The LNG Logistics chain

BUSINESS WHITE PAPER

The purpose of this paper is to give an overview of the effect of the LNG logistics on the end-user price of LNG.

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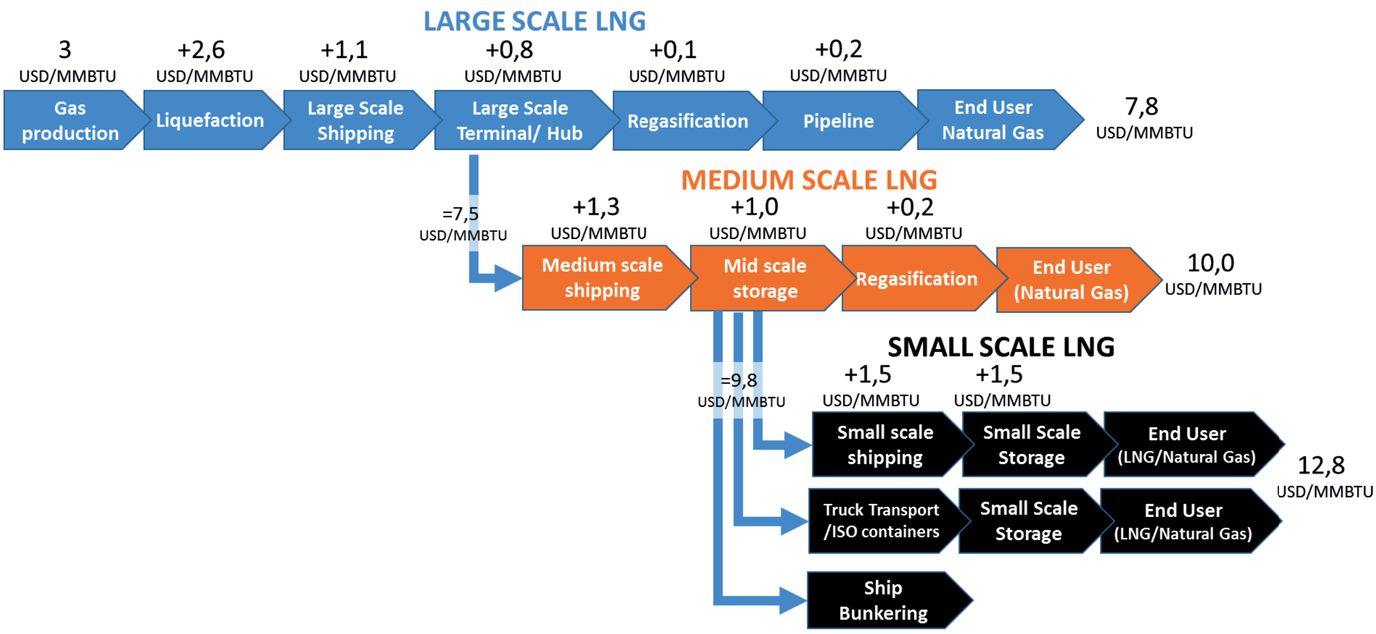
‘Cost Adders’ along the logistics chain

The final cost of LNG at its eventual destination will largely be dependent on the length of the logistical chain. The main influencing parameters in this are the source cost of the LNG, the location of the LNG liquefaction plant versus the final destination, the size and route of the LNG carrier, the size and location of the receiving terminal(s), the utilisation of BOG in the users' processes, and their requirements regarding the availability of gas.

Fig.1 Typical values for the cost contributors or “add on costs” in the LNG logistics chain.



Let us take the example in Figure 1 above. The starting cost is the Henry Hub index, which is the pricing point for natural gas futures contracts traded on the New York Mercantile Exchange (NYMEX) and the OTC swaps traded on the Intercontinental Exchange (ICE). Assuming the Henry Hub price to be 3.0 USD/MMBTU, our example looks at what happens to this price when delivered from the Southern US gas network to a consumer on an island somewhere in Asia.

To make this possible there are a few steps, all of which affect the price, along the way. First of all, the gas needs to be purchased and sent to a liquefaction plant in the USA. The cost for liquefying the gas depends on the cost of transferring the gas from the Henry Hub priced pipeline to the liquefaction plant. To this must be added the investment and running costs of the liquefaction plant, plus storing the LNG prior to an LNG carrier coming to load it. The combined “add on cost” for all of this could be in the +2.6 USD/MMBTU range.

