Drafting group on the ‘Combined approach‘

Progress report for the DTP meeting 5 June 2013

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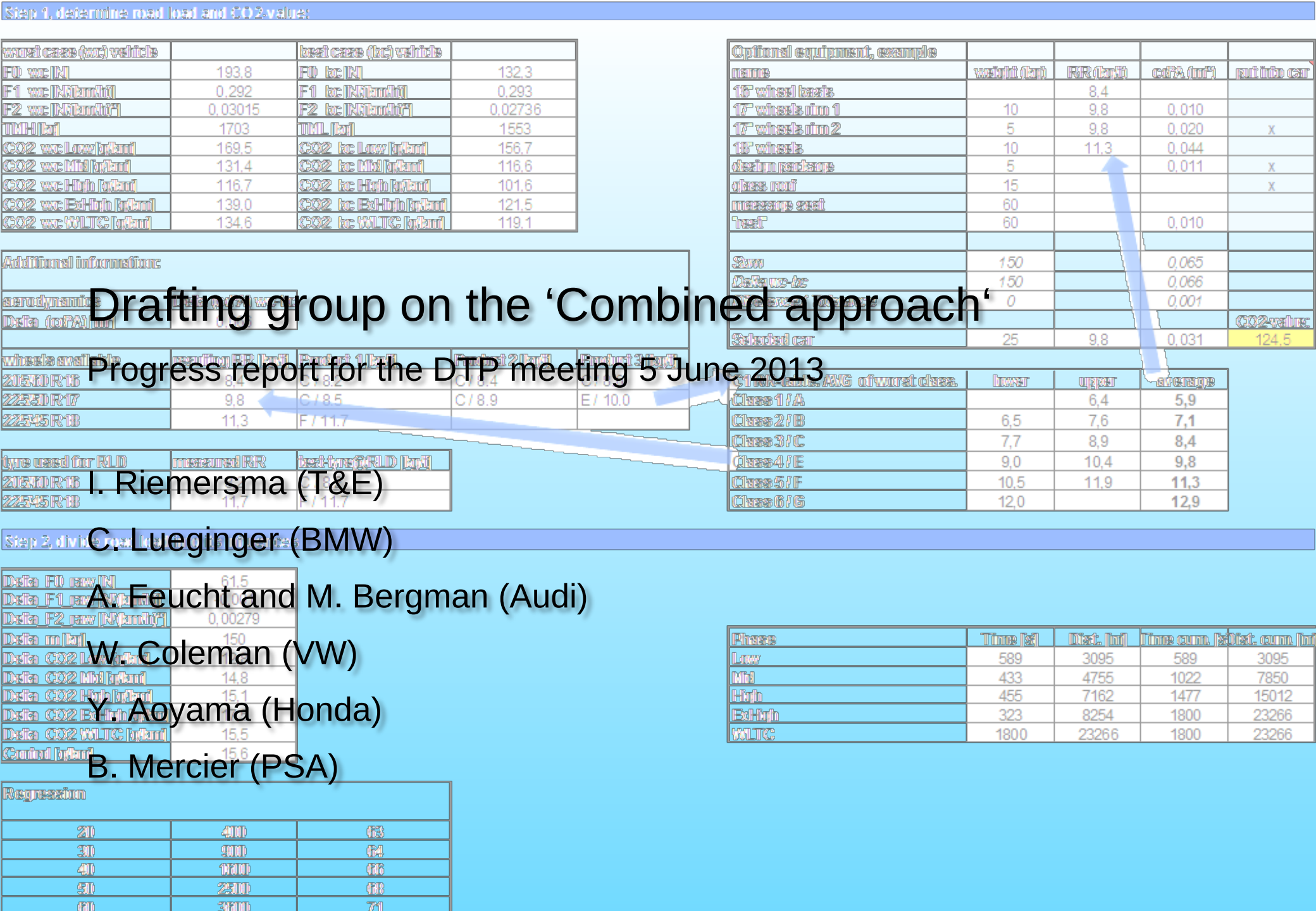


