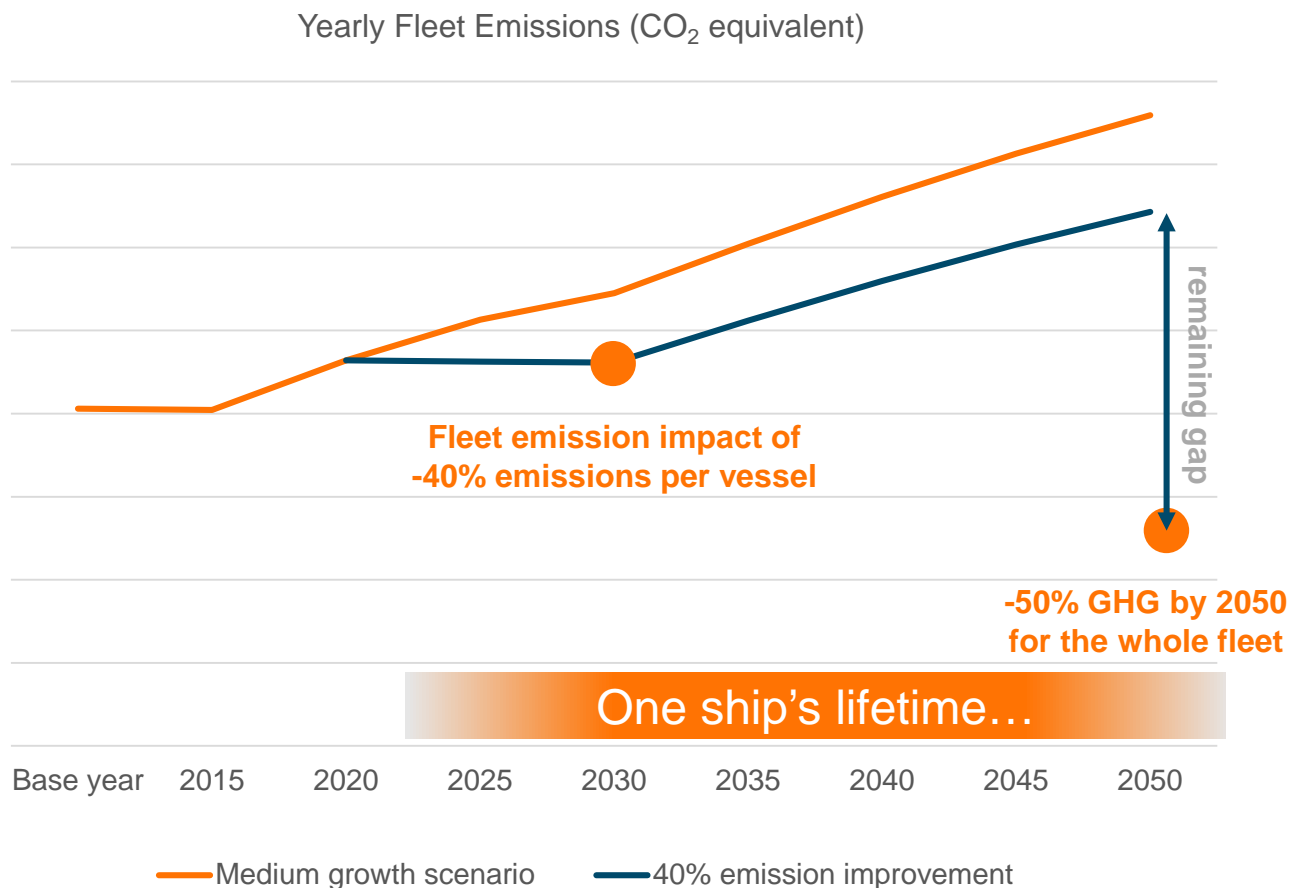


FUTURE FUELS

Claudia Beumer
Sales and Marketing Manager Wärtsilä

A SUSTAINABLE FUTURE REQUIRES CLEANER FUELS



DATA, TECHNOLOGY AND THE ENERGY SOURCE WILL TAKE US TO 2030

Use of data in operation

- Increased fleet efficiency
- Increased asset utilisation

Energy storage and savings technologies

- Energy production optimisation
- Energy consumption optimisation
- Hybridisation (batteries, fuel cells, etc)

Energy source

- Fossil LNG
- Biofuel blends
- Renewable energy utilization (wind, solar, etc.)

