



The European Association of the Electricity Transmission
and Distribution Equipment and Services Industry

Gases for Switchgear

2018 , June 12th meeting

François Trichon

Membership information

MEMBERSHIP NEWS

- New members
 - Vincent Hay (ENA)
 - Maik Hyrenbach (ABB)
 - Dirk Uhde (GE)
- New Guest
 - Hervé Vaudray
- New kind of member « associate members »
 - For GFS : Gas producers (Solvay, Inventec, 3M)
 - Can participate on Report, position papers
 - Report must be validated by executive committee of T&D EUROPE
 - Status proposed to the 3 companies

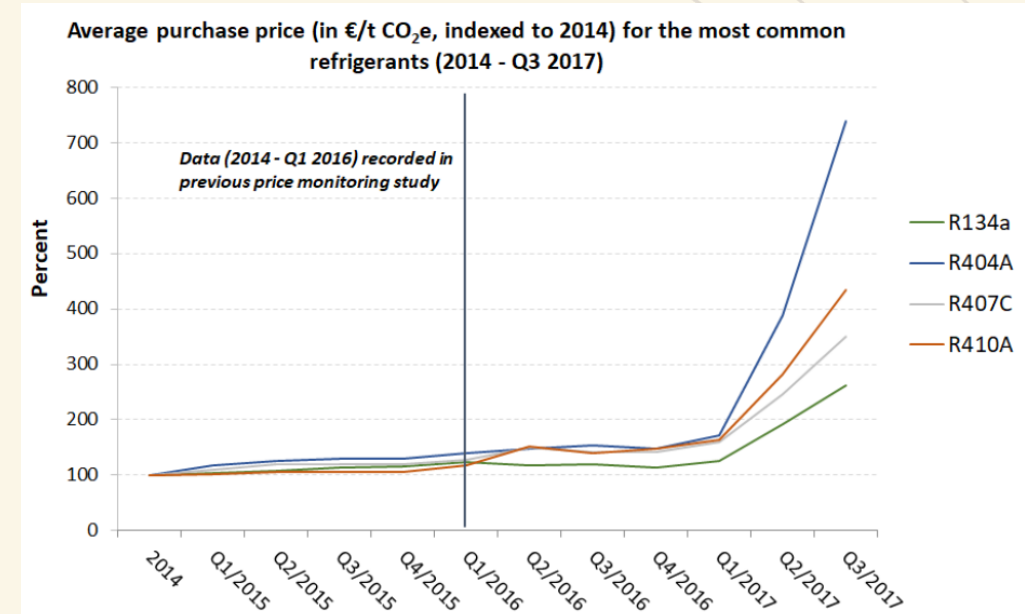
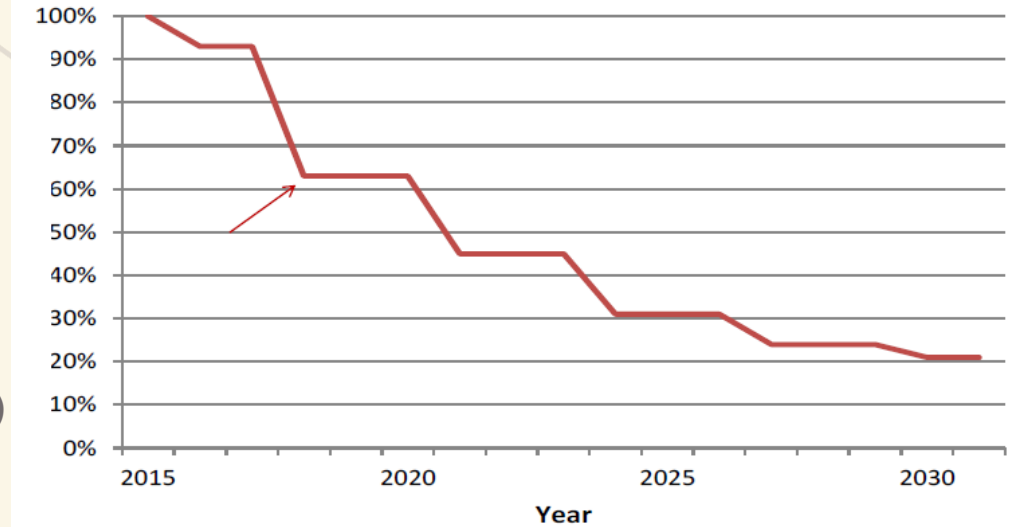
Consultation forum

CONSULTATION FORUM (MARCH 2018)

- Standard setting for flammable refrigerants
 - Most of alternatives are flammables
 - Project LIFE
 - leak analysis (type/causes, laboratory study of leak and gas concentration)
 - improved product safety (redesign)
 - standardisation action & capacity building (procedure of revision just started in countries)
 - communication centre with web site
 - Issue with building codes that forbid the use
- training on personnel for safe handling of alternatives refrigerants
 - Some focus on flammable refrigerants
 - Lots of gases : complexity and lack of skilled people

