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Monitoring emission savings from low rolling resistance tire labeling and phase-out regulations

MRV Blueprint based on an example from the European Union
MRV Expert Group Workshop, 20 March 2015

Authors: **Frank Dünnebeil** & Heiko Keller
IFEU Institute Heidelberg, Germany

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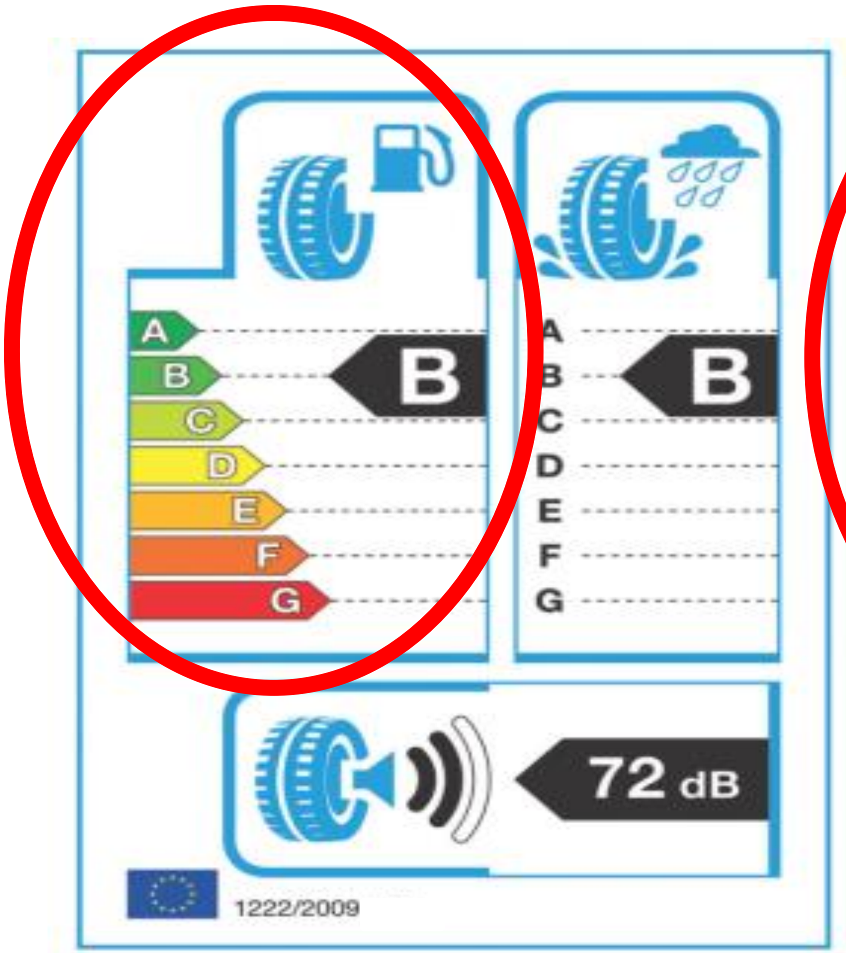
European Tire labelling and phase-out regulations

- EU regulations with technical specifications of new tires for most on-road vehicle types, introduced in 2009 and 2011.
- Main objectives of the EU regulations:
  - Improving tire-related fuel efficiency by improving rolling resistance
  - Improving road safety of vehicles
  - Reducing external rolling noise of tires
- This MRV blueprint addresses only heavy-duty trucks.

European Tire labelling and phase-out regulations
1. Step: Limit values

Rolling Resistance coefficient	
8.0 kg/t	01.11.2016 for original equipment of new vehicles and replacement tires (sale and entry into service)
6.5 kg/t	01.11.2016 for new types of tires (type approval) and 01.11.2020 for original equipment of new vehicles and replacement tires (sale and entry into service)
External rolling noise (as from 01.11.2016)	
73 dB(A)	Normal tires
75 dB(A)	Traction tires

European Tire labelling and phase-out regulations
2. Step: Standardised tire labels



Label class	Energy efficiency	Wet grip
	RRC in kg/t	G
A	<= 4	1.25 ≤ G
B	> 4 <= 5	1.10 ≤ G ≤ 1.24
C	> 5 <= 6	0.95 ≤ G ≤ 1.09
D	> 6 <= 7	0.80 ≤ G ≤ 0.94
E	> 7 <= 8	0.65 ≤ G ≤ 0.79
F	> 8	G ≤ 0.64
G	empty	empty


