

# Trends in SF<sub>6</sub> Sales and End-Use Applications: 1961-2003

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3<sup>rd</sup> International Conf. on SF<sub>6</sub> and the Environment  
1-2 December 2004

# SF<sub>6</sub> Data Summary

## Key Questions

How much SF<sub>6</sub> is being produced worldwide?

What are the major applications?

What are the trends in sales and uses over time?

# SF<sub>6</sub> Data Summary

## Presentation Overview

Purpose and Genesis of SF<sub>6</sub> Data Collection Effort

Approach and Key Features

Results of Current Survey

- Global Coverage (participating companies)
- Total Annual Sales (1961-2003)
- Sales by End-Use Categories / Market Sectors (1980-2003 & 1996-2003)
- Trends in SF<sub>6</sub> Sales

# SF<sub>6</sub> Data Summary

## Purpose

To provide the scientific community with historical SF<sub>6</sub> data for

- analyzing trends, sources and applications
- calculating SF<sub>6</sub> emissions
- calculating equivalent CO<sub>2</sub> emissions loading
- correlating production data with atmospheric measurements

To inform policy makers of current SF<sub>6</sub> market data

# SF<sub>6</sub> Data Summary

## Study Background

Initial Retrospective Survey: 1961-1996  
(compilation of historical annual sales data)

Follow-on Survey: 1997-1999

Next Update: 2000-2001 and 2002-2003

Data Reported at International SF<sub>6</sub> Conference  
in 2000, 2002 and 2004

# SF6 Data Summary

## Key Features

Survey of direct sales from manufacturers to customers (primary market sectors)

Voluntary Participation (7 core companies)

Independent Third Party (RAND)

- Survey companies
- Compile and report aggregated data

Confidentiality Agreement

# SF<sub>6</sub> Data Summary

## Reporting Companies

- Airgas, Inc. (*acquired part of APCI in 2003*)
- Air Products and Chemicals, Inc.
- Asahi Glass Chemicals
- Honeywell International (formerly AlliedSignal)
- Kanto Denka Kogyo
- Nuclear Energy Corp. of South Africa (NECSA)
- Solvay Fluor, including Ausimont (*acquired in Spring 2002*)

# SF<sub>6</sub> Data Summary

## Sponsors

SF<sub>6</sub> manufacturers

U.S. Environmental Protection Agency

U.S. National Electrical Manufacturers  
Association (NEMA) / SF<sub>6</sub> Task Group



# SF<sub>6</sub> Data Summary

## Overview of Results

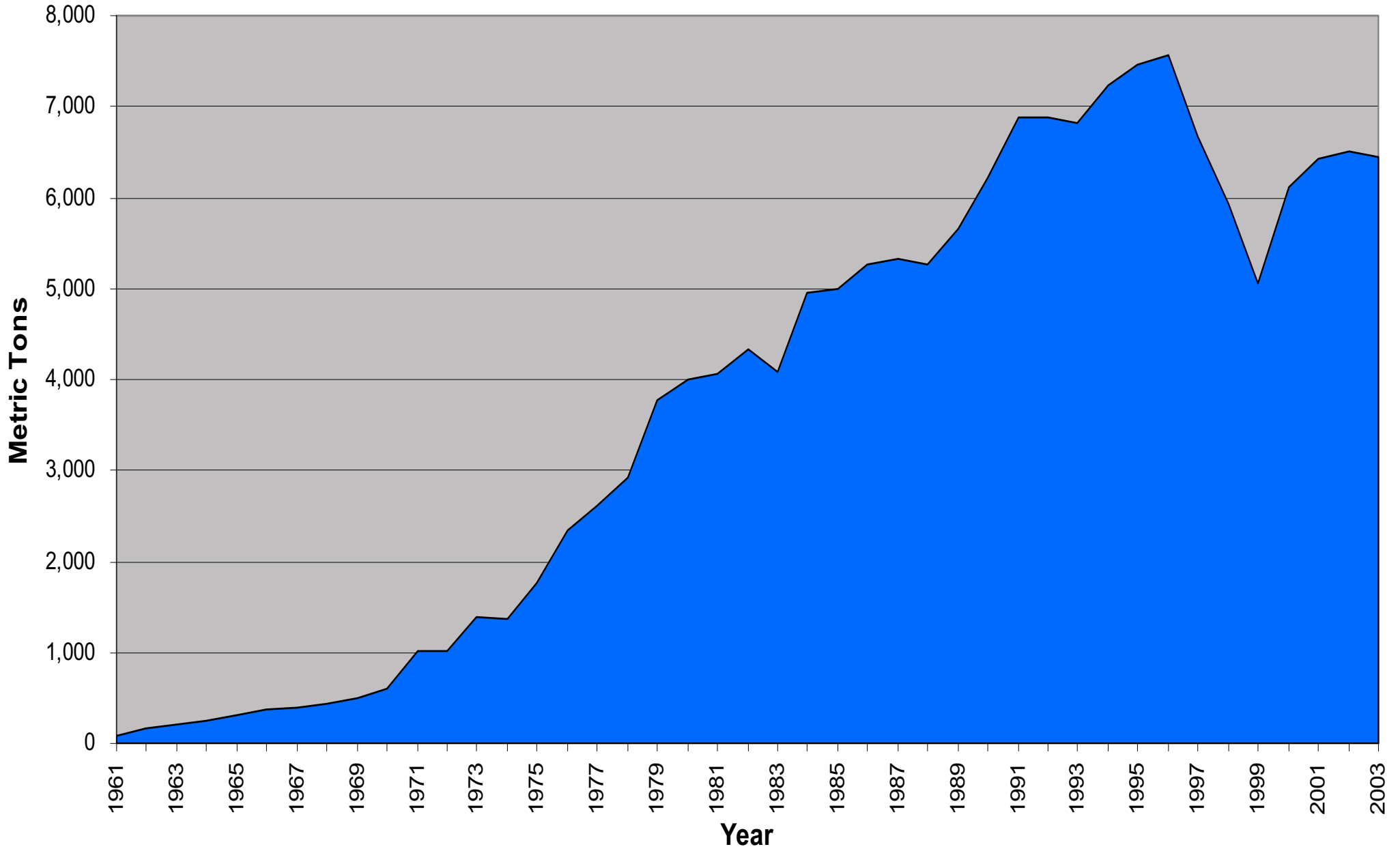
Total Annual Sales (1961-2003)

