Scientific Journals
Maritime University of Szczecin

Zeszyty Naukowe
Akademia Morska w Szczecinie

2013, 36(108) z. 1 pp. 59–63
ISSN 1733-8670

2013, 36(108) z. 1 s. 59–63

Prospects for LNG in the South Baltic Sea Region

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Key words: LNG, environment protection, regulations, emission control, ship's fuel

Abstract
The global policy of protection environment enforces much more stringent regulations to reduce pollutants from exhaust gases. These requirements are being implemented gradually from 2010 and will have full force in 2015 and 2016. The shipping industry is facing a big challenge to meet these regulations, especially on ECA (emission control area). This paper describes the activities within project "MarTech LNG", that promotes the use of LNG as a ship's fuel on south Baltic Sea region.

Introduction

The worldwide policy is going towards environment protection and the limiting pollution in the seas, inland waters, grounds and the air. Therefore, the international organizations like IMO implements new, much tighter regulations.

The Annex VI "Regulations for the Prevention of Air Pollution from Ships" was added to the International Convention for the Prevention of Pollution from Ships (MARPOL) in 1997. The main aim of the annex is finding a solution to minimize emissions from ships oxides of sulfur (SO_x), particulate matter (PM), nitrogen oxides (NO_x), ozone depleting substances (ODS), volatile organic compounds (VOC) and their contribution to local and global air pollution and environmental problems. Annex VI entered into force in 2005, but in 2008 was revised. The significant tighten emissions limits adopted in 2008, were gradually introduced from 2010 and another milestones of limiting air pollutants are coming during next years which are shown on figures 1 and 2.

In addition IMO has adopted mandatory technical and operational energy efficiency measures which will significantly reduce the amount of CO_2 emissions from international shipping.

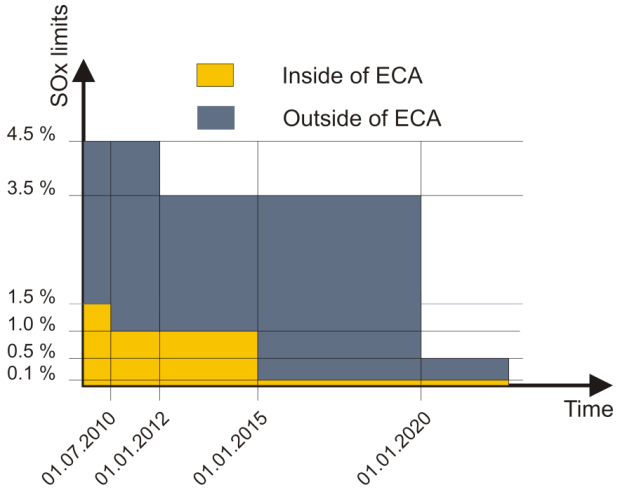

Fig. 1. The MARPOL Annex VI fuel oil sulphur limits [1]

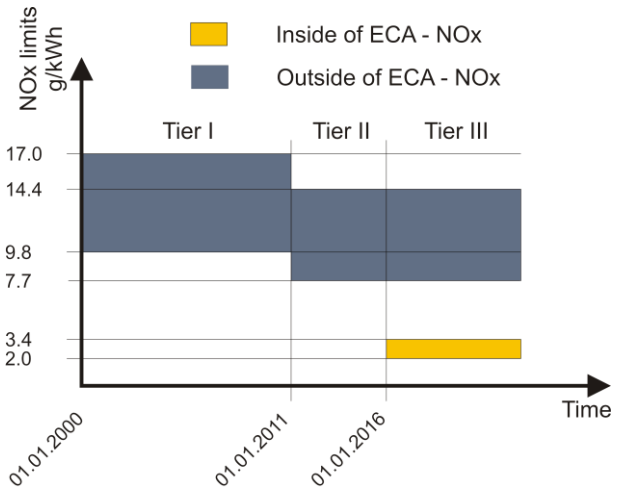

Fig. 2. The MARPOL Annex VI, emission limits for NOx [1]

Currently Baltic Sea and North Sea are established as an ECA only for SO_x, but everybody engaged in sea transport business should think perspectively. North America and from 1 January 2013 United States Caribbean Sea are SO_x, NO_x and PM ECA.

