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Overview of the Correlation and CO2MPAS Process

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Ispra, 15/05/2017

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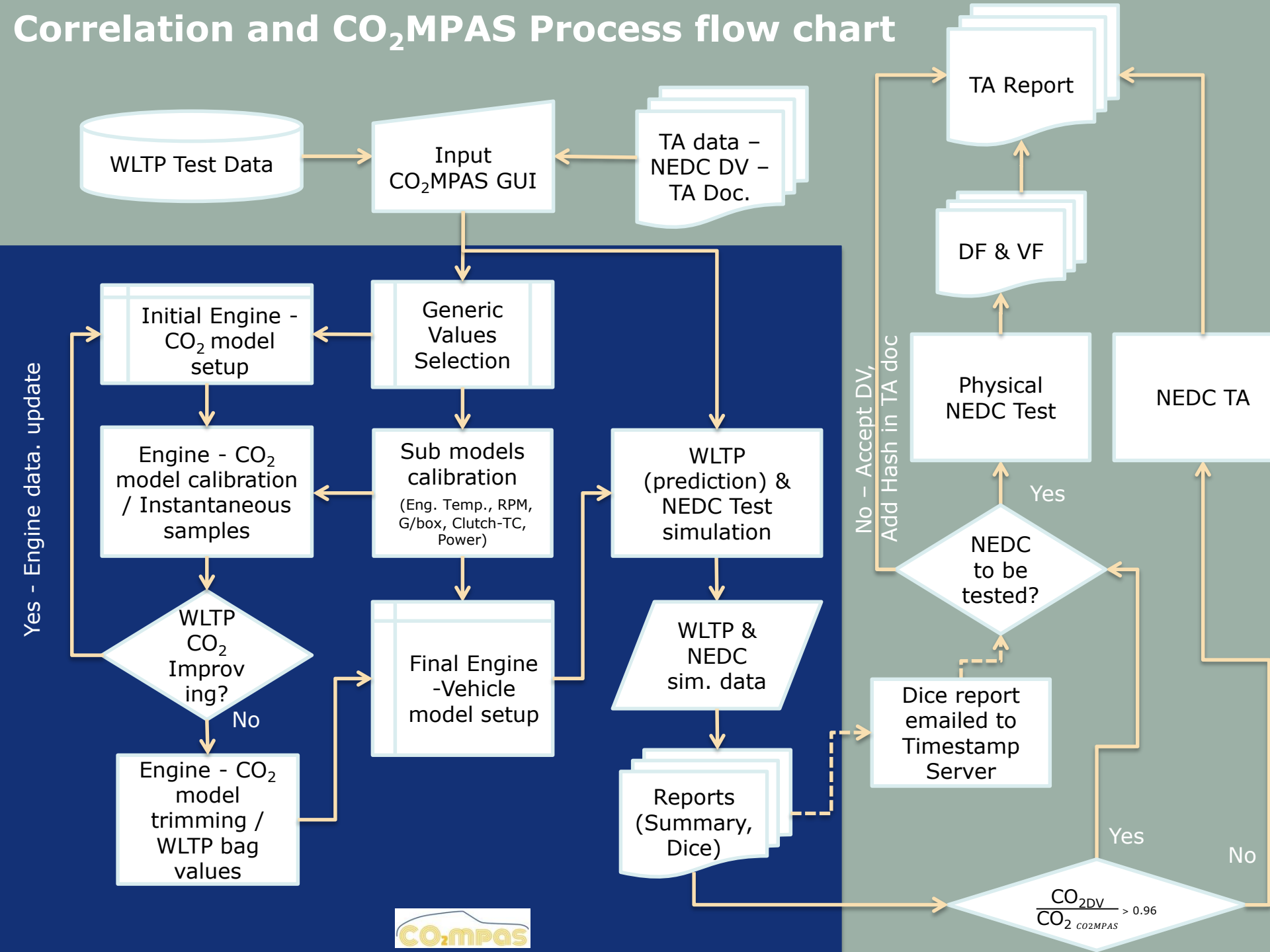
Correlation and CO_2MPAS Process flow chart



CO2MPAS Report

- CO2MPAS detailed report contains all input/output data, charts, summarized results.
- Two important tabs for TA process in that report are:

1. OUTPUT REPORT and
2. DICE REPORT

Output Report

CO2MPAS version	1.5.0rc0
Date/Time	2017/04/06-12:20:06
Type approval mode	False

NEDC Average Specific CO2 Emissions*	Vehicle H	Vehicle L	units
NEDC CO2 declared value	124.40		g/km
NEDC CO2MPAS simulated	122.06		g/km
CO2MPAS deviation	-1.88		%

*Ki factor - corrected

NEDC CO2MPAS CO2 Emissions	Vehicle H	Vehicle L	
CO2MPAS simulated NEDC	122.06		g/km
CO2MPAS simulated UDC	129.52		g/km
CO2MPAS simulated EUDC	117.74		g/km

	Vehicle H	Vehicle L	units
Fuel Type	diesel		-
Engine Capacity	1596.00		cc
Gearbox type	manual		-
Turbo engine	TRUE		-
alternator_model score	11.90		A
at_model score			-
clutch_torque_converter_model score	24.91		RPM
co2_params score	0.03		CO2g/s
engine_cold_start_speed_model score	37.81		RPM
engine_coolant_temperature_model score	1.24		°C
engine_speed_model score	6.41		RPM
start_stop_model score	-0.99		-
CO2MPAS deviation	-1.88		%

NEDC Inputs	Vehicle H	Vehicle L	
F0	89.10		N
F1	0.8790		N/km/
F2	0.0387		N/(km,
Inertia	1590.0		kg
WLTP Inputs	**Vehicle H**	**Vehicle L**	
F0	101.90		N
F1	0.8920		N/km/
F2	0.0393		N/(km,
Test Mass	1698.8		kg
CO2 emission phase Low	141.34		g/km
CO2 emission phase Medium	128.25		g/km
CO2 emission phase High	121.60		g/km
CO2 emission phase Extra-High	153.37		g/km

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Output Report

1. If CO2MPAS deviation ≤4% OEM declared NEDC CO2 value is accepted;

2. If CO2MPAS deviation >4% OEM has option to accept new value or to request physical test.

CO2MPAS SUMMARY OUTPUT REPORT

TA Certificate Number	
CO2MPAS version	1.4.1rc0
Date/Time	2016/11/22-14:19:09
Type approval mode	True

NEDC Average Specific CO2 Emissions*	Vehicle H	Vehicle L	units
NEDC CO2 declared value	145.31	143.90	g/km
NEDC CO2MPAS simulated	145.39	142.31	g/km
CO2MPAS deviation	0.05	-1.10	%

*Ki factor - corrected

NEDC CO2MPAS CO2 Emissions	Vehicle H	Vehicle L	
CO2MPAS simulated NEDC	145.39	142.31	g/km
CO2MPAS simulated UDC	161.34	157.63	g/km
CO2MPAS simulated EUDC	136.14	133.43	g/km

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Output Report

From OUTPUT REPORT phase-specific CO2 values should be calculated

$$NEDC\ CO_{2,p,H} = NEDC\ CO_{2,p,H,c} \cdot CO_{2,AF,H}$$

$CO_{2,\ AF}$ is adjustment factor and ratio between final combined NEDC CO_2 (declared, CO2MPAS) and CO2MPAS simulated value.

CO2MPAS SUMMARY OUTPUT REPORT

TA Certificate Number	
CO2MPAS version	1.4.1rc0
Date/Time	2016/11/22-14:19:09
Type approval mode	True

NEDC Average Specific CO2 Emissions*	Vehicle H	Vehicle L	unit
NEDC CO2 declared value	145.31	143.90	g/km
NEDC CO2MPAS simulated	145.39	142.31	g/km
CO2MPAS deviation	0.05	-1.10	%

*Ki factor - corrected

NEDC CO2MPAS CO2 Emissions	Vehicle H	Vehicle L	
CO2MPAS simulated NEDC	145.39	142.31	g/km
CO2MPAS simulated UDC	161.34	157.63	g/km
CO2MPAS simulated EUDC	136.14	133.43	g/km

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Dice Report

For each WLTP interpolation family this file should be sent to a functional mailbox – as a result random number will be received (from 0 to 99).

