

ON-SITE & REAL TIME THz MONITORING OF GASEOUS EMISSION FROM A WASTE RECOVERY CENTER

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THE TERAWASTE PROJECT

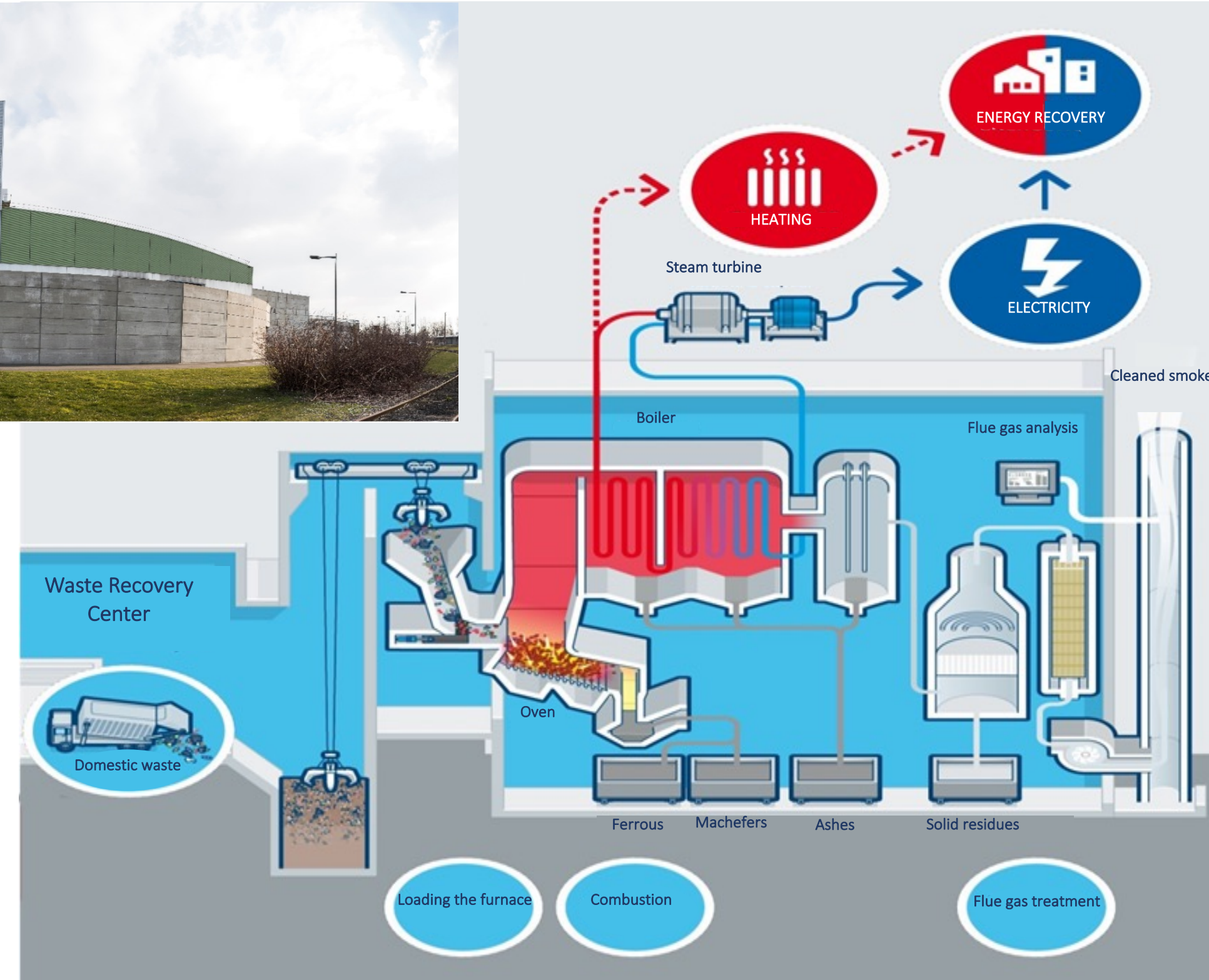
The TeraWaste project explores the potential of high-resolution TeraHertz (THz) spectroscopy for the monitoring of gaseous emissions in industrial site, by developing an on-site diagnostic unit. The selectivity as well as the ability to detect in realistic scattering media of the THz radiation without any calibration steps make it an alternative of choice to current solutions (IR spectroscopy & standard chemical methods). A multi-species time-resolved mapping and quantification, extended to all polar compounds absorbing submillimeter waves of industrial gaseous emissions, will allow the operator to better control pollutants emission in the combustion process and future normative evolutions.



THE WASTE RECOVERY CENTER



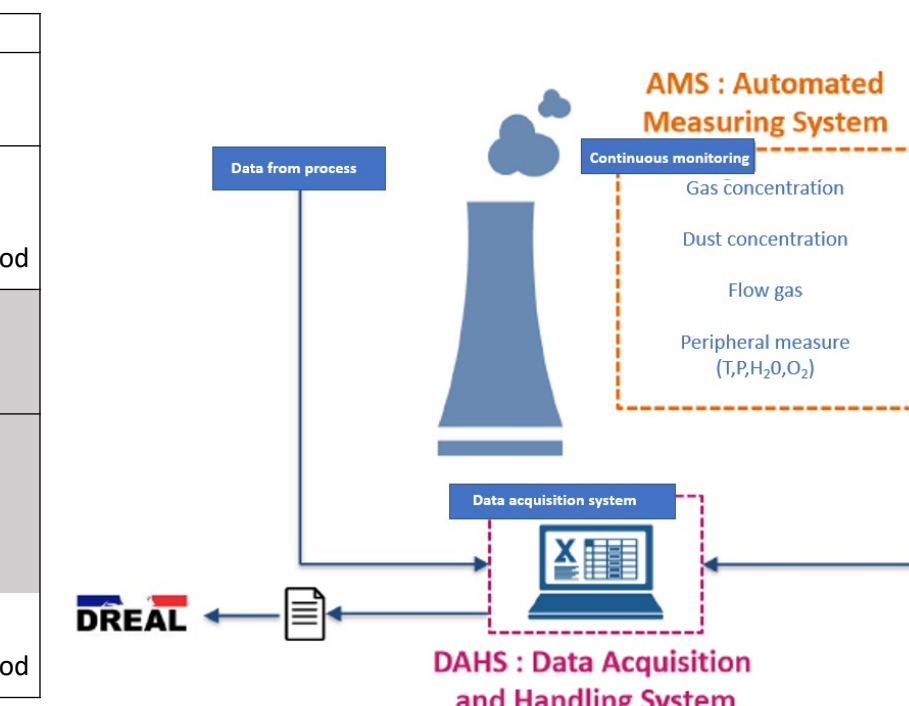
- 32 staff / 24-hour operation
- 250T waste daily
- Max capacity of 86 kT/year
- 76 GWh of thermal energy
11 GWh of electrical energy
- 17k households supplied



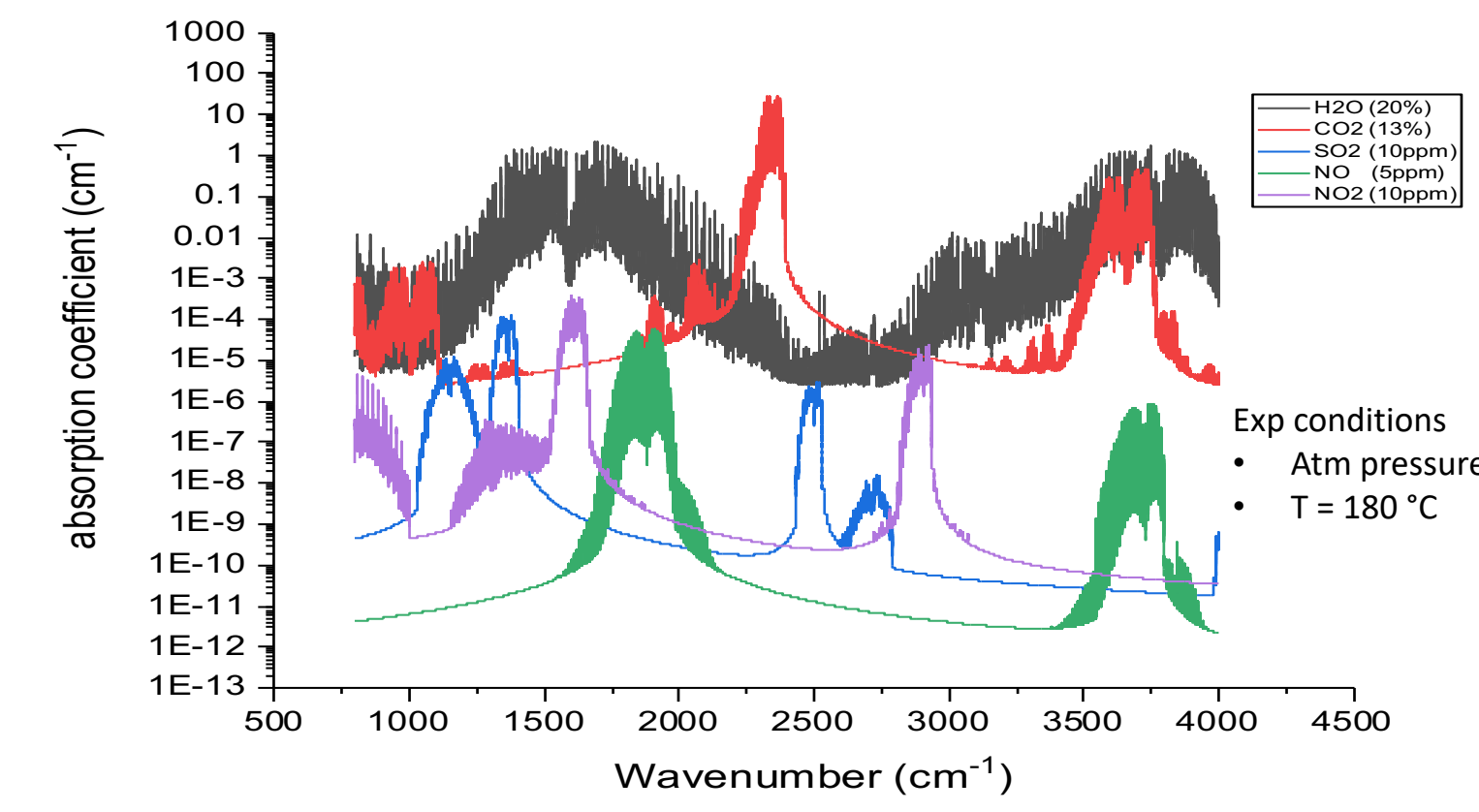
Continuous Emission Monitoring System
3 (FT-mid-IR + DTP) (multi-gas)
1 before / 2 after gas treatment process



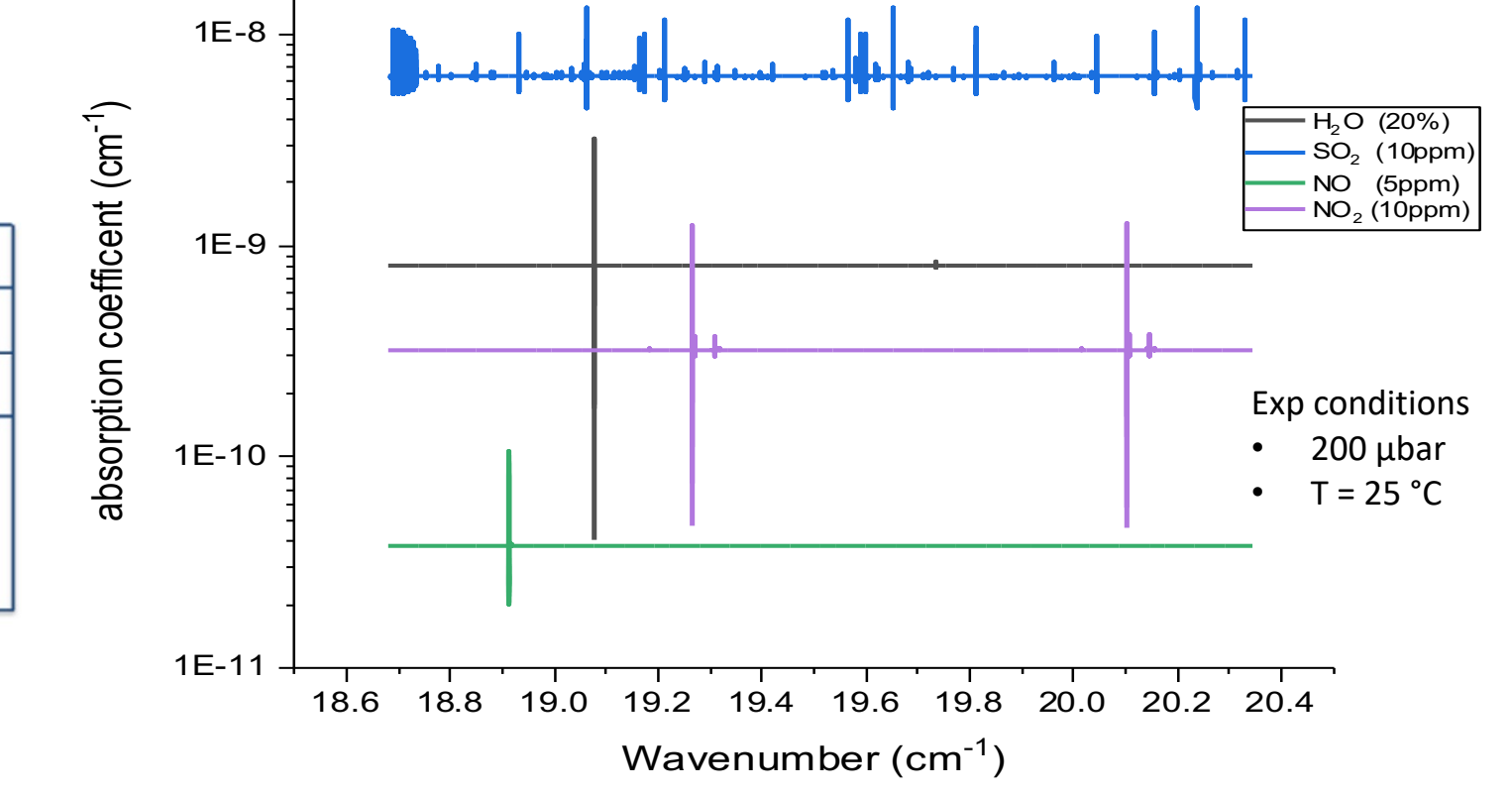
Parameter	BAT in mg/Nm3	BAT in ppm	Averaging period
Dust Cs+Tl	< 2 - 5 0.005 - 0.02		Daily Over the sampling period
Sb+As+Pb+Cr+Cu+Mn+Ni+V	0.01 - 0.3		
HCl	< 2 - 8	< 1 - 5	Daily
HF	< 1	< 2	
SO ₂	< 5 - 40	< 2 - 14	
NO _x	< 50 - 150	< 37 - 112 / < 25 - 75	
CO	< 10 - 50	< 8 - 40	Daily
NH ₃	< 2 - 10	< 2 - 8	
VOC _x	< 3 - 10	< 4 - 14	
PCDD/PCDF	< 0.01 - 0.08		Over the sampling period
PCDD/PCDF + PCB dioxin type	< 0.01 - 0.08		



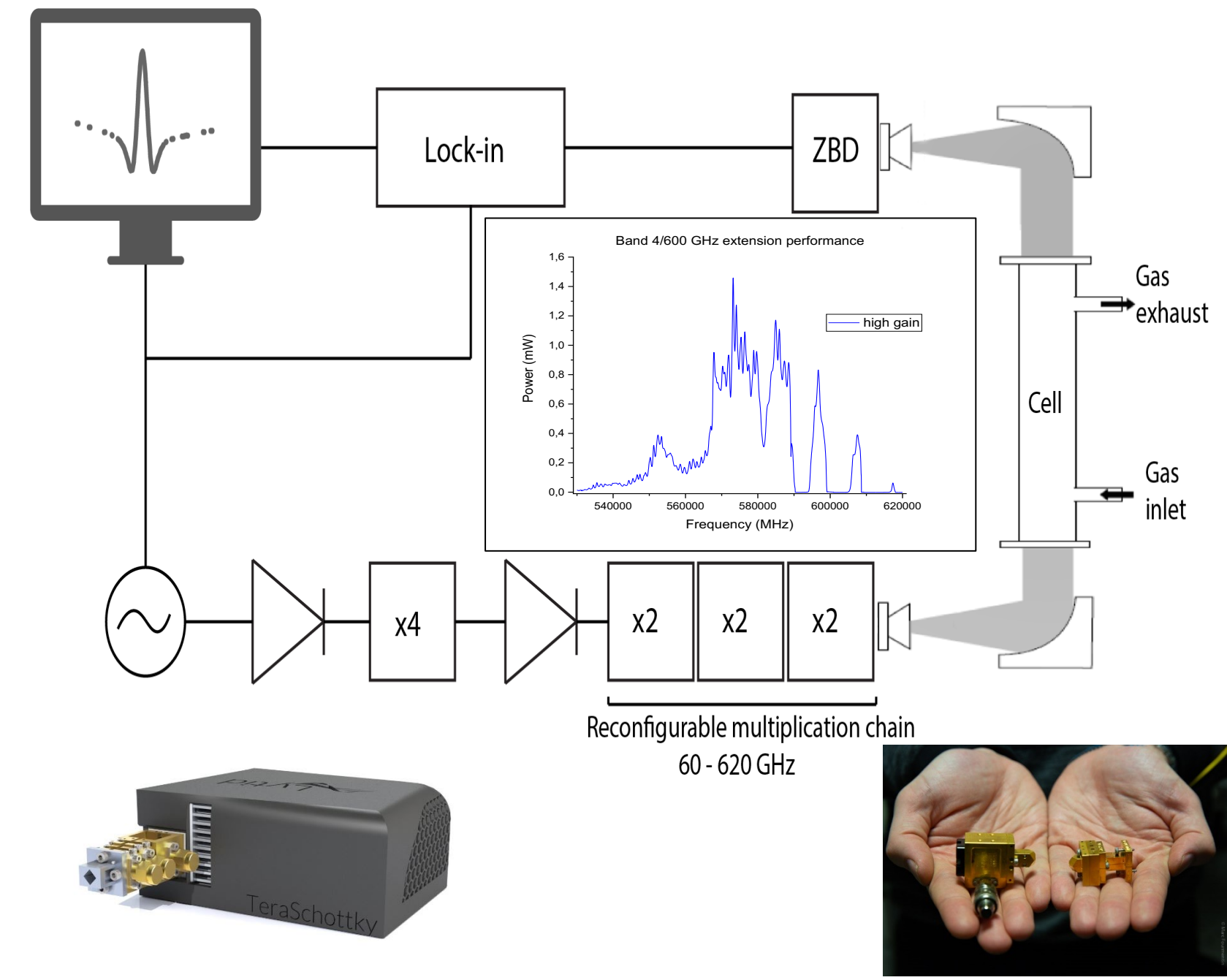
Simulation of the vibrational IR bands measured by the actual AMS (FTIR low-resolution spectroscopy)



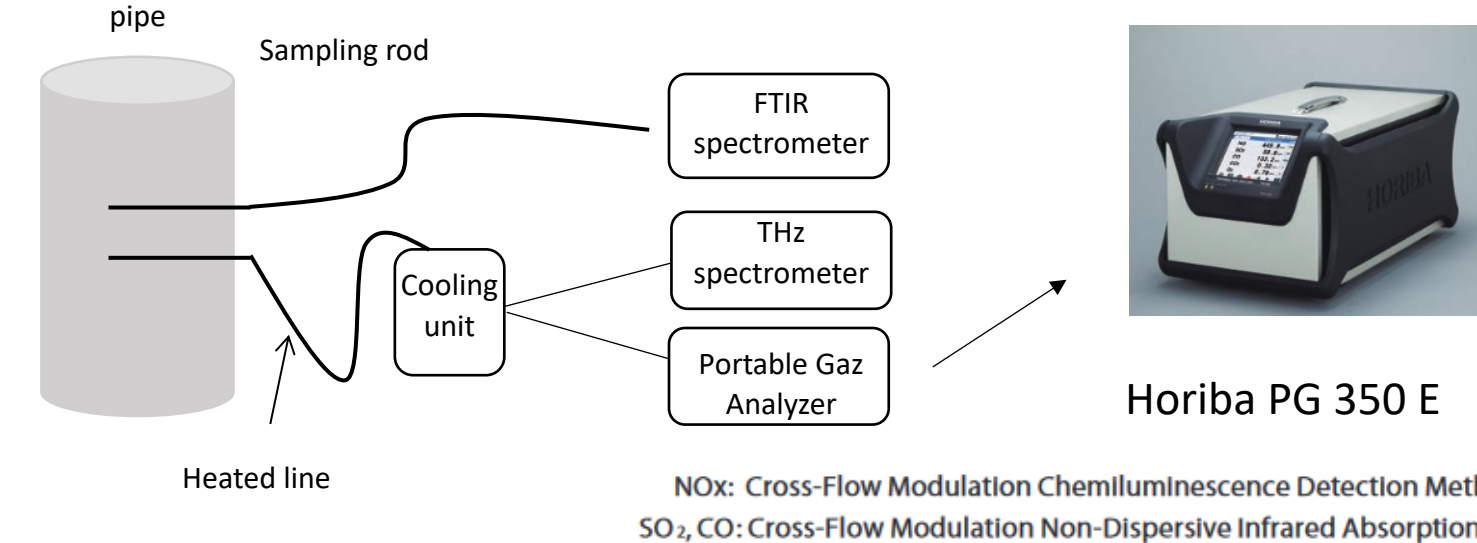
Simulation of the rotational lines which can be measured by our spectrometer (high-resolution THz spectroscopy)



THE THz SPECTROMETER

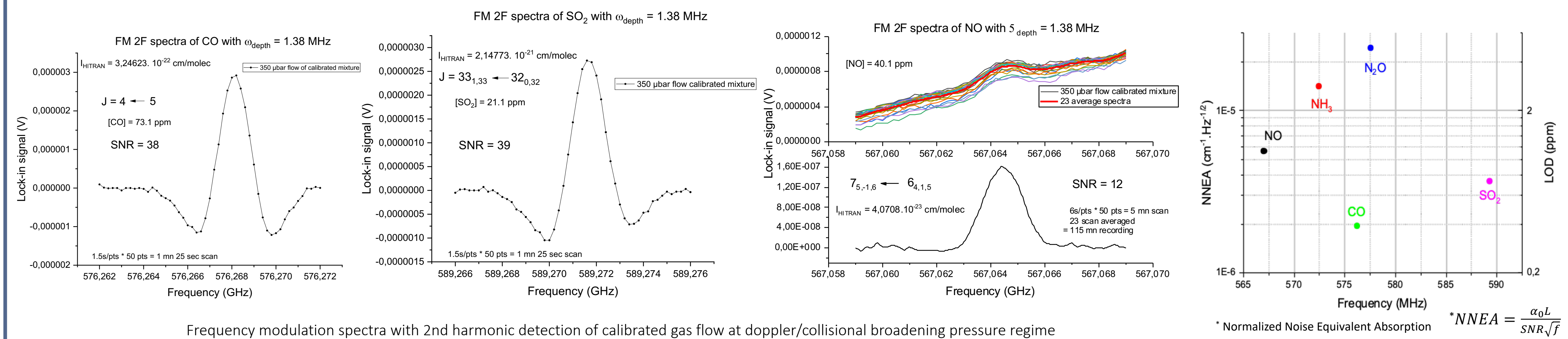


Electronic THz devices are now compact and robust and can go outside the laboratory

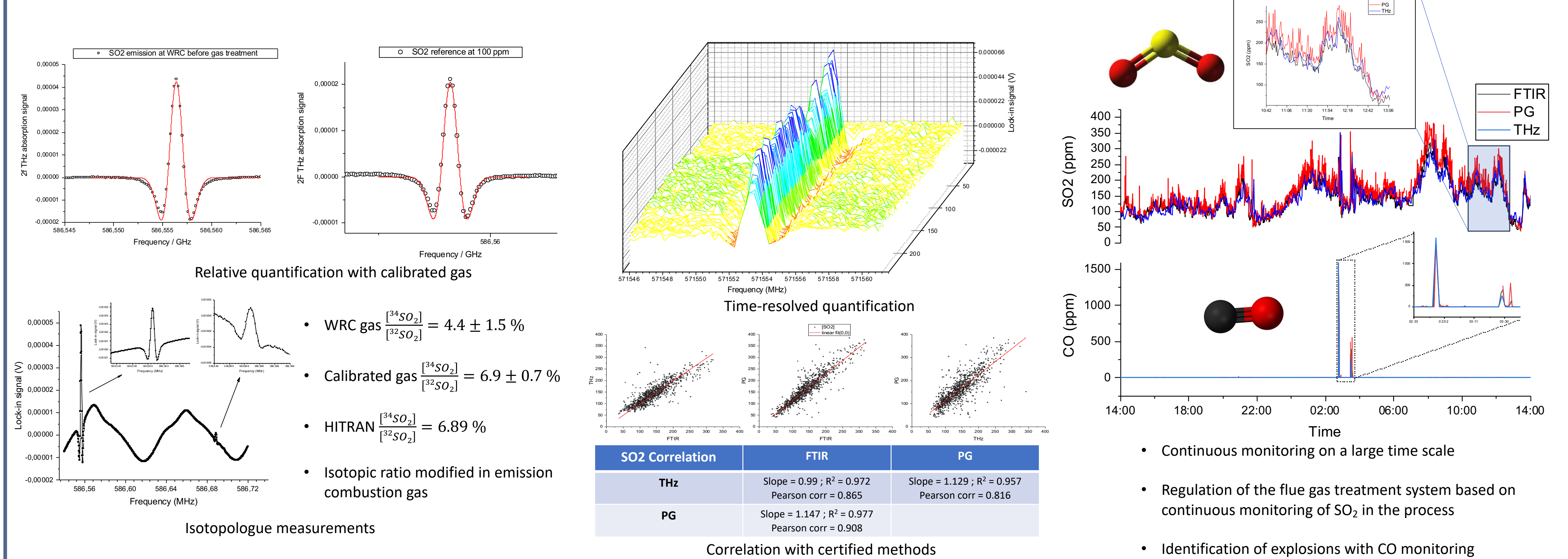


MONITORING OF THE REGULATED POLLUTANTS AT TRACE LEVEL

Limit of Detection (LOD) of regulated compounds on standard gases

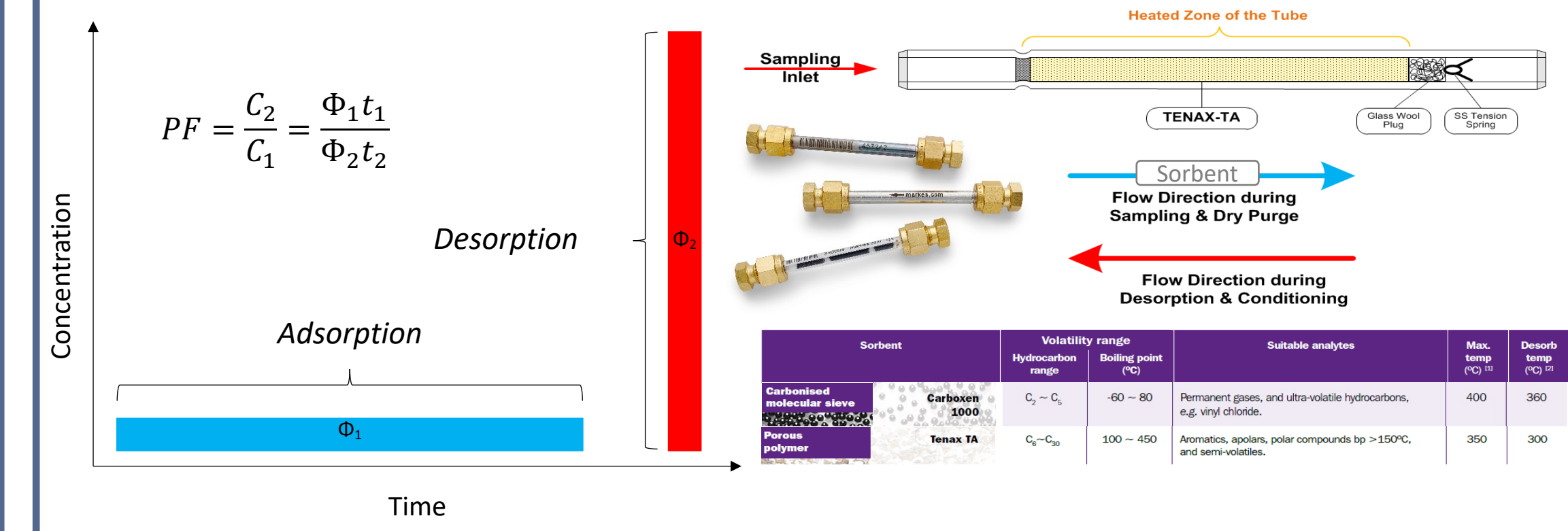


Measurements at the WRC : on-site & real-time THz monitoring of regulated pollutants



VOCs MEASUREMENT USING PRE-CONCENTRATION

Principle of pre-concentration : adsorption & thermal desorption

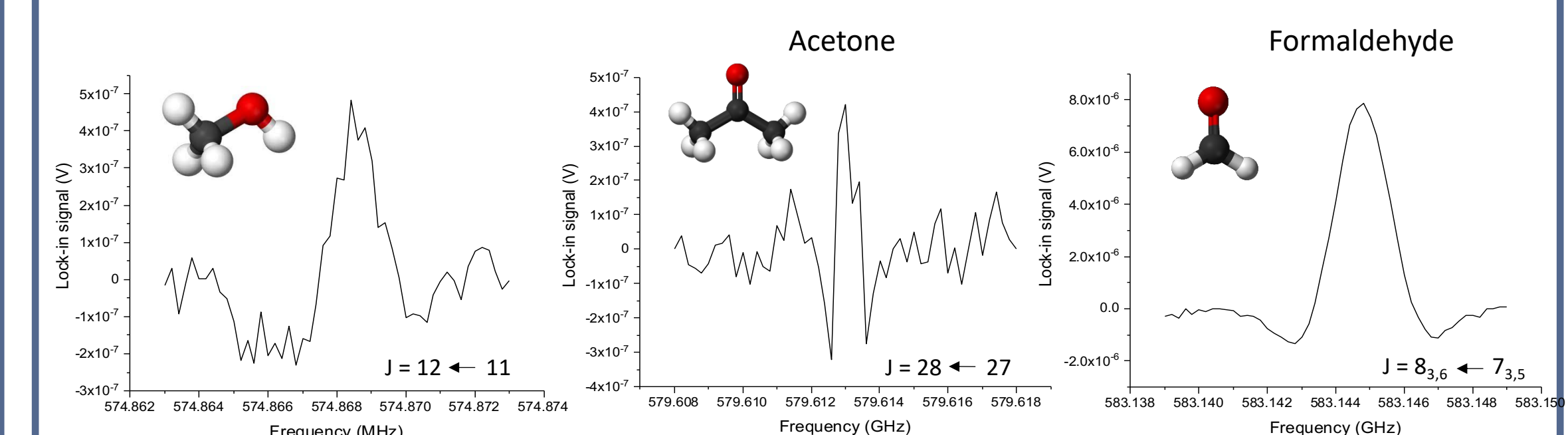


Preliminary experiments:

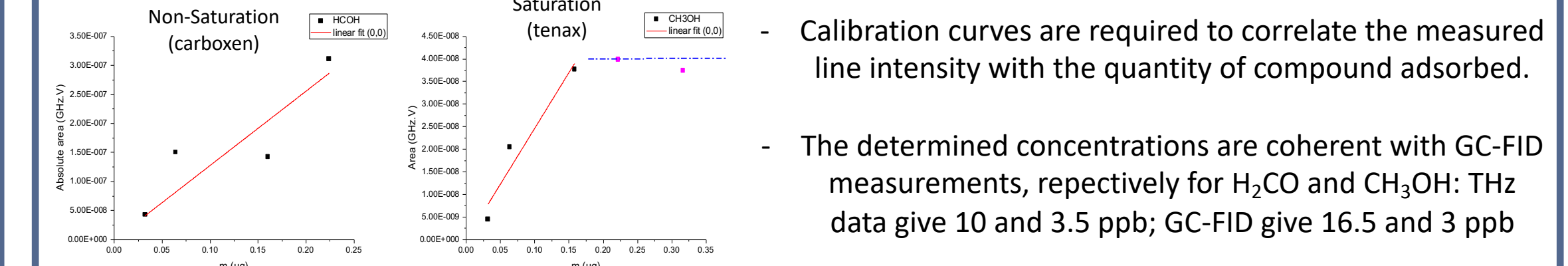
Direct injection of the desorbed molecule in the absorption cell (static measurements at low pressure; cycle < 5 min.):

1. Adsorption: $t_1 \sim 2 \text{ min}$; $\Phi_1 \sim 0.5 \text{ L min}^{-1}$
2. Desorption: Purge of the sorbent (few s.) → cartridge under vacuum Heating $T_{\text{room}} \rightarrow 300^\circ\text{C}$ (2 min.) Instantaneous injection at working pressure (10 - 250 mbar)
3. Measurements: from 5 to 10 compounds (lines) targeted, scan of 30 s. ($\delta\nu \sim 200 \text{ kHz}$; $\tau_{\text{lock-in}} \sim 200 \text{ ms}$)

First on-site THz detection of individual VOCs in the atmospheric emissions:



Frequency Modulation spectra with 2nd harmonic detection of VOCs at 250 μbar and 0.896 MHz modulation depth



SMART project: towards a THz AMS for the regulated pollutant monitoring:

