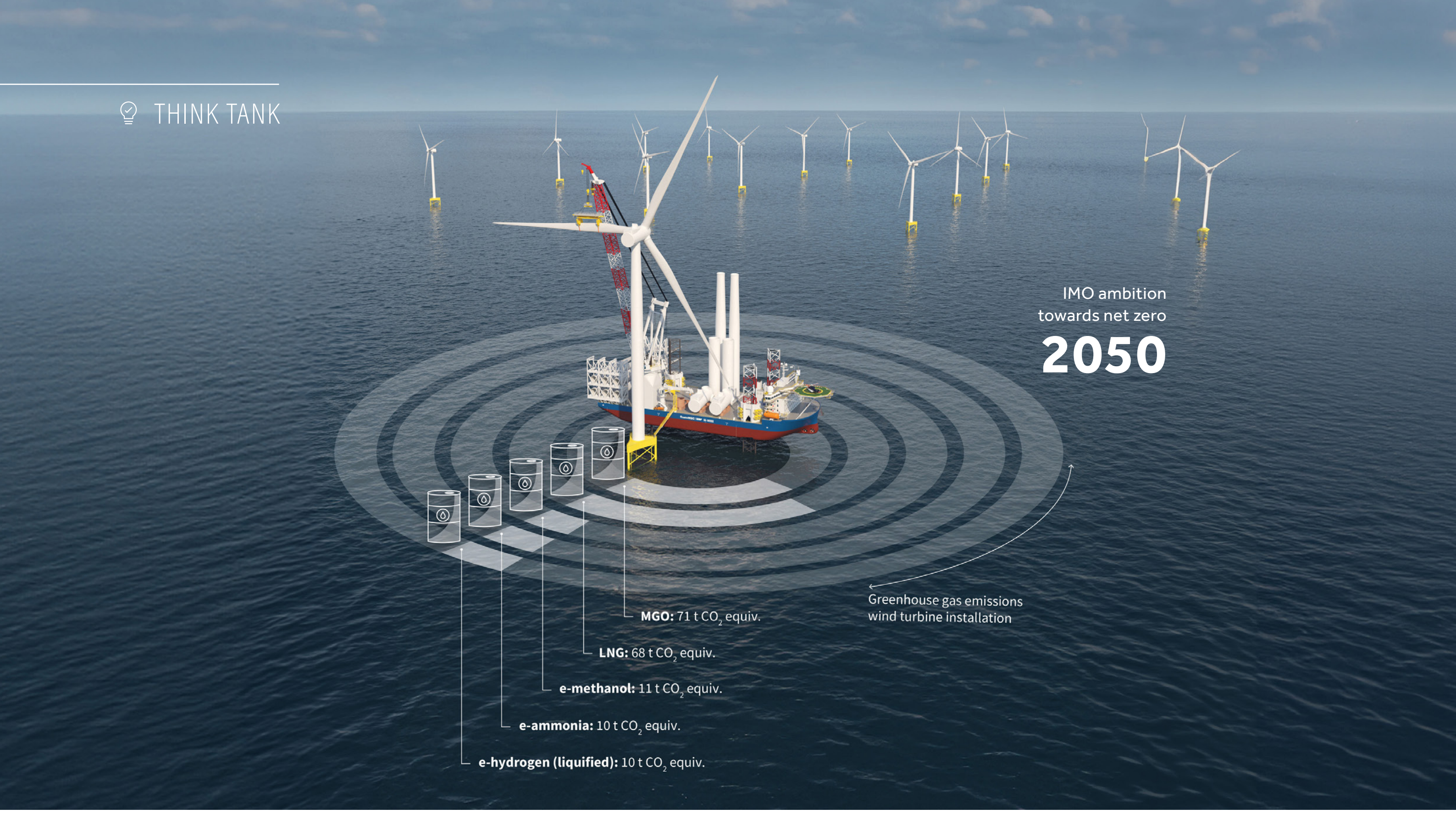


GustoMSC case study: Wind turbine installation well-to-wake CO_2 equiv. emissions

Reducing emissions for offshore operations

As the energy transition advances worldwide, the offshore industry faces stricter regulations, coupled with growing societal and stakeholder demands to reduce greenhouse gas emissions (GHG) and the environmental impact of its operations. NOV's GustoMSC, a leading offshore engineering firm, has launched the GustoMSC Energy and Emissions Quest (GEEQ) program to address these challenges, enhance efficiency, and lower the GHG emissions of the products in its portfolio.

Through this dedicated initiative, GustoMSC is working to develop energy efficient mobile offshore unit (MOU) designs that can operate with minimal GHG emissions. It also aims to quantify the impact of design choices on emissions and provide guidance on future proof energy supply systems.

