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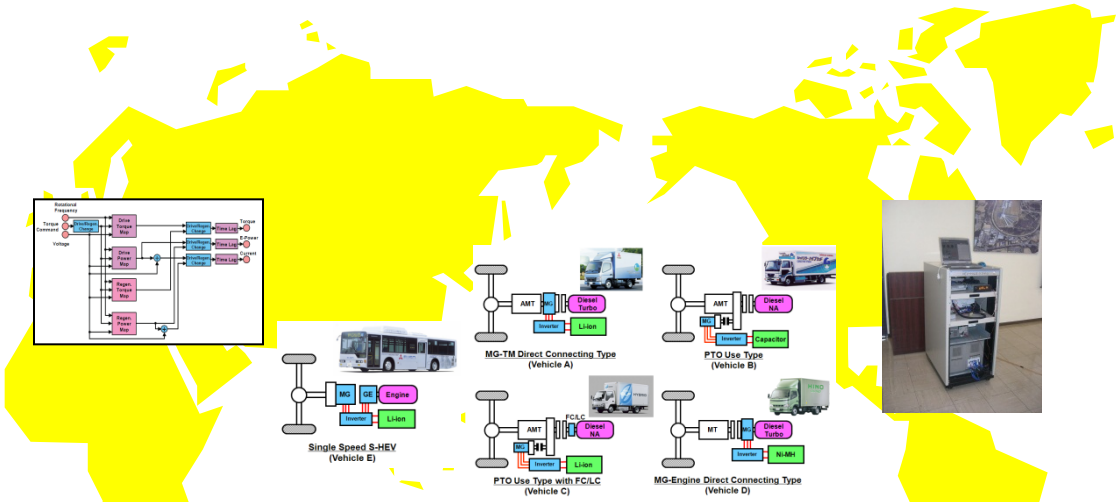
Working Paper No. **HDH-14-05e**
(14th HDH meeting, 04 June 2013)




# GRPE Informal Working Group on Heavy Duty Hybrids

## 14th HDH, Geneva, 04 June 2013

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# Summary of 13th HDH Meeting

- **The results of the 13th meeting in Borlänge on 21 and 22 March 2013 are summarized, as follows:**
  - **The basic vehicle cycle will be the WHVC with road gradients; 2 methods for calculating the road gradients will be investigated**
  - **The institutes propose that the model structure allows for using OEM specific models**
  - **The institutes will communicate the deliverables of validation test program 1 and the related time schedule within the next two weeks**
  - **The new model structure will be available by the end of April**
  - **The VECTO transmission model by TU Graz will be added to the open source model**
  - **Master ECU needs to be defined, supportive ECUs via interface or software emulation**
  - **Validation test program 2 will start in May with Volvo parallel hybrid bus, followed by Iveco parallel hybrid MD truck and MAN serial hybrid bus**
    - **Chassis dyno tests and road tests (w/o emissions measurement) will be run at JRC, engine dyno tests at OEM**
    - **Command signal frequency for engine tests will be 1 Hz, 10 Hz, 50 Hz**
  - **OICA and EPA will discuss bilaterally the possibility of HILS testing at EPA and report at the 14th HDH meeting**
  - **Model verification will be investigated during validation test program 2 including powertrain verification**
  - **The hybrid test procedure will be developed as an amendment to gtr n° 4 (new Annex 8)**

# Status of Validation Test Programs

- **Validation test program 1 largely completed**
  - Japanese open source model has been re-structured
  - New component library and signal naming convention has been developed
  - Drive cycle investigations have been completed
  - Serial hybrid and parallel hybrid models are available for testing
  - Final comments should have been submitted by 22/05/2013
- **Validation test program 2**
  - Validation test program 2 with real HVs has started at JRC with in May 2013
  - Test with first vehicle (Volvo parallel hybrid bus) completed
  - Data evaluation will be completed by mid-September 2013
  - OICA will cover budget for contributions of institutes (approx. 200 k€)
  - OICA members will consider HILS testing at EPA

# Topics for HDH Work Program

- **Assessment of chassis dyno and powerpack testing**
  - **input from Contracting Parties required by October 2013**
- **Drafting of the gtr**
  - **Drafting group established, but Technical Secretary not yet available**
  - **New Annex 8 to gtr n° 4 will include HILS method based on JP regulation Kokujikan 281 modified by input from HDH work program, and powertrain method based on US-EPA procedure**
  - **Informal document to be submitted to GRPE 68 in January 2014**
- **Other topics**
  - **OICA suggest to include plug-in hybrids and will develop a proposal for the 15th HDH meeting**
  - **Based on discussions with EU-COM, it is suggested to use the $CO_2$ result from HILS, if necessary, as input to the regional $CO_2$ regulations (details see page 6)**

