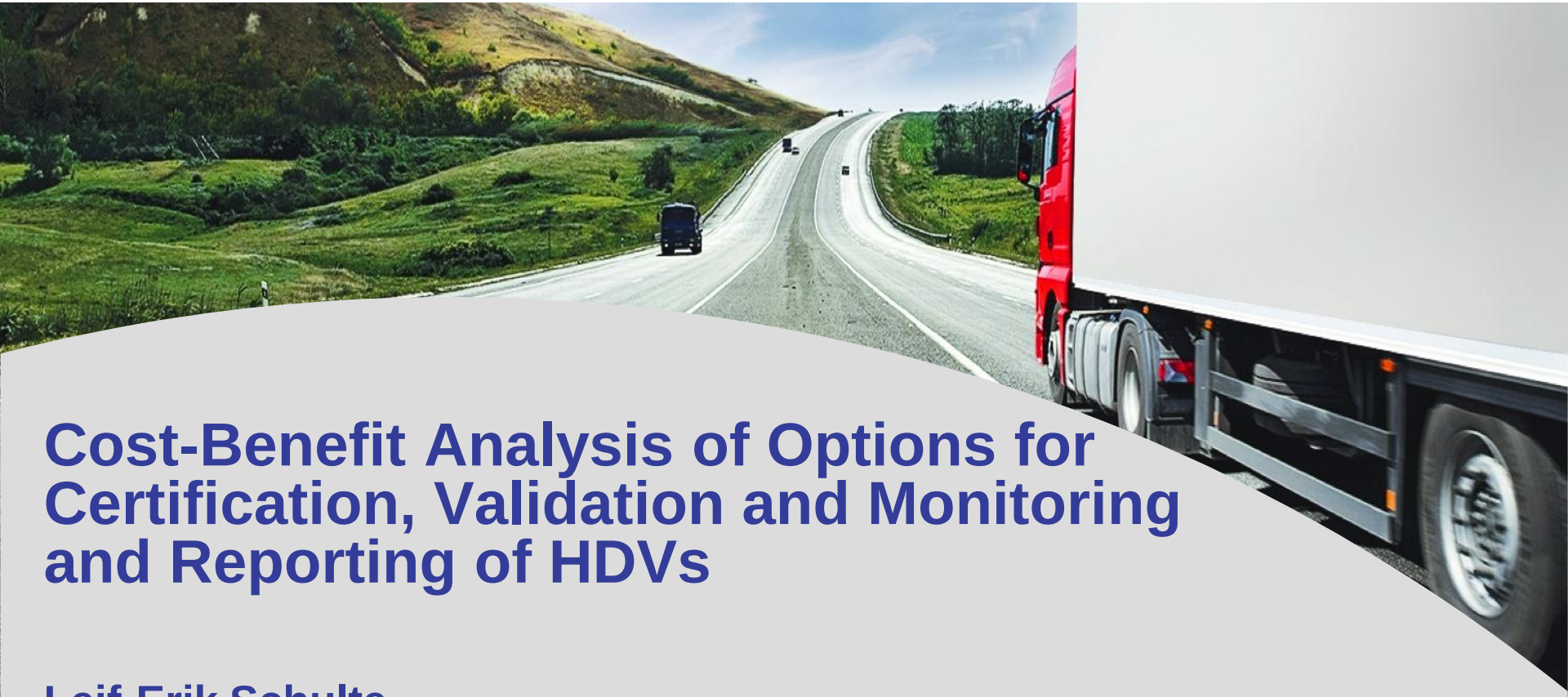

Cost-Benefit Analysis of Options for Certification, Validation and Monitoring and Reporting of HDVs

Leif-Erik Schulte
Jan Hammer
Robin Vermeulen
Vicente Franco

Brussels, September 16th 2014

Overview

- Introduction
- CO_2 Determination Methodology (Task 1)
- Confomity of Production / Ex-Post Validation (Task 2)
- Certification related Issues
- Summary Task 1 and Task 2
- Monitoring and Reporting (Task 3)
- Stakeholder Consultation (Task 7)

Introduction

A specific service request has been issued by the EC under Framework Service Contract CLIMA.C.2/FRA/2013/0007. The work under this contract, managed by TNO, has the following objectives:

- to identify, define and assess options for Certification, Validation, and Reporting and Monitoring of fuel consumption and CO_2 emissions from heavy-duty vehicles.
- to determine the costs of these options to the relevant stakeholders.

Tasks

- Task 1 Certification (TüV NORD)
- Task 2 Ex-post validation (TüV NORD)
- Task 3 Monitoring and reporting (TNO)
- Task 4-6 Costs for tasks 1-3 (ICCT)
- Task 7 Stakeholder consultation (ICCT)

Time line

- Project start: definition of options May - September 2014
- Stakeholder consultation: August - September 2014
- Interim report: 8 September 2014
- Stakeholder workshop: 16 September 2014
- Assessment of options: September - December 2014
- Report: December 2014
- Stakeholder workshop: January 2014

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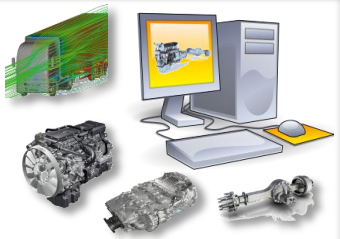
CO_2 Determination Methodology

Overview

Options

D1	D2	D3	D4	D5
				

Simulation based Engine Testing (HILS)

Real Driving

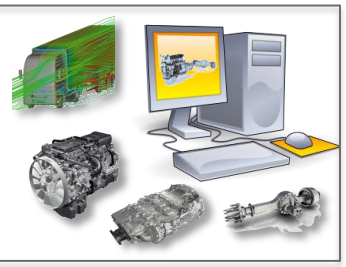
Chassis Dyno

Reduced Testing Effort and Simulation

Component Testing and Simulation (baseline option)

CO_2 Determination Methodology

Component Testing and Simulation (baseline option)



Vehicle Configuration

↓

Identification of Vehicle Class

↓

Component Testing (optional default values)

Air Drag | Transmission | Axle | Engine

Sub-option
Air Drag
CFD
Simulation

RRC | Auxiliaries

↓

VECTO
Vehicle Energy Consumption Calculation Tool

CO_2 Determination Methodology

Reduced Testing Effort and Simulation

Vehicle Configuration

↓

Identification of Vehicle Class

↓

Component Testing

Engine

Air Drag

Default values

RRC

Transmission

Axle

Auxiliaries

Sub-option
Air Drag
CFD
Simulation

↓

VECTO
Vehicle Energy Consumption Calculation Tool

CO_2 Determination Methodology

Chassis Dyno Testing

Family Definition

↓

Identification of Vehicle Class

↓

Component Testing

Air Drag

RRC

↓

Chassis Dyno Testing

↓

Family specific

↓

Technology specific Boni

↓

Vehicle specific

Sub-option

Air Drag

CFD

Simulation

CO_2 Determination Methodology

Real Driving

Family Definition

↓

Definition of Parent

↓

Allocation of cycle characteristics and choice of route

↓

PEMS / FC Measurement
(correction for wind speed)

↓

Family specific 

↓

Technology specific Boni

↓

Vehicle specific 

CO_2 Determination Methodology

Simulation based Engine Testing (HILS)

Vehicle Configuration

↓

Identification of Vehicle Class

↓

Component Testing (optional simulation / default values)

Air Drag | Transmission | Axle

RRC | Auxiliaries

↓

VECTO
Vehicle Energy Consumption Calculation Tool

↓

Engine Speed and Load Profile

↓

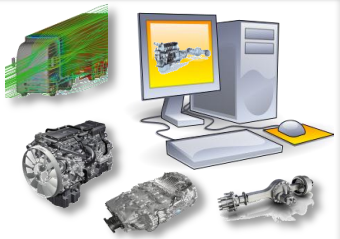
Engine Testing

Sub-option
Air Drag
CFD
Simulation

CO_2 Determination Methodology

Summary

Options

D1	D2	D3	D4	D5
				

D5: Simulation based Engine Testing
High test bench capacities needed. Accurate.

D4: Real Driving
Measurement equipment available. High influence of ambient conditions, driver. High inaccuracy due to needed family approach on vehicle level.

D3: Chassis Dyno
Availability/Costs of test benches? Similarity to LDV approach. Less effort compared to D1. Complexibility? High inaccuracy due to needed family approach on vehicle level.

D2: Reduced Test
Legal basis on component level needed? Reduced effort but increased inaccuracy compared to D1.

D1: Component Testing and Simulation (base line option)
High effort regarding component testing. No legal basis on component level available. CO_2 value via simulation acceptable? Accurate approach.

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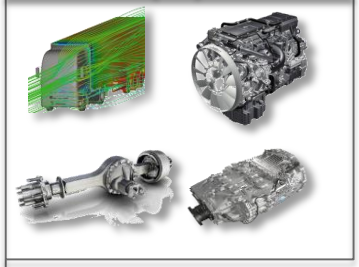
CO_2 Determination Methodology

Overview

Confomity of Production / Ex-Post Validation

P1



P2

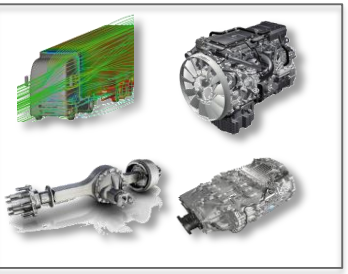
P3

Vehicle specific CoP

Process specific CoP

Comoponent specific CoP

Confomity of Production
Component specific CoP



CoP Component Identification

Component Testing

Air Drag | Transmission | Axle | Engine | RRC ?

Limit / Tolerance / Conformity Factor for each Component

Conformity | Non-Conformity → Remedial Measures

Confomity of Production

Process specific CoP

CoP Vehicle Configuration

Component Testing

Air Drag | Transmission | Axle | Engine

RRC ?

Auxiliaries

VECTO

Vehicle Energy Consumption Calculation Tool

Certified 

Limit / Tolerance / CF

Non-Conformity

Conformity

Remedial Measures

Confomity of Production / Ex-Post Validation

Vehicle specific CoP - SiCo

Simulation of Simplified Cycle during Certification

Identification of CoP/EPV Vehicle

FC Measurement during SiCo Testing on Test Track

Limit / Tolerance / Conformity Factor

Conformity | Non-Conformity → Remedial Measures

Confomity of Production / Ex-Post Validation

Vehicle specific CoP - Real Driving

Identification of CoP/EPV Vehicle

↓

Allocation of cycle characteristics and choice of route

↓

PEMS / FC Measurement (correction for wind speed)

↓

Limit / Tolerance / Conformity Factor (compared to certified value)

↓

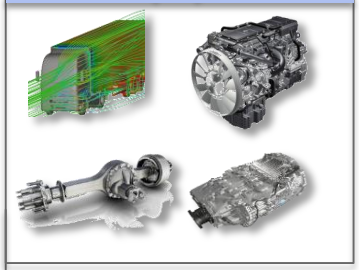
Conformity | Non-Conformity → Remedial Measures

Confomity of Production / Ex-Post Validation

Summary

Confomity of Production

P1



P2

Ex-Post Validation

P3

P3: Vehicle specific
SiCo: very simplified test
Real driving: high influence of ambient conditions and driver

P2: Process specific
No direct identification of non-conform components. Sum of component quality issues could lead to conform product, even if a single components is non-conform

P1: Component specific
CoP on component level possible if not directly certified? Direct identification of non-conform components

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Certification related Issues

Non-Standard Bodies/Trailers/Semi-Trailers and Multi-Stage

Current status (Lot3): 1-Stage certification on basis of standard bodies/trailers/semi-trailers

Vehicle Combinations

Source: DAF

Multi-Stage

Manufacturer A

Manufacturer B

Source: Mercedes Benz

Certification of non-standard bodies/trailers/semi-trailers to stipulate introduction of fuel/CO_2 efficient bodies/trailers/semi-trailers

Certification related Issues

Non-Standard Bodies/Trailers/Semi-Trailers and Multi-Stage

Certification of non-standard bodies/trailers/semi-trailers to stipulate introduction of fuel/CO_2 efficient bodies/trailers/semi-trailers

Option 1
Complete VECTO Simulation

Body/Trailer/Semi-Trailer Config.

Chassis Identification

Component Testing

Air Drag

VECTO Vehicle Energy Consumption Calculation Tool

with original OEM input data and updated air drag

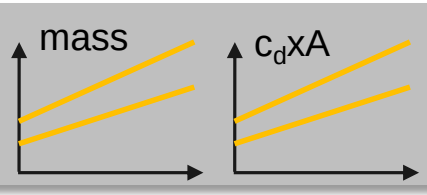
Option 2
Table values

Body/Trailer/Semi-Trailer Config.

Chassis Identification

Component Testing

Air Drag



influence on CO_2 / FC from first stage certification

Certification related Issues

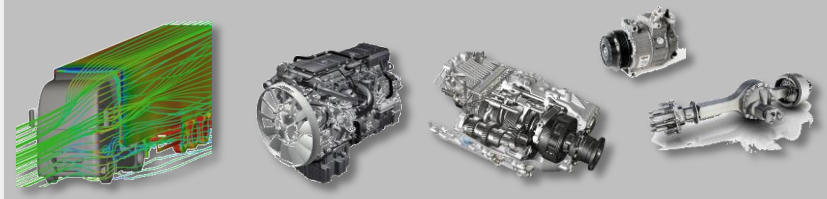
Families

Different Levels of Family Definitions

Inaccuracy

Family Size

Component



Body/Trailer/Semi-Trailer

Vehicle

Source: Mercedes Benz

- The larger the familiy, the lower the accuracy
- A multi-stage certification and possible certification of non-standard vehicle combinations may help to increase accuracy of overall approach

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Summary Task 1 and Task 2

CO_2 Determination Methodology

D1

D2

D3

D4

D5

Conformity of Production / Ex-Post Validation

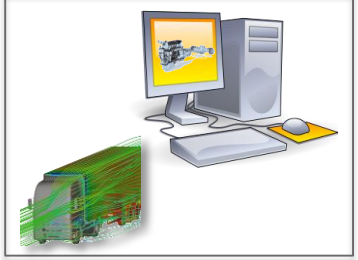
P1

P2

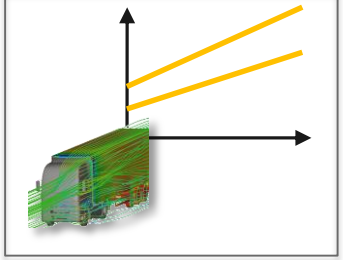
P3

Certification related Issues

S1



S2



Families

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Monitoring and Reporting (Task 3)

- Objective: Ensuring a better understanding of the level of and trends in CO_2 emissions from whole HDVs

- Monitoring: the process of data collection.
- Reporting: the processing of the monitoring data and the reporting of the results.

Monitoring options

Options are to be considered for a few different elements of monitoring

Data parameters	Data sources	Process
Minimum Vehicle identifier Vehicle classification CO_2 g/km FC l/100km CO_2 g/ t.km? CO_2 g/m^3. Per missio Technical parameter dimension characteris Data from Data from **Maximum**	Type approval Production Sale	Combined monitoring e.g. OEM technical data + MS registration Monitoring e.g. like for M1 and

Certification

Reporti

Data sourced at the moment of registration of new vehicles

- National registration documentation databases which include data from CoCs and/or type approval data; (note – registration data do usually not include all the CoC data and may be different from one Member State to another)
- Responsible entity: National Registration Authorities

Authorities

Reporting options

- Data aggregation
  - OEM
  - Member state
  - Other
- Metrics and technical data
  - CO_2 emission (g/km, g/ t. km, mission profile…)
  - Technical data (masses, dimensions, component data, …)
  - Trailers
  - Bodywork
- Process
  - Checking loop
  - Simplified process without checking loop

Considerations for M+R

- The monitoring data needs to ensure comparability between vehicles.
- Given the heterogeneity and size of the EU HDV fleet it is suggested that individual HDVs will be monitored.

  → A unique vehicle identifier is needed.
- The CoC seems a good 'vehicle' for data transfer. It would need to be amended to include HDV CO_2 emission data and possible other relevant technical data about the HDV.
- The heterogeneity of HDVs and variation and quantity of attributes that affect HDV CO_2 emissions probably require an extended data set to follow and understand the trends of CO_2 emissions of HDVs.

  →Digitalization and the use of databases should be considered.

  →This could make the data set more reliable and consistent.

Considerations for M+R

- The monitoring options involves choices to be made about data sources and the process. The different options affect different entities (stakeholders and their responsibilities).
- Consistency with the LDV monitoring and reporting needs to be ensured.
- Consider the monitoring of real body work and trailers, as for non-standard bodies these determine a significant portion of the HDV CO_2 emission. As a results monitoring could become more accurate. This impacts the Certification and the trailer and final stage manufacturers.
- The accuracy of monitoring also depends on the method of CO_2 determination for Certification.

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Stakeholder consultation

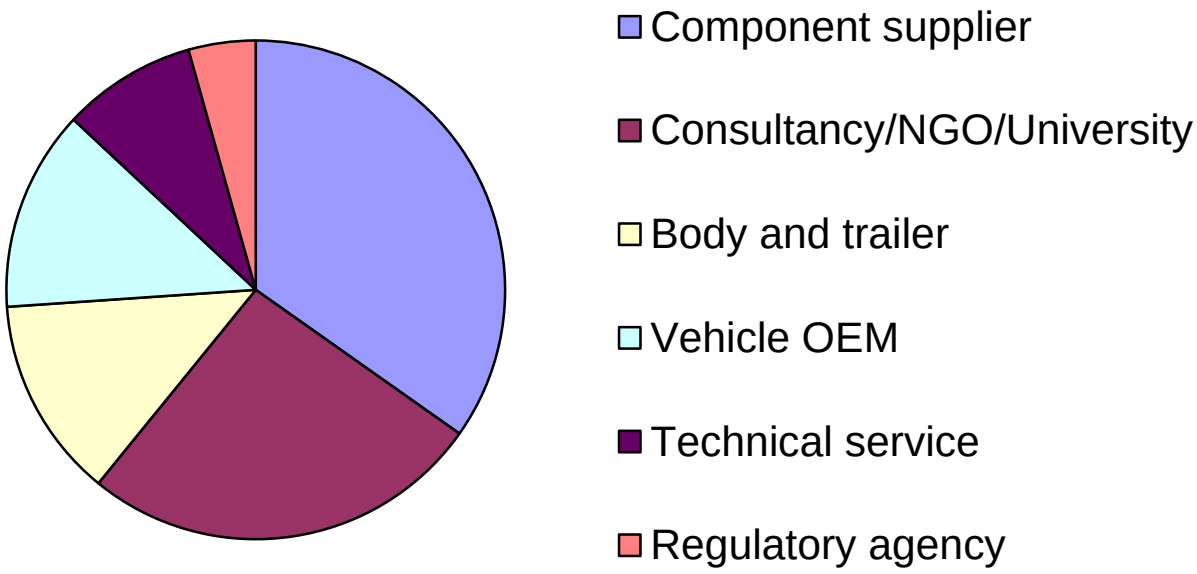
Goal of consultation

- to gain a common understanding of the options, and collect suggestions for their further development
- to gather data needed for the **cost estimations**, and
- to improve the transparency of the regulatory process and acceptance of results by stakeholders.

- Ongoing process (until end of September)
  - *Online survey (everyone)*: general preference regarding the proposed options, technical merit of the options, quality of results
  - *One-on-one interviews (stakeholders who choose to provide additional feedback)*: cost estimations, specific suggestions, AOB
  - Contact: Vicente Franco (vicente@theicct.org)

Preliminary results

(Total no. of respondents so far: 32)



Preliminary results

- CO_2 determination: Clear general preference for *simulation options* (especially D1, also D2), also in terms of technical merit, quality of results and feasibility.
- CoP: Some preference for Vehicle-specific CoP (P3), process-specific a close second.
- Monitoring: Preference for options M1 or M2 + M3 (current CoC data or expanded CoC data to be monitored by Member states and/or TA authorities and reported to EEA).
- Reporting: preference for R2+R3 (reporting extended data + publication of provisional data by EEA and verification by OEMs).
- Cost and general preferences not perfectly aligned (stakeholders value quality and technical merit over monetary savings)

Thank you for your attention