European Automobile Manufacturers Association

COMMERCIAL VEHICLES, FUEL EFFICIENCY AND CO_2

Challenges & Possible solutions

IEA Freight Truck Fuel Economy Workshop
Challenge Bibendum, 20-21 May 2011, Berlin

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ACEA Position

Fuel Efficiency is Market Driven

- Fuel efficiency is one of the most important competitive factors in developing and selling trucks and buses. Therefore, market forces ensure continuous progress in fuel economy and CO_2 emission reduction in the most efficient way.
- Our “Vision 2020” expects a 20% improvement of fuel efficiency by 2020 (compared to 2005) due to these market forces.
- Any product-oriented legal requirement regarding fuel efficiency and CO_2 emissions should aim to further strengthen these market forces.

Challenges with a regulatory approach

- Using the right metric for fuel efficiency
- Satisfying customers expectations on fuel efficiency
- The huge variety of complete heavy-duty vehicles
- Heavy-duty vehicles are often custom-built in several stages involving different manufacturers
- The high number of unique and different usage patterns
- Using test cycles that reflects actual vehicle usage
- The traditional use of the combustion engine is changing when operating in hybrid vehicles

Using the right metric for fuel efficiency

- **“liter/100 km”** is **not** a good fuel efficiency metric for commercial vehicles **as it requires same duty cycles and vehicles with similar specifications**
- Metric based upon **“Fuel Used/Work Done”** is **more relevant**
- **“Work”** with respect for transport of goods can be specified in **“tonne-km”** which focuses on the weight but as loading volume is becoming more important **“cubic meter-km”** is an option and for transport of people **“passenger-km”**

GCW/GVW ton	Loading Capacity ton	Distance km	tonnekm	l/1000tonkm **at 100%** utilisation	CO2* g/tonkm **at 100%** utilisation
URBAN DISTRIBUTION					
3.5	1.5	100	150	80.0	**210**
7.5	4	100	400	35.0	**92**
12	7.2	100	720	23.6	**62**
18	11	100	1100	18.2	**48**
LONG DISTANCE					
26	17	100	1700	13.5	**36**
40	25	100	2500	12.0	**32**
60	40	100	4000	10.0	**26**

*using the factor 2.63 to convert 1 litre diesel to kg CO_2

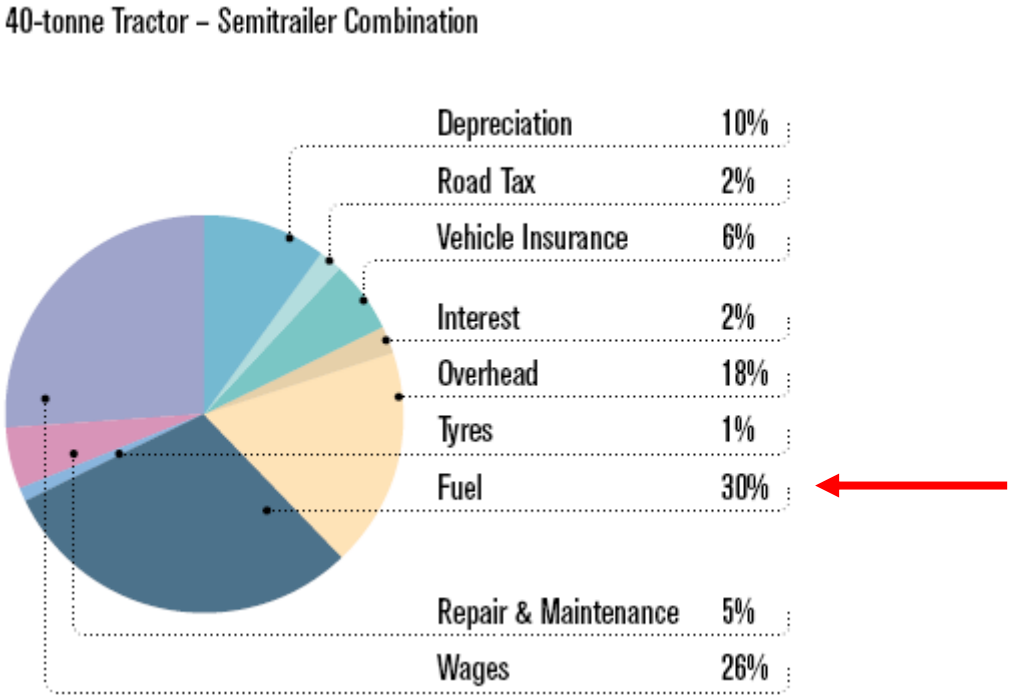
SOURCE VOLVO

Satisfying customers expectations

European goods transports on roads are characterized by:

- ***High fuel prices***
- ***High weights and volumes***
- ***Relatively long distances***

Fuel efficiency has therefore since long been a 1st priority because of its major impact on the Total Operating Costs