SUSTAINABLE FUELS AND ADVANCED TECHNOLOGIES WILL TAKE US TO 2050

- Bio/synthetic fuels for the combustion engine
- Waste heat recovery
- Carbon capture
- Carbon credits

Data adapted from CE Delft Proprietary data; same modelling methodology as used in the 3rd IMO GHG study

WHERE TO GO?



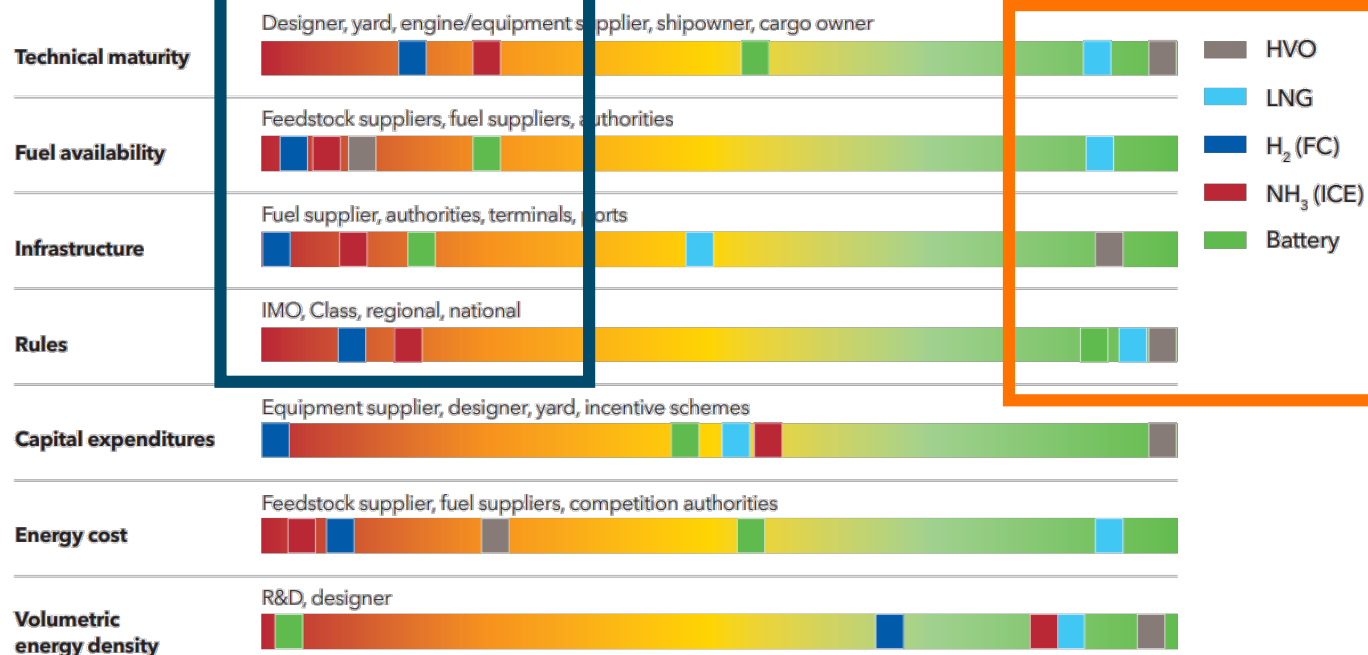
WE HAVE TO START RIGHT NOW!

TO MEET THE TARGET IN 2050

AND ALSO
DEVELOP
ALTERNATIVES

FIGURE 3

The Alternative Fuel Barrier Dashboard: Indicative status of key barriers for selected alternative fuels



WE NEED TO FOCUS
ON AVAILABLE
TECHNOLOGIES

WE HAVE TO START RIGHT NOW!

