WÄRTSILÄ MOBILE LNG: EASILY THE BEST
THE FASTER, CLEANER, MORE FLEXIBLE AND RELIABLE ROUTE TO LNG POWER GENERATION

As the current LNG infrastructure is mostly large-scale and of limited reach, wide-spread implementation of the Wärtsilä Mobile LNG for medium- and small-scale consumption could democratize this clean and safe fuel.

“...The spot trading market in oil has been so dominant that the infrastructure has been built to reflect this dominance. But now we see that the balance, as well as the politics, are changing,” says Reidar Strande, Director Midstream, Wärtsilä Gas Solutions.

“In the past, the LNG infrastructure was huge because of the necessity to achieve economies of scale. Now, however, the market is driven also by environmental pressures and by the fact that many countries want to reduce their dependence on oil.”

In some places, where policymakers are ready to diversify the energy mix, LNG could ultimately help to lower electricity prices. The businesses, communities and households that would stand to gain represent untapped markets for oil and gas majors and utilities looking to extend their reach – a clear win-win situation.

This is not to mention the environmental gains from weaning away from oil.

With a smaller format than the current LNG infrastructure, a widened implementation of LNG could alter the gas equation fundamentally. Building the LNG system on a barge makes it even more flexible. And Wärtsilä is in pole position to make it happen.

“We have an understanding of the entire LNG value chain and therefore we’re in a good position to help different stakeholders come together and make this happen,” says Kenneth Engblom, Director, LNG Business Development of Wärtsilä Energy Solutions. “A barge-mounted solution is a quick and reliable way to get LNG delivery started also on a small scale.”

BARGING IN ON SMALL TO MEDIUM SCALE LNG POWER GENERATION

Floating an idea has never been more apt a metaphor, as Wärtsilä proposes an all-in-one barge that receives and regasifies LNG for power generation and distribution. The Wärtsilä Mobile LNG solution could unleash the economic potential of many regions struggling to reinvent their energy mix and lower electricity prices.

As the current LNG infrastructure is mostly large-scale and of limited reach, wide-spread implementation of the Wärtsilä Mobile LNG for medium- and small-scale consumption could democratize this clean and safe fuel.

“The spot trading market in oil has been so dominant that the infrastructure has been built to reflect this dominance. But now we see that the balance, as well as the politics, are changing,” says Reidar Strande, Director Midstream, Wärtsilä Gas Solutions.

“In the past, the LNG infrastructure was huge because of the necessity to achieve economies of scale. Now, however, the market is driven also by environmental pressures and by the fact that many countries want to reduce their dependence on oil.”

In some places, where policymakers are ready to diversify the energy mix, LNG could ultimately help to lower electricity prices. The businesses, communities and households that would stand to gain represent untapped markets for oil and gas majors and utilities looking to extend their reach – a clear win-win situation.

This is not to mention the environmental gains from weaning away from oil.

With a smaller format than the current LNG infrastructure, a widened implementation of LNG could alter the gas equation fundamentally. Building the LNG system on a barge makes it even more flexible. And Wärtsilä is in pole position to make it happen.

“We have an understanding of the entire LNG value chain and therefore we’re in a good position to help different stakeholders come together and make this happen,” says Kenneth Engblom, Director, LNG Business Development of Wärtsilä Energy Solutions. “A barge-mounted solution is a quick and reliable way to get LNG delivery started also on a small scale.”
WHY WÄRTSILÄ MOBILE LNG?

- Enables efficient use of smaller quantities of LNG than previously possible
- Overcomes infrastructure limitations
- Provides the flexibility to relocate according to market needs

### ALL BUILDING BLOCKS IN PLACE

The Wärtsilä Mobile LNG solution represents the perfect union of Wärtsilä’s two-pronged expertise in its Marine Solutions and Energy Solutions divisions.

“We have all the building blocks and experience to put this concept together,” says Timo Koponen, Vice President, Flow and Gas Solutions, Wärtsilä Marine Solutions. “The more so as we are the only player in the market who can build these different elements from our in-house competences and portfolio.”

The all-in-one solution includes a jetty-based LNG receiving system, LNG storage and a regasification barge. The barge can be used in combination with a fixed or floating power plant with installed capacity of up to 250MW, which is ideal for many medium-sized communities that lack or have limited access to the national grid. Its capacity can be ramped up by floating a second barge next to it; it is in fact somewhat similar to an Ikea flat-pack option – would you like to add extra drawers to your shelving unit? Or in this case, would you like the possibility of processing more LNG with your barge?

As a flexible and easy-to-set-up option, the Wärtsilä Mobile LNG could help avoid time-consuming red tape in some locations. As it can be moveable, investors should feel safe in the knowledge that should demand change, the barge could be transported elsewhere. This should open up financing options to would-be customers and facilitate a broader range of viable financial models.

