The New World of U.S. Gas Exports

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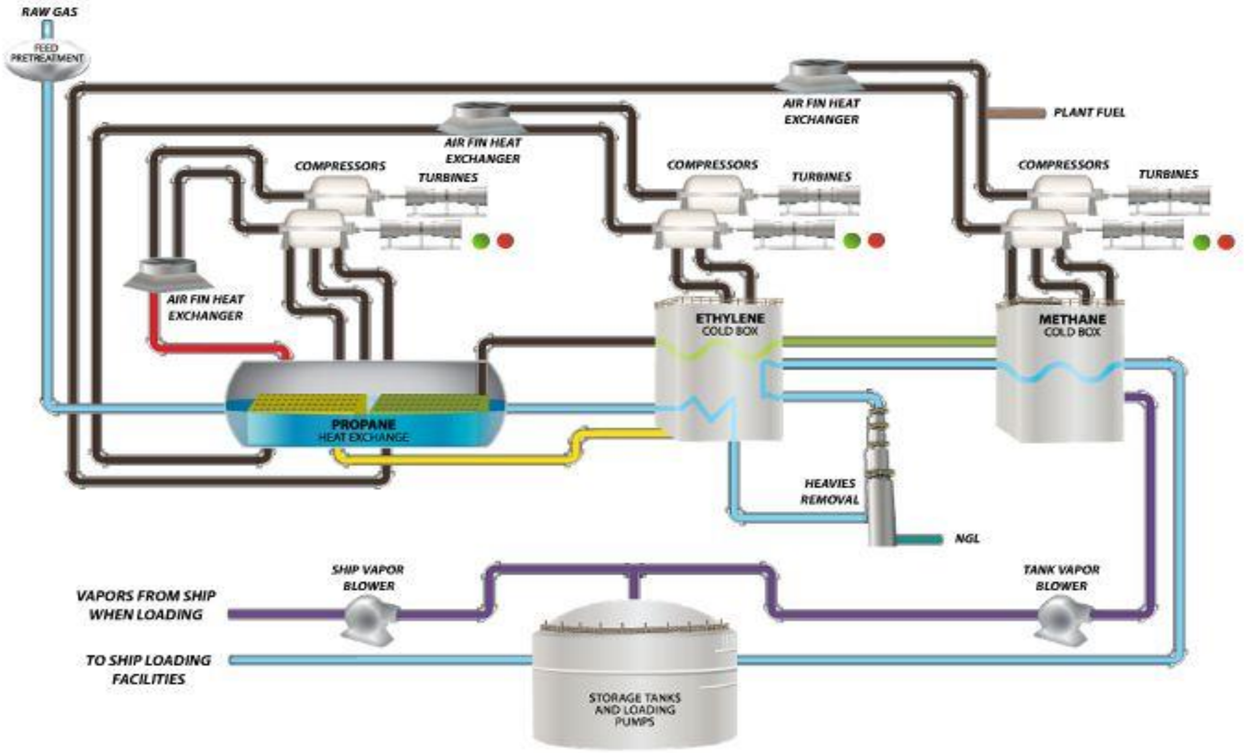
The U.S. Congress has just put aside the restrictions on the export of U.S. oil and natural gas which had been imposed since 1972.In February 2016 the U.S. exporters will make their first major contract delivery of U.S. shale gas to Lithuania.

The February delivery will be of U.S. liquefied natural gas (LNG) transported by sea from the U.S. to a custom-built receiving vessel off of the port of Klaipeda; itself a major technological achievement in the shipping of liquefied natural gas ('LNG') by sea.

Traditional transportation of natural gas has been done through a web of pipelines which criss-cross North America as well as through a smaller concentration of pipelines in Europe, Asia and the Middle East. Natural gas is pumped through these pipelines and delivered to distribution points which take the gas received and delivers it to customers. Nothing is done to the gas but pressuring and blowing it through the pipeline. The nature of the gas remains unchanged. This is a sufficient system to transfer and deliver gas on land as the pipeline carries the gas from point to point using valves and blowers. However, pipeline transport is very inefficient in the moving of gas between non-adjacent and distant countries as the volume of the gas is too great to be handled except by specialised marine vessels.

