



# PSEG Voluntary Greenhouse Gas Emissions Inventory

**2000 – 2006  
U.S. Emissions**

**Public Service Enterprise Group (PSEG)  
80 Park Plaza  
Newark, NJ 07102  
[www.pseg.com](http://www.pseg.com)**

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**PSEG**

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## **Executive Summary**

PSEG has a long history of taking action on climate change. In 1993, the company joined the Global Climate Challenge Program and agreed to stabilize CO<sub>2</sub> emissions from its New Jersey plants at 1990 levels by 2000. PSEG met this challenging goal.

In 2002, PSEG took the next step by joining the EPA's Climate Leaders program, in which the company committed to reducing its CO<sub>2</sub> emissions rate by 18% by December 31, 2008. This inventory discusses the company's progress toward meeting its goal.

*"Climate change is the preeminent issue of our time. How we respond to climate change will define our company and our industry for decades to come."*

-- Ralph Izzo, Chairman of the Board, President and Chief Executive Officer, PSEG

The Climate Leaders program required PSEG to develop a new emissions inventory, incorporating the accounting standards developed by the World Resources Institute and World Business Council for Sustainable Development (WRI/WBCSD) in their "Greenhouse Gas (GHG) Protocol". It also required PSEG to select a more recent baseline year. PSEG chose 2000 as its new baseline year as a way to build on its previous goal. This inventory provides an accounting of all GHG emissions across PSEG's domestic operations based on equity ownership. Over 99% of PSEG worldwide GHG emissions occur in the United States.<sup>1</sup>

EPA's Climate Leaders program requires a rigorous goal setting and emissions accounting process. This starts with ensuring that the goal goes beyond business as usual and requires the creation of an inventory management plan (IMP). This is followed by an onsite review to ensure that the management plan is being well implemented at the facility level and includes an annual review of the emissions data.

PSEG's emissions inventory includes an accounting of the six greenhouse gasses covered by the Kyoto Protocol. Not surprisingly, the largest source of greenhouse gas emissions at PSEG comes from carbon dioxide (CO<sub>2</sub>) produced during the combustion of fossil fuels used to generate electric power. CO<sub>2</sub> from electric power generation accounts for about 94% of PSEG's annual greenhouse gasses emissions.

While overall GHG emissions from power generation have increased by 32% since 2000, electric power generation has increased by 50% during this time. Much of this can be attributed to expansion of the generating fleet. This expansion has involved the retirement of older, less efficient generating units and the installation of clean and efficient combined cycle natural gas units. These units emit CO<sub>2</sub> at a rate that is less than half that of a typical coal-fired power plant. As a result, PSEG's GHG emissions rate, the amount of GHG's produced per megawatt-hour of electricity produced, has declined significantly.

PSEG is well on its way to meeting its Climate Leaders GHG emissions rate reduction goal.

<sup>1</sup> Emissions from foreign operations can be found in PSEG's 2006 Carbon Disclosure Project Report: [http://www.cdproject.net/online\\_response.asp?cid=1216&id=5&exp=61&desc=Electric+Utility&letter=P&year=2](http://www.cdproject.net/online_response.asp?cid=1216&id=5&exp=61&desc=Electric+Utility&letter=P&year=2)

## **Background**

PSEG has been focused on the issue of climate change for well over a decade. It was the first electric power company in the nation to take part in the Global Climate Challenge Program. In 1993, PSEG committed to stabilize carbon dioxide (CO<sub>2</sub>) emissions from its New Jersey power plants at 1990 levels by 2000.

PSEG met this challenge,

while at the same time supplying its customers with

almost two million more megawatt hours (MWh) of electricity in 2000 as it did in 1990.

### **PSEG “Climate Challenge” Goal**

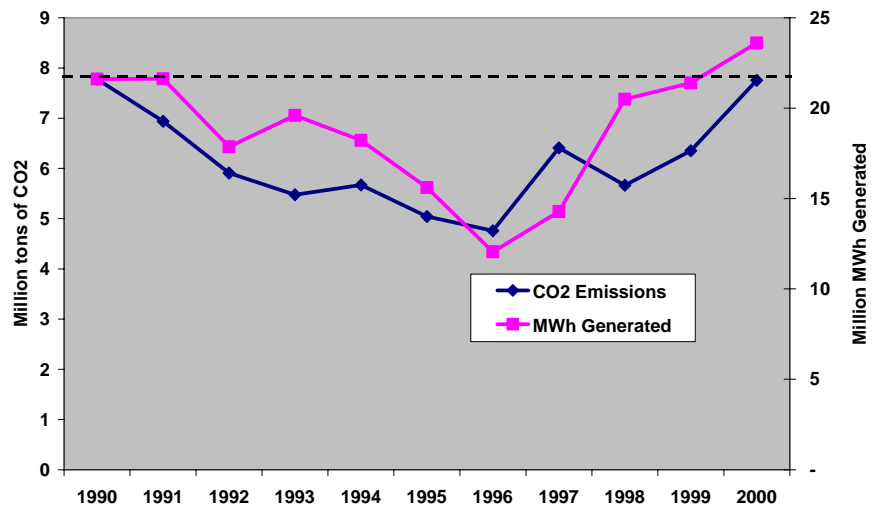


Figure 1.

