

# SF<sub>6</sub> Sales and Distribution by End-Use Application (1961-2001)

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# 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 over time?

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# 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 (1961-2001)
  - Sales by End-Use Categories (1980-2001 / 1996-2001)
  - Trends in SF<sub>6</sub> Sales

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# 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
  - correlating production data with atmospheric measurements
- ◆ To inform policy makers of current SF<sub>6</sub> market data

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

## Initial Study (1996/1997)

- ◆ Initiated and sponsored by SF<sub>6</sub> manufacturers
  - international participation (US, Europe, Japan)
  - voluntary industry initiative
- ◆ Compiled historical annual sales data (1961-1996)
- ◆ Reported sales data by major end-use applications
  - data used to calculate emissions and correlate to atmospheric measurements (Maiss and Brenninkmeijer 1998, 2000; J. Olivier 1999, 2002)

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

## Follow-on Study (1999/2000)

- ◆ Updated previous survey to include 3 additional years of data (1997-1999)
  - 7 participating companies (6 original + 1 new)
- ◆ Initial contact with other known producers (e.g., China and Russia)
  - Production had expanded beyond initial base in US, Europe and Japan
  - Need for broader survey to capture global production
- ◆ Presented data summary at 2000 SF<sub>6</sub> Conference

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

## Survey Update (2002)

- ◆ Updated previous survey to include 2 additional years of data (2000-2001)
  - Same core participating companies
- ◆ Discussions with producers in China and Russia
  - Sales data from manufacturers in China pending
  - Initial contacts with Russian producer(s) in progress
- ◆ Present data summary at 2002 SF<sub>6</sub> Conference
- ◆ Prepare for next survey update (2004)

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# SF6 Data Summary

## Key Features

- ◆ Survey of direct sales from manufacturers to customers (primary market sectors)
- ◆ Voluntary Participation
- ◆ Independent Third Party (RAND)
  - Survey companies
  - Compile and report aggregated data
- ◆ Confidentiality Agreement

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# 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

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

## Approach

### Phase I. Investigation of SF<sub>6</sub> Producers

- Confirm Previous Participants and Affiliates
- Identify and Contact Other Producers

### Phase II. Data Collection (annual sales data)

- Survey distribution, data compilation, follow up
- Final summary and interpretation of results  
(presentation + summary paper)

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

## Reporting Companies

- 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*)

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# SF6 Data Summary

## Other Producers

- ◆ Initiate contact with other known producers
  - China and Russia
  - Other countries?
- ◆ Maintain ongoing dialogue; share survey results
- ◆ Encourage participation in future updates

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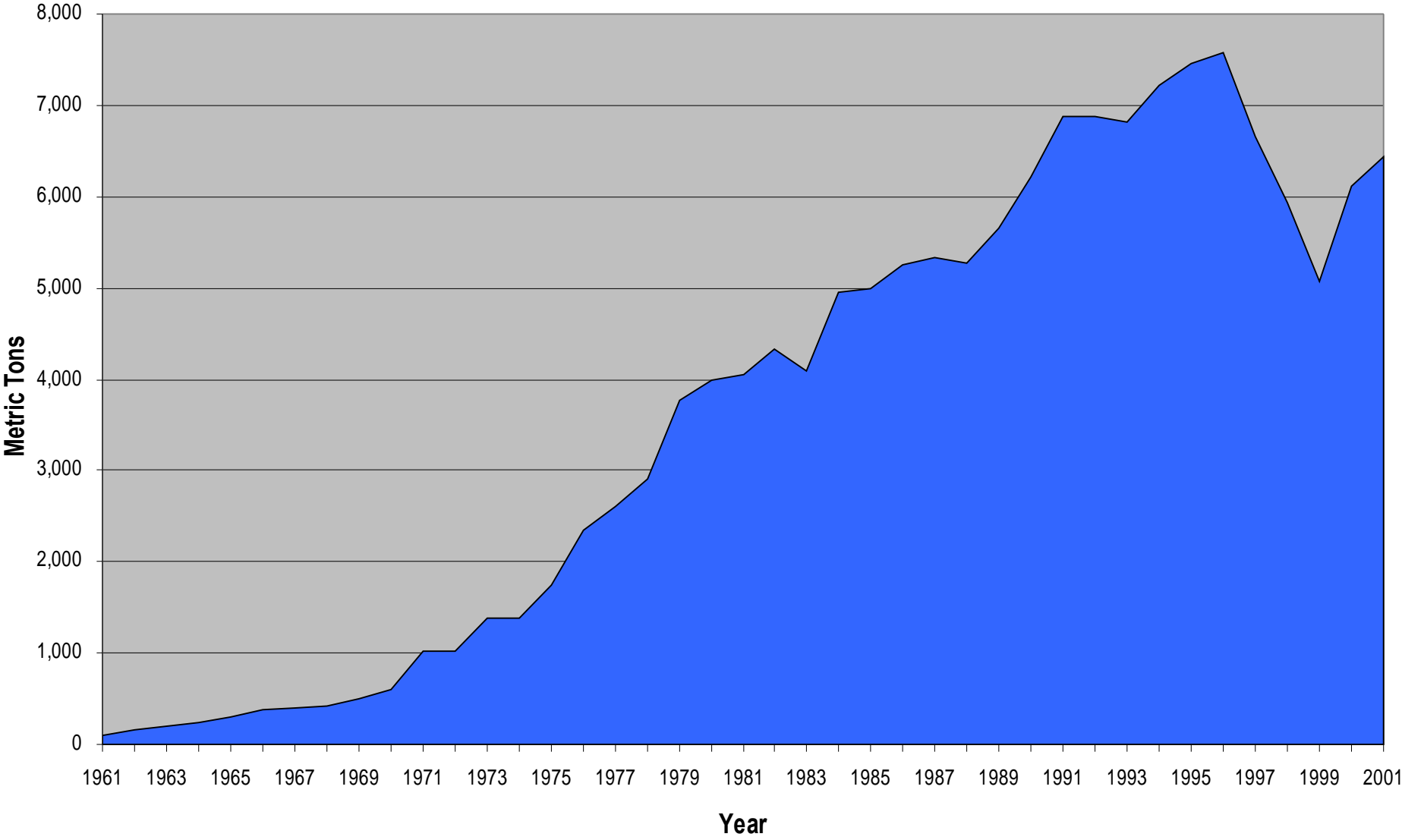
# SF6 Data Summary

