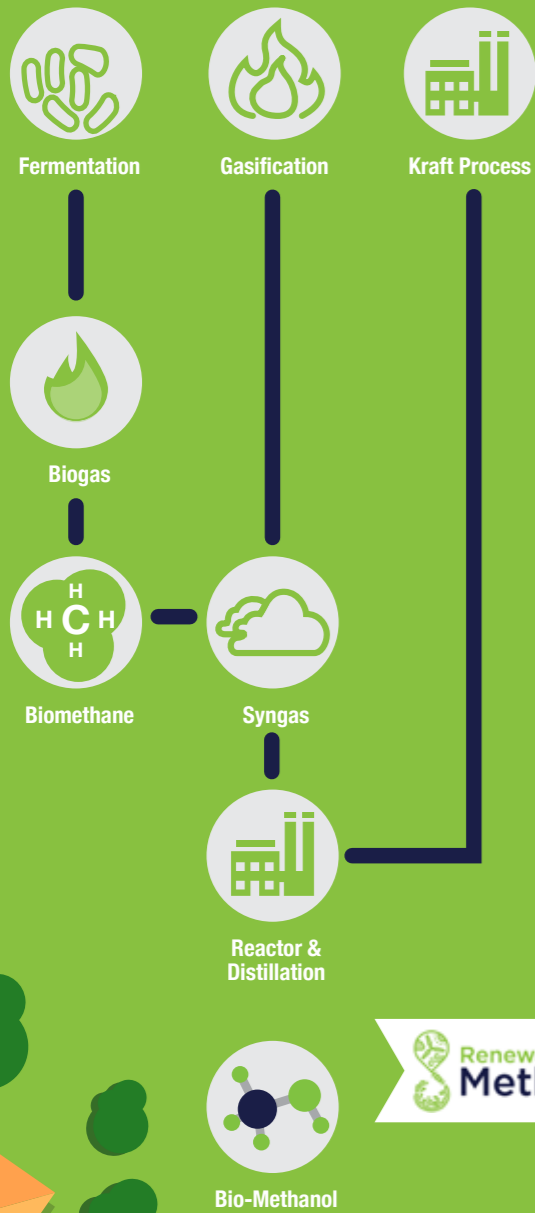


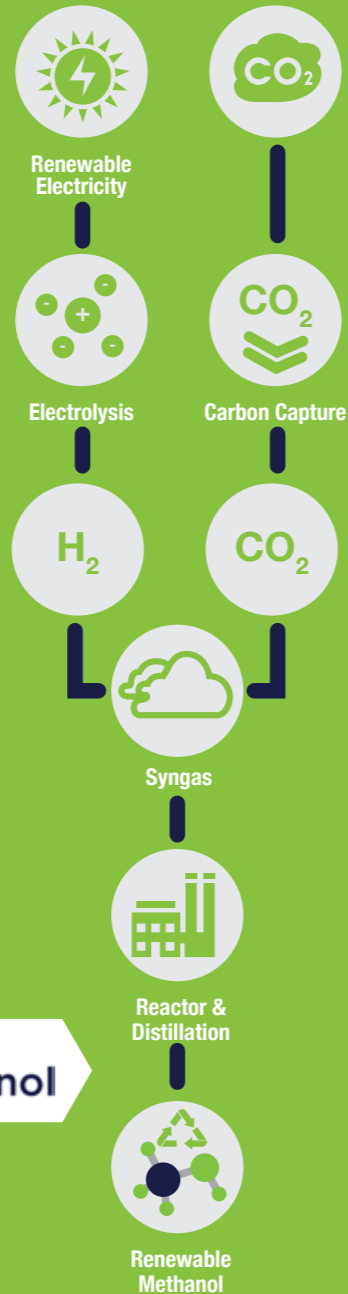
# THE MARINE FUEL OF THE FUTURE

## METHANOL AS A SUSTAINABLE SOLUTION

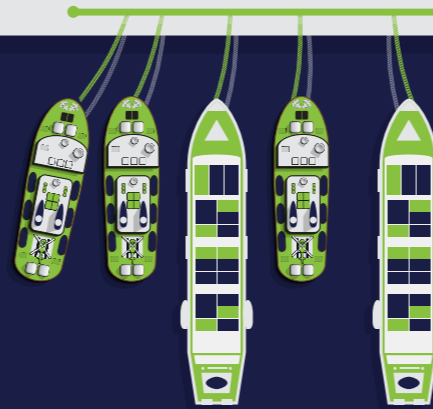
### SUSTAINABLE BIOMASS (Residues, MSW, etc)