Building on this success, PSEG joined the Environmental Protection Agency’s (EPA) Climate Leaders program in 2002. Under this program, PSEG committed to reduce its CO<sub>2</sub> equivalent greenhouse gas emissions on a pounds per megawatt-hour basis by 18% from 2000 levels by December 31, 2008. It also committed to creating a new greenhouse gas emissions inventory using the “Greenhouse Gas Protocol” developed by the World Resources Institute and World Business Council for Sustainable Development<sup>2</sup> (WRI/WBCSD). PSEG worked with WRI/WBCSD in the development of this protocol.

The stringent accounting standards adopted by WRI/WBCSD and the Climate Leaders program required PSEG to update its baseline year in order to assure a high quality inventory. For example, since 1990 a number of PSEG’s electric generating units have been fitted with continuous emissions monitors (CEMs), which have improved the accuracy of emissions reporting. PSEG selected 2000 as a new baseline year as a way of building on its previous greenhouse gas reduction goal.

<sup>2</sup> The Greenhouse Gas Protocol can be found at <http://www.ghgprotocol.org/>

## **Inventory Quality Control & Verification**

EPA, through the Climate Leaders program, continually reviews PSEG's emissions inventory data as well as its GHG emission reduction goal progress. In addition, PSEG received significant technical assistance from EPA in determining organizational and operational boundaries, identifying the most appropriate emission factors, and in documenting these decisions in an Inventory Management Plan (IMP) that will ensure consistency and transparency in the inventory over time. EPA performs desktop reviews of both the inventory data and IMP to ensure they meet EPA's quality standards and also conducted a risk-based on-site IMP review to ensure that the management plan is being well implemented at the facility level. While these reviews do not generally reflect the level of detail examined in a full third-party verification, they provide reasonable assurance to EPA that a well-implemented GHG data collection and management system is in place.

## Direct Emissions from Electric Power Generation

The GHG protocol requires the reporting of all six greenhouse gases covered by the Kyoto Protocol—carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF<sub>6</sub>)

The majority of greenhouse gas emissions from PSEG's subsidiaries are emitted in the form of carbon dioxide from fossil fuel combustion used to generate electric power. PSEG's subsidiary companies, PSEG Power LLC and PSEG Global LLC, together own about 16,000 megawatts of generating capacity in the United States.

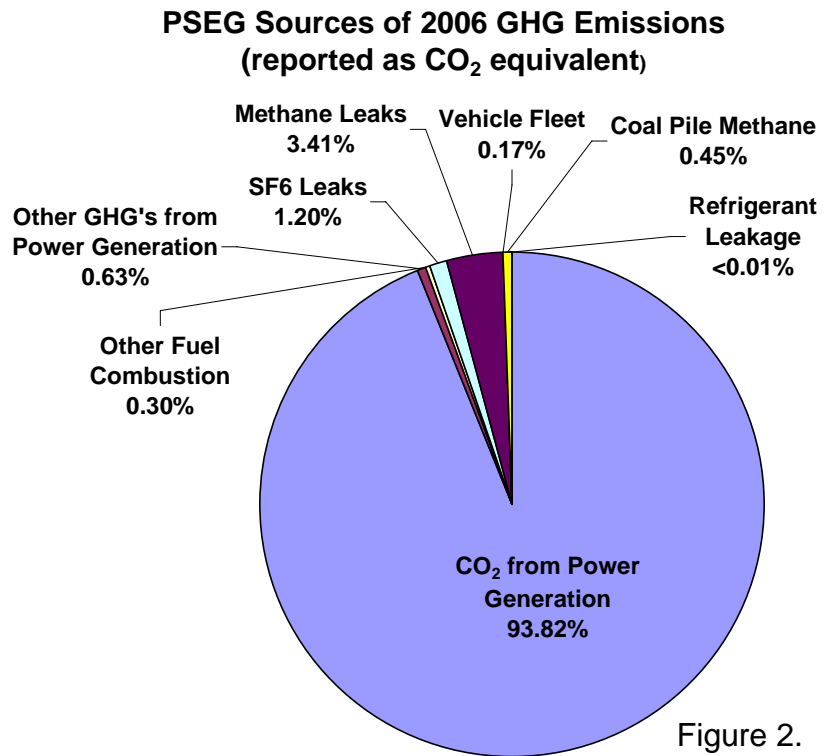


Figure 2.

PSEG uses two reporting approaches – performance and absolute – to measure its emissions.

### **Emissions Reporting by Performance Approach**

The “performance approach” to measuring greenhouse gas emissions compares greenhouse gasses emitted per unit of useful output. Useful output, in PSEG's case, is electric power generation. The performance approach provides a useful metric for measuring changes in how efficiently a company produces electricity, while normalizing for emissions growth due to expanded operations.

Using the performance approach, PSEG'S 2006 emission rate from electric power generation was below the 2000 baseline, both from a fossil-only perspective and when nuclear is included in the calculation.

### PSEG CO<sub>2</sub> Emission Rate from Electric Power Generation

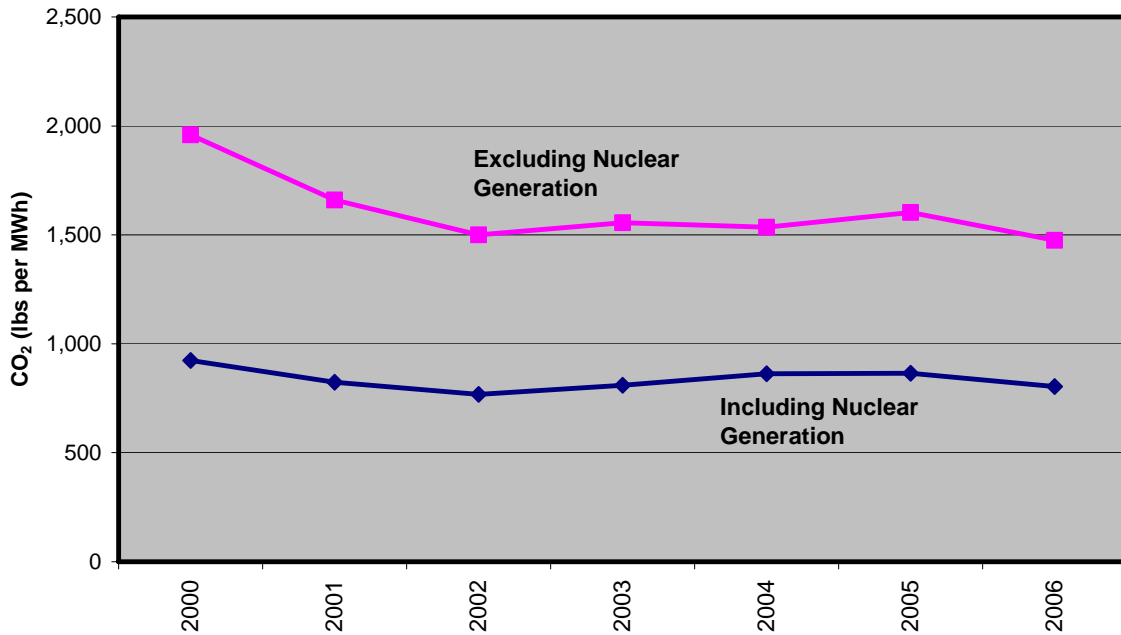


Figure 3.

The reduction in PSEG's CO<sub>2</sub> emission rate can be attributed to increased performance from the nuclear units and an increased reliance on cleaner, more efficient combined cycle natural gas units.

PSEG's CO<sub>2</sub> emission rate is well below both national and PJM system averages.

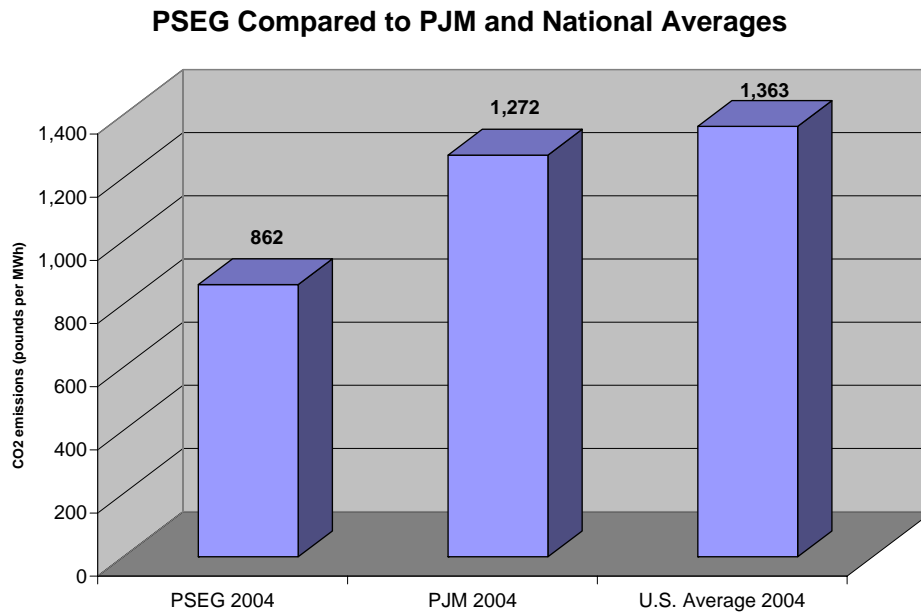


Figure 4.

## Emissions Reporting by Absolute Approach

Unlike a performance approach, which measures CO<sub>2</sub> intensity per unit of useful output, the absolute emission approach only accounts for total GHG emissions. This approach is useful because emissions from the electric power sector can be compared with emissions from other greenhouse gas emitting activities and other sectors of the economy. It is also important, because from an environmental perspective, total global greenhouse gas emissions into the atmosphere drives global warming and will likely drive the ultimate policy response to global warming. For example, a cap-and-trade program for CO<sub>2</sub> emissions from power plants will limit total power plant emissions.

Overall CO<sub>2</sub> emissions have increased from 2000 to 2006. While 2006 emissions are above the 2000 baseline, the overall efficiency of the generation fleet has also increased. As shown below, total CO<sub>2</sub> emissions from electric power generation have increased by 32%, while total generation output has increased by 50%.

