European Automobile Manufacturers Association

ACEA

Off Vehicle Charge Fuel Cell Vehicle

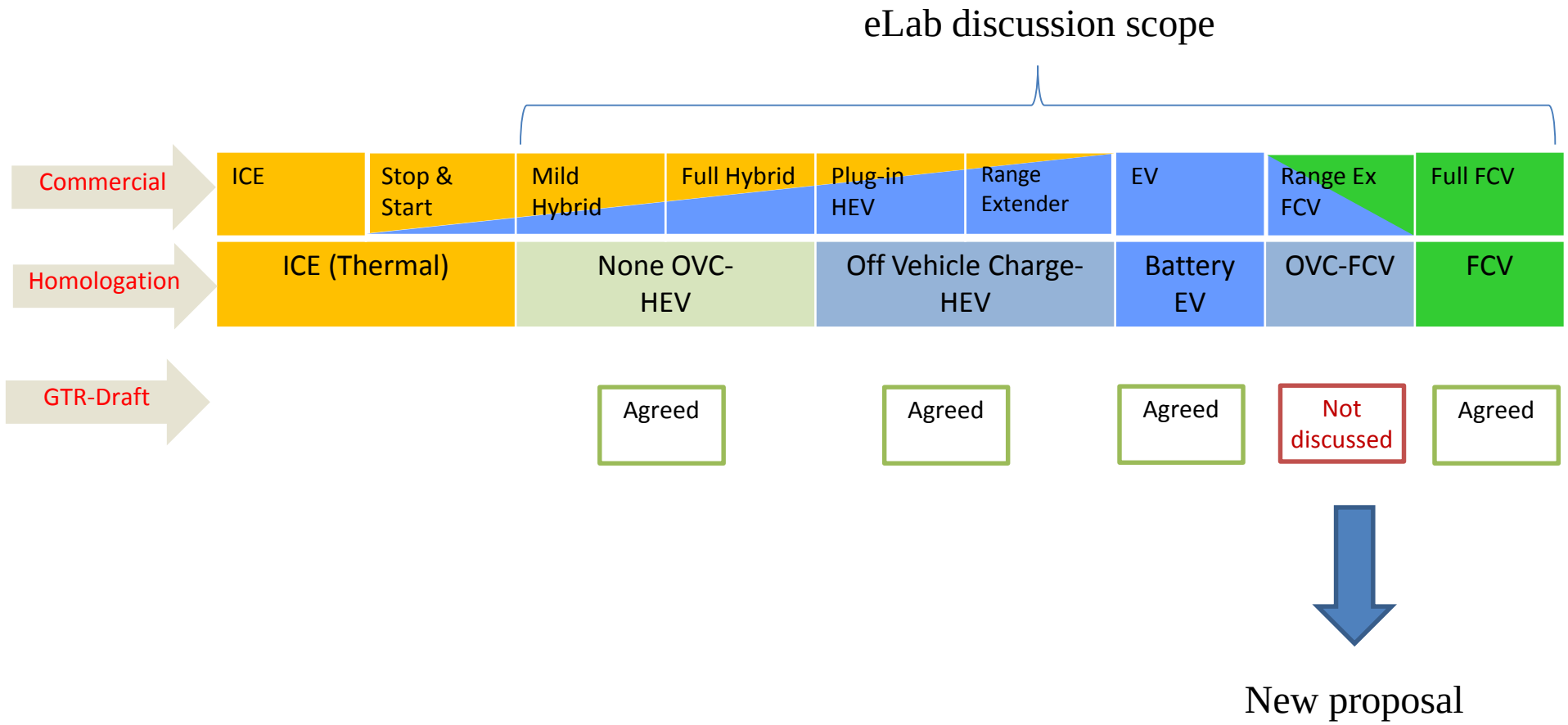
Hydrogen consumption and range determination

12TH WLTP SG EV MEETING, 08.06.2016

EU DELEGATION, RUE DU GRAND-PRÉ 64, CH-1211 GENEVA

ACEA WLTP EV Group

OVC-FCHV : Situation in present GTR



OVC-FCHV : Example of vehicles in the market

Symbio FCell

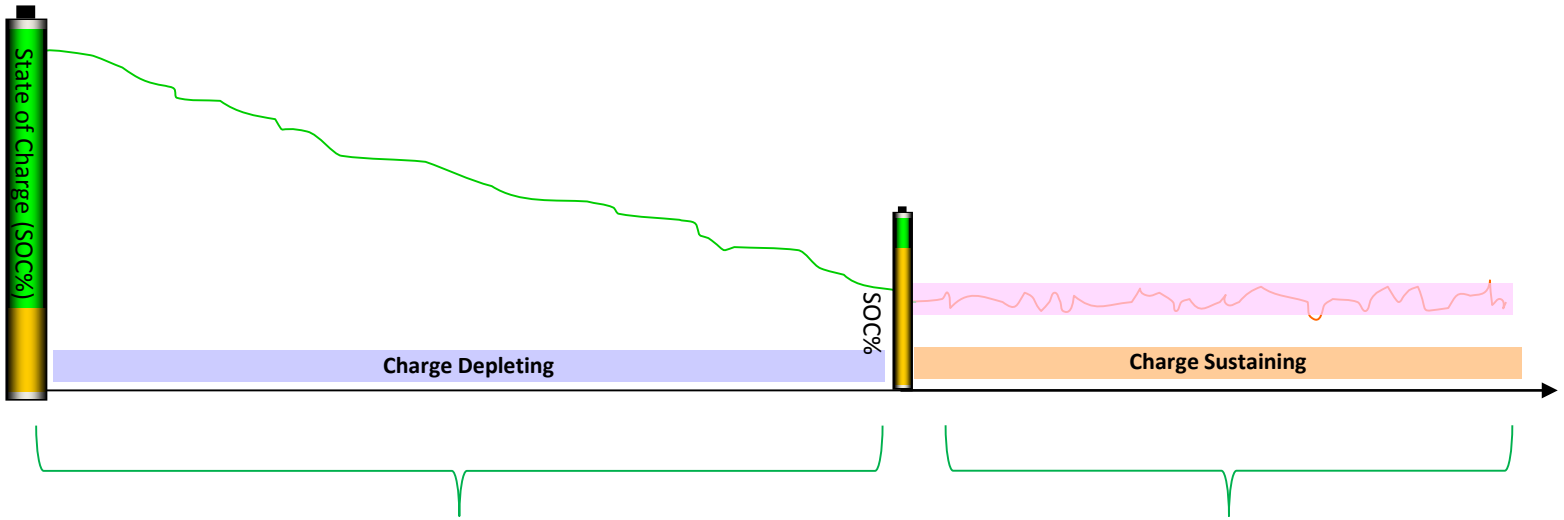
HyKangoo by SymbioFCell

Source: http://www.symbiofcell.com/symbiov3/wp-content/uploads/2014/09/kangoozeh2-uk2013.pdf

OVC-FCHV : DEFINITION AND WORKING CONDITION

Add
3.3.XX "Off-vehicle charging Fuel Cell Hybrid vehicle" (OVC-FCHV) means a Fuel Cell hybrid electric vehicle that can be charged from an external source.