Additionally, while loading the LNG carrier there will be some port fees and in transit, potential canal fees as well. Passing through the Panama canal with a 173,000 m3 vessel will cost around 380,000 USD, which would add 0,1 USD/MMBTU to the cost of the LNG. However, the major shipping costs will come from the fuel used during the journey, plus the daily ship charter rate. The total shipping related costs will naturally depend on the ship’s size and the length of the voyage. In this example we have assumed an add-on cost of +1.1 USD/MMBTU to cover all the shipping related factors.

Upon reaching the destination, the LNG is unloaded from the carrier to the receiving terminal. The investment and operating costs for a receiving terminal, plus the harbour fees can add a further +0.8 USD/MMBTU to the LNG’s cost. To that we can assume an approximate addition of 0.1 USD/MMBTU for regasification and another 0.2 USD/MMBTU for the pipeline fee. This will then all add up to a gas price of about 7.8 USD/MMBTU for the consumer at the end of the gas pipeline.

If the end user needs smaller amounts of LNG than the large LNG terminal is willing or able to sell, he will need to purchase via medium scale operators. In that case he would be able to buy LNG for 7.5 USD/MMBTU from the large terminal, to which would be added the mid-scale logistical costs. The final price for the mid-scale consumer would then be in the range of 10,0 USD/MMBTU.

Finally, for small scale users, there would be another smaller storage with the LNG being shipped either with a small size carrier, or an LNG truck/ISO Container. The final price here might be as much as 12.8 USD/MMBTU.

Thus, in this theoretical example, for the small gas user on an island somewhere in Asia, the original Henry Hub price of 3.0 USD/MMBTU will end up being 12.8 USD/MMBTU at his final destination. As a comparison, LNG sold in ISO containers FOB Miami is ranging from 10- 16 USD/MMBTU.

Optimising the logistics chain

Since the major cost of producing electricity is the fuel, there is a huge difference if the cost of fuel is 3 USD/MMBTU instead of 12.8 USD/MMBTU. It is, therefore, in the end users' interest that this value chain is as cost efficient as possible. There are several means of optimising the LNG logistics chain in order to reduce the cost of LNG or gas at the final destination. The logistics chain, which incorporates the large, medium, and small-scale chains can be very complex. To be able to optimise this complex chain with lots of variables, Wärtsilä has developed an LNG Value Chain optimisation tool. This tool estimates, through an iterative process, the cost of LNG at its final destination(s). The tool requires various inputs, such as:

- the consumers (location(s), consumption profile, cost vs. feasibility)
- gas availability requirement
- supply (location(s), suitability, cost)
- receiving terminals (need for break-bulk, location, type, sizes, investment cost)
- shipping (route, shipping, charter-rate, fuel consumption)
- Boil Of Gas (BOG) handling
- financing (ownership arrangements, cost of capital, pay-back time)

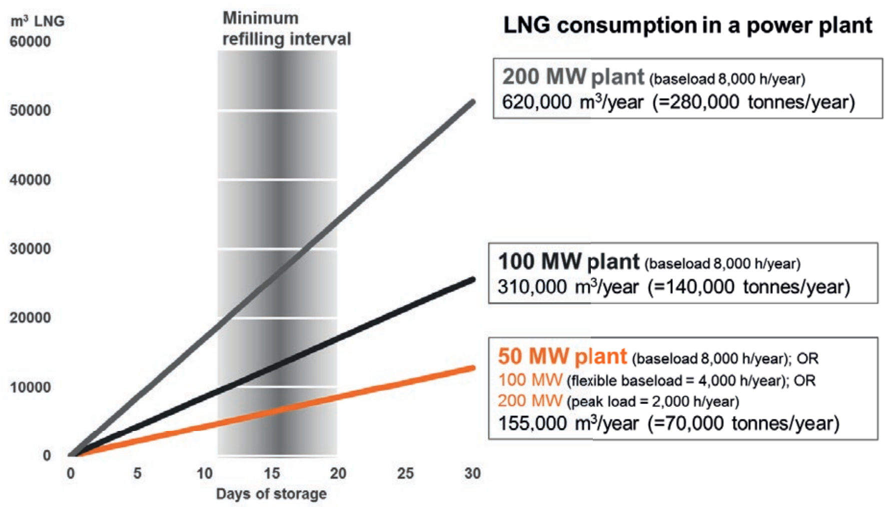
The tool works in such a way that first one defines the consumers, the locations, and the anticipated consumption profile. Based on this the logistics are analysed in order to decide where to get the LNG, and where the receiving location(s) should be. There can be several different end terminals and consumer locations. Depending on the exporting terminal's compliance with smaller ships, it can also be decided if a large breakbulk intermediate terminal is needed. Then, based on the number of terminals and their sizes, the size of ships and the routings can be proposed.

