

Impactul SF6 asupra mediului

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Eaton Electric

Powering Business Worldwide

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Situatia curenta

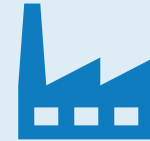
SF6 – Impactul asupra mediului



1 kg SF6 =
23,900 kg CO2



SF6 dureaza in
atmosfera **3,200** de ani



Industria energetica
este responsabila de
**80% din totalul
emisiilor de SF6**

Protocolul de la Kyoto

Acronym, Common Name or Chemical Name	Chemical Formula	Lifetime (Years)	Radiative Efficiency (W m ⁻² ppb ⁻¹)	AGWP 20-year (W m ⁻² yr kg ⁻¹)	GWP 20-year	AGWP 100-year (W m ⁻² yr kg ⁻¹)	GWP 100-year
HFC-1243zf	CF ₃ CH=CH ₂	7.0 days	0.01	1.37e-14	1	1.37e-14	<1
HFC-1345zfc	C ₃ F ₅ CH=CH ₂	7.6 days	0.01	1.15e-14	<1	1.15e-14	<1
3,3,4,4,5,5,6,6,6-Nonafluorohex-1-ene	C ₆ F ₉ CH=CH ₂	7.6 days	0.03	1.25e-14	<1	1.25e-14	<1
3,3,4,4,5,5,6,6,7,7,8,8,8-Tridecafluorooct-1-ene	C ₈ F ₁₃ CH=CH ₂	7.6 days	0.03	9.89e-15	<1	9.89e-15	<1
3,3,4,4,5,5,6,6,7,7,8,8,9,10,10,10-Hep-tadecafluorodec-1-ene	C ₁₀ F ₁₇ CH=CH ₂	7.6 days	0.03	8.52e-15	<1	8.52e-15	<1
Chlorocarbons and Hydrochlorocarbons							
Methyl chloroform	CH ₃ CCl ₃	5.0	0.07	1.44e-11	578	1.47e-11	160
Carbon tetrachloride	CCl ₄	26.0	0.17	8.69e-11	3480	1.59e-10	1730
Methyl chloride	CH ₃ Cl	1.0	0.01 ^a	1.12e-12	45	1.12e-12	12
Methylene chloride	CH ₂ Cl ₂	0.4	0.03 ^b	8.18e-13	33	8.18e-13	9
Chloroform	CHCl ₃	0.4	0.08	1.50e-12	60	1.50e-12	16
1,2-Dichloroethane	CH ₂ ClCH ₂ Cl	65.0 days	0.01	8.24e-14	3	8.24e-14	<1
Bromocarbons, Hydrobromocarbons and Halons							
Methyl bromide	CH ₃ Br	0.8	0.004	2.16e-13	9	2.16e-13	2
Methylene bromide	CH ₂ Br ₂	0.3	0.01	9.31e-14	4	9.31e-14	1
Halon-1201	CHBrF ₂	5.2	0.15	3.37e-11	1350	3.45e-11	376
Halon-1202	CBr ₂ F ₂	2.9	0.27	2.12e-11	848	2.12e-11	231
Halon-1211	CBrClF ₂	16.0	0.29	1.15e-10	4590	1.60e-10	1750
Halon-1301	CBrF ₃	65.0	0.30	1.95e-10	7800	5.77e-10	6290
Halon-2301	CH ₃ BrCF ₃	3.4	0.14	1.59e-11	635	1.59e-11	173
Halon-2311 / Halothane	CHBrClCF ₃	1.0	0.13	3.77e-12	151	3.77e-12	41
Halon-2401	CHBrCF ₃	2.9	0.19	1.68e-11	674	1.68e-11	184
Halon-2402	CBrF ₂ CF ₃	20.0	0.31	8.59e-11	3440	1.35e-10	1470
Fully Fluorinated Species							
Nitrogen trifluoride	NF ₃	500.0	0.20	3.19e-10	12,800	1.47e-09	16,100
Sulphur hexafluoride	SF ₆	3,200.0	0.57	4.37e-10	17,500	2.16e-09	23,500
(Trifluoromethyl) sulphur pentafluoride	SF ₅ CF ₃	800.0	0.59	3.36e-10	13,500	1.60e-09	17,400
Sulphuryl fluoride	SO ₂ F ₂	36.0	0.20	1.71e-10	6840	3.76e-10	4090
PFC-14	CF ₄	50,000.0	0.09	1.22e-10	4880	6.08e-10	6630
PFC-116	C ₂ F ₆	10,000.0	0.25	2.05e-10	8210	1.02e-09	11,100
PFC-c216	c-C ₂ F ₆	3,000.0	0.23 ^a	1.71e-10	6850	8.44e-10	9200
PFC-218	C ₃ F ₈	2,600.0	0.28	1.66e-10	6640	8.16e-10	8900
PFC-318	c-C ₄ F ₈	3,200.0	0.32	1.77e-10	7110	8.75e-10	9540

