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An international platform for cooperation on liquefied natural gas (LNG) – a report on the MarTech LNG project

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Abstract
There were a number of circumstances which became the basis for the MarTech liquefied natural gas (LNG) project: the forthcoming regulations reducing permitted sulphur content of a ship's fuel, and aspirations of Poland and Lithuania to diversify sources of natural gas import by building LNG import terminals. The project was launched in 2012 and lasted more than three years until April 2015. It concerned the uses of LNG in the South Baltic Sea region and was realized by eight partners from five countries surrounding this area. The main aims were promotion of LNG as a fuel and dissemination of knowledge and experiences related to LNG. They were achieved by organizing training courses, seminars and meetings between stakeholders, research institutions and policy makers. This paper is an informal report of activities within the MarTech LNG project.

Preface

At the beginning of 2015, all ship-owners whose ships sail on the Baltic Sea had to take a strategic decision about the future of their fleet. Due to new fuel regulations in this area, vessels could only use a fuel with sulphur content less than 0.1% (Figure 1a).

In addition, the MARPOL convention described areas where contents of NOx in exhaust gases are limited as well (Table 1).

Table 1. Emission Control Areas (IMO, 2008)

	Emissions
Baltic Sea	SOx
North Sea	SOx
North America	SOx, NOx
United States Caribbean Sea ECA	SOx, NOx

Currently the Baltic Sea does not have the NOx constraints, but the policy and tendency are directed to the protection of the natural environment, therefore everybody engaged in the sea transport business should take them into account.

Technically only three solutions can meet these very strict rules:

– a low sulphur fuel (SOx);
– an exhaust gas scrubber (SOx);
– a liquefied natural gas (LNG) fuel (SOx, NOx).

LNG belongs to the fossil fuels group, the same as gasoline and diesel. But LNG has a properties which allow us to score it higher than the others, or even to call it a XXI century fuel. This fuel is cleaner than any other fossil fuel. When it burns, it does not produce SOx and particulate matter. Compared to conventional fuels, its exhaust gases contain significantly less NOx and about 20% less CO2 (Figure 2).

Raw natural gas consist primarily of methane, but also contains varying amounts of heavier gaseous hydrocarbons, acid gases, other gases like nitrogen and helium, water and liquid hydrocarbons. But during the liquefaction process most of those substances are removed, and the content of methane in LNG is at least 95%. LNG is clean not only in respect of exhaust gases, but also in the case of a spill. LNG does not cause an environmental disaster because in such a case it will evaporate quite quickly.

