LeanShips

A ‘Mobility for Growth’ European Innovation project call “Towards the energy-efficient and very low emission vessel”

Prof. Sebastian Verhelst, Ghent University, WP05 leader

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LeanShips ...

... aims to demonstrate the effectiveness and reliability of energy saving and emission reduction technologies at real scale.

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<th>Target markets ...</th>
<th>Eight demonstrators will be carried out ...</th>
<th>Main objectives ...</th>
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| ... are the small to midsized ships for intra-European waterborne transport, vessels for offshore operations and the leisure and cruise market. | ... combining technologies for improved efficiency and pollution reduction, in line with end-users’ needs and requirements. | ✓ CO₂ reduction of at least 25%  
✓ Estimated fuel saving of up to 25%  
✓ Expected decrease of SOₓ/NOₓ/PM air pollutants by up to 100% |

Coordinated by [Damen]
Examples of Demonstrator Cases

- Develop a large diameter propeller to improve the performance of the vessel propulsion system, reducing fuel consumption and emissions.
- Design and build a new generation ship handling tug with two LNG-fuelled engines.
- Develop a refit strategy for a fleet of general cargo vessels.
- Demonstrate a high-speed diesel engine converted to dual fuel operation (diesel/methanol).

Parallel development of demonstrators and their contribution to the project objectives, following the same harmonised innovation process.
LeanShips covers the entire energy chain

<table>
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<th>Demonstrator platforms</th>
<th>Technology cluster 1: Engines, fuels, drive trains</th>
<th>Technology cluster 2: Hull, propulsors</th>
<th>Technology cluster 3: Energy systems and emissions abatement technologies</th>
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<td>WP04: Tug</td>
<td><img src="image" alt="Internal combustion engines" /> XX</td>
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<td>WP05: SWATH/dredge</td>
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<td>WP06: LNG carrier</td>
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<td>WP07: General cargo ship</td>
<td><img src="image" alt="Storage device" /> XX</td>
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<td>WP08: Inland ship</td>
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<td><img src="image" alt="Electrical motor" /> X</td>
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<td>WP09: Ice going cargo ship</td>
<td><img src="image" alt="Fuels" /> X</td>
<td><img src="image" alt="Improved geometry" /> XX</td>
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<td>WP10: Cruise/Leisure</td>
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<tr>
<td>WP11: Cruise/Leisure</td>
<td><img src="image" alt="Fuels" /> X</td>
<td><img src="image" alt="Propulsors" /> XX</td>
<td><img src="image" alt="Energy management systems" /> XX</td>
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LeanShips’ mission:

Prove that:

a) green technology can be installed onboard (new and old - retrofit);

b) green technology works in maritime and is reliable

c) green technology can be economically viable

And can significantly contribute to the EU energy and emission policies by collaborating with:

a) ship equipment manufacturers;

b) ship builders;

c) ship operators;

d) classification societies;

e) research centres and universities
LeanShips’ stakeholders:

- System integrators / Shipyards
- Technology providers / Equipment manufacturers
- End-users / Ship owners

46 partners

80% from industry

€ 17 Mio.
EU funding

LeanShips

Low Energy And
Near to zero emissions Ships
LeanShips’ layered structure

The Guide to Innovation aims to create value beyond the sum of the eight DEMO cases, funnelling lessons learned, policy advice, etc. to the EU maritime community and rule makers...
WP 05

Demonstrating the potential of methanol as an alternative fuel
Background

IMO Tier III $\rightarrow$ major reduction in NO$_x$

- HFO: scrubber + SCR system
- LNG

Both add cost and are hard to implement/retrofit on smaller vessels
The case for methanol

• Available now
  • One of the most widely shipped chemicals in the world
  • Already present in most terminals

• Can be made from renewables (long-term)
  – Fits within long-term view of UGent on energy supply and transportation
    → keywords sustainable – scalable – energy-dense

• Currently produced from natural gas, but liquid at atmospheric conditions
  – Much easier to handle, distribute, store onboard, ...

• Great engine fuel!
Ghent University background

• Focus on sustainable, scalable (& liquid) fuels

• Experience with methanol since 2009
  – Converted (automotive) engines (SI&CI base, to SI operation) & measured potential (power-efficiency-emissions)
  – Developed modeling tools (engine cycle simulation)
  – 2 PhD’s, 9 MSc, 15 papers
Diesel-like peak BTE
Part load efficiency gains
up to 20%
(compared to throttled operation)

VW TDI → SI
CR 19.5:1
turbocharged + EGR

Vast engine-out
NOx reductions (ppm)
Diesel-like efficiencies
while using cheap aftertreatment systems
Ghent University background

• “Resistance” in automotive, willingness in marine industry
  – & cooperation with Anglo Belgian Corporation nv

• Demonstrators with medium-speed engines on methanol, using proprietary equipment

→ WP05 main objective: demonstrate universal methanol dual-fuel retrofit of high-speed diesel engine while maintaining 100% diesel capability
interest: smaller vessels, LNG alternative

interest: SWATH vessels, storage challenge

interest: dredgers, storage challenge

interest: marine engine supplier

interest: methanol producer and supplier
DUAL FUEL CONCEPT

DI of diesel  PFI of methanol

Adapted from Tutak et al.

VOLVO PENTA D7C-B TA

- 6 in-line cylinders
- 7.15 L
- CR = 17.6:1
- 265 hp @ 2300 rpm
- 904 Nm @ 1500 rpm
Additional objectives

- Map the engine’s potential on power, efficiency and emissions
  - & compare to original diesel operation
  - UGent testbench
- Use the data in an LCA calculation of using methanol as a fuel in shipping, for 2 cases:
  - SWATH (Small Waterplane Area Twin Hull)
  - TSHD (Trailing Suction Hopper Dredger)
- Provide concrete tools for the dissemination of methanol’s potential and its exploitation
  - Goal: market uptake
WP05 value chain vs. partners

- Research inst.
- Engine manuf.
- Shipyard
- Ship owner
- Engine retrofit
- Fuel supplier
- Fuel producer
- Class. society
- Fuel bulk storage
- …
Thank You
& Stay Tuned

Contact us at:
Mr. Pieter Huyskens,
LeanShips Project Manager,
E-mail: pieter.huyskens@damen.com
Website: www.leanships-project.eu

Contact us at:
Prof. Sebastian Verhelst,
LeanShips WP05 leader,
E-mail: sebastian.verhelst@UGent.be
Website: http://users.ugent.be/~sverhels/