

FORECASTING THE FUTURE OF MARINE FUEL

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LIQUEFIED NATURAL GAS (LNG) is likely to become the marine fuel of the future—that much is clear to stakeholders in the commercial-shipping industry. But the important question is when will LNG become the dominant bunker? The answer is critical to planning and executing investment decisions that will amount to hundreds of billions of dollars industry-wide in the coming years.

Ship owners and operators must forecast the adoption of LNG as they continue to confront challenging times. For years, the shipping industry's performance has been weighed down by the twin burdens of plunging freight rates and increasing bunker costs, and a full recovery is not in sight. The plunge in crude oil prices that began in mid-2014 and continued into early 2015 has eased the pressure on margins, but it is premature to declare victory in the struggle against bunker costs. Even though a return to crude oil prices exceeding \$100 per barrel is unlikely anytime soon, managing bunker costs remains crucial to maintaining competitiveness. These costs still repre-

sent the largest expense item for vessels, accounting for 30 to 40 percent of total operating costs.

Beyond economics, environmental considerations argue against a complacent attitude toward bunker. Executives rejoicing in low crude-oil prices may be tempted to take a wait-and-see approach regarding investments in LNG and other low-sulfur fuels. But even in the near term, delaying the adoption of cleaner fuels will mean that large cargo ships will continue making an outsized contribution to carbon dioxide emissions globally. Executives who are committed to transitioning to a “green” shipping industry will stay focused on the environmental advantages of burning cleaner fuel.

Regulators—particularly the International Maritime Organization (IMO)—are pushing the industry in this direction and playing a critical role in determining the optimal time line for shifting to LNG. The growing number of IMO Emission Control Areas (ECAs) has already forced shipping compa-

nies to shift a greater share of their fuel consumption to low-sulfur fuel, which is more expensive but environmentally friendlier. And beginning this year, vessels operating in ECAs must abide by stricter sulfur-emissions regulations.

Perhaps most significant, the IMO plans to apply a global cap on sulfur emissions as of 2020. The IMO is currently reviewing the availability of cleaner fuel and may decide to postpone the date the global cap takes effect until 2025; the review will be concluded in 2018. The uncertainty about when the cap becomes effective has added to the complexity of deciding when to switch to LNG.

Three Main Options for Cleaner Emissions

In the context of challenging market conditions and stricter environmental regulations, The Boston Consulting Group set out to assess the fuel options that are available to ship owners and operators as they seek to remain cost competitive. LNG is one of three main options for cleaner emissions. The choice among these options is not clear-cut, as each one has benefits and drawbacks:

- *LNG.* Natural gas that has been converted to a liquid is the cleanest option from an environmental perspective. However, using LNG will require costly investments in new bunkering infrastructure, which is scarce today. Moreover, the performance of the engines that are designed to be fueled exclusively by LNG has not been fully tested at sea.
- *Heavy Fuel Oil Cleaned by Scrubbers.* Scrubbers are systems for cleaning the exhaust gas that is emitted when burning heavy fuel oil (HFO). These systems use fluids to absorb sulfur dioxide and neutralize the effluent that's discharged with the exhaust gas. This option has the advantage of enabling vessels to continue to use cheap HFO; however, scrubbers require a significant investment, and some components of the technology (such as

processes for waste treatment) have not yet been fully proved.

- *Distillate Oils.* Marine gas oil and marine diesel oil are distillates that are readily available and have properties similar to the diesel fuel used in high-speed engines. Distillates are cleaner than HFO untreated by scrubbers and represent the easiest solution from a technical perspective. Distillates are much more expensive than the other fuel options, however, and the cost differential could become greater if increased demand throughout the shipping industry drives distillates' prices even higher.

Distillates and untreated HFO are the conventional options for bunker, compared with the technically advanced options of LNG or cleaned HFO. Today, only vessels operating outside ECAs can burn untreated HFO. When the global sulfur-emissions cap goes into effect, the use of untreated HFO will not be permitted on any routes. However, HFO-powered engines can readily be adapted to switch to distillates, which will become the main conventional option.

