SF_6 Emissions Abatement Strategy in Taiwan

Ching-Huei Leu
Center for Environmental, Safety and Health Technology Development, ITRI
E-mail: joey@itri.org.tw

Industrial Technology Research Institute
Energy & Resources Laboratories

Outline

- Uses of SF_6 in Taiwan
  - ✓ Electric power industry,
  - ✓ semiconductor industry,
  - ✓ TFT-LCD industry,
  - ✓ Magnesium industry,
- Taiwan's SF_6 Emissions Reduction
- Future work
- Conclusions

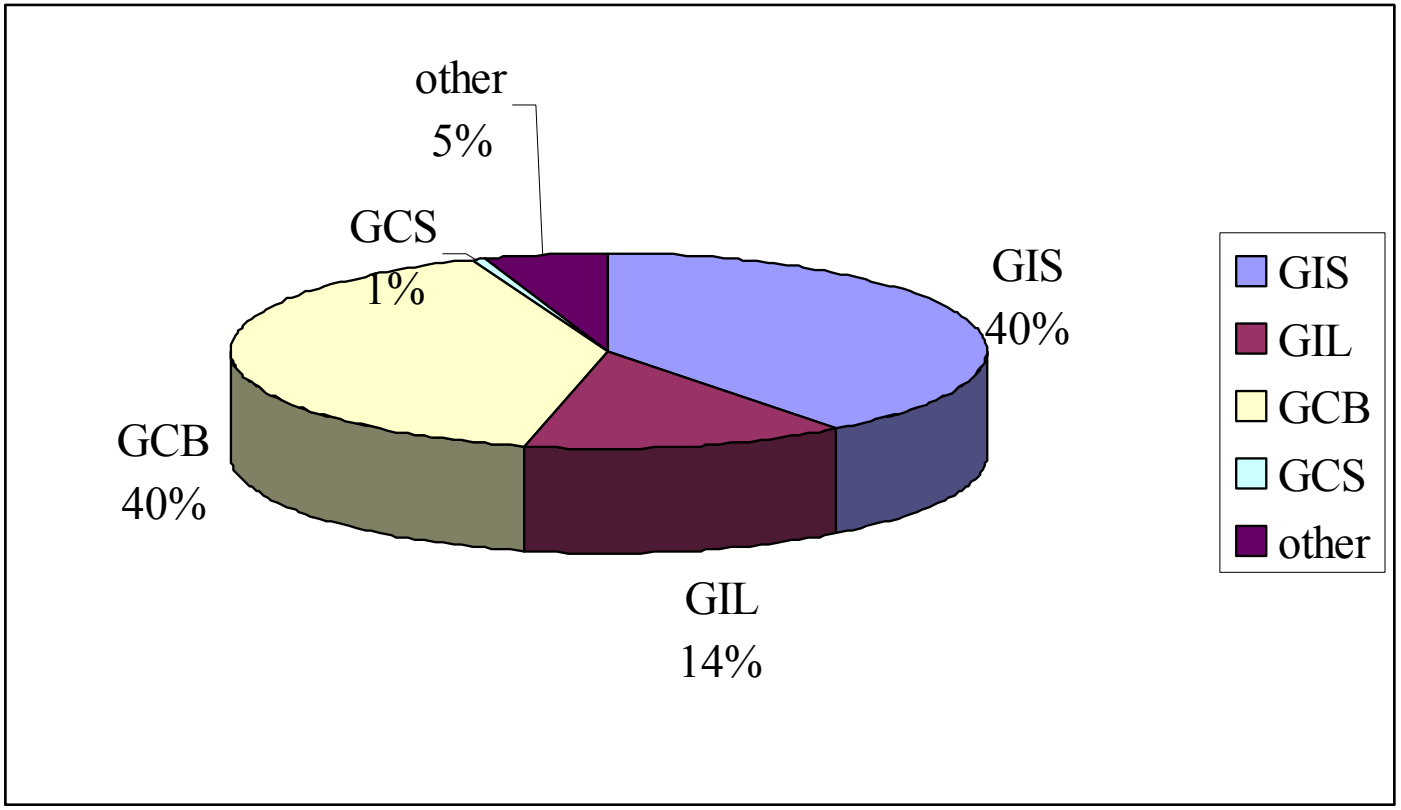
SF_6 Used in Electric Power Sector

GIL(Gas Insulation Line)

GIS(Gas Insulation Switchgear)

GCB(Gas Circuit Breaker)

Share of SF_6 Emission in Electric Power

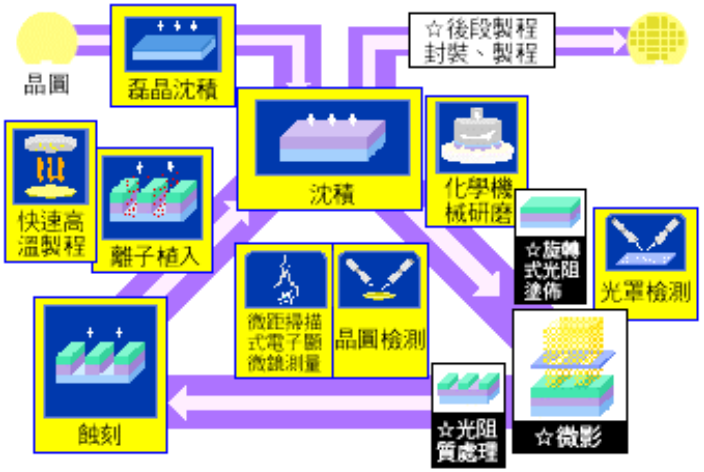


SF6 Emissions Reduction Strategies for Electric Power Systems

- Environmental management system
  - ✓ Taipower is ISO 14000 certified.
  - ✓ SF_6 gas recovery for servicing SF6 equipments
- To survey SF_6 emission
  - ✓ Taiwan EPA provides the Electric power industry with personal training
  - ✓ To introduce the international protocol on global atmosphere,
  - ✓ The emission reduction of SF_6
  - ✓ The SF_6 recovery equipment and demonstration

