

System Power Determination of Electrified (Light Duty) Vehicles - Status Report -

Subgroup Leader: Germany, Korea

EVE-17 meeting

Geneva - January 11, 2016

Outline

1. Status: Screening of methods for determination of EV system power
2. Status: Proposal for a work program
3. Next steps and Timeline

1. Screening of test methods

Input:

Test methods: SAE and ISO activities (EVE-16-06e, EVE-16-12e)

SAE J2908:

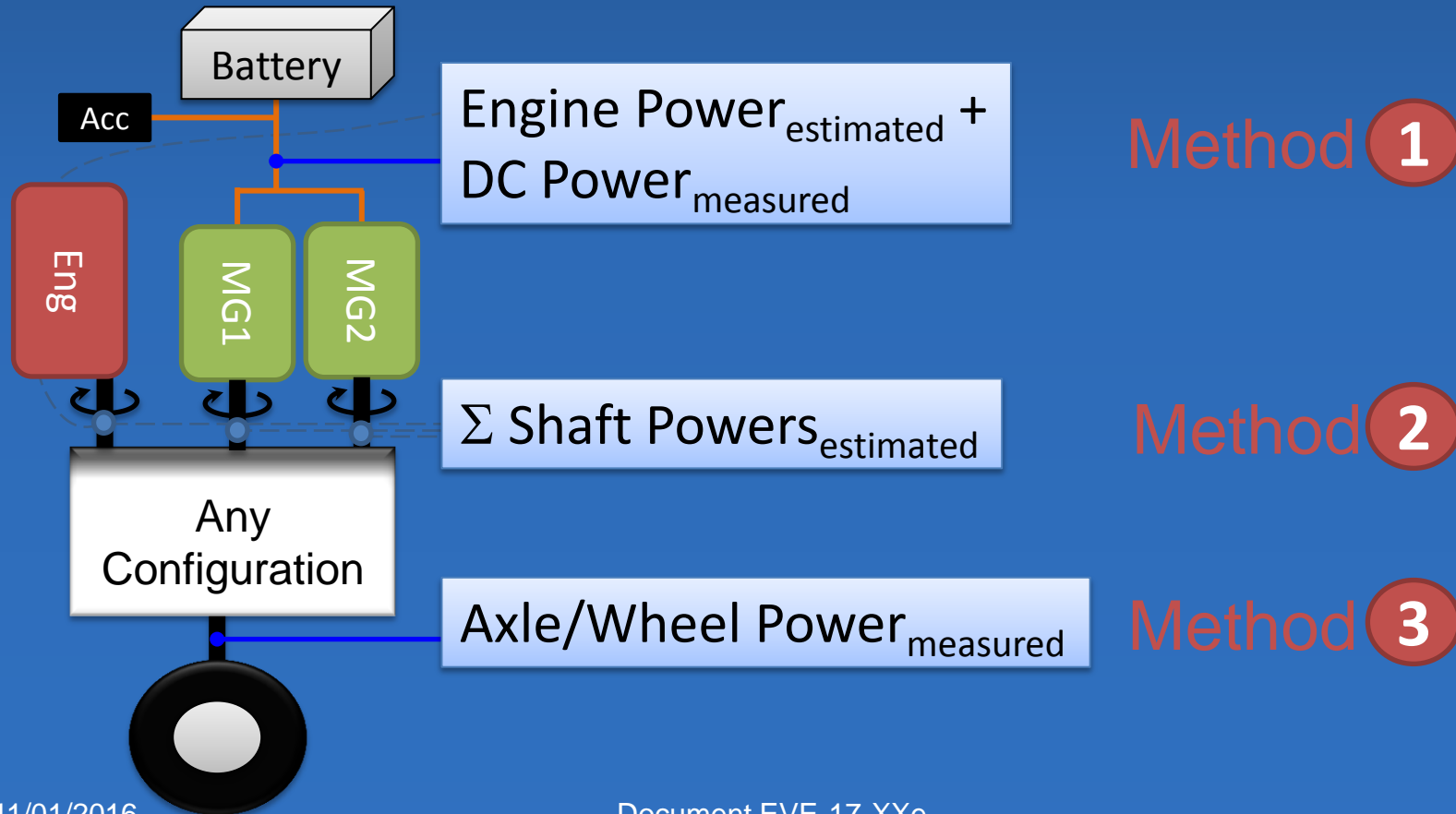
- Program launched 2013, many tests done
- 3 Methods emerged so far which lead to different power ratings
- discussion still ongoing, clear recommendation is pending

ISO J2908:

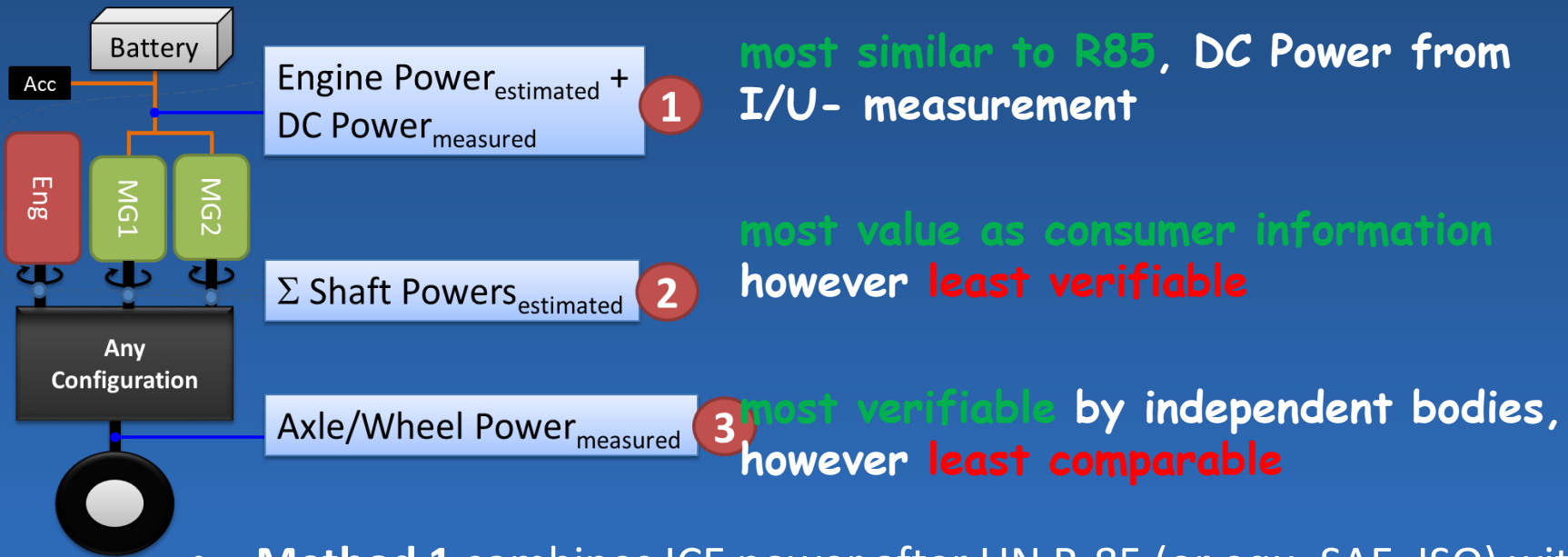
- Program launched 2015, goal: max. HEV system power rating
- Combination of ICE power rating (acc. test bench methods like ISO, SAE or R85) and battery power measurement

SAE J2908 Status

Chassis Dyno / Hub Dyno
Three methods emerged



SAE J2908 Status

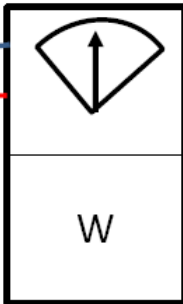


- **Method 1** combines ICE power after UN R-85 (or equ. SAE, ISO) with battery power (not considered in R-85).
- **Method 2** combines power of the ICE acc. UN R-85 (or equ. SAE, ISO) with actual motor power data from vehicle network.
- **Method 3** is not compatible with existing power ratings which is a base requirement from WLTP