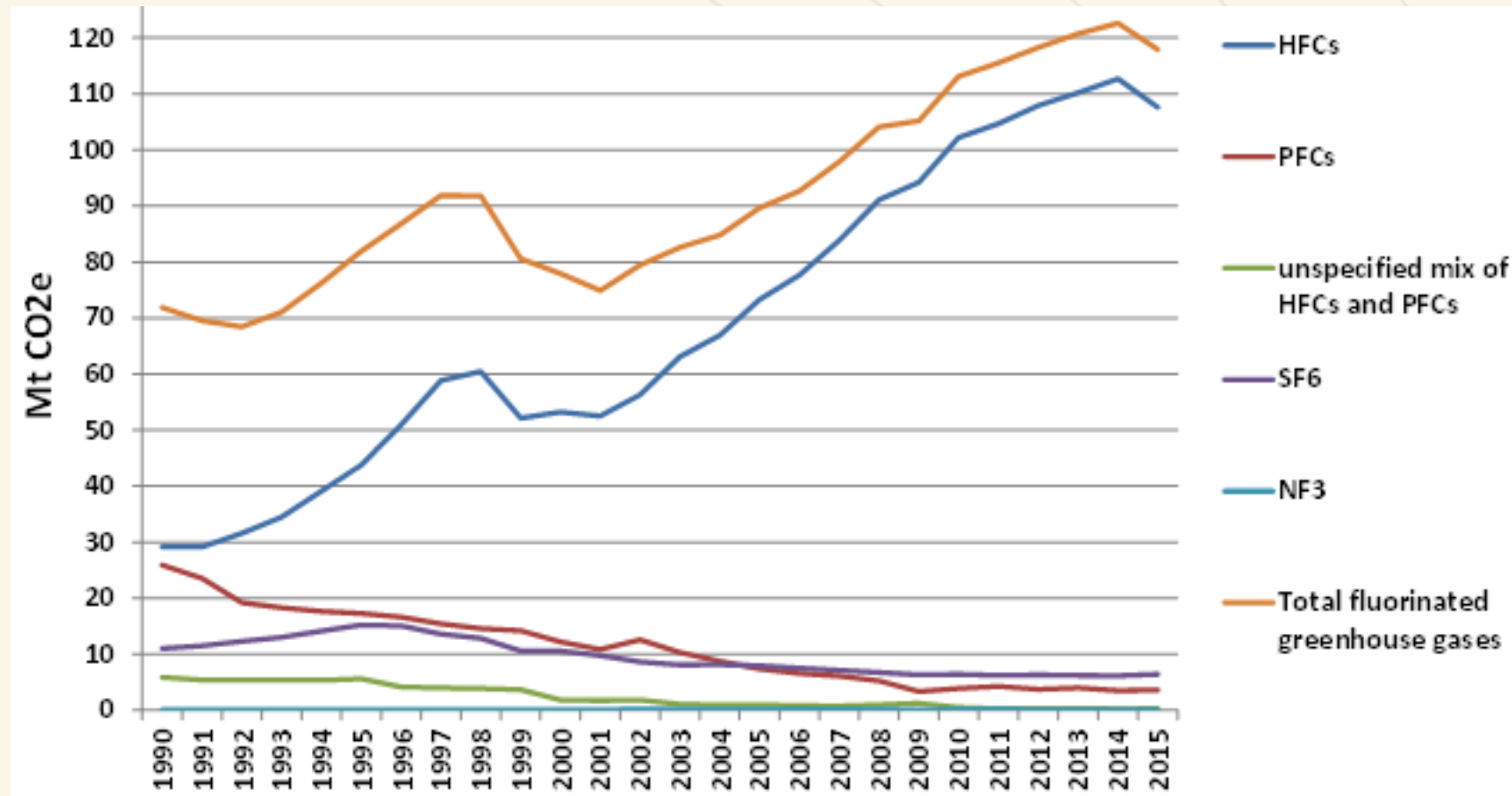
CONSULTATION FORUM

- Progress on HFC phase-down
- Interesting process from EPEE
 - establish a roadmap
 - action for new equipment (low gwp , less refrigerant)
 - action for existing equipment (leak, retrofit)
 - use of reclaimed refrigerant (not yet done)
 - monitoring progress
 - refrigerant in new equipment
 - in existing equipment (Leakage , supermarket)
 - low start of retrofit (too slow than expected)
 - reclaim and recycling (very difficult to get the data)
 - communication
 - leaflet - all EU language



EEA report

- SF6 accounts for 50% of EU production and exports*



CONSULTATION FORUM (MARCH 2018)