Thus, with all the basic parameters in place and the basic set-up prepared, the optimisation/iteration starts whereby the parameters, including the LNG purchase price, the terminal EPC cost, and the charter rates are simulated to arrive at the optimal solution giving the lowest cost of LNG at the final destination, dependent on various scenarios.

LNG consumption & load profiles

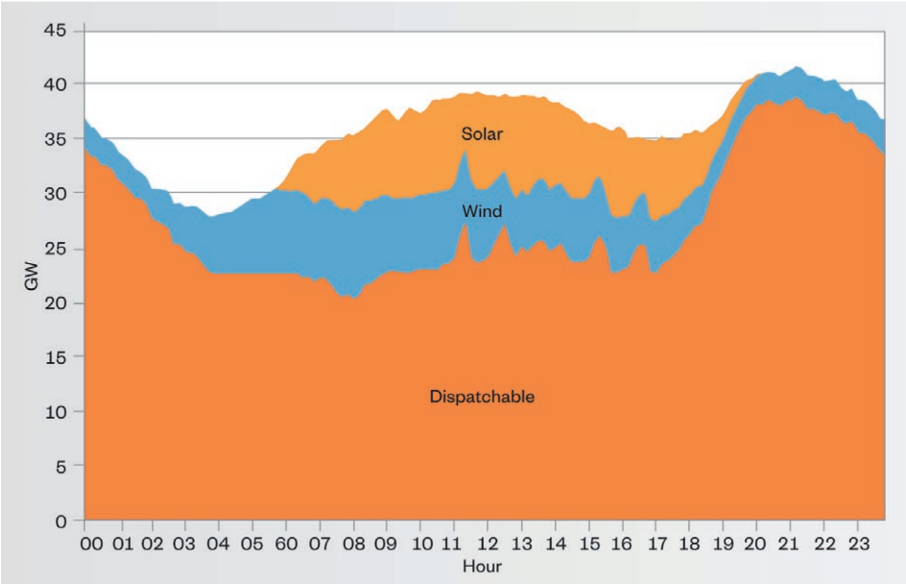
When optimising the logistics chain we need to start from the consumers, because without consumers there is no business case. It makes sense to cluster together as many consumers as possible in order to create some economy of scale in the chain. In areas previously lacking gas or LNG, the LNG consumption typically comes from industry, power plants, or transportation - both land and sea. Industries can benefit from changing from other fossil fuels to LNG, which is always a cleaner fuel and in some cases, largely depending on the economics of the LNG logistics chain, having even a lower cost. New gas power plants and existing diesel or HFO power plants have probably the biggest potential for increasing gas consumption. The marine industry is also faced with new legislation that will force ships to start changing from HFO to a cleaner fuel, such as LNG.

Fig.2 Typical consumption and storage size for gas power plants.



When considering power plants, it is important to understand the operating profile and corresponding gas consumption. Most gas power plants today will not run a baseload supply, but will rather compensate for the intermittent production from renewable energy sources or follow the varying load of the residential and service sectors. In other words, the actual gas consumption will not be the same as the rated max capacity multiplied by the specific fuel consumption of the power plant. This is important to understand when designing the LNG infrastructure. An advantage with gas stored as LNG, is that it gives greater flexibility for a varying load and power factor, and is not dependent on the natural gas pipeline's fixed capacity.

Fig.3 Dispatchable energy production supporting wind and solar.



By clustering together several consumers and increasing the volumes, LNG can be purchased at a potentially better price and larger supply ships with lower specific shipping costs can be utilized. But at the same time, with several consumers in the loop, complexity is added to the logistics and a plan for how to break up the distribution of the larger amount of LNG into many smaller consumers is needed. This might call for some additional infrastructure to be built. The additional cost of this infrastructure has to be balanced against the lower cost of the source LNG.

Consumers will, unless forced by legislation, normally decide whether it is worthwhile changing fuel based on the estimated cost of LNG. At the same time, the cost of LNG will depend on the number of consumers ready to start using LNG. This is an iterative process where adding more consumers will make the value chain more economical, thereby reducing the final LNG price, which in turn will further attract more consumers. But because of the heavy investments needed to get the LNG logistics chain started, it is always difficult to be the first consumer in a new location with an undeveloped logistics chain. This is the classic chicken and egg situation that can best be resolved by finding a major anchor customer and appointing a strong project leader.

