U.S. DEPARTMENT OF ENERGY

# Analysis of Small-Scale LNG Market Potential in the Baltic States

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# Executive Summary

Mitigating the impacts of climate change requires a global transition to lower-carbon energy production and consumption, while maintaining a secure and affordable energy supply. In support of these goals, members of the European Union (EU) have committed to environmental and climate driven policies such as the Paris Agreement to achieve an economy–wide net domestic reduction of at least 55 percent in greenhouse gas (GHG) emissions by 2030 (compared to 1990 levels). The *Analysis of Small-Scale LNG (SSLNG) Market Potential in the Baltic States Report* (the present Report) investigates the opportunities for natural gas and liquefied natural gas (LNG) to serve as transitional fuels to advance the decarbonization of the shipping, transport, and remote industry and power sectors in Estonia, Latvia, and Lithuania (the Baltic States).[1]

Existing and projected growth in demand for LNG in the Baltic States, while relatively modest on a global basis, is being driven substantially by several factors, including robust global LNG supplies, economically competitive regional LNG prices, and the 2014 opening of the Klaipėda LNG import terminal in Lithuania. The Klaipėda LNG import terminal, which has a regasification capacity of over 4 billion cubic meters (bcm) per year and LNG storage capacity of over 170,000 $m^3$, also includes an LNG reloading station for SSLNG supply and distribution to serve the marine, truck, rail, and power generation markets. Companies in Latvia and Estonia have had early advances in the development of their own SSLNG import terminals and infrastructure to satisfy local demand in the marine bunkering and land transportation markets. However, despite this considerable regional interest in developing SSLNG projects, each of these markets for LNG within the Baltic States remain relatively small when considered independently.

Historically, the Baltic States have been a small natural gas market, competing with other sources such as coal, oil, and biofuels, especially in power generation. Imported piped gas also supplies a significant share of the power generation market, raising energy security concerns. As EU member states prioritize the decarbonization of their energy supply, natural gas will lose market share in favor of renewable energy in power generation and other alternative fuels for heating and industrial processes, such as hydrogen or biomethane. Given this likely long-term policy and market trajectory, and the high costs to construct natural gas and LNG import infrastructure, this Report does not foresee significant demand for additional large-scale LNG import terminals (like the Klaipėda LNG import terminal) in the Baltic States.

However, this Report illustrates that near-term substitution of LNG for heavy fuel oil (HFO), marine gas oil (MGO), and diesel fuel can reduce emissions and the environmental impacts of key transport industries, including shipping, trucking, and rail. This substitution can be achieved cost-effectively by utilizing existing SSLNG technology and supply sources. Further, LNG imports to the EU for use in SSLNG can play an important role in enhancing energy security by providing diversified supplies of natural gas in the form of LNG and decreasing reliance on dominant regional suppliers. Demand for carbon-neutral LNG may enhance energy security objectives in the region by promoting the supply of LNG from environmentally responsible and non-malign actors, such as the United States.

[1] This Report defines small-scale terminal infrastructure as smaller than 50,000 cubic meters ($m^3$). Small-scale markets are defined as bunkering and land transportation that use LNG as fuel, and remote demand centers that use LNG for industrial application or combined heat and power.

The Report identifies marine bunkering[2] as the most attractive opportunity in the immediate term for SSLNG growth and emissions reduction in the Baltic States, as compared to the opportunities in the trucking, rail, and remote industrial sectors. The Report also recommends further cooperation and regional coordination of natural gas markets in the Baltic States, as individually, these markets constitute small levels of demand and limit the economics of LNG supply for domestic consumption.

Specifically, this Report identifies three main opportunities for growing the LNG bunkering market in the Baltic States: 1) tapping into existing LNG-fueled vessel traffic in ports; 2) taking a regional approach to building out the market; and 3) development of franchise arrangements. This Report recommends the following to increase LNG marine bunkering:

- Support LNG bunkering as an important component of EU and Baltic States' policies to achieve environmental and climate policy goals;
- Major ports in Estonia, Latvia, and Lithuania that currently serve LNG-fueled vessels should market LNG bunkering services to these vessels;
- The Baltic States should support and pursue an EU-funded review of the status of the LNG bunkering market, especially compared to its previously projected development;
- The Baltic States should encourage and facilitate the development of franchise models for LNG bunkering services at ports;
- The Baltic States should develop a public Baltic States LNG Transport Forum for project developers, fuel suppliers, bunkering infrastructure operators, and local stakeholders to facilitate the alignment of objectives that support the development of the industry; and
- SSLNG infrastructure design and operational plans in the Baltic States should consider the requirements of a bunkering business, especially mandatory third-party access (TPA) requirements for bunker operators.

Although this Report identifies marine bunkering as the greatest opportunity for growth of LNG in the Baltic States, there are also opportunities for land transportation and remote industry and power to replace use of higher carbon dioxide emitting fuels, such as diesel, with LNG. Existing LNG road and rail transportation infrastructure is limited in the region, and expansion of the infrastructure will require significant private-sector investment and regulatory incentives at the national, and possibly EU, level. Nonetheless, this Report recommends the following to capitalize on land transportation opportunities:

- The EU and the Baltic States should apply targeted incentives and support for LNG infrastructure to aid these markets to decarbonize;
- The Baltic States should fund a study to characterize the viability of LNG as a transportation fuel, the cost of building out the required supply network, its competitive position compared to alternative fuels such as compressed natural gas (CNG) and Bio-LNG, and estimate the impact of harmonized pricing on the market;

[2] The supply of fuel for marine propulsion is known as "bunkering".

- The creation of the Baltic States LNG Transport Forum would facilitate coordination across land transportation sector stakeholders (as it would for marine sectors) to promote a more cohesive approach to implementing policy for LNG transportation;
- The Baltic States should explore bundling of fueling services to support growth in the market; and
- The Baltic States should consider LNG in rail transportation in terms of dual-fuel engine conversions for existing diesel locomotives.

Finally, this Report notes that LNG trucks or small-scale off-pipeline liquefaction facilities can serve remote industry and power markets. The development of LNG as a transportation fuel in the Baltic States through the above recommendations could encourage the development of off-pipeline plants to provide LNG to truck filling stations as part of an SSLNG infrastructure expansion. This Report recommends the following to capitalize on remote industry and power opportunities:

- Identify specific opportunities for conversion of light industrial facilities to use natural gas needs to be characterized across the Baltic States;
- Conduct a study to analyze the impact of LNG on GHG emissions and the possibility of creating incentives such as tax benefits or advantageous depreciation treatment for such conversions; and
- Identify specific opportunities to replace existing diesel power generation with remote industry and power applications of LNG.

# ANALYSIS OF SSLNG MARKET POTENTIAL IN THE BALTIC STATES

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# I. Introduction

This Report examines the opportunities for importing LNG into the Baltic States for SSLNG to decarbonize the marine bunkering, transportation, and remote industry and power sectors. While the analysis considers trade with and demand from other states including Finland and Poland, this Report will primarily focus on the Baltic States. In developing this Report, the study team engaged directly with the U.S. Department of Energy and with government counterparts and stakeholders in the Baltic States. Their feedback and input shaped the outline and focus of the Report and provided data to inform the recommendations. Due to COVID-19 travel restrictions, the study team did not travel to the region and relied primarily on desktop research and publicly available information to develop the Report. A full list of sources referenced is provided in Annex A.

For the purposes of this Report, SSLNG terminal infrastructure is defined as smaller than 50,000 $m^3$. Due to the limited size of the Baltic LNG market, additional conventional or large-scale terminals will be challenging to develop and make economically viable in the near term. Proven LNG demand in SSLNG markets and greater connectivity with demand centers in neighboring markets could potentially underpin larger investments in the long term, but such investment considerations are outside of the scope of this Report. SSLNG markets are defined in this Report to include marine bunkering and land transportation that use LNG as fuel, and remote industry and power. This Report examines the current size and operation of these markets in the Baltic States and identifies opportunities for growth, which could increase SSLNG demand and supply in the region. The LNG marine bunkering market is the main focus of the analysis in this Report, as marine bunkering is a more established market in the region and has more near-term opportunities than the truck, rail, or remote industry and power markets.

The Report includes nine sections and is organized as follows:

Executive Summary

Section I Introduction

Section II Baltic States Gas Sector Overview

Section III Marine Bunkering

Section IV Land Transportation

Section V Remote Industry and Power

Section VI Conclusions

Appendix A Data Sources

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# II. Baltic States Gas Sector Overview

This section of the Report will provide a brief overview of the gas market in the Baltic States including supply, demand, and policy. This section will outline our understanding of the current state of the gas sector in the Baltic States, on which subsequent analysis and recommendations in this Report are based.

## Supply Overview

The Baltic States' natural gas consumption is, with no significant domestic production[3], 100 percent dependent on natural gas imports. Natural gas is imported into the region via pipeline and LNG shipment.

Estonia imports natural gas via pipeline from Russia, Lithuania, and the Inčukalns underground gas storage (UGS) facility in Latvia. Estonia imports natural gas from Russia during the summer months, and the Inčukalns facility displaces Russian pipeline imports for Estonia in the winter. The newly constructed Baltic Connector Pipeline connects the gas network of Finland to Estonia and the rest of the Baltic region, providing access to additional gas supplies including LNG imports to Lithuania. Estonia is currently awaiting the delivery of the LNG bunker vessel (LNGBV) *Optimus*.

Latvia imports its natural gas via pipeline from Russia and Lithuania (via imports at the Klaipėda LNG Terminal). Latvia's Inčukalns UGS facility has a working capacity of approximately 4.5 billion cubic meters (bcm).[4] Inčukalns UGS is the only functional natural gas storage facility in the Baltic States. In the summer months, the facility is primarily filled with Russian gas imports, but also has access to the Klaipeda terminal. During cold-weather heating months, the facility supplies gas to customers in Latvia, Estonia, Russia, and Lithuania.

Lithuania is the only importer of LNG in the Baltic States via the Klaipėda LNG Terminal and LNG Reloading Station. In 2020, Lithuania imported 4.1 million cubic meters (mcm) of LNG from Norway, the United States, and Russia. Lithuania also imports natural gas via pipeline from Russia and the Inčukalns UGS facility.[5] In late 2021, the Gas Interconnector Poland – Lithuania (GIPL) will be another source of pipeline gas supply for Lithuania.

See both **Figure 1** and **Table 1** below for a summary of the key natural gas infrastructure assets in the Baltic States.