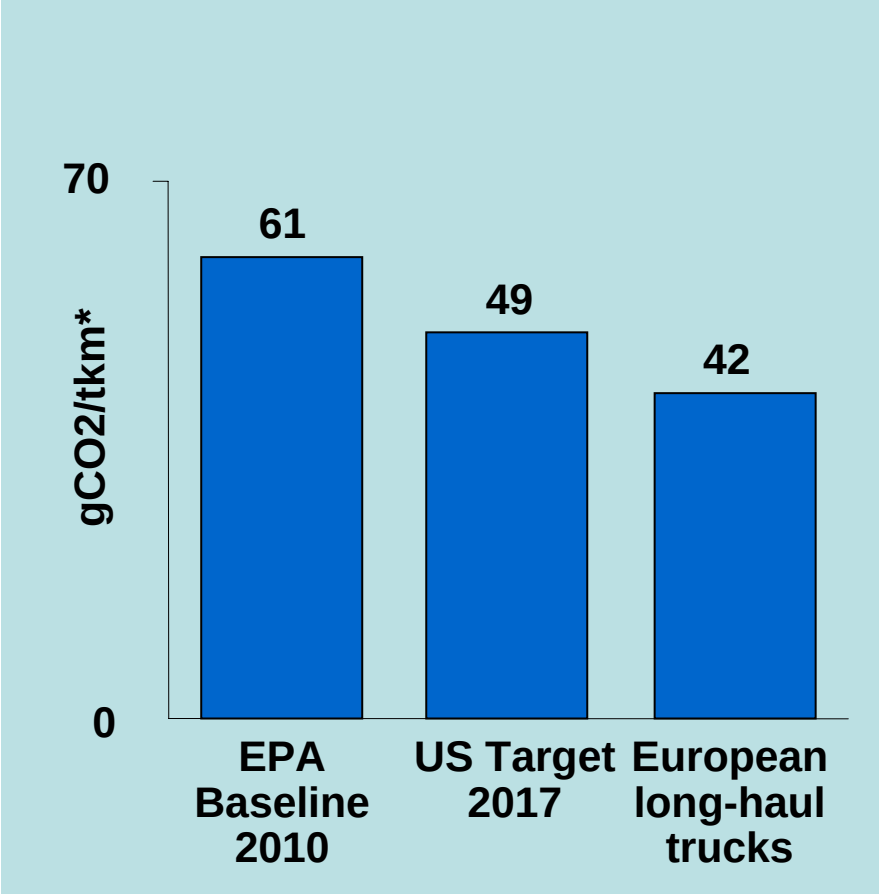
Fuel consumption is a customer priority

Western European Customers		
Rank	**Criteria**	**Category**
1	Reliability	Vehicle
2	Service quality	Service
3	Fuel consumption	Vehicle
4	Spare part availability	Service
5	Manufacturing quality	Vehicle
6	Safety	Vehicle
7	Mileage cost	Price & costs
8	Purchase price	Price & costs
9	TCO[2]	Price & costs
10	Down-times	Service

Eastern European Customers		
Rank	**Criteria**	**Category**
1	Reliability	Vehicle
2	Fuel consumption	Vehicle
3	Purchase price	Price & costs
4	Service quality	Service
5	Manufacturing quality	Vehicle
6	Warranty and goodwill	Service
7	Spare part availability	Service
8	Mileage cost	Price & costs
9	TCO[2]	Price & costs
10	Down-times	Service

Source: European Truck Customer 2010, Oliver Wyman Analysis 2 TCO= Total cost of ownership

Fuel efficiency - European versus U.S. HDVs



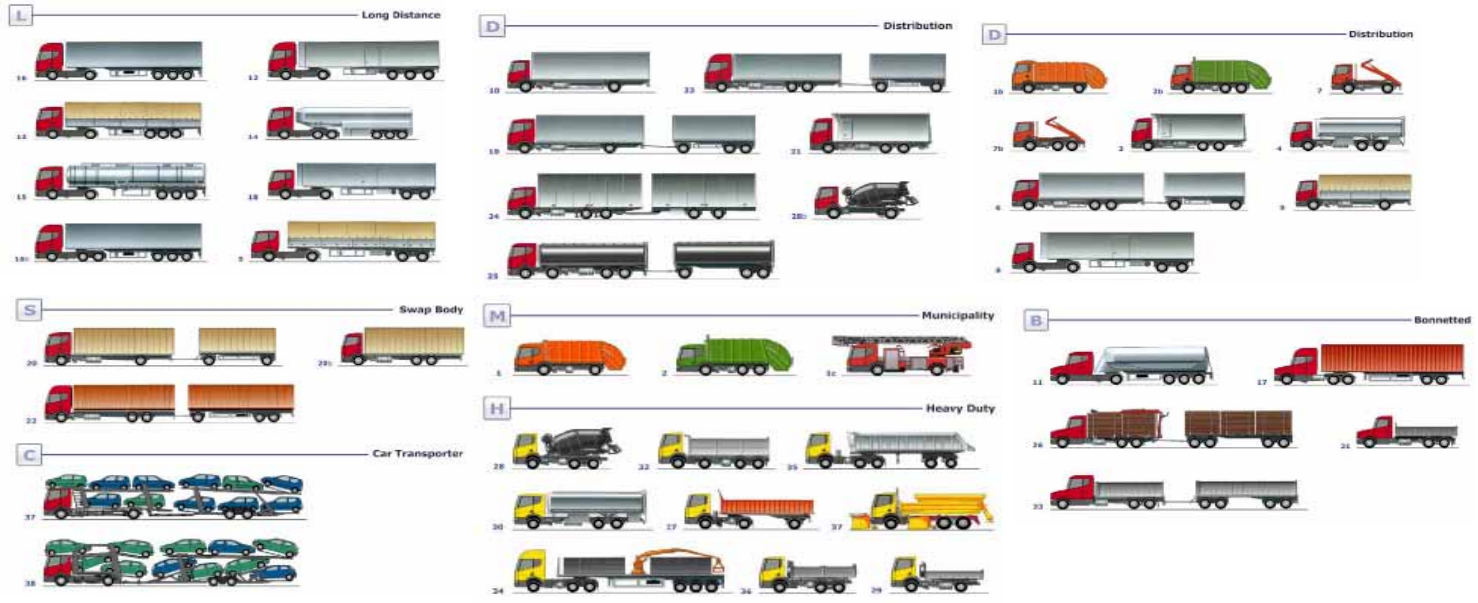
- U.S. EPA has published performance requirements for Heavy-Duty vehicles.
- Current European long-haul trucks have already better fuel efficiency** than the US 2017 target for long-haul Class 8 vehicles.
- Compared to EPA 2010 baseline current European long-haul trucks show about a 30% better efficiency**.

