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AtmoChem-ECV

KEY-VOCs

EMRP
European Metrology Research Programme
Programme of EURAMET

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

SI-traceable reference gas mixtures for VOCs and water vapour at atmospheric concentration produced dynamically with a portable generator

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Metrological traceability

- **Traceability**: measurement linked to the definition of SI-units through an unbroken chain of calibrations – m, kg, s, K, mol

- **Measurement uncertainty**: estimation of possible sources of uncertainties. Needed when comparing results obtained from different methods.

- **Method validation**: evaluation of all influencing parameters

- **Results independant of method, time and place**

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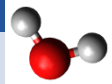
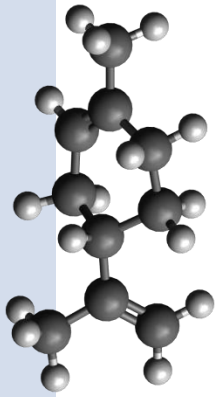
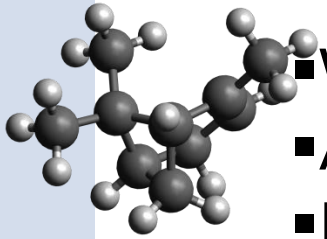
Target molecules

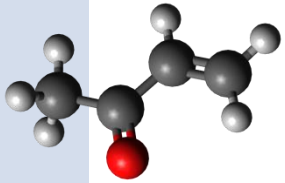


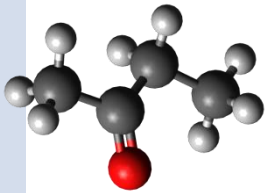


- Unstable in cylinders at atmospheric concentration
- Effects of adsorption/desorption on surfaces
- Any substance that can be filled as a liquid into a permeator



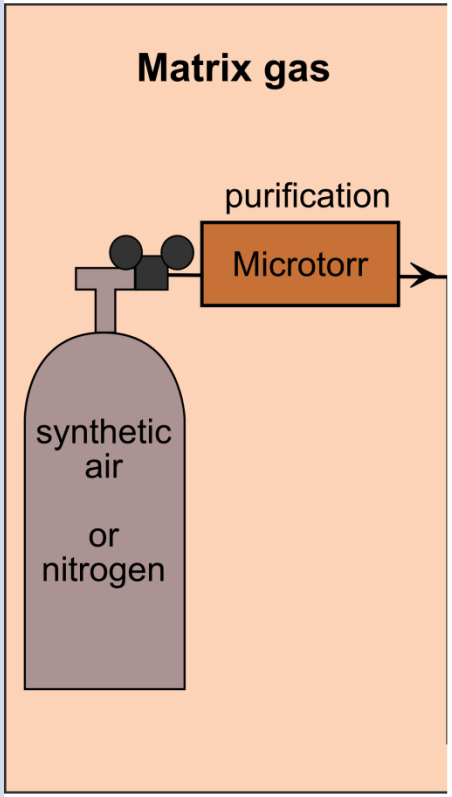
- Water vapour 1- 10 µmol/mol (ppm)
- Ammonia ~nmol/mol (ppb)
- Fluorinated gases : HFCs, HCFCs… pmol/mol (ppt)
- Volatile organic compounds (ppb):
  - (R)-limonene
  - α-pinene
  - MVK or butenone, $CH_3C(O)CH=CH_2$
  - MEK or butanone, $CH_3C(O)CH_2CH_3$





Method overview

Successfully applied to: NO_2, water vapour, BTEX (benzene, toluene, ethylbenzene, xylene), NH_3, HFC-125, HFC-1234yf, **at atmospheric concentration**



