

SF₆ Emission Reduction Partnership for Electric Power Systems

2005 Annual Report

August 2006, Revised



Preface – The SF₆ Emission Reduction Partnership for Electric Power Systems

Several chemical compounds found in the atmosphere act as greenhouse gases. While many occur in nature, such as carbon dioxide, methane, and nitrous oxide, others are produced through industrial processes. Although carbon dioxide (CO₂) is the most abundant greenhouse gas, it is not the most potent (on a per unit weight basis). Sulfur hexafluoride (SF₆) has been identified by the Intergovernmental Panel on Climate Change (IPCC)¹ as the most potent non-CO₂ greenhouse gas, with an ability to trap heat in the atmosphere 23,900 times more effectively than CO₂. Approximately 80 percent of SF₆ gas produced is used by the electric utility industry in high voltage electrical equipment as an insulator or arc quenching medium.² Currently, more than 80 environmental leaders in the U.S. electric utility industry are recognized by EPA under the SF₆ Emission Reduction Partnership for Electric Power Systems for actively targeting SF₆ emissions. Partners are proactively helping to prevent global climate change and in doing so, are experiencing operational and cost efficiencies through improvements to equipment reliability and reduced SF₆ gas purchases and maintenance expenditures. Each year, SF₆ Partners have collectively prevented large quantities of SF₆ gas from escaping into the atmosphere; the 2005 reporting year marks another year of outstanding achievement for the program.

Common Greenhouse Gases and Their Global Warming Potentials (GWPs) (100-Year Time Horizon)

Gas	GWP
CO ₂	1
CH ₄	21
HFC-152a	140
N ₂ O	310
HFC-134a	1,300
HFC-4310mee	1,300
HFC-227ea	2,900
HFC-236fa	6,300
CF ₄	6,500
C ₆ F ₁₄	7,400
C ₂ F ₆	9,200
HFC-23	11,700
SF₆	23,900

Source: IPCC (1996) *Climate Change 1995: The Science of Climate Change*. Intergovernmental Panel on Climate Change; J.T. Houghton, L.G. Meira Filho, B.A. Callander, N. Harris, A. Kattenberg, and K. Maskell, eds.; Cambridge University Press. Cambridge, U.K.

This year's annual report presents the cumulative successes of Partners in reducing emissions of SF₆ gas from electric utility operations from 1999 through 2005.

¹ The IPCC is an international scientific body organized by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in 1988.

² Smythe, K. "Trends in SF₆ Sales and End-Use Applications: 1961-2003," Conference on SF₆ and the Environment. Scottsdale, Arizona, December 1-3, 2004.

Partner Accomplishments

Below is a summary of the accomplishments made by EPA's SF₆ Partners. The results of the 2005 reporting year as well as cumulative achievements since the inception of the Partnership in 1999 are presented.

Partner-Reported Emissions

The SF₆ Emission Reduction Partnership has historically tracked a declining trend in the annual average SF₆ emission rate (the ratio of SF₆ emissions relative to total nameplate capacity reported by Partners). The 2005 reporting year furthers this trend with another decrease in the overall Partnership's average emission rate. The 2005 SF₆ emission rate is 8.3 percent, down from 9.4 percent in 2004. Overall, between 1999 and 2004, the Partnership's SF₆ emission rate has dramatically decreased by more than half (Figure 1).

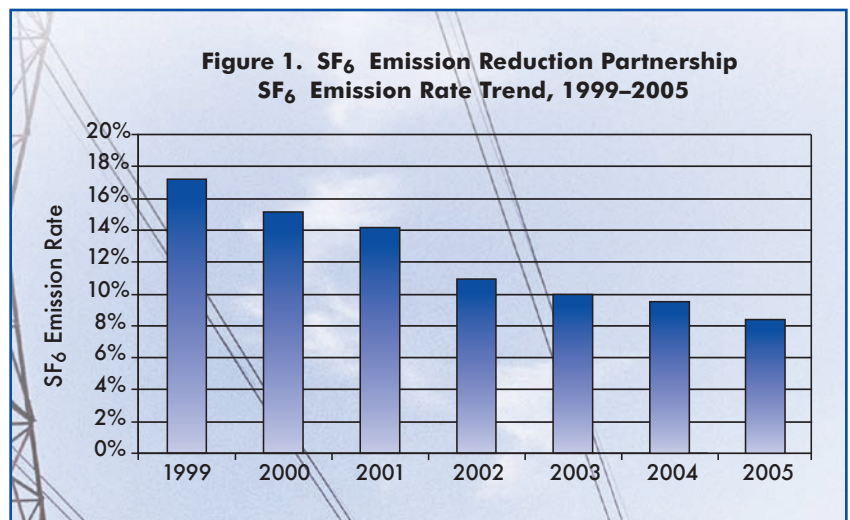


Figure 2 displays a distribution of emission rates reported by Partners for 2005.