*at 75% utilisation of loading capacity

** Recognising that difference in vehicle specification of long haul trucks is to the European advantage - 4x2 in Europe versus 6x4 in US and the location of the fifth wheel in US which results in a larger gap between cab and trailer

Huge variety of complete heavy-duty vehicles

- **Trucks and buses are often custom-built in several stages** and adjusted to specific needs concerning load, driving patterns …

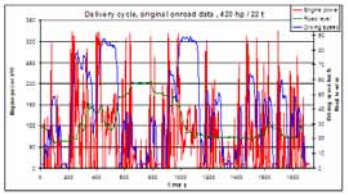


- As there is an **enormous variety of different vehicle designs** and resulting payloads that have significant impact on CO_2 generation there are few uniform high-volume vehicle categories.
- ***This means that CO_2 emissions of trucks and buses cannot be addressed or influenced via one-size-fits-all policies.***

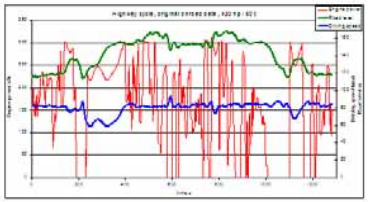
High number of unique & different duty cycles

Due to the importance of fuel efficiency, the performance of complete HD vehicles are evaluated as close as possible to their actual usage.

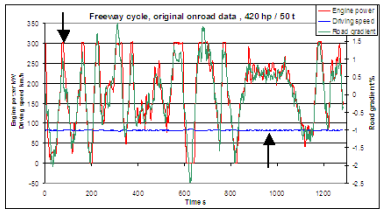
Duty-cycle for urban delivery driving



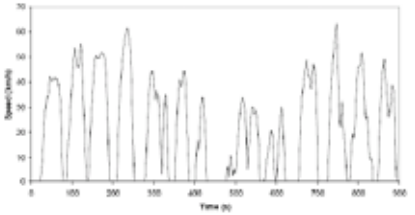
Duty-cycle for driving on rural roads



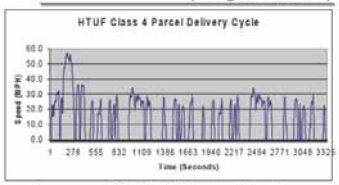
Duty-cycle for driving on motorway



Dunch Urban Bus Driving Cycle

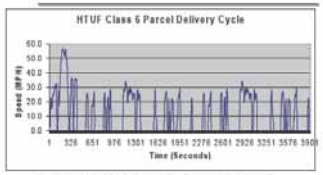


Local Delivery – Class 4 (Neighborhood)



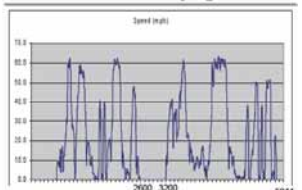
•Average speed 21 (11) mph Max speed 57 mph
•Distance 11 miles
•Incorporates "stem" travel to and from P&D route

Local Delivery – Class 6 (Business)



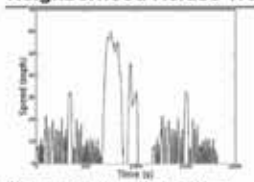
•Average speed 20 (10) mph Max speed 57 mph
•Distance 11 miles
•Incorporates "stem" travel to and from P&D route

Intermodal Drayage Truck



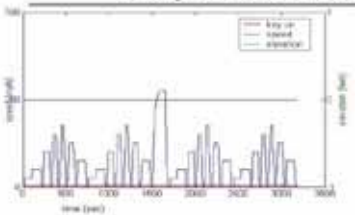
•Average speed 25 mph Max speed 63 mph
•Distance 32 miles
•Two 10-minute idle phases, with 4600 seconds travel time

Neighborhood Refuse Truck



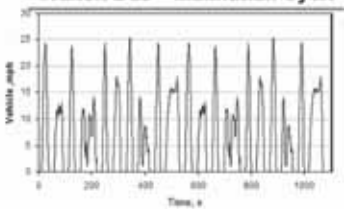
•Average speed 39 (11) mph Max speed 60 mph
•Distance 6 miles
•Incorporates aggregated "stem" travel to and from collection route

Utility Service Truck



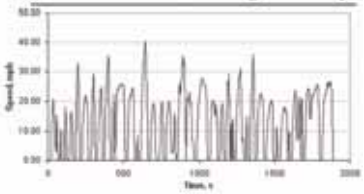
•Average speed 14 mph Max speed 55 mph
•Distance 12 miles

Transit Bus – Manhattan Cycle



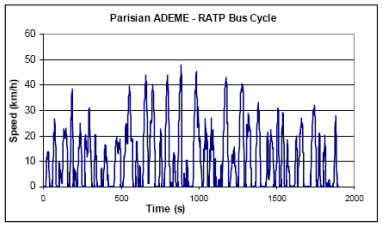
•Average speed 7 mph Max speed 25 mph
•Distance 4 miles (cycle x 2)