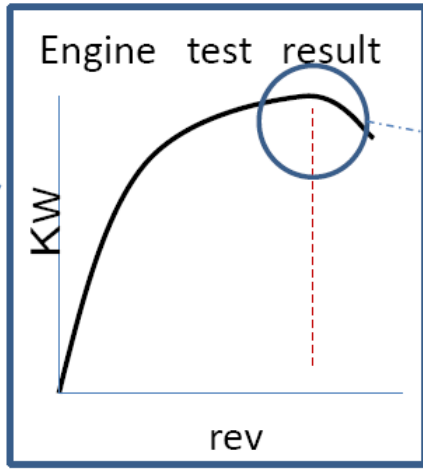
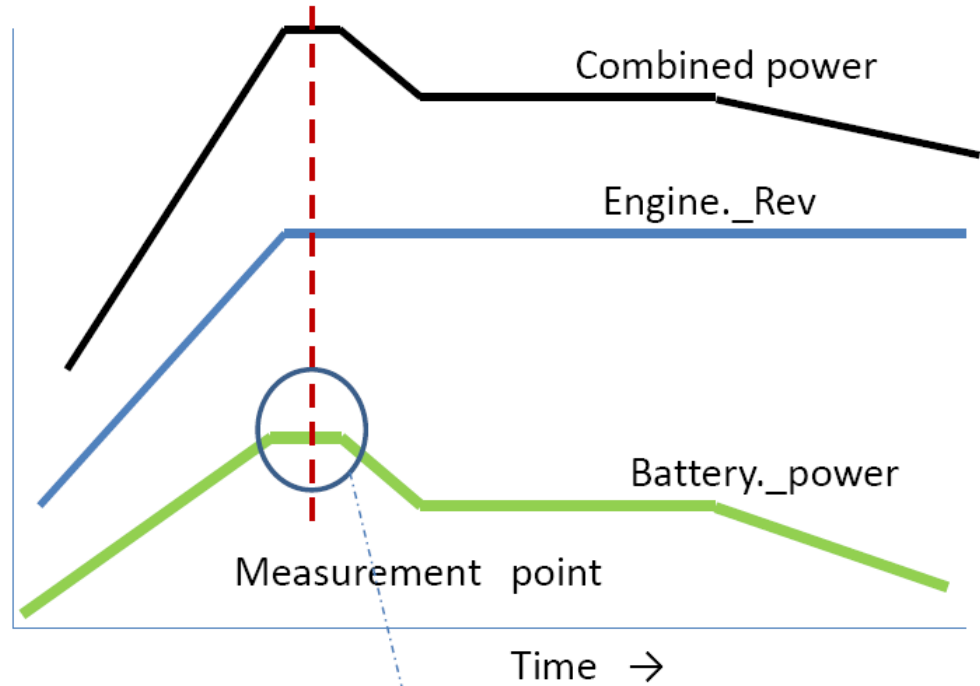
ISO Status



Rev. Throttle



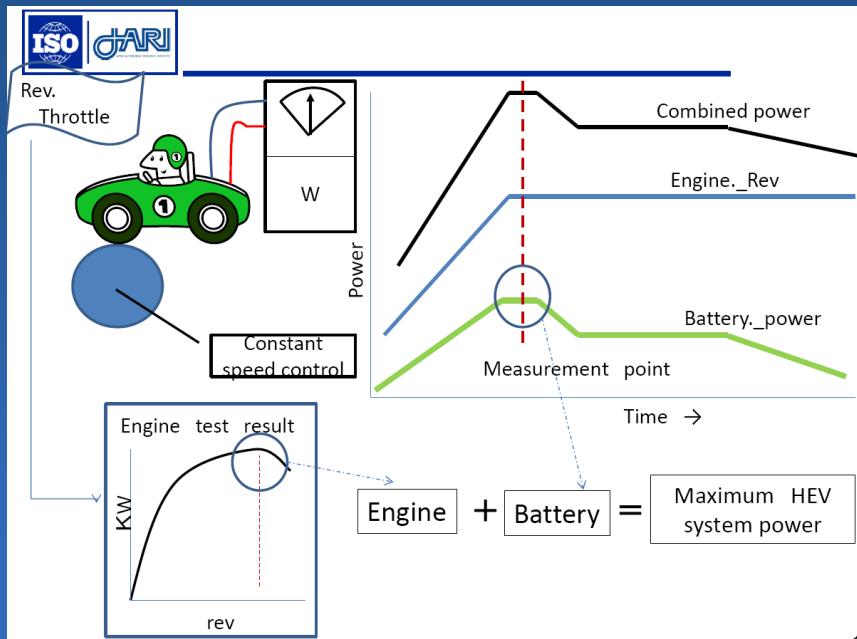
Constant speed control



$$\text{Engine} + \text{Battery} = \text{Maximum HEV system power}$$

1. Screening of methods

ISO Status



- Separate test of ICE and Battery power
- Determination of the measurement point (=max. Power) is a challenge
- Efficiency of the Electric Motor is not considered

