

SF₆

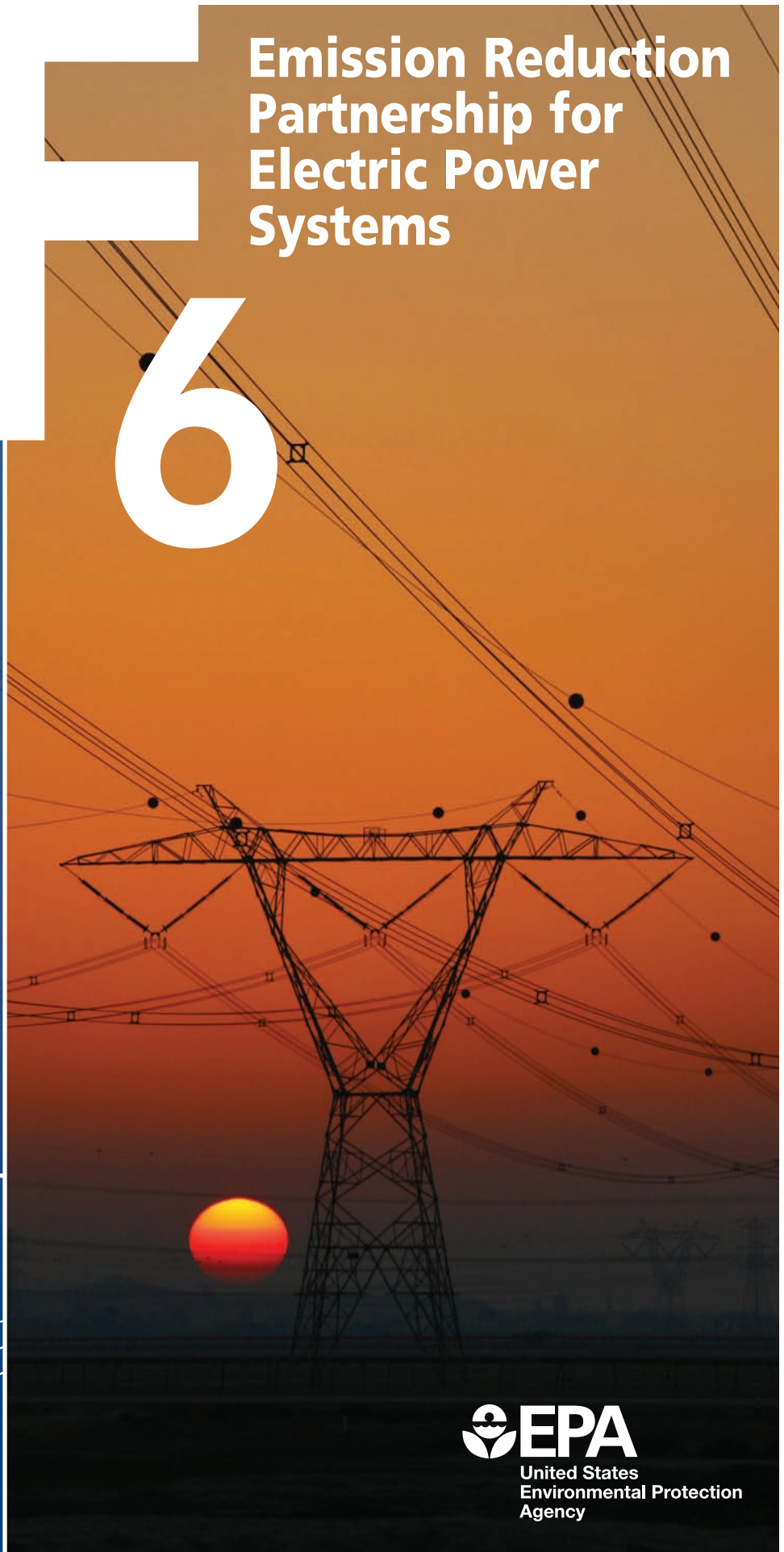
Emission Reduction Partnership for Electric Power Systems

2010 Annual Report

December 2011



SF₆ Emission Reduction
Partnership for Electric Power Systems



 **EPA**
United States
Environmental Protection
Agency

1999

Inception of the “Partnership” with 49 Charter Partners.

2000

1st International Conference on SF₆ and the Environment held in San Diego, CA.

2001–2003

Technical literature developed and made available on program web site including, “Byproducts of SF₆ Use in the Electric Power Industry” and “Catalog of Guidelines and Standards for the Handling and Management of SF₆.”

2nd International Conference on SF₆ and the Environment held in San Diego, CA in 2002.

2004

3rd International Conference on SF₆ and the Environment held in Scottsdale, AZ (substation tour).

Partners start receiving customized benchmark reports on their progress in the program. Service Provider directory made available.

2005

Webcast tutorials on estimating and reporting SF₆ emissions offered. Field study on leak rates from circuit breakers manufactured between January 1998 and December 2002 is completed.

2006

4th International Conference on SF₆ and the Environment held in San Antonio, TX (substation tour). Partnership participation increases to 77 companies representing 42% of U.S. grid.

2007-2009

The SF₆ emission rate continues to drop; by 2007, Partners have reduced SF₆ emissions by more than half of baseline emissions. In 2009, the Partnership celebrates its 10 year anniversary at the 5th Workshop in Phoenix, AZ. Partners convene at a Partner Meeting in Chicago in June 2009, hosted by Partner utility ComEd.

2010

The lowest SF₆ emission rate of the program to-date, 3.8% is set. Partner utility Oncor hosts Partner Meeting in May in Dallas, Texas.

The SF₆ Emission Reduction Partnership for Electric Power Systems

In 1999, members of the U.S. electric power industry and the U.S. Environmental Protection Agency (EPA) collaborated to establish the SF₆ Emission Reduction Partnership for Electric Power Systems (the Partnership). Partner utilities voluntarily commit to reduce emissions of sulfur hexafluoride, or SF₆, a potent and long-lived greenhouse gas with a global warming potential (GWP) 23,900 times that of carbon dioxide (CO₂).¹ This means that SF₆ is 23,900 times more effective at trapping infrared radiation than an equivalent amount of CO₂ over a 100-year period. Greenhouse gases range in their potency, and SF₆ is classified as the highest GWP gas. Although SF₆ is emitted in smaller quantities than many other greenhouse gases, its extremely long atmospheric lifetime of 3,200 years causes it to accumulate in the earth's atmosphere for several millennia.

Because of its unique dielectric properties, electric utilities rely on SF₆ in electric power system for high voltage electrical insulation, current interruption and arc quenching in the transmission and distribution of electricity. While SF₆ should theoretically remain contained within pressurized equipment, in reality, the gas is inadvertently emitted into the atmosphere as leaks develop during various stages of the equipment's lifecycle. SF₆ can also be released at the time of equipment manufacture installation, servicing, or decommissioning. Because there is no clear alternative to SF₆, Partners reduce their greenhouse gas emissions through implementing emission reduction strategies such as detecting, repairing and/or replacing problem equipment, as well as educating gas handlers on proper handling techniques of SF₆ gas during equipment installation, servicing, and disposal. This Partnership fosters information sharing of these management practices and is one of EPA's voluntary public-private partnerships aimed at reducing or slowing the growth of greenhouse gas emissions. This report presents the SF₆ emission reduction achievements of the Partnership through 2010.

Inside the 2010 SF₆ Emissions Reduction Partnership Annual Report

▶ Partner Accomplishments 2010.....	2
▶ SF ₆ Emissions Rate Trends	2
▶ Partnership Spotlight.....	5
▶ Meetings and Workshops	6
▶ Mandatory Reporting of Greenhouse Gases Rule.....	7
▶ Continued Growth, Success and Future of the Partnership	8
▶ Updated List of Partners	9

¹ 2001 IPCC Third Assessment Report.

Partner Accomplishments

As part of their commitment to the Partnership, each year Partners voluntarily report their SF₆ emissions and nameplate capacity estimates to EPA. EPA collects and aggregates this information to determine the overall accomplishments of the Partnership.