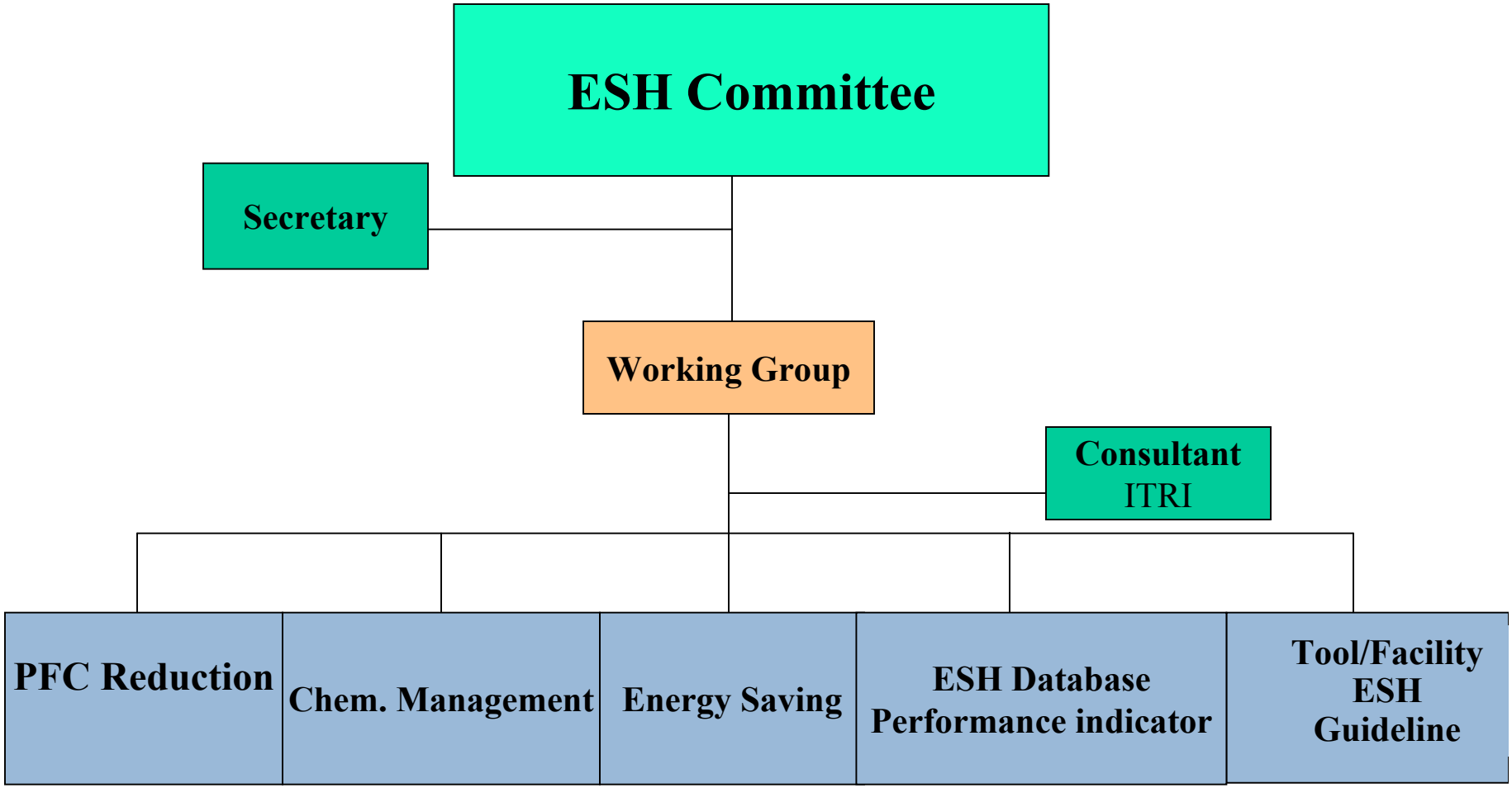
TFT-LCD and Semiconductors Use SF_6

1. CVD chamber cleaning



2. Dry-etching processes.

TSIA ESH Committee Organization

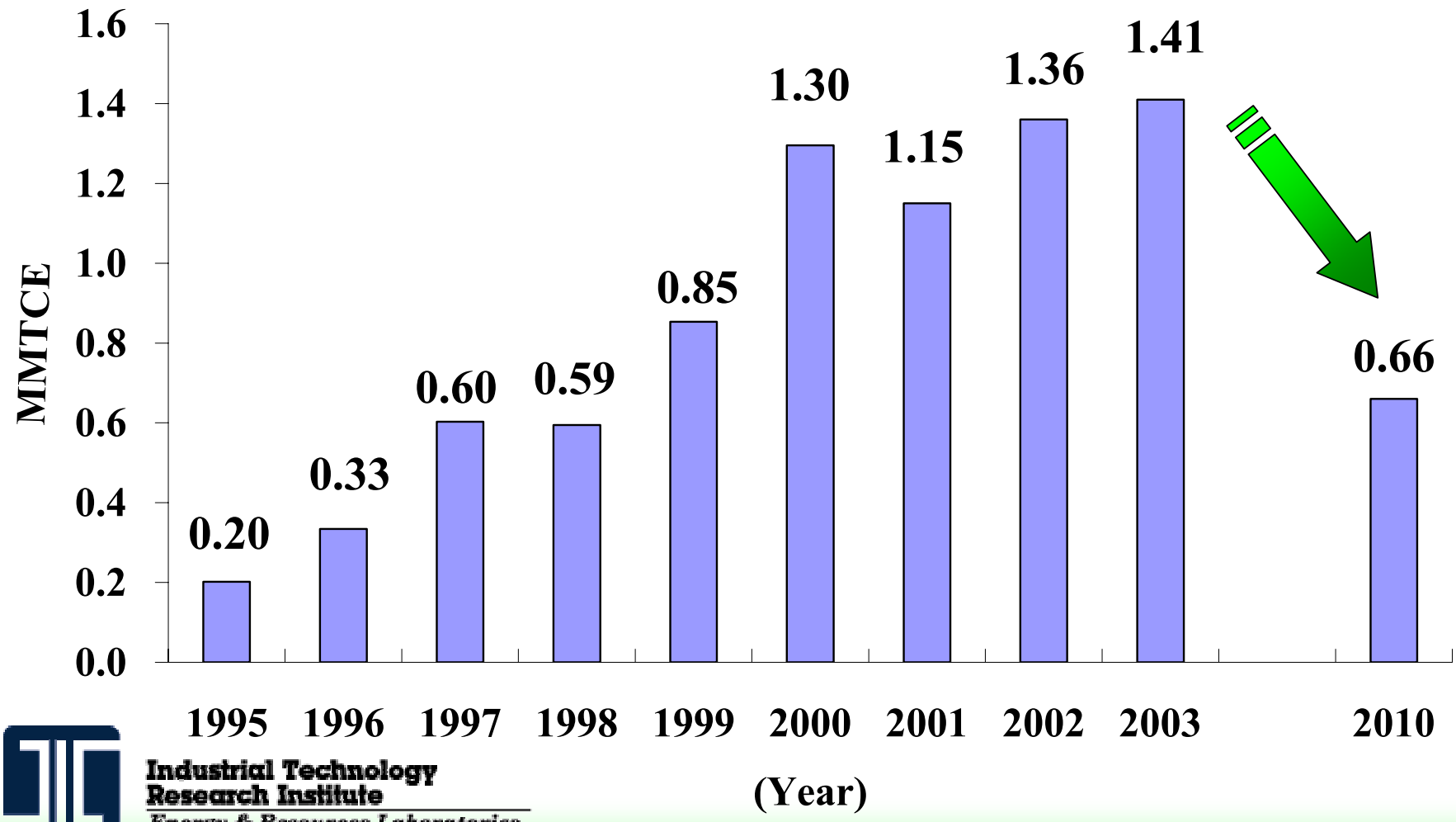


TSIA:(Taiwan Semiconductor Industrial Association)

Industrial Technology Research Institute
Energy & Resources Laboratories

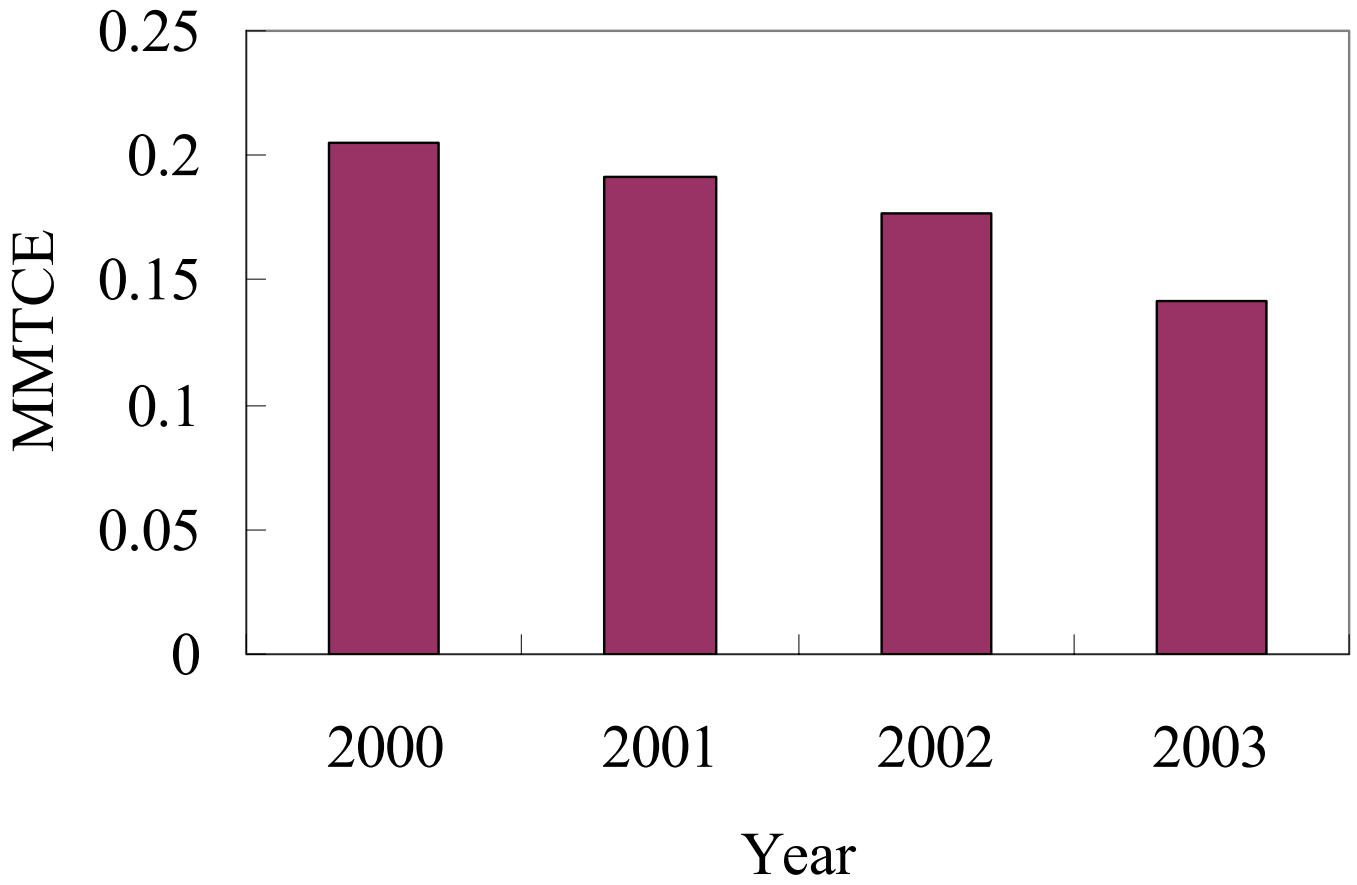
TSIA-PFC Emission Data

PFCs:C_2F_6,CF_4,CHF_3,SF_6,NF_3,C_3F_8,C_4F_8



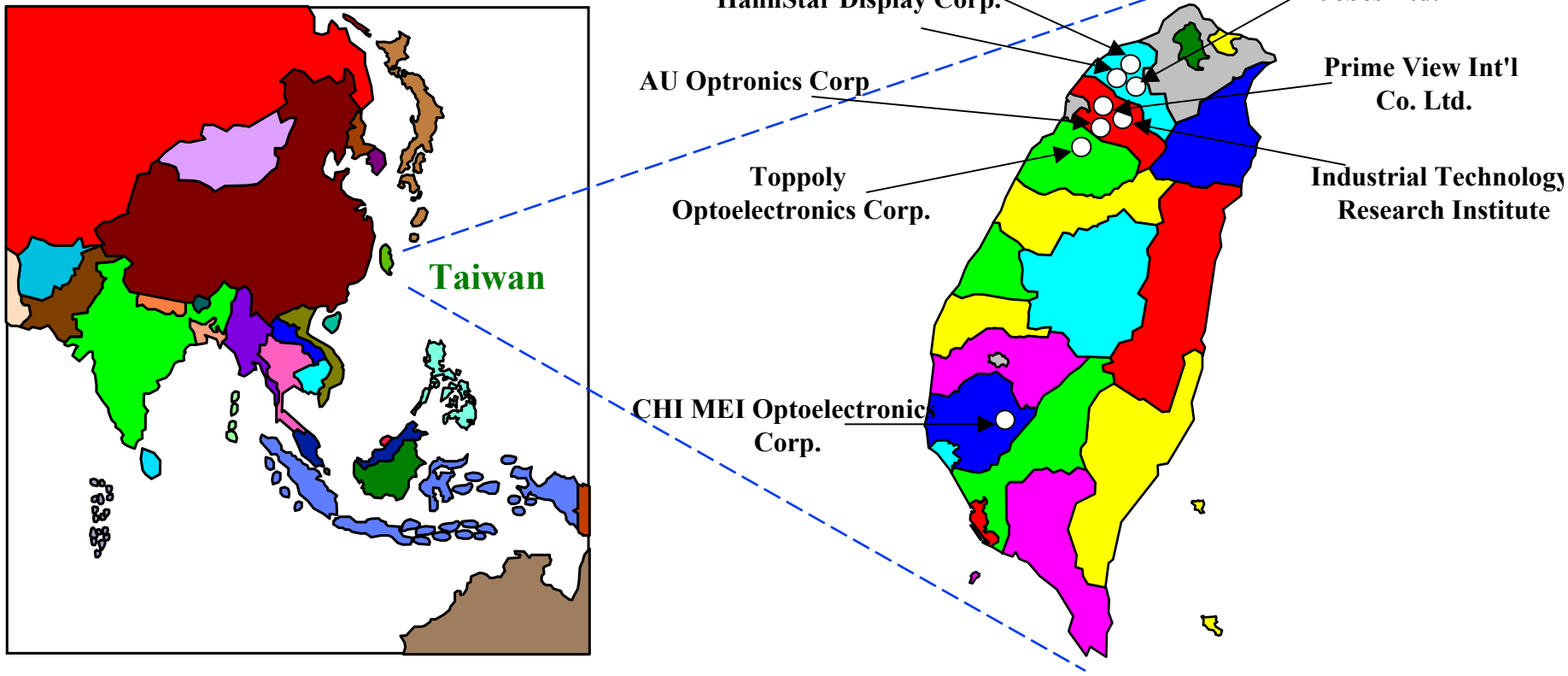
Industrial Technology Research Institute
Energy & Resources Laboratories