“On land you can’t take your investment with you, you’re stuck, which means an investor needs to know that there is a sustainable and long-term need,” points out Engblom. “Compared to constructing conventional land-based terminals in difficult soil conditions and areas with an undeveloped infrastructure, the barge concept can represent a lower capital investment,” he continues.

A key feature of Wärtsilä Mobile LNG is accessibility – it can go almost anywhere, including places where a pipeline would never be feasible. Furthermore, the green credentials of LNG make it also the optimal fuel for emission-controlled areas.

“The Wärtsilä Mobile LNG solution has been developed for shallow water areas where access is restricted for larger vessels of more than 6 metres draft, unless major dredging operations are carried out. It is also intended for challenging locations where large-scale LNG receiving terminals are not feasible or where the quantities of the needed LNG are smaller,” Koponen says.

### SOLUTION FOR ISOLATION

The Wärtsilä Mobile LNG could be of immense benefit to islands, such as the Caribbean or Indonesia, or otherwise isolated communities. The Caribbean, for example, currently struggles with high electricity prices which, the World Bank argues, is holding back the otherwise tourist-magnet islands.

“Most small Caribbean countries, particularly the Eastern Caribbean States, depend almost entirely on petroleum to supply their electricity needs – with oil and gas expenditures taking between seven to 20 percent of a country’s GDP,” a 2015 World Bank report said. “With an average cost of electricity four times higher than in rich nations such as the United States, high energy costs are one of the key bottlenecks for unleashing economic growth and prosperity in the region.”

Of course, it’s not just consumers who stand to benefit, but the suppliers too. Many oil and gas majors have expressed interest in accessing this market, if only the LNG value chain could be expanded, noted Koponen after attending the OTC conference in Houston, TX earlier this year.

“Almost everyone had many more questions than there were answers. There is a huge demand for people who can consult the customer and sit down and think together with them,” says Koponen.

“Wärtsilä is ready,” his colleague Strande adds. “Wärtsilä is in prime position with the technology, the references, and the building blocks to enable us to make a complete offering to the customer, along the entire gas value chain.”

### THREE OPTIONS FOR BRINGING LNG ON-SHORE

<table>
<thead>
<tr>
<th>FEATURE</th>
<th>ON-SHORE (Terminal)</th>
<th>OFF-SHORE (FSRU)</th>
<th>NEAR-SHORE (Wärtsilä Mobile LNG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asset flexibility</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Weather sensitivity</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Capex</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Opex</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Small size</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>On-shore permits</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Delivery time</td>
<td>1 - 4 Years</td>
<td>2 - 3 Years</td>
<td>1 - 2 Years</td>
</tr>
</tbody>
</table>
In January 2014, Wärtsilä signed a contract to supply a liquefied natural gas (LNG) receiving terminal to be built in Tornio, northern Finland. The customer is Manga LNG Oy, a joint venture between the Finnish companies Outokumpu Group, Ruukki Metals Oy, Gasum Oy and EPV Energy Ltd.

With the Tornio Manga LNG receiving terminal, Wärtsilä is for the first time combining its strong engineering, procurement and construction (EPC) capability with its industry leading LNG gas handling technology to provide a turnkey LNG terminal solution. As LNG continues to replace oil and other fuels worldwide, Wärtsilä sees strong global market potential for medium-scale LNG distribution. The company’s market-leading LNG technology, ship designs for LNG fuelled vessels, and gas-fired marine propulsion and power plants has given Wärtsilä a leading role in end-to-end LNG systems.

The Tornio Manga LNG terminal is part of a long-term infrastructure investment programme. The beneficiaries include shipping and road transportation companies, power and heat utilities, as well as other industrial and mining companies in northern Europe. The terminal is scheduled to be ready to commence operations in early 2018.

The Tornio terminal represents a significant industrial and environmental milestone. As more and more coastal areas, including the waters surrounding the Nordic countries, are classified as Sulphur Emission Control Areas (SECAs) in order to reduce emissions, the demand for more sustainable fuels will continue to grow. As LNG contains far fewer particulates than diesel and next to no sulphur, it complies with the SECA requirements and thereby reduces emissions in this environmentally sensitive arctic region.

The delivery of the first import terminal supplied by Wärtsilä includes all the EPC work and the complete unloading, storing, and regasification equipment needed for LNG. The capacity of the LNG storage tank will be 50,000 cubic metres. In addition, Wärtsilä has also been awarded an exclusive ten year contract to provide the terminal with all necessary service and maintenance operations.

TORNIO MANGA LNG TERMINAL, TORNIO, FINLAND

Wärtsilä supplied a barge-mounted power plant to serve a mining operation in Papua New Guinea. The customer is Lihir Gold Limited, a leading global gold mining company, and the power plant provided electricity to its Lihir Island mine.

