REVISION

Representative Vehicle

Reworked proposal

Why Representative Vehicle (RV)?

Only Passenger cars

- Vehicle‘s LCAs are complex calculations
  - It is essential to clearly define a RV, which is representing a group of vehicles
    - **One RV represents One “LCA group”**
  - RV selection should be globally harmonised
  - We focus only on passenger cars, HDVs need a separate discussion
- Specific „non generic“ LCAs can‘t be performed in advance of a vehicle‘s production
  - RV is the solution to deliver LCAs that are fit for use

Note:

☞ Carbon emissions are generated during the manufacturing stage of the vehicle: raw material acquisition, manufacturing of parts & vehicle **[Upstream emissions]**

☞ Further carbon emissions are generated during the use phase **[Downstream emission]**

☞ Finally at the end of life of the vehicle further emissions to be considered **[EoL emission]**

Only Passenger cars

Only upstream emission

Purpose to define a RV

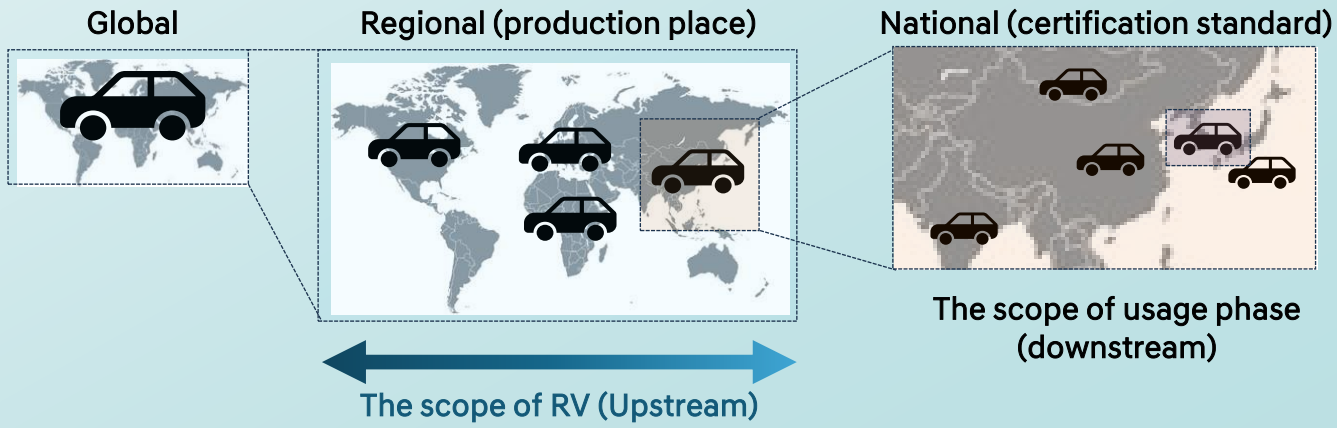
- Is downstream emission required for RV definition? → NO
  - Downstream emissions are well covered in the certified fuel / energy efficiency data.
  - Downstream emissions do not influence the upstream emissions, and they can be handled independently
    → Downstream emission is sales region specific
    → Upstream emission is production region specific

How to define „LCA group“?

- The definition of “Vehicle Type” can be taken as reference
  → EU Regulation 858/2018, which specifies the criteria for M1 vehicles.
  - “Type” refers to a group of models with the same design and basic structure.
  - “Variant” is a further division of “Type” based on major technical differences that include transmission type, fuel type, and driving method(2WD/AWD).
  - “Version” is a further division of “Variant”. The basic technical specifications are the same, but they are differentiated by options, trim, parts, etc.
- “LCA group” can be specified by “vehicle Type” & fuel type /powertrain type*

** Gasoline ICE / Gasoline HEV / Gasoline PHEV / Diesel / LPG / Electric / Hydrogen / (…)*

- Expansion the definition of LCA group by region to cover the production place



How to define „LCA group“?