### SYNTHETIC FUELS



## RETROFITS ECONOMICALLY VIABLE



## METHANOL FUELED VESSELS AND PILOTS

**DUAL FUEL**

Chemical Tankers **11+9\***

Ropax Ferry **1**

Pilot Boat **1**

**FUEL CELL**

Tourist Boat **2**

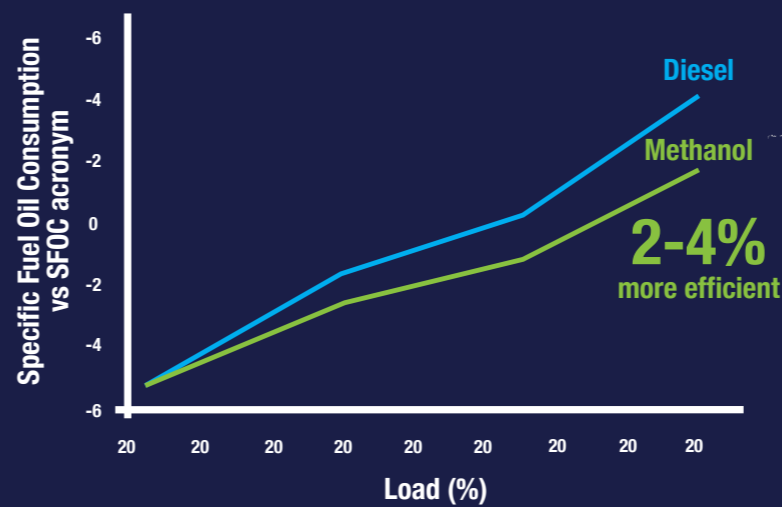
Ferry **1**

**PROJECT R&D**

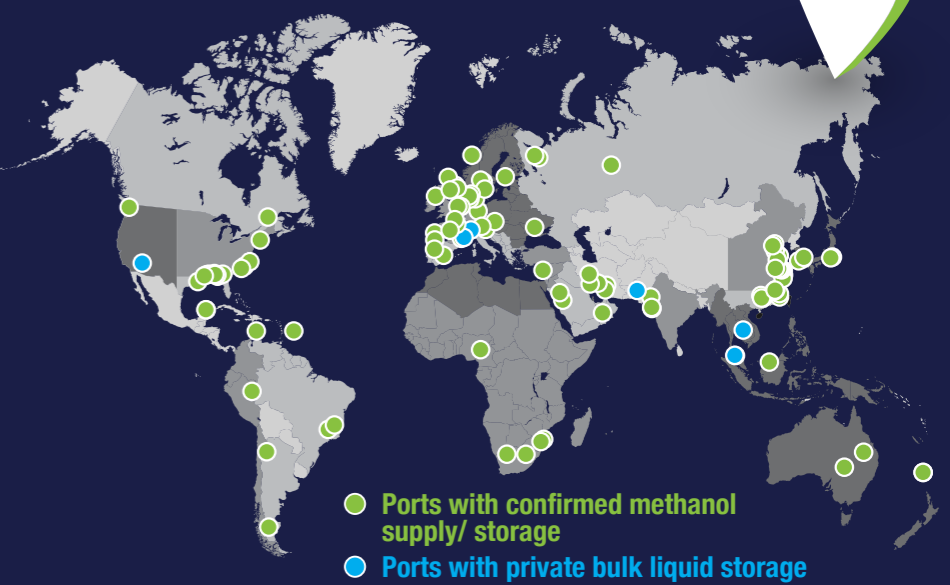
Cruise Ships, Fishing Boats, Barges, Dredges, Others **4**

\*9 additional new builds scheduled for delivery by 2023

## METHANOL IS MORE EFFICIENT THAN DIESEL IN ICE



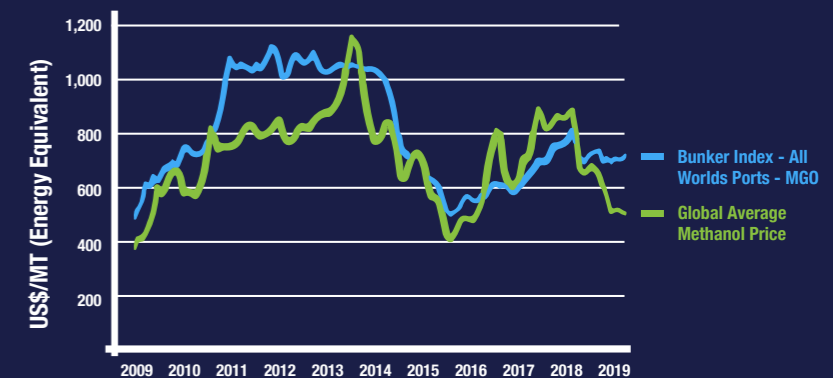
## METHANOL AVAILABLE IN OVER 100 PORTS TODAY