- Illegal trade of HFC
 - Too early to conclude (price has just raised)
- Information on next step
 - report by july 2020 on SF6
 - beginning of next year the work will start with a external consultant
 - December 2018 European Commission call for tender
 - Q1 2019 Award of tender to consultant
 - Q2 2019 Preparation of consultant report
 - Q3 2019 Final consultant report to DG Environment
 - July 2020 European Commission Report

Event in front of EP (7 March 2018)

EVENT IN FRONT OF EP (7 MARCH 2018)



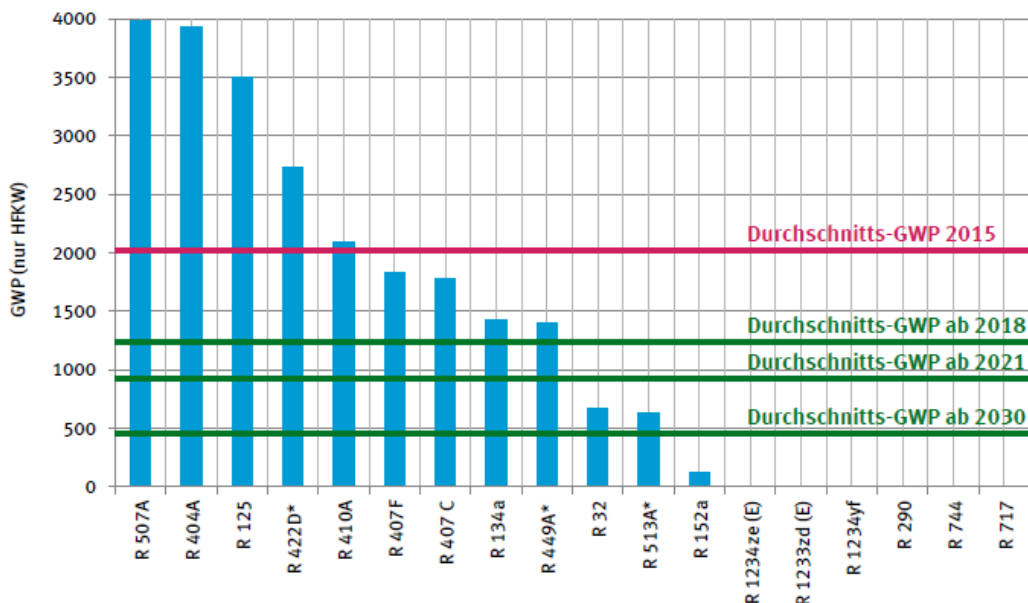
presentations 7th
March



MOM 7th March



- Wanted to be
« ambitious » about SF6



13:00 – 13:15 Opening remarks: Bas Eickhout (MEP, Greens/EFA) & Yvon Slingenberg (EU Commission)

13:15 – 13:45 Panel 1: F-Gas Regulation impact on the Refrigerants sector (HFCs replacement)

Moderator: Bas Eickhout (MEP, Greens/EFA)

Speakers:

- Klara Skacanova, Shecco: Impact of F-Gas Regulation on HVAC&R Industry
- David Schalenbourg, Delhaize: End-user perspective on transitioning away from HFCs
- Joachim Maul, ait-deutschland: Experience from heat pump manufacturer
- Clare Perry, EIA: Challenges around ensuring a smooth transition to low-GWP (natural) refrigerants

13:45 – 14:00 Q&A

14:00 – 14:30 Panel 2: F-Gas Regulation impact on the Energy sector (SF6 replacement)

Moderator: Morten Petersen (MEP, ALDE)

Speakers:

- Dr. Sven Baumann, UBA: Concept for SF6-free transmission & distribution of electricity in Germany
- Rudi Van San, 3M: Development of alternatives to SF6 in the Energy Sector
- Maik Hyrenbach, ABB: Market solutions for SF6 replacement in the MV switchgear
- Philippe Ponchon, GE: Market solutions for SF6 replacement in the HV switchgear
- Maarten Van Riet, Alliander: End-user perspective on transitioning away from SF6 (Utility Sector)

