Effect of ambient temperature (15 °C÷28 °C) on CO_2 emissions from LDV over NEDC

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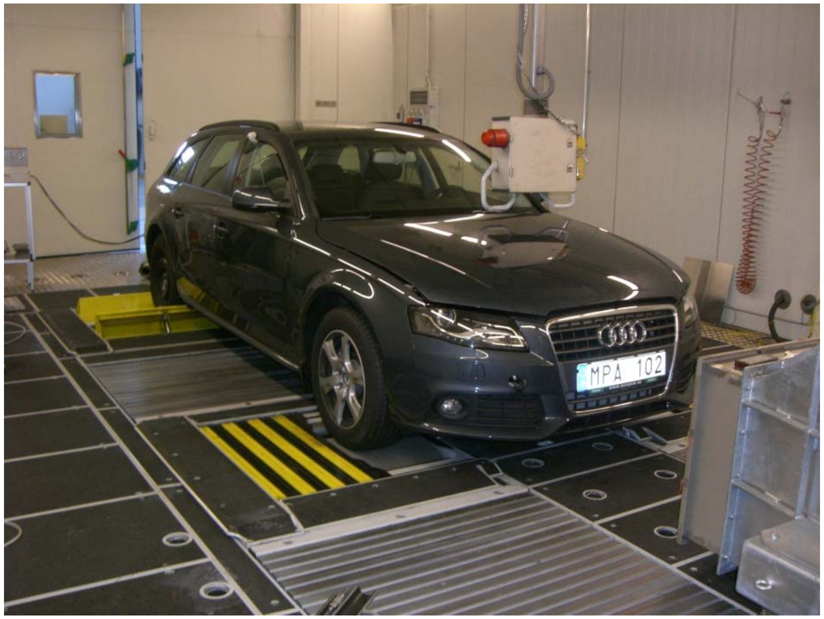
Vehicle test matrix

			No. of tests			
			15 °C	22 °C	25 °C	28 °C
Vehicle 1	M1-Gasoline 1200 cm3	Euro 4	**2**	**2**	**2**	
Vehicle 2	M1-FFV(G-E) DI 2000 cm3	Euro 5A	**3**	**5**		
Vehicle 3	M1-Gasoline 1368 cm3	Euro 5A	**6**	**4**	**4**	**4**
Vehicle 4	M1-Diesel 1248 cm3	Euro 5A	**2**	**3**	**2**	
Vehicle 5	N1-Diesel 2179 cm3	Euro 3	**2**	**2**	**2**	

Test conditions

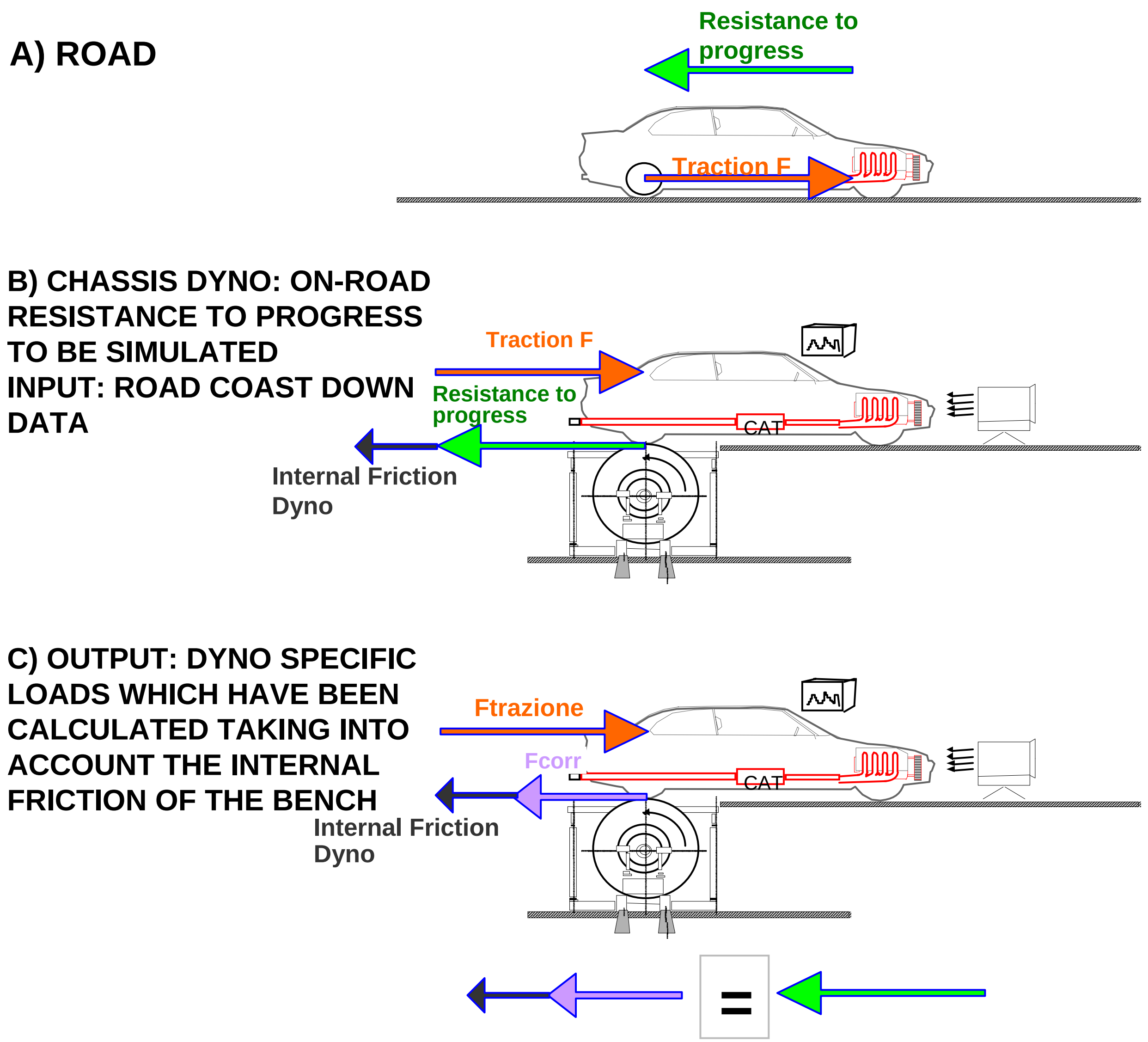


- Ambient temperature
- Vehicle coast down data
- Chassis Dyno settings

Which is the best way to deal with these three changing parameters?