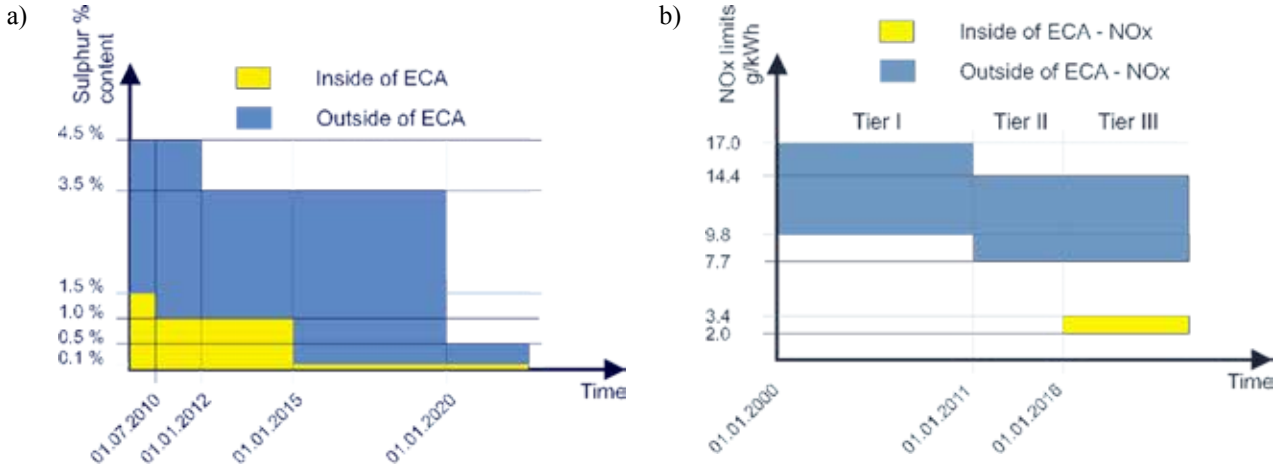

Figure 1. MARPOL Annex VI: a) fuel oil sulphur limits; b) emission limits for NOx (IMO, 2008)

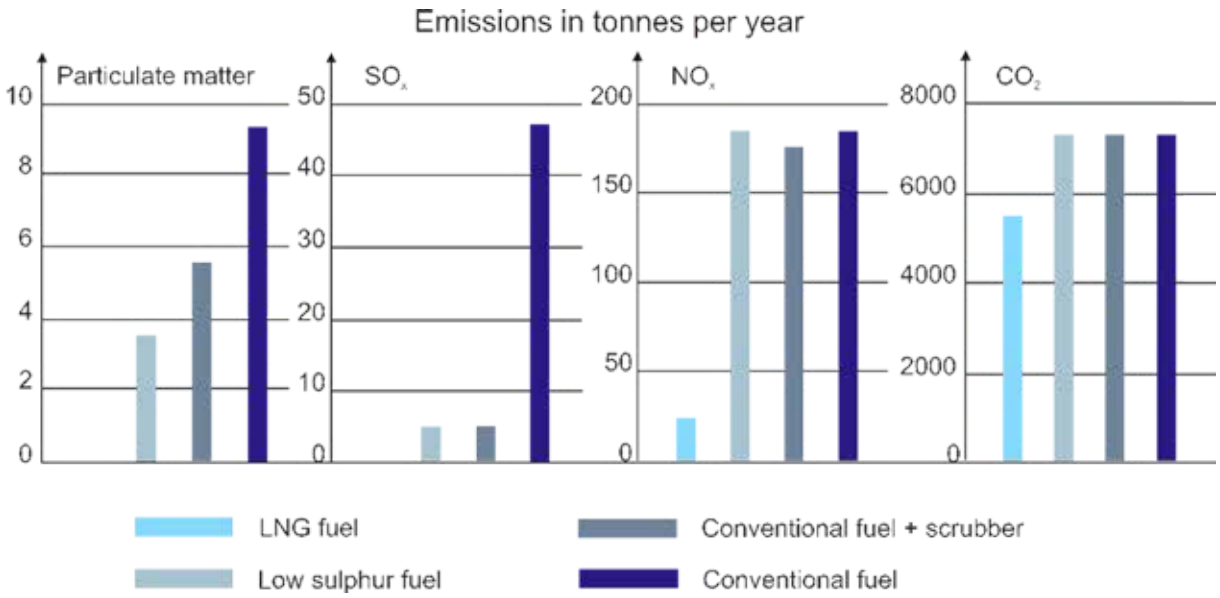

Figure 2. Emissions of different fuel solutions for typical Baltic Sea cargo vessel (Det Norske Veritas, 2010)

All these advantages of LNG contributed to the idea of the MarTech LNG project.

MarTech LNG – a platform for cooperation

Project MarTech LNG (Marine Competence, Technology and Knowledge Transfer for LNG in the South Baltic Sea Region (SBSR)) was aimed at dissemination of LNG technology by exchanging experiences, knowledge and competencies within the SBSR. The project supports activities related to LNG technology and promotes LNG as a green energy and the cleanest marine fuel. The main idea of the project is to create better access to technology and knowledge on LNG-related business activities, in order to build better competencies and specialization among the SBSR maritime business value chain.

