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INTERNATIONAL BUNKER INDUSTRY ASSOCIATION

FAQs

Biomethane (bioLNG) in the Shipping Sector

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A. General FAQ

01.
a) What is bioLNG?

BioLNG is liquified biomethane, which is essentially purified biogas generated from the anaerobic digestion of a broad spectrum of biodegradable organic waste sources, such as food waste, municipal waste, manure and other agro-processing residues. Biogas goes through a purification process to remove impurities such as CO_2, H_2S and water vapour to achieve typically 95% methane purity levels.

01.
b) How does it differ from conventional LNG?

BioLNG is produced primarily from renewable biomass and considered a low carbon alternative to LNG, which is made from fossil fuel sources. Both fuels are similarly high in methane, which is a potent contributor to global warming. However, the production of bioLNG captures and utilises the methane from decaying biomass that would otherwise have been released into the atmosphere. Saunak: Conventional LNG has a CI (Carbon Intensity) range of 70-90 gCO_2eq/MJ, while Bio-methane depending on the raw material used and the process can have a CI range of –141 to 60 gCO_2eq/MJ.

02.
What are the environmental benefits of using bioLNG in the shipping industry?

The use of bioLNG as a marine fuel has significant Green House Gas (GHG) emission benefits because of the prerequisite capture and use of methane to produce biogas in a bioLNG production cycle.

On a broader environmental sustainability scale, the production of bioLNG and indeed all bio-based fuels is a powerful driver for more effective resource and waste management in several industries.

03.
Is bioLNG compatible with existing ship engines?

Yes, bioLNG is compatible with existing engines, though as it has a high methane content and therefore methane number.

04.
What are the key considerations for ship owners looking to transition to bioLNG?

Shipowners and operators who already run their vessels on conventional LNG require little or no modifications to their vessels and can rely on the accessibility of existing LNG infrastructure, if they make the switch to bioLNG or an LNG/bioLNG blend.

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B. Bunkering Process and Supply Chain Logistics

01. What is the bunkering process for bioLNG in the shipping sector?

BioLNG bunkering follows a similar process to conventional LNG bunkering. It typically involves the transfer of bioLNG from storage facilities to the ship's storage tanks using bunkering vessels, trucks, or onshore facilities. The ship's crew then manages the transfer of bioLNG into the ship's fuel tanks, ensuring safety protocols are followed throughout the process.

02. How is bioLNG produced and distributed for bunkering purposes?

BioLNG is produced through the liquefaction of biogas, which is primarily composed of methane. Biogas is obtained from the anaerobic digestion of organic waste materials such as agricultural residues, municipal solid waste, and wastewater sludge. Once biogas is purified and liquefied, it becomes bioLNG. Distribution for bunkering purposes involves transportation via specialised tankers or pipelines to bunkering terminals located at ports or other strategic locations along shipping routes.

Biomethane can have a lower methane content than regular LNG, resulting in an additional purification step before it can be burnt in a marine engine.

Biomethane can be distributed for bunkering purposes in three ways:

a) Physical dedicated bioLNG delivery: Biomass is collected and brought to a centralised/decentralised biomethane plant, produced biomethane is then liquified in a centralised/decentralised liquefaction and storage plant, thereafter it is moved to an LNG terminal to be supplied directly or through trucks/ LNG bunker vessels to the receiving vessels.

b) BioLNG delivery through mass balancing: Biomass is collected and brought to a centralised/decentralised biomethane plant, produced biomethane is then supplied into a gas grid. The gas grid is connected to an existing liquefaction and storage plant or an LNG receiving terminal (virtual reliquification) thereafter it is moved to an LNG terminal to be supplied directly or through trucks/ LNG bunker vessels to the receiving vessels.

c) Virtual bioLNG delivery through book and claim: For book and claim there is no physical link between the injection and extraction of the biogas. This is solely done by certificates. This mechanism is not recognised yet as being compliant.