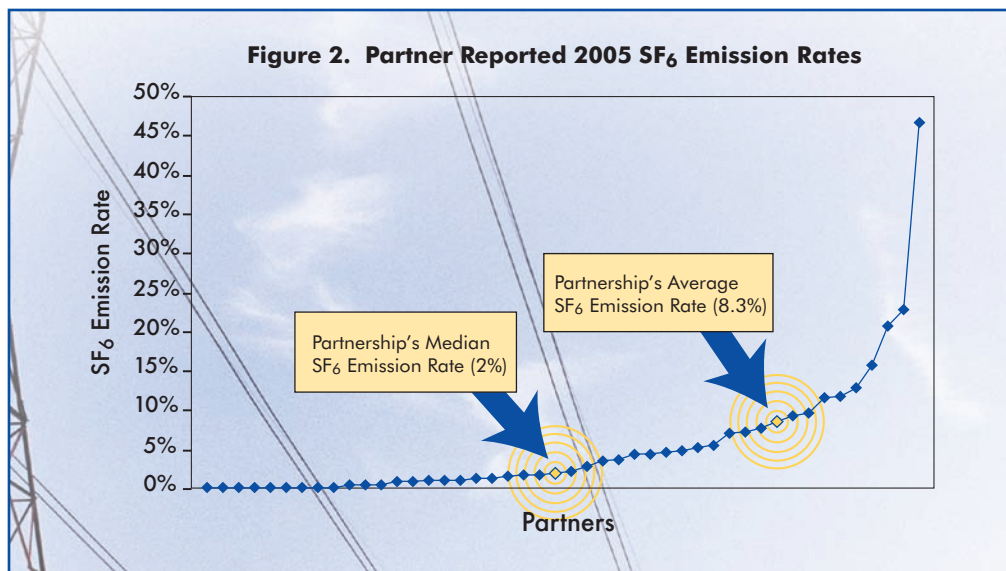


Table 1 summarizes the aggregated program statistics for each year since 1999. Because of inconsistency in data reporting, the SF₆ emission rate should be used (rather than SF₆ emissions) for annual comparative purposes. Results for the 2005 reporting year include total reported SF₆ emissions of 414,830 pounds and a nameplate capacity close to 5 million pounds.

Table 1: Aggregated Statistics for all Reporting Partners

	1999	2000	2001	2002	2003	2004	2005
Reporting Partners ^a	81%	79%	80%	69%	84%	86%	87%
Total SF ₆ Emissions (lbs.)	605,474	583,524	584,297	501,993	460,771	452,246	414,830
Total Name-Plate Capacity (lbs.)	3,484,335	3,858,884	4,073,501	4,589,151	4,633,776	4,801,652	4,976,591
SF ₆ Emission Rate ^b	17.4%	15.1%	14.3%	10.9%	9.9%	9.4%	8.3%

^a Reports received/ reports expected.

^b SF₆ emission rate is calculated by dividing total emissions by total name-plate capacity (i.e., the total quantity of SF₆ contained in electrical equipment).

Table 2 presents a summary of total annual SF₆ emission reductions achieved by all reporting Partners through 2005. The information presented is derived by evaluating emissions data provided by reporting Partners for each year (see Table 1), and is not adjusted to account for Partners who have not provided data consecutively. Emissions reductions are also presented in terms of million metric tonnes of carbon dioxide equivalent (MMTCO_{2e}) with 1999 as the baseline year (the start of EPA's SF₆ Partnership).

For 2005, SF₆ Partners have collectively achieved a 32 percent decrease in emissions from the 1999 baseline year. Approximately 190,644 pounds of SF₆, or the equivalent of 2.07 MMTCO₂ emissions have been avoided. Cumulatively (1999-2005), emissions avoided total 635,182 pounds or 6.88 MMTCO_{2e} (i.e., the sum of reductions from baseline as provided in Table 2 in MMTCO_{2e}).