1. Matrix gas purification

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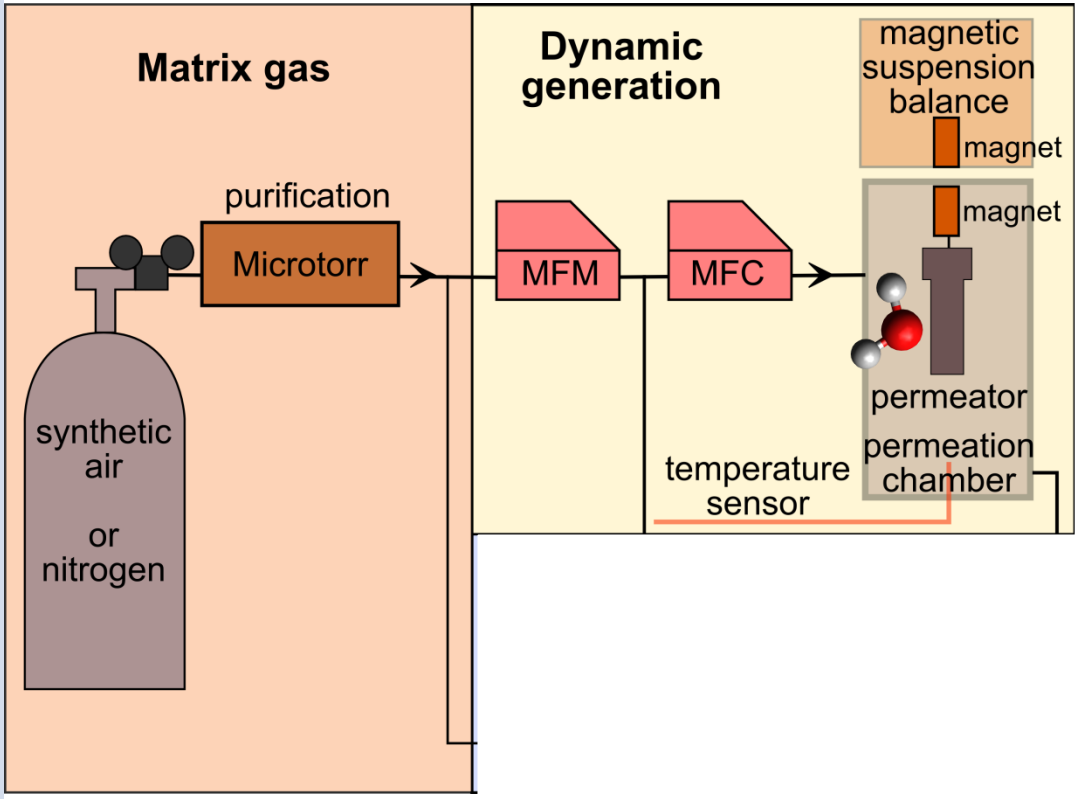
1. Purification of matrix gas in 2 steps

1) clean dry air /nitrogen in cylinder
2) further purification with commercially available cartridge « MicroTorr », SAES Getters

- Flow normally used: 1 L/min
- Purified nitrogen measured by CRDS “LaserTrace” from TigerOptics
- Minimum reached : 7 ppb water in nitrogen
- Currently testing efficiency to purify from VOCs

See talk by R. Pearce this session 16:00

Method overview



2. Adding pure substance to matrix gas

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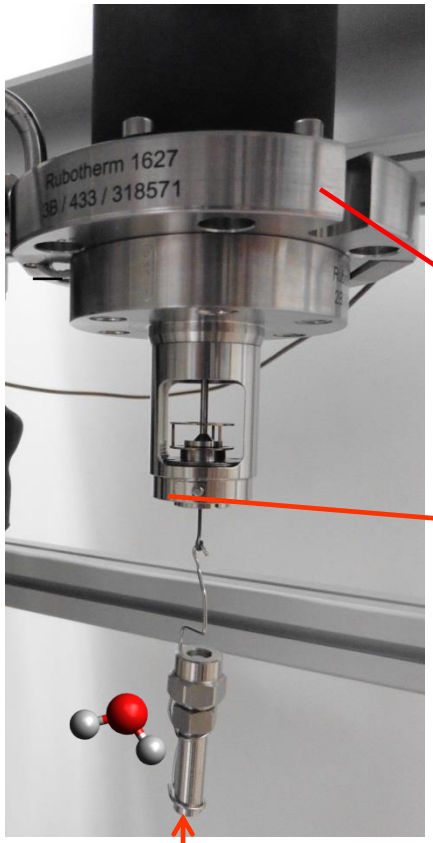
2. Adding pure substance to matrix gas

- Dynamic : continously produced over time
- New magnetic suspension balance tested at METAS:
  - stainless steel
  - SilcoNert2000 coating
  - Temperature control 30-70°C
  - Pressure control up to 6 bar-a

$$\text{Molar fraction} \propto \frac{\textit{mass loss rate}}{\textit{total carrier gas flow}}$$



Permeator,
Fine Metrology

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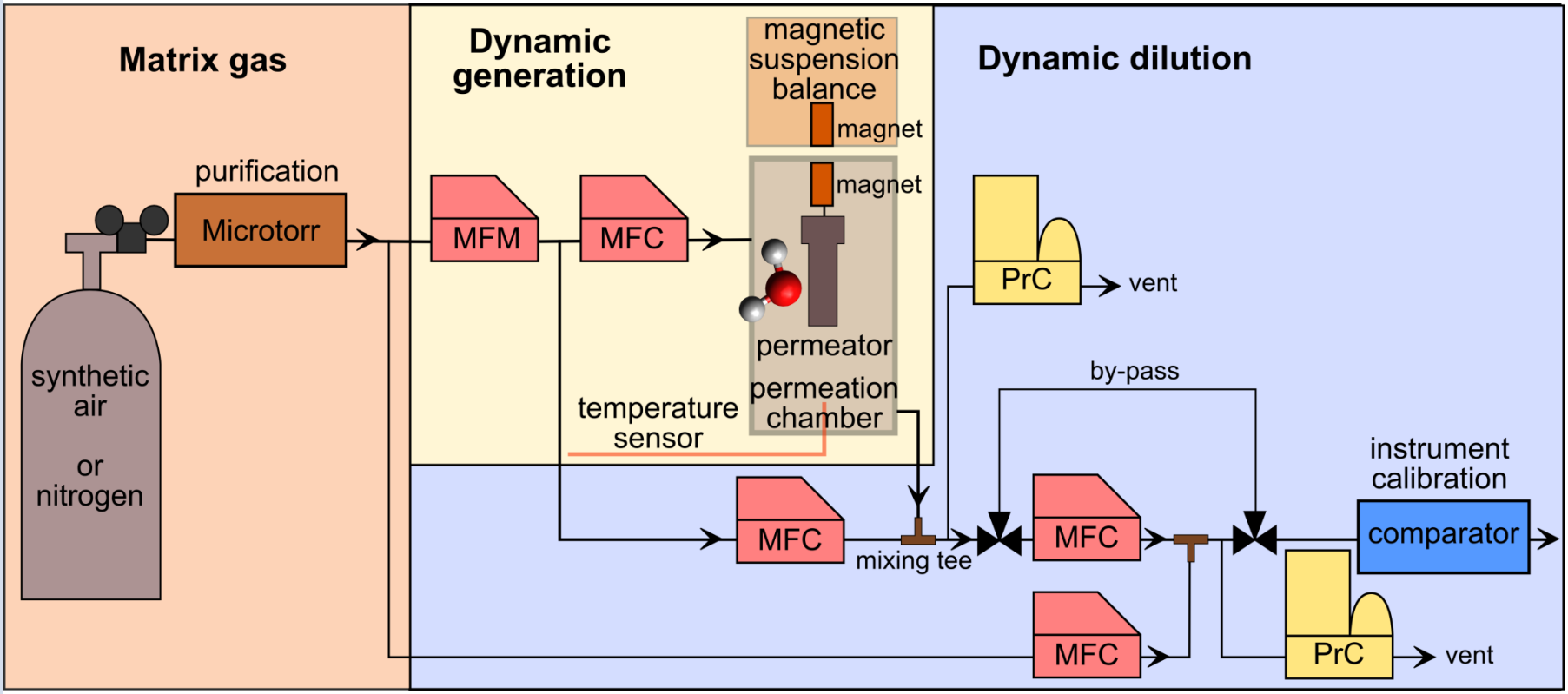
Method overview

3. Dynamic dilution



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3. Dynamic dilution

- 2 successive dilution steps
- Using mass flow controllers (MFC) from Vögtlin
- Pressure controlled
- SilcoNert2000 on all metal surfaces

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Results: water generation at ~10 µmol/mol (ppm)

- Carrier gas: nitrogen purified with Microtorr cartridge
- Entire system dried down to 100 ppb water
- Generated concentration measured with laser Intrument from TigerOptics

- Expanded uncertainty at 10 µmol/mol (95% confidence interval): 1%, 100 nmol/mol
  - 65% residual water
  - 26% mass loss permeator
  - 9 % flow

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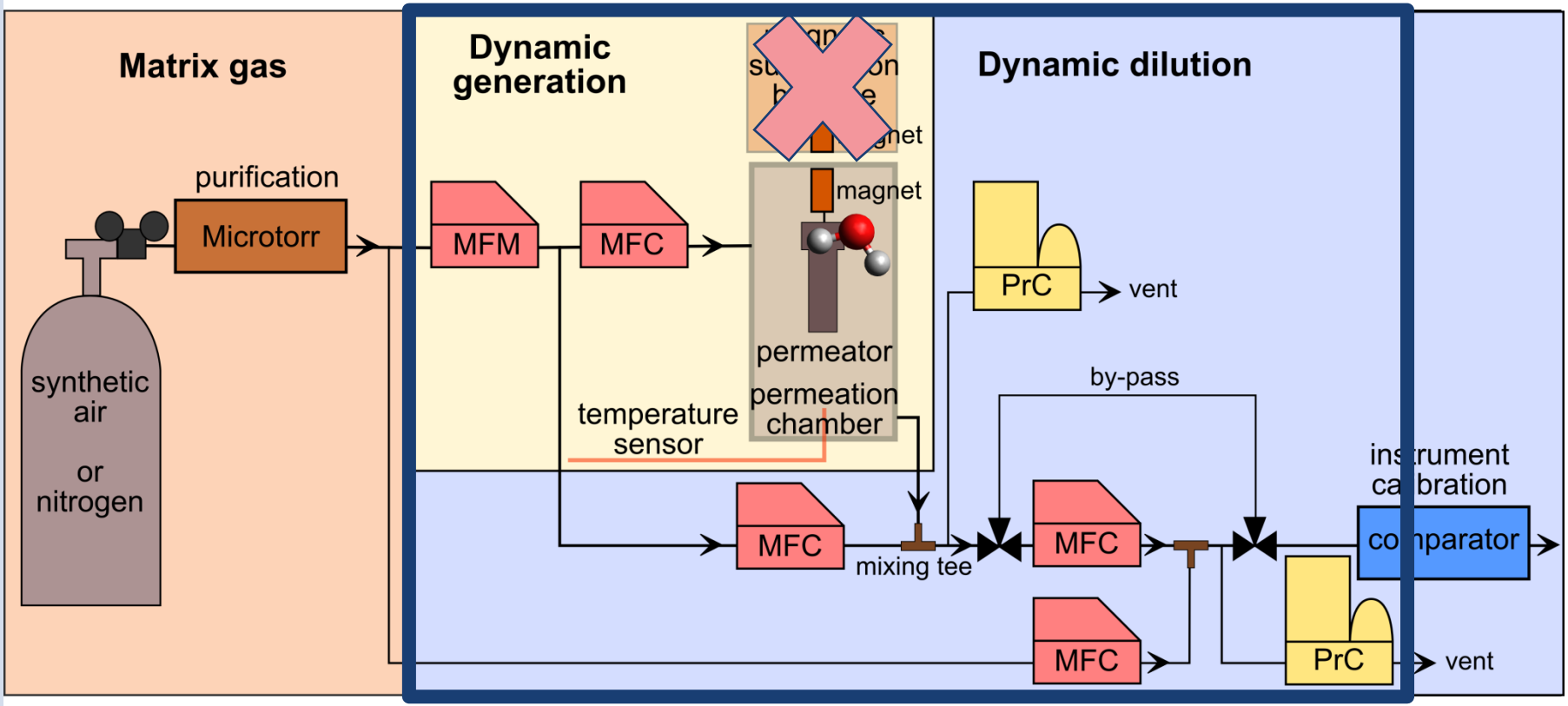
Design – portable generator

- **All-in-one, portable setup**: Generation of multi-component reference gas mixture by combining permeation and dynamic dilution steps



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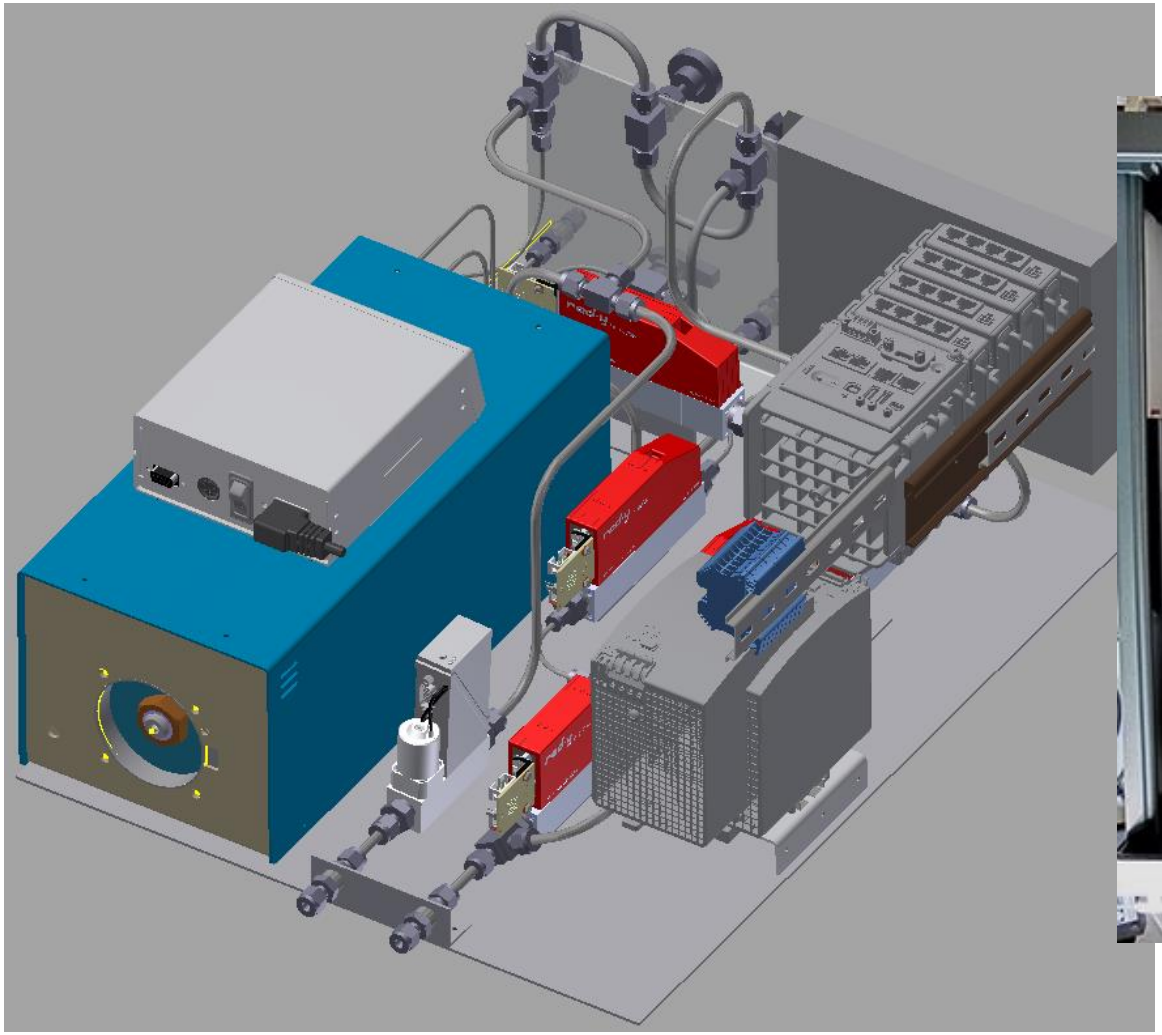
Design – generator for ammonia NH_3

MetNH3

Project MetNH_3



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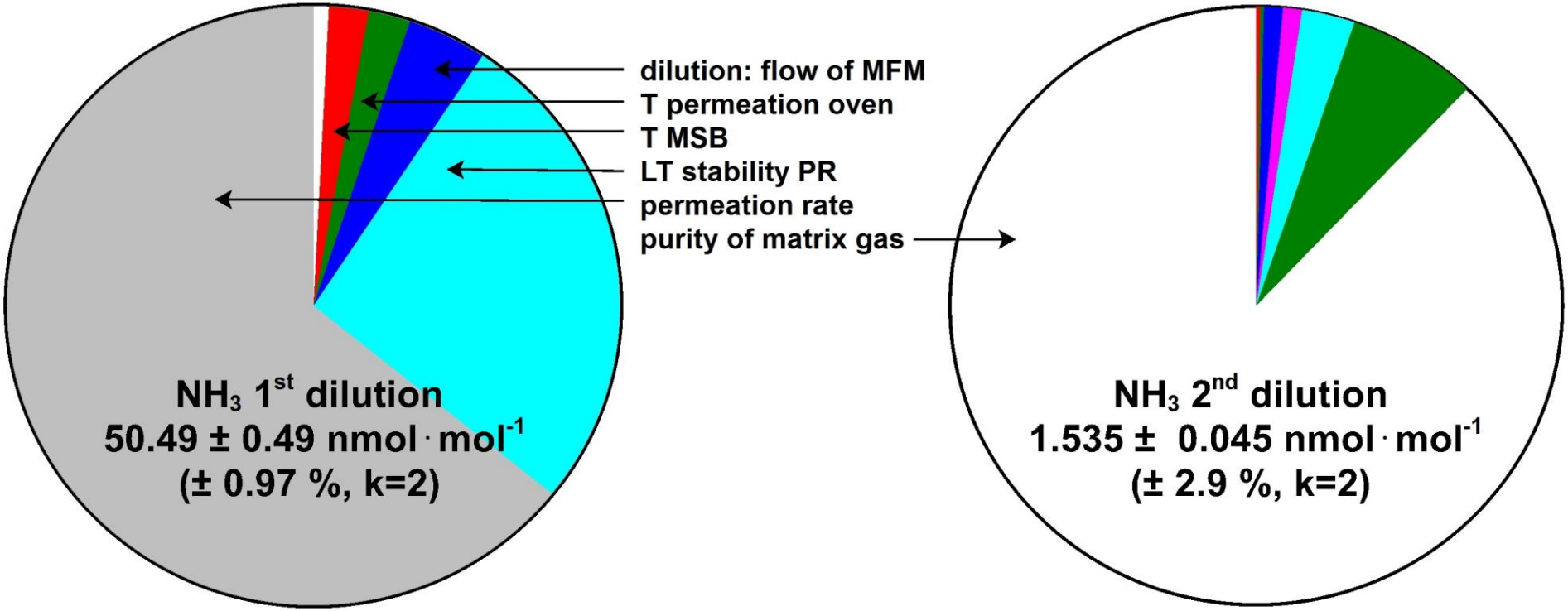
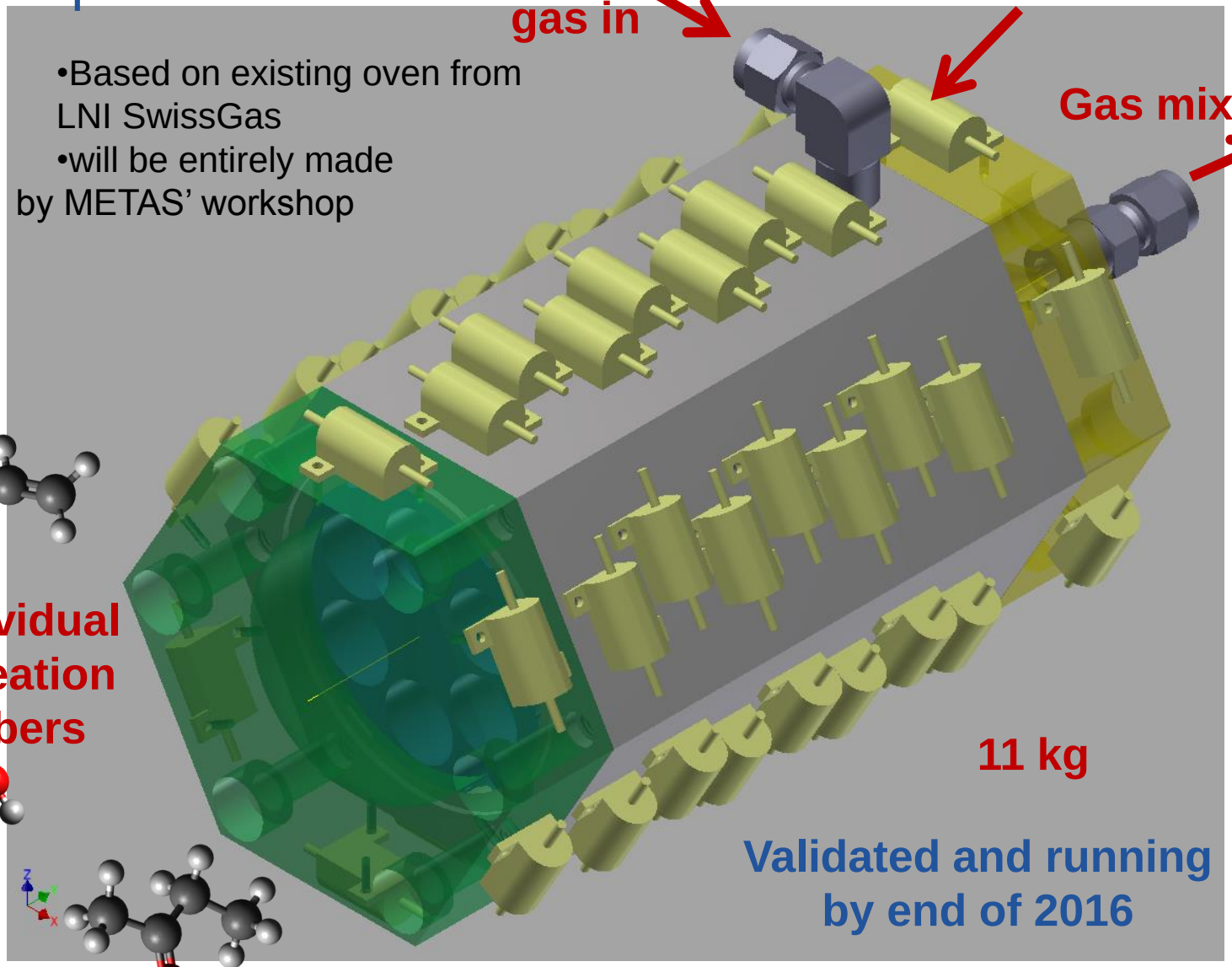
Results: ammonia generation at ~nmol/mol (ppb)



Design for VOCs – with multiple permeators

- Based on existing oven from LNI SwissGas
- will be entirely made by METAS' workshop



Reference gases for fluorinated gases:

poster A.438 in this session

17:30 – 19:00 today, Hall A

More on making zero air standard: talk by R.Pearce 16:00 – 16:15

Thank you for your attention

Questions?

Many thanks to METAS Gasanalytik team, workshop and electronics workshop