3dB or more below the European limit from 2016


Between the European limit from 206 and 3dB below


Above the European limit from 2016

Development of a NAMAs specific MRV methodology

Identify relevant GHG and non-GHG impacts

↓

Define „optimal“ MRV assessment boundaries and methodology: GHG and non-GHG

↓

Identify present regular data availability

↓

Define actual MRV boundaries and methodology

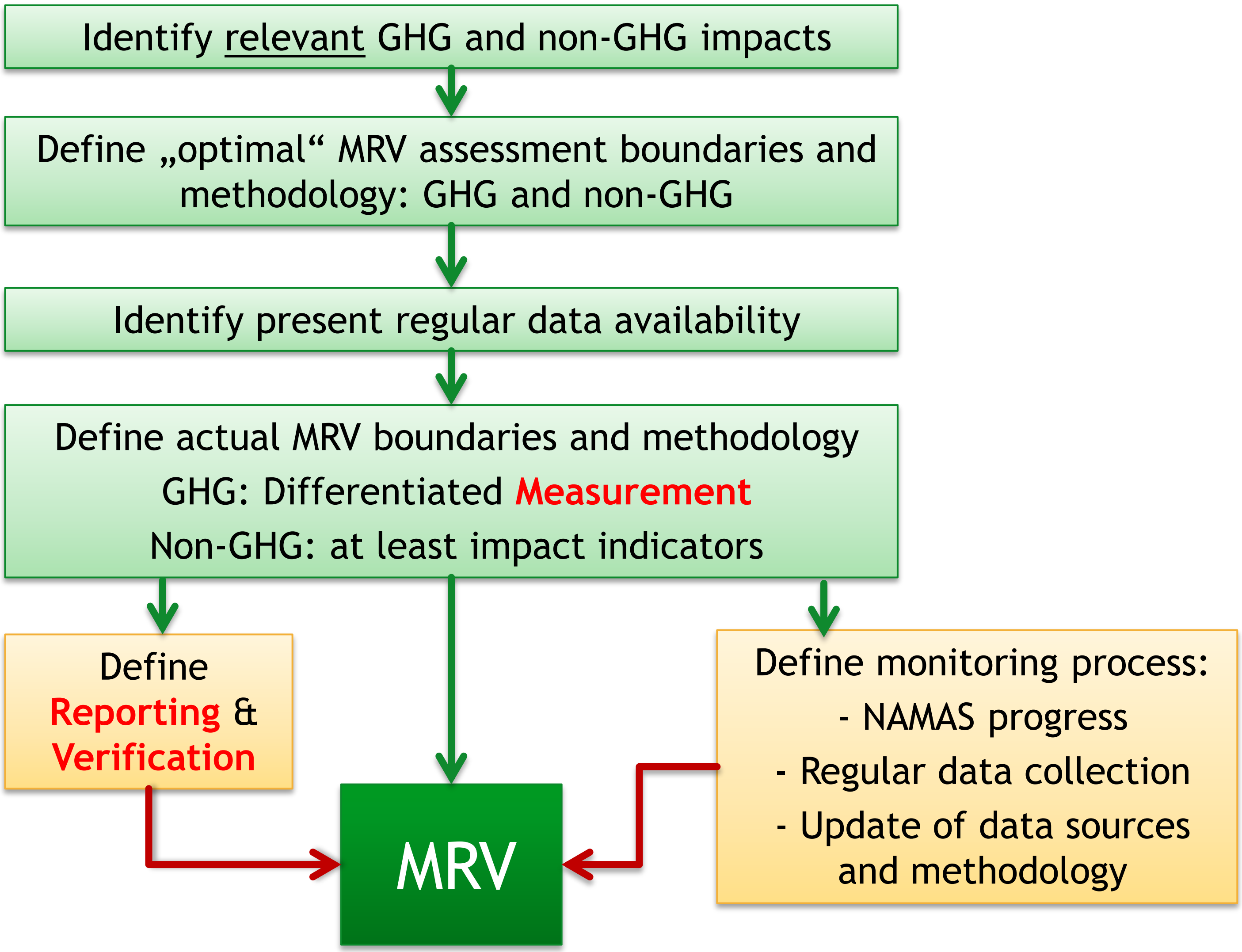
GHG: Differentiated **Measurement**

Non-GHG: at least impact indicators

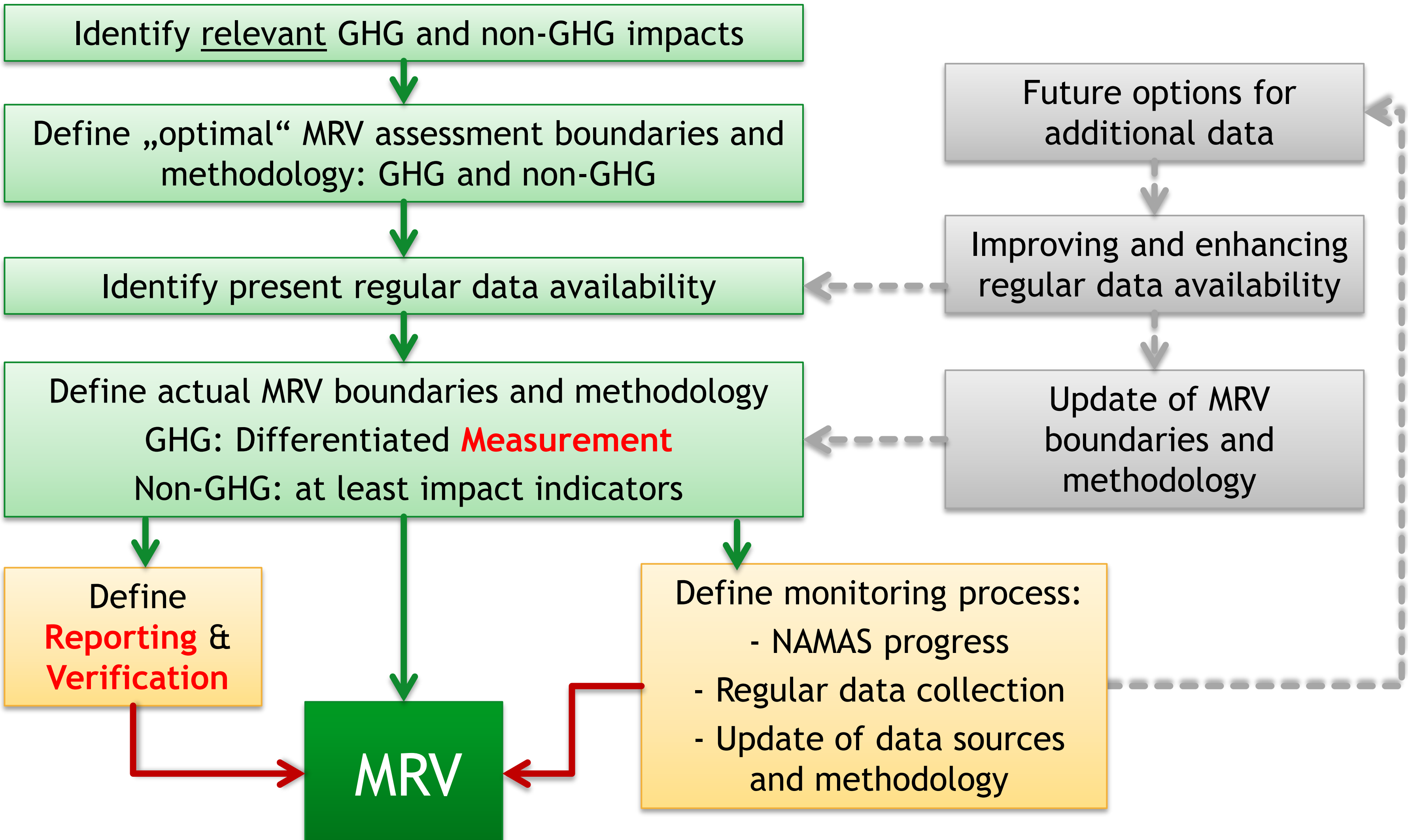
↓

MRV

Development of a NAMAs specific MRV methodology



Development of a NAMAs specific MRV methodology



GHG impacts of the measure - Impact chains

Impact chains		Activity	Structure	Intensity	Fuel
Direct impacts	Trucks	(x)		X	
Indirect impacts	Trucks	(x)			
	Trains	(x)			

