

# Management of SF<sub>6</sub> Emissions from T&D HV equipment in the European Union

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## The updated inventory methodology

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**on behalf of CAPIEL**

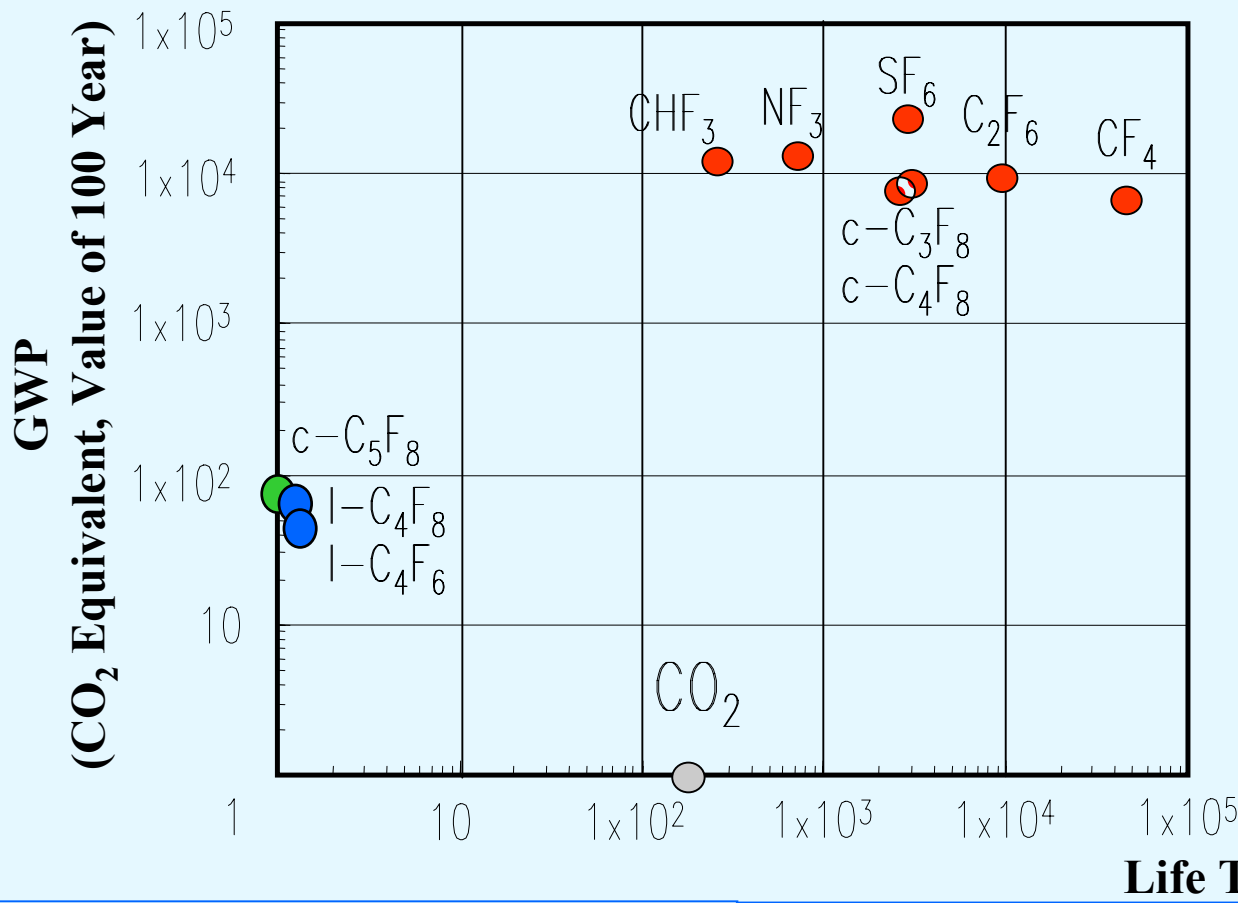
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- **Introduction**
  - CAPIEL/Kyoto protocol/SF<sub>6</sub> Issue
- SF<sub>6</sub> in Electrical equipment in Europe
  - SF<sub>6</sub> emissions reduction strategies
  - Standards, etc..., Voluntary agreements
- CAPIEL Inventories
  - Inventory methodology (1998/2000)
  - Updated Inventory methodology (2005)
- Conclusion

