Ricardo – Feedback on JRC proposals for use-phase concept; proposed revisions *update*

IWG Automotive LCA, SG4 – Use Phase 4th Meeting,
WebMeeting, 10 October 2023

Draft CO₂eq Calculation (JRC)**

Lifetime GhG [CO2eq] = GhG [CO2eq] * total average distance [km] + Maintainance * occurrences + waste (total)

Might also consider age-dependent km/yr; or too complex?

Urea use related to energy consumption, rather than 'occurrences' at least for HDV

…(g/km)?

Not clear what arrows mean is this a sequence or change?

GhG [CO2eq.] (g/km) = Energy consumption (MJ/km) * Factor SG6 + Fuel Energy Consumption (g/km) * Factor SG6 + fugitive emissions + other emissions (TBD from the guidebook)

Might be related to energy consumption not km in some cases – e.g. H2 *

Unclear why twice/two units – do you mean for operation on more than one energy type?

Energy consumption OR Fuel energy consumption = TA Value (or equivalent) * RW correction factor [lvl1, lvl2, lvl3, lvl4] * degradation factor [lvl1, lvl2, lvl 3,lvl 4] * other factors (?)

e.g. fuel cell efficiency loss (degradation) over lifetime up to 10% (EoL); Battery efficiency loss at 80% SoH (EoL) vs new

Somewhere: how to account for share of operation on multiple modes, e.g. PHEV, dual-fuel or Catenary vehicle (also factoring in real-world energy consumption corrections)

** Important to define levelling concept [lvl1, lvl2, lvl 3,lvl 4] and the data sources

* Source: A multi-model assessment of the Global Warming Potential of hydrogen (nature.com); Hydrogen is a more potent greenhouse gas than previously reported, new study reveals (hydrogeninsight.com)

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Fuel Consumption/Efficiency

Ideal situation – may be practically difficult to achieve… also question if really needed…

Specify for each type of vehicle, cycle (i.e. for HDVs there may be multiple for the same vehicle sub-class), and powertrain

Equivalence matrix (for positive energy demand & mean efficiency)

ratio	WLTP	NEDC	US06	FTP	JC08	....	other
WLTP							
NEDC							
US06							
FTP							
JC08							
.....							
other							

Applicable test cycle-procedure

Normalization to common reference based on equivalence matrix

OBFCM/Real world correction

Energy & CO2 Factor (EF)

Also need to consider different shares/definitions for powertrain operation on multiple fuels? E.g. PHEV, REEV, Catenary vehicles operating on overhead vs battery or gaseous or liquid fuel?

But this is also likely to be regional… and also cycle-specific: more complex for different HDV operational cycles…

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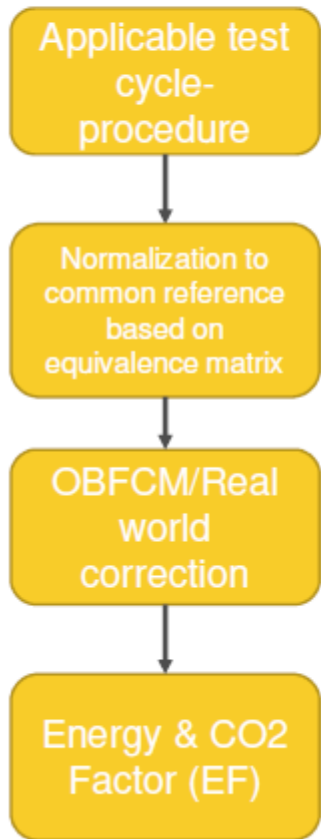
Vehicle specification needs to be defined at least by class/subclass, cycle and powertrain…
(for reference model variant, or specific model variant)