Acest tabel prezinta Global Warming Potential (GWP) pentru fiecare din gazele de sera

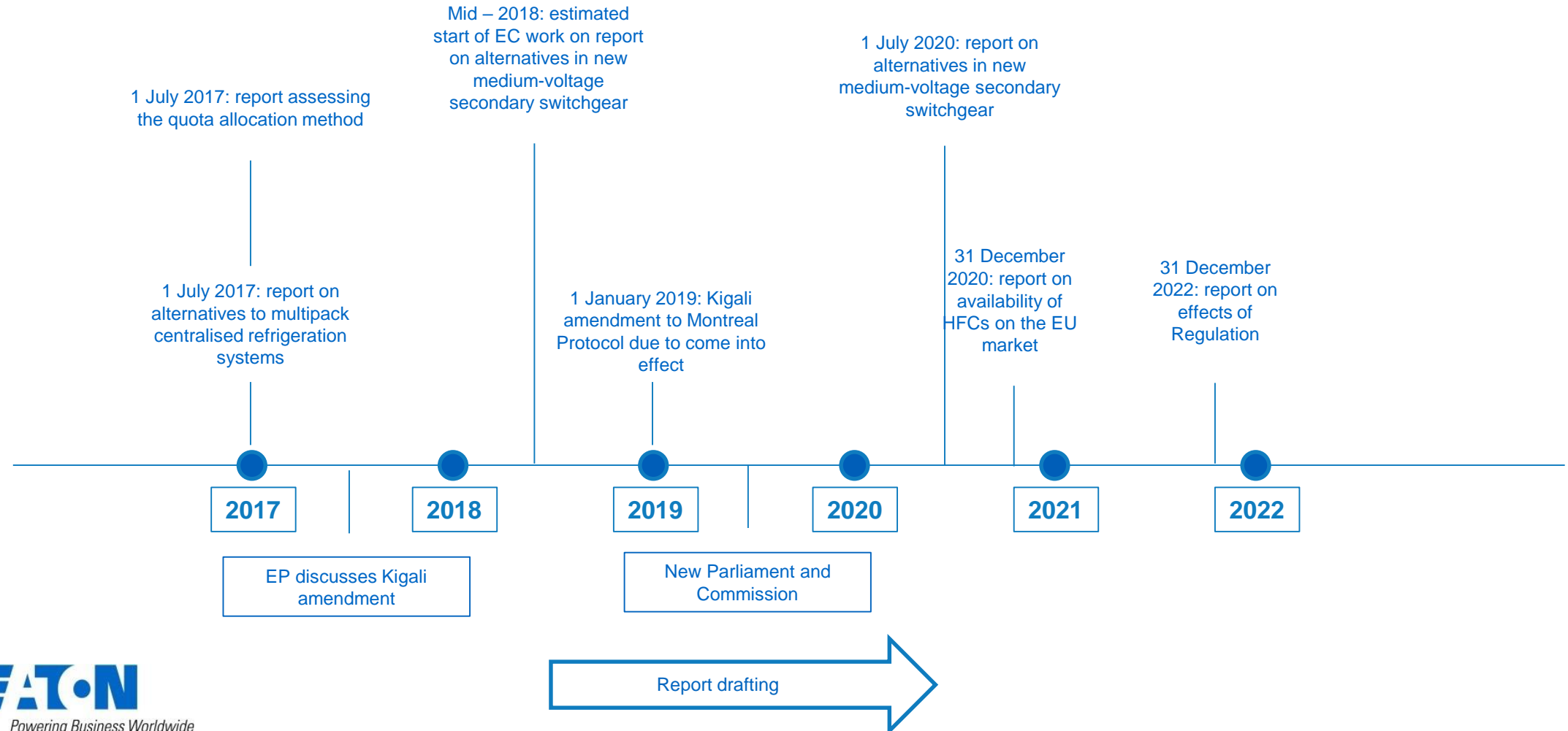
SF₆ este de departe cel mai nociv gaz de sera cu GWP de approx. 23,500!



Source: IPCC (2013)

Reglementarile EU F-gas

“No later than 1 July 2020, the Commission shall publish a report assessing whether **cost-effective, technically feasible, energy-efficient and reliable alternatives** exist, which make the replacement of fluorinated greenhouse gases possible in new medium-voltage secondary switchgear and new small single split air-conditioning systems and shall submit, if appropriate, a legislative proposal to the European Parliament and to the Council to amend the list set out in Annex III.” – **Current F-gas regulation**



Pozitionarea SF6 astazi in piata

Aplicatii curente si trecute

Sport shoes

(SF₆ filled bags for shock absorption)



Tennis balls

(Less pressure loss with SF₆)



Car tires

(Less pressure loss with SF₆)



Double glazing

(Temperature insulation with SF₆)



Switchgear systems

(SF₆ switching & insulation)

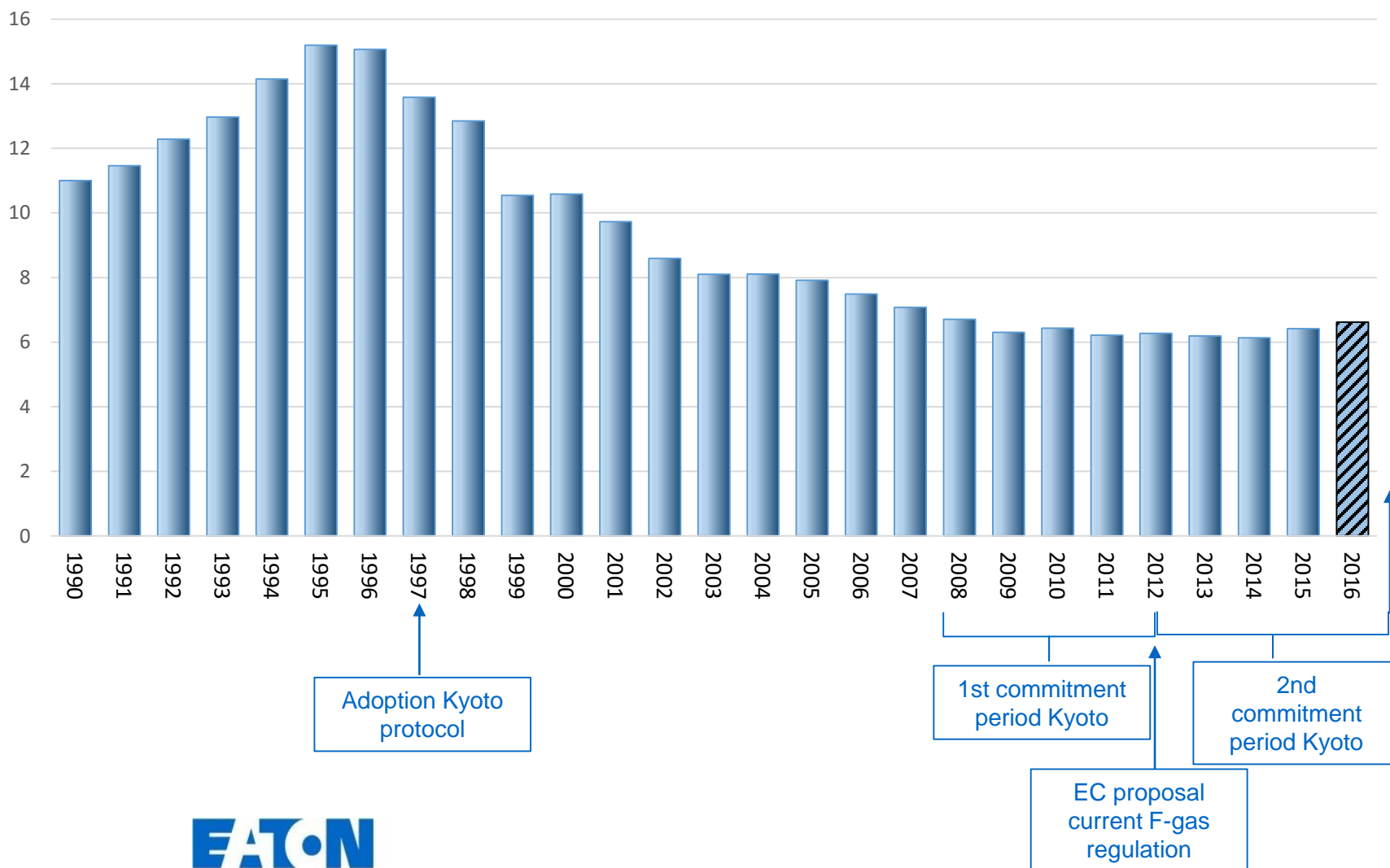


The Kyoto protocol stimulated the European Union to enforce the 2007 F-gas regulation.

SF₆ usage is now prohibited for most industries. Exception is the switchgear industry because in 2014 SF₆ was deemed to have no reliable alternative.

Emisiile de gaz SF6 cresc in continuare

Emissions - EU28 (Convention) - Tg (million tonnes) Source: EEA (2017)



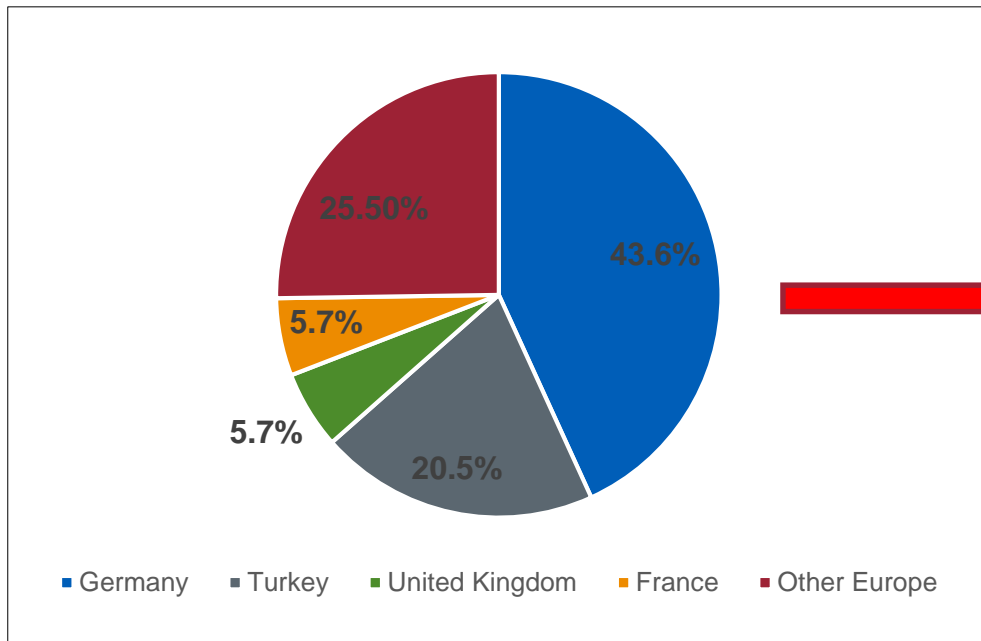
Since the adoption of the Kyoto protocol and the EU F-gas regulation SF6 emissions progressively decreased.

However 2015 marked another increase in emissions.

Emissions are expected to **further increase by 2050** as decentralized electricity grid will require more and intense switching.