Direct

Emission source	ASIF parameter	GHG impact
Heavy-duty trucks	Intensity: Specific fuel consumption per VKT	Improvement

Indirect

Emission source	ASIF parameter	GHG impact
Heavy-duty trucks	Activity: Induced additional road freight transports	Deterioration
Train, inland navigation	Structure: Shift of freight transport activities from train or inland navigation to road transport	Deterioration

Relevance of GHG impacts and interaction with other measures

Kind of GHG impact	Direction of GHG impact	Priority for inclusion in MRV
Direct impact via fuel savings in the use phase	GHG reduction	Essential
Direct impacts from other life cycle stages	Positive or negative	Negligible
Indirect impacts via vehicle cost reduction (rebound effect)	GHG increase	Optional
Interaction with other GHG mitigation measures in freight transport	Weakening of GHG reducing impacts	Relevance depends on individual measures and their impacts on transport activities, modal split, fuel efficiency and GHG conversion factors.

Non-GHG Impacts

- Other environmental impacts

Non-GHG impact	Impact
NO_x and soot particle exhaust emissions	Improvement possible
Emissions from tire abrasion	Negligible
Noise	Improvement expected
Impacts from other life cycle stages	Negligible

- Non-environmental impacts

Non-GHG impact	Impact
Road safety	Improvement expected
Vehicle operation costs	Considerable cost savings