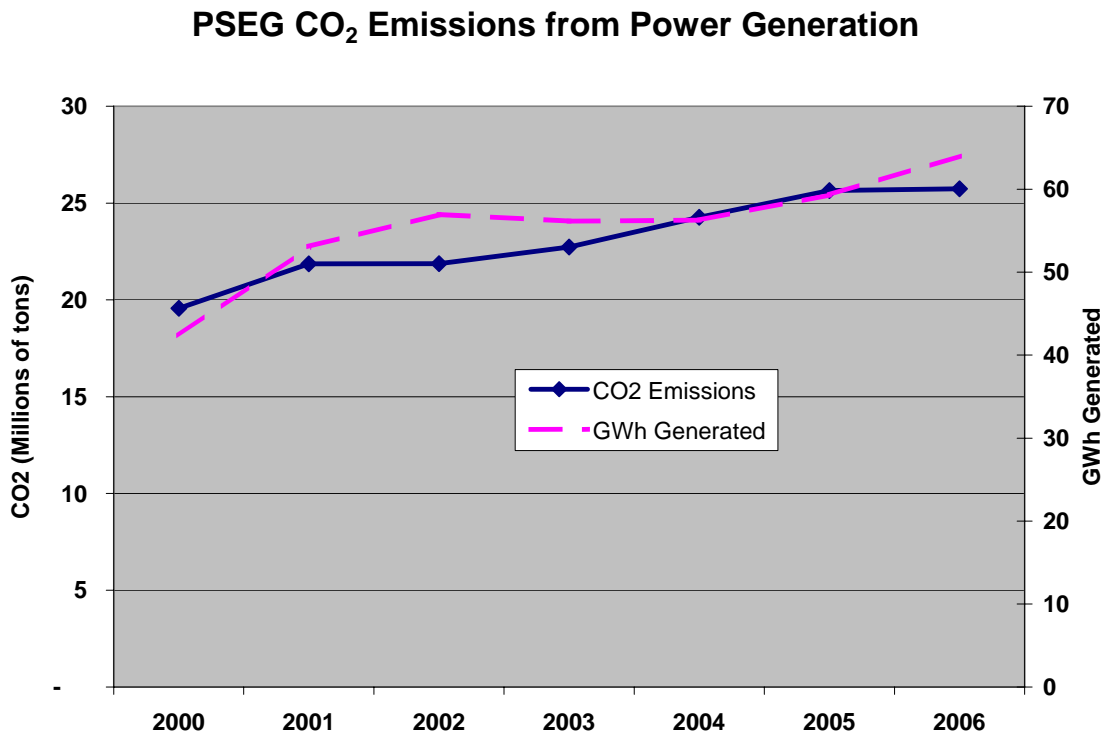


Figure 5.

The absolute emissions approach methodology is also more sensitive to fluctuations in electric demand due to weather conditions and changes in generating capacity. Much of the increase PSEG has experienced in its total emissions of CO<sub>2</sub> since 2000 is the result of the installation of clean and efficient combined cycle natural gas generation technology. While PSEG also purchased some additional coal capacity since 2000 (PSEG's Bridgeport Harbor Station in Connecticut), the historic emissions from this facility have been added to PSEG's 2000 baseline emissions in accordance with the WRI/WBCSD GHG Protocol.

### 2000 - 2006 Generating Capacity Additions

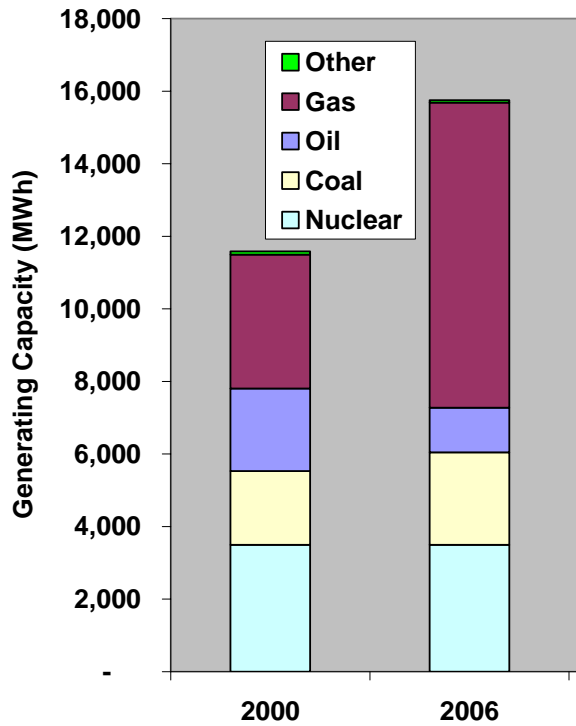


Figure 6.

### Global Warming Potential of Greenhouse Gasses

Greenhouse Gas	GWP
Carbon Dioxide	1
Methane	23
Nitrous Oxide	296
HFC-23	12,000
HFC-125	3,400
HFC-134a	1,300
HFC-143a	4,300
HFC-152a	120
HFC-227ea	3,500
HFC-236fa	9,400
Perfluoromethane (CF <sub>4</sub> )	5,700
Perfluoroethane (C <sub>2</sub> F <sub>6</sub> )	11,900
Sulfur Hexafluoride (SF <sub>6</sub> )	22,200

Figure 7.

### Other Greenhouse Gasses from Electric Power Generation

In addition to emitting CO<sub>2</sub>, fossil fuel burning power plants also release methane and nitrous oxide (N<sub>2</sub>O) as byproducts of fuel combustion. Methane and nitrous oxide are greenhouse gasses of concern because of their higher potential to cause global warming. Emissions of these non-CO<sub>2</sub> greenhouse gasses are often normalized into CO<sub>2</sub> equivalent units so their environmental impacts can be compared with other GHG producing activities.

Even when normalizing PSEG's emissions of N<sub>2</sub>O and methane into CO<sub>2</sub> equivalent units, overall, these emissions account for less than 1% of PSEG's emissions inventory.

## Emissions from Non-Generation Sources

### Sulfur Hexafluoride

Sulfur hexafluoride (SF<sub>6</sub>) has a unique combination of physical and chemical properties that makes it an excellent gaseous dielectric for high voltage power applications such as circuit breakers. There are currently no substitutes for SF<sub>6</sub> that possess the same desirable properties. SF<sub>6</sub> is also a very potent greenhouse gas. According to the Intergovernmental Panel on Climate Change (IPCC), SF<sub>6</sub> has a global warming potential (GWP) of 22,200 times that of CO<sub>2</sub>, making it the most potent of greenhouse gasses. This means that just one pound of SF<sub>6</sub> has the same potential to contribute to global warming as 11 tons of CO<sub>2</sub>.

PSE&G implemented a release detection program in 1996 to find and seal leaking breakers. PSE&G was one of the first utility companies to use the GasVue laser camera detection system. This system allows smaller leaks to be detected on live electrical equipment. Traditionally, leaks were detected by deenergizing the equipment and applying a soap-water solution to visually detect leaks through soap bubbles. This new leak detection program, along with better management practices, have led to reductions in the amount of SF<sub>6</sub> leaked into the atmosphere.

### Annual Emissions of SF<sub>6</sub> (as CO<sub>2</sub>-e)

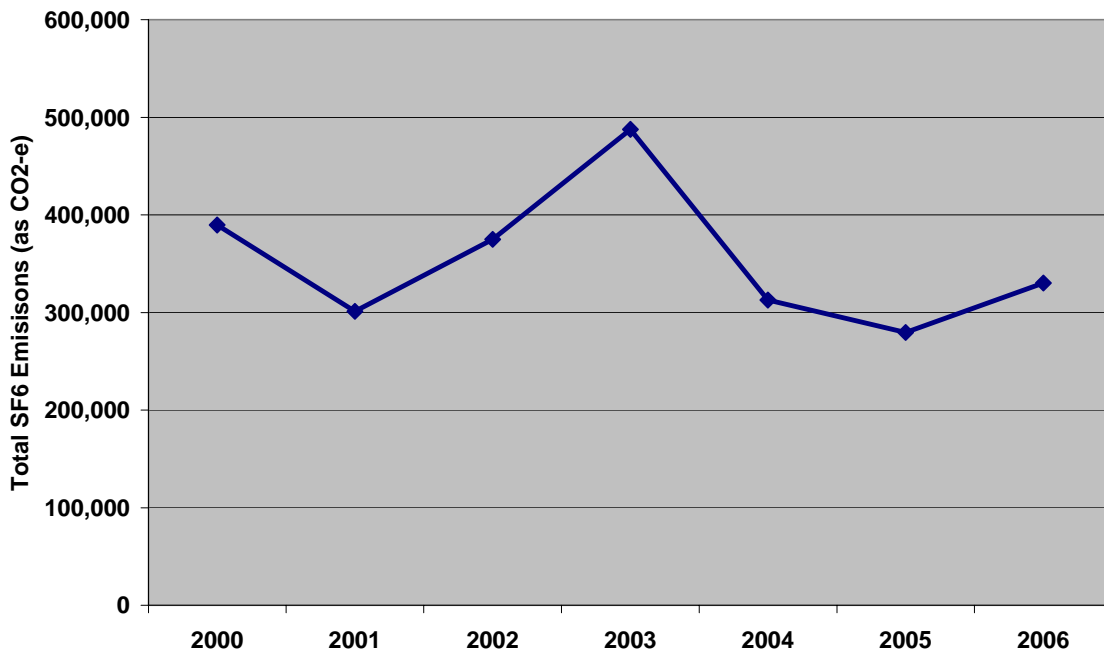


Figure 8.

The calculation methodology used to estimate emissions assumes that any SF<sub>6</sub> purchased in a given year was used to replace SF<sub>6</sub> that leaked from the breakers. It is also assumed that 10% of any SF<sub>6</sub> purchased is returned to the vendor. Since both the equipment and SF<sub>6</sub> bottles are pressurized, it is often not possible to utilize all of the SF<sub>6</sub> in a given bottle. While this is a generally accepted methodology for estimating SF<sub>6</sub> emissions, it probably overestimates emissions.

SF<sub>6</sub> leaks are highly weather dependent. SF<sub>6</sub>-containing equipment tends to experience greater leakage in colder weather, as fittings and seals contract. In 2006, SF<sub>6</sub> emissions were below 2000 baseline levels and well below leak levels experienced prior to implementation of the leak detection program in 1996.

### Gas Transmission and Distribution

PSE&G maintains a gas transmission and distribution system with 71 miles of transmission pipeline, 12,000 miles of distribution pipeline, and almost 1.2 million service connections. PSE&G serves approximately 1.7 million gas customers in New Jersey.

Methane, the main constituent of natural gas, has a global warming potential of 23 times that of CO<sub>2</sub>. This means that one ton of methane has the same potential to contribute to global warming as 23 tons of CO<sub>2</sub>.

