

Small Going Big... and Greener

LNG: the green future for bunkering

In association with:

Petroleum Economist

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Acknowledgements



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EXECUTIVE SUMMARY

As predicted in our earlier viewpoint, *Small going Big: why small-scale LNG may be the next big wave*, LNG has grown to become an established technology in most advanced economies. Global nominal liquefaction capacity grew more than 40% since 2015 to reach 430 MTPA in 2019.¹ In this follow-up paper we shall focus on a segment that boasts significant growth opportunities in the near term: LNG for bunkering (or more simply put fuel for shipping).

In the maritime sector, pollution and specifically carbon emissions are a major concern. Among the different fuels on the market, LNG complies with the increasingly stringent regulatory environment and is currently the most environmentally sustainable solution for newbuild ships as we strive for a greener future. From a shipowner's standpoint, LNG offers an immediate reduction in pollution enhancing a company's corporate social responsibility (CSR) credentials while delivering economic benefits. For LNG suppliers, small-scale infrastructure allows for the scalability of investment and the flexibility to meet green demand in different markets, such as road transport and off-grid industrial power.

The main beneficiaries of this technology will be point-to-point vessels, such as cruise ships, passenger ferries and container ships. For these segments, LNG as a fuel source is estimated to represent up to 25% of the current orderbook for global newbuild vessels.²

The outlook for LNG bunkering however, does still have some potential challenges. The availability of alternative conventional fuels (such as fuel oil), unexpected regulatory developments and access to capital may undermine LNG's potential in this area. So what needs to be done to ensure LNG bunkering realises its full potential?

If the shipping industry wants to make an immediate and materially impactful move towards sustainable mobility, it has to accelerate the adoption of LNG bunkering. The sector will need to persuade shipping operators on the benefits of LNG while creating a supportive ecosystem and attracting institutional investors. The development of new capabilities and strategic partnerships will also be key enablers.

While the shipping industry has been heavily impacted by COVID-19, especially cruise ships and ferries, small-scale LNG infrastructure deployment has proven resilient as it continues to grow. Given the growing momentum of the energy transition, demand for LNG as a green bunkering fuel will continue to develop despite the temporary disruption triggered by the COVID-19 crisis.

¹ MTPA is million tons per annum. Growth estimates based on PwC Strategy& research

² Source: Interviews

LNG CAN ADDRESS A MORE STRINGENT REGULATORY ENVIRONMENT FOR EMISSIONS

Sustainable mobility and awareness of climate change have gained significant traction in recent years. Governmental and institutional commitments, constantly renewed and reinforced, are driving the transition to greener energy sources in all sectors, including transportation. In line with the predictions in our viewpoint "Small Going Big", LNG as a fuel has experienced a first wave of growth: more than 350,000 LNG vehicles and 175 LNG-fueled ships are currently in operation worldwide.³ The maritime industry represents a source of carbon emissions. Some 90% of global goods are transported by sea and total maritime greenhouse gas (GHG) emissions grew by almost 10% between 2012 and 2018.⁴ While the current share of global of GHG emissions of this sector is about 2.5%, these emissions could increase dramatically by 2050 (see Exhibit 1). Ships are also a source of local pollutants.

EXHIBIT 1 Current and Forecasted CO2 Emissions from the Maritime Sector



3 SEA-LNG; European Alternative Fuel Observatory; Sublime China Information

4 IMO: Fourth GHG study 2020

5 Nature Communications: cleaner fuels for ships provide public health benefits with climate tradeoffs

To protect the environment and reduce health risks to people the International Maritime Organisation (IMO) has been active since the 1960s in promoting regulation on pollutants, such as nitrogen oxides (NOx) and sulphur oxides(Sox) among others. Additionally, the IMO aims to cut in absolute terms GHG emissions by 50% (compared to 2008 levels) by 2050. The organisation will also soon implement a stricter Energy Efficiency Design Index (EEDI) to complement the emissions goal.