## Overview of Results

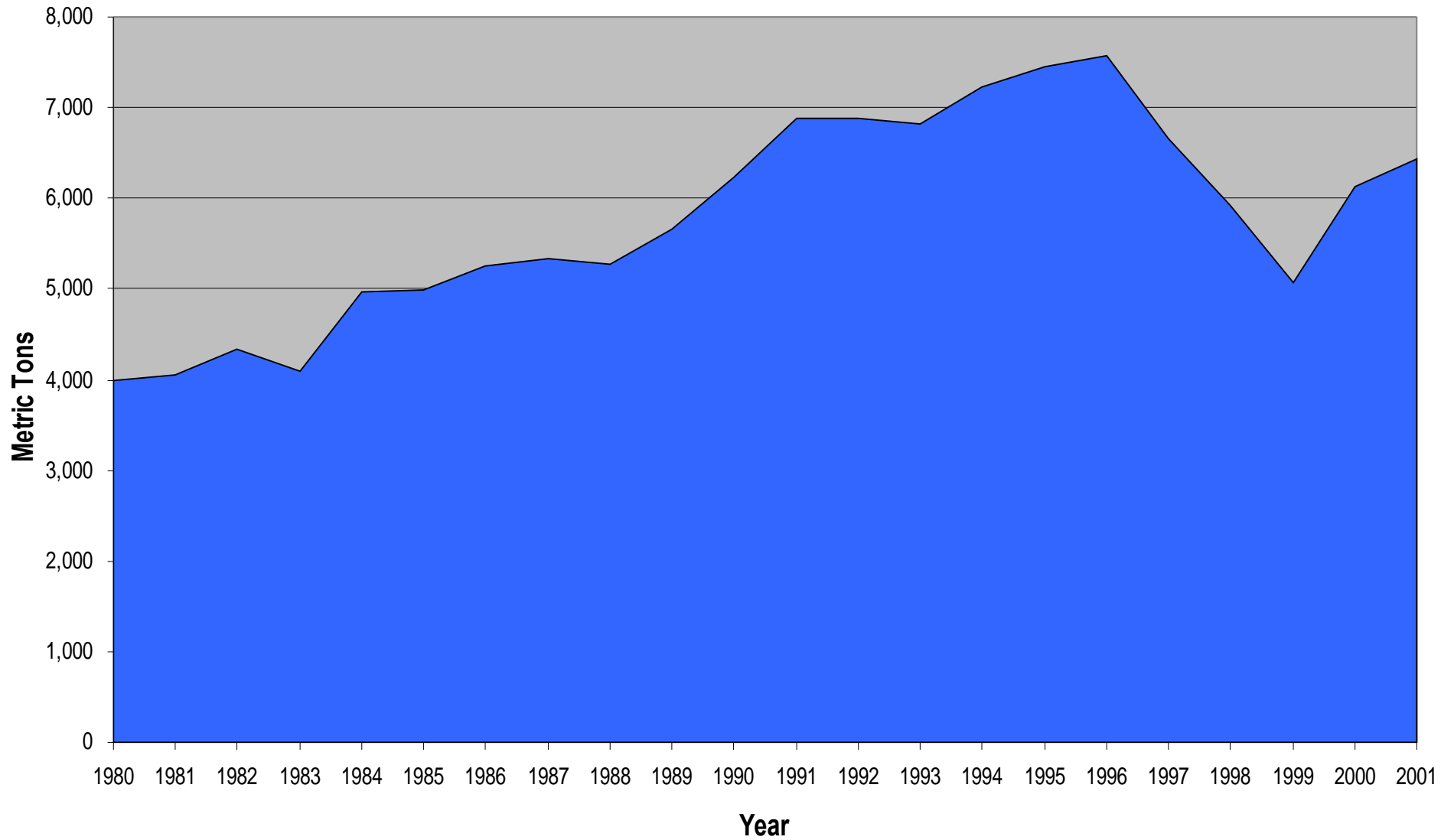
- ◆ Total Annual Sales (1961-2001)
- ◆ Sales by End-Use Categories  
Periods 1980-2001 and 1996-2001
- ◆ Trends in Sales by Category