COMBUSTION ENGINE + LNG AS A FUEL

IS A FUTURE-PROOF
SOLUTION **TO 2030**



COMBUSTION ENGINE + BIO/SYNTHETIC LNG

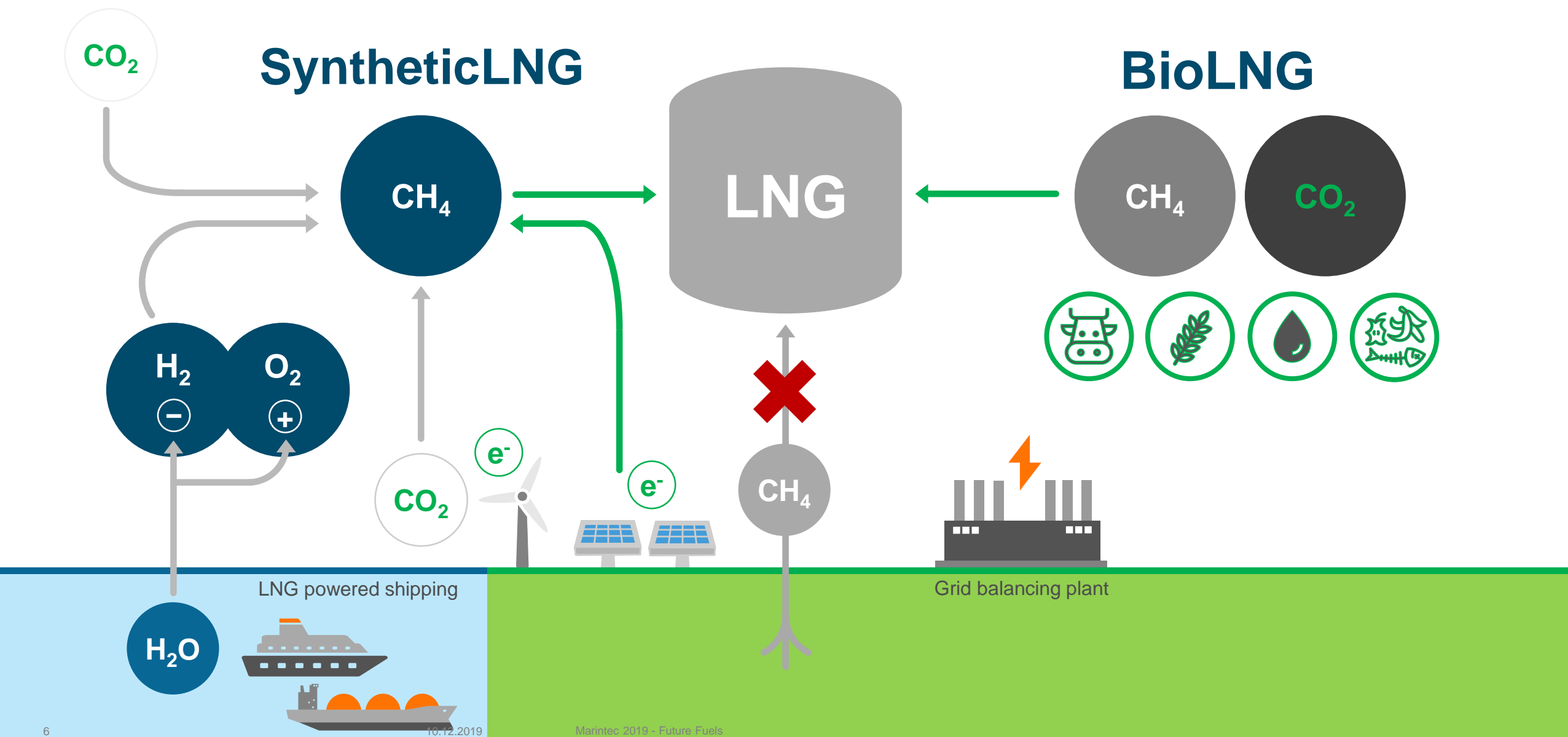
BRINGS YOU EASILY
TO 2050

WITHOUT ANY ADAPTIONS ON YOUR ENGINE
ARRANGEMENT

LNG as Marine Fuel

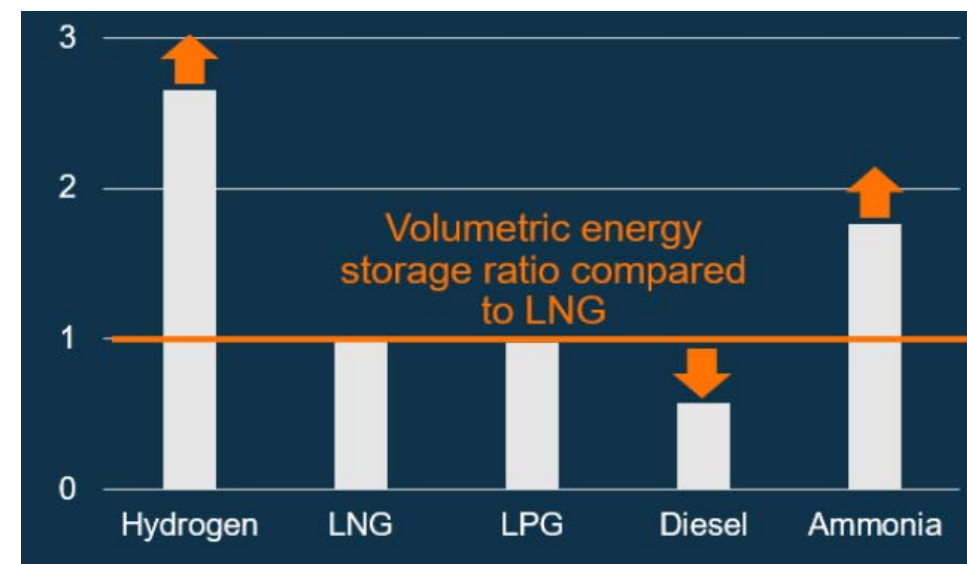
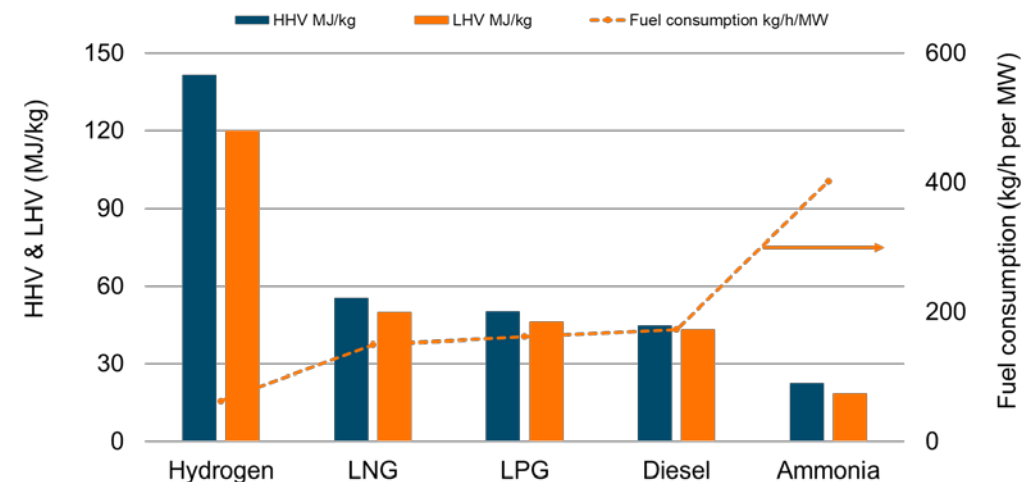
- A clean fuel, no after-treatment needed for emission compliance
- Infrastructure in place/maturing
- Shifting from diesel to fossil LNG reduces CO₂ emissions by 7 to 21%
- Reliable engine technology. More than 2100 engines > 26.000.000 running hours
- Providing an infrastructure and the pathway for renewable fuels
- **Easy to blend with BioLNG and Synthetic LNG**