# $CO_2$ Emission

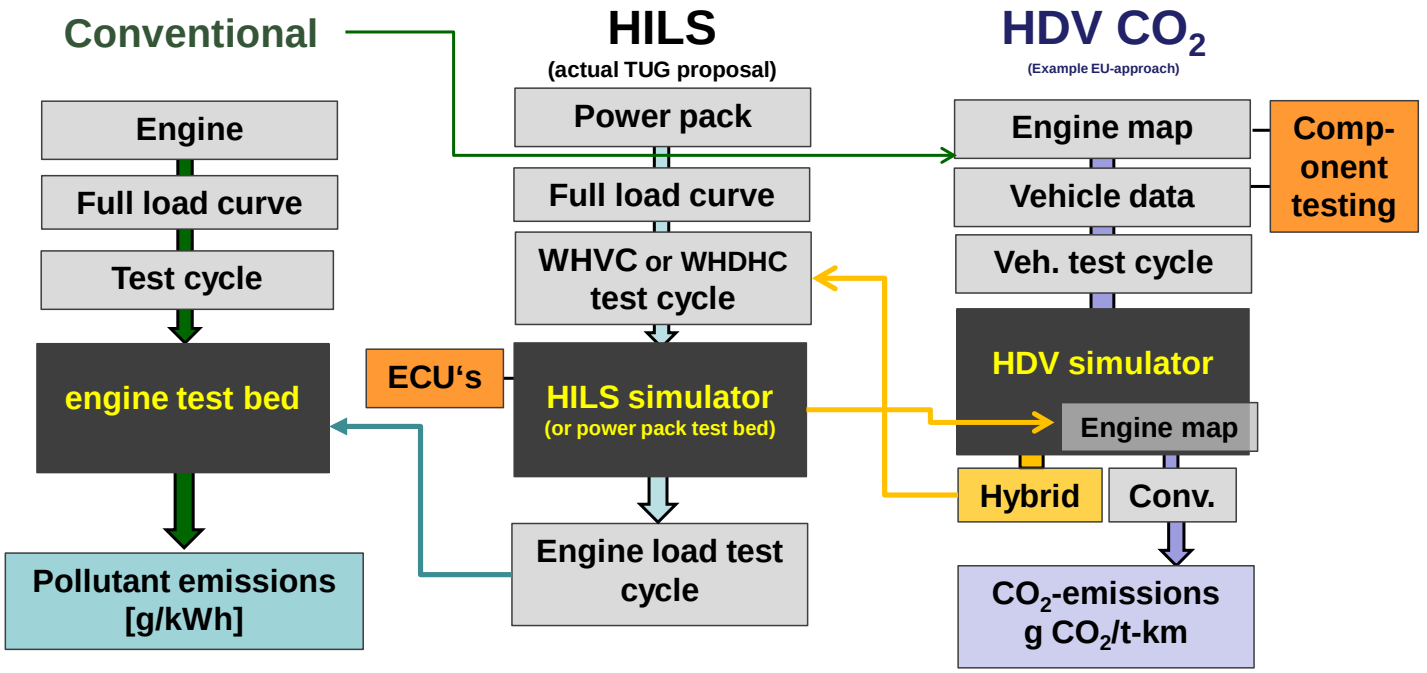
- **Background**
  - $CO_2$ emission is covered by the HDH mandate
  - Currently, CPs have their own regional HD $CO_2$ regulations in place or are developing $CO_2$ regulations for HD vehicles
  - There is no WP.29 mandate for a $CO_2$ regulation for conventional heavy duty vehicles
- **Conclusions from meeting with DG-CLIMA of EU-COM**
  - It is not appropriate to develop a $CO_2$ regulation by UNECE just for HD hybrid vehicles
  - HDH should develop the procedure for $CO_2$ determination
  - The HILS $CO_2$ result may then be used as input for the regional $CO_2$ regulations
  - The example for the EU is shown on pages 7 to 10
  - A similar approach is suggested for other CPs