In this context, marine fuel technology has evolved to comply with increasingly stringent emission regulations. Although cleaner fuels (think of biogas, ammonia and hydrogen) could become more prevalent in the future, they still face challenges with regards to fuel availability, development of infrastructure and advancements in technology. Within Emission Control Areas (ECAs) imposing minimal pollution emission thresholds, there are three main solutions currently available:

- Heavy Fuel Oil (HFO) with scrubber technology: the addition of advanced emission purification systems (scrubbers) to reduce sulphur emissions from a vessel fueled by conventional fuel oil. This is currently the most widely used option, especially for retrofits, but its future is under discussion due to the issue of waste liquids disposal.
- Marine Gas Oil (MGO): marine fuel consisting only of distillates with a reduced quantity of sulphur allowed and other compliant fuels, such as VLSFO.
- Liquefied Natural Gas (LNG): LNG used as a fuel.



THE CASE FOR LNG BUNKERING: A CLEAR SUSTAINABLE OPPORTUNITY

Currently, 175 LNG-fueled vessels are operating globally and approximately 200 more are on order.⁶ This is still very much a niche market, but LNG for bunkering is a reality.

Following the implementation in the North Sea of the Emission Control Area, this region has undergone a rapid transformation in energy. With the pioneering leadership of Norway, the country has developed a strong LNG industry with 76 LNG-fueled ships (equating to some 40% of the global LNG-fueled fleet). This achievement is underpinned by strong government incentives, such as the *bonus-malus* 'NOx fund'.⁷ Aside from the Nordics, other European regions like ARA (Amsterdam-Rotterdam-Antwerp) and Spain have seen a local LNG bunkering industry evolve. Globally, Singapore and Japan show the highest potential for LNG bunkering activities to flourish.

The most attractive segments for LNG bunkering are vessels with high fuel consumption and performing regular and repetitive routes (for example RO-RO, RO-PAX and containerships).⁸ LNG is gaining particularly strong momentum as a fuel for cruise ships where it delivers not only for cleaner mobility, but is also a source of lower carbon electricity while in ports.

Up to 25% of the containership orderbook is composed of LNG-fueled vessels. LNG is already there, and the perspective is a booming market."

Xavier Pfeuty, Strategy Manager at Total Marine Fuels Global Solutions

Rapid demand growth, driven by regulation

The IMO introduced in 2020 a lower threshold of allowable sulfur oxides (SOx) and emissions at a global level, from 3.5% to 0.5%. In the Emission Control Area it remains at 0.1%. Looking ahead, the Mediterranean Sea and Central America coastline are expected to become ECA zones as early as 2023. The ongoing implementation of stringent environmental regulation will be a prerequisite for LNG to strengthen its position as a green fuel alternative. Regulation was one of the main drivers for investing in LNG ships at Carnival, the largest cruise company in the world. In addition to retrofitting most of its existing cruise ships with Advanced Air Quality Systems, it decided to bet on LNG for its newbuilds. After launching their LNG-fueled ships AIDAnova and Costa Smeralda, and with a third recently delivered, eight more LNGfueled vessels are on order.

⁶ SEA-LNG: Bunker Navigator - 2020

⁷ The Norwegian NOx fund was created in 2008 to support the reduction in NOx emissions from shipping. The participants in the fund pay based on their level of NOx emissions and are rewarded for implementing emission reduction solutions. 8 RO-RO: Roll-on Roll-off; RO-PAX: Roll-on Passengers

Regulatory, reputation and our sustainability profile were the key drivers in the choice for LNG. We sell clean, pristine destinations. That is part of the product that we sell and LNG fits into that very well. That's why we chose LNG as our fuel of the future."

Tom Strang, SVP Maritime Affairs at Carnival Corporation

Worldwide LNG demand for bunkering is expected to grow from the current 1.4 MTPA to exceed 15 MTPA by 2030 and 30 MTPA in 2040 (See Exhibit 2).

EXHIBIT 2 Forecast of Worldwide LNG Demand for Bunkering



Today, no other sustainable solution is available on such a large scale and there probably won't be any up to 2030. LNG is part of the path to decarbonisation and is here to stay."