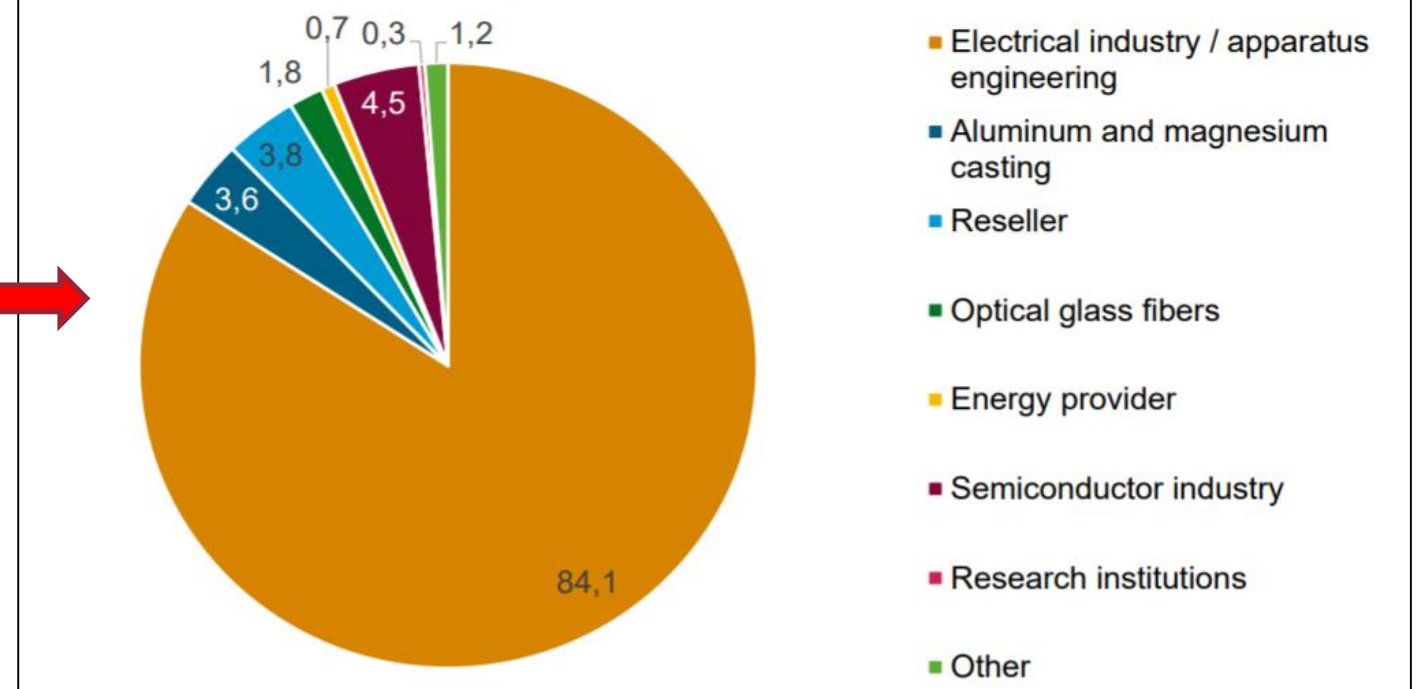
Cererea de gaz SF₆ este cea mai mare in industria energetica

Cumulative SF₆ emission for key countries in Europe, 2016 (%)



*Includes all countries of European Union (Convention)

Demand sectors of SF₆ in Germany according to the field of application in 2016 (%)