## What is CAPIEL ?

- Co-ordinating Committee for the Associations of Manufacturers of Industrial Electrical Switchgear Controlgear in the European Union
- Members :  
National associations from :  
Belgium, Denmark, Germany, Greece, Spain, France, Ireland, Italy,  
Luxembourg, the Netherlands, Austria, Portugal, Finland, Sweden, U.K.
- Total turnover : 18.25 billion € (export 25 %)
- Employees : around 118.000 in Europe

# Kyoto Summit (1997) : Greenhouse Gases emissions reductions



**PFCs, HFCs, SF<sub>6</sub>**

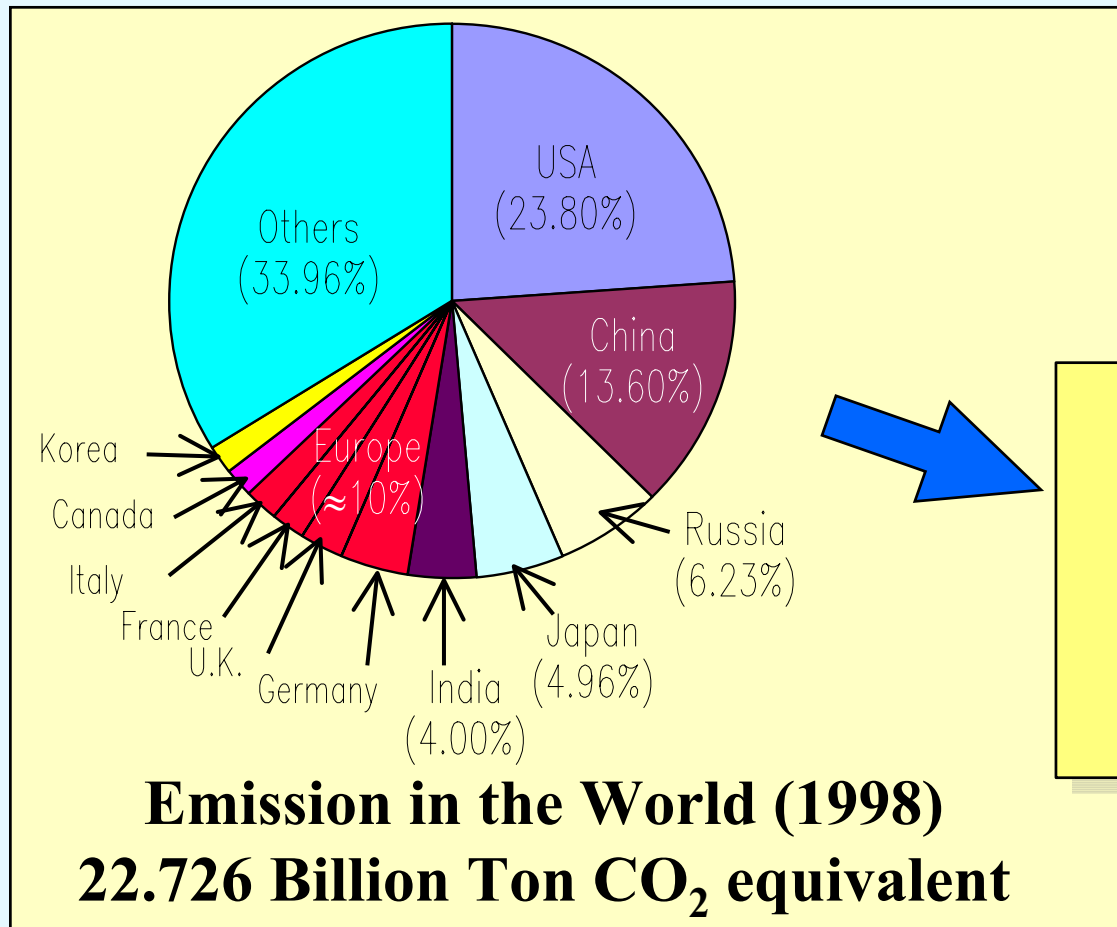