14:30 – 14:45 Q&A

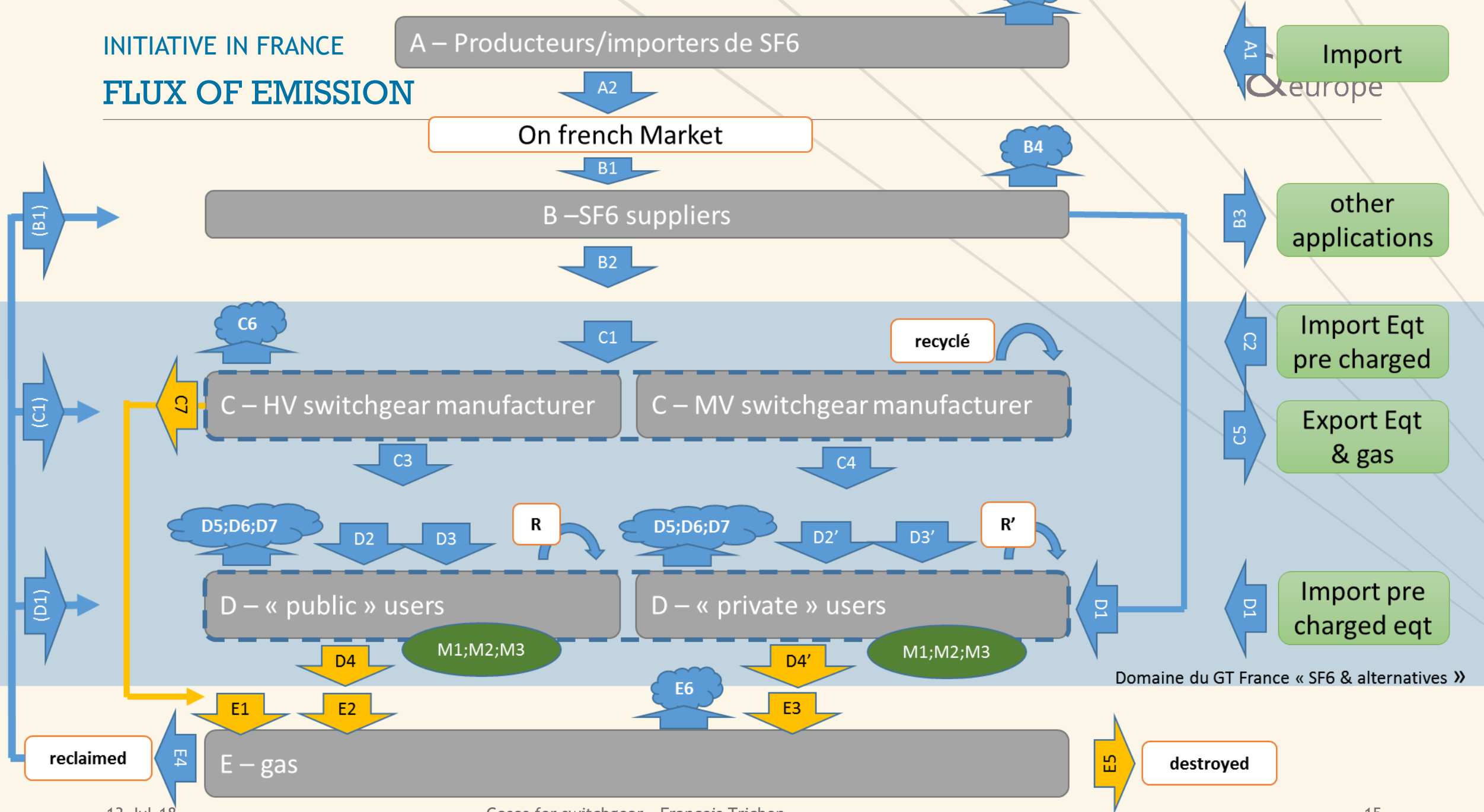
14:45 – 15:00 Closing remarks: Jo Leinen (MEP, S&D) & Yvon Slingenberg (EU Commission)

Initiative in Germany (E. Dullni)

Initiative in France

- Participants
 - DSO (ENEDIS) , TSO (RTE) , Energy provider (EDF)
 - Switchgear Manufacturers (GE, Siemens, Ormazabal, Schneider Electric, ENSTO)
 - Missing : « private » utilities (small DSO), ENGIE,
- Common position to inform French representatives
- Flux of emission (Based on SWISSMEM)

INITIATIVE IN FRANCE
FLUX OF EMISSION



- Introduction
- SF6 emissions from the electricity sector
- State of art and proposals for the high voltage sector
 - Detailed state of arts in High Voltage
 - Inventory of alternatives to SF6 in HV
 - Improvements
 - Existing equipment
 - Future installations (new stations and renewal of equipment on existing structures):
- Proposal for a specific position on the medium voltage (MV) sector
 - Detailed inventory of average voltage.
 - State of art of alternative solutions
- CONCLUSION

- New technology available
 - Investigation on progress
 - Focus on Maintenance , safety of operators
 - Reference on T&D Europe technical report
- Existing equipment
 - No retrofit possible
 - Leakage control and reduction first
 - Replacement of worst situations
- Future installation
 - SF6 free solution to be preferred (by regulation)
 - Use SF6 only in very constrained environment
 - Increase pilot project
 - Warranty GHG : conformity for leakage rate due by manufacturer

COMMON POSITION : MV MAIN POINTS (STILL IN DISCUSSION)

- Primary substations

Voltage level	Architecture	function	Current technology	middle term technology
MV. Primary subs.	AIS	disconnection	Air	Air
		switching	SF6	Vacuum
		Insulation	Air	Air

By 2020 new installation will use Vacuum

- Secondary substation

Voltage level	Architecture	function	Current technology	Long term technology
MV secondary	GIS	disconnection	SF6	Dry air or alternative gas
		switching	SF6	Vacuum, Dry air or alternative gas
		Insulation	SF6	Dry air or alternative gas

There is no cost effective equivalent solution for secondary

- True reduction of emission
- Control on weight of SF6 and reporting to reduce emission in virtuous circle
- Reactivity for reaper in HV
- Track and follow up the banked quantity in MV : register to control the recycling at end of life
- Move to Vacuum technology for MV primary substations
- Next step : (after finalization)
 - Slideware to prepare
 - appointment with the ministry in September at the latest

Action plan VS 2020 assessment

Regulation and standards

Martin Kristoffersen spreadsheet

ACTION PLAN VS 2020 ASSESSMENT

REGULATION AND STANDARDS

	EUROPE	Legislation affecting use of SF6	Political issues potentially affecting use of SF6	Other green movements/CO2 reduction actions	General issues Global Warming NGOs	Current policy measures in place/Historical	Comments
Giovanni Zaccaro	EU	F-gas Regulation	F-Gas Reg report due 1.7.2020				
Giovanni Zaccaro	IT	National Adoption				Check status voluntary agreement	
François Trichon	FR	National Adoption	Initiative in France			Voluntary agreement, expired 2010	
Jose-Manuel Inchausti	ES	National Adoption				Voluntary agreement	
François Trichon	DE	National Adoption	ZVEI Roadmap	Why the EU should ban SF6		Voluntary commitment until 2020	
			Ecofys Study				
			Niedersachsen SF6 ban - status?				
Mike Adams Vincent Hay	UK	National Adoption		SF6-free project initiated by Western Power Distribution			
Yannick Kieffel	CH	National Adoption				Voluntary Agreement	
Martin Kristoffersen	NO	F-gas regulation 517/2014 not yet adopted	NEA study on abatement cost of SF6 equipment	Report cited in trade publications - advocates rapid outphasing of SF6 equipment		Voluntary agreement possibly replaced by Regulation (2018) Reporting handled by	
						Brukergruppen for SF6-anlegg (SF6 user's group) HV	
						RENAS - MV	
Martin Kristoffersen	DK	National Adoption	"Mijøstyrelsen" Proposed ban on SF6 from 2030 abandoned 6/2016	Prepare for EU's announced ban on SF6...			green switching
		Tax increased to DKK 600/kg =< 36 kV exempt					
Martin Kristoffersen	SE	National Adoption					
	Rest of World	Legislation affecting use of SF6	Status political issues potentially affecting use of SF6	Other green movements/CO2 reduction actions	General GW issues NGOs	Current policy measures in place	For comments
Giovanni Zaccaro	South Korea						
Giovanni Zaccaro	South America						

SF6 Roadmap

- Step 1 : Objective definition
 - Define the proposals that T&D Europe want to be written into the new F-Gas regulation.
 - these proposals shall be easy to promote in front of the European Commission.
 - the proposals shall achieve a goal of significant reduction of SF6 emission in Europe.
 - the proposal shall provide workload for T&D manufacturing and services industry in Europe.
- SWOT analysis based on the objectives
- decide the message (step 3 - analyze the SWOT - propose to T&D Europe executive committee)
- Work on the message (step 4) (what we want to achieve / what we want to avoid)
- Work on the narrative (Step 5)
- Lobby (Step 6)

- December 2018 European Commission call for tender
 - Q1 2019 Award of tender to consultant
 - Q2 2019 Preparation of consultant report
 - Q3 2019 Final consultant report to DG Environment
 - July 2020 European Commission Report
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- Q3-4 (possibly) Debate and resolution/conclusions in European Parliament and Council

SF6 ROADMAP – DEFINITION OF OBJECTIVE : PRELIMINARY SELECTION

category	equipment type	technical step		
		Low	medium	high
MV product	12 kV			
	24 kV			
	36 kV and more			
	secondary			
	primary			
	renewable			
	outdoor			
HV product	GIL			
	145 kV			
	outdoor			
	420 kV			
Generator CB	< 50 MVA			
	<150 MVA			
	<300 MVA			
	delayed current zero			
	> 300 MVA			
other	bushings			
	ins. Transform			