There is a high probability that new ECAs will be established (Fig. 3) or that the existing ones will be more restrictive.

Fig. 3. DNV's map of current and possible ECAs in the future [2]

Alternatives for heavy fuel oil (HFO)

The review of existing engine technology and its development indicates that currently only three solutions are in accordance with SOx regulations. If shipowners wish to continue sailing on Baltic Sea after 2015 they have to choose [3]:

– low sulphur fuel;
– an exhaust gas scrubber;
– LNG fuel (liquefied natural gas).

The first solution requires only minor modifications on vessel fuel systems. The content of sulphur in a fuel like MDO (marine Diesel oil) and MGO (marine gas oil) can be below 0.1%. The main disadvantage such a choice is limited availability of low sulphur fuel is that rising demand is expected to increase its price uncertainty.

The second solution requires installation of an exhaust gas scrubber to remove sulphur from the engine exhaust gas by using chemicals or seawater. This technology requires significant modifications on ship systems. Additional tanks, pipes, pumps, and a water treatment system. The sulphur-rich sludge produced is categorized as special waste, to be disposed of at dedicated facilities. Moreover, scrubbers increase the power consumption, thereby increasing its CO_2 emissions.

The third solution is using LNG (liquid natural gas) as a fuel. Natural gas is the cleanest form of fossil fuels available, and when fuelling a ship with LNG no additional abatement measures are required in order to meet the ECA requirements. However, an LNG-fuelled ship requires purpose-built or modified engines and a sophisticated system of special fuel tanks, a vapouriser, and double insulated piping. Available space for cylindrical LNG fuel tanks on board ships has been a key challenge, but new hull integrated tanks are expected to simplify this issue.

For new ships delivered after 1 January 2016, exhaust gas purification by Selective Catalytic Reduction (SCR) or LNG fuel are the only two currently available abatement measures to meet Tier III requirements.

LNG as a fuel

LNG means liquefied natural gas. The natural gas is temporarily converted to liquid form at –163°C, under atmospheric pressure. It takes up 600 times less space than as a gas, therefore, it is more efficient for storage and transport. LNG is currently tested as a fuel on more than 20 vessels sailing on Norwegian waters.

In addition, LNG is clean not only in aspect of exhaust gases, but also in case of spill. LNG does not cause environmental disaster because in such a case it will evaporate quite fast. The main hazard in case of LNG spill, are frostbites due to extremely low temperature.

Taking account above mentioned three solutions it should be said, that LNG is the best alternative in aspect of economic and environmental impact to Baltic Sea.

LNG as a fuel has the lowest emission of all three pollutants NO_x, SO_x, and particles, as well as the greenhouse gas CO_2 (GHG). SO_x and particles are reduced by close to 100%, NO_x emissions close to 85–90%, and net GHG emissions by 15–20% (Fig. 4). Below (Fig. 4) are presented emissions for typical Baltic Sea vessel.

The typical cargo vessel was determined as follows:

– gross tonnage: 2700;
– power of main engine: 3300 kW;
– yearly sailing hours: 5250.

Nowadays, the LNG trade market is large and flexible. The forecast developed by U.S. Energy Information Administration (EIA) in 2008 are optimistic and indicates an expanding gap between conventional fuel and LNG [4]. On the other hands the Lloyd's Register's forecasts of the fuel market indicate that demand of LNG as a fuel will depends on number of vessels fueled by LNG and its price [5].