The response to this challenge of storing and shipping natural gas was to use cryogenic procedures to liquefy the natural gas through refrigeration to less than -161° Centigrade (the boiling point of methane at atmospheric pressure). By liquefying the gas, the volume of the gas is reduced 600 times, making it easier to store and to ship. The freezing of the natural gas is done in a specialised unit, called a "train". It includes a process of purification of the gas before it is frozen so the Liquefied Natural Gas is free of impurities.

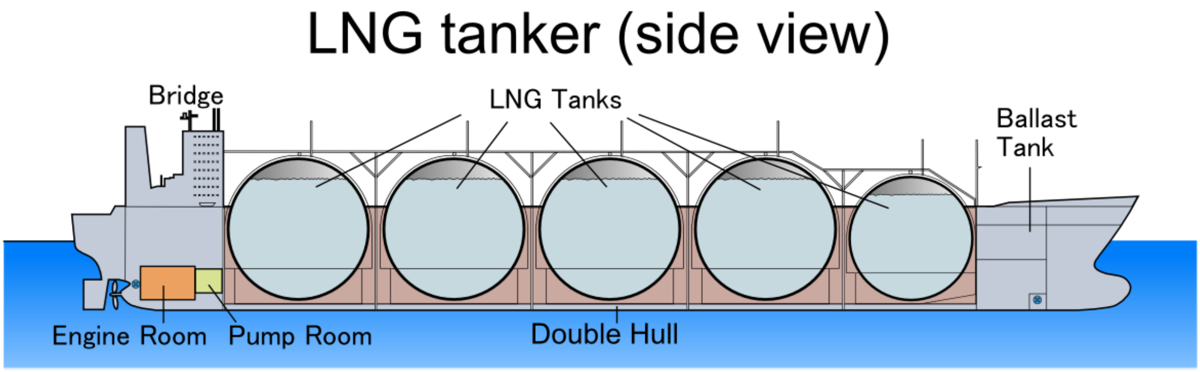
Each LNG plant consists of one or more trains to compress natural gas into the liquefied natural gas. A typical train consists of a compression area, propane condenser area, methane, and ethane areas. They are very expensive to build and operate. These trains are fed by pipelines from the land which pass the liquefied gas into specialised marine vessels docked at the train. These vessels are loaded alongside the train and sail to a receiving train at the import end. The process is reversed on delivery in a receiving, regasification, train.



A typical LNG train

Marine Vessels For the Transport of LNG

The liquefied gas cannot be loaded into normal bulk carriers or tankers. The vessels used to carry LNG are like giant Thermos bottles. They are built like conventional tankers but include a variant of one of two systems. For the most part the majority of LNG vessels use the Moss Bottle system. The have these 'bottles' inside the vessel.



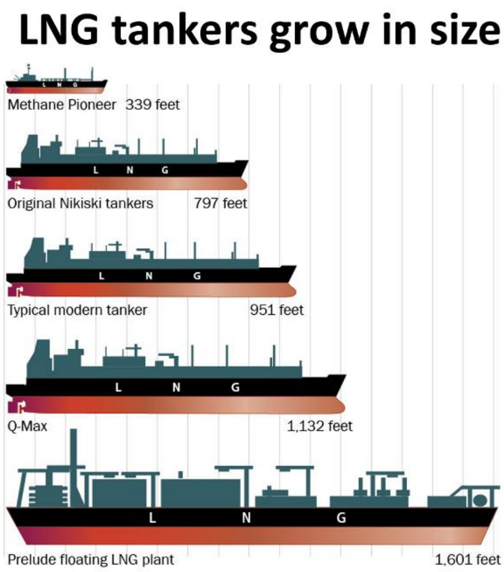
Moss-style LNG tankers use individual, spherical storage tanks built separately and set in place in the hull.