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# Total Annual Sales of SF<sub>6</sub> (1961-2001)



# Total Annual Sales of SF<sub>6</sub> (1980-2001)



# Annual Change in Sales (1980-2001)

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



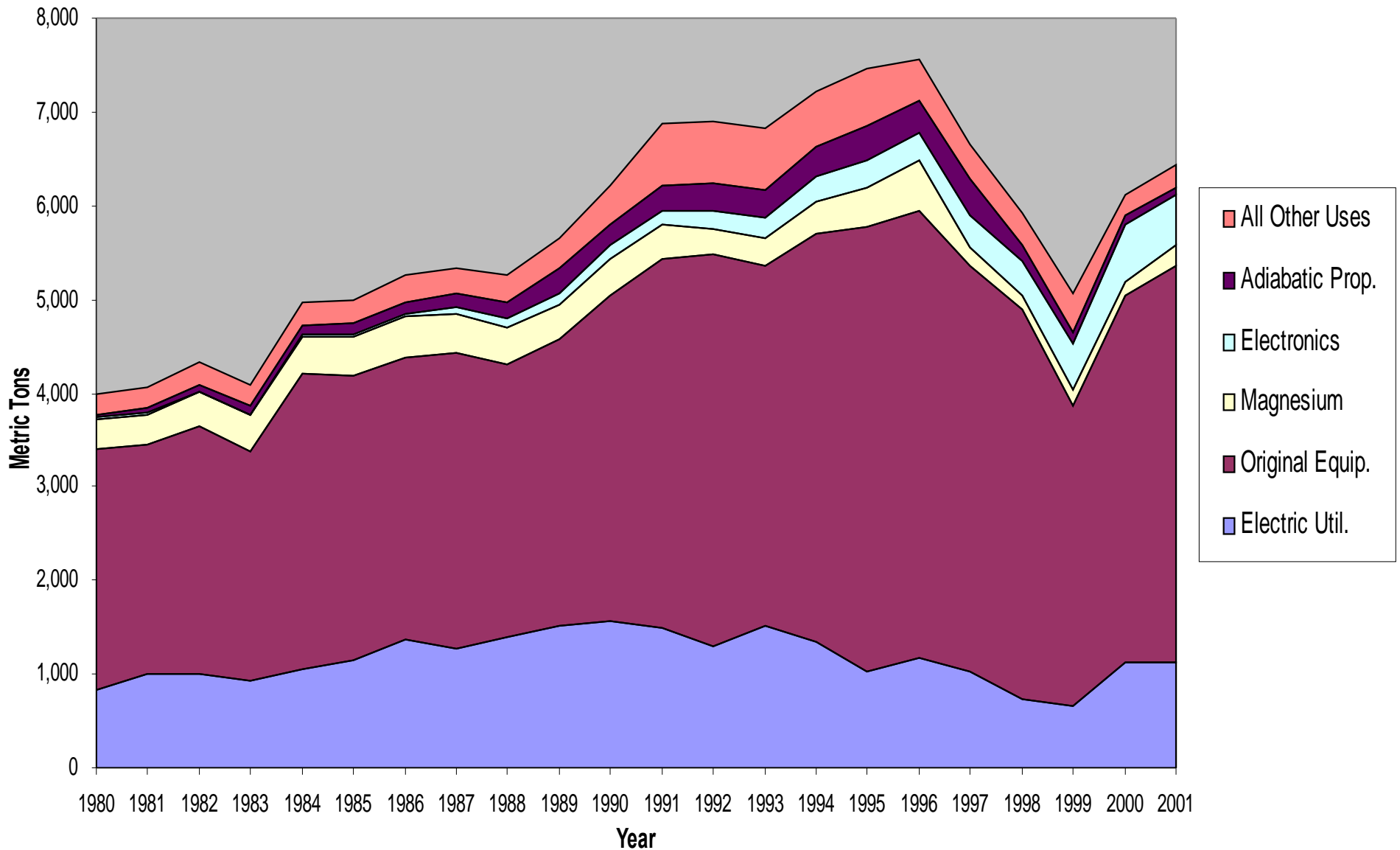
# SF<sub>6</sub> Data Summary

## End-Use Categories

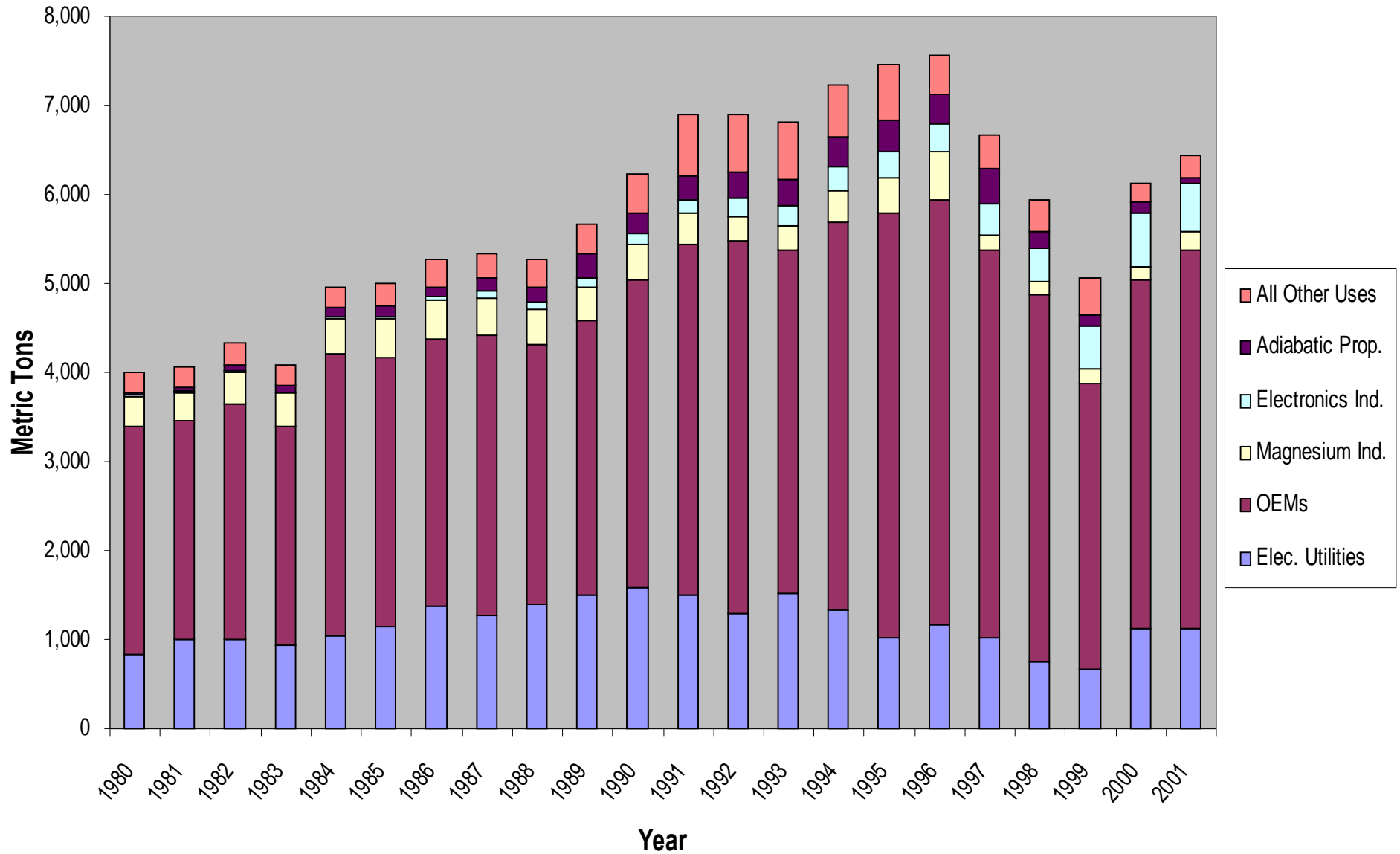
- ◆ Electric Utilities
- ◆ Original Equipment Manufacturers (OEMs)  
(for electric power systems)
- ◆ Magnesium Industry
- ◆ Electronics Industry
- ◆ Utilizing SF<sub>6</sub> Adiabatic Property (e.g., tires)
- ◆ All Other Uses  
Accelerators, optical fiber production, glazing, lighting,  
biotechnology, medical, refining, pharmaceutical,  
laboratory / university research, sound proof windows

