



Regulatory Needs for Electrified HD Vehicles

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GRPE workshop on low- and zero- emissions heavy duty vehicles

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Types of Electric Vehicles and Test Methods

	Japan		GTR		UNR		EC	
	FE(GHG)	Emission	FE(GHG)	Emission	FE(GHG)	Emission	FE(GHG)	Emission
Conv. (ICE only)	Simulation based	GTR4	N	GTR4	N	R49	Y (Vecto simulation)	Y (Euro VI/R49)
HEV	HILS PT	GTR4	N	GTR4	N	?	In finalisation (Vecto simulation)	-
PHEV	Under Review		N	N	N	?	In finalisation (Vecto simulation)	-
BEV	Under Review	-	N	-	N	-	In finalisation (Vecto simulation)	-
FCV	Under Review	-	N	-	N	-	Planned (Vecto simulation)	-



Characteristics of HD and Electrified Vehicles

Heavy Duty Vehicle

Heavy-duty vehicles have a large number of different types of vehicles for a single powertrain.

Fewer complete vehicles are shipped, making it difficult to conduct tests using complete vehicles.



- In order to obtain fuel efficiency values for many types of vehicles without using actual vehicles, fuel efficiency values are measured and calculated using simulations and powertrains.

Electrified Vehicle

- Electric vehicles equipped with batteries are driven and regenerated from the batteries.
 - It is necessary to measure the amount of energy source accurately.

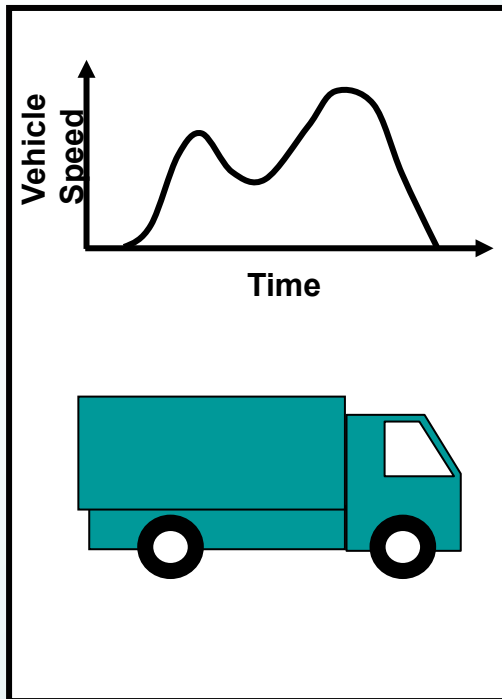


- Simulation and powertrain testing, including regeneration and drive control, are necessary.



HD Hybrid Vehicle Test Method

Test methods for HD HV emission measurement is prepared in GTR4 which can meet the characteristics of HD electrified vehicle.



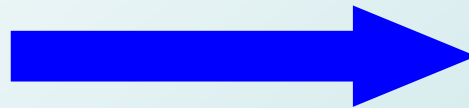
HILS Method:
Simulation methods with high flexibility