- One table for preliminary choice

- Technical step mean research effort to step out SF6. It combines both technical difficulties and R&D amount (k€) and impact on future acceptance (increase in cost , lost on functionalities...)
- Low** : as an example can be MV primary GIS 12 kV dry air or GIL gas mixture
- Medium** : as an example can be MV secondary 24 kV dry air
- High** : as an example can be MV 36 kV secondary/renewable dry air or 420 kV HV GIS

New product installed in Europe

SF6 ROADMAP – DEFINITION OF OBJECTIVE :

category	equipment type	keep SF6	ban & time frame	phase out & time frame	voluntary agreement	funding	export issues (precharged)	reuse gas	SF6 free promotion policy
MV product	12 kV								
	24 kV								
	36 kV and more								
	secondary								
	primary								
	renewable								
	outdoor								
HV product	GIL								
	145 kV								
	outdoor								
	420 kV								
Generator CB	< 50 MVA								
	<150 MVA								
	<300 MVA								
	delayed current zero								
	> 300 MVA								
other	bushings								
	ins. Transform.								

For definition of objective see the word document

New product installed in Europe

SF6 ROADMAP – DEFINITION OF OBJECTIVE :

category	equipment type	EOL constraint	localisation	leakage	Voluntary agreement	retrofit case
MV product	12 kV					
	24 kV					
	36 kV and more					
	secondary					
	primary					
	renewable					
	outdoor					
HV product	GIL					
	145 kV					
	outdoor					
	420 kV					
Generator CB	< 50 MVA					
	<150 MVA					
	<300 MVA					
	delayed current zéro					
	> 300 MVA					
other	bushings					
	ins. Transform.					

For definition of objective see the word document

IEC activities

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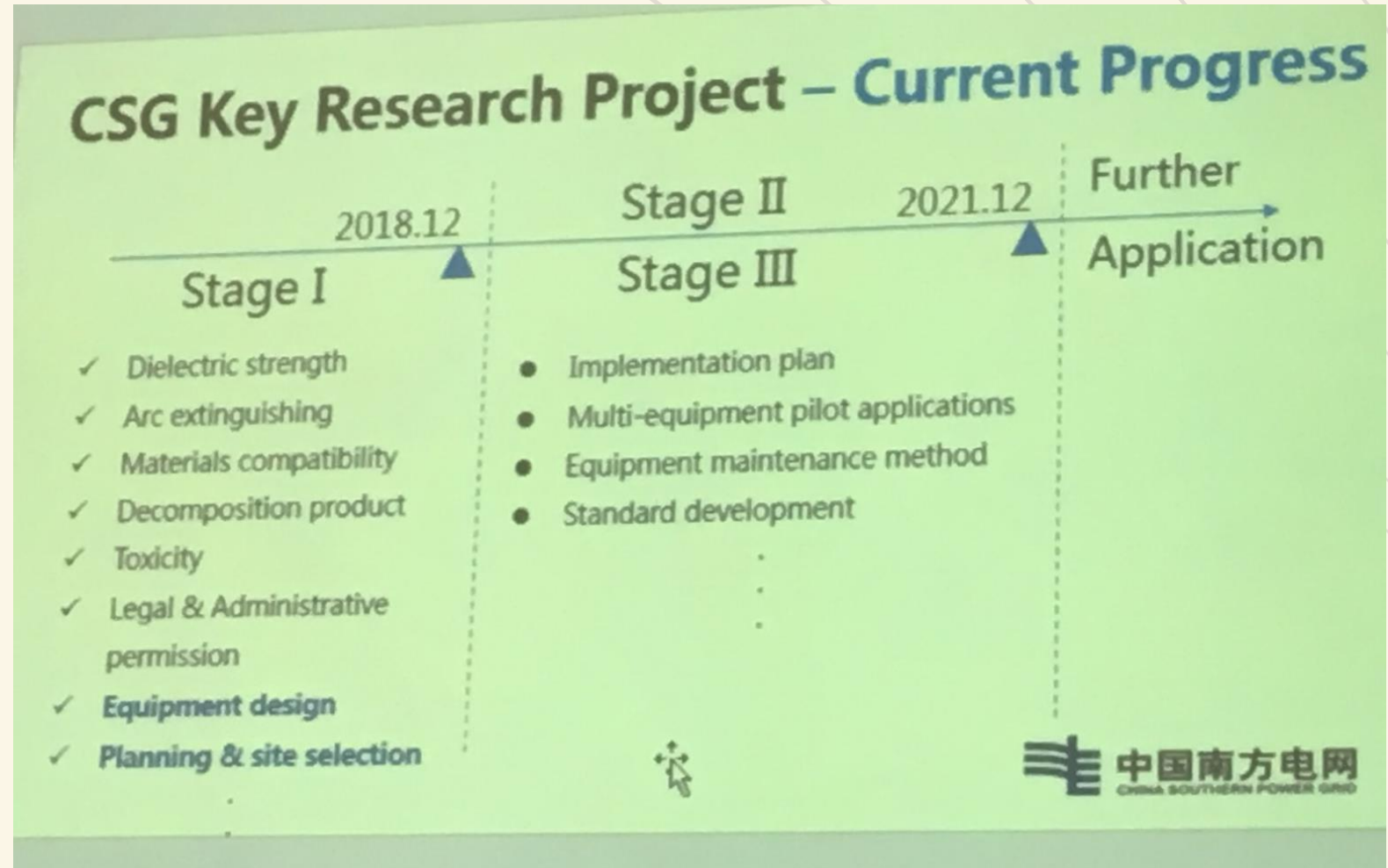
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CIGRE activities

