



# Non-legislated Emissions of a Passenger Car with Ethanol Blend Fuel E85

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## Abstract

An important objective for a sustainable development of individual transportation worldwide is a well-balanced use of alternative fuels. Several countries have objectives to substitute a part of the energy of traffic by ethanol as the renewable energy source. The global share of Bioethanol used for transportation is continuously increasing.

Investigations of limited and unregulated emissions of a flex fuel vehicle with gasoline-ethanol blend fuel have been performed in the present work according to the measuring procedures, which were established in the previous research in the Swiss Network (since 90ties).

The investigated fuel contained ethanol (E), in the portion of 85% by volume. The investigated vehicle represented a newer state of technology and an emission level of Euro 5. The engine works with homogenous GDI concept and with 3-W-catalyst (3WC).

Since there is a special concern about the particle emissions of gasoline cars with direct injection, the nanoparticle counts measurements were systematically performed with SMPS at stationary and with CPC at dynamic operation.

The non-legislated gaseous emissions were tested with FTIR, this with special focus on NH<sub>3</sub>, N<sub>2</sub>O and HCHO (Formaldehyde).

The main results to be mentioned are:

- the particle counts emissions are generally significantly reduced with E85,
- in WLTC there is a clear increase of NH<sub>3</sub> with E85 and an insignificant tendency of increasing HCHO (below 1 ppm),
- with both fuels (E0 & E85) there are no emissions of N<sub>2</sub>O.

The present research did not address the durability aspects and the cold startability in extreme conditions.



**GasOMeP ... Gasoline Organic & Metal Particles**

**EmGasCars ... Emissions of Gasoline Cars**

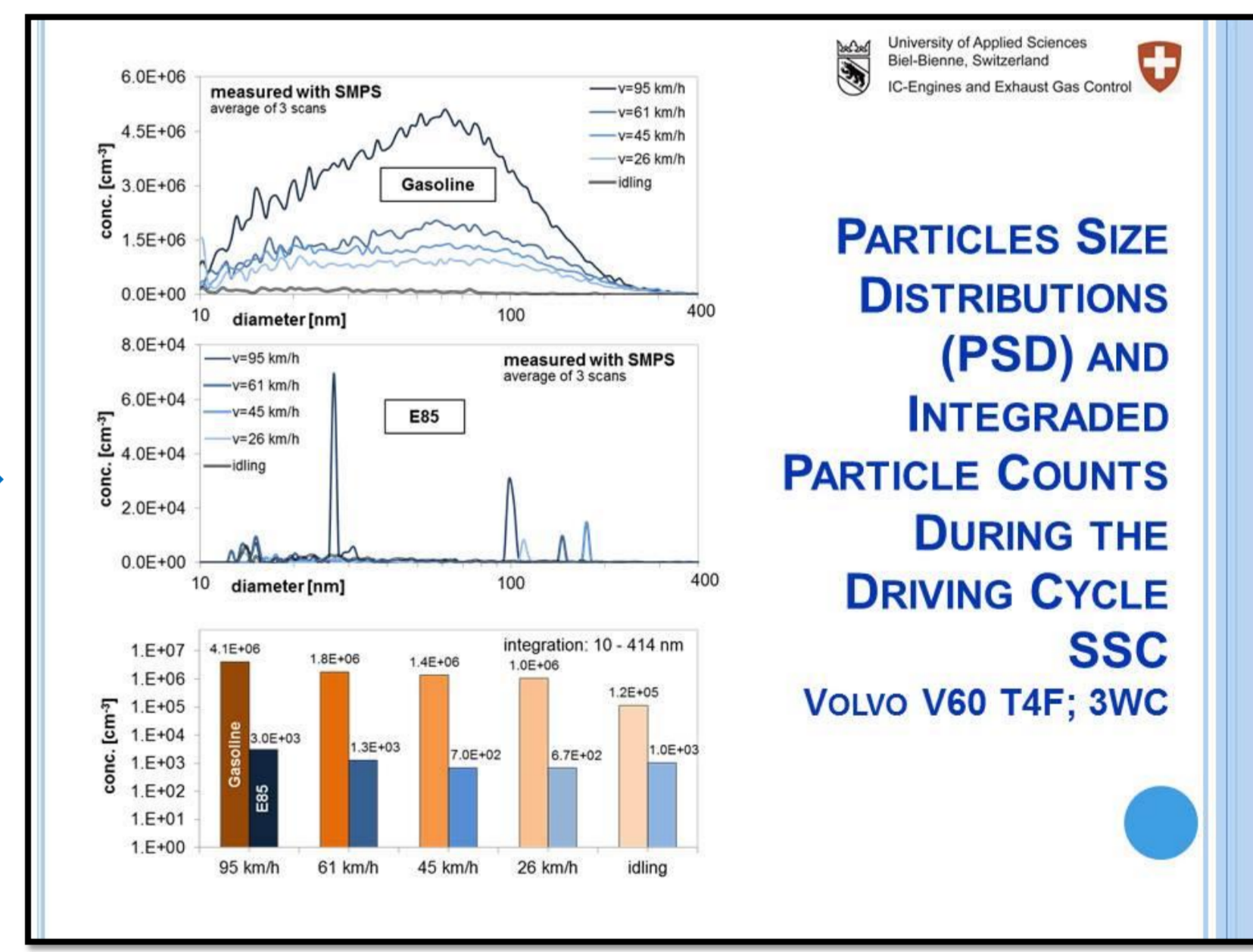
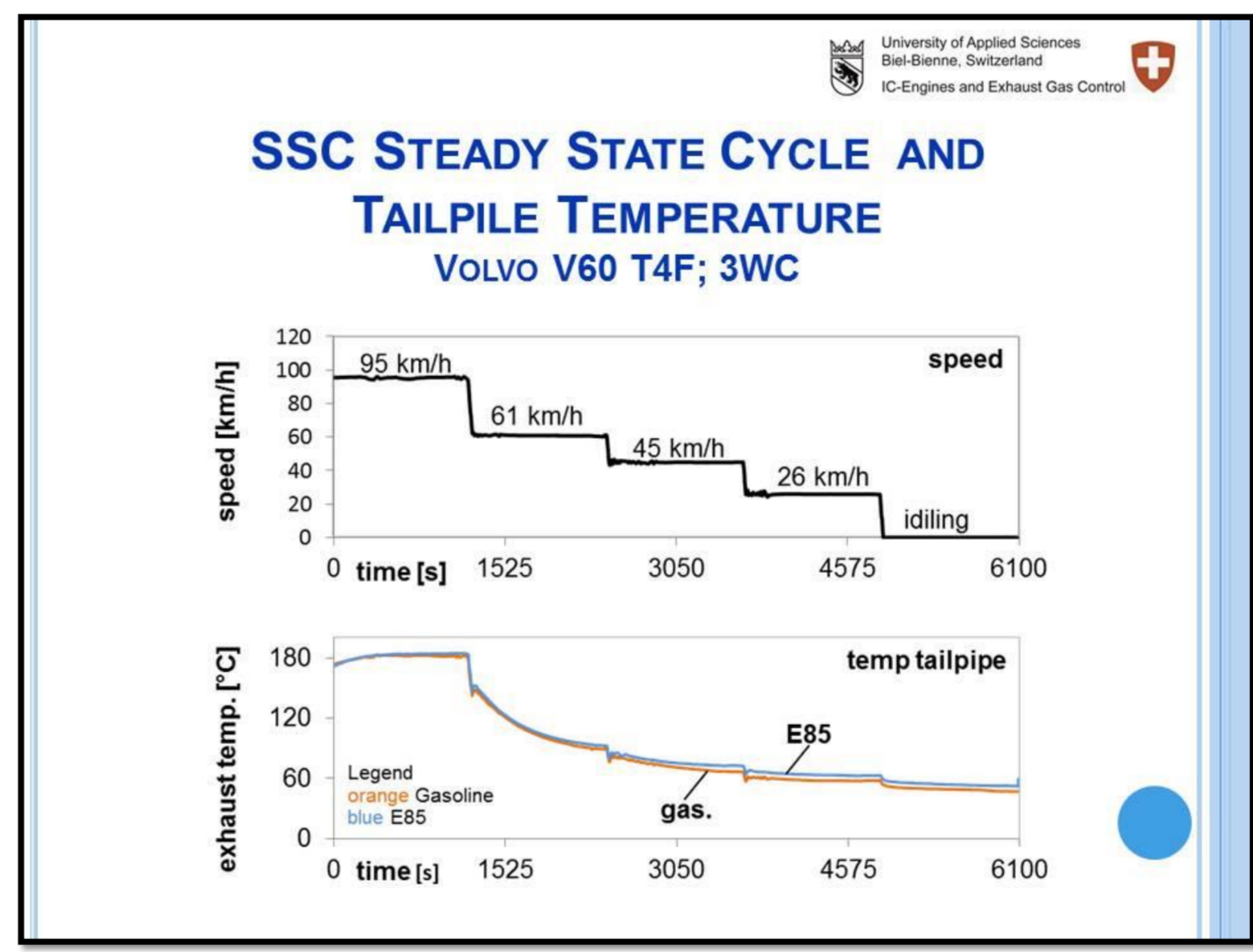
**Network project: EMPA, PSI, FHNW, AFHB, TTM**

**Support of: CCEM, BAFU, BfE, Swissoil, Swisslubes**

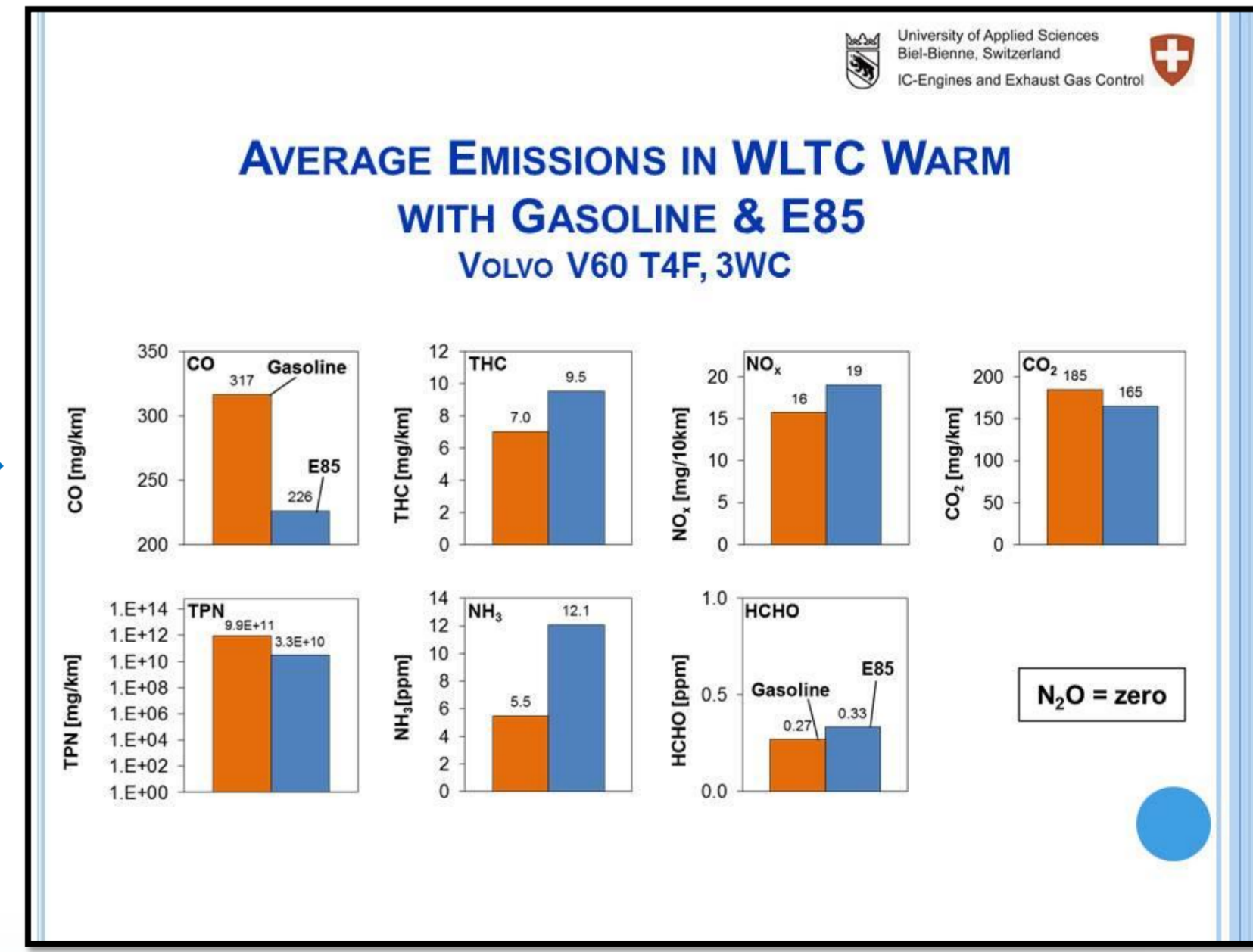
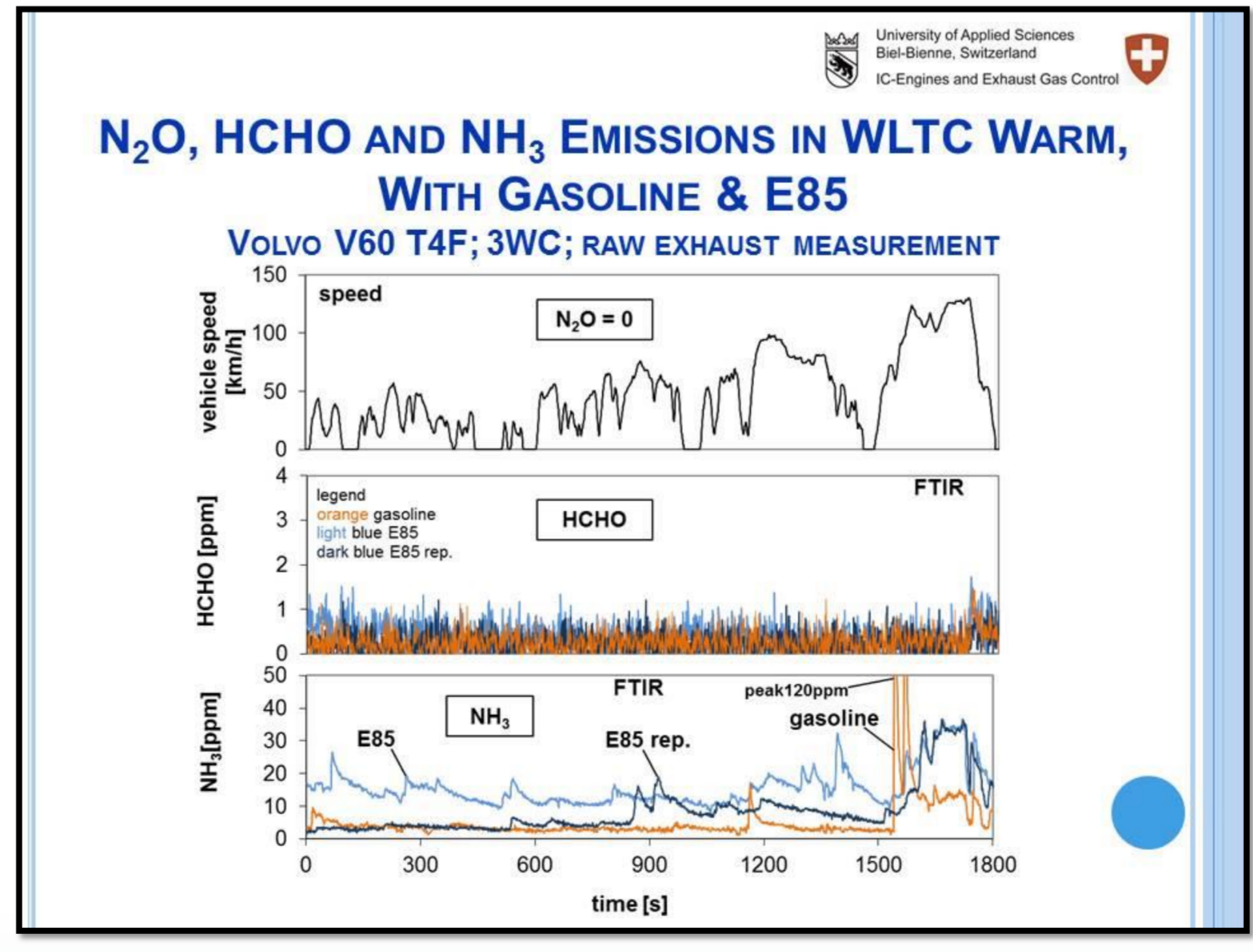
**DATA OF TESTED VEHICLE VOLVO V60**

Vehicle	Volvo V60 T4F	Gasoline C.H.O.H	E10	E85
Engine code	B4164T2	density 15°C [g/cm <sup>3</sup> ]	0.737	0.789
Number and arrangement of cylinder	4 / in line	stoichiometric air/fuel ratio	14.6	9.0
Displacement cm <sup>3</sup>	1596	lower calorific value [MJ/kg]	43.0	26.8
Power kW	132 @ 5700 rpm	boiling point research octane [°C]	30-200	78.5
Torque Nm	240 @ 1600 rpm	latent heat of evaporation [kJ/kg]	95	110
Injection type	DI	oxygen content [%m]	<5	34.8
Curb weight kg	1554	<b>PARAMETERS OF USED FUELS</b>		
Gross vehicle weight kg	2110			
Drive wheel	Front-wheel drive			
Gearbox	a6			
First registration	27.01.2012			
Exhaust	EURO 5a			
VIN	YV1FW075BC1043598			

## Steady State Cycle SSC



## WLTC



## Conclusions

**Stationary operation:**

- clear reduction of summary PC's after switching the fuel from gasoline to E85,
- no distributions (PSD), but only sporadic NP-peaks with E85 at all stationary operating points,
- at 50 km/h lowering of the particle count concentrations of size spectrum bigger 80 nm and shift of PSD median diameter to lower sizes.

**Dynamic cycles:**

- in the time-intervals of acceleration, peaks of CO, CPC (NP) and sometimes of NO<sub>x</sub> can be observed,
- in higher-speed cycles there is mostly higher CO with E85,
- the particle counts emissions are generally significantly reduced with E85
- in WLTC there is a clear increase of NH<sub>3</sub> with E85 and an insignificant tendency of increasing HCHO (below 1 ppm),
- emissions of NH<sub>3</sub> in the same cycle are fluctuating,
- with both fuels (E0 & E85) there are no emissions of N<sub>2</sub>O.