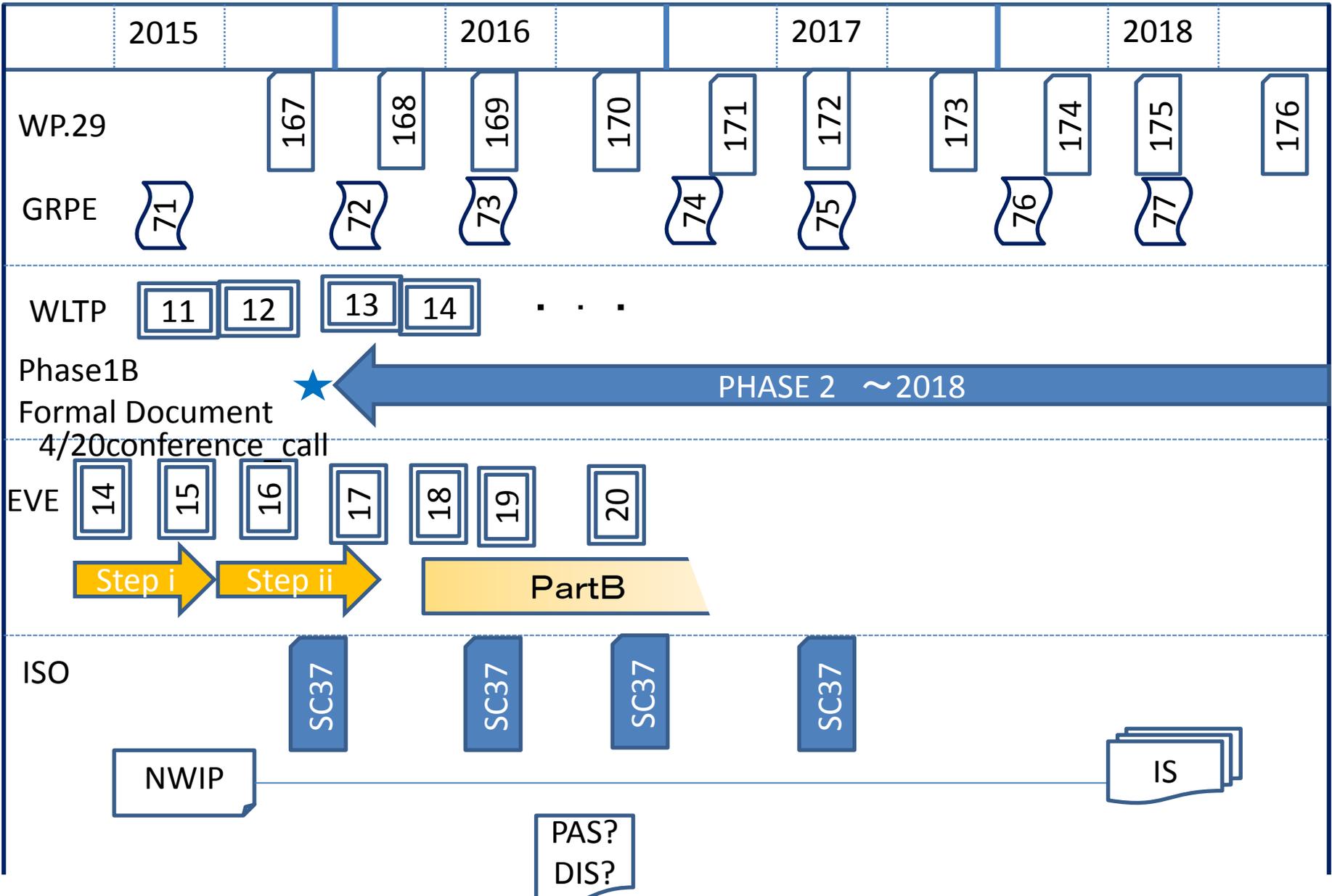


ISO activity



HEV System Power WG
Japan Automobile Research Institute

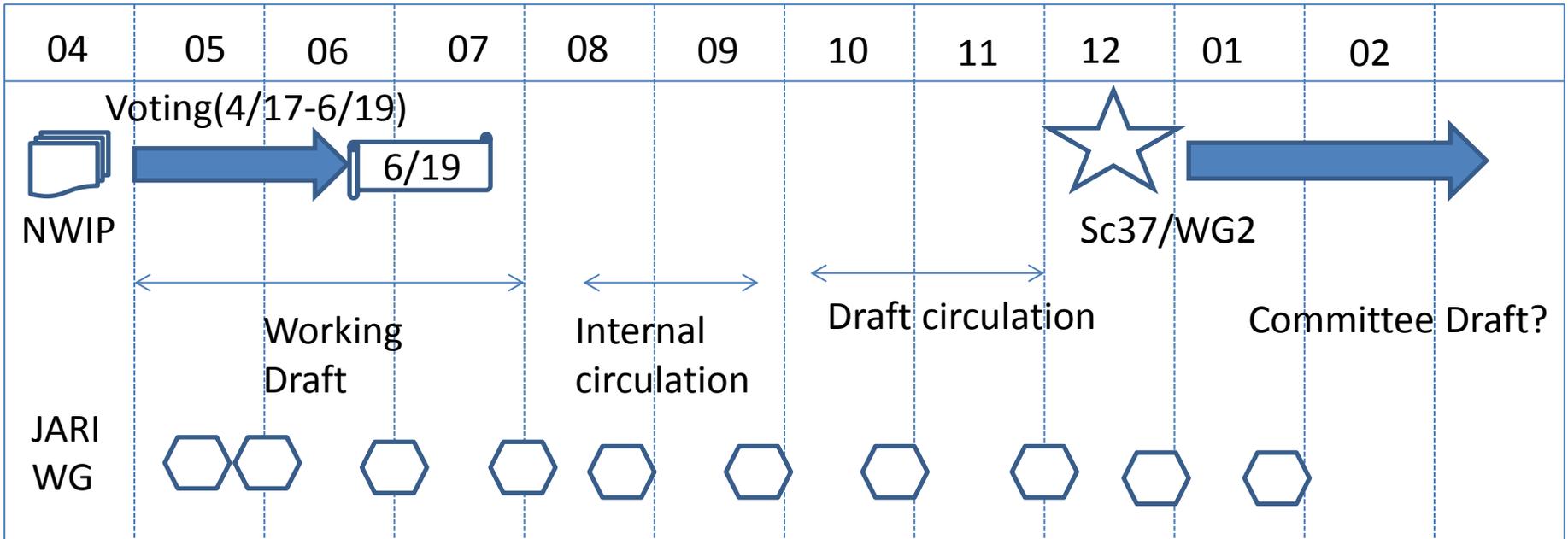
Schedule



Schedule

ISO SC37/WG2 march 5th
 NWIP voting Apr.17-Jun 19th

Next WG2 meeting will be held on week of Dec.15th



Determination of power for propulsion of hybrid electric vehicle



HEV System Power WG
Japan Automobile Research Institute

□ Title for an International Standard

“Determination of power for propulsion of hybrid electric vehicle”

- ◆ Contents: Evaluation method of the maximum hybrid system power
- ◆ Items should be achieved
 - 1) The results can be compared with the data of internal combustion engine(ICE) vehicle power measured with the current method such as UN R85.
 - 2) The method can apply to most of HEV systems.
 - 3) The method should have accuracy and repeatability.
- ◆ Background
 - 1) There is no international standard or regulation.
 - 2) It is necessary for MFRs to show the reasonable value of the power of hybrid system and compare it with the value of the ICE power measured in the existing test method.