**Reduction**

**Entry into force in 2005**

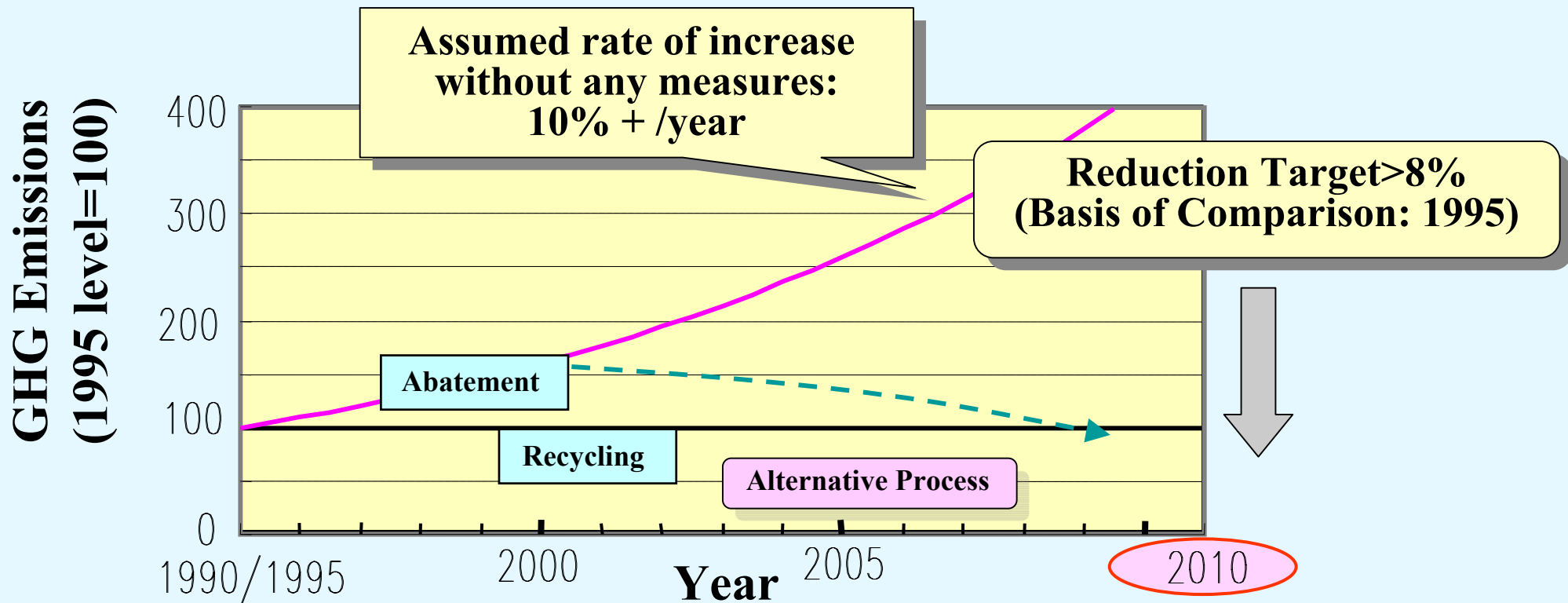


## Green-house gasses (equiv. CO<sub>2</sub>) Emissions in the World



**EU :  
8 % Reduction  
Compared with  
That in 1990**

# Reduction Strategy for Green-House Gasses Emissions -Europe



## Content

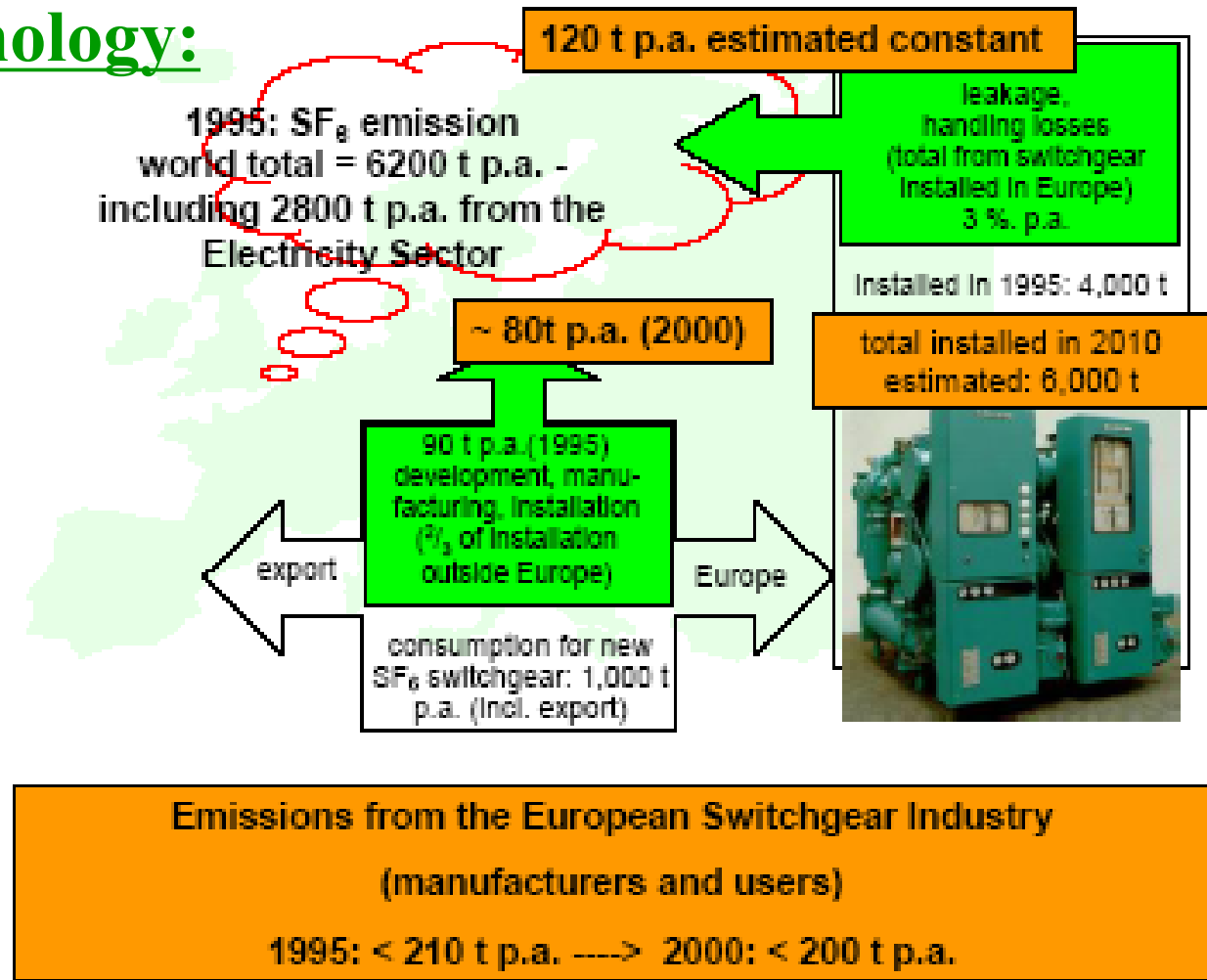
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## SF<sub>6</sub> From the Electrical Industry

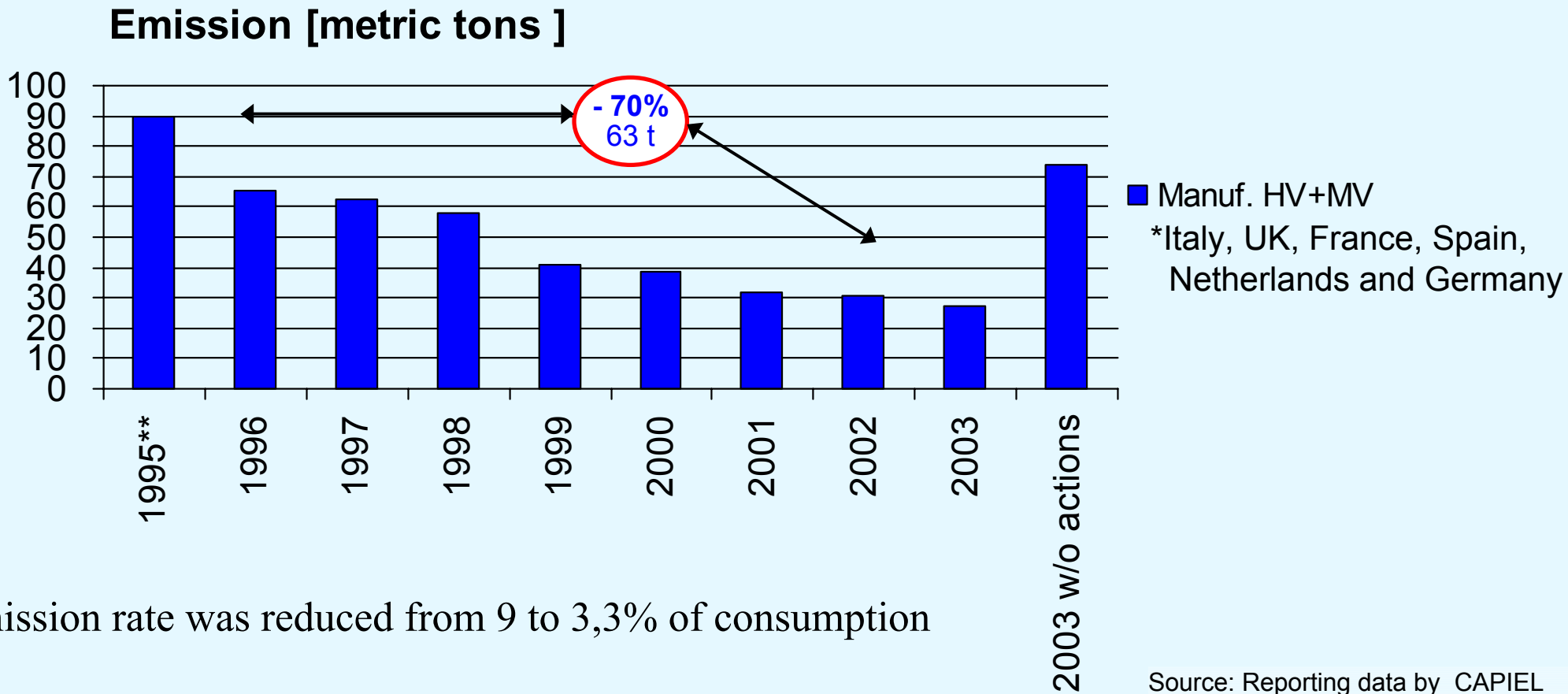
- World SF<sub>6</sub>-emissions from electricity Sector less than 0,1% of man made GW
- European Electricity Sector contributes only about 0,01 % .
- European Union is preparing an F-Gasses regulation  
Possible restrictions in the SF<sub>6</sub> use even in the electrical industry
- European switchgear manufacturers & users aware that SF<sub>6</sub> is a persistent gas.
- Voluntary actions announced by CAPIEL and EURELECTRIC in 2001 to contribute to the European Climate Change Program (ECCP).