One of the most important opportunities to launch the project were two planned LNG terminals in Świnoujście and Klaipeda. Despite the fact that the primary task of both terminals was the supply of natural gas to national grids after regasification, part of the imported LNG could be used as fuel for ships. The terminal in Klaipeda started operating in December 2014, and the terminal in Świnoujście will start to operate at the end of September 2015. The Polish terminal, as a big shore installation, has been equipped with facilities to reload LNG to road cisterns. This way it can be used for bunkering sea ferries. The Lithuanian terminal consists of a floating storage and regasification unit (FSRU) and cannot be used for reloading of LNG. Klaipedos Nafta will build an LNG reloading station for this purpose, which should start operating in 2017.

These two places where LNG is available seem to be insufficient to supply LNG for ships sailing on the Baltic Sea, even on its southern part only (Figure 3).

The above figure shows ships' routes on the southern part of the Baltic Sea. The question marks ('?') indicate places where there is a lack of continuous LNG bunkering services. Even considering only passenger vessels' ports (Figure 4), these two LNG terminals won't be sufficient.

Most passenger vessels' tracks shown on Figure 4 represent movements of sea ferries, which have a specific mode of work: sailing according to

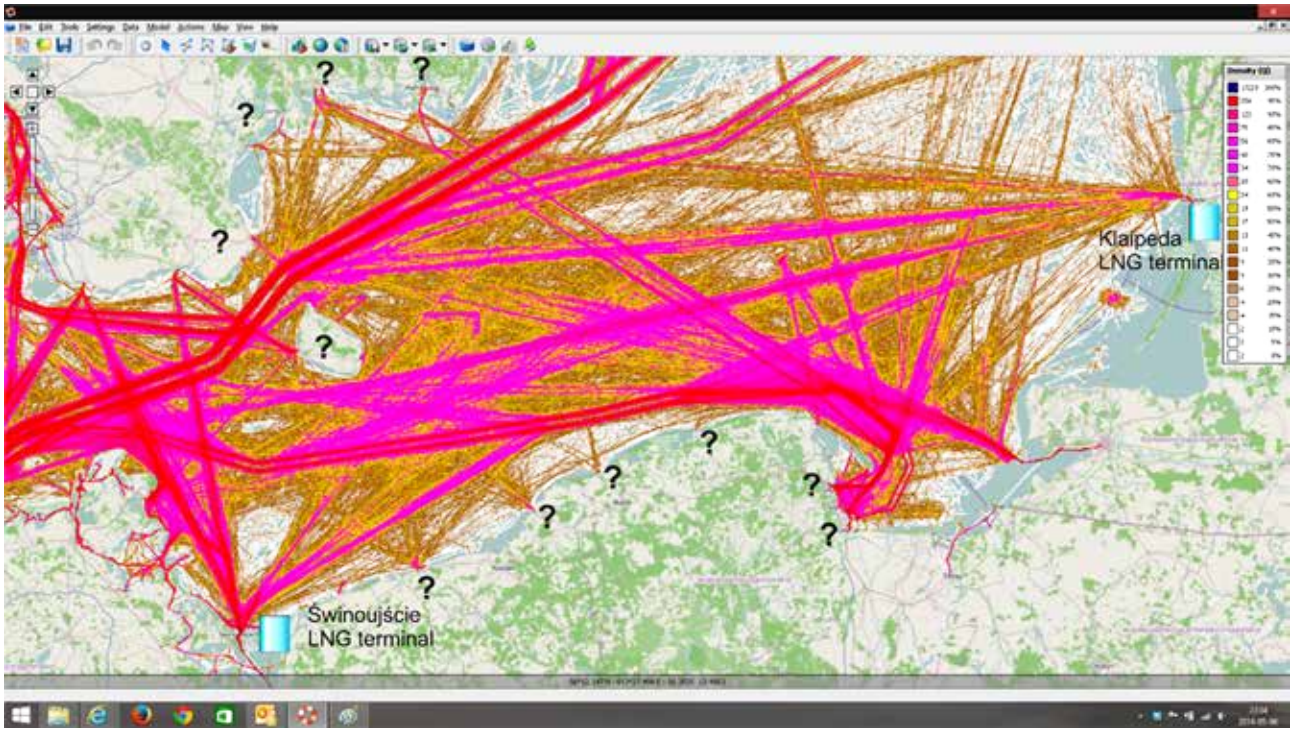

Figure 3. Main routes on the Baltic Sea; based on AIS reports 2011 – all ships

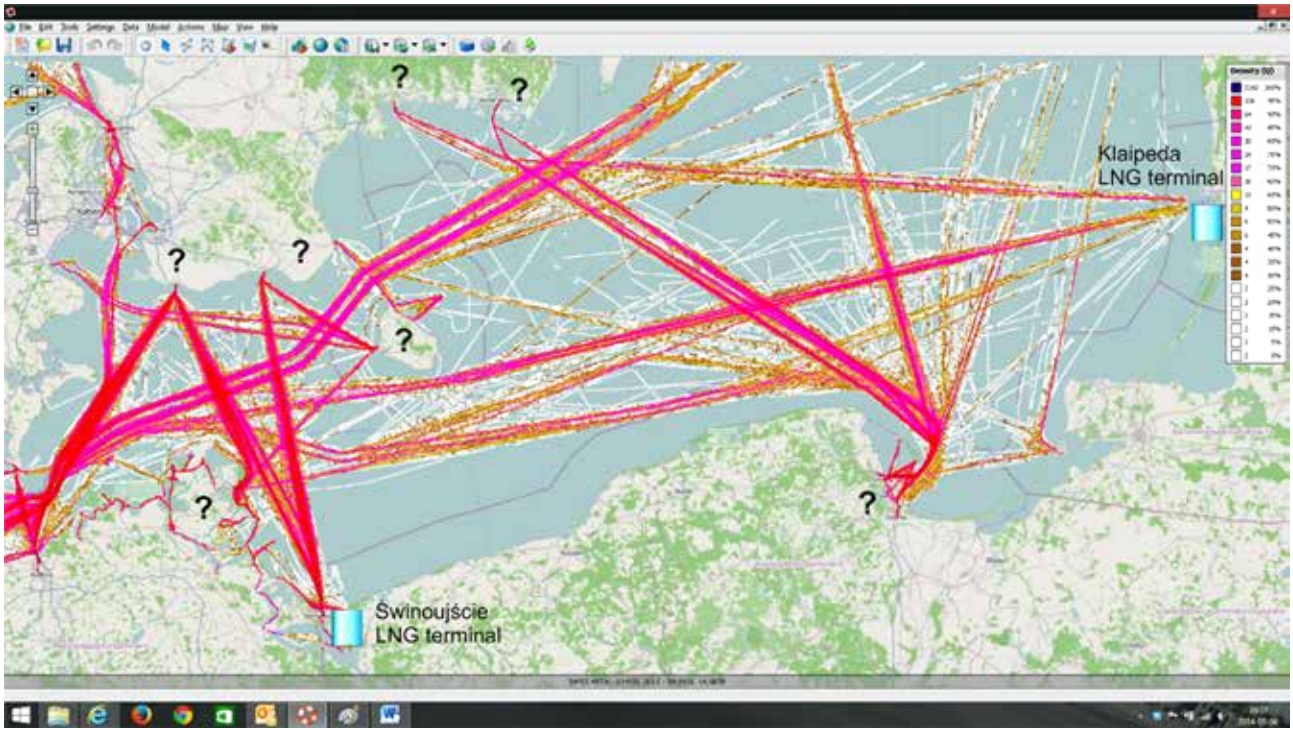

Figure 4. Main routes on the Baltic Sea; based on AIS reports 2011 – passenger ships

a schedule with short stays in ports. This very often means simultaneous loading and bunkering operations. In this case it would be very difficult or even impossible to call to a port which does not belong to the schedule just for bunkering. This is important due to fact that this operation will be repeated every one or two days because of tank capacities. It has to be taken into consideration that the smaller the tank, the shorter the period of time for storing LNG.