 - 3) It is required in the drafted UN-GTR to classify the vehicles including HEVs by using the power of the system.

- ✓ It is necessary for MFRs to show the reasonable HEV system power and compare it with the ICE power of ICEVs measured in the existing test method
- ✓ There is no international evaluation method of the maximum hybrid system power. MFRs show the power in the catalogues in their own way to express.

TECHNICAL DATA	
Combustion engine:	110 kilowatts/150 hp
Electric motor:	75 kilowatts/102 hp
System:	150 kilowatts/204 hp
Maximum torque, combustion engine:	250 newton metres
Maximum torque, electric motor:	330 newton metres
Maximum torque, system:	350 newton metres
Electric range:	50 kilometres
Electric consumption:	11.4 kilowatt hours per 100 kilometres

✓ It is required in the drafted UN-GTR to classify the vehicles including HEVs by using the power of the system.

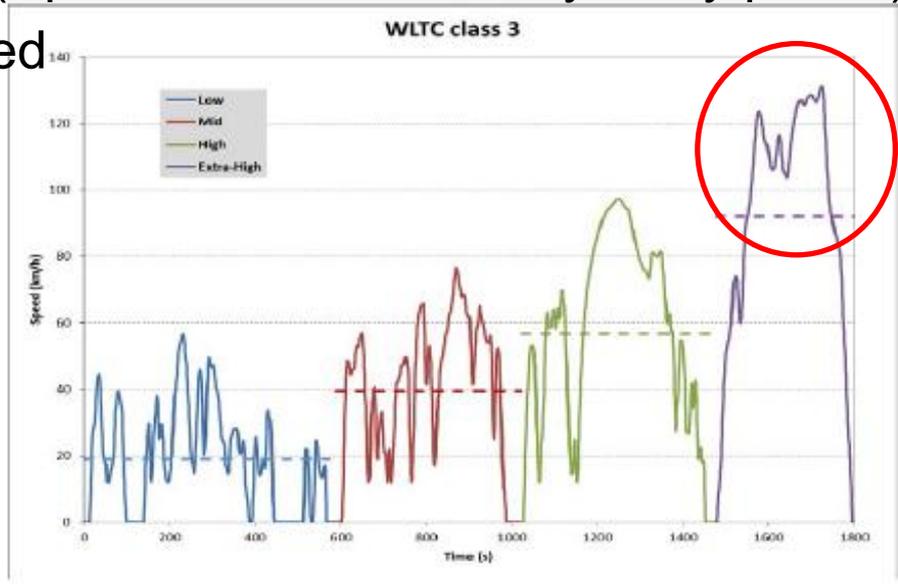
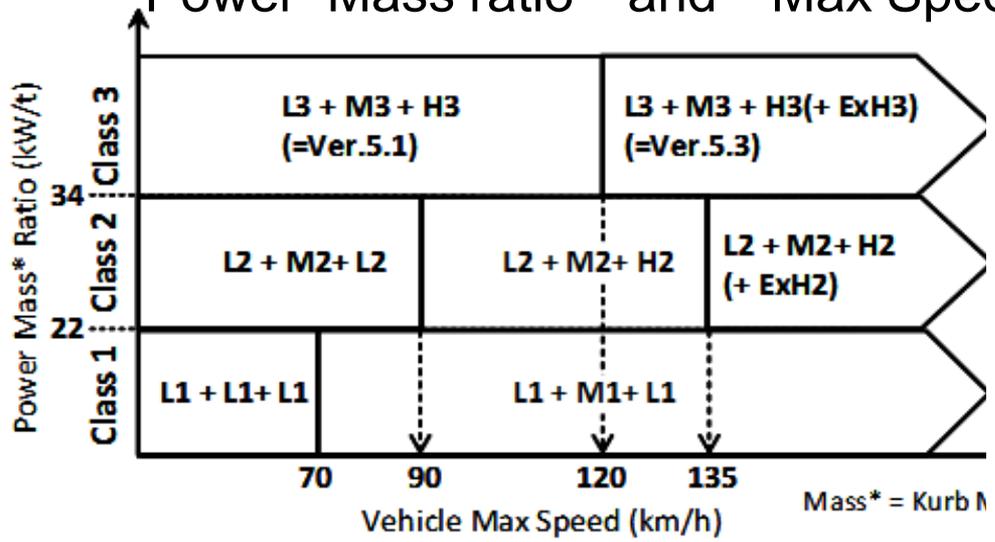
WLTP(GTR No.15) Under discussion