- WG B3.45 alternative to SF6
- WG D1.67 Insulation alternatives to SF6

- General meeting in Berlin (9th April) - Presentation of initiatives in China
- China is focusing on C6 (Boiling point 49° C)
 - No patent
 - Production exist in China

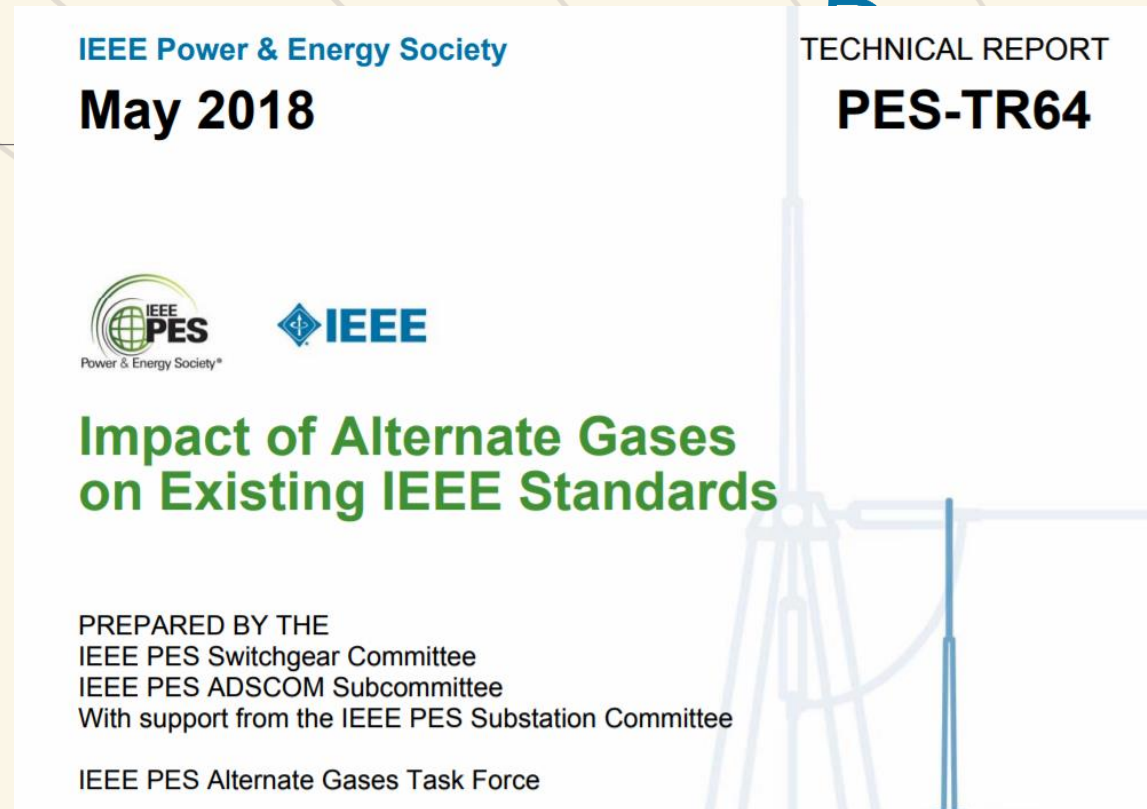


- [Chapter 1: Quality and Purity Requirements](#)
- [Chapter 2 - Ageing Aspects](#)
- [Chapter 3: Gas Handling](#)
- [Chapter 4: Filling Accuracy](#)
- [Chapter 5: Tightness Requirements](#)
- [Chapter 6: Interlocking Requirements](#)
- [Chapter 7: EHS Aspects](#)
- [Chapter 8: Maintenance and life-cycle aspects](#)

IEEE & US activities

- **CALIFORNIA Proposals:** Sulfur Hexafluoride Phase Out Beginning January 1, 2025, no GIE utilizing sulfur hexafluoride as an insulating gas can be installed in California; nor shall an existing device be converted to use sulfur hexafluoride as an insulating gas.
- **there is a group of utility that met and discussed about the way to get rid of SF6**

