Methanol as an alternative fuel for smaller marine vessels

Washington Methanol Policy Forum

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SSPA Your Maritime Solution Partner

Drivers for alternative fuels for shipping

- SOx emissions regulations: 0.1% in emission control areas (2015) and 0.5% globally by 2020 (IMO MEPC, October 2016)
- NOx Tier III regulations (2016) for emission control areas – new vessels
- Particulate Matter, Black Carbon emissions: of concern and subject of study at IMO
- CO_2 : EC's 2011 White Paper on transport: the EU's CO_2 emissions from maritime transport should be cut by **at least 40%** from 2005 levels by 2050
  - 1st Step: monitoring, reporting and verification of CO_2 emissions from ships calling EU ports by 1 Jan. 2018

Significant reduction of CO_2 from shipping requires a switch to low carbon fuel

Drivers for alternative fuels

Example of national / regional targets for vessels (not international shipping)

- Sweden: Long term goal to have zero net emissions of GHG by 2050
- Swedish Transport Administration (STA) Road Ferries: preliminary targets for CO_2 emissions as compared to 2015:
  - 15% reduction by 2020
  - 30% reduction by 2025

The STA owns 69 ferries operating on 41 routes in Sweden. 22 million passengers and the equivalent of 14.7 million cars were transported in 2014. Annual fuel use was 12.3 million litres of diesel fuel.

Smaller vessels – methanol fuel developments

- Designs and recommendations for adaptations of on-board systems for methanol operations on smaller vessels are being developed within the SUMMETH and GreenPilot Projects in Sweden
- Engine research as there are no engines commercially available for the smaller marine engine segment (up to 1200 kW range)

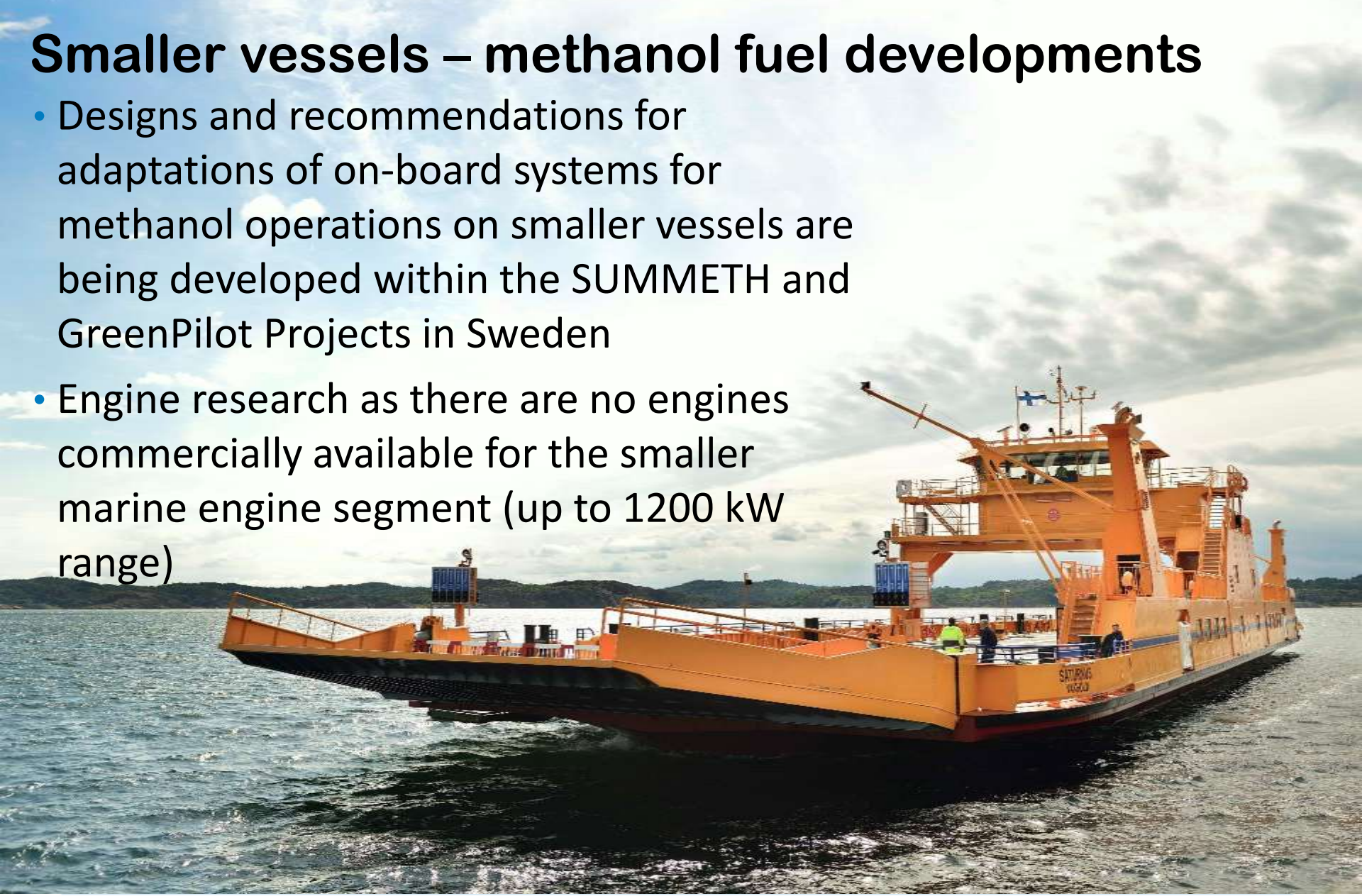

Photo: Truls Persson

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SUMMETH Project

- Overall aim is to contribute to a solution to reduce emissions and carbon footprint of smaller vessels
- Market study of smaller vessels in NW Europe
- Development work for smaller methanol marine engines
- Case study design for methanol conversion of a road ferry
- Renewable methanol supply chain investigation

Photo: Kasper Dudzik

PROJECT PARTNERS

TRAFIKVERKET SWEDISH TRANSPORT ADMINISTRATION · LUND UNIVERSITY · MARINE BENCHMARK · SCANIA · VTT · Swedish Maritime Technology Forum · SSPA Your Maritime Solution Partner · StandNAOS AB

SUMMETH project market analysis

- Focus is on vessels using main propulsion engines in the following size range:
  - 250 to 800 kW (covering marine engines that had an “automotive equivalent”)
  - 800 to 1200 kW – larger marine engines

- Uses AIS (Automatic Identification System) records to determine the number of ships using engines in the size range, together with modelling data. Total fuel use and emissions reduction potential to be estimated using operating hours.

Engine Testing: MD95 concept

Marine applications typically use diesel cycle engines. Methanol blends with several ignition improver candidates (MD95) were tested first at small-scale and then in a Scania engine designed for additive treated ethanol (ED95).

Solubility → Combustion chamber → Engine testing

Solubility of different components to methanol were studied with nine blends.

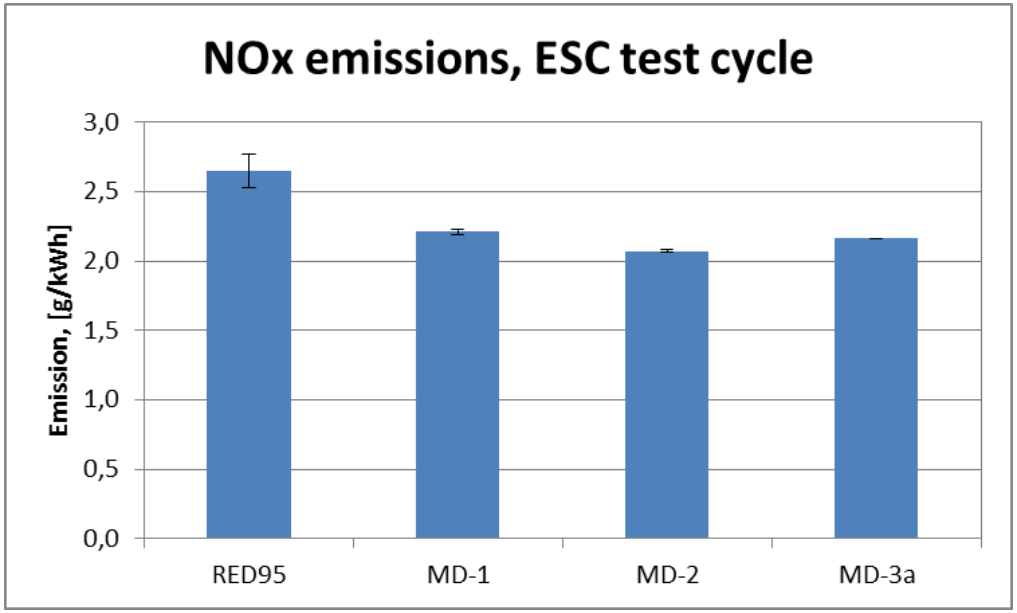
Results and photo from SUMMETH project partner VTT Technical Reeearch Centre of Finland, P. Aakko-Saksa

MD95 Blend: Preliminary results were promising

- **Combustion of MD95 was good**

- Lower NO_x, only slight differences in CO, HC and alcohol emissions when comparing MD95 with ED95. No significant formaldehyde emission for MD fuels. Semivolatile PM from some additive candidates.

- Promising concept for further development.



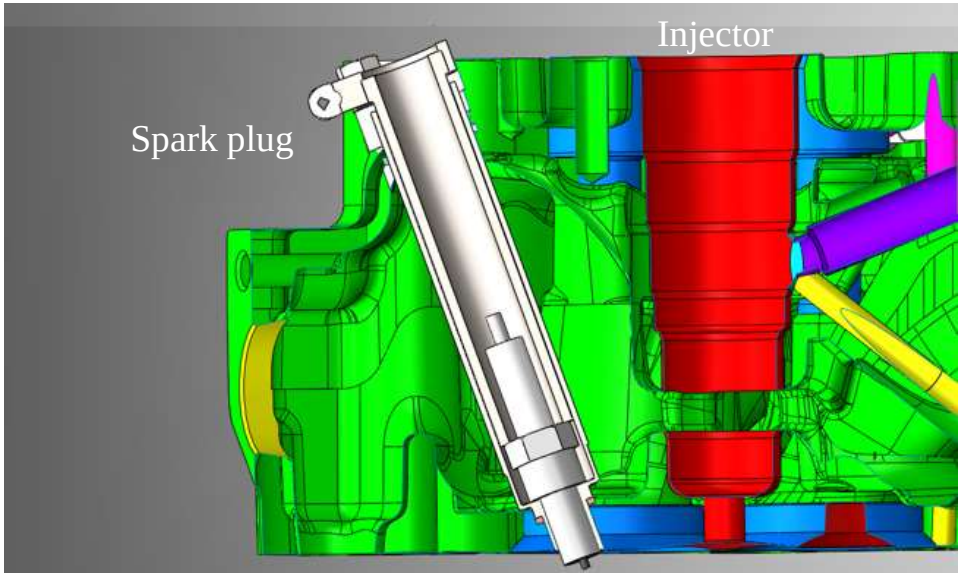
See also: Nylund, N.-O. et al. Testing of various fuel and additive options in a compression-ignited heavy-duty alcohol engine. 21st International Symposium on Alcohol Fuels, 10 - 14 March 2015, Gwangju, Republic of Korea. ISAF (2015), ISAF-0056

Results from SUMMETH project partner VTT Technical Research Centre of Finland, P. Aakko-Saksa

Engine Testing: Direct Injection Spark Ignition

- tests of direct injection spark ignition combustion of methanol were carried out in early 2017
- effects of spark timing, start of ignition, common rail pressure, and exhaust gas recirculation assessed
- indicated gross efficiencies of 54% were found to be possible with methanol
- further testing will focus on port ignition with a glow plug concept

Modified cylinder head



Results and figure from SUMMETH project partner Lund Technical University

Case study: Conversion of a Swedish Road Ferry to methanol operation

- M/S Jupiter road ferry – 86 metre length, capacity for 397 passengers and 60 cars
- Currently running on diesel fuel, bunkered by truck
- Developed a methanol conversion design with recommendations for fuel storage and supply, safety systems, and bunkering
- Cost comparison and emissions reduction to be compared to operation on diesel fuel

Conversion design developed by project partner ScandiNAOS

GreenPilot

- A pilot boat has been converted to methanol operation, showing how a methanol conversion of a smaller vessel can be carried and demonstrating the environmental benefits
- Operated 60 hours as of 20170607

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Summary

- Good potential for smaller vessels – small engine testing with methanol has shown good results with the different concepts tested
- Conversion of smaller vessels is feasible at a reasonable cost
- Availability of a commercial marine certified engine is important for smaller operators

- Important to ship operators to have the future potential to reduce CO_2 emissions – availability of sustainable methanol to meet future targets