Sales by End-Use Categories

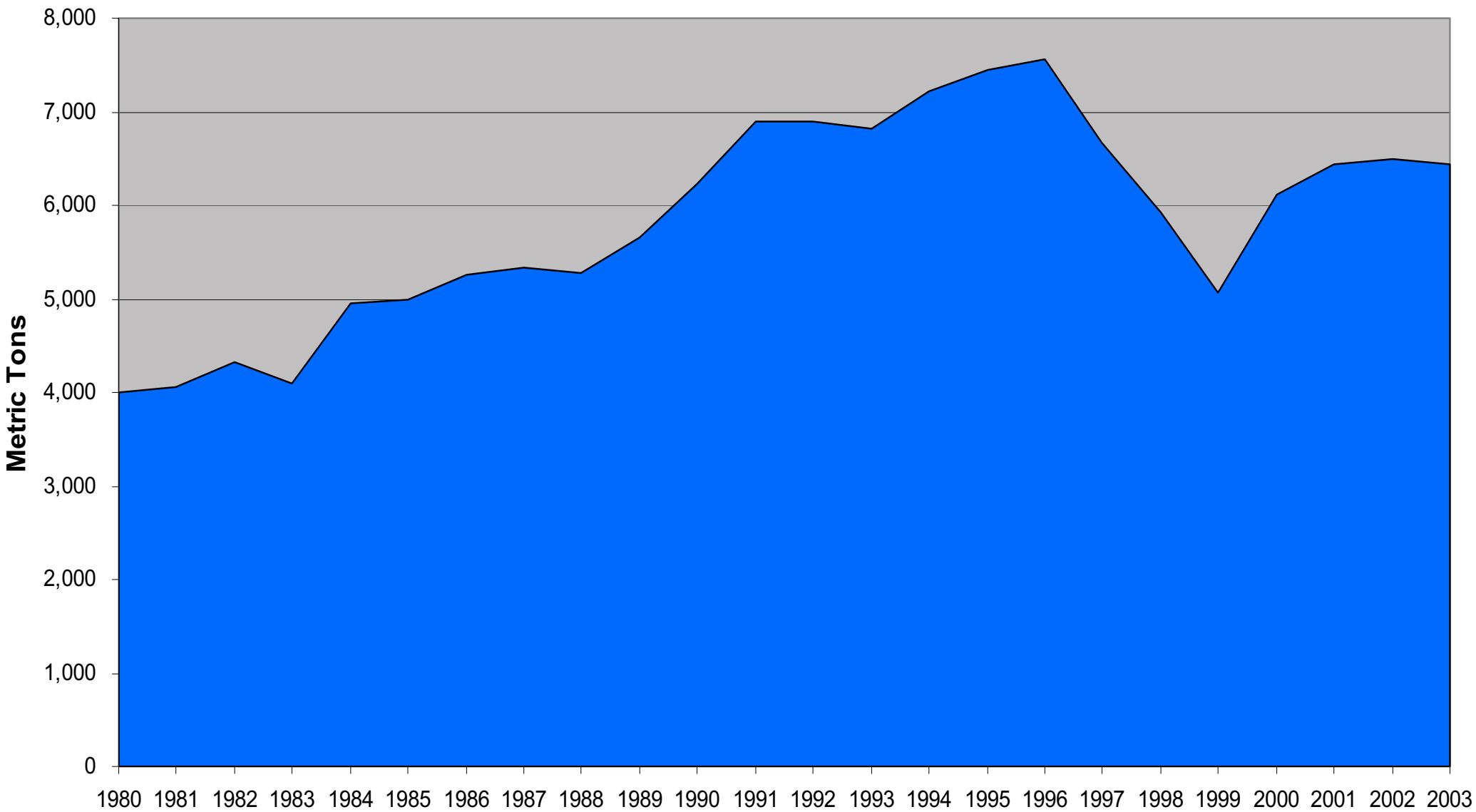
Periods 1980-2003 and 1996-2003

Trends in Sales by Market Sector / End-Use  
Category

# Total Annual Sales of SF<sub>6</sub> (1961-2003)



# Total Annual Sales of SF<sub>6</sub> (1980-2003)



# Annual Change in Sales (1980-2003)

YEAR	Total Sales (metric tons)	Annual Change (from previous yr)		YEAR	Total Sales (metric tons)	Annual Change (from previous yr)
1980	3,991	6%		1992	6,887	0%
1981	4,053	2%		1993	6,821	-1%
1982	4,329	7%		1994	7,225	6%
1983	4,091	-5%		1995	7,457	3%
1984	4,960	21%		1996	7,571	2%
1985	4,996	1%		1997	6,665	-12%
1986	5,262	5%		1998	5,929	-11%
1987	5,324	1%		1999	5,067	-15%
1988	5,270	-1%		2000	6,119	21%
1989	5,658	7%		2001	6,435	5%
1990	6,225	10%		2002	6,501	1%
1991	6,886	11%		2003	6,438	-1%

# SF<sub>6</sub> Data Summary

## End-Use Categories

Electric Utilities

Original Equipment Manufacturers (OEMs)  
(for electric power systems)