Vehicle class	Vehicle sub-class (Is globally generic possible?)	Cycles (regional variations)	Powertrain
Passenger car (M1)	e.g. Mini, small, lower medium, etc. ?	e.g. WLTP, etc.	Gasoline ICEV, Gasoline HEV, Diesel ICEV, …, Gasoline PHEV, …, BEV, FCEV, etc.
Van/LCV (N1)	e.g. N1 Class I, II, III?	e.g. WLTP, etc.	
Heavy rigid truck/van (N2, some N3)	e.g. heavy vans, various rigid GVW categories, e.g. EU Vecto classifications or as defined in regions	e.g. EU certification cycles: Urban delivery, Regional delivery,…, other regional cycles	
Heavy articulated truck (N3)	e.g. EU Vecto classifications		
Minibuses, buses and coaches (M2, M3)			
2/3 wheelers			

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Level Concept for SG4

Would argue for Level 4 it should be specific model/variant, not just a 'reference vehicle'

We may need to agree always standard global or regional, AS WELL as a more specific variation for >Level 1?

USE PHASE	Reference Vehicle	Representativeness	Energy consumption		Maintenance	Service Life
			In-use	**Charging**		
Level 1	General concept per powertrain tech /energy carrier	Global average	Average homologation value normalized to WLTP corrected for RW (global)	Generic charging efficiency (?)	Generic (by powertrain)	Generic/Global
Level 2	Same as Lv 1	Regional (EU/US/JP/KR/CN…)	Regional RW correction	Regional charging efficiency value (standardised)	Generic/regional (by powertrain)	Regional / Unique service life
Level 3	Representative vehicle for each OEM/powertrain/energy carrier (need to define criteria)	OEM/National	OEM-resolution and assumptions for RW performance	OEM average efficiency (standardised?)	OEM Specific (by powertrain)	Regional with option to declared higher life
Level 4	Specific OEM's vehicle model	OEM's specific vehicle model	High-resolution RW value (based on OBFCM or similar data)	Vehicle specific charging efficiency (standardised?)	Model specific	OEM/Model specific average data

Already included in WLTP, NEDC. Do you mean a correction, or accounting for rapid charging or for other cycles where might not be already included?

This should already be OEM and model-specific (for the representative configuration) at Level 3? There is really no excuse for it not to be.

Missing: (i) rules for <u>using</u> default energy mix projection (SG6 defines method), (ii) Recommended sensitivities for use-phase, e.g. activity/lifetime, real-world or use-case sensitivities, battery/V2G sensitivities, etc.

- "OEM's specific vehicle model **and variant /configuration**" – i.e. engine, battery size, other options

Should already be a "Representative vehicle **model variant /configuration** for each…"

Here it might be further specific to a particular vehicle model **and variant/configuration**?

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Level Concept for SG4 – Ricardo feedback on potential revisions 10/10/23

Up to the relevant CP/ region to decide what is needed/used or not.

USE PHASE	Reference Vehicle	Representativeness	Energy consumption		Maintenance	Service Life	Other
			In-use	Charging			
Level 1 (Generic)	General concept per powertrain tech /energy carrier	Global average	Average regional homologation value (*ideally* normalized to WLTP) corrected for RW (e.g. basic global SBTI value of 1.1)	Generic charging efficiency (unless already included in homologation)	Generic by powertrain	Generic/Global	Projected energy mix use (current policy); Default factors fugitive emissions + degradation
Level 2	Same as Lv 1	Regional (EU/US/JP/KR/CN…)	+Regional RW correction (can be =Lv1 if required by specific CP)	+Regional charging efficiency value (standardised)	As for Level 1	Regional / Unique service life	As previous level, plus specific sensitivities?
Level 3 (OEM)	*Representative* vehicle model variant for each OEM /powertrain /energy carrier (need to define criteria)	OEM's specific vehicle model	OEM model variant, regional RW corr. *or optional* OEM specific alternative assumptions for RW performance	OEM model efficiency (standardised)	OEM model-specific (for the representative configuration) by powertrain	Regional with *option* for OEM to declared higher life with evidence	As previous level
Level 4 (OEM+)	**None:** OEM specific vehicle model and variant /configuration (i.e. engine, battery size, other options, etc)	OEM's specific vehicle model and variant	Specific model/variant EC, plus High-resolution RW value (based on OBFCM or similar data)	As for Level 3, but also by specific model variant (if different)	As for Level 3, but also by specific model variant (if different)	As for Level 3	OEM model-specific fugitive emissions + degradation factors

FOR DISCUSSION

Level Concept for SG4 – Ricardo simplified alternative 10/10/23

> Up to the relevant CP/region to decide what is needed/used or not.