The cost of a new vessel equipped with LNG propulsion is higher about 10–20% than conven-

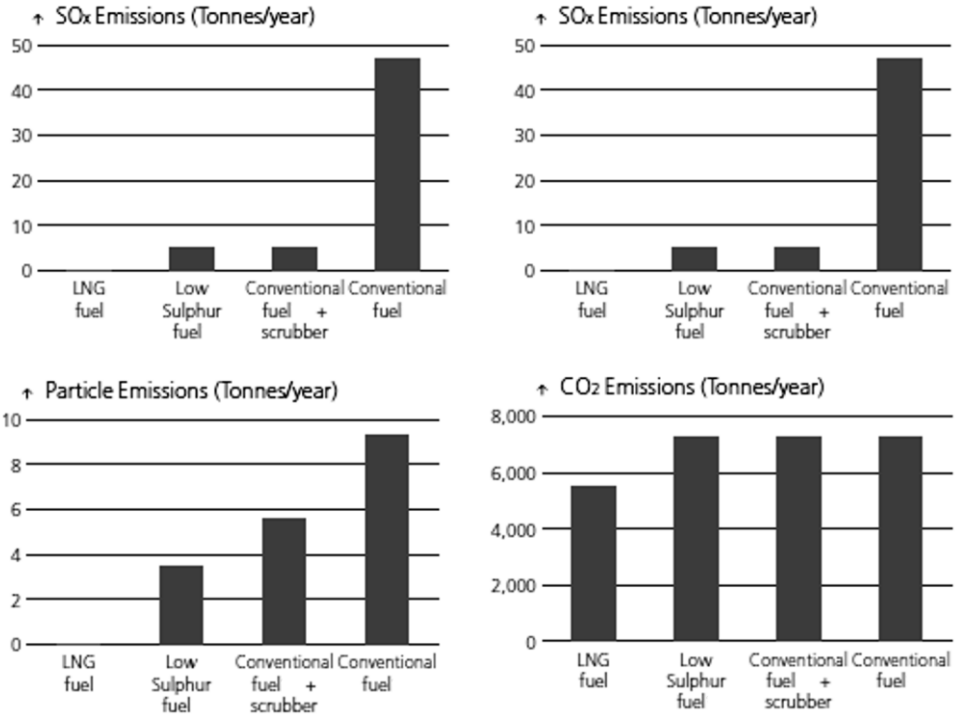

Fig. 4. The pollutants' emissions for typical Baltic Sea vessel [4]

tional vessel with similar gross tonnage. The additional cost is mainly due to the sophisticated LNG storage tanks, the fuel piping system and in some cases a slightly larger ship. Based on experience from ships built, the additional investment cost for the LNG fuelled typical Baltic Sea cargo vessel has been estimated to about 4 million USD. Estimated cost of scrubber installation should be around 1 million USD. Taking these assumptions into account and forecasting price of marine gas oil (MGO) in 20 years perspective the lowest exploitation cost are in case of LNG vessel (Fig. 5).

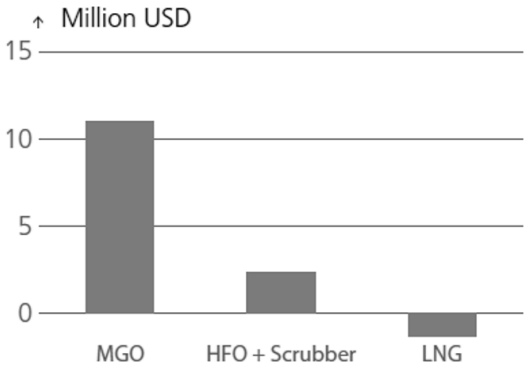

Fig. 5. Exploitation costs over 20 years related to conventional fuel (DNV 2010) [4]

The exploitation costs analysis indicates that fueling LNG is cheaper even in comparison to HFO, and differences between MGO option is up to 12 million USD.

Current status of LNG infrastructure on Baltic Sea

In order to enable navigation of vessels using LNG as a fuel, a grid of bunker stations is required. An average period between bunkering for the LNG vessels today is about one week, and vessels should have possibilities to obtain LNG in one of the ports during their trips. Currently, the LNG infrastructure on Baltic Sea is very weak (Fig. 6).