Membrane-Type Carrier

The other type of vessel is a ‘membrane’ carrier where, instead of bottles, the refrigerated sections are built into the vessel itself. They carry less gas but are easier to sail. However, unlike the Moss bottles they are subject to ‘sloshing’. Sloshing refers to waves being generated inside an LNG tank as the vessel plies the ocean. These waves can damage the tank and the vertical pump so, for safety’s sake the amount of LNG it can carry ranges between 10% and 70% because of having to cope with sloshing.

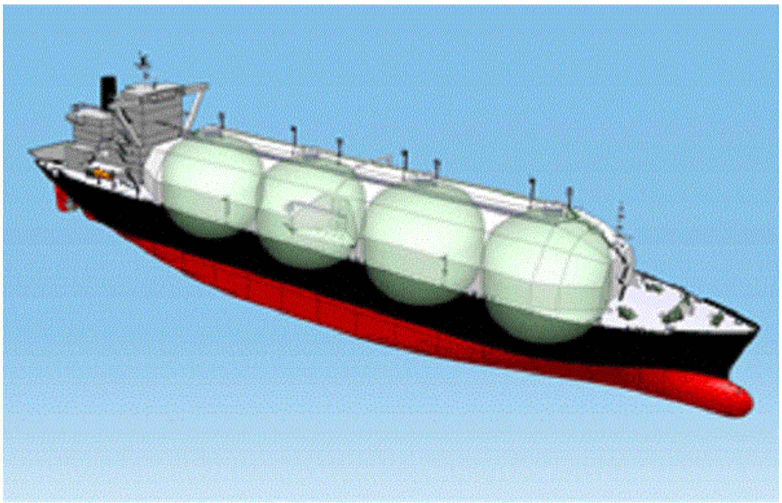
Keeping a minimum of 10% in the tank (or ’heel’) is required to keep the tanks cold for the next load but adds to the effect of “boil-off” in both types of carriers as some gas leaks inevitably occur in transit.

These LNG carriers have grown in size and number as the trade in LNG has increased.



There are some important trade-offs in the size of LNG vessels. While the new Q-max (built for Qatar) vessels are 1,132 feet long and 177 feet wide, they have a draught of 39 feet of water (about 12 metres). The draught (the depth of water required for a vessel alongside a berth) is often too deep for many existing ports with receiving trains for LNG. They are called Q-max vessels as they have been designed for the draught restrictions of Qatar. Most LNG vessels are around 950 feet, with about 10.2 metres draught and carry between 125,000 to 175,000 cubic metres of gas. In 2013 these LNG vessels carried about 11.5 trillion cubic feet of LNG.[i]

In late November 2014 Mitsubishi introduced the Sayaringo STaGE, a next-generation LNG carrier, built to meet New Panamax category, i.e. capable of passing through the newly expanding Panama Canal which is expected to go into service early in 2016. The new structural configuration succeeds in efficiently increasing LNG carrying capacity. The basic design of the Sayaringo STaGE has now been completed, with the vessel's LOA (length overall) set at 297.5m, width at 48.94m, depth at 27.0 and draft at 11.5m. Four apple-shaped tanks are featured. The developed design provides 180,000 cubic meters in total LNG tank capacity, but capacity can be set in accordance with the customer's transport needs. Plant efficiency has been significantly improved through the UST's effective use of the engine's waste heat, resulting in a propulsion system enabling high-efficiency navigation throughout a full range of speeds.



The Lithuanian Floating Storage and Regasification Unit

However, by far the most innovative change in LNG shipping is the world's first new-built liquefied natural gas (LNG) floating storage regasification unit (FSRU). It was built at Hyundai Heavy Industries' (HHI) shipyard in Ulsan, South Korea, for floating LNG services provider Höegh LNG. The vessel is chartered to Klaipedos Nafta in Lithuania on a ten-year lease agreement signed in March 2012, which also includes an option for purchase.

It is a vessel which sits in the port, receives LNG cargos from vessels alongside and regasifies the LNG on board without the need for an expensive regasification train on the quay. The FSRU, built at an estimated cost of $330million, is now a major entry point for LNG into Lithuania and its neighbours. It was ordered in June 2011 and the first steel was cut in September 2012. It was christened Independence in a naming ceremony held at Ulsan in February 2014. The ship arrived in Klaipeda Port to start operations during December 2014.

The LNG terminal project, of which 72.32% is state-owned, is being implemented by Klaipedos Nafta. The terminal is located at the southern part of Klaipeda sea port near Kiaules Nugara Island. It has a regasification capacity of around 400,000scf/d and is powered by a dual fuel diesel electric propulsion system.

The Independence

It receives and stores LNG on the FSRU, which regasifies it to its original form, and supplies the main transmission system. The main components of the terminal include the LNG FSRU, a 450m-long jetty and associated facilities, and an 18km-long gas pipeline connecting the terminal to the gas metering station.

The Independence’s storage capacity is significant – at 6 million cubic feet or 170,000 cubic metres - it can handle almost 140 billion cubic feet a year of natural gas. This means the FSRU has the capacity to supply 100% of Lithuania’s current demand of natural gas, allowing them to forgo reliance on pipelines and unpredictable Russian supplies. Until recently Lithuania – like many of its neighbours – had relied almost exclusively on Gazprom to fulfil domestic consumption demands. More Baltic nations are now following Lithuania’s lead, turning seaward for energy supplies rather than to the traditional overland gas pipelines. Poland is in the process of preparing an LNG import terminal of its own, projected to be complete next year. Poland's Świnoujście LNG terminal, is to be completed in May 2016. If the Independence model proves successful, other Baltic nations will almost certainly follow suit.

The Baltic states are actually quite well-connected with pipelines and have decent infrastructure connecting all three countries with pipelines connecting all three countries. This has been the case for over the last 10 years, but had never been used for trading because each of the countries had their own suppliers and no trade was arranged with others, despite the significant differences in price

Now, Lithuania traders are currently supplying around 20% of Estonia's natural gas supplies and look to supply more to the Baltics as well as to the larger Polish market.

In addition, the U.S. is negotiating with both Bulgaria and Greece to deliver LNG to receiving terminals in those countries including a new floating LNG reception, storage and regasification unit to be built in the Alexandroupolis region close to the borders with Bulgaria, a project facilitated by the GasTrade Company belonging to Copelouzos group. Gas Trade, together with the Greek DEPA Company and the US based Cheniere, has established a mutual holding corporation that will manage the installation and import of LNG sourced from US shale gas. Once gas reaches Greece, it will be gasified, transferred within the Greek internal transmission system and then exported to Bulgaria.

The Floating Offshore Marine-Based Gas Train (FNLG)

In addition to the vessels like the Independence which can create an almost instant LNG import facility in the port, Shell has pioneered the use of a floating vessel to liquefy natural gas at sea.

After years of discussion and investments, the first Floating LNG project, Shell's Prelude, was announced in 2011. Today there are over twenty other FLNG projects and its business is sized to exceed 60 Billion USD for the next decade.

While liquefaction is traditionally performed onshore, Floating LNG literally displaces the entire process to the top of a vessel, located nearby a subadjacent offshore gas field. Thanks to this shift, the need for an extensive pipeline structure to shore as well as a production platform is eliminated, thereby potentially reducing the cost of taking the gas to the market. Moving the liquefaction offshore also facilitates the permitting process, reduces the risks for neighbouring communities as well as the impact on the environment. Additionally, there is a possibility to relocate the vessel at the end of its project life to a different offshore point.

By stacking components vertically and using deep-sea water to cool the gas to its liquid state, the FLNG saves dramatically on deck space and enables the whole facility to occupy an area of roughly 4 football pitches: 28,500 square meters. One of its most innovative features involves the plant's unique cryogenic scheme: an assembly of eight one-meter diameter pipes will extend 150m below the ocean's surface, delivering around 50 million litres of cold seawater an hour, used to cool the gas.

With the scheduled February delivery of US LNG to Klaipeda the international market for gas will change dramatically. U.S. companies have already invested $60 billion in building four giant export schemes on the U.S. costs to seek to feed U.S. gas to the many under-used import terminals in Europe. With U.S. exports set to top 60 million tonnes/year in 2019, EU regulators see LNG as the solution to rising Russian market dominance as they challenge the legality of Russia's Gazprom's pipeline strategy.