Downscale

(Application of the drive cycle by power)

Classification

Power Mass ratio and Max Speed



UN WP29 GRPE established on Nov. 2014 a TF for "Determination of Powertrain Performance of Hybrid Electric Vehicles" under EVE Informal WG. Germany and Korea will lead the project.

Hybrid system power at present

There is no regulation or standard to evaluate and determine "maximum hybrid system power".

- Existing International Standards and Regulations in terms of power measurement
ISO1585:Road vehicles — Engine test code — Net power
-> This specifies how to measure the net power of ICE.

UN R85 : Power Measurement of Internal Combustion Engines and Electric Motors

-> This specifies how to measure the power of ICE and that of electric motor respectively.

It doesn't specify the hybrid system power which derives from an ICE, an electric motor(s) and a battery.

- How to express the power of HEV at present
In catalogues, MFRs show the power in their own way to express.

There is no regulation or standard to evaluate and determine the power of HEV (hybrid system power) and be able to compare it with the power of ICEV.

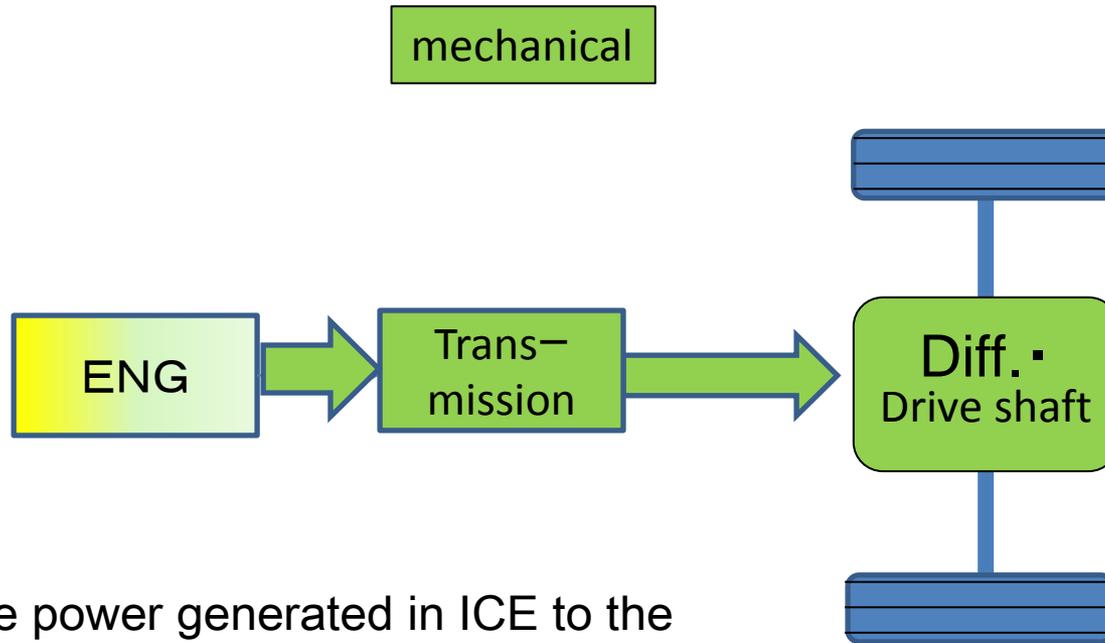
To define the HEV system power, an engine, a motor and a propulsion battery are important parts.

Hybrid systems have different configurations and controls. The power of HEVs depends on how these important parts relate each other.

The role of motor in the HEV is different from each hybrid system. It is not as simple as we can only measure the motor output as the additional power to the system.

The idea how we can define the HEV system power is shown in the following slides.