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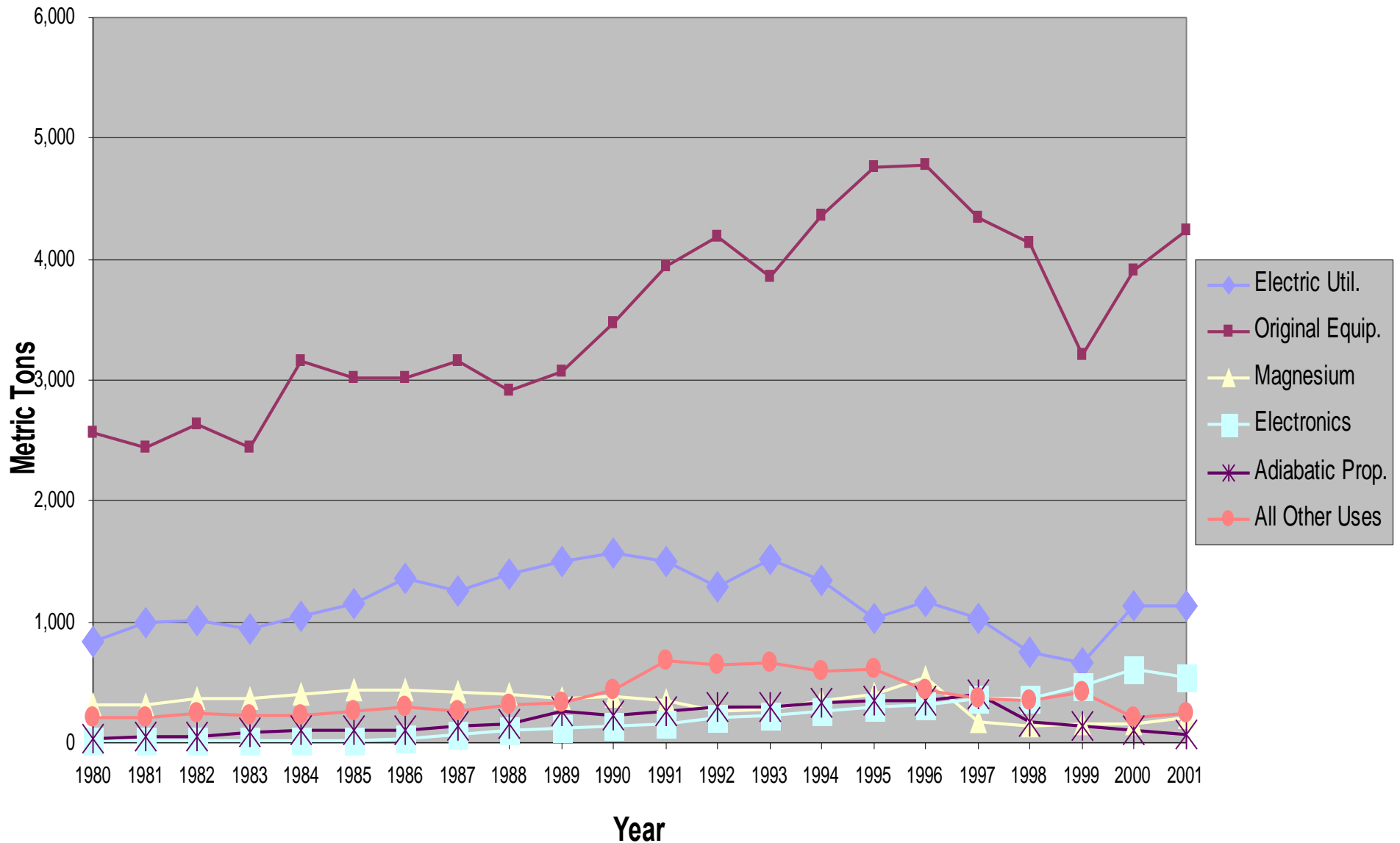
# Annual Sales of SF<sub>6</sub> by End-Use Application (1980 - 2001)