03. What are the key considerations for establishing bioLNG bunkering infrastructure?

Establishing bioLNG bunkering infrastructure requires careful planning and consideration of various factors, including:

- Identifying suitable locations for bunkering terminals, considering proximity to shipping routes and availability of bioLNG production facilities.
- Investing in the construction of storage tanks, loading equipment, and safety systems compliant with relevant regulations and standards.
- Ensuring sufficient supply of bioLNG through partnerships with biogas producers and waste management facilities.
- Developing logistical arrangements for the efficient distribution of bioLNG to bunkering terminals and ultimately to ships.
- Addressing regulatory and permitting requirements related to environmental impact, safety, and operational standards.

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B. Bunkering Process and Supply Chain Logistics

04.
What Safety Measures are in place for handling and storing bioLNG?

The safety measures for bioLNG are identical to the safety measures in place for fossil LNG and eventually synthetic methane. The material specifications are identical, and it is only in origin that they differ.

05.
Are there any challenges or limitations in the supply chain logistics of biomethane for shipping?

Despite its environmental benefits, bioLNG faces several challenges in its supply chain logistics:

- Limited availability of feedstock - the production of bioLNG relies on the availability of organic waste materials, which may be inconsistent or insufficient in certain regions.
- High production costs - the production process for bioLNG, including biogas capture, purification, and liquefaction, can be expensive compared to conventional LNG production, though still much cheaper than other alternative fuels e.g., green methanol, green ammonia etc.
- Infrastructure development – establishing a comprehensive bunkering infrastructure for bioLNG requires significant investments in storage facilities, transportation networks, and regulatory compliance.
- Market acceptance and demand – bioLNG is still relatively new in the shipping industry, and its adoption may be hindered by uncertainties regarding performance, availability, and cost compared to other alternative fuels.
- High production costs - the production process for bioLNG, including biogas capture, purification, and liquefaction, can be expensive compared to conventional LNG production.

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C. Regulations and Regulatory Environment

01.
What regulations govern the use of bioLNG as a marine fuel?

IGF Code of Seagoing vessels and ADN regulations for inland waterway vessels regulate the use of methane/ LNG, independent of its origin. For using it as a compliance fuel, then the applicable regulations are ETS/ FuelEU Maritime and RED II/III.

02.
Are there any specific incentives or subsidies provided to encourage the adoption of bioLNG in shipping?

Globally, the subsidies for bioLNG production are mostly tied to broader renewable energy and carbon-reduction policies, with varying levels of direct support depending on the country. While bioLNG is still a niche product, the increasing emphasis on reducing greenhouse gas emissions and promoting clean energy is expected to drive more targeted incentives in the future.

1. European Union (EU):

The EU has a range of policies and financial instruments aimed at promoting renewable energy and reducing carbon emissions, many of which indirectly support bioLNG production.

- **Renewable Energy Directive (RED II):** This directive sets a binding renewable energy target for 2030, aiming for 32% of the EU's energy mix to come from renewable sources. BioLNG qualifies as a renewable fuel under this directive.
- **EU Emissions Trading System (EU ETS):** BioLNG producers can benefit from the carbon market, where they can earn credits by reducing emissions compared to fossil fuels.
- **Horizon Europe and Connecting Europe Facility (CEF):** These are EU funding programmes that support innovative renewable energy projects, including bioenergy and Bio-LNG production.
- **National Support Mechanisms:** Countries like Germany, the Netherlands, and the UK offer subsidies or tax incentives for biogas production, which can be upgraded to bioLNG. For example, Germany provides feed-in tariffs for biogas plants that generate renewable gas.

2. United Kingdom:

The UK has implemented several financial incentives to support the development of bioLNG.

- **Renewable Transport Fuel Obligation (RTFO):** This programme incentivises the use of renewable fuels, including bioLNG, in the transport sector (the maritime sector is excluded). Producers of bioLNG receive credits based on the volume of renewable fuel produced, which can be traded or sold.
- **Green Gas Support Scheme:** The UK government offers a subsidy scheme for biogas producers, encouraging the injection of renewable gas into the national grid. This indirectly supports the growth of the bioLNG sector.
- **Carbon Price Floor:** The UK's carbon price floor, which sets a minimum carbon price for the power sector, increases the attractiveness of low-carbon fuels like bioLNG.