Transit Bus – Orange County

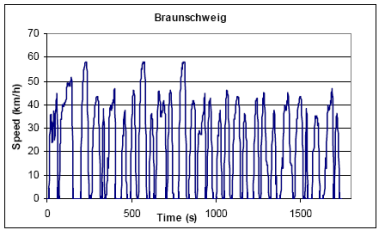


•Average speed 12 mph Max speed 41 mph
•Distance 6.5 miles

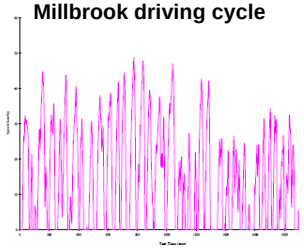
Parisian ADEME - RATP Bus Cycle



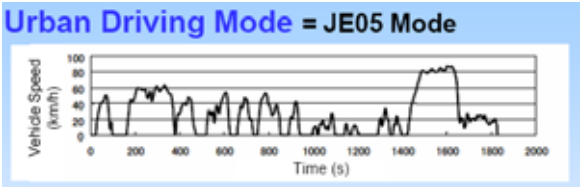
Braunschweig



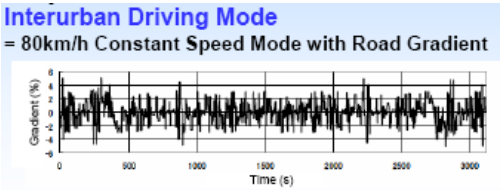
Millbrook driving cycle



Urban Driving Mode = JE05 Mode



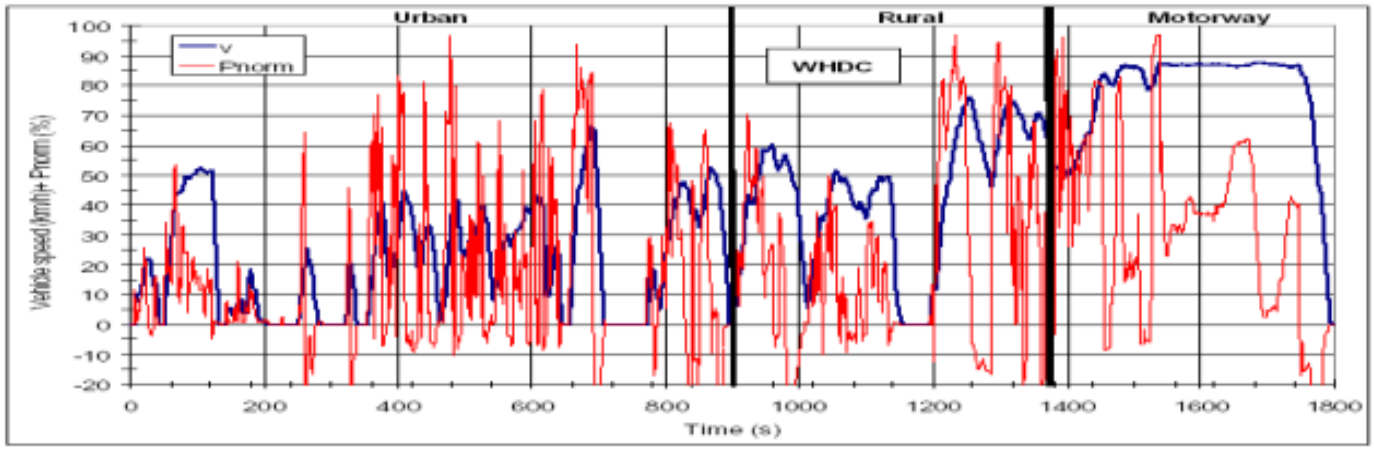
Interurban Driving Mode
= 80km/h Constant Speed Mode with Road Gradient



The World Transient Vehicle Cycle (WTVC)

The basis for evaluating air quality emissions from **heavy-duty engines**

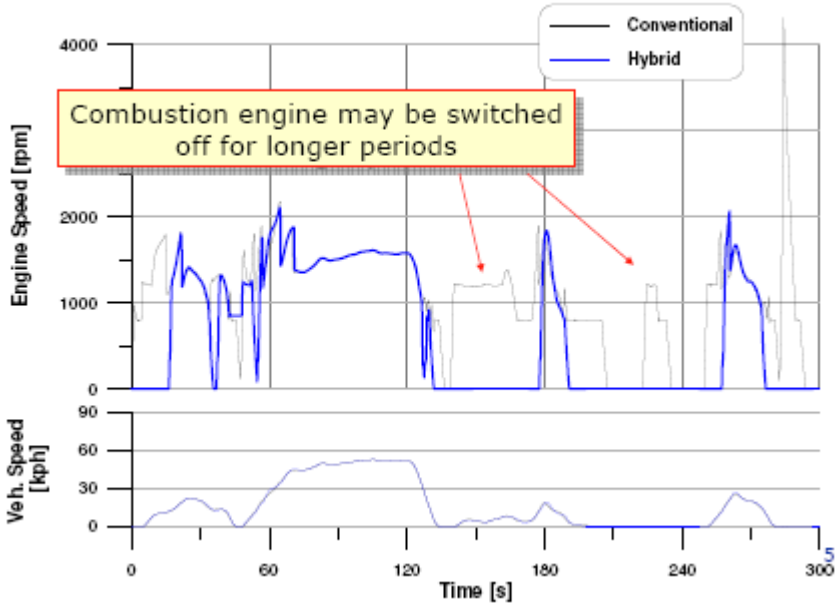
The WTVC **is not an appropriate cycle for** specific vehicle configuration and mission deviating from the **average** one, therefore not recommended in a simulation to evaluate the fuel efficiency of complete vehicles in specific missions.



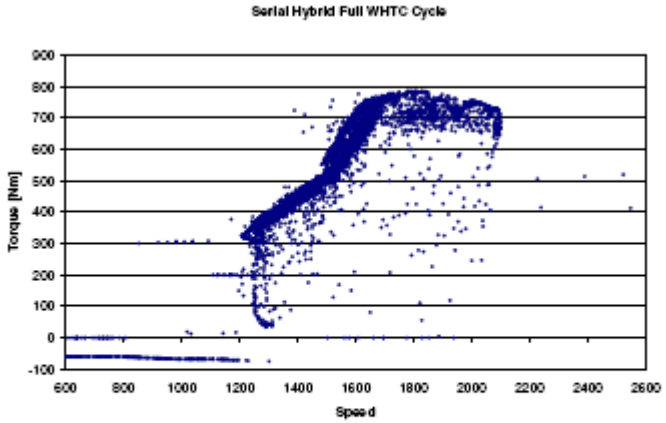
Vehicle speed **Engine power**

The role of the combustion engines will change when operating in hybrid vehicles

Parallel Hybrid



Serial Hybrid



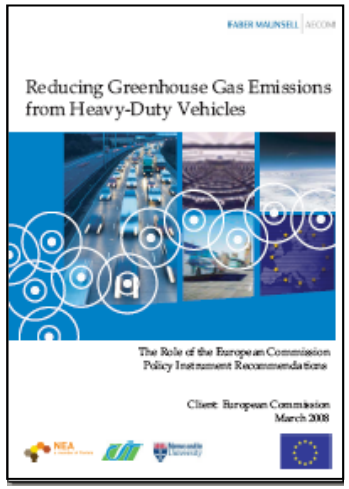
Engine operates principally as generator, which is very different from conventional engine operation

This is the reason behind the OICA initiative to develop a certification procedure for **HD powertrains of HEVs with respect to NOx and PM**, based upon the Japanese HILS approach, as an annex to the existing WHDC GTR n°4 under the UN/ECE 1998 agreement.

DG Environment study - March 2008

Recommendations

- European HDV Operational Efficiency Programme
- **HDV Energy Efficiency Labelling Policy Instrument**
  1. Step 1: Labelling of the CO2 emissions from HDV engines as recorded by a standardised test procedure;
  2. **Step 2: Labelling of entire vehicles predicting the overall efficiency of a whole vehicle combination in operation.**
  3. Step 3: Labelling of vehicle components (such as superstructures, trailers and semi-trailers).
- Labelling of the fuel efficiency of tyres
- Revision of the Weights and Dimensions
- Market-Based Instruments



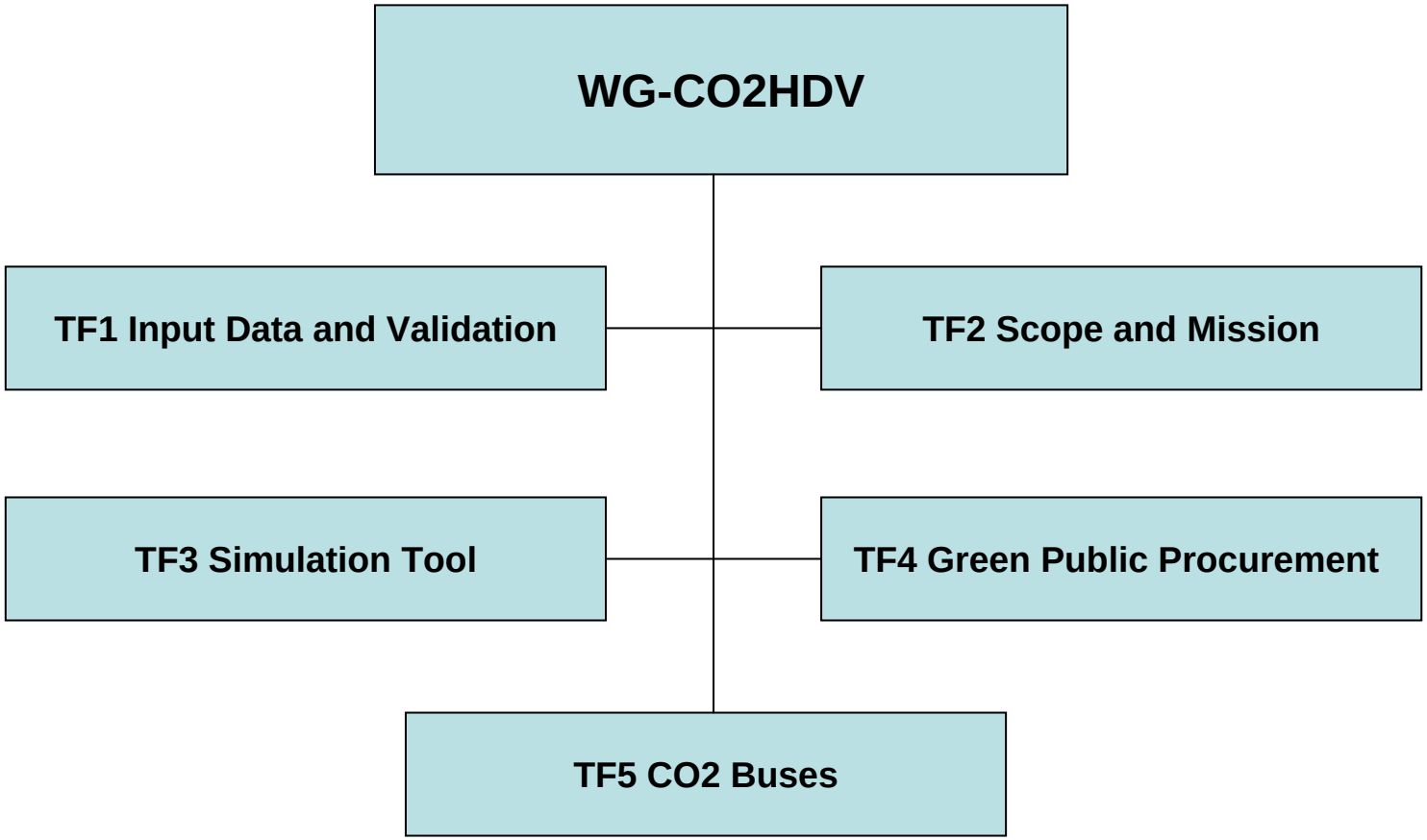
ACEA Position

To satisfy a “labelling” (B2B) requirement ACEA promotes:

- The development of a method to calculate the fuel efficiency of complete heavy-duty vehicles **according to the “work done” principle** (g/tonkm, g/m3km or g/pass.km).
- Using **computer simulation**:
  - allows a **large number of vehicle types** to be efficiently evaluated in **many different transport missions.**
- Using a **common** simulation tool:
  - with **agree assumptions** and **specific input data generated by agreed methods** enables HDV manufacturers to provide the customers with a **certified declaration of fuel efficiency** for their different product offerings.