Xavier Pfeuty, Strategy Manager at Total Marine Fuels Global Solutions

A GREEN FUEL ALTERNATIVE

Among the three fuel technologies that meet the existing regulation, LNG guarantees the lowest emissions in terms of local pollutants (SOx, NOx and PM - particulates) and greenhouse gases.

Despite being a cheap solution for retrofits, adding a scrubber to a conventionally fueled vessel presents issues around the disposal of liquids and raises the risks of ammonia leakages (which are highly toxic). In some Norwegian fjords, scrubbers are not allowed and there is a wide consensus in the shipping industry that scrubbers will not be the solution for the future.

Using fuels with lower sulphur content, like MGO, is a temporary solution that might be superseded by stricter future regulation. MGO is subject to very strict regulation, thus it is an expensive fuel and it might not be available at the required specification. As a result, LNG remains the greenest fuel option. LNG engines meet the most recent IMO Tier III NOx requirements that limit nitrogen oxides emissions and comply with IMO regulations on sulfur emissions even for stricter areas (such as ECAs). In addition, LNG engines also comply with the 'phase 3' Energy Efficiency Design Index threshold that will come into force between 2022 and 2025. Thanks to the reduced content of carbon, LNG results in about 20-25% lower GHG emissions than conventional fuels like MGO or HFO in terms of 'Tank-to-Wake' emissions (emissions released on board of the ship).

Given that the ships being built and ordered today are expected to last to 2045 and beyond, LNG can be considered a bridging technology able to provide immediate pollution benefits while supporting the ongoing energy transition.

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LNG is currently the most future-proof technology and the only scalable option available. Despite all the talk there is about ammonia and hydrogen, there is nothing else out there today that can offer the same level of reductions, even on carbon emissions, as LNG can. Hydrogen might have a significant role to play in the future, but in what form is not clear yet."

Tom Strang, SVP Maritime Affairs at Carnival Corporation

EXHIBIT 3

Environmental benefits of LNG by Emission Category



Source: Strategy& research based on DNV GL, SEA LNG and Transport and Environment



AN ECONOMICALLY VIABLE SOLUTION FOR NEW BUILDS

Switching to LNG will require a careful assessment of all aspects of the business case. LNG propulsion systems take roughly 1.8 - 2 times more in volume than a traditionally fueled propulsion system as they have to fit larger storage and insulation.

The high level of capital expenditure and the on-board logistic complexities make LNG not feasible for retrofits, but ideal for new builds. Some shipowners looking to upgrade their existing fleet have opted to switch to MGO or installing scrubbers. This is for example the case of Maersk, the largest container ship company in the world.

Nevertheless, in the current context of stricter global emission limitations (such as ECAs) and low oil prices, the use of LNG has already become economically viable for shipowners buying new ships. Incentives, such as the ones implemented by Norway, support the initial investment in capital expenditure thus improving the economics of the LNG's business case. Nevertheless, the real game changer for LNG is the price of fuel. Fuel costs typically contribute to about 70 - 80% of the Total Cost of Ownership (TCO) of the vessel's propulsion system over its lifetime.

Where the infrastructure logistics is already developed and the value chain is efficient and short (with limited number of intermediate LNG transportation and storage steps), despite a higher initial capital expenditure investment, the lower fuel costs make LNG vessels already cheaper in terms of TCO compared to traditional solutions. As illustrated in Exhibit 4, the TCO of LNG propulsion systems is already lower than those fuelled with MGO and competitive with HFO and scrubber solutions. The application of incentives, similar to the Norway case, to reduce NOx emissions would further increase LNG's attractiveness against less futureoriented technologies like scrubbers.