In selecting an option, shipping companies should also consider how refineries and ports will need to respond to the changing supply environment and how their actions will affect ship operators' costs. To meet the increased demand for distillates, refineries will need to invest more in hydrocrackers and coker units that convert fuel oil into distillates. To supply LNG, ports will need to invest in onshore infrastructure.

Assessing How Bunker Demand Will Develop

To help shipping companies navigate through the challenging investment decisions in the complex and evolving marine-fuel environment, BCG has developed a proprietary tool that evaluates the economics of selecting each fuel option over the next 15 years. The model's output is reported for vessels segmented on the basis of type (for example, tanker or container), size, year built, and route.

Two factors will have the greatest influence on LNG's penetration of the bunker market until 2025: the price differentials among LNG, HFO, and distillates and the date the global sulfur-emissions cap becomes effective. Analyzing these two factors across various scenarios, we estimate that LNG's market penetration in 2025 could range from 5 to 27 percent.

In the base case—where price differentials remain constant and the global sulfur-emissions cap takes effect in 2020—LNG's market penetration in 2025 would be approximately 20 percent. LNG's market penetration would rise to about 27 percent if LNG becomes more competitively priced, while penetration would fall to 18 percent if the IMO delays the global sulfur-emissions cap until 2025. If governments subsidize capital expenditures for building new ships and retrofitting older vessels (and the base case assumptions otherwise apply), LNG's penetration would rise to about 25 percent. If HFO prices decline to relatively low pre-2008 levels, the economics of selecting cleaned HFO would improve, and LNG's penetration would potentially reach a low level of 5 percent.

Looking at the evolution of bunker demand for each fuel option in the base case specifically, several key insights emerge. (See Exhibit 1.)

- In the short term (2015 through 2020), the conventional options will be the best solution for all vessel sizes and ages, although distillates will be the main conventional option for vessels operating in ECAs. Because the IMO will not determine until 2018 when the global sulfur-emissions cap will take effect, investing in LNG-fueled vessels or HFO scrubbers is a risky move in the short term for ship owners operating outside ECAs.
- Assuming the base case described above occurs, LNG will gain share globally beginning in 2020. Until the industry knows for certain the date the global sulfur-emissions cap will take effect, LNG-fueled engines will be

included only on the very small share of new vessels built to operate primarily within ECAs.

- Most ship owners will not retrofit vessels with scrubbers to clean HFO. The payback time for the investment can be up to seven years, whereas ship owners typically want to be paid back within three years at most.
- After 2020, scrubbers will become more prevalent on new tankers and other vessels that require flexible bunkering because they travel on many different routes. It is not likely that bunkering infrastructure for LNG will be available at ports outside North America or northern Europe until 2025, so cleaned HFO will be the best option for ship operators wanting to comply with emissions regulations.

Most industry players seem to be onboard with these forecasts and are taking a wait-and-see attitude toward investing in either HFO scrubbers or LNG-fueled engines. Although the timing for LNG's anticipated widespread adoption remains uncertain, the first LNG engines in container vessels will soon be in operation. There are already 16 container vessels with LNG propulsion on order. Most of these vessels will be operating exclusively in ECAs. Moreover, some major container liners have ordered "LNG ready" vessels that are simpler to retrofit to burn LNG than traditional vessels.

Focusing on the Container Segment

Bunker demand in the container segment will nearly double from 2014 through 2030. In 2030, market penetration of cleaned HFO will be close to 50 percent, while LNG will capture about one-third of the market. Conventional fuel, mainly distillates, will capture 22 percent of the market in 2030.