CO2MPAS DICE REPORT

TA Certificate Number	
CO2MPAS version	1.4.1rc0
Date/Time	2016/11/22-14:19:09
Type approval mode	True

	Vehicle H	Vehicle L	units
Fuel Type	diesel	diesel	-
Engine Capacity	2041.00	2041.00	cc
Gearbox type	manual	manual	-
Turbo engine	TRUE	TRUE	-
sub_models_uuid	b'\x80\x03}q\x00(X\x0	b'\x80\x03}q\x00(X\x0	-
alternator_model score	4.44	6.01	A
at_model score			-
clutch_torque_converter_model score	0.35	0.35	RPM
co2_params score	0.00	0.00	CO2g/s
engine_cold_start_speed_model score	0.00	0.05	RPM
engine_coolant_temperature_model score	0.87	0.81	°C
engine_speed_model score	0.00	0.00	RPM
start_stop_model score	-1.00	-1.00	-
CO2MPAS deviation	0.05	-1.10	%

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Random Number

SCENARIO A

CO2MPAS DEVIATION ≤4%

DV ACCEPTED

SCENARIO B

CO2MPAS DEVIATION >4%

CO2MPAS ACCEPTED

DICE REPORT SENT

↓

RN 0-89

↓

END TA PROCESS

RN 90-94

↓

1 NEDC-L TEST

RN 95-99

↓

1 NEDC-H TEST

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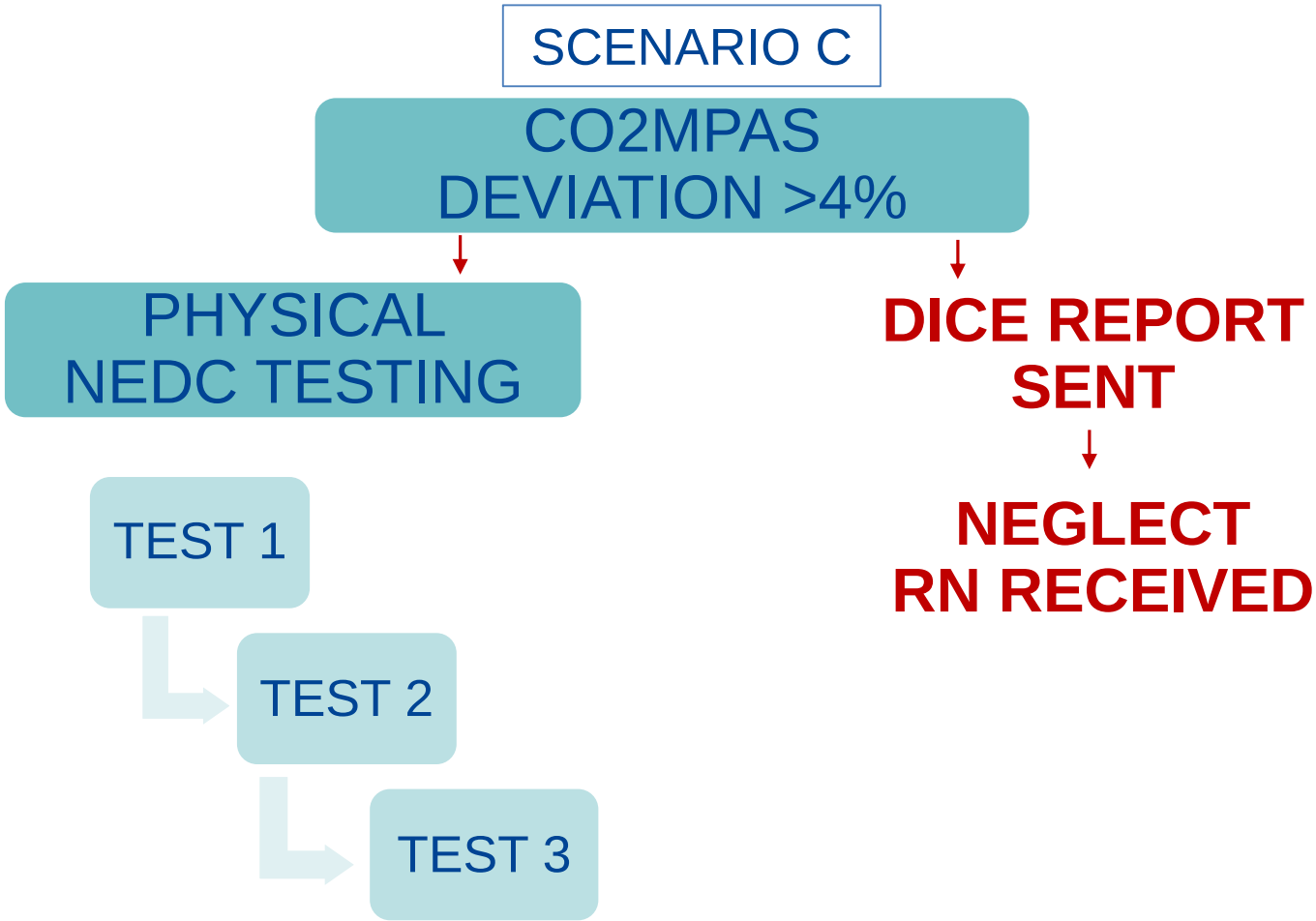
Random Number