Partner-Reported Emissions Summary

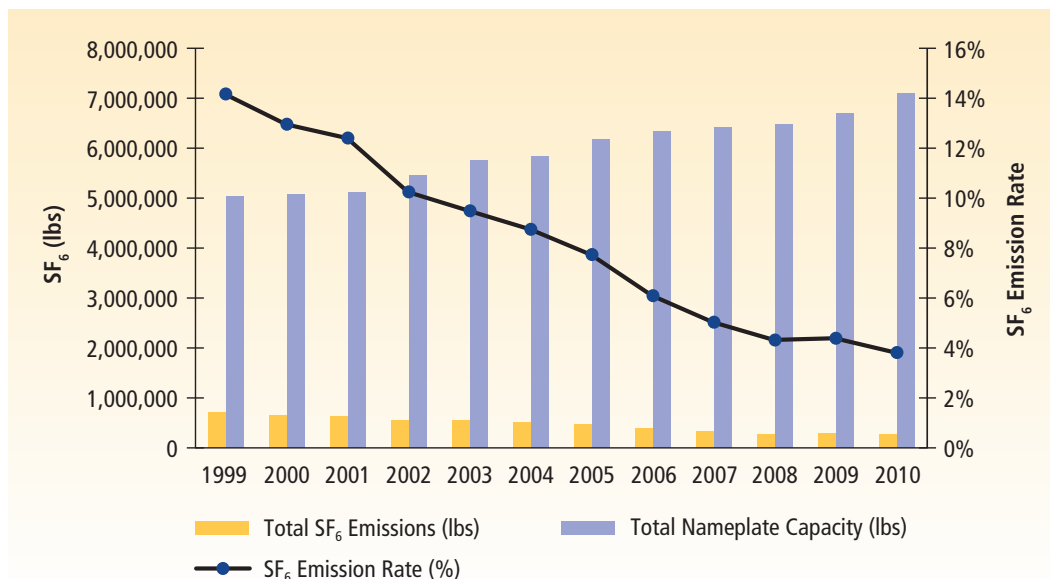
The Partnership's annual average SF₆ emission rate, the ratio of SF₆ emissions relative to total SF₆ nameplate capacity (i.e., the total quantity of SF₆ contained in electrical equipment), is a benchmark metric by which achievements of the Partnership are tracked. As illustrated in Figure 1, the annual average SF₆ emission rate of Partners has decreased significantly since 1999. The Partnership's annual average emission rate reached 3.8% in 2010. Overall, the annual

average SF₆ emission rate for the Partnership is down 73 percent from the 1999 baseline emission rate of 14.2 percent.

Table 1 summarizes the Partnership's aggregate SF₆ emissions, nameplate capacity, and emission rate for the 1999 to 2010 reporting years.¹ From 2009 to 2010, total SF₆ emissions decreased to approximately 270,500 pounds, while the Partnership nameplate capacity increased to approximately 7,066,000 pounds. Both of these changes led to an overall decrease in the annual average Partnership SF₆ emission rate. A summary of the Partnership's SF₆ emissions and reductions are presented in Table 2. The

¹ Trends across years should be evaluated using the SF₆ emission rate, rather than SF₆ emissions. The SF₆ emission rate is a valuable assessment of Partnership trends because it allows for a normalized comparison. While Partners vary in total SF₆ nameplate capacity, a larger utility, although using more SF₆, will not necessarily have a higher emission rate than a smaller utility.

Figure 1: SF₆ Emission Rate Trends



SF₆ emission reductions, presented in terms of pounds of SF₆ and million metric tons of carbon dioxide equivalent (MMTCO_{2e}), were calculated using a baseline year of 1999.

To date, Partners have decreased absolute emissions of SF₆ by 62 percent. Annual SF₆ reductions collectively made by Partners from 2009 to 2010 were approximately 23,900 pounds, or the CO₂ equivalent of 0.26 million metric tons (MMTCO_{2e}). From 1999 through 2010, Partnership emissions reductions totaled close to a cumulative of 2.9 million pounds of SF₆ or 31.4 MMTCO_{2e} (i.e., based on the sum of “Reduction from Baseline” as provided in Row 3, Table 2). If the Partnership’s SF₆ emission rate of 14 percent remained unchanged since 1999, then the total amount of emissions

Estimation Methods

The results presented in Table 1 are based on the estimated 1999-2010 time series data for all current Partners, including those Partners that joined after 1999. Extrapolation and interpolation techniques were used to estimate emissions and nameplate capacity for years in which a current Partner had not reported data. For example, if a Partner provided a report for 2007 and 2009 but not for 2008, a 2008 estimate was determined through linear interpolation.