The barge-mounted plant is based on Wärtsilä 20V32 engines operating on heavy fuel oil. Since the plant was planned as being an interim solution to the company’s power needs for the site, it was decided to mount the power plant on a barge so that it can be later moved to another location when no longer needed at Lihir Island.

Extra electrical power was needed at the mine since Lihir Gold Limited is in the process of extending the facilities. In addition to the flexibility of the Wärtsilä power solution, the company also emphasised the importance of having a firm and specified delivery time.

“We were able to assure this important customer that Wärtsilä was capable of meeting the delivery requirements, and we have worked closely with them throughout the process in evaluating different solutions, scope levels and clarifications. Our past experience in providing barge-mounted power plant solutions, together with our support capabilities in the region, were both important factors in Wärtsilä winning this valuable contract”, says Sushil Purohit, Vice President, Middle East, Asia & Australia, Wärtsilä Energy Solutions.

A barge-mounted power plant solution has the excellent advantage of location flexibility, and is, therefore, an ideal solution for producing power on an interim basis. Wärtsilä has earlier supplied some 20 power barges to the Philippines, Jamaica, the Dominican Republic and Bangladesh.

FLOATING POWER BARGE TO PAPUA NEW GUINEA
Wärtsilä has supplied an LNG regasification plant for an import facility constructed for Petronas Gas Berhad, in Malaysia.

The Petronas LNG regasification facilities in Mukim Sungai Udang, Melaka, have a capacity of 3.8 million tonnes per annum. The facility imports LNG, stores it in a Floating Storage Unit (FSU) and vaporizes it in the regasification unit.

Reidar Strande, Director Midstream, Wärtsilä Gas Solutions, said: “With gas being fed directly into the peninsula’s gas distribution network, this project represents another example of the way offshore regasification is increasingly becoming a critical part of the energy supply chain in Asia.

“In principle, the Wärtsilä regasification installation features similar technology to that supplied in the breakthrough shipboard equipment delivered to Golar Freeze, Golar Winter and the forthcoming Golar Khannur,” said Mr Strande. “However, this regasification module was placed offshore as part of a fixed jetty, demonstrating the flexibility of our design.”

The Jetty Regas Unit (JRU) was constructed in the harbour of Sungai Udang, some 3km away from shore. It was designed for two permanently moored FSUs (130,000m$^3$ capacity each) and the berthing of an LNG carrier (ranging from 130,000m$^3$ to Q-flex 220,000m$^3$ in capacity).

Wärtsilä’s scope of supply included the complete regas unit, seawater filters, and training, which included use of a simulator at Wärtsilä’s premises in Norway. Wärtsilä also provided start-up, commissioning and two years of operational support, as well as spares, inspection and testing services, commissioning assistance at the yard, and performance testing.

South Korean shipyard Hyundai Heavy Industries (HHI) has placed two important contracts with Wärtsilä for seawater/propane based regasification modules. The systems are to be installed on FSRU (Floating Storage and Regasification Unit) vessels owned by Höegh LNG, the Norway based leading owner and operator of floating energy solutions, and by Russian energy company Gazprom. The contracts were signed in July 2015. There is also an option for a further contract from HHI for another Höegh vessel that is valid until December 2015.

Both regasification systems are modularised for easy installation. They will also be supplied with seawater filter and steam/seawater heating modules. The system to be supplied for Gazprom will be winterised so as to be capable of operating in ambient temperatures as low as minus 30°C. The use of Printed Circuit Heat Exchangers and Plate Heat Exchangers enables the systems to be far more compact and lighter than alternative solutions. By utilising seawater for heating, CO2 emissions are far less than solutions using steam heating.

“Wärtsilä has a major share of the large energy demand market, which is a direct result of the reliability and efficiency of our systems. The global demand for LNG is rapidly increasing, and Wärtsilä’s experience and expertise throughout the entire LNG value chain is a key factor in the marine sector’s adoption of gas based technologies,” says Timo Koponen, Vice President, Flow and Gas Solutions, Wärtsilä Marine Solutions.

Wärtsilä’s portfolio of LNG regasification technologies represents an industry benchmark in terms of energy efficiency, robustness, and operational flexibility.

Wärtsilä has delivered and commissioned numerous floating LNG regasification plants based on either closed loop regasification technology, using steam with water/glycol as the intermediate heating medium, or open loop regasification technology using seawater with propane as the intermediate heating medium.

The company has also delivered modularised regasification plants for jetty installations. These facilitate a much shorter construction time compared to conventional land based LNG regasification terminal projects.

“Wärtsilä supplied the regasification technology for the Petronas Gas Berhad facility in Malaysia.

#WartsilaKnowsGas

WÄRTSILÄ® is a registered trademark. Copyright © 2015 Wärtsilä Corporation. Specifications are subject to change without prior notice.