EXHIBIT 4



Vessel Propulsion System TCO Analysis with Different Available Fuels under Different Scenarios

Note: TCO estimation based on Strategy& TCO proprietary model for Passenger ships (RO-PAX). Fuel prices recorded in September 2020. Source: PwC Strategy& analysis

As more infrastructure is deployed and knowledge about logistic processes improves through experience and efficiency gains, the costs of LNG bunkering are forecast to decrease over time. On the other hand, the logistics regarding conventional fuels might become more complex due to the different types of specifications introduced and the lower quantities required. This will strengthen LNG's position as the most economic solution in the long term. Some entrepreneurial shipowners have moved first to drive the improvement in the supply chain. For example, Caronte & Tourist launched the first LNG-ready ship in the Mediterranean sea: Its flagship Elio was launched in 2018 in an effort to promote the LNG industry and trigger the building of related infrastructure.

The biggest challenge that we face today is related to LNG logistics. It has a critical impact on the final price. LNG is not like oil that you can leave in a tank for years: you need to take care of it. Only if we develop an infrastructure able to handle LNG in a cost-efficient manner, this technology will have a future."

Lorenzo Matacena, CEO at Caronte & Tourist

SCALABILITY AND FLEXIBILITY OF LNG INFRASTRUCTURE

LNG infrastructure is growing rapidly. As of January 2020, LNG could be delivered in almost 100 ports with 55 more in the process of facilitating LNG bunkering investments and operations. Also ship-to-ship bunkering is seeing a sharp increase. There are currently 12 LNG bunkering vessels in operation and 27 more on order or being commissioned.

Several oil majors have invested in LNG for bunkering. Shell was a pioneer in the LNG market and has developed a global LNG offering. It has operations in Norway (through Gasnor), northwest Europe (three bunker vessels), the USA (one bunker barge) and Asia. Total has made LNG a priority in recent years with the acquisition of Engies' LNG assets. Total has strengthened its position as the second largest global LNG provider. Total has always been closely involved in the whole natural gas and LNG supply chain, from extraction, transportation, liquefaction and shipping, to regasification, marketing and trading. Total's balanced international footprint and recognised expertise across the entire LNG value chain has made it a global LNG leader. The French firm, in partnership with Mitsui, has just launched the largest bunker vessel in the world - "Gas Agility".

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As with any new market development, there is always a business and investment risk. LNG is no different. The risk is taken on by the LNG suppliers in the creation and growth of infrastructure to support its use. We strongly believe in the future of this fuel. Estimations are that global bunkering vessel capacity will reach 8 MTPA by 2023, and will be able to support the expected demand."

Xavier Pfeuty, Strategy Manager at Total Marine Fuels Global Solutions



First movers in the LNG bunkering market are gas companies and terminal operators. From Titan LNG in Netherlands, Fluxys in Belgium, Enagas in Spain, Gasum in the Nordics to Toho Gas in Japan and Pavilion Energy in Singapore, operators are extremely active in LNG bunkering activities around the world.

Some LNG players are moving to larger solutions to drive economies of scale and reduce costs, while others see in small-scale LNG an opportunity to drive scalable investments. The reduced amount of investment required to build the fully operational infrastructure of a small-scale LNG plant, compared to an industrial-sized one, can be an advantage for players to enter the market and become enablers of market growth.

Existing LNG infrastructure, with minor modifications, can be used to supply a wide range of sectors. This flexibility allows for future scalability which will shape investment flows to obtain faster returns in line with expected demand. Specifically, small-scale LNG infrastructure can provide fuel to ships, as well as road transport users and off-grid industries.

Typical end users for LNG in transport are heavy goods vehicles, haulage companies, large logistic operators and retail and consumer companies. These type of end users require a clean burning fuel which is price competitive and widely available to meet their needs of typically long distance journeys and short refueling times. Given the challenges related to electrifying heavy transport, LNG is currently the most feasible green alternative. In Europe there are more than 300 LNG filling stations (almost 40% of them in Italy and Spain alone) that support a growing demand for cleaner fuel for heavy transport.⁹ In 2019, LNG for road transport accounted for the majority of total final small-scale LNG uses and could provide synergies for infrastructure developed for bunkering purposes.