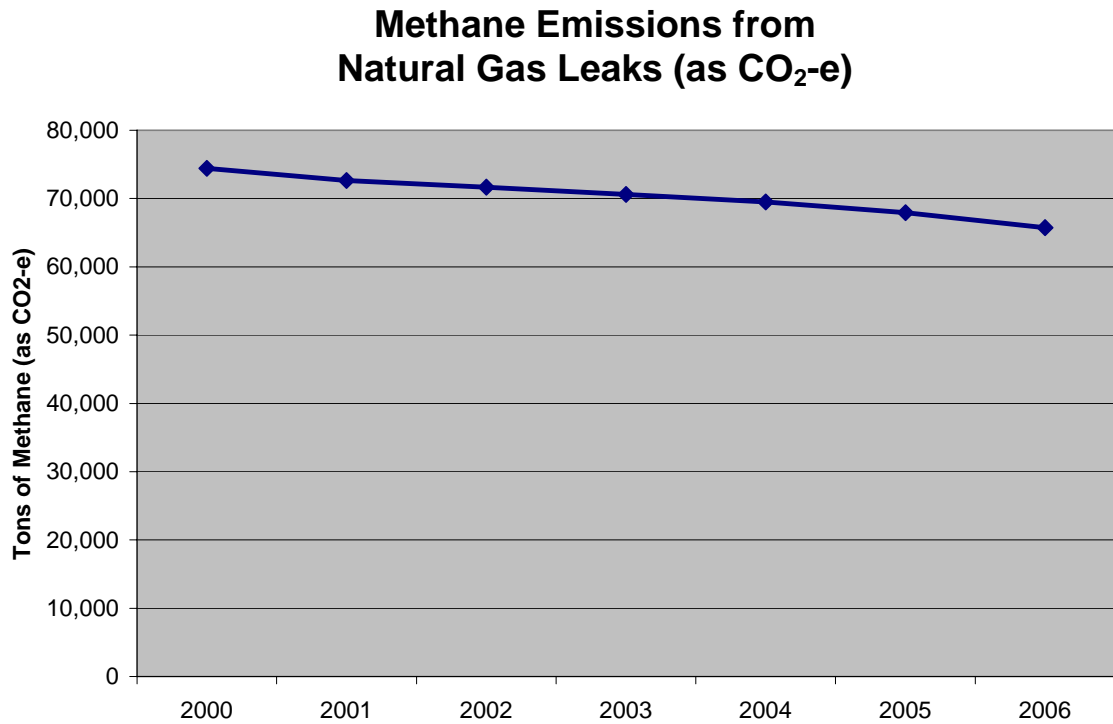


Figure 9.

PSE&G's methane emissions from gas transmissions and distribution have been steadily declining due to the continued replacement of cast iron and unprotected steel pipeline with protected steel and plastic pipeline. Cast iron distribution pipeline leaks approximately 11 times as much natural gas as compared with plastic distribution pipeline. These reductions in leaks occurred despite the fact that PSE&G has added nearly 64,000 services and 840 miles of pipeline since 2000. PSE&G expects this downward trend in emissions to continue.

PSE&G also participates in EPA's Natural Gas Star Program. This program encourages utilities to locate and repair leaks from their gas transmission and distribution systems. Through these efforts, PSE&G has reduced methane emissions from pipelines and metering and regulation facilities. These reductions are not reflected in the chart above.

### Vehicle Fleet Operations

PSE&G maintains a vehicle fleet with around 6,000 vehicles ranging from cars, to light duty trucks, to heavy-duty trucks and construction equipment. Like power plants, vehicles combust fuel which releases CO<sub>2</sub> and other greenhouse gasses into the atmosphere.

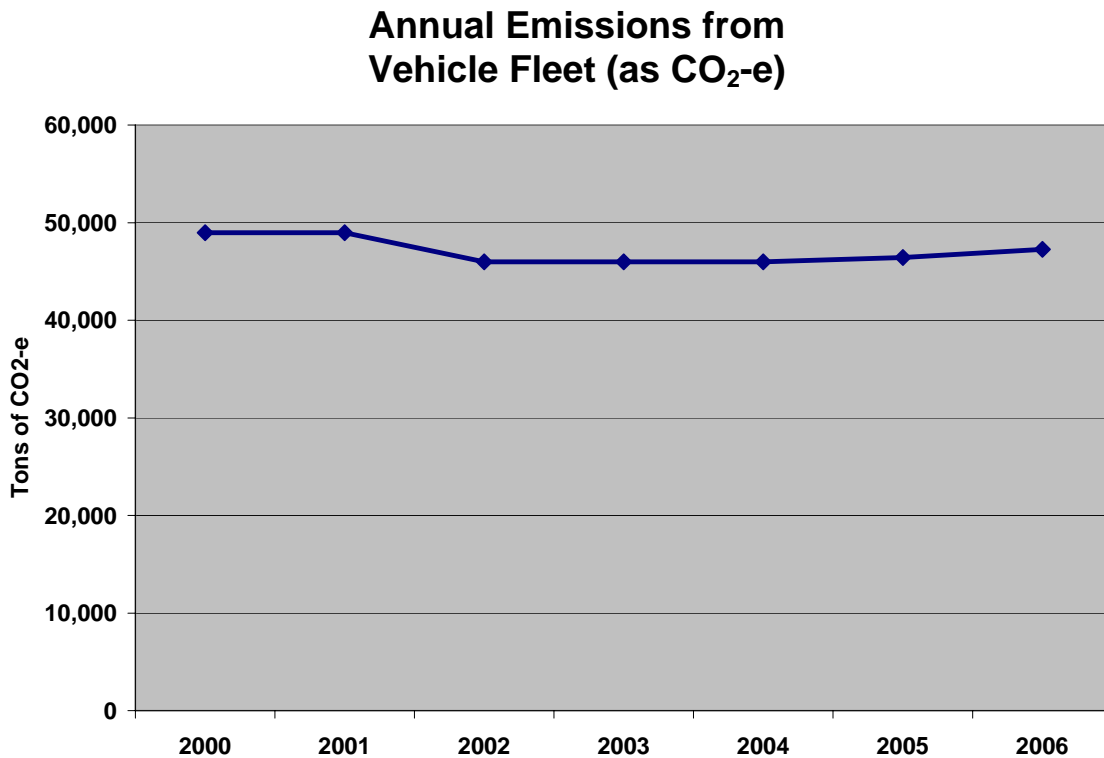
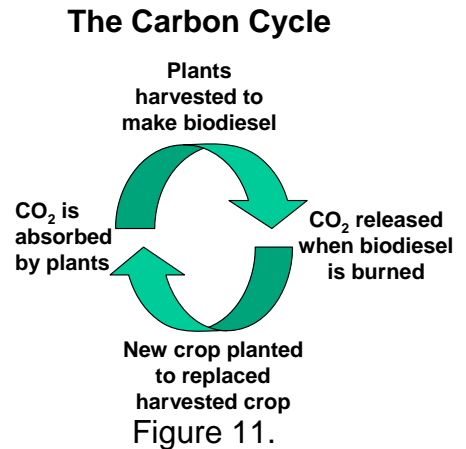


