



Making a Power Move on LPG

8 December 2021



Decarbonizing our fleet with LPG propulsion technology



The maritime industry is ready for LPG as mainstream marine fuel

12 ships on water

- BW LPG has 12 LGIP VLGCs on water, 3 retrofitting planned in Q1 2021, total 15 VLGCs committed
- The sector's largest investment to decarbonise at USD 130 million

Ready for LPG

- Refuel of LPG bunker can be done via Ship-to-Ship transfer, an established practice
- Shipping has infrastructure to support LPG as marine fuel

Decarbonize

- Our retrofit program saves 1 million tons in CO₂ emissions
- LPG is a cleaner energy fuel, and is part of the solution as we work towards a zero-carbon future



> 50% of VLGCs and 7,500 ships can be retrofitted with LPG propulsion engines

Liquefied Gas Injection (Propane) Technology

Proven and scaled with >10,000 hours in operation and counting

A Step Forward

- LPG is drawn into fuel gas supply system & piped to engine
- A small amount of compliant pilot fuel such as VLSFO or MGO is injected into the engine as the piston nears the top
- It sparks under pressure, and LPG burns cleanly to create propulsive force
- Reduce emissions:
 - Sulphur Oxides (~97%)
 - Particulate Matter (~90%)
 - Carbon Dioxide (~20%)
 - Nitrous Oxides (~20%)
- Increase efficiency on many fronts



Moving people and parts was key operational challenge

Safety of crew a priority while minimizing logistical impact from Covid-19



Smooth adoption of new technology onboard current ships

- No major surprises during retrofitting process, including for world's first LPG-powered VLGC, BW Gemini
- Importance of filters to manage organic materials in LPG
- STS of LPG bunker a success, allowing site team better control over project timelines

LGIP technology scaled successfully, collaboration is key

- Experienced, dedicated site team is critical to project success
- Had to manage quality concerns from main and sub-suppliers, but overall good experience
- Special thanks to Yiu Lian dockyard for their flexibility and patience
- Special thanks to Wärtsilä and MAN ES for partnering us in this pioneering project

Impact from Covid-19 on project progress

- Over 14,000 hours spent in quarantine. Colleagues spend 2 weeks in hotels upon arrival in China/ back home (Singapore/ Norway)
- Crew confined to vessel and yard with no shore leave
- Shipping delays for critical parts

Delivering cleaner energy safely and sustainably with LPG



A necessary and complementary step towards zero-carbon propulsion

Compliance with Regulations

- Full compliance with IMO 2020
- Improves performance related to EEXI, CII and enhanced SEEMP
- A step forward in complying with IMO 2050

Ideal Transition Fuel

- Lowest climate impact from well-to-wake life (WTW) and tank-to-wake (TTW) LCA perspective
- LPG provides significant reductions in GHG emissions; no methane slip

Benefits Boost Bottom Line

- Savings from reduced fuel consumption
- Buffer from fuel price sensitivity
- More efficient engines are cheaper to maintain
- Reduce turnaround time because vessel refuel as it loads



Beyond shipping and towards a Better World with LPG



Significant growth prospects along the LPG value chain



Replacing pollutive biomass, saving lives and ecosystems

- Cooking for Life Campaign by WLPGA aims to facilitate the transition of 1 billion people to cook with LPG by 2030
- > 4 million people die from illnesses related to household air pollution annually
- Replacing biomass with LPG reduces deforestation and degradation

Investing and expanding our shipping presence in India

- BW LPG is India's largest operator and operator of world-class VLGCs with a growing fleet of India-flagged vessels
- Well-positioned to lead the Middle East - India LPG trade
- Governmental push to increase LPG as part of energy mix, with retail consumption outpacing domestic production; industrial demand for LPG is also growing

Looking beyond shipping and into gas infrastructure

- Opportunities to invest directly into modern terminals to increase utilization and efficiency
- Floating storage may increase useful life of vessels beyond 35 years
- Potential for onshore investments eg terminals, storage & pipelines



THANK YOU