Random Testing

Only in cases where CO2MPAS was used to confirm declared value there is 10% of chance for performing one random physical test.

From this test **Verification Factor** and **Relative Deviation** should be recorded in TA certificate and CoC.

Verification Factor VF is used to check accuracy of the input data (fuel saving gear, start-stop activation time, and BERS). In case of non conformity it shall be set to 1.

Relative Deviation De is deviation between measured and OEM declared value

$$De = \frac{RTr - DV}{DV}$$

VERIFICATION FACTOR

In the following slides,

- Start-Stop Activation Time
- Fuel saving for automatic vehicles
- Brake Energy Recuperation System

will be clarified with specific methods in real examples.

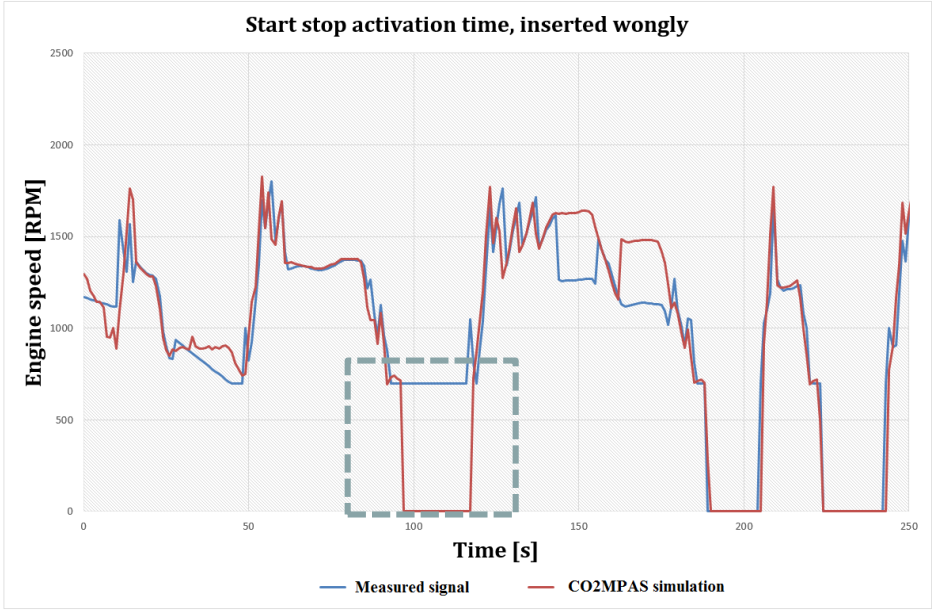
CO_2MPAS team will support you
and try to find
the solution if you face any doubts
about the model and its usage.