## LNG VS METHANOL

| FUEL TYPE                         | LNG                   | METHANOL              |
|-----------------------------------|-----------------------|-----------------------|
| Heat capacity                     | 49,200 kJ/kg          | 20,000 kJ/kg          |
| Density                           | 425 kg/m <sup>3</sup> | 800 kg/m <sup>3</sup> |
| Volumetric factor (vs MDO)        | 1,8                   | 2,4                   |
| Fuel Gas Supply System Cost 15 MW | \$2,5 mln             | \$0,5 mln             |
| Availability                      | +                     | +++                   |
| Engine price                      | + 25 %                | + 25%                 |
| Fuel Price (vs MGO)               | ++                    | +                     |

## MGO VS METHANOL

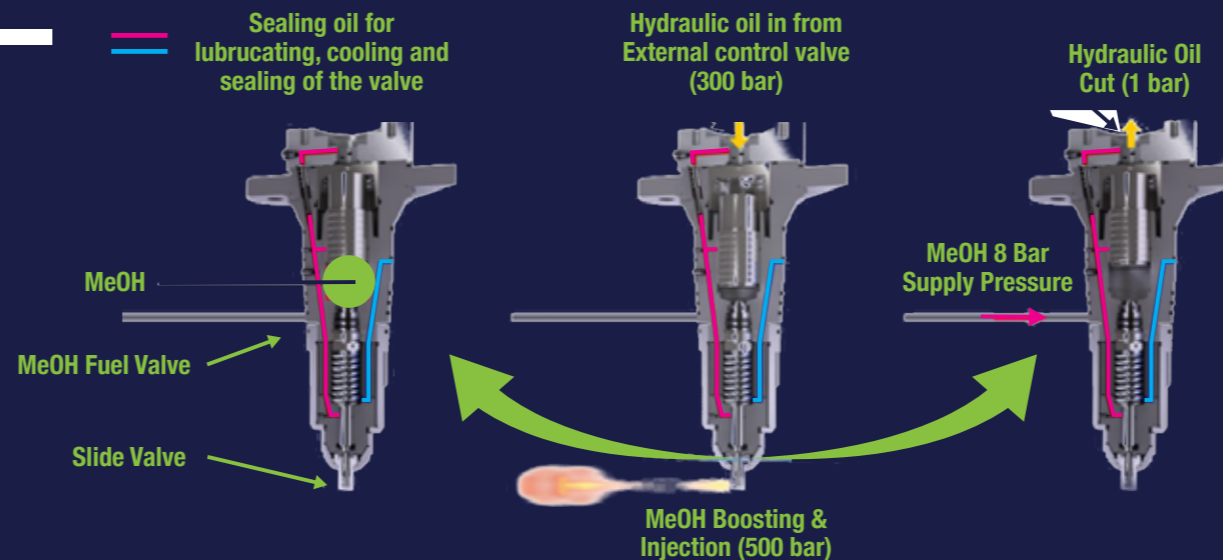


# ADVANCED DUAL FUEL TECHNOLOGY

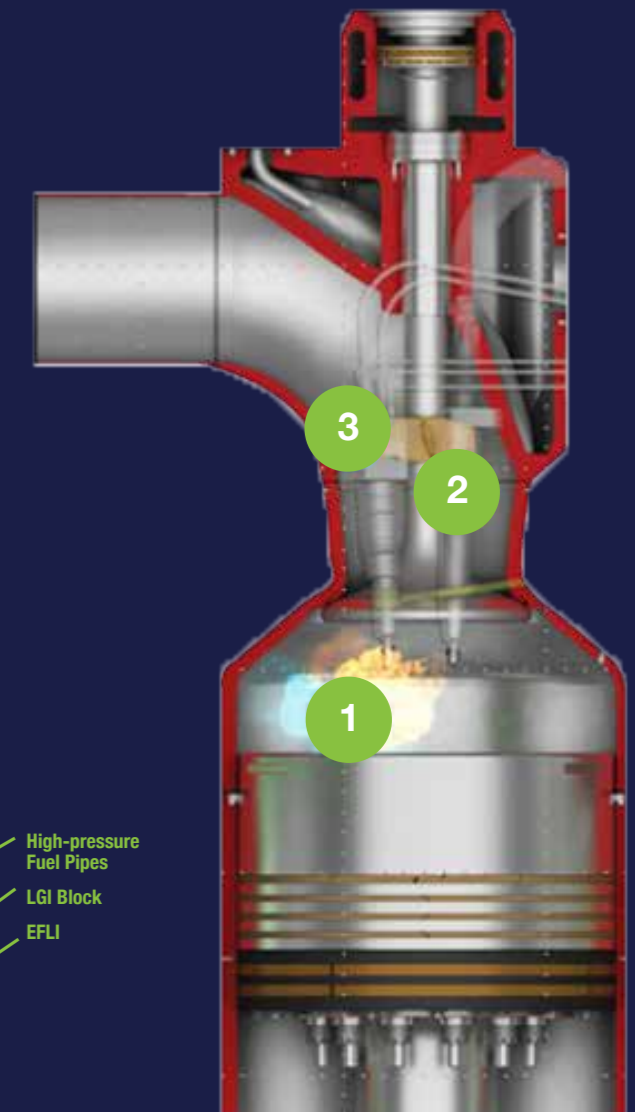