Typical dyno load setting procedure

- Coast down times measured on-road are input in the chassis dyno software
- The chassis dyno starts an automatic iterative procedure to match the on-road coast down times
- After several trials, when the tolerance criteria are met, the software provides corrected dyno loads taking into account the internal dyno friction



Test conditions

- **A theoretically correct approach to carry out these tests would require to take into account the effect of T on:**
  - Vehicle coast down data
  - Internal friction of the CD GM1
  - ……

For each Temperature of the test, the relevant coast down parameters should be input and the chassis dyno should be allowed to adjust its settings taking into account internal friction.

Slide 5

GM1 Definisci prima il significato di CD o usa il nome completo (potrebbe sembrare Coast Down)
Giorgio Martini; 06.06.2011

Test conditions

If the vehicle coast down data at different temperatures are not available, a pragmatic approach is to carry out the tests (between 15 °C and 28 °C) keeping constant the CD settings used at 22 °C.

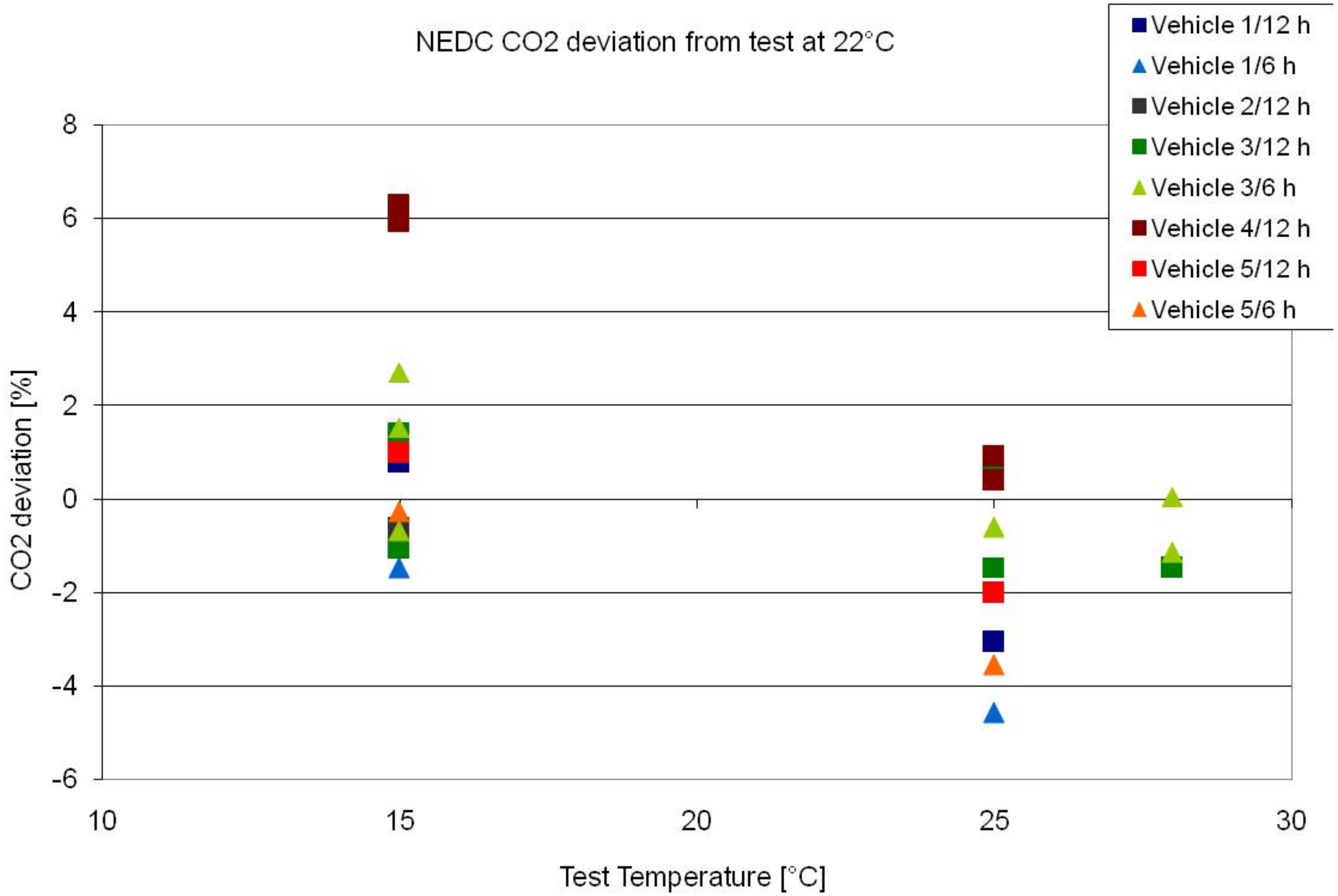
A test at 15 °C will thus be characterized by a slightly higher resistance to progress than at 22 °C (due to the increased internal friction of the CD), which in part compensates for the lower coast down times of the vehicle at 15 °C compared to 22 °C.