TABLE 1: Summary of Partnership SF₆ Emissions, Nameplate Capacity, and Emission Rate

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total SF₆ Emissions (lbs)	712,454	657,978	635,746	559,314	547,354	510,772	477,920	386,042	323,033	280,460	294,349	270,484
Total Nameplate Capacity (lbs)	5,028,383	5,077,010	5,123,614	5,456,496	5,762,347	5,835,407	6,175,679	6,333,518	6,415,440	6,485,296	6,700,731	7,065,999
SF₆ Emission Rate (%)^a	14.2%	13.0%	12.4%	10.3%	9.5%	8.8%	7.7%	6.1%	5.0%	4.3%	4.4%	3.8%

Note: Historical estimates have been updated based on the estimation methodology used by EPA and data made available by Partners.

^a Emission rate is defined as total emissions divided by total nameplate capacity (i.e., the total quantity of SF₆ contained in electrical equipment).

TABLE 2: Summary of Absolute Partnership SF₆ Emission Reductions

	1999 ^a	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total Partner-Reported SF₆ Emissions (lbs)	712,454	657,978	635,746	559,314	547,354	510,772	477,920	386,042	323,033	280,460	294,349	270,484
Total Partner-Reported SF₆ Emissions (MMTCO_{2e})	7.72	7.13	6.89	6.06	5.93	5.54	5.18	4.18	3.50	3.04	3.19	2.93
Reduction from 1999 Baseline (lbs)		54,476	76,708	153,140	165,100	201,682	234,535	326,412	389,421	431,994	418,106	441,970
Reduction from 1999 Baseline (MMTCO_{2e})		0.59	0.83	1.66	1.79	2.19	2.54	3.54	4.22	4.68	4.53	4.79
Percent Reduction from 1999 Baseline		7.6%	10.8%	21.5%	23.2%	28.3%	32.9%	45.8%	54.7%	60.6%	58.7%	62.0%

Note: Historical estimates have been updated based on the estimation methodology used by EPA and data made available by Partners.

^a Baseline year.

Cumulative SF₆ emissions reductions of 2,893,500 pounds relative to the 1999 baseline are equivalent to CO₂ emissions reductions from:

- ▶ **6 million** passenger cars not driven for one year
- ▶ **73 million** barrels of oil not used
- ▶ **8 million** households reducing electricity use by 50 percent for one year

Because SF₆ has an atmospheric lifetime of 3,200 years, the benefits of reducing emissions accrue for many generations.

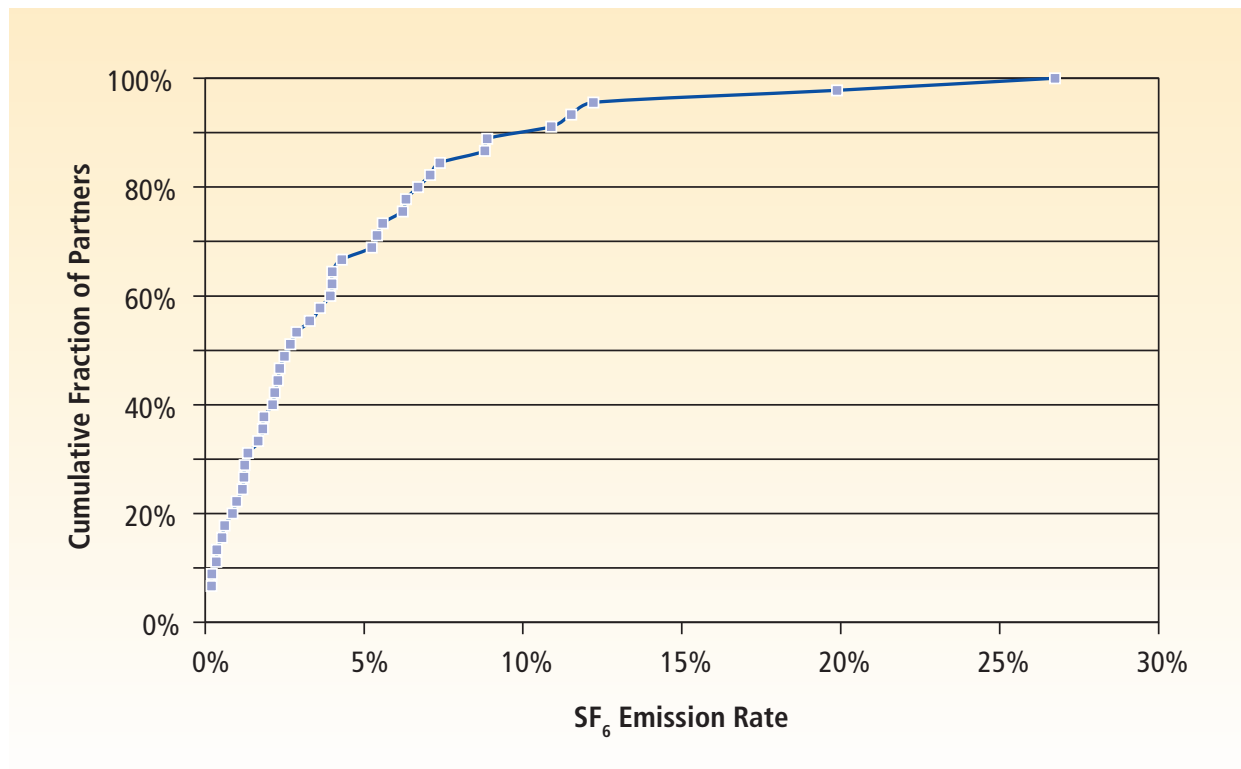
Source: <http://www.epa.gov/cleanenergy/energy-resources/calculator.html>

emitted to the atmosphere since 1999 would be 4.5 million pounds greater than has actually occurred.

Figure 2 displays the distribution of Partners according to their emission rate. As illustrated, nearly 70 percent of Partners are below an emission rate of 5 percent, and half of all

Partners have achieved an emission rate of 2.5 percent or less. Emission rates of Partners vary due to a number of factors such as total nameplate capacity within their system, transmission miles, age and geographic location of equipment, and the number of years participating in the Partnership.

Figure 2: SF₆ Emission Rate Trends



Partner Spotlights

Partners that are involved in the EPA SF₆ Partnership are leaders in their industry in efforts to reduce SF₆ emissions.

Partners are actively seeking opportunities to improve the management and tracking of their cylinder inventories, maximizing recycling, and continually training personnel on responsible handling of SF₆ in the field. Another key action is prioritizing equipment repair and replacing equipment with major leaks as they see the financial benefit in such an investment (i.e., improved system reliability and of the avoided cost to replace gas lost to the atmosphere), in addition to environmental benefits. Partners are also gathering at Partnership events to exchange information and learn from one another.

MidAmerican Energy

MidAmerican Energy, a subsidiary of MidAmerican Energy Holdings Company, is Iowa's largest energy company. MidAmerican Energy provides service to customers in a 10,600 square mile area in Iowa, Illinois, South Dakota and Nebraska.

Since joining the Partnership in 2004, MidAmerican Energy Company has successfully reduced its SF₆ emissions rate from 17.1 percent to 5.6 percent. The cumulative reduction of SF₆ emissions is equivalent to the avoidance of more than 276 metric tons of CO₂e, or an estimated

54,300 passenger cars not driven for a full year. MidAmerican Energy's success can be attributed to a comprehensive reduction plan that includes the establishment of an SF₆ program; employee training regarding the environmental effects of SF₆ gas; an SF₆ manual featuring proper gas handling procedures; equipment utilization; tracking of leaking equipment; and replacement of any identified leaking equipment. In 2010, MidAmerican Energy replaced a leaking 345kV circuit breaker, which supported its emission reduction efforts.

National Grid

National Grid is an international electricity and gas company and is one of the largest investor-owned energy companies in the world. In the United States, National Grid provides service to millions of customers throughout the Northeast.

National Grid joined the Partnership in 2003. During its time in the program, it has effectively reduced SF₆ emissions by 63 percent, reporting a SF₆ emission rate of 2.3 percent for 2010. National Grid's cumulative reduction is equivalent to 204 metric tons of CO₂e, or an estimated 40,000 passenger cars not driven for one year. SF₆ leak repairs, SF₆ equipment replacements, and improved reporting procedures were key to their success in 2010.

Partnership Announcements and Updates

This section covers updates on outreach events, the latest developments in the Greenhouse Gas Reporting Program, and New Partners to the program.

Workshop on SF₆ Emission Reduction Strategies, April 17-18, 2012

The SF₆ Emission Reduction Partnership for Electric Power Systems will be hosting another two-day Workshop on April 17 and 18 of 2012. EPA is pleased to announce that Partner utility Southern Company has offered to host the workshop, which will take place in Atlanta, Georgia at the Georgia Power Company Headquarters.

Similar to the last workshop, held in 2009 in Phoenix, Arizona, this workshop will bring together between 100-150 participants from Partner utilities, service providers, gas producers and distributors, and equipment manufacturers. Sessions will cover a climate change policy update, SF₆ emission reduction strategies, and managing and tracking SF₆ Inventories. EPA is welcoming sponsors and will offer a room for exhibitors. The workshop will end with a site tour from our Partner host, Southern Company.

More information will be made available through email announcements and updates to the Partnership's web site (www.epa.gov/electricpower-sf6).

2010 Partner Meeting: Dallas, TX

On May 13-14, 2010, the Partnership conducted a Partners-only meeting held in Dallas, Texas to discuss best practices for SF₆ inventories and emission reductions. The meeting also discussed new developments in climate change policy. The meeting was to facilitate the exchange of information relevant to improving SF₆ emission estimates and reducing SF₆ emissions in the context of the recent developments in climate policy. Roundtable discussions were held, allowing an open forum for Partners in attendance to discuss improving SF₆ emission and nameplate capacity estimates, best management practices, and mitigation strategies for SF₆ emission reductions and the future of the SF₆ Partnership.

Close to 40 attendees with representatives from 18 Partner companies participated in the meeting. The host of the event, SF₆ Partner Oncor, shared their facilities and provided meeting participants a site tour of their Parkdale facility, which consists of 14 SF₆ gas breakers and seven oil breakers hung off of two 138kV buses. Co-located on the property is Oncor's Static Var Compensator (SVC), the largest and fastest SVC in the world.

EPA would like to specially recognize and thank Partner utility, Oncor. This successful meeting would not have been possible without the hard work and hospitality of the Oncor staff.

2012 Partner Recognition Nominate Your Company!

EPA will be presenting certificates to selected Partners, recognizing their efforts to reduce SF₆ emissions. If you would like to nominate your company for this special recognition, please email the Program Manager a brief description of your SF₆ emission reduction efforts and successes. EPA will be accepting nominations through February 10, 2012; specifics on the self nomination process will be distributed in early 2012.

Contact:
Sally Rand, EPA Program Manager
rand.sally@epa.gov

Mandatory Reporting of Greenhouse Gases Rule

On October 30, 2009, EPA published a rule for the mandatory reporting of greenhouse gases (GHGs) from large GHG emissions sources in the United States. Implementation of 40 CFR Part 98 is referred to as the Greenhouse Gas Reporting Program (GHGRP).

This comprehensive, nationwide emissions data will provide better understanding of sources of GHGs and will guide development of the policies and programs to reduce emissions. Publicly available data will allow reporters to track their own emissions, compare them to similar facilities, and aid in identifying cost effective opportunities to reduce emissions in the future. An estimated 85-90 percent of the total U.S. GHG emissions from across 41 industrial categories are covered by this rule. In general, the threshold for reporting is 25,000 metric tons or more of carbon dioxide equivalent (CO₂e) per year. Reporting is at the facility level.

Reports under this regulation are submitted annually and provide data collected during the previous calendar year (i.e. reporting year). Reports for calendar year 2011 are due on September 28, 2012. Reports for future years are due on March 31 for emissions in the previous calendar year, e.g., 2012 data will be due by March 31, 2013.

Reporting requirements for SF₆ from Electric Power Systems are set forth under Subpart DD of the regulation (75 FR 74774). A copy of the regulation and related information can be found online (<http://www.epa.gov/climatechange/emissions/ghgrulemaking.html>). Facilities are required to report under the GHGRP if their total nameplate capacity of SF₆-containing equipment exceeds 17,820 lbs of SF₆, which is estimated to be the equivalent to an emissions threshold of 25,000 metric tons of CO₂e per year.

Voluntary reporting of emissions under the SF₆ Partnership will continue for Partner companies that do not meet the threshold of Subpart DD of the GHGRP. Submission of the previous year data is requested by March 31. Partners that are required to report under the GHGRP no longer need to submit data via the Partnership report form.

EPA will continue to communicate relevant announcements regarding mandatory reporting via the Partnership email distribution list.

New Partners

The Partnership welcomes San Diego Gas & Electric and Westar Energy as new Partners in the program. The Partnership has continued to grow in size, nearly doubling from 48 members to 84 members as of December 2011. Charter members are specially recognized in the complete Partner list, which can be referenced at the end of this report.

Continued Growth and Success

When EPA and the electric power industry launched the Partnership in 1999, the challenge to reduce SF₆ emissions in technically and economically feasible ways was at hand. Partners met this challenge making significant reductions primarily by identifying and replacing or repairing old, leaking breakers. Over the years, Partners advanced their strategies to reduce SF₆ emissions, examining their system for all possible sources of potential emissions; purchasing new laser leak detection cameras; working with their vendors to receive SF₆ inventory related reports; tightening their gas cylinder inventories; purchasing more recycling carts; introducing software systems to better monitor and manage inventory; and improving on their overall management and training procedures. Voluntary action under the Partnership has yielded impressive results. In this reporting year, SF₆ Partners collectively reduced the average SF₆ emission rate to 3.8 percent compared to 4.4 percent in 2009 and 14.2 percent in 1999. SF₆ emissions in the 2010 reporting year are 73 percent lower than in the

1999 baseline year. Cumulatively, over the course of the Partnership, SF₆ Partners have prevented the escape of approximately 2.9 million pounds of SF₆ or 31.4 MMTCO₂e. Preventing the loss of this much gas into the atmosphere translates into an equivalent of \$23.1 million to \$34.7 million of avoided SF₆ purchases to replace such losses.

EPA applauds all Partners for the program's success and encourages Partners to continue setting and working towards ambitious reduction goals with the program.

For additional information, please contact:

Sally Rand
Program Manager
U.S. Environmental Protection Agency
Climate Change Division (6207J)
Washington, DC 20460
Tel: (202) 343-9739
E-mail: rand.sally@epa.gov

Know your System – Take the Partner Challenge to Improve SF₆ Nameplate Capacity Estimates

Partners are encouraged and challenged to reevaluate and develop thorough and accurate estimates of SF₆ nameplate capacity. Total nameplate capacity is recognized as difficult for Partners to determine given the various ages and types of SF₆-containing equipment and its varied distribution across numerous substations; having a reliable estimate is imperative to understanding system-wide SF₆ usage and accurately determining an SF₆ emission rate.

List of Partners (as of December 2011)

* Charter Partner

Subsidiaries are bulleted under parent companies

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

City of Palo Alto
Palo Alto, CA

Consolidated Edison Company of New York, Inc. *
New York, NY

CPS Energy (formerly San Antonio City Public Service Board)*
San Antonio, TX

Duquesne Light Company*
Pittsburg, PA

E.ON U.S. LCC
Louisville, KY

El Paso Electric Company*
El Paso, TX

Eugene Water and Electric Board*
Eugene, OR

Exelon Energy Delivery (EED)

➤ **ComEd Energy Delivery***
Chicago, IL

➤ **PECO Energy Delivery**
Philadelphia, PA

FirstEnergy Corporation*
Akron, OH

Florida Power and Light Company (FPL)*
Juno Beach, FL

➤ **New Hampshire Transmission- Seabrook Station**
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

ITC Transmission
Novi, MI

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

NSTAR Electric and Gas
Westwood, MA

➤ **Boston Edison Company**
Boston, MA

➤ **Cambridge Electric Light Company**
Boston, MA

➤ **Commonwealth Electric Company**
Boston, MA

Nashville Electric Service (NES)
Nashville, TN

National Grid

➤ **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

New York State Electric and Gas
Ithaca, NY

Northeast Utilities Services Company*

➤ **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)
Merriville, IN

Oglethorpe Power
Tucker, GA

Oklahoma Gas and Electric Corporation* (OG&E)
Oklahoma City, OK

Oncor (formerly TXU)*
Dallas, TX

Otter Tail Power Company
Fergus Falls, MN

PNM Resources
Albuquerque, NM

Pacificorp
Portland, OR

➤ **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**
Phoenix, AZ

San Diego Gas & Electric
San Diego, CA

Seattle City Light
Seattle, WA

Silicon Valley Power*
Santa Clara, CA

South Carolina Electric & Gas Company
Columbia, SC

Southern California Edison
Rosemead, CA

Southern Company*
Atlanta, GA

State of California – Department of Water Resources
Sacramento, CA

Tennessee Valley Authority (TVA)
Knoxville, TN

Texas Municipal Power Agency*
Bryan, TX

VT Transco LLC
Rutland, VT

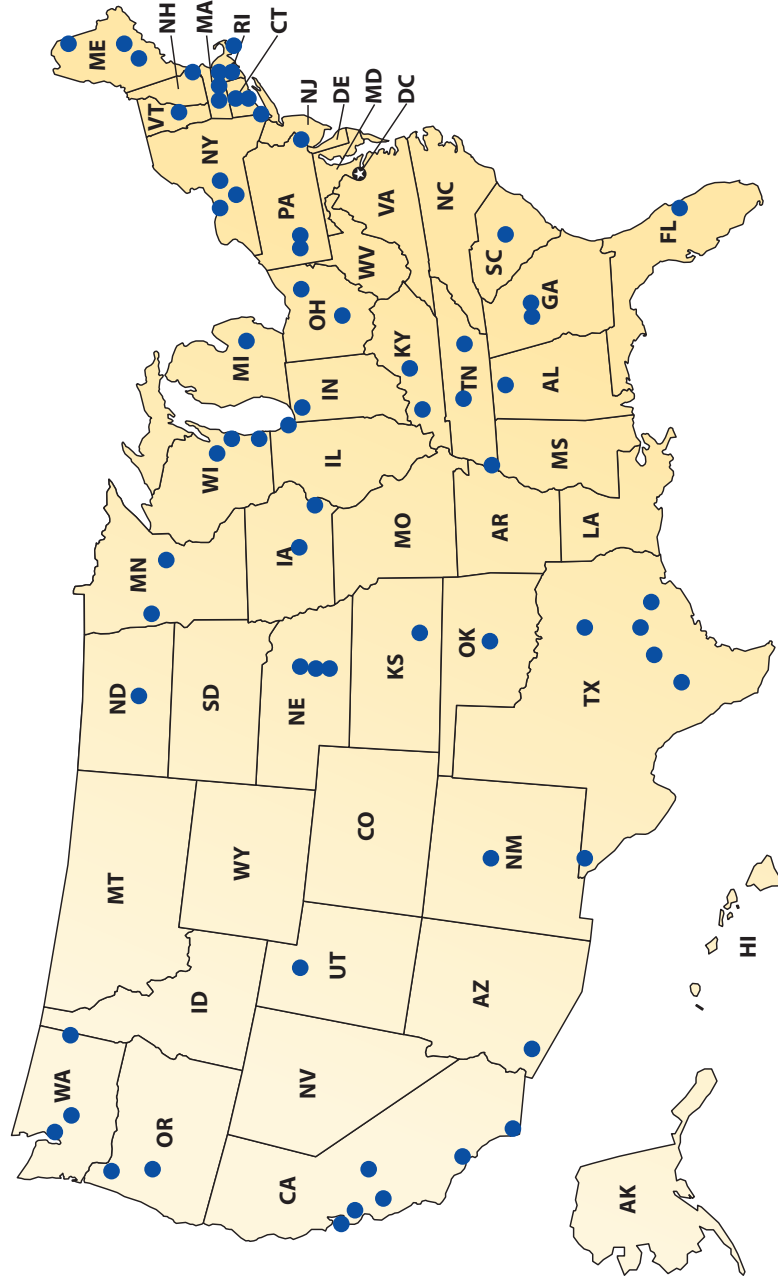
Wallingford Electric Division*
Wallingford, CT

We Energies*
Milwaukee, WI

Westar Energy
Wichita, Kansas

** Salt River Project is a Charter Partner that left the Partnership, but recently rejoined in 2009.

Distribution of Partners





United States
Environmental Protection
Agency

Climate Change Division (6207J)
www.epa.gov
December 2011

