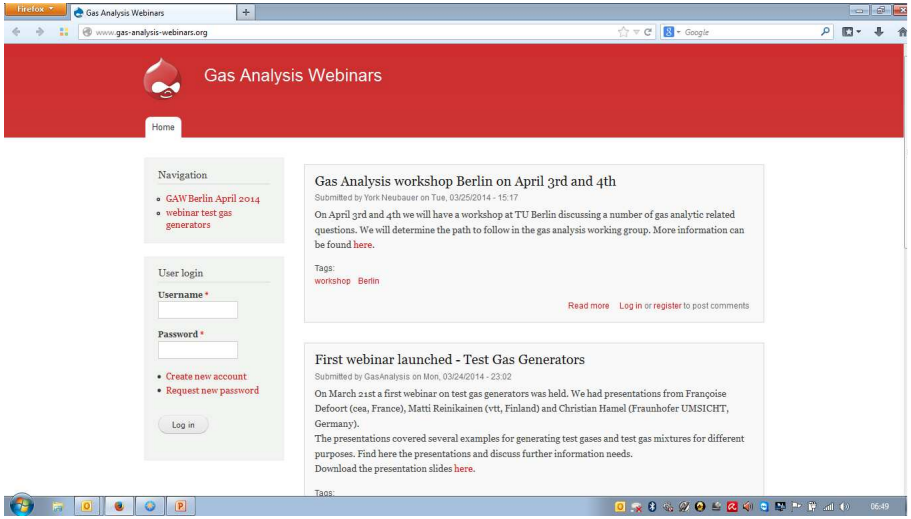
bioenergy2020+

Review of most relevant applications for diagnostic toolboxes



Markus Kleinhappl Bioenergy2020+

→ http://www.gas-analysis-webinars.org/

Workshop Berlin
3. and 4. th Aprile Berlin

innovations kompetenz

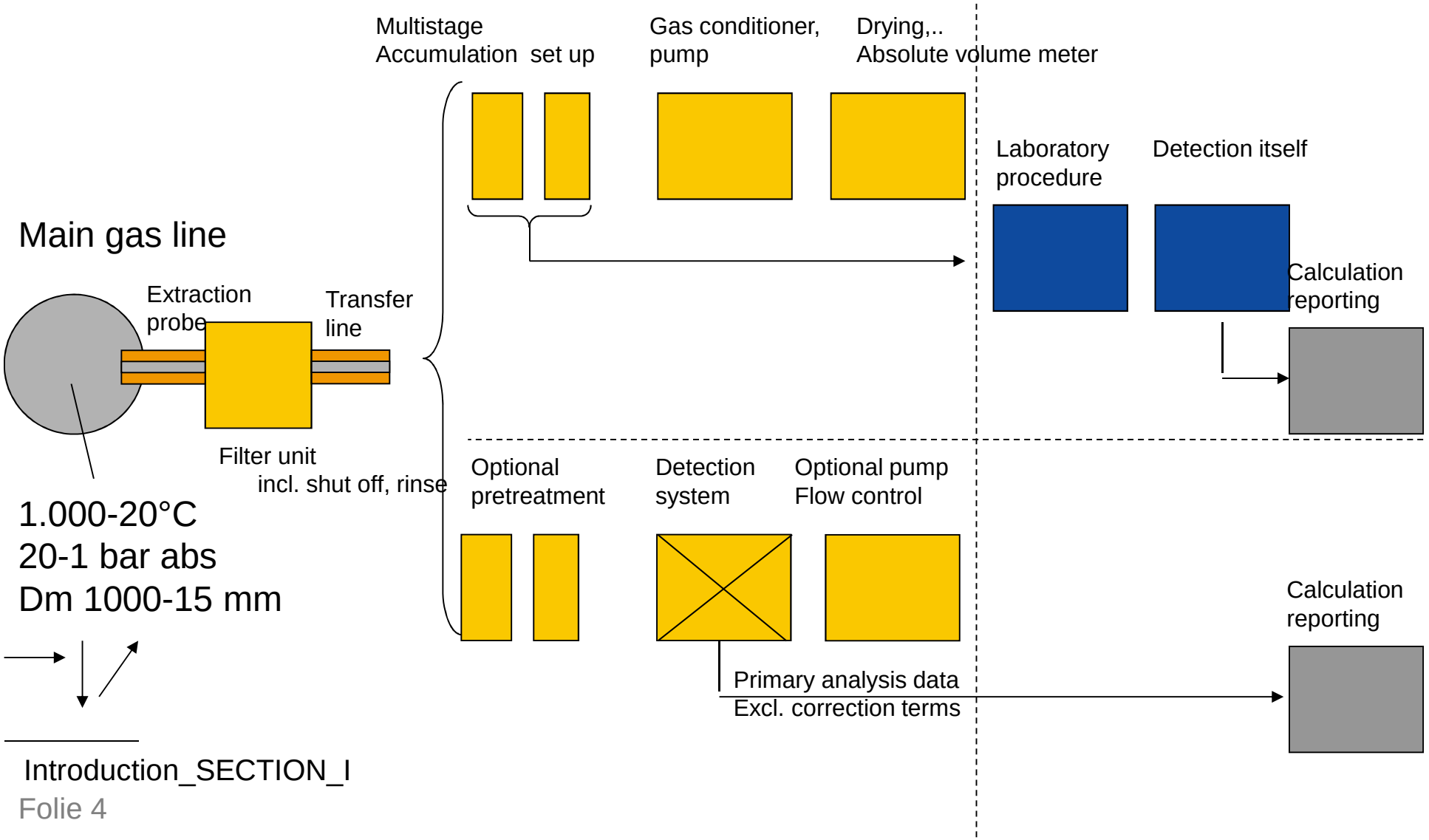
content

- Targets for measurements in gases
- Technological tasks in sampling and quantification
- Gas families, parameters & range
- Degree of difficulties
- Some scientific background
- Application of toolboxes
- Results from review 2013 / copenhagen

Targets for measurements in gases

Status & degree of plant evolution	**Lab test for effect experiments**	**Lab plant with real feedstock**	**Pilot plant**	**Full commercial plant**
Purpose	Study in lab (e.g. reforming reaction)	Plant operation a. component testing	Plant operation a. plant testing & optimisation	Plant operation & further optimisation trouble shouting OR **authorities**
Substances #	1 and simple	1-3, Matrix defined	1-5, Matrix defined	3 most important, Matrix defined
Matrix				
Frequency of measurement	1/ minute, or online	1/ hour, or online	1/ hour, or 1/ shift	1/ hour, 1/ shift, 1/month 1/year
Type of result	Manny points, continuous curve	Manny points, continuous curve	Sufficient stable points, average/shift	Result protocol Plant control
Labour expectations	Expert from lab. familiar with all equipment	Expert from lab. available	External expert contacted	a) automated: continuously b) Periodically from external experts
Expert knowledge	Practical expert knowledge	Practical expert knowledge recommended	Practical expert knowledge recommended	Expert from service & maintenance, calibration, quality control.
Automation	Sample switching Control, Diff. software applications	Sample switching Control, Diff. software applications	Sample switching Control, via full plant control or	Automated = online Quality procedures

Sampling train of extractive = non insitu measurement



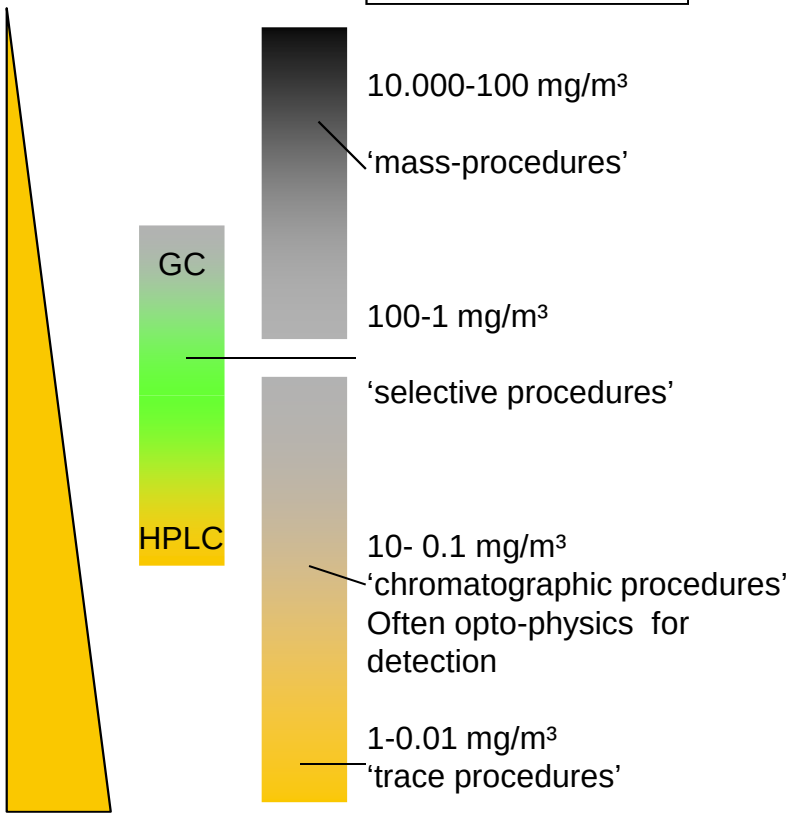
Technological Tasks in sampling and their structure in scientific point of view

T1A: gas extraction & pre treatment	**T1B: sample transport, Volume metering**
T2A: accumulation offline solvents & SPA	**T2B: online detection-systems** basics
T3A: analytical procedure: solvent & solids: detection and quantification	**T3B: analytical procedure:** detection and quantification calibration-reference
T4: result procedures calibration & references (steps, full) quality insurance, guidelines	
T5: safety / measures gases/liquids/solvents/solids/dust samples/treatment/wastes safety relevant tips and tricks	

Gas families, Sampling parameter, Conditions, Range

Particle ***Aerosol*** ***Tar***	Gas family	Sampling conditions
Particulate	Pyrolysis	***Crude Gas*** High dust High tar High water High temperature Pressure
Tar for grav.	Torrefaction.	
Tar for HPLC	Counter current gasifiers	
Tar for GC	Fluidized bed gasifiers	***Treated gas*** Medium dust Medium tar Medium water Medium temperature
Tar similar comp	Entrained flow gasifiers	
And discrete chemical compounds.	Co-current gasifiers	
	Staged gasification	***Finished gas*** Low dust Low tar Low water Ambient temperature Very high pressure
	Treated product gas	
	Treated synthesis gas	
	Flue gas	

Relative Gas volume V_{Gas}/V_{Liquid}



Range of detection

Interface connector: sampling-analysis combination

Sampling parameter, Conditions, Range

Particle ***Aerosol*** ***Tar***	Gas family	Sampling conditions	Relative Gas volume V_{Gas}/V_{Liquid}	Range of detection

Particulate

Tar for grav.

Tar for HPLC

Tar for GC

Tar similar comp.

Pyrolysis

Torrefaction.

Counter current gasifiers

Fluidized bed gasifiers

Entrained flow gasifiers

Co-current gasifiers

Staged gasification

Treated product gas

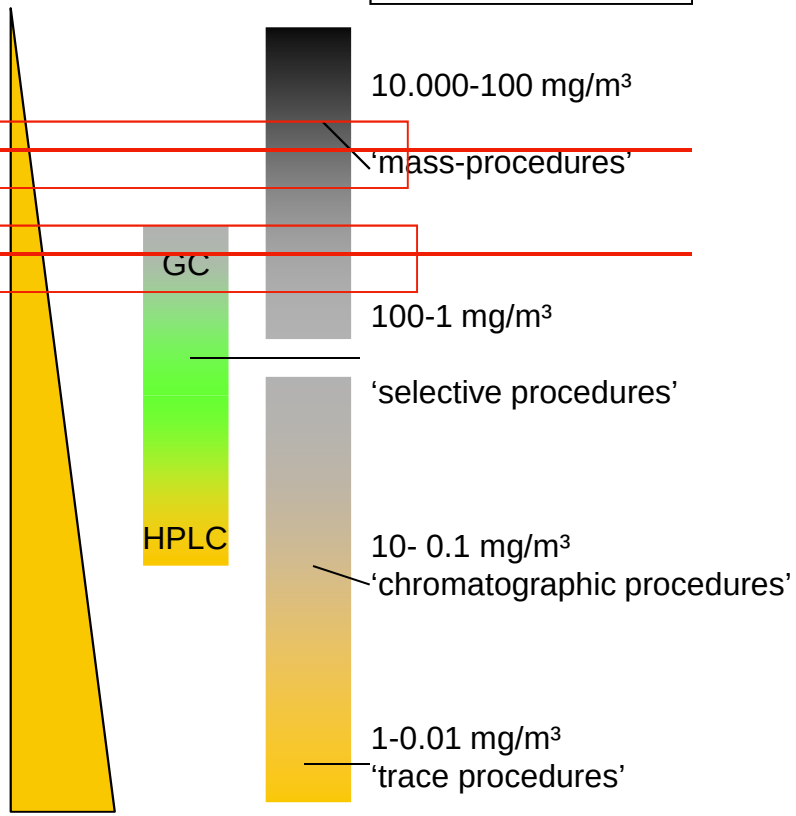
Treated synthesis gas

Flue gas

Crude Gas
High dust
High tar
High water
High temperature
Pressure

Treated gas
Medium dust
Medium tar
Medium water
Medium temperature

Finished gas
Low dust
Low tar
Low water
Ambient temperature
Very high pressure



10.000-100 mg/m³
'mass-procedures'

100-1 mg/m³
'selective procedures'

10- 0.1 mg/m³
'chromatographic procedures'

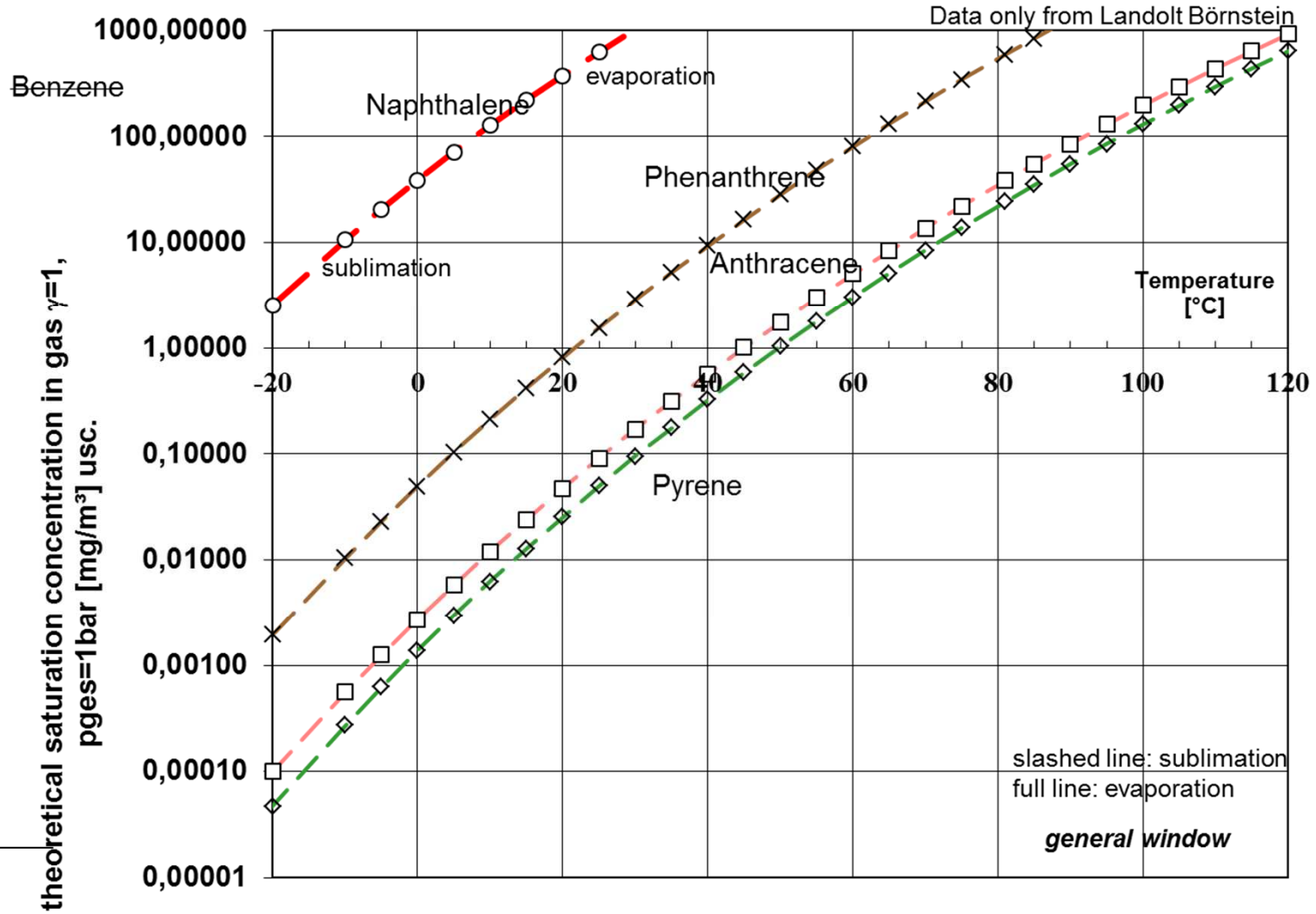
1-0.01 mg/m³
'trace procedures'

Degree of difficulties; scale

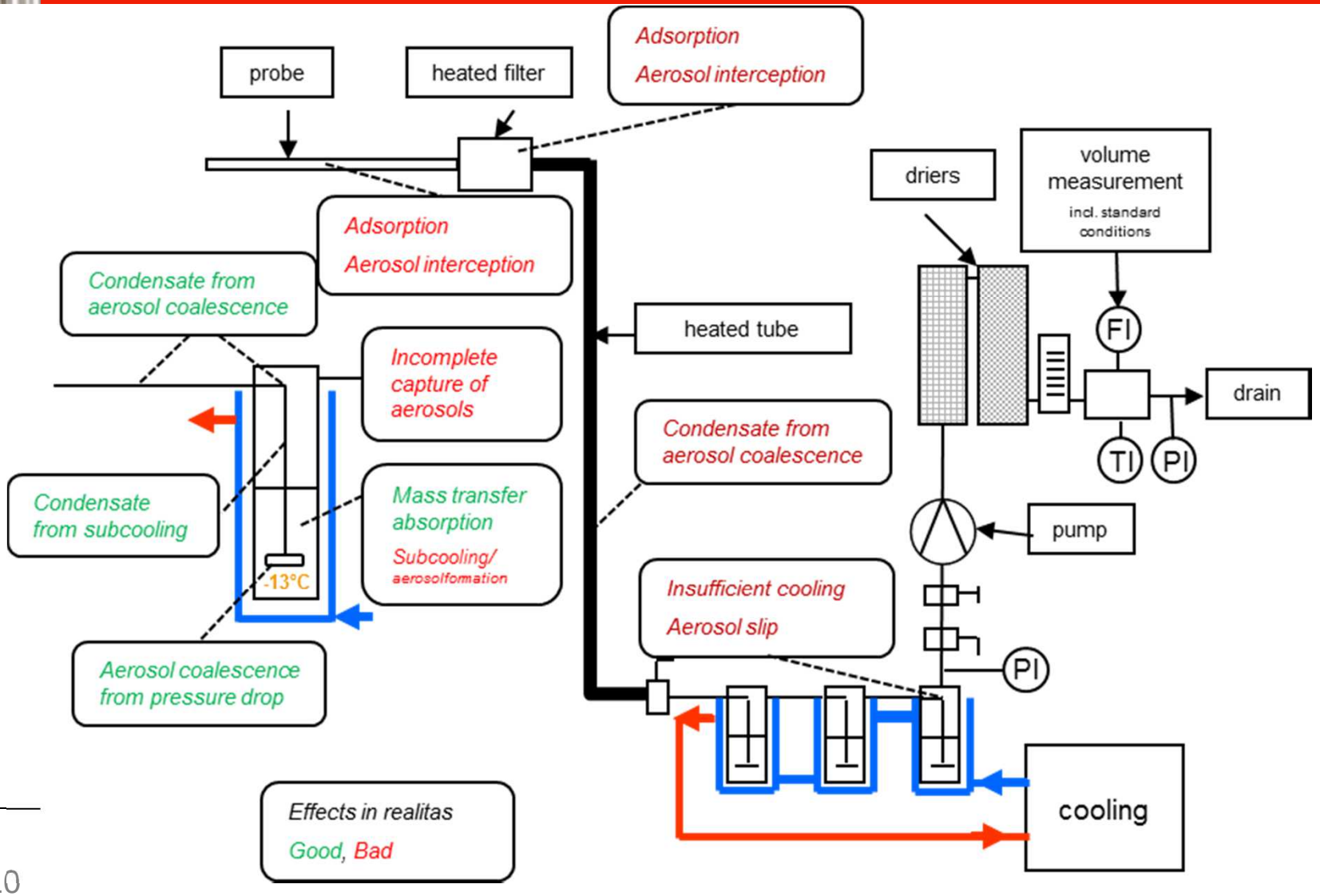
Temperature at sampling point	*Content of DUST*	*Content of WATER*	*Content of organics ('tars')*	*Compounds organic*	*Compounds in-organic*	*total*
1,000 → 4	>10,000 → 5	>80°C → 5	>10,000 → 5	**Manual**: Multiply x 1	**Manual**: Multiply x 1	
800 → 4	<10,000 → 5	<80°C → 3	<10,000 → 3			
600 → 4	<1000 → 3	<60 → 2	<1,000 → 2			
400 → 3	<100 → 2	<40 → 1	<100 → 1	**online**: Multiply x 10	**online**: Multiply x 5	
200 → 2	<10 → 1	<10	<10			
ambient	<1	<0°C	<1			
°C	mg/m³	dewpoint local pressure	mg/m³ dewing			

TF	+	DF	+	WF	+	OF	=		DEGREE
2+		2+		1+		2	=	normal application	7 (=medium)
4+		5+		3+		2	=	e.g. high dust fluidised bed sampling	14 high

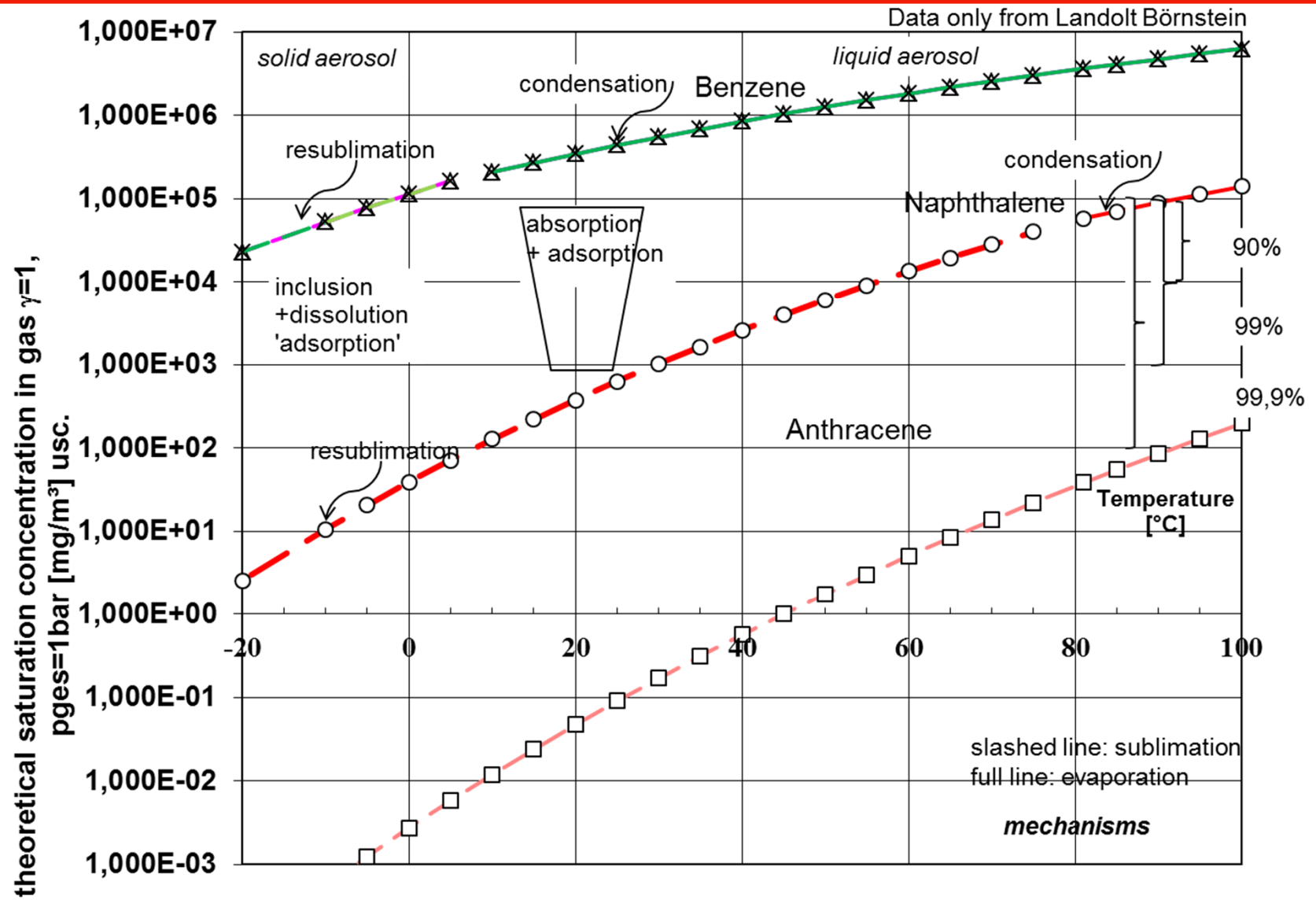
Primitive fundamental = basic value
Saturation pressures/ concentrations



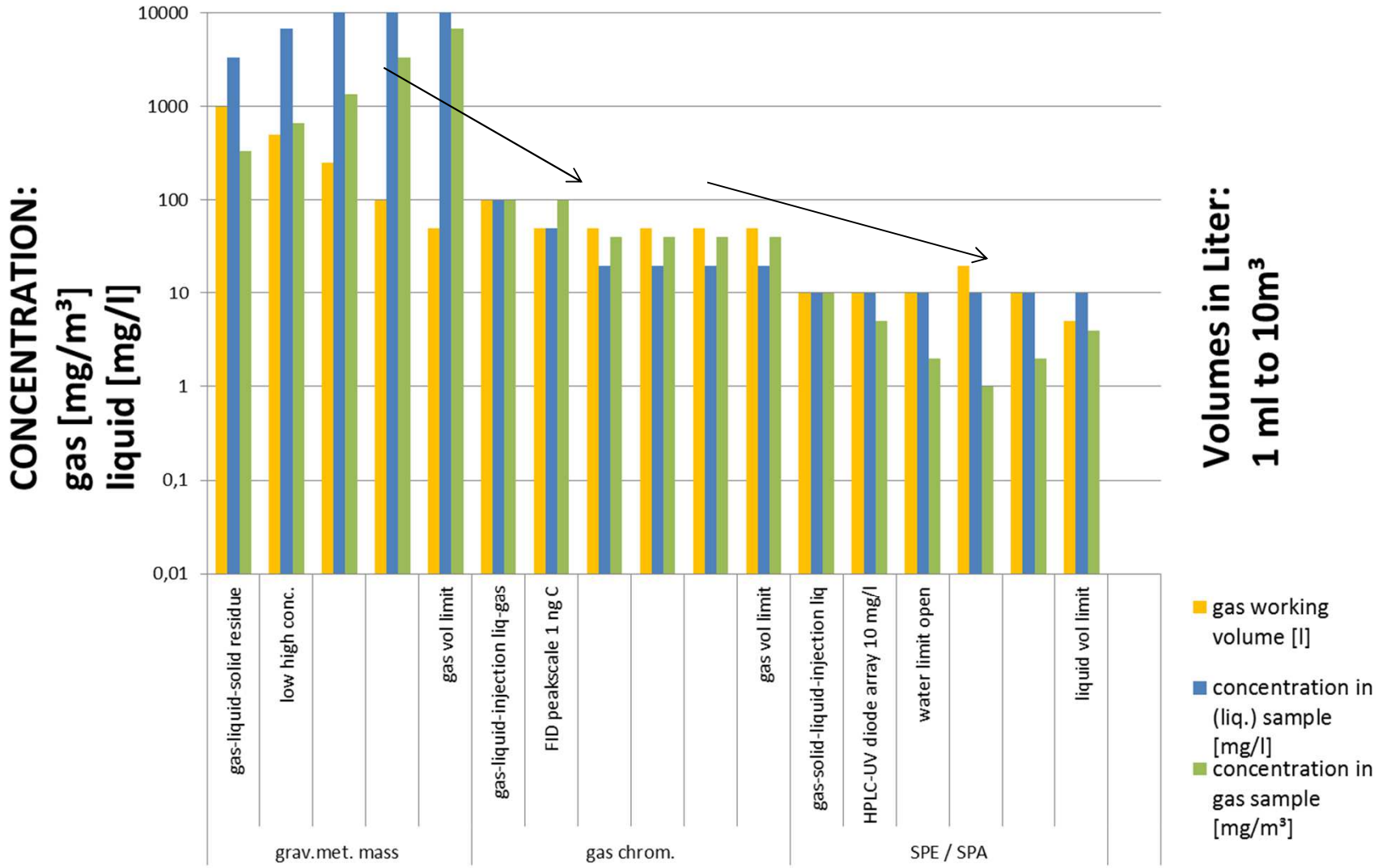
Effects all over the sampling line



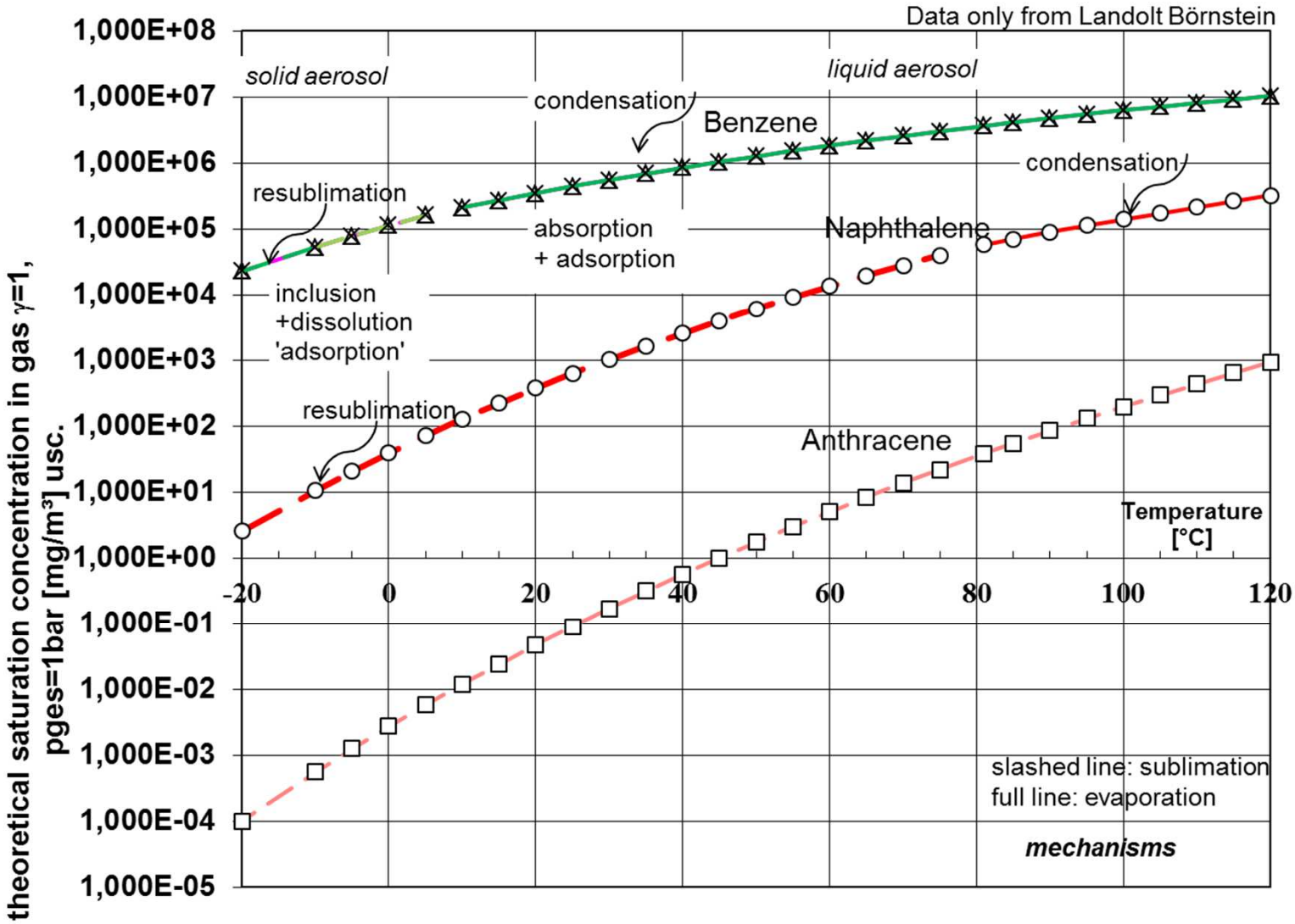
Completness of capture: 90% 1 magnitude; 99% 2magnitudes



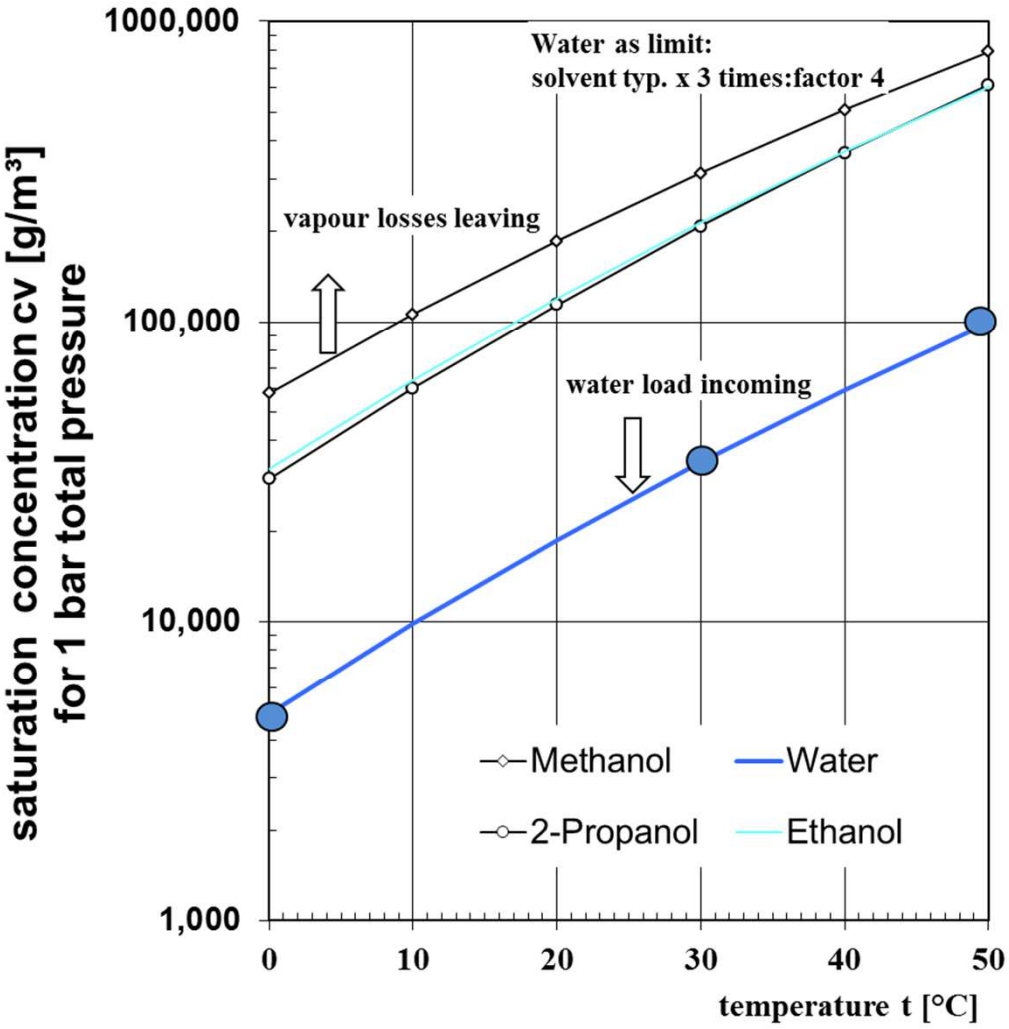
The gas/liquid ratio limits of quantification: *lower limits*



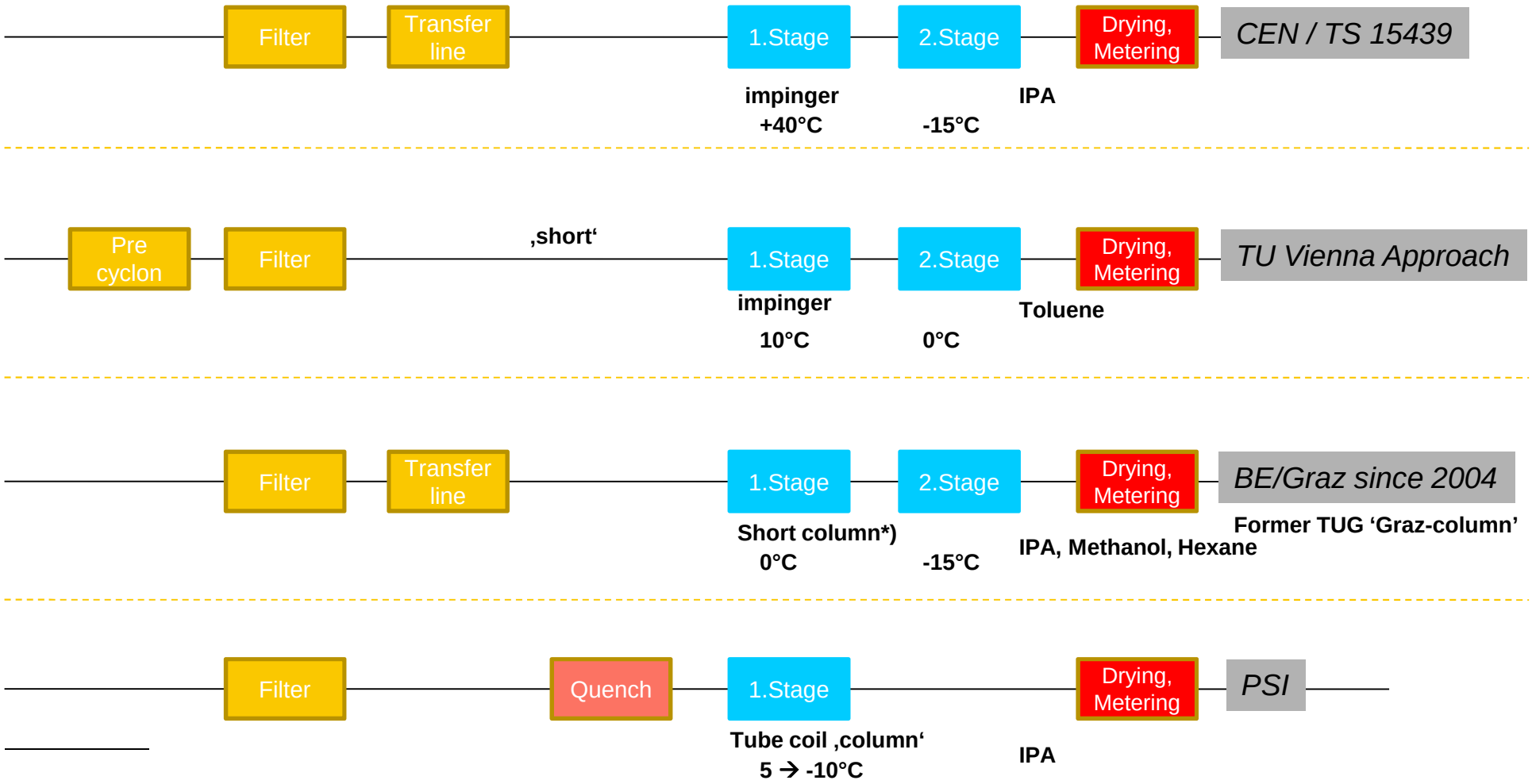
Primitive fundamental = basic value
Saturation pressures/ concentrations



The water problem in liquid acc. sampling



Suitable Concepts ‘derivatives of CEN / TS 15439’ ~ toolboxes



‚bio-diversity‘ of applications with good experience.

Application of toolboxes

	Offline sampling & later analysis		**online sampling & quasi cont. sampling**	**Real time sample extraction and/or detection/quantification**
	Accumulation on solid phase	Accumulation in liquids (cooled)	Dosage, fractioning chromatographic separation in retention	Dosage or dilution, selective detection & quantification
Necessary accessories	Dilution against water condensation	Pre-separation of solids/aerosols ‘dust-extraction’	Diff. pre-separations of solids/aerosols ‘dust-extraction’ & dehumidification	additional Measures against scaling, layering, deposition Online calibration
Benefit	Simple equipment Sample storable & transport	Sample storable & transport (heavy eqipment)	Quasi continous result reporting	All in real time
COSTS	**Very low**	**medium**	**high**	**Very high**

Results from the questionnaire 2013 copenhagen

- About the application of CEN / TS
- For topics of webinars

Participants workshop 2013 and near feedback (08/2013); 22 institutions particibated

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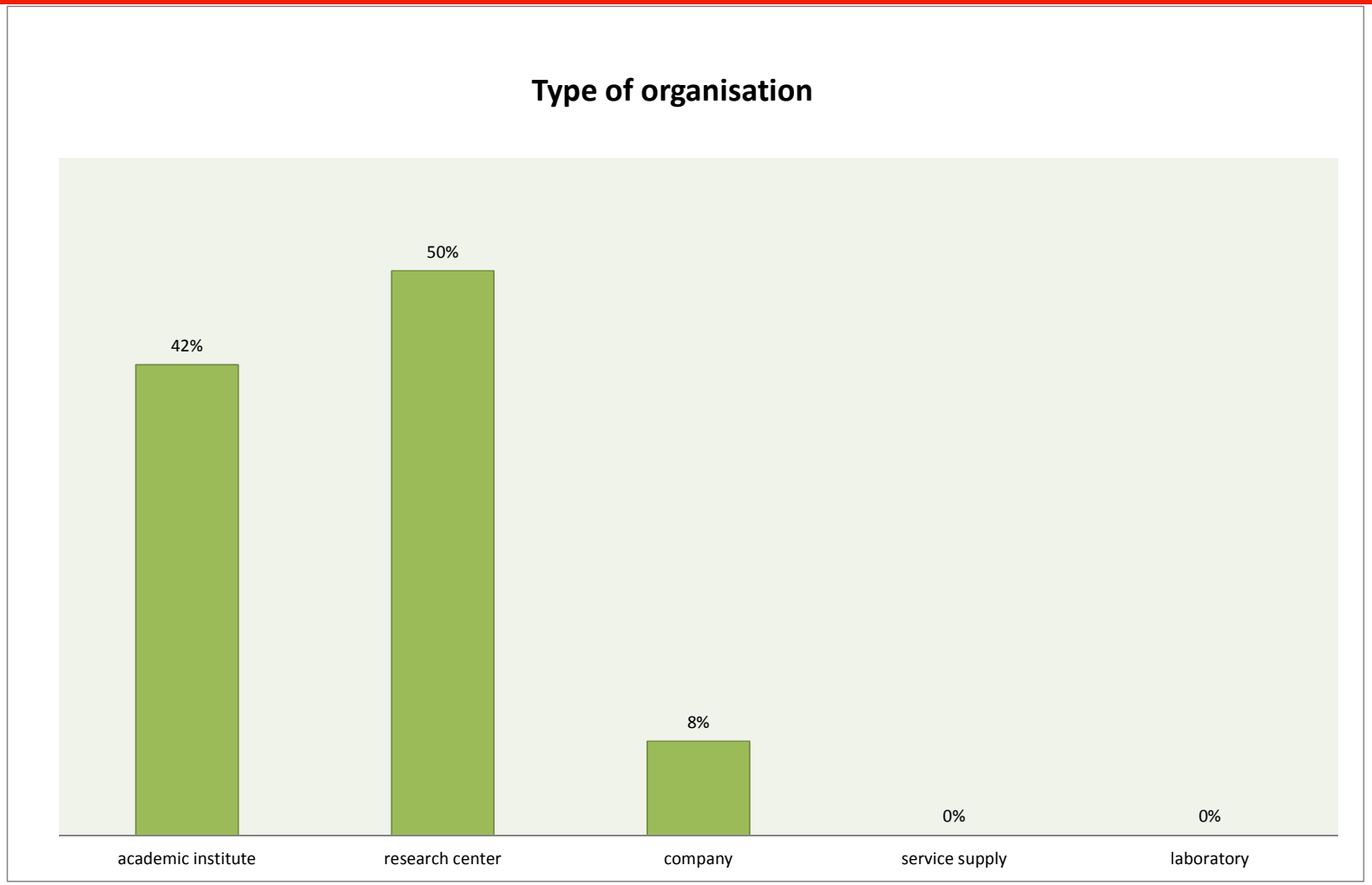
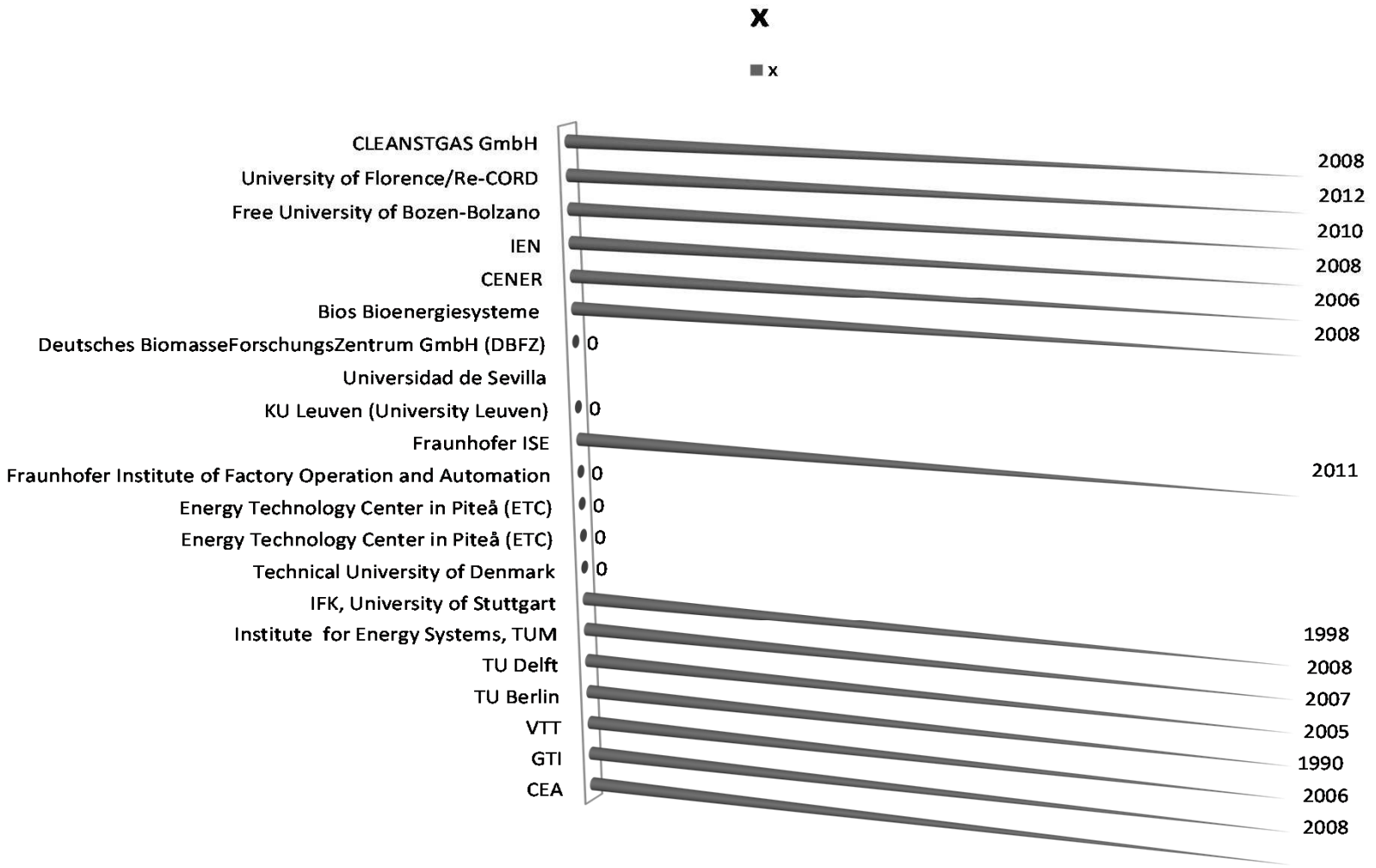
							Type of organisation				
Name	Address	Group or working area inside this institution	(Name) person in charge	Person, has answered the poll	Person, wants to be contacted for future	internals/externals	academic institute	research center	company	service supply	laboratory
ECN	Netherlands	Biomass: SNG, gasification, gascleaning		Johan Knipers	Johan Knipers			x			
CEA	Grenoble 17, rue des Martyrs 38054 Grenoble, France	UTEN/DTBH/LTB	Françoise Defoort	Françoise Defoort	Françoise Defoort		x	x			
GTI	Chicago, USA	Energy Conversion	Rachid Slimane/ Karen Crippen	Rachid Slimane	Rachid Slimane			x			
VTT	P.O.BOX 1000, FI-02044VTT, Finland	Gasification, Pyrolysis	Matti Reinikainen	Matti Reinikainen	Matti Reinikainen			x			
TU Berlin	Fasanenstr. 89, D-10623 Berlin	fluidized bed gasification/ online gas analysis	York Neubauer	York Neubauer	York Neubauer		x				
TU Delft	Leeghwaterstraat 44, 2628CA Delft, Netherlands	Energy Technology section		Wiebren de Jong	Wiebren de Jong, George Tsalidis		x				
Institute for Energy Systems, TUM	Boltzmannstrasse 15, 85748 Garching			Sebastian Fendt	Sebastian Fendt		x				
IFK, University of Stuttgart	Pfaffenwaldring 23, 70569 Stuttgart, Germany	Department of Decentralized Energy Conversion (DEU), Gasification working Group	Andreas Gredinger, Heiko Dieter	Andreas Gredinger	Andreas Gredinger		x				
Technical University of Denmark	Risø Campus, Building 313,DK-4000 Roskilde	Gasification Group	Zsuzsa Sárossy	Helge Egsgaard, Zsuzsa Sárossy	Helge Egsgaard, Zsuzsa Sárossy		x				
Energy Technology Center in Piteå (ETC)	Box 726 94128 Piteå, Sweden		Magnus Marklund	Ann-Christine Johansson				x			
Energy Technology Center in Piteå (ETC)	Box 726 94128 Piteå, Sweden		Magnus Marklund	Olov Öhrman				x			
Fraunhofer Institute of Factory Operation and Automation	Sandtorstraße 22, 39106 Magdeburg	Process and Plant Engineering	Torsten Birth (Theme); Dr. Gohla (Department)	Torsten Birth	Torsten Birth (torsten.birth@iff.fraunhofer.de)			x			
Fraunhofer ISE		Energy Technology	Thomas Aicher	Luisa Burhenne				x			
KU Leuven (University Leuven)	Celestijnenlaan 300c - box 2421, 3001 Leuven, Belgium	Department of Mechanical Engineering-Applied Mechanics and Energy Conversion Section		Anouk Bosmans	Anouk Bosmans		x				