Nevoia de solutii fara SF6 in Echipamentele Electrice

Aplicatii ale echipamentelor electrice

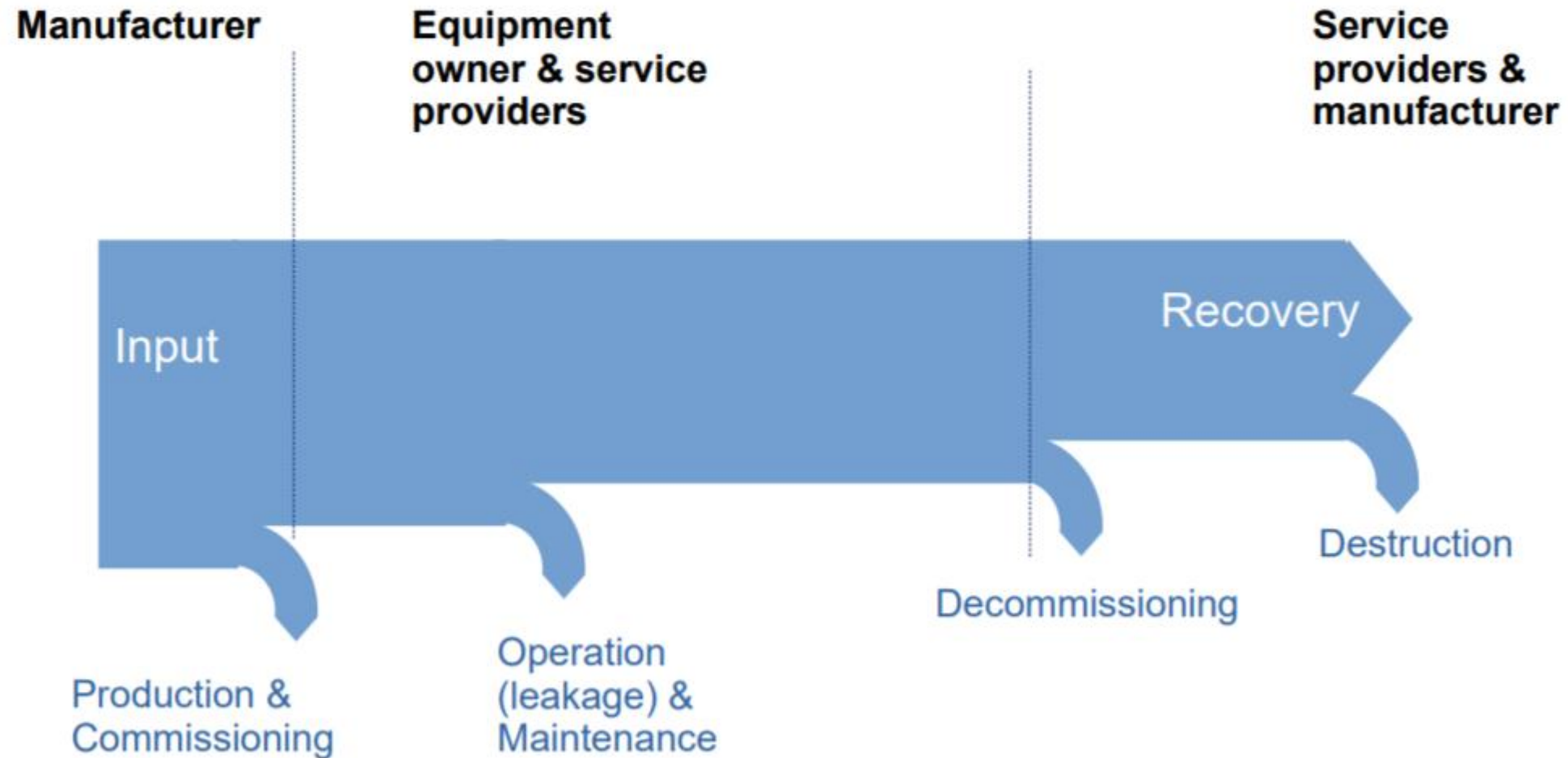
High
Voltage
Switchgear



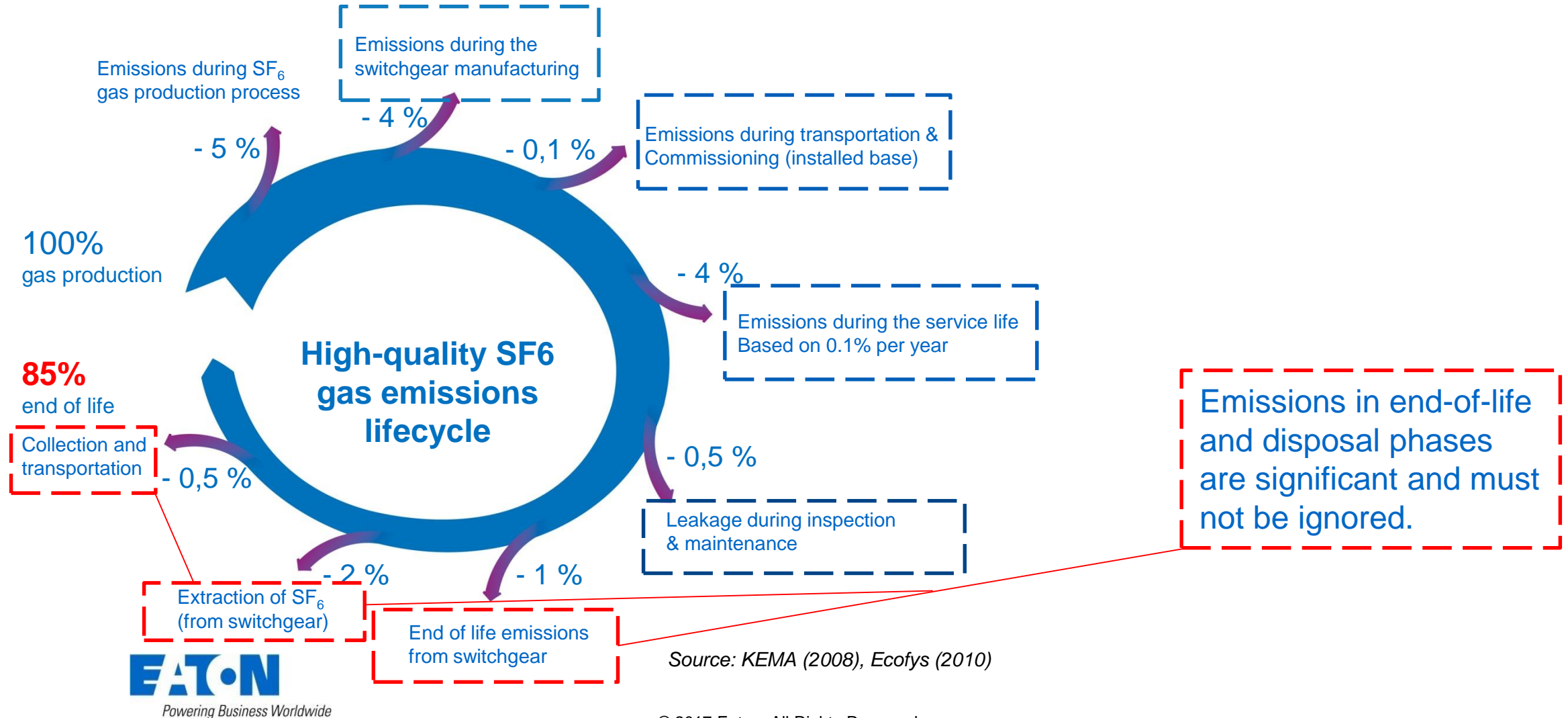
Medium
Voltage
Switchgear



De-a lungul duratei de viata a gazului SF6 fiecare operator are diverse obligatii



15% scurgeri de SF6 pe timpul duratei de viata



Comutatia in gaz are cea mai rapida crestere

Equipment	2015	2016	2017-e	2022-p	CAGR (2017-2022)
Gas Insulated Switchgear	15.68	17.14	18.75	29.52	9.50%
Circuit Breakers	12.34	13.10	13.91	18.96	6.38%
MCB and MCCB	6.52	6.92	7.37	10.25	6.84%
Air Insulated Switchgear	6.14	6.41	6.41	8.05	4.68%
Motor Control Centers	4.30	4.53	4.77	6.22	5.47%
Fuses	3.06	3.23	3.41	4.51	5.76%
Surge Protection Devices	1.86	1.95	2.06	2.69	5.47%
Ring Main Unit	1.37	1.51	1.64	2.45	8.35%
Surge Arresters	1.35	1.42	1.49	1.91	5.11%
Others	29.04	27.94	28.92	40.54	6.99%
Total	81.65	84.14	88.71	125.10	7.12%