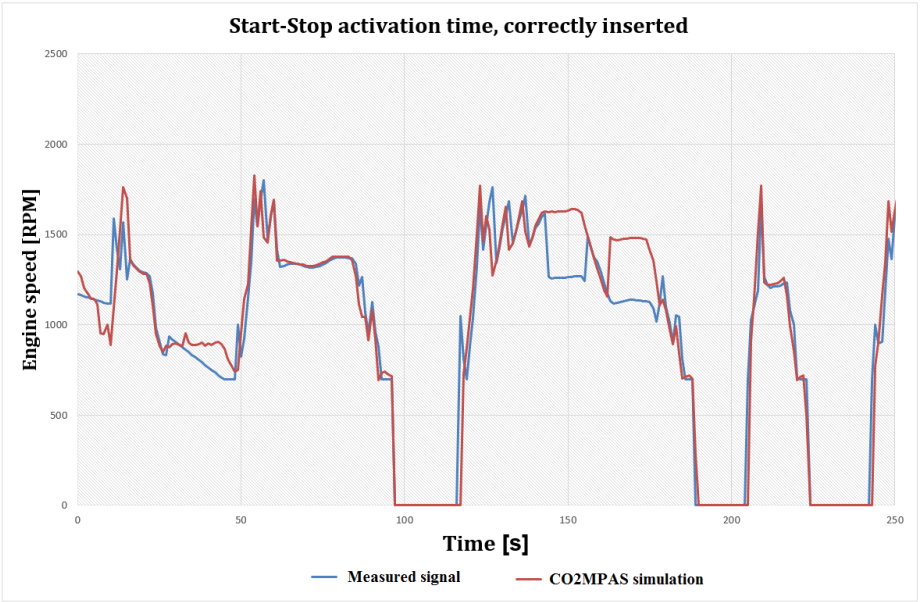
START STOP ACTIVATION TIME

Is the Start-Stop activation time declared correctly?

- Identify from random NEDC test when the first Start-Stop occurred from the measured engine speed signal (RPM=0 for the first time). T