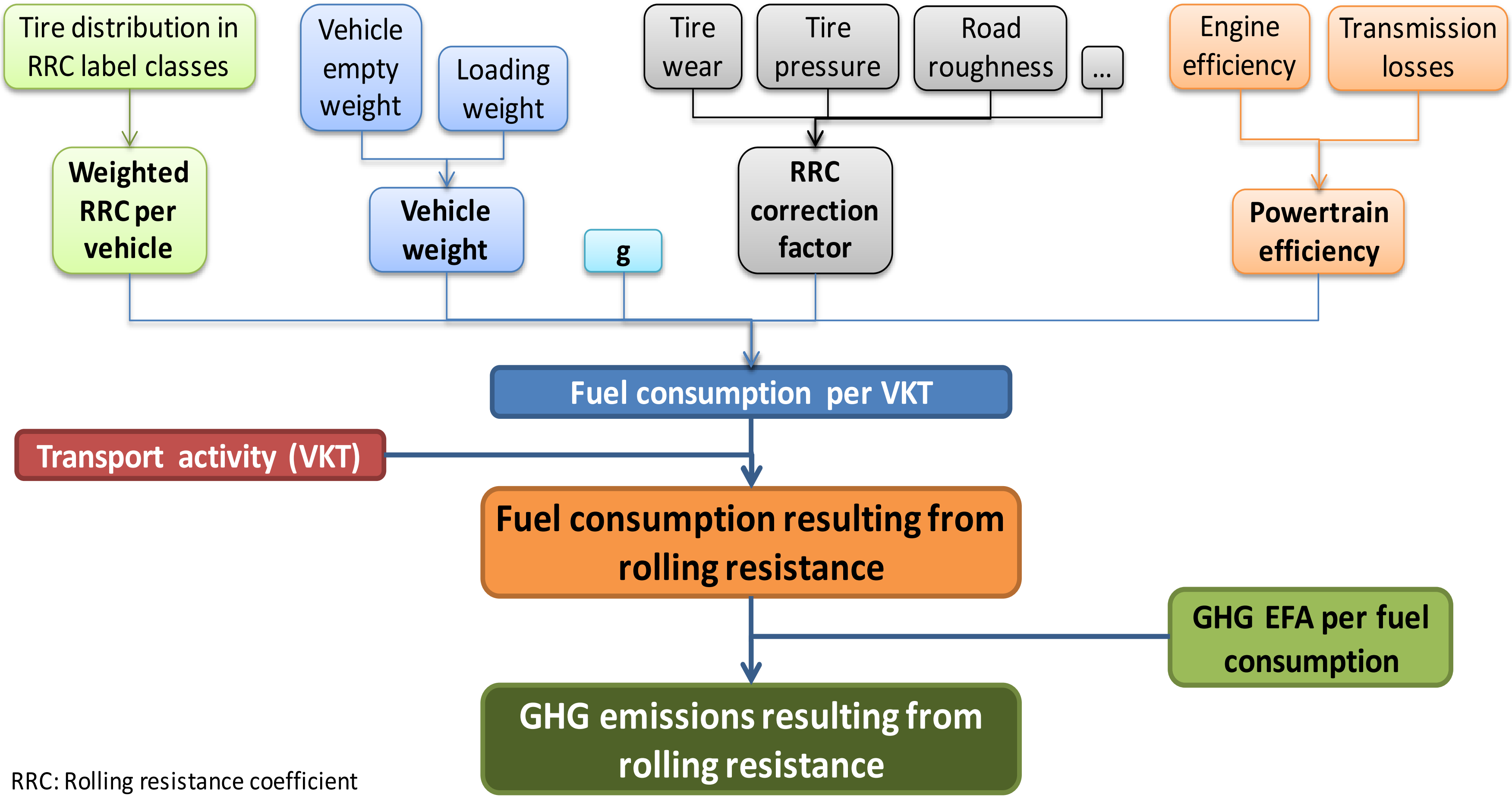
MRV assessment boundaries

- **System boundaries**
  Transport activities in the EU territory
- **Emission sources**
  heavy-duty trucks > 3.5t GVW, differentiated by 3 vehicle size segments
- **Covered GHG emissions**
  CO_2 equivalents well-to-wheel
- **Assessed non-GHG impacts**
  road safety, external noise, vehicle operation costs
- **Time interval and Reporting period**
  2020 – 2030 or later, every 1, 2 or 5 years

GHG measurement: Methodological steps

1. **Calculating real GHG emissions of heavy-duty truck transport in Europe per reporting year**
   - Calculating real **rolling-resistance related GHG emissions.**
   - Calculating real **total GHG emissions** of heavy-duty truck transport.
   - Deriving the share of rolling resistance on total GHG emissions.
2. **Measurement of absolute GHG impacts per reporting year**
   - Calculating **baseline rolling-resistance related GHG emissions.**
   - Calculating **absolute GHG impacts**.
3. **Assessment of overall GHG impacts for heavy-duty truck transport in Europe in the reporting year**
   - Calculating **baseline total GHG emissions** of heavy-duty truck transport.
   - Calculating **percentage change of total GHG emissions of heavy-duty truck transport** in Europe.

GHG measurement: Basic model approach



RRC: Rolling resistance coefficient

GHG measurement: Equations and calculation parameters

$$FC_{RR,spec.} = RRCreal \times C_{RRC} \times m \times g / \eta_{pt} /1000 \qquad (1)$$

Where:

$FC_{RR,spec}$	Real specific fuel consumption per VKT from rolling resistance (in MJ/vkm)
RRCreal	Real Rolling resistance coefficient (in kg/t)
C_{RRC}	RRC correction factor (dimensionless)
m	vehicle weight (=empty weight + vehicle load) (in tons)
g	gravity acceleration (9,81 m/s²)
η_{pt}	average powertrain efficiency of the vehicle (in %)

Calculation parameter	Description	Unit	Influenced from measure	Data sources in section
RRCreal	Real medium Rolling resistance coefficient per vehicle segment and year	kg/t	Yes	4.6.1
C_{RRC}	RRC correction factor	-	No	4.6.2
m	Vehicle mass (=empty weight + vehicle load) per vehicle segment and year	metric tons	No	4.6.2
g	Gravity acceleration: 9.81 m/s²	m/s²	No	-
η_{ttw}	Medium powertrain efficiency per vehicle segment and year	%	No	4.6.2

