LNG2026 Qatar 2-5 FEBRUARY

PRESENTED BY IGU INTERNATIONAL GAS UNION GTI ENERGY IIF IIR INSTITUT INTERNATIONAL DU FROID INTERNATIONAL INSTITUTE OF REFRIGERATION

HOSTED BY QatarEnergy

Methane Pyrolysis as a Pathway for LNG Supply Chain Decarbonization – The Case of Maritime Transport

Lead author: Dr. Ma'moun Al-Rawashdeh, CEO, CircleProcess Technologies

Co-author: Erkan Erkul, Manager, Business Development, American Bureau of Shipping
Dimitrios Bardakos, ABS Global Sustainability, American Bureau of Shipping
Utkarsh Kulshreshtha, VP Gas & Petrochem, Milaha

Methane pyrolysis presents a promising technological solution to unlock LNG's potential as a long-term sustainable fuel option. Maritime and large ships, an essential element of LNG supply chain, significantly benefit from this technology to achieve decarbonization. The process involves the thermal decomposition of methane (CH4), the primary component of LNG, into gaseous hydrogen (H2) and solid carbon (C) onboard the vessel (CH4→C+2H2). The produced hydrogen can then be utilized directly in modified internal combustion engines, for generation of steam, or fuel cells for propulsion and auxiliary power, resulting in near-zero CO2 emissions at the point of use. Simultaneously the co-product, solid carbon, is captured onboard, much easier to handle than CO2, can be offloaded in port for potential valorization in various industrial applications, creating a circular economy pathway. This "turquoise hydrogen" approach effectively decarbonizes the energy derived from LNG while utilizing the existing LNG bunkering infrastructure.

The maritime industry is under increasing pressure to decarbonize, driven by stringent global emissions reduction targets set by the International Maritime Organization (IMO) and growing environmental concerns. Liquefied Natural Gas (LNG) has emerged as a significant transitional fuel, offering immediate reductions in SOx, NOx, and particulate matter compared to traditional marine fuels, and providing a pathway for lower carbon operations. As the sector looks towards 2050 net-zero ambitions, leveraging existing and future LNG infrastructure while addressing its associated greenhouse gas footprint, particularly methane slip, becomes crucial. LNG's established global supply chain and onboard handling protocols position it as a potentially sustainable fuel feedstock for the future, provided its carbon intensity can be drastically reduced during use.

This work presents a comparative analysis to benchmark methane pyrolysis making solid carbon and hydrogen as a strategy to reduce CO2 emissions from large carrier ships to that of CO2 post-combustion onboard carbon capture (OCCS). The analysis includes energy perspective, system design, handling, economics, and business case. The work is conducted on a representative LNG-fueled vessel. The study analyzes the energy balance, heat integration potential between the pyrolysis unit and ship systems (e.g., waste heat recovery from engines, LNG vaporization), and overall system efficiency improvements compared to conventional LNG operation and benchmark technologies like OCCS.

Furthermore, the study do initial assessment of the overall operational economics considering carbon co-product value, and investment viability against alternatives. This work aims to clarify the potential role and competitiveness of onboard methane pyrolysis, helping to position this technology as a viable and impactful decarbonization solution for the future of LNG in the maritime industry.

To view the full technical programme, visit https://lng2026.com/technical-programme

This abstract will be presented during LNG2026 conference on 2-5 February in Doha, Qatar