# EU Approach on $CO_2$ Emission (1)

Institute for Internal Combustion Engines and Thermodynamics

TU Graz

## Option for harmonisation of test procedures




Input test cycle:
WHTC

Engine load cycle:
Depends on full load curve
Independent of vehicle

Input test cycle:
WHTC + WHVC

Engine load cycle:
Depends on full load curve
Independent of vehicle

Input test cycle: vehicle class specific target speed cycle

Engine load cycle:
Vehicle dependent and
full load curve dependent

# EU Approach on $CO_2$ Emission (2)

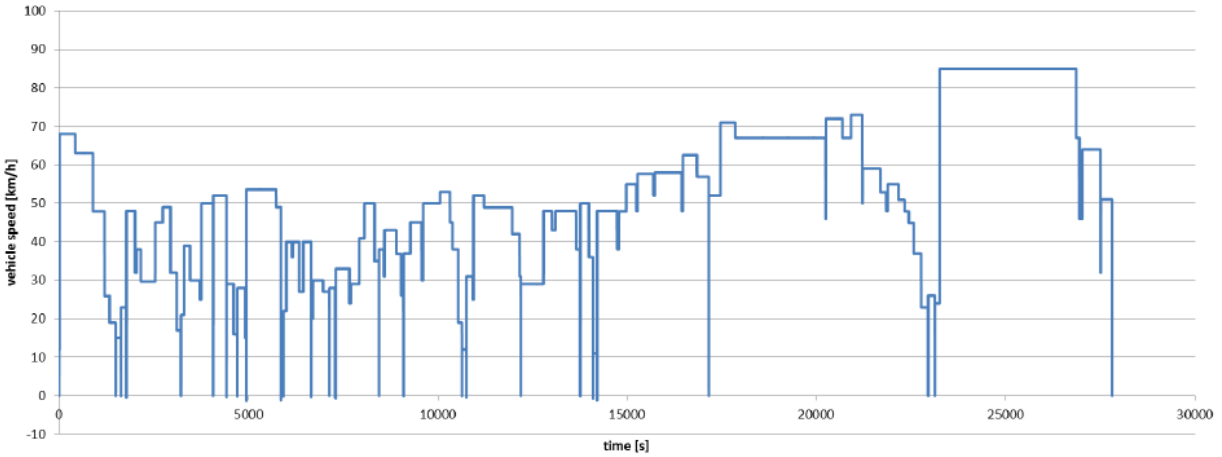


## Example of interface test VECTO – HILS (1)

### Vehicle data – vehicle modeled as serial hybrid

| | |
|---|---|
| MHD truck with 2 axles | |
| 6 speed gearbox | |
| | |
| vehicle mass [kg] | 8860 |
| cd value [-] | 0.6014823 |
| Cross sectional area [m²] | 8.8 |
| Rolling resistance coefficients | 0.0104188 |

### 1) ACEA urban delivery cycle as input for VECTO



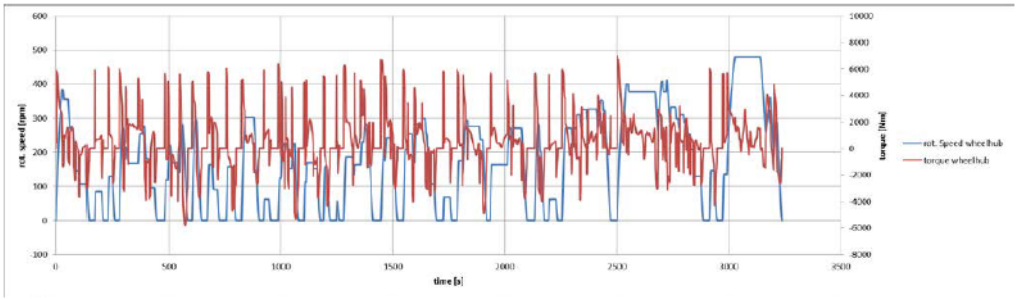
# EU Approach on $CO_2$ Emission (3)

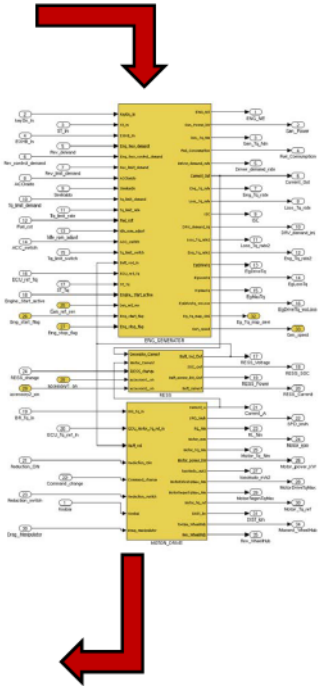
Institute for Internal Combustion Engines and Thermodynamics