Like any ‘Off Vehicle Charge’ vehicle OVC-FCHV has two driving conditions

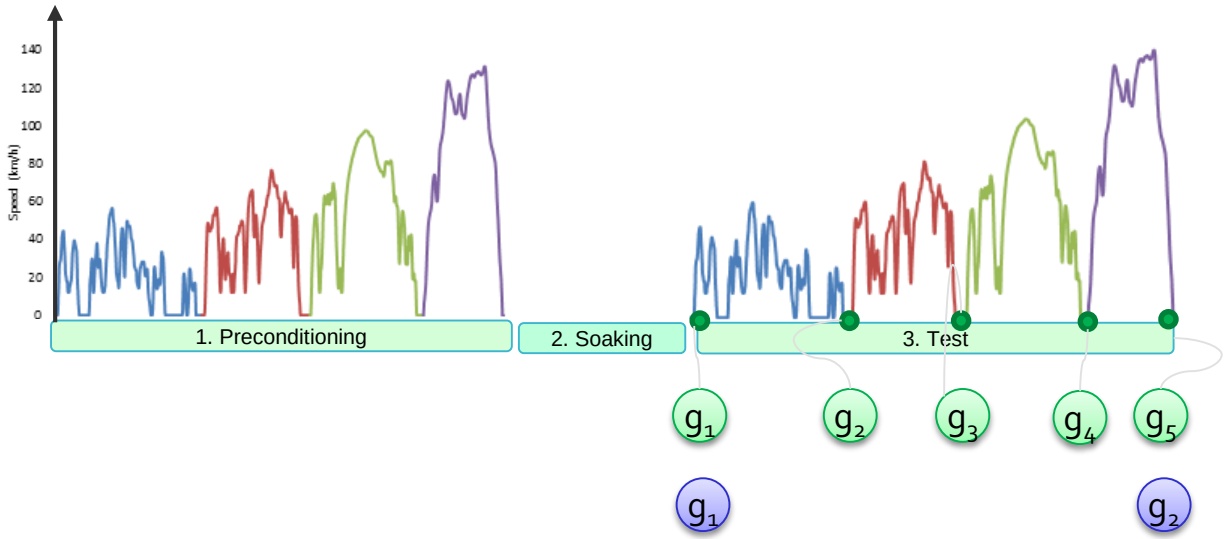


The existing OVC-HEV charge depleting test procedure need to be modified to include the specificities of OVC-FCHV

Test procedure is same as that of NOVC-FCHV in the GTR

No change to existing NOVC-FCHV

OVC-FCHV: CHARGE SUSTAINING TEST PROCEDURE



Reservoir mass measured for each phase

Reservoir mass measured for complete cycle

Hydrogen consumption: Complete cycle

$$FC_{CS,nb} = \frac{g_1 - g_2}{d} \times 100$$

Same as Annex 8 – 3.5 (NOVC-FCHVs)

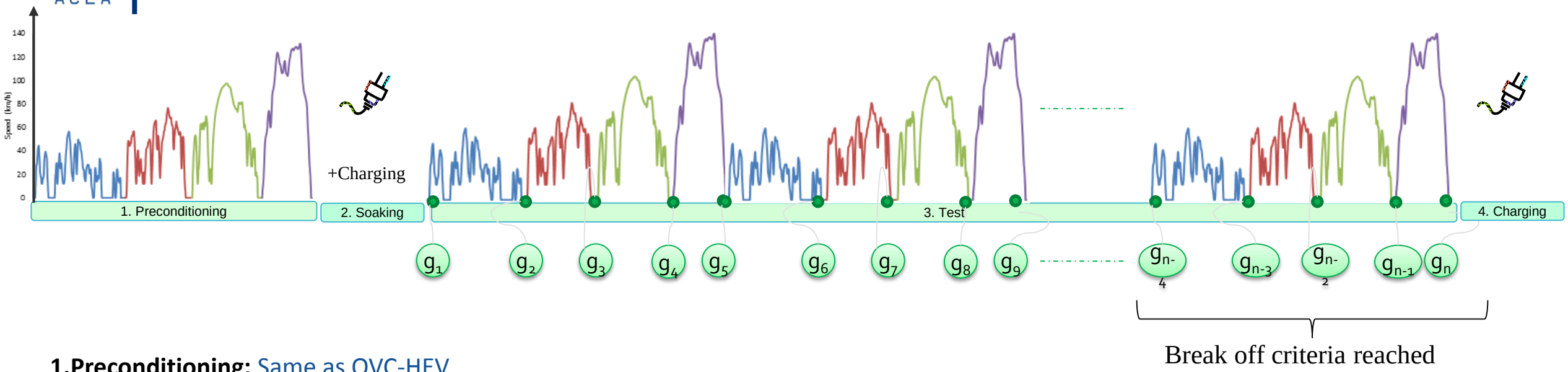
Hydrogen consumption correction:

$$FC_{CS} = FC_{CS,nb} - K_{fuel,FCHV} \times EC_{DC,CS}$$

Same as Annex 8 - Appendix 2 (REESS energy change-based correction procedure)

Modification to existing OVC-HEV

OVC-FCHV: CHARGE DEPLETING TEST PROCEDURE



1.Preconditioning: Same as OVC-HEV

2. Soaking + Charging: Same as OVC-HEV

3. Depleting test :

Driving mode selection: Same as OVC-HEV

Hydrogen measurement: Reservoir mass has to be measured for each phase (according to Annex 8 - Appendix 7 (2.2.7)