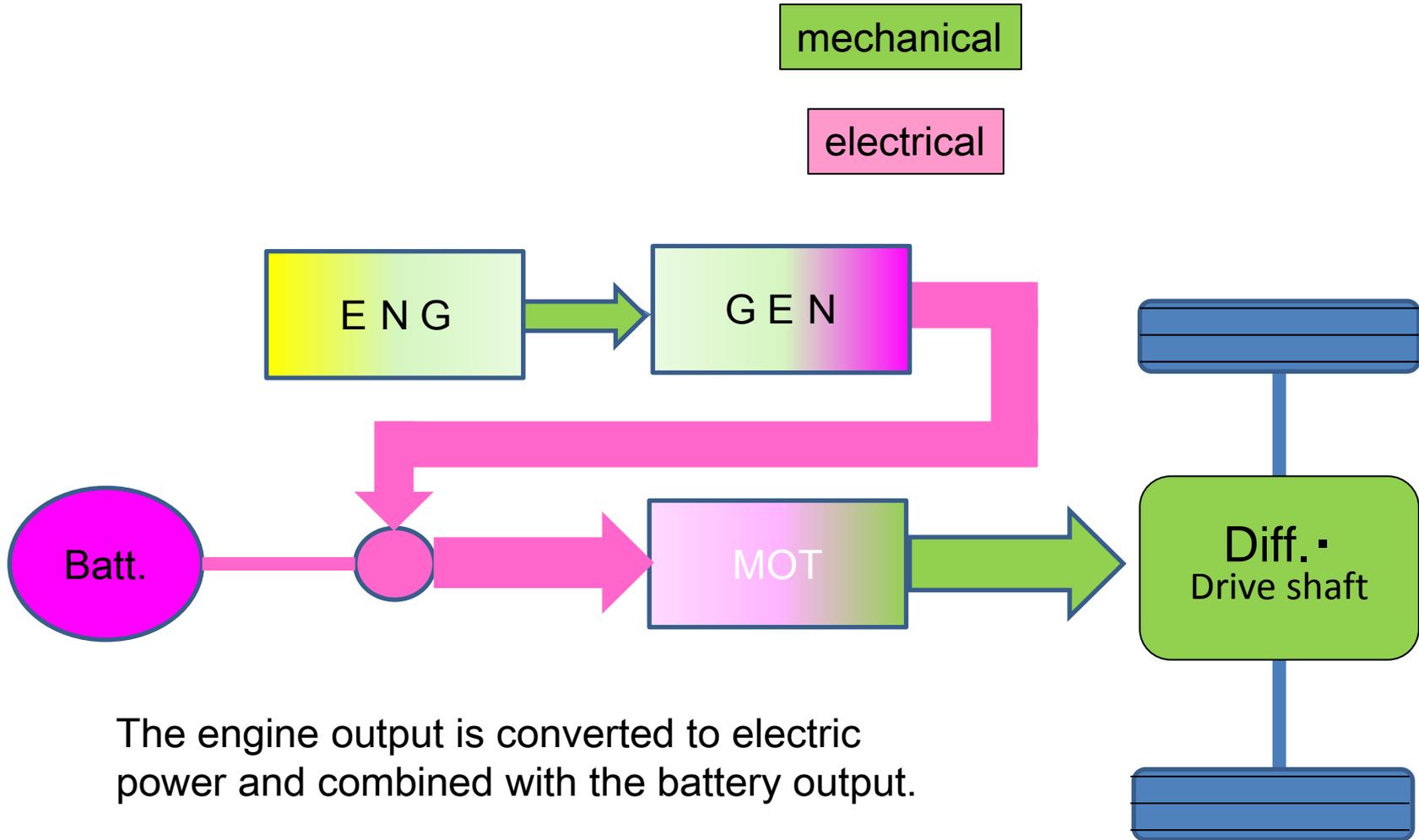
ICEV



ICEVs input the power generated in ICE to the transmission and propel the vehicles.

The example of study of HEV system

Series Type (AER type)