Magnesium Industry

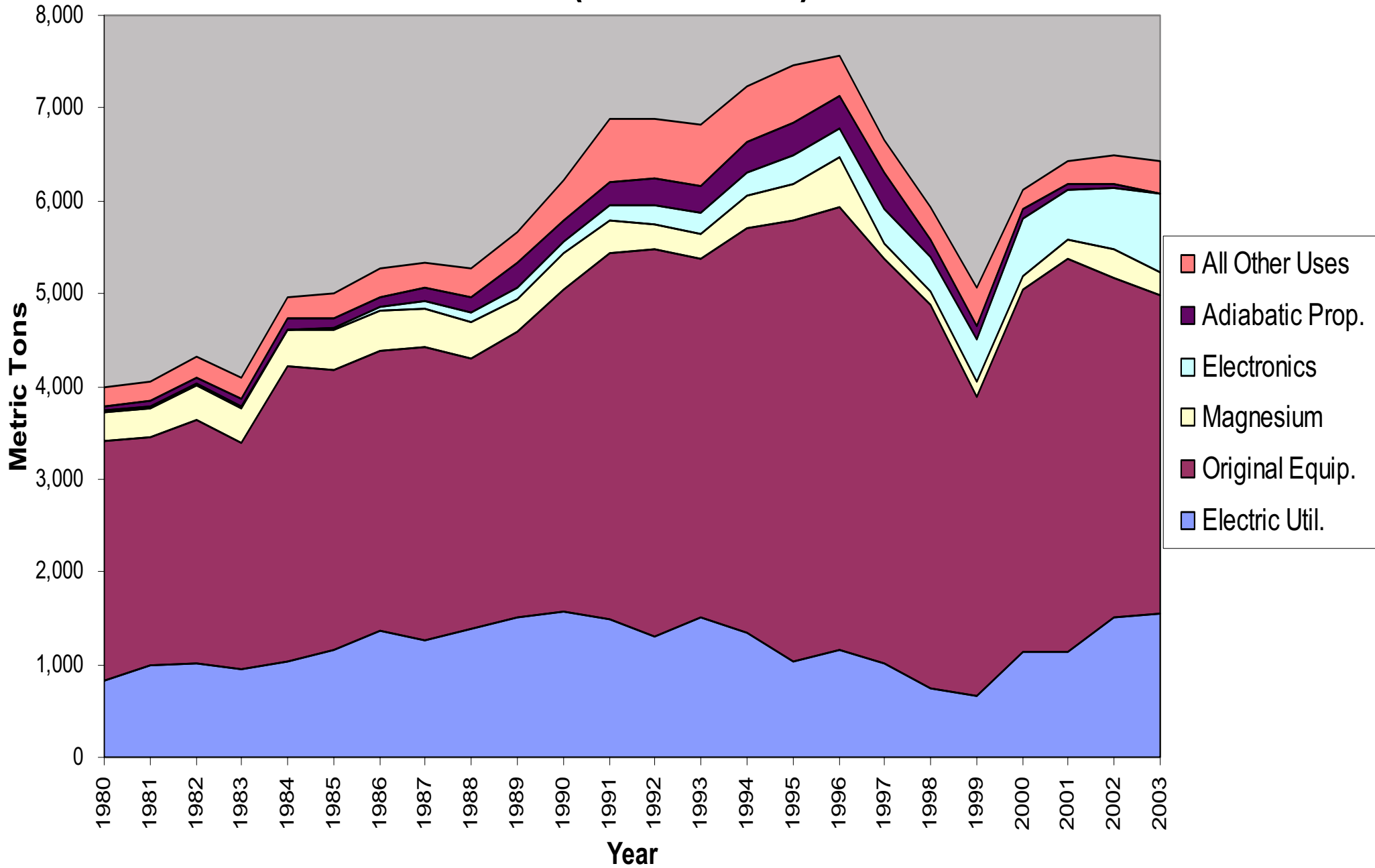
Electronics Industry

Utilizing SF<sub>6</sub> Adiabatic Property (e.g., tires)