SF_6 Gas Emission by TSIA



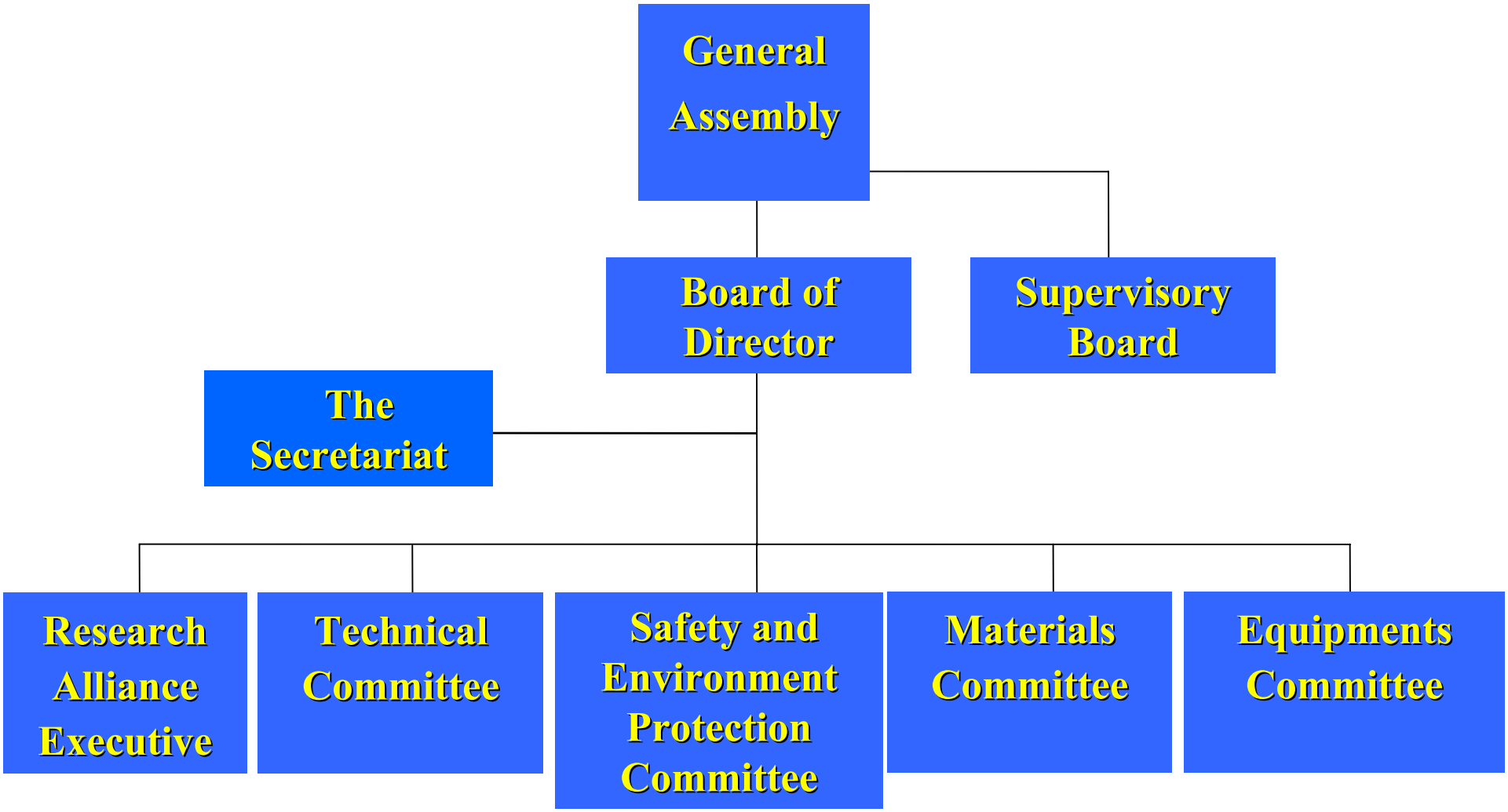
TTLA Member Distribution

TTLA:Taiwan Thin Film Transistor – Liquid Crystal Display Association



Industrial Technology Research Institute
Energy & Resources Laboratories

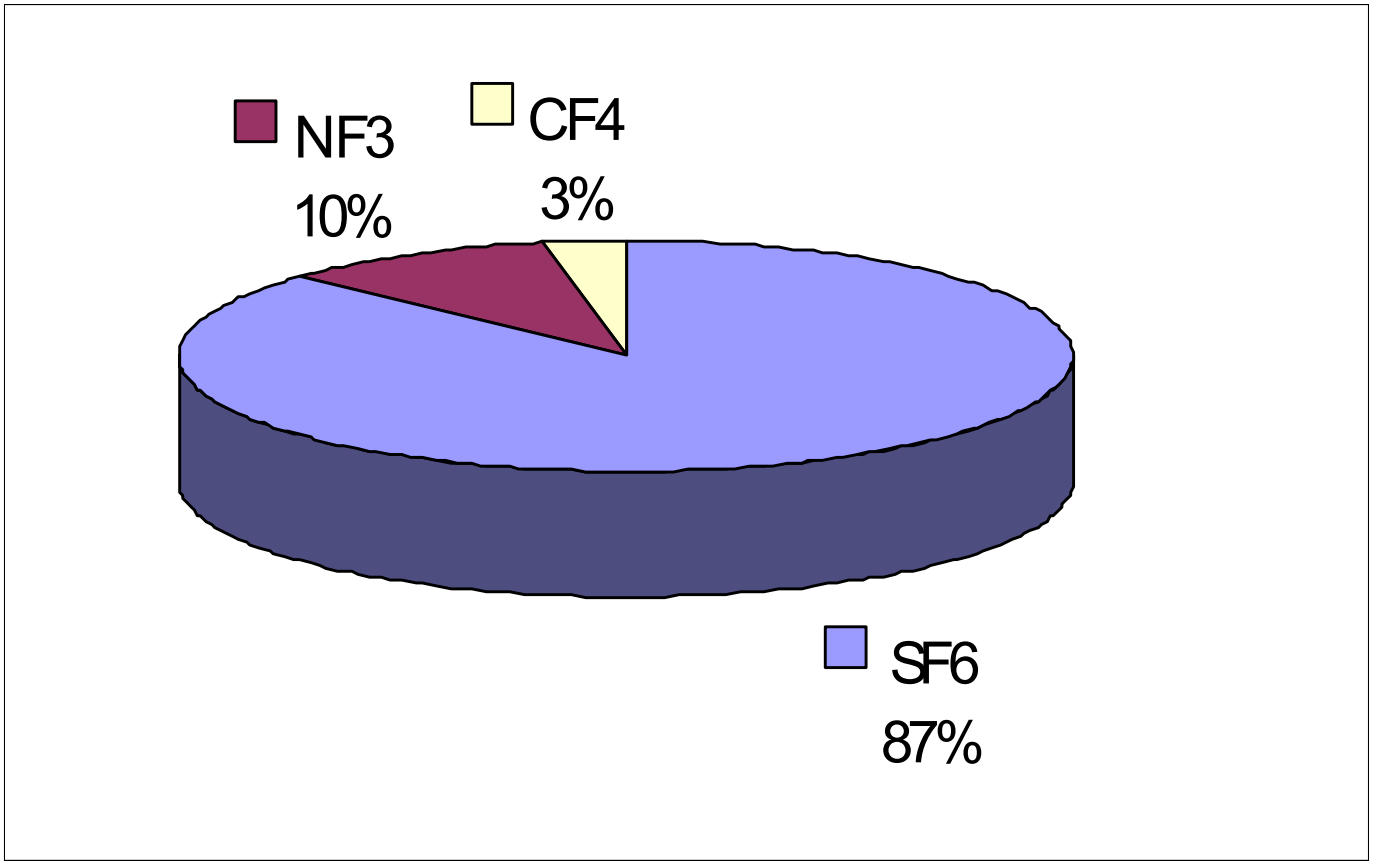
TTLA Organization



Safety and Environment Protection Committee

- SEP Committee devotes itself to studying and finding solutions for the safety and environmental related issues of Taiwan TFT-LCD industry. The SEP Committee also participates in international safety and environmental protection related organizations and activities.

TFT-LCD Industry Use PFCs

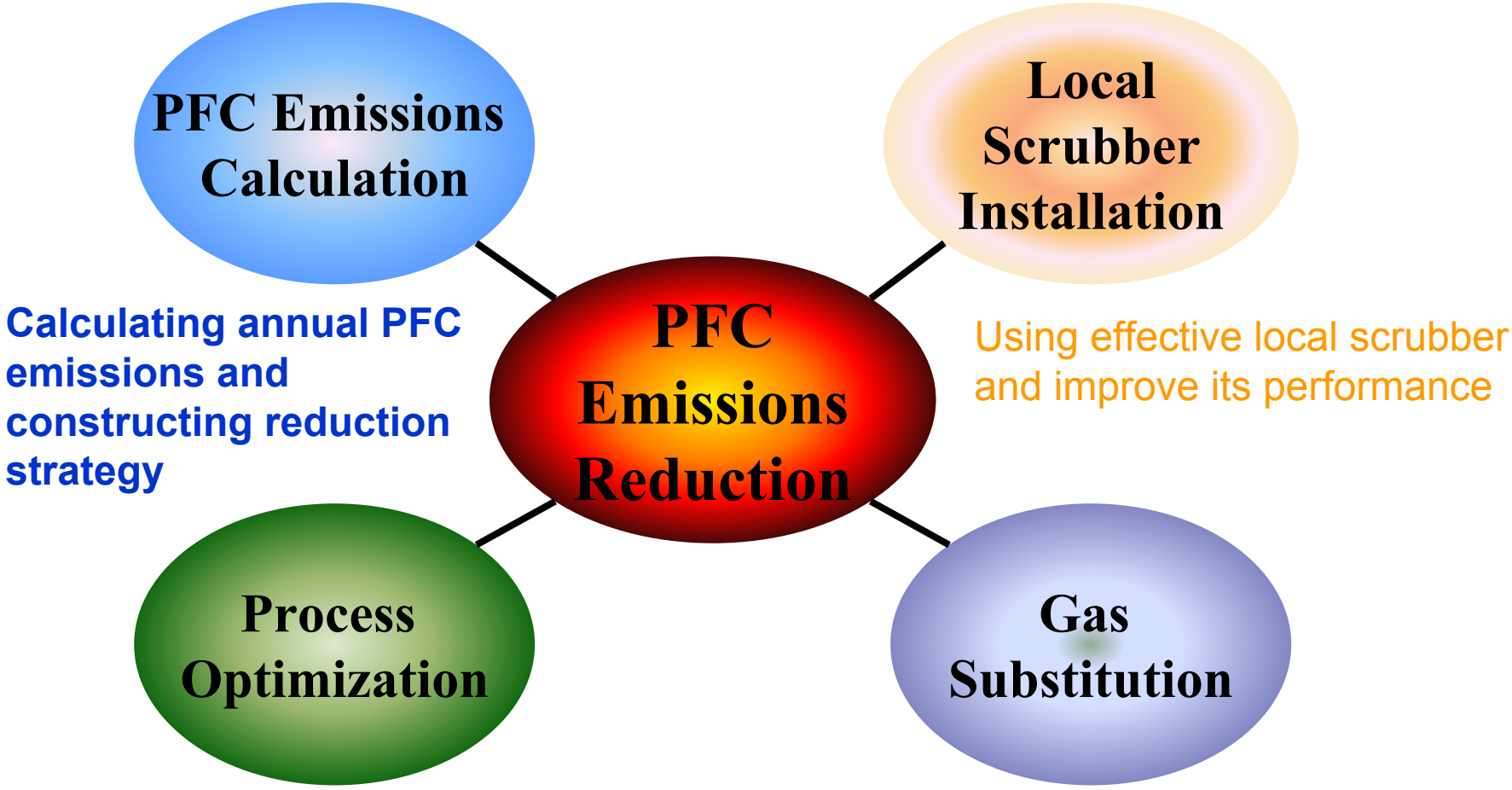


The PFCs of TTLA total emissions is 0.274MMTCE in 2003

TTLA PFCs Abatement strategy

- Join World TFT-LCD Association, achieve the PFCs emission reduction goal for Taiwan, Japan and Korea
- Sign with Taiwan EPA the voluntary memorandum for PFCs emission reduction
  - ✓ Taiwan EPA will assist TTLA on reporting and checking of the PFCs emission amount and provide
  - ✓ TTLA agrees to choose 2002 as the base year for PFCs emissionreduction
  - ✓ Use the PFCs emission intensity 0.0335 tonnes carbon equivalent/square meter substrate area used
- Implement reduction measures on the use and emission of PFCs.

The Technologies of reduction PFCs emission



Calculating annual PFC emissions and constructing reduction strategy

Using effective local scrubber and improve its performance

Optimizing the PFC usage inside the process chamber

Using gases with less global warming effects

PFC Emissions Calculation
IPCC Tier 2C Method

PFC emissions= (1-h)[PFC_i (1-C_i)(1-A_i) + (B_i*PFC'_i)(1-A'_i)]

h = residual PFC in the gas cylinder = 0.1

PFC_i= purchased PFC amount

PFC'_i = PFC used in the process tool (= **PFC_i** * C_i)

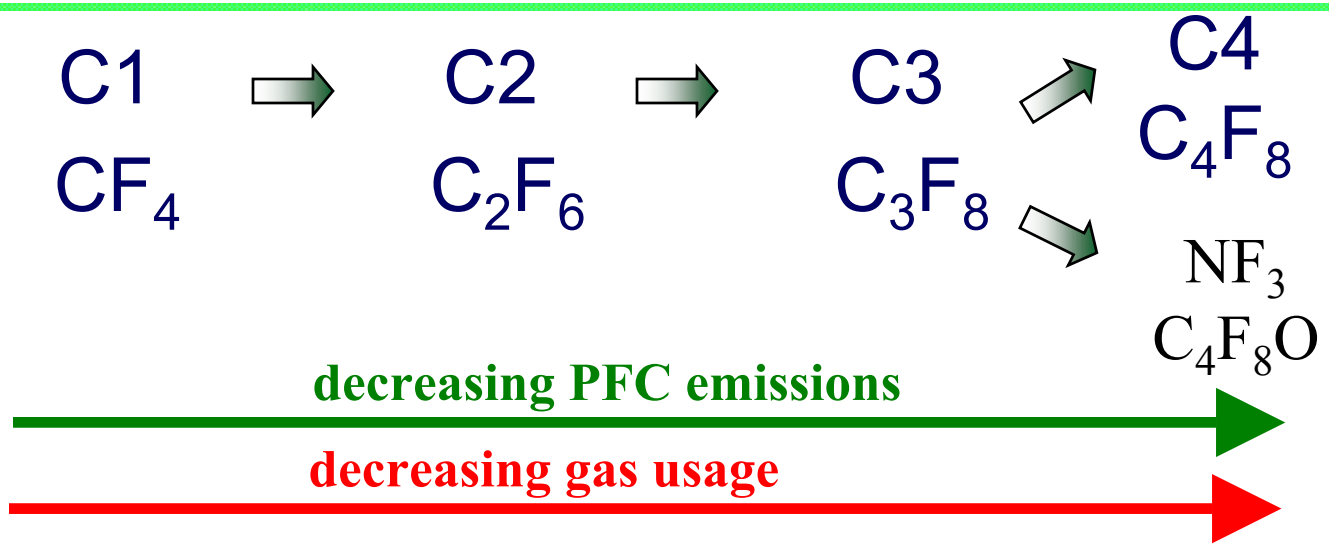
C_i= usage ratio of PFC in the process tool (rf. IPCC published value)

B_i=ratio of PFC converted to CF_4 (rf. IPCC published value)

A_i = DRE value of local scrubbers(rf. IPCC published value)

A'_i = DRE value of local scrubbers for CF_4 (rf. IPCC published value)