Edison is an Italian midstream operator active in the gas and LNG markets. With decarbonisation at the core of its strategic ambitions, Edison took advantage of the scalability and flexibility of LNG infrastructure to consolidate its position in the industry. Edison has invested along the entire value chain from coastal terminals to LNG ships and bunkering barges and will be the first mover in Italy to launch a small-scale LNG integrated logistics chain able to serve both heavy-duty transport and maritime transport. In partnership with PIR (Petrolifera Italo Rumena) and Enagas, Edison is developing LNG infrastructure expected in Ravenna in 2021 while it has recently announced a partnership with Q8 (Kuwait Petroleum Italia) for the construction and operation of maritime LNG infrastructure in the port of Naples.

To enhance the market development, Edison will cover all the steps of LNG logistics, from first reloading all the way down to the final delivery thanks to dedicated vessels and deposits. That's what we are doing by creating the first integrated logistic chain for LNG in Italy."

Pierre Vergerio, EVP Gas Midstream, Energy Management and Gas Infrastructures at Edison

Another pillar of the energy transition: biogas

Recent studies have raised concerns about overall GHG emissions of LNG fueled maritime engines arguing that, despite the reduction in emissions over a long period of time (100 years) and the limited emissions on board the ship, the positive effects are nullified in the short term.¹⁰ This is due to significant Well-to-Tank (WTT) methane emissions and methane leaks (emitted through engine exhaust gases).

Current IMO regulations do not consider GHG emissions related to the fuel value chain, nor limit methane emissions on board ships. Significant improvements have been made in recent years to reduce methane slip in the engine technology, as well as commitments for the major upstream suppliers. Nevertheless, these aspects must be taken into consideration by LNG suppliers who want to offer a valuable product to their customers and ensure long-term business sustainability.

Despite current challenges, small scale LNG infrastructure is future-proof and could provide a bridge towards more sustainable solutions. In fact, LNG infrastructure can be 'greened' further by increasing the quantities of biogas mixed with LNG. Biogas is a renewable fuel obtained by the decomposition of organic wastes sourced from agriculture or sewage. Although the transition to biogas still faces challenges, this fuel could decrease greenhouse gas emissions by up to 80% across entire fuel value chain, thus meeting the ambitious environmental targets set by the IMO for 2050.

LNG is not the final destination of the journey. It will stay for a few decades, the time required for a cleaner technology, not related to hydrocarbons, to emerge. A portion of the future Energy market will be covered by biogas, that will leverage the same technological infrastructure as LNG."

Lorenzo Matacena, CEO at Caronte & Tourist

10 ICCT: the climate implications of using LNG as a marine fuel - 2020;



THE FINAL PUSH TO A BOOMING MARKET

Given its positive environmental impact, LNG for bunkering could be included in government financial recovery packages around the world. Governments and investment institutions could benefit greatly from the development of an LNG bunkering industry. In fact, investments in infrastructure have a positive multiplier effect on GDP, creating sustainable jobs.

Despite its growth potential and economic and environmental benefits, small-scale LNG for maritime bunkering still faces a number of hurdles if it is to unleash its full potential.

LNG bunkering is competing with conventional fuels that are more widely available and rely on an existing infrastructure. Innovative technologies like hydrogen are also increasingly attracting the attention of investors, despite being early stage technologies. A final push is needed for the shipping industry to accelerate the widespread adoption of a greener fuel that is LNG.

Stepping up the pace of the transition

The LNG bunkering industry needs to reach a tipping point in order to become a widely adopted technology and to obtain the benefits that come with network effects. A few key measures could be implemented to increase the speed of penetration of LNG bunkering:

- Simplification of the authorisation process for the construction of infrastructure, providing a well-defined framework and ensuring timely decisions from local and national governments.
- Creation of a well thought through financial incentive system to convince skeptical shipowners to increase investments to renovate their fleets and reduce emissions (for example as in the Norwegian bonus-malus NOx fund)¹¹.
- To support the application of such measures and ensure the success of the transition to LNG bunkering, it is necessary to raise awareness at an industrial and institutional level.
 A 'lobbying' association should be created made up of funding institutions and industry players that work together to enhance the uptake of LNG bunkering solutions. Electric vehicle (EV) associations were successful in working together with various partners in the automotive and utility industry to accelerate the penetration of EVs in the car market.