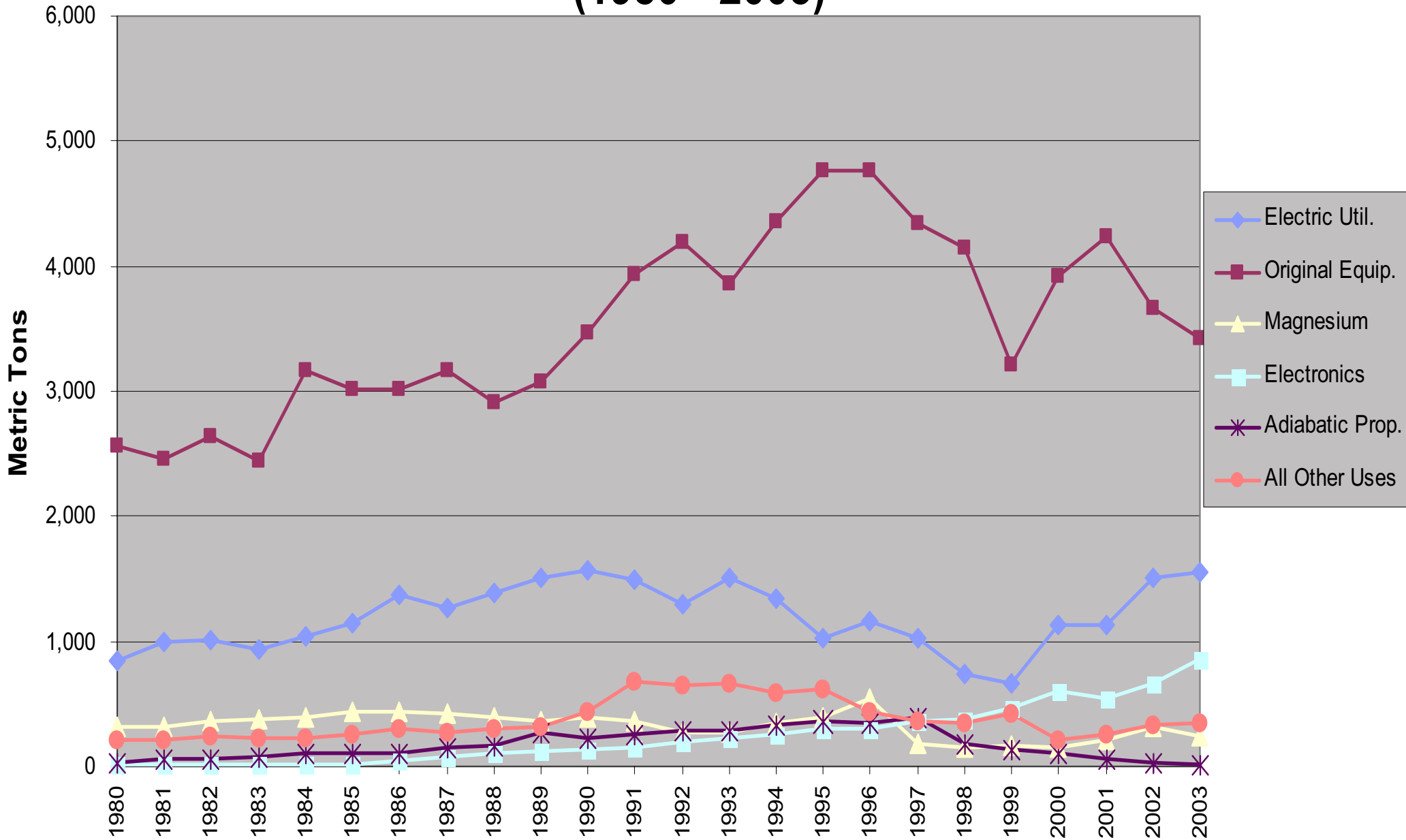
All Other Uses

Accelerators, optical fiber production, glazing, lighting, biotechnology, medical, refining, pharmaceutical, laboratory / university research, sound proof windows

