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Voluntary Reporting of Greenhouse Gases 2003

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Energy Information Administration
Office of Integrated Analysis and Forecasting
U.S. Department of Energy
Washington, DC 20585

This publication is on the WEB at:
www.eia.doe.gov/oiaf/1605/vrrpt/index.html.

For More Information

Individuals or members of organizations wishing to report reductions in emissions of greenhouse gases under the auspices of the Voluntary Reporting of Greenhouse Gases Program can contact the Energy Information Administration (EIA) at:

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For reporting purposes, EIA has both a long form (EIA-1605) and a short form (EIA-1605EZ) available, as well as an electronic version of the form. They are available upon request or on EIA's web site at *www.eia.doe.gov/oiaf/1605/forms.html*.

The reports submitted to EIA are compiled into a database that can be obtained on CD-ROM by contacting the Voluntary Reporting of Greenhouse Gases Program Communications Center at 1-800-803-5182 or can be downloaded from EIA's web site at *www.eia.doe.gov/oiaf/1605/database.html*.

General or specific technical information concerning the contents of this report may also be obtained by contacting the Voluntary Reporting of Greenhouse Gases Program.

Preface

Title XVI, Section 1605(b) of the Energy Policy Act of 1992 (EPACT) directed the Energy Information Administration (EIA) to establish a mechanism for "the voluntary collection and reporting of information on . . . annual reductions of greenhouse gas emissions and carbon fixation achieved through any measures, including fuel switching, forest management practices, tree planting, use of renewable energy, manufacture or use of vehicles with reduced greenhouse gas emissions, appliance efficiency, methane recovery, cogeneration, chlorofluorocarbon capture and replacement, and power plant heat rate improvement . . . ."

The legislation further instructed EIA to create forms for the reporting of greenhouse gas emissions and reductions, and to establish a database of the information voluntarily reported under this subsection of EPACT. The reporting Forms EIA-1605 and EIA-1605EZ, "Voluntary Reporting of Greenhouse Gases," were first made available to the public in July 1995, providing a vehicle for voluntary reporting on activities that occurred before and during 1994. This publication summarizes data reported for 2003, the tenth year of data collection for the Voluntary Reporting of Greenhouse Gases Program.

The data reported to the Program are available through several media. All nonconfidential reports received by the Program are compiled into a Public Use Database, available on CD-ROM or by download from the Internet. The software is interactive and modular by design, allowing the user to select, view, or print the reports filed by the voluntary reporters, for each year of their participation. The user can also connect to and query the database with Microsoft Access 97 (or later versions) or other software that supports 32-bit open database connectivity (ODBC).

The Public Use Database and the current reporting software are also available at the Program's FTP (File Transfer Protocol) site on the Internet at *http://www.eia.doe.gov/oiaf/1605/database.html*. Interested parties are encouraged to visit the Program's home page at *http://www.eia.doe.gov/oiaf/1605/frntvrgg.html* for more information and background on the Program. Software, additional copies of this report, paper reporting forms, and technical support information can be downloaded from that web site or obtained from the Voluntary Reporting of Greenhouse Gases Communications Center by e-mail at *infoghg@eia.doe.gov*, toll-free at 1-800-803-5182, or locally at 202-586-0688.

This report was prepared under the guidance of John Conti, Director of EIA's Office of Integrated Analysis and Forecasting. Significant contributions to the Program, the current software, and the preparation of this report have been made by Paul McArdle, Stephen Calopedis, Matthew Aberant, Keith Forbes, Kristin Franks, Laura Gehlin, Sarah Goldstein, William LaPerch, Michael Mondshine, Dick Richards, Charles L. Smith, and Peggy Wells.

EIA would like to express special thanks to the voluntary reporters, without whom this program would not be possible.

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Introduction

The Voluntary Reporting of Greenhouse Gases Program, required by Section 1605(b) of the Energy Policy Act of 1992, records the results of voluntary measures to reduce, avoid, or sequester greenhouse gas emissions. For the 2003 reporting year, 234 U.S. companies and other organizations reported to the Energy Information Administration (EIA) that they had undertaken 2,188 projects to reduce or sequester greenhouse gases in 2003. The reported greenhouse gas emission reductions for the projects reported included 268 million metric tons carbon dioxide equivalent of direct reductions, 81 million metric tons of indirect reductions, 7 million metric tons of reductions from carbon sequestration, and 16 million metric tons of unspecified reductions (Table ES1). Total U.S. greenhouse gas emissions in 2003 are estimated at 6,936 million metric tons carbon dioxide equivalent.[1]

For definitional purposes, direct reductions are emission reductions from sources owned or leased by the reporting entity; indirect reductions are emission reductions from sources not owned or leased by the reporting entity but that occur as a result of the entity's activities; carbon sequestration reductions represent the removal of atmospheric carbon to a carbon sink; and unspecified reductions represent emission reductions reported on Form

Table ES1. Reporting Indicators for the Voluntary Reporting of Greenhouse Gases Program, Data Years 1994-2003

Indicator	1994	1995	1996	1997	1998	1999	2000	2001	2002(R)	2003
Number of Entities Reporting	108	142	150	162	207	207	236	232	234	234
Number of Projects Reported	634	960	1,040	1,288	1,549	1,722	2,089	1,897	2,055	2,188
Number of Entity-Level Reports Received	40	51	56	60	76	83	108	114	119	126
Project-Level Reductions Reported (Million Metric Tons Carbon Dioxide Equivalent)										
Direct[a]	63	88	90	95	148	155	211	247	265	268
Modified Reference Case[b]	59	76	75	88	127	126	176	209	257	261
Basic Reference Case[c]	4	13	15	7	21	29	35	38	8	7
Indirect[d]	5	52	53	38	43	57	62	72	80	81
Modified Reference Case[b]	5	52	51	36	38	51	57	61	78	75
Basic Reference Case[c]	0	1	3	2	5	6	5	11	2	6
Sequestration[e]	1	1	9	10	12	10	9	8	7	8
Unspecified[f]	4	6	6	9	19	13	12	15	17	16

[a]"Direct" emission reductions are reductions in releases of greenhouse gases "on site." For the purpose of completing Form EIA-1605, "on site" is defined as any source owned (wholly or in part) or leased by the reporting entity.

[b]In a "modified reference case," actual emissions (or sequestration) are compared to an estimate of what emissions (or sequestration) would have been in the absence of the project.

[c]In a "basic reference case," actual emissions (or sequestration) are compared with an estimate of historical emissions (or sequestration) in a particular base year or an average of up to 4 years.

[d]"Indirect" emission reductions are reductions in emissions from sources not owned or leased by the reporting entity but that occur, wholly or in part, as a result of the entity's activities (for example, an automobile manufacturer's investment in increased automotive fuel economy can result in decreased emissions from vehicles owned by individuals or managed fleets).

[e]"Sequestration" is the fixation of atmospheric carbon dioxide in a carbon sink through biological or physical processes, such as photosynthesis.

[f]"Unspecified" emission reductions represent quantities reported on the short form (Form EIA-1605EZ) for which the reporting entity did not specify whether the emission reduction or carbon sequestration was direct or indirect.

(R) = revised.