# Sales of SF<sub>6</sub> by End-Use Category (1980-2001)

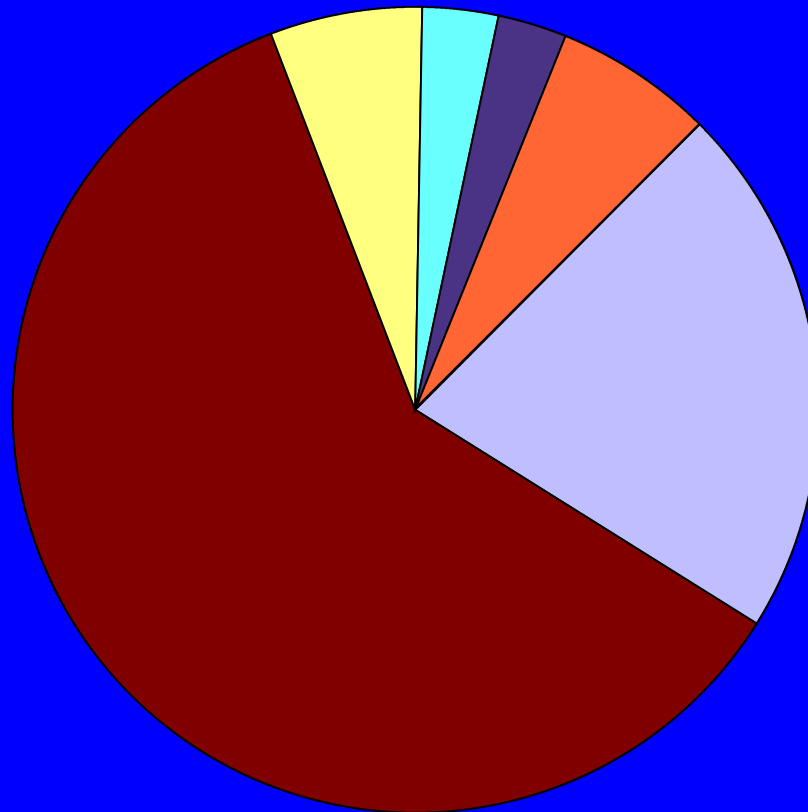


# Annual Sales of SF<sub>6</sub> by End-Use Application (1980 - 2001)



# SF6 Sales by End Use: 1961-2001

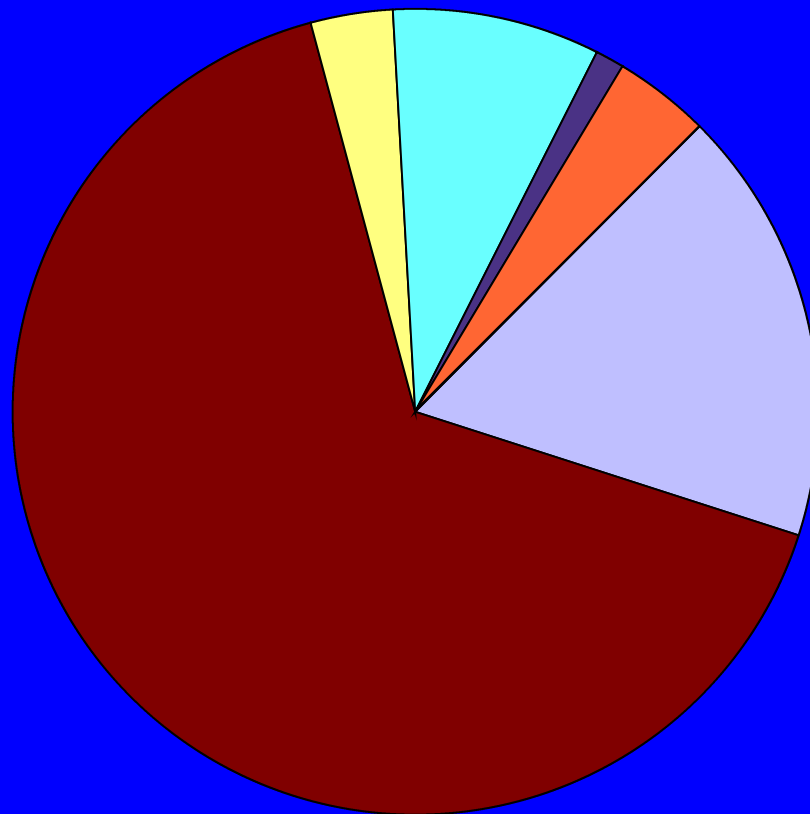
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- Electric Utilities (21%)
- Orig. Equipment Manuf. (60%)
- Magnesium Industry (6%)
- Electronics Industry (3%)
- SF6 Adiabatic Properties (3%)
- All Other Uses (6%)

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# SF6 Sales by End Use in 2001



- Electric Utilities (18%)
- Orig. Equipment Manuf. (66%)
- Magnesium Industry (3%)
- Electronics Industry (8%)
- SF6 Adiabatic Properties (1%)
- All Other Uses (4%)

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# Sales by End-Use Application

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End-Use Application	1996	1997	1998	1999	2000	2001	6-Yr Ave.	*	40-Yr Ave.
Electric Utilities	15%	15%	13%	13%	18%	18%	15%	*	21%
Orig. Equipment Manuf.	63%	66%	70%	64%	64%	66%	66%	*	60%
Magnesium Industry	7%	3%	2%	3%	3%	3%	4%	*	6%
Electronics Industry	4%	5%	6%	9%	10%	8%	7%	*	3%
SF6 for Adiabatic Properties	5%	6%	3%	3%	2%	1%	3%	*	3%
All Other Uses	6%	5%	6%	8%	3%	4%	5%	*	6%