The Need For U.S.-Built Ships

As the export of LNG grows in the U.S. there is a concomitant need for LNG carriers to deliver this gas worldwide. By year-end 2015, there were 62 mmtpa of LNG production capacity under construction. which would make the United States the world's third largest LNG exporter by 2020. These volumes will push down prices, increase flows to "sink" markets, and create a surplus of LNG that can be used to create new demand. More importantly, additional LNG could be available for export. According to representatives from these five facilities, their liquefaction capacity has already been sold mainly through 20-year contracts and their customers are responsible for transporting the LNG to export markets. These are primarily FOB contracts. Based on estimates from these liquefaction facilities, transport of the full capacity of these liquefaction facilities will require about 100 or more LNG carriers.[ii]

Most of the worldwide fleet of LNG carriers are foreign built and operated. LNG carriers have not been built in the United States since before 1980, and no LNG carriers have been registered under the U.S. flag. Under the Merchant Marine Act of 1920 (the Jones Act) foreign flag vessels are prohibited from cabotage in U.S. It requires that all goods transported by water between U.S. ports be carried in U.S.-flag ships, constructed in the United States, owned by U.S. citizens, and crewed by U.S. citizens and U.S. permanent residents. This protects the U.S. maritime industry but adds dramatically to the cost of operating these vessels.

Environmental and labour rules tend to inflate the cost of operating U.S. ships, and critics cite a 2011 Marad study that put the average daily operating costs for foreign-flag operators at $7,454 compared to $20,052 for U.S. ships — a difference of more than $12,500 a day. The biggest difference is in crew costs. The proposed requirement to transport exports of LNG via U.S.-built-and-flagged carriers currently under consideration by Congress could expand employment for U.S. mariners and shipbuilders if it does not reduce the expected demand for U.S. LNG. According to representatives of U.S. mariner groups, between 4,000 and 5,200 mariners would be needed to operate the estimated 100 LNG carriers needed to transport the five U.S. facilities' full capacity of LNG once the five are fully operational.

Congress has voted against any dilution of the Jones Act rule for the LNG vessels but it is not entirely clear that loading an LNG cargo and sailing for Europe or Asia constitutes cabotage. The U.S. may have to continue to make FOB sales of LNG instead of earning the value-added of CIF deliveries as long as the Jones Act constraints stay in place.

The Pricing of U.S. LNG Exports

Despite the efforts of OPEC, especially the Saudis, to drop the price of crude oil dramatically, the U.S. LNG industry is diminished but thriving. That is because the extraction of shale gas in the U.S. is more constrained by an inability to store the gas than by the cost of its production.

While growth in the U.S. fracking business is very positive there are some unusual characteristics of this form of extraction which acts as a constraint on its expansion. These fracking wells yield a high volume of product immediately after drilling but the yields tend to decline rapidly during the first year and then more slowly over time.

When a new well is drilled it penetrates a rock unit with abundant gas, sometimes under pressure. These new wells can yield at a very high rate, but over time - as gas escapes from the well - the pressure in the formation goes down and the result is a well with a lower rate of yield

Most lower yield wells produce one to two million cubic feet per day in the first month. Many wells yield between three and five million cubic feet per day, but gigantic wells could produce as much as twenty million cubic feet per day. The more the well yields in the first month the more valuable it generally will be over time. A typical well might yield as much as half of its gas in the first five years of production. Wells might then continue to produce for a total of twenty to thirty years but at lower and lower production rates. So it is necessary to keep drilling new wells to keep up the production levels on the acreage available,

Year	Initial Production	Closing Production	Decline from Previous Year	Annual Royalties $4/mcf Gas 12.5% Share
First	2.0 Mmcf/d	0.70 Mmcf/d	68%	$207,605
Second	0.70 Mmcf/d	0.36 Mmcf/d	41%	$82,037
Third	0.36 Mmcf/d	0.25 Mmcf/d	27%	$53,327
Forth	0.25 Mmcf/d	0.19 Mmcf/d	24%	$38,966
Fifth	0.19 Mmcf/d	0.15 Mmcf/d	19%	$29,536
Sixth	0.15 Mmcf/d	0.12 Mmcf/d	18%	$23,428

TABLE: Production decline statistics from a hypothetical natural gas well in shale with horizontal drilling and hydraulic fracturing.