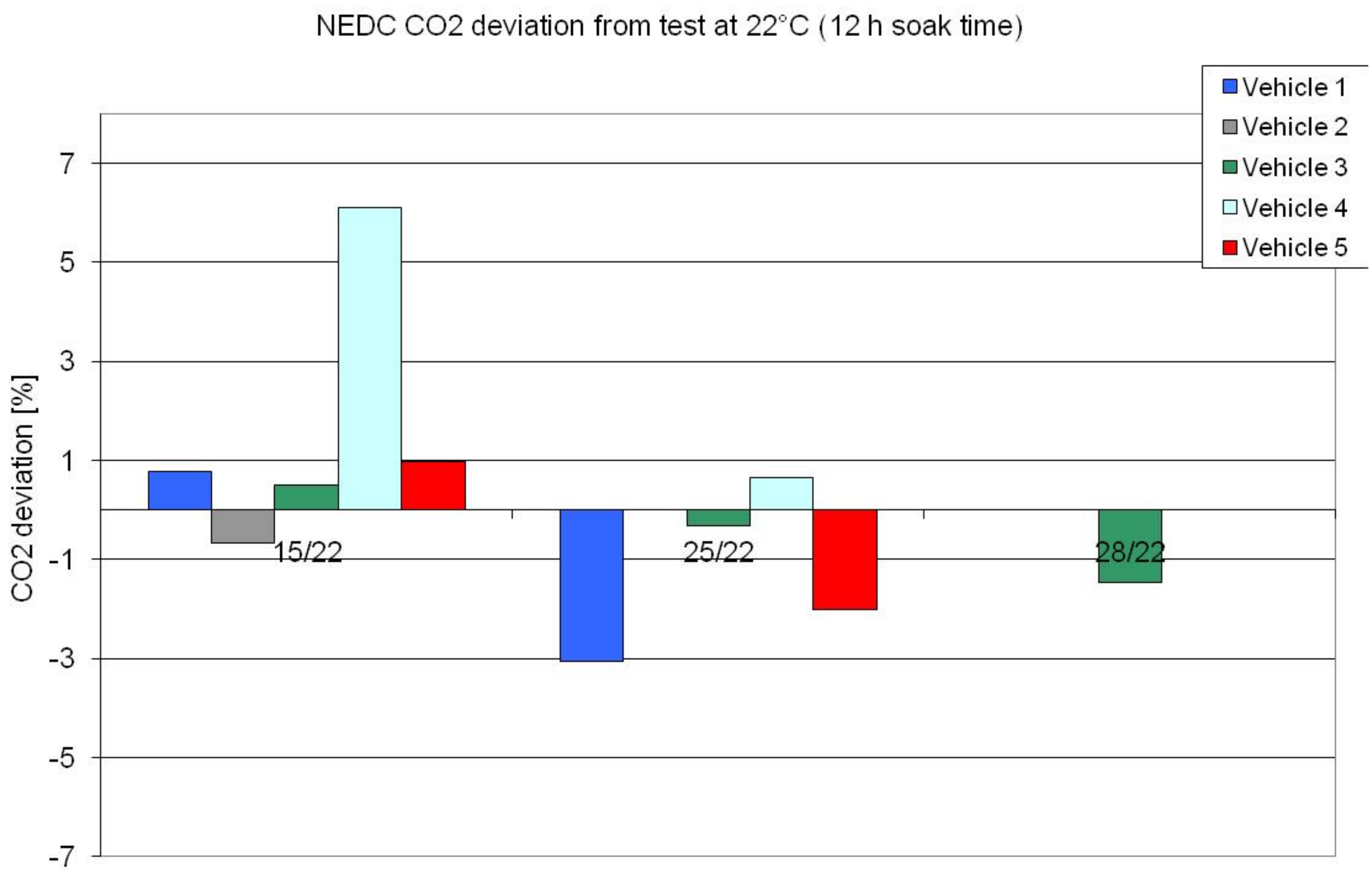
At 25 °C there is the opposite effect.

