Building future-proof marine engines

IMO Symposium on alternative low-carbon and zero-carbon fuels for shipping

09 February 2021
About EUROMOT

• EUROMOT is the European association of internal combustion engine manufacturers, founded in 1991 in London

• Our scope
  • Interest representation for manufacturers of industrial combustion engines
  • International environmental requirements and related legislation such as product safety, certification and testing, fuels, standards,…

• Member companies from all over the world

• A non-governmental organization in consultative status at IMO
Engines and System Integration

Marine Vessels of the future

- Alternative fuels & technologies
  - Gas / LNG
  - Ethane, LPG
  - Methanol
  - Ammonia
  - Hydrogen
  - Power to Liquid/Synthetic Fuels
  - Fuel-Cell
  - ...

- Efficiency & emission technologies
  - Exhaust After Treatment
  - Waste Heat Recovery
  - Dynamic propulsion control (e.g. trim & fuel optimization)
  - Propulsion System efficiency, through system integration
  - Air lubrication
  - Wind Rotors
  - ...

- Electrification/ Hybridization & Intelligent Power Management
  - Diesel-electric
  - Hybrid
  - Pure-e / battery electric
  - Microgrid / Intelligent Power Management
  - ...

- Automation, Digitalization & “Smart Ship”
  - Automation incl. efficiency mgt.
  - Connectivity
  - Equipment Health Mgt./ Condition Based Maintenance
  - Digital services (fuel performance, fleet / route optimization, EHM, hull cleaning)
  - Remote & autonomous control
  - ...

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Hybridization and Intelligent Power Management

Improving Energy Efficiency

- Excellent short-term measure to improve energy efficiency of ships
- Technology with high maturity and wide range of available systems
- Application to new ships and retrofitting of existing ships
- Potential for further decarbonization
- High degree of system integration is key
- May be used with conventional marine fuels, low flashpoint diesel fuels or low/zero carbon fuels
LNG, LPG, Synthetic- and Bio-Methane
Increasing share of synthetic and bio methane is used in a broad variety of gas- and dual fuel-engines

- Excellent short-term measure
- Ongoing technology development to minimize methane slip for pre-mixed engines
- Highly mature technology
- Application to new ships and retrofitting of existing ships is possible
- Wide range of available dual fuel and gas engines
- LNG/LPG as a transition to synthetic-/bio-methane and all other low flashpoint fuels
Hydrogen and Hydrogen Admixture

- Adaptations to marine engine running on hydrogen is at an early development stage
- Max. 20 - 30% hydrogen admixture to LNG as a first development target
- LNG engines as transition technology to hydrogen
- Engines running with pure hydrogen are at an early research stage
- Technical challenges using hydrogen, e.g. a broad explosive range and impact on material
- Hydrogen needs to be liquefied in order to achieve comparable energy density
Methyl- / Ethyl-Alcohols (Methanol and Ethanol)

- Mature engine technology, derived from LNG-dual fuel engines
- Short-term availability
- Application to new ships and retrofitting of existing ships possible
- Moderate technical adaptations needed to ensure safe storage and use on board
- Requires adaptation of safety concepts due to physical and chemical properties
- Fuel feedstock needs consideration (land-use)
Ammonia

- Engine technology derived from LNG-dual fuel engines
- Ongoing development, engines anticipated to be available in a few years
- Application to new ships and retrofitting of existing ships is possible
- Moderate technical adaptations needed to ensure safe storage and use on board
- Requires adaptation of safety concepts due to toxicity
- Exhaust after treatment for NO\textsubscript{x} and N\textsubscript{2}O will be adapted when required

<table>
<thead>
<tr>
<th>Start</th>
<th>+1 year</th>
<th>+2 years</th>
<th>+3 years</th>
<th>+4 years</th>
<th>+5 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Study</td>
<td>Project Kick-off</td>
<td>1st engine test</td>
<td>Emission specification</td>
<td>Full Scale Engine test</td>
<td>1st engine delivery to yard</td>
</tr>
<tr>
<td>• NH\textsubscript{3} combustibility investigation</td>
<td>• Test engine received as platform for the Ammonia engine development</td>
<td>• 1st engine confirmation at R&amp;D facilities</td>
<td>• Specification of emission after-treatment systems done</td>
<td>• Ammonia engine in engine programme</td>
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<td>• Workshop on engine concept</td>
<td>• Engine basis concept defined based on engine tests</td>
<td>• Full scale engine test at R&amp;D facilities completed</td>
<td>• 1st ammonia burning engine to be installed at yard</td>
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Maritime Energy Transition – Prerequisites to make it happen

- Combustion engines combine an outstanding endurance with high energy density which is key as well for the use of future marine fuels.
- IMO MSC and CCC (Sub)Committees need to speed up development of the IGF-Code. More resources to be provided especially to CCC.
- Regulations have to be developed in a technology-neutral way under consideration of state-of-the-art risk assessments.
- GHG-intensity of fuels has to be considered in a well-to-wake approach.
- The future share of presented fuel options is at the time being unpredictable.
- Therefore, manufacturers are advancing the development of engine technology and systems for all presented fuel options.
- Sustainable production of marine fuels, reliable supply to ships to affordable prices is the challenge of the maritime energy transition.
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*For further question and comments pls contact the EUROMOT Secretariat under secretariat@euromot.eu*