



Euro VI achievements and the future for heavy-duty vehicles

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The Euro VI challenge

- Driveability and fuel efficiency
- Tough reduction in emission requirements
 - 77% lower nitrogen oxides (NOx)
 - 50% lower particulate emissions (PM), Particulate number limit (PN)
 - Extensive OBD requirements, PEMS emissions limits, durability up-to 700 000 km, Repair & Maintenance Information...



Measures to meet Euro VI

What

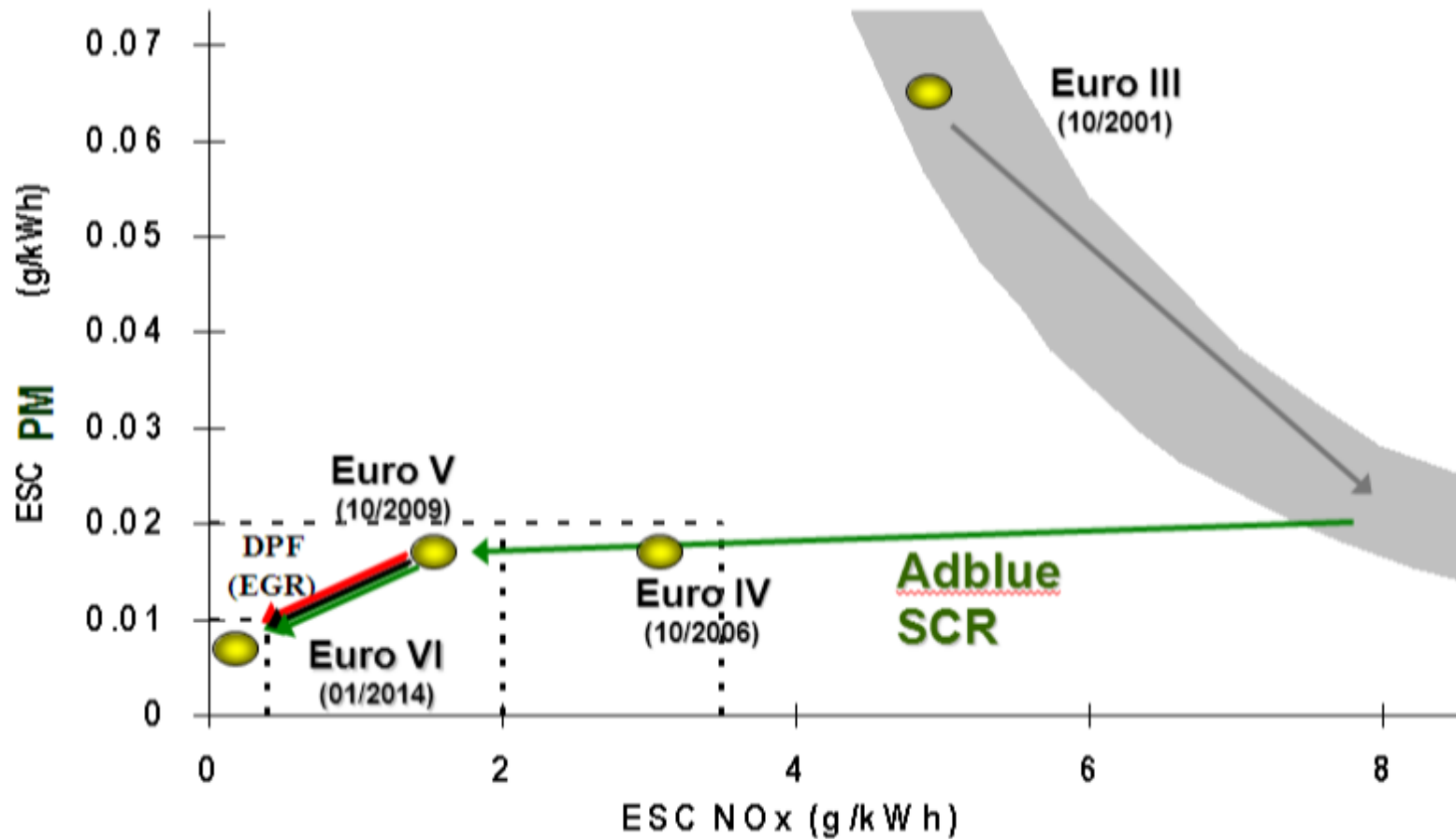
- SCR - Selective Catalytic Reduction
- EGR - Exhaust Gas Recirculation
- DPF - Diesel Particulate Filter
- Heat Management
- DPF cleaning