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3. United States:

In the U.S., subsidies for bioLNG are often linked to broader bioenergy and biogas incentives.

- **Renewable Fuel Standard (RFS):** Administered by the U.S. Environmental Protection Agency (EPA), the RFS programme mandates the blending of renewable fuels, including bioLNG, with conventional fuels. It provides economic incentives through the Renewable Identification Numbers (RINs) that can be traded.
- **Investment Tax Credit (ITC) and Production Tax Credit (PTC):** These tax credits are available for renewable energy projects, including those related to biogas production. BioLNG facilities can benefit from these incentives.
- **State-Level Incentives:** Some U.S. states, such as California, offer additional incentives, including subsidies, grants, and low-interest loans for bioLNG and biogas projects. California's Low Carbon Fuel Standard (LCFS) is a key programme that incentivises the use of bioLNG in transport.
- **Agricultural Incentives:** U.S. agricultural policies support biogas production from farm waste, which can be upgraded to bioLNG, with subsidies for waste-to-energy projects.

03.
How do international regulations impact the global adoption of bioLNG as a marine fuel?

Mass Balance, GHG emission factor.

BioLNG can be blended with fossil LNG in relatively small amounts to reach the 2030 International Maritime Organization (IMO) targets and the Biofuel proportion in the mix can be increased to meet 2050 target[1].

04.
What are the potential future regulatory developments that may affect the use of bioLNG in shipping?

Methane slip from engines is a central concern, and addressing this will be crucial to secure the LNG pathway.

1. https://sea-lng.org/wp-content/uploads/2022/10/SEA-LNG_BioLNG-Study-Key-Findings-Document_October-2022_amended.pdf

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D. Progress of Green Maritime Corridors

01.
a) What are Green Maritime Corridors?

Green Maritime Corridors are shipping routes on which commercially operating ships use low carbon or carbon neutral fuels exclusively.

01.
b) How do they promote the use of alternative fuels like bioLNG?

Green Maritime Corridors initiate end-to-end decarbonisation within a supply chain linking two or multiple ports/regions. It is an approach that de-risks the production of alternative fuels by addressing the commercial gaps such as the higher costs of production, the supply and demand imbalance, the regulatory and policy bottlenecks that affect biomethane production, storage and distribution.

02.
What progress has been made in establishing Green Maritime Corridors for the transportation of goods using bioLNG?

The predominant alternative fuel choices underpinning green corridor developments have been hydrogen, ammonia, and fully electric solutions; however, there are one or two notable projects in conception touting the possible use of bioLNG, such as the LA-Shanghai Green Corridor and the Pacific Northwest Green Corridor.

03.
What regions or countries are leading the development of Green Maritime Corridors for Biomethane powered vessels?

The European Green Corridor Network is leading the possible use of biofuels in the establishment of several possible green shipping networks in Northern Europe and the Baltics, though the Pacific Northwest Green Corridor initiative, which sprang from the Clydebank Declaration[2] has made certain strides and narrowed the focus of their efforts to cruise liner operations from British Columbia to Alaska.

04.
How do Green Maritime Corridors contribute to the overall decarbonisation of the shipping industry?

By connecting all the stakeholders in a marine fuel value chain, dedicated to one specific trade route, the supply chain and demand can be more balanced. In addition, potential producers can secure their offtake by taking part in the Green Maritime Corridor.

2. https://www.gov.uk/government/publications/cop-26-clydebank-declaration-for-green-shipping-corridors/cop-26-clydebank-declaration-for-green-shipping-corridors

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E. Commercial Considerations

01.
What volume of bioLNG can we expect to come into the market in the short-term?

Findings from the SeaLNG report[3] suggest that bioLNG has the potential to meet up to 3% of the total energy demand for shipping fuels in 2030 and up to 13% in 2050. If it is considered as a drop in fuel blended with fossil LNG, bioLNG could cover up to 16% and 63% of the total energy demand in 2030 and 2050 respectively, assuming a 20% blending ratio.