Infrastructure needs to be deployed quickly in response to growing demand. In Ravenna we were able to accelerate the permitting phase thanks to a partner strongly rooted in the region (PIR) and through a transparent involvement of local government. Presenting the environmental benefits that LNG provides for citizens and local authorities was key."

Pierre Vergerio, EVP Gas Midstream, Energy Management and Gas Infrastructures at Edison

11 The Norwegian NOx fund was instituted in 2008 to support the reduction in NOx emissions from shipping. The participants to the fund pay based on their level of NOx emissions and are rewarded for implementing emission reduction solutions

Developing capabilities in the LNG bunkering value chain

As small-scale LNG is a nascent industry, many companies face challenges and uncertainties and need to develop new internal capabilities to support the sector's growth.

The scale of investments required for smallscale LNG bunkering and the development of long-term contracts are currently the main barriers to entry in this industry.

For this reason, LNG suppliers are mainly leveraging their existing large-scale LNG business experience but need to avoid underestimating the differences in the two businesses. It is crucial to carefully define the level of integration of the small-scale LNG business unit to ensure incentives are set up, accountability is met and inefficiencies are reduced. Small-scale LNG suppliers should focus on the development of key capabilities: LNG shipping, bunkering operations, GHG emissions controls, contract management, optimisation of small-scale LNG portfolios and market intelligence. Enagas realised that the integrated LNG chain required investments and a different approach compared to its regulated business. For this reason Enagas created an internal start-up called "Scale Gas" which was able to react quickly to the market and was characterised by a strong entrepreneurial mindset required to balance risks and profitability in an uncertain environment.

Shipowners are beginning to come to terms with LNG as a fuel in their operations. However, they still need to become more comfortable with this new commodity and its pricing dynamic. For this reason, shipowners will need to develop strategic capabilities in contract management and price hedging in the LNG sector. Additionally, they will need to build greater confidence in their operations handling vessels with a diverse fuel mix and varying refueling needs. Needless to say, the need for training to educate the crew and ship personnel on these changes will be essential.

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The main characteristic of this market is that it is a growing market with a lot of uncertainty. Thanks to the creation of "Scale Gas" we were able to invest even with a different level of risk and to develop the logistics chain in an agile way to follow the market."

Fernando Impuesto Nogueras - General Manager at Enagas Emprende



No one can make it alone

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Despite its proven economic and environmental benefits, small-scale LNG still needs to solve the challenge of balancing demand and supply to support the growth phase in a sustainable way. The landscape of maritime bunkering is peppered with a wide range of players impacting the value chain. Port authorities, local and international governments, shipowners, bunkering operators and LNG suppliers are just some of the most relevant ones. In this context, the transition towards a sustainable small-scale LNG business will require an ecosystem that accelerates the achievement of decarbonisation goals.

Some regions like Spain have already promoted the creation of an ecosystem of players in the LNG industry, enabling the growth of the market and providing higher resilience to uncertainty.

LNG has now become a reality in Spain: it is the third market in Europe. Now all the LNG terminals in Spain offer also LNG as a fuel alternative for bunkering. This was thanks to collaboration between government, port authorities, and all the companies involved."

Fernando Impuesto Nogueras - General Manager at Enagas Emprende

Different players could assume the role of orchestrators of the ecosystem. In some cases, the port authority and the government could take the lead by promoting the transition through regulations and incentives. In other cases, the shipowners might bring together OEMs and LNG suppliers with long term contracts ensuring the demand and necessary infrastructure investments. Finally, the role of the orchestrator could be assumed by the LNG supplier, granting fuel and a series of connected services to the final users and fostering a positive environment for demand to flourish. In any of these examples, the success of the business cannot rely on a single operator but rather depends on the development of committed and transparent partnerships among the value chain players.

DESFA, the Greek National gas Transmission System Operator, is working on the creation of an LNG ecosystem together with the regulator. It aims to promote small investments in infrastructure to become a 'market opener' and enabler of the transition of demand towards LNG.

