Developments in the usage of LNG as fuel in inland waterway vessels

Bas Kelderman (SPB/EICB)
Content

• Expertise and Innovation Centre inland Barging
  - EICB and LNG projects
  - EICB Innovation Lab

• Breakthrough LNG deployment in Inland Waterway Transport
  - LNG developments
  - Background and scope of the project
  - Partners
  - Activities
EICB: Background

- Stichting Projecten Binnenvaart (Shipping Projects Bureau, 1996)
- Binnenvaart Convenant (IWT covenant, 2006):
  - Between (then) Ministry of Transport and Public Works (now Ministry of Infrastructure and the Environment) and Dutch IWT sector organisations
  - Stimulation of concrete innovation in IWT and the greening of IWT
  - Foundation of an expertise and innovation centre (→ Expertise and Innovation Centre inland Barging)
- Subsidy for Innovation in IWT (SIB)
  - Duration 2008-2011
  - Amongst the funded projects ‘Dual fuel (LNG) engine for inland navigation’ (MTS Argonon)
EICB and LNG

• EICB Innovation Lab:
  - Working group LNG

• Knowledge- and Expertise Centre LNG
  - Total Cost of Ownership model LNG

• Research sailing pattern of potential LNG-vessels

• PROMINENT:
  - LNG as alternative fuel

• European Inland Barging Innovation Platform:
  - Concerning ‘rapid uptake of alternative fuels’

• Dutch National LNG Platform
  - Board member
EICB Innovation Lab

Bringing together:
- Innovative suppliers;
- Early adopters;
- Representatives (ship-owning companies);
- Stakeholders;
  - ....

Facilitate:
- Meetings;
- Topics;
- Networking;
- Experts;
- Statistics;
- Analyses;
- Standards;
- Requirements;
  - ....

Develop:
- Proven technology;
- Standard components;
- Standard configurations/designs;
- Process;
- Specifications;
  - ....

Demonstrate:
- Pilot projects;
- Demonstration models;
- Information;
  - ....

Eliminate resistance:
- Knowledge;
- Legislation;
- Financing;
  - ....
EICB Innovation Lab

Greening of 4100 engines

- 300 LNG
- 2500 SCR/DPF
- 900 Low power
- 400 Alternative
- 600 Hybrid
- 300 Rightsizing
EICB Innovation Lab

Project Partners
- Expertise- en InnovatieCentrum
- Binnenvaart
- Havenbedrijf Rotterdam
- HDM Sustainable Solutions
- Hug Engineering
- Inspectie Leefomgeving en Transport
- Koedood Dieselservice
- MS Anda
- MTU Benelux
- Multronic
- NPRC

Pon Power
- Scheepvaartonderneming Verkade
- Solfic
- Teus Vlot Diesel Marine
- TriFleet Leasing BV
- Vereniging Importeurs van Verbrandingsmotoren
- Vidol Marine
- Volvo Penta
- Wärtsilä Netherlands

Aspirant members
- Hybrid Ship Propulsion
- Veth Propulsion
- DCL
European Inland Barging Innovation Platform (EIBIP)

• Promote the uptake of innovation by the IWT sector, by:
  - Identifying and addressing barriers to the market transfer of innovation, covering technological, organisational and financing aspects;
  - Conducting promotion and awareness campaigns, and business cases.
  - Facilitated by a European Platform of existing and new Innovation Centres.

• 3 Innovation Centres:
  - INDanube (Danube region, managed by Pro Danube)
  - D-ZIB (Germany, managed by MARIKO)
  - BATELIA (France, managed by VNF)

• www.eibip.eu
Research of sailing pattern potential LNG vessels

Research performed for Dutch Ministry of Infrastructure and the Environment

Tracked ±300 Dutch inland vessels with an annual fuel consumption of ≥500 m²
Current LNG vessels
Development in bunkering
Legislative developments

- CESNI: European standard laying down technical requirements for inland navigation vessels (ES-TRIN)
- New (Stage V) emission limits and type-approval for internal combustion engines for non-road mobile machinery
## EU NRMM Stage V

