
Budnaft (PL)	AGA AB in Nynäshamn port (SE)
Petrolinvest (PL)	Royal Vopak in Gothenburg port (SE)

Dovetailed with the storage companies are bunkering companies that are of paramount importance when dealing with LNG-related issues. However, bearing in mind the bunkering solutions landscape in the SBSR it appears to be scarce with a record of only 5 bunkering service providing companies:

- Dan-Bunkering Ltd (DK);
- OW Bunker & Trading (DK);

- White Smoke (SE);
- Swedish Marine Technology Forum (SE);
- SSPA Sweden AB and ÅF AB (SE).

Distributing, storage, shipbuilding & repair, as well as shipping stakeholders are significant only in a case, where there exists respective LNG-related sufficient "room" to operate for the identified stakeholders. Here, this particular room or space to operate has to be understood as infrastructure. Coming back to the LNG-related discourse, usually the infrastructure is located in ports, and often, in the immediate proximity. Taking the SBSR into account against this background, the SBSR possess a series of ports that are relevant for LNG-activities. At the second glance, however, 23 identified ports along the SBSR manifest different degree of relevance for the LNG-activities and infrastructure. In order to provide a clear insight into the significance of the identified ports, it was decided to build the following discussion concerning the ports upon a proposed classification of these particular ports. After having studied the information on the ports, there was made an observation that SBSR can be divided into some groups in terms of their current participation into LNG activities. The proposed classification is as follows: ports currently involved into LNG activities (1), future participation into LNG activities (2), high level of maturity / potential for LNG activities (3) and having potential, but necessary to undergo further development (4).

By bearing on the potential stakeholders identified so far, the potential for the LNG development in the SBSR appears of solid nature. However, solid supply chain is ground not only on the private sector stakeholders, but involves actors from the public sphere that may be crucial in changing, for instance, the perception of the development of LNG

Table 5. Ports involved and potentially involved in LNG activities

Ports currently involved into LNG activities	Nynäshamn Port (SE)	
Ports involved into LNG activities in the near future	Gothenburg Port (SE)	
	Port of Klaipeda (LT)	
	Port of Świnoujście (PL)	
Mature Ports and/or ports of high potential for LNG activities Location in the SBSR	Hirtshals Port (DK)	Port of Wilhelmshafen (DE)
	Port of Hamburg (DE)	Port of Brunsbüttel (DE)
	Rostock Port (DE)	Port of Lübeck (DE)
Ports having potential for LNG activities but requiring certain modifications	Esbjerg Port (DK)	Helsingor Port (DK)
	Rønne Harbour (DK)	Spodsbjerg Port (DK)
	Aarus Harbour (DK)	Tårs Port (DK)
	Port of Copenhagen and Malmö (DK)	Port of Gdynia (PL)
	Port of Sjællands Odde (DK)	Port of Gdańsk (PL)
	Rødby Færgehavn (DK)	Port of Szczecin (PL)
	Gedser Port (DK)	

in the SBSR. Hence, stakeholders that take significant decisions are involved into relevant ruling procedures, or outlines, e.g. regulations pertaining to maritime industry etc., such as standards etc., provide normative grounds that in the particular context of LNG development shows up as significant. This study reveals that there are a number of such “regulators” involved into respective processes. As key authorities can be listed (Table 6).

Table 6. Authorities related to LNG

Denmark	Lithuania
Danish Maritime Authority	Lithuanian Ministry of Energy
Danish Ministry of Business and Growth	Lithuanian Ministry of Transport and Communications
Danish Ministry of Transport	Lithuanian Ministry of Finance
Danish Ministry of Climate, Environment and Building	Lithuanian Ministry of Environment
Germany	Lithuanian Ministry of Foreign Affairs
BSH – Federal Maritime and Hydrographic Agency	SE Klaipeda State Seaport Authority
Federal State of Mecklenburg-Vorpommern	Sweden
German Ministry of Transport (federal and/or regional)	Swedish Ministry of Defence
German Ministry of Environment (federal and/or regional)	Swedish Ministry of Transport
German Ministry of Regional Planning (federal and/or regional)	Swedish Ministry of Enterprise regional)
Poland	Swedish Ministry of Energy and Communications
Maritime Office Szczecin	Swedish Ministry of Environment
Maritime Office Gdynia	Swedish Maritime Administration
Maritime Office Słupsk	Swedish Ministry of Defence

Key identified authorities (alongside a large number of regional municipalities and regional

authorities) are accompanied by the relevant organisations and/or associations, which may have an important impact when developing LNG in the SBSR (Table 7).