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

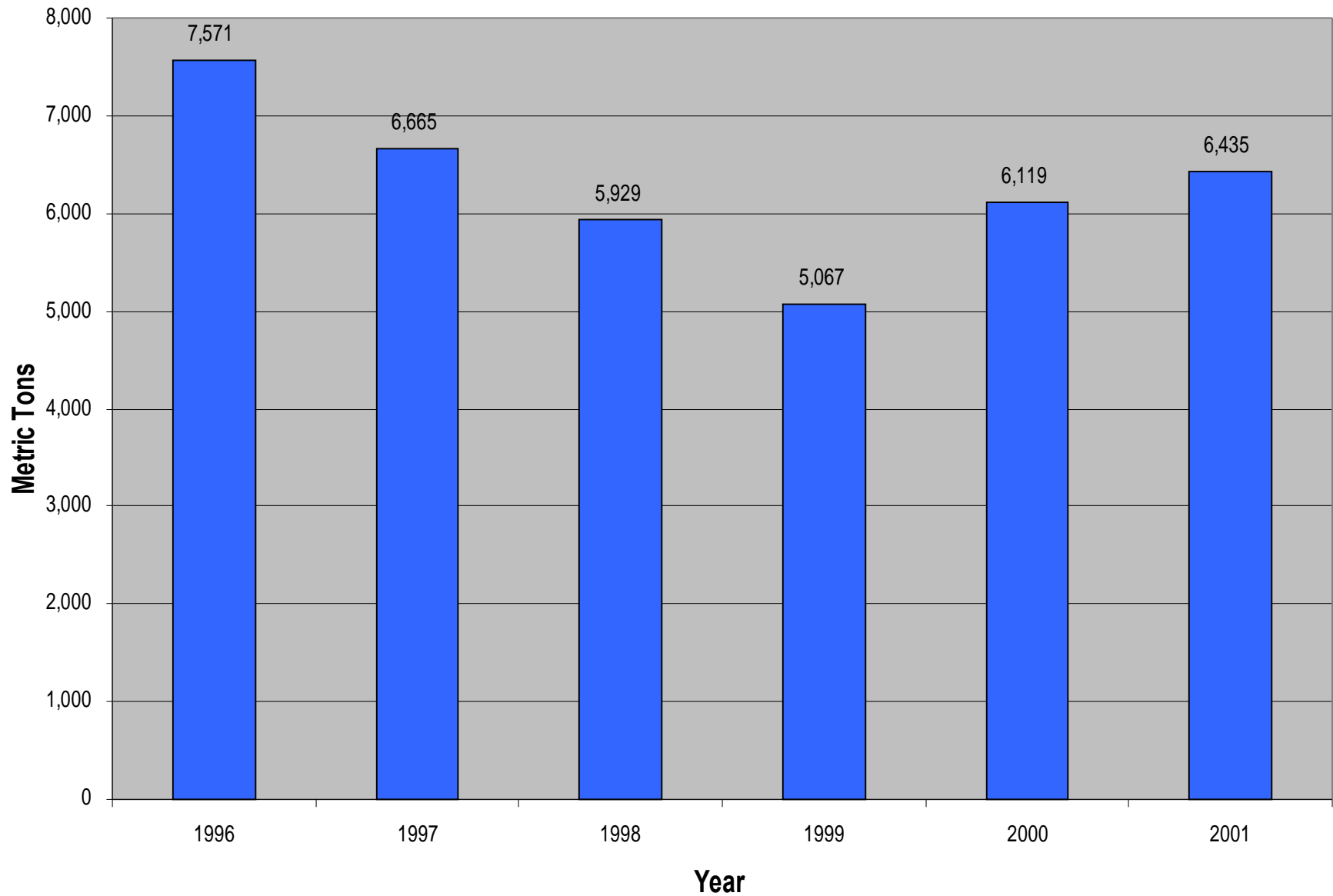
## Current Reporting Period

- ◆ Comparison of 2000-2001 results to 1<sup>st</sup> report (1996) and 2<sup>nd</sup> report (1999)
- ◆ Annual sales by end-use application
- ◆ Annual change in sales levels – by category – between 1996 (peak) and 2001 (current)

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# Total Annual Sales of SF<sub>6</sub> (1996-2001)