In the long term, shipowners who have invested in the LNG pathway will need to shift to renewable synthetic LNG (e-LNG).

02.
How does the pricing model of biomethane compare to traditional LNG?

Biomethane/ LNG is mostly priced as a premium over the fossil version.

03.
Can Mass Balance be used for implementing biomethane?

Yes, it can, if the biomethane is certified according to the applicable rules and regulations.

3. https://sea-lng.org/wp-content/uploads/2022/10/SEA-LNG_BioLNG-Study-Key-Findings-Document_October-2022_amended.pdf

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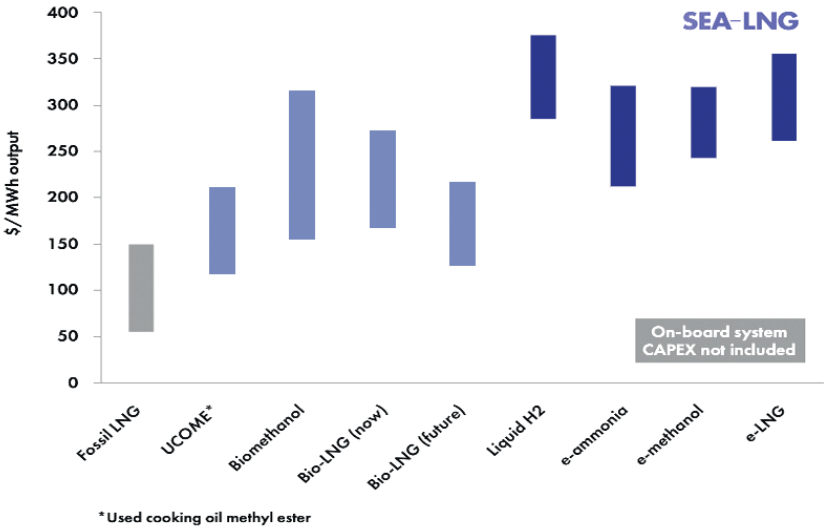
F. Impact on the Sector at Large

01.
What are the potential economic benefits of transitioning to bioLNG in the shipping sector?



Alternative fuels energy cost comparison, per unit of output energy from the engine. It includes transport and bunkering costs (bio-LNG and e-LNG transport cost is based on fossil LNG, thus implying the use of existing infrastructure). Assumed engine conversion efficiency 45% (50% for liquid hydrogen used in a fuel cell) (Note, the higher and lower ends of the spectrum represent 2030 and 2050 costs, respectively.)