[3] Eurostat (online data code: nrg_cb_gasm)
[4] "Inčukalns UGS." *Conexus Baltic Grid*. https://www.conexus.lv/incukalns-ugs-459
[5] Eurostat (online data code: nrg_ti_gas)

***Figure 1: LNG Infrastructure in the Baltic States***


***Table 1: LNG Infrastructure in the Baltic States***

| Number | Country | Name of Infrastructure | Status | Description |
|---|---|---|---|---|
| 1 | Estonia | Optimus LNG BV | Existing | Type: Bunker Vessel<br>Storage Capacity: 6,000 $m^3$ |
| 2 | Latvia | Inčukalns UGS | Existing | Type: Underground Storage Facility<br>Storage Capacity: 4.47 bcm |
| 3 | Lithuania | Klaipėda LNG Terminal - FSRU Independence | Existing | Type: Large Scale Floating Regasification Storage Unit<br>Capacity: 170,000 $m^3$ |
| 4 | Lithuania | Klaipėda LNG Reloading Station | Existing | Type: Small-Scale Reloading Facility<br>Capacity: 5,000 $m^3$ |

## Demand Overview

Since 2008, Estonia's natural gas demand has decreased by more than 50 percent from 961 bcm to 463 bcm in 2020.[6] Estonia's rapid decline in natural gas consumption can be attributed to the economic crisis in 2008 and 2009, the transition from natural gas to biomass and other fuels for heat production, and the closure of a large fertilizer plant in 2014. Estonia's natural gas consumption is distributed between the district heating, industry, and residential-tertiary sectors.[7]

Power generation is the predominant driver of natural gas consumption in Latvia. Combined heat and power (CHP) plants are the largest consumers of natural gas.[8] Natural gas is also used for residential heating and industrial use.[9] With the addition of wind and other intermittent renewables to the electricity mix in Latvia, natural gas has also served as an effective complement.

Lithuania is the largest consumer of natural gas in the Baltic States. However, that consumption has been steadily declining for the past ten years. Lithuania consumed 2.2 bcm of natural gas in 2019 (compared to 2.9 bcm in 2010).[10] Lithuania's decline in natural gas consumption is attributed to the gradual introduction of more inexpensive fuel sources (i.e., fuel oil and biomass in heat production) and an increased share of renewables in power generation.[11] Natural gas consumption in Lithuania is driven by industrial users, specifically fertilizer production.[12]

## Policy Overview

The EU and its member states have committed to a clean energy transition, which will contribute to fulfilling the goals of the Paris Agreement on climate change. As stipulated in Article 3(1) of Regulation (EU) No 2018/1999 on the Governance of the Energy Union and Climate Action (the Regulation), each member state is required to prepare and submit its National Energy and Climate Plan to the European Commission every ten years, to meet the objectives set by the EU, within the Paris Agreement. The Regulation provides a template for the plan, so that plans are comparable across member states. The plans submitted by each of the Baltic States are described in the country-specific sections below.

In June 2019, the Governments of Denmark, Germany, Estonia, Latvia, Lithuania, Poland, Finland, and Sweden agreed on an energy market integration by way of the Baltic Energy Market Interconnection Plan (BEMIP). The main goal of the BEMIP initiative is to achieve an open and integrated regional electricity and gas market among EU countries in the Baltic Sea region. As part of the BEMIP implementation, several cross-border and domestic infrastructure projects such as Nordbalt and the LitPol Link, connecting the electricity sectors of Estonia, Latvia, and Lithuania

[6] "Estonia Energy Information." *Enerdata*. https://www.enerdata.net/estore/energy-market/estonia/
[7] Ibid.
[8] "Latvia: What sources does the country get its electricity from?" *Our World in Data*. https://ourworldindata.org/energy/country/latvia?country=~LVA#what-sources-does-the-country-get-its-electricity-from
[9] "Latvia Energy Information." *Enerdata*. https://www.enerdata.net/estore/energy-market/latvia/
[10] Eurostat database
[11] "Lithuania Energy Information." *Enerdata*. https://www.enerdata.net/estore/energy-market/lithuania/
[12] "Latvia Energy Information." *Enerdata*. https://www.enerdata.net/estore/energy-market/latvia/

to Finland, Sweden, and Poland respectively, significantly improved the Baltic States' integration in the EU energy market, and consequently their security of supply.[13]

In February 2019, gas transmission operators in Finland, Estonia, and Latvia signed an agreement to set up a single gas transmission tariff zone for the three countries effective January 1, 2020.[14] The agreement unifies entry point tariffs at the external borders of the region and removes commercial interconnection points between countries and custom duties in accordance with the EU Gas Directive 2009/73/EC (EU Gas Directive). The EU Gas Directive outlines the shared rules for the EU natural gas market including addressing the unbundling of energy supply and generation from transmission, promoting non-discriminatory network access, and strengthening the independence of regulators. The agreement among Finland, Estonia, and Latvia is expected to result in higher market liquidity by enabling shippers and traders an easier path to sell gas to the region, and LNG for small-scale applications.

## Estonia

Estonia's national policies and targets for environment and climate policy are outlined in: 1) Estonia's 2030 National Energy and Climate Plan; and 2) policies for the regional Baltic gas market among Finland, Estonia, and Latvia discussed above. The key objectives of Estonia's 2030 National Energy and Climate Plan related to natural gas are:

- Achievement of an 80 percent reduction in GHG emissions by 2050 (including 70 percent by 2030).
- Achievement of a 13 percent reduction of GHG emissions by 2030 compared to 2005 levels in the following sectors: transport, small-scale power, agriculture, waste management, forestry, and industry.
- Use of research and development and innovation in measures to retain the competitiveness of the economy.

## Latvia

Latvia's national policies and targets on the environment and climate policy are defined in: 1) Latvia's National Energy and Climate Plan 2021-2030; and 2) policies for the regional Baltic gas market between Finland, Estonia and Latvia discussed above. In January 2020, the Government of Latvia approved its National Energy and Climate Plan 2021-2030, which is the main document for the formulation of long-term energy and climate policy. The plan aims to promote the long-term development of a climate-neutral and internationally competitive country and sets 2030 targets including reduction of GHG emissions by 6 percent compared to 2005 levels.

## Lithuania

In Lithuania, the national policies and targets on the environment and climate policy are defined in two major strategic documents: 1) National Energy Independence Strategy of the Republic of

[13] "Baltic energy market interconnection plan," European Commission, last update: October 9, 2020, https://ec.europa.eu/energy/topics/infrastructure/high-level-groups/baltic-energy-market-interconnection-plan_en

[14] "Baltic-RGMCG," European Union Agency for the Corporation of Energy Regulators, http://www.acer.europa.eu/en/Gas/Regional_%20Intiatives/Pages/BALTIC-RGMCG.aspx

Lithuania; and 2) the National Energy and Climate Action Plan of the Republic of Lithuania for 2021-2030, approved in 2018 and 2019, respectively.

The Lithuania National Energy Independence Strategy establishes the vision for natural gas in Lithuania to "*promote a technically reliable and diversified supply of natural gas to consumers based on efficiency and cost-effectiveness principles and competitive prices."* To achieve this, the National Energy Independence Strategy focuses on:

1. Efficiency – Active participation in the search of new natural gas transit routes and infrastructure users
2. Competitiveness – Improved access to infrastructure and increased efficiency of infrastructure operators
3. Innovation – To lead in LNG technologies and distribution in the Baltic region related smart energy, and to develop innovative technologies for the use of LNG in the energy, transport, shipping, and industry sectors in Lithuania
4. Integration – Create favorable conditions for natural gas trade within the region
5. Energy Security – Have the ability to independently supply Lithuania with natural gas from international LNG and EU natural gas markets

The natural gas objectives included in Lithuania's National Energy and Climate Action Plan for 2021-2030 align with the objectives outlined in the National Energy Independence Strategy discussed above.

# III. Marine Bunkering

The supply of fuel for marine propulsion is referred to as bunkering, and demand consists primarily of liquid fuels either as marine gas oil (MGO), which is the marine equivalent of diesel fuel, or heavy fuel oil (HFO). Between them, they account for almost all of the global demand for carbon-based marine fuels, which as of 2019 is estimated to be worth $120 billion.[15] Due to stricter emissions requirements for marine transport, LNG has become a more popular fuel choice option for marine transportation in recent years, although LNG carriers have used LNG that boils off from their tanks as a fuel source for over 40 years. Current market estimates indicate that the value of the LNG bunkering market was approximately $214 million in 2016, $700 million in 2018, and with an expected compound annual growth rate (CAGR) of 15 percent during 2020 – 2025, which would make the market worth over $1.8 billion by 2025.[16]

In 2015, the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78), which includes Annex VI Rules for the Prevention of Atmospheric Pollution from Ships, required stricter controls to minimize airborne emissions from ships. That year, the Baltic States became a designated Emission Control Area (ECA), requiring a 0.10 percent sulfur cap on marine fuel. The imposition of a sulfur limit of 0.10 percent in marine fuels within the North Sea and Baltic regions from January 2015 gave rise to EU-funded studies to address how the marine sector could meet the compliance requirements. The major participants were representatives from Denmark, Sweden, and Finland under the support of the Baltic Ports Organization, and this work led to regional integration efforts and the development and construction of LNG storage and distribution infrastructure.

In 2020, the International Maritime Organization (IMO) mandated an 85 percent reduction of the cap on sulfur emissions from marine fuels globally from 3.5 percent to 0.5 percent (IMO 2020). Shipowners have expressed concerns over which of the options best meets their fleet requirements both within ECAs and globally. In the near term, compliance with IMO 2020 can be accomplished in one of three ways: (1) using very low sulfur fuel oil (VLSFO), (2) installation of scrubbers to remove sulfur oxides from engine exhaust gases, or (3) conversion to LNG.[17] Following the enactment of IMO 2020, some operators have opted to burn VLFSO, as this requires minimal investment or modification to vessels. However, there have been instances of engine damage and even failure due to the delayed combustion and afterburning characteristics of VLSFO.[18] Shipowners that have favored LNG for their future needs either retrofit existing vessels or order the construction of new-build vessels that use LNG as a fuel. The current global fleet of vessels

[15] "Global Bunker Fuel Market Size study, By Type (High Sulfur Fuel Oil, Low Sulfur Fuel Oil, Marine Gasoil, and Others), Commercial Distributor (Oil Majors, Large Independent, and Small Independent), and Application (Container, Bulk Carrier, Oil Tanker, General Cargo, Chemical Tanker, Fishing Vessels, Gas Tankers, and Others), and Regional Forecasts 2020-2027," Market Study Report, November 23, 2020, https://www.marketstudyreport.com/reports/global-bunker-fuel-market-size-research

[16] "LNG BUNKERING MARKET - GROWTH, TRENDS, COVID-19 IMPACT, AND FORECASTS (2021 - 2026)," Mordir Intelligence, https://www.mordorintelligence.com/industry-reports/lng-bunkering-market

[17] Andrew Slaughter, Subhasis Ray, and Thomas Shattuck, "International Maritime Organization (IM)) Strategies in a Non-Compliant World," Deloitte & Touche, LLP, 2019, https://www2.deloitte.com/content/dam/Deloitte/us/Documents/finance/international-maritime-organization-pov-2020.pdf

[18] Chew, Martin. "Mysterious engine damages Post IMO 2020 caused by VLSFO?" *Manifold Times*. February 2021. https://www.manifoldtimes.com/experts/mysterious-engine-damages-post-imo-2020-caused-by-vlsfo/

that use LNG is expected to more than double over the next few years. Currently there are over 175 operating vessels (excluding LNG carriers), with another 200 vessels on order.[19]

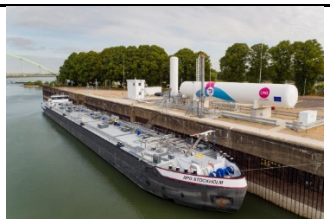
Six of the world's 15 LNGBVs operate within the North and Baltic Sea region, demonstrating that the Baltic States have been a global leader in developing an active LNG bunker market. Establishing LNG bunkering infrastructure and capabilities at key ports will further position the Baltic States to capture some of the growing market share of LNG in meeting bunkering fuel demands. EU-funded initiatives such as the HEKLA project in which the ports of Helsingborg and Klaipėda participated in developing LNG bunkering infrastructure, including the Markos Bay LNG reloading station in Klaipėda harbor, enhanced the growth of the regional market. The inclusion of Latvia and Estonia in similar EU-funded LNG bunkering initiatives would further support the development of an integrated Baltic States LNG bunkering market. The following sections describe several technical approaches and commercial services commonly employed in the LNG bunkering market and how they can be expanded in the Baltic States.