USE PHASE	Reference Vehicle	Representativeness	Energy consumption		Maintenance	Service Life	Other
			In-use	Charging			
Level 1 (Generic)	General concept per powertrain tech /energy carrier	Global or regional average (EU/US/JP/KR/CN…)	Average global or regional homologation value (*ideally* normalized to WLTP) corrected for RW (global, e.g. SBTI value of 1.1, or regional RW if required by CP)	Generic global or regional charging efficiency (unless already included in homologation)	Generic by powertrain type	Generic global or regional	Projected energy mix use (current policy); Default factors fugitive emissions + degradation factors
Level 2							
Level 3 (OEM)	*Representative* vehicle model variant for each OEM /powertrain /energy carrier (need to define criteria)	OEM's specific vehicle model	OEM model variant + regional RW corr. *or optional* OEM specific alternative assumptions for RW performance	OEM model efficiency (standardised)	OEM model-specific (for the representative configuration) by powertrain	Regional with *option* for OEM to declared higher life with evidence	As previous level, plus specific sensitivities *(to be agreed)*
Level 4 (OEM optimal)	**None:** OEM specific vehicle model and variant /configuration (i.e. engine, battery size, other options)	OEM's specific vehicle model and variant	Specific model/variant EC, plus high-resolution RW value (based on OBFCM or similar data)	As for Level 3, but also by specific model variant (if different)	As for Level 3, but also by specific model variant (if different)	As for Level 3	+OEM model-specific fugitive emissions + degradation factors

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Methodological question

- What happens if the user selects values from different levels because of data availability e.g. 4/6 values are level 4 one value is level 3 and one is level 2?

  – Is that acceptable?

  – RIC: Yes, I think we should always encourage maximum fidelity/level possible, however if we were to consider 'certification' it would only be possible to be (for example) 'Level 3' if compliant with all elements. Perhaps could consider a Level X+ (e.g. Level 2+) to indicate that some elements go beyond the minimum requirements for the level.

- If yes, then lower levels should have more conservative values to encourage measurement/data provision

  – RIC: Not necessarily; this could potentially be counter-productive in providing as accurate as possible information to the consumer at different levels. Perhaps selectively – needs discussion.

- Other boundaries to be included?

  – RIC: Unsure what this question means…

Thank you

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Colour key:
OEM foreground
Vehicle variant specific reporting
Informing internal strategy or policy analysis

Ricardo's initial conceptual thinking
Potential options to apply the levels concept to the Use Phase

Level	Potential assessment methods / items for development by SG
Lv.1	• Define default operational cycles to be considered (also for relevant regions), e.g. vehicle specific energy consumption and CO_2 on driving cycles, e.g. WLTP or VECTO • Develop guideline for basis and coverage of emission components, and operation/maintenance aspects; e.g. for non-CO_2 GHG from exhaust or fugitive emissions (e.g. CH_4, N_2O, H_2), generic definition of default fluids and parts consumed/replaced, intervals, etc. • Define key sensitivities that should be considered (for policy/internal use), including accounting for real-world effects on energy consumption/CO_2
Lv.2	• Develop an approach for model-specific maintenance, part replacements and consumables • Define also approaches for alternative regional use cases and/or sensitivities
Lv.3	• Add manufacturer-specific accounting for real-world performance (i.e. from monitoring of products)? • Extend detailed LCA to provide specific accounting for model variants/configurations *[also production]* • Add sensitivities for other considerations e.g. battery 2nd life, V2G (or other consequential aspects)
Lv.4	• Develop guidelines for accounting for higher-resolution manufacturer-specific real-world performance accounting (i.e. from monitoring of similar existing products)

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