Note: Others includes transfer switches, disconnect switches, protective relays, contactors, safety switches, isolators, solid insulated switchgear, hybrid switchgear, and paralleling switchgear

e:Estimated; p:Projected

Source: Annual Reports, Company Publications, Press Releases, Investor Presentations, Expert Interviews, and MarketsandMarkets Analysis

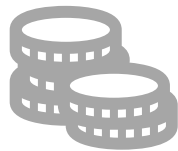
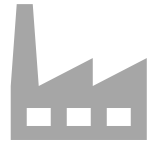
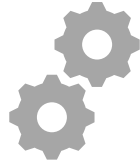
SWITCHGEAR MARKET

GLOBAL FORECAST TO 2022

BY VOLTAGE (< 1 KV, 1 KV - 36 KV, 36 KV - 72.5 KV, > 72.5 KV), END-USER (TRANSMISSION & DISTRIBUTION UTILITIES AND MANUFACTURING & PROCESS INDUSTRIES), EQUIPMENT (GAS INSULATED, AIR INSULATED, AND CIRCUIT BREAKERS)

Alternative la gazul SF6

Tehnologia fara SF6 - sustenabilitate



- Echipamentele cu comutatie in SF6 au un cost semnificativ pe intreaga durata de viata, considerand costul de utilizare cat si cel de reciclare
- Aceste costuri vor creste pe masura ce cererea pentru energie si echipamente electrice va creste
- Astazi tehnologia fara gaz SF6 are un cost de investitie mai mare in medie cu 20% insa costul de operare pe intreaga durata de viata a echipamentului este semnificativ mai mic

Alternative sunt disponibile

- Tehnologii alternative la SF6 sunt disponibile azi la toti producatorii importanti

- Aceste tehnologii sunt:

- accesibile
- tehnic - posibil
- eficiente energetic
- sigure

Insulation medium	Air (AIS)	Alternative gas	Alternative gas	Solid	Fluid
Switching medium	Vacuum	Vacuum	Alternative gas	Vacuum	Vacuum
MV switchgear Primary distribution	implemented > 5 years in the market	implemented < 5 years in the market	not implemented	implemented > 5 years in the market	not implemented
MV switchgear Secondary distribution	implemented > 5 years in the market	implemented < 5 years in the market	not implemented	implemented > 5 years in the market	implemented > 5 years in the market

Source: Ecofys (2017)

- 50% din tehnologiile disponibile sunt fara gaz SF6
- Insa nu au atins inca productia si distributia pe scara larga din lipsa reglementarilor necesare

Eaton IEC MV Systems:



Transformers



36kV Primary Switchgear



Fixed & Withdrawable Primary
11 – 24kV



Secondary Switchgear
11-36kV



Ring Main Units
11-36kV

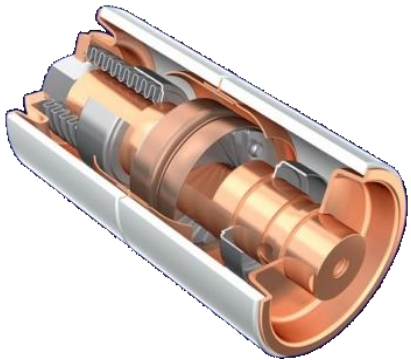
Core technologies that meet your challenges

Protect people, assets and reputation
for business continuity

Design and build for resiliency
and sustainability

Lower risk with on-time project execution
and expertise

Vacuum Interrupters, Solid insulation and Electrical field control

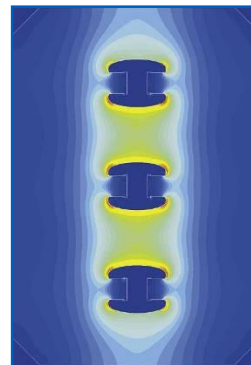


Vacuum Interrupters

- Reliably switch high currents
- Long life, low maintenance, saves space and reduces costs
- Up to 30.000 switching cycles

Electrical field control

- Enables reliable construction
- Ensures compact panels



Solid insulation (cast resin)

- Solid insulation increases external dielectric performance
- Enables robust construction
- Sealed for life conductors (single phase insulation)
Enables cooling purposes
- Environmentally-friendly with no emission of greenhouse gases (SF₆)



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