- Then, considering the start stop activation time the above must apply:

$$t_{declared} \geq t_{measured}$$





WRONG INPUT!

CORRECT INPUT!

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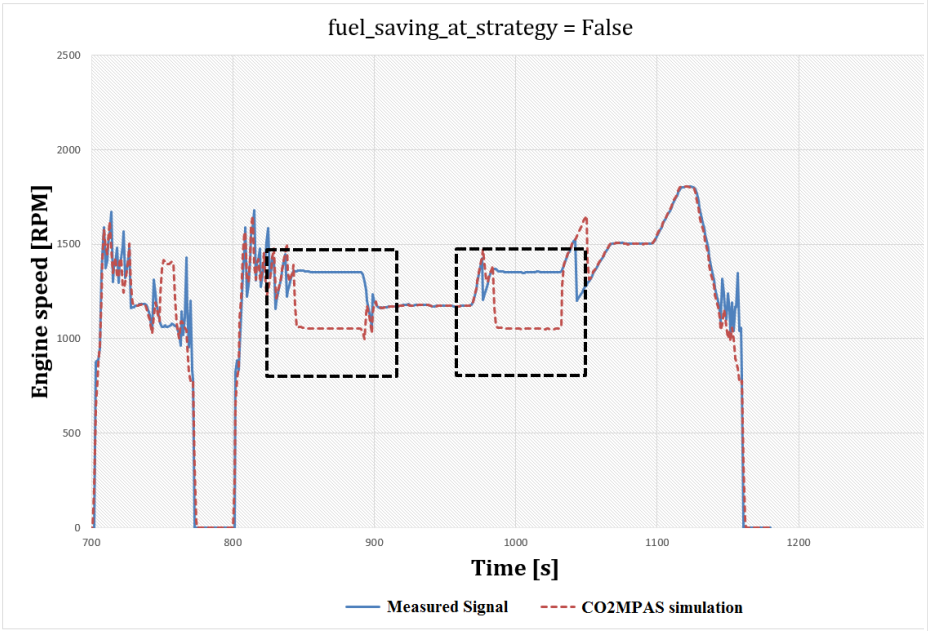
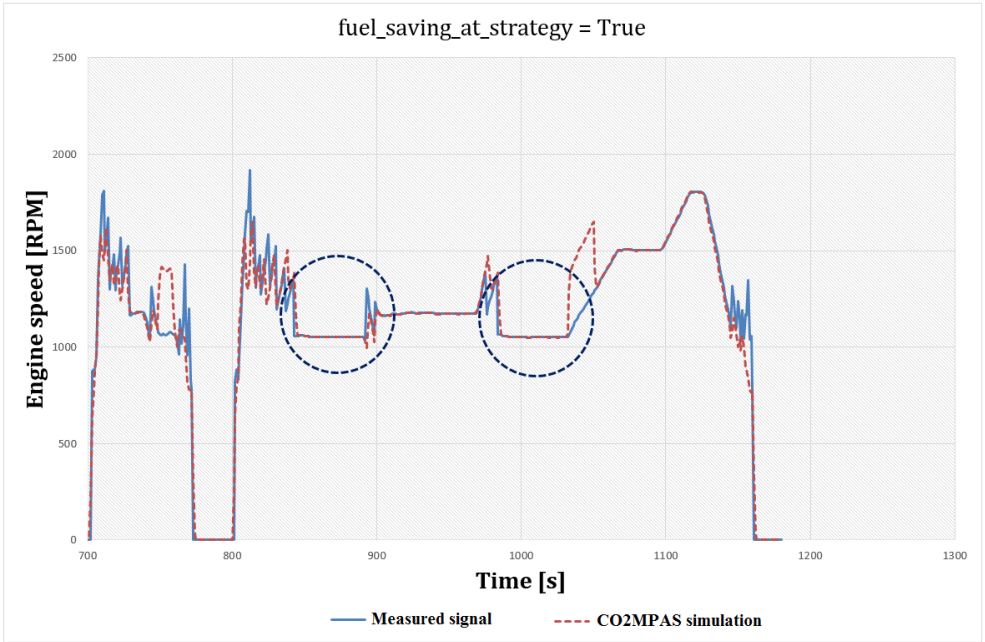
FUEL SAVING FOR AT

