

## METHANE EMISSIONS IN LNG ENGINES

In May 2023, the GREEN RAY project published the scientific article *Methane emissions from a state-of-the-art LNG powered vessel* in *Atmosphere* journal, detailing a novel emissions study carried out onboard a vessel by the project's partners.

The authors, Kati Lehtoranta, Niina Kuittinen, Hannu Vesala and Päivi Koponen from the VTT Technical Research Centre of Finland, studied emissions from the exhaust of two Wärtsilä 31DF engines onboard the Wasaline ferry Aurora Botnia. Both engines were studied under five engine load conditions while the vessel operated on its normal route between Vaasa, Finland and Umeå, Sweden. One of the engines was piloting the new combustion concept and running on LNG, while the other was a standard setup built in 2021. This experiment was possible thanks to a strong partnership between Wärtsilä and Wasaline, cooperating to reduce emissions from ship engines.

Decarbonising maritime transport is one of the shipping industry's biggest challenges, and LNG is considered the best available alternative fuel in the transition to the widespread use of renewable and low-carbon fuels.

With its composition of mostly methane meaning that it has a higher hydrogen-to-carbon ratio compared to traditional fuels like diesel, LNG emits significantly less CO<sub>2</sub> when combusted in a low-pressure dual-fuel engine. It also produces negligible amounts of particle emissions, NO<sub>x</sub> and sulphur – small enough to achieve the Tier III NO<sub>x</sub> and sulphur limits set by the International Maritime Organization, which has set stringent rules and designated emission control areas onboard vessels to encourage the continued swift uptake of alternative fuels and technologies to lower GHG outputs. In addition, bio-based and synthetic LNG, while not expected to begin provisional rollout until the end of 2023, will present a further step towards meeting clean fuel targets.

Now, with March 2023 marking the agreement of the FuelEU Maritime regulations as part of the EU's Fit for 55 package, decarbonisation goals are even more ambitious. Vessels above 5000 gross tonnes operating in European ports will be obliged to reduce their GHG emissions by as much as 80% by 2050 – a significant step up from the IMO's 50% 2050 goal.

Currently, there is limited open-access information quantifying methane slip levels from the LNG engines in use onboard existing vessels. In general, there have been only a few emissions studies conducted onboard four or five different vessels operating with dual-fuel engines, indicating a need for deeper research in the area.

Results of the measurements taken onboard Aurora Botnia showed that, overall, methane emissions were lower than what has been reported by previous onboard studies with similar-sized low-pressure dual-fuel engines (the most popular type of LNG engine). Although the CO<sub>2</sub> was found to slightly increase with the new combustion concept, the CO<sub>2</sub> equivalent (including both methane and CO<sub>2</sub>) was smaller than from the standard dual-fuel engine, indicating that the recent development in engine technology has the potential to greatly benefit the environment by reducing overall emissions. Lower nitrogen oxide (NO<sub>x</sub>) and formaldehyde levels were also recorded from the new combustion concept engine, while an increase in particle emissions compared to the standard dual-fuel engine setup was observed. This presents a topic for further consideration in the development and deployment of methane slip abatement technologies.

More details about the study can be found in the report published by the GREEN RAY project on <https://greenray-project.eu/> titled *D1.1 Review of Methane Slip from LNG Engines*, and in the paper published on the *Atmosphere* journal website: <https://www.mdpi.com/2073-4433/14/5/825>.

## 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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