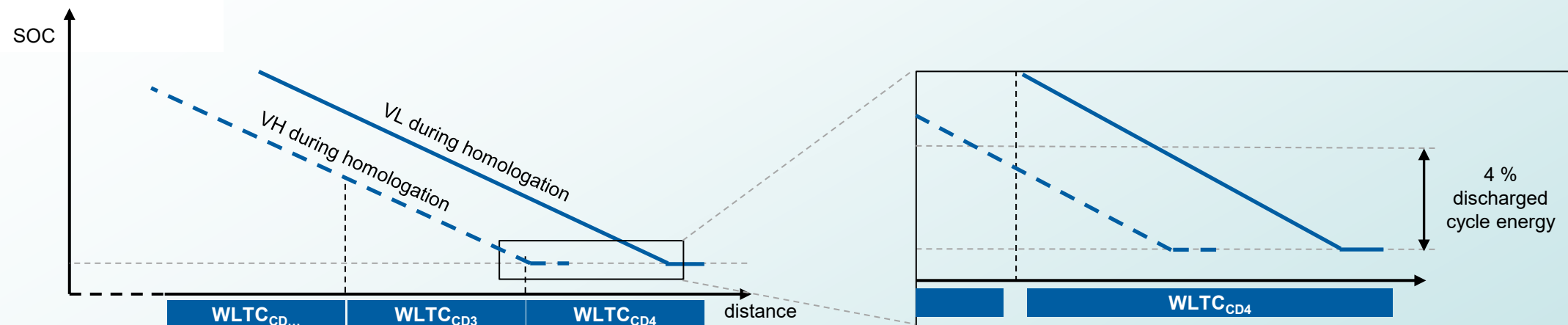




EAER calculation VH and VL



	Vehicle L	Vehicle H
RCDC-nr.	4 (→ WLTC _{CD4} is transition cycle)	3 (→ WLTC _{CD3} is transition cycle)

Current situation:

- For several calculation, the approach to use the number of CD cycles from vehicles L is already implemented as e.g. for $EC_{AC,CD}$ (Annex B8, §4.3.1.)
- The implementation of this approach has been missed to be integrated for EAER (see next slide)
- Interpolation method working for the R_{CDC} difference of 1 cycle (between VH and VL) but manufacturer need to add a safety margin that is not caused by physical energy but by the calculation method (lessons learned)

Overview of values* where “VL approach” is applied

*note: AER not in the tables as triggered by engine start

Except of FE_{CD} and EAER based values, all interpolated CD or weighted values apply the VL approach:

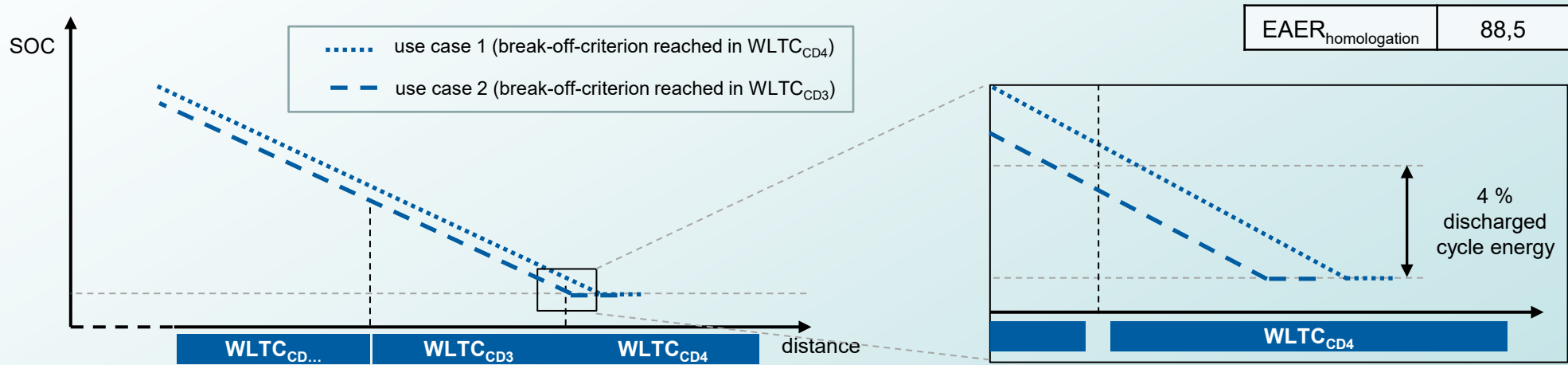
Parameter	Application of VL approach	Interpolation method
$M_{CO_2,CD}$ (both levels)	Yes	Yes
$M_{CO_2,weighted}$ (Level 1A)	Yes	Yes
FC_{CD} (Level 1A)	Yes	Yes
FE_{CD} (Level 1B)	No	Yes
$FC_{weighted}$ (Level 1A)	Yes	Yes
$EC_{AC,CD}$ (Level 1A)	Yes	Yes
$EC_{AC,weighted}$ (Level 1A)	Yes	Yes
EC (both levels) → (result of E_{AC} divided by EAER)	No	Yes
EC_p (both levels) → (result of E_{AC} divided by $EAER_p$)	No	Yes
EAER (both levels)	No	Yes
$EAER_p$ (both levels)	No	Yes

Only values, which are not using the interpolation method, are not applying the VL approach:

Parameter	Application of VL approach	Interpolation approach
$PN_{weighted}$ (both levels)	No	No
$PM_{weighted}$ (both levels)	No	No
R_{CDA} (both levels)	No	No

Break-off criterion for the charge-depleting test (less than 4% of cycle energy from REESSs) influences R_{CDC}