# Annual Sales of SF<sub>6</sub> by End-Use Application (1980 - 2003)

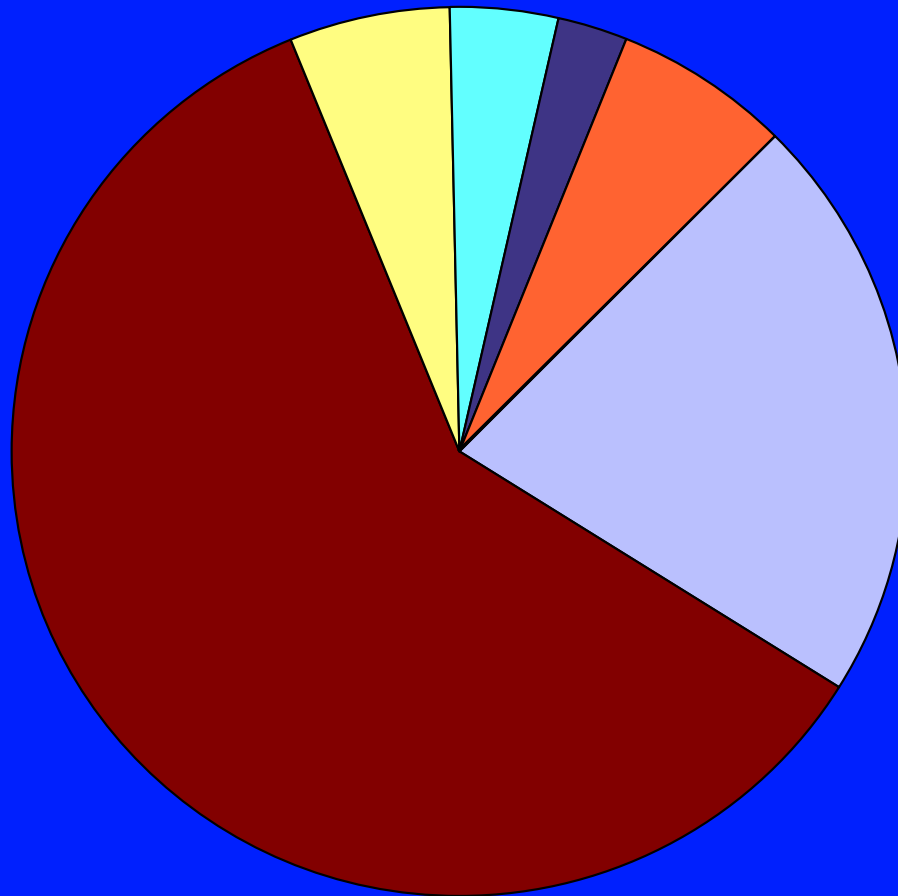


# Annual Sales of SF<sub>6</sub> by End-Use Application (1980 - 2003)



# SF6 Sales by End Use: 1961-2003

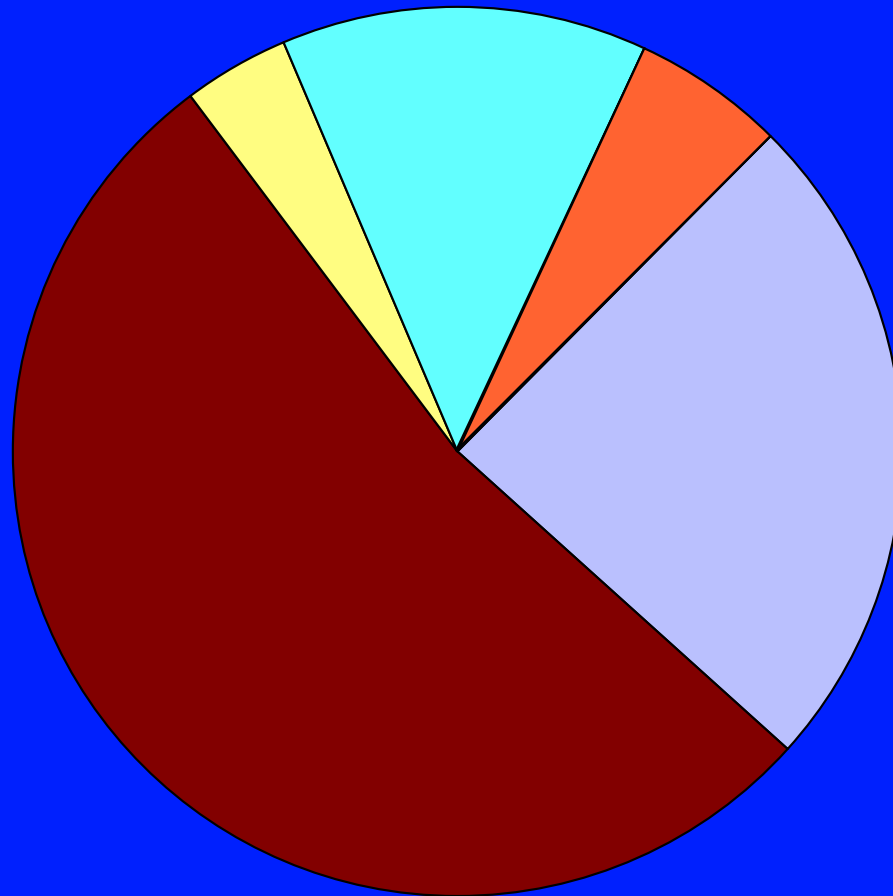
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- Electric Utilities (21%)
- Orig. Equipment Manuf. (60%)
- Magnesium Industry (6%)
- Electronics Industry (4%)
- SF6 Adiabatic Properties (3%)
- All Other Uses (6%)

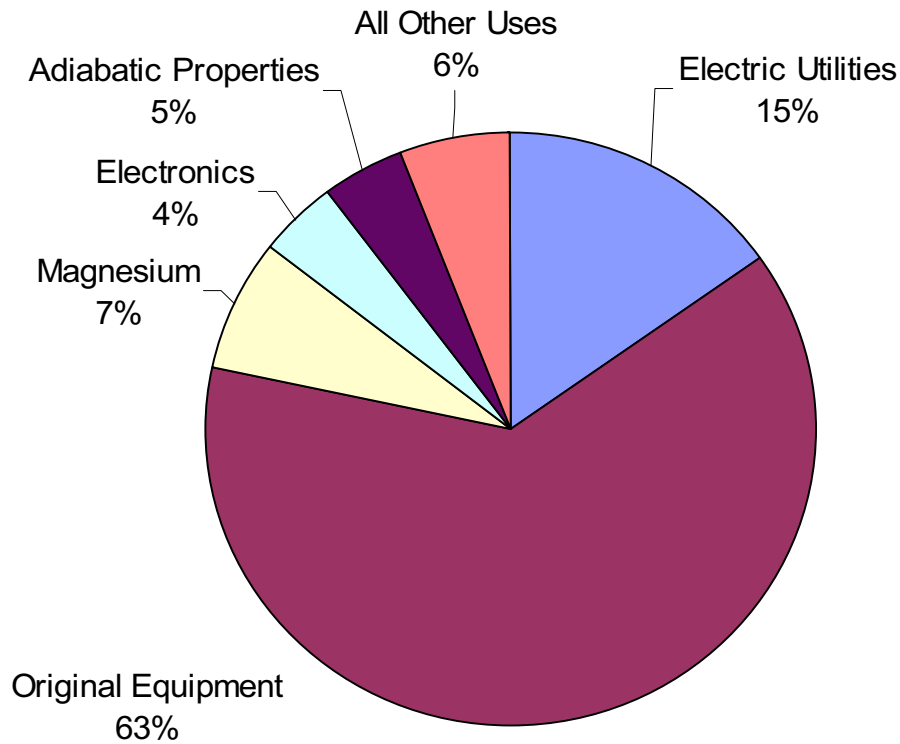


# SF6 Sales by End Use in 2003



- Electric Utilities (24%)
- Orig. Equipment Manuf. (54%)
- Magnesium Industry (4%)
- Electronics Industry (13%)
- SF6 Adiabatic Properties (0%)
- All Other Uses (5%)