Tasks for the drafting group

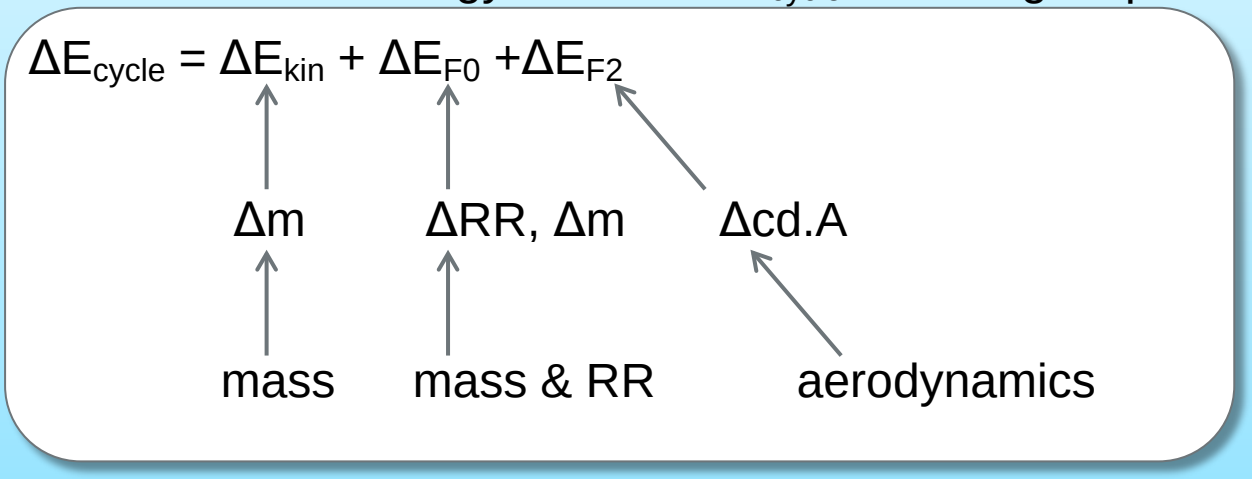
- Work out a detailed methodology to calculate/interpolate CO_2 for individual vehicles between a best-case and a worst-case vehicle
- Check the feasibility to interpolate vehicle parameters:
  mass, tyre rolling resistance (RR) and aerodynamic options
- Evaluate the accuracy of the methodology
- Transpose the methodology into the GTR (including relevant definitions)

Outline of the calculation method

CO_2 results from 2 road load determination tests (worst-case and best-case mass, rolling resistance and aerodynamics) yields:

ΔCO_2 , ΔF_0, ΔF_2, Δm,

Calculate delta energy demand ΔE_{cycle} from target speed and road load coefficients :