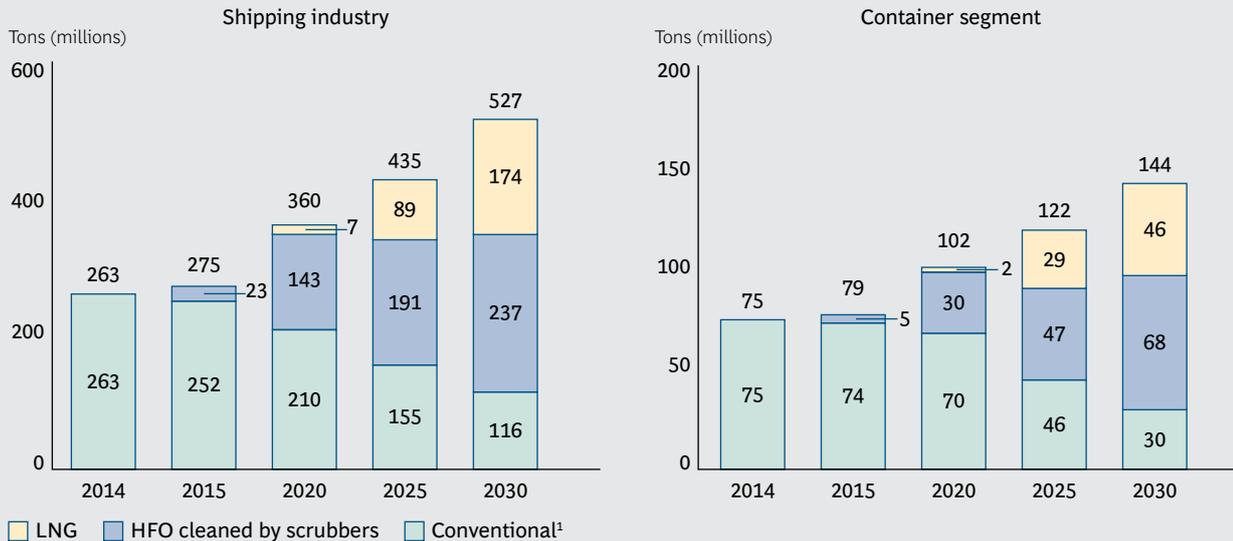
The container segment's stable routes make it easier for companies to target investments in LNG, given that specific vessels may operate exclusively in ECAs or in locations where LNG infrastructure exists

EXHIBIT 1 | Liquefied Natural Gas Will Gain Traction After 2020, but It Will Not Yet Dominate the Market

Base case

Conventional options will dominate through 2020, while HFO treated by scrubbers and LNG will gain share thereafter

An analysis of the container segment reveals a similar trend



Source: BCG analysis.

Note: HFO = heavy fuel oil; LNG = liquefied natural gas.

¹Distillates and untreated HFO are the conventional options for bunker today. When the global sulfur-emissions cap goes into effect (the scenario above assumes the year will be 2020), the use of untreated HFO will not be permitted on any routes and distillates will be the main conventional option.

or is being developed. However, ship owners and operators must still carefully evaluate when and where to make the substantial investments that are required to comply with environmental regulations. Funding these investments will be challenging given that shipping companies are strapped for cash while financing options are limited.

If investments to comply with emissions regulations are well designed and executed, companies can expect a net positive return. (See Exhibit 2.) Our forecast shows that stakeholders in the container segment will need to invest \$159 billion from 2015 through 2030, but companies will save \$179 billion in operating expenses as a result—a net gain of \$22 billion. The cumulative savings in operating expenses will exceed total capital expenditures beginning in 2029.

Moreover, assuming the base case described above occurs, the price differential between LNG and the other fuel types will

be sufficient to offset the LNG investments and generate additional value. On top of this, government subsidies for capital expenditures relating to LNG might add to the value created by switching to this fuel.