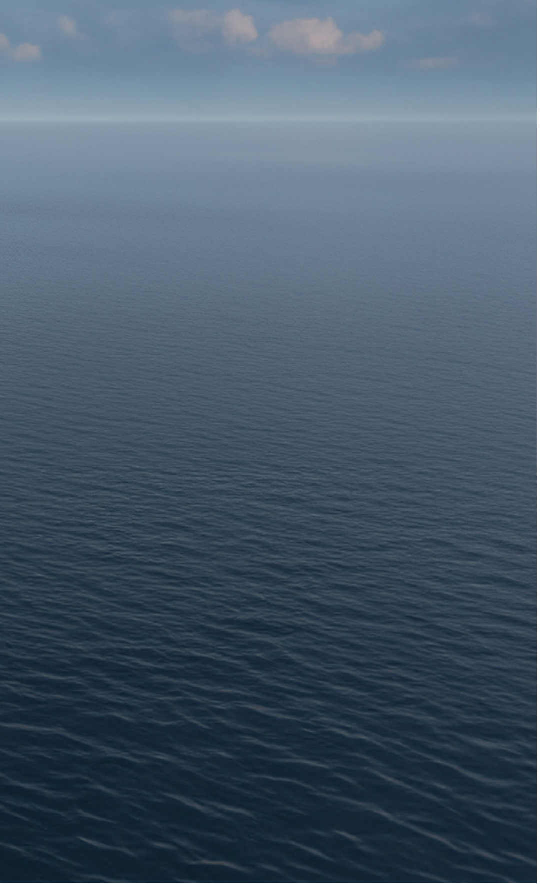
The insights from the GEEQ initiative, detailed in the company's latest whitepaper, 'Pathway and case study on alternative fuels for wind installation vessels,' provide a clear course for the industry to reduce GHG emissions from MOUs and help navigate toward a more sustainable and environmentally responsible future.

Regulatory landscape

The global push for decarbonization has led to bold emissions reduction regulations and targets that significantly impact the offshore industry. The International Maritime Organization (IMO), for instance, has set ambitious targets for the maritime industry. These include a 40% reduction in fleet wide CO_2 emissions by 2030, compared to 2008 levels, a 70% reduction by 2040, and, ultimately, net zero emissions from international shipping by 2050.

Achieving these targets poses a significant challenge for vessel owners, as the lifespan of many vessel types exceeds 20 years. This means that most of the current conventional powered fleet will still be in operation in 2030. Without immediate emissions reduction measures, these vessels would continue to emit the same levels of CO_2, making the IMO's 2030 target unattainable.

Offshore work vessels and units are currently exempt from certain IMO reporting requirements, such as the Energy Efficiency Design Index (EEDI) and Carbon Intensity Indicator (CII). However, there is increasing demand for the offshore industry to report and reduce emissions, particularly in the fast growing offshore wind installation and maintenance segment.



Regional authorities are also implementing emissions reduction regulations. A prime example is the European Commission's Fit for 55 package, which aims to reduce the European Union's (EU) GHG emissions by at least 55% by 2030, compared to 1990 levels. This package includes expanding the EU Emissions Trading System (ETS) to cover the offshore and maritime industries. The EU ETS will initially apply to vessels of more than 5,000 gross tonnage from 2024, but its scope is expected to expand to include smaller offshore units, such as installation vessels, in the future.

The financial implications of these regulations are significant. The current EU ETS carbon price is around 80 to 100 euros per tonne of CO_2, which could result in a 30% increase in the total cost of using conventional Marine Gas Oil (MGO). This serves as a strong financial incentive for MOU owners to improve energy efficiency and adopt alternative, lower emission fuels.

Emissions reduction pathway

Reducing the GHG emissions of MOUs requires a multifaceted approach. It starts with awareness and monitoring of energy consumption and current emissions at the system and operational levels. This data gives vessel owners valuable insights into their environmental footprint, enabling them to identify potential energy and emissions savings. Owners can use these insights to implement practical efficiency measures and integrate alternative fuels.

Improving the energy efficiency of MOUs is a direct way to reduce their GHG emissions. There are several routes to achieve this, ranging from hull shape optimization and electrification to energy storage and recovery systems, waste heat recovery, and advanced process control.

A concrete example is the GustoMSC™ NG-14000XL-G wind turbine installation vessel. It features an optimized hull and spud can shape, a state-of-the-art direct current electrical distribution architecture for the thrusters and main crane, and an energy storage and regenerative recovery system. These energy efficiency measures result in substantial weight and space savings onboard the vessel, as well as reduced fuel consumption and emissions.

While energy efficiency serves as the foundation, the offshore industry is also pursuing alternative fuels to reduce its GHG emissions further. The GEEQ program has identified a range of fuel options, each with its advantages and challenges.