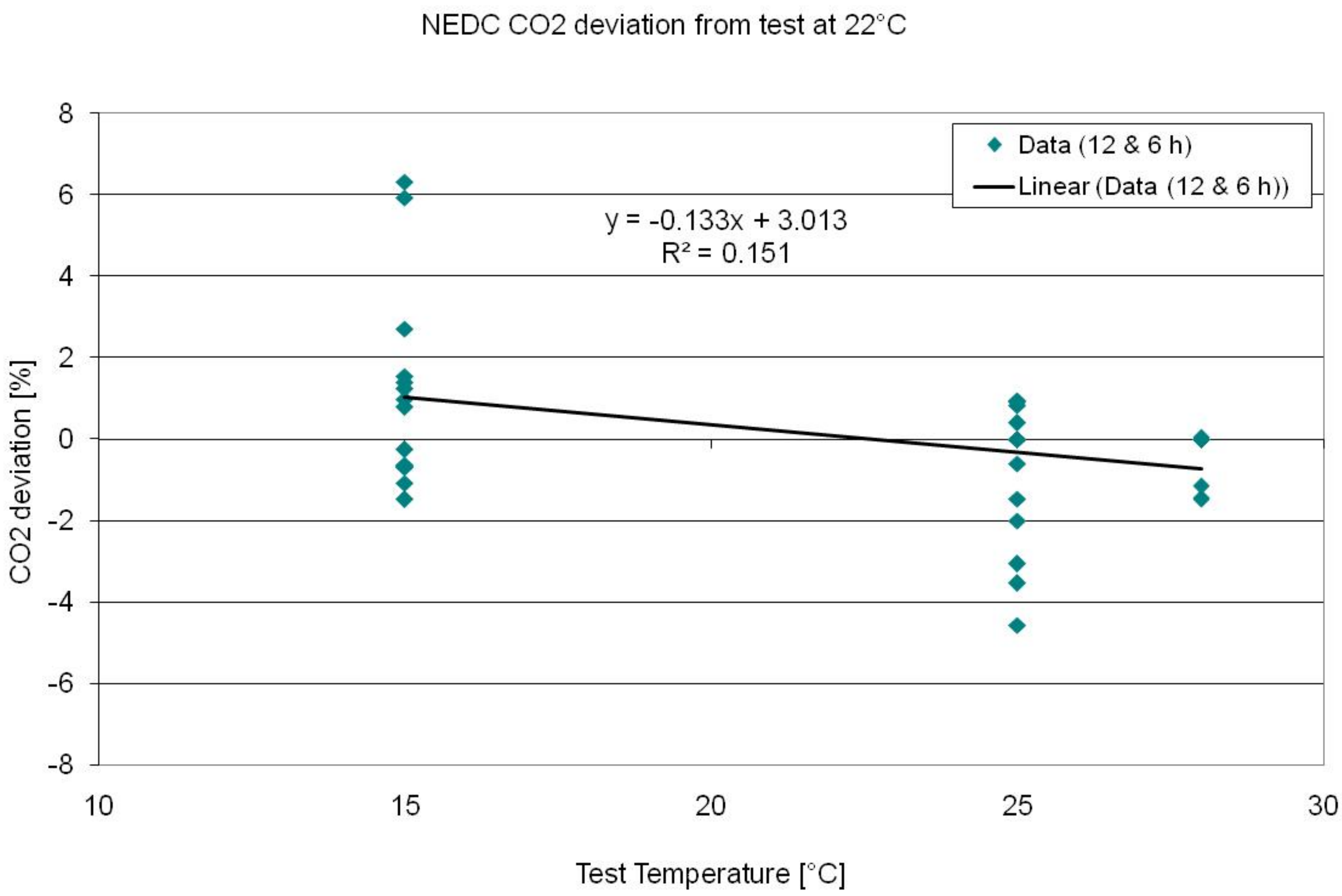
Experimental results

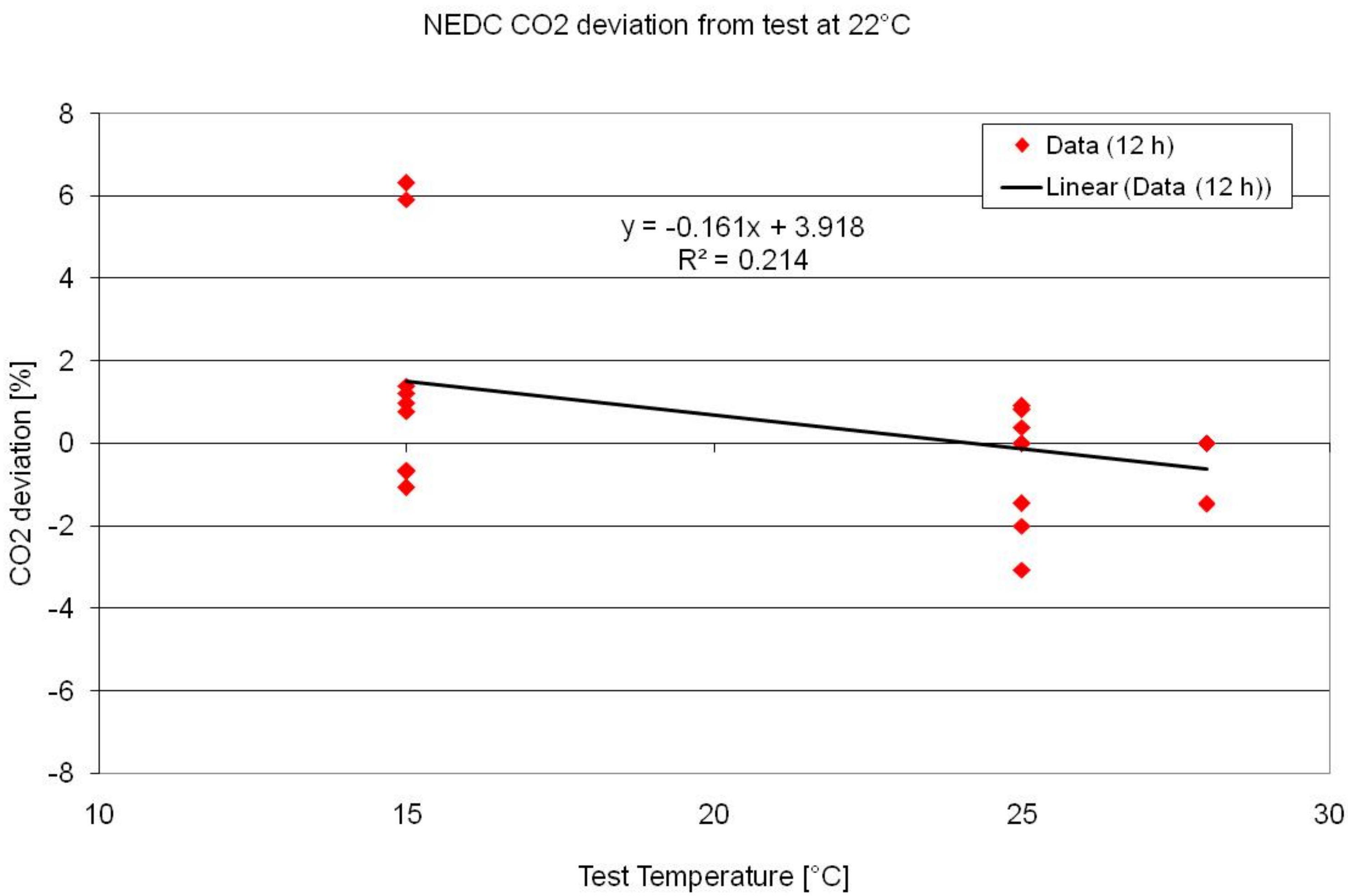
Results are presented as % change of CO_2 emissions at 15/25/28 °C over CO_2 emissions at 22 °C.

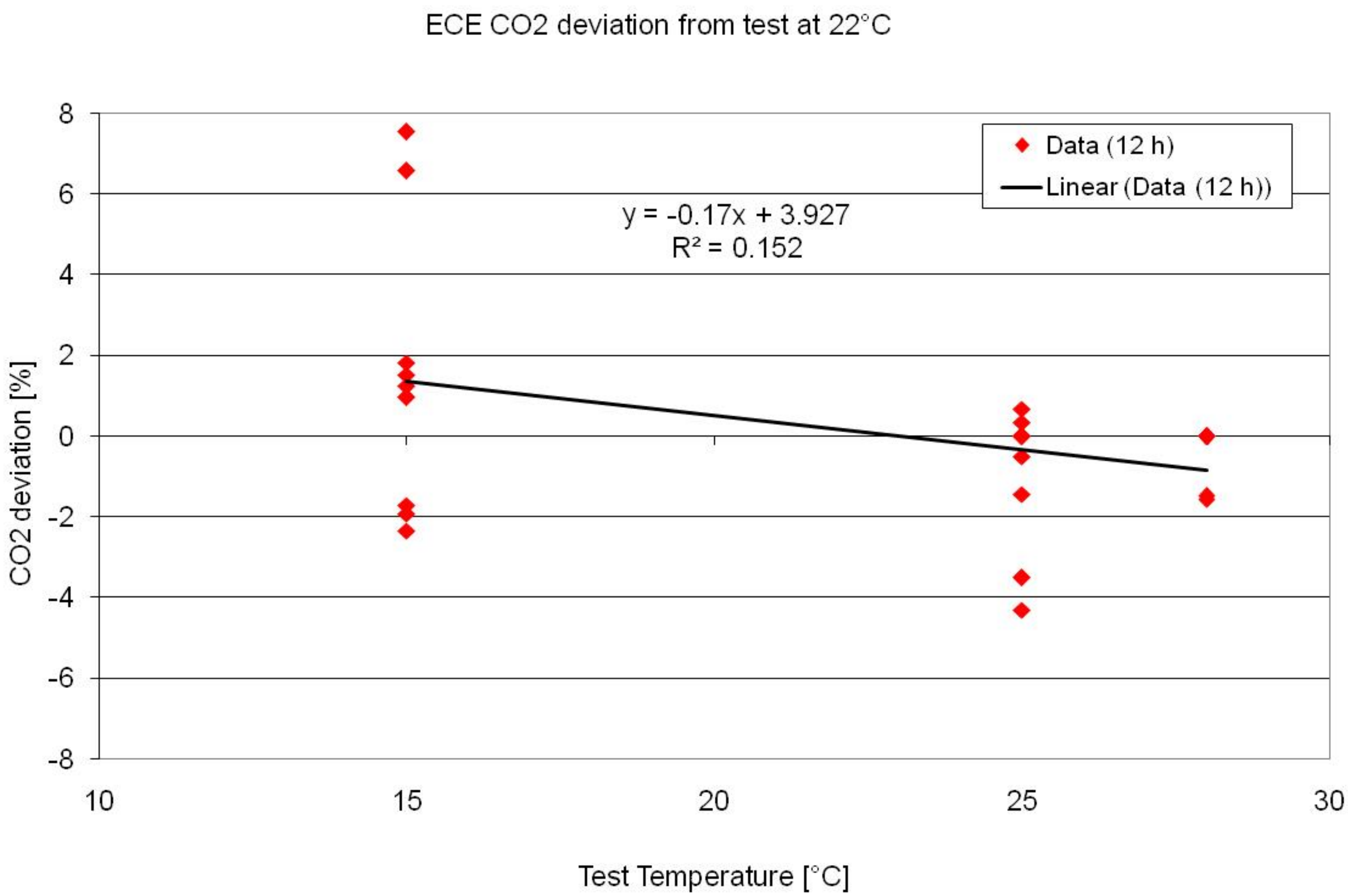
Points on the diagrams represent the ratio between the single test value at 15/25/28 °C and the average CO_2 emissions at 22 °C for the same vehicle.