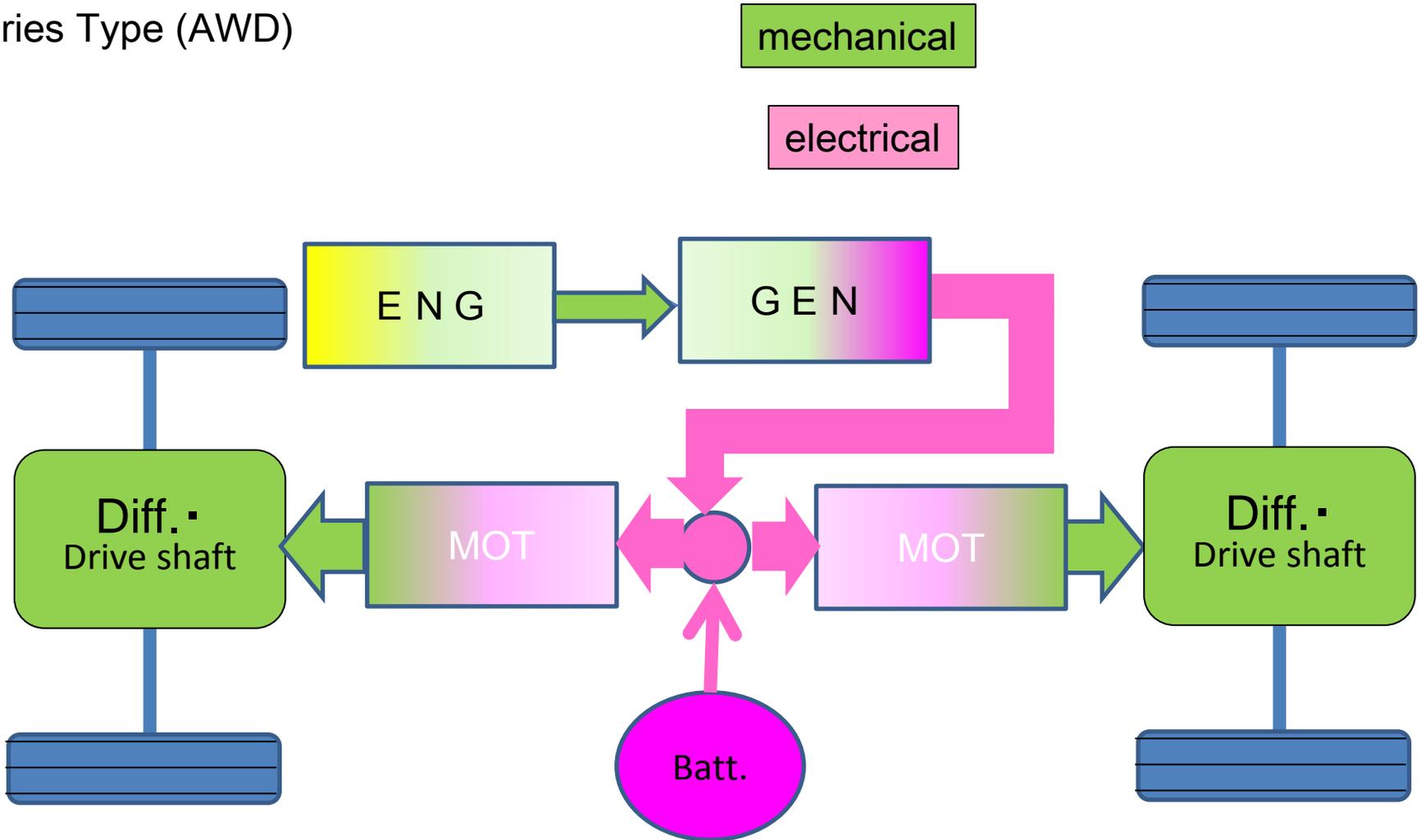


The engine output is converted to electric power and combined with the battery output.

The motor output can be the comparable system power to the engine power of the ICEV system.

The example of study of HEV system

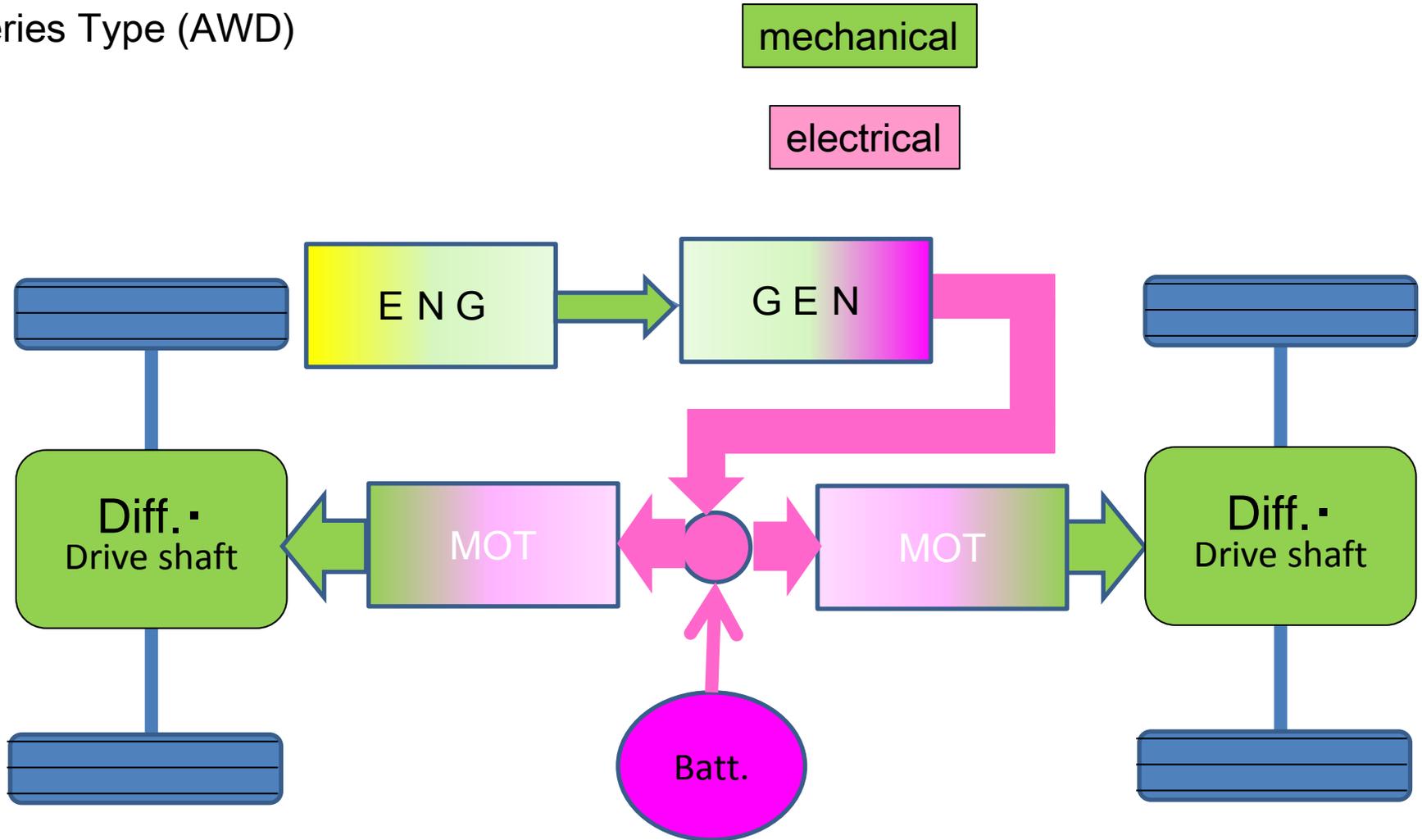
Series Type (AWD)



The e-motors output are limited by electrical power.

The example of study of HEV system

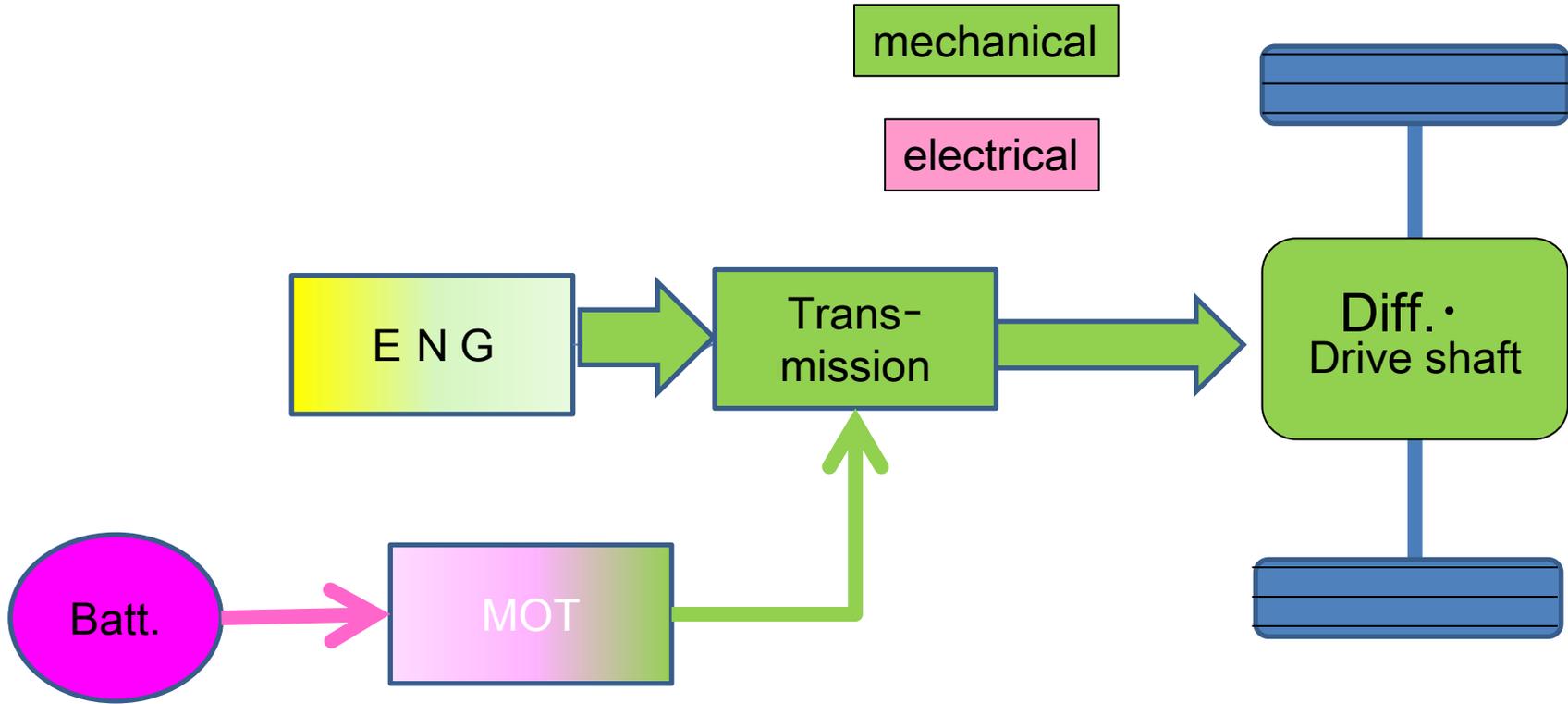
Series Type (AWD)



The motor output can be the comparable system power to the engine power of the ICEV system.

