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## STUDY HIGHLIGHTS METHANE REDUCTION IN REAL-WORLD SHIP OPERATION

Finland – August 2024. In a leading-edge study conducted by the Transport Emission Control Team at VTT Technical Research Centre of Finland, significant insights were gained related to methane slip and other emissions from LNG-powered marine engines under real-world operation of a state-of-the-art cruise ship.

The now published study 'Methane slip and other emissions from newbuild LNG engine under real-world operation of a state-of-the-art cruise ship', sheds light on the environmental impact of liquefied natural gas (LNG) as a shipping fuel, particularly focusing on its methane emissions together with other climate warming agents including black carbon.

LNG has emerged as a promising fuel in the maritime industry due to its lower carbon dioxide emissions and reduced air pollutants compared to conventional fuels. However, concerns have been raised regarding the slip of unburned methane, a potent greenhouse gas, which can offset some of the environmental benefits of LNG use.

The study, conducted on a state-of-the-art cruise ship equipped with a low-pressure dual-fuel engine, provides valuable data on methane slip under real-world operating conditions. The investigation shows that methane slip varies significantly according to engine load and presents methane emission based on the actual engine load profile of the ship.

Some key findings from the study include:

1. **Lower Methane Emissions:** *The methane slip from the newly built engine was found to vary according to engine load, from 2.3-3.0 g/kWh high engine loads of 50-80% to 21 g/kWh at 12% load, positioning it at the lower end of values reported in the literature.*
2. **CO<sub>2</sub> Reduction:** *At load conditions of 50% and above, low methane slip values resulted in a 13-15% lower total CO<sub>2</sub> equivalent emissions with LNG (Liquefied Natural Gas) compared to MGO (Marine Gas Oil). However, at lower load conditions, the situation is reversed.*
3. **Real-world Load Profile:** *Analysis of the vessel's engine load profile over 8 months revealed that the majority of the vessel's operation time (~90%) occurred at engine loads higher than 40%. This indicates that the operational pattern of the engine can contribute to methane reduction efforts.*
4. **Real-world methane slip:** *Based on the real-world load profile, the study developed a weighted emission factor for methane, resulting in 2.8 g/kWh for the specific ship. This represents 45% lower methane slip compared to the default value from FuelEU Maritime regulation.*

These findings underscore the potential for reducing methane emissions from LNG engines in marine operations. By optimising engine development and operational strategies, significant progress can be made toward achieving emissions reduction targets in the maritime sector.

Furthermore, the study highlights the importance of ongoing research and innovation in the maritime industry to address environmental challenges and promote sustainable practices.

The findings of the study are expected to inform policymakers, industry stakeholders, and ship operators in their efforts to reduce greenhouse gas emissions from maritime transport.

With the maritime industry facing increasing pressure to meet emission targets, studies like this play a crucial role in advancing our understanding of the environmental implications of alternative fuels. For more information about the study and its findings, please contact Senior Scientist Niina Kuittinen at [niina.kuittinen@vtt.fi](mailto:niina.kuittinen@vtt.fi).

About VTT Technical Research Centre of Finland Oy: VTT Technical Research Centre of Finland is a leading research and technology organization in Northern Europe. With over 80 years of experience, VTT provides research and innovation services to both private and public sectors, driving sustainable growth and societal impact.

The study, '[Methane slip and other emissions from newbuild LNG engine under real-world operation of a state-of-the art cruise ship](#)'<sup>1</sup> is published in the open access journal Atmospheric Environment X.

## About GREEN RAY

GREEN RAY aims at minimising methane slip from marine fuel. Three technologies will be developed to install on Liquefied Natural Gas (LNG) engines of both existing and new ships. This will contribute to improving fuel efficiency and reducing the environmental impact of maritime transport.

The project is coordinated by VTT Technical Research Centre of Finland and brings together partners from across the shipping value chain: Chantiers de l'Atlantique, CMA Ships, Wärtsilä, Shell, DNV, the Finnish Meteorological Institute, MSC Cruises Management, and REVOLVE.

The five-year project, beginning in June 2022, has received a total grant of €7 million from the European Commission within the new Horizon Europe research and innovation programme, addressing the topic of "Assessing and preventing methane slip from LNG engines in all conditions within both existing and new vessels (ZEWTP Partnership)", TOPIC ID: HORIZON-CL5-2021-D5-01-12.

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<sup>1</sup> N. Kuittinen, P. Koponen, H. Vesala, K. Lehtoranta (2024). Atmospheric Environment: X Methane slip and other emissions from newbuild LNG engine under real-world operation of a state-of-the art cruise ship - ScienceDirect