Drop-in replacement trends for Gas Substitution



Trends based on the decreasing stability of the compounds with increasing F, and so their more efficient conversion to atomic fluorine, the active cleaning species

DATA SOURCE:
International Seminar on PFC Emission control in Taiwan 2003

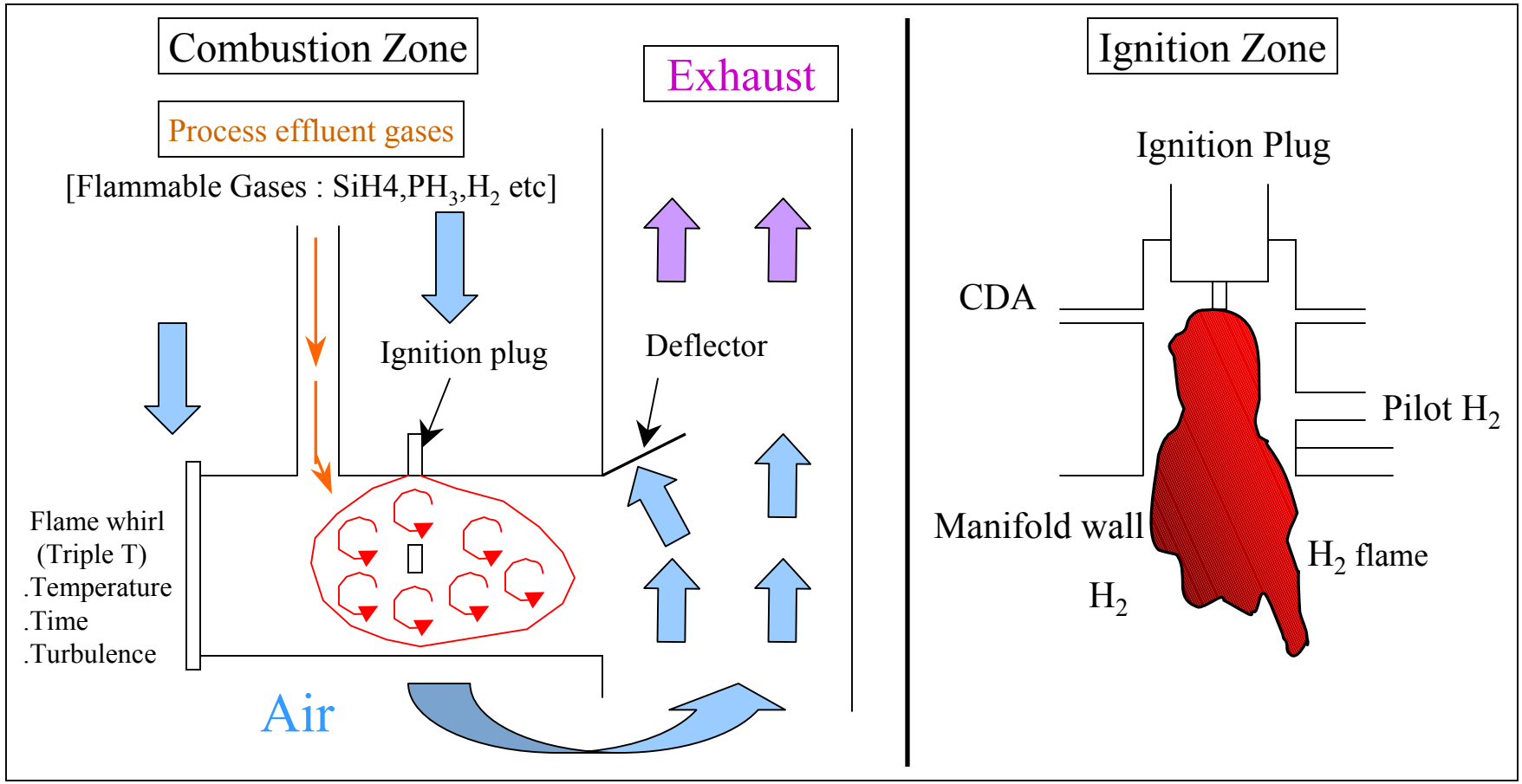
Optimization of NF_3 Remote Clean Process Optimization

- Control Item
  - ✓ NF_3 Flow rate
  - ✓ pressure
- Characteristics of remote NF_3Clean:
  - ✓ 99.7% destruction of NF_3
  - ✓ Faster process
  - ✓ No direct ion bombardment in CVD chamber
- Goal: reduce NF_3use

Local Scrubber Installation

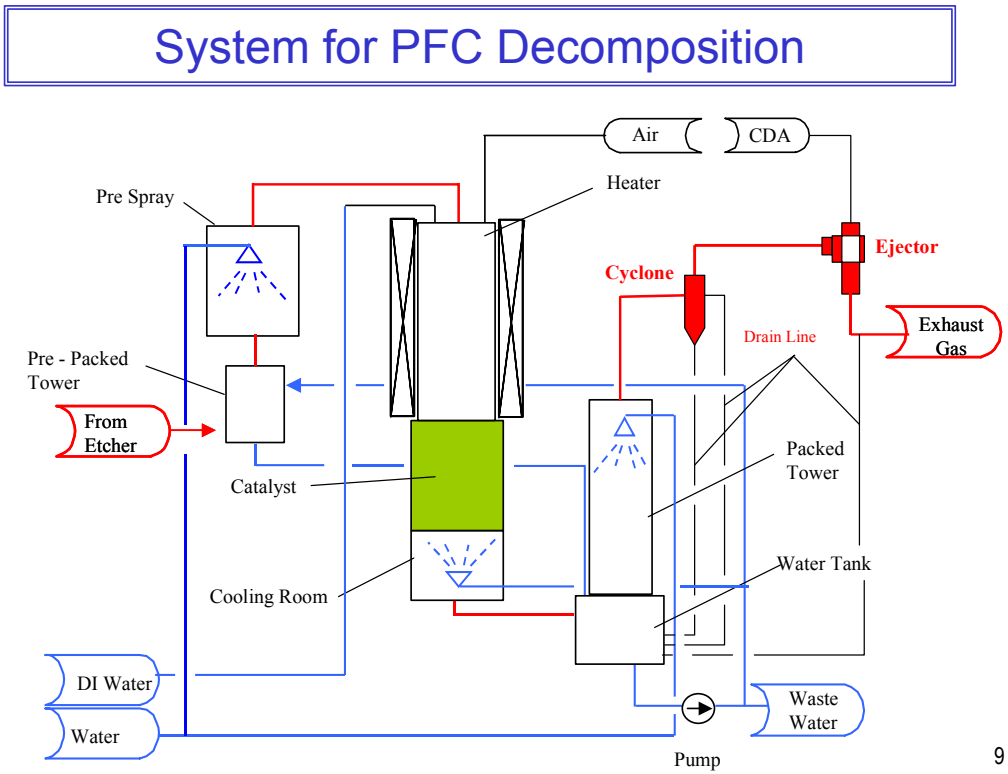
- The calculation of PFCs Emission is based on IPCC Method Tier 2c
- Local Scrubber DRE(destruction rate efficiency) to be 90%
  - ✓ Fueled combustion
  - ✓ Plasma
  - ✓ Catalytic devices
- The other local scrubbers DRE is 0%
  - ✓ Thermoelectric