TYPE (Vehicle X)

VARIANT Ⅰ (ICE AWD)

- Gasoline 2.5T, 5~7 seats, 18” wheel
- Gasoline 2.5T, 5~6 seats, 20” wheel
- Gasoline 2.5T, 5 seats, 21” wheel
- ⋮

Each VERSION

VARIANT Ⅱ (ICE 2WD)

- Gasoline 2.5T, 7 seats, 18” wheel
- Gasoline 2.5T, 5~6 seats, 18” wheel + Built-in Cam
- ⋮

Each VERSION

“LCA group”
- Gasoline ICE

VARIANT Ⅲ (HEV AWD)

- Gasoline 1.6T, 6~7 seats, 18” wheel
- Gasoline 1.6T, 5 seats, 18” wheel
- Gasoline 1.6T, 5~7 seats, 20” wheel
- ⋮

Each VERSION

VARIANT Ⅳ (HEV 2WD)

- Gasoline 1.6T, 5~6 seats, 18” wheel
- Gasoline 1.6T, 7 seats, 18” wheel
- ⋮

Each VERSION

“LCA group”
- Gasoline HEV

Representative Vehicle Concept

Compromised concept: Base-line approach

- Overview: Select one RV out of the LCA group, perform a full LCA and extrapolate LCA value of vehicles in the same LCA family

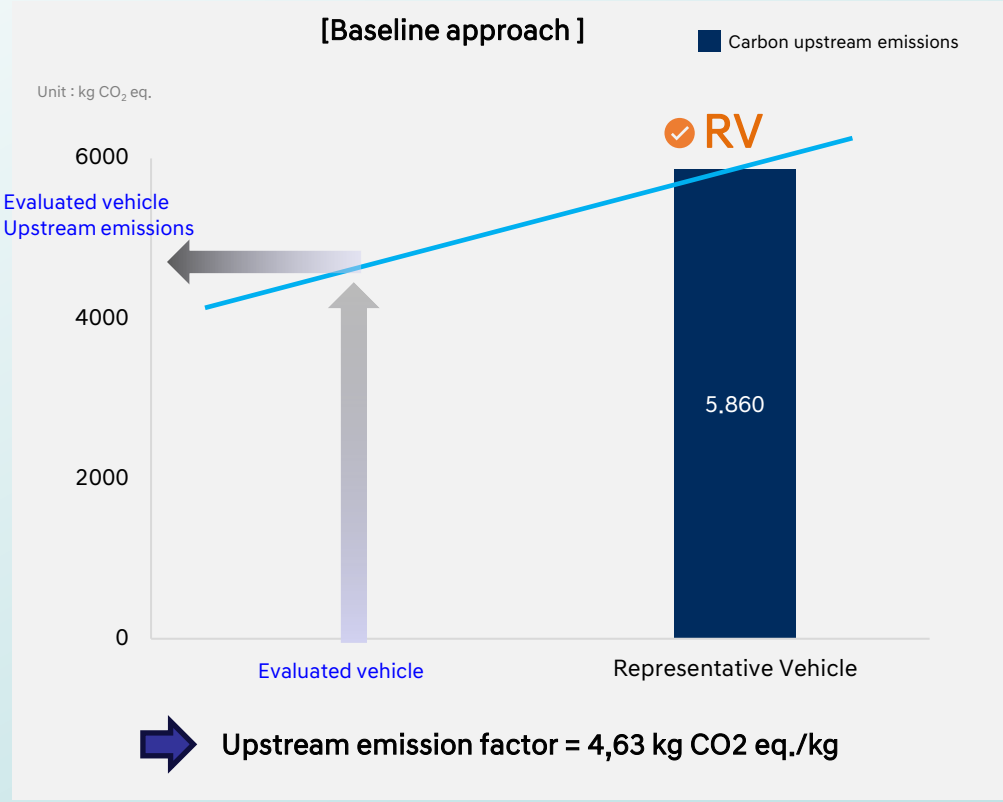
  a) Calculate the upstream emission factor (carbon emission per kilogram of vehicle weight) based on the LCA result (excluding use phase & traction battery)

  Upstream emission factor [kg $CO_{2\ eq.}$/kg] = Upstream emission of RV [kg $CO_{2\ eq.}$] / Curb Vehicle weight of RV [kg]

  b) Extrapolated LCAs: Upstream emission of vehicles in the same LCA group to be estimated (extrapolated) based on the CVW of the evaluated vehicle.

  Upstream emission (evaluated vehicle) = Curb Vehicle Weight (evaluted vehicle) x Upstream emission factor

- The Base-line approach is applied after excluding the carbon emissions from the use phase and the traction battery from the total carbon emissions



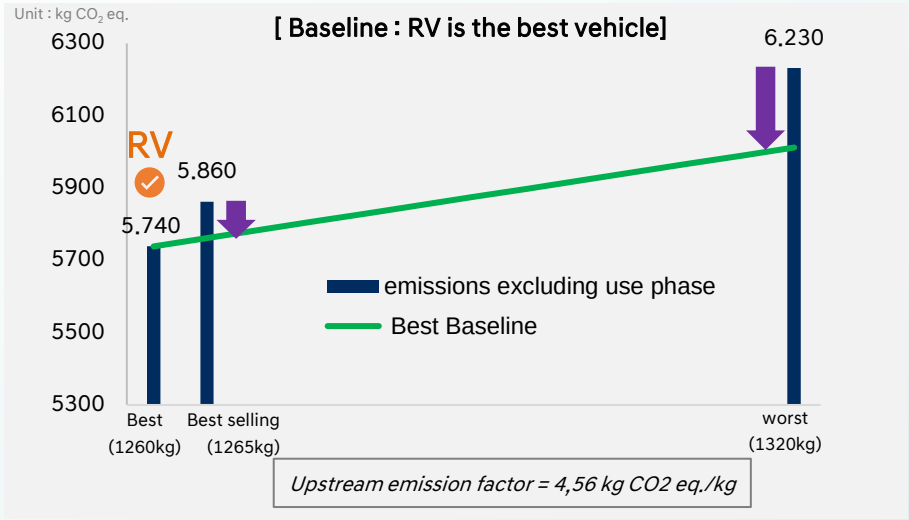
Representative Vehicle Concept

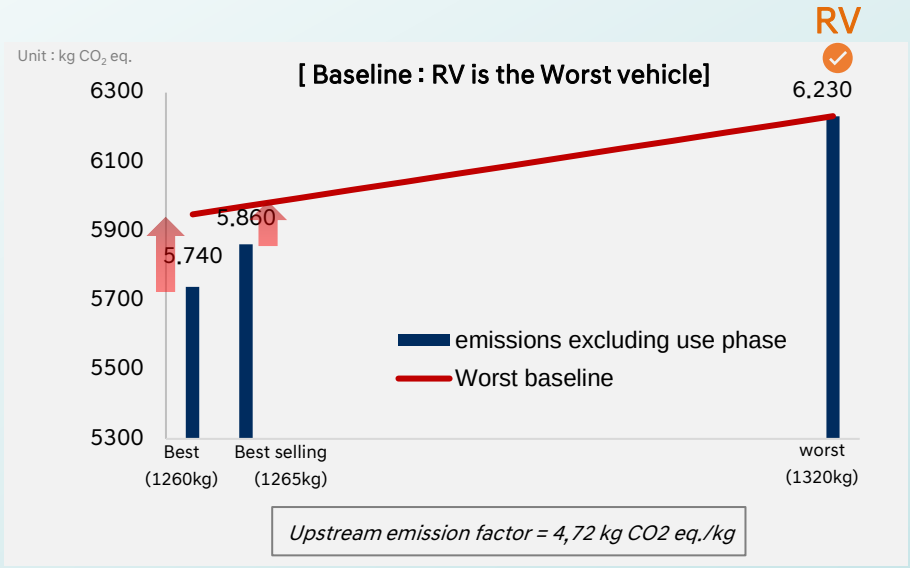
Base-line approach (example)

Unit : kg CO_2 eq.	Total emission	Upstream emission
Best	35150	5740
Best selling	35975	5860
Worst	38510	6230

※ Best: Min. option, Smallest tire
※ Worst: Max. options, biggest tires
※ Mileage : 200,000km

- Method: Compare the results of extrapolated- vs. calculated data based on the LCA results of the example vehicle model