Table 2: Summary of Partnership SF₆ Emissions and Reductions

	1999 ^a	2000	2001	2002	2003	2004	2005
Total Partner-Reported SF ₆ Emissions (lbs)	605,474	583,524	584,297	501,993	460,771	452,246	414,830
Total Partner-Reported SF ₆ Emissions (MMTCO _{2e})	6.56	6.32	6.33	5.44	4.99	4.90	4.50
Reduction from Baseline (MMTCO _{2e})		0.24	0.23	1.12	1.57	1.66	2.07
Percent Reduction from Baseline	-	3.6%	3.5%	17.1%	23.9%	25.3%	31.5%

^a Baseline year.

Partner Spotlights

SF₆ Partners represent a wide range of electric utilities in the United States. Through the accomplishments of three Partners, this section highlights opportunities available to other utilities to realize and maintain noteworthy emission reductions of SF₆ gas.

Northeast Utilities

(Connecticut Light & Power, Public Service of New Hampshire & Western Massachusetts Electric Company)

For larger utilities with significant SF₆ nameplate capacity to manage, great strides are being made in reducing emissions. As a relatively large Partner, Northeast Utilities has a nameplate capacity of nearly 100,000 pounds. Since 1999, Northeast Utilities has reduced its SF₆ emission rate by over 90 percent, a great achievement given that the utility has experienced significant transmission system growth during this period. These emissions reductions were achieved in part through a dedicated equipment replacement program.

PUD No. 1 of Douglas County

Smaller utilities, such as PUD No. 1 of Douglas County, have found that partnering with EPA enables them to be recognized for reducing and maintaining low emissions of SF₆ from their operations. Douglas PUD, with a nameplate capacity of less than 10,000 lbs, has been a Partner since 1999. Douglas PUD has reduced emissions through proper handling techniques, identification and elimination of leaks, and the replacement of equipment that do not meet specific leak rate thresholds. Douglas PUD successfully reduced their emission rate to zero in 2004 and continues to maintain zero emissions as of 2005.

Duquesne Light SF₆ Project Profile

Duquesne Light Company undertook a project to carefully decommission one of their substations in an environmentally responsible manner. Duquesne Light's Carson Substation was originally built to provide power primarily to two arc furnaces operated by a local steel production facility. After the steel company ceased operation, Duquesne Light decided to install a new, more applicable transformer. To decommission the old substation, Duquesne Light worked with a vendor to recover the SF₆ gas and reclaim it to ASTM standards. The project resulted in the removal of approximately 7,300 lbs of SF₆ that would otherwise have been lost to the atmosphere. These emission reductions are equivalent to the CO₂ emission reductions from not driving 17,000 passenger cars for one year.

For the complete Duquesne Light Project Profile, please visit EPA's SF₆ Partnership website at www.epa.gov/electricpower-sf6. Utilities interested in sharing their experiences in mitigating SF₆ emissions should contact Jerome Blackman, EPA Program Manager.

Partnership Update

New Partners

In late 2005 and through July 2006, EPA welcomed the following new Partners into the SF₆ Emission Reduction Partnership for Electric Power Systems:

- **Seattle City Light** – *Seattle, WA*
- **Montana-Dakota Utilities** – *Bismark, ND*
- **NSTAR Electric and Gas**^a – *Westwood, MA*
 - **Boston Edison Company** – *Boston, MA*
 - **Cambridge Electric Light Company** – *Boston, MA*
 - **Commonwealth Electric Company** – *Boston, MA*
- **Pacificorp**^a – *Portland, OR*
 - **Pacific Power** – *Portland, OR*
 - **Rocky Mountain Power** – *Salt Lake City, UT*

^a Parent Company.

EPA continues to conduct outreach to the electric utility industry; the SF₆ Emission Reduction Partnership in 2006 now totals 77 companies. Appendix A contains a list of participating utilities as of August 2006.

Equipment Field Study

EPA recently conducted a study on SF₆ leak rates from approximately 2,300 high voltage circuit breakers manufactured between 1998 and 2002. This study was undertaken to investigate and increase industry knowledge concerning SF₆ leak rates from newly manufactured circuit breakers.