Local Scrubber
Guardian Combustion



DRE=97% for NF3 (*Solid-State Technology (in Taiwan version),* May/June, 2004)

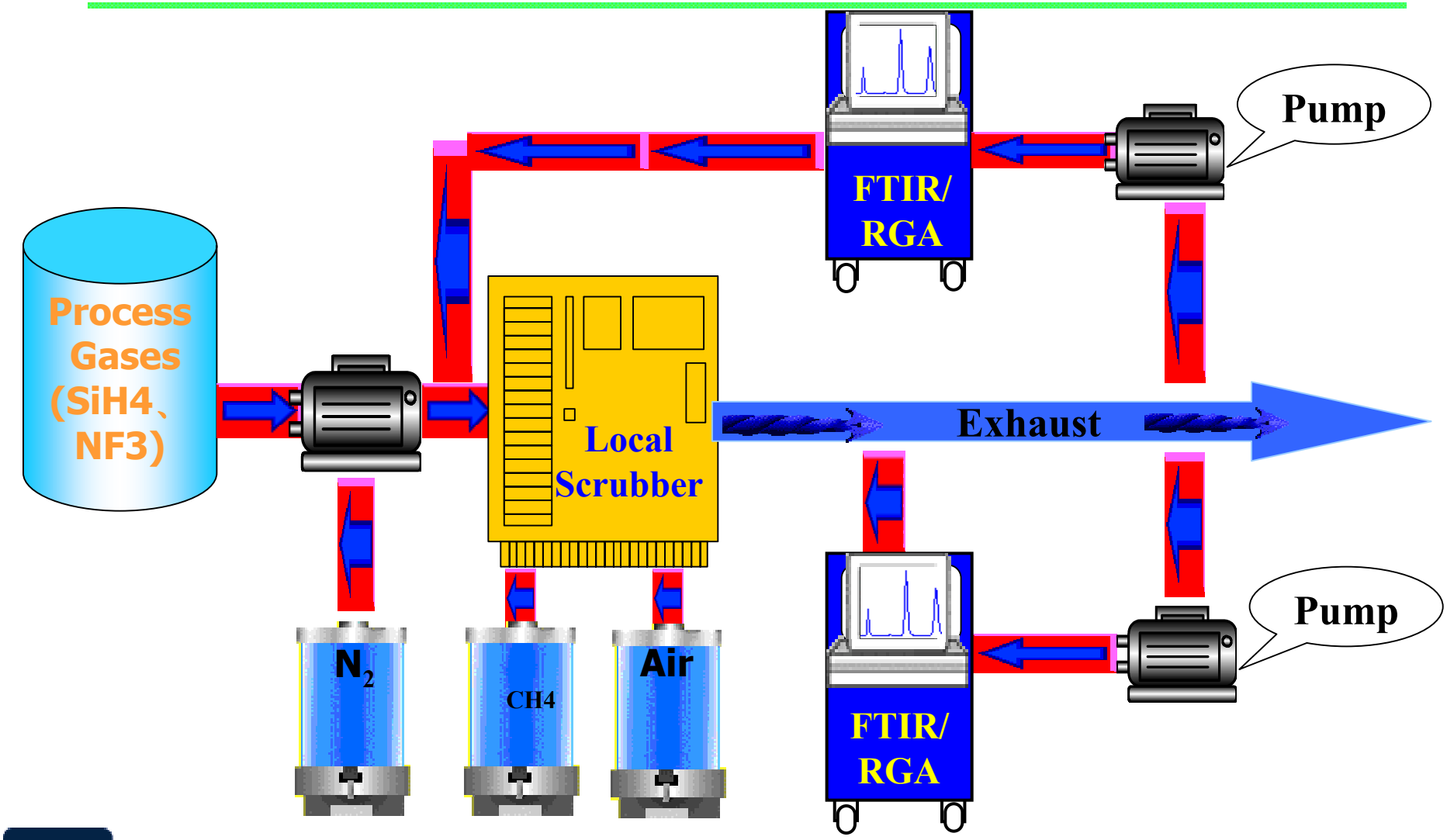
Local Scrubber
SCDS (thermal catalyst)



DRE>99% for CF4, C2F6, SF6

(*Solid-State Technology,* Sep. 2004)

Abatement Performance Evaluation of a Local Scrubber



Applications of Magnesium in Taiwan

1. Notebook PC	Casing & Interior framework
2. Consumer Electronic	Camcorder, Digital camera, PDA, MD, LCD projector, Internet appliance
3. Communication	Mobile phone
4. Automotive	Engine cover, Airbag housing, Steering wheel
5. Bicycle Industry	Fork Slider, Pedal, Frame, Crane, Hub, Stem

TMA SF_6 Abatement strategy

- There are 15 companies in TMA(Taiwan Magnesium Association) use SF_6 on 2002
- Taiwan EPA is working with TMA to assess substitute gases in hope to reduce the use and emission for SF_6.
- Current substitute gases in priority include SO_2, HFC-134a and other cover gases

Conclusion

- SF_6 emission from Industrial is less than 0.1% of greenhouse gases in Taiwan
- Taiwan semiconductor industry and TFT-LCD industry are committed to greenhouse gas reduction target
- Power industry and magnesium aluminum alloy industry are working with EPA to recover SF_6 and assessing substitute gases in hope to reduce the use and emission for SF_6.
- Taiwan will continue to develop saving energy and improve manufacturing process to reduce the use and emission for SF_6

Thank You