Notes: 2002 data have been revised to include reports that were submitted after the filing deadline. It is expected that the 2003 data will also be revised upward in next year's report with the inclusion of late 2003 reports. Totals for direct and indirect reductions may not equal sum of components due to independent rounding.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

[1]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

EIA-1605EZ, on which the reporting entity cannot specify whether the emission reduction was a direct or indirect reduction.

To calculate reported emission reductions, reporters are allowed to use a "basic" reference case or a "modified" reference case. A reference case is an emissions or sequestration level against which actual emissions are compared in order to estimate emission reductions. In a "basic" reference case, actual historical emissions (or sequestration) in a specific year, or an average of a range of years, are used. In a "modified" reference case, an estimate is made of what emissions or sequestration would have been in the absence of the project.

Generally, as illustrated in Table ES1, most reductions are reported relative to a modified reference case. For 2003, 261 million metric tons, or 97 percent, of the total 268 million metric tons carbon dioxide equivalent of reported direct reductions was based on modified reference cases. Similarly, for reported indirect reductions, 75 million metric tons, or 92 percent, of the total 81 million metric tons carbon dioxide equivalent of reported indirect reductions was based on modified reference cases.

The number of entities (234) reporting to the Voluntary Reporting Program for 2003 is the same as the number that reported for 2002; however, the number of reporters for 2002 has been revised upward to include 6 additional entities that filed late reports, after the 2002 database was closed. EIA also expects a similar upward revision of the number of 2003 reporters in next year's report, to reflect late reporters in the 2003 reporting cycle. As of February 7, 2005, EIA had received 6 additional 2003 reports and 1 additional 2002 report since the 2003 database was closed for preparation of this 2003 annual report.[2]

The number of entities reporting to the program has grown by 117 percent from its inception in 1994, when 108 entities reported. The number of projects reported has grown at a more rapid rate than the number of reporters, because the number of projects reported by repeat reporters has increased. The 2,188 projects reported for 2003 represent an increase of 245 percent over the 634 projects reported in 1994 and a 7-percent increase from the final tally of 2,055 projects reported for 2002.

Of the 234 organizations reporting for 2003, 126 provided entity-level reports, which include estimates of emissions and/or emission reductions for their entire organizations—7 more than the number (119) that submitted entity-level reports in 2002. In addition, 89 of the reporters for 2003 recorded commitments to take action to reduce emissions, mostly during the 2000 to 2005 time frame.

Of the 126 organizations reporting at the entity level, 120 calculated their 2003 entity-level greenhouse gas emissions. These entities reported direct greenhouse gas emissions of 889 million metric tons carbon dioxide equivalent, equal to about 14 percent of total U.S. greenhouse gas emissions in 2003.[3] Also reported by these organizations was 105 million metric tons carbon dioxide equivalent of indirect emissions, equal to 2 percent of total U.S. greenhouse gas emissions in 2003. Of the 126 entity-level reporters, 117 also reported emission reductions, including 214 million metric tons carbon dioxide equivalent of direct emission reductions, 42 million metric tons carbon dioxide equivalent of indirect emission reductions, and 7 million metric tons carbon dioxide equivalent of emission reductions resulting from carbon sequestration projects.

Reports for 2003 were received from participants in 27 different industries or services, as compared with the 29 different industries or services for 2002. The number of different industries represented continues to be higher than it was in the first year of the program (1994 data year), when the 108 reports received included participants in 9 different industries or services (Table ES2). In the early years of the program, reporting was dominated by the electric power sector. In the first reporting year, the 95 submissions from electric power producers represented 88 percent of the 108 reports received (Figure ES1). Since then, the program has seen an influx of new participants from outside the electric power sector, representing a diverse set of other industries. In addition, several mergers and acquisitions involving reporters to the Program have accompanied the ongoing restructuring of the electric power industry. Many of these merged entities have submitted single, consolidated reports, thus reducing the number of reports received from electricity producers. As a result, only 42 percent of the organizations reporting to the Program for 2003 (98 firms) were from the electric power sector.

Although the number of reporters from other individual industries remains relatively small, in many cases, reports were received from key companies in those other industries: for example, DaimlerChrysler Corporation, General Motors, the Ford Motor Company, and

[2]The deadline for submitting reports to EIA for inclusion in each annual edition of the Public Use Database is June 1. EIA typically grants reporters extensions to the deadline, usually until early July, before closing the database to new reports to allow analysis of the information for the annual report. EIA includes reports received after the database has been closed in the next annual edition of the Public Use Database and revises the data for that reporting year in the corresponding annual report, to reflect the addition of late reports.

[3]Based on total emissions from Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

Table ES2. Forms Filed by Standard Industrial Classification, Data Years 1994-2003 (Number of Reports)

SIC Code	Description	Data Year									
		1994	1995	1996	1997	1998	1999(R)	2000(R)	2001(R)	2002(R)	2003
01	Agricultural Production: Crops	—	—	—	—	1	—	—	1	—	—
08	Forestry	1	2	1	1	3	3	1	—	1	2
12	Coal Mining	1	2	2	1	4	3	4	6	7	4
13	Oil and Gas Extraction	—	—	—	—	—	1	1	1	1	1
14	Nonmetallic Minerals, Except Fuels	—	—	—	—	1	1	—	—	—	—
20	Food and Kindred Products	—	—	—	—	1	2	6	4	4	4
22	Textile Mill Products	—	—	—	—	—	1	5	11	12	14
23	Apparel and Other Textile Products	—	—	—	—	—	—	1	1	2	2
24	Lumber and Wood Products	—	—	—	—	—	—	1	—	—	—
25	Furniture and Fixtures	—	—	—	—	—	—	1	1	1	—
26	Paper and Allied Products	—	—	—	—	—	1	1	—	—	—
27	Printing and Publishing	—	1	—	1	—	1	1	—	—	—
28	Chemical and Allied Products	1	3	2	3	8	5	11	9	11	11
29	Petroleum Refining and Other Related Industries	—	—	2	3	8	8	7	6	6	5
30	Rubber and Miscellaneous Plastic Products	—	—	—	—	—	—	2	2	2	2
32	Stone, Clay, Glass, and Concrete Products	—	—	1	4	12	13	7	5	5	5
33	Primary Metals Industries	2	2	4	4	5	5	5	11	11	11
34	Fabricated Metal Products, Except Machinery and Transportation Equipment	—	2	1	1	3	1	1	1	1	1
35	Industrial and Commercial Equipment and Components	—	—	—	—	—	—	1	1	1	2
36	Electronic and Other Electrical Equipment	1	1	2	4	4	4	9	9	8	6
37	Transportation Equipment	1	1	1	2	3	5	6	7	9	10
38	Instruments and Related Products	—	—	—	—	2	—	1	1	1	1
39	Miscellaneous Manufacturing Industries	—	1	1	—	2	2	1	1	1	1
40	Railroad Transportation	—	—	—	—	—	—	—	—	—	1
48	Communications	—	—	—	—	—	1	—	—	1	1
49	Electric, Gas, and Sanitary Services	95	121	125	129	138	135	151	145	138	141
57	Furniture and Home Furnishings Stores	—	—	—	—	2	1	1	—	1	1
63	Insurance Carriers	—	—	—	—	—	—	—	—	—	1
65	Real Estate	—	1	1	1	1	1	1	1	1	—
67	Holding and Other Investment Offices	—	—	1	1	1	1	1	1	2	2
72	Personal Services	—	—	—	—	—	—	1	1	1	1
80	Health Services	—	—	—	—	1	—	—	—	—	—
82	Educational Services	1	2	2	2	—	2	—	—	—	—
86	Membership Organizations	—	—	—	1	1	1	1	—	1	—
87	Engineering and Management Services	—	—	2	2	2	1	—	1	—	—
88	Private Households	2	1	1	1	1	1	1	1	1	1
89	Services Not Elsewhere Classified	—	—	—	1	1	3	2	1	1	1
91	Executive, Legislative, and General	—	—	—	—	1	2	2	2	1	1
97	National Security and International Affairs	—	—	—	—	—	—	1	—	—	—
99	Nonclassifiable Establishments	—	—	—	—	—	—	—	—	1	—
Total Number of Reporters[a]		**108**	**142**	**150**	**162**	**207**	**207**	**236**	**232**	**234[b]**	**234**
Number of 2-Digit SIC Codes Represented		**9**	**13**	**16**	**18**	**24**	**27**	**31**	**27**	**29[b]**	**27**