## LNG Bunkering Methods

There are three key LNG bunkering methods in use today, as described in **Table 2** below.

[19] "Bunkering," SEA-LNG, https://sea-lng.org/why-lng/bunkering/

***Table 2: LNG Bunkering Methods***[20]

| Method[21] | Description | Regional Locations | Characteristics | Photo |
|---|---|---|---|---|
| **Ship-to-Ship** | LNG delivered to the receiving vessel via another ship or barge alongside | Klaipėda, Lithuania<br>Gothenburg, Sweden<br>Rotterdam, Netherlands<br>Amsterdam, Netherlands<br>Emdem, Germany<br>Zeebrugge, Belgium<br>Huelva, Spain<br>Algeciras, Spain<br>Barcelona, Spain<br>Bilbao, Spain<br>La Spezia, Italy | Limited by the number of LNGBVs and barges available and operational in the market. However, many are on order because of their ability to move among multiple ports, provide bunkering at sea, and service inland waterways |  <br>LNGBV *Kairos* reloading at the small-scale terminal in Klaipėda [22] |
| **Terminal-to-Ship** | LNG delivered to the receiving vessel via a small LNG storage tank, station, or an import or export terminal | Zeebrugge, Belgium<br>Rotterdam, Neth.<br>Klaipėda, Lithuania<br>Hammerfest, Norway | Compared to other methods, this is permanent infrastructure that can be expanded. |  <br>Europe's first permanent LNG bunker station at the Port of Cologne[23] |
| **Truck-to-Ship** | LNG delivered to the receiving vessel via a hose connected to an LNG truck | Klaipėda, Lithuania<br>Stockholm, Sweden<br>Algeciras, Spain<br>Valenica, Spain<br>Barcelona, Spain<br>Le Harve, France<br>Zeebrugge, Belgium<br>Antwerp, Belgium<br>Rotterdam, Neth.<br>Amsterdam, Neth.<br>Hamburg, Germany | Used globally due to greater availability of LNG trucks for loading. Further, truck-to-ship can be economical for even small amounts, compared to terminal-to-ship and ship-to-ship options. Particularly favored for short haul and ferry routes. |  <br>Truck-to-ship loading of the cement carrier MV Greenland at the Port of Klaipėda [24] |

[20] "LNG Bunkering: Key challenges & best practices," SAFETY4SEA, July 03, 2019, https://safety4sea.com/cm-lng-bunkering-key-challenges-best-practices/

[21] It is important to note that LNG bunkering can also occur using ISO cryogenic containers, but is not a focus of this Report as it is not as widespread in Europe.

[22] "The 10th loading from a ship at Klaipėda LNG reloading station," Vessel Finder, February 20, 2019, https://www.vesselfinder.com/news/14688-The-10th-loading-from-a-ship-at-Klaipeda-LNG-reloading-station

[23] "PITPOINT OPENS EUROPE'S FIRST PERMANENT LNG BUNKER STATION," PitPoint, October 31, 2019, https://www.pitpointcleanfuels.com/news/pitpoint-opens-europes-first-permanent-lng-bunker-station/

[24] "LNG-Powered Vessel Successfully Bunkered For The First Time In The Port Of Klaipėda;" Vessel Finder, March 10, 2020, https://www.vesselfinder.com/news/17675-LNG-Powered-Vessel-Successfully-Bunkered-For-The-First-Time-In-The-Port-Of-Klaipda

## LNG Bunkering Activity in the Baltic States

LNG bunkering in the Baltic ports has developed as an extension of LNG bunkering activities in Scandinavia, where Norway and Sweden initiated the use of LNG as a fuel for ferries, starting in 2000 when the world's first LNG-fueled ship, a Norwegian car/passenger ferry *GLUTRA*[25], began operation. The port of Stockholm was the first port on the Baltic Sea to offer LNG as a fuel to ships, beginning LNG bunkering operations in January 2013 when the ship *Viking Grace*[26] was put into service. Since then, the LNG-fueled fleet has expanded to more than 20 vessels but has remained concentrated in the North Sea passenger ferry market until recently.

In the Baltic States, the existing SSLNG market provides a variety of bunkering services to the market, including:

- Truck-to-ship bunkering
- Ship-to-ship bunkering via LNG bunker barges
- Distribution of LNG to users
- Cooldown services for LNG carriers (cooling cargo tanks from ambient to cryogenic temperatures before loading the next LNG cargo)
- Installation of stationary LNG storage
- Chartering of larger LNGBVs to serve the non-ferry market

In some cases, a single SSLNG company will perform all these services, as is the case with Titan LNG in the Netherlands. Titan publishes LNG bunker prices on its website, including prices for delivery in the Baltic States. Recently, Titan entered into a multi-year charter for the 5,200 $m^3$ *Green Zeebrugge* LNGBV.[27]

Titan LNG serves as a valuable example of how an SSLNG company operating in the marine sector can create multiple business streams based around its bunker supply business. Bunker infrastructure creates an opportunity for new local companies to enter the market or for an existing company to expand into the market. Both options create new local employment. Mandatory TPA requirements mean the project sponsors and infrastructure operators will be different from the companies seeking to provide LNG bunker fuel or take capacity in the project. In the Baltic States, it is unclear which entities will operate new bunker infrastructure, as discussed in Section IV of this Report.

Today, the LNG-fueled fleet extends throughout Europe[28] and, more significantly, the market for LNG bunkers has extended beyond the ferry market to cruise ships, tanker vessels, and container

[25] "Natural gas-fuelled ferry GLUTRA." *WÄRTSILÄ*. https://www.wartsila.com/encyclopedia/term/natural-gas-fuelled-ferry-glutra

[26] "Natural gas-fuelled ferry VIKING GRACE." WÄRTSILÄ. https://www.wartsila.com/encyclopedia/term/natural-gas-fuelled-ferry-viking-grace

[27] "Titan LNG charters Green Zeebrugge long term from NYK." Titan LNG. February 2021. https://titan-lng.com/titan-lng-charters-green-zeebrugge-long-term-from-nyk/

[28] Rozmarynowska-Mrozek, Monika. "The Development of the LNG-Fuelled Fleet And The LNG-Bunkering Infrastructure." January 2015. https://www.researchgate.net/publication/309000932_The_Development_of_the_LNG-Fuelled_Fleet_and_the_LNG-Bunkering_Infrastructure_within_the_Baltic_and_North_Sea_Region.

ships. New deliveries and orders of ships in these sectors are announced on a weekly basis. A more recent application for LNG as a marine fuel has been the advent of tugboats fueled by LNG in Singapore, Japan, and China, using dual-fuel engines.[29] Other companies in the region, including Cryo-Shipping in Norway, are seeking to expand their service offerings in the market.

## Estonia

Due to investment to date in LNG bunkering and existing operations, Estonia is an attractive market with significant short-term demand potential. Estonia currently provides truck-to-ship bunkering services to LNG-fueled vessels in the northeastern section of the Baltic Sea. Eesti Gaas (branded as Elenger for international operations) is the LNG bunkering operator in Estonia, conducting an average of 65 truck-to-ship bunkering operations in Tallinn, Helsinki, and Hanko ports per month.[30] Eesti Gaas began offering LNG bunkering services in 2018 to Tallink's ferry *Megastar*, its primary customer. Elenger receives its LNG supplies from Russia, Finland, Lithuania, and Poland. However, supply from Lithuania will not be available again until 2025, when the agreement between Klaipėdos Nafta (KN), the operator of Klaipėda's LNG import terminal, and the Polish Oil and Gas Company (PGNiG) for the full capacity of the Markos LNG station expires. Prior to the last tender, Eesti Gaas reserved 1,500 $m^3$ of the reloading stations' capacity in 2018 and used LNG tanker trucks to supply LNG to the Estonian market.

In an effort to expand operations in the region and increase its LNG supply options, Elenger invested in a 6,000 $m^3$ LNGBV, the *Optimus*, which was due to enter service in the first quarter of 2021.[31] The *Optimus* will primarily serve the Gulf of Finland and will expand Estonia's LNG bunkering capabilities to include ship-to-ship transfer - both in ports and at sea. These vessels provide flexibility in the Baltic market and can serve multiple ports.

An SSLNG import facility in Estonia could be used to build out the country's LNG bunkering business and act as the home port for the *Optimus*.[32] Adding permanent LNG storage capacity would allow Estonia to broaden its bunkering market by taking on more truck-to-ship and ship-to-ship operations, and enable the potential addition of terminal-to-ship and ISO container-to-ship services. This infrastructure could also increase energy security in the region by providing diversity of supply and increased competition, in line with TPA.

Elenger is a member of the Society for Gas as a Marine Fuel (SGMF), demonstrating its intent to expand Estonia's role in the regional LNG bunkering market and promote the company's offerings to potential customers.[33] It is estimated that up to one fifth of the passenger transportation through the port of Tallinn is LNG-fueled, which could serve as an opportunity for Elenger to expand its

[29] Wingrove, Martyn. "LNG on the menu for terminal tugs." Riviera. September 2018. https://www.rivieramm.com/opinion/opinion/lng-on-the-menu-for-terminal-tugs-23231

[30] "Elenger launches in Finland, Latvia and Lithuania." Eesti Gaas. May 2019. https://www.gaas.ee/en/elenger-launches-in-finland-latvia-and-lithuania/

[31] "Estonia's Elenger Joins LNG Bunker Industry Group." *Ship & Bunker* News. January 2021. https://shipandbunker.com/news/emea/527747-estonias-elenger-joins-lng-bunker-industry-group

[32] "LNG bunker vessel of Elenger Marine has been launched." Elenger. September 2020. https://elenger.com/lng-bunker-vessel-of-elenger-marine-has-been-launched/

[33] The SGMF was created in 2013 and has over 140 members including oil and gas majors, fuel suppliers and port authorities. They promote safety and industry leading practices in the sector, serving as a resource for information, training, and special events for members. To learn more, visit https://www.sgmf.info/why-us/

LNG bunkering customer base.[34] The Port of Tallinn supports growth of LNG as a bunker fuel and has offered a four-percent discount on tonnage fees for vessels primarily fueled by LNG.[35]

Of the potential importers, Estonia is the most likely candidate to build out terminal-based LNG bunkering infrastructure such as storage tanks in the near term, as they already provide truck-to-ship services and have purchased an LNGBV. The addition of permanent SSLNG storage near Tallinn would support growth of existing bunkering activity at the port. Unlike other ports which may use the construction of storage infrastructure to help initiate bunkering activity, permanent storage in this case would enable an expansion of services and volumes provided to a small but established market.