Electric energy measurement: Same as OVC-HEV

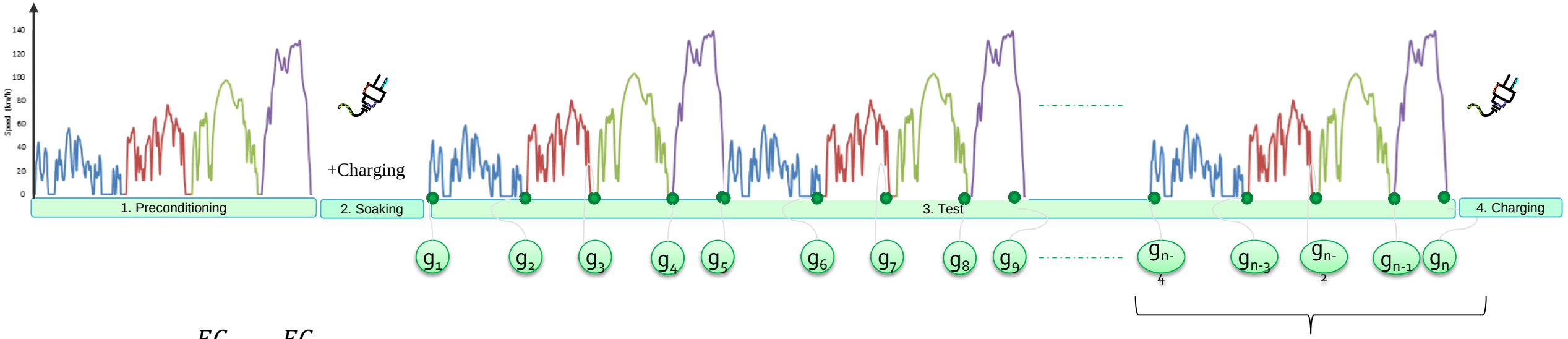
Hot soak in between drive cycles : Not required (to be reconfirmed later on)

Break off criteria: Same as OVC-HEV

4. **Charging**: Same as OVC-HEV

Modification to existing OVC-HEV

OVC-FCHV : DEFINITION AND WORKING CONDITION



$$EAER = \frac{FC_{CS} - FC_{CD,avg}}{FC_{CS}} \times R_{CDC}$$

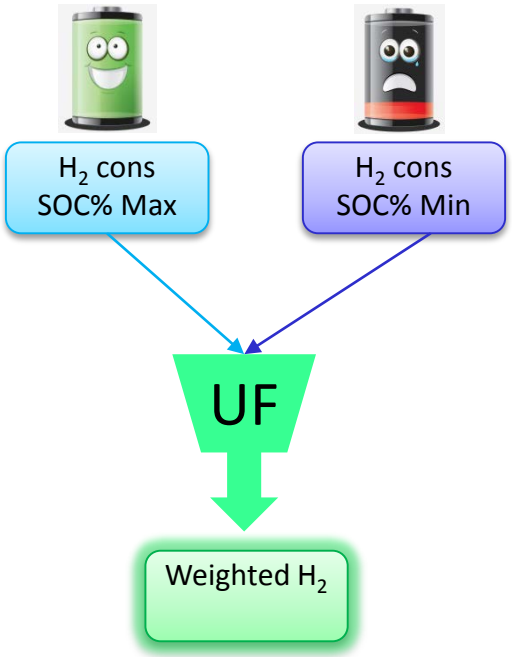
$$R_{CDA} = \sum_{c=1}^{n-1} d_c \quad + \left(\frac{FC_{CS} - FC_{n,cycle}}{FC_{CS} - FC_{CD,avg\ ,n-1}} \right) \times d_n$$

H_2 value replace the CO_2 value of OVC-HEV equations

AER: The AER is defined as the distance driven from the beginning of the charge-depleting Type 1 test to the point in time where the *'fuel cell system' starts consuming fuel*.

Modification to existing OVC-HEV

OVC-FCHV: WEIGHTED VALUES



- Weighting procedure between charge depleting and charge sustaining test results are same as OVC-FCHV
- CO_2 values are replaced by H_2 consumption values
- Utility factor reflects the user behavior and not dependent on vehicle type, hence we propose to use the same utility factor as that of OVC-HEV

$$FC_{weighted} = \sum_{j=1}^{k} \left(UF_j \times FC_{CD,j}\right) + \left(1 - \sum_{j=1}^{k} UF_j\right) \times FC_{CS}$$

- electric energy consumption calculation method is same as OVC-HEV

$$EC = \frac{E_{AC}}{EAER}$$

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THANK YOU FOR YOUR ATTENTION