A “Certified declaration of fuel efficiency” is the appropriate way to provide purchase guidance to professional customers

ACEA organisation



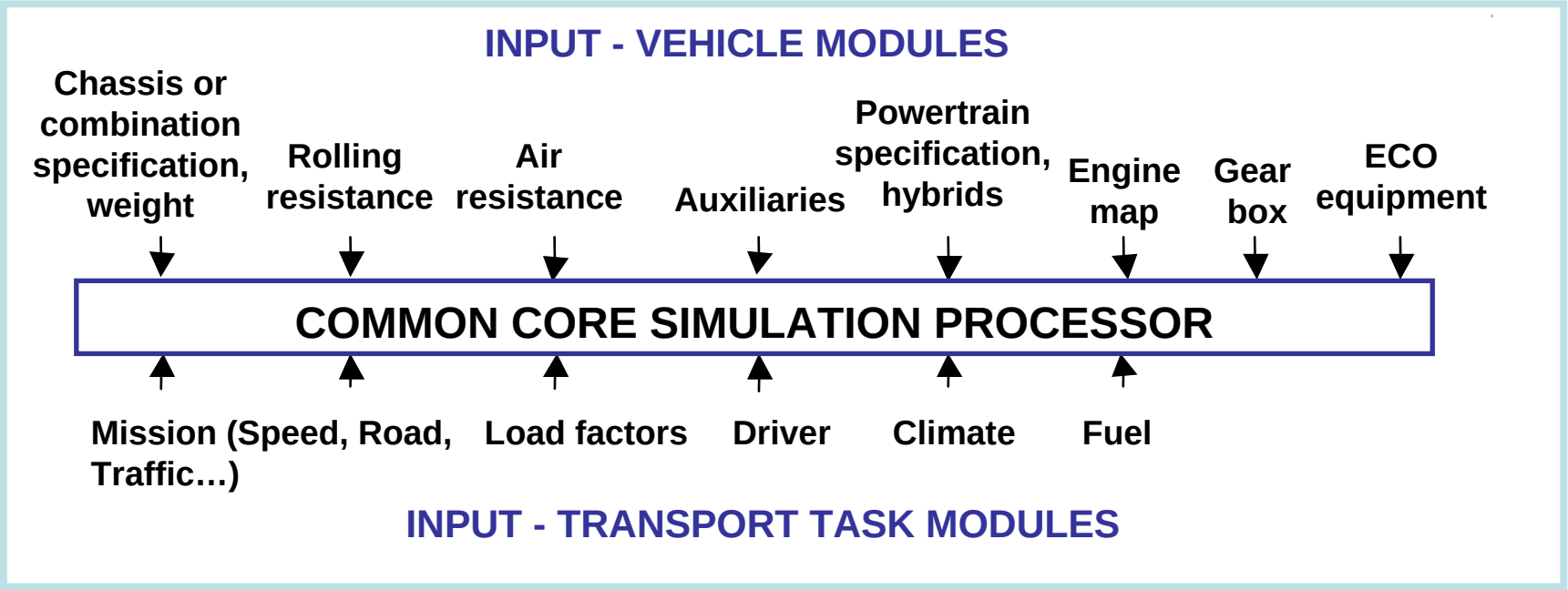
ACEA / EUCAR Project proposal

ACEA and EUCAR developed a project proposal on a methodology to calculate fuel efficiency of HD Vehicles using computer simulation

The project should:

- Define and develop **common metrics and methodologies.**
- **Matching vehicle classes** with **missions and duty cycles.**
- **Develop a tool** for calculating **fuel efficiency and CO_2 generation** of heavy-duty goods vehicles, buses and coaches

Simulation tool



- Input modules could be standardised, generic, or specific.
- With standardised interfaces to the core processor, input modules could be developed and improved over time
- Transparent declaration of inputs and results
- A tool generally available, (except with respect to proprietary data) to customers, manufacturers, authorities and researchers….
- **A tool that supports an integrated approach**

Simulation tool - Demonstrators

ACEA is supporting the development of two “demonstrators” for verifying the feasibility of the recommended approach. These “demonstrators” are based upon established simulation tools – **Autonomie** (ANL) and **CRUISE** (AVL)

In January 2011 Argonne National Laboratory released the “ACEA Demonstrator” on their website for download (www.autonomie.net)

The “demonstrator” from AVL will be available in July 2011

Vehicle classes and missions

ACEA proposal Vehicle segmentation trucks >= 7,49 t

	Identification vehicle configuration			Class	Cycle allocation						
	Axle configuration	Chassis configuration	GVW	Vehicle class	Long Haul	One daytrip t	Regional Delivery/Collectio	Urban Delivery	Municipal Utility	Light Off-road	Heavy Off-road
2 axles	4x2	Rigid + (Tractor)	7,49t-10t	1			R/GVW	R/GVW	R/GVW		
		Rigid + (Tractor)	>10-12t	2		T/R+T/GCW	R/GVW	R/GVW	R/GVW		
		Rigid + (Tractor)	>12-16t	3			R/GVW	R/GVW	R/GVW		
		Rigid	>=16 t	4	R+T/GCW	R+T/GCW	R/GVW	R/GVW	R/GVW		
		Tractor	>=16t	5	T/GCW	T/GCW	T/GCW			T/GCW	
	4x4	Rigid	7,49t-16t	6					R/GVW	R/GVW	
		Rigid	>=16t	7					R/GVW	R/GVW	
		Tractor	>=16t	8						T/GCW	
3 axles	6x2/2-4	Rigid	all GVW	9	R+T/GCW	R+T/GCW	R/GVW		R/GVW		
		Tractor	all GVW	10	T/GCW	T/GCW					
	6x4	Rigid	all GVW	11		R+T/GCW				R/GVW	R/GVW
		Tractor	all GVW	12		T/GCW				T/GCW	T/GCW
	6x6	Rigid	all GVW	13							R/GVW
		Tractor	all GVW	14							T/GCW
4 axles	8x2	Rigid	all GVW	15			R/GVW		R/GVW		
	8x4	Rigid	all GVW	16						R/GVW	R/GVW
	8x6/8x8	Rigid	all GVW	17							R/GVW