## Latvia

Although Latvia does not currently provide LNG bunkering services, existing cargo throughput at the ports of Riga and Ventspils, and an increase in LNG-fueled vessel traffic, could provide an LNG bunkering market opportunity for Latvia. In 2019, Latvia's oil-based bunker fuel throughput was 15,000 tonnes/month. The ports of Riga and Ventspils account for approximately 90 percent of the country's cargo traffic and the majority of the traditional bunkering business.[36] Unlike Estonia, Latvia's bunker market is more likely to focus on LNG as a fuel for container vessels, due to ferry traffic traditionally refueling at Swedish ports and growing use of the port by LNG-fueled container vessels. Container operator CMA CGM has taken the lead as a promoter and user of LNG as a marine fuel, and in 2019 the port of Riga began receiving visits from two of the company's LNG-fueled container vessels, *Polar* and *Nord,* three times per week.[37]

In the near term, Latvia could consider introducing truck-to-ship bunkering at ports or chartering an LNGBV as an entry point into the regional LNG bunkering market without investing in permanent port infrastructure. Latvia could also consider investment in permanent infrastructure once the opportunity for LNG bunkering in the country is more defined, using truck-to-ship and LNGBV operations to test demand.

## Lithuania

Klaipėda is the only seaport in the country, and a high proportion of the ship calls made to Klaipėda consist of cruise liners, which comprise a segment of the maritime market that is increasingly supportive of LNG as a fuel.[38] KN has promoted the port as an LNG bunkering location and on March 8, 2020, the first bunkering operation took place at the Klaipėda Reloading Station. During this operation, the fuel tanks of the cement carrier *MV Greenland* were filled at the KN-operated Malkos Bay Terminal via a truck-mounted ISO container supplied by Norwegian company Cryo-

[34] "Baltic Bunkering," Bunkerspot, June/July 2020, https://www.bunkerspot.com/features-alternative-fuels/item/baltic-bunkering
[35] "Baltic Bunkering," Bunkerspot, June/July 2020, https://www.bunkerspot.com/features-alternative-fuels/item/baltic-bunkering
[36] Ibid.
[37] World Maritime News – Port of Riga Starts Servicing LNG-Fueled Boxships
[38] Brinkmann, Paul. "Cruise ships switching fuel to cleaner liquefied natural gas." UPI. February 2020. https://www.upi.com/Top_News/US/2020/02/04/Cruise-ships-switching-fuel-to-cleaner-liquefied-natural-gas/9471580331799/

Shipping. Since then there have been a further 10 bunkering operations involving conventional truck-to-ship LNG transfer, all to the *MV Greenland*.[39]

Current gross LNG storage capacity at the port is 5,000 $m^3$ and LNG-powered vessels coming to Klaipėda Reloading Station can be bunkered in three different ways: (1) truck-to-ship at jetties and wharves in the port; (2) terminal-to-ship at the Malkos Bay LNG reloading station operated by KN; and (3) ship-to-ship using an LNGBV. Although Klaipėda port does not currently have a dedicated LNGBV, LNG transportation and bunkering services are provided in the Baltic and North Sea region by a few available vessels, including *Seagas* and *Kairos*. KN had originally promoted ship-to-ship bunkering and held a 10 percent share in Blue LNG, the long-term charterer of the *Kairos*. However, the vessel has found employment mainly outside of Lithuania, other than to make LNG deliveries to the Malkos Bay facility, required under the terms of its charter. This shift in utilization resulted in KN selling out of Blue LNG and the vessel is now under full control of Nauticor.[40] KN notes that several LNG-fueled vessels visited Klaipėda State Seaport in 2019 and 2020, and could be potential target LNG bunker customers for the port.

## LNG Suppliers to the Baltic States

LNG supplied in the Baltic States currently comes from suppliers/sources listed below, each with different ties to the LNG bunker fuel market. There is an opportunity to support competition in the LNG bunkering market in the Baltic States through the involvement of multiple suppliers and carbon-neutral LNG. While some LNG portfolio players (discussed below) do not appear to be as interested in expanding into LNG bunkering, others are signaling interest in bunkering supply, especially as buyers become more focused on the impact of LNG supply on climate. Cheniere of the United States has been at the vanguard in responding to this push, making a commitment to account for emissions from the entire supply chain, beginning in 2022. This is discussed further below.

### Novatek

Publicly listed Russian company Novatek and Gazprombank own and operate a medium-scale LNG production facility near Vysotsk in Russia. The plant has a capacity of 600,000 tonnes per year, and Novatek plans to expand its capacity by an additional 1.1 million tonnes.[41] LNG from Vysotsk has been delivered to Lithuania, Finland, and Sweden.[42] Following the suspension of LNG deliveries from the Snohvit project in 2020, a large proportion of deliveries to KN have come from Vysotsk.

Novatek sees the Baltic States as markets for the plant's output and is also focused on SSLNG deliveries to Rostock in Germany, where it plans to build a receiving terminal for inland truck distribution. Novatek already has an LNG filling station in Rostock.

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[39] Hong Liang, Lee. "Lithuania's Klaipeda port embarks on LNG bunkering." *Seatrade Maritime News*. February 2021. https://www.seatrade-maritime.com/bunkering/lithuanias-klaipeda-port-embarks-lng-bunkering

[40] Blenkey, Nick. "Nauticor to be sole charterer of LNG bunkering vessel Kairos." MarineLog. April 2019. https://www.marinelog.com/news/nauticor-to-be-sole-charterer-of-lng-bunkering-vessel-kairos/

[41] Duran, Mirza. "Russia's Novatek could almost triple Vysotsk LNG capacity." *Offshore Energy*. May 2019. https://www.offshore-energy.biz/russias-novatek-could-almost-triple-vysotsk-lng-capacity/

[42] Bajic, Adnan. "Cryogas-Vysotsk hits 1 mt LNG milestone." *Offshore Energy*. January 2021. https://www.offshore-energy.biz/cryogas-vysotsk-hits-1-mt-lng-milestone/

## Equinor

Equinor (formerly Statoil) has been the major supplier of LNG to the KN terminal, accounting for 70 percent of deliveries. Although Equinor has not entered the LNG bunkering market, it has chartered LNG fueled shuttle tankers to be supplied by Gasum, and its Snohvit LNG production facility is able to load SSLNG carriers.[43] Equinor has encountered numerous problems at the Snohvit plant, which was shut down following a fire in September 2020 and is expected to return to service in October of 2021. Equinor has yet to make a policy statement regarding its interest in supplying LNG for bunkering.

## Shell

Shell has invested in SSLNG shipping and bunkering activities, and SSLNG carriers. Shell currently controls three LNGBVs, notably the *Cardissa*, a 6,500 $m^3$ LNGBV which operates primarily out of the GATE LNG terminal at the Port of Rotterdam as does the *LNG London*, a bunker barge on long-term charter to Shell. Shell has other LNGBVs on order and has stated its intention to double its LNGBV fleet by 2025.

In supply terms, Shell has long-term contract volumes available to serve west of Suez markets from the United States, Nigeria, Trinidad, and Equatorial Guinea. In addition, it has formed a joint venture with Qatar Petroleum to develop worldwide bunkering supply.[44] As an LNG portfolio player, Shell is structurally long on LNG and therefore bunker markets are important to its growth.

## Total

The oil major Total has recently attained portfolio player status in LNG following its acquisition of Engie's LNG assets. It is aggressively pursuing LNG export from North America through both existing projects and those under development. Total's most significant move in LNG bunkering has come from its relationship with container ship owner CMA CGM. The latter is currently taking delivery of new, world class LNG-fueled container ships to operate on circumnavigational trade routes, and these will be fueled from LNG supplied by Total on its bunker vessel the *Gas Agility*, with 18,600 $m^3$ capacity. The first two container ships have been delivered and fueled at Rotterdam, with the LNG supplied by Total from the GATE terminal. CMA CGM intends to use LNG fuel in 26 container vessels by 2022.

## Cheniere

Cheniere has made cargo deliveries into Poland and Lithuania and has sold numerous cargoes to European terminals. The company is long in LNG and has been active in looking to develop medium- and long-term sales agreements. Cheniere's LNG access will increase with the commissioning of the third train at its Corpus Christi facility, currently undergoing completion. Although it does not have terminal capacity in NW Europe, Cheniere might have interest in supplying capacity holders who wish to supply the bunker market. Regarding companies with supplies from the United States, it is important to note that the Panama Canal is now proving to be

[43] "Equinor testing new LNG-powered shuttle tankers." *Oil & Gas* 360. June 2020. https://www.oilandgas360.com/equinor-testing-new-lng-powered-shuttle-tankers/

[44] "Qatar Petroleum and Shell to Establish Global LNG Bunkering Venture." *Maritime Executive*. September 2019. https://www.maritime-executive.com/article/qatar-petroleum-and-shell-to-establish-global-lng-bunkering-venture

a bottleneck for supplying LNG to Asia[45], and this has caused suppliers to look more closely at their options for delivery to European destinations.

To date, the other LNG portfolio players, Naturgy and BP, have not entered LNG bunkering. However, these and the companies cited above are developing policies and plans regarding decarbonization, starting with accountability for their carbon emissions. In the case of Cheniere, from 2022 the company will account for the emissions involved in the LNG chain from well head to cargo delivery from its United States plants. These developments add momentum to the argument for natural gas and LNG as a transition fuel, and increase awareness as to its future role and impact on energy supply. They also align with the proposed EU policy to reduce methane emissions along the supply chain through improved measurement and reporting of emissions.

### GATE LNG Terminal

Although the terminal itself is not a supplier of LNG, it has been designed and developed to serve the LNG bunker market at the Port of Rotterdam. Any bunkering initiative in the Baltic States will likely draw on supply from GATE, which has a jetty dedicated to SSLNG carriers. Small-scale distribution from GATE within the Baltic States and Scandinavia is already commonplace.

## Opportunities for Growth in the LNG Bunkering Market

The bunkering market and SSLNG in the Baltic States are very diverse in terms of infrastructure, participants, and customer type compared to the international bulk trade of LNG. This section will explore three main opportunities for growing the LNG bunkering market in the Baltic States: (1) tapping into existing LNG-fueled vessel traffic in ports; (2) taking a regional approach to building out the market; and (3) development of franchise arrangements.