MarTech LNG activities were concerned with the promotion of LNG fuel, as a solution for the South Baltic Sea Region, by training courses and seminars, business to business meetings and meetings between stakeholders, policy makers and scientists. Most of those events were conducted in the project partners' countries: Sweden, Lithuania, Poland, Germany and Denmark. This constitutes almost all countries surrounding the South Baltic Sea, except Kaliningrad District (Russia).

Among the most important events organized within the project were two series of training courses conducted in five project countries according to the original methodology worked out by the project's partners. The first series was divided into two parts: theoretical and practical, where a ship's handling simulator was used (fixed or portable depending on the situation). The training programme is presented in Table 2.

Table 2. The training programme 2013/2014

The first day (practical part / simulator)	The second day (theoretical part)
1. Ship's steering – principles	1. LNG – general knowledge
2. Hydro-meteorological influences	2. LNG fuel tank operations
3. LNG carrier and tug cooperation	3. Safe practices and procedures
4. Emergency situations	4. Emergency procedures

The second training series was shortened to one day, the practical part removed and the scope of the theoretical part was modified. The programme of that training is presented in Table 3.

Table 3. The training programme 2015

The one day training
1. LNG – general knowledge
2. LNG fuel for different transport modes
3. LNG fuel for port equipment
4. Small scale LNG terminals and LNG fuelling opportunities

The scope of training was dedicated to other uses of LNG, e.g. as a fuel for port equipment. The reasons of developing the idea of using LNG as a fuel for port equipment were simple. Firstly, if LNG is already available in ports, why not use it to power transport equipment inside ports? Further, reducing emissions of air pollutants and cost of fuel should be a key issue for container terminals and ports located close to cities. There are many vehicles with diesel engines in ports and container terminals: rubber-tyred gantry cranes, terminal tractors, reach stackers, forklifts etc. and they consume a lot of diesel oil (e.g. Noatum Container Terminal Valencia: about 7 m litres) which is much more expensive then LNG. The total cost of a terminal tractor during ten years' service life (including the initial cost of vehicle) is about $153,000. It is more or less same for the LNG version, but using LNG the air pollution is significantly less and driver comfort is better. Part of the initial cost of the vehicle can be covered by the government, because some countries support a technology which protects the natural environment by giving subsidies of up to $40,000 (Henesey, 2014).

Another type of events was seminars. Each project partner organized a seminar about technological or economic aspects of LNG. In Poland, technological topics were presented about exploring and producing natural gas, the liquefaction processes, methods of storing and different ways of using LNG.

Also within the project, a study visit to Stavanger in Norway was organized. This included a voyage on the world's largest LNG-powered ferry, the MS Stavangerfjord from Fjord Lines, and a visit to the SKANGASS LNG Terminal at Risavika Harbour. More than 50 different companies/organisations/authorities from at least 11 different nations participated in the study visit to explore LNG.

During the project a series of seminars was held entitled 'Small scale distribution for coastal and short-sea shipping' where international experts from Bomin Linde, Linde Gas, Sund Energy and DNV GL presented different aspects of LNG, including economic, legal, technological, logistic etc.

Project results

Each project partner had examined its region in respect of LNG. This research was divided into two points: finding institutions related to LNG, and stakeholders engaged in LNG technologies. After gathering and analysing data obtained from partners, the joint study, titled 'Mapping LNG knowledge and competence in the SBSR', was completed, and in