T = Tractor + Semitrailer
R+T = Rigid + Body + Trailer
R = Rigid + Body
GVW = reference weight for FE simulation = vehicle individual GVW released by OEM but maximal up to legal limit (26 t for 3-axle rigid vehice)
GCW = reference weight for FE-simulation = vehicle individual GCW released by OEM but maximal up to legal limit (e.g. 40 t for 18t 4x2 Tractor or 60 t for 6x4 R+T)

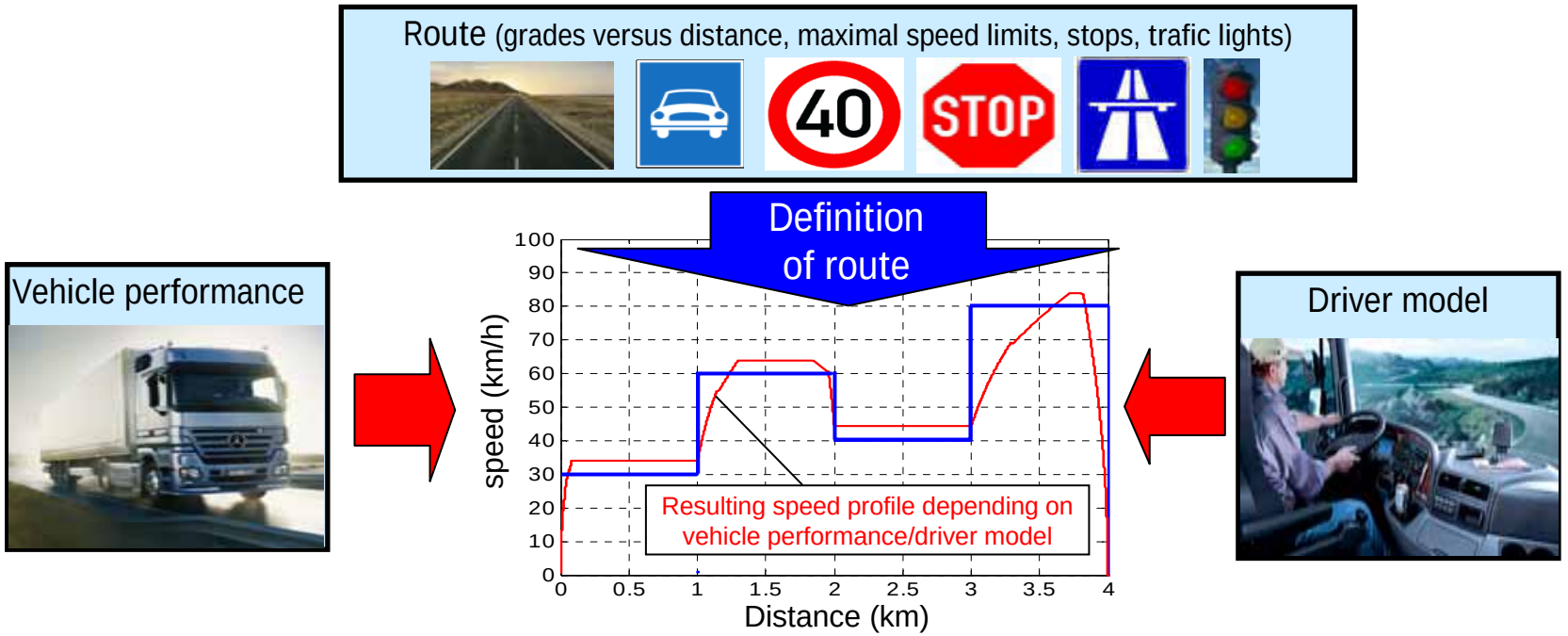
ACEA proposed cycles for truck >7.5 t GVW/GCW

Vehicle cycle/mission	Description	Average yearly run distanc (km)
Long Haul	Delivery to international sites more than one day trip	**135.000**
One daytrip	Delivery to national/international sites on a 1 day trip.	**115.000 (1 shift)** **160.000 (2 shifts)**
Regional delivery/collection	Regional delivery from a central warehouse to local stores (innercity or suburban, also mountain road goods collection, …)	**60.000**
Urban delivery/collection	Distribution in cities or suburban sites of consumer goods from a central store to selling points.	**40.000**
Municipal utility	e.g. garbage trucks, road sweepers**, …**	**25.000**
Light off road- construction zone	Construction site vehicles on light mission (e.g concrete mixers) 10% off-road	**60.000**
Off- road use - heavy off road	Construction site vehicles on heavy missions. 60% off-raod	**40.000**

Drive cycles

Main target for drive cycles is to give **realistic** fuel consumption values for **all vehicle variants**. Therefore the cycles should be **defined as routes**.

This is the concept that most existing simulation tools have implemented.



Cycles could be created by **measurement of representative, real and long routes** and following **shortening process** with comparable slope, engine load and engine speed profiles. The length of routes depend on the vehicle classes.

Additional issues under evaluation

- Reference cycles for all truck and bus missions
- Fuel map certification process
- Determination of total vehicle drag
- Power consumption of auxiliaries
- Concept to cover control strategies
- General concept on trailers and bodies

Key factors for success

Develop a method to **measure**
the fuel efficiency of complete heavy duty vehicle
with **sufficient precision**.