2. Status: Proposal for a work program

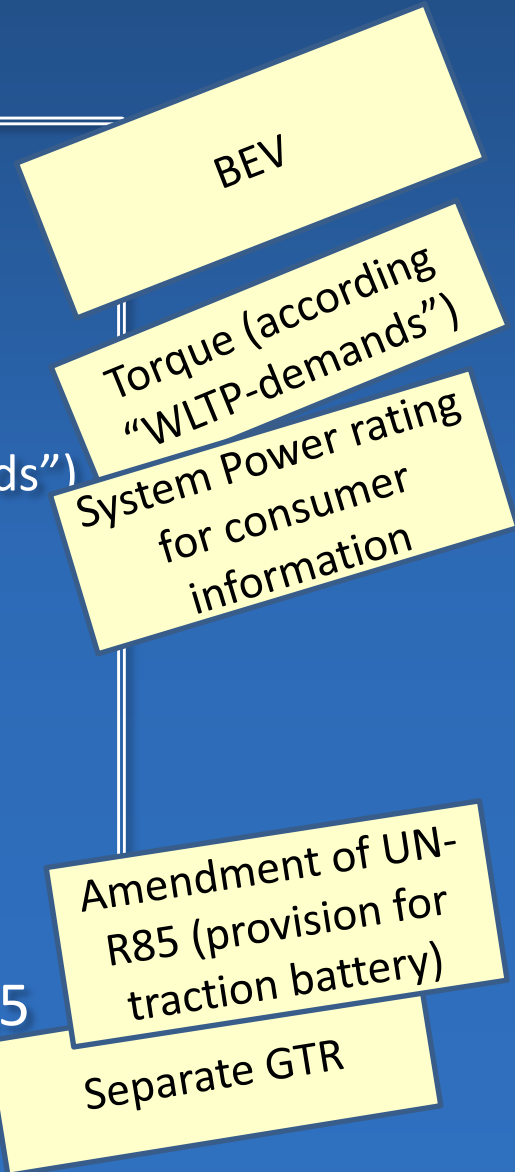
Review EVE-16 “In-frame Out-frame” discussions:

(EVE-16-03e)

- ✓ HEV (light duty: M, N-category vehicles)
- ✓ Rated System Power (according “WLTP-demands”)
- ✓ Component testing
- ✓ Chassis dyno testing
- ✓ Integration into GTR15

Out of frame:

- NRMM,
- L-category
- All engines, motors and combinations of propulsion units



Demands from WLTP

(Discussion with experts from WLTP-SG-EV after EVE-16, 20.11.2015)

Conclusions:

- Only Max. System Power rating is needed. This is for correct cycle classification according to the WLTP power-to-mass rule
- System power curve or system torque is not needed
- UN R-85 is sufficient for PEVs equipped with one single el. Motor
- No need for FCVs
- ISO / SAE (Method 1) approach seems reasonable

Test Method Development

Conclusion:

- Standardization projects from SAE and ISO could be used as basis for a development but not copied 100%
- ICE power measurement according UN R-85
- Electric power measurement can be:
 - Battery power
 - Electric Motor shaft power
 - With HEV control system
- Appropriate mathematical model / HILS must be developed to determine HEV System power from the component test ->
Candidate Method
- Chassis dyno test can be used as **Reference Method** for validation of the Candidate Method

Project Frame (Generation 1)

Scope:	HEV + BEV with more than 1 E-Motor (light duty: M, N-category vehicles)
Task:	Determination of system peak power for vehicle P-t-M classification and Downscale (WLTP)
Exercise:	Development of Reference Method based on a chassis dyno testing and a Candidate Method based on component testing and mathematical model
Regulation:	Integration into GTR15

Further Technical Discussions

- Determination of max. system power depends on the appropriate measuring point and how this point is approached:
Definition of test burden collectives, dynamic effects, highest or most representative peak power
- OVC-HEVs:
State of charge (SoC): SoC Min, SoC Max, representative SoC
- Correct results with all HEV-layouts:
Serial, Parallel, Power-Split architectures

3. Timeline

- Jan – March 2016: continuation of the discussion with experts from WLTP SG EV and preparation of a tentative work program
- EVE-18, April 2016: Presentation and final discussion
- Mai – June 2016: Preparation of informal documents / recommendation for an addendum that could be integrated into GTR 15. Request to GRPE, AC.3
- November 2016: AC.3 decision to authorize the development

Background

UN R-85 provides currently a regulation under the 58' Agreement that can be used for approval of internal combustion engines (ICE) and electric drive trains in M and N category vehicles. It focusses on the determination of engine power values, however, the technical description part of the regulation merely provides for the individual determination of the mechanical power of either an ICE or an electric motor.

Problem

The role of the propulsion battery is not considered by the regulation. A determination or recommendation for a calculation of the ‘motive power’ of the vehicle expressed as combined power or system power is missing.

Focus & Scope

- ❖ HEV (light duty: M, N-category vehicles)
- ❖ Rated System Power (according “WLTP-demands”)
- ❖ Component testing, chassis dyno testing
- ❖ Integration into GTR15

Motivation & Goal

Harmonized technical regulation for an efficient determination of the system power of hybrid electric vehicles or pure electric vehicles (PEV) with more than one electric motor.

Recommendation

- ❖ Adaption of ISO/ SAE method 1 for purposes of Harmonized Rated System Power for GTR 15 (WLTP)
- ❖ Reference Method: -> chassis dyno
- ❖ Candidate Method: -> component testing