# Trends in Annual Sales: 1996-2001

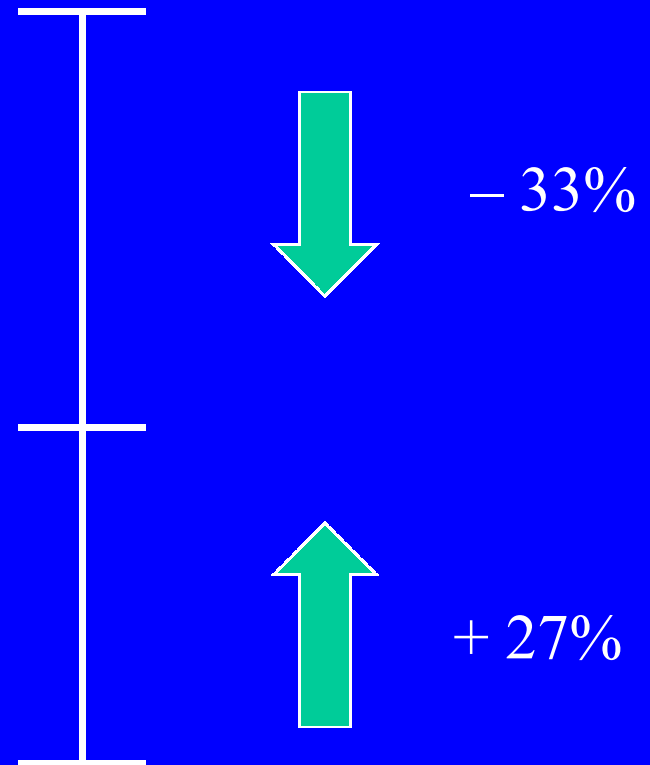
1996 – 1997      – 12%

1997 – 1998      – 11%

1998 – 1999      – 15%

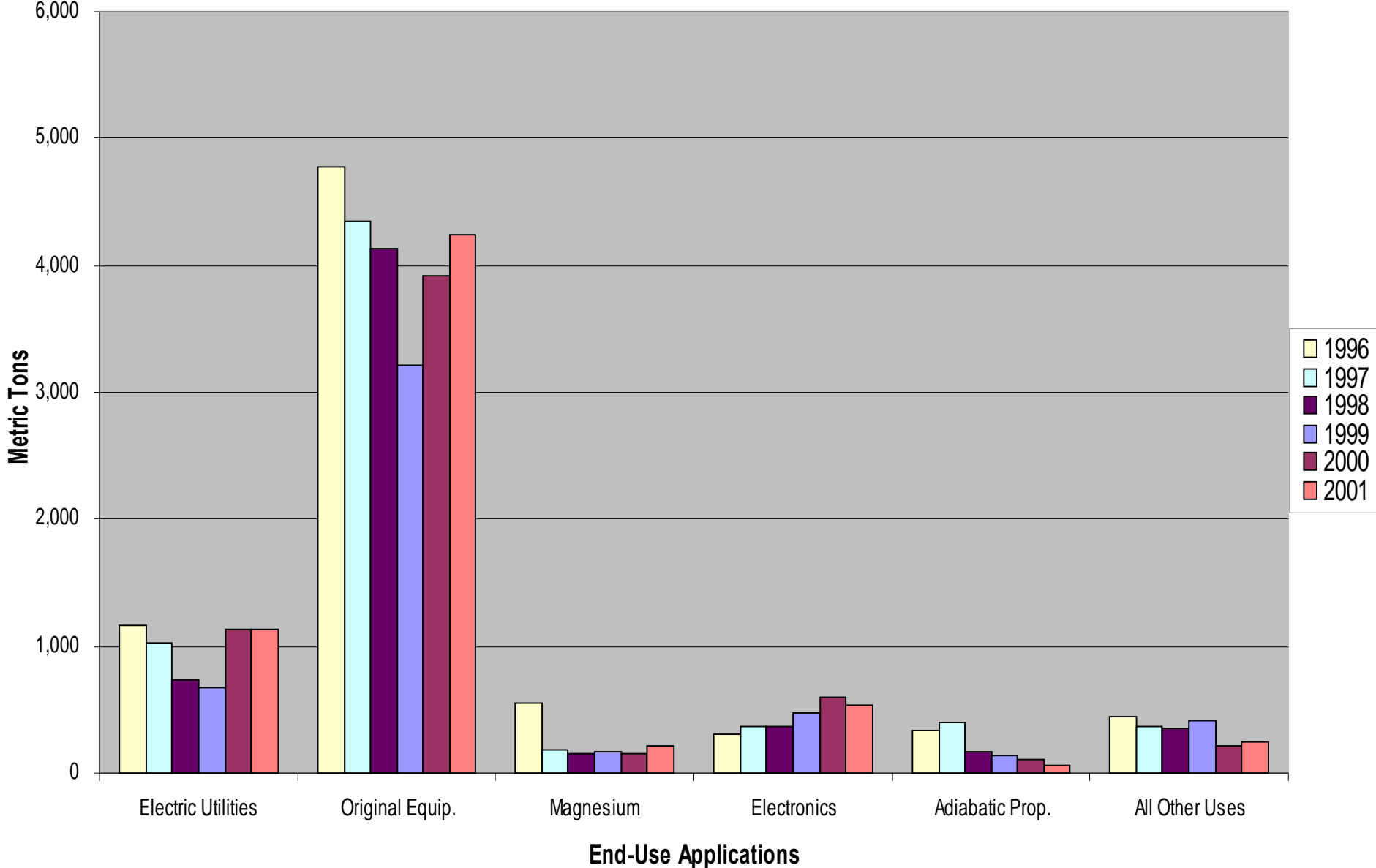
1999 – 2000      + 21%

2000 – 2001      + 5%



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# SF<sub>6</sub> Sales for the Period 1996-2001



# Change in End-Use Sales: 1996-2001

Annual Change	Electric Utilities	Original Equip. Manufacturers	Magnesium Industry	Electronics Industry	for Adiabatic Properties	All Other Uses (listed below)
1996-97	-12%	-9%	-67%	18%	14%	-17%
1997-98	-27%	-5%	-17%	3%	-55%	-4%
1998-99	-10%	-23%	12%	27%	-23%	19%
1999-00	69%	22%	-7%	27%	-19%	-49%
2000-01	0%	8%	38%	-10%	-42%	19%

# 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 12% in 1997, 11% in 1998, 15% in 1999
  - by 2,504 metric tons between 1996 and 1999
- ◆ 1999 sales at same level as in 1985 (~5,000 te)
- ◆ Total sales increased from 1999 to 2001
  - by 21% in 2000 and 5% in 2001
  - by 1,368 metric tons between 1999 and 2001
- ◆ Sales in 2001 still 15% below peak year (1996)

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

## Summary of Results (cont.)

- ◆ Sales to various market sectors show mixed results since 1999 (last report)
  - Sales *increased* to Utilities, OEMs and Electronics Industry
  - Magnesium Industry held fairly *steady*
  - Sales *decreased* for Adiabatic Properties and All Other Uses
- ◆ Percent of world represented unknown; other producers encouraged to participate in study

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

## Significance of Results

- ◆ Historical annual sales data; continuous record for 1961 – 2001
- ◆ Distribution by major end-use applications (market sectors)
- ◆ International participation -- with possible expansion; same original core companies
- ◆ Source of data for research community and policy makers

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

## Ongoing Activities

- ◆ Inclusion of other producers (e.g., China, Russia, others?)
- ◆ Estimate of global coverage by current survey
- ◆ Regular reporting cycle (every 2 years); next update to include 2002-2003 data
- ◆ Collaboration with other data collection and emissions estimating programs

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