Figure 1: SEA-LNG, October 2022

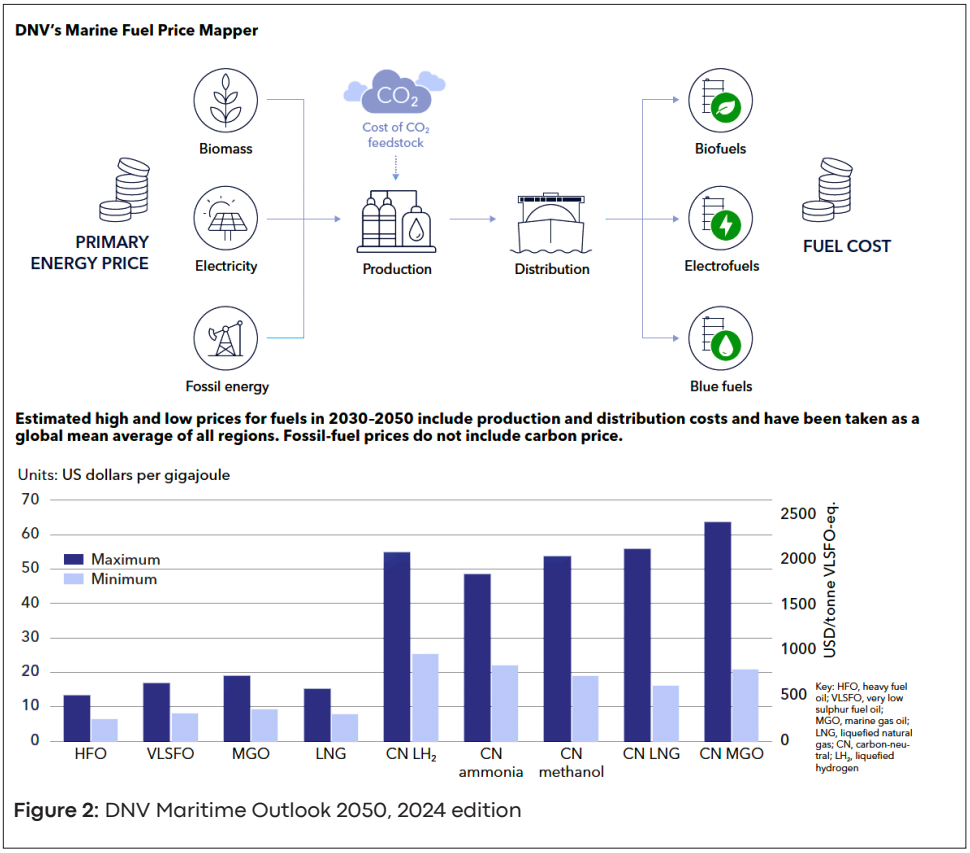


Figure 2: DNV Maritime Outlook 2050, 2024 edition

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F. Impact on the Sector at Large

02.
What is the expected difference in price between LNG and bioLNG?

The majority of the cost increase for ship owners and operators switching to bioLNG would be the higher costs of the fuel itself, as vessels will require little or no modifications.

Distinctions however need to be made between physical biomethane molecules and mass balance; as with physical molecules, the costs of transportation (last mile) can be higher as production location is typically not in the bunkering location/port.

03.
What are the expected costs of adoption of bioLNG for shipowners over the next five (5) years?

Apart from the difference in cost of molecules and certification, there is no additional costs expected for shipowners to use bioLNG, as the bioLNG received on board is physically not different from the fossil LNG being used as fuel. Depending on the infrastructure or logistics mode, there can be a slightly higher price, when one decides to use physical bioLNG molecules as these are normally not produced in the port (place of bunkering).

04.
What are the switching costs of bioLNG and how does it affect future fleet operations and management?

- BioLNG requires the same specialised storage and handling infrastructure as LNG. Receiving Ships retrofitted to burn LNG or be built specifically for it, are able to use bioLNG as fuel without any additional switching costs.
- BioLNG is not yet widely available; it is available in very few ports. Additionally, we have the possibility of bunkering bioLNG in well-connected ports using sustainability certificates, but this is also limited. Therefore, shipping companies may be reluctant to make the switch if they are unsure of fuel availability in key shipping routes.
- In the ARA region and for most vessel owners, the only practical way is to take mass-balanced bioLNG currently.
- To ensure that bioLNG is sustainable, we need to follow a certification process, same as for other biofuels, which might add complexity to the process.
- We know that Rotterdam currently subsidises certain biofuels and might do the same with bioLNG as time progresses, which may make it a bit more attractive. However, for the time being, it is expensive and with limited availability, which doesn't make it a desirable and viable option for most shipowners.
- Overall, assuming that as time progresses and the regulations tighten, fuel availability increases and price becomes more attractive, with more and more LNG-fueled ships being built/retrofitted, we will see more ships burning bioLNG.

05.
How does the widespread adoption of bioLNG impact the broader energy and transportation sectors?

BioLNG for road transport is subject to different incentive schemes (maut exemption Germany and RIN's in the US for example) which make the use of Renewable Natural Gas, which is the starting point for biomethane, very attractive to use in these sectors. This is potential competition for the maritime industry.