[a]Totals may be greater than the sum of reporters in each SIC code, because confidential reporters are excluded from the latter.

[b]Includes 6 late reports for the 2002 data year. The 2003 total will also be revised upward in next year's report with the inclusion of late 2003 reports. As of February 22, 2005, EIA had received 6 late 2003 reports, which are not included in this report's 2003 database.

(R) = Revised.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

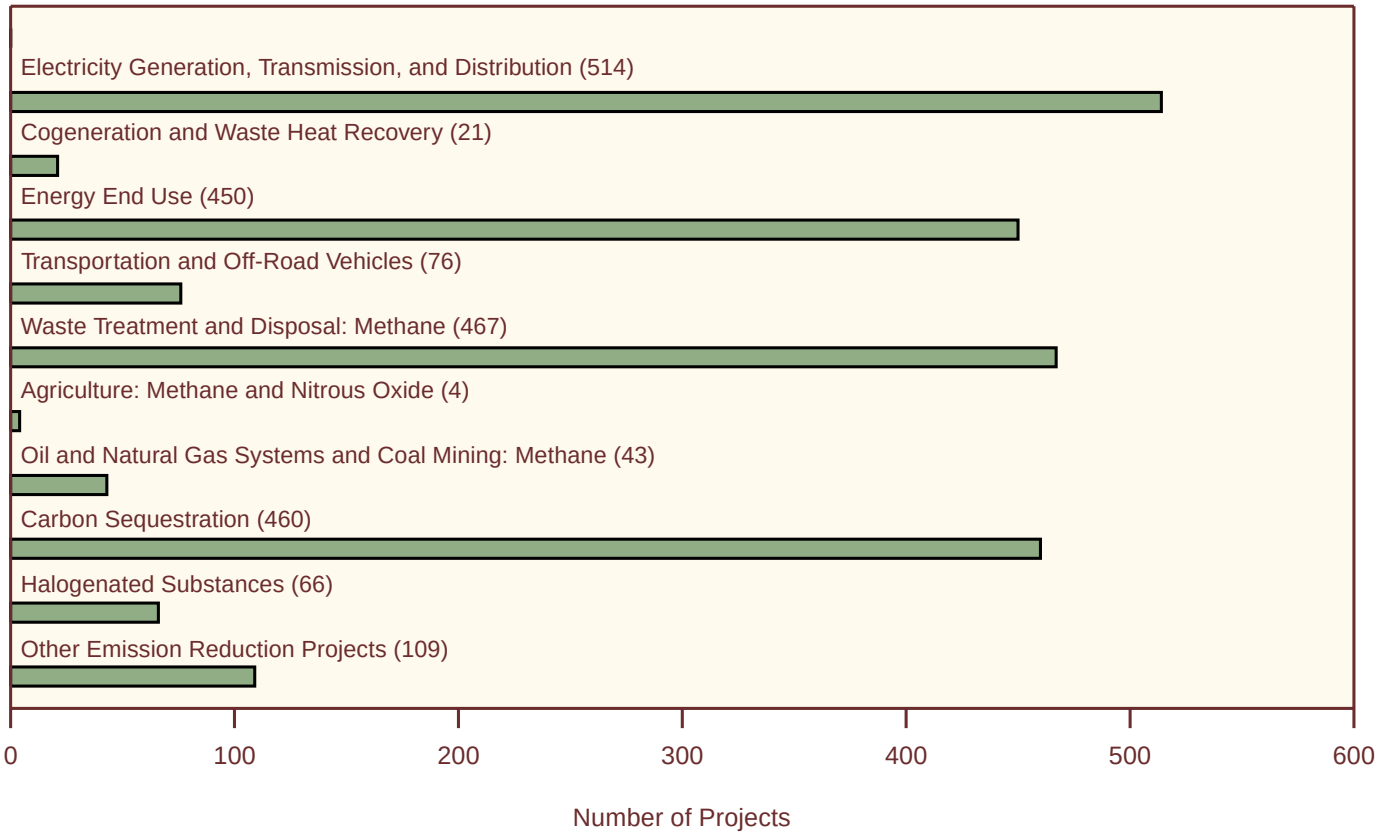
Toyota North America in the automotive products industry; Noranda and an operating division of Alcan's Primary Products in the metals industry; Sunoco, Inc., ChevronTexaco Corporation, and BP America in the petroleum industry; Johnson & Johnson and The Dow Chemical Company in the chemicals industry; Rolls Royce in the aerospace industry; Bristol-Myers Squibb Company and Pfizer Pharmaceuticals, LLC, in the pharmaceuticals industry; and Advanced Micro Devices, Inc., and IBM in the electronic equipment industry.[4]

Projects Reported

Electric power sector reporters (including independent power producers) accounted for 1,485 (68 percent) of the projects reported for 2003. Also reporting were alternative energy providers (446 projects), industrial concerns (245 projects), and agriculture and forestry organizations (3 projects). Organizations in other sectors (government, commercial, and residential) submitted reports on 9 projects.

Most of the projects reported for 2003 affected energy supply or use. The electric power sector reported 514 projects that were related to the generation, transmission, or distribution of electricity (Figure ES1). Another 450 were related to energy end use, 76 were transportation projects, and 21 were cogeneration projects. Other projects reduced emissions of methane from waste treatment and disposal facilities (467 projects), from oil and natural gas systems and coal mines (43 projects, many of which included the displacement of fossil fuels through the use of methane as a fuel), and from agricultural activities (4 projects). Other projects (109) included the reuse of fly ash in concrete and materials recycling, which reduce emissions in part by reducing energy consumption. The largest reductions were reported for projects that improved the performance of nuclear power plants. The non-energy-related projects reported fell into two major categories: sequestration of carbon, usually in forests (460 projects); and recycling, reuse, or destruction of halogenated substances, such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6) (44 projects).

