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EVENTS**



# Will alternative fuels be ready for shipping to meet its GHG target in 2050?

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# Alternative Energy/ Fuels



## GENERATION of alternative fuels/ energy

## TRANSPORT

## APPLICATION

- Feedstock (current & potential):  
Type, availability, and usage
- Production technologies
- Capacity (current & planned):  
plants worldwide
- Cost and other concerns:  
fluctuation, factors affecting the cost

- Storage requirement
- Logistics
- Safety & regulations

- Applicability
- Operation, safety & environment
- Emission reduction:  
GHG and pollutant emission reduction (on board/ LCA)



# Alternative Energy/ Fuels



**LNG (fossil-based):**  
Dominant alternative fuels due to its adequacy (supply) to support entire shipping industry, but unable to meet 2050's GHG target



**Biodiesel (1<sup>st</sup> and 2<sup>nd</sup> gen):**  
Able to support partially due to its supply and land use change (<5% of energy demand by shipping industry), used as a drop-in fuel with diesel



**Methanol (fossil-based and biomass-based):**  
Mainly used as a clean fuel and on-board GHG emission reduction



**Bio-LNG (biomass-based):**  
Produced from waste and wastewater, able to use as a drop-in fuel with LNG facilitating the industry to meet 2050's GHG target



**Bio-methanol (biomass-based):**  
On-board and LCA GHG emission reduction



**Biodiesel (3<sup>rd</sup>):**  
There is a need for R&D for 3<sup>rd</sup> gen biodiesel towards sustainability

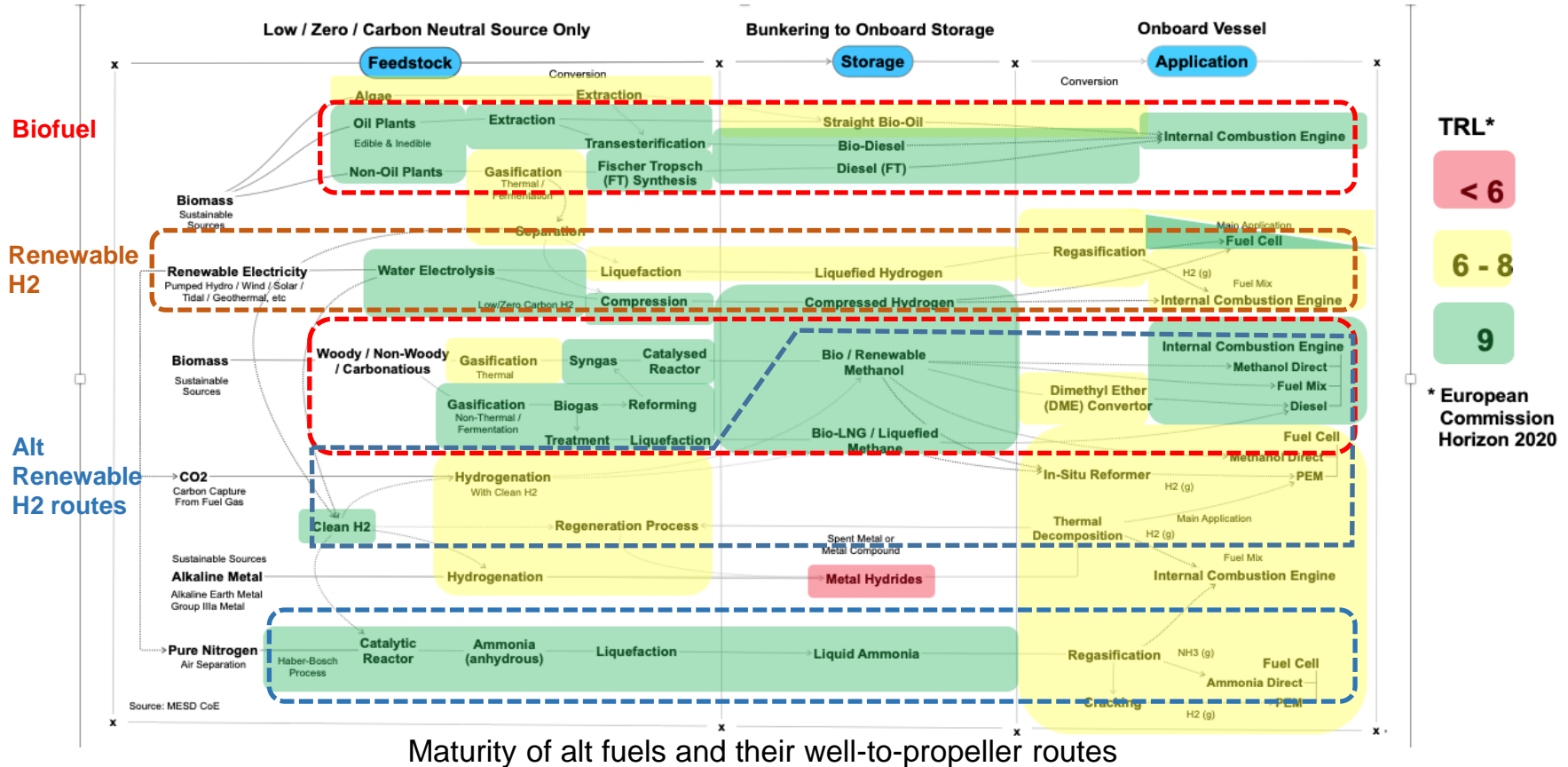