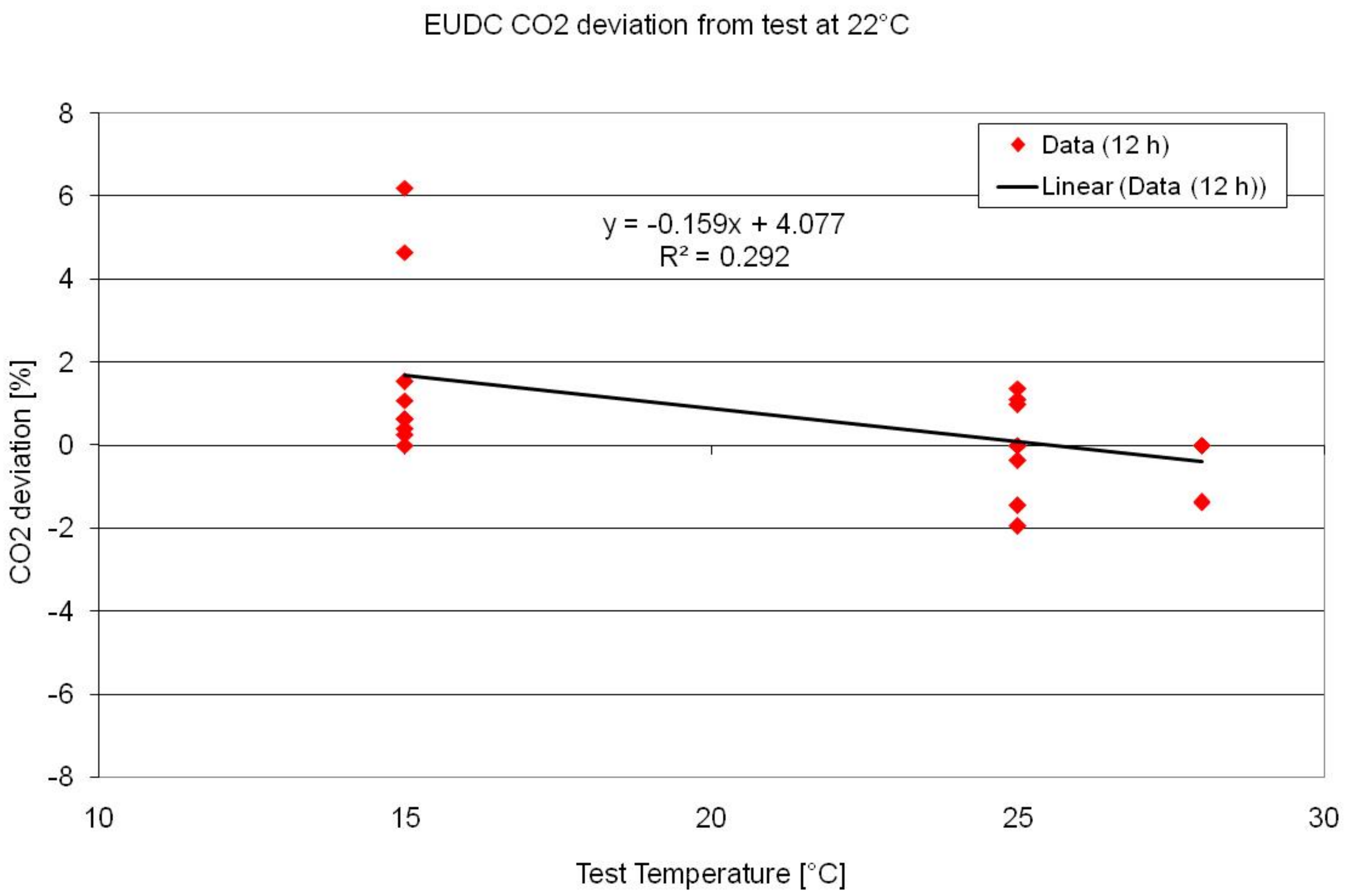

NEDC CO2 deviation from test at 22°C
Vehicle 1/12 h
Vehicle 1/6 h
Vehicle 2/12 h
Vehicle 3/12 h
Vehicle 3/6 h
Vehicle 4/12 h
Vehicle 5/12 h
Vehicle 5/6 h
CO2 deviation [%]
8
6
4
2
0
-2
-4
-6
10
15
20
25
30
Test Temperature [°C]


NEDC CO2 deviation from test at 22°C (12 h soak time)
CO2 deviation [%]
7
5
3
1
-1
-3
-5
-7
15/22
25/22
28/22
Vehicle 1
Vehicle 2
Vehicle 3
Vehicle 4
Vehicle 5


NEDC CO2 deviation from test at 22°C
Data (12 & 6 h)
Linear (Data (12 & 6 h))
y = -0.133x + 3.013
R² = 0.151
CO2 deviation [%]
8
6
4
2
0
-2
-4
-6
-8
10
15
20
25
30
Test Temperature [°C]


NEDC CO2 deviation from test at 22°C
Data (12 h)
Linear (Data (12 h))
y = -0.161x + 3.918
R² = 0.214
8
6
4
2
0
-2
-4
-6
-8
CO2 deviation [%]
10
15
20
25
30
Test Temperature [°C]


ECE CO2 deviation from test at 22°C
Data (12 h)
Linear (Data (12 h))
y = -0.17x + 3.927
R² = 0.152
CO2 deviation [%]
8
6
4
2
0
-2
-4
-6
-8
10
15
20
25
30
Test Temperature [°C]


EUDC CO2 deviation from test at 22°C
Data (12 h)
Linear (Data (12 h))
y = -0.159x + 4.077
R² = 0.292
8
6
4
2
0
-2
-4
-6
-8
CO2 deviation [%]
10
15
20
25
30
Test Temperature [°C]

Discussion

Based on the experimental measurements carried out at JRC (CD settings unchanged), an average correlation of CO_2 emissions with T over the NEDC could be proposed. GM2

It should be kept in mind that JRC test results cannot be directly compared to other similar studies due to the different test protocol adopted.

However, a correlation very similar to the one obtained by JRC is being discussed at EU level for the "eco-innovations" that provide engine heat storage during parking times.

GM2 Non mi sento comfortable con questa dichiarazione...preferirei qualcosa di piu' soft.

Per esempio:

The limited experimental campaign carried out at the JRC showed a correlation between the test temperature and the measured CO2 emissons

(mi sono accorto che e' la stessa frase che hai usato nelle conclusioni)
Giorgio Martini; 06.06.2011