- Setting it to 1 allows CO_2MPAS to use a higher gear at constant speed driving than when in transient conditions, resulting in a reduction of fuel consumption;
- How to check: Plotting the measured and the simulated signals you may see a which case follows better the original measured RPM signal.





WRONG INPUT!

CORRECT INPUT!

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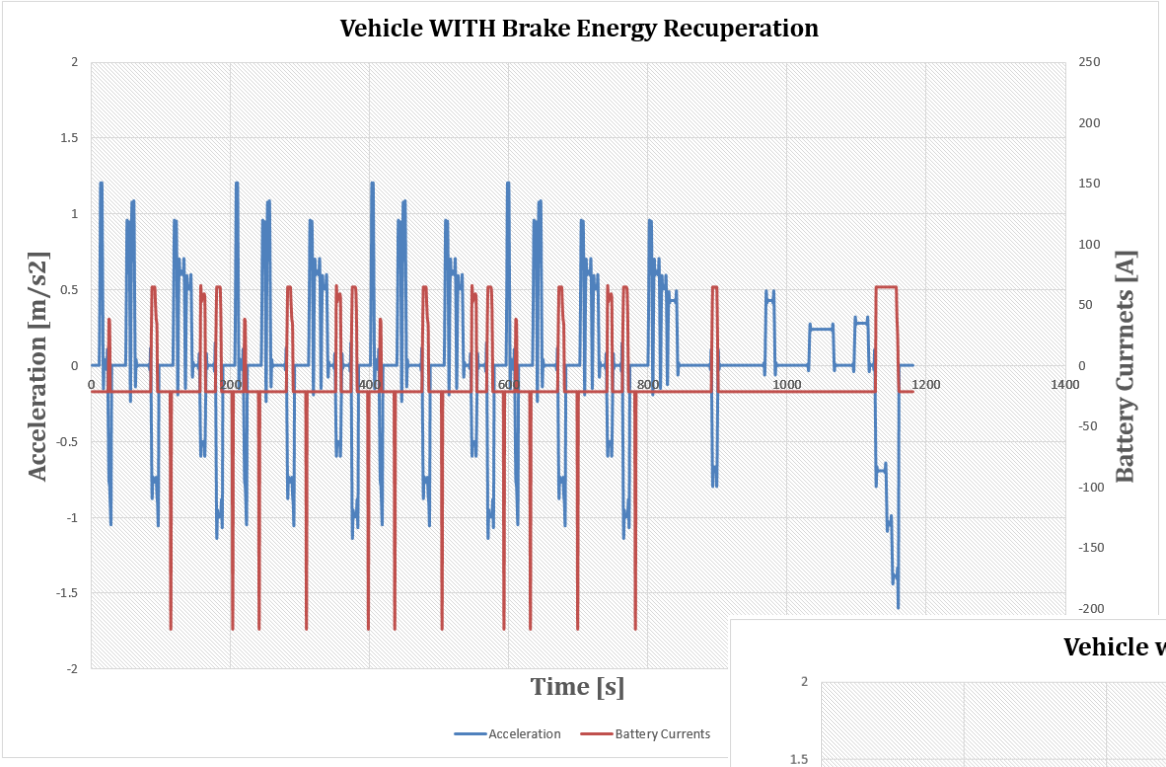
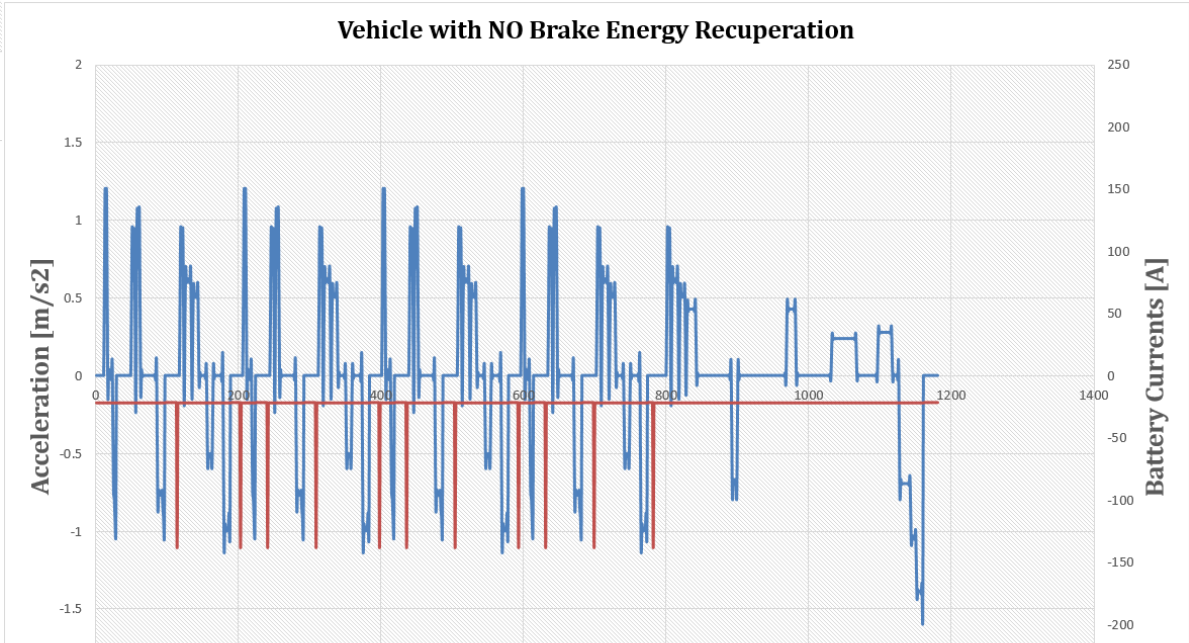
BERS

Setting it to 1 means that the vehicle is equipped with any kind of break energy recuperation technology or regenerative breaking;