- The IEEE report has been published
- This report is intended to be updated on regular base
- New PAR : (Project Authorisation Request)
- *The guide reviews existing standards and performance criteria for switchgear above 1000V .each aspect of the performance is discussed within the context of SF6 alternative how their behaviour may differ from existing technology and how this behaviour may lead to change in the qualification process. relevant analytical numerical or test methods are discussed which may contribute to the process of performance evaluation and evolution of the standards*



Document , paper , conference

DOCUMENT , PAPER , CONFERENCE

- EURELECTRIC technical report on technologies for transmission systems



Available technologies Report Review_TYNDP2018_02.05.2018.docx

- ZVEI remarks on T&D Europe PP on the condition of gas tightness



9-2 ZVEI Input - PP on Warranty conditions regarding gas tightness of SF6-SWG.docx

Ongoing country projects on SF6 and SF6 alternatives

EPEE Roundtable

EPEE ROUNDTABLE

- Focus on refrigerant industry with « mirror » side for T&D
- Forewords from EC about the phase down of HFC (same message as consultation forum)
- Round table
 - Users complain, because too much alternatives in refrigerant.
 - EOM complains because precharged equipment exported outside EU are also under quota and as the price of HFC is increasing , there is a losse of competitiveness.
 - 3M Is asking incentives to develop alternative gases (for SF6)
 - T&D took the exemple of ammonium and asked where is the balance between health issues for operator, and GWP (no answer but has been considered by some participants as “interesting question”)

Blog « why EU should ban SF6 »

Proposal for answer

BLOG « WHY EU SHOULD BAN SF6 »

From: Nicholas Ottersbach [<mailto:nicholas.ottersbach@nuventura.com>]

Sent: 22 May 2018 15:20

To: DULIERE Laure <laure.duliere@orgalime.org>

Subject: SF6 Research

Dear Ms. Duliere,

I came accross your paper 'Technical report on alternative to SF6 gas in medium voltage & high voltage electrical equipment' while I was doing my own research into SF6 and found it very interesting.

I am researching policy around SF6 in the European Union and the possibility of SF6 being phased out in 2020.

Moreover, I work for a cleantech startup that has developed a medium voltage GIS that uses dry air instead of SF6, and also goes up to 36kV.

I was hoping that you may be interested in discussing the research around SF6-policy over the phone. Would Monday at 11am work?

BLOG « WHY EU SHOULD BAN SF6 »

Proposition for answer #1

The title of the article should target **only the New equipment** as due to the difference in insulation or arc quenching *behaviour and as well, material compatibility*, it is highly unlikely that retrofit can be made on installed base by just changing the gas (retrofit).

T&D Europe has recently published a report giving an overview of the R&D effort made by European switchgear manufacturers in order to find alternatives to SF6. In Medium voltage some possible alternatives can be dry AIR, or its combination with solid insulation, or its mixture with C5F100 (fluoroketone), or can be a pure gas as HFC1234ze (already used for HFC substitution in refrigerant industry). In HV as Yannick Kieffel mentionned there are CO2 used in mixture with C4F7N (fluoronitril) or again C5F100, or pressurized air in combination with vacuum switching. In some case there are still no alternative yet. you can refer to

<https://www.tdeurope.eu/component/attachments/attachments.html?id=923>

BLOG « WHY EU SHOULD BAN SF6 »

Proposition for answer #2

This article looks a bit extreme as many regulatory evolution happened in last year, as EU517/2014 regulation which proposed a lot of improvement about the management of SF6 in switchgear : mandatory training for all relevant workers, leakage control systems and processes, mandatory recover and recycling/destroying of decommissioned equipment. All these new requirements plus voluntary agreements between producers, manufacturers and users enable a steadily reduction of SF6 emissions for electrical switchgear .

DECISION NOT TO ANSWER / Reason : it will give too much importance for this small aggressive company that propose a solution for a niche market

BLOG « WHY EU SHOULD BAN SF6 »

Proposition for answer #3

Reminder on SF6 Experiences :

SF6 is an extremely stable and inert molecule and when exposed to electrical discharges during normal operation it is recombining naturally. that is why its lifetime is so long! The production of SF10 may be generated only when very heavy switching arc or internal arc occurs. These two events are extremely rare during the lifetime of a switchgear, moreover a molecular sieve is enclosed into the switchgear in order to keep dry the gas (avoid HF) and to absorb the by-product. you can refer to CIGRE ELECTRA N° 436 pp 68-89 (1991) and specially in table II.

The probability of accidental release of SF6 is very unlikely and combined to the probability of heavy arcing gas and saturated molecular sieve It results an extremely unlikely probability for releasing toxic by-product. last point, Thanks to F-Gas regulation all workers that need to handle used SF6 are now trained and personal protections are mandatory : the risk for people is extremely low!



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