Based on the study findings, the leakage rates of these circuit breakers range from 0.2 to 2.5 percent of nameplate capacity per year. A recently published paper is available for download from the Partnership's web site www.epa.gov/electricpower-sf6 in the "Research & Studies" section under "Documents, Tools & Resources." Additionally, a complete summary of the report will be presented at the upcoming SF₆ Conference in November 2006.

The 2006 International Conference on SF₆ and the Environment

The 4th International Conference on SF₆ and the Environment will be held from November 28-30, 2006 in San Antonio, TX. This biennial conference brings together representatives from the electric power industry, the scientific community, and governments to share their knowledge and experience of SF₆ management and reduction strategies, costs and benefits of reductions, alternatives research, and partner achievements.

For more information, please visit EPA's Electric Power Systems Partnership website at www.epa.gov/electricpower-sf6. Partners interested in speaking or presenting a paper at the conference should contact Jerome Blackman, EPA Program Manager.

Building on Success

In 2005, SF₆ Partners achieved considerable reductions in SF₆ emissions. Partners collectively reduced the average SF₆ emission rate to 8.3 percent compared to 9.4 percent in 2004 and 17 percent in 1999. SF₆ emissions in 2005 are 32 percent lower than in 1999 baseline. Cumulatively, SF₆ Partners have prevented the escape of 635,182 pounds of SF₆ or 6.88 MMTCO₂e. In terms of dollars saved from avoided purchases to replace gas losses to the atmosphere, this quantity translates into approximately \$3.8 to \$5.7 million dollars. These savings are shown in Figure 3.

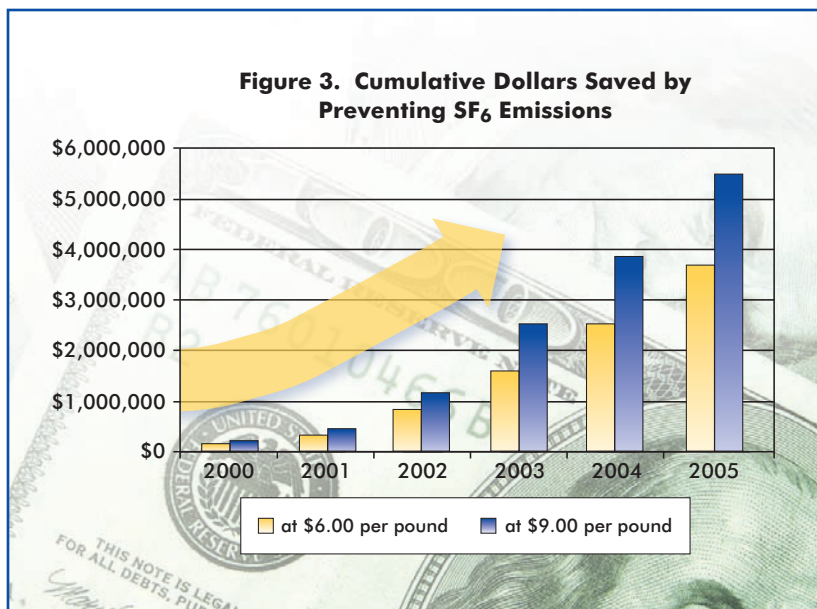
The potential threat from SF₆ to our climate is great since one pound of SF₆ released is roughly equivalent to thermal warming from 11 tons of CO₂. As of 2005, SF₆ emission reductions are the equivalent to CO₂ emissions from 16 million barrels of oil NOT consumed, or CO₂ emissions from 1.8 million households reducing electricity use by 50 percent for one year, or CO₂ emissions from 1.5 million passenger cars NOT driven for one year.

The SF₆ Emission Reduction Partnership has established a framework to help electric utilities manage SF₆ gas, successfully reduce emissions of this potent greenhouse gas, and maintain these reductions. A significant amount of SF₆ is still emitted each year; yet the future holds promise.

In order to build upon the successes achieved over the past six years, EPA asks all SF₆ Partners to update and/or extend their SF₆ emission reduction goals through December 2012. This effort will help to provide uniform structure to and a consistent time-frame for measuring the collective accomplishments of SF₆ Partners over time. SF₆ Partners should notify EPA's Program Manager of their updated goals.

