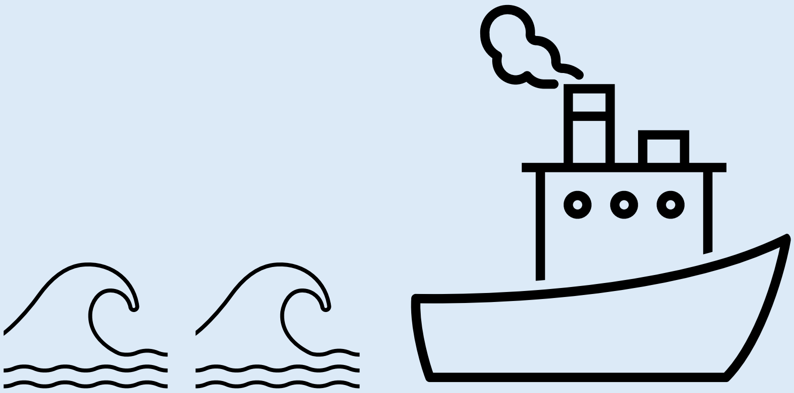
HAVILA VOYAGES

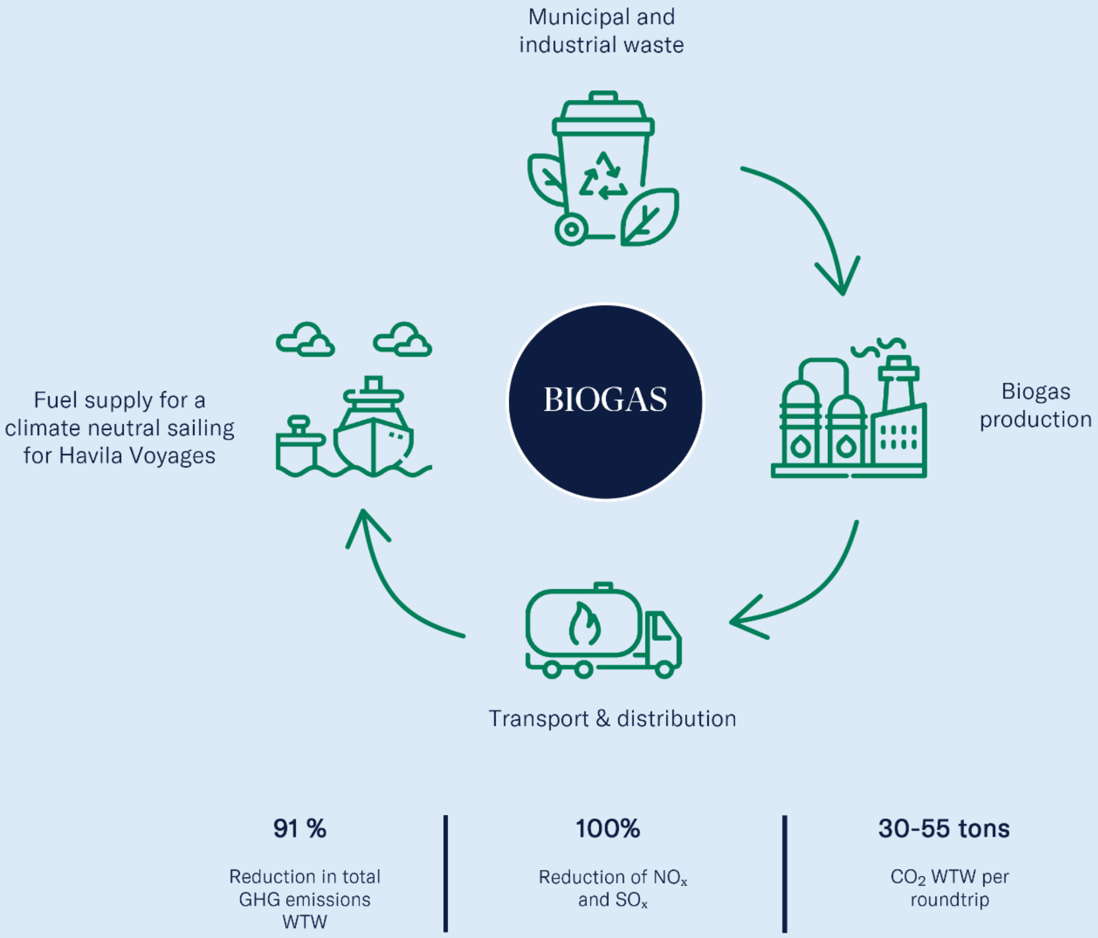
The Coastal Route of the Future:

The Path Towards Climate Neutrality



1.0 A Climate-Neutral Voyage with Havila Polaris

The round trip with Havila Polaris will be climate-neutral with biogas. By using biogas, we help the environment by reusing waste that is recycled into gas. The total greenhouse gas emission for the round trip will then be reduced by about 91 percent.



PURE VOYAGES
POWERED BY BATTERY & N ATURAL/ BIO GAS

Figure 1: The lifecycle of biogas.

2.0 Biogas – setting the course for a sustainable future for the coastal route

At the end of November, Havila Polaris will have its first voyage with pure liquid biogas, marking a historic round trip along the Norwegian coast. Norway generates substantial amounts of biological waste with an underutilized energy potential. The more we utilize waste, the better equipped we are to meet the environmental challenges of the future (Document 8:131 S (2024-205), p. 1). With this voyage, Havila Polaris will demonstrate how reusing waste can help reduce greenhouse gas emissions in the maritime sector.

2.1 From waste to fuel: How biogas cuts emissions

To understand why our biogas cruise can be considered a zero-emission cruise, it is relevant to understand what biogas is. Biogas is considered an emission-free energy source and comes from organic materials that are already part of the carbon cycle. Carbon (C) is essential for organic life on the planet. However, when too much carbon is emitted, we end up with a surplus since plants are unable to absorb all the carbon during photosynthesis. This creates an imbalance in the carbon cycle and increases climate change (Biogas Norway, n.d.;

Fact Box 1: Talk biogas – understand the production

Biogas is produced in biogas plants. The waste that is processed must first undergo "pre-treatment". Pre-treatment varies depending on the material used for gas production (Norwegian Directorate of the Environment, 2021; Biogas Oslofjord, u.d.).

The decomposition process then takes place in a "decomposition tank". The process can also occur naturally as decomposition processes in bogs or manure piles. When producing fuel, the biogas is fed into an "upgrading plant" where CO_2 and methane are separated. The pure methane gas produced here is called "biomethane" (Norwegian Directorate of the Environment, 2021; Biogas Oslofjord, u.d.).

Biomethane can replace natural gas and is stored in compressed or liquid form. In this case, Liquefied BioGas (LBG) is used, which is liquid biomethane (Biogas Oslofjord, u.d.; Biovind, u.d.). Liquid biomethane is more expensive to produce than compressed biomethane. However, liquid biomethane requires half the volume of compressed biomethane and is thus more efficient to transport (Biovind, n.d.; Biogass Oslofjord, n.d.).

The remaining organic material that is not converted into gas is called "bioresidue" or "biofertilizer". Bioresidue is a nutrient-rich mass that can be used as fertilizer, for instance for food production or growing plants (Miljødirektoratet, 2021; Biogass Oslofjord, u.d.).

After this process, LBG will be transported to the ship.

Aamaas, 2025; Biovind, n.d.). By using biogas as fuel, we can help reduce the imbalance. To produce biogas, organic material is decomposed by microorganisms without access to air. The production is described in Fact Box 1. The organic material consists of waste, residues, or raw materials that have no other uses – for instance, food waste or fish waste. The decomposition forms a mixture of gases called biogas (Biogas Oslofjord, n.d.; Miljødirektoratet, 2021; Miljødirektoratet, 2025-present; Biogas Norway, n.d.). The biogas consists mainly of methane (CH4) that, during combustion, forms carbon dioxide (CO2) and water. Since the raw material for producing biogas comes from biological material, the combustion is considered CO2-neutral. Biogas utilizes carbon in its natural cycle and thus does not introduce new carbon into the ship's cycle. The production of biogas therefore does not release more CO2 into the atmosphere (Biogass Norge, u.d.; Llnnås, 2023; Fornybaren, 2024-present). On this voyage, Liquefied BioGas (LBG) will be used as fuel, which is liquid biomethane. LBG is considered a parallel to liquefied natural gas (LNG), which the ship currently uses. Ships currently using LNG can transition to LBG without modifying the vessel (Biovind, u.d.; Norwegian Environment Agency, u.d.). The ship's emissions from biogas are considered "negative emissions" since the emissions are subtracted from the total carbon emissions, as

Fact Box 2: Talk biogas – understanding carbon intensity

We use several different terms when discussing biogas. In this context, a key term is "carbon intensity" (CI). Carbon intensity measures the amount of carbon dioxide equivalents (CO2e) emitted per unit of activity, output, or product (Zevero, 2025). For us, CI is relevant for choosing which biogas to utilize.

During biogas production, the gas must be purified and upgraded to achieve the desired purity and methane content (DSB, 2016, p. 57). Biogas is a higher-purity methane product than natural gas, which contains several other gases. Gas purity refers to the composition of substances in the gas, such as methane, CO_2, ammonia, and water.

Which biogas is "worth" using is determined by its climate footprint and CI. Raw materials that would have a high climate footprint anyway give a high CI. For example, manure can have a high CI. The distance the raw material must be transported is also a key factor. Raw materials that require long-distance transport or that would not have had a significant climate footprint if left unused give a low CI.

For this round trip, we use biogas with two separate CI values, supplied by Molgas and Barents. The CI values vary because the biogas comes from two different production plants, which use separate raw materials and involve different transport distances to the plants. The distance from the plant to the ship is also included in the WtW calculations. The Norwegian Environment Agency states that the gas yield of biogas is often improved if various raw materials are combined (Norwegian Environment Agency, 2021). This may imply a better yield from the biogas by combining biogas produced from different raw materials.

opposed to adding new carbon to the atmosphere (Cooper et al, 2021). Havila Polaris will thus reduce its CO2 emissions by 100% by using biogas as fuel. The ship's reduction in greenhouse gases will result in a reduction of its total climate footprint by over 90 %.

2.2 Actual emissions this round trip

Calculations based on consumption figures and the EU framework indicate that normal LNG operation, without charging, will have a Well-to-Wake (WtW) footprint of 86.94 gCO2e/MJ. With two charging stops (approx. 8000 kWh), the WtW footprint will be 86.60 gCO2e/MJ. Total emissions for a round trip with LNG, including both production and transport of the gas, are about 650 metric tons of CO2 equivalents. On the round trip with LBG, between 300-350 m^3 of fuel will be utilized. Including production and transport of the biogas, total emissions will be reduced to 30-55 tons of CO2 equivalents. The total climate footprint is reduced by at least 91.7% when using biogas. Compared to own figures from 2024, NOx emissions from the ship will be reduced by 100%. The ship already reduced SOx emissions by 100% with LNG and they will remain 0 with LBG. Table 1 gives the carbon intensities of the biogas used, with the corresponding WtW footprint. Based on this, the total emissions from LBG are compared to those from normal LNG operation in Figure 2.

	Volume [m^3]	**WtW [gCO2e/MJ]**
LBG (5 CII)	300	22.21
LBG (-100 CII)	50	-82.79

Table 1: On the round trip, biogas is combined with two different carbon intensities, which give different WtW-values.

The size of the emissions depends on the production chain of the biogas we use. Charging during the round trip will reduce the WtW values by up to 0.45 gCO2e/MJ. According to the government, ships can use biogas to achieve the zero-emission requirement. There are also requirements for the use of shore power in cases where it is possible (Ministry of Climate & Environment, 2024). Since the use of biogas is considered a 100% reduction in CO2 emissions, Havila Polaris can achieve the zero-emission requirement with a voyage like this one. However, it is important to add that the fuel tanks will not only contain biogas during the voyage. The natural gas already in the tanks from normal operation cannot be pumped out into the sea simply to empty the tanks. For safety reasons, some natural gas must also be stored on board during a voyage to the Polar base (Havila Kystruten, 2025). Nevertheless, the amount of biogas that is bunkered will correspond to the fuel requirement for an entire round trip. Thus, Havila Polaris will complete a round-trip using biogas as fuel.

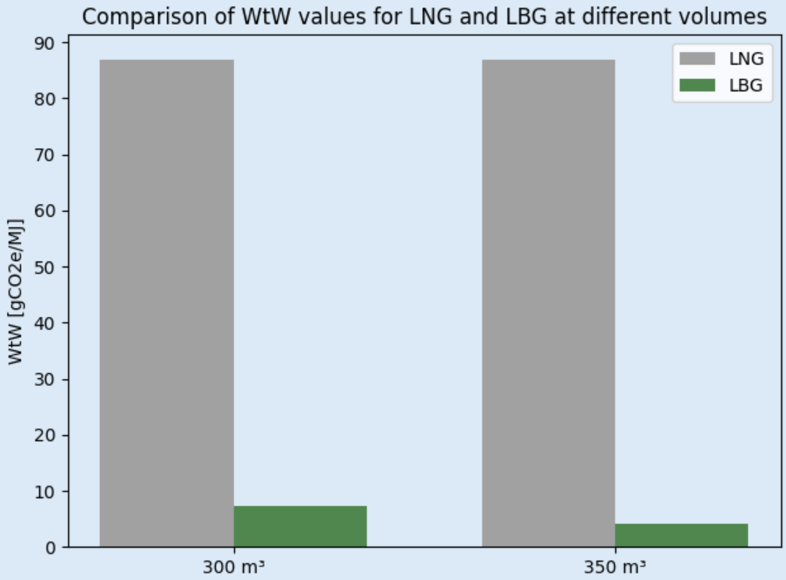


Figure 2: Comparison of total emissions (WtW) from LNG and LBG. The WtW for LNG is 86.94 gCO2e/MJ, independent of volume. The WtW for LBG depends on the combination of the different carbon intensities (see Table 1). If 350 m^3 LBG is used, the WtW will be 7.21 gCO2e/MJ, and at 300 m^3 LBG, the WtW is reduced to 4.04 gCO2e/MJ. The latter is a "best-case scenario".

2.3 Together we are creating a sustainable coast

Havila Voyages wishes to be a contributor to sustainability by showing that ambitious goals in emission reduction and value creation are possible. Biogas is important in Norway for energy creation, emission reduction, and for local value chains, as it can create more jobs. It can also help solve climate challenges related to waste management (Document 8:131 S (2024-205), p. 2). We have ambitions to use biogas produced along the Norwegian coast and strengthen the value chains along the route we sail. Therefore, this solution is especially important to us: We want to be a contributor to solving the challenges of emission reduction and value creation along the Norwegian coast and in the local communities we serve (Havila Kystruten, 2025).

3.0 Talk biogas – understand the terms:

CO2 equivalent emissions:	Refers to how much CO_2 is needed to have the same effect on the climate as another greenhouse gas, over a specific period. The term is used to compare emissions of different greenhouse gases, but it does not mean that the gases affect the environment equally (Norwegian Directorate of the Environment, u.d.).
Carbon footprint:	Like the climate footprint, the carbon footprint refers to the total amount of greenhouse gases that are directly or indirectly emitted because of human activity (Gassnova, u.d.). It is usually expressed as kg of carbon dioxide (CO2) per unit of activity. It is often "indirect emissions" that constitute the carbon footprint. For example, they can come from materials or products produced far from the consumer (Gassnova, u.d.).
CO2 emissions:	When large amounts of the gas CO2 are released into the atmosphere, a "CO2 emission" occurs (Statkraft, unpublished).
Carbon intensity indicator (CII):	A measure of a ship's energy efficiency. The measure is expressed in grams of CO2 emitted per cargo capacity and nautical miles (DNV, n.d.).
Climate footprint:	Here, the term is defined as "the total amount of greenhouse gases or CO2 directly or indirectly emitted due to human activities" (Jalborg, 2024). According to Greenpeace, tons of CO2 equivalents are usually used as the measurement unit. (Jalborg, 2024).
Climate gases:	When several gases that heat the Earth (such as methane) are emitted in addition to CO2, the gases are collectively called "climate gases" (Statkraft, u.d.).
Climate neutrality:	According to the EU, climate neutrality means reducing greenhouse gas emissions as much as possible while also compensating for the remaining emissions. By doing this, a "net-zero emissions balance" can be achieved. This means that the amount of greenhouse gases released into the atmosphere is neutralized. Within the maritime sector, emissions can be reduced by transitioning to more energy-efficient and greener fuels (European Council of the European Union, 2024).
Organic material:	Refers to all carbon compounds, except CO2 (mineral carbon), mineral carbonates, and graphite. Almost all soil consists of organic material. A high content of organic material in soil may mean that a lot of carbon is stored in the soil. Therefore, attempts have been made to increase the content of organic matter in the soil to reduce the greenhouse effect. The decomposition of organic material causes carbon to be converted to CO2 and the release of other substances (NIBIO, 2025).
Raw material:	In this context, "raw material" and "waste" are used to describe the types of organic material from which biogas may be produced.

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