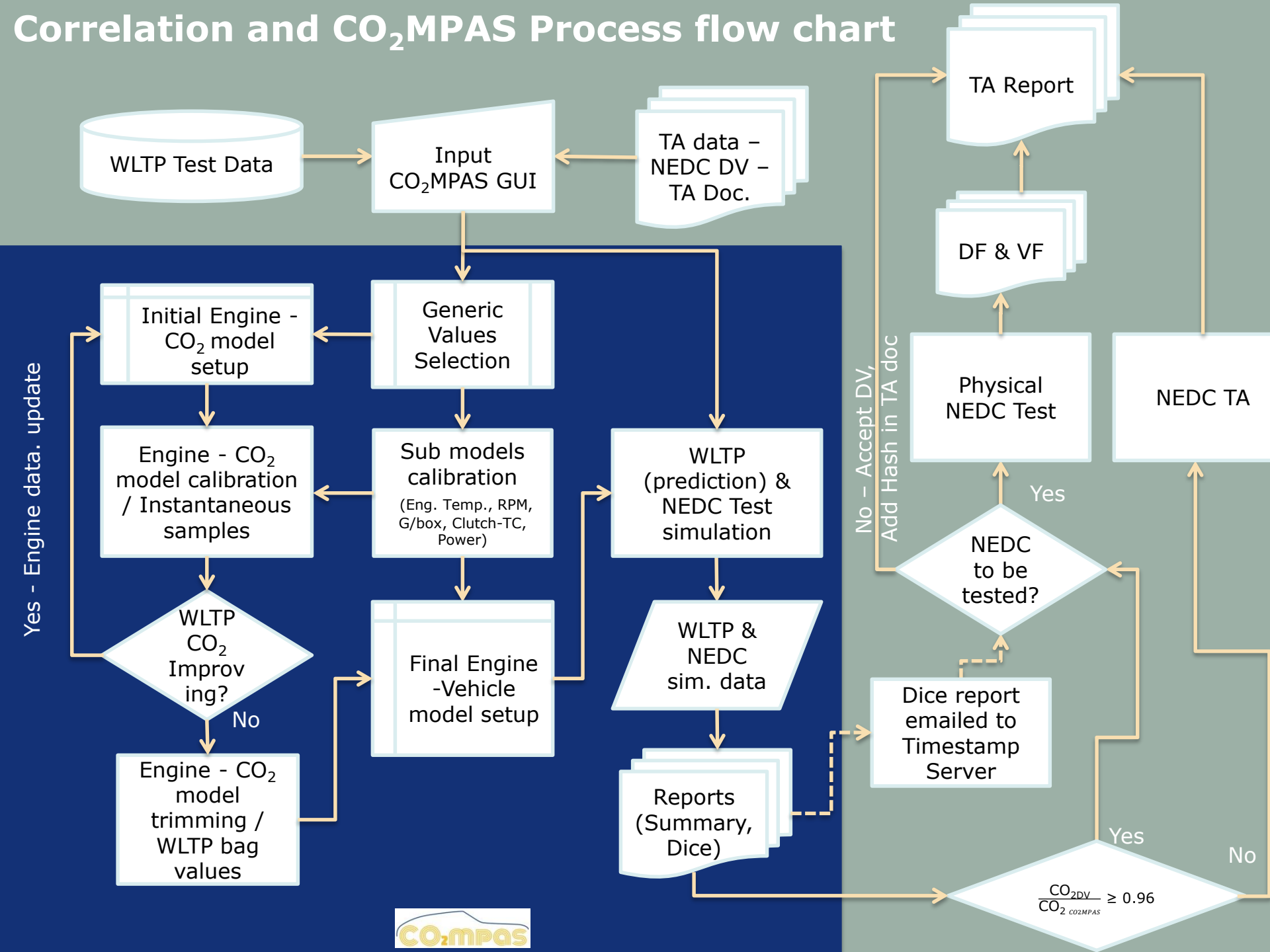
- You should check in parallel the **acceleration signal** and the **battery current**. When the vehicle brakes, the acceleration is **negative.**
- At the periods of breaking (`Acceleration < 0`), you will observe positive peaks in the battery signal.

BERS


Vehicle WITH Brake Energy Recuperation
Acceleration [m/s2]
Battery Currnets [A]
Time [s]
Acceleration
Battery Currents


Vehicle with NO Brake Energy Recuperation
Acceleration [m/s2]
Battery Currents [A]

Correlation and CO_2MPAS Process flow chart



Technologies not covered with CO2MPAS

- Physical NEDC measurements shall be used instead of CO2MPAS in case of HEVs (both OVC-HEVs and NOVC-HEVs)
- However, other provisions set out in Annex I regarding the physical testing shall be respected, in particular:

1. Calculation of NEDC RLs and inertia;
2. Number of tests and interpretation of results; and
3. Calculation of CO2 and FC attributed to individual vehicles in the NEDC interpolation family

Stay in touch

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FUEL SAVING FOR AT

- Second option to check: In case that it is still difficult to visually verify if in a specific automatic vehicle this technology applies, you shall calculate the mean error between the measured and the simulated engine_speed vector for the steady state parts of UDC and EUDC:

$$error = \sum_{i=0}^{n} (RPM_{measured}[i] - RPM_{simulated}[i])$$

If the mean error is higher than 0, the fuel saving gear is likely not to be present in the vehicle