



# **OVC-HEV: $AER_{City}$ : „Measurement“ versus „Calculation“**

## Analysis of the criterion for the UBE determination

# OVC-HEV: $AER_{city}$ : „Measurement“ versus „Calculation

Idea – Calculate  $AER_{city}$  according to PEV calculation scheme

- $E_{DC,p,c}$  – Used energy of each individual phase, Wh;
- $K_{p,c}$  – Weighting factor for each individual phase, - ;
- $EC_{DC,p,c}$  – Electric consumption of each individual phase, Wh/km;
- $n_p$  – Phase specific number of available phases, -;
- $EC_{DC,p}$  – Phase specific electric consumption, Wh/km;
- $p$  – Index for each phase of the test cycle (low, mid,...)
- $c$  – Index for the number of the considered cycle
- $UBE$  – Usable battery energy – Used battery energy during type 1 test, Wh;

The usable battery energy is determined from the beginning of type 1 test until the EoT is reached (last incomplete driven phase is included).

Weighting factors

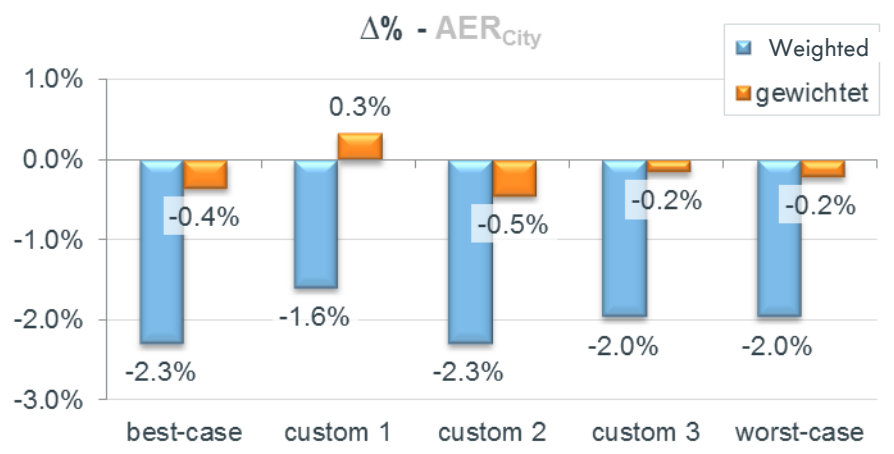
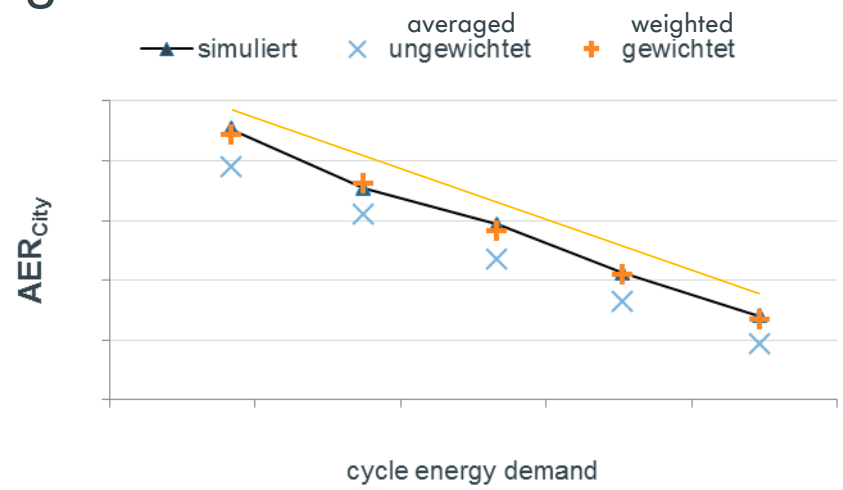
$$K_{p,1} = \frac{E_{DC,p,1}}{UBE} \quad K_{p,i} = \frac{1 - K_{p,1}}{n_p - 1} \text{ for } i = 2 \dots n_p$$

Phase specific electric consumption

$$EC_{DC,p} = \sum_{c=1}^{n_p} EC_{DC,p,c} \times K_{p,c}$$

Phase specific all electric range

$$AER_p = \frac{UBE}{EC_{DC,p}}$$



# OVC-HEV: $AER_{city}$ : „Measurement“ versus „Calculation

## Concern – Calculate $AER_{city}$ according to PEV calculation scheme

### Requirement:

The calculation scheme has to work in each and every occurring case

### Concern:

It's not possible to determine UBE for the  $AER_{city}$  calculation from the whole cycle test

### Reason for the concern:

- *Determination of  $AER_{city}$  via City-cycle test*
  - *engine start which determines  $AER_{city}$  is SoC-triggered*
  
- *Calculation/determination of  $AER_{city}$  via whole cycle test*
  - *The load collective of the City-cycle is totally different to the whole cycle*
  - *Therefore, it's impossible (without knowing the vehicle strategy) to determine which engine start in the whole cycle test would be the corresponding SoC-triggered engine start in the City-Cycle*
  - *But the quality of the engine start is essential for the UBE determination which leads to a correct  $AER_{city}$  value*