We need to create an ecosystem that starts from regulation and goes all the way down to the final users. If we put together the environmental benefits, image returns and economic competitiveness, developing the LNG market represents a great opportunity to create a momentum for the recovery."

Nicola Battilana, CEO at DESFA

In short, small-scale LNG and specifically LNG for bunkering will play a critical role in decarbonising the maritime sector. Not only can the technology deliver immediate reductions in emissions but can act as a bridging fuel for future sustainable mobility solutions. And the growth of this technology can more broadly contribute to and stimulate a greener economic recovery.

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Small scale LNG activities of the contributors

Carnival Corporation

Carnival Corporation & plc is the largest cruise ship company in the world with a portfolio of the world's most widely recognised cruise brands currently numbering 97 ships. Carnival has been at the forefront of the transition of the cruise ship industry towards LNG and chose LNG as its fuel of the future. While retrofitting more than 80 of its vessels with Advanced Air Quality Systems, when faced with the choice of fuel technology to equip its new builds, Carnival decided to go with the most future-proof solution ready to meet increasing environmental requirements. For this reason, in 2018 Carnival launched the first LNG-fueled cruise ship in the world, AIDAnova. This was followed in 2019 by a second LNG vessel, Costa Smeralda, and most recently with the delivery of a third LNG ship, Iona, in October 2020. Eight additional LNG ships are currently on order and planned to be delivered over the next few years.



AIDAnova: the first LNG-fueled cruise ship in the world

Caronte & Tourist

In line with its entrepreneurial spirit, Caronte & Tourist was a first mover in LNG solutions and was the first to buy an LNG ferry in the Mediterranean Sea. The flagship Elio launched in 2018 is fully equipped to travel with LNG. Moreover, it was ordered at a time when talk about LNG as a green fuel was in its infancy. From legislation on LNG bunkering activities to institutional resistance, Caronte & Tourist faced many challenges. Even now, Elio faces difficulties when refueling with LNG due to the lack of available infrastructure in southern Italy. Nevertheless, this has not stopped the company in its efforts to move towards more sustainable solutions.

The company plan is to start powering its vessels with LNG as soon as possible and use LNG as a bridging fuel, while other greener solutions, like biogas, become available. This will allow Caronte & Tourist to have a fleet capable of using clean fuel immediately without having to change engine technology or refueling procedures for the next fifty years



Elio: the first LNG-fueled ferry int Mediterranean Sea

DESFA

DESFA is the Gas Transmission System operator in Greece. It owns and operates, under a regulated regime, a high pressure transport network of about 1,500 km, as well as a regasification terminal at Revithoussa. With a storage capacity of 225,000 m3 of LNG and a regasification capacity of 1250 m3/h as a Sustained Maximum Send out Rate, the Terminal is an important energy asset for Greece, providing security of energy supply, operational flexibility in the transmission system and increased capability to meet peak gas demand. DESFA has entered the small scale LNG market with the PoseidonMed project promoted by the European Union. DESFA is currently moving head after assigning the works for a truck loading station at Revithoussa that will be active in 2021. Soon it will proceed with the FID of the small-scale LNG terminal for bunkering to allow ships from 1.5 to 20 kton to refuel at the Revithoussa terminal. To respond to increasing LNG demand, the first LNG bunkering infrastructure can be doubled in the future with a second infrastructure using floating technology and allowing the works to be completed without disruption of services. These investments are concrete steps towards adopting LNG as a marine fuel in the Eastern Mediterranean, making Greece the focal point for supplying and distributing this energy source in Southeast Europe and helping the Country to reduce the use of more pollutant fuels. Finally, after a long and challenging tendering phase, DESFA is very close to finalize a contract to provide operation and maintenance services to one of the largest LNG terminals in the world located in Kuwait.