The LNG supply

Global LNG prices are determined by a few regional pricing mechanisms. For example, the typical set up in various regions is as follows:

The Americas: In the western hemisphere (North and South America) prices are based on the so-called Henry Hub system. This price is relatively low today at 3-4 USD/MMBtu and is under pressure to stay low due the large amounts of shale gas in the US. US liquefaction capacity is also decoupled from the ownership of gas molecules. Consequently, LNG prices can be kept low and contracts remain flexible.

Europe, Russia, Africa: In Europe, Russia and North Africa the gas market is a mixture of some LNG but mostly pipeline natural gas. The LNG price in Europe is in some cases oil-linked, and in some cases linked to the two major gas exchange hubs, NBP and TTF. Gas prices in these European main hubs are today in the range of 7-8 USD/MMBtu.

Asia: The Asian market has traditionally been very LNG dependent, led by Japan, South Korea and China. The LNG prices in Asia have earlier been the highest in the world, but have dropped from levels of 14-18 USD/MMBtu seen a few years ago down to the same as European levels, i.e. USD 7-8/MMBtu but with a slight increase lately.

When it comes to LNG supply, it is important to understand that only a few of the existing export terminals are able to take small size (<40,000 m3) LNG carriers. Therefore, in order to get LNG in smaller amounts, there needs to be a break-bulk terminal in-between. There are some technical issues to overcome, with the jetties planned for large carriers needing to be capable of handling the smaller carriers, but the main reason why the large terminals do not take small size carriers is the risk of disturbing their large scale operations.

The delivery terms and cost of LNG are the most important factors when choosing the supplier. In particular, large scale contracts can be concluded in various different ways today, with possibilities to choose oil price linkage, market based pricing, or a combination of both. Small-scale buyers will probably not have the same flexibility. To obtain the lowest price today, the best bet is most likely to be a stable, fairly short-term contract with a minimum take or pay contract. For large scale customers that are able to buy spot cargos, that might also be a wise decision while delaying the signing of long-term contracts as there is much more production now coming online, putting downward pressure on prices.

LNG terminals

The receiving and re-distribution terminal can be of many types. The choice of terminal will depend on the site locations and the volumes required.

For large onshore terminals, flat bottom concrete tanks are the most commonly used. For smaller sizes, pressurized steel tanks (or Type-C bullet tanks) are becoming popular.

For large-scale terminals there are possibilities to employ an off-shore solution, either with an FSRU (Floating Storage and Re-gas Unit) or an FSU (Floating Storage Unit) with a re-gas unit mounted on the jetty. Projects have also been planned using old LNG carriers serving as FSUs. These old LNG carriers can be purchased at a low price because they are not economical to use as carriers anymore due to their old and inefficient steam engines.

In locations where an on-shore location is not suitable and the gas amounts are too small to make an FSU or FSRU feasible, Wärtsilä's LNG storage and re-gas barge can be the best alternative.

LNG shipping

Large-scale shipping is already well established and today there is an overcapacity of large scale carriers. For the older less efficient LNG carriers, there has been a drastic reduction in charter rates during the last year. But when it comes to small-scale carriers there is a lack of ships today, and in many cases the charter rate for a small-scale carrier might be the same as for an older larger carrier. The shipping of LNG between the FOB sales hub and new terminal can be arranged in three ways:

1) operating one's own LNG carrier;
2) contracting a carrier from the market place
3) arranging transport through an LNG provider.

For the first two options, freight volumes should be sufficiently large so that in-house organisations can be established to manage this. The third option is the norm when volumes are small or moderate. In this case the entire supply chain and associated risks can be sub-contracted as a single package to LNG providers.

Conclusion

To assess the purchase price of LNG, it is important to understand how the entire LNG logistics and value chain will affect the final cost. To illustrate this, the various pricing ‘add-ons’ have been evaluated to gauge their influence on the end-user cost. Wärtsilä has developed an optimisation tool that uses input from various sources and an iterative process to establish the cost of LNG at its final destination. The landed cost of LNG can be drastically reduced by clustering together several consumers, thereby increasing the volumes purchased. This allows for better purchasing prices and the use of larger LNG carriers, which lowers the specific shipping costs.

For power plant and shipping companies using LNG as fuel, the purchase price of LNG has the biggest impact on the cost of the fuel and it is worth shopping around to find the cheapest supplier. The terminal investment cost also has a significant impact on the final cost. Furthermore, the shipping component of the cost may contribute to an even bigger part of the final LNG cost, unless it is well planned.

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