Former issues of this standard: none

1. Scope and field of application:

1.1 This EUWA - Standard defines guidelines on what the CO_2 Footprint Efficiency Indicator is about and how the calculation of the CO_2 Footprint Efficiency Indicator should be executed

1.2 Please also use EUWA ES 1.13 for reference. This EUWA standard defines in detail how the PCF (Product Carbon Footprint) calculation must be executed by EUWA members in order to have a correct and reproducible PCF value that must be used for any CO_2 Footprint Efficiency Indicator Calculation as per this spec and marked clearly as EUWA Indicator. If there are specific customer requests for the calculation, then these have to be marked/labelled accordingly. Following these two EUWA standards guarantees that calculations on sustainability are consistent across EUWA members.

2. References

2.1 Definition - A parallel definition has been done in EUWA ES 1.13 and ES 1.14

2.2 Baseline definitions for the PCF calculation as per actual ISO 140 67 and other relevant standards of ISO 140 xx series.

3. Application

3.1 The EUWA CO_2 Footprint Efficiency Indicator is a tool that quantifies the effectiveness of the ratio of the product's carbon footprint in relation to other characteristics and the way the vehicle is used. This quantification is missing in the industry and hence qualitative comparisons from one product to another are complicated to execute.

3.2 The EUWA CO_2 Footprint Efficiency Indicator gathers first of all the CO2 equivalent - Cradle to Gate relative to the wheel production – and sums that up in a separate LCA/PCF calculation as per EUWA ES 1.13. Extending the observation time to Cradle to Grave has been considered by the EUWA members but for the current situation rated as considerably limited possibility of application by EUWA members.

3.3 The EUWA CO_2 Footprint Efficiency Indicator is valid for any kind of wheel produced. No matter whether a steel, an aluminum cast or forged wheel, a composite wheel or a hybrid one.

3.4 In order to be actual, the EUWA CO_2 Footprint Efficiency Indicator Calculation should be repeated within a reasonable time (proposal would be each two years or if the indicator value changes by more than 30%). It is assumed that EUWA members strive to permanently reduce their CO_2 footprint for the business operations Scope 1, 2 and 3. In

order to make this visible for improvements on the indicator, LCAs/PCF analysis as a basis for the indicator calculation should be up to date. See definition in EUWA ES 1.13.

3.5 For some wheels different maximum wheel loads (or wheel application loads) may be defined. For the indicator calculation the wheel load from the customer definition (RFQ or SOR) must be used, i.e. the one that is also driving the wheel test load calculation for the fatigue testing of the wheel. This load constitutes always the worst load condition, i.e. the maximum static load.

3.6 The EUWA CO_2 Footprint Efficiency Indicator can be theoretically be used for many other vehicle components that are driven by one exposed physical dimension (in case of wheels: the maximum wheel load). By normalizing the CO_2 equivalent emissions to this exposed value a fair comparison from part to part are possible on how well they are performing on CO_2 Equivalent Cradle to Gate emissions.

4. Definition

4.1 The definition formula of the EUWA CO_2 Footprint Efficiency Indicator is as follows

$$\mathbf{ICO_2} = EQ*M*100/T$$

Where:

ICO_2	EUWA CO_2 Footprint Efficiency Indicator for a specific product
EQ	**PCF** value Cradle to Gate for this product as calculated according to the EUWA standard ES 1.13 in [kg CO_2 Equivalent/kg wheel weight]
M	Average nominal mass as calculated/measured middle of tolerance in [kg]
T	Nominal maximum wheel load as defined by the customer in SOR or maximum half axle load as per the homologation papers of the vehicle for this specific wheel (maximum static load) in [kg]

4.2 The resultant from EQ and M will map the total carbon footprint load on this wheel expressed in [kg] CO2 eq. for cradle to gate scope of calculation

4.3 The fraction T/M is a typical light weight indicator. For mechanical components it clearly shows how much [kg] a mechanical part can bear per [kg] of its own mass. The higher this value the better the lightweight performance of the part.

4.4 The “100” is a calibration factor to bring the indicator to a one or two digit positive dimension

4.5 It is clear that there is no better value than in ideal “0” for the EUWA CO_2 Footprint Efficiency Indicator. If the LCA turns out to be 0 kg CO2 equivalent loading on the part per kg wheel weight, then the Carbon footprint Efficiency value must be always 0. The value will be small the bigger the light weight indicator is. There will not be negative values for the EUWA CO_2 Footprint Efficiency Indicator since offset calculations are not allowed following EUWA ES 1.13.

4.6 As essential for a typical indicator the EUWA CO_2 Footprint Efficiency Indicator is dimensionless.

5. Sample CO_2 Footprint Efficiency results

5.1 A typical sample calculation and visualization for the EUWA CO_2 Footprint Efficiency Indicator is shown in diagram 1.