Figure ES1. Number of Projects Reported to the Voluntary Reporting of Greenhouse Gases Program by Project Type, Data Year 2003



Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

[4]A complete listing of all 2003 reporters will be provided in Appendix B, Table B1 of the full report, *Voluntary Reporting of Greenhouse Gases 2003*, DOE/EIA-0608(2003) (Washington, DC, February 2005), which will be available from web site www.eia.doe.gov/oiaf/1605/vrrpt. Table B8 in Appendix B of the report lists reporters by sector and Standard Industrial Classification (SIC) code.

Reductions Reported

Electric Power

For 2003, 485 electric power and cogeneration projects were reported on Form EIA-1605.[5] Total emission reductions from electric power and cogeneration projects reported on Form EIA-1605 (the long form) included 158 million metric tons carbon dioxide equivalent from direct sources and 18 million metric tons from indirect sources. A total of 257 projects that reduced the carbon content of fuels used to generate electricity were reported, with emission reductions totaling 147 million metric tons carbon dioxide equivalent from direct sources and 13 million metric tons from indirect sources. Reported emission reductions for projects increasing energy efficiency in generation, transmission, and distribution included 16 million metric tons carbon dioxide equivalent from direct sources and 4 million metric tons from indirect sources. Another 50 electric power and cogeneration projects were reported on Form EIA-1605EZ for 2003, with reported emission reductions from unspecified sources that totaled 11 million metric tons carbon dioxide equivalent.[6]

Energy End Use and Transportation

For 2003, 375 energy end use and transportation projects were reported on Form EIA-1605, with total reported emission reductions of 25 million metric tons carbon dioxide equivalent from direct sources and 10 million metric tons from indirect sources. Nearly all (93 percent) of the energy end-use reductions were reported for stationary-source applications, such as building shell improvements, lighting and lighting control, appliance improvement or replacement, and heating, ventilation and air conditioning (HVAC) improvements. Much smaller reductions were reported for the 66 transportation projects reported on the long form, including 2.5 million metric tons carbon dioxide equivalent from direct sources and 0.1 million metric tons from indirect sources. Another 86 energy end-use and transportation projects were reported for 2003 on Form EIA-1605EZ, with total emission reductions of 0.4 million metric tons carbon dioxide equivalent.

Carbon Sequestration

There were 446 carbon sequestration[7] projects submitted on Form EIA-1605 for 2003, with total reported sequestration of 8 million metric tons carbon dioxide equivalent. Most of the reported reductions resulted from afforestation, reforestation, urban forestry, forest management, and forest preservation efforts. Another 14 carbon sequestration projects were reported on Form EIA-1605EZ, for which about 29,000 metric tons carbon dioxide equivalent of sequestered carbon was reported.

Methane and Nitrous Oxide Emissions

Emission reductions for the 470 methane and nitrous oxide abatement projects reported for 2003 on Form EIA-1605 included 69 million tons carbon dioxide equivalent from direct sources and 40 million metric tons from indirect sources. The three most frequently reported sources of methane reductions were municipal waste landfills (412 projects), natural gas systems (28 projects), and coal mines (13 projects). In addition to reducing methane emissions, projects that involved the recovery and use of methane for energy also reduced carbon dioxide emissions by displacing fossil fuels, such as oil and coal, that have higher carbon contents and thus produce more carbon dioxide when burned. Another 44 methane or nitrous oxide reduction projects were reported on Form EIA-1605EZ for 2003, with reported reductions of methane or nitrous oxide emissions that totaled 4 million metric tons carbon dioxide equivalent.

Hydrofluorocarbons, Perfluorocarbons, and Sulfur Hexafluoride

A total of 66 projects were submitted on Form EIA-1605 for 2003 that reported reductions in emissions of HFCs, PFCs, and SF_6. Reductions reported for these projects included 6.1 million metric tons carbon dioxide equivalent from direct sources and 2.4 million metric tons from indirect sources. The largest reported reductions were direct reductions of perfluoromethane (a type of PFC) (3.0 million metric tons carbon dioxide equivalent), SF_6 (2.6 million metric tons carbon dioxide equivalent), and perfluoroethane (a type of PFC) (0.6 million metric tons carbon dioxide equivalent). Reductions of PFCs and SF_6 totaling 29 thousand metric tons carbon dioxide equivalent were reported for one project on Form EIA-1605EZ.

[5]The Voluntary Reporting of Greenhouse Gases Program allows reporting on two forms: EIA-1605 and EIA-1605EZ. EIA-1605, the long form, allows reporters to create an in-depth, multi-year, public record of emission reduction efforts for an entire organization and/or for individual projects, including information on activities conducted outside the United States and commitments to reduce greenhouse gas emissions in the future. EIA-1605EZ, the short form, allows reporters only to provide brief summaries of greenhouse gas projects for the current reporting year; it does not allow reporting of activities outside the United States or of future emission reduction commitments.

[6]The emission reductions reported on Form EIA-1605EZ are unspecified, because the form does not ask the reporter to distinguish between direct and indirect reductions.

[7]Carbon sequestration is the fixation of atmospheric carbon dioxide in a carbon sink through biological or physical processes.

1. Voluntary Reporting 2003: An Overview

Introduction

The Energy Policy Act of 1992 (EPACT) directed the U.S. Department of Energy (DOE), with the Energy Information Administration (EIA) as the implementing agency, to develop a program to document voluntary actions that reduce emissions of greenhouse gases or remove greenhouse gases from the atmosphere (see box on page 2).[1] DOE's Office of Policy and International Affairs developed the Guidelines to the Voluntary Reporting of Greenhouse Gases Program[2] in consultation with the U.S. Environmental Protection Agency (EPA) and other Federal agencies, as well as through a public comment process. In addition to providing recognition for entities that reduce greenhouse gas emissions or sequester carbon voluntarily, the program serves to identify innovative and effective ways of reducing emissions.

This report presents information on the tenth reporting cycle of the Voluntary Reporting Program, including reported information on emissions, emission reductions, and carbon sequestration activities through 2003. The report is divided into eight chapters. This chapter provides an overview of participation in the Voluntary Reporting Program, a perspective on the composition of activities reported, and a review of some key issues in interpreting and evaluating achievements associated with reported emission mitigation initiatives.

Chapters 2 through 6 provide a more detailed review of project-level emission reduction initiatives reported to the Program. Chapter 2 examines projects in the electricity sector that reduce carbon dioxide emissions through thermal efficiency improvements or switching to lower emitting fossil fuels. Chapter 3 considers improvements in end-use efficiency and fuel switching in the residential, commercial, industrial, and transportation sectors. Activities to improve or expand carbon sinks through such activities as reforestation, afforestation, and forest preservation are the subject of Chapter 4. Emission reduction initiatives associated with methane and halogenated substances are examined in Chapters 5 and 6, respectively.

Chapter 7 reviews emissions reports from participants who provided data on aggregate entity emissions. Chapter 8 summarizes information on emission reductions and carbon sequestration projects reported in brief on the short form (Form EIA-1605EZ). Appendixes (available on web site *www.eia.doe.gov/oiaf/1605/vrrpt*) provide information on the development and structure of the data collection instrument, a discussion of issues in the interpretation of the data, and tabular summaries of the participating reporters and the information they reported.