“If you can’t **measure** it, you can’t **manage** it”

If it is not **precise enough** it will not guide customer and therefore not **strengthen market forces**

“Certified declaration of fuel efficiency”
is also a validation activity
of both the method and its precision

ACEA objectives

Customer objective

by providing a

“Certified declaration of Fuel Efficiency ”

Assist customers in choosing the optimal truck by quantifying **relative** fuel efficiency/CO2 of **truck configuration/ brand** choices per application class

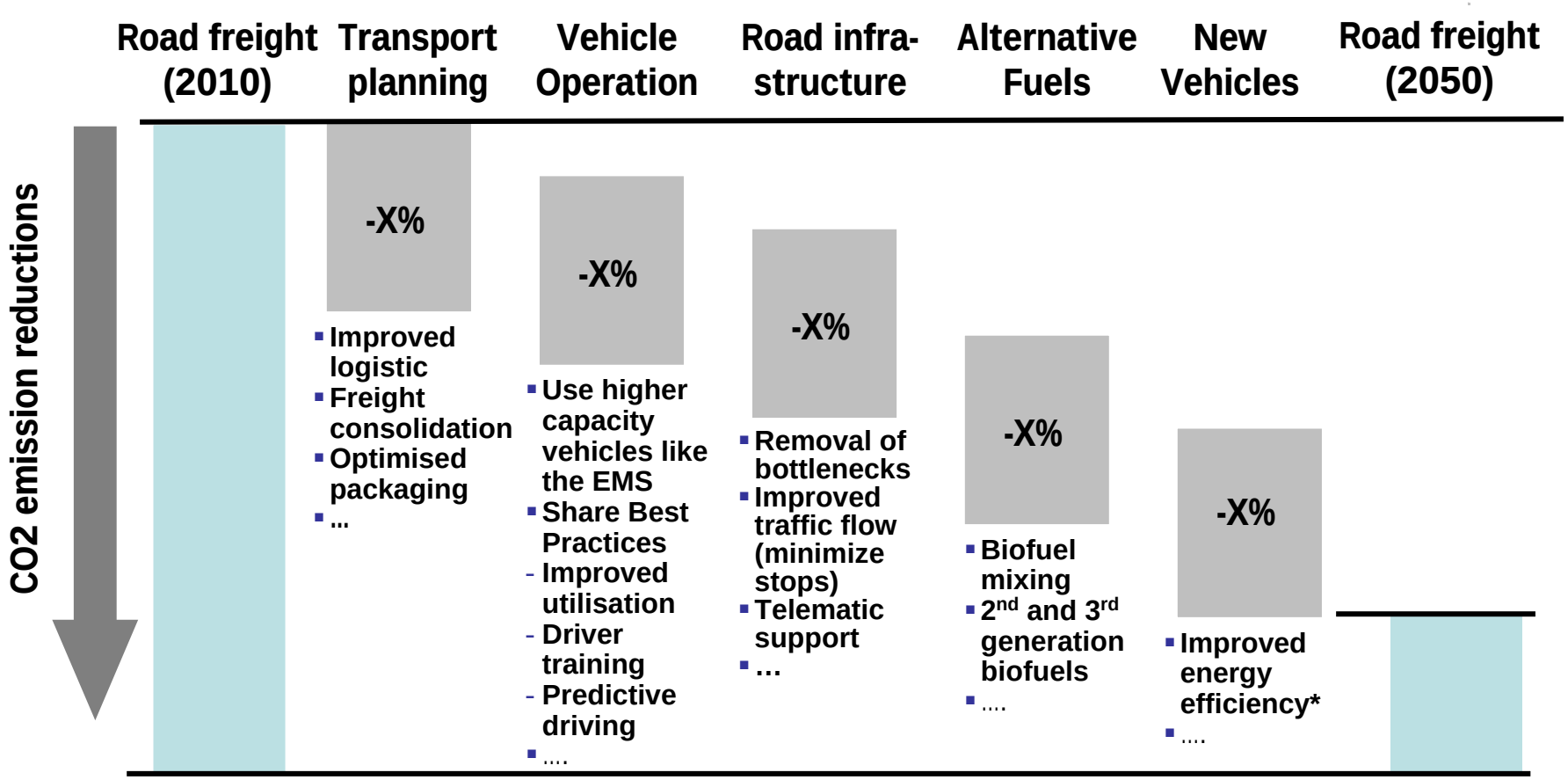
Authority objective

by supporting the development of a

“Computer tool capable of simulating an Integrated approach”

Enable **monitoring and predicting effects of different road freight measures** on fuel efficiency and CO2

Integrated Approach



* Will also require changes of existing vehicle size and weight legislation

Decoupling of CO2-emissions of road freight transport and economic growth can be achieved by an integrated approach.

Low cost FE measures – ACEA survey

Chassis cab

- Biodiesel (B7+ advanced biofuels)
- Automatic gear shift logic
- Low rolling resistance tyres
- Super single

Body

- Aerodynamic improvements* – front, rear, side and top

Trailers

- Low rolling resistance tyres
- Super single
- Aerodynamic improvements* –front, rear, side, top and bottom
- Weight reduction

Vehicle usage

- Driver training
- Eco driving tool – Driver support
- Freight consolidation
- Higher capacity vehicles (Wider use of EMS)

Fuels

Fee/Tax related to the global warming potential of fuels

* Long haul

ACEA further supports

- **Taking an integrated approach to further CO_2 emission reductions.**
- **Using cost-effectiveness as the basis for selecting policy measures for the different sectors.**
- **Studying the inclusion of road freight transport into an international, non-sector specific emission trading scheme.**
- **Pursuing globally harmonised policies for heavy-duty vehicles.**

Vehicle manufacturers are already investing in new technologies to improve fuel efficiency and to reduce CO_2

Mercedes-Benz
H2 FC City Bus

SCANIA
Ethanol Bus

VOLVO
Hybrid Bus

Thank you for your attention!

DAF
Hybrid Truck

IVECO
Eurocargo Ibrido

MAN
Hybrid Distribution Truck