The example of study of HEV system

Parallel Type

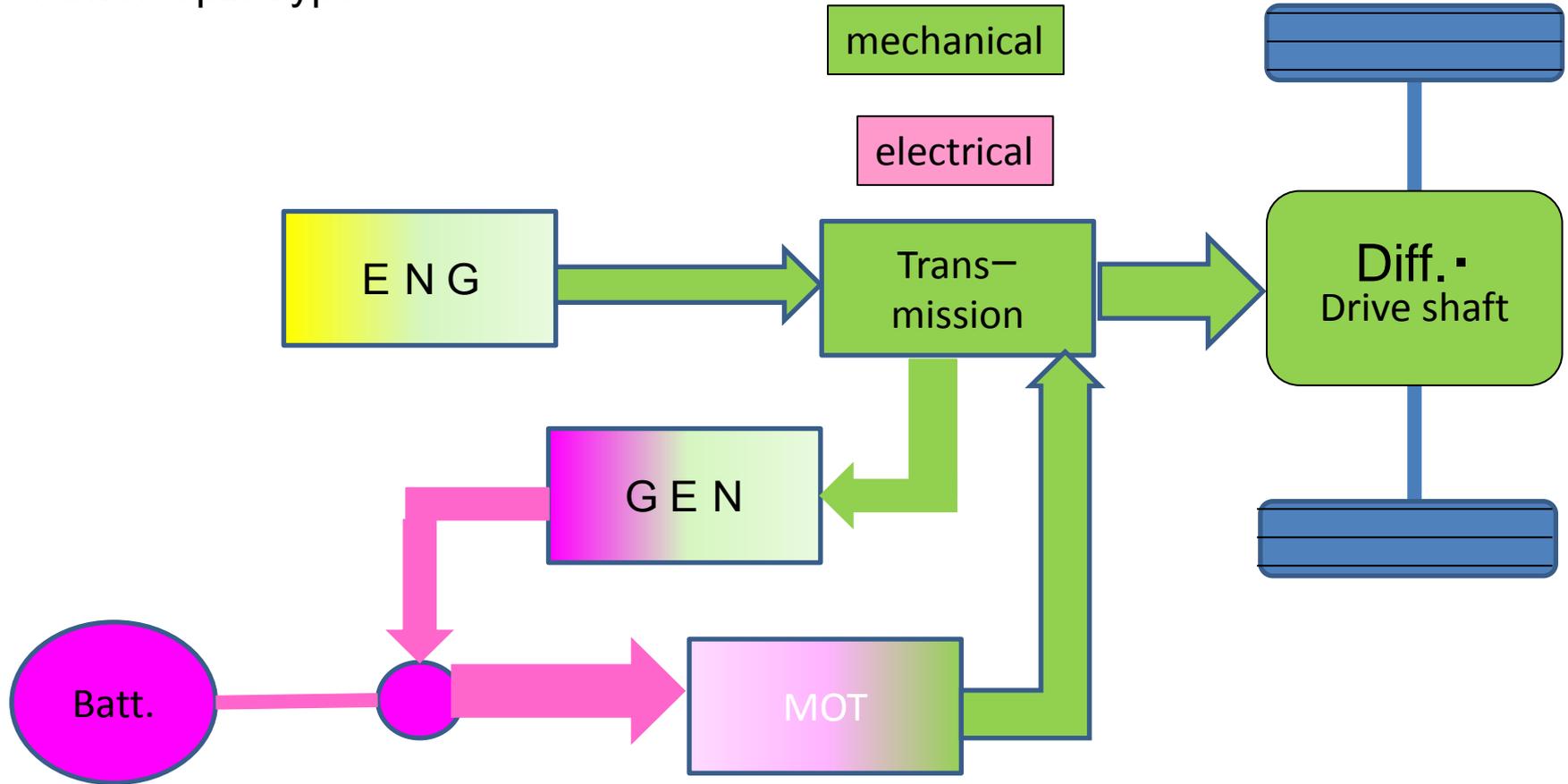


The battery output is converted to mechanical power and combined with the engine output.

The motor output can be the additional power to the power from the engine.

The example of study of HEV system

Power-Split Type

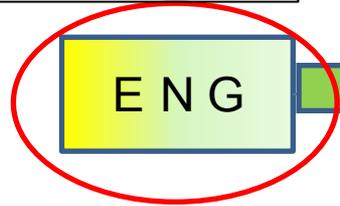


The engine output partially goes to the motor via the generator and as the motor output, it is combined with the rest of engine output.

Adding the power of motor to that of engine does not show the system power of this HEV system.

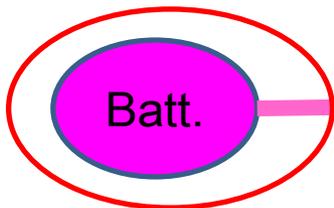
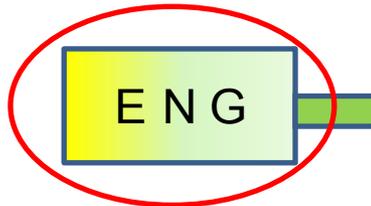
ICEV

Engine



HEV

Engine + Battery



The battery and engine are power sources of HEVs. Measuring powers of engine and battery are common with every hybrid system.

Summary 1

In the hybrid system, not only the engine output but also the battery output contribute to propel the vehicle.