TU Graz

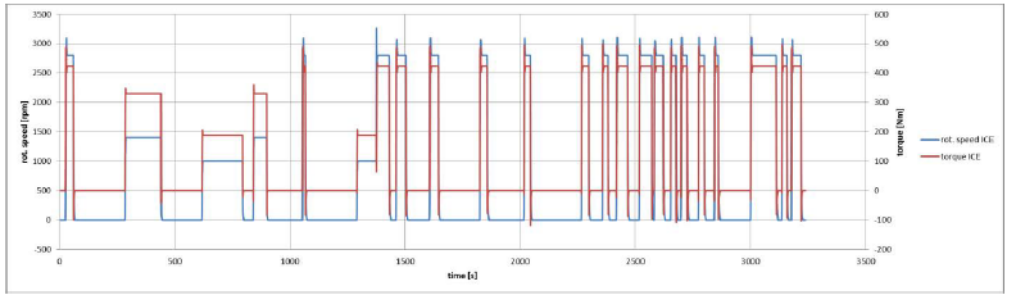
## Example of interface test VECTO – HILS (2)

2) rotational speed and torque at wheelhub as output from VECTO and input for HILS



3) rotational speed and torque for ICE as output from HILS

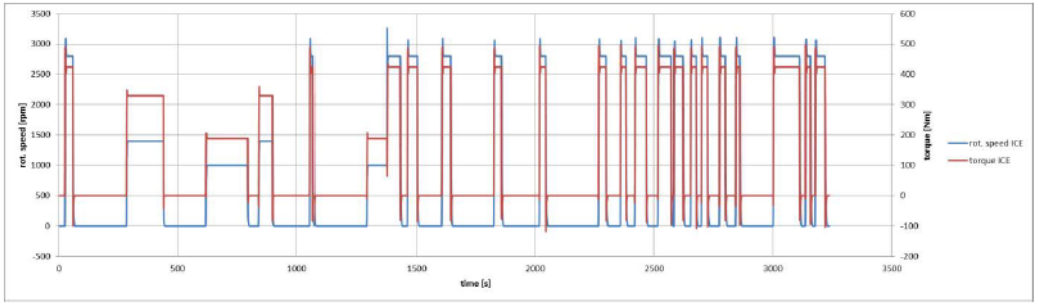


# EU Approach on $CO_2$ Emission (4)

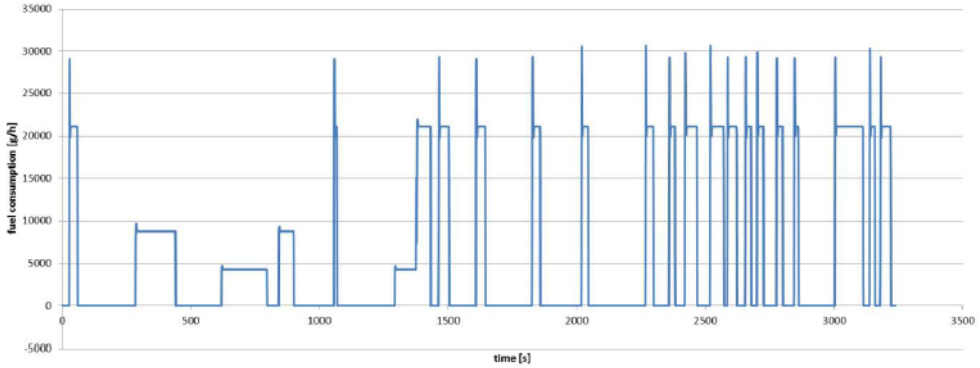


## Example of interface test VECTO – HILS (3)

**4) output from HILS = input for fuel consumption calculation in VECTO**




**5) calculated fuel consumption as output from VECTO**



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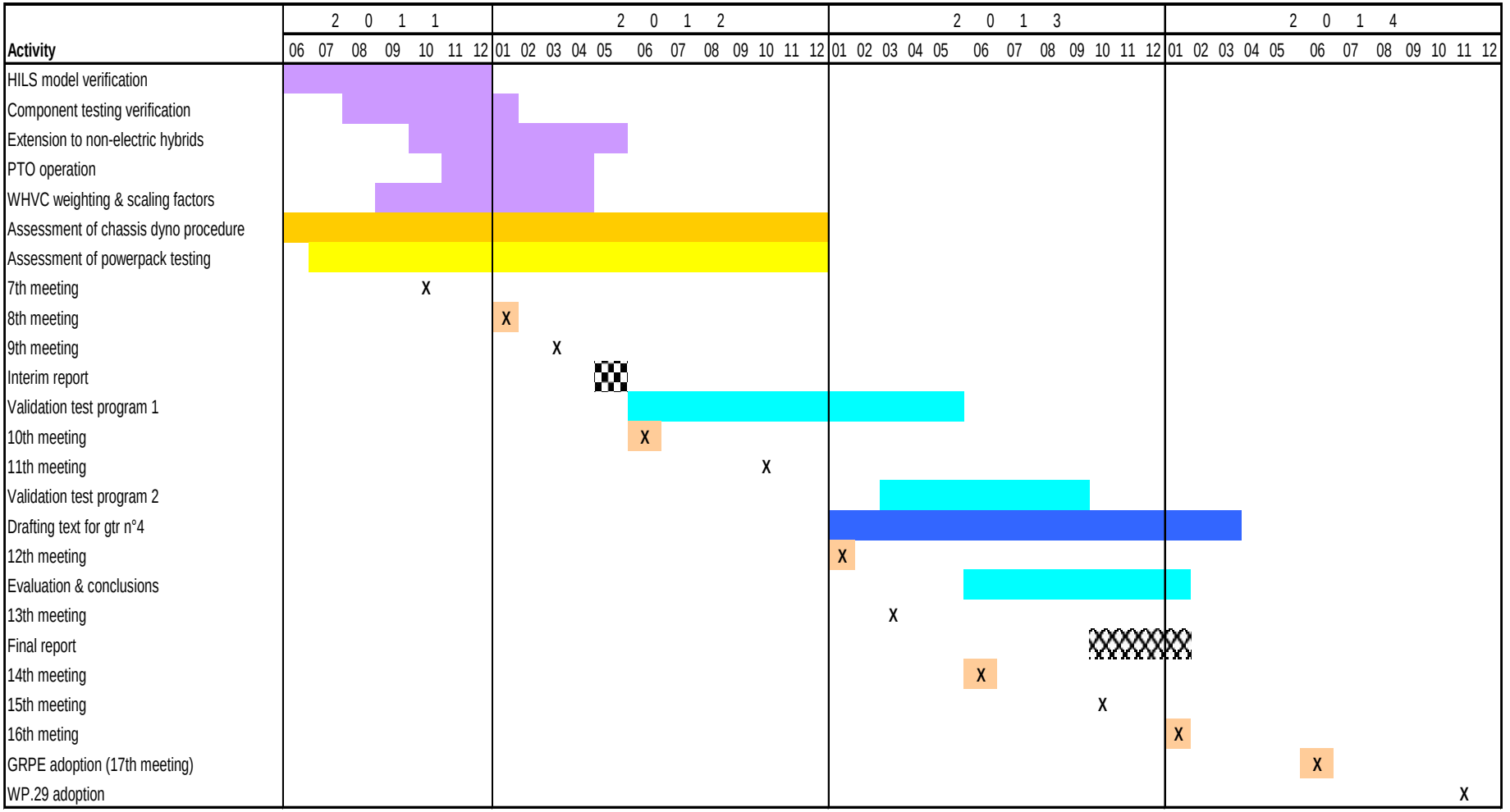
# Updated Roadmap & Project Planning




➔ Final report to GRPE delayed to 68th session, GRPE adoption to 69th session

➔ Timing for WP.29 adoption delayed to 164th WP.29 (11/2014)

# Next Meetings

- **The next HDH meetings are scheduled as follows:**
  - **The 14th meeting will be on 04 June 2013 in Geneva**
  - **The 15th meeting will be on 24 and 25 October 2013 in San Francisco**
  - **The 16th meeting will be in January 2014 in Geneva (to be confirmed)**
- **The next drafting group meetings are scheduled as follows:**
  - **The 3rd meeting will be on 03 July 2013 in Brussels (to be confirmed after nomination of Technical Secretary)**
  - **Web meetings planned in July, September, October 2013**
  - **The 4th meeting will be on 22 and 23 October 2013 in San Francisco**
  - **The 5th meeting will be planned for December 2013/January 2014**