<table>
<thead>
<tr>
<th>Power range</th>
<th>CO</th>
<th>HC</th>
<th>NOx</th>
<th>PM mass</th>
<th>PN</th>
<th>A</th>
<th>Mandatory date of application of this Regulation for engines</th>
</tr>
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<tr>
<td>kW</td>
<td>g/kWh</td>
<td>g/kWh</td>
<td>g/kWh</td>
<td>g/kWh</td>
<td>#/kWh</td>
<td></td>
<td>EU type- approval of engines</td>
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<tr>
<td>19≤P&lt;75</td>
<td>5</td>
<td>(HC+NOx≤4.70)</td>
<td>0.3</td>
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<td>6</td>
<td>1 January 2018</td>
<td>1 January 2019</td>
</tr>
<tr>
<td>75≤P&lt;130</td>
<td>5</td>
<td>(HC+NOx≤5.40)</td>
<td>0.14</td>
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<td>6</td>
<td>1 January 2019</td>
<td>1 January 2020</td>
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<td>130≤P&lt;300</td>
<td>3.5</td>
<td>1</td>
<td>2.1</td>
<td>0.1</td>
<td>-</td>
<td>6</td>
<td>1 January 2019</td>
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<tr>
<td>P≥300</td>
<td>3.5</td>
<td>0.19</td>
<td>1.8</td>
<td>0.015</td>
<td>1x10¹²</td>
<td>6</td>
<td>1 January 2019</td>
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</tbody>
</table>

For gas engines:
HC = 0.19 + (1.5*A*Gas Energy Ratio)
Max.: HC = A + 0.19 = 6.19 g/kWh
Breakthrough LNG deployment in Inland Waterway Transport

Contributing to the implementation of the TEN-T Network:

Core network
Horizontal priority: New technologies & innovations

Location of the action:
The Netherlands, Germany and Belgium

Duration of the action:
01/01/2016 - 31/12/2018

Mission:
Reducing investment barriers for ship-owning companies targeting a large-scale implementation of LNG in IWT
Forcing breakthrough in the LNG market
Partners involved

Stichting Projecten Binnenvaart / Expertise- en InnovatieCentrum Binnenvaart (SPB/EICB) (Coordinator)

ENGIE LNG Solutions BV
Scheepswerf Gebr. Kooiman BV
Pon Power BV
Trifleet Leasing B.V.
Koedood Dieselservice BV
Dolderman BV
Pitpoint BV
Cryonorm Systems B.V.
Wärtsilä Netherlands B.V.
Activities

• Activities:
  - Study concerning standardisation and type approval of the most common used components and configurations, resulting in an absolute reduction of the investment costs;
  - Application of innovative financial constructions in the business client relationship to avoid the need of capital investments by ship owners and safeguard the benefits for the operator by securing a fixed price gap between diesel and LNG;
  - Elaboration of robust business cases
  - Identification of the best locations for LNG bunker stations

• Pilots:
  - 6 LNG-vessels
  - 4 LNG-bunker stations
## Activities

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<td>2</td>
<td>Pilot deployment: equipping 6 representative vessels with LNG fuelling technology</td>
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<td>3</td>
<td>Study on innovative financial constructions in the business-client relation for LNG vessel retrofitting</td>
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<td>5</td>
<td>Study into best locations for LNG bunkering stations</td>
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<td>6</td>
<td>Pilot deployment study of four LNG bunkering stations</td>
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<td>Project management, evaluation of results and dissemination</td>
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1. Study regarding standardisation and type approval

- Execution of ex-ante cost/benefit analyses for the best available LNG technologies for vessels
- Development of standardised components for best available LNG technologies
- Defining a total configuration of a vessel-bunker station solution
- Adoption of the standard configuration by the competent authorities
- Specification of pilot test settings
2. Pilot deployment: equipping 6 representative vessels with LNG fuelling technology

- Equip 6 vessels with an LNG installation
- Pilot test
- Evaluate the results of the pilot test and write report
3. Study on innovative financial constructions in the business-client-relation for LNG vessel retrofitting

- Study on financial lease of exchangeable fuel tank containers
- Pilot study on proposed solution for the Capex/Opex paradox
4. Business case calculations

• Analysis of the potential and sailing profiles of LNG using vessels in Europe
• Development of total cost-of-ownership model and financing constructions
• Stakeholder consultation and market research
6. Pilot deployment study of four LNG bunkering stations

- Within Activity 5. Study into best locations for LNG bunkering stations
- Analysis of the potential and sailing profiles of LNG using vessels in Europe
- Development of total cost-of-ownership model and financing constructions
- Stakeholder consultation and market research
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