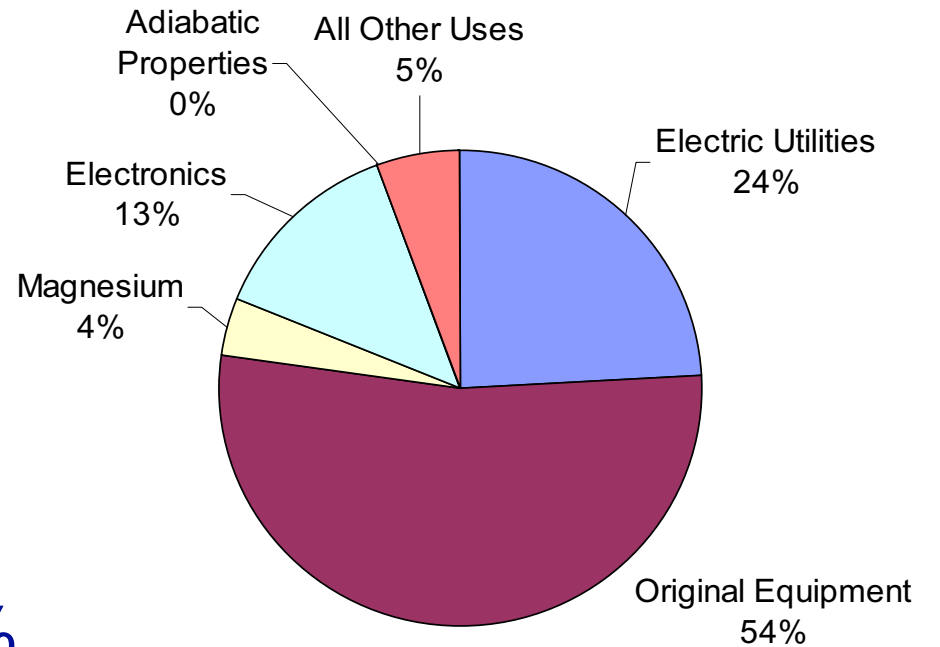
### Breakdown of Total SF6 Sales: 1996



Peak Year

- 15%

### Breakdown of Total SF6 Sales: 2003



Current Year

# Sales by End-Use Application

									(1996-2003)		(1961-2003)
<b>End-Use Application</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	<b>8-Yr Ave.</b>	<b>*</b>	<b>43-Yr Ave.</b>
Electric Utilities	15%	15%	13%	13%	18%	18%	23%	24%	17%	*	21%
Orig. Equipment Manuf.	63%	66%	70%	64%	64%	66%	57%	54%	63%	*	60%
Magnesium Industry	7%	3%	2%	3%	3%	3%	5%	4%	4%	*	6%
Electronics Industry	4%	5%	6%	9%	10%	8%	10%	13%	8%	*	4%
SF6 for Adiabatic Properties	5%	6%	3%	3%	2%	1%	0%	0%	3%	*	3%
All Other Uses	6%	5%	6%	8%	3%	4%	5%	5%	5%	*	6%

# SF<sub>6</sub> Data Summary

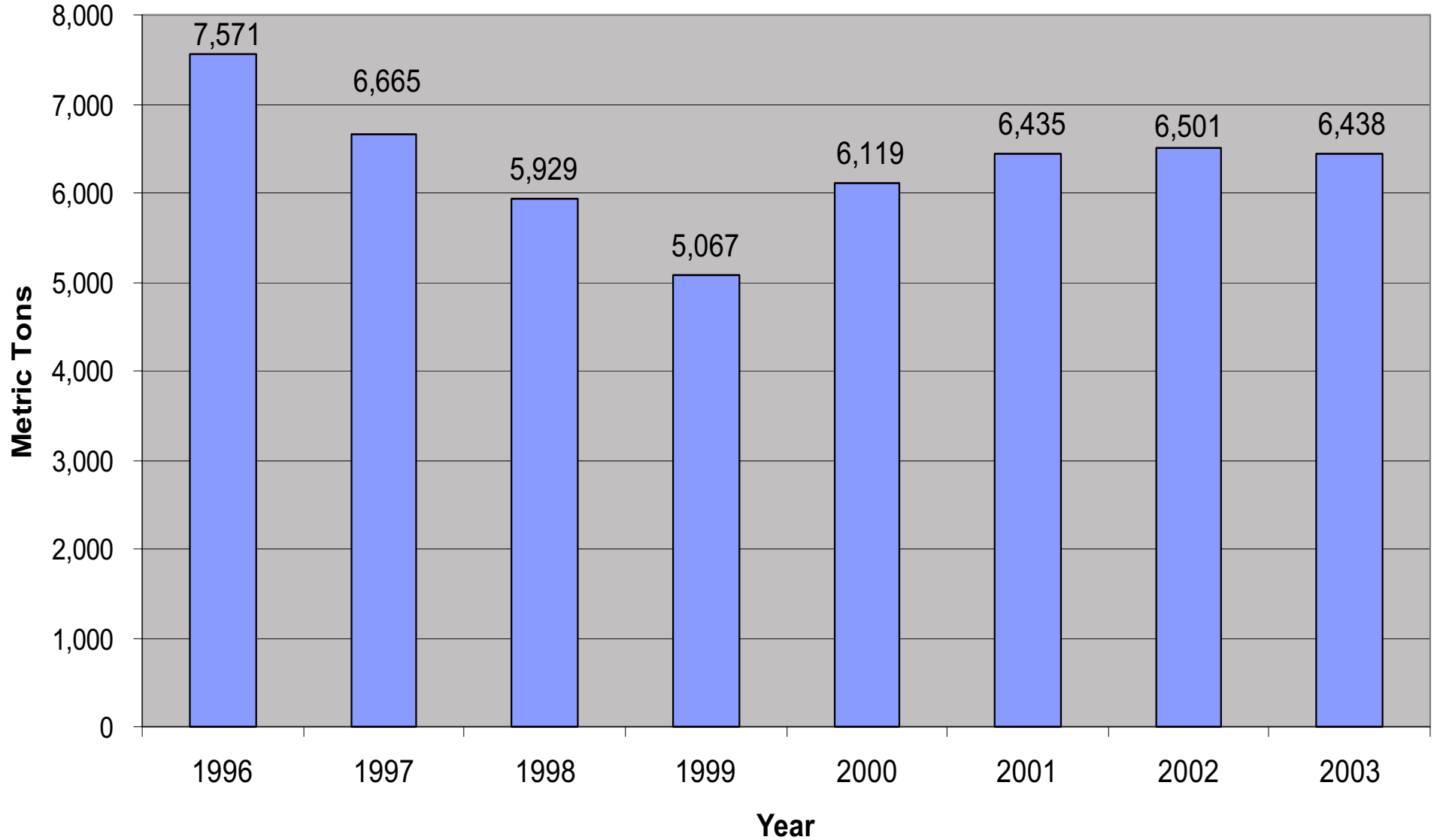
## Current Reporting Period

Comparison of 2002-2003 results to peak year (1996) and previous reporting period (2000-2001)