The reports submitted to EIA are compiled into a database that can be obtained on CD-ROM by contacting the Voluntary Reporting of Greenhouse Gases Program Communications Center at 1-800-803-5182 or downloaded from EIA's web site at *www.eia.doe.gov/oiaf/1605/databases.html*.

Benefits of the Voluntary Reporting Program

The Voluntary Reporting Program is unique among the many voluntary programs initiated during the early 1990s in its diversity of project types, participation, and approaches. The Voluntary Reporting Program's database provides abundant examples of the types of concrete actions that organizations can undertake to reduce greenhouse gas emissions. Some of the most important societal benefits of the Voluntary Reporting Program are:[3]

- The program has served to teach staff at many of the largest corporations in the United States how to estimate greenhouse gas emissions and has educated them on a range of possible measures to limit emissions.

[1]Title XVI of the Energy Policy Act, Public Law 102-486 (October 24, 1992), in Section 1605(a) called for an annual report on national aggregate emissions of greenhouse gases. EIA has issued the report—*Emissions of Greenhouse Gases in the United States*—every year since 1993. Section 1605(b) called for the establishment of a database of annual emissions and reductions of emissions reported on a voluntary basis.

[2]See U.S. Department of Energy, *General Guidelines to the Voluntary Reporting of Greenhouse Gases Program*, and, *Sector-Specific Issues and Reporting Methodologies Supporting the General Guidelines for the Voluntary Reporting of Greenhouse Gases* (Washington, DC 1994), web site www.eia.doe.gov/oiaf/1605/guidelns.html.

[3]Testimony of Jay Hakes, former EIA Administrator, on March 30, 2000, before the Senate Committee on Energy and Natural Resources on Senate Bills S. 882 and S. 1776 and their potential impacts on EIA's Programs. The full text of the testimony is available on EIA's web site at www.eia.doe.gov/neic/speeches/hrtest3-30-00/testimony3.htm.

- The program has helped to provide concrete evidence for the evaluation of activities reported to the many government voluntary programs launched since 1993.
- Reporters have been able to learn about innovative emission reduction activities from the experiences of their peers.
- The program has created a "test" database of approaches to emission reductions that can be used to evaluate future policy instruments aimed at limiting emissions.
- The program has helped to illuminate many of the poorly appreciated emissions accounting issues that must be addressed in designing any future approaches to emission limitations.

Who Reported?

Reports for the 2003 data year were received from 234 participants in 27 different industries or services (defined by the two-digit Standard Industrial Classification code), a decrease from the 29 different industries represented among 2002 reporters. In comparison, reports for the 1994 data year—the first year of the program—were received from 108 participants in 9 different industries or services (Table 1).

In the early years of the program, reporting was dominated by the electric power sector. In the first reporting year (data year 1994), the 95 submissions from electric power producers represented 88 percent of the 108 reports received (Figure 1). Since then, the program has seen an influx of new participants from outside the

The Energy Policy Act of 1992, Sections 1605(b) and (c)

(b) Voluntary Reporting.—

(1) ISSUANCE OF GUIDELINES.—Not later than 18 months after the date of the enactment of this Act, the Secretary shall, after opportunity for public comment, issue guidelines for the voluntary collection and reporting of information on sources of greenhouse gases. Such guidelines shall establish procedures for the accurate voluntary reporting of information on—

(A) greenhouse gas emissions—

(i) for the baseline period of 1987 through 1990; and

(ii) for subsequent calendar years on an annual basis;

(B) annual reductions of greenhouse gas emissions and carbon fixation achieved through any measures, including fuel switching, forest management practices, tree planting, use of renewable energy, manufacture or use of vehicles with reduced greenhouse gas emissions, appliance efficiency, methane recovery, cogeneration, chlorofluorocarbon capture and replacement, and power plant heat rate improvement;

(C) reductions in greenhouse gas emissions achieved as a result of—

(i) voluntary reductions;

(ii) plant or facility closings; and

(iii) State or Federal requirements; and

(D) an aggregate calculation of greenhouse gas emissions by each reporting entity.

Such guidelines shall also establish procedures for taking into account the differential radiative activity and atmospheric lifetimes of each greenhouse gas.

(2) REPORTING PROCEDURES.—The Administrator of the Energy Information Administration shall develop forms for voluntary reporting under the guidelines established under paragraph (1), and shall make such forms available to entities wishing to report such information. Persons reporting under this subsection shall certify the accuracy of the information reported.

(3) CONFIDENTIALITY.—Trade secret and commercial or financial information that is privileged or confidential shall be protected as provided in section 552(b)(4) of title 5, United States Code.

(4) ESTABLISHMENT OF DATA BASE.—Not later than 18 months after the date of the enactment of this Act, the Secretary through the Administrator of the Energy Information Administration shall establish a data base comprised of information voluntarily reported under this subsection. Such information may be used by the reporting entity to demonstrate achieved reductions of greenhouse gases.

(c) Consultation.—

In carrying out this section, the Secretary shall consult, as appropriate, with the Administrator of the Environmental Protection Agency.

Table 1. Forms Filed by Standard Industrial Classification, Data Years 1994-2003
(Number of Reports)

SIC Code[a]	Description	Data Year									
		1994	1995	1996	1997	1998	1999	2000(R)	2001(R)	2002(R)	2003
01	Agricultural Production: Crops	0	0	0	0	1	0	0	1	0	0
08	Forestry	1	2	1	1	3	3	1	0	1	2
12	Coal Mining	1	2	2	1	4	4	4	6	7	4
13	Oil and Gas Extraction	0	0	0	0	0	1	1	1	1	1
14	Nonmetallic Minerals, Except Fuels	0	0	0	0	1	1	0	0	0	0
20	Food and Kindred Products	0	0	0	0	1	2	6	4	4	4
22	Textile Mill Products	0	0	0	0	0	1	5	11	12	14
23	Apparel and Other Textile Products	0	0	0	0	0	0	1	1	2	2
24	Lumber and Wood Products	0	0	0	0	0	0	1	1	0	0
25	Furniture and Fixtures	0	0	0	0	0	0	1	1	1	0
26	Paper and Allied Products	0	0	0	0	0	1	1	0	0	0
27	Printing and Publishing	0	1	0	1	0	1	1	0	0	0
28	Chemicals and Allied Products	1	3	2	3	8	5	11	9	11	11
29	Petroleum Refining and Other Related Industries	0	0	2	3	8	8	7	6	6	5
30	Rubber and Miscellaneous Plastic Products	0	0	0	0	0	0	2	2	2	2
32	Stone, Clay, Glass, and Concrete Products	0	0	2	4	12	13	7	5	5	5
33	Primary Metals Industries	2	2	4	4	5	5	5	11	11	11
34	Fabricated Metal Products, Except Machinery and Transportation Equipment	0	2	1	1	4	2	2	1	1	1
35	Industrial and Commercial Equipment and Components	0	0	0	0	0	0	1	1	1	2
36	Electronic and Other Electrical Equipment	1	1	2	4	4	4	9	9	8	6
37	Transportation Equipment	1	1	1	2	3	5	6	7	9	10
38	Instruments and Related Products	0	0	0	0	2	0	1	1	1	1
39	Miscellaneous Manufacturing Industries		1	1	0	2	2	1	1	1	1
40	Railroad Transportation	0	0	0	0	0	0	0	0	0	1
48	Communications	0	0	0	0	0	1	0	0	1	1
49	Electric, Gas, and Sanitary Services	98	123	125	129	138	135	151	145	138	141
57	Furniture and Home Furnishings Stores	0	0	0	0	2	1	1	0	1	1
63	Insurance Carriers	0	0	0	0	0	0	0	0	0	1
65	Real Estate	0	1	1	1	1	1	1	1	1	0
67	Holding and Other Investment Offices	0	0	1	1	1	1	1	1	2	2
72	Personal Services	0	0	0	0	0	0	1	1	1	1
80	Health Services	0	0	0	0	1	0	0	0	0	0
82	Educational Services	1	2	2	2	0	2	0	0	0	0
86	Membership Organizations	0	0	0	1	1	1	1	0	1	0
87	Engineering and Management Services	0	0	2	2	2	1	0	1	0	0
88	Private Households	2	1	1	1	1	1	1	1	1	1
89	Services Not Elsewhere Classified	0	0	0	1	1	3	2	1	1	1
91	Executive, Legislative, and General	0	0	0	0	1	2	2	2	1	1
97	National Security and International Affairs	0	0	0	0	0	0	1	0	0	0
99	Nonclassifiable Establishments	0	0	0	0	0	0	0	0	1	0
Total Number of Reporters[b]		**108**	**142**	**150**	**162**	**207**	**207**	**236**	**232**	**234[c]**	**234**
Number of 2-Digit SIC Codes Represented		**9**	**13**	**16**	**18**	**24**	**27**	**31**	**27**	**29[c]**	**27**