Figure 10.

Figure 10 shows that PSE&G's CO<sub>2</sub>-e emissions from its vehicle fleet are currently below 2000 levels.

In 2002, PSE&G began using a 20% blend of biodiesel in its vehicle fleet. Biodiesel is a petroleum diesel replacement made from renewable energy sources such as soybean oil or recycled restaurant oils. Because the CO<sub>2</sub> emissions associated with biodiesel are part of the natural carbon cycle, biodiesel emissions do not contribute to increased atmospheric concentrations of CO<sub>2</sub> and therefore do not contribute to global warming.



In addition to using biodiesel, PSEG also announced a program to acquire 1,300 hybrid vehicles over the next ten years. Hybrid vehicles reduce gasoline consumption by combining an electric motor along with a gasoline engine. Energy that would normally be wasted during braking is captured to charge the battery. Hybrid vehicles can provide substantial fuel savings, especially in the urban driving conditions typical of PSE&G's service area.

## Other Emission Sources

### Coal Pile Methane

The coal used at power plants is typically stored outdoors in large pile. These coal piles can release methane, a greenhouse gas, prior to being combusted to produce electricity.

### Other Fuel Combustion

While the majority of fuel burned by PSEG is used in power plants, PSEG also owns and operates other fuel burning equipment such as heaters, house heating boilers, emergency generators and fire pumps.

### Refrigerant Usage

PSEG uses various refrigerants for air conditioning and other cooling purposes. Some of these refrigerants have a potential to contribute to global warming.

### Indirect Emissions from Electricity Usage

PSEG accounts for indirect emissions from electricity usage. Indirect emissions occur when an activity does not directly emit GHGs, but rather *causes* GHGs to be emitted somewhere else. For example, switching on a light bulb does not

directly emit CO<sub>2</sub>. However, a power plant must now increase its electrical output to supply power to that light bulb, which does cause increased emissions of CO<sub>2</sub>.

PSEG is a generator of electricity and the emissions associated with this generation are counted under “direct emissions from electric power generation”. PSEG only accounts for indirect emissions from electric power if the electricity was generated at a non-PSEG plant. This avoids “double counting”. PSEG compares its total PSE&G retail electricity sales in New Jersey with its total electric power generation in the PJM-ISO. If electricity sales exceed generation, PSEG accounts for its share of the purchased power it uses from non-PSEG power plants.

PSEG accounts for indirect emissions from non-PSEG generated electricity usage in three areas:

- 1) **Line losses** – When electricity is transmitted over power lines, some of the electricity is lost from the point of generation to the point of end use due to resistance in power lines. Electricity is also lost when insulating materials absorb electricity and convert it to heat.
- 2) **Electricity usage (other than power plants)** – PSEG accounts for the electricity it uses at the facilities it owns and operates, such as office building and field locations.
- 3) **Electricity usage at power plants** – PSEG accounts for the electricity it uses at power plants by using power plant “net generation” in its CO<sub>2</sub> emissions rate goal. Net generation backs out station electric usage from the total amount of electricity generated by the facility. If a facility used more electricity than it generated, the net electrical usage would be counted under “indirect emissions from electricity usage”.

In 2006, net generation from PSEG power plants in PJM exceeded PSE&G’s retail sales. Therefore, PSEG does not have any reportable indirect emissions from electric usage in 2006.

While PSEG did not have any reportable indirect GHG emissions resulting from line losses, line losses can be a significant contributor to indirect emissions of CO<sub>2</sub>. PSEG recently announced a program invest in more efficient electric delivery equipment, a move expected to reduce energy use and cut CO<sub>2</sub> emissions by some 60,000 tons by the year 2020.

PSE&G will use more energy-efficient primary and secondary wires for new overhead installations, install more energy-efficient transformers atop utility poles when new or replacement units are needed, and expedite the replacement of aging transformer banks with state-of-the-art units in some of its electrical substations.

