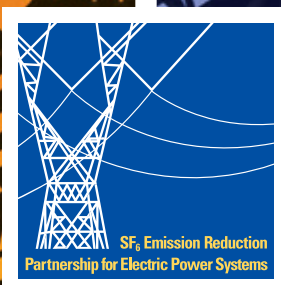
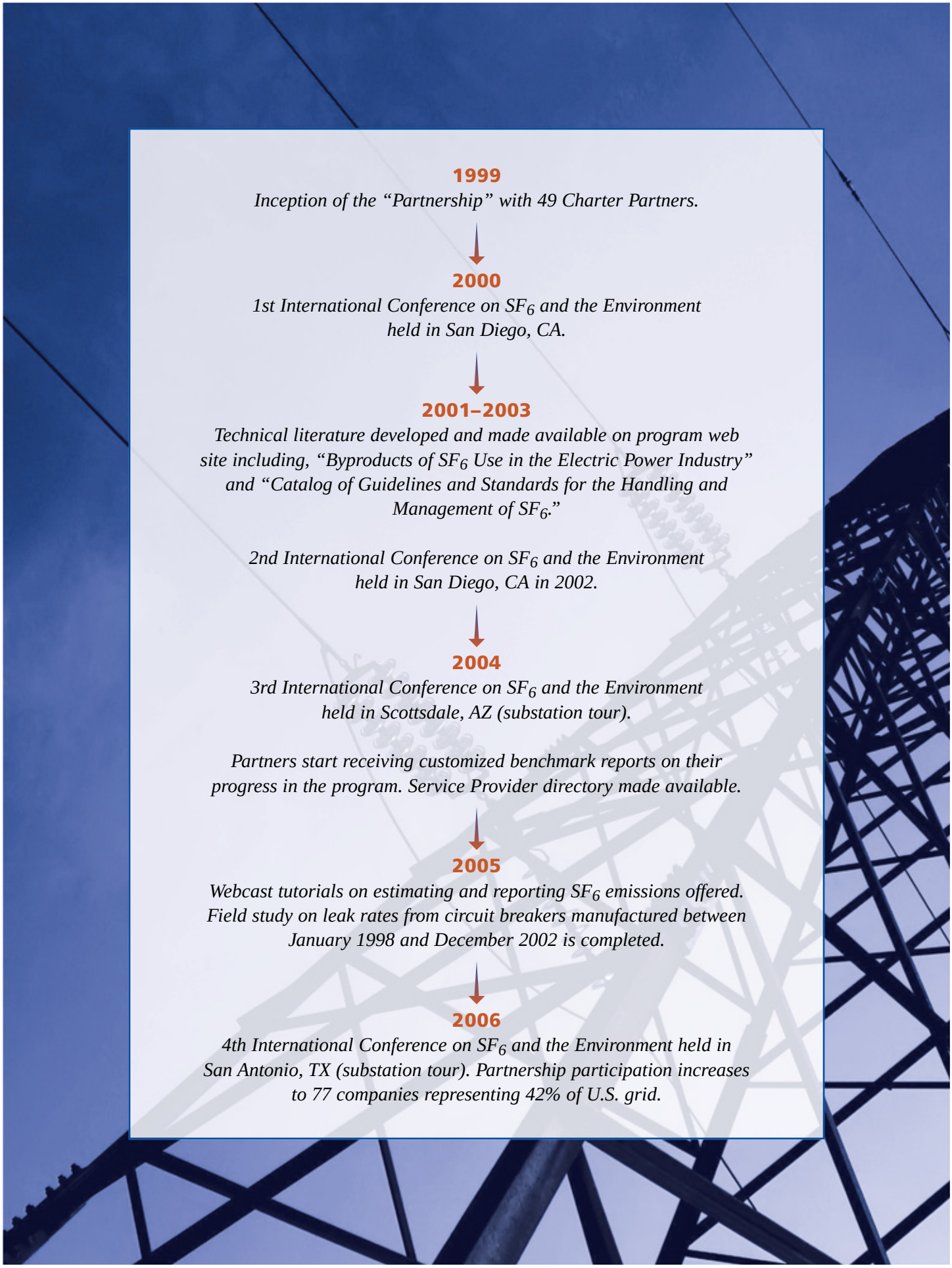
SF_6 Emission Reduction Partnership for Electric Power Systems

2006 Annual Report

November 2007





1999

Inception of the "Partnership" with 49 Charter Partners.

2000

1st International Conference on SF_6 and the Environment held in San Diego, CA.

2001–2003

Technical literature developed and made available on program web site including, "Byproducts of SF_6 Use in the Electric Power Industry" and "Catalog of Guidelines and Standards for the Handling and Management of SF_6."

2nd International Conference on SF_6 and the Environment held in San Diego, CA in 2002.

2004

3rd International Conference on SF_6 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 SF_6 emissions offered. Field study on leak rates from circuit breakers manufactured between January 1998 and December 2002 is completed.

2006

4th International Conference on SF_6 and the Environment held in San Antonio, TX (substation tour). Partnership participation increases to 77 companies representing 42% of U.S. grid.