The lack of available existing infrastructure presents challenges to growth in the LNG market. While KN operates the existing Klaipėda Reloading Station on a TPA basis, the facility's capacity is fully booked by PGNiG until 2025, effectively eliminating this as a near-term option for increased throughput to SSLNG markets if no changes are made to the facility. Near-term investments could include adding storage tanks, coupled with additional truck loading bays, but would require (1) health, safety, security, and environment (HSSE) related studies and regulatory approvals and (2) an open season or tender to justify the expansion. Since PGNiG and KN initiated the agreement in April 2020, PGNiG has been the sole user of the facility, loading more than 4,000 tonnes of LNG into over 250 tanker trucks bound for small-scale markets in Poland.[46]

### Existing LNG-fueled Vessel Port Traffic

Major ports in Estonia, Latvia, and Lithuania all currently serve LNG-fueled vessels, even if they do not necessarily have them as LNG bunkering customers. This access creates an opportunity to tap into existing LNG-fueled vessel traffic in the region by marketing LNG bunkering services to these vessels, whether truck-to-ship, ship-to-ship, or terminal-to-ship, depending on the port's capabilities. This would be the most straightforward option, involving directly contracted

[45] Currently only one LNG carrier can transit the Panama Canal per day, limiting traffic from suppliers in the Gulf of Mexico and Atlantic region more broadly that are trying to access customers in Asia.

[46] Pekic, Sanja. "PGNiG received its fourth LNG delivery in Klaipėda." *Offshore Energy*. January 2021. https://www.offshore-energy.biz/pgnig-received-its-fourth-lng-delivery-in-klaipeda/

arrangements between bunker providers and vessel owners. These contractual arrangements are in place in Lithuania and Estonia and could be replicated in Latvia with additional customers.

## Regional Approach – Market and Regulatory Alignment

The second opportunity for LNG bunkering growth is the development of a regional approach to building out the market. The Baltic States may wish to build on their positive measures (described below) to achieve such an aim by creating a Baltic States LNG Transport Forum. Such a forum could promote a more cohesive approach to implement policy for LNG transportation, support investment, assess the market potential, agree on technical standards, adopt consistent taxation or regulatory policies, and develop dialogue with major oil companies as supply sources.

### *Regulatory Alignment*

The EU-funded HEKLA project and Markos Bay LNG reloading station cited above developed a harmonized approach towards supporting LNG bunkering infrastructure in the Baltic States in terms of identifying the pre-feasibility work required, project designs, regional market studies, and safety manuals needed. This culminated in the issue of the "LNG Guidebook" containing information on leading practices, recommendations, and standards on how to develop infrastructure. This was followed by the "LNG in Baltic Sea Ports II" initiative. LNG in Baltic Sea Ports II aims to minimize maritime transport pollution in the Baltic region by supporting the widespread use of LNG, while maintaining the competitiveness of maritime transport. The project involves ports from Sweden, Germany, and Lithuania.

The absence of Estonian and Latvian representation in these initiatives suggests that further work incorporating operating experiences to date and involving all potential LNG bunkering ports in the Baltic States could help create a harmonized LNG bunker market and encourage further investment by shipowners in LNG fueled vessels.

This also offers the opportunity to create common, EU-compliant regulatory policies in the sector. This could be facilitated by an EU-funded review of the status of the LNG bunkering market including participation from Estonia and Latvia, especially compared to its previously projected development. The LNG market for bunker fuel in the Baltic States is diverse, and it has now been six years since the introduction of the North Sea/Baltic ECA sulfur cap. The review could include pre-investment studies, technical design, required permits, and risk assessment procedures for LNG bunkering infrastructure in a harmonized manner. A concerted effort to identify gaps in the LNG bunkering network and the options for filling them is required to give guidance to sponsors of new import facilities.

Adoption of common technical standards for LNGBV and LNG distribution vessels could help to create a standard configuration for such ships, which would have the effect of reducing vessel costs, given that all LNGBVs operating in the Baltic and North Sea are bespoke vessels. Further interfacing of LNG bunkering plans with the EU-funded Motorways of the Sea project[47] could help promote further bunkering developments.

[47] "Motorways of the Sea." European Commission. https://ec.europa.eu/transport/modes/maritime/motorways_sea_en

### *Market Alignment*

From a commercial standpoint in the Baltic States, LNG is sold on a small scale to several customers from shipping sectors, where each ship owner is treated individually and the prices are settled individually according to each customer's needs. The approach creates a limited amount of market transparency in LNG bunker prices in the region.

The two main LNG fuel pricing mechanisms used are:

1. LNG fuel price index to Gas Hub prices (e.g., Title Transfer Facility in the Netherlands or National Balancing Point in the UK, which are the analogous markets to that of the Henry Hub in the United States); and
2. LNG fuel price index to MGO prices (now, Low Sulfur and Very Low Sulfur with current emissions caps).

Given the increasing number of locations where LNG bunkers can be purchased, a more regional approach to market development would increase competition among buyers and sellers, support the construction of additional bunkering vessels, and support the creation of a regional, traded and transparent LNG bunker fuel price, contributing to greater liquidity in the LNG-bunker fuel market.

Seen from a supplier perspective, an integrated Baltic and North Sea LNG market would offer better prospects for sales volume growth and provide opportunities to overcome the lack of economies of scale displayed by the current patterns of trade within the region. Adoption of common technical standards and vessel designs could help promote this process. Similarly, development of a transparent and unified pricing structure for LNG supplies at the wholesale level, as described above, would send clear signals to existing and potential future suppliers and investors in the sector.

## Franchise Arrangements

The third opportunity to grow the LNG bunkering market is the development of franchise arrangements. The market for traditional bunker fuels is characterized by companies that purchase their supplies from refiners for onward sale to ship operators and charterers. Although some oil majors have bunkering subsidiaries, the business for them represents more of a disposal route for heavy bunkering products rather than a profitable or growth business. Trading companies who are active in the LNG sector such as Trafigura, Vitol, and Glencore also have bunkering companies but have yet to enter LNG bunkering. However, their markets will inevitably face challenges from a growing market share of LNG in shipping, and their entry into the sector is probable.

Looking to Estonia, which has the most active LNG bunkering market, there are several independent bunkering companies such as NT Bunkering, Marine Energy Solutions, and Shield Bunkering, all of which could see their market decrease in size if they are unable to compete in the LNG bunker sector. In this regard, there may exist opportunities in the northwestern European and Baltic market via a form of franchise structure. This could take a structure similar to that used to supply gasoline and diesel fuels for road transportation, as employed in countries such as the United States. Under this structure, the operator of the gas station can either own the facility or lease it and sell products supplied by an oil major or refiner in a competitive and transparent market.

This model can be applied to LNG bunkering with oil suppliers such as Shell and Total that are already active in SSLNG and bunkering. Such oil majors could provide the requisite technical and HSSE input, including training if necessary, and LNG supply including LNG delivery to a franchisee. To be effective, the franchisee would need to contract for use of SSLNG terminal capacity at one or more of the import terminals in the Baltic States. EU policies that require TPA to these facilities for bunkering, based on realistic parameters for cargo size and throughput, would enhance the potential of such a model. A volumetric limit could be placed on the amount of LNG that the bunker supplier may hold at the terminal at any time, coupled with specific usage provisions to create incentives for LNG throughput.

To realize a franchise structure, bunkering companies would need to contract for supply of LNG at the wholesale level. In some instances, they may be able to purchase LNG from small liquefaction plants linked to small-scale terminals such as the Gasum facility in Risavika, or, more likely, from bulk breaking activity at the Dutch GATE or Belgian Zeebrugge terminals, giving access to internationally traded LNG. There exists the possibility of LNG carriers performing multiple deliveries to small-scale terminals or loading shuttle vessels to deliver to them. This will require dialogue with bulk LNG suppliers, identified in the previous section.

As demonstrated, many of the underlying requirements for developing an enhanced LNG bunker market within the Baltic States are already in place. Given the different sizes and control of SSLNG carriers, especially LNGBVs, the market appears to be very diverse, notwithstanding the work performed under the Baltic Ports Organization and HEKLA projects.

Overall, the scope for growth of LNG as a bunker fuel to replace higher emitting alternative fuels in the Baltic and North Sea region is encouraging, given the commitments made for LNGBVs by shipowners and the growth in number of terminals supplying LNG. However, recent transactions such as KN's sale of its stake in Blue LNG (charterer of *Kairos*) and Titan's control of the *Green Zeebrugge* imply that the market is still in a nascent stage.

## Recommendations Summary

- The Baltic States should support LNG bunkering as part of their plans to reach their environmental and climate change goals. LNG bunkering replaces fuels with higher carbon and sulfur emissions, and is currently the lowest emitting fuel alternative for marine bunkering. LNG bunkering deploys natural gas as a bridge fuel to a low-carbon future without requiring significant investment in expensive permanent infrastructure. It should therefore be included in climate policies.
- Major ports in Estonia, Latvia, and Lithuania that currently serve LNG-fueled vessels should market LNG bunkering services to these vessels. It could be truck-to-ship, ship-to-ship, or terminal-to-ship, depending on the port's capabilities. This would involve direct arrangements between bunker providers and vessel owners on a contract basis. These contractual arrangements are already in place in Lithuania and Estonia and could be replicated in Latvia or with other customers.
- The Baltic States should support and pursue an EU-funded review of the status of the LNG bunkering market, especially compared to its previously projected development. The LNG market for bunker fuel in the Baltic States is diverse and dynamic. As a result, the Baltic States should conduct an updated review of the current sulfur emission cap and include participation by ports from Estonia and Latvia, whose involvement in related studies to

date has been minimal. This review could include pre-feasibility studies, technical designs, required permits, and risk assessment procedures for LNG bunkering infrastructure in a harmonized manner. Project sponsors of new SSLNG projects would benefit considerably from a concerted government-supported effort to identify gaps in the LNG bunkering network and the options for filling them.

- The Baltic States should encourage and facilitate the development of franchise models for LNG bunkering services at ports, similar to those used for road transportation fuels, to increase participation by local traditional bunker suppliers or by new market entrants as a means of promoting competition.
- To support investment in LNG as a fuel for marine bunkering (as well as land transportation as discussed below), the Baltic States should consider the development of a public Baltic States LNG Transport Forum for project developers, fuel suppliers, bunkering infrastructure operators, and local stakeholders to facilitate the alignment of objectives to support the industry's development. A Baltic States LNG Transport Forum could promote a more cohesive approach to implementing policy for LNG transportation (including both land and marine transport) to (1) assess the market potential, (2) agree on technical standards, (3) adopt consistent taxation or regulatory policies, and (4) develop dialogue with major oil companies as supply sources. This would help create a more predictable and consistent enabling environment for potential investors looking for opportunities in the Baltic States, both on land and at ports.
- SSLNG infrastructure design and operational plans in the Baltic States should consider the requirements of a bunkering business, especially mandatory TPA requirements for bunker operators. This will require differentiation between project sponsors and infrastructure operators from the commercial or state-owned companies seeking to provide LNG bunker fuel and capacity bookings. It is possible for companies to get exemptions from the TPA requirements, but this is not easily justified for less capital intensive SSLNG infrastructure and is not recommended for the Baltic States to consider as it could deter potential users that will expect TPA provisions.