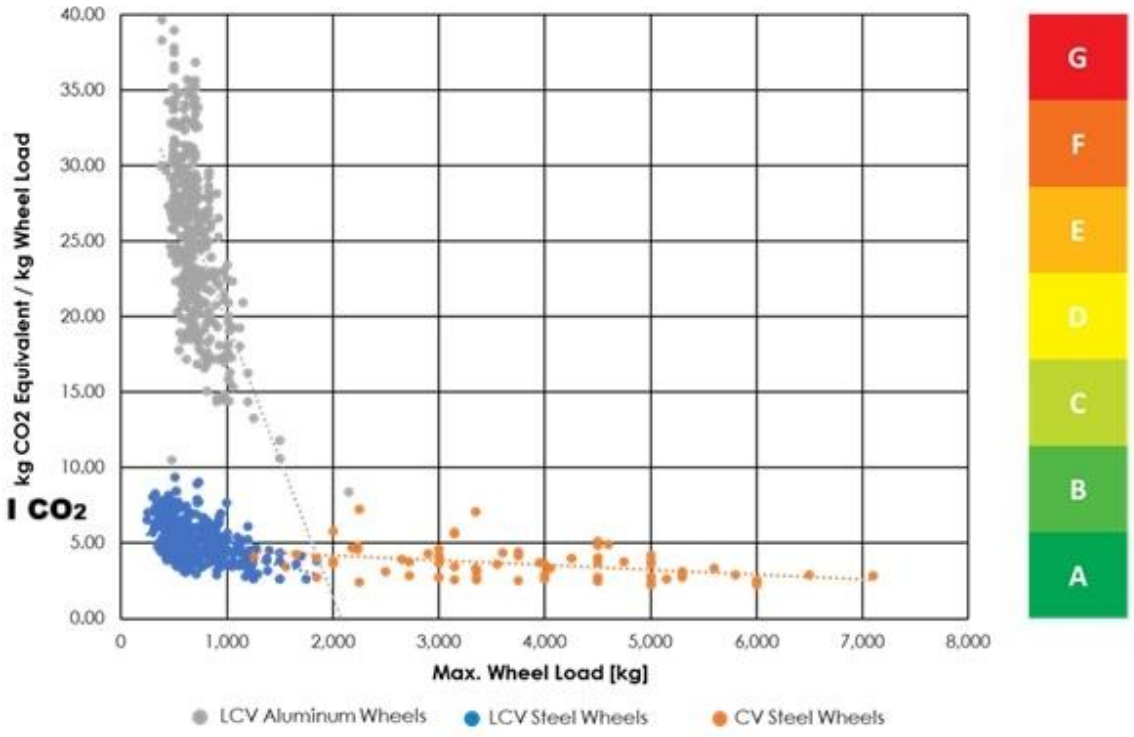

Diagram 1: Sample visualization of the EUWA CO_2 Footprint Efficiency Indicator vs wheel load

5.2 Interpretations of diagram 1

- The steel wheels will generally show better indicator values than the aluminum cast wheels. Main reason is that the raw material (Primary aluminum influence 70-90%) for Aluminum is more energy intensive for production and brings a bigger contribution to the carbon emissions of the material.

- Steel wheels, PC and truck, agricultural and off the road are in the same range
- Wheels with a higher load rating have slightly better performance due to better lightweight indicator usually
- Both aluminum and steel wheels are improving year over year due to the improvements that EUWA members are introducing for their products

5.3 Possible Applications

The wheel industry is facing several competing targets on sustainability from the OEM customer base. Customers are demanding either a target value for a maximum CO_2 Equivalent level for the raw material or for the finalized product. But also recycled content definition percentages and even usage of x% pre-consumer and/or post-consumer scrap or requirements concerning primary aluminum/steel are valid targets for new RFQs.

The wheel suppliers suffer from this diverse target base and have extreme difficulties to steer and monitor the fulfilment of these competing targets in the wheel production plants.

6. CO2 Footprint Efficiency Label

6.1 A further idea from the EUWA has been to introduce a CO_2 Footprint Efficiency Label to clearly visualize for OEM, OES and aftermarket customers, what the CO_2 Equivalent performance of their products is like and how it compares in relation to other products. The basis for the rating is always the CO_2 Footprint Efficiency Indicator as described under items 1-5.

6.2 EUWA discussed CO_2 Footprint Efficiency labels as unified or separated ones for steel and aluminum.

6.3 EUWA members discussed the content to be shown on a potential CO_2 Footprint Efficiency label for wheels that should indicate:

- Material of the wheel (aluminum, steel, composite, hybrid, etc.)
- Wheel category (Passenger Car, Truck, Agricultural, Off the road, Forklift, etc.)
- Wheel manufacturer
- Wheel part number
- Date of the LCA as basis for the Indicator
- Value of the indicator
- Total kg CO_2 Equivalent Cradle to Gate load on the wheel in [kg]
- QR code with additional information on the wheel

6.4 Finally it was decided to actually not use the label with EUWA promotion currently. Based on the developments at the EU level this proposal might be revisited.