[a]The Voluntary Reporting of Greenhouse Gases database was designed in 1994-1995, when the Standard Industrial Classification (SIC) system was still in use.

[b]Totals may be greater than the sum of reporters in each SIC code, because confidential reporters are excluded from the latter.

[c]Includes 6 late reports for the 2002 data year. The 2003 total will also be revised upward in next year's report with the inclusion of late 2003 reports. As of February 22, 2005, EIA had received 6 late 2003 reports, which are not included in this report's 2003 database.

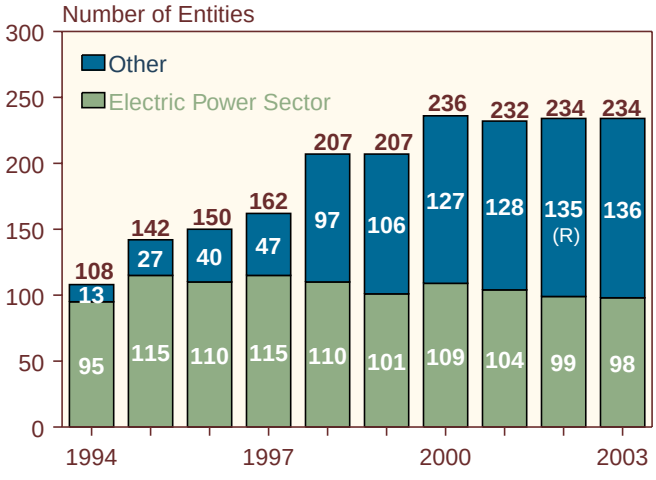
(R) = Revised.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

electric power sector, representing a diverse set of industries. In addition, several mergers and acquisitions involving reporters to the program have reduced the number of reports received from electricity producers. As a result, only 42 percent of the organizations reporting to the program for data year 2003 were from the electric power sector.

Although the number of reporters from other individual industries remained relatively small, in many cases, reports were received from key companies in those other industries: for example, General Motors, Ford Motor Company, DaimlerChrysler Corporation, Nissan North America, Inc., and Toyota Motor North America, Inc., in the automotive products industry; Noranda and an operating division of Alcan in the metals industry; BP America, Sunoco, Inc., and ChevronTexaco Corporation in the petroleum industry; Johnson & Johnson and The Dow Chemical Company in the chemicals industry; Rolls Royce in the aerospace industry; Bristol-Myers Squibb Company and Pfizer Pharmaceuticals, LLC, in the pharmaceuticals industry; and Advanced Micro Devices, Inc., and IBM in the electronic equipment industry. A complete listing of all 2003 reporters is provided in Appendix B, Table B1.[4]

Figure 1. Electric Power Sector and Other Entities Submitting Reports to the Voluntary Reporting of Greenhouse Gases Program, Data Years 1994-2003



(R) = revised.

Notes: Electric power sector includes electric utilities and independent power producers. 2002 data year includes 6 late reports that were not included in the totals presented in last year's annual report and database.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

Most reporters indicated that their projects were affiliated with one or more government-sponsored voluntary programs. Of the 2,188 projects reported for 2003, 1,066 were affiliated with the DOE's Climate Challenge Program, 381 with the EPA's Landfill Methane Outreach Program, 94 with the various DOE/EPA ENERGY STAR[5] programs (including ENERGY STAR Buildings, ENERGY STAR Computers, and ENERGY STAR Transformers), 50 with the EPA's Climate Wise Recognition Program, 39 with the U.S. Initiative on Joint Implementation, 23 with the EPA's Natural Gas STAR Program, 16 with the EPA's Green Lights Program, 11 with the EPA's Sulfur Hexafluoride Emissions Reduction Partnership, 9 with the EPA's WasteWise, 7 with DOE's Compressed Air Challenge, and 6 with the EPA's Coalbed Methane Outreach Program. Other voluntary programs cited included the EPA's Voluntary Aluminum Industrial Partnership and DOE's Motor Challenge, Rebuild America, and Cool Communities Program. Not all participants in the various voluntary programs provided information to the Voluntary Reporting Program.

What Was Reported?

The Voluntary Reporting Program permits three distinct types of reporting:

- Project-level reporting, defined as the reporting on the emission reductions or carbon sequestration achieved as a result of a specific action or group of actions
- Entity-level reporting, defined as the reporting on emissions, emission reductions, and carbon sequestration for of an entire organization, usually defined as a corporation
- Commitments to take action to reduce emissions in the future.

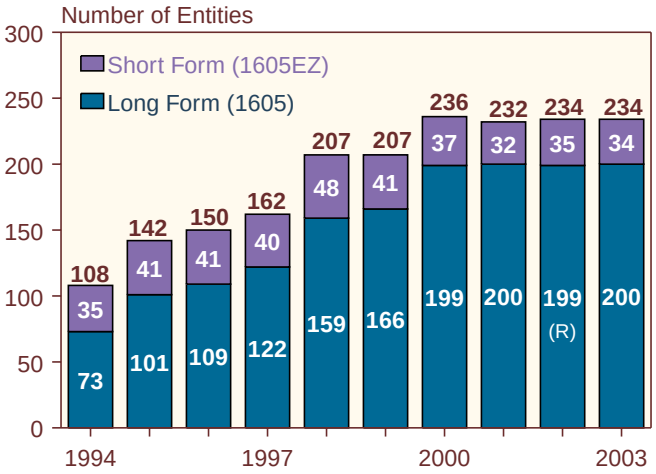
Of the 234 reports received for 2003, 200 (85 percent) were submitted on Form EIA-1605 (the long form) (Figure 2). The long form allows reporters to create an in-depth, multi-year, public record of emission reduction efforts for an entire organization and/or at the project level, including information on activities conducted outside the United States and commitments to reduce future greenhouse gas emissions. The remaining reports were submitted on Form EIA-1605EZ (the short form), which allows reporters only to provide brief summaries of greenhouse gas projects for the current reporting year and does not allow the reporting of activities outside the United States or of future emission reduction commitments. The proportion of reporters using the short form

[4]Appendixes for this report will be available in the near future from web site www.eia.doe.gov/oiaf/1605/vrrpt.