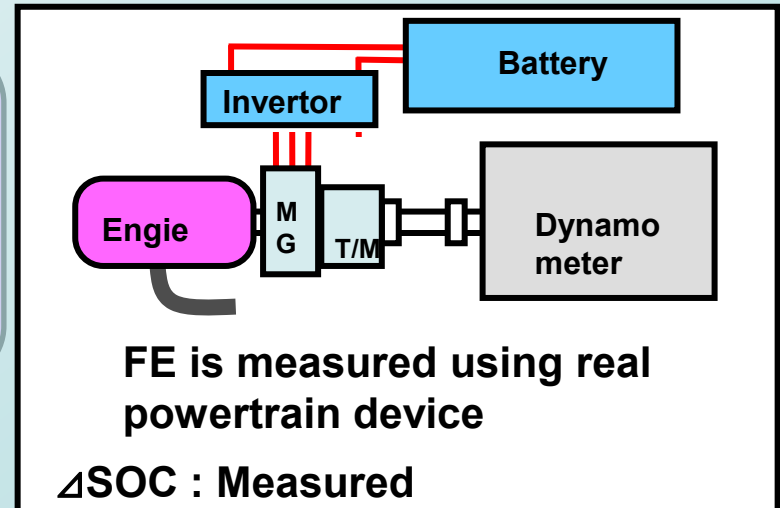
Actual ECUs

FE is calculated using simulation with ECU

Δ SOC : Calculated



Powertrain Method:
Simple test method using engine, MG, and battery devices

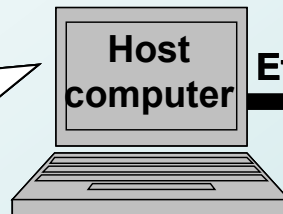
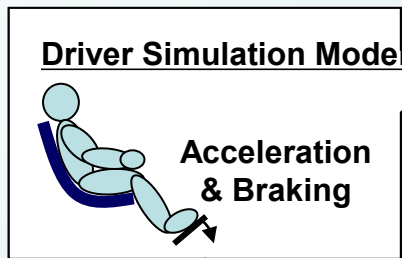
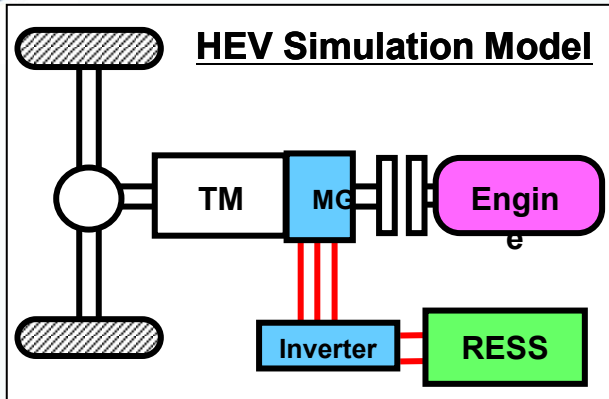
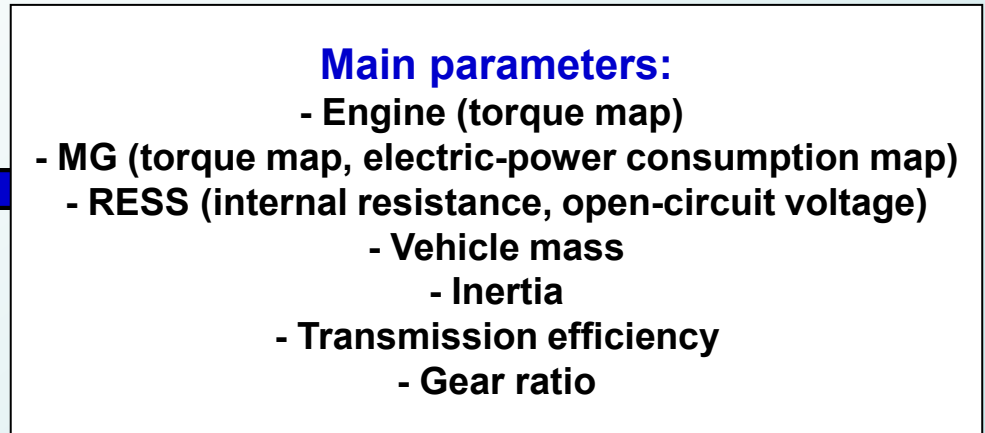


FE is measured using real powertrain device

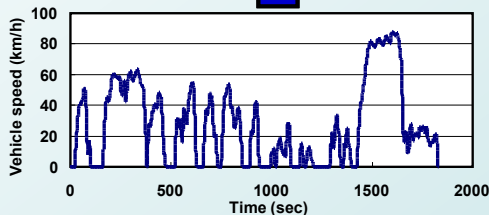
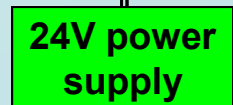
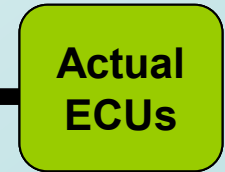
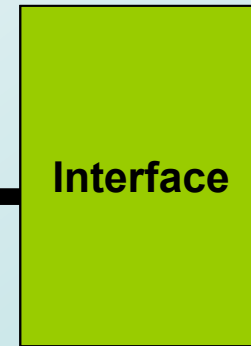
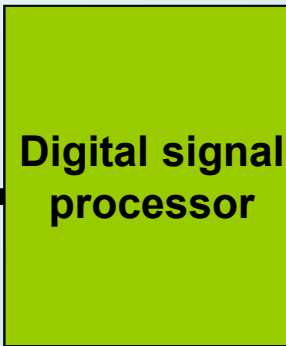
Δ SOC : Measured