### **Discussed solution in the Subgroup EV meeting in Brussels:**

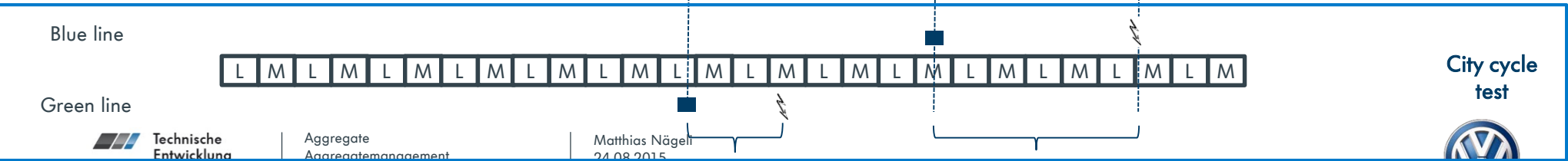
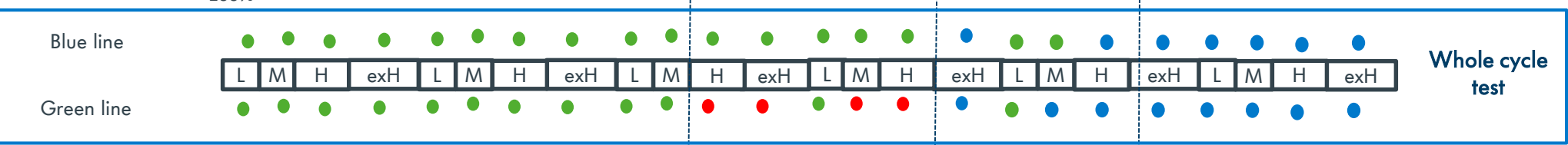
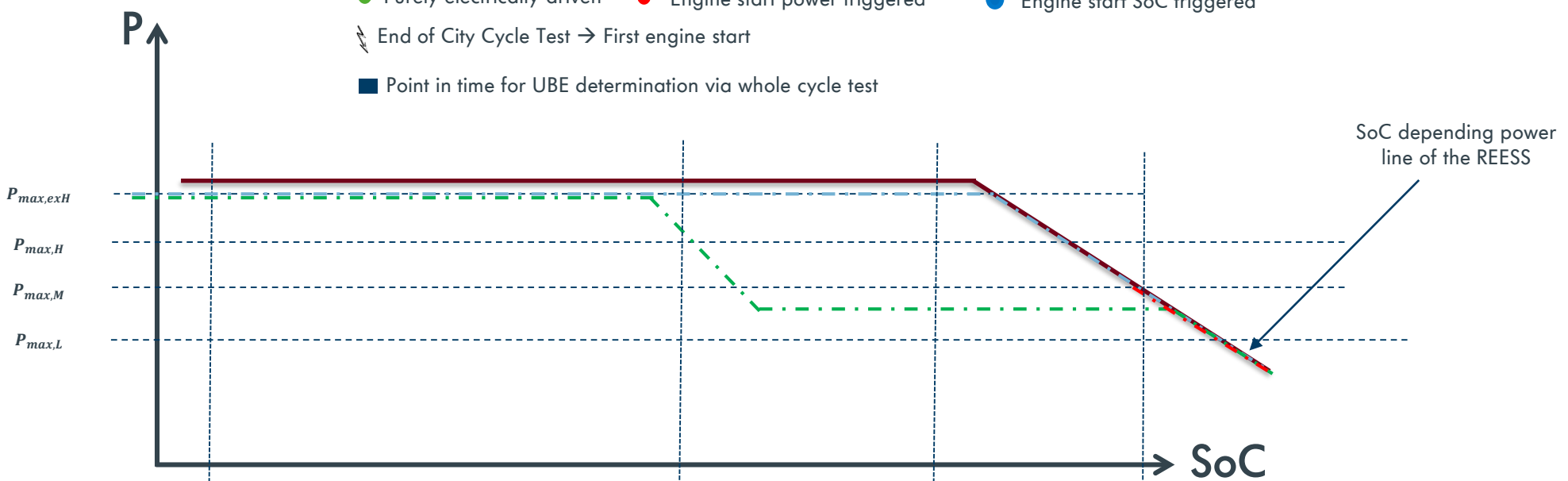
As it is not possible to determine the correct engine start in the whole cycle test which allows to determine the correct UBE for the  $AER_{city}$  calculation, the manufacturer is allowed to conduct

- either the AER-City-Test
- or to calculate the  $AER_{city}$  value by using the worst case UBE value (determined by the first engine start in the whole cycle test – UBE and the resulting  $AER_{city}$  will always be worst case).

# OVC-HEV: $AER_{City}$ : „Measurement“ versus „Calculation“

## Analysis of the criterion for the UBE determination – worst case

- Purely electrically driven
- Engine start power triggered
- Engine start SoC triggered
- ⚡ End of City Cycle Test → First engine start
- Point in time for UBE determination via whole cycle test



# OVC-HEV: $AER_{City}$ : „Measurement“ versus „Calculation

Analysis of the criterion for the UBE determination – worst case

Further evaluation is running