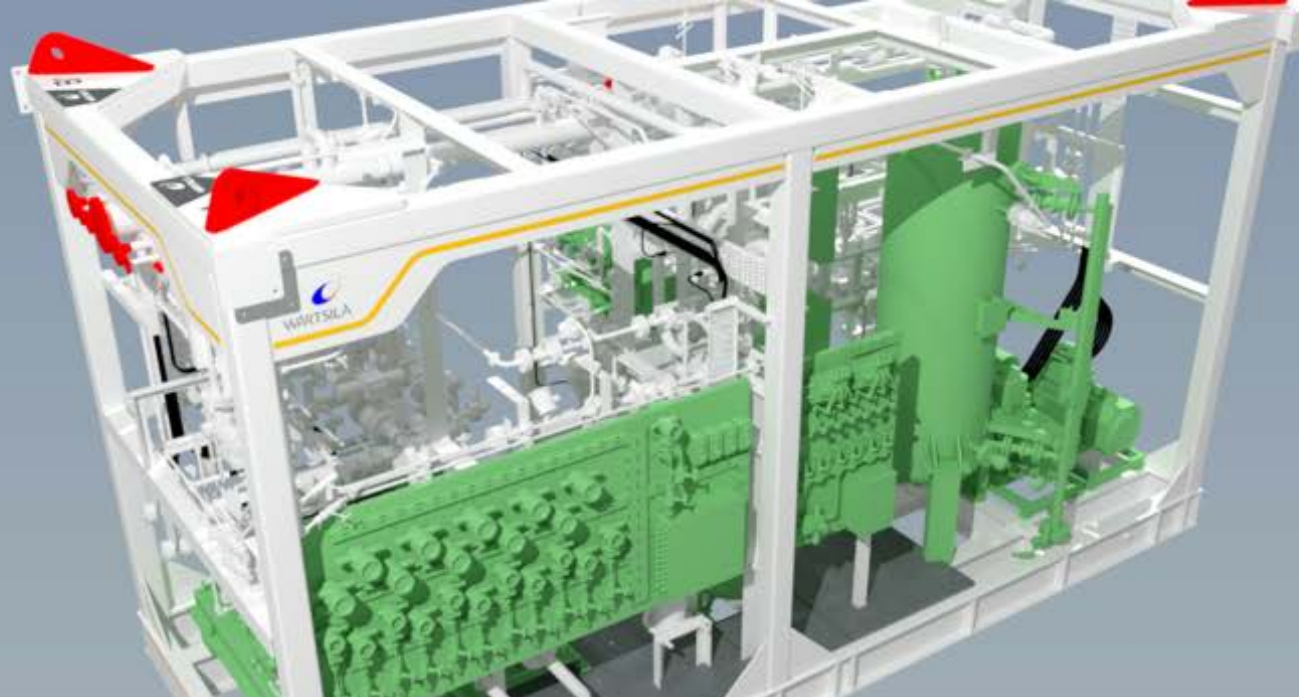
WE CAN START RIGHT NOW!



ADVANTAGES OF LPG AS FUEL

- LPG has a high energy density
- Easy to store
- Reliable distribution network
- Non toxic
- Less CO₂, compared to traditional fuel
- High NO_x (~83%) emission reduction
- Almost zero SO_x emissions
- No particles in the exhaust gas





ENSURING A RELIABLE, CONTINUOUS OPERATION BY DESIGN

- **Redundancy, Safety, Robustness** and **Maintenance Friendly** Design to ensure continuous operation.
- Specific system design to cope with the potential presence of debris in LPG fuel
- Dedicated Control panel with touchscreen user interface, interfaced with Engine Management System and other 3rd party onboard Systems



OPERATIONAL EFFICIENCY TO MATCH SPECIFIC VOYAGE PROFILES

- For a LPG carrier, the size of the deck/ fuel tanks can be customized based on the operational profile of the vessel and the operators preference.
 - From small (refueling from cargo tanks in weekly operations) to larger tanks, covering the intended voyage profiles.
- Fueling the deck tanks can be operated/ handled via the liquefaction plant, ensuring maximum efficiency

NACOS AUTOMATION PLATFORM - BENEFITS

- LPG as fuel is new for many users,
- NACOS platform offers:
 - ✓ Peace of mind
 - Safety Management
 - Mustering System
 - ✓ Easy operations
 - Remote access
 - Integrated automation system
 - Monitoring operations from multiple stations



OTHER FUTURE FUELS UNDER DEVELOPMENT

- Hydrogen
- Ammonia
- Methanol
- Fuel Cells
- ...
- ...



Courtesy of Stena



Courtesy of C-Job

CONCLUSION



- There is not ONE fuel for the future
- By using Wärtsilä expertise and knowledge, shipowners will be able to find the right fuel for their application



WÄRTSILÄ