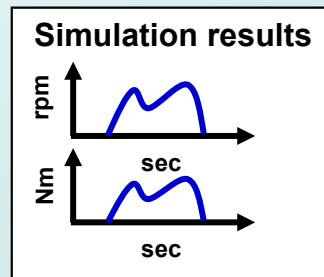
HILS Method



Ethernet



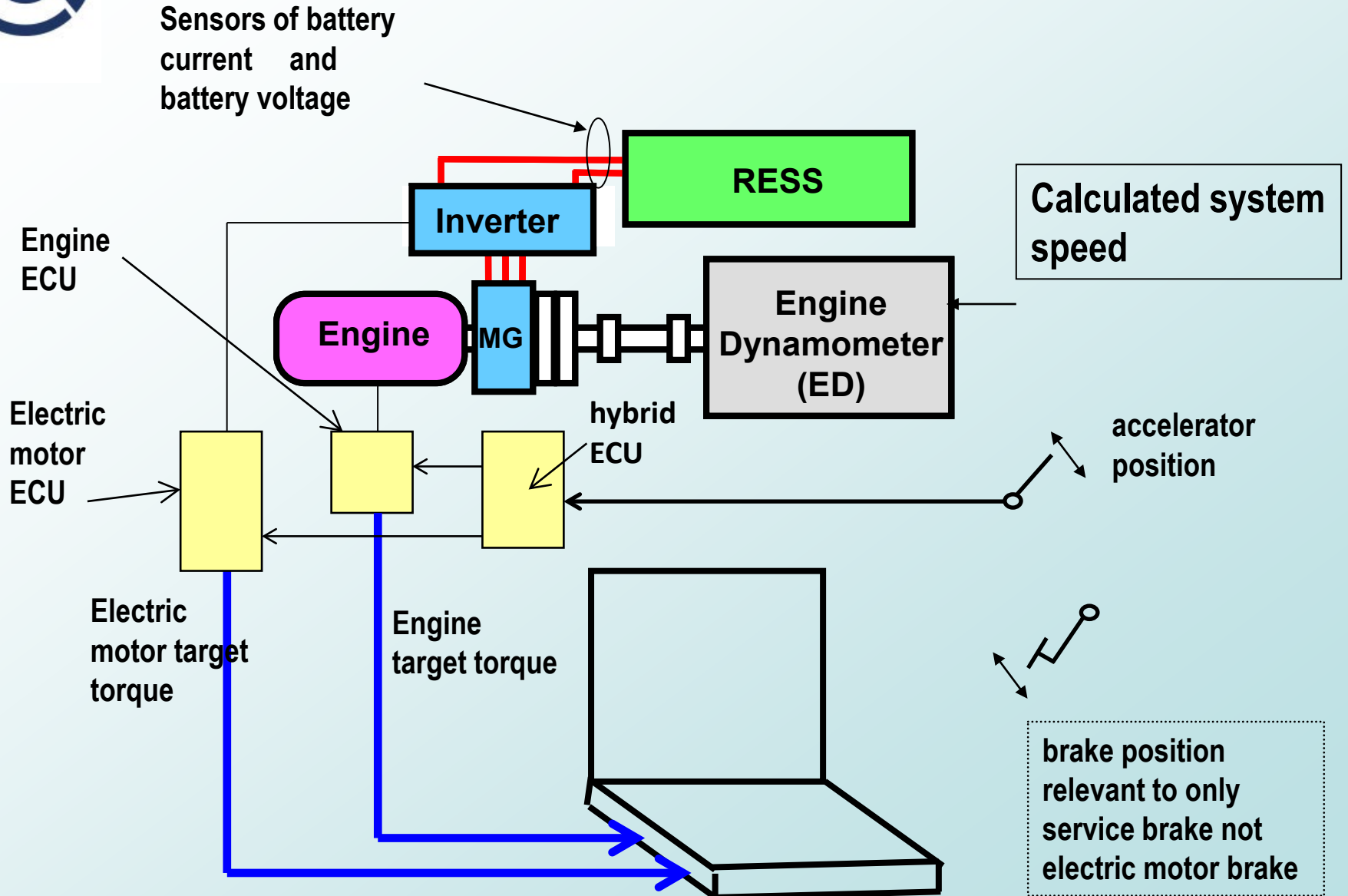
Reference vehicle speed (JE05 test cycle)



**Calculate fuel efficiency with F.C. map
or
Measure exhaust emissions with
an engine unit**



Powertrain Method





Electrified Vehicle Test Methods

Test methods for HD HV emission measurement is prepared in GTR4 which can meet the characteristics of HD electrified vehicle. The prospects and challenges for the application of this test method to electric vehicles are as follows.

	HILS Method	Powertrain Method
EV	<ul style="list-style-type: none">➤ Simulation is possible by removing the engine from the HV HILS method.➤ Necessary accuracy can be ensured by measuring the performance of the motor and refining each model.	<ul style="list-style-type: none">➤ Operation and measurement can be performed in the same way as HV using MG, battery, and ECU.➤ It is necessary to add measurement methods for power used, charging efficiency, etc.
FCV	<ul style="list-style-type: none">➤ By adding a model of the FC stack, it is possible to simulate it as well as HV and EV.➤ FC stack models and performance measurements are required.	<ul style="list-style-type: none">➤ FC stack, MG, battery, and ECU can be operated and measured in the same way as HV.➤ A method for measuring hydrogen consumption will need to be added.
PHEV	<ul style="list-style-type: none">➤ EV and HV driving can be simulated using the HV HILS method.➤ Necessary accuracy can be ensured by measuring motor performance and refining each model.	<ul style="list-style-type: none">➤ Operation and measurement can be performed in the same way as for HV using MG, battery, and ECU.➤ It is necessary to add measurement methods for power used, charging efficiency, etc.



Summary

- The number of electric vehicles is expected to increase in order to comply with carbon neutrality, etc., and a method of measuring efficiency will be necessary.
- Heavy-duty vehicles are characterized by the fact that there are so many types of vehicles and so few finished vehicles are shipped. In addition, energy regeneration is performed in electric vehicles. A performance measurement method that takes these characteristics into account is necessary.
- An extension based on the HILS method and the Powertrain method of GTR4 was introduced as one approach to create a measurement method to meet these needs.
- In order to develop harmonized test methods for electric vehicles in the future, it is necessary to compare the approaches of various governments and to consider the most appropriate ones as harmonized regulations.
- This WS was the first opportunity to exchange opinions on needs and approaches for electric vehicle test methods, and further progress is expected.