The number of import terminals is not enough to provide a supply of LNG for every route on Baltic Sea. They should operate rather as a hub of LNG and distribute it to small scale bunker stations.

In case of decision about building new import terminal, it belongs to government in order to securing energy independence of given country, but decisions about building small scale LNG terminals or bunker stations, depend on market. Currently, there is no LNG bunker stations on Baltic because there is a small number of LNG powered vessels, and lack such vessels is a result of lack of bunker stations. It seems correct that at least at the beginning, the bunker stations should also have a political support.

MarTech LNG – "Marine Competence, Technology and Knowledge Transfer for LNG in the South Baltic Sea Region (SBSR) is one of the projects which aims are dissemination of LNG technology by exchanging experiences, knowledge and competencies within SBSR. The project supports

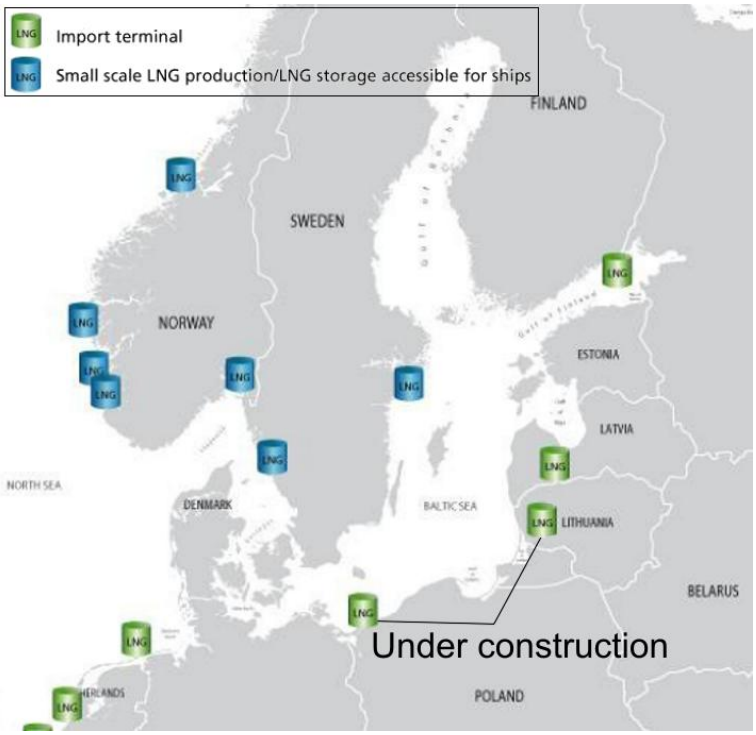

Fig. 6. LNG terminals on Baltic Sea [6]

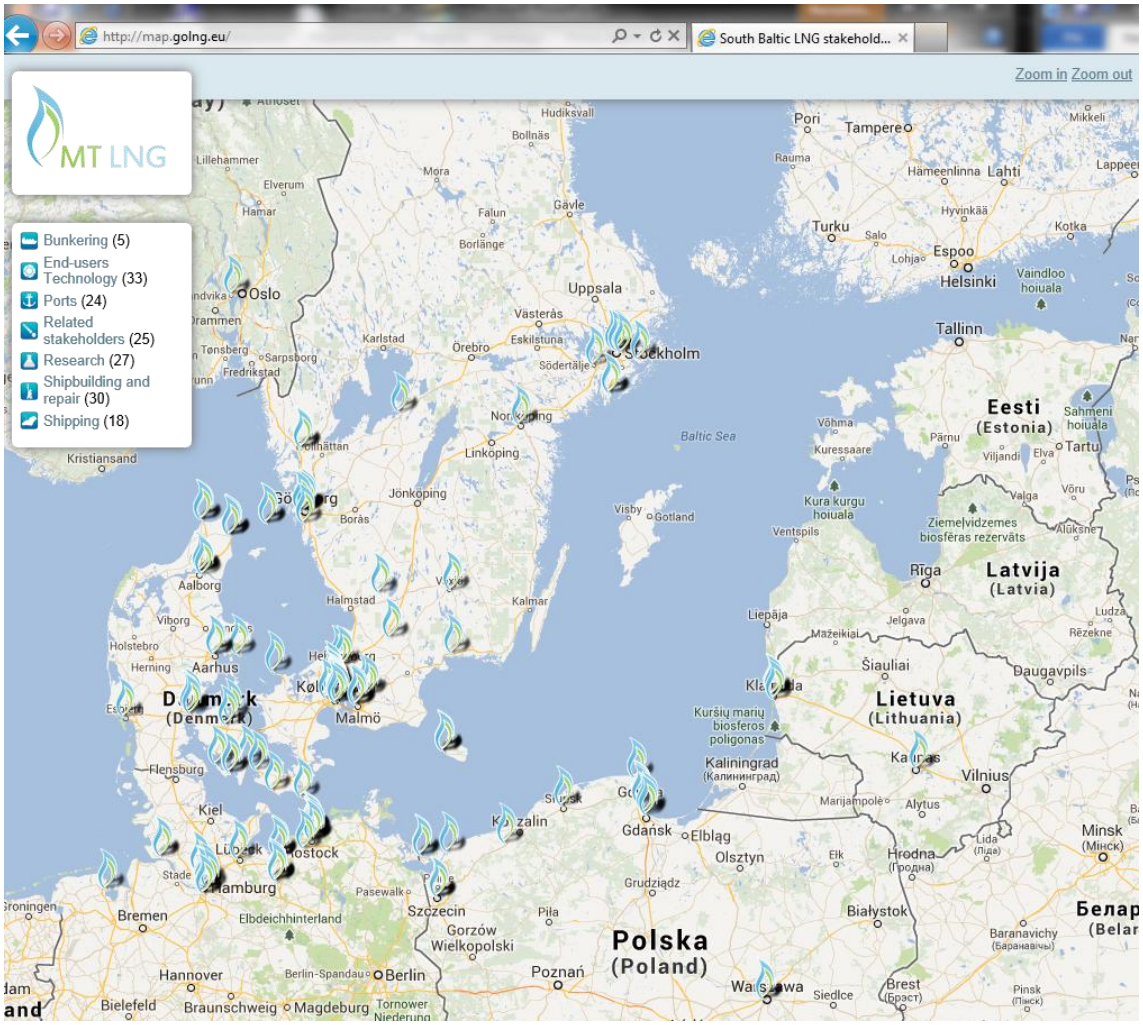

Fig. 7. LNG activities on Baltic Sea [6]

the activities related to LNG technology, promotes LNG as a green energy and the cleanest marine fuel. Main idea of the project is to create a better access to technology and knowledge on LNG related business activities to build up a better competences and specialization among the SBSR maritime business supply chain. The main idea will be achieved by realize following aims:

- develop the LNG related competences for the Maritime industries in SBSR;
- foster LNG targeted scientific research;
- create LNG supply / value chain in SBSR;
- support LNG development and operation processes in SBSR.

One of the first task of the project was region study in terms of existing education, research, training and consulting institutions providing activities related to LNG technology. Based on this analysis interactive map were created (Fig. 7).

The region was also analyzed in aspect of stakeholders dealing with LNG technology. The region LNG profile or joint study "Mapping LNG knowledge and competence in the SBSR" indicates on lack or too small amounts of LNG that could enable development of the LNG business. Cooperation between stakeholders and institutions is weak and really hard to find LNG supply chain. But LNG enterprises have a big potential which can be activated when LNG as a fuel will be available (MarTech LNG).

Conclusions

LNG is one of the best solutions for Baltic region to protect environment against pollution caused by conventional fuels. Now is the time for owners to decide which solution to choose to be in compliance with the MARPOL Convention. They will choose LNG, if on Baltic Sea the LNG infrastructure will exist. Unfortunately, it seems that without political support, building infrastructure may be difficult.

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