## THE FUEL BOOSTER INJECTION VALVE

### Principle of the FBIV – Fuel Booster Injection Valve



- 1 Combustion Illustration  
Yellow = Pilot Oil  
Blue = Methanol
- 2 Conventional Slide Fuel Valve
- 3 Methanol Injection Valve (FBIV-M)



## MAN ME-LGI METHANOL

ME-B Engine + LGI-M Technology =

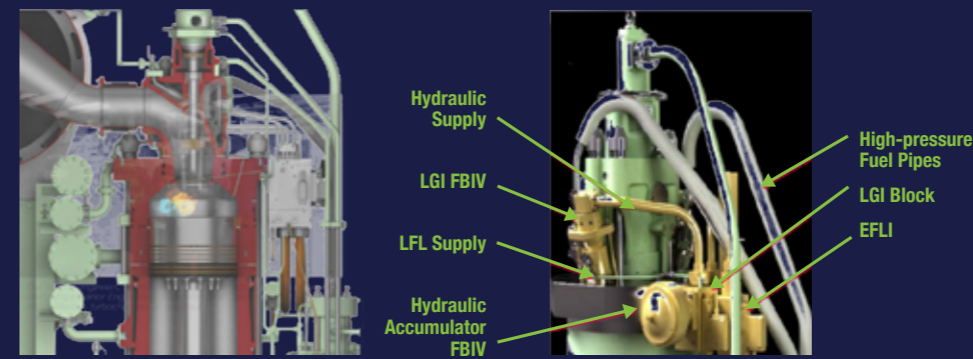
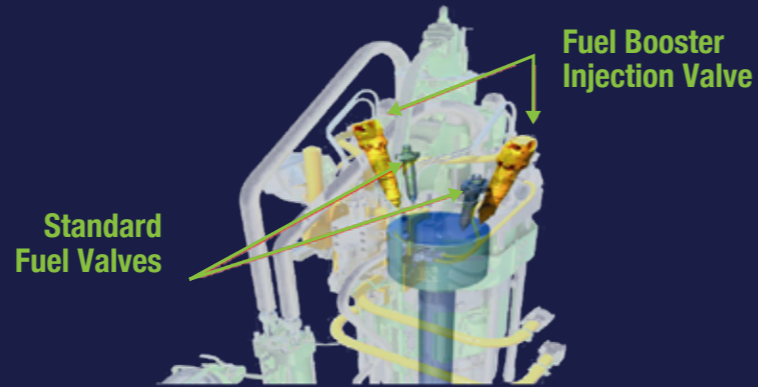


ME-B LGI-M



4 FUEL VALVES PER CYLINDER

TWO STANDALONE FUEL SUPPLY SYSTEMS



## ME-LGI METHANOL DEVELOPMENT MILESTONES

2015



LGI Demonstration Event at RCC 4T50ME-X



Test at MES 7S50ME-B9-3-LGIM



Test at HHI 7G50ME-B9-3LGIM

2016



1<sup>st</sup> Sea Trials On Methanol MNS Taranaki Sun & HMD Lindanger

2017



Development of Test III compliance by water in methanol

2019



NOx Certification 6G50ME-C9.5 LGIM-W at HHI June 2019

2020



Order Book of 14 LGIM engines in total, 11 in service >65,000 running hours accumulated on Methanol

[www.man-es.com](http://www.man-es.com)