Estimate > Calculation
Estimate < Calculation

	Extrapolated values (kg CO2 eq.)	Relative to upstream emission (%)	**Relative to Total carbon emissions (%)**
Best	(Reference)	(Reference)	(Reference)
Best selling	-91.6	-1.6	**-0.3**
Worst	-210.8	-3.4	**-0.6**

	Extrapolated values (kg CO2 eq.)	Relative to upstream emission (%)	**Relative to Total carbon emissions (%)**
Best	+207.2	+3.6	**+0.6**
Best selling	+110.8	+1.9	**+0.3**
Worst	(Reference)	(Reference)	(Reference)

- Results : There is a difference in the deviation depending on the selection of the RV, over-estimated or under-estimated value
  However the deviation is not significant in compare to the total emission ± 0.6%

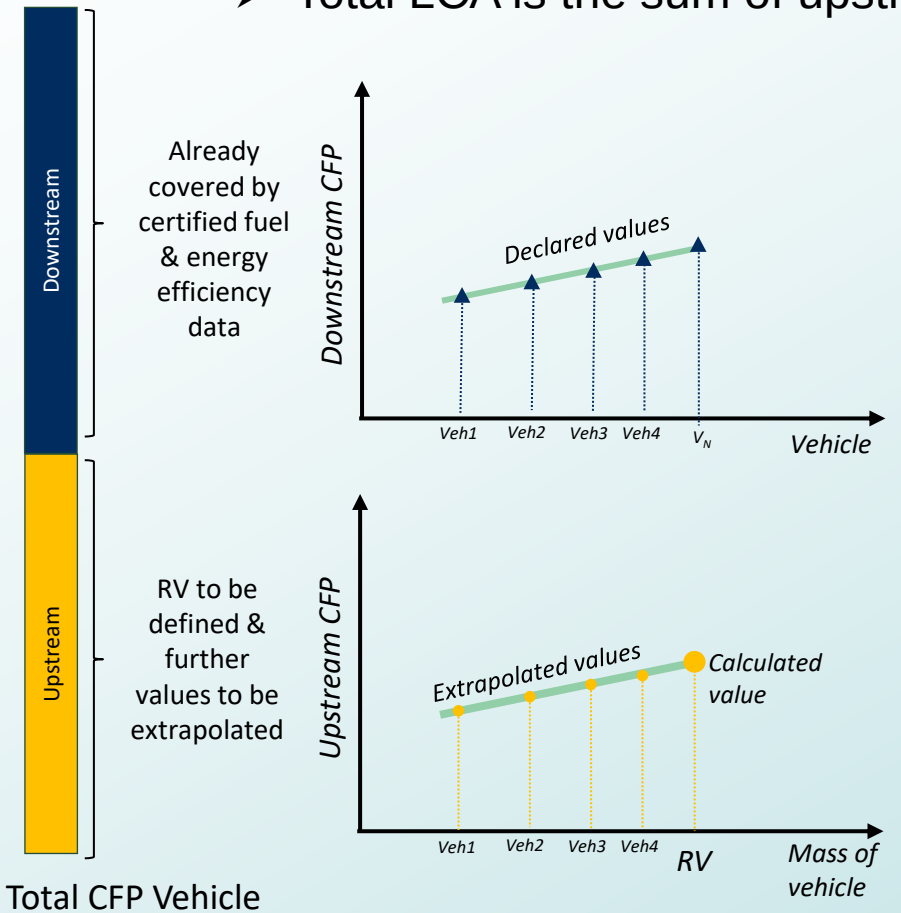
✓ **"Base-line approach" is a method** that **minimizes the disadvantages of the "single RV" while extrapolation is possible with only one LCA.**

☞ The suitability of base-line approach is under evaluation based on actual data of other OEMs as well

☞ **CPs are requested to give their preference for the selection of the RV Best- or Worst vehicle in the LCA group**