→ resulting EAER different → resulting SOCR indicator different → **Will lead to problems in context of EVE-GTR**



$$M_{CO2,CD,avg} = \frac{\sum_{j=1}^k (M_{CO2,CD,j} \times d_j)}{d_j}$$

$$EAER_{measured} = \left(\frac{M_{CO2,CS} - M_{CO2,CD,avg}}{M_{CO2,CS}} \right) \times R_{cdc}$$

	Use case 1: more than 4 % cycle energy discharged in WLTC_{CD,4}	Use case 2: less than 4% cycle energy discharged in WLTC_{CD,4}
CO2_CD1	0	0
CO2_CD2	0	0
CO2_CD3	0	0
CO2_CD4	96	96
CO2_CS	100	100
RCDC-nr.	4 (→ WLTC _{CD4} is transition cycle)	3 (→ WLTC _{CD3} is transition cycle)
RCDC	93,2	69,9
EAER _{ISC}	70,832	69,9
SOCR (EVE-GTR)	80	78,94736842

Action item ISC:

In context of an individual vehicle @ ISC (e.g. EVE-GTR) it is necessary to refer to the R_{CDC} -value determined during type approval.

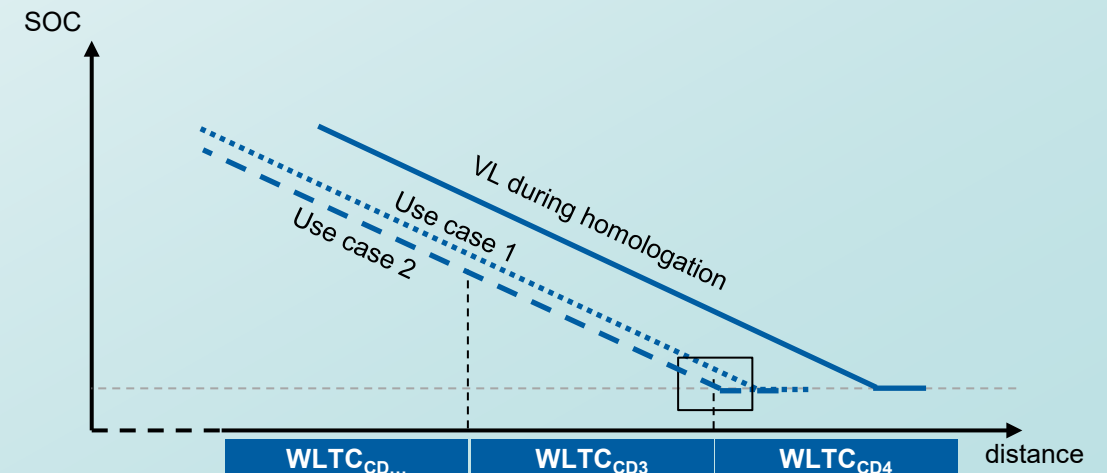
→ This eliminates the impact of the break-off-criterion on R_{CDC} and therefore on EAER for ISC-testing.

Action item homologation:

→ In case of different R_{CDC} -values at homologation for VH and VL, some individual vehicles close to the break-off criterion (4% threshold) would lose EAER caused by the calculation method

→ Way forward to resolve this problem is just one R_{CDC} -value for the purpose of EAER calculation within one IP-family → R_{CDC} of vehicle L

	Homologation	Use case 1 (dotted)	Use case 2 - - - (dashed)
Use case	VL @Type Approval (TA)	Vehicles with the same R_{CDC} -value than VL@TA (e.g.: VH@TA or any individual vehicle in IPF)	Vehicles with different R_{CDC} -value than VL@TA (e.g.: VH@TA or any individual vehicle in IPF or vehicles during ISC)
R_{CDC} -value	4 x WLTC (WLTC _{CD4} is transition cycle)	4 x WLTC (WLTC _{CD4} is transition cycle)	3 x WLTC (WLTC _{CD3} is transition cycle)
Action	No amendment required as this is reference.	No amendment required as R_{CDC} identical to reference.	Amendment required as R_{CDC} different to reference.



The following paragraphs in UN-R-154 would need to be amended:

- Annex B8, Paragraph 4.4.3. (Charge-depleting cycle range **for OVC-HEVs**) → **Bold** text to be added

The charge-depleting cycle range RCDC shall be determined from the charge-depleting Type 1 test described in paragraph 3.2.4.3. of this annex as part of the Option 1 test sequence and is referenced in paragraph 3.2.6.1. of this annex as part of the Option 3 test sequence. The RCDC is the distance driven from the beginning of the charge-depleting Type 1 test to the end of the transition cycle according to paragraph 3.2.4.4. of this annex.

In the case that the interpolation method is applied, the transition cycle of vehicle L n_{veh_L} shall be used for the RCDC determination. If the transition cycle number driven by vehicle H, n_{vehH} , and, if applicable, by an individual vehicle within the vehicle interpolation family n_{vehind} is lower than the transition cycle number driven by vehicle L, n_{veh_L} , the confirmation cycle of vehicle H and, if applicable, an individual vehicle shall be used as the end of the transition cycle.

- Amend UN R 154, Annex B8, §4.4.4.1. Determination of cycle-specific equivalent all-electric range
- Amend UN R 154, Annex B8, §4.4.6.1. Determination of cycle-specific equivalent all-electric range

→ Bold text to be added at the end of both paragraphs:

(...)

In the case that the interpolation method is applied, k shall be the number of phases driven up to the end of the transition cycle of vehicle L n_{veh_L} . If the transition cycle number driven by vehicle H, n_{vehH} , and, if applicable, by an individual vehicle within the vehicle interpolation family n_{vehind} is lower than the transition cycle number driven by vehicle L, n_{veh_L} , the confirmation cycle of vehicle H and, if applicable, an individual vehicle shall be included in the calculation.