Reducing air pollutant emissions of inland waterway transport in Europe

Technical Assistance for the impact assessments to reduce emissions of inland waterway transport

Strasbourg, 8 October 2013,
Roundtable Greening IWT, CCNR

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Contents

• Introduction

• Technologies to reduce emissions

• Options for new emission limits

• Evaluation of policy options

• Next steps
Study to support the Impact Assessment

- Technical assistance provided under the Marco Polo accompanying measure by a consortium consisting of Panteia/NEA (lead), EICB, Planco, via donau and CCNR.

- Study started in October 2012 and was finalised in June 2013

- 5 meetings during September 2012 and March 2013 with the Common Expert Group with representatives from European Commission, Member States, international organisations, associations and individual companies

- Reference studies:
  - IA report on revision of 97/68/EC by TML and Arcadis (2009)
  - Medium and Long Term perspectives of IWT in the EU (2012)
  - PLATINA (2008-2012)
Sense of urgency

Despite the economies of scale of IWT, the external costs of air pollutant emissions of IWT is higher than road haulage and the gap is increasing quickly.

Underlying drivers:

- Compulsory emission standards in IWT are lagging behind
- Small size of the market for engines in IWT
- Long service time of engines in IWT
- Lack of incentives for vessel operators/owners
Emission standards in IWT lagging behind

Limit value NOx:
IWT: 6.0 gram/kWh
Road: 0.4 gram/kWh
=> Factor 15 difference

Limit value PM:
IWT: 0.2 gram per kWh
Road: 0.01 gram per kWh
=> Factor 20 difference
Evolution of external cost of air pollutant emissions in euro per 1,000 tonkm, based on Marco Polo external cost calculator for business as usual scenario (BAU)

Gap in 2030: 87%, factor 6.7 more external costs
EC policy goal: close gap of air pollutant emissions external costs by the year 2030

Potential technical measures

Policy option framework that accounts for:
- new/existing vessels and engines
- small/medium/large vessels
- power range

Emission performance stages

Within a potential policy option, allocate:
- emission limits, timing and scope

Select technical measures needed
Requirements are:
- Achievable and realistic
- Minimal operational costs

If policy objective is met

Select policy option for in-depth analysis
Main technical measures to reduce emissions in IWT

- **SCR** to reduce NOx according to REC principles, reduction -80%:
  - 6 gram NOx per kWh engine out → 1.2 gram NOx per kWh exhaust
  - 9 gram NOx per kWh engine out → 1.8 gram NOx per kWh exhaust

- **DPF** to reduce PM according to REC principles, reduction -90%:
  - 0.3 gram PM per kWh engine out → 0.03 gram PM per kWh exhaust
  - 0.2 gram PM per kWh engine out → 0.02 gram PM per kWh exhaust

- **LNG Dual Fuel** to reduce NOx and PM
  - Expected to reach 1.8 gram NOx and 0.04 gram PM per kWh

- Others: Fuel Water Emulsion, Hydrogen injection, Gas or Diesel-electric configurations (monofuel LNG), Methanol
Focus on largest vessels to reduce external costs:

- Push Boats >2000 kW, 3264 kW, 5%
- Push Boats 1000-2000 kW, 1331 kW, 3%
- 135m, 5600t, 2097 kW, 26%
- 55*6.6m, 550t, 274 kW, 1%
- 85*9.5m, 1540t, 737 kW, 7%
- 85*8.2m, 1260t, 547 kW, 5%
- 67*8.2m, 913t, 447 kW, 2%
- 85*9.5m, 1540t, 737 kW, 7%
- 110m, 2750t, 1178 kW, 48%
Identified emission stages

New engines
- Stage 5
- Stage 4B
- Stage 3B

Adapt existing engines according to REC
- Stage 4A

Existing engines
- Stage 3A / CCNR 2
- CCNR I
- Unregulated
Emission stages and limit values for NOx and PM
New engines

Stage 3B (IMO Tier 3, EPA Tier 4)
- SCR
- SCR + DPF

Stage 4B
- LNG DF + SCR + DPF
  (or monofuel LNG + SCR + (DPF?))

Stage 5
- SCR + DPF + ...
  * cEGR
  * internal engine upgrades
  * FWE
  * Hydrogen injection
  * diesel-electric
  * multiple engines

Stage 3A / CCNR 2 (BAU)
Existing engines
Stage 4A according to REC:
-80% NOx,
-90% PM

Stage 3B
(IMO Tier 3, EPA Tier 4)

Existing engine <350 mg/kWh PM engine out

Stage Stage 3A / CCNR 2

Stage CCNR 1

Stage <CCNR 1 (unregulated)

SCR + DPF

DPF

LNG DF + SCR + DPF

FWE or Hydrogen injection + SCR + DPF

Stage 4A

Existing engine >350 mg PM engine out
Main variation in options

- **Leadtime** needed to develop **stage 5** performance for LNG and diesel
  - Introduction by the year **2022**: Option 1
  - Introduction by the year **2020**: Options 2 and 3