# SF<sub>6</sub> and switchgear technology: Situation in the EU 15 (1995 and 2000)



# SF<sub>6</sub> Emissions from HV Switchgear - Manufacture in Europe\*



Emission rate was reduced from 9 to 3,3% of consumption

## SF<sub>6</sub> Emission Reduction in the Switchgear Industry

- Avoid unnecessary transport & Promote re-use of SF<sub>6</sub>
- Ensure re-use in/via relevant standards:
  - IEC 60480 already revised – IEC 60376 under revision
  - IEC 61634 (to be revised) - IEC 62271series
- Promote appropriate handling, ensuring low emissions of SF<sub>6</sub>
  - Cigre "Practical SF<sub>6</sub> Handling Instructions" – Ed. 2
  - Cigre "SF<sub>6</sub> recycling guide, Re-Use of SF<sub>6</sub> in electrical power equipment and final disposal", 1997, 46p.
  - Cigre "SF<sub>6</sub> Tightness Guide", to be published.
- Voluntary agreements (Government/Industry) on SF<sub>6</sub>
  - Germany, Italy, France, Switzerland, Norway

## Voluntary actions - Emission reduction on HV Switchgear\*

	•manufacturer	•user
•Permanent improvements in switchgear design for minimal leakage and simplified handling in service	x	
•Reduction of emission during manufacture	x	
•Improved filling procedures on site	x	x
•Better monitoring in service (for larger equipment)		x
•Use of “sealed-for-life” techniques for in particular smaller equipment	x	x
•Target older existing equipment with known leakage problem for repair/replacement		x
•Improved maintenance procedures		x
•Improved end-of-life recovery and recycling		x

\* EU 15



## Voluntary actions - Emission reduction on HV Switchgear\*

- Increased awareness of complete staff, handling SF<sub>6</sub>
- Implementation of the Re-Use system with gas-producer
- Inventory of all relevant data
- Integration of handling guide into standard training program
- State of the art handling equipment ( < 10 mbar) and piping
- Installation of self-closing couplings for pipes
- Installation of self-closing valve technology within piping system

## Voluntary actions - Emission reduction on HV Switchgear\*

- Implementation of integral-leakage detection systems with highest sensitivity into standard quality system for hermetically sealed mv switchgear; detection of far less than 0,1% leakage rate
- Introduction of welded containment for MV switchgear
- Replacement of SF<sub>6</sub> by Helium for leakage detection
- Installation of recovery stations for returned switchgear
- Installation of facility to separate SF<sub>6</sub> from air for internal re-use in HV

## Emission reduction on HV Switchgear\* manufacture

FRANCE	Estimates						Inventory 1		
	1995	1996	1997	1998	1999	2000	2001	2002	2003
Annual Consumption (tons)	350	336	323	341	214	210	239	216	202,7
Emissions in the Country (tons)	17,5	17,4	13,4	13,2	12,5	13,1	12,4	11,5	10