The SF_6 Emission Reduction Partnership for Electric Power Systems

As part of a comprehensive policy to address climate change, the United States administers a wide array of public-private partnerships to slow the growth of greenhouse gas emissions, including the SF_6 Emission Reduction Partnership for Electric Power Systems. This partnership is one of a suite of non-CO_2 programs that target the high global warming potential (GWP) greenhouse gases (e.g., hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs)). Sulfur hexafluoride (SF_6) is a man-made fluorinated compound with a long atmospheric lifetime of 3,200 years and has the ability to trap heat in the Earth's atmosphere 23,900 times more than that of carbon dioxide (CO_2). U.S. electric utilities that participate in this program (SF_6 Partners) have recognized the opportunity to reduce their carbon footprint through cost-effective reductions in SF_6 gas emissions. Sulfur hexafluoride is the industry's preferred gas for high voltage electrical insulation, current interruption, and arc quenching in the transmission and distribution of electricity; the gas is used extensively in circuit breakers, gas-insulated substations, and switchgear because of its inertness and dielectric properties. SF_6 Partners are identifying sources of fugitive emissions from equipment using different leak detection methods, and repairing or replacing the problem equipment. SF_6 Partners are also implementing techniques to reduce emissions that occur when handling the gas during equipment installation, servicing, and disposal.

Another successful year can be added to the SF_6 Emission Reduction Partnership's track record. This report documents the cumulative results of the program from 1999 to 2006; recognizes certain Partners leading such progress; provides an update on the program; presents a discussion on the state of knowledge of climate change; and concludes with a vision for the future.

Warming Trends

While heat-trapping greenhouse gases are necessary for keeping the planet's surface warm, their concentrations are increasing significantly in the atmosphere, offsetting the natural atmospheric composition and increasing the average temperature of the Earth's surface at an unprecedented rate. According to the Intergovernmental Panel on Climate Change (IPCC), the concentration of SF_6 in the atmosphere has been increasing linearly over the past decade.

The potential threat from SF_6 to our climate is great since one pound of SF_6 released is roughly equivalent to thermal warming from 11 tons of CO_2. In the table to the right, the GWP of SF_6 is compared to the GWPs of other common greenhouse gases.

For more information, see the section, "Climate Change, State of Knowledge", in this report.

Source: IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

GWPs (100-Year Time Horizon) of Common Greenhouse Gases*

Gas	GWP
CO_2	1
CH_4	21
HFC-152a	140
N_2O	310
HFC-134a	1,300
HFC-4310mee	1,300
HFC-227ea	2,900
HFC-236fa	6,300
CF_4	6,500
C_6F_{14}	7,400
C_2F_6	9,200
HFC-23	11,700
SF_6	**23,900**

* Source: Second Assessment Report values as reported in IPCC, 2007.

Partner Accomplishments

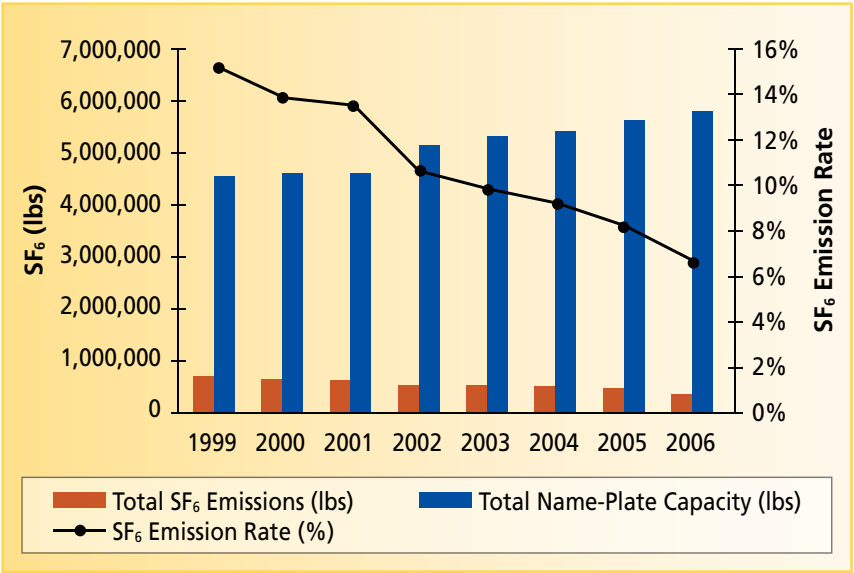
EPA's SF_6 Partners continue to make great strides in reducing emissions of SF_6. This section presents the results of the 2006 reporting year as well as cumulative emission reductions for the program overall in comparison to the 1999 baseline year. EPA also spotlights two Partners based on their commendable achievements in 2006 as well as their overall success with the program.

Partner-Reported Emissions

The SF_6 Emission Reduction Partnership has historically tracked a declining trend in the annual average SF_6 emission rate, the ratio of SF_6 emissions relative to total nameplate capacity (i.e., the total quantity of SF_6 contained in electrical equipment) reported by Partners. As shown in Figure 1, the 2006 reporting year continues this trend. The 2006 SF_6 emission rate is 6.5 percent, down from 8.1 percent in 2005.[1] Overall, the Partnership's SF_6 emission rate has decreased by 57 percent between 1999 and 2006.

Table 1 summarizes the aggregated program statistics for each year since 1999. The results presented in this report are based on new methodology for the program to address instances when reporting Partners have not provided data and to account for the continually changing size of the program.[2] As such, results in Table 1 are based on Partners in the program in 2006 as the representative population size for estimates for the entire time-series (1999-2006). Conservative assumptions were used to estimate emissions and nameplate capacity not reported by Partners; for example, if a Partner provided a report for 2004 and 2006, a 2005 estimate was determined through linear interpolation. Results for the 2006 reporting year include total SF_6 emissions of 377,140 pounds and a nameplate capacity of 5,819,641 pounds.

Figure 1. Trend in SF_6 Emission Rate



[1] Emission rate is defined as total emissions divided by total nameplate capacity (i.e., the total quantity of SF_6 contained in electrical equipment).

[2] Previous reports only presented aggregated annual data for those Partners that reported in that year. Consequently, emissions were previously under estimated due to lack of partner reporting in some years.

A summary of the total estimated SF_6 emission reductions achieved by Partners through 2006 is presented in Table 2. The information presented is derived by evaluating emissions estimates (as shown in Table 1). Emissions reductions are also presented in terms of pounds and million metric tons of carbon dioxide equivalent ($MMTCO_2E$) with the Partnership's inception year (1999) as the baseline.

To-date, SF_6 Partners have achieved a 45.6 percent decrease in emissions from the 1999 baseline year. From 2005 to 2006, Partners were able to reduce emissions of SF_6 gas by approximately 83,460 pounds, or the equivalent of 0.90 $MMTCO_2$. Cumulatively, from 1999 through 2006, the emissions reductions total 1,184,210 pounds or 12.84 $MMTCO_2E$ (i.e., the sum of "Reduction from Baseline" as provided in Table 2 rows 3 and 4, respectively).

Table 1: Aggregated Partnership Statistics

	1999	2000	2001	2002	2003	2004	2005	2006
Total SF_6 Emissions (lbs)	692,652	637,672	617,466	546,295	526,863	498,322	460,600	377,140
Total Name-Plate Capacity (lbs)	4,552,888	4,607,210	4,605,251	5,175,675	5,390,331	5,426,964	5,665,301	5,819,641
SF_6 Emission Rate[a]	15.2%	13.8%	13.4%	10.6%	9.8%	9.2%	8.1%	6.5%

[a] Emission rate is defined as total emissions divided by total name-plate capacity (i.e., the total quantity of SF_6 contained in electrical equipment).

Table 2: Summary of Partnership SF_6 Emissions and Reductions[a]

	1999	2000	2001	2002	2003	2004	2005	2006
Total Partner-Reported SF_6 Emissions (lbs)	692,652	637,672	617,466	546,295	526,863	498,322	460,600	377,140
Total Partner-Reported SF_6 Emissions ($MMTCO_2e$)	7.51	6.91	6.69	5.92	5.71	5.40	4.99	4.09
Reduction from Baseline (lbs)	–	*54,980*	*75,187*	*146,358*	*165,790*	*194,331*	*232,052*	*315,512*
Reduction from Baseline ($MMTCO_2e$)	–	*0.60*	*0.81*	*1.59*	*1.80*	*2.11*	*2.52*	*3.42*
Percent Reduction from Baseline	–	*7.9%*	*10.9%*	*21.1%*	*23.9%*	*28.1%*	*33.5%*	*45.6%*

[a] Population size represented for the entire time-series, 1999 to 2006, includes only the 2006 Partners to allow for year to year comparisons.

Methods Partners Use to Reduce Emissions of SF_6 Gas:

- Equipment leak detection and repair.
- Equipment upgrades and the replacement of old with new equipment.
- Training of employees to carefully handle, manage, and monitor SF_6.
- Systematic operations tracking including managing cylinder usage and SF_6 gas recycling carts usage.

Cumulative SF_6 emissions reductions of 1,184,210 pounds relative to the 1999 baseline are equivalent to mitigating CO_2 emissions due to:

- 2.8 million cars not driven for one year;
- 29.4 million barrels of oil not used; or
- 3.3 million households reducing electricity use by 50 percent for one year.

Source: http://www.usctcgateway.net/tool/

Partner Spotlights

SF_6 Partners represent a wide range of electric utilities in the United States. Significant opportunities to reduce SF_6 emissions are available for both large and small utilities. In particular, opportunities exist at all utilities to reduce leaks and improve handling losses. Larger utilities with significant SF_6 nameplate capacity can develop a long term SF_6 management strategy to accelerate the retirement of old equipment with high leak rates and prioritize repair schedules. Smaller utilities, in particular those with relatively smaller emission rates, can monitor and track their SF_6 storage inventories to maintain low emissions of SF_6 from their operations. Two Partners, MidAmerican Energy and Southern Company, are recognized in this section for their significant emission reductions in 2006 and their exemplary participation in the Partnership.

MidAmerican Energy

MidAmerican Energy, with a nameplate capacity of about 50,000 pounds, operates across Iowa, Illinois, and South Dakota, and serves over 714,000 customers. In 2004, when MidAmerican Energy joined the Partnership, their SF_6 emissions rate was 17 percent; since then, they have successfully reduced their rate to below 7 percent in 2006. This reduction is due in part to the replacement of several leaking circuit breakers, and an increased focus on SF_6 handling and education of personnel regarding the environmental impacts of SF_6 emissions. Not only has MidAmerican Energy reduced emissions significantly, the company has also reduced their annual expenditures on SF_6 gas.

Southern Company

Southern Company, with a nameplate capacity of over 300,000 pounds, serves more than 4.3 million customers through its electric utilities in Alabama, Florida, Georgia, and Mississippi, and also operates a growing competitive generation business focused on the Southeast. Despite the challenges that such a large nameplate capacity could pose, Southern Company has reduced their SF_6 emissions rate from 10.4 percent in 1999, when the utility joined as a Charter Partner, to 2.9 percent in 2006. At the same time, nameplate capacity has increased by approximately 76,000 pounds (30 percent). Southern Company attributes the success of their emission reductions primarily to replacing many of their older leaking two-pressure breakers, aggressive leak detection and equipment repair, and improvements to managing their inventory of gas. The decrease in emissions has lessened the need to purchase SF_6 gas, saving the company approximately $130,000 in 2006. In addition, reduced emissions have also lowered costs associated with outages and maintenance.

Partnership Update

In 2006 and into 2007, the Partnership had several important developments and events. EPA held the fourth successful conference on SF_6 and the Environment, and, more recently, launched a technology transfer series using online webcasts (i.e., web-based seminars). EPA continues to share technical information through speaking opportunities, such as results from the 2005 study of SF_6 leak rates in newly installed circuit breakers, which was presented at the Institute of Electrical and Electronics Engineers, Inc. (IEEE) Power Engineering Society (PES) General Meeting in June 2006. Through exposure at industry events, as well as targeted outreach, increasing numbers of companies are learning about the program and agreeing to voluntarily commit to reducing SF_6 emissions.

The 2006 International Conference on SF_6 and the Environment

In November of 2006, EPA held the Fourth International Conference on SF_6 and the Environment in San Antonio, Texas. This biennial conference brought together representatives from the electric power industry, the scientific community, and governments to share their knowledge and experience of SF_6 management and reduction strategies, costs and benefits of reductions, alternatives research, and Partner achievements. In attendance were representatives from China, Nigeria, Brazil, Taiwan, Japan, Australia, and Germany. EPA and cosponsors, including the World Bank and the National Electrical Manufacturers Association (NEMA) welcomed 16 exhibitors to the conference. The conference concluded with a site tour of a recently upgraded switchyard at the W.B. Tuttle Power Plant that is owned by the SF_6 Partner, San Antonio's City Public Service Board (CPS Energy). Vendors were stationed at CPS Energy to give product demonstrations. The staff at CPS Energy were gracious hosts for a large group of conference attendees and ended an unusually cold day with a Texas-styled barbeque lunch.

For conference proceedings, please visit EPA's Electric Power Partnership website at www.epa.gov/electricpower-sf6 and click on workshops/conferences.

Southern California Edison Receives SF_6 Emission Reduction Partnership Award from EPA

At the 2006 conference, EPA recognized Southern California Edison (SCE) for its global climate protection efforts through their commitment to and successful accomplishments in reducing SF_6 emissions. SCE, an Irvine, California based electric company, joined the Partnership in March 2001. The company has since reduced its SF_6 emissions by 41 percent. SCE's SF_6 emission rate is lower than the overall average for the Partnership, which is remarkable given the company's size and the amount of SF_6 equipment it maintains.

SCE has been instrumental in sharing information with EPA, electric power associations, and other power companies regarding SF_6 management practices and emission reduction activities.

Dina Kruger and Jerome Blackman, EPA, with the Electric Power Systems Partner Awardees from Southern California Edison, Howard Gollay and Alex Salinas.

SF_6 Technology Sessions—New Webcast Series

EPA commenced a series of "SF_6 Technology Sessions" for SF_6 Partners in 2007. The sessions are conducted through online webcasts, or "web-based seminars". Partner utility representatives are able to call and log in free of charge to participate in discussions focusing on the technical aspects of different SF_6 emission reduction options. Each session includes industry guest speakers presenting on various aspects of SF_6 emissions abatement. EPA hosted the first webcast of the SF_6 Technology Sessions series on May 31st 2007 on "Managing your Cylinder Inventory." The topics included in the series are displayed below; EPA is interested in hearing from Partners on any other ideas for topics. Announcements on future webcasts will be made via Partner e-mails.

SF_6 Technology Sessions Series

- SF_6 Cylinder Inventory Methods
- SF_6 Monitoring Equipment
- SF_6 Recycling
- SF_6 Leak Detection
- SF_6 Equipment Repair

New Partners

Since late 2006, EPA welcomed four new Partners into the SF_6 Emission Reduction Partnership for Electric Power Systems. Starting with 49 Charter Partners in 1999, the Partnership now totals 77 Partners. A full list of participating utilities, as of October 2007, is presented at the end of this report.

Newest Partners of the SF_6 Emission Reduction Partnership for Electric Power Systems:

- **City of Palo Alto Utilities**—Palo Alto, CA
- **Oglethorpe Power**—Tucker, GA
- **PNM Resources**—Albuquerque, NM
- **ITC Transmission**—Novi, MI

New Goals and a Vision for 2012

Over the past year, Partners have been working to update and/or extend their individual SF_6 emission reduction goal through December 2012 in an effort to establish a collective Partnership goal. Furthermore, this Partnership-wide effort will help all Partners evaluate how their company can meet the challenge to further reduce SF_6 emissions.

To date, 13 Partners have set new reduction goals. Based on the goals received to date and the results from Partner reported emission estimates for 2006, by 2012, the Partnership will reduce emissions to an average emission rate just under 5.0 percent. Historic achievements illustrate that Partners who have developed goals, have successfully striven to not only meet them, but exceed them. Given that approximately 60 percent of Partners currently have an emission rate at 3.5 percent or less, as illustrated in Figure 2, an aggressive partnership wide goal of less than 4 percent could be achieved by 2012. Figure 3 presents these two trajectories.

To accomplish a target Partnership emission rate of 3.5 percent by 2012, EPA encourages those that have not yet re-assessed their goal to do so in light of their current progress. Partners should also develop a long-term strategy for their use of SF_6 and consider what procedures can be put in place to re-focus mitigation efforts.

Figure 2. 2006 SF_6 Emission Rates of Partners

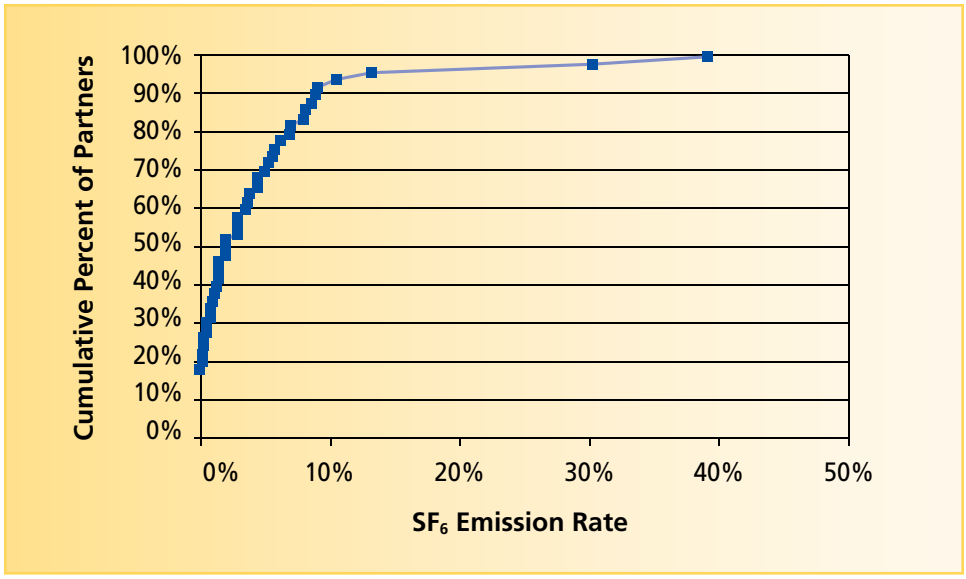
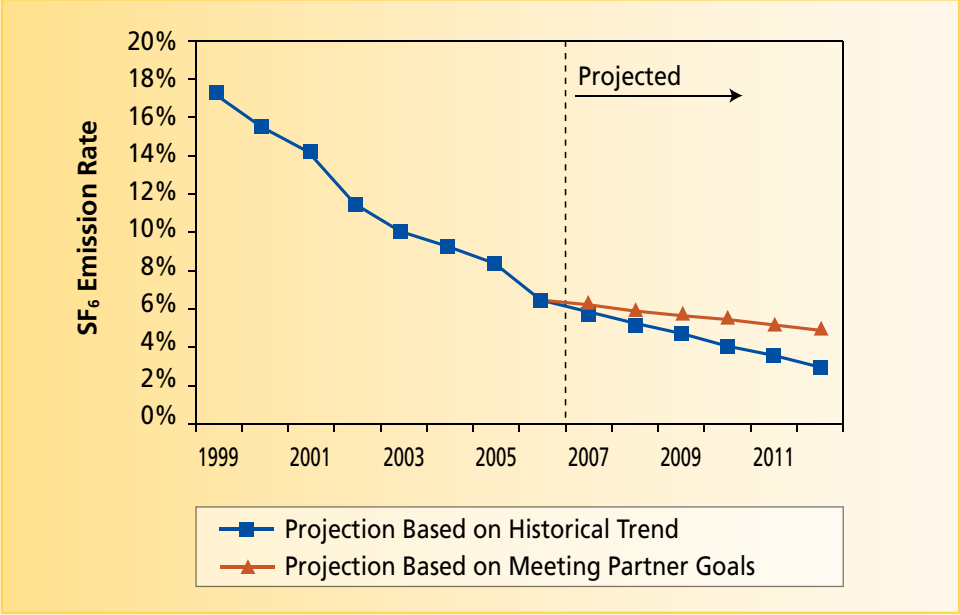
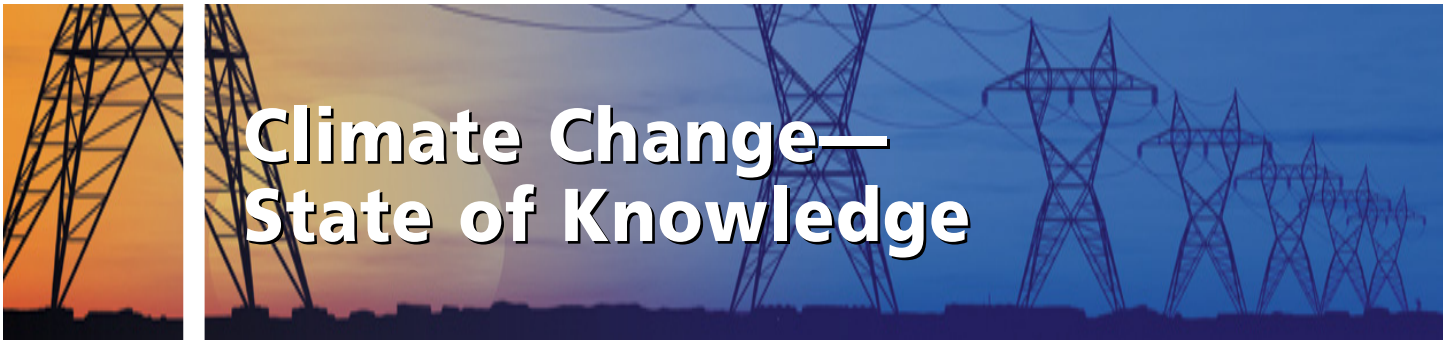


Figure 2 benchmarks the rates and range of emissions amongst Partner companies. The purpose of the partnership is to enable all participating companies to better manage their use of SF_6 and reduce emissions to cost-effective, technically feasible levels. Emission rates may differ due to a number of variables including total nameplate capacity, net transmission miles, age and geographic location of equipment, and number of years participating in the Partnership, amongst other factors.

Figure 3. Partnership SF_6 Emission Rate, Actual and Projected





Climate Change—State of Knowledge

Climate change refers to a significant change in a measure of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). During the past century humans have substantially added to the amount of greenhouse gases in the atmosphere. Changes in the abundance of atmospheric greenhouse gases alter the balance of energy incoming and outgoing into the Earth's atmosphere. The consequences of these changes are subject to extensive on-going studies.

The winner of the 2007 Nobel Peace Prize, the Intergovernmental Panel on Climate Change (IPCC), is recognized for its efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change. The IPCC was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts, and options for adaptation and mitigation. The panel is currently finalizing its Fourth Assessment Report "Climate Change 2007." The reports by the three Working Groups provide a comprehensive and up-to-date assessment of the current state of knowledge on climate change.

As with any field of scientific study, there are uncertainties associated with the science of climate change. This does not imply that scientists do not have confidence in many aspects of climate science. In particular, some aspects of the science are known with virtual certainty,[3] because they are based on well-known physical laws and documented trends. Current understanding of many other aspects of climate change ranges from "very likely" to "uncertain."

What's Known

Scientists know with virtual certainty that:

- Human activities are changing the composition of Earth's atmosphere. Increasing levels of greenhouse gases like carbon dioxide (CO_2) in the atmosphere since pre-industrial times are well-documented and understood.

- The atmospheric buildup of CO_2 and other greenhouse gases is largely the result of human activities such as the burning of fossil fuels.

- An "unequivocal" warming trend of about 1.0 to 1.7° F occurred from 1906-2005. Warming occurred in both the Northern and Southern Hemispheres, and over the oceans (IPCC, 2007).

[3] Use of "virtual certainty" (or virtually certain) conveys a greater than 99% chance that a result is true. Other terms used to communicate confidence include "extremely likely" (greater than 95% chance the result is true), "very likely" (greater than 90% chance the result is true), "likely" (greater than 66% chance the result is true), "more likely than not" (greater than 50% chance the result is true), "unlikely" (less than 33% chance the result is true), "very unlikely" (less than 10% chance the result is true), and "extremely unlikely" (less than 5% chance the result is true). These judgmental estimates originate from the Intergovernmental Panel on Climate Change (IPCC, 2007).

- The major greenhouse gases emitted by human activities remain in the atmosphere for periods ranging from decades to centuries. It is therefore virtually certain that atmospheric concentrations of greenhouse gases will continue to rise over the next few decades.

- Increasing greenhouse gas concentrations tends to warm the planet.

What's Very Likely?

IPCC has stated "Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations."[4] In short, a growing number of scientific analyses indicate, but cannot prove, that rising levels of greenhouse gases in the atmosphere are contributing to climate change (as theory predicts). In the coming decades, scientists anticipate that as atmospheric concentrations of greenhouse gases continue to rise, average global temperatures and sea levels will continue to rise as a result and precipitation patterns will change.

What's Not Certain?

Important scientific questions remain about how much warming will occur, how fast it will occur, and how the warming will affect the rest of the climate system including precipitation patterns and storms. Answering these questions will require advances in scientific knowledge in a number of areas:

- Improving understanding of natural climatic variations, changes in the sun's energy, land-use changes, the warming or cooling effects of pollutant aerosols, and the impacts of changing humidity and cloud cover.

- Determining the relative contribution to climate change of human activities and natural causes.

- Projecting future greenhouse emissions and how the climate system will respond within a narrow range.

- Improving understanding of the potential for rapid or abrupt climate change.

Addressing these and other areas of scientific uncertainty is a major priority of the U.S. Climate Change Science Program (CCSP). The CCSP is developing twenty-one Synthesis and Assessment Products to advance scientific understanding of these uncertainty areas by the end of 2008. For more information see: www.climatescience.gov.

[4] IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning (eds.)]. For more information see: www.ipcc.ch

Leadership, Responsibility, and Opportunity

In 2006, SF_6 Partners collectively reduced the average SF_6 emission rate to 6.5 percent compared to 8.1 percent in 2005 and 15.2 percent in 1999. SF_6 emissions in 2006 are 45.6 percent lower than in the 1999 baseline. Cumulatively, SF_6 Partners have prevented the escape of approximately 1.2 million pounds of SF_6 or 12.84 $MMTCO_2e$. Preventing the loss of this much gas into the atmosphere translates into an equivalent of $7.1 to 10.7 million dollars of avoided SF_6 purchases to replace such losses.

The demonstrated leadership of SF_6 Partners is critical to the future success of the program. Opportunities exist to further abate emissions of this greenhouse gas from transmission and distribution systems, especially in light of the aging infrastructure of the U.S. electric grid and the call to modernize it.[5] Any new high voltage electrical equipment in general "should" use less and leak less SF_6 gas than SF_6-bearing equipment of the past. As environmental stewards, SF_6 Partners take on an important responsibility to ensure that newer equipment is not leaking beyond its guaranteed leak rate. In meeting the Partnership's 2012 goal, it is also critical for Partners to work toward their individual goals and pursue additional economically and technologically feasible strategies that prevent SF_6 gas releases into the atmosphere.

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
Email: rand.sally@epa.gov

Jerome Blackman, SF_6 Emission Reduction Partnership Program Manager since 2002, has joined EPA's Natural Gas STAR Program. Sally Rand, who is the Team Leader for EPA's High GWP Voluntary Industry Partnerships, has been with EPA for 15 years and has extensive domestic and international experience working with industry on environmental protection issues. She is a Task Force member under the Asia Pacific Partnership for Clean Development and Climate and has contributed to several reports by the Intergovernmental Panel on Climate Change (IPCC). She earned a Master of Science (SM) in Environmental Health Management at the Harvard School of Public Health.

[5] Anderson, K., D. Furey, and K. Omar (2006) *Frayed Wires: U.S. Transmission System Shows Its Age.* Global Power/North America Special Report. FitchRatings. October 2006

List of Partners

(as of November 2007)

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

Columbia River People's Utility District
St. Helens, OR

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

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)[a]

- **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

ITCTransmission
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

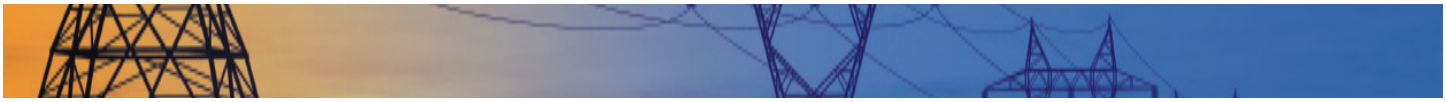
Memphis Light, Gas & Water Division
Memphis, TN

Menasha Utilities
Menasha, WI

MidAmerican Energy
Des Moines, IA

Montana-Dakota Utilities
Bismarck, ND

[a] Parent Company.



Muscatine Power & Water
Muscatine, IA

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, NH
- **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

Otter Tail Power Company
Fergus Falls, MN

PNM Resources
Alburuerque, NM

Pacificorp[a]

- **Pacific Power**
  Portland, OR
- **Rocky Mountain Power**
  Salt Lake City, UT

Pacific Gas and Electric Corporation (PG&E)
San Francisco, CA

Paragould City Light & Water
Paragould, AR

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

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

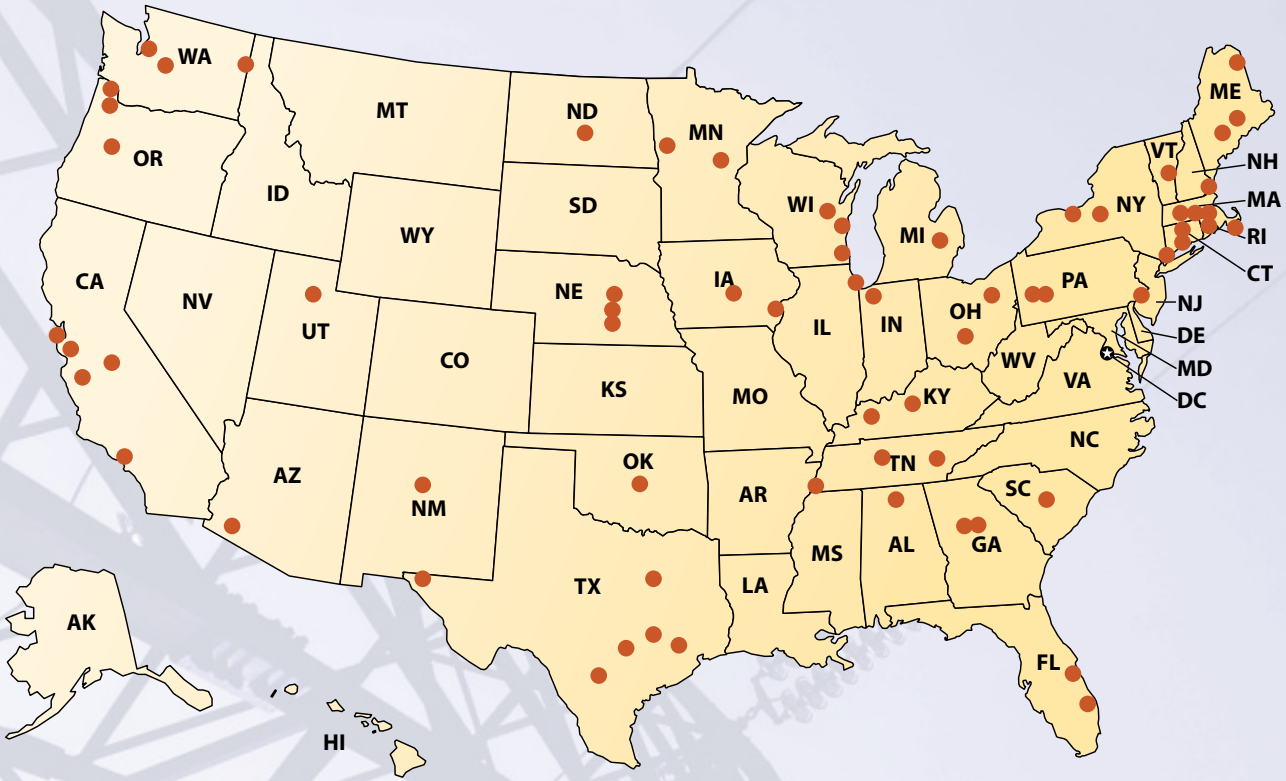
Wallingford Electric Division
Wallingford, CT

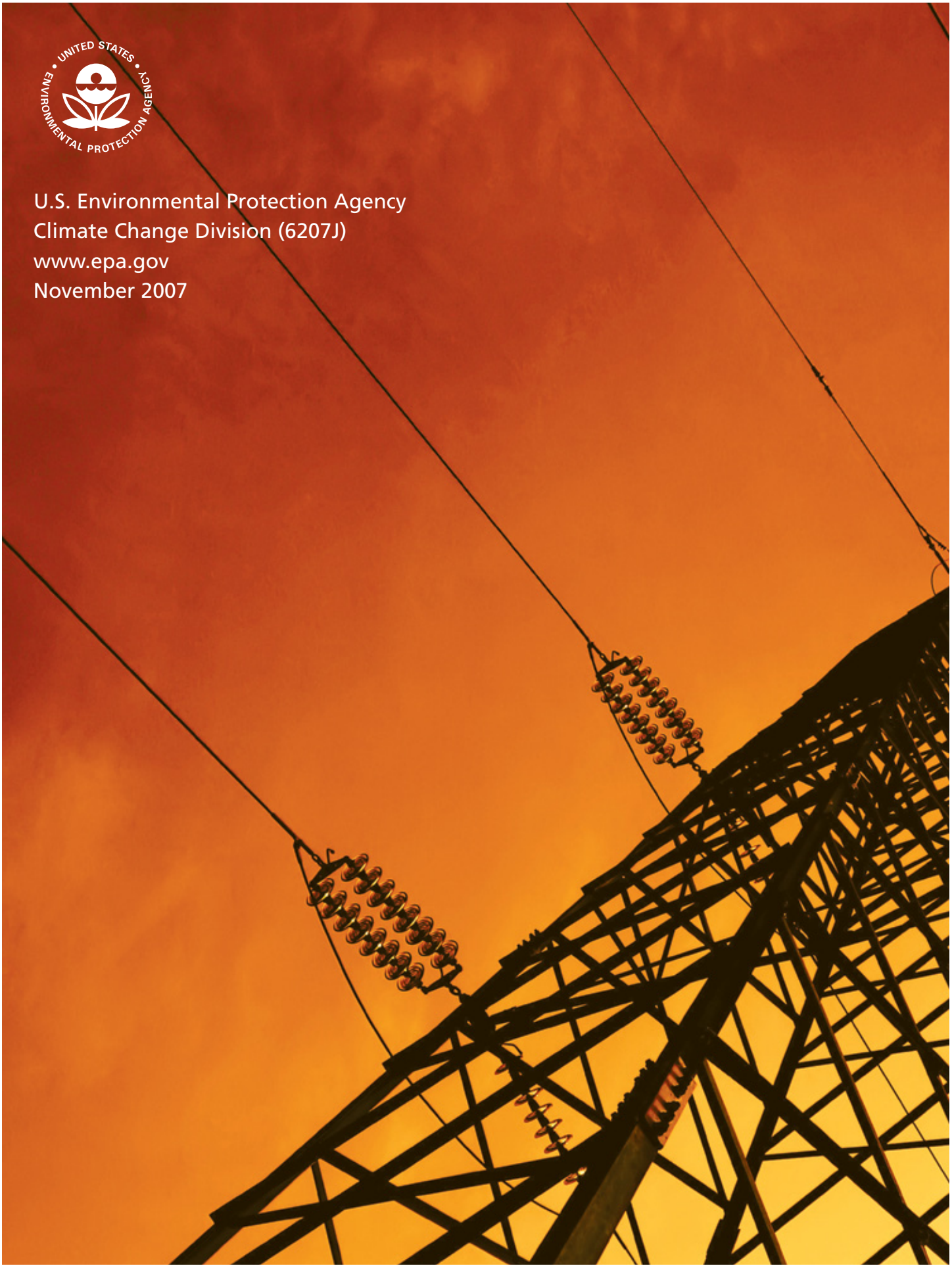
We Energies
Milwaukee, WI

Wellton-Mohawk Irrigation & Drainage District
Wellton, AZ

[a] Parent Company.

Distribution of Partners





U.S. Environmental Protection Agency
Climate Change Division (6207J)
www.epa.gov
November 2007