- Technical and financial challenges for **smaller vessels** to install SCR and DPF on the **existing engines**:
  - No exemptions: Option 1
  - Exempt class up to 55 metres, 304 kW installed power: Option 2
  - Exempt class up to 38 metres, 220 kW installed power: Option 3
## Policy options for main propulsion engines

| New Engines: | Option 1  
Maximised time to develop Stage 5 engine combined with level playing field | Option 2  
Optimised cost effectiveness | Option 3  
Mix between cost effectiveness and level playing field |
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<tr>
<td>75 ≤ P ≤ 220 kW</td>
<td>L ≤ 38</td>
<td>4B by 2017</td>
<td>3B by 2017</td>
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<tr>
<td>220 &lt; P ≤ 304 kW</td>
<td>38 &lt; L ≤ 55</td>
<td>4B by 2017</td>
<td>3B by 2017</td>
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<td>304 &lt; P &lt; 981 kW</td>
<td>55 &lt; L &lt; 110</td>
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<tr>
<td>P ≥ 981 kW</td>
<td>L ≥ 110</td>
<td>4B by 2017, 5 by 2022</td>
<td>4B by 2017, 5 by 2020</td>
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<th>Existing engines:</th>
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<td>75 ≤ P ≤ 220 kW</td>
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<td>38 &lt; L ≤ 55</td>
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<tr>
<td>P &gt; 304 kW</td>
<td>L &gt; 55</td>
<td>4A between 2017-2027</td>
<td>4A between 2017-2027</td>
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Effectiveness: external costs of air pollutants, in euro per 1000 tonkm, Marco Polo external cost calculator values

- ROAD BAU
- IWT BAU

Alternative Baseline: IWT Stage 3B New engines only >2017
- Option 1: IWT L Stage 5 New 2022 + SML 4B New & Retrofit 4A 2017-2027 (maximised time to develop Stage 5 engine)
- Option 2: IWT L Stage 5 New 2020 + ML 4B New & Retrofit 4A 2017-2027 + S 3B New only (optimised cost effectiveness)
- Option 3: IWT L Stage 5 New 2020 + ML 4B New & 4A Retrofit 2017-2027 + S 3B New only <38 m (mix)
- Option 2b: IWT: as option 2 but IWT new engines only (NRMM), no retrofit existing engines
LNG application for larger freight vessels

Cumulative discounted cash flows for 110 metre vessel length (1178 kW), semi-continuous operation, for the relevant emission standards/technology
Overview of main CBA results freight vessels:
net present value for period until year 2050

Alternative Baseline - Stage 3B New engines only
OPTION 1 - Maximised time for development Stage 5 large vessels
OPTION 2 - Optimised cost effectiveness
OPTION 3 - Mix of cost effectiveness and level playing field

NPV Total costs IWT  NPV Investments by IWT  NPV Savings on external costs  NPV Net impact for society
## CBA results: new and existing engines

**Option 2: Optimised cost effectiveness, breakdown new engines and existing engines**

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<tr>
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<th>Part A New engines (NRMM)</th>
<th>Part B Existing engines</th>
<th>Part A+B Total impact</th>
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<tbody>
<tr>
<td>Reduction of external costs</td>
<td>€ 19,943 m</td>
<td>€ 3,290 m</td>
<td>€ 23,233 m</td>
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<td>Relative saving compared to BAU</td>
<td>38.7%</td>
<td>6.4%</td>
<td>45.1%</td>
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<td>Impact for IWT industry</td>
<td>-€ 278 m</td>
<td>-€ 214 m</td>
<td>-€ 492 m</td>
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<td>Net impact for society</td>
<td>€ 19,665 m</td>
<td>€ 3,076 m</td>
<td>€ 22,741 m</td>
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<td>Investment costs for IWT Industry</td>
<td>€ 1,681 m</td>
<td>€ 254 m</td>
<td>€ 1,935 m</td>
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<td>Benefit/ cost ratio</td>
<td>70.6</td>
<td>14.4</td>
<td>46.2</td>
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<td>Benefit / investment ratio</td>
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<td><strong>MULTI CRITERIA SCORES</strong></td>
<td><strong>Option 1</strong></td>
<td><strong>Option 2</strong></td>
<td><strong>Option 3</strong></td>
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<td><strong>Technical feasibility</strong></td>
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<td>new engines stage 5 introduction</td>
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<td>retrofit existing engines</td>
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<td><strong>Effective?</strong></td>
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<td>yes</td>
<td>yes</td>
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<td><strong>Additional environmental effects</strong></td>
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<td>PM/NOx reduction</td>
<td>+++</td>
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<tr>
<td>CO2 reduction</td>
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<tr>
<td>PN/HC/CO reduction</td>
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<tr>
<td>CH4 reduction</td>
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<td><strong>Efficiency</strong></td>
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<td>Benefit/investment ratio</td>
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<td>Benefit/cost ratio</td>
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<td><strong>Financing feasibility</strong></td>
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<td><strong>Labour market effects</strong></td>
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<td><strong>Side effects</strong></td>
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<td>Level playing field vessel classes</td>
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<td>Level playing field existing/new engines</td>
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<td>Level playing field IWT vs road</td>
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<td>Stimulation of new investments</td>
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<td>Modal shift towards IWT</td>
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<td><strong>Legal issues</strong></td>
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<td>LNG development before 2017</td>
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<td>Retrofit existing engines before 2017</td>
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<td>Certification and enforcement efforts</td>
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<td>Reduction of administrative burden</td>
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Next steps

• Development of financing instruments to overcome investment barriers

• Need to strengthen R&D:
  • LNG technology and the actual emission performance (NOx, PM, CH4)
  • Low cost retrofit modules for SCR + DPF
  • Stage 5 diesel based engine and further research on other techniques (FEW, hydrogen, …)
Next steps

• Legal framework

  • New engines: revision of Directive 97/68/EC on emissions from non-road mobile machinery engines

  • Existing engines: include procedure and requirements in Directive 2006/87/EC on technical requirements for inland waterway vessels regarding after treatment systems

• LNG

  • Safe use of LNG in vessels (2006/87/EC, 2008/68/EC)
  • Safe bunkering and deployment of bunkering stations

• Procedure on exemptions for existing vessels / engines

• Training and education
Thank you for your attention

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