Transition fuels, such as e-diesel and biodiesel, offer not only solutions for the now and near future but also the longer term, as they can be used as 'drop in' replacements for conventional fuels with minimal system modifications. However, the availability of these fuels in sufficient quantities remains a challenge.

Liquified Natural Gas (LNG) is also being considered as an alternative fuel for MOUs. While LNG can provide modest emissions reductions compared to MGO, the risk of methane slip in the combustion engine and the need for cryogenic storage tanks limit its long term viability as a sustainable solution.

Methanol and ammonia are emerging as promising medium term alternative fuel options. Methanol is a liquid fuel that can be stored in tanks at atmospheric pressure, unlike some other alternatives. Although methanol contains carbon and produces CO_2 emissions, using green methanol, which is produced from renewable energy sources, such as e-fuels or biofuels, lowers these emissions. However, its extremely low flash point and high toxicity pose safety risks.

Similarly, green ammonia also has the potential to significantly lower emissions. Yet, the highly toxic nature of ammonia presents safety challenges, particularly for MOUs with large crews and congested deck layouts. Both fuels still require further development of supply chains and infrastructure to become viable alternatives.

In the long term, hydrogen is widely regarded as a key zero emission fuel of the future. Green hydrogen, produced through the electrolysis of water using renewable energy, can achieve near zero well-to-wake emissions. However, current storage methods, whether in cryogenic liquid or high pressure compressed form, present considerable design challenges for weight sensitive offshore units.

Case study

To illustrate the potential of various alternative fuels, the GEEQ team conducted a case study on a GustoMSC NG-16000X wind turbine installation vessel performing a typical North Sea offshore wind farm installation campaign. The jack-up vessel's roundtrip involved loading, transporting, and installing five 12+ megawatt wind turbines at a site 40 nautical miles from the loadout port.

The case study assessed the well-to-wake GHG emissions and the impacts on fuel storage (volume and weight) for a range of fuel options, including conventional MGO, LNG, gray, fossil based and green, bio/e-, methanol, ammonia, and hydrogen. The analysis considered the entire life cycle of the fuels, from production and delivery to onboard consumption, to accurately capture the global warming potential of the various GHG emitted.

The findings were striking. Fossil based alternative fuels like gray methanol, gray ammonia, and gray hydrogen were found to have higher well-to-wake emissions than MGO, making them unsuitable as marine fuels.

Alternative maritime fuels for offshore vessels - options and suitability

Continued innovation and open dialogue will be essential to propel the offshore industry toward a more sustainable future.

WTIV energy supply and regeneration

In contrast, green methanol, green ammonia, and green hydrogen were able to achieve an 85% reduction in GHG emissions compared to MGO, meeting the EU's 2030 and IMO 2040 targets.

Meanwhile, the case study also highlighted a major challenge with alternative fuels: their impact on vessel design. The volume and weight of storing fuels like liquid hydrogen and compressed hydrogen can be six times greater than that of conventional MGO. This poses a particular challenge for weight sensitive MOUs, such as jack-ups and semi-submersibles, where the additional fuel storage requirements could limit the payload capacity.

To overcome this hurdle, the GEEQ team suggests a dual fuel approach as a potential compromise for some types of units. In this scenario, the vessel would use an alternative fuel, such as green methanol or green ammonia, for short trips or specific operational phases where emissions reduction is the priority. For longer voyages or high power demands, the vessel would revert to using MGO or biofuel blends, leveraging the existing fuel storage and infrastructure.

Conclusion

No single universal solution exists for reducing operational GHG emissions from MOUs. A combination of measures is required, including energy efficiency improvements, alternative fuels, and, potentially, carbon capture. The optimal solution will depend on a range of factors, such as the MOU's operational profile, geographical area, applicable emissions regulations, fuel availability, and safety considerations.

Additionally, the availability and supply chain maturity of alternative fuels will play a crucial role in their adoption. While green methanol, green ammonia, and green hydrogen hold great promise, their widespread availability and cost competitiveness to conventional fuels remain uncertain in the near term.

Navigating these challenges and developing future proof MOU designs will require collaboration between vessel designers, engineers, owners, and operators. The decarbonization journey detailed in the whitepaper provides a practical and multifaceted approach to emissions monitoring, energy efficiency, and alternative fuels. The insights and findings from the GEEQ initiative demonstrate that substantial emissions reductions are achievable through innovative design, strategic fuel selection, and collaboration.

While challenges remain, particularly around the storage and handling of emerging alternative fuels, continued innovation and open dialogue will be essential to propel the offshore industry toward a more sustainable future.

To download the whitepaper, visit https://experience.nov.com/gmsc-geeq-whitepaper/p/1.

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