This is known as the "Red Queen Effect. Most oil and gas companies who drill some of the first wells in a new natural gas area do not often have a way to deliver their gas to market from the new site. To obtain delivery from the well site to the pipeline they must enter into contracts for the gas with a natural gas pipeline company. The producing oil and gas company promises to provide a specific amount of gas per day and the pipeline company promises to provide transmission capacity.

So if, for example, an oil and gas company plans on drilling fifty wells during their first year in a new shale play they must then then contract with a pipeline company who will transmit that gas to market. One year after these wells are drilled their production rate may have fallen by 60 to 80%. So, to meet the amount of gas promised to the pipeline the oil and gas company must drill at least 30 to 40 new wells to make up for the drop in production. At the end of the second year the company has first year production drops on all of its new wells and second year production drops on all of the wells drilled in the first year. This forces the oil and gas company to keep drilling to keep up with its promise to the pipeline.

That's why it is called the "Red Queen Effect". It is named after a character in Lewis Carroll's Through the Looking-Glass novel. The Red Queen lectures Alice: "Now, here, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!"

Another fundamental drag on the full utilisation of the fracking method is that there is an urgent need to have a storage facility on or near the site so that the gas can be contained before it is put into the pipeline or sent to a nearby plant and converted into ethylene and polyethylene for the plastics industry. Without this storage or conversion process to contain all the gas produced, the U.S. fracking industry has been burning off ("flaring") a large percentage of its production before it ever reaches the pipeline. In August 2014 the North Dakota Industrial Commission announced that the August capture percentage was 73 percent with increased daily volume of gas flared from July to August of 23.5 million cubic feet per day. Before the improvements the historical high flared percent was 36 percent in September, 2011. As the retention and intermediate storage capacity increases at the fracking site the decline in well output is compensated for by reduced flaring. Once these storage facilities are built they can be used for the replacement wells without extra cost as they come on stream.

In the early days of horizontal drilling and hydraulic fracturing of shale it was customary practice to allow the well to produce at full capacity as soon as it was placed on line. This produced rapid income for the company and helped generate enough funds to build intermediate storage facilities to reduce flaring. Recent experiments suggest that throttling the production of a new well might result in a longer productive lifetime for the well and a greater total recovery of gas. The theory behind this is that rapid initial production allows the pore spaces in the shale to deflate unevenly. Pores near the well collapse first as the gas rapidly moves to the well and that causes more distant gas to be trapped within the formation. Slowing the production rate allows the pores to deflate more evenly and allows an orderly, more efficient and more complete gas recovery.[iii] This very much like the introduction of techniques to recover capacity in "stripper wells" in oil extraction.

Now, with the development of export trains for removing gas from the U.S. storage constraints and the opening of export markets it will be much easier to invest in connections from the wellhead to the pipeline and reduce the need for flaring of the gas for want of storage. This will help maintain a low price for the LNG in the U.S. domestic market and an attractive price on the world scene.

The best advantage for U.S. LNG is that it is not pegged to the oil price. This has resulted in a new pricing regime in LNG markets and undermines oil indexation, which has already been dethroned in NW Europe. It clear that US LNG will be sold in prices linked to Henry Hub: LNG might leave the United States under one pricing system and arrive under another (linked to NBP, for example, or oil, or spot prices). And while there is some effort to incorporate Henry Hub pricing in non-US contracts, those efforts have been limited so far. iv US natural gas spot prices in 2015 at the Henry Hub in Louisiana, a national benchmark, averaged $2.61 per million British thermal units, the lowest annual average level since 1999, the US Energy Information Administration said

U.S. LNG is sold FOB without territorial restrictions, which means that the supply of destination-flexible LNG will grow substantially. The short-term / spot market is about 65 to 70 mmtons, so the addition of another 60 mmtons of LNG that is contractually free to be sold on the spot market is a big deal. v The market for LNG is expanding rapidly domestically and internationally as it is being adopted as the fuel of choice in land-based and maritime transport.

The Growing International Market for LNG as A Fuel

The move to LNG-fuelled vessels has been termed a revolution for the shipping industry both for its lower cost and its environmental impact. Burning LNG as a marine fuel can reduce up to 95 percent SOx, nearly 100 percent particulate matter, 90 percent of NOx and up to 25 percent CO2. It also allows ships to meet MARPOL Annex VI requirements (Reg13 NOx + Reg14 SOx), the E.U. Sulphur Directive requirements (Directive 2012/33/EU) and promotes the implementation of the Alternative Fuels Infrastructure Directive (Directive 2014/94/EU).[vi]

Many vessels are being converted to run on natural gas, both LNG and Compressed Gas. Several new vessels have been built which run entirely on natural gas. The Harvey Power, the second LNG-fuelled OSV operating in the United States, entered service in October 2015. The vessel is working for Shell Upstream America's deep water operations in the Gulf of Mexico. Harvey Power is the second of six LNG OSVs being built for Harvey Gulf International Marine by Gulf Coast Shipyard Group, and like its sister ship, Harvey Energy, Harvey Power is capable of operating on LNG or diesel fuel. When operating on LNG, the Harvey Power can operate in excess of 19 days in normal Gulf of Mexico rig supply mode between refuelling.

In late October 2015, Crowley Maritime announced that construction of the first of two LNG-powered, combination container (ConRo) ships reached an important milestone with the installation of three LNG fuel tanks. The double-walled, stainless steel tanks – which are 110 feet in length and 20.6 feet in diameter – weigh 225 tons and will hold more than enough LNG fuel for two round-trip voyages between the vessel's future ports of call, Jacksonville, Florida, and San Juan, Puerto Rico. The two Jones Act vessels, which will be named El Coquí and Taíno, are currently under construction at VT Halter Marine.vii

On 16 October 2015 General Dynamics NASSCO has delivered the world's first LNG powered container ship, the Isla Bella, to TOTE Maritime. The ship was delivered nearly two months ahead of schedule. As part of a two-ship contract signed in December 2012 with TOTE, the 764-foot long Marlin Class container ships will be the largest dry cargo ships powered by LNG, making them the cleanest cargo-carrying ships anywhere in the world, says the shipbuilder. This green ship technology will dramatically decrease emissions and increase fuel efficiency when compared to conventionally-powered ships, the equivalent of removing 15,700 automobiles from the road.

It is also leading to the growth of an LNG or compressed gas worldwide bunkering industry to service these gas-powered vessels.

The Growth of A Spot Market In The Charter of LNG Vessels

Perhaps one of the most important changes in the LNG market is the growth of a spot market for the carriage of LNG worldwide. For many years each LNG project was tied to the operation of a dedicated vessel. Contracts of affreightment were made for periods of around thirty-five years. Each vessel was tied to a project. While it provided security to the exporters it was maddeningly irrational for the shipping market. It meant that the cargo capacity of LNG vessels was only used for half its voyage. It completed its carriage of LNG and then sailed home in ballast, just as oil tankers used to do. So, for example, if a LNG vessel loaded in Woodside in Australia it often delivered its cargo to Lake Charles in Louisiana and then sailed back in ballast to Australia. This was a very expensive way to ship. The trip back to Australia was made in ballast.

It was pointed out that if the vessel, having discharged in Lake Charles it could then sail to Trinidad and load a cargo of LNG for Spain; discharge in Spain; sail from Spain to Algeria to pick up another cargo; deliver that cargo to Turkey; sailed from Turkey to Qatar where it could pick up a cargo for Korea; then said back from Korea to Australia. This was pretty much the route it would take in ballast anyway. Picking up and delivering these return cargos would only add about twelve extra days to the voyage but would have transported (and earned money on) four extra cargos. The problem was that there was no spot charter market for LNG vessels.

