Cost and benefits of using alternative fuels

Joint study of DNV GL and MAN Diesel & Turbo

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**Introduction**

<table>
<thead>
<tr>
<th>Variant</th>
<th>ECA fuel</th>
<th>Non-ECA, 2018-2019</th>
<th>Non-ECA, 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>MGO</td>
<td>HFO</td>
<td>LSFO 0.5%</td>
</tr>
<tr>
<td>LNG</td>
<td>LNG</td>
<td>LNG</td>
<td>LNG</td>
</tr>
<tr>
<td>LPG</td>
<td>LPG</td>
<td>LPG</td>
<td>LPG</td>
</tr>
<tr>
<td>Methanol</td>
<td>Methanol</td>
<td>Methanol</td>
<td>Methanol</td>
</tr>
<tr>
<td>LNG/HFO</td>
<td>LNG</td>
<td>HFO</td>
<td>LSFO 0.5%</td>
</tr>
<tr>
<td>LPG/HFO</td>
<td>LPG</td>
<td>HFO</td>
<td>LSFO 0.5%</td>
</tr>
<tr>
<td>Methanol/HFO</td>
<td>Methanol</td>
<td>HFO</td>
<td>LSFO 0.5%</td>
</tr>
<tr>
<td>ULSFO 0.1%</td>
<td>ULSFO 0.1%</td>
<td>ULSFO 0.1%</td>
<td>ULSFO 0.1%</td>
</tr>
</tbody>
</table>

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Application – LR1 tanker (75,000 d.w.t.)

- Engine upgrades
- Fuel supply system
- Fuel storage
- Engineering and installation

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**Application – trading route**

<table>
<thead>
<tr>
<th>Leg</th>
<th>State</th>
<th>Total distance (nm)</th>
<th>Approach (h/leg)</th>
<th>Port (h/leg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Houston – Rotterdam</td>
<td>Cargo (diesel)</td>
<td>5,052</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>Rotterdam – Ventspils</td>
<td>Ballast</td>
<td>961</td>
<td>10</td>
<td>36</td>
</tr>
<tr>
<td>Ventspils – Houston</td>
<td>Cargo (MGO)</td>
<td>5,670</td>
<td>10</td>
<td>36</td>
</tr>
</tbody>
</table>

**Power (MW)**

- **Port (10%)**
- **Approach (3%)**
- **Transit (87%)**
Fuel prices – historic data

Europe vs. USA

- HFO and Methanol: same price
- LNG and LPG cheaper in USA
- MGO slightly cheaper in Europe

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Fuel price scenarios

- High price scenario based on mid 2014 prices
- For LNG and LPG distribution costs are added
Fuel price scenarios

- High price scenario based on mid 2014 prices
- For LNG and LPG distribution costs are added
- Low price scenario based on mid 2015 prices
- Less price reduction for methanol and LNG

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Annual cashflow for single-fuel variants

- LNG and LPG generate a positive cashflow after the investment
- Methanol and ULSFO not financially attractive
Annual cashflow for combined variants

- Combined variants are not affected by global sulfur cap

- A global sulfur cap favours the single-fuel variants

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Payback time for LNG and LPG

- Payback time is faster for single-fuel variants
- Payback time is faster by increased speed
- Payback time is faster in the high price scenarios
- LPG is at least comparable to LNG
  - Shorter payback
  - Less sensitive to price scenario
  - Less investments

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Payback time as a function of fuel-price spread

- For most of the period 0.5% S fuel (LSFO) is the relevant comparison
- LNG requires a larger discount than LPG
- Single fuel variants (LNG or LPG) are better than to use the alternative fuel only in the ECA
- Methanol: Requires ~18% discount on MGO to be comparable to LNG

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Conclusions

- Regulations call for alternative fuels as a means of compliance.
- Costs and benefits for various fuels (LNG, LPG, methanol, ULSFO) were investigated.
- LNG and LPG were found to be the most promising options.
- For the most promising alternative fuels, the best option is to use the fuel both in ECAs and non-ECAs.
- Financial attractiveness is highly dependent on fuel price scenario.
Payback time (months) vs. Specific cost LNG tank system ($/m$^3$) for LNG and LNG/HFO fuels. The graph shows a linear relationship, with payback time increasing as the specific cost increases. DNV-GL and MAN Diesel & Turbo joint study - Cost and benefits of using alternative fuels.
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