**Hydrogen (non-bio renewable energy-based):**  
Ideal fuel towards sustainability. Due to the technology maturity, there is a requirement in R&D in its carrier and fuel cell for marine application and establishment of renewable hydrogen supply chain and bunkering infrastructure.

Short- and medium- term  
2018-2023 and 2023-2030

Long-term  
2030 onwards

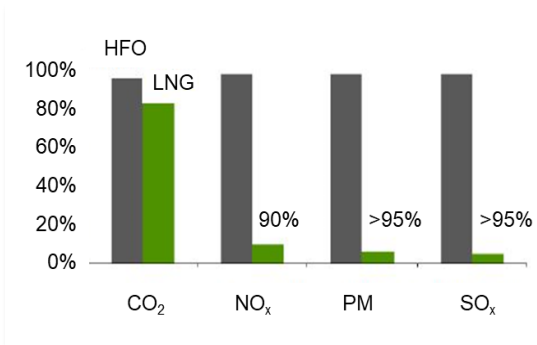
# Technology Readiness



# LNG and bio-LNG

Natural gas reserves  
~180 trillion m<sup>3</sup> (R/P ratio 60-80 year)

Dual-fuel engine, fuel gas supply system and storage on board vessels (TRL 9)



Requirement of a global network of infrastructure for its application worldwide

LNG



Produced from organic waste and wastewater via landfill degradation or anaerobic digestion

Potential for bio-methane production worldwide ~1,000 million m<sup>3</sup>

Used as a drop-in fuel with LNG

Able to leverage on LNG infrastructure

Presence as bioenergy providing further emission reduction

Requirement of sufficient production of bio-methane and value chain development to support its application



Bio-LNG

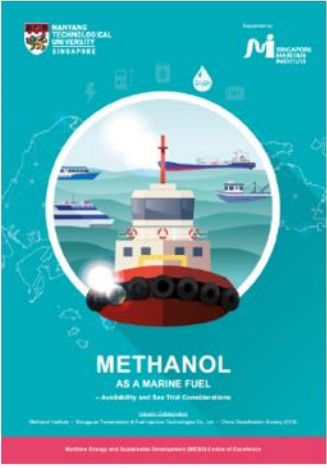
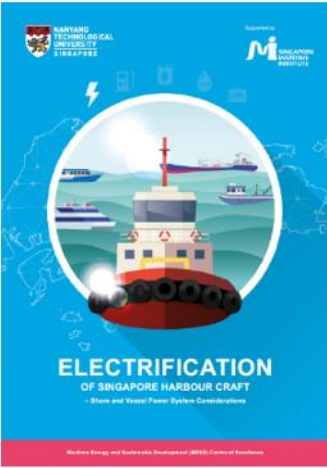
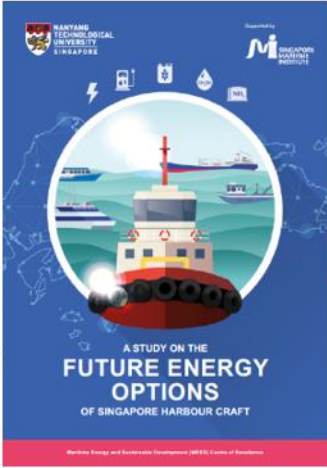
# Efforts to pave the way for Low-Carbon options in Singapore

- Singapore LNG Terminal, started in 2013, is the first open-access, multi-user LNG terminal in Asia.
- R&D projects; Living labs for green technologies
- Digitalization (digitalPORT@SG) to improve integrated services and efficiency
- Maritime Singapore Green Initiative with a new focus on decarbonisation with new carbon emissions-related incentives



Source: SLNG

# MESD Centre Public Reports



# Thank you

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For more information, please visit MESD website [http://coe.ntu.edu.sg/MESD\\_CoE](http://coe.ntu.edu.sg/MESD_CoE)