Now, with the increased interest in the development and expansion of the LNG trade there is a concomitant development of a spot market for LNG vessels. In August 2015 Dynagas Ltd., GasLog Ltd. and Golar LNG Ltd. agreed to jointly market their liquefied natural gas tankers for spot charters as trading of flexible cargoes widens. The 'Cool Pool', the first-ever LNG carrier pool, opened in September with fourteen ships.

Dynagas and GasLog will each contribute three vessels, while Golar will provide eight ships. Owners will continue to be fully responsible for each tanker's manning and technical management. The number of ships in the pool may increase over time. Now, there are between 40 and 60 ships operating in the spot market. Global LNG trade will double to about 500 million metric tons a year by 2030, expanding the total fleet to as many as 1,000 vessels from about 400 ships now.viii

THE ROSY FUTURE OF THE GAS INDUSTRY

The expansion of the U.S. shale gas industry is a game-changer for the world's energy industry. The drop in oil prices, initiated by the Saudis to diminish the attractiveness of investments in the U.S. shale oil and gas industry, was a major factor in the willingness of the U.S. Administration to repeal the 1972 act which restricted the export of oil and gas. The key to the success of the U.S. shale industry is the ability of the U.S. to export the products overseas. Without that outlet, prices in the U.S. would rise because of the increased costs of storage and the cost of carrying an expensive inventory.

Now it is possible to use the earnings of the throughput to finance better interim storage facilities at the well sites which can reduce flaring to a minimum. The political advantages of the U.S. assumption of a major role as a trading nation in the international energy market is very important for U.S. foreign policy. One of the major effects of global warming is that, in many areas of the world, the vast permafrost regions of the world are thawing. Russia is experiencing a doubling of the rate of warm-up of its environment in Siberia, making the exploitation of new fields and the maintenance of existing fields much more expensive.

Russia also has a very big problem with the increase in gas generated by its extraction of oil. Russia is wasting $3.6 billion a year by burning off unsellable fossil fuels at the wellhead. Constrained by international sanctions and entering its first recession in six years, Russia is unable to invest enough to stop the practice known as flaring. The result is that the nation's oil industry leads the world in flaring natural gas -- setting alight supplies where they are produced because it's not profitable bring them to market. While those volumes have been dropping substantially since 2009, Russia's waste is more than double the next biggest offender. The predicament is that Russia, whose main export earnings come from oil, can't afford to cut back on flaring at the moment. The gas that's being burned off comes up with oil produced for export. [ix]

Options such as erecting a gas pipeline for this flared gas to markets, building power plants to use the gas or re-injecting it at the wellhead all require greater funding; funding which is scarce due to sanctions, the fall of the value of the rouble and the high levels of inflation. So, as Russia increases its production of oil, as it has been doing, it is also increasing the volumes of natural gas which it is flaring off at the well sites. If it cannot recover that gas and send it through pipelines to its international customer base it will lose money, opportunity costs and political clout. That is why the opening of a U.S. gas export industry is a major threat to Russia as its customers abandon Russia for a safer, less political, supply from the U.S.

It will be difficult for Russia to regain its dominance of the European energy market and the building of LNG receiving terminals from the Baltics to the Balkans to receive LNG from all the word's suppliers will have a major impact on the Russian economy and the bluff and bluster of its foreign policy.

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[i] Stan Jones, "LNG Carriers Called Floating Pipelines", Alaska Natural Gas 29 April 2014

[ii] "U.S. Needs 100 LNG Ships, 30 Years", MarEx 2015-12-07"

[iii] "Production and Royalty Declines in a Natural Gas Well Over Time", Geology.com. 11/13

[iv] Nikos Tsafos , "Why US LNG Matters" Natural Gas Europe January 6th, 2016

[v] Ibid

[vi] Wendy Laursen, "The LNG-As-Fuel Revolution" Marex 2015-10-23

[vii] Ibid

[viii] "LNG Vessel Owners Form First Ship Pool as Spot Trade Expands", International Shipping News 19/08/2015

[ix] Stephen Bierman, Elena Mazneva, "Russia's Effort to Limit Pollution Is Going Up in Smoke", Bloomberg July 1, 2015