[5]ENERGY STAR is a joint program of the U.S. Department of Energy and the U.S. Environmental Protection Agency. See web site www.energystar.gov.

has declined from 32 percent in the first year of the program (1994 data year) to 15 percent in the 2003 data reporting cycle. EIA believes that reporters are choosing the long form in order to document their emission reductions more thoroughly. Also, for the same reason, several voluntary programs (such as the Landfill Methane Outreach Program) encourage participants to use the long form.

Figure 2. Number of Reports Received by Form Type, Data Years 1994-2003



(R) = revised.

Notes: Electric power sector includes electric utilities and independent power producers. 2002 data year includes 6 late reports that were not included in the totals presented in last year's annual report and database.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

For the 2003 reporting year, 177 program participants (76 percent of the total) reported project-level reductions, and 126 reported entity-level emissions and/or reductions: 70 reported at both the entity and project levels, 107 submitted only project-level reports, and 57 reported only entity-level information. In addition, 89 reporters provided information on their commitments to reduce emissions or increase sequestration in the future, including one program participant that reported only commitments without reporting on past activities.

Sources of greenhouse gas emissions and emission reductions reported to the Voluntary Reporting Program are characterized as direct, indirect, sequestration, or unspecified. The unspecified category includes all reductions and sequestration reported on the short form because the short form does not allow a reporting entity to specify whether an emission reduction is direct or indirect. Because of concern about possible double counting of emissions and reductions, particularly between direct and indirect emissions, EIA does not aggregate reported emissions or emission reductions across these four categories.

Project Level

Reporters provided information on a total of 2,188 projects for 2003 (Table 2). Most (1,969 or 90 percent) were

Table 2. Distribution of Projects by Reduction Objective, Project Type, and Form Type, Data Year 2003

Reduction Objective and Project Type	Number of Projects			Number of Reporters		
	Long Form	Short Form	Total	Long Form	Short Form	Total
Reducing Carbon Dioxide Emissions	**925**	**136**	**1,061**	**93**	**29**	**122**
Electricity Generation, Transmission, and Distribution	464	50	514	68	23	91
Cogeneration and Waste Heat Recovery	21	0	21	13	0	13
Energy End Use	374	76	450	67	20	87
Transportation and Offroad Vehicles	66	10	76	35	6	41
Reducing Methane and Nitrous Oxide Emissions	**470**	**44**	**514**	**71**	**6**	**77**
Waste Treatment and Disposal (Methane)	425	42	467	54	5	59
Agriculture (Methane and Nitrous Oxide)	4	0	4	3	0	3
Oil and Natural Gas Systems and Coal Mining (Methane)	41	2	43	22	2	24
Carbon Sequestration	**446**	**14**	**460**	**51**	**12**	**63**
Halogenated Substances	**43**	**1**	**44**	**29**	**1**	**30**
Other Emission Reduction Projects	**85**	**24**	**109**	**46**	**10**	**56**
Entity-Level Reporting Only (No Projects)	**NA**	**NA**	**NA**	**57**	**NA**	**57**
Commitment Reporting Only (No Projects or Entity-Level Data)	**NA**	**NA**	**NA**	**0**	**NA**	**0**
Total	**1,969**	**219**	**2,188**	**200**	**34**	**234**

NA = not applicable.

Notes: The total number of reporters is smaller than the sum of the number of reporters for each project type, because most reporters provided information on more than one project. Table excludes projects submitted in confidential reports.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

reported on the long form. The total number of projects reported increased by 133, or 6 percent, compared with the previous reporting cycle.[6] Most of the 2,188 projects reported for 2003 were also among the 2,055 projects reported for 2002, because they continued to yield emission reductions in 2003. Projects often yield emission reductions over an extended period; for example, an availability improvement project at a nuclear power plant typically involves the adoption of new maintenance and refueling programs that, once in place, are followed over a multi-year period. Likewise, the reforestation of an area in one year can result in the sequestration of carbon in many subsequent years, even if no additional trees are planted. Reporters continue to report the annual emission reductions and carbon sequestration achieved by such long-lived projects on a yearly basis.

The principal objective of the majority of projects (1,061 or 48 percent) reported for 2003 was to reduce carbon dioxide emissions (Table 2). Most reduced carbon dioxide either by reducing fossil fuel consumption or by switching to lower emitting sources of energy. Many also achieved small reductions in emissions of other gases. Other project objectives cited included reducing methane and nitrous oxide emissions (514 or 23 percent), increasing carbon sequestration (460 or 21 percent), and reducing emissions of halogenated substances (44 or 2 percent). Projects that also primarily reduced carbon dioxide emissions included the 109 "other" emission reduction projects, most of which involved either the reuse of fly ash as a cement substitute in concrete or the recycling of waste materials.

Most projects involve actions within the United States; however, some are conducted in foreign countries, designed to test various concepts of joint implementation with other nations (Table 3). Of the 94 foreign projects reported for 2003, 60 represented shares in two forestry programs in Belize and Malaysia sponsored by the electric power industry.

Total project-level emission reductions reported included 268.3 million metric tons carbon dioxide equivalent in direct reductions, 81.1 million metric tons carbon dioxide equivalent in indirect reductions, 7.7 million metric tons carbon dioxide equivalent in carbon sequestration, and 16.4 million metric tons carbon dioxide equivalent in unspecified reductions (Table 4). EIA uses global warming potentials (GWPs) from the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) to calculate carbon dioxide equivalents (see box on page 7).

Projects whose reduction objective was to reduce carbon dioxide emissions reported direct reductions of 193.1 million metric tons carbon dioxide equivalent, indirect reductions of 39.0 million metric tons carbon dioxide equivalent, and unspecified reductions of 12.4 million metric tons carbon dioxide equivalent. The vast majority of the reported emission reductions were carbon dioxide reductions.