LNG Terminal at Revithoussa

Edison

Edison accounts for approximately 15% of natural gas sales in Italy and is a unique player in the LNG value chain. It can guarantee its availability thanks to a diversified portfolio and long-term contracts signed for the supply of LNG from the USA and Qatar. Leveraging that position and in coordination with a business strategy centered on the energy transition, Edison is building the first integrated value chain for small-scale LNG in Italy. Its small-scale LNG development plan involves the construction of a system of coastal terminals. This will start with the Ravenna plant due to be operational in 2021, as well as the construction of a small-sized ship to supply the depots. Edison's goal is to become a leading player in the Italian small scale LNG market by 2030, so Ravenna is only the first step in this direction. Recently Edison partnered with Q8 (Kuwait Petroleum Italia) to launch a joint venture for the development, construction and operation of an LNG coastal storage terminal in Naples and will evaluate further investments both for coastal terminals and vessels as the market evolves.

With the certainty of this new infrastructure, cruise companies, ferries, or ships transporting goods and operating in the Mediterranean will finally be able to invest with confidence in LNG, benefiting from security of supply and improved air quality in port areas. Furthermore, Edison's expectation is that the terminals will contribute to boosting the development of LNG maritime traffic in the surrounding seas. For example, cruise liners, which have already invested in LNG ships, will be able to allocate new ships to their Mediterranean operations.



Edison's LNG infratructure in Ravenna

Enagas Emprende

Enagas Emprende is the corporate venturing arm of Enagas. It has has adopted an open innovation model to nurture energy transition businesses by supporting them financially and structurally and allowing for a more agile approach to the market. Part of the Enagas Emprende ecosystem is Scale Gas, the spin-off company that offers integrated solutions in downstream LNG. Enagas entered the LNG bunkering market in 2012, with a pioneering approach. From the start it focused on developing projects able to address the two main characteristics of this market:technology and regulation. It invested in creating the capabilities required to delivering value in the market and worked with authorities to develop regulation. Having invested to support bunkering activities at all its terminals in Spain, Enagas fostered the growth of the Spanish market which is one of the biggest in Europe. Now Enagas is active on many projects from a new floating bunker in Argentina, to a bunker barge in Bilbao and more recent activities in Mallorca. Enagas has an infrastructure business model. It invests in, develops and manages complex small-scale LNG infrastructures and logistics, providing services to those companies which are focused on the molecule and require specialised solutions in this field. This business model allows third parties to access the infrastructure and thus is a key enabler to making the market grow.



LNGHIVE2 project coordinated by Enagas in Huelva (Spain)

Total Marine Fuels Global Solutions

Total is the second largest private global LNG player and has been extremely active in strengthening its position in the LNG value chain in recent years. Following the signing of the 10 year agreements with CMA CGM for the supply of LNG for its 23,000 and 15,000 TEUs fleet, Total has grown considerably its role in the LNG bunkering market. Two new bunker vessels will be delivered by Mitsui O.S.K. Lines for this purpose: the "Gas Agility" has just launched in the North Sea, while a sister bunker vessel is expected to be delivered near the end of 2021 to be located in Fos-Marseille, where it will support activities in the Mediterranean Sea. In the Port of Singapore, Total is strengthening its position thanks to a logistical partnership with Pavilion Energy, while other LNG bunkering projects are under review, in Oman and China in particular. The bunkering use of LNG fits very clearly in Total's new climate ambition. In June 2020, Total joined the Getting to Zero Coalition. This coalition supports the maritime industry's decarbonization by collaborating with companies across the maritime, energy, infrastructure and finance sectors. In July 2020, Total contributed to the creation, together with ten other international groups, of the Coalition for the Energy of the Future, which "aims to accelerate the development of energy sources and technologies to address the challenges posed by sustainable mobility in the transport and logistics industry by reducing emissions, fighting global warming and protecting biodiversity. All these steps demonstrate that while Total is interested in developing the energy of the future, it is also interested in doing so in partnership with other international groups sharing the same goals and values. These goals are very ambitious and it is only by working together with peers, partners and customers, that we can make them happen.



Gas Agility, the world's largest LNG bunker vessel Credit: Chris Schotanus

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