For additional information please contact:

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Appendix: List of Partners (as of August 2006)

Allegheny Power

Greensburg, PA

American Electric Power (AEP)

Columbus, OH

Arizona Public Service Company (APS)

Phoenix, AZ

Athens Electric Department

Athens, AL

Austin Energy

Austin, TX

Bangor Hydro-Electric Company

Bangor, ME

Big Rivers Electric Corporation

Henderson, KY

Bonneville Power Administration

Portland, OR

CenterPoint Energy

Houston, TX

Central Maine Power Company

Augusta, ME

Central Vermont Public Service Corporation

Rutland, VT

Cinergy Corporation

Cincinnati, OH

City of Monroe

Monroe, NC

Columbia River People's Utility District

St. Helens, OR

Consolidated Edison Company of New York, Inc.

New York, NY

Crisp County Power Commission

Cordele, GA

Duquesne Light Company

Pittsburg, PA

E.ON U.S. LCC

Louisville, KY

Edison International

Rosemead, CA

El Paso Electric Company

El Paso, TX

Eugene Water and Electric Board

Eugene, OR

Exelon Energy Delivery (EED)^a**ComEd Energy Delivery**

Chicago, IL

PECO Energy Delivery

Philadelphia, PA

FirstEnergy Corporation

Akron, OH

Florida Power and Light Company (FPL)

Juno Beach, FL

FPL Energy New England Division

Seabrook, NH

Fort Pierce Utilities Authority

Fort Pierce, FL

Grand Island Utilities Department

Grand Island, NE

Great River Energy

Elk River, MN

Hastings Utilities

Hastings, NE

Kings River Conservation District

Fresno, CA

Lower Colorado River Authority (LCRA)

Austin, TX

Maine Public Service Company

Presque Isle, ME

Manitowoc Public Utilities

Manitowoc, WI

Memphis Light, Gas & Water Division

Memphis, TN

Menasha Utilities

Menasha, WI

MidAmerican Energy

Des Moines, IA

Montana-Dakota Utilities

Bismarck, ND

Muscatine Power & Water

Muscatine, IA

^a Parent Company.

Appendix: List of Partners (continued)

NSTAR Electric and Gas^a

Boston Edison Company

Boston, MA;

Cambridge Electric Light Company

Boston, MA

Commonwealth Electric Company

Boston, MA

Nashville Electric Service (NES)

Nashville, TN

National Grid^a

Granite State Electric

Northborough, MA

Massachusetts Electric

Northborough, MA

Nantucket Electric

Nantucket, MA

Narragansett Electric

Providence, RI

New England Power Company

Westborough, MA

New England Electric Transmission Corporation

Westborough, MA

New England Hydro-Transmissions Company Inc.

Westborough, MA

Niagara Mohawk Power Corporation

Syracuse, NY

Nebraska Public Power District

Doniphan, NE

New York Power Authority

New York, NY

Northeast Utilities Services Company^a

Connecticut Light and Power Company

Berlin, CT

Public Service Company of New Hampshire

Manchester, CT

Western Massachusetts Electric Company

West Springfield, MA

Northern Indiana Public Service Company (NIPSCO)

Merrville, IN

Oklahoma Gas and Electric Company (OG&E)

Oklahoma City, OK

Otter Tail Power Company

Fergus Falls, MN

Pacificorp^a

Pacific Power

Portland, OR

Rocky Mountain Power

Salt Lake City, UT

Pacific Gas and Electric Corporation (PG&E)

San Francisco, CA

Public Utility District No. 1 of Douglas County

East Wenatchee, WA

Public Utility District No. 1 of Pend Oreille County

Newport, WA

Rochester Gas and Electric Corporation

Rochester, NY

Salt River Project (SRP)

Phoenix, AZ

San Antonio City Public Service Board

San Antonio, TX

Seattle City Light

Seattle, WA

Silicon Valley Power

Santa Clara, CA

South Carolina Electric & Gas Company

Columbia, SC

Southern Company

Atlanta, GA

TXU

Dallas, TX

Tennessee Valley Authority (TVA)

Knoxville, TN

Texas Municipal Power Agency

Bryan, TX

Wallingford Electric Division

Wallingford, CT

We Energies

Milwaukee, WI

Wellton-Mohawk Irrigation & Drainage District

Wellton, AZ

^a Parent Company.



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