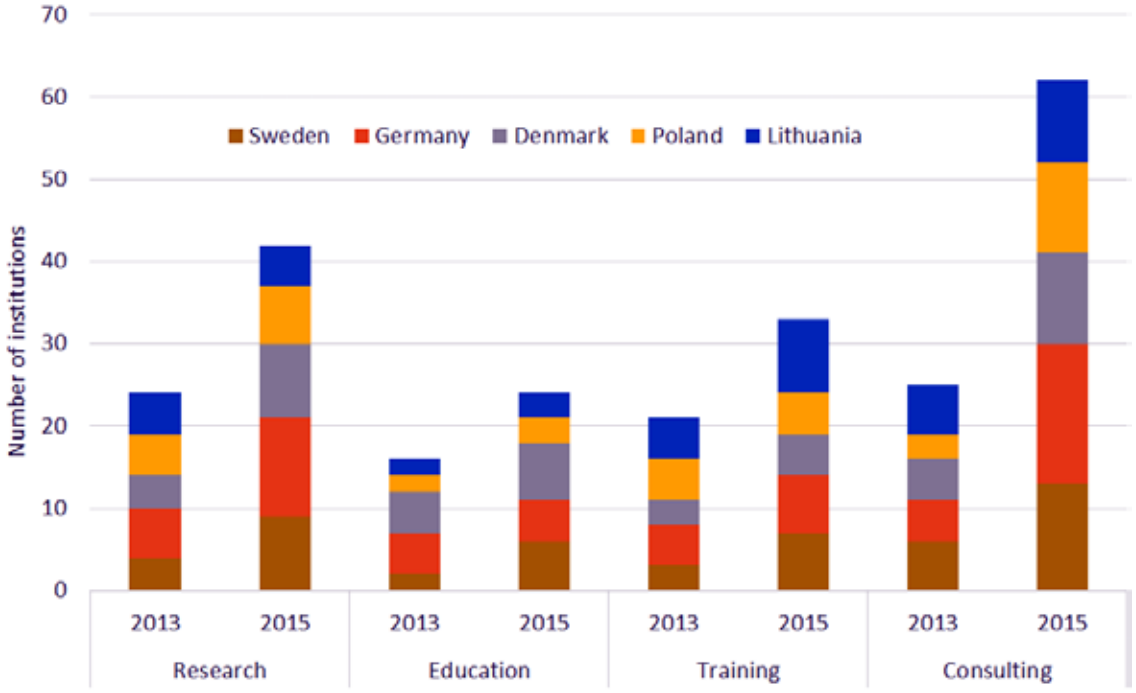

Figure 5. Institutional portfolio in SBSR 2013/2015 (Project MarTech LNG, 2015)