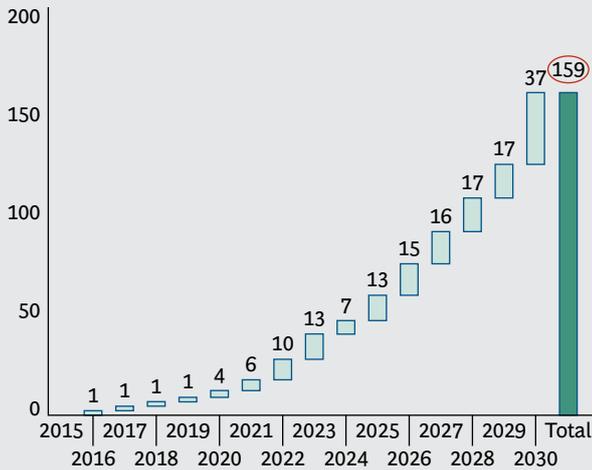
It is important to note that this forecast of investment returns assumes that all ship owners and operators in the container segment will make the best investment decisions at the right time. This will not always be the case, of course, and companies risk incurring higher capital expenditures and operating costs if their investment decisions are suboptimal. Consequently, it is crucial for companies in the container segment to gain a better understanding of their best options for complying with regulations affecting vessels that operate in ECAs today and to be ready for the global sulfur-emissions cap if it is applied in 2020. Eventually, entering into long-term agreements with fuel suppliers will be essential for enabling ship owners and operators to lock in low LNG prices (if that proves to be the best option) and reduce investment risks.

EXHIBIT 2 | Required Investments in Clean Fuel Will Net Billions for the Container Segment

Base case

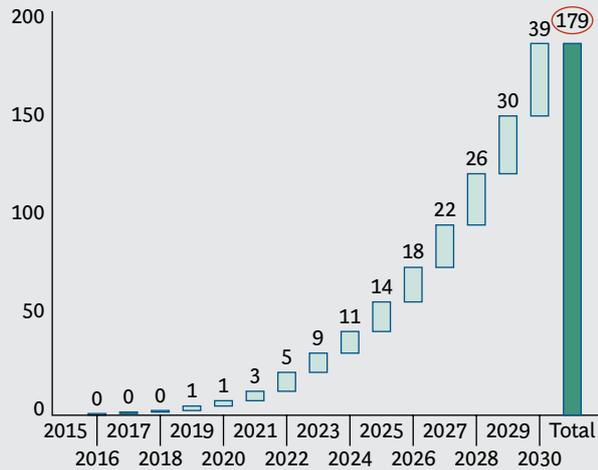
The container segment will need to invest \$159 billion from 2015 through 2030 to comply with emissions regulations

Capital expenditure requirement (\$billions)



These investments will yield \$179 billion in operating-expense savings from 2015 through 2030

Operating-expense savings (\$billions)



Source: BCG analysis.

Note: Capital expenditure figures represent investments that are in addition to those required for using distillates.

TO BUILD A COMPETITIVE edge for the future, shipping companies need to decide which marine fuel option will provide the highest return in the coming years and how they will comply with the increasingly stringent rules and regulations imposed by regulators. The answers to a set of strategic questions can help companies identify which option is the best fit:

- Do you know the business case for investments in each fuel option for your fleet, as segmented by vessel type, vessel size, and route?
- What percentage of your fleet operates exclusively in ECAs or in locations where LNG infrastructure exists or is being developed? When might LNG infrastructure be in place in other locations served?
- Will your fleet be ready to comply with new rules and regulations imposed by the IMO and other regulatory bodies?
- How will the evolution of prices for distillates affect the right time to invest in LNG-fueled engines or scrubbers for HFO?

- Will investing in scrubbers for HFO yield returns quickly enough to justify the expenditure, or should you focus exclusively on LNG to comply with emissions regulations?
- Have you measured the operational and economic risks that could occur if you do not pursue the bunker option that offers the highest return in the coming years?

For many companies, the answers will point to the need to develop a better fact base for assessing fuel options in the dynamic environment. Companies that take action now to understand their options will be best positioned to reap the benefits of wise investments in the future.

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