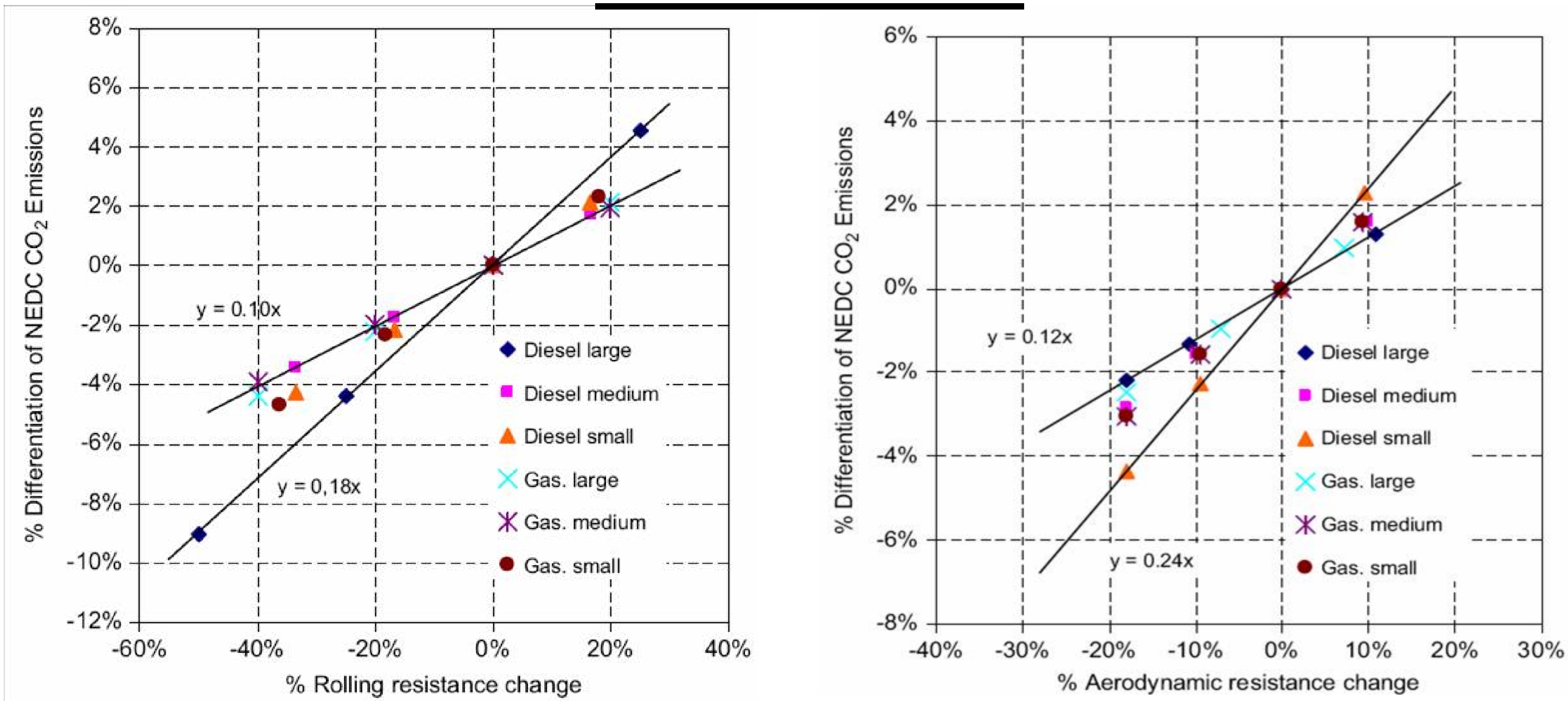
CONCLUSIONS

- **JRC has carried out a limited test campaign using the most pragmatic approach that was possible in the light of the data and time available.**
- **A correlation between CO_2 emissions and ambient Temperature has been detected and seems in line with the findings of the eco-innovations working group.**
- **A more accurate quantification of the CO_2/T correlation would require more complex test campaigns and an agreed test protocol.**
- **In the light of all above considerations, it would be preferable to select a test Temperature for the WLTP as close as possible to 20 °C.**

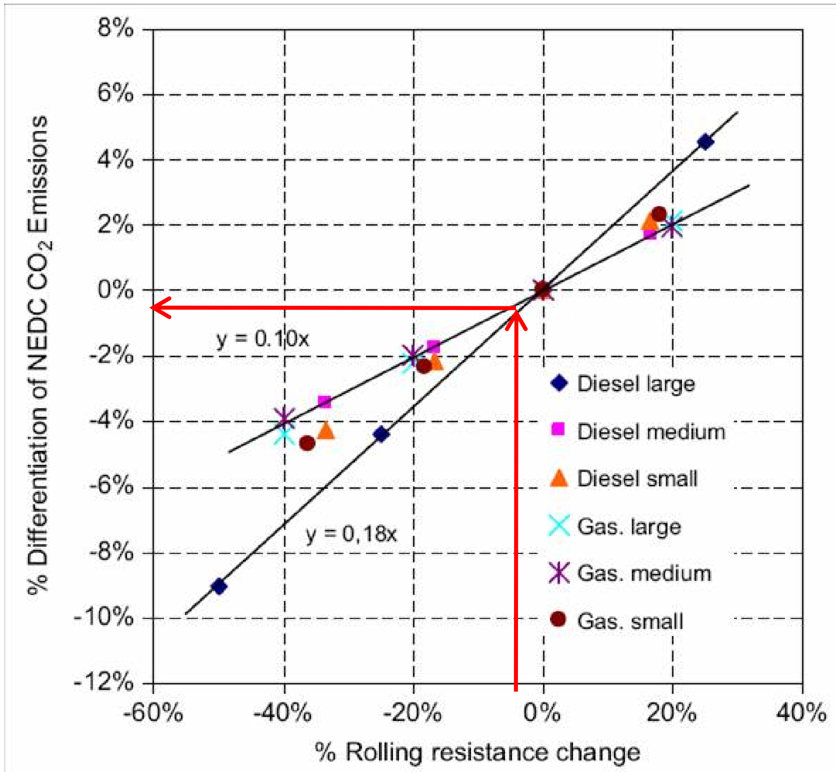
End of the presentation.