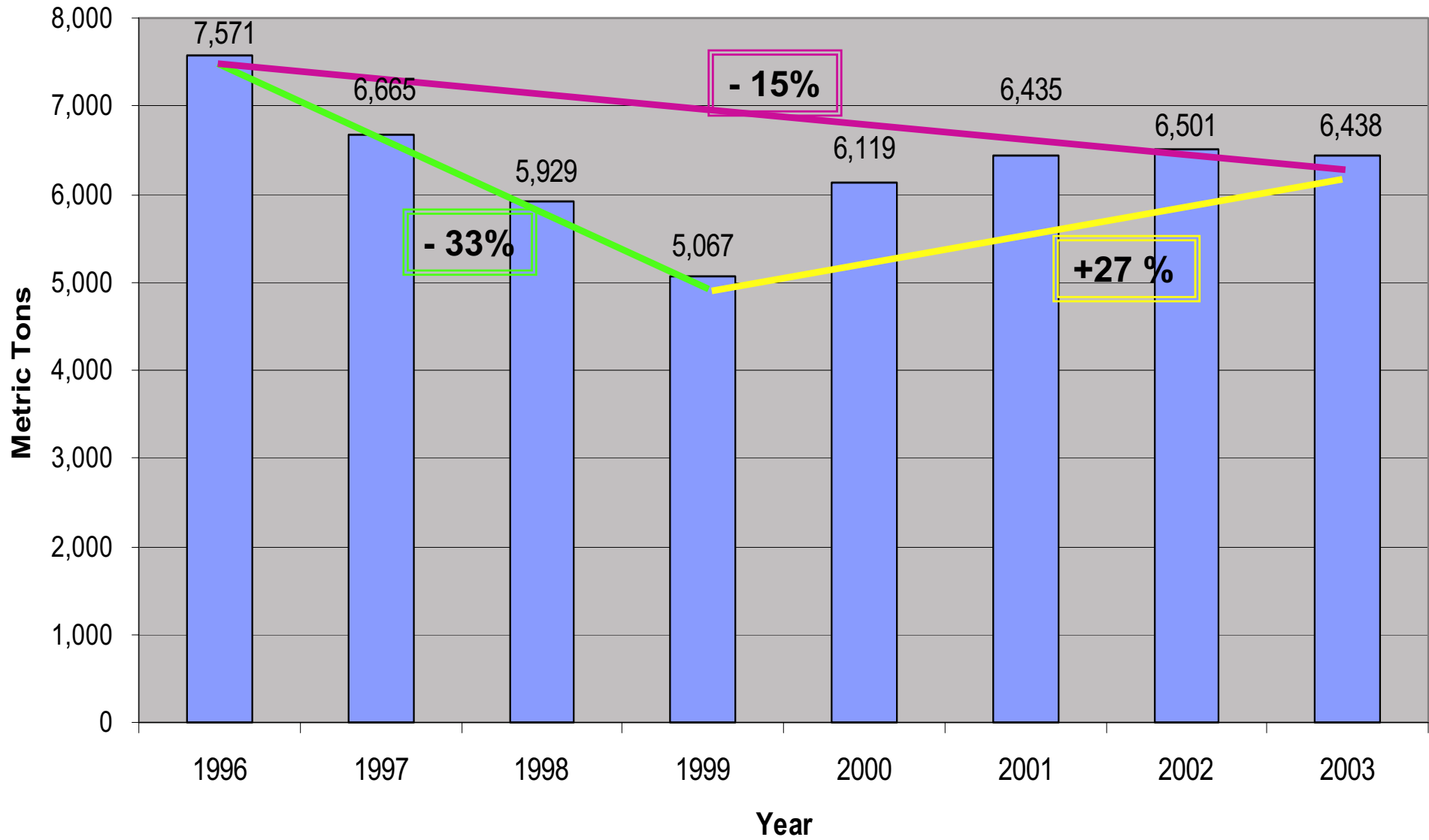
Annual sales by end-use application

Annual change in sales levels – by category – between 1996 (peak) and 2003 (current)