Table 7. Organisations and associations related to LNG

Danish Ship-owners Association	Lithuanian Ship-owners Association
Danish Maritime	Association of Polish Maritime Industries
Danish Gas Association	Polish Ship-owners Association
Danske Havne	Swedish Maritime Administration
Society for Naval Architecture and Marine Engineering	Swedish Ship-owners Association
DTL	Swedish Gas Association
German Association for Positioning and Navigation (DGON) e.V.	Swedish Transport Agency
German Ship-owners Association	Gothenburg Transport Agency
Association of Lithuanian Stevedoring Companies	

The last group of “regulators” refer to classification societies. When overviewing these ones in the SBSR, the distribution of them tends to be equal. However, most of them refer to the same organisations, but have a status of branch or are established in the particular region. There can be listed following classification societies in the SBSR:

- Bureau Veritas (DK), (DE), (LT);
- DNV (DK), (DE), (LT), (PL), (SE);
- Germanischer Lloyd (DK), (DE);
- Lloyds Register (DK), (PL);
- Polish Register of Ships (PL);
- SIS (SE);
- CIMET (SE).

Beside the regulation institutions providing with the norms and normative information, there can be

Table 8. Consulting companies, organisations and associations

Danish Gas Technology Centre (DK)	Sweco Lietuva (LT)
Rambøll Oil & Gas (DK)	DNV Poland (PL)
Grontmij (DK)	Polish Register of Ships (PL)
Force Technology (DK)	AGA AB (SE)
IMAVIS – Maritime Wirtschafts- und Schiffbauforschung GmbH (DE)	CRYO AB (SE)
Marinesoft – Entwicklungs- und Logistikgesellschaft mbH (DE)	Skangass AS (SE)
ATI erc GmbH (DE)	White Smoke Consulting (SE)
ATI Küste GmbH (DE)	Frederiet AB (SE)
FGW – Forschungs-GmbH Wismar (DE)	FKAB Marine Design (SE)
DNV Lithuania (LT)	Samson (SE)
Klaipeda Science and Technology Park (LT)	Mann-Teknik AB (SE)
Novikontas SCM, UAB (LT)	CIMET (SE)
Association “Baltic Valley” (LT)	DNV (SE)
NPPE Klaipeda Shipping Research Centre (LT)	

consulting companies, organisations or associations that may assist in LNG-related issues. To the key consultants in the SBSR can be ascribed (Table 8).

To finalise the stakeholder profile, it is inevitable to look at the end-users that will be approached in terms of LNG products, services etc. and thus are regarded of paramount importance for demanding and absorbing the knowledge and competence accumulated in the SBSR. Relevant for identification of end-users are, first, end-user technologies stakeholders that are already available in the SBSR. As end-user related technologies are understood technologies that refer to ship-owners and ship operators, land infrastructure (e.g. trucks, cars), industry power generation and gas grid (Table 9).

Table 10. Matrix of LNG supply chain in the SBSR

Segment of the Supply chain	Short specification of the capabilities	Distribution of capabilities along the SBSR	Evaluation criteria	
			Existing	++
Shipping	LNG feeder vessels			
	LNG bunker vessels	SE		++
	Ship-to-ship bunkering (STS)	SE		++
LNG Terminals	LNG Import terminal	SE / LT & PL		++ / +
LNG onshore infrastructure	Small-scale export / bunker facilities	DE, DK, LT, PL		0
	LNG bunker stations	DE, DK		0
	LNG filling stations	DE		0
	LNG fuel tank containers	DE		++
	LNG trucks	SE		++
End-users	Tank & bunkering solutions	SE, DK		++
	Shipping	SE, DK		++ / +

