

# Workshop: Can EURO VI engines solve Stage V NRMM requirements?

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## **COMPARISON OF EURO VI AND STAGE V REQUIREMENTS**

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# CONTENTS

Introduction

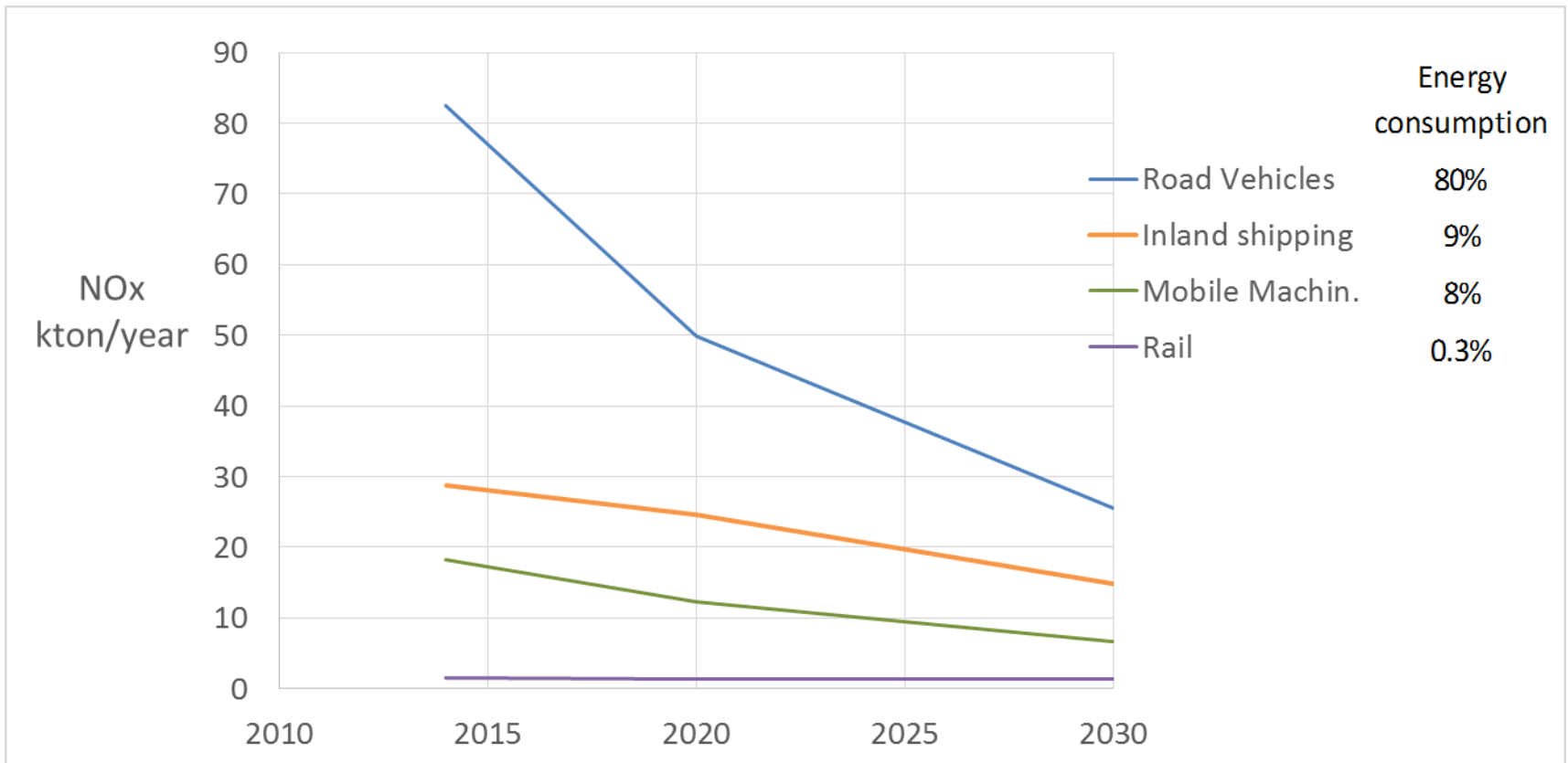
Emission requirements

Test procedures

Conclusions

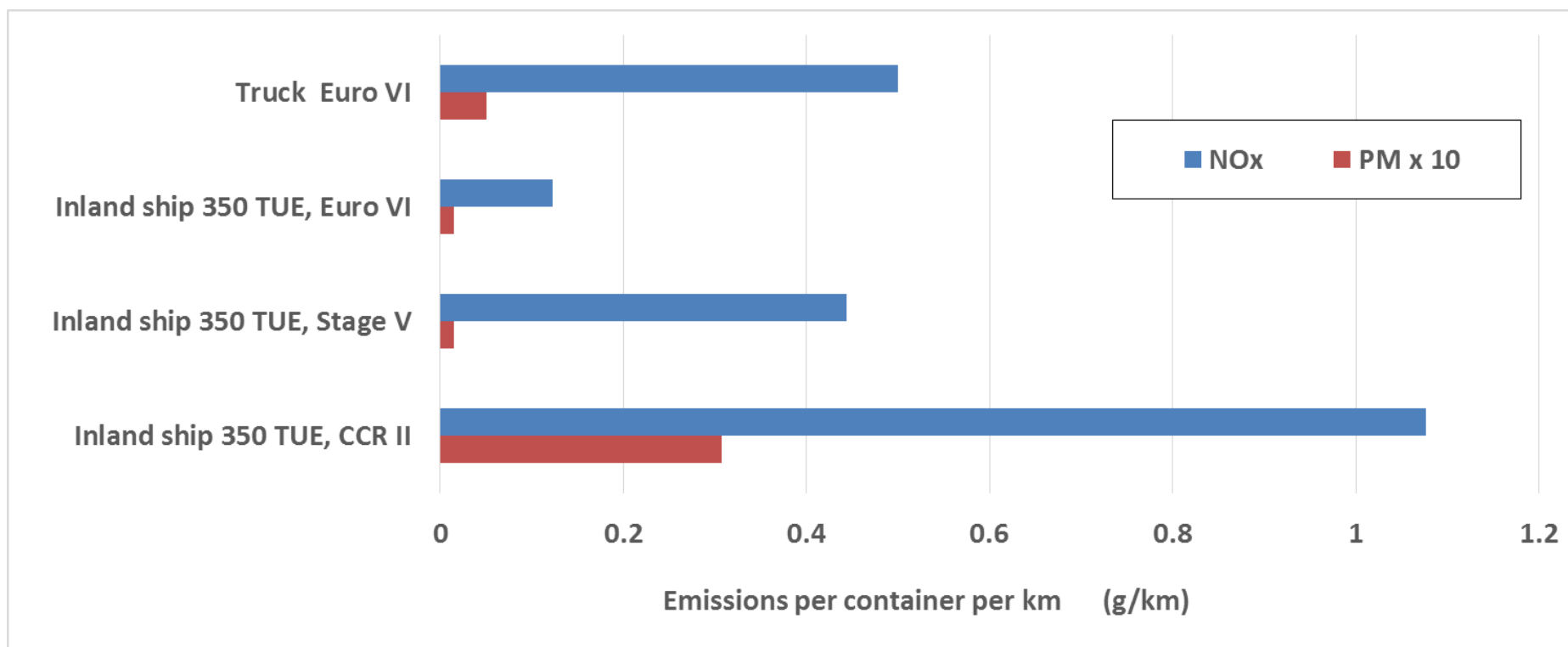
# COMPARISON MODALITIES

## NOx emissions per year in The Netherlands



# COMPARISON MODALITIES

## Emissions per container per km



# CONTENTS

Introduction

Emission requirements

Test procedures

Conclusions

# EMISSION REQUIREMENTS EURO VI AND STAGE V

HD vehicles

<i>P</i> [kW]	<i>cycle</i>	<i>NOx</i> [g/kWh]	<i>PM</i> [g/kWh]	<i>PN</i> [#/kWh]	<i>Date</i>
Euro VI	WHTC	0.46	0.01	6x10 <sup>11</sup>	2013
Euro VI	WHSC	0.40	0.01	8x10 <sup>11</sup>	2013
Euro V	ESC	1.8	0.02	-	2008

Stage V - EU 2016/1628 - IWP

<i>P</i> [kW]	<i>NOx</i> [g/kWh]	<i>PM</i> [g/kWh]	<i>PN</i> [#/kWh]	<i>Date</i>
19 ≤ P < 75	4.7*	0.30	-	2019
75 ≤ P < 130	5.4*	0.14	-	
130 ≤ P < 300	2.1	0.10	-	
P ≥ 300	1.8	0.015	1x10 <sup>12</sup>	2020

\* NOx + HC

# ELEMENTS OF TYPE APPROVAL

Element	Description
Laboratory test: <ul style="list-style-type: none"> <li>• Test cycle(s)</li> <li>• Off-cycle</li> </ul>	Parent engine emission test: <ul style="list-style-type: none"> <li>• Weighted average during a cycle</li> <li>• Random points lower than limit value (NTE)</li> </ul>
ISC - In-Service Conformity	Test on the road (waterway)
EDP	Emissions Durability Period
OBD On Board Diagnostics  Anti-tampering	Emissions too high: <ul style="list-style-type: none"> <li>• Operator warning</li> <li>• Record each event</li> <li>• Possible power reduction</li> </ul>
Ambient conditions	Range of operational conditions in which requirements need to be fulfilled
CoP	Conformity of Production

# ELEMENTS OF TYPE APPROVAL

<i>Element</i>	<i>Euro VI - EC 595/2009</i>	<i>Stage V 2016/1628 Ship</i>
Laboratory test: Test cycle(s) Off-cycle	WHSC-WHTC 15 points (in 3 grids)	E3, E2, D2 1 or 2 random points?
In-Service Conformity	RDE: Road trip with PEMS	Monitoring requirement
Emissions Durability (EDP)	700.000 km	10.000 hrs
OBD	NCD-PCD	NCD-PCD
Anti-tampering / Inducement	Power reduction 2 steps	No requirements (yet)
Ambient conditions	-7 to +38 °C (PEMS) Up to 1500m	+2 to +30°C Up to 500m altitude



# CONTENTS

Introduction

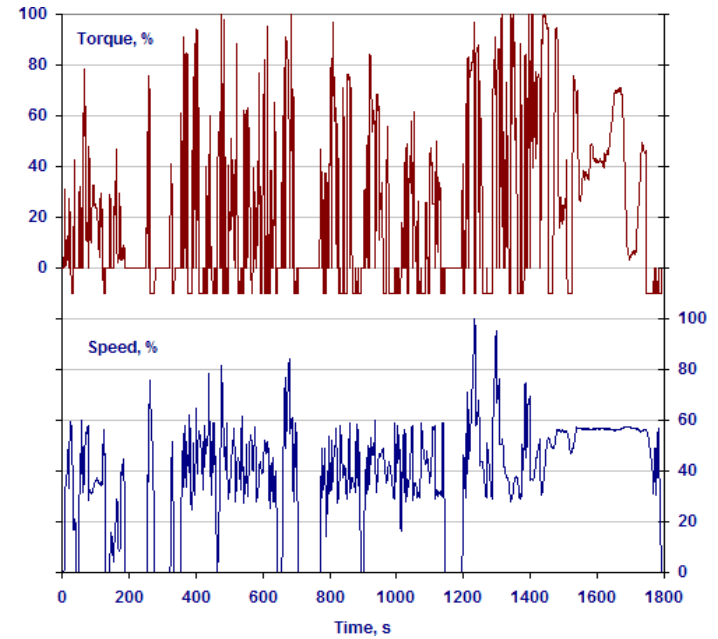
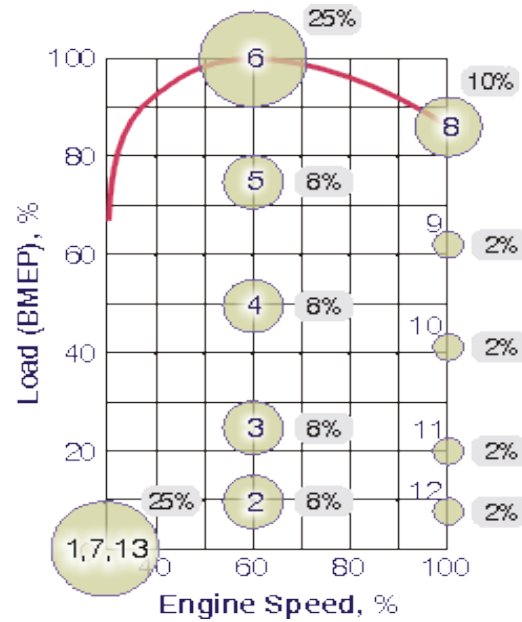
Emission requirements

Test procedures

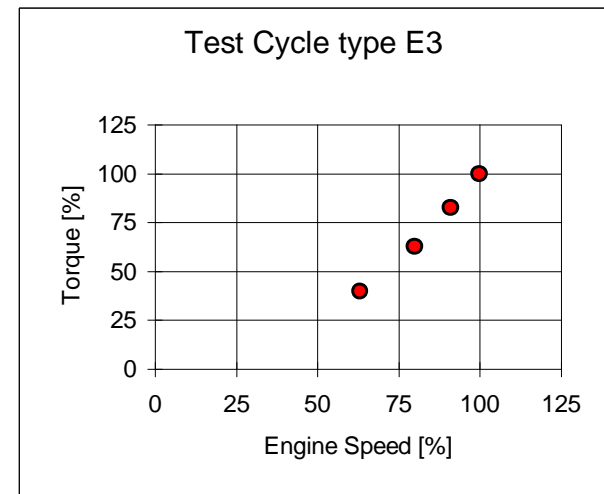
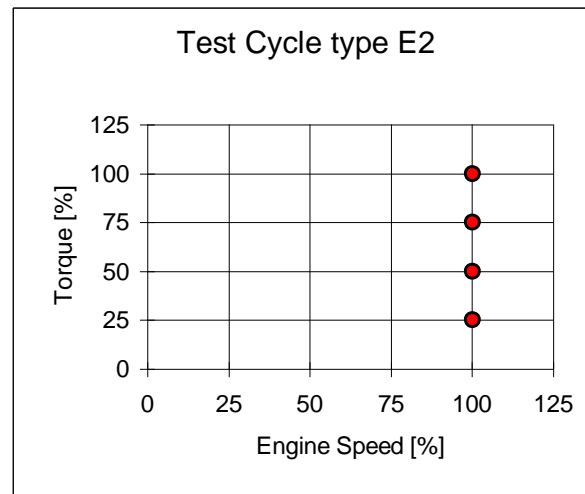
Conclusions

# TEST CYCLES

Euro VI  
WHSC – WHTC



Stage V  
Ship  
E2 – E3

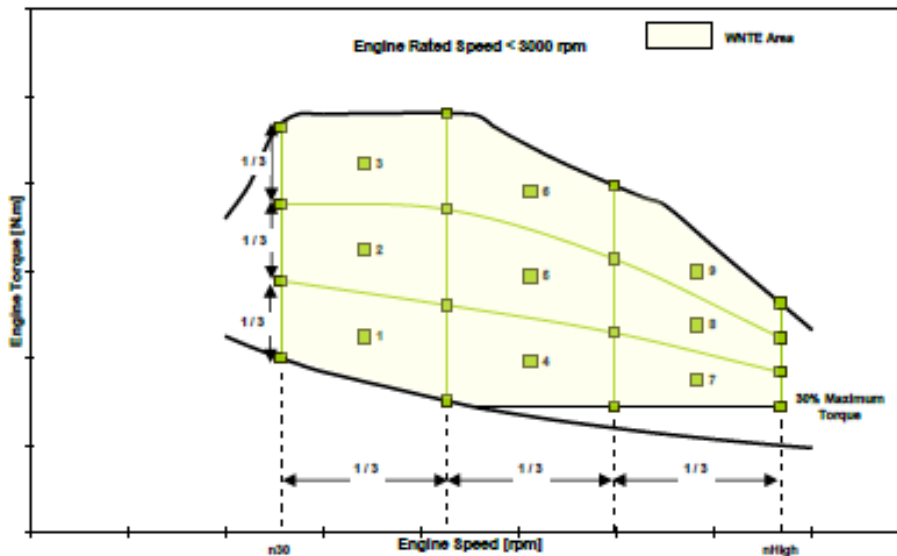


# OFF-CYCLE-EMISSIONS (OCE)

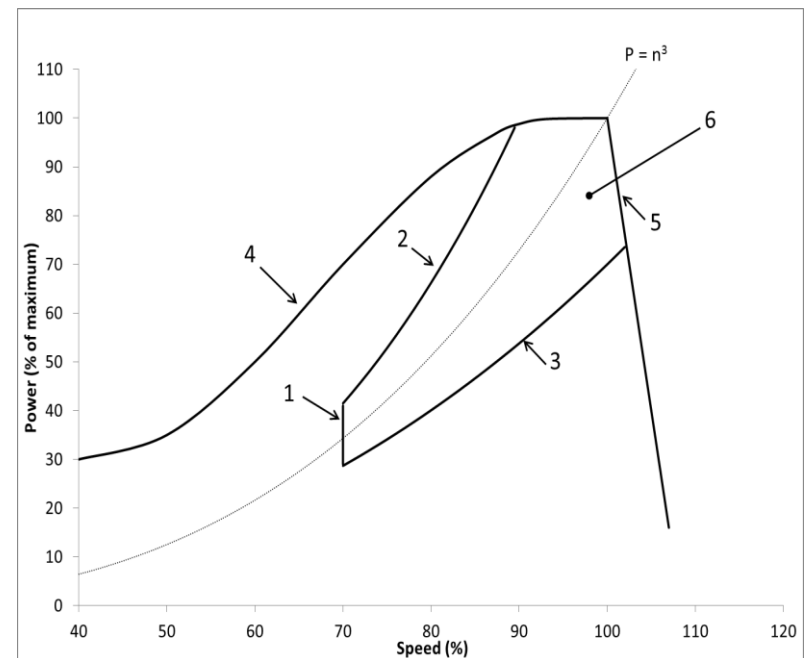
## Emission control areas

### Euro VI

WNTe test cycle grids



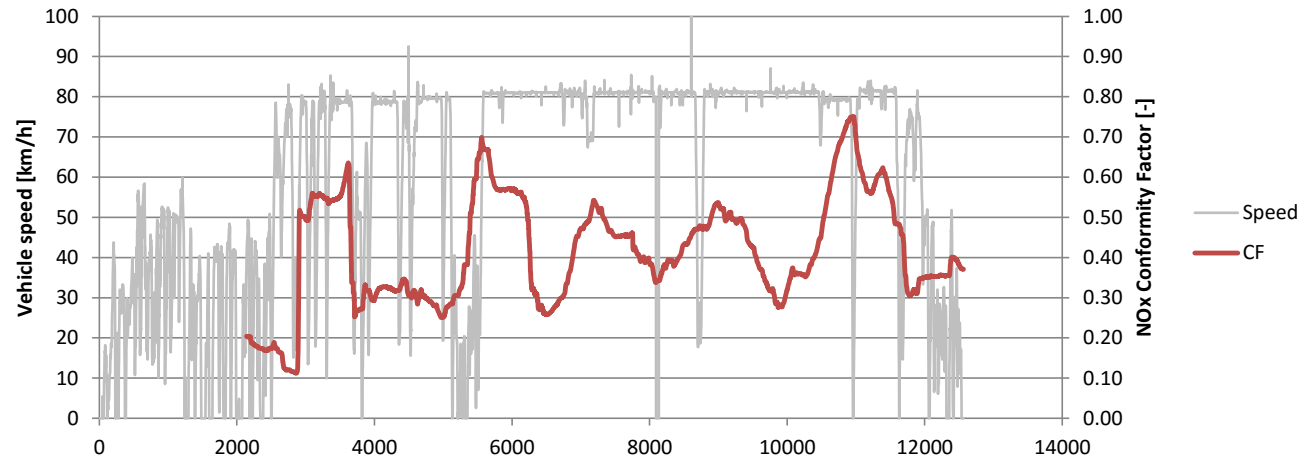
### Proposal for NRMM Stage V (IWP)



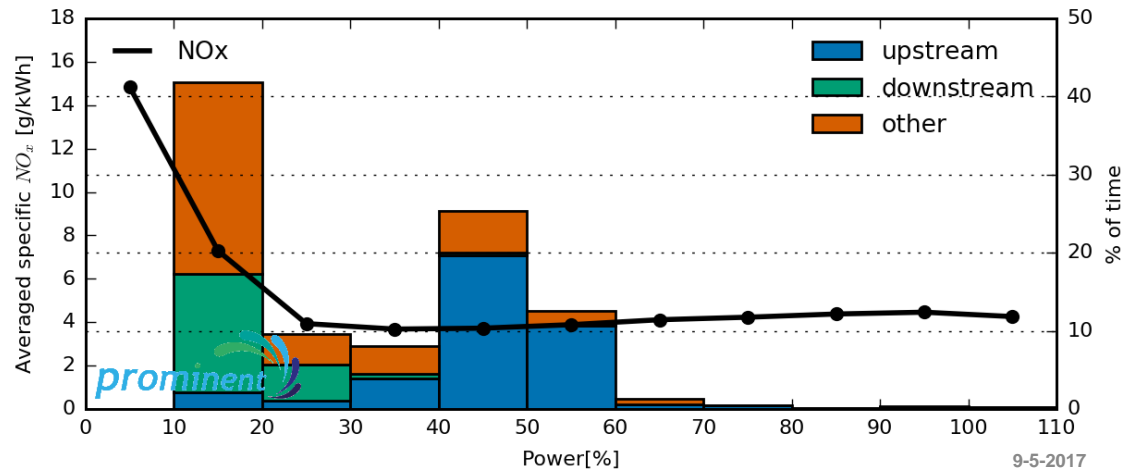
Source: Discussion paper draft concept  
delegated act NRMM V1.1, date 23 March 2016

# EXAMPLES REAL-WORLD EMISSIONS MEASUREMENT

ISC - Euro VI  
RDE - PEMS



On board monitoring  
PROMINENT

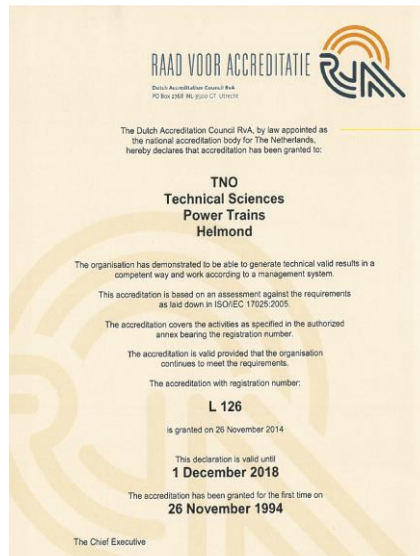


# POWERTRAIN TEST CENTRE



## QUALITY ACCREDITATION

- **Powertrain Test Centre is ISO 14001 accredited since 2004**
- **Powertrain Test Centre is ISO 17025 accredited since 1994**
  - **Type of activity:**
    - 13-Mode (R49, 88/77/EC)
    - ELR & ESC & ETC (R49, 2005/55/EC, 2005/78/EC)
    - WHSC & WHTC (R49, 582/2011/EC)
    - PEMS (R49, 582/2011/EC)
    - NRSC, NRTC (R96, 2004/26/EC)
    - Power (R85, R120, 80/1269/EC)
    - Smoke (R24, 72/306/EC)
  - **Type Approval Authority:**
    - Heavy Duty: RDW, VCA ( UK National Programs)
    - Non Road Mobile: RDW
    - Inlet waterway vessel Rhine CCNR: Ministry of Transport



# CONTENTS

Introduction

Emission requirements

Test procedures

Conclusions

# CONCLUSIONS

- NOx emissions for Euro VI are 4.5 times lower than for Stage 5. Particulate emission limits are very similar.
- Test procedures for Euro VI and NRMM IWT are very different but Euro VI has a large 'Emission Control Area'  
→ good basis to fulfil IWT 'Emission Control Areal' requirements
- Ships with Stage V engines will have about equal NOx emissions per container.km of per ton.km, as Euro VI trucks.  
But ships with Euro VI engines should be much better.



# THANK YOU FOR YOUR ATTENTION



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