GHG measurement: Data sources of calculation parameters

Calculation parameter	Description	Unit	Data sources
RRCreal	Real medium Rolling resistance coefficient per vehicle segment and year	kg/t	Market offer of truck tires (see section 4.6.1)
RRCbaseline	Baseline medium Rolling resistance coefficient per vehicle segment and year	kg/t	Estimates in section 4.6.1
g	Gravity acceleration: 9.81 m/s^2	m/s^2	- (physical constant)
C_{RRC}	RRC correction factor	-	[Bode / Bode, 2013], [IFEU, 2015]
η_{ttw}	Medium powertrain efficiency per vehicle segment and year	%	[IFEU, 2015]
m	Vehicle mass (=empty weight + vehicle load) per vehicle segment and year	metric tons	HBEFA 3.1 [INFRAS, 2010], TRACCS [Emisia, 2013]
VKT	Annual VKT per vehicle segment	million vkm	TRACCS [Emisia, 2013], EU Transport in figures [EU, 2013]
$FC_{total,spec}$	Specific fuel consumption per VKT per vehicle segment and year	MJ/vkm	TRACCS [Emisia, 2013], HBEFA [INFRAS, 2010]
Biofuel share	Share of biofuels on diesel fuel in Europe. (required for calculating weighted GHG conversion factors)	%	EU transport in figures - statistical pocketbook [EU, 2013]
$GHG_{fuel,spec}$	GHG conversion factor for diesel fuel in Europe per year	g CO_2e/MJ	EN 16258 [COM, 2013]

→ Real market data (RRCreal)

→ Baseline estimates (RRCbaseline)

} Scientific research (C_{RRC}, η_{ttw})

} Official statistics and coordinated country data (m, VKT, $FC_{total,spec}$, Biofuel share)

→ Standards ($GHG_{fuel,spec}$)

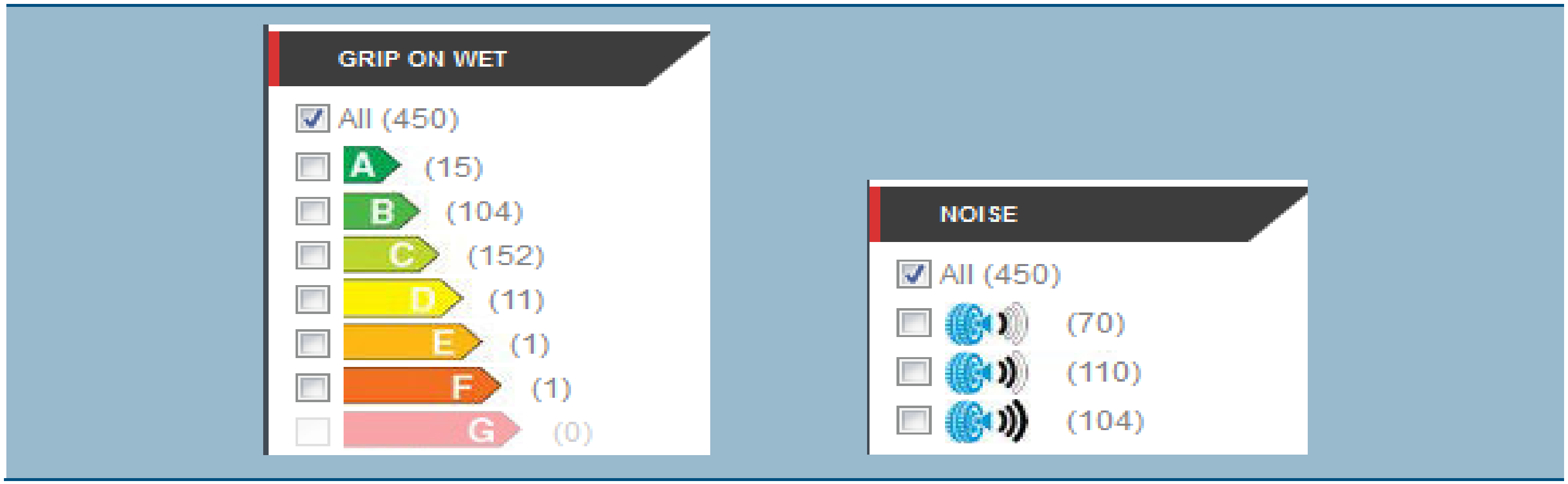
GHG measurement: Calculation example

Calculation parameter	Value 2020	Unit
RRCreal	5.75	kg/t
RRCbaseline	6.30	kg/t
C_{RRC}	1.0	-
m	25.1	metric tons
g	9.81	m/s^2
η_{ttw}	41%	%
VKT	124'363	million vkm
$FC_{total,spec}$	11.04	MJ/vkm
$GHG_{fuel,spec}$	87.2	g CO_2e/MJ

Equation		Calculation	Result	Unit
1	***$FC_{RR,spec}$ real***	5.75 x 1.0 x 25.1 x 9.81 / 0.41 / 1000	3.45	MJ/vkm
	$FC_{RR,spec}$ baseline	6.30 x 1.0 x 25.1 x 9.81 / 0.41 / 1000	3.78	MJ/vkm
2	***GHG_{RR} real***	124'363 x 3.453 x 87.2 / 10^6	37.4	million tons
	GHG_{RR} baseline	124'363 x 3.784 x 87.2 / 10^6	41.0	million tons
3	***GHGtotal real***	124'363 x 11.04 x 87.2 / 10^6	119.7	million tons
4	***GHGshare real***	0.037 / 0.120	31.3	%
5	***$GHGsaving_{absolute}$***	0.041 - 0.037	**3.6**	**million tons**
6	***$GHGtotal_{,baseline}$***	0.120 + 0.004	123.3	million tons
7	***$GHGsaving_{share}$***	0.004 / 0.124	**2.9**	**%**

Indicators for non-GHG impacts

Road safety and external rolling noise



Vehicle operation costs

$$COSTsaving = \frac{GHGsaving_{absolute}}{GHG_{fuel.spec.}\ x\ 35.74\ x\ 10^6}\ x\ fuel\ price\ x\ 80\% \qquad (8)$$

Where:

$COSTsaving_{,share}$	Cost saving per year (in million Euro)
$GHGsaving_{absolute}$	Absolute GHG saving (in million tons)
$GHG_{fuel,spec.}$	GHG conversion factor for the used fuel (in g CO_2e/MJ)
35.74	Conversion factor for fuel consumption (35.74 MJ/litre diesel)
fuel price	Fuel price (in Euro/litre Diesel)
80%	Reduction factor for additional investment costs

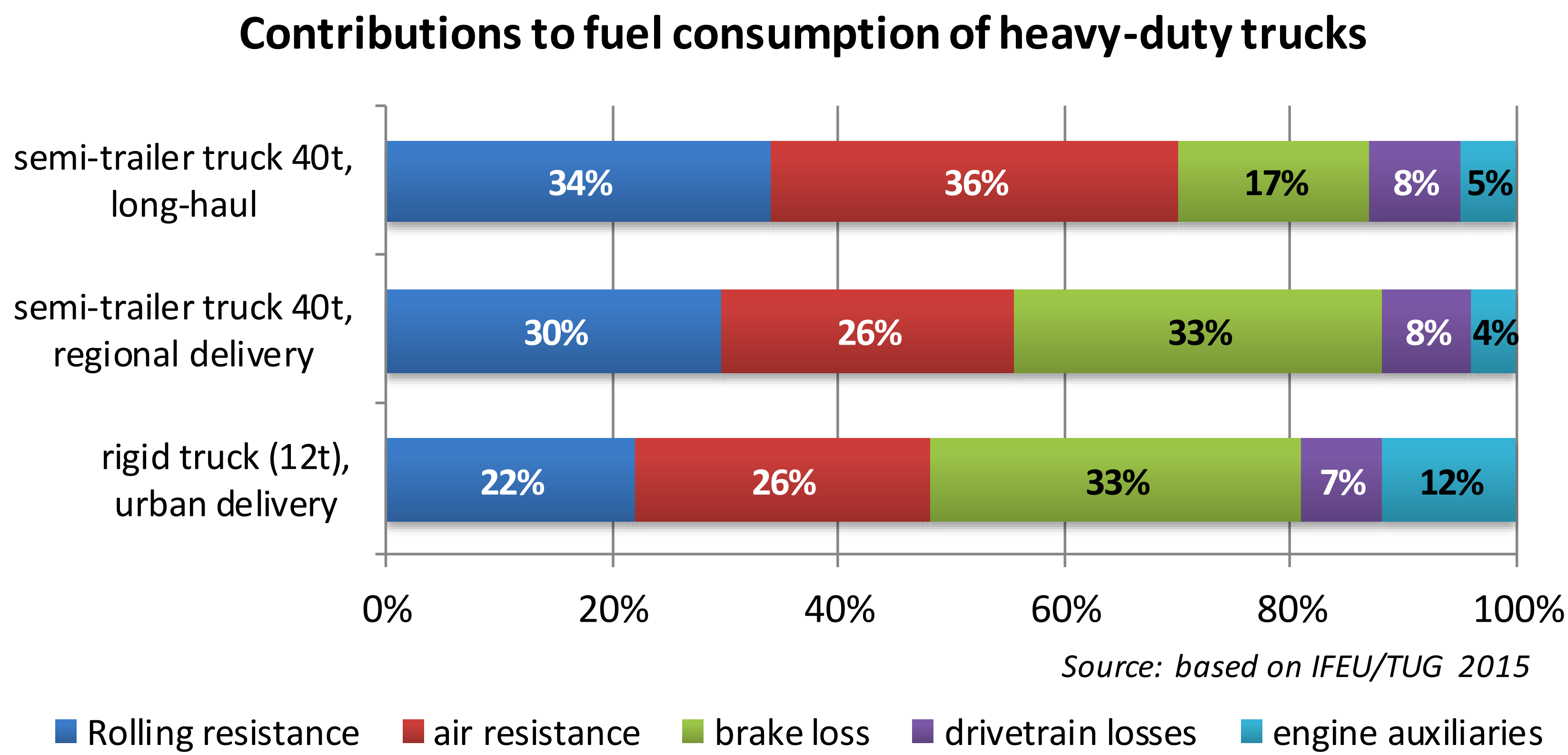
Thank you for your attention!

Questions and remarks?

Frank Dünnebeil
ifeu - Institut für Energie- und
Umweltforschung Heidelberg GmbH
Wilckensstraße 3
69120 Heidelberg

Fon: +49 (0) 6221 / 47 67 -61
Fax: +49 (0) 6221 / 47 67 -19
E-Mail: frank.duennebeil@ifeu.de

Role of rolling resistance for fuel consumption and GHG emissions



10% reduction in rolling resistance reduces fuel consumption and GHG emissions by 2-3.5%.

Assessment of uncertainties

Following uncertainties of GHG impacts are assessed in the MRV blueprint:

- Accuracy of calculation parameters
  - Real development of rolling resistance coefficients
  - Powertrain efficiency and RRC correction factors
  - Basic data for transport activities and specific fuel consumption
- Differentiation level of calculation methodology and therewith possible accuracy of results
  - High differentiation levels with high accuracy, but with high data requirements and calculation efforts
- Appropriateness of baseline assumptions
  - Baseline development of rolling resistance coefficients

Applicability of the MRV blueprint for related NAMAs

- Applicability of this exemplary MRV blueprint to NAMAs in other regions depends first on the comparability of the measures. ➔ Focus = improving rolling resistance?
- Measurement of **GHG impacts**: Main differences concern
  - **Level of detail in the calculations:** Adopting this MRV blueprint to NAMAs for regions with reduced data availability might require simplified calculations, e.g. using one average RRC for the whole vehicle fleet.
  - **Assessment boundaries:** Adopting this MRV blueprint to other regions might require a change of assessment boundaries, e.g. only including truck transport on highways and only semi-trailer trucks, depending on the regular availability of transport statistics.
  - **Baseline assumptions:** In Europe, there are still no relevant interactions of tire regulations with other GHG mitigation measures. However, interaction with further measures can be relevant in other regions. E.g. fuel efficiency standards for heavy-duty trucks (as in China) can lead to RRC improvements also without a tire-specific measure.
- Indicators for **non-GHG impacts** can be adopted from the exemplary European MRV blueprint, if NAMAs in other regions include similar requirements on wet grip and rolling noise and information on the real development of these parameters is regularly available.

Main differences to the originally suggested structure

- Non-GHG impacts are not only co-benefits.
- Non-GHG impacts are relevant part of the continuous MRV process.
- MRV blueprint does not document data availability for optimal, but for actual MRV boundaries and methodology. ➔ Part of methodology section, not impact chains.
- Selected MRV assessment boundaries and potential future enhancements are explained in the impact chains section. Could also be first step in the methodology section.
- Methodological approach first step in the methodology section, not part of the impact chains section.
- Applicability, definition of key terms, consistency are discussed after methodological approach for impact measurement.
  - Assumptions are part of data sources section.
  - Consistency could be part of MRV boundaries or discussed together with assessment of uncertainties.
  - Applicability for further NAMAs is a separate section.
- Reporting and verification sections included in the MRV blueprint