GERMANY	Inventory 1	
	1995	2003
Annual Consumption (tons)	329	356
Emissions in the Country (tons)	20,3	5,4

SWEEDEN	Inventory 1	
	1995	2003
Annual Consumption (tons)	269	390
Emissions in the Country (tons)	4,9	1,9

NORWAY	Inventory 1	
	2000	2003
Annual Consumption (tons)	29	37
Emissions in the Country (tons)	2,4	1,2

Source : ECOFYS/CAPIEL Study 2004

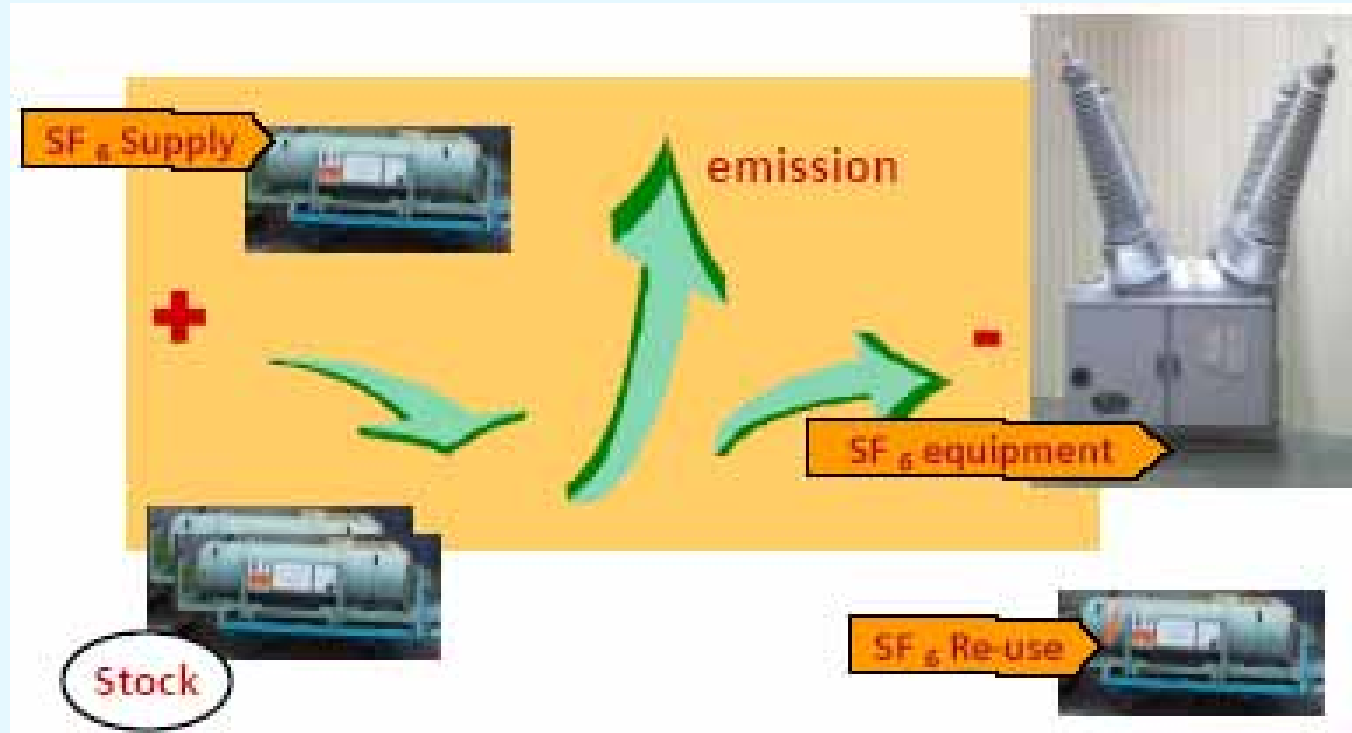
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## CAPIEL Inventory Methodology (1998/2000)

- Completely based on mass balance method
- $SF_6$  Input -  $SF_6$  Output +/- Delta Stock  
=  $SF_6$  Emission
- Implementation :  
CAPIEL Countries (8)
- $SF_6$  content on name-plates



## CAPIEL Updated Inventory Methodology (2005)

Reasons for evolution :

- Difficulty in practical implementation and some discrepancies could appear
- Need to assess banked quantities and related emissions
- Mass balance sometimes difficult to apply
- Figures could not be aggregated at European level