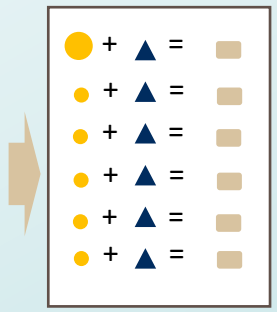
Summary

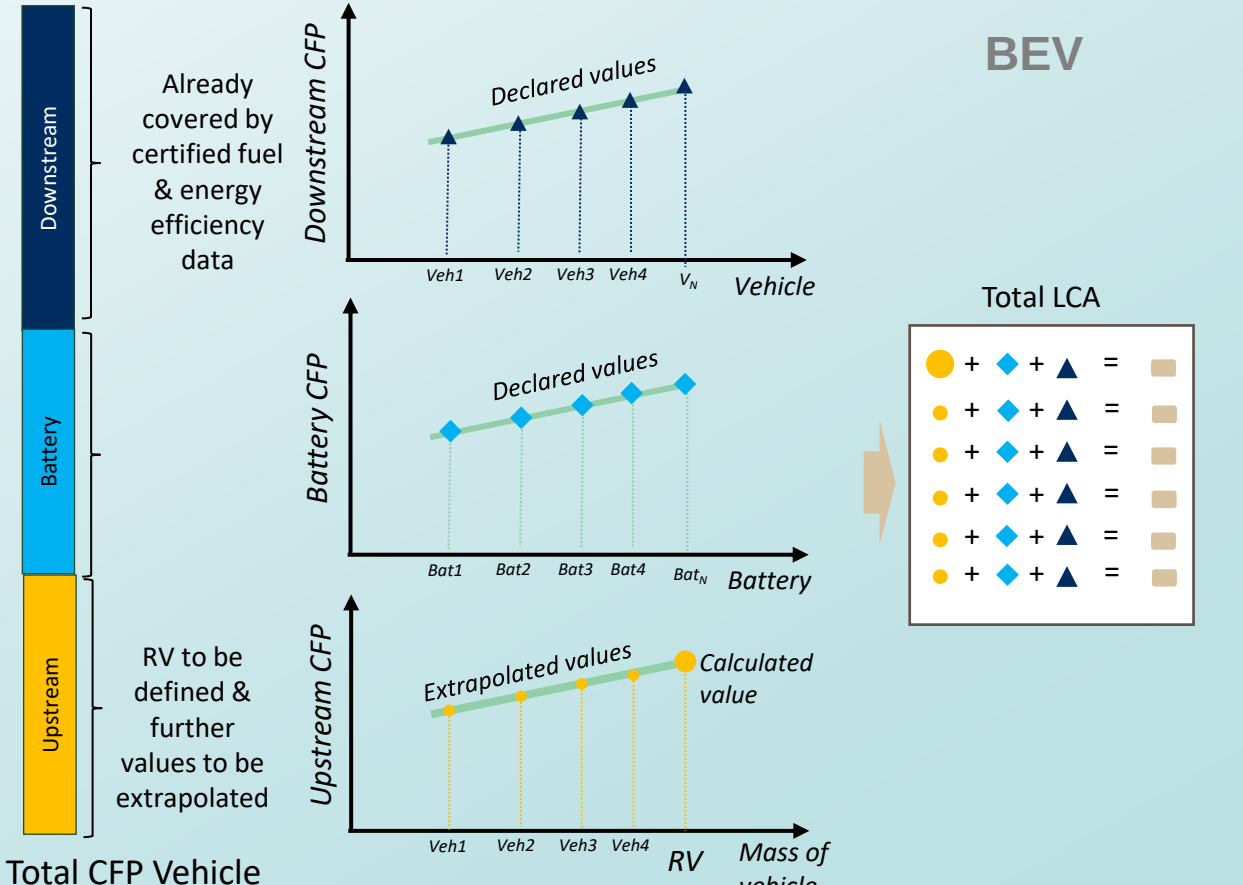
- Upstream emission & downstream emission to be handled separately in the RV discussion
- “LCA group” can be specified for upstream emission by “vehicle Type” & fuel/powertrain type
- Upstream emission (excluding the traction battery): One RV to be selected out of the LCA group, perform a full LCA and extrapolate LCA value for other vehicles in the same LCA family
- Total LCA is the sum of upstream & downstream emission (for BEV: + the CFP of the Battery)



ICE

Total LCA





BEV

Total LCA