Table 9. End users of LNG

Østkraft produktion A/S (DK)	Marine Service GmbH Hamburg (DE)
Dong Energy A/S (DK)	Energobaltic (PL)
Clipper Group (DK)	AGA AB (SE)
FjordLine A/S (DK)	ETG (SE)
Lauritzen Kosan A/S (DK)	Volvo AB (SE)
Maersk Line Ltd (DK)	Wayne (SE)
Maersk LNG (DK)	Alfa Laval (SE)
Mols linien AS (DK)	AGA Gas AB (SE)
Reederiet færgen (DK)	AGA / Volvo Trucks (SE)

Bearing in mind the overview of the main stakeholders and players within the SBSR, it is, however, apparent that some of the identified actors across the SBSR can be ascribed to more than one type of the stakeholders and players, since some of them are simultaneously involved into more activities. Therefore, overlappings cannot be excluded. Nevertheless, when making a comparison of the key stakeholders pinpointed, it is evident that the highest proportion of the stakeholders and players consists of companies, where most of them are involved into maritime-related activities, i.e. shipping, ship repair and construction, as well as gas and oil supply. What appears to be at stake at the moment is the involvement of the authorities and public institutions into LNG activities and infrastructure. Hence, the promotion of LNG and awareness of LNG advantages might be limited to the business sector, thus gaining little consent in the public sphere and political support. Furthermore, when it comes to the assessment of the stakeholders and players, it can be argued that also the SBSR in general has available stakeholders and players relevant for the LNG supply chain, the bottlenecks tend to lie in LNG itself as a primary resource and its

supply or export. On the contrary, when it comes to those components of the LNG supply chain that refer to LNG shipping, potential locations for LNG importing (terminals), regasification, its storage, distribution and marketing, the region seems to reveal a sound potential for the utilisation of LNG in the future. From the data gathered it is apparent that there are actors capable of taking over the particular LNG activities within the LNG supply chain, for instance, ports, manufacturers, shipyards, consultants etc.

Conclusions

To anchor the capabilities presented in the region concerned, the following matrix was delineated. On the one hand, this matrix embraces the information reflecting what parts of the supply chain and to what extent entail developed knowledge and competence portfolio, which, in turn, is capable to support businesses to with the LNG-related knowledge and technologies. On the other hand, the matrix unveils the capabilities of the SBSR supply chain more specific how LNG-related infrastructure has been handled at present and will be dealt with in the next future.

References

1. MF Boknafjord – the world's largest gas ferry, 2012, http://www.dnv.com/industry/maritime/publicationsanddownloads/publications/updates/ferry/2012/01_2012/mf_boknafjord_theworldslargest_gas_ferry.asp, accessed on 20 March 2012.
2. Polskie LNG: Works on Second Swinoujście LNG Tank Progressing Well, 2011, <http://www.lngworldnews.com/polskie-lng-works-on-second-swinoujscie-lng-tank-progressing-well/>, accessed on 9 July 2012.
3. Polskie LNG – LNG Re-gasification Methods, <http://en.polskielng.pl/lng/re-gasification-methods/>, accessed on 9 July 2012.
4. GUCMA L., GUCMA M., BAK A.: Pilot Docking System – New Tool for Safe Maritime Operation. 2012, 1–11.
5. Poland at Sea – Review of Polish Maritime Industry, 2012, http://www.portalmorski.pl/resources/poland-atsea/poland_at_sea_2012.pdf, accessed on 9 July 2012.
6. <http://whitesmoke.se/files/WS1%20web.pdf>, accessed on 19 November 2012.
7. LNG Hybrid Barge, http://www.lng-hybrid.com/2_projects/barge_intro.html, accessed on 19 November 2012.
8. LNG Hybrid Ferry WattenLink, http://www.lng-hybrid.com/2_projects/fering_data.html, accessed on 19 November 2012.
9. LNG fuel tank containers, 2013, <http://www.marine-service-gmbh.de/content.php?seitenid=5>, accessed 12 January 2013.
10. Viking Grace, 2013, <http://www.vikingline.com/en/Investors-and-the-Group/Safety-environment/Environment/Viking-Grace/>, accessed on 11 January 2013.
11. Fjord Line LNG cruise ferries, 2013, <http://www.fjordline.com/Our-ships/Our-new-ships/Environmental-profile>, accessed on 11 January 2013.