With LNG now commonly referred to as the 'fuel of choice', and with the best shipping system of lightering/feeding proven over decades for all liquid fuels; the question we should deal with is not what it is or how it works, but why LNG feeder tankers are not commonly seen in the LNG sector. Why has it not entered into widespread usage wherever it is needed so it can be available within a relatively short time for any small or medium sized energy consumer?

There are now 19 LNG exporting countries with supply available ex-train, and 23 more countries with supply available out of their dozens of receiving terminals spread all over the market. The potential market is destinations where no grid is available or possibly too expensive or technically too complicated to build (the Norwegian coastline for example).

Moty Kuperberg, Dynamic Shipping Services, Israel, explains the benefits of using the small scale LNG feeder system to supply consumers spread over many destinations.

LNG feeder tankers are LNG tankers sized between 1100 m^3 (operated in Norway) and 20 – 30 000 m^3 that can serve destinations and customers that require up to 1 - 1.5 billion m^3/yr. Good examples are the six Japanese-built 18 800 – 22 500 m^3 LNG tankers shipping small volumes of LNG from Malaysian and Indonesian LNG production trains directly to power plants and other gas utilities.

Other smaller size tankers of 1500 – 2500 m^3 serve small gas companies in the coastal waters of Japan, taking their LNG from the large receiving terminals (ex-hub). The LNG feeder tankers need

limited land space and limited supply chain links of storage and regas systems that are compact and much more economical to build and operate.

This way, a typical Japanese small scale terminal will use just 35 000 – 90 000 m^2 of land to handle up to 410 000 tpy. While an average large terminal needs 200 000 m^2 to handle 1.5 million tpy, 1.2 million m^2 to handle 6 million tpy, and the largest one will use 1.93 million m^2 of land to handle 8 million tpy.

Smaller size terminals, which consist of a small jetty to allow the 1100 – 2500 m^3 feeders with their 3.6 – 4.2 m draft to dock and discharge their LNG load into 500 - 1500 m^3 storage tanks are a common sight now in Japan and along the Norwegian coastline.

Japan is leading the way with small scale LNG feeders, as well as land based distribution. There are now more than 50 satellite terminals in operation in Japan. The same system is widely used in many countries that import or export LNG, from the USA through to Norway, Turkey and other countries.

Three case studies

Turkish coastal waters

Turkey has a large road tanker LNG distribution fleet serving hundreds of customers with satellite terminals spread from the Marmara and Izmir receiving terminals across the whole country. This land based distribution system is operated by 10 companies using a fleet of 250 trucks that travel on average approximately 700 km to supply LNG. In some cases the trucks travel more than 1000 km with their 20 - 25 t loads of LNG. In total they supply approximately 0.5 billion m^3/yr. The land transportation adds approximately 20% to the delivery price of the gas.

The national gas company has been looking into using LNG feeder tankers to supply a few coastal locations to cut down transport costs and increase the reach of the trucking fleet at the same time. A feasibility study carried out back in 2005 provided better economic data on two main routes. The first from Marmara to three destinations along the Black Sea northern shore, spread from the Samsun area to Rize, close to the Georgian border. The second route is from Marmara to three more destinations spread from Antalya to Adana on the southeast Mediterranean coast.

The intention was to feed several communities that were out of the grid and out of any planned grid. The initial plan was to start with a capacity of 0.25 billion m^3 and increase it to over 1 billion m^3 after five years, then gradually continue to grow to over 1.5 billion m^3 after a further 10 years.

This way, the 'long range' travelling trucks could feed many more customers out of the new small scale regional hubs to be built for the feeders.

Caribbean Sea

The region, with its islands and close supply hubs is an ideal area for the LNG feeders. Trinidad and Tobago are LNG producers and the two existing receiving terminals can serve as regional hubs for distribution into the islands and neighbouring coastal countries. This way, more Central American countries like Panama, Costa Rica and the rest can benefit from the available gas.

Other directions that were studied were local LNG small scale production of 0.5 – 1.0 billion m^3/yr serving neighbouring countries.

The full range of the Caribbean Sea could be covered within one to three days sailing time for an LNG feeder tanker. If we add to it the developing LNG export options out of the US Gulf, there is a lot of potential to grow the market.

