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Working Paper No. HDH-05-08
(5th HDH meeting, 16 to 18 March 2011)



GRPE Informal Group on Heavy Duty Hybrids

5th HDH, Ann Arbor, 16 to 18 March 2011



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Contents

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- **Report from 4th HDH meeting**
- **Framework of hybrid emissions certification**
- **Roadmap & project planning**



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Relation between HILS and WHDC

- **Development of WHTC (universal engine cycle)**
 - **Tasks 1 to 5 resulted in the universal WHDC vehicle cycle (WHVC), which is the basis for the engine cycles WHTC and WHSC**
 - **Under task 6, the WHVC was transformed into an engine cycle on the basis of a standardized drivetrain and vehicle model**
 - **Under task 7, the resulting engine cycle was finalized into the reference transient cycle WHTC by regression analysis**

- **Development of HILS/WHDC (individual engine cycle)**
 - **WHDC tasks 6 and 7 are replaced by HILS on the basis of an individual (hybrid) drivetrain and vehicle model**
 - **As a result, individual engine reference cycles will be established**
 - **Since only the engine is tested, the test cell and data evaluation procedures of gtr n°4 can be applied w/o major modification**
 - **A new annex on the HILS procedure need to be added to the gtr**



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Report 4th HDH Meeting / GRPE 61

- **The results of the 4th meeting are as follows:**
 - **Amendment to gtr 4 as first option, as proposed by the Chairman, has been agreed; development of a separate gtr will be re-assessed and the conclusions reported back to GRPE at a later stage**
 - **Roadmap and project planning as presented by the Secretary have been agreed with minor modifications**
 - **The open source model provided by Japan will be evaluated**
 - **4 research institutes expressed interest in conducting the work program, and will be asked for quotes**
 - **OICA will provide 200 t€budget, COM contribution is pending**

- **GRPE has**
 - **Approved the roadmap and project planning**
 - **Approved extension of the mandate to the assessment of powerpack testing**
 - **Approved the 6th HDH meeting on 06 June 2011 at 14:30**



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Framework of Hybrid Certification

- **As a result of the discussion within the HDH group, hybrid emissions certification must**
 - **cover a wide range of RESS (battery, capacitor, hydraulic accumulator, kinetic storage device, flywheel capacitor, fuel cell)**
 - **account for RESS and engine power**
 - **allow for technology development**
 - **include provisions for transmission, gearing and rear axle ratio**
 - **account for benefits of hybrid PTO operation**
 - **account for vehicle regenerative energy gained or lost during testing**
 - **minimize discrepancy between certification and real world CO₂ and criteria emissions**



UNITED NATIONS **Task List for HDH Research Program**

- **To accommodate with its mandate, HDH will conduct a research program on the major elements of the HILS method. The research program covers the following five tasks:**
 - **Task 1: Investigation and modification, if applicable, of the Japanese HILS model and interface including a proposal for a verification method w/o vehicle testing**
 - **Task 2: Investigation and modification, if applicable, of the HILS component testing**
 - **Task 3: Extension of HILS to non-electrical hybrids, which are currently not covered by the Japanese test procedure**
 - **Task 4: Inclusion of PTO operation, which normally takes place outside the test cycle**
 - **Task 5: Development of WHVC weighting/scaling factors to represent real world vehicle operation**



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Roadmap & Project Planning

Task	2 0 1 0												2 0 1 1												2 0 1 2												2 0 1 3												2 0 1 4																							
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05																			
Preparatory work program																																																																								
OICA proposal	X																																																																							
1st meeting				X																																																																				
GRPE approval ToR					X																																																																			
2nd meeting																																																																								
3rd meeting								X																																																																
4th meeting																																																																								
Report to GRPE												X																																																												
Total project timing																																																																								
Quote by research institutes																																																																								
5th meeting														X																																																										
HILS model verification																																																																								
HILS component testing verification																																																																								
WHVC weighting & scaling factors																																																																								
Extension to non-electric hybrids																																																																								
PTO operation																																																																								
Assessment of chassis dyno procedure																																																																								
6th meeting																																																																								
Assessment of powerpack testing																																																																								
7th meeting																																																																								
Interim report																																																																								
8th meeting																																																																								
Validation test program 1																																																																								
9th meeting																																																																								
Validation test program 2																																																																								
10th meeting																																																																								
Evaluation & conclusions																																																																								
11th meeting																																																																								
12th meeting																																																																								
Final report																																																																								
Draft amendment to gtr n°4																																																																								
13th meeting, if necessary																																																																								
Final meeting																																																																								
GRPE adoption																																																																								
WP.29 adoption																																																																								



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Quotes on Research Program

- **A request for quote on the five tasks was sent to the following research institutes on 16/02/2011:**
 - **Graz University of Technology (Austria), Prof. Hausberger**
 - **Chalmers University of Technology (Sweden), Prof. Sjöberg**
 - **Vienna University of Technology (Austria), Prof. Geringer**
 - **University Institute of Automobile Research (Spain), Dr. López**

- **Offers were received by**
 - **TU Graz / TU Vienna (joint program) on 04/03/2011**
 - **Chalmers University on 07/03/2011, modified on 14/03/2011**



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Quotes on Research Program

➤ General Overview

- **Earliest completion date of any task is November 2011, which basically determines date of 7th HDH meeting**
 - **Task 1 and 2: November 2011**
 - **Task 3: May 2012 (Chalmers only)**
 - **Task 4 and 5: January 2012**
- **On Task 1, Chalmers University will partly use results from an earlier project**
- **TU Graz/Vienna do not quote on Task 3**
- **Chalmers price only valid for complete package**
- **TU Graz/Vienna offer gives more detailed information about the work packages**
- **TU Graz is also involved in the EU CO2 project, which creates significant synergies with HDH**



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Cost Comparison

Task	Chalmers	TU Graz / TU Wien
1	15 k€	55 k€
2	30 k€	45 k€
3	30 k€	-
4	20 k€	28 k€
5	30 k€	41 k€
Travel	20 k€	25 k€
TOTAL	145 k€	194 k€