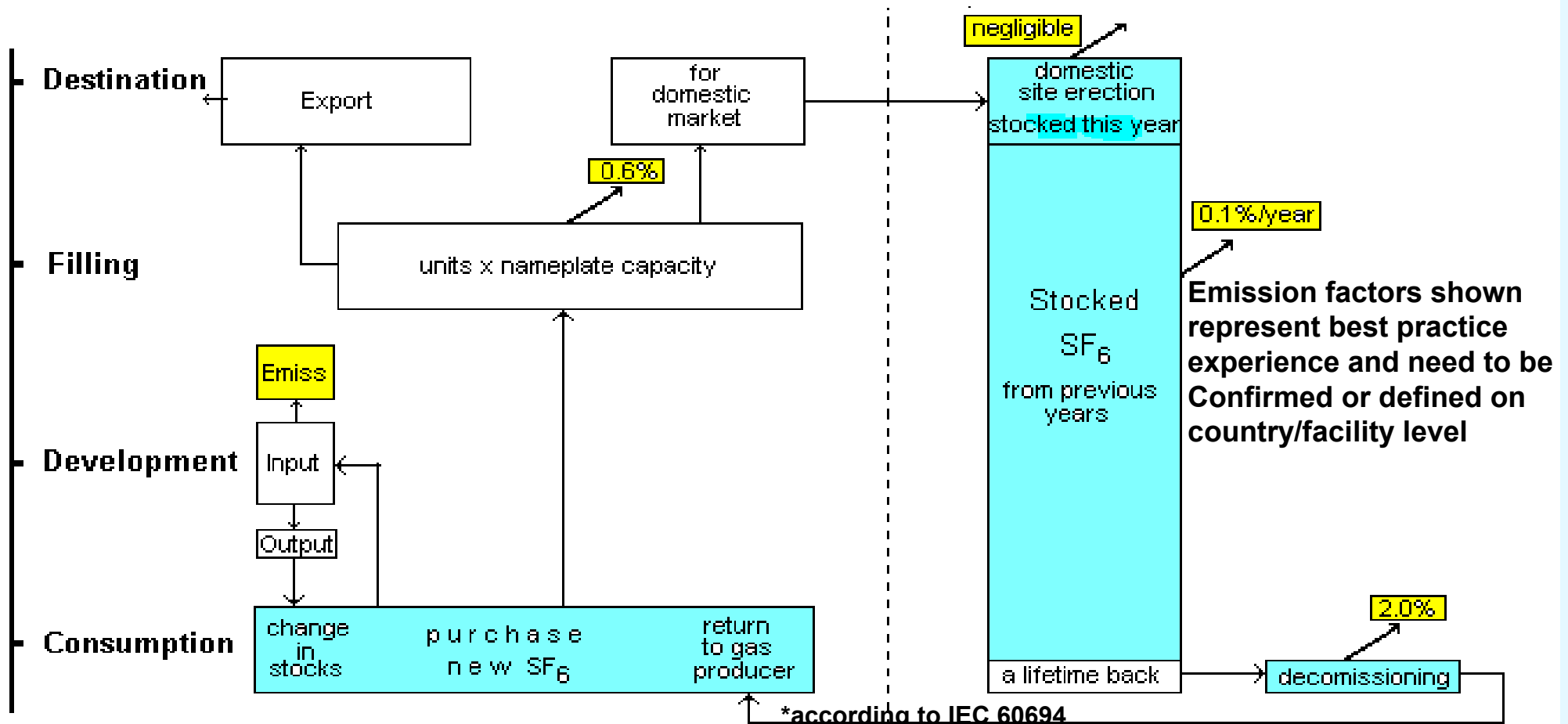
## CAPIEL Updated Inventory Methodology (2005)

Main changes :

- Banked quantities :  
Figure of a reference year + yearly installed/remove quantities
- Emissions :  
Give choice between mass balance/emission factor as best appropriate
- Implemented in EU 29
- Figures to be aggregated at European level