A variety of efforts to reduce emissions of gases with high GWPs were also reported, including 514 projects with the objective of reducing methane and nitrous oxide emissions. These projects focused on waste

Table 3. Geographic Scope of Reports Received and Location of Emission Reduction Projects, Data Years 1994-2003

	Reports Received					Projects Reported[b]			
	U.S. Only					U.S. Only			
Year	Long Form	Short Form	Foreign Only	Both U.S. and Foreign	Total[a]	Long Form	Short Form	Foreign Only	Total[a]
1994	65	34	2	4	**108**	500	125	9	**634**
1995	82	40	2	16	**142**	760	164	36	**960**
1996	83	41	1	24	**150**	828	179	33	**1,040**
1997	90	40	1	31	**162**	1,017	201	70	**1,288**
1998	118	47	1	40	**207**	1,212	252	85	**1,549**
1999	125	39	4	37	**207**	1,397	237	87	**1,721**
2000	153	36	1	45	**236**	1,761	229	99	**2,089**
2001	155	32	1	43	**232**	1,596	210	91	**1,897**
2002(R) . . .	156	35	3	39	**234**	1,708	253	94	**2,055**
2003	157	34	2	40	**234**	1,873	219	96	**2,188**

[a]Totals are greater than the sum of the components because the latter exclude information from confidential reports.
[b]Excludes projects submitted in confidential reports.
(R) = revised.
Notes: The number of reports received for 2002 was revised to reflect the receipt of 6 reports after the finalization of the Public Use Database for last year's annual report. The number of projects reported for 2002 has also been revised to reflect the projects included in those reports.
Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

[6]The total number of projects reported for 2002 has increased from 2,027 to 2,055 with the receipt of 6 additional reports after the database used to prepare the annual report and Public Use Database for 2002 was finalized. See note to Table 3.

management systems, animal husbandry operations, oil and gas systems, or coal mines. Reported net direct emission reductions from these projects totaled 68.6 million metric tons carbon dioxide equivalent, which represents 26 percent of the total direct reductions reported for 2003. The estimate of net reductions includes 76.6 million metric tons carbon dioxide equivalent in direct reductions of methane emissions along with 8.0 million metric tons carbon dioxide equivalent in carbon dioxide and nitrous oxide emissions increases. Indirect reductions reported for projects that reduced methane and nitrous oxide emissions totaled 39.8 million metric tons carbon dioxide equivalent. Unspecified reductions reported on the short form totaled 3.9 million metric tons carbon dioxide equivalent.

Almost all of the 460 carbon sequestration projects reported on either the long form or the short form increased the amount of carbon stored in sinks through various forestry measures, including afforestation, reforestation, urban forestry, forest preservation, and modified forest management techniques. These activities accounted for 21 percent of the projects reported for 2003; however, 284 of the reported carbon sequestration projects represented shares in 10 projects conducted by the UtiliTree Carbon Company, which were reported by 28 participating electric utilities. Carbon sequestration projects reported on the long form for 2003 totaled 7.7 million metric tons carbon dioxide equivalent in carbon sequestration achieved.

Projects with the objective of reducing emissions of halogenated substances—including perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and hydrofluorocarbons (HFCs)—reported direct reductions of 6.1 million metric tons carbon dioxide equivalent for 2003, which included 3.5 million metric tons carbon dioxide equivalent of PFC emissions and 2.6 million metric tons carbon dioxide equivalent of SF_6 emissions, as well as indirect reductions of 2.2 million metric tons carbon dioxide equivalent, the vast majority of which was SF_6.

Global Warming Potentials Used to Calculate Carbon Dioxide Equivalent Emissions

Global warming potentials (GWPs) are used to compare the abilities of different greenhouse gases to trap heat in the atmosphere. GWPs are based on the radiative efficiency (heat-absorbing ability) of each gas relative to that of carbon dioxide (CO_2), as well as the decay rate of each gas (the amount removed from the atmosphere over a given number of years) relative to that of CO_2. The GWP provides a construct for converting emissions of various gases into a common measure, which allows climate analysts to aggregate the radiative impacts of various greenhouse gases into a uniform measure denominated in carbon or carbon dioxide equivalents. The table at the right presents the GWPs published in the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

In analyzing greenhouse gas emissions and emission reductions reported to the Voluntary Reporting of Greenhouse Gases Program, EIA attempts to employ the most current data sources. For that reason, and because the IPCC is generally considered the authoritative source for GWPs, EIA uses the IPCC's most recent GWP values, from the Third Assessment Report, to convert reported greenhouse gas emissions to the carbon dioxide equivalent units used in this report. It is important to point out, however, that countries reporting to the United Nations Framework Convention on Climate Change (UNFCCC), including the United States, have been compiling estimates based on the GWPs from the IPCC's Second Assessment Report. The UNFCCC Guidelines on Reporting and Review, adopted before the publication of the Third Assessment Report, require emission estimates to be based on the GWPs in the IPCC Second Assessment Report. This will probably continue in the short term, until the UNFCCC reporting rules are changed.

100-Year GWP Estimates from the IPCC's Third (2001) Assessment Reports

Gas	2001 IPCC GWP[a]
Methane	23
Nitrous Oxide	296
HFC-23	12,000
HFC-32	550
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_4)	5,700
Perfluoroethane (C_2F_6)	11,900
Perfluoropropane (C_3F_8)	11,900
Sulfur Hexafluoride (SF_6)	22,200

[a]Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis. Summary for Policymakers* (Cambridge, UK: Cambridge University Press, 2001).

Table 4. Summary of Reported Project-Level Emission Reductions and Carbon Sequestration by Reduction Objective and Gas, Data Year 2003
(Metric Tons Carbon Dioxide Equivalent)

Gas	Reductions by Project Objective				Total Reductions
	Reduce Carbon Dioxide Emissions	Reduce Methane and Nitrous Oxide Emissions	Increase Carbon Sequestration	Reduce Emissions of Halogenated Substances	
Direct					
Carbon Dioxide	193,113,253	-7,975,336[a]	1,932	—	185,139,849
Methane	347,122	76,645,627	—	—	76,992,749
Nitrous Oxide	32,778	-23,899[a]	—	—	8,879
HFCs	—	—	—	—	0
PFCs	25,536	—	—	3,524,969	3,550,504
SF_6	—	—	—	2,611,910	2,611,910
Total Direct	**193,518,689**	**68,646,392**	**1,932**	**6,136,879**	**268,303,892**
Indirect					
Carbon Dioxide	38,461,582	16,977,303	—	—	55,438,884
Methane	264,381	22,737,072	—	—	23,001,453
Nitrous Oxide	56,049	121,374	—	—	177,423
HFCs	—	—	—	38,702	38,702
PFCs	236,823	—	—	567	237,390
SF_6	—	—	—	2,184,750	2,184,750
Total Indirect	**39,018,835**	**39,835,749**	**—**	**2,224,018**	**81,078,602**
Sequestration					
Carbon Dioxide	—	—	7,730,969	—	7,730,969
Methane	—	—	—	—	—
Nitrous Oxide	—	—	—	—	—
HFCs	—	—	—	—	—
PFCs	—	—	—	—	—
SF_6	—	—	—	—	—
Total Sequestration	**—**	**—**	**7,730,969**	**—**	**7,730,969**
Unspecified[b]					
Carbon Dioxide	12,427,175	39,057	28,576	—	12,494,809
Methane	21,456	3,813,915	—	—	3,835,371
Nitrous Oxide	—	—	—	—	—
HFCs	—	—	—	—	—
PFCs	1,910	—	—	—	1,910
SF_6	22,154	—	—	6,495	28,649
Total Unspecified	**12,472,694**	**3,852,972**	**28,576**	**6,495**	**16,360,738**

[a]Negative reductions represent increases in emissions.

[b]Unspecified emission reductions represent quantities reported on the short form (Form EIA-1605EZ), where reporters are not asked to specify whether the emission reduction or sequestration is direct or indirect.

Notes: CFCs, HCFCs, and methyl chloroform are not included in the totals because of the uncertainty associated with estimