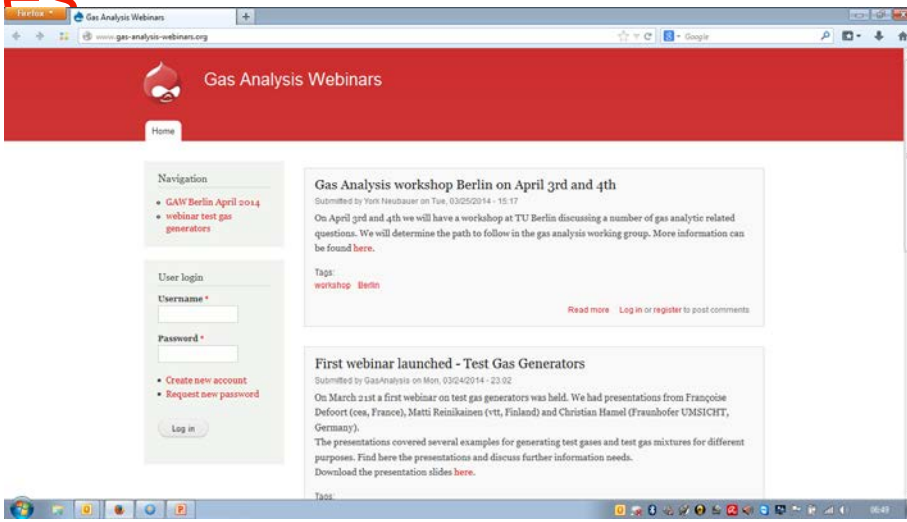
bioenergy2020+

Comparative evaluation of different measurement approaches



Markus Kleinhappl Bioenergy2020+

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

Workshop Berlin
3. and 4. th April Berlin

innovations kompetenz

Content

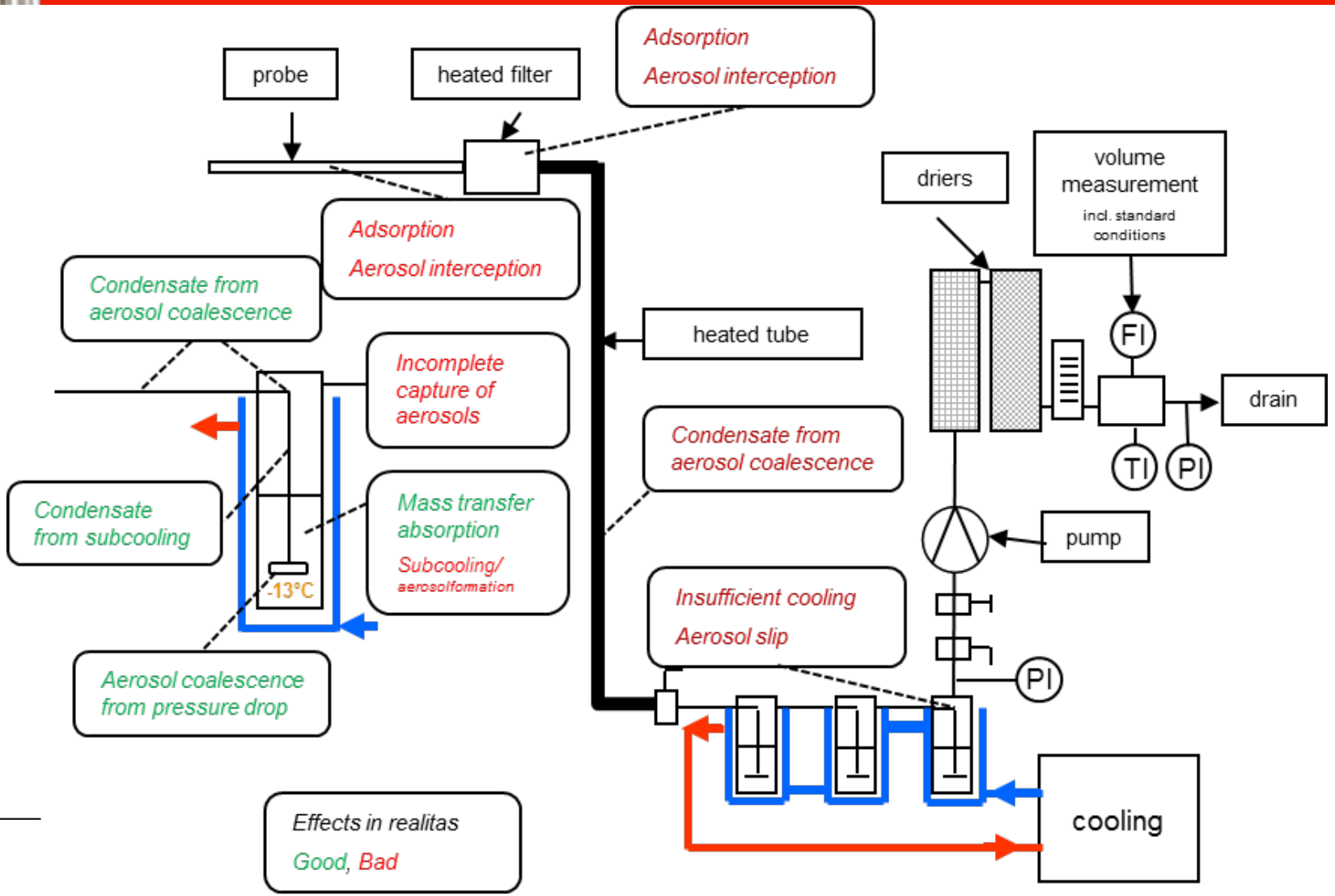
- Targets / yesterday presented
- Degree of difficulties / yesterday presented
- Results from review 2013 / Copenhagen
- Reference applications

  Gasifier-equipment-suggestion on sampling/analysis-degree of difficulties

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
			Sufficient stable points, average/shift	Result protocol
Type of result	Many points, continuous curve	Many points, continuous curve		Plant control
Labour expectations	Expert from lab. familiar with all equipment	Expert from lab. available	~~External expert~~ contacted	a) automated: continuously
		Practical expert knowledge recommended	Practical expert knowledge recommended	b) Periodically from external experts
Expert knowledge	Practical expert knowledge			Expert from service & maintenance, calibration, quality control.
Automation	Sample switching	Sample switching	Sample switching	Automated = online
	Control, Diff. software applications	Control, Diff. software applications	Control, via full plant control or offline devices	Quality procedures

Effects all over the sampling line



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	**online**: Multiply x 10	**online**: Multiply x 5	
400 →3	<100 →2	<40 →1	<100 →1			
200 → 2	<10 → 1	<10	<10	**Pressure**:*) Multiply x p[bar]/10	**Pressure**:: Multiply x p/10	
ambient	<1	<0°C	<1			
°C	mg/m³	dewpoint local pressure	mg/m³ dewing			

Pressure:*) *factor for extractive sample preparation*

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

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 equipment)	Quasi continuous result reporting More data	All in real time Much more data High frequency monitoring
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 participated

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 300a - box 2421, 3001 Leuven, Belgium	Department of Mechanical Engineering-Applied Mechanics and Energy Conversion Section		Anouk Bosmans	Anouk Bosmans		x				
Universidad de Sevilla	Universidad de Sevilla, Escuela Superior de Ingenieria, Dep. Ingeniería Química y Ambiental	Gasification of biomass and waste		Susanna Nilsson			x				
Deutsches BiomasseForschungsZentrum GmbH (DBFZ)		Syngas	André Herrmann	Michael Kröger	André Herrmann			x			
Bios Bioenergiesysteme	Inffeldgasse 21b, 8010 Graz, Austria	Research Group		Christoph Mandl	Christoph Mandl				x		
CENER	Ciudad de la Innovación, nº 7 · 31621 Sarriguren (Navarra) · Spain	The CENER Biomass Department	Mr. Gil	Mr. Gil	Mr. Gil			x			
IEN	Warsaw, Poland	Gasification of biomass and waste	Marcin Siedlecke	Marcin Siedlecke	Marcin Siedlecke			x			
Free University of Bozen-Bolzano	Piazza Universita, 5-39100 Bolzano-Italy. Universitätsplatz, 5-39100 Bozen	Technical Physics Group	Marco Baratieri	Marco Baratieri	Marco Baratieri		x				
University of Florence/Re-Cord	Via Valfonda 40, 50134 Firenze Italy		Andrea Maria Rizzo (andreamaria.rizzo@unifi.it)	David Chiaramonti, Andrea Maria Rizzo	Andrea Maria Rizzo		x	x			
CLEANSTGAS GmbH	Industriestrasse 12, 8321 St.Margarethen an der Raab, Austria	Chemical laboratory, R&D	Dr. Peter Haselbacher	Dr. Peter Haselbacher	Dr. Peter Haselbacher	e			x		

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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			
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Institute for Energy Systems, TUM	Boltzmannstrasse 15, 85748 Garching			Sebastian Fendt	Sebastian Fendt		x				
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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 300a - box 2421, 3001 Leuven, Belgium	Department of Mechanical Engineering-Applied Mechanics and Energy Conversion Section		Anouk Bosmans	Anouk Bosmans		x				
Universidad de Sevilla	Universidad de Sevilla, Escuela Superior de Ingenieria, Dep. Ingeniería Química y Ambiental	Gasification of biomass and waste		Susanna Nilsson			x				
Deutsches BiomasseForschungsZentrum GmbH (DBFZ)		Syngas	André Herrmann	Michael Kröger	André Herrmann			x			
Bios Bioenergiesysteme	Inffeldgasse 21b, 8010 Graz, Austria	Research Group		Christoph Mandl	Christoph Mandl				x		
CENER	Ciudad de la Innovación, nº 7 · 31621 Sarriguren (Navarra) · Spain	The CENER Biomass Department	Mr. Gil	Mr. Gil	Mr. Gil			x			
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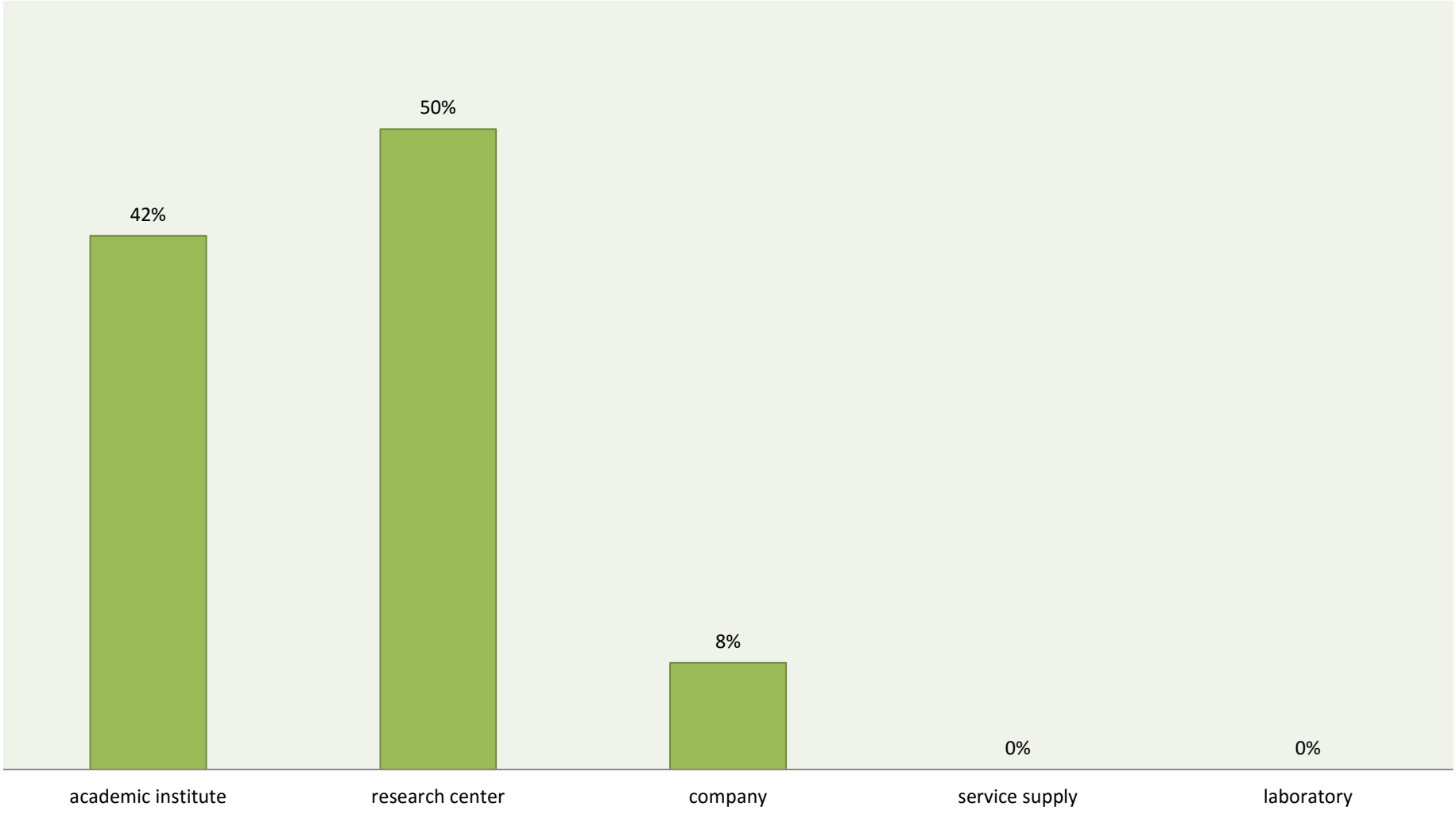
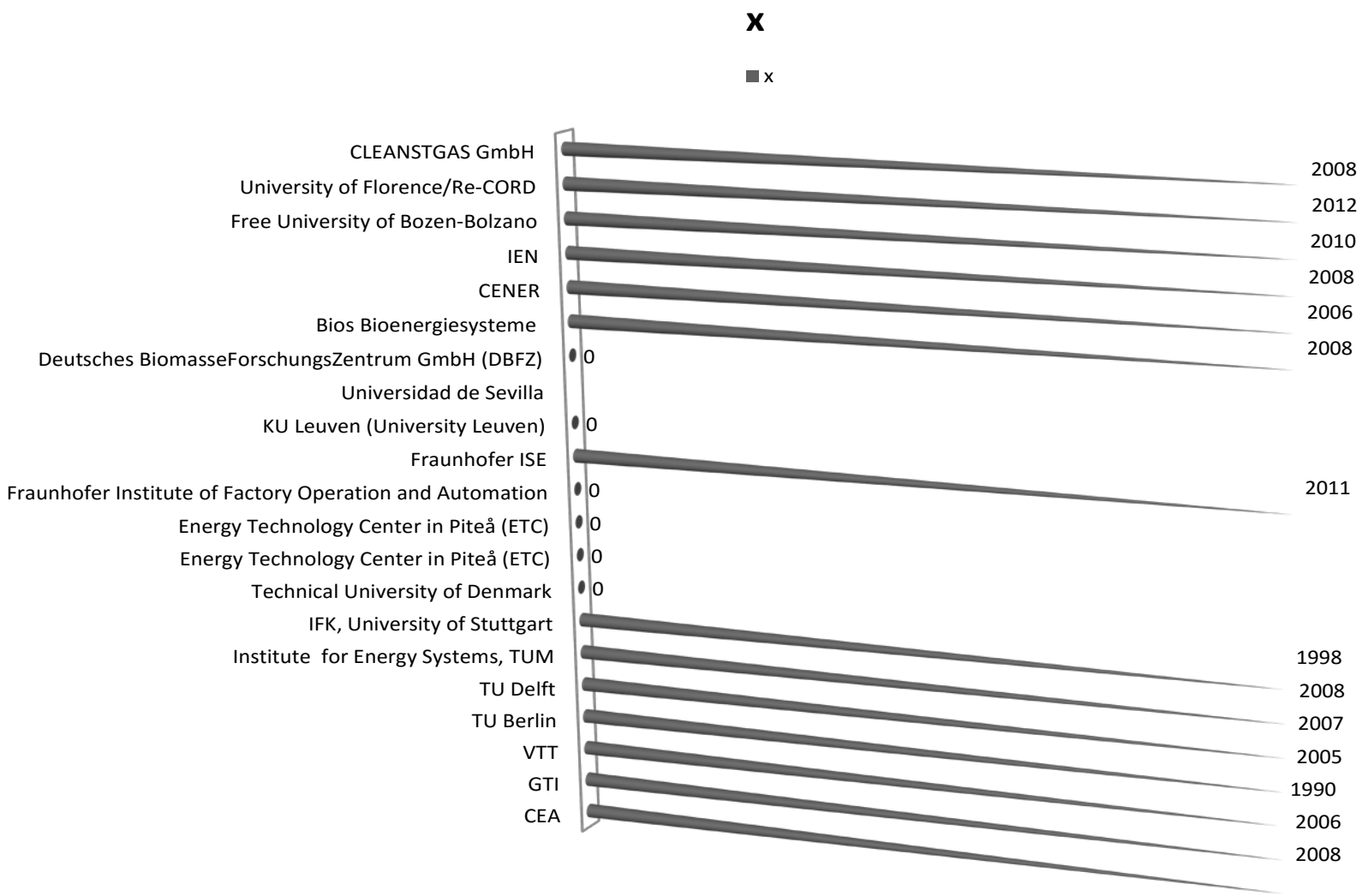
University of Florence/Re-CORD	Viale Morgagni 40, 50134 Firenze Italy		Andrea Maria Rizzo (andreamaria.rizzo@unifi.it)	David Chiaramonti, Andrea Maria Rizzo	Andrea Maria Rizzo		x	x			
CLEANSTGAS GmbH	Industriestrasse 12, 8321 St.Margarethen an der Raab, Austria	Chemical laboratory, R&D	Dr. Peter Haselbacher	Dr. Peter Haselbacher	Dr. Peter Haselbacher	e			x		

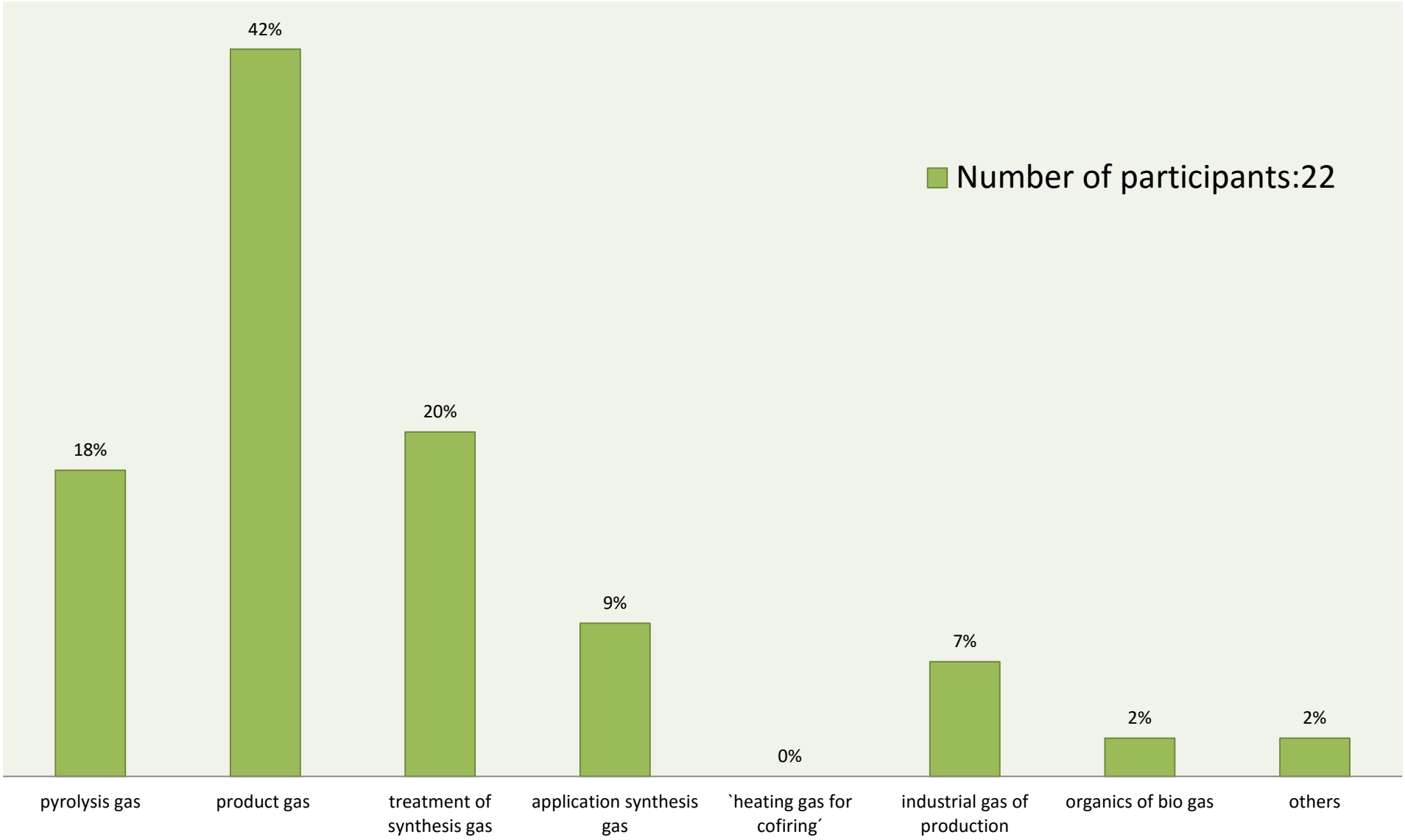
Type of organisation



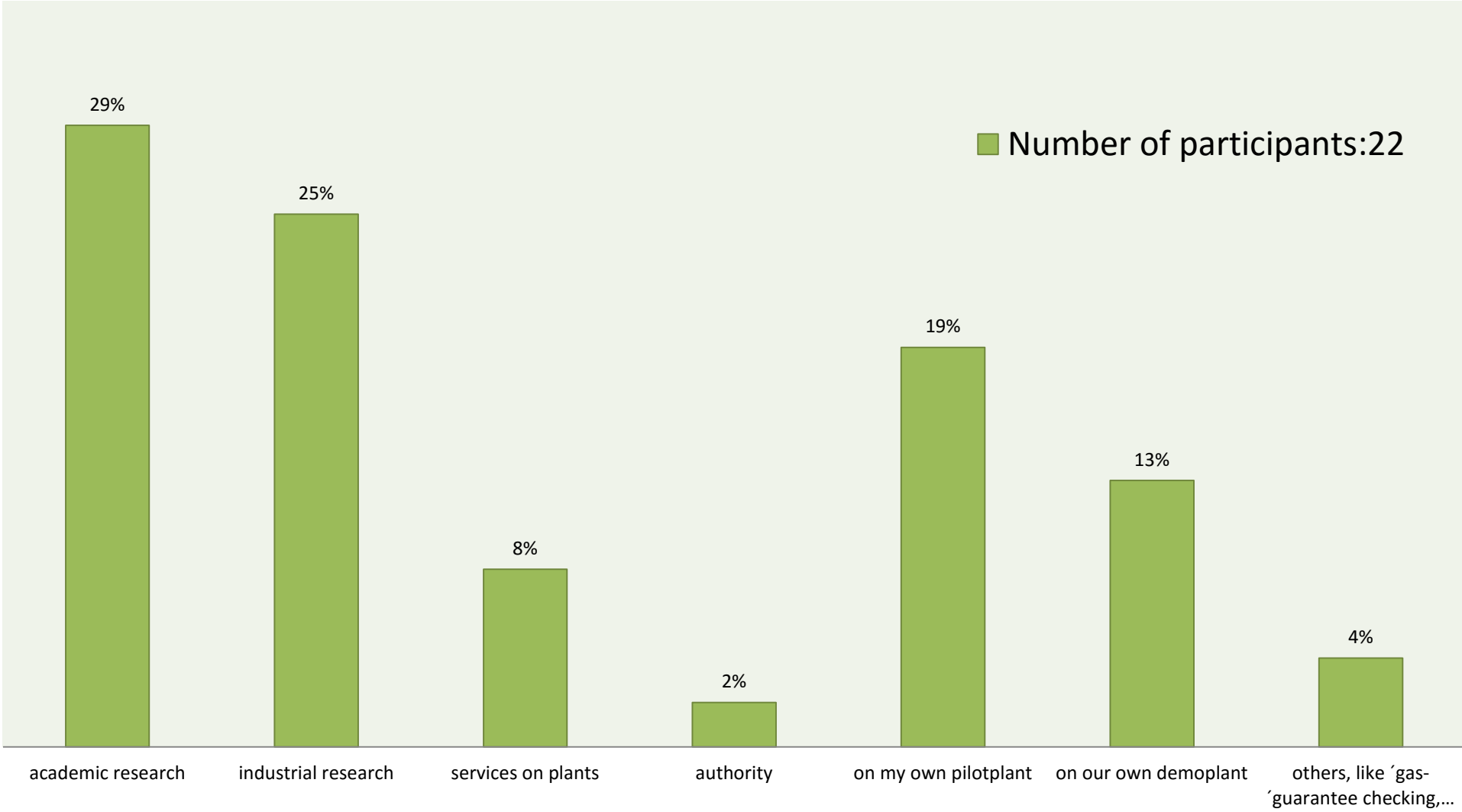
Result questionaire: activity of voter since



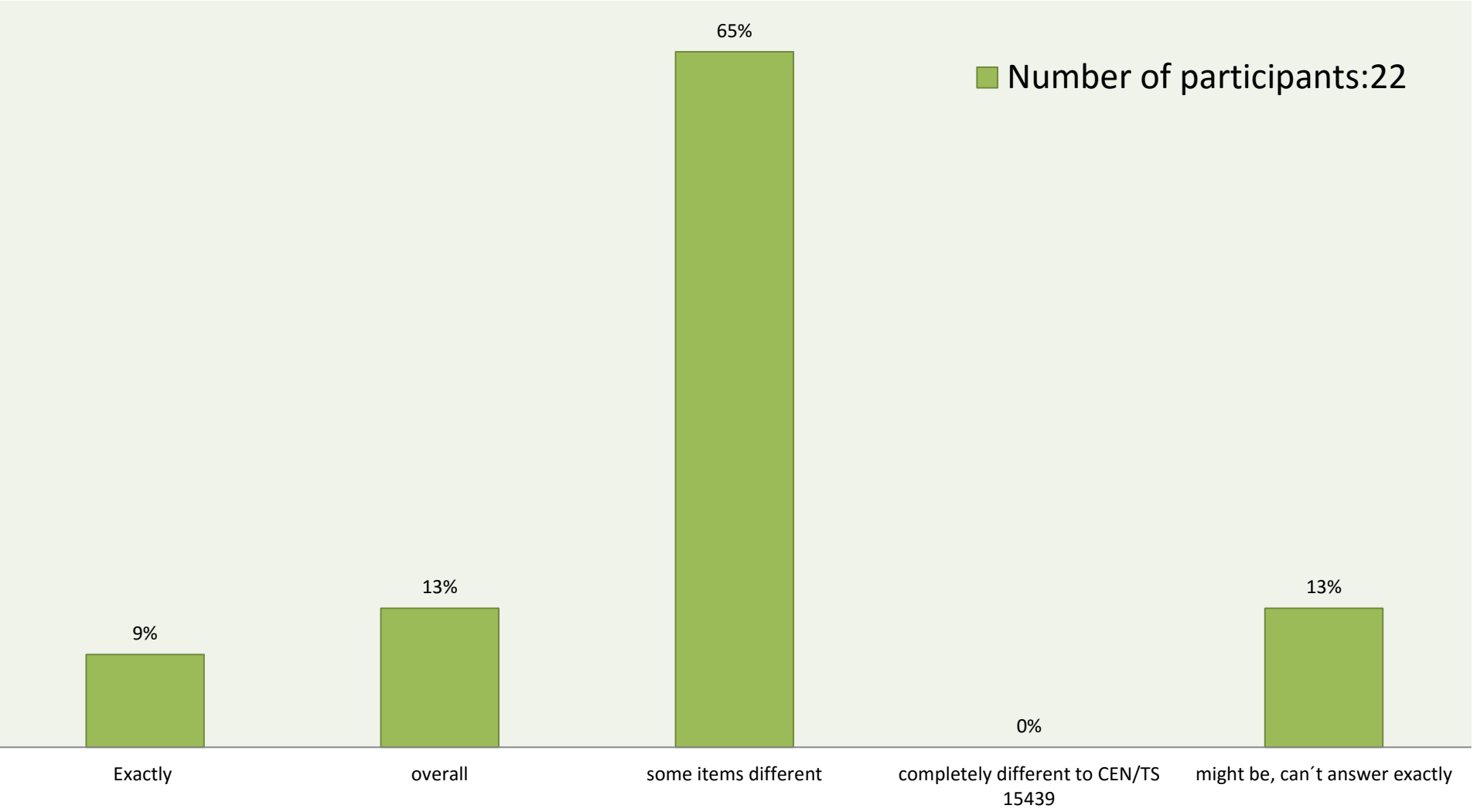
The sampling/analysis procedure is used for:



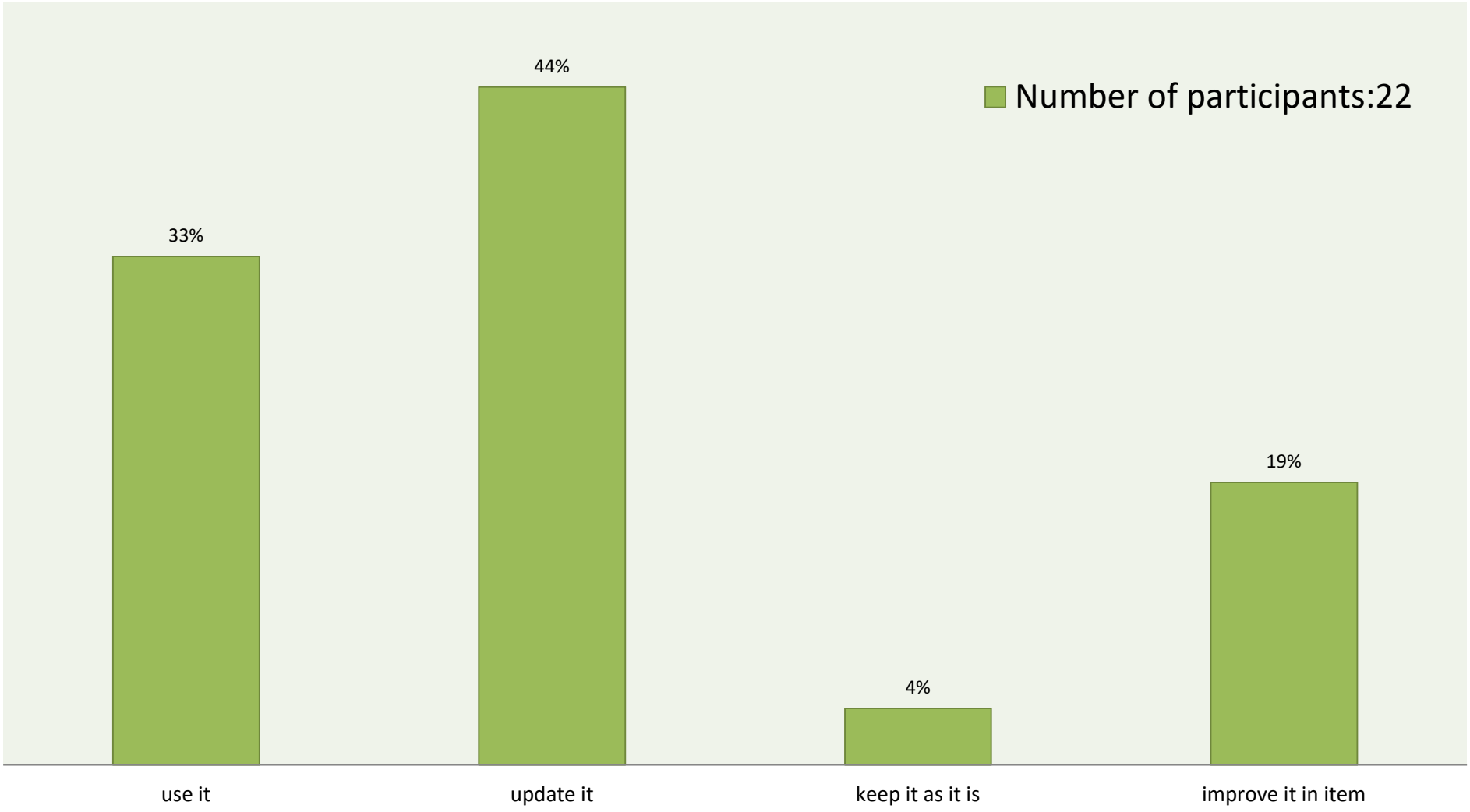
The purpose of the sampling is:



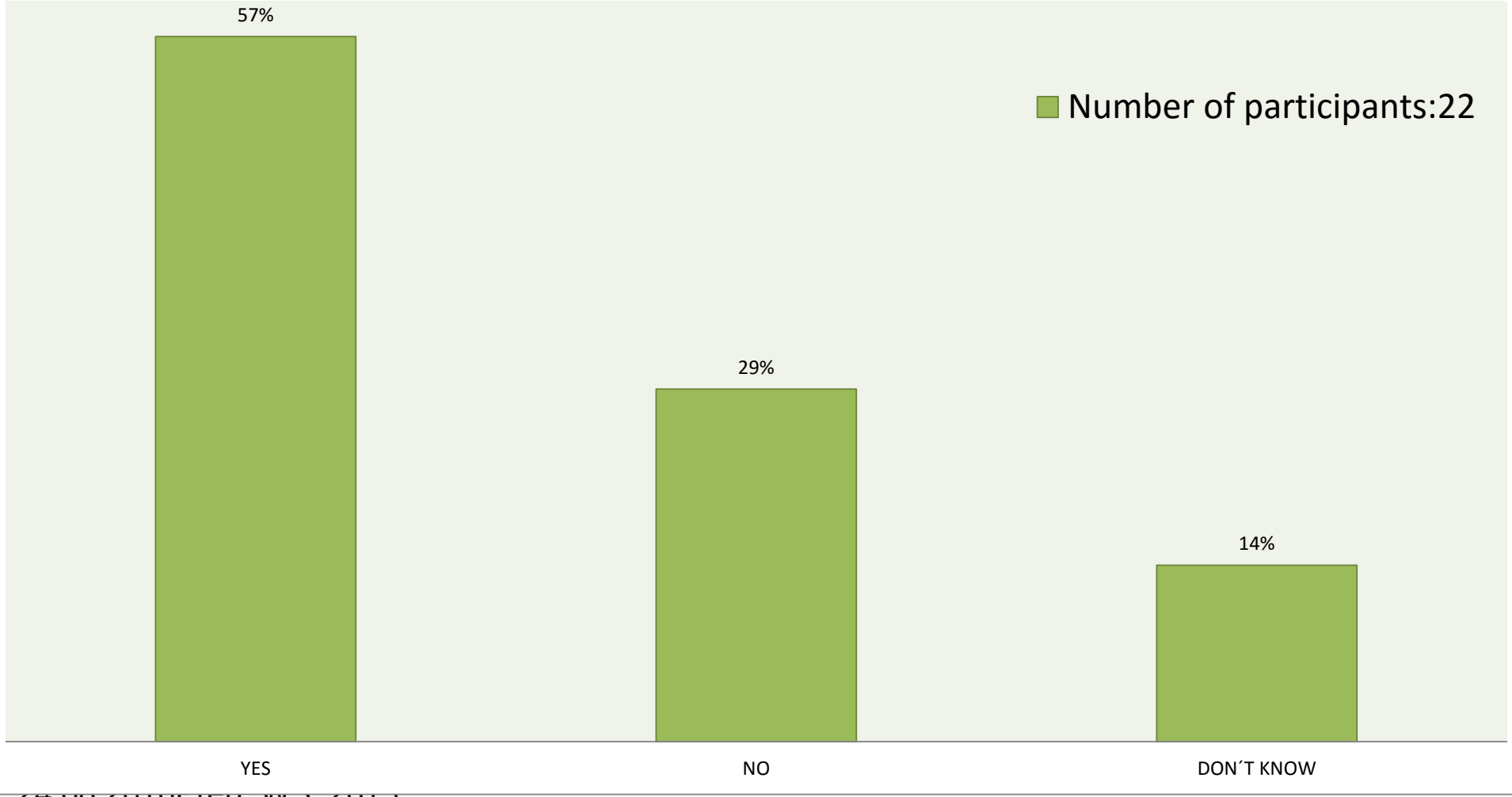
The setting, equipment and procedure are according CEN/TS 15439



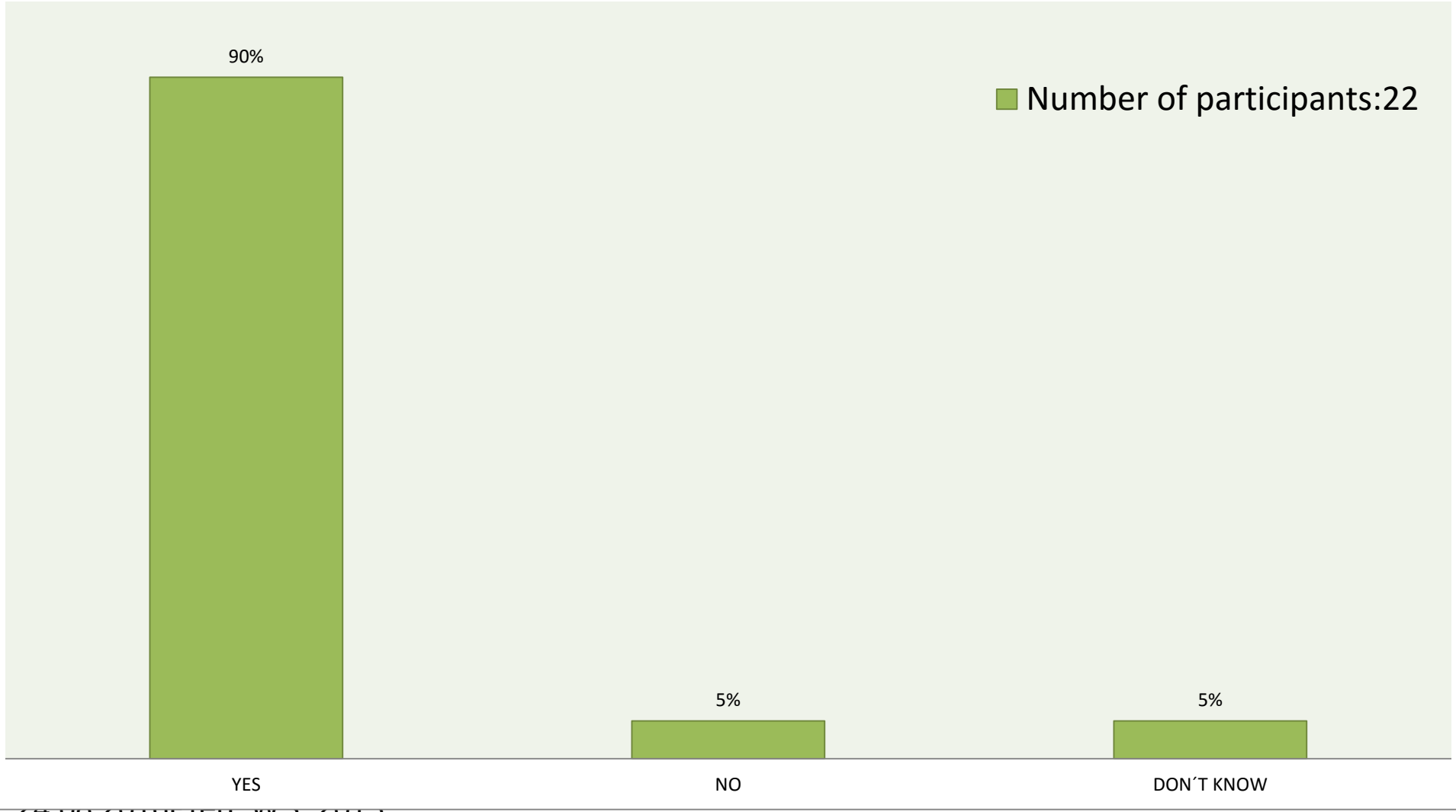
What are your future expectations about this CEN/TS



Do you want to report about your experience in detail of sampling/analysis (accum. methods)



Involvement: We want to be involved into the further update activities



Ref. application: Gasengine at staged gasifier

Status of plant:

Pilot plant well developed

	Staged gasifier	***Gas clean up***	***Gas engine***	***Exhaust treatment***
Parameter	PAH,	Dust BTXE, PAH,		
Frequency	1/shift	1/shift		
Parameter	Dust BTXE, PAH, NH3	BTXE, PAH, NH3 Volatile mineral matter	BTXE, PAH, CO+NOx	BTXE, PAH CO+NOx
Frequency	1/new fuel	1/new fuel	1/year	1/year

Technology: manual sampling (CEN/TS) or
LL like PSI is fixed installed for sampling, but analysis is offline
no continuously detection system applied.

Degree of difficulties:	TF+DF+WF+OF 4+3+2+0=9	0+3+1+1 =5	4+1+2+1 =8	0+1+2+1=4
Online-version::	(90)	(50)	(40)	(40)

Ref. application: fluidised be gasifier for SNG

Status of plant:

Pilot plant well developed

	Gasifier	***Gas clean up I***	***Syngas treatment (=Gas clean up II)***	***Synthesis and ancillary equipment***
Parameter	PAH,	Dust BTXE, PAH, H2S, NH3	H2S, NH3 Total sulfur	CO CH4 CO2
Frequency	1/shift	1/shift	**1/h** H2S: continuously	continuously
Parameter	Dust BTXE, PAH, NH3	BTXE, PAH, H2S NH3 Volatile mineral matter Total sulfur	Dust BTXE, PAH HCN	BTXE, PAH Total sulfu
Frequency	1/new fuel	1/new fuel	**1/shift**	1/month

Technology: manual sampling (CEN/TS) or
LL like PSI is fixed installed for sampling,
And some parameter also online

Degree of difficulties:	TF+DF+WF+OF 4+5+3+3=15	2+1+2+1=6	0+0+0+2 =2*)	0+0+0+2=2*)
			**) Because rather low concentrations must be monitored*	
Online-version::	(150)	(60)	2x5=10	2x5=10

Ref. application: entrained flow under pressure, MeOH-Plant

Status of plant:

commercial

	Pressurised gasifier	***Gas clean up I***	***Syngas treatment (=Gas clean up II) HTS,..***	***Synthesis and ancillary equipment***
Parameter	PAH,	Dust BTXE, PAH, H2S, *continuously*	H2S, NH3 Total sulfur	CO CH4 CO2 H2 Σ INERTS (N2)
Frequency	1/shift	NH3 1/shift	**1/h** H2S: continuously	continuously
Parameter	Dust BTXE, PAH, NH3	BTXE, PAH, H2S NH3 Volatile mineral matter Total sulfur	Dust BTXE, PAH HCN Hg / Mercury	H2S Total sulfur
Frequency	1/new fuel	1/new fuel	**1/shift**	**1/h automated** Mercury Hg, As P **1/month**

Technology: manual sampling (CEN/TS) or
LL like PSI is fixed installed for sampling, but analysis is offline
essentials: continuously detection systems are applied.

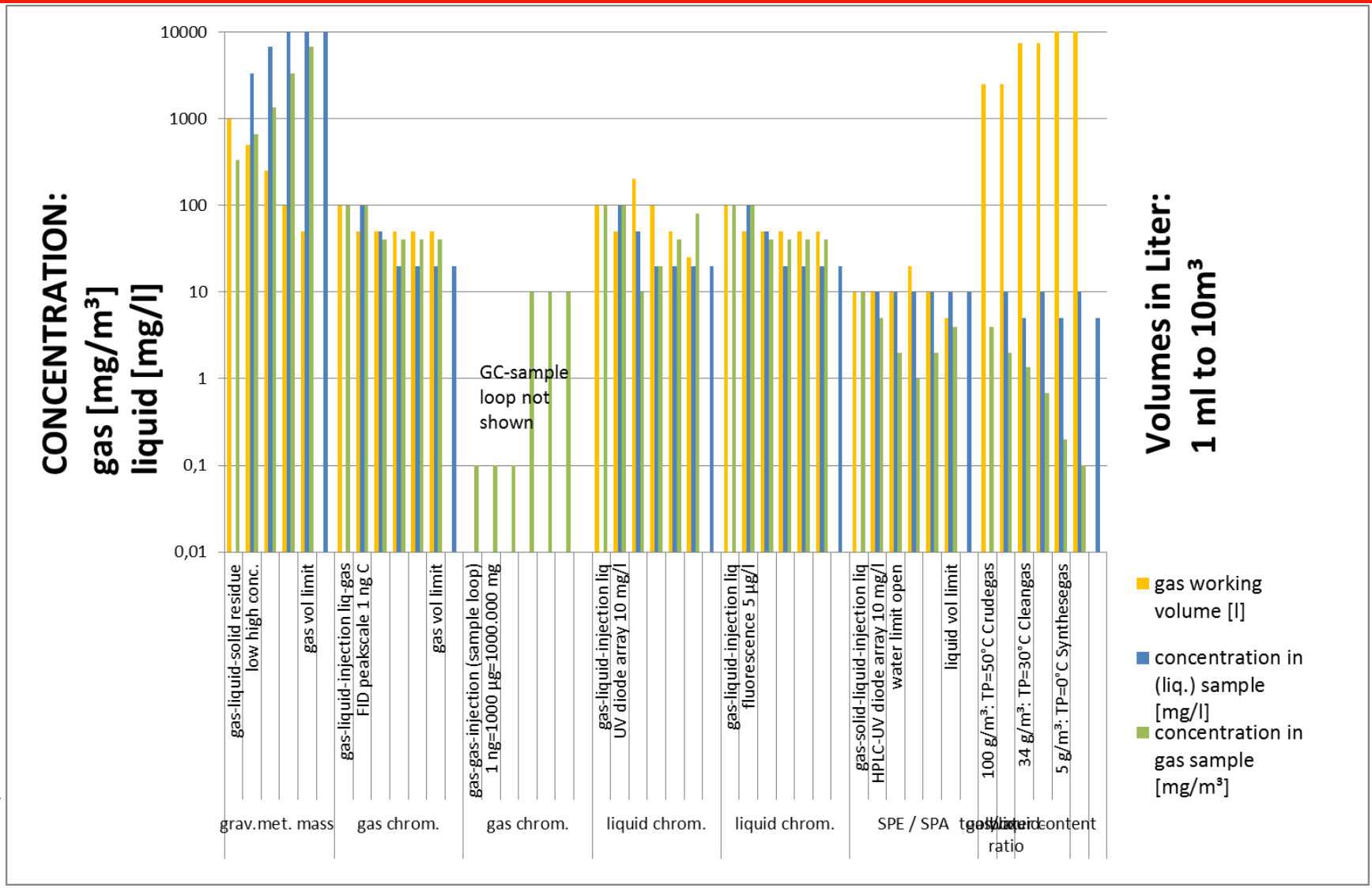
Degree of difficulties:	TF+DF+WF+OF 4+5+3+2=14	0+1+1+1 =3	2+1+1+2*) =6	0+1+2+2*)=5
Pressure factor:	# x 5=70	# x 5=15	# x 5=30	# x 5=25
Online-version::	(140+70)	30	60	50

discussion

- Protocol of main facts:

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

The gas/liquid ratio



H. Bosch *1450-1516*; *der Gauckler, the faker, il falsario*