SF₆ Emission Reduction: What Taiwan is Doing

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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
Share of SF$_6$ Emission in Electric Power

- 45% Original Equipment Manufacturer
- 30% System Leak
- 18% Others
- 7% Maintenance system
- 3% Others
SF6 Emissions Reduction Strategies for Electric Power Systems

- To set a maintenance center
  - For small distribution system
  - For phasing out SF$_6$

- To recover SF$_6$ in servicing SF$_6$ equipment
  - From international companies using larger system
  - From Local companies using small/medium system

- To inventory SF$_6$ emission
  - To accelerate removal older facility
  - To Plan to sign the voluntary memorandum for SF$_6$ emission reduction with Taiwan EPA
  - To provide the Electric power industry with personnel training through Taiwan EPA
Semiconductors and TFT-LCD SF₆ Use

PFCs: C₂F₆, CF₄, CHF₃, SF₆, NF₃, C₃F₈, C₄F₈

1. CVD chamber cleaning

2. Dry-etching processes.
The Technologies of SF₆ Emission Reduction

- **SF₆ Emissions Calculation**: Calculating annual SF₆ emissions and creating reduction strategy.
- **Local Scrubber Installation**: Using effective local scrubber and improving their performance.
- **Process Optimization**: Optimizing the SF₆ usage inside the process chamber.
- **Gas Substitution**: Using gases with less global warming effects.

SF₆ Emissions Reduction
TSIA PFC Gas Purchase Share

- Trend up: NF3, C3F8
- Trend down: CF4, C2F6, SF6
TSIA PFC Emission Data

1. Install abatement system.
2. Change chemicals.
3. Process optimization
ISO 14064 GHG Verification of TSIA

This stage is a foundation for GHGEV and it is intended to confirm verification scope, methodology and materiality.

Verification Application

Identification Verification Scope

Cantonal and schedule arrangement

Document And materiality assessment

Stage 1 Verification

Stage 2 Verification

Stage 1 Verification for GHG Report

Non conformity

Corrective and Preventative action (CAP)

Verification Statement

CAP Conformation

Once per year
Achieving the TSIA Emission Roadmap Goal

Target: 0.67 MMTCE

[Graph showing the emission roadmap from 1995 to 2010, with categories for PFC Emission, Emission Reduction by abatement system, and Emission Reduction by Gas Replacement.]
TTLA SF$_6$ Gas Purchase

![Graph showing the purchase of SF$_6$ gas from 1999 to 2005. The y-axis represents the amount of gas purchased in Kg, ranging from 0.00E+00 to 6.00E+05. The x-axis represents the years 1999 to 2005. The data points show the following purchases:
- 1999: 4.02E+04 Kg
- 2000: 5.01E+04 Kg
- 2001: 1.12E+05 Kg
- 2002: 1.46E+05 Kg
- 2003: 2.40E+05 Kg
- 2004: 3.38E+05 Kg
- 2005: 5.62E+05 Kg]
TTLA SF₆ Emission

MMTCE

1999 2000 2001 2002 2003 2004 2005

0.032 0.033 0.060 0.122 0.246 0.260 0.437
The TTLA’s total PFCs of emissions was 0.46 MMTCE in 2005

TTLA: Taiwan TFT-LCD Association
TTLA Roadmap for PFC Emission Reduction

Target: $3.35 \times 10^{-8}$ MMTCE/M$^2$

BAU: Business as usual line
TTLA PFCs Abatement strategy

- To Join World TFT-LCD Association, to achieve the PFCs emission reduction goal for Taiwan, Japan and Korea

- To Sign the voluntary memorandum for PFCs emission reduction with Taiwan EPA
  - Taiwan EPA will assist TTLA in reporting and checking the PFCs emission amount and provide support
  - TTLA agrees to choose 2002 as the base year for PFCs emission reduction
  - To use the PFCs emission intensity 0.0335 Million tonnes carbon equivalent/square meter substrate area used
  - All new Fabs will set up PFC abatement system after 2003

- Implement reduction measures on the use and emission of PFCs.
  - Local Scrubber Installation
  - GHG Emissions Calculation and Verification to seek where PFCs can be reduction emission
Future work for SF₆ reduction emissions

- To Accelerate to set up SF₆ abatement system for old TFT-LCD plants
- To recycle the SF₆ emission transited to other industries
# Applications of Magnesium in Taiwan

<table>
<thead>
<tr>
<th>Supply industry</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Notebook PC</td>
<td>Casing &amp; Interior framework</td>
</tr>
<tr>
<td>2. Consumer Electronic</td>
<td>Camcorders, Digital cameras, PDAs, MDs, LCD projectors, Internet appliances</td>
</tr>
<tr>
<td>3. Communication</td>
<td>Mobile phones</td>
</tr>
<tr>
<td>4. Automotive Industries</td>
<td>Engine covers, Airbag housings, Steering wheels</td>
</tr>
<tr>
<td>5. Bicycle Industry</td>
<td>Fork Sliders, Pedals, Frames, Cranes, Hubs, Stems</td>
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There are 19 companies in TMA (Taiwan Magnesium Association) which used SF$_6$ in 2005.

Taiwan EPA is working with TMA to assess substitute gases in hopes of reducing the use and emission of SF$_6$.

Current substitute gases in priority include SO2, HFC-134a, Novec TM 612 and other cover gases.

TMA will cooperate with TTLA’s members to reuse the SF$_6$ to get Win-Win benefit.
Conclusion

- SF$_6$ emission from Industry is less than 0.1% of greenhouse gases in Taiwan
- The Taiwan semiconductor industry and TFT-LCD industry have signed with EPA MOU to commit to greenhouse gas reduction target
- Power industry and magnesium aluminum alloy industry are working with EPA to recover SF$_6$ and assess substitute gases in hope of reducing the use and emission of SF$_6$.
- Taiwan will continue to develop energy saving methods and improve manufacturing processes to reduce the use and emission of SF$_6$ and to study the post-Kyoto protocol strategy
Thank You