# Total Annual Sales of SF<sub>6</sub> (1996-2003)



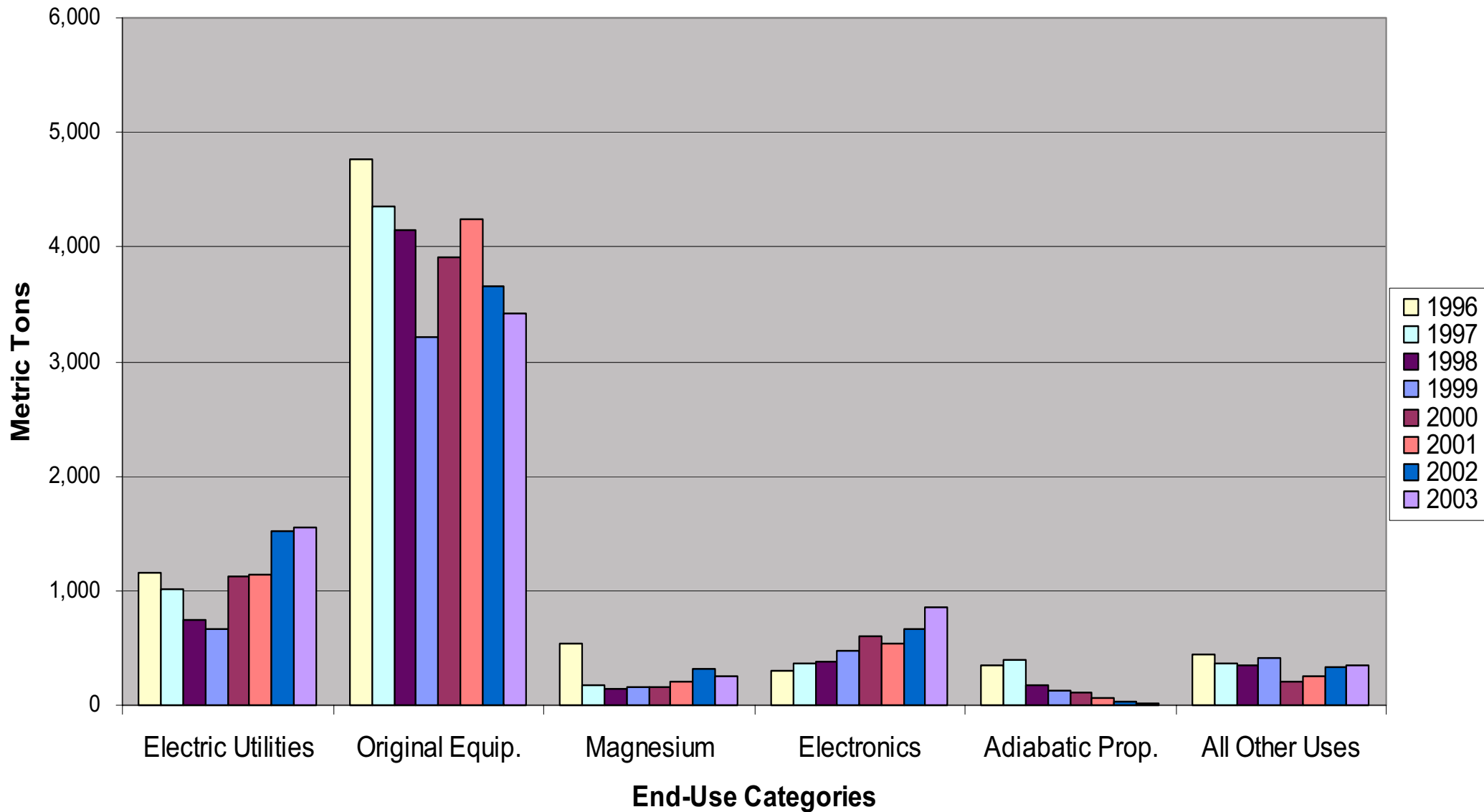
# Total Annual Sales of SF<sub>6</sub> (1996-2003)



# Trends in Annual Sales: 1996-2003

1996 – 1997	– 12%		– 33%
1997 – 1998	– 11%		
1998 – 1999	– 15%		
1999 – 2000	+ 21%		+ 27%
2000 – 2001	+ 5%		
2001 – 2002	+ 1%		
2002 – 2003	– 1%		– 15%

# SF<sub>6</sub> Sales for the Period 1996-2003





# Change in End-Use Sales: 1996-2003

Annual Change	Electric Utilities	Original Equip. Manufacturers	Magnesium Industry	Electronics Industry	for Adiabatic Properties	All Other Uses
1996-1997	(142) -12%	(425) -9%	(366) -67%	54 18%	49 14%	(76) -17%
1997-1998	(279) -27%	(206) -5%	(30) -17%	12 3%	(218) -55%	(15) -4%
1998-1999	(73) -10%	(932) -23%	17 12%	101 27%	(41) -23%	67 19%
1999-2000	459 69%	707 22%	(12) -7%	130 27%	(26) -19%	(206) -49%
2000-2001	4 0%	321 8%	58 38%	(63) -10%	(45) -42%	41 19%
2001-2002	459 69%	707 22%	(12) -7%	130 27%	(26) -19%	(206) -49%
2002-2003	40 3%	(235) -6%	(66) -21%	194 29%	(20) -68%	24 7%

"All Other Uses" includes accelerators, optical fiber production, glazing, biotechnology, lighting, medical, refining, pharmaceutical, laboratory / university research, sound proof windows.

# SF<sub>6</sub> Data Summary

## Electronics Sector

Largest growth in SF<sub>6</sub> sales is in Electronics

End-use applications (2002-2003):

- Semiconductors 68%
- LCD / Flat Panel Displays 32%

First time information on specific electronics applications was requested from producers (companies participating in SF<sub>6</sub> survey)

# SF<sub>6</sub> Data Summary

## Summary of Results

Peak year for sales occurred in 1996 (~7,600 te)

Overall annual sales declined from 1996 to 1999 by 2,504 metric tons (-33%)

1999 sales at same level as in 1985 (~5,000 te)

Total sales increased from 1999 to 2002/2003 by 1,371 metric tons (+27%)

Sales in 2003 are 15% below peak year (1996) – at approximately the same level as in 1990

# SF6 Data Summary

## Summary of Results (cont.)

Sales to various market sectors show mixed results since 2001 (last report)

- Sales *decreased* in the Electric Power Sector, which is represented by the Utilities and OEM categories – from 84% to 78%
- Electronics Industry showed the *largest increase* (5% growth)
- Magnesium Industry and All Other Uses held fairly *steady*
- Sales *decreased* for Adiabatic Properties to 0% (only 9 te)

Percent of world represented is unknown; other producers are encouraged to participate in the study

# SF<sub>6</sub> Data Summary

## Significance of Results

Historical annual sales data; continuous record for 1961–2003 (next update 2004-2005)

Distribution by major end-use applications (market sectors)

International participation -- same original core companies, with possible expansion

Source of data for research community and policy makers

## Use of SF6 Sales Data

SF6 Sales Data

SF6 Emissions  
Calculations

Atmospheric  
Measurements

Equivalent CO2 Emissions Loading