Why

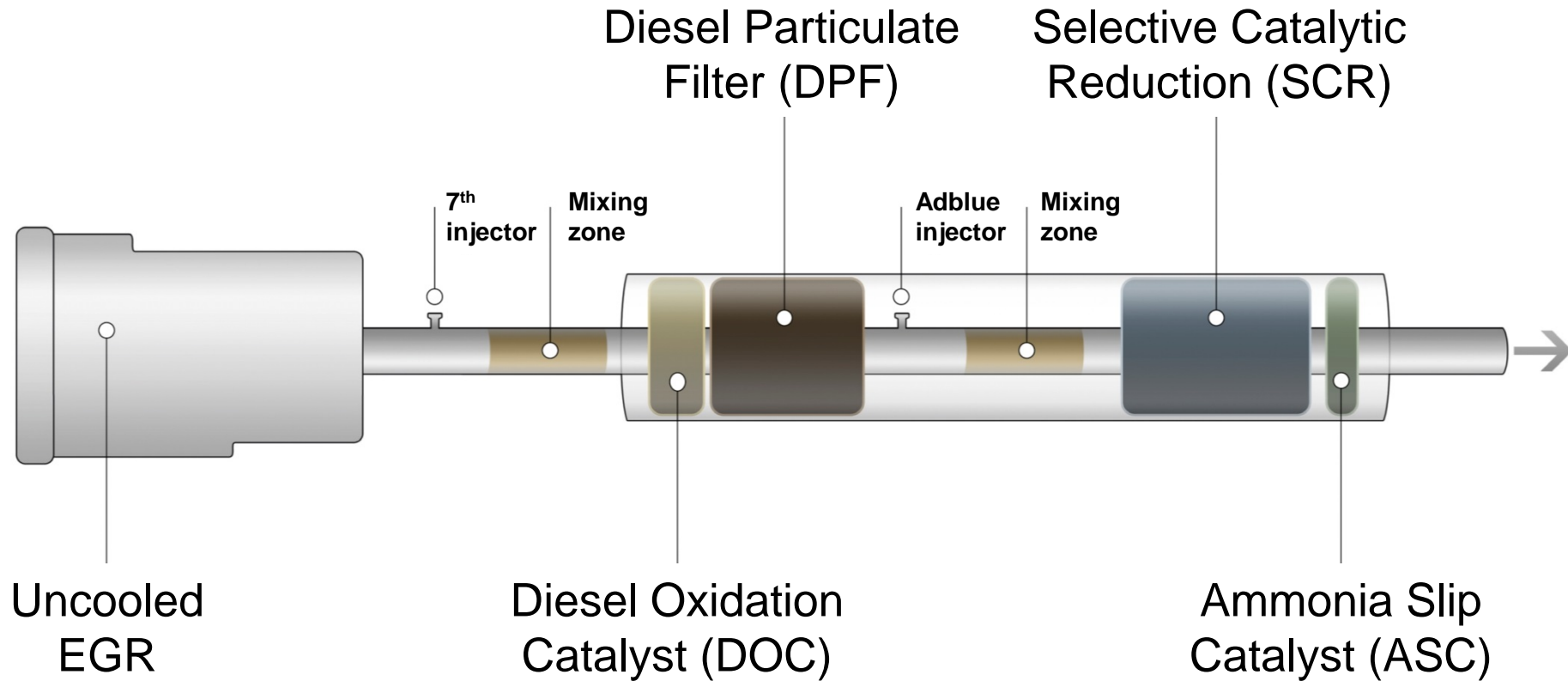
- Reduction of NOx
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- Heat management
- Reduction of PM and PN
- NOx reduction in cold cycles
- Regeneration of DPF and SCR
- Removal of ashes