European coastal waters and waterways

The pioneers in Europe were the Norwegians back in 2004, introducing another potential concept for LNG feeders – a small scale production plant near Bergen, serving the nearby coastal region. What started with a 40 000 t plant is now growing and spreading further south from the Norwegian western fjords into the Baltic Sea.

When the new emission control limitations come into force, more gas will be needed for more and more applications. One of the major applications in Europe will be shipping propulsion. This will add vessels that will require LNG bunkering barges.

The Baltic and Norwegian coastal trade and offshore industry already operate some LNG driven vessels.

On another feasibility study carried out a couple of years ago into European waterways, some length/beam/draft and air draft limitations were crucial to allow the required LNG volume of the project to be carried. Together with TGE Marine Gas Engineering, a special shallow draft design was introduced to give the best carrying capacity for that restricted waterway.

Road map to success of feeder project

Several feasibility studies were carried out and a number of required parameters were developed. The company used the following criteria and parameters when delivering solutions to customers over the last few years:

- Time frame. Schedule as set by suppliers (of LNG, land based infrastructure, vessel availability, yard availability).
- The suggested solutions: size and general design for vessel and receiving terminal/storage.
- Budget and economics of the vessels.
- Fleet requirements: number of vessels, other types required, their general design (GA – General Arrangement).
- Safety: local regulations, class requirements, worldwide standards.
- The next stage: pre-FEED, FEED, selecting yard/EPC company, negotiation, contract for first vessel – first type, order and supervise.
- First vessel delivered. Continue to the second one, if required, and onward to establish a strong operating fleet.
- Further co-operation: fleet management, supply of LNG to other destinations, 'franchising' the concept in other places as an 'off the shelf solution'.

The 'intentions and plans/methods' can consist of regional distribution of LNG, distribution and further downstream operation, trading hub, bunkering and more. Then the vessel size, number of units, storage size, required LNG volumes, destinations, time frame, storage days required and all other requirements.

The company also took into consideration load and discharge port limitations (for example what maximum draft is allowed or possible at the ports, length restrictions, air draft). In one recent project the company carried out, there were draft limitations on

an inner waterway of 3.5 m; the company produced a design to cover that.

Then attention is paid to linking supply chain parts – production, load port and jetty, discharge port and jetty, storage, regas. It is a very detailed feasibility study that lays the foundation to continue into a firm project. It provides all the necessary tools to make decisions toward further development of the customer's LNG supply programme.

From a successful feasibility study, the next stage is to develop the project for commissioning within 24 months or earlier:

- The method of work is an open mutual hands-on work on all required issues.
- It is a truly tailor made solution, based on LNG experience in similar projects.
- One of the main achievements of such a study is the possible smooth continuation into implementing it.
- Together with the customer, the company dictates missions and intentions and works to execute them.

The future:

- More locations and destinations to build regional distribution, including upriver consumers of gas.
- Serving regional distribution out of FSRUs and FLNGs.
- Bunkering.

Conclusion

The LNG small scale feeder system is a proven way to supply LNG to small and medium size consumers spread over many destinations. It is ideal for consumers of up to 1 million tpy over any range between 200 nautical miles or less, and up to 1000 nautical miles range.

The beauty of it is the full package is available with a very small footprint; much more economical to build and operate to serve those markets in comparison to other alternatives.

LNG has many advantages as a fuel over other liquid fossil fuels as it is clean burning and readily available, and the technical delivery method is not too different. If an island generates its electricity from coal, heavy oil or gas oil that is supplied with small LPG or crude tankers, then an alternative LNG feeder operation would be much the same for them.

As 'security of supply' becomes a much more important aspect of any energy market, natural gas and LNG feeders will have important roles to play in supplying energy markets.

More gas will soon become available out of the planned floating LNG projects that will bring more 'stranded gas' to market and there are new suppliers of unconventional gas sourced LNG. LNG feeders will have their important role to carry some of that gas to nearby markets. The combination or integration of floating LNG and feeders will contribute to the small and medium size markets. In a way this article is a 'wake up call' for the many consumers of other fossil fuels to upgrade their energy sources, economy and environment, regardless of their size, to adopt what the LNG small scale system can provide for them. **LNG**