- ❑ For most cars(ICEVs), the maximum power in the catalogue is the maximum output of the engine power.
- ❑ Those engine powers in catalogues are measured by the same procedures of testing the engine power such as ISO, UN regulation and regional standards and regulations.

- ❑ In order to compare the power of HEVs with that of ICEVs, the engine power of HEVs should also be measured.
- ❑ But, in addition to the engine, HEVs have a motor(s) and a propulsion battery related to an electric power source.

- ❑ We recommend to measure the battery power, not the motor power.

Why is hybrid system power determined as the engine power and battery power instead of the motor power?

❑ The battery and engine are only power source of the hybrid system. Measuring the battery output is an ideal approach to see the output from the electric power source separated from the engine power. The output can be measured by testing the vehicle as a whole.

In conclusion, the value of hybrid system output can be obtained from the engine output and battery output.

Determination of power for propulsion of hybrid electric vehicle

- ❑ To evaluate and determine :

Engine power + Battery power = Hybrid system power

- It is necessary to measure the battery output under the HEV system control. The battery output should be measured when the hybrid system as a whole (is considered as) outputs the maximum power.



- ❑ To measure the battery output when the engine outputs the maximum power.

- The battery output in HEVs have different output profiles depending on each vehicle system design, such as the upper value of the maximum power, the duration of the maximum power, timing.

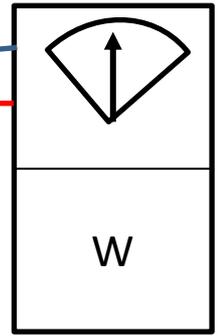


- ❑ To measure the engine operating status and the battery output of the vehicle with WOT on the chassisdynamometer set up under fixed throttle opening conditions.

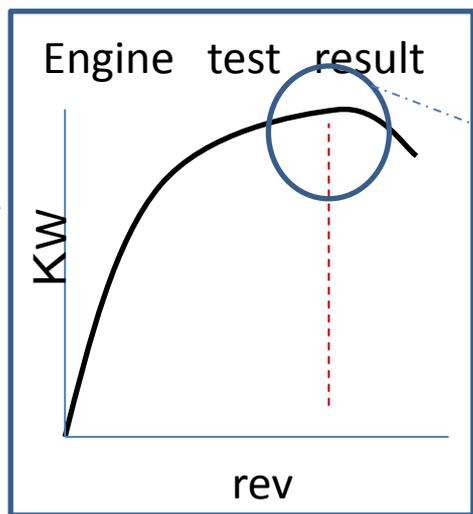
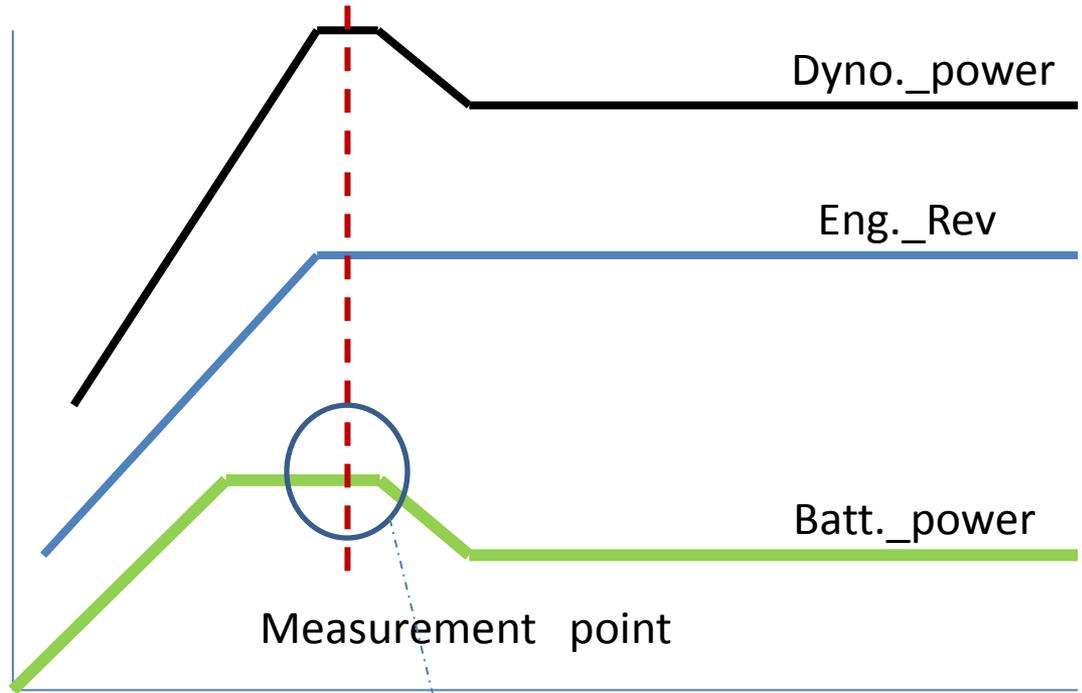
- ❑ To prepare the engine maximum power record prior to the test and determine the corresponding output value to the same engine operating status.

- ❑ To combine the engine output value from the record and the measured battery output. The combined outputs can be compared with the engine output of the ICEVs.

Rev.
Throttle



Dyno_power



Engine + Battery = Hybrid system power

END