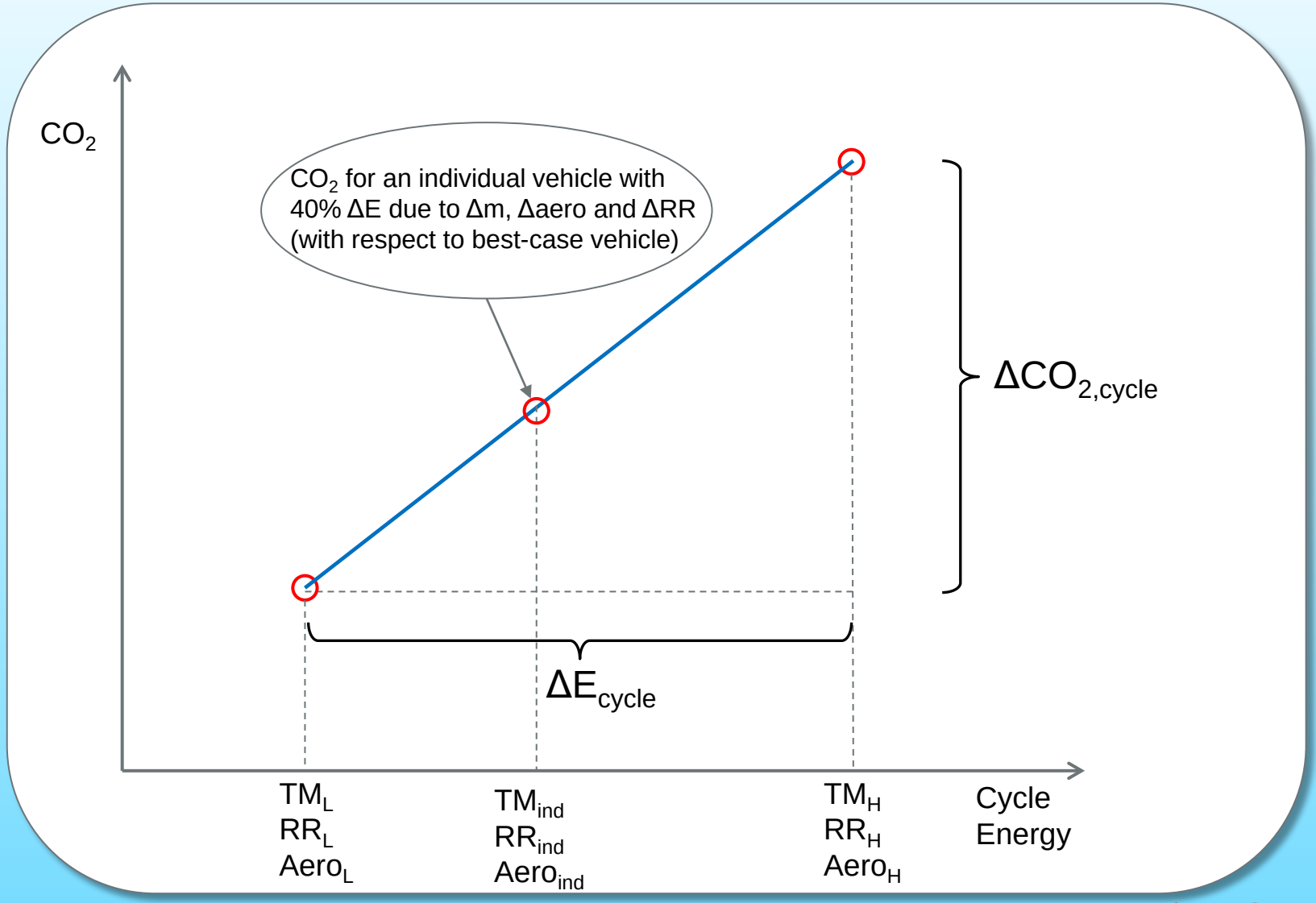


For individual vehicles $\Delta E_{cycle,ind}$ is calculated based on Δm_{ind}, ΔRR_{ind} and $\Delta Cd.A_{ind}$

Assume for individual vehicles ΔCO_2 to be proportional to ΔE_{cycle}

⇨ engine efficiency is relatively constant for small ΔE variations (Willans lines)

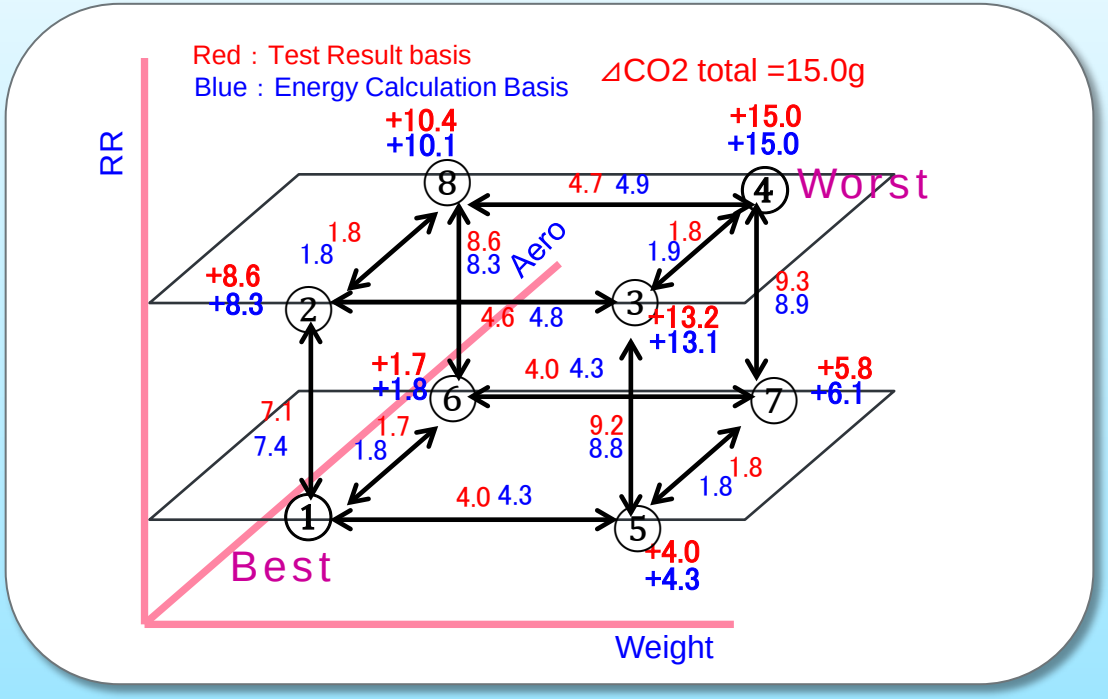
Interpolation method



Current state of play

- 5 tele/web meetings held since 27 February 2013
- Good progress due to efforts by all team members
- Main calculation/interpolation methodology is agreed
- Outputs:
  - Step by step description of the methodology (see document WLTP-DTP-LabProcICE-211)
  - Excel sheet with the calculation/interpolation procedure (see document WLTP-DTP-LabProcICE-212)
  - GTR text proposal: first draft just completed (not issued yet)
- Main open issues resolved
- Recent decision: interpolation is based on 2 measurements (worst-case and best-case vehicle)
- Work of the task force is near completion

Example: Simulation results by Audi



- Standard B-class vehicle with 4-cyl. gasoline engine and autom. transmission
- TM_L: 1568 kg; TM_H 1678 kg
- Difference in cd*A: 0,0315 m^2
- Rolling Resistance min: 7,2 kg/t; max: 10,5 kg/t
- Range of 15 g/km CO_2 between worst- and best case vehicle

Example: Simulation results by Audi

Whole WLTC

					ENERGY [kJ]	CO2[g/km] Simulation	CO2 [g/km] Interpolation by energy	⊿CO2
		WEIGHT	⊿aero (m	RR (kg/t	Total	Total	Total	Total
1	**BASE**	**1568**	**0**	**7.2**	**10807**	**155.4**	**155.4**	**0.0**
2	1+RR	1568	0	10.5	11700	163.9	163.7	0.2
3	2+Weight	1678	0	10.5	12221	168.6	168.5	0.1
4	**3+Aero**	**1678**	**0.0315**	**10.5**	**12420**	**170.4**	**170.4**	**0.0**
5	1+Weight	1678	0	7.2	11269	159.4	159.7	-0.3
6	1+Aero	1568	0.0315	7.2	11004	157.1	157.2	-0.1
7	5+Aero	1678	0.0315	7.2	11465	161.1	161.5	-0.4
8	2+Aero	1568	0.0315	10.5	11900	165.7	165.5	0.2
	ind	1604	0.0079	8.2	11283	159.7	159.8	-0.1

- Range of 15 g/km CO_2 between worst- and best case vehicle
- Maximum deviation between the simulation and the interpolated values is less than 0.5 g/km (standard gasoline engine).
- Deviations are lower for individual vehicles.

Final steps

- Discuss the draft GTR text on the combined approach
- Address remaining details:
  - Vehicle family parameters
  - Definition of unladen mass
  - Allowable CO_2 interpolation range
  - Cycle downscaling
- Finish an agreed GTR text proposal before the summer