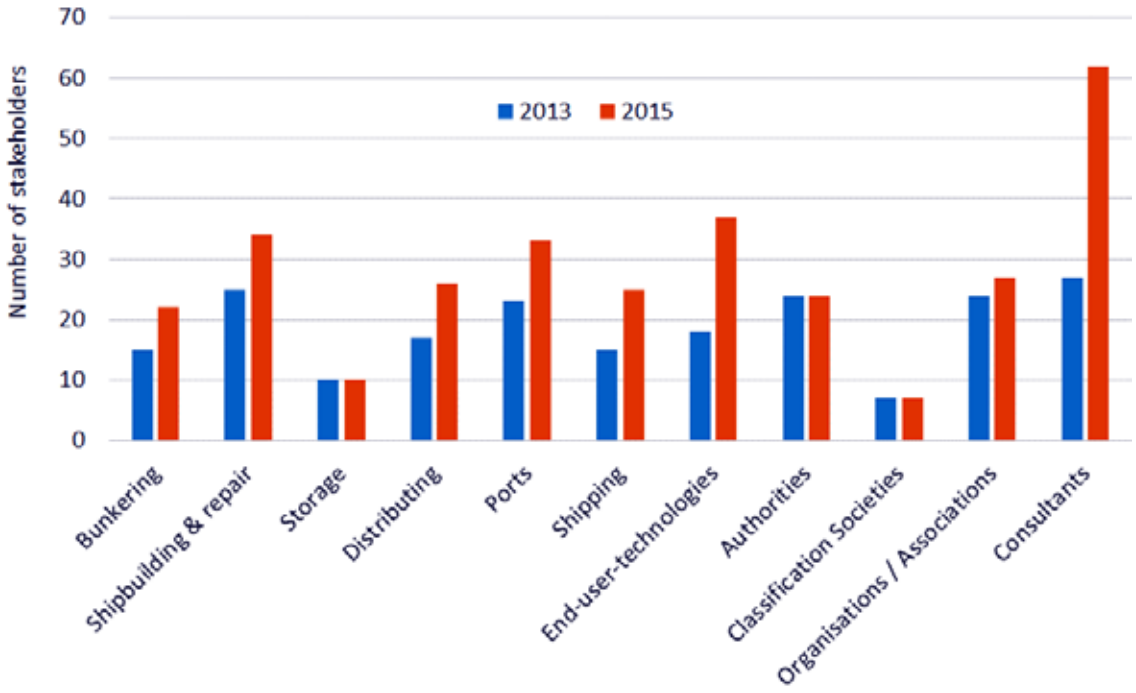

Figure 6. Profile of stakeholders 2013/2015 (Project MarTech LNG, 2015)

February 2013 the final version of the study was presented. The same research was repeated at the end of the project lifespan in 2015. The changes in the institutional and stakeholders profiles between these two periods are presented in Figures 5 and 6.

An increase can be seen in almost every group of stakeholders (except storage, authorities and classification societies). Of course not all of these increases can be attributed to project activities, but it is necessary to emphasize that during this project 10 training sessions based on the project training methodology were conducted and more than 150 experts trained. During all events stakeholders had the possibility to meet each other for business issues.

All presentations, papers and photographs gathered and taken during the project are available on the

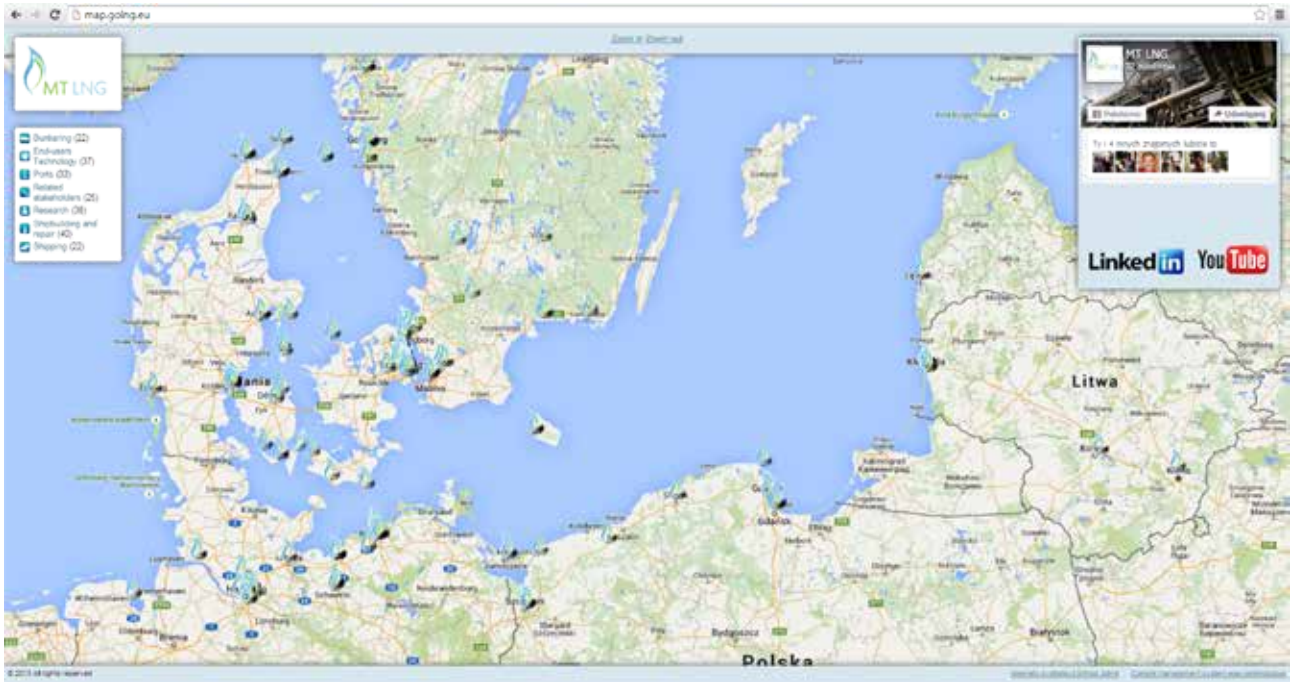

Figure 7. The interactive map containing data about stakeholders involved in the LNG business

website www.golng.eu. In addition, all stakeholders and their data are presented on an interactive map at map.golng.eu (Figure 7).

The database used in creation of this map is updated in a regular basis. The stakeholders' details can be displayed by clicking on the green and blue flame.

The future of LNG

The most interesting facts for stakeholders are price and sustainability of LNG. The prices of any fossil fuels seem to be more influenced by policy than governed by the market forces. This was very visible in case of crude oil and natural gas prices within last year (Figure 8). There was not any reason other than policy which could cause such a drop in prices (by about 50%) during the last months of 2014.

In the case of LNG, there were not such rapid changes in prices in the same period of time (Figure 9) and at the end of 2014 prices in Europe and US oscillated around $8.5. LNG prices in Asia are higher by about $7, reflecting greater use of LNG, especially after the Fukushima disaster in 2011.

Figure 8. The variation of crude oil and natural gas prices over 18 months in 2014-5 (Nasdaq, 2016)

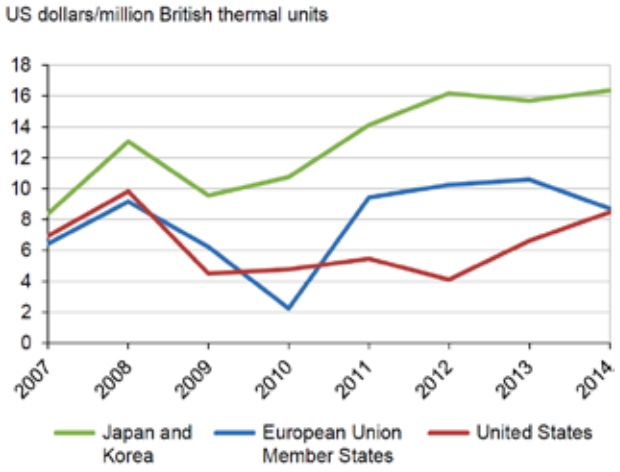

Figure 9. The variation of the LNG price since 2007 (International Energy Agency, 2015)

British Petroleum (BP) estimates that the world proven reserves of natural gas at the end of 2014 stood at 187.1 trillion cubic metres, and total world proven oil reserves reached 1700.1 billion barrels at the end of 2014. Those amounts will be sufficient to meet 54.1 years of natural gas global production and 52.5 years in case of oil. What will happen to the infrastructures which were built to process and store fossil fuels? There is one more advantage of natural gas and LNG. This fuel can be more sustainable than other fossil fuels. Natural gas consists mainly of methane. Methane also exists in biogas which can be produced by processing organic waste. The European Biogas Association reported that in 2013, 1.3 billion m^3 of bio-methane was produced by 282 biogas plants located in Europe.

Conclusions

In the project partners' opinion, LNG is a fuel which should be used in the Baltic Sea region, not only by ships but also by other vehicles exploited in ports and cities. LNG has the potential to be not only a clean fuel but also to become a green energy source. Cryotechnology is still developing and many devices are near to prototype. Because production is low, the price is high. Currently ship-owners are facing the requirement to install dual-fuel engines because of lack of an LNG distribution grid. But it is not the first time this has happened in the history of transport, and similar solutions can be found: oars and sails, sails and coal, coal and oil. The better solution for man always prevailed, and this time the better solution is LNG.

Due to these challenges, it is very important to support all activities aimed at making LNG fuel more popular.

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