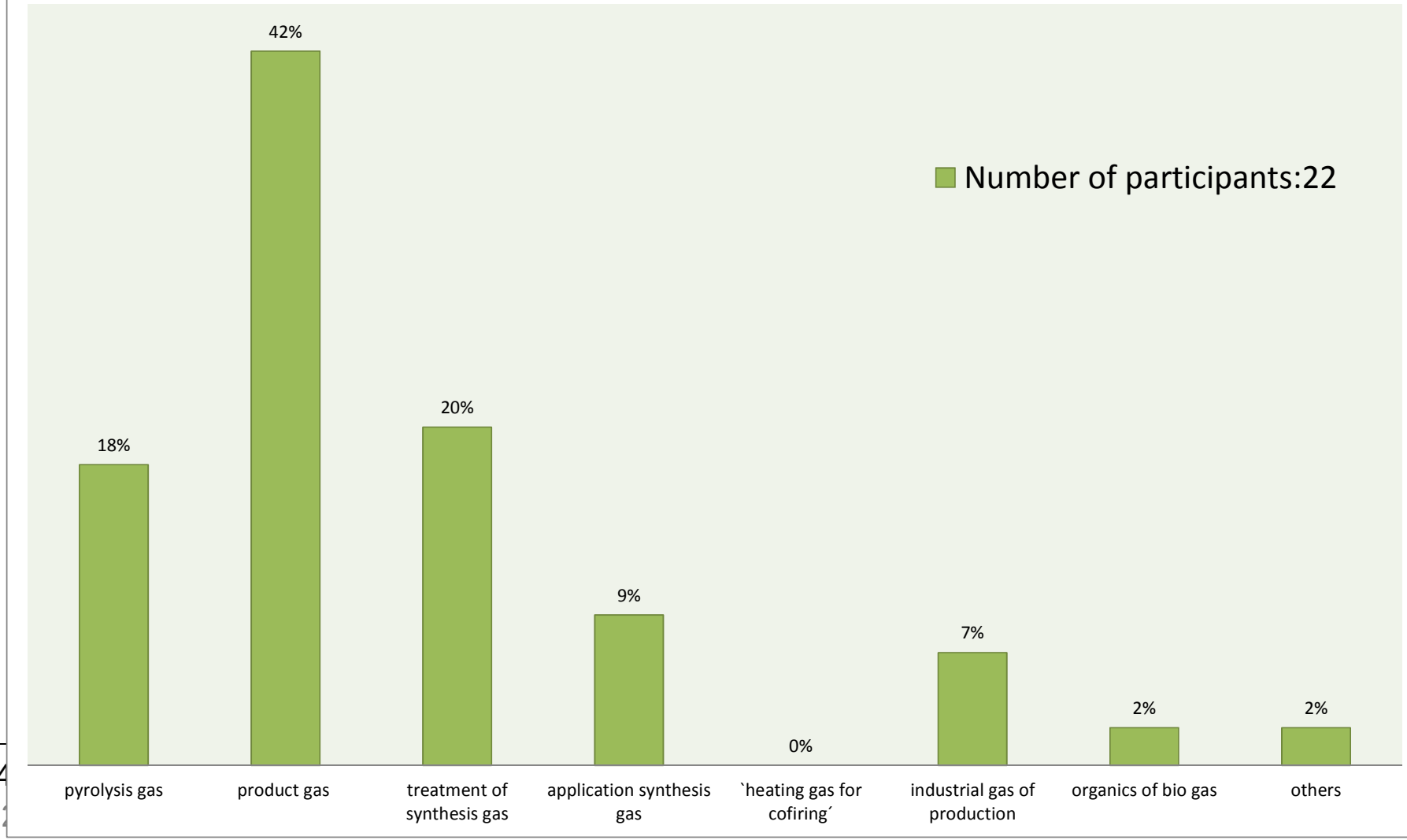
Result questionaire: Profile of voters



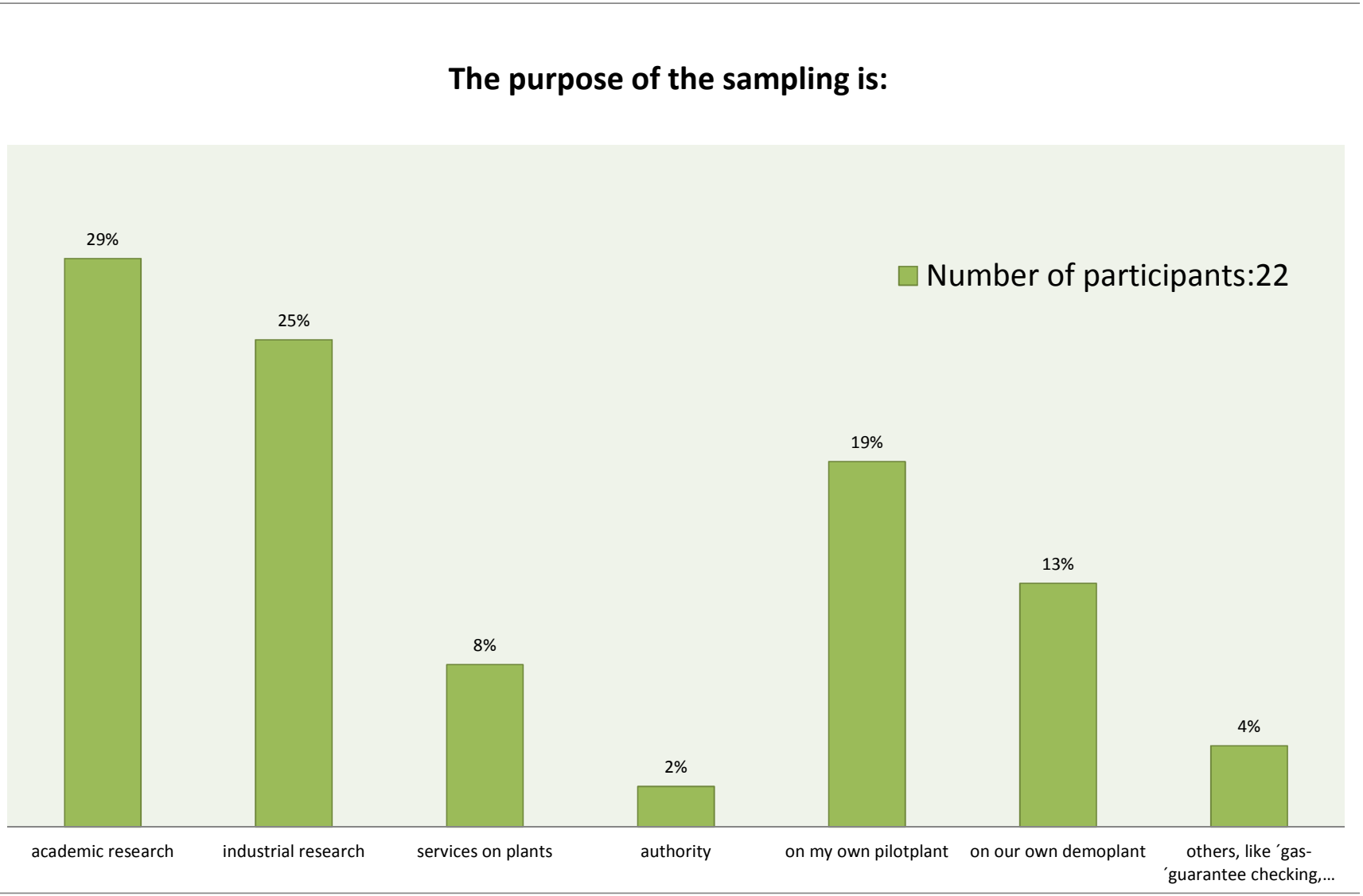
Result questionaire: activity of voter since



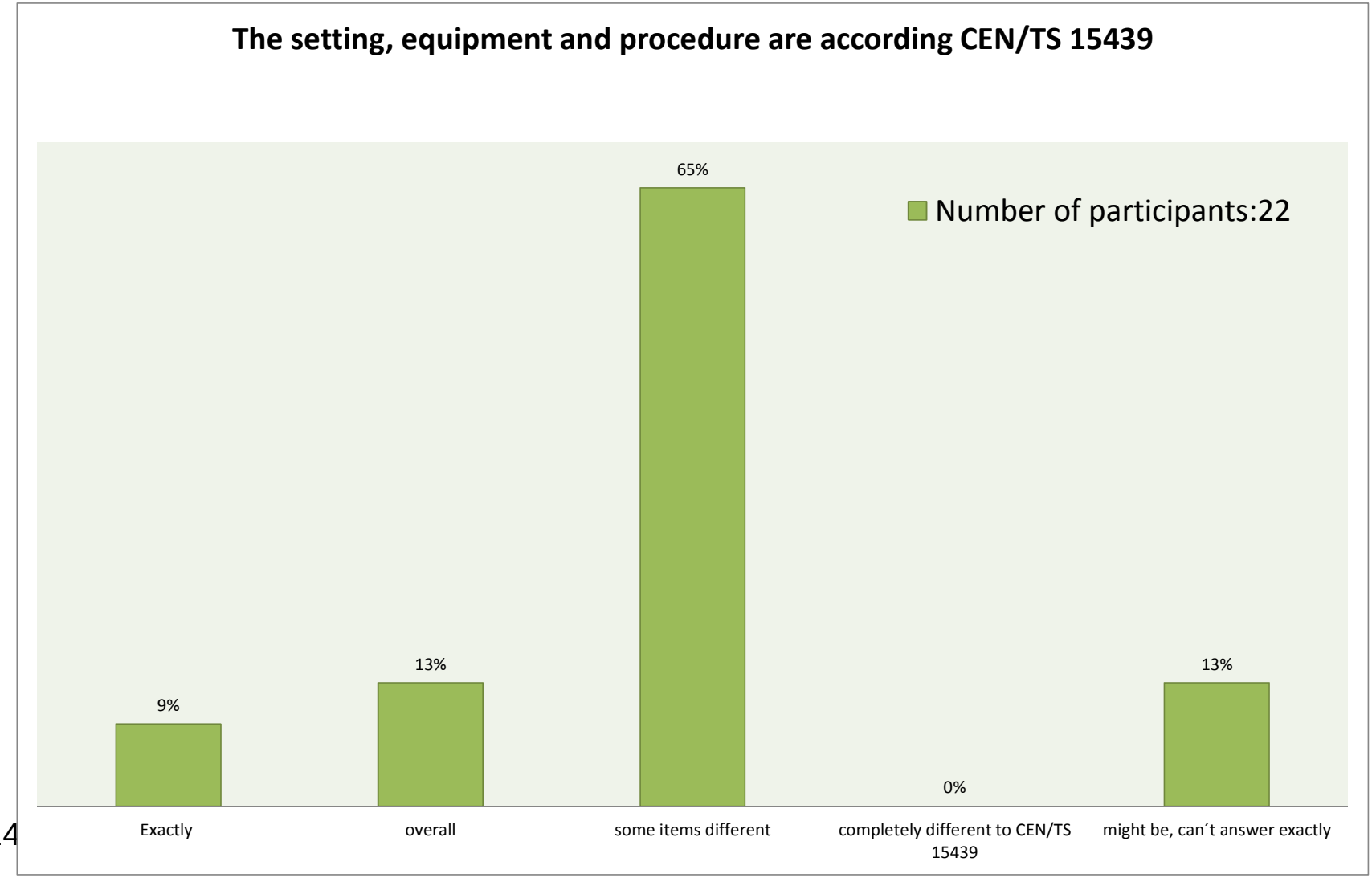
Result questionaire: sampling is used for…



Result questionaire: activity is done for purpose



Result questionaire: equipment used



discussion

- Protocol of main facts:

- 1.
- 2.
- 3.
- 4.
- 5.