LNG fuel for ships. A chance or a must?

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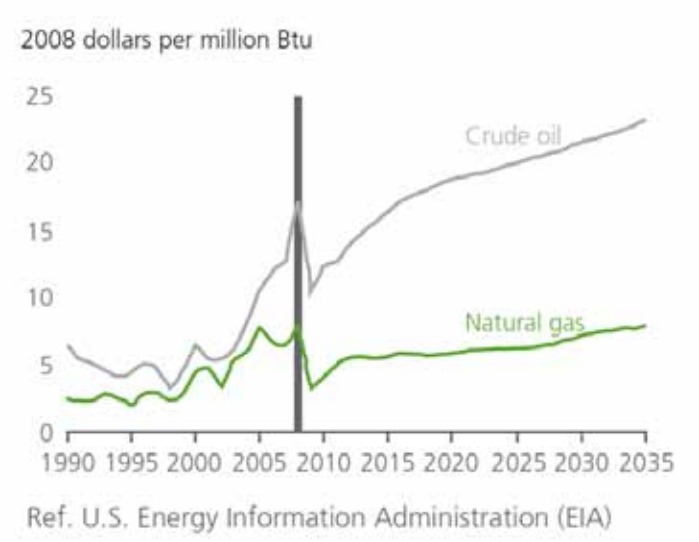
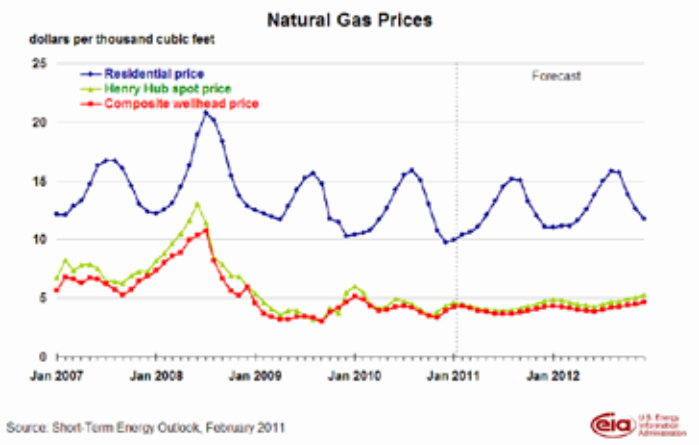
The use of LNG as ship fuel becomes a hot topic. Numerous new terminals are built or planed and the availability of liquefied gas increases. According to the DNV's LNG Segment director Lars Petter Blikom, the majority of ships ordered in 2020 will be LNG fuelled.

A price prognosis published by EIA- US Energy Information Administration shows that the disparity of prices between oil and gas fuels will systematically increase in the coming 30 years; crude oil is predicted to reach a price three times higher than natural gas (NG), counted in USD per million BTU (British Thermal Unit). The heavy fuel oil (HFO) price is correlated with crude oil prices while LNG price is nicely correlated with price of natural gas. The difference between prices of diesel oils and NG is even more noticeable.





LNG produced and distributed in small amounts may be presently purchased at price levels comparable with price of crude oil, while bought on the international market on long-term contracts may be available at almost half of that price. The recent discoveries of NG found in e.g. US shales, made availability of gas more reliable.

LNG production increases. Large production and export terminals have been recently built or are being developed in places such as the US, Norway, Australia, Indonesia, Nigeria, Libya, Algeria, the Middle East, Peru, Canada and Russia.

Responding to the IMO's regulations

Due to the fact that IMO has adopted a scheme for reduction of emissions of sulphur oxides, the required sulphur maximum content in fuel will need to drop from the current 4,5 % to

0,5 % by 2020 and in the environmentally sensitive areas, so called Emission Control Areas (ECAs) from1 % down to 0,1% by 2015. The latter limit is already required for ships at berth in EU ports and inland waters. The availability of low sulphur fuel is limited and rising demand is expected to increase its price uncertainty.

IMO's scheme for reduction of NOx emissions in ECAs specifies the limits for marine engine emissions. The current requirement for 20% reduction will be increased by another 75 % NOx reduction after the end of 2015.

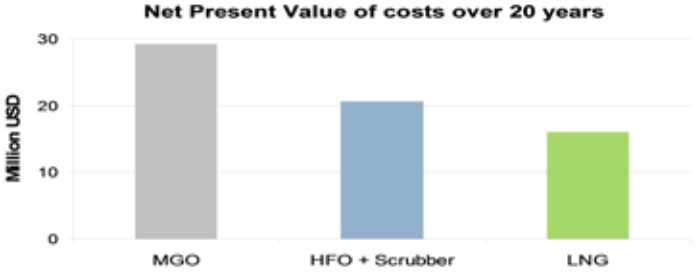
Restrictions imposed on shipowners by the IMO force them to invest either in "cleaner fuel" marine gas oil (MGO) or marine diesel oil (MDO) with their storage facilities and/or installations cleaning the exhaust or alternatively in installations for storage and burning of the cleanest fossil fuel, i.e. the natural gas.

Removal of SOx and of NOx from exhausts requires significant alterations onboard, including additional tanks, pipes, pumps, water treatment systems and storage of chemicals and special waste to be disposed of at dedicated facilities. Scrubbers removing sulphur from the engine exhaust increase the power consumption, thereby increasing emission of CO2.

The use of LNG will cut emission of solid particles and sulphur oxides by almost 100%, nitrogen oxides by 85% and carbon emissions by about 25%. Thus, no additional exhaust cleaning installations are required. Reduction of CO2 emission is possible due to the most favorable proportion of number of carbon and hydrogen atoms in methane particles (CH4) compared with other hydrocarbons. Reduction of NOx is achieved due to lower combustion temperature comparing with oil fuels. On existing, conventional vessels conversion into LNG requires investment approximately 3-4 times higher than that of a scrubber installation. However, in a long term perspective, taking price level similar to the present average 870 USD/t for MGO, 495 USD/t for HFO and 450 USD/t for LNG, owners can save in 20 years an estimated 45% and 22% on an LNG installation compared to MGO or HFO with scrubber installations, respectively.

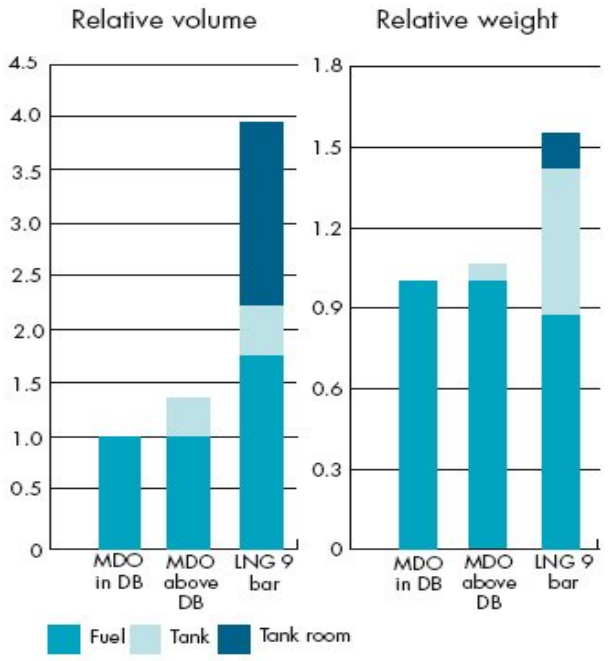
Typically, the new ships with LNG propulsion have an added investment cost of 10-20%.

This additional expenditure is expected to decrease in the future, depending on the number of LNG fuelled ships being constructed.



The main problem with using LNG in ships is the large amount of space required for the LNG tanks. Compared with marine diesel oil (MDO), an equal energy content of LNG requires about 1.8 times more volume than MDO. When adding the tank insulation, noting the maximum filling ratio of 95%, the required volume is increased to about 2.3 times.

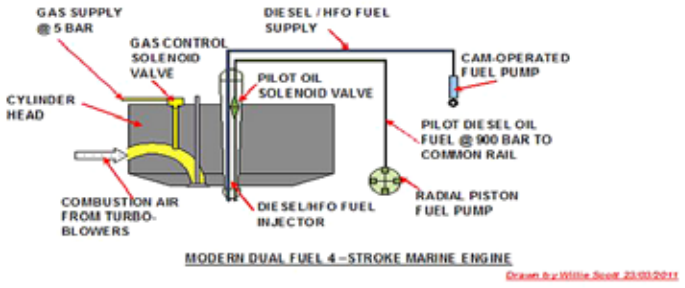
The practical space required in the ship becomes about four times higher when taking into account the squared space around the cylindrical LNG tank. If compared with an MDO tank located above a double bottom, the total volume difference is smaller, about 3.0.



Volume and weight of LNG and MDO storage in current ships with equal energy content

Higher efficiency

Most natural gas engines are either dual fuel or dedicated. Dedicated natural gas engines are Otto cycle (spark ignited) operated only by natural gas. The dual fuel engine maintains two fuelling systems: a natural gas system as well as a diesel oil system.



NG in the natural gas-powered internal combustion engines operating with the high pressure direct injection (HPDI) principle is infused at the end of the compression stroke or is supplied as a mixture with air. As it has a higher ignition temperature compared with diesel oil, a diesel pilot injection is used to initiate combustion. In this case the same horsepower and torque curves as a diesel engine are achieved. When idling, these engines tend to operate on 100% diesel. Some of the dual fuel engines are throttle controlled using a system that adds natural gas to the engine as higher speed is required. Other dual fuel systems are computer controlled to ensure that the optimal ratio of natural gas and diesel fuel is delivered to the engine depending upon load and performance requirements.

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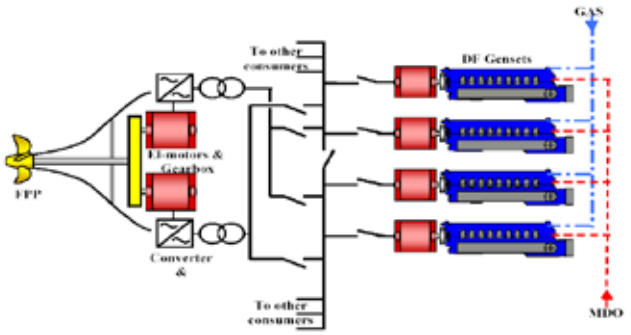
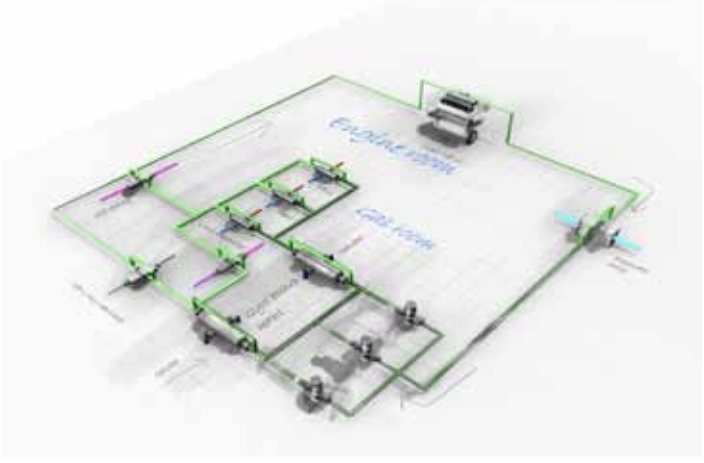
Dual fuel, low pressure gas supply



Once low temperature LNG is available onboard a ship, it should be used for increasing engine efficiency through cooling of scavenging air. MAN Diesel & Turbo claims that up to 3% more engine efficiency can be gained when the air into the main engine is cooled to 10°C, as opposed to the present solutions. Engine cooling, air conditioning, freezing and refrigerating are also possible with LNG/glycol installations. Cooling of volatile organic compounds (VOCs) onboard tankers helps to recover the otherwise lost cargo vapours and protect the atmosphere from pollution by hydrocarbon gases.



The scavenging air cooling system

Rules and standards

Det Norske Veritas was the first classification society which issued rules for gas fuelled engine installations. The use of gas as fuel in ships other than LNG carriers needs acceptance from flag states due to lack of international conventions. The first ever gas fuelled vessel, not being a gas carrier, the ferry GLUTRA, was built in 2000 based on DNV's regulations. Twenty two such vessels have been built since then (21 classed by DNV). Eighteen more to be delivered by 2013; those are car/passenger ferry, PSV, Ro-Ro, patrol vessel, tug etc. The first LNG fuelled, gas turbine powered, high speed, passenger catamaran will built to DNV class in Australia for delivery in 2012. Remontowa Shipyard in Gdańsk is completing a second series of four LNG car/passenger ferries. Much bigger ships are planned.

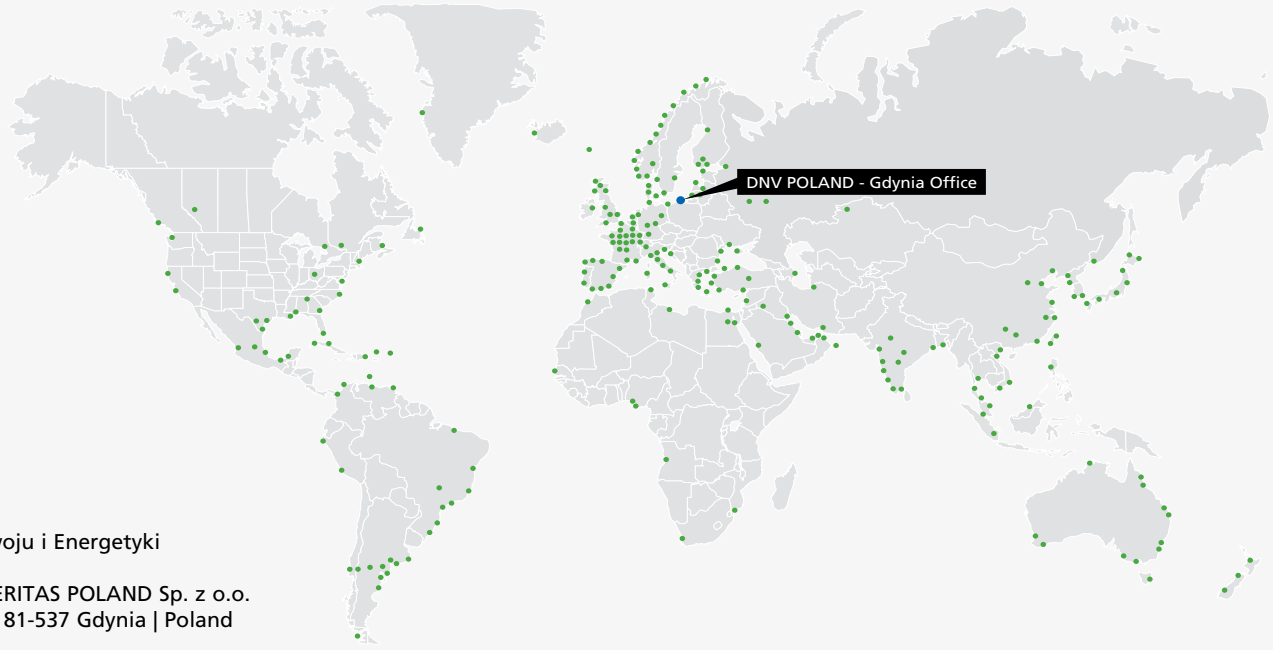
Inadequate availability of LNG used to be one of the most important factors stopping the LNG fuelled fleet expansion. This is quickly changing. Construction of the Świnoujście Import LNG Terminal opens new perspectives for the Baltic area. Establishing infrastructure for supplying LNG fuel for ships in the Baltic is happening right now. Numerous new import and distribution terminals are to start up here by 2011-2014.

The above article is based on:

DNV Report – Greener Shipping - Baltic Leadership, June 2010

Lowering downstream entry barriers for natural gas. Small scale LNG distribution in Norway, Erik Jarlsby AS; Paper at the IRaEE Conference, TeheranMay 2004

LNG Update. News from DNV to the LNG industry no. 01/2010



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