Strategy in Europe for truck engines



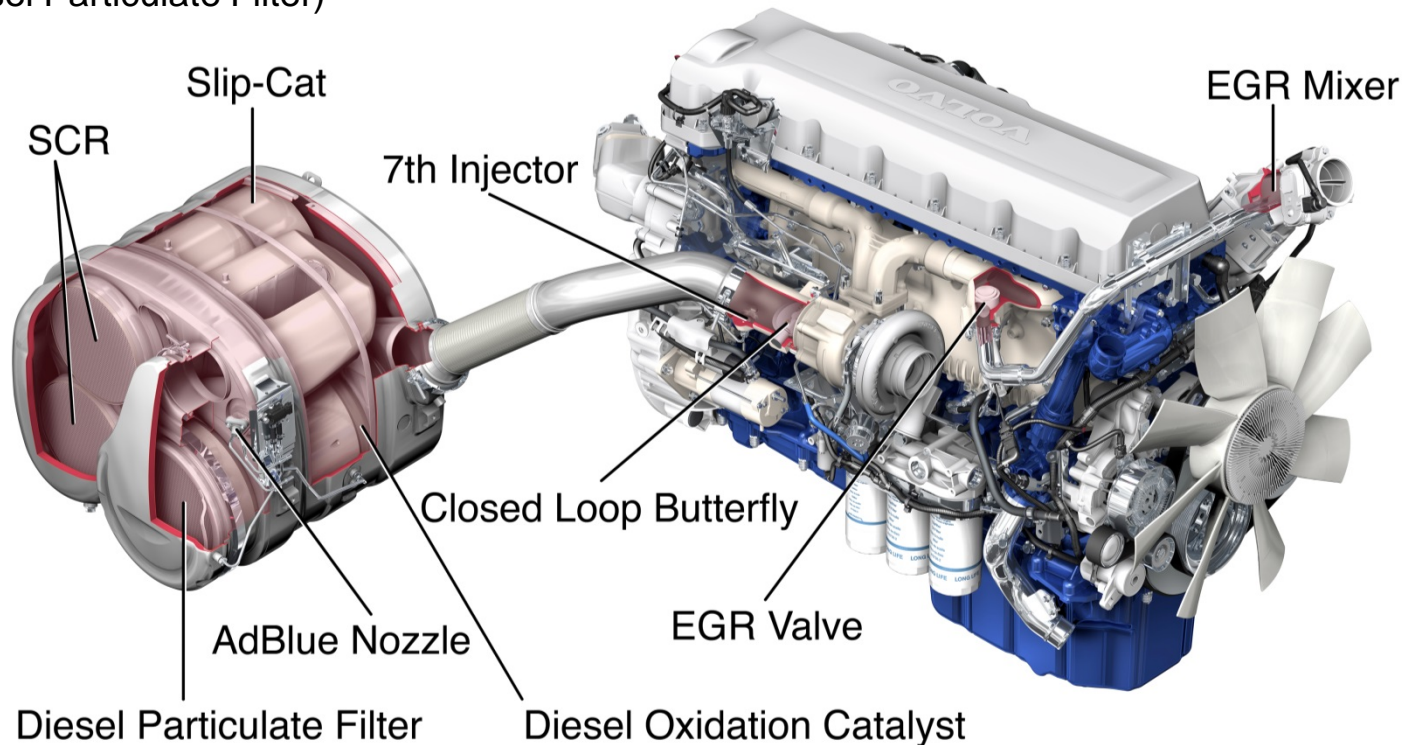
Typical Euro VI solution



Euro VI – refined and developed

Volvo D11 and D13

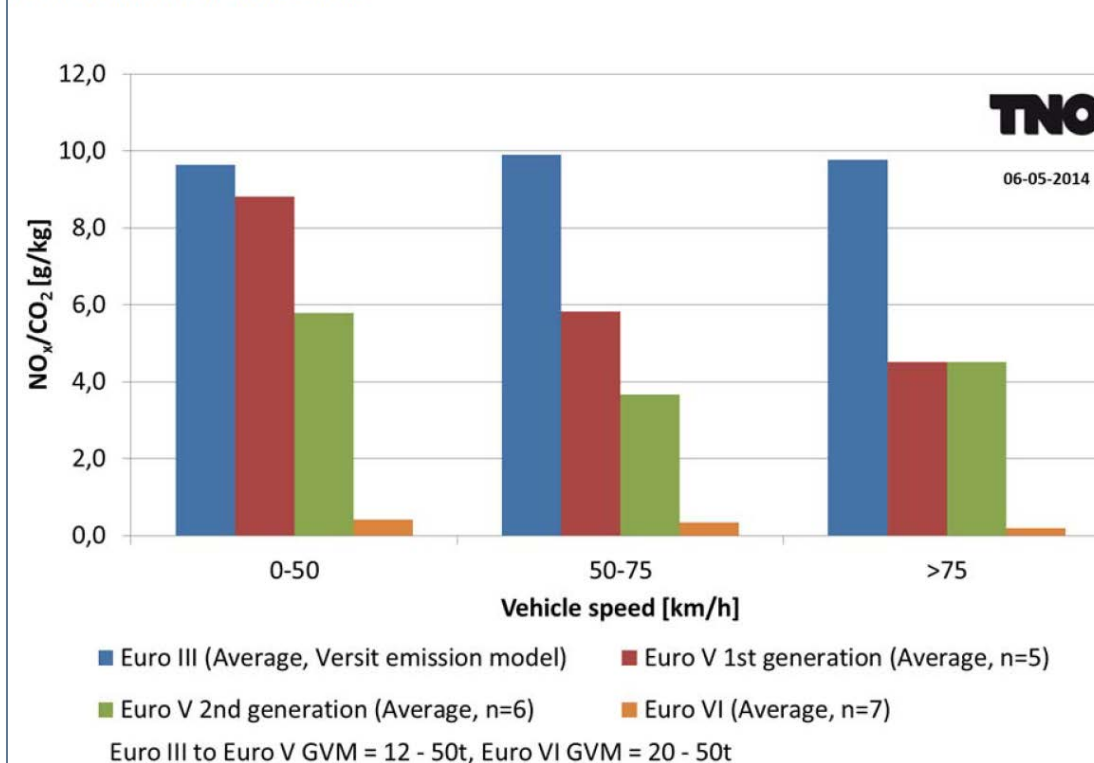
- SCR (Selective Catalytic Reduction)
- Uncooled EGR (Exhaust Gas Recirculation)
- DPF (Diesel Particulate Filter)



Have we succeeded?

TNO In-Service Emissions Testing Programme for HDV

Long haulage diesel fuelled Euro VI vehicles show a strong reduction of the real-world NO_x emissions



Average real-world NO_x emissions (PEMS) during typical Dutch urban, rural and motorway conditions

TNO - *Netherlands Organisation for Applied Scientific Research*

TNO report, TNO 2014 R10641 | 2, The Netherlands In-Service Emissions Testing Programme for Heavy-Duty 2011-2013

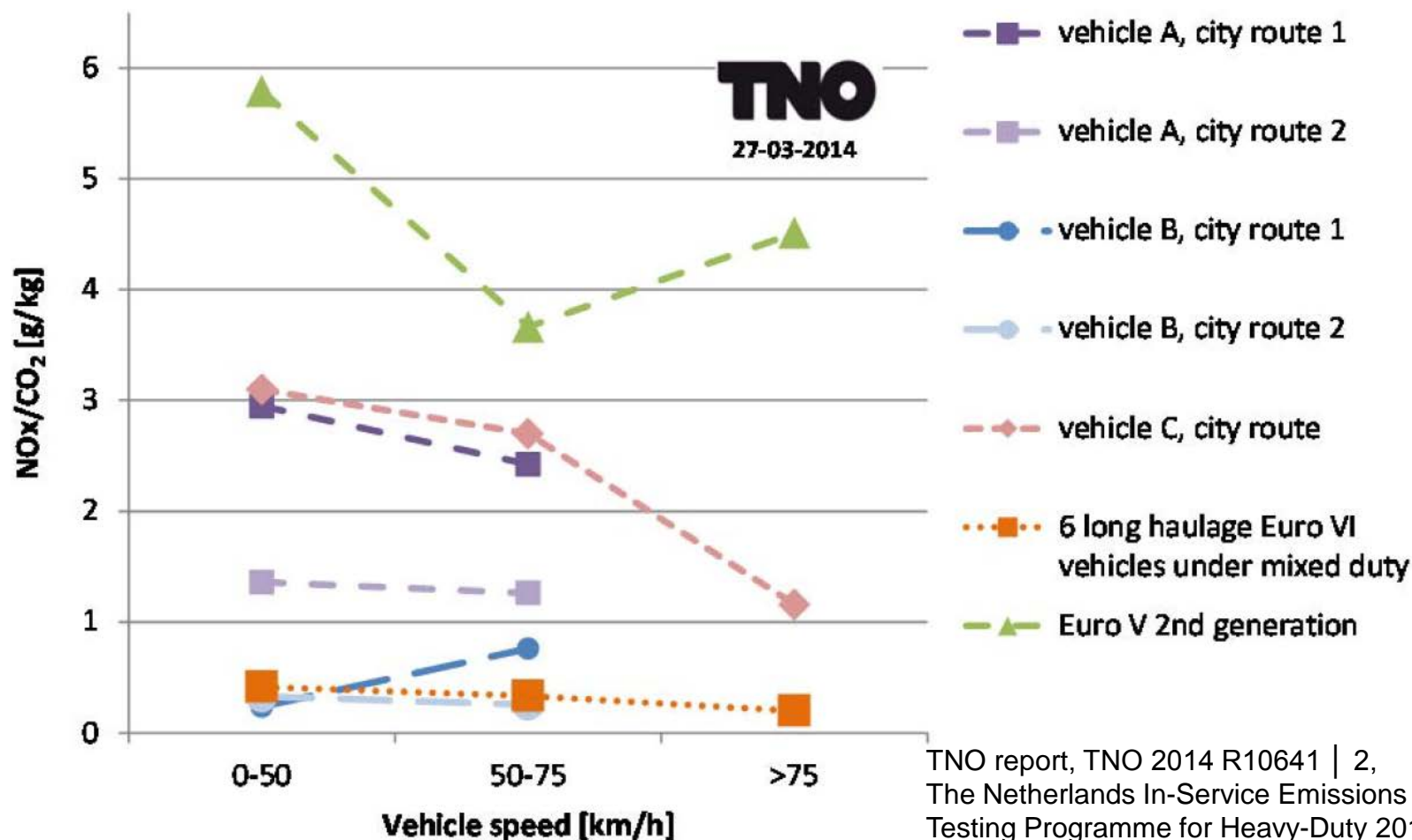
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Euro VI vehicles in real-world operation in an urban environment



TNO conclusions

TNO report, TNO 2014 R10641 | 2

- “All Euro VI vehicles tested by TNO comply with the EU standard for in-service conformity.”
- “The new and more stringent Euro VI legislation has led to significantly lower real world emissions of the heavy commercial vehicles.”
- “Not all Euro VI vehicles that are used in urban environment have a low tail-pipe emission of NOx under all representative circumstances.”

So, are we done now?

- Low load cycles
 - Hybrids, plug-in hybrids
- Alternative fuels
- Air quality, California
 - 90% NOx reduction 2010 - 2032 to reach Ambient Air Quality Standards
 - 33% of NOx emissions from on-road Heavy Duty Vehicles
 - Optional Low NOx Engine standards of 0.10-0.02 g/bhp-hr (0.20 g/bhp-hr mandatory)



Next major area – CO₂ emissions



EU Strategy for reducing HDV fuel consumption and CO₂ emissions

- Heavy-Duty Vehicles' CO₂ emissions trends are unsustainable
 - Technology can reduce HDV fuel consumption and CO₂ emissions
 - A knowledge gap and market barriers needs to be addressed
 - Other countries have already acted
- Short-term action addressing the knowledge gap
 - Completion of a simulation tool - VECTO
 - Legislation to measure, certify and report HDV CO₂ emissions
- Policy options for the medium-term?

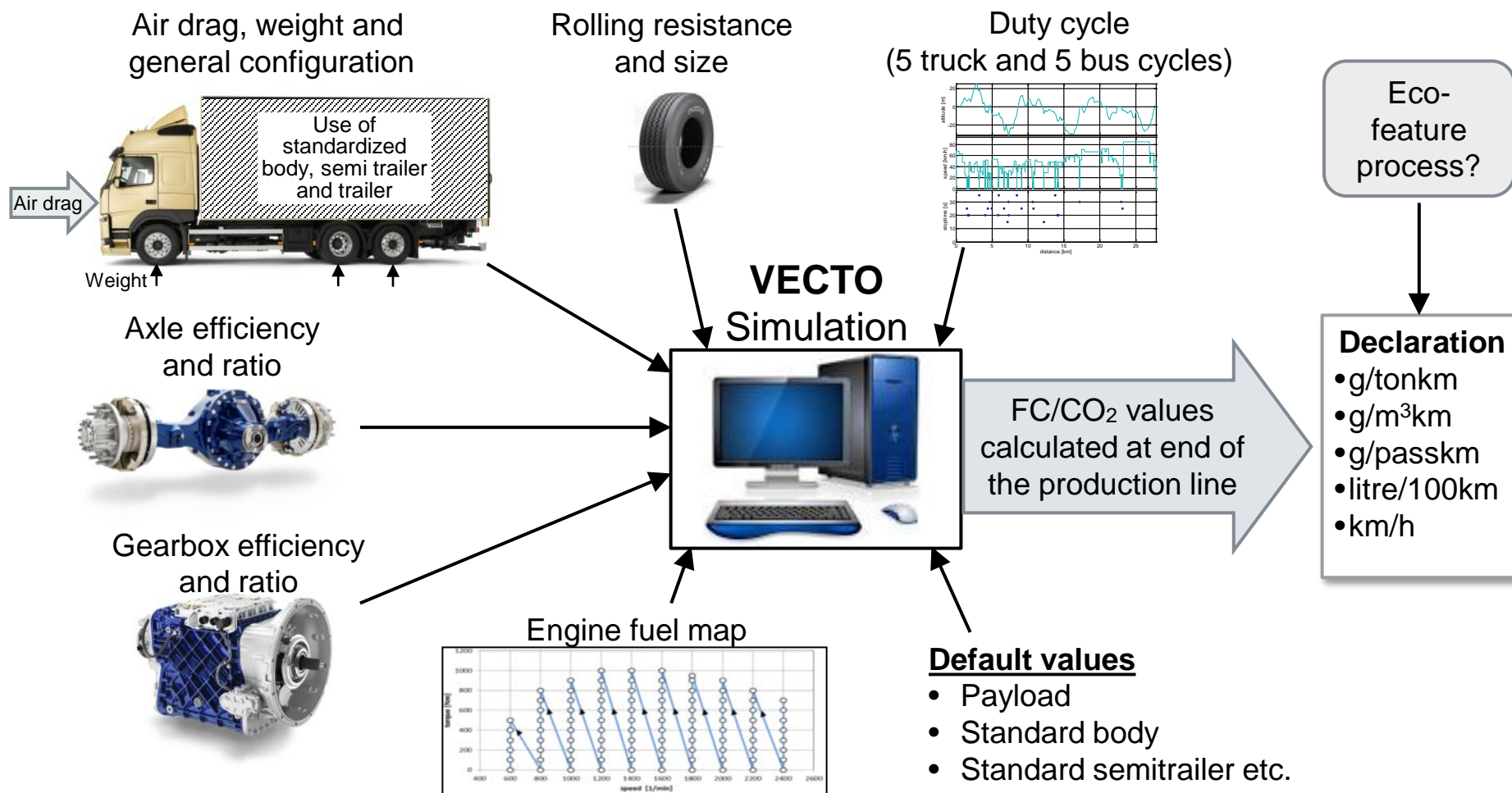


OEM targets on the CO₂ declaration

- Give realistic values
 - Reflect real on-road performance
 - Avoid unintended consequences
 - Declaration procedure needs to be reproducible, robust and practicable
- Only a full vehicle simulation based approach can meet the targets



Measurement of components and calculation of FC/CO₂



How will the CO₂ declaration affect us?

- Cost and benefit for our customers will always be our first priority
- CO₂ declaration targets in product development
- The declared value will influence the sales process
- The CO₂ values will probably be used locally/nationally to decide taxes, road fees etc.
- Transport buyers will require transports by trucks with low CO₂ values



Harmonization with other markets?

- Harmonization of FC/CO₂ regulation is important
 - Will reduce development cost and needed resources
 - Will reduce cost for testing
 - Will reduce technology cost
 - Increase the number of technologies with reasonable pay-back
- Harmonize methods and systems, not duty cycles and other market specific items



Looking forward

What can be achieved?

- Improved FC/CO₂ information to customers and transport buyers
- Even more focus on FC/CO₂ on all levels
 - New technologies/features
 - Improved specification of vehicles
 - Driver training
 - Fuel consumption follow-up
 - Transport efficient solutions
- Harmonization of regulations?
- How to handle well-to-wheel CO₂ emissions?



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