### CO<sub>2</sub>-e Emissions from Other Sources

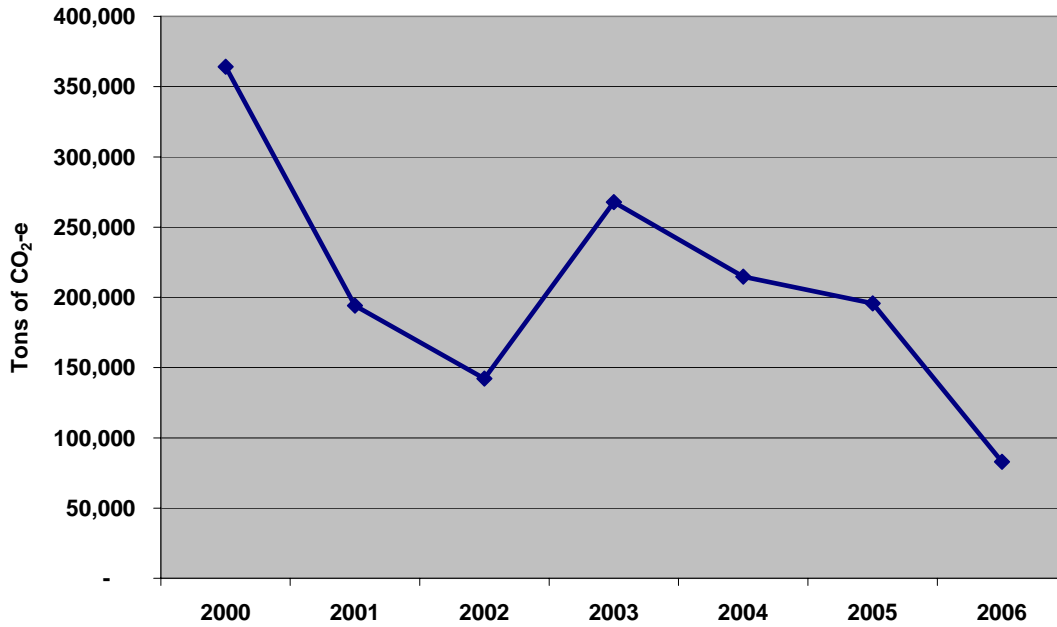


Figure 12.

## Summary – PSEG is On-Target to Achieve Its Climate Leaders Goal

PSEG joined the Environmental Protection Agency's Climate Leaders program in 2002. Under this program, PSEG committed to reduce its CO<sub>2</sub> equivalent greenhouse gas emissions on a pounds per megawatt-hour basis by 18% from 2000 levels by December 31, 2008 across its operations (excluding generation from nuclear power).

This goal not only includes emission associated with electric power generation, but also all of the greenhouse gas-producing activities across the company described above.

### **PSEG Company-Wide Emissions Rate (Pounds per Megawatt-Hour (as CO<sub>2</sub>-e))**

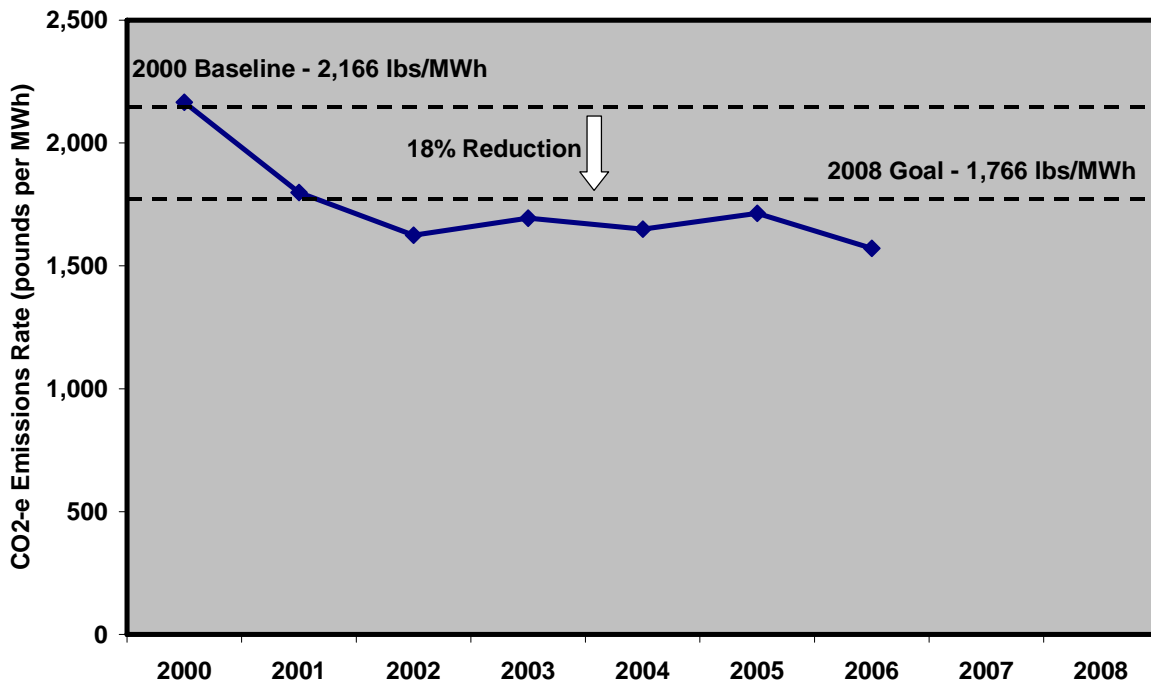


Figure 13.

PSEG is currently below its targeted emissions rate of 1,766 pounds per MWh and expects to meet its goal in 2008. Much of the improvement in performance can be attributed to the installation of clean and highly efficient combined-cycle natural gas generation technology and the retirement of older less efficient units.