# Medium Voltage

## SF<sub>6</sub> Monitoring by Manufacturers [Controlled by operators]



Emissions estimation

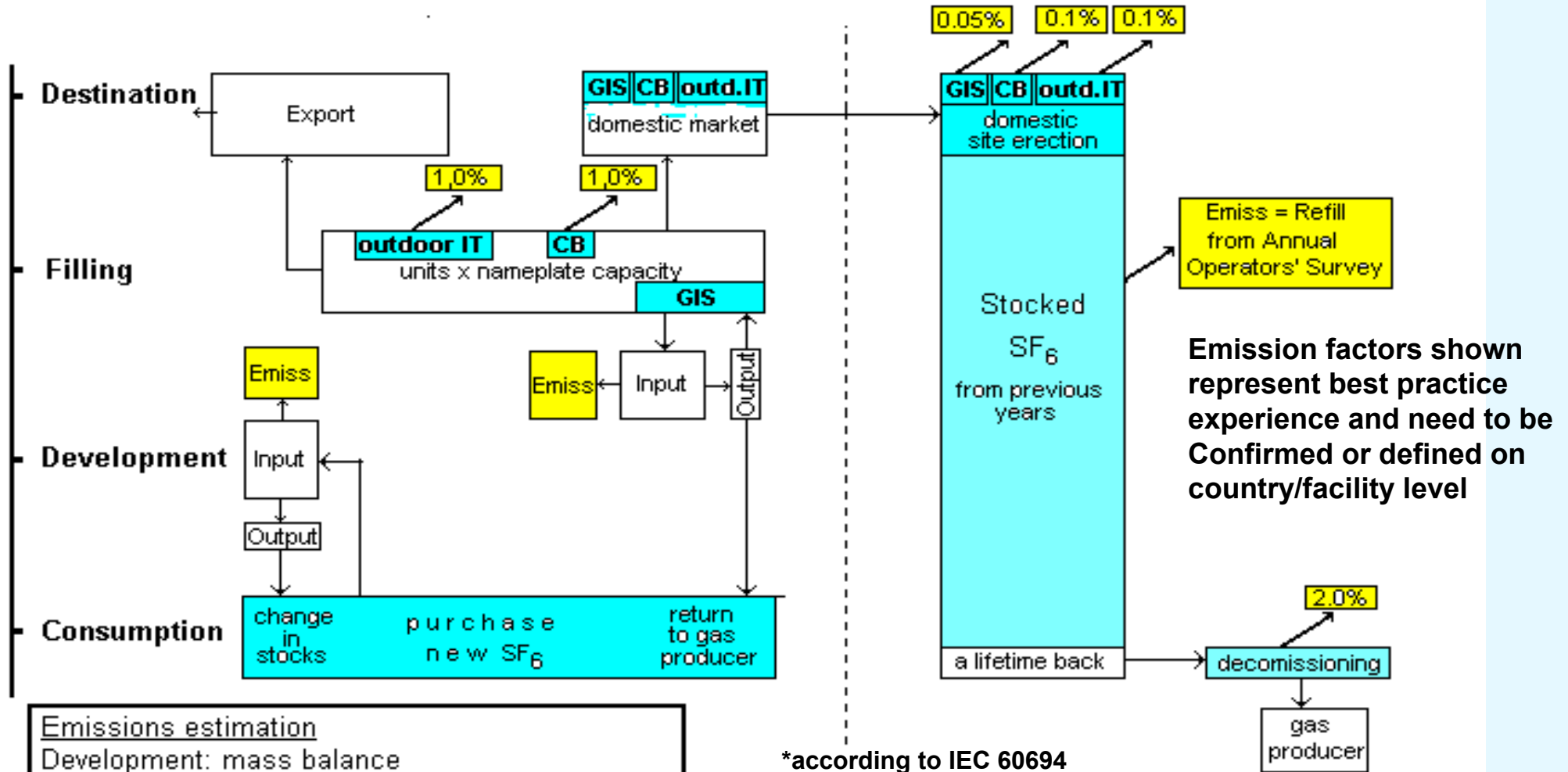
Development: mass balance.

Filling, stock, decommissioning: Emission factors.

Emission factors shown represent best practice experience and need to be Confirmed or defined on country/facility level



## High Voltage Joint SF<sub>6</sub> Monitoring by Manufacturers and operators



**Emission factors shown represent best practice experience and need to be Confirmed or defined on country/facility level**

\*according to IEC 60694  
 IEC=International Electro technical Commission

- Emissions estimation
- Development: mass balance
  - Filling GIS: mass balance
  - Filling CB and IT: Emission Factors
  - Site Erection: Emission Factors
  - Stock: Operators' Survey
  - Decommissioning: Emission Factor



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## Conclusions

- The CAPIEL Inventory Methodology first developed in co-operation with EURELECTRIC
- The Inventory Methodology is updated to stick to reality and intends to be extended to EU29 within CAPIEL (i.e. electrical switchgear manuf.)

However :

- National inventories already ran successfully (i.e. DE, CH, FR...)
- Emissions are already reduced thanks to industry's voluntary actions