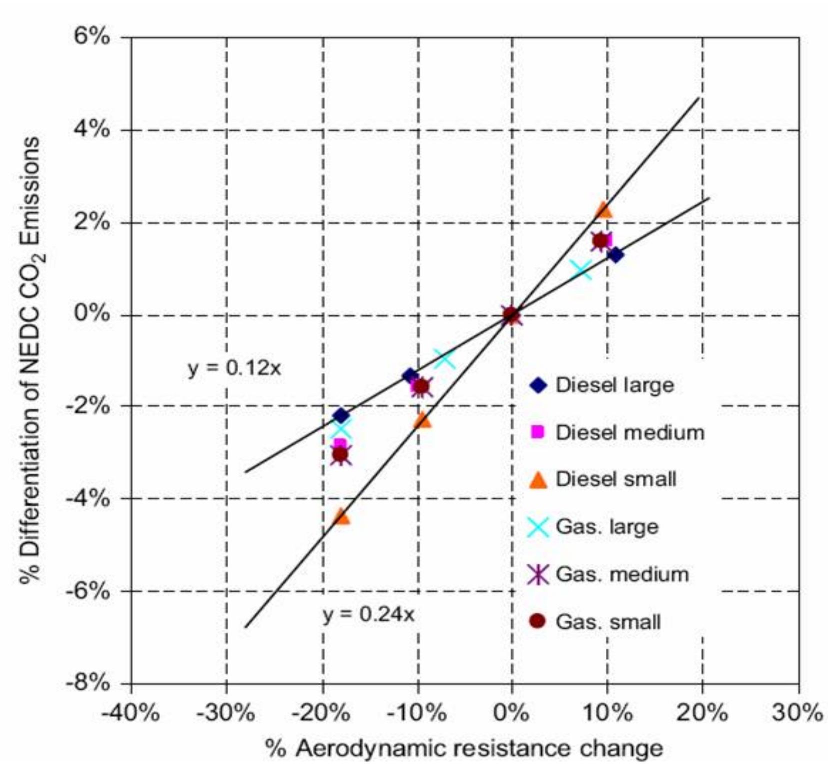
Any question?

Test conditions



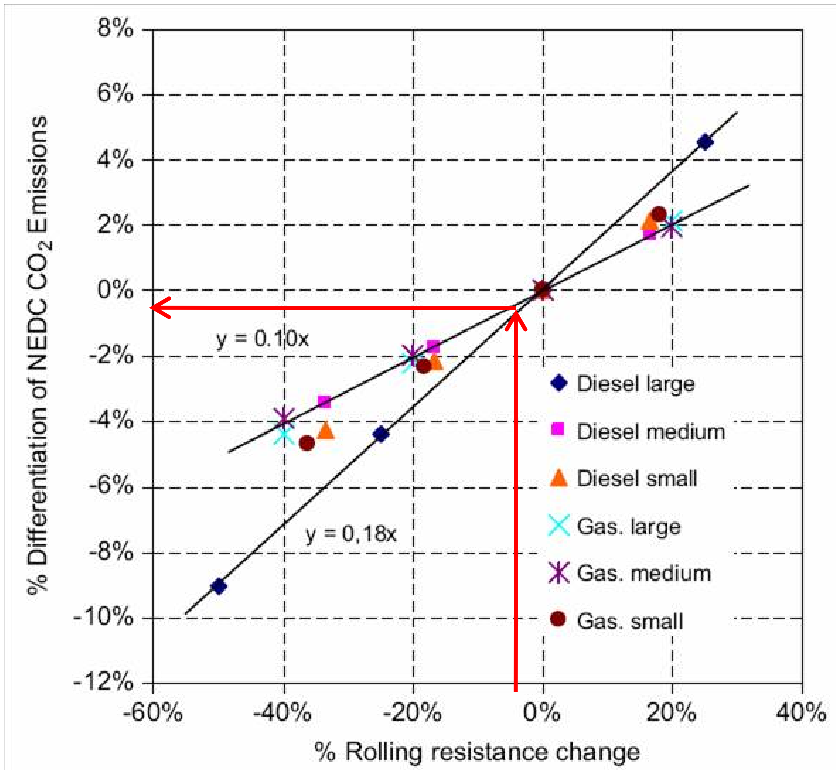
Test conditions

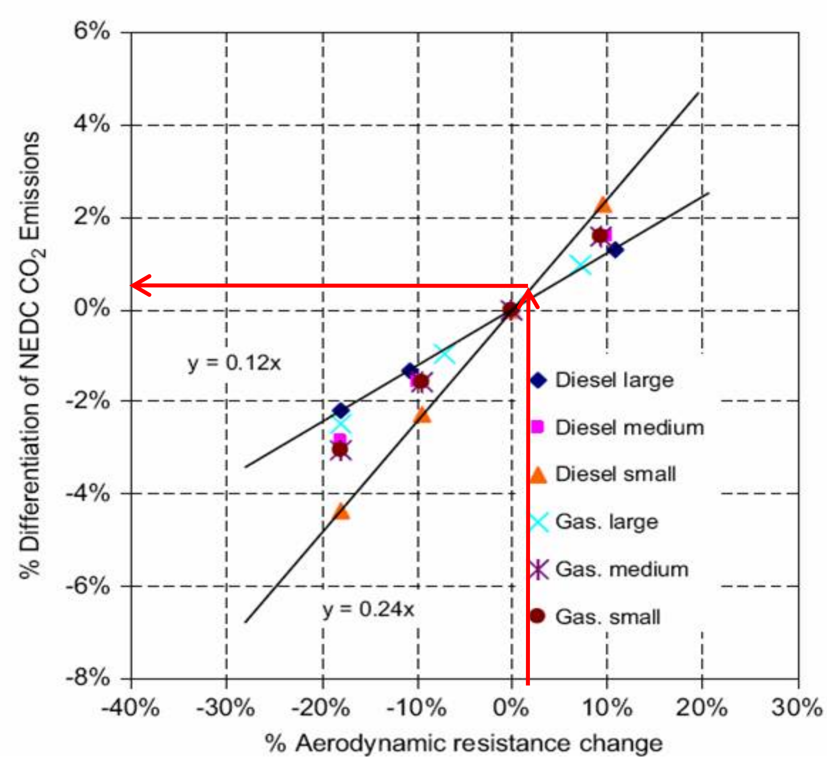




If we want to correct for the internal friction of the CD (ex. ~4.0%)

Test conditions





If we want to correct for the internal friction of the CD (ex. ~4.0%)

Then we should also correct for the actual vehicle cost-down times at 15 °C (air density at 15 °C/ air density at 22 °C = 1.024)