# IV. Land Transportation

This section analyzes the market for LNG fuel in transportation in the Baltic States, specifically heavy-duty trucks and rail infrastructure, and determines that these markets have more limited growth opportunities for SSLNG (compared to bunkering). Existing LNG road and rail transportation infrastructure is limited in the region, and expansion of the infrastructure will require significant private-sector investment and regulatory incentives at the national and possibly EU level. While near-term investment in LNG-fueled trucking may be attractive in Lithuania (which has an existing direct supply of LNG coupled with government-led initiatives and incentives), other countries may not prioritize investment in LNG transportation infrastructure until other higher-priority projects are completed, such as new SSLNG terminals. Competition with other low or zero-emission technologies in the sector (e.g., renewably sourced electricity or bio-LNG) will also impact LNG's ability to gain market share. In the case of rail, LNG is unlikely to be considered for new-build locomotives, but there is an opportunity to replace high-emissions diesel-powered engines already in operation using dual-fuel engine technology. Governmental priorities and policies will have significant influence over the eventual fuel mix in transportation as the Baltic States move towards their decarbonization goals.

## Existing LNG-fueled Transportation Infrastructure

### Trucking

LNG truck fueling infrastructure is very limited in the Baltic States. There are currently only two LNG-capable fueling stations in the Baltic States, both of which are located in Estonia and cater primarily to CNG customers, such as passenger bus fleets (see **Figure 2** below). This lack of infrastructure creates an investment dilemma where fuel suppliers do not want to invest in the fueling infrastructure if there are no LNG-fueled trucks in service, and fleet operators do not want to invest in LNG-fueled trucks if there is no fueling infrastructure in place. A particular feature of the cryogenic nature of LNG is that it requires higher capital costs to store the LNG compared to conventional liquid fuels, and thereby rewards projects that employ economies of scale to make them economical. The relatively small and fragmented market for land-transport LNG fuels exacerbates the barriers to the near-term replacement of conventional fuels with LNG in the trucking sector.

***Figure 2: LNG Vehicle Fueling Stations[48]***
***(Green circles indicate number of fueling stations by country)***


Development of this market requires a commitment to infrastructure investment reinforced by regulatory and financial support from governments. The Alexela L-CNG Station outside of Tallinn is the first of its kind in the Baltic States, and it received approximately €130,050 in financial support through the EU Cohesion Fund and Connecting Europe Facility.[49] Further, Latvian truck fleet operator Dinotrans purchased its first LNG powered truck in 2020, despite there not being LNG filling stations open yet in the country.[50] However, lack of infrastructure at regional and national levels continues to act as a barrier to sector growth.

### Rail

While countries in southwestern Europe have adopted LNG-powered locomotive technology, there is no existing LNG-fueled rail industry in the Baltic States. In 2018, the shares of rail in total inland freight transport in the Baltic States were the highest across the EU at 46.2 percent for Estonia, 75.8 percent for Latvia, and 67.9 percent for Lithuania.[51] This demonstrates the importance of rail transport in the freight industry in the region, which could support a transition to greener fuel alternatives to help meet decarbonization targets, discussed further below in in the section on opportunities.

## Opportunities for Growth in the LNG Transportation Sector

### Trucking

LNG in trucking will require policy support and the availability of financial incentives to encourage investment in LNG-fueled trucks to help meet EU and member country decarbonization targets. Lithuania presents the most promising market for LNG as a truck fuel because of the government policies in place to support LNG fueling infrastructure. Latvia and Estonia also show

[48] "CNG Stations in Europe." NGVA. https://www.ngva.eu/stations-map/
[49] "Mobiilne lahustankla, Võru." Environmental Investment Centre. https://kik.ee/en/projekt/mobiilne-lahustankla-voru
[50] SIA Dinotrans – First company from Baltic Countries who brought LNG Trucks
[51] "Freight Transport Statistics." Eurostat. https://ec.europa.eu/eurostat/statistics-explained/index.php/Freight_transport_statistics

potential if they can also enjoy supportive government policies for LNG infrastructure investments. These policies have played a significant role in growing the global LNG fuels market because of the environmental requirements underpinning this fuel transition to cleaner burning natural gas.

Due to limited LNG fueling infrastructure and lack of regulatory incentives, the road freight industry is considered a hard-to-abate industry. The road freight sector accounts for 9 percent of global $CO_2$ emissions – 60 percent of which are generated by approximately 63 million medium- and heavy-duty trucks in operation globally.[52] However, recent developments at the EU and country level could increase the market opportunity for LNG trucking. In 2019, the EU passed rules requiring new trucks to emit 15 percent less $CO_2$ on average compared to 2019 levels by 2025 and 30 percent less from 2030.[53] These rules increase the competitiveness of LNG as a lower-emissions transportation fuel. LNG fuel can reduce greenhouse gas emissions from trucks by up to 30 percent compared to diesel and gasoline.[54]

Regional policies, in the absence of commercial and financial support mechanisms, will not provide enough incentives to promote LNG fuel investment in the Baltic States at the scale required to accelerate a near-term shift away from conventional fuels in the trucking sector. However, such policies demonstrate a broader commitment to decarbonize the transportation industry and will facilitate the creation and implementation of more robust policy measures.

There are two sources of LNG for truck fuel: (1) import terminal, either large- or small-scale; and (2) small- or medium-scale liquefaction plants that liquefy pipeline gas drawn from the main transmission systems. In terms of liquefaction plants, the medium-scale facility located at Vysotsk in Russia, owned and operated by Novatek, has made truck exports to Estonia for bunkering purposes. At present, there is no off-pipeline liquefaction source of LNG.

Lithuania does not have any LNG fueling stations, but recent local policies, initiatives, and incentives have created the greatest opportunity for small-scale demand growth in the region for the LNG-fueled trucking industry in the near-term. The National Energy and Climate Action Plan of the Republic of Lithuania for 2021-2030 (NECAPRL)[55] highlights two key commitments to support LNG use in road transportation:

1. The government will offer a subsidy covering 50 percent of the installation cost of two LNG stations, with estimated annual sales of 792 metric tonnes per year; and

[52] "Decarbonizing Road Freight: Getting into Gear." Shell and Deloitte. January 2021. https://www.shell.com/energy-and-innovation/the-energy-future/decarbonising-road-freight.html?utm_source=&utm_medium=&utm_content=Deloitte_web_link_010_&utm_campaign=decarbonisingroadfreight__jan-feb_2021

[53] Hall, Siobhan. "EU rules set to boost LNG in new trucks could apply in July." *S&P Global*. June 2019. https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/062819-eu-rules-set-to-boost-lng-in-new-trucks-could-apply-in-july

[54] "Environmental benefits of LNG or CNG-fuelled truck fleets." *Fortis BC*. https://www.fortisbc.com/est/truck-fleets/environmental-benefits-of-lng-or-cng-fuelled-truck-fleets

[55] "NATIONAL ENERGY AND CLIMATE ACTION PLAN OF THE REPUBLIC OF LITHUANIA FOR 2021-2030." https://ec.europa.eu/energy/sites/ener/files/documents/lt_final_necp_main_en.pdf

2. The government will grant subsidies to businesses in order to compensate the cost of purchasing commercial vehicles fueled by LNG. The plan is to provide a single, nonrepayable flat-rate subsidy for around 1,000 vehicles per year.

Following the publication of the NECAPRL, three applications were submitted for LNG fueling stations, which are expected to be developed and launched within two years.[56] Subsidies for LNG fueling stations are also considered under Lithuania's "Plan for the DNA of the Future Economy."

As mentioned previously, the capacity at the Klaipėda reloading station is fully booked until 2025, meaning that the facility's ability to supply LNG fueling stations will be limited in the near term without further investment. Near-term investments could include adding storage tanks, coupled with additional truck loading bays, but would require: 1) HSSE related studies and regulatory approvals; and 2) an open season or tender to justify the expansion.

To promote a more cohesive approach to implementing policy for LNG transportation and supporting investment, the Baltic States should consider including LNG and CNG trucking market activities as part of a potential Baltic States LNG Transport Forum, as referenced in the marine bunkering section. Currently, there are 28 CNG filling stations in the Baltic States (compared to only two LNG stations – see **Figure 3**). LNG fueling services can be integrated with existing CNG filling stations, which could support the efficient rollout of new installations, and such a forum could explore bundling of fueling services to support growth in both markets.

***Figure 3: CNG Stations***[57]
***(Green circles indicate number of CNG filling stations by country)***


## Rail

LNG-powered locomotives will have to compete with electric-powered options in the region against a policy background of decarbonization. Recently, the EU awarded €1.6 billion ($1.9 billion) to support 55 rail infrastructure projects along the trans-European transport core network,

[56] Based on information provided by counterparts in Lithuania.
[57] "Station Map." NGVA. https://www.ngva.eu/stations-map/

including the Rail Baltica project.[58] This project will integrate the Baltic States with the European rail network, connecting major cities across Finland, Estonia, Latvia, Lithuania, and Poland, and will be powered entirely by electricity.[59] This is a major endorsement of electric-powered rail freight in the region, and it is not anticipated that many new-build rail projects will run on LNG.[60]

While the opportunity for LNG demand in the rail industry may not be large for new builds due to competition from electricity, conversions of existing rail infrastructure to dual-fuel engines with LNG, though expensive, are possible. Like most of these LNG fuel options, they are costly, and investors will look for regulatory and possibly fiscal support from governments to facilitate investment decisions. Regulatory support could come in the form of fuel subsidies, accelerated depreciation, or other tax incentives.

Private developers and companies are considering several conversion projects across the Baltic States. DiGas, a Latvian dual-fuel natural gas system manufacturer, and Estonian state-owned energy company Enefit Kaevandused are leading a project to retrofit two diesel shunter locomotives to operate in dual-fuel mode using LNG.[61] DiGas's dual fuel system is designed to reduce fuel costs by up to 30 percent and reduce harmful emissions. DiGas received funding from the EU's Horizon 2020 research and innovation program.[62] Successful completion of this project could support future conversions to dual-fuel engines as fuel savings and emissions reductions are realized.[63] Further, in Estonia, Operail is converting the first of up to 30 Union Pacific locomotives to dual-fuel technology for diesel or LNG.[64] The estimated cost of conversion is $300,000 per locomotive. Fuel emissions reductions are the primary motivation behind this project and Operail anticipates that the converted locomotives will emit 20 percent less $CO_2$ and 70 percent less sulfur dioxide compared to conventional diesel fuel powered locomotives.

The status of LNG as a locomotive fuel is made uncertain due to the existence of a diverse range and age of prime mover units in the region and competition from other, untested fuel types. LNG might be more suitable for some configurations of rail systems, such as commuter trains, than others such as freight or shunting. The development of pilot schemes such as in Estonia should help to inform rail operators as to the merits of LNG as an alternative fuel source and how it might best be applied.

[58] Nissimov, Ron. "EU Grants Promote Use of LNG as Transportation Fuel." *Natural Gas Intel.* July 2020. https://www.naturalgasintel.com/eu-grants-promote-use-of-lng-as-transportation-fuel/#:~:text=The%20European%20Union%20(EU)%20has,transportation%20projects%20in%20the%20EU

[59] "Rail Baltica – Project of the Century." *Rail Baltica.* https://www.railbaltica.org/about-rail-baltica/

[60] Fender, Keith. "Development of hydrogen-powered trains continues, but battery-powered equipment making more inroads." *Trains.* December 2020. tinyurl.com/1lg3cajl

[61] "Two LNG Shunter Locomotives Planned in Estonia." *NGV Global News*. November 2019. https://www.ngvglobal.com/blog/two-lng-shunter-locomotives-planned-in-estonia-1129

[62] "Novel dual-fuel system for modernisation of air-polluting diesel locomotives to clean and efficient gas operation." European Commission. https://cordis.europa.eu/project/id/784620

[63] The retrofitted locomotives were expected to go into operation in mid-2020, but no more recent updates on the project's status could be found.

[64] Fender, Keith. "Project in Estonia will convert former Union Pacific locomotives to run on LNG." *Trains.* February 2021. https://trn.trains.com/news/news-wire/2021/02/10-project-in-estonia-will-convert-former-union-pacific-locomotives-to-run-on-lng

## Recommendation Summary

- Policy support and the availability of financial incentives to meet aggressive decarbonization targets will be the primary drivers of LNG demand for transportation in the region. Trucking and existing rail are difficult to decarbonize, and efforts to achieve net-zero emissions will require specific policy support in these regions. The EU and the Baltic States should apply targeted incentives and support for LNG infrastructure to aid these markets to decarbonize.
- The Baltic States should conduct a study to characterize the viability of LNG as a transportation fuel, estimate the cost of building out the required supply network, evaluate its competitive position compared to alternative fuels such as CNG and Bio-LNG, and assess the impact of harmonized pricing on the market. This will help the Baltic States to develop a more regional strategy for build out and investment in road transportation and quantifying potential GHG emissions reductions.
- The creation of a Baltic States LNG Transport Forum could facilitate coordination across land transportation sector stakeholders (as it would for marine sectors) to promote a more cohesive approach to implementing policy for LNG transportation.
- The Baltic States should explore bundling of fueling services to support growth in the market. Bundling of services will allow existing companies in the market to be involved and preserve market share if LNG becomes a more widely accepted fuel in the region. It is recommended that any discussion of LNG as a truck fuel should involve gauging the interest of companies such as Shell, BP, or Total in not only entering but supporting the market in the Baltic States via supply commitments. LNG fueling services also can be integrated with existing CNG filling stations, which could support the efficient roll out of new installations.
- The Baltic States should consider LNG in rail transportation in terms of dual-fuel engine conversions for existing diesel locomotives. Due to decarbonization goals and the EU's backing of electric-powered infrastructure such as the Rail Baltica project, pursuing LNG-powered new builds is not recommended. However, conversions of existing rail infrastructure to dual-fuel engines with LNG would help cut emissions and are already being tested in the region. Regulatory and possibly fiscal support from governments would help investors to make crucial investment decisions on these conversions.

# V. Remote Industry and Power

## Opportunities for Growth in the Remote Industry and Power Sectors

A market for LNG exists in locations that are not served by natural gas distribution networks but have demand potential, typically for industrial use such as food processing, paper and plastic goods production, breweries, and distilleries. Examples of such demand centers exist in many countries. These markets can be served by LNG trucks, which are filled from small liquefaction plants that typically source their gas from the transmission pipeline system.

Although there are currently no such liquefaction facilities in the Baltic States, the development of LNG as a transportation fuel in the region may encourage the development of off-pipeline plants to provide LNG to truck filling stations as part of an SSLNG infrastructure expansion. However, the lack of companies operating in the SSLNG sector across the Baltic States presents a barrier to such development. It should be noted that gas marketing and supply is primarily carried out by the state-owned gas companies, rather than by local utility companies, and that these large gas companies have significant requirements to modernize the gas transmission and distribution systems they inherited from the increasingly distant Soviet era. Any remote LNG initiative, therefore, would most likely need to come from a private sector that currently plays a small role in the Baltic gas industry or stem from EU policy directives.[65]

Where a potential opportunity for such development exists, it would be more likely based on liquefaction of biomethane as part of a decarbonization policy. Combined heat and power facilities are a major feature of the Baltic States' gas markets. Although the use of LNG in such facilities could offer demand potential, such plants are more likely to be fueled by biomethane, given that renewable fuels such as wood pulp and biomass are employed for a large proportion of the district heating systems in the region.

The lack of market for this sector can partly be explained by the history of the Baltic States' gas markets in which the former Soviet Union promoted the use of gas to very high levels. Following the collapse of the Soviet Union, the Baltic States have reduced their gas demand through improved energy conservation measures coupled with switching to renewable sources of energy such as wood pulp. This leaves oil consuming industries as the primary targets for fuel conversion. An example of such a conversion has taken place in Latvia, with LNG supplied by Elenger out of Estonia, where Jetgas also provides similar services to a small number of customers.[66]

Realistically, any development of remote SSLNG would have to take place as a result of LNG demand for transportation and even then, biomethane would be a competing fuel in this market.

## Recommendation Summary

- The Baltic states should identify specific opportunities for conversion of light industrial facilities to use natural gas. This could be a standalone study, but the results should be integrated with the findings on LNG bunkering and transportation applications of LNG.

[65] "Estonian Gas Transmission Network Development Plan 2018-2027." Elering. March 2018. https://issuu.com/elering/docs/estonian_gas_transmission_network_d

[66] "LNG for energy production." Jet Gas LNG. https://jetgas.ee/et/referentsid

As evidenced during the research stage of this Report, there is very little existing data on the potential for remote SSLNG demand.

- The Baltic States should conduct a study that analyzes the impact on GHG emissions and the possibility of creating incentives such as tax benefits or advantageous depreciation treatment for such conversions. Development of standardized and modular installations should also be part of the study along with an emphasis on HSSE, siting, and installed cost. Following such a review, the results need to be integrated with the findings on LNG bunkering and transportation application of LNG.
- The Baltic States should identify specific opportunities to replace existing diesel power generation with remote industry and power applications of LNG. Off-grid LNG supply via trucks or off-pipeline liquefaction facilities could both support and act as a transition fuel for renewable mini-grid technology which is not yet widely deployed in the Baltic States. As the Baltic States increase their reliance on renewable generation, such as wind turbines, to power their electric grid, the intermittent nature of renewables will require dispatchable generation to balance it; however, in the near team, an electric grid powered solely by battery storage and renewables will face operational and resilience challenges. As a bridge fuel, LNG can provide an immediate, cleaner, and resilient alternative to diesel.

# VI. Conclusions

This Report identifies marine bunkering as providing the greatest opportunity in the immediate term for SSLNG growth in the Baltic States, as compared to opportunities in the trucking, rail, and remote industrial sectors. The Report also recommends further cooperation and regional coordination of natural gas markets in the Baltic States, as individually, these markets constitute small levels of demand, which limits the economics of LNG supply for domestic consumption.

The subsequent sections below provide more detailed information on the key findings and recommendations contained in the Report.

## Key Findings

***Marine Bunkering***

Environmental policies on shipping fuel emissions and the climate benefits provided by use of LNG fuels have driven the recent growth of the global LNG marine bunker market. This market is projected to increase ten-fold to 10 million metric tonnes by 2021, creating an opportunity for those investing in new LNG bunkering infrastructure. [67] Establishing LNG bunkering infrastructure and capabilities at key ports will further position the Baltic States to capture some of the growing market share of LNG in bunkering fuels.

In considering the scope for LNG bunkering in the region, it is important to recognize that commerce in 2020 has been negatively impacted by the COVID-19 pandemic, reducing not only passenger demand for cruises, ferries, and roll on/roll off cargo vessels, but also container traffic. This has served to slow the momentum towards consideration and investment in LNG as a bunker fuel. However, there is an anticipated resumption in growth once the effects of the COVID-19 pandemic have subsided.

Due to investment to-date in LNG bunkering and existing operations, Estonia is an attractive market with significant short-term demand potential. Of the potential importers, Estonia is the most likely candidate to build terminal-based LNG bunkering infrastructure, such as storage tanks in the near term, utilizing existing truck-to-ship services and a purchased LNGBV.

Although Latvia does not currently provide LNG bunkering services, existing cargo throughput at the ports of Riga and Ventspils and an increase in LNG-fueled vessel traffic could provide a domestic LNG bunkering market opportunity for Latvia. Near-term, Latvia could enter the market via truck-to-ship operations or the chartering of an LNGBV, which would not require an immediate investment in permanent port infrastructure.

Klaipėda in Lithuania is the only seaport in the country, and a high proportion of the ship calls made to Klaipėda consist of cruise liners, which is a segment of the maritime market that is increasingly supportive of LNG as a fuel. KN has promoted the port as an LNG bunkering location. Although Klaipėda port does not currently have a dedicated LNGBV, LNG transportation and bunkering services are provided in the Baltic and North Sea region by several available vessels, including *Seagas* and *Kairos*. KN operates the reloading station on a TPA basis,

[67] "Strong growth expected in LNG bunker demand: Total," S&P Global, January 28, 2020, https://www.spglobal.com/platts/en/market-insights/latest-news/oil/012820-strong-growth-expected-in-lng-bunker-demand-total

but it is important to note that the 5,000 $m^3$ capacity is fully booked by PGNiG until 2025, effectively eliminating this as a near-term option for increased throughput to SSLNG markets without further facility expansions. Near-term investments could include adding storage tanks coupled with additional truck loading bays, but would require (1) HSSE related studies and regulatory approvals, and (2) an open season or tender to justify the expansion.

Due to the time and costs associated with such an expansion, the development of alternative SSLNG in markets closer to demand centers in Latvia and/or Estonia becomes economically more competitive. To increase LNG supply in the region to meet small-scale market demand, Latvia and/or Estonia could develop their own SSLNG infrastructure, including storage capacity for LNG bunkering and truck loading services (discussed below). In Lithuania, KN has taken the role of an infrastructure provider, leasing capacity to third-party customers for use of the small-scale reloading facility. It is not clear who would take that infrastructure provider role in Latvia and Estonia at present, given EU TPA requirements, which prohibit the same company from operating and using the facility at the same time.

***Land Transportation***

The transportation sector, specifically heavy-duty trucking and rail, has more limited growth opportunities for SSLNG (compared to bunkering). Existing LNG road and rail transportation infrastructure is limited in the region, and expansion of the infrastructure will require significant private sector investment and regulatory incentives at the national, and possibly EU, level.

Because of limited infrastructure (compared to near universal access to diesel fuel infrastructure) and lack of regulatory incentives, road freight is considered a hard-to-abate industry. Growth in the LNG trucking market will require policy support and the availability of financial incentives to drive investment in LNG-fueled trucks and LNG-fueling infrastructure to help meet aggressive decarbonization targets. Due to its policy support for LNG-fueling infrastructure, Lithuania presents the most promising market for LNG as a truck fuel. However, Latvia and Estonia also show potential, if infrastructure investments supported by government policies are implemented.

LNG-powered locomotives will compete with electric-powered options in the region against a policy background of decarbonization. While the opportunity for LNG demand in the rail industry may not be large for new builds due to competition from electricity, conversions of existing rail infrastructure to dual-fuel engines with LNG are possible and already underway. The development of pilot schemes, such as in Estonia, should help to inform rail operators as to the merits of LNG as an alternative fuel source and how it might best be applied.

***Remote Industry and Power***

A market for LNG exists in locations that are not served by natural gas distribution networks but have natural gas demand potential, typically for industrial use such as food processing, paper and plastic goods production, breweries, and distilleries. LNG trucks or small-scale off-pipeline liquefaction facilities can serve these markets. The development of LNG as a transportation fuel in the Baltic States could encourage the development of off-pipeline plants to provide LNG to truck filling stations as part of an SSLNG infrastructure expansion. However, the lack of companies operating in the SSLNG sector across the Baltic States presents a barrier to such a development in the near term. This is exacerbated by competition with fuels from the liquefaction of biomethane, due to existing and potential decarbonization policies.

# Key Recommendations

This section summarizes Report recommendations for SSLNG development by market sector:

## Marine Bunkering

- The Baltic States should support LNG bunkering as part of their plans to reach their environmental and carbon emissions mitigation goals. LNG bunkering replaces fuels with higher carbon and sulfur emissions. It is currently the lowest-emitting fuel alternative for marine bunkering. LNG bunkering deploys natural gas as a bridge fuel to a low-carbon future without requiring investments in expensive permanent infrastructure. It should therefore be included in any carbon emissions reduction policies in the near term.
- Major ports in Estonia, Latvia, and Lithuania that currently serve LNG-fueled vessels should market LNG bunkering services to these vessels, whether truck-to-ship, ship-to-ship, or terminal-to-ship, depending on the port's capabilities. This would involve direct arrangements between bunker providers and vessel owners on a contract basis. These contractual arrangements are already in place in Lithuania and Estonia and could be replicated in Latvia or with additional customers.
- The Baltic States should support and pursue an EU-funded review of the status of the LNG bunkering market, especially compared to previous demand projections that have not yet been met. The LNG market for bunker fuel in the Baltic States is diverse and dynamic. As a result, the Baltic States should conduct an updated review of the current sulfur emission cap and include participation by ports from Estonia and Latvia, whose involvement in related studies to date has been limited. This review should include pre-feasibility studies, technical designs, required permits, and risk assessment procedures for LNG bunkering infrastructure in a harmonized manner. Project sponsors of new SSLNG projects would benefit considerably from a coordinated government-supported effort to identify gaps in the LNG bunkering network and the options for filling them.
- The Baltic States should encourage and facilitate the development of franchise models for LNG bunkering services at ports, similar to those used for road transportation fuels, to increase participation by local traditional bunker suppliers, or by new market entrants as a means of promoting competition.
- To support investment in LNG as a fuel for marine bunkering (as well as land transportation, as discussed below), the Baltic States should consider the development of a public Baltic States LNG Transport Forum for project developers, fuel suppliers, bunkering infrastructure operators, and local stakeholders to facilitate the alignment of objectives that support the development of the industry. A Baltic States LNG Transport Forum could promote a more cohesive approach to implementing policies for LNG transportation (including both land and marine transport) to (1) assess the market potential; (2) agree on technical standards; (3) adopt consistent taxation or regulatory policies; and (4) develop dialogue with major oil companies as supply sources. This would help create a more predictable and consistent enabling environment for potential investors looking for opportunities, on land and at ports, in the Baltic States.
- SSLNG infrastructure design and operational plans in the Baltic States should consider the requirements of a bunkering business, especially mandatory TPA requirements for bunker

operators. This will require the differentiation between project sponsors and infrastructure operators from the commercial or state-owned companies seeking to provide LNG bunker fuel and capacity bookings. It is possible for companies to get exemptions from the TPA requirements, but this is not easily justified for less capital-intensive SSLNG infrastructure and is not recommended for the Baltic States to consider as it could deter potential users that will expect TPA provisions.

## Land Transportation

- Policy support and the availability of financial incentives to meet aggressive decarbonization targets will be the primary drivers of LNG demand for transportation in the region. Trucking and existing rail are difficult to decarbonize, and efforts to achieve net-zero emissions will require specific policy support in these regions. The EU and the Baltic States should apply targeted incentives and support for LNG infrastructure to aid these markets in their efforts to decarbonize.
- The Baltic States should fund a study to characterize the viability of LNG as a transportation fuel, the cost of building out the required supply network, its competitive position compared to alternative fuels such as CNG and Bio-LNG, with an estimated impact of harmonized pricing on the market. This study will help the Baltic States develop a more regional strategy for build-out and investment in road transportation and for quantifying potential GHG emissions reductions.
- The creation of the Baltic States LNG Transport Forum referenced above would facilitate coordination across land transportation sector stakeholders (as it would for marine sectors) to promote a more cohesive approach to implementing policy for LNG transportation.
- The Baltic States should explore bundling of fueling services to support growth in the market. Bundling of services will allow existing companies in the market to be involved and preserve market share if LNG becomes a more widely accepted fuel in the region. It is recommended that any discussion of LNG as a truck fuel should involve gauging the interest of major suppliers such as Shell, BP, or Total in not only entering but supporting the market in the Baltic States via supply commitments. LNG fueling services also can be integrated with existing CNG filling stations, which could support the efficient roll out of new installations.
- The Baltic States should consider LNG in rail transportation in terms of dual-fuel engine conversions for existing diesel locomotives. Due to decarbonization goals and the EU's backing of electric-powered infrastructure such as the EU funded Rail Baltica project, pursuing LNG-powered new builds is not recommended. However, conversions of existing rail infrastructure to dual-fuel engines with LNG would help reduce emissions and are already being tested in the region. Regulatory and possibly fiscal support from governments would help investors to make investment decisions on these conversions.

## Remote Industry and Power

- The scope for conversion of light industrial facilities to use natural gas needs to be characterized across the Baltic States. This could be a standalone study, but the results should be integrated with the findings on LNG bunkering and transportation applications

of LNG. As evidenced during the research stage of this Report, there is little existing data on the potential for remote industry SSLNG demand.

- A study, which should include the impact on GHG emissions and the possibility of creating incentives such as tax benefits or advantageous depreciation treatment for such conversions, is recommended. Development of standardized and modular installations with an emphasis on HSSE, siting, and installed cost should also be part of the study Following such a review, the results need to be integrated with the findings on LNG bunkering and transportation application of LNG.

A remote industry study to evaluate the benefits and implementation plans for replacing existing diesel power generation with remote industry and power applications of LNG is recommended. Off-grid LNG supply via trucks or off-pipeline liquefaction facilities could both support and act as a transition fuel for renewable mini-grid technology, which is not yet widely deployed in the Baltic States. As the Baltic States increase their reliance on renewable generation, such as wind turbines to power their electric grid, the intermittent nature of renewables will require dispatchable generation for balancing. In the near term, an electric grid powered solely by battery storage and renewables will face operational, cost, and resilience challenges. As a bridge fuel, LNG can provide an immediate, cleaner, and resilient alternative to diesel.

# Abbreviations

| | |
|---|---|
| bcm | billion cubic meters |
| BEIMP | Baltic Energy Market Interconnection Plan |
| CAGR | compound annual growth rate |
| CHP | combined heat and power |
| CNG | compressed natural gas |
| ECA | emission control area |
| EU | European Union |
| GHG | greenhouse gas |
| GIPL | Gas Interconnector Poland – Lithuania |
| HFO | heavy fuel oil |
| HSSE | health, safety, security, and environment |
| IMO | International Maritime Organization |
| KN | Klaipėdos Nafta |
| LNG | liquefied natural gas |
| LNGBV | LNG bunker vessel |
| mcm | million cubic meters |
| MGO | marine gas oil |
| NDCs | nationally determined contributions |
| NECAPRL | National Energy and Climate Action Plan of the Republic of Lithuania for 2021-2030 |
| PGNiG | Polskie Górnictwo Naftowe i Gazownictwo (Polish Oil and Gas Company) |
| SGMF | Society for Gas as a Marine Fuel |
| SSLNG | small-scale LNG |
| TPA | third-party access |
| UGS | underground gas storage |
| UNFCCC | United Nations Framework Convention on Climate Change |
| VLSFO | very low sulfur fuel oil |

# Appendix A: Data Sources

| | Source |
|---|---|
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# Appendix B: Data Sources Provided by Country

Each country provided answers to the questions posed in the Information Request documents sent by Deloitte. The table below displays sources provided in addition to the Information Request responses.

***Table 3: Data Sources Provided by Country***

| Country | Source | Link |
|---|---|---|
| Estonia | Information on the Paldiski LNG Terminal Project | https://baltigaas.eu/en/ |
| Estonia | Information on the Tallinn LNG Terminal Project | https://www.tallinnlng.com |
| Estonia | Natural Gas Consumption Data | www.elering.ee |
| Estonia | Physically Available Capacity and the Nominations on Exit and Entry Points Dashboard | https://dashboard.elering.ee/en/gas-nominations/nominations?interval=hours&period=months&start=2021-01-01T05:00:00.000Z&end=2021-02-01T04:59:59.999Z |
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| Latvia | Gas Consumption Data: csb.gov.lv | |
| Latvia | Gas Consumption, Transmission, and Storage Data published by Latvia's TSO "Conexus Baltic Grid" | https://capacity.conexus.lv/?lang=eng |
| Latvia | Natural Gas Consumption by Sector | http://data1.csb.gov.lv/pxweb/en/vide/vide_energetika_ikgad/ENG010.px/ |
| Latvia | JSC "Conexus Baltic Grid" Yearly Reports | https://www.conexus.lv/uploads/filedir/Zinojumi/tso_report_2019.pdf |
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| Latvia | National Gas Consumption Database | http://data1.csb.gov.lv/pxweb/en/vide/vide_energetika_ikgad/ENG010.px/ |
| Latvia | Graph: Amount of Natural Gas Delivered to the Latvian Distribution System (GWh) and gas price (EUR.MWh) in 2018 and 2019 | Image |

| Country | Source | Link |
|---|---|---|
| Latvia | Cabinet Regulation No. 312: Procedures for the Supply of Energy Users and Sale of Heating Fuel During Declared Energy Crisis and in Case of Endangerment to the State | https://likumi.lv/ta/en/en/id/229557-procedures-for-the-supply-of-energy-users-and-sale-of-heating-fuel-during-declared-energy-crisis-and-in-case-of-endangerment-to-the-state |
| Lithuania | National Energy and Climate Action Plan of the Republic of Lithuania for 2021-2030 | PDF File |
| Lithuania | National Energy independence Strategy | PDF File |
| Lithuania | Natural Gas Flow and Consumption Data from 2018 - 2020 | Excel File |