

Provaris demonstrates RED II Compliance for its Compressed Hydrogen supply chain

Provaris Energy Ltd (Provaris, ASX.PV1) is pleased to report the preliminary results for meeting Europe's Renewable Energy Directive II (RED II) emissions standards for bulk hydrogen shipping using its proprietary H2Neo carrier on a round-trip between Norway and Germany.

Implemented in December 2018, RED II sets stringent emissions standards aimed at fostering the use of renewable energy sources and reducing greenhouse gas emissions across the European Union. RED II mandates that by 2030, at least 32% of the EU's energy consumption must come from renewable sources.

A key component of RED II is its requirement for the lifecycle greenhouse gas emissions of biofuels, bioliquids, and biomass fuels to be significantly lower than the fossil fuel alternatives they replace. Specifically, for hydrogen production, the emission threshold is set at 28.2 grams of CO₂ equivalent per megajoule (g CO₂e/MJ) of hydrogen, ensuring that the production and supply chain processes adhere to sustainable practices.

Wärtsilä supported the analysis with a proposal for alternative propulsion plant configurations, together with Provaris' own analysis on fuel consumption and carbon emissions - over a range of sailing speeds and fuel types.

The analysis undertaken by Provaris, based on a round-trip schedule between Norway and Germany using the H2Neo carrier:

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|---|---|
| H2Neo estimated emission level | 7.6 g CO₂e/ MJ H₂ |
| Required for EU REDII compliance | 28.2 g CO₂e/ MJ H₂ |

Provaris Chief Technical Officer, Per Roed, commented: *"These positive results highlight our ongoing efforts to optimize our hydrogen supply chain to not only meet but exceed the stringent requirements set forth by the EU's RED II and RFNBO. The hybrid electric propulsion system developed with Wärtsilä provides a highly efficient solution today while ensuring a maximum level of flexibility to introduce alternative fuels and new technologies such as fuel cells in the future. We are dedicated to pioneering sustainable energy solutions and these advancements are a testament to the hard work and innovation of our team."*

The key outcomes of the analysis were:

- > **3rd Party Support / Analysis:** Wärtsilä supported Provaris in estimating the CO₂e emission per kg H₂ according to their emission factors, including methane slip values from test bed.
- > **Use of available propulsion configurations:** the estimated emissions were based on a proposed H2Neo hybrid electric propulsion plant with modern 4-stroke LNG Dual Fuel generating sets. Options for future hydrogen blending have been assessed based on existing generator set options, and further for when fuel cell / and generating set technology matures.
- > **Low Emission Intensity:** at a typical sailing speed of 13 knots, the carbon (equivalent) intensity was estimated at 7.6g CO₂e / MJ H₂ (or 0.92 kg CO₂e / kgH₂) for the proposed "LNG +pilot" propulsion plant over a 1,600 nautical mile roundtrip (800 nautical miles one way).
- > **Satisfied EU REDII requirements:** the estimated emission level of 7.6 g CO₂e/ MJ H₂ was well below the 28.2 g CO₂e/ MJ level required for EU REDII compliance.



- > **Improvements through integration of future technologies:** The hybrid electric propulsion concept enables easy integration of future technologies. Wärtsilä also modelled a potential future scenario involving the integration of a 3,000 kW hydrogen fuel cell into the propulsion plant, which would further reduce emissions by 20 to 30%, depending on the operating profile.

Stefan Nysjö, Vice President of Power Supply, Wärtsilä Marine added: *"In just 25 years – the lifetime of a single vessel – shipping must eliminate its contribution to climate change. To aid in the industry's energy transition, we, at Wärtsilä, remain dedicated to the testing and development of technologies and solutions aimed for low and zero carbon marine fuels. Increasingly electrified and hybridised propulsion systems will emerge to safeguard the necessary flexibility to introduce new decarbonisation technologies during the vessel's lifetime*

"We are fully aligned with Provaris' vision to accelerate the maritime industry towards net-zero emissions shipping, with these positive results underscoring our joint commitment to supporting the industry's sustainable future."

Use of available propulsion technologies

The positive outcomes of the analysis underscore the potential of integrating advanced propulsion technologies to achieve substantial emission reductions and meet stringent regulatory standards. These findings reinforce Provaris' commitment to innovation and sustainability for bulk-scale hydrogen production and transport.

The proposed LNG + pilot propulsion plant is at scale and commercially available with no further research and/or development or certification required. It is provided by a globally recognised marine propulsion solution provider- Wärtsilä.

Provaris will continue to work on the optimisation of the entire compressed hydrogen production and supply chain certification to meet RED II requirements and RFNBO compliance.

Further details of the Emission Intensity Assumptions and Results are provided in Appendix A that follows.

Figure 1: Provaris H2Neo Carrier



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This announcement has been authorised for release by the CEO of Provaris Energy Ltd

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About Provaris Energy

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Provaris Energy Ltd (ASX: PV1) is an Australian public company developing a portfolio of integrated green hydrogen projects for the regional trade of Asia and Europe, leveraging our innovative compressed hydrogen bulk storage and carrier. Our focus on value creation through innovative development that aligns with our business model of simple and efficiency hydrogen production and transport can establish an early-mover advantage for regional maritime trade of hydrogen and unlock a world of potential. In August 2022 Provaris Norway AS was established to advance the development of regional hydrogen supply in Europe.

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APPENDIX A - Emission Intensity Assumptions and Results

The Provaris Carbon Intensity (CI) analysis is based on:

- A Hybrid electric propulsion plant (battery/electric) proposed for its H2Neo hydrogen carrier consisted of:
 - Hydrogen capacity of 450t net cargo.
 - 3 x Wärtsilä 8V31DF LNG Generating Sets
 - 2 x Low RPM direct electric FPP propulsion + Permanent Magnet motors
 - Flexible & expandable AC & DC grids to handle future power sources without compromising propulsion efficiency
 - Low Loss Hybrid electrical system (LLH) in combination with DC grids
 - High redundancy and operational safety – both via AC grid and DC grid
- Fuel Options:
 - Liquefied natural gas (LNG) + marine gas oil (MGO, as pilot fuel)
 - A combination of gas only (SG) generator sets and liquefied natural gas (LNG) + marine gas oil (MGO, as pilot fuel)
 - Marine Gas oil (MGO only)
 - Biodiesel
 - Liquefied natural gas (LNG) + hydrogen
- CI calculations for shipping only, with electrical shore connection assumed at both ports (export and import)
- Shipping distance of 1,600 nautical miles round trip (800 nautical miles one-way)
- Emission factors based on below published EU factors

| TTW Emissions | MGO | LNG | Biodiesel | |
|----------------|---------|---------|-----------|-----------------|
| Carbon Dioxide | 3.206 | 2.750 | 2.834 | t CO2/t of fuel |
| Methane Slip | 0.00005 | 0.01416 | 0.00005 | t CO2/t of fuel |
| Nitrous Oxide | 0.00018 | 0.00011 | 0.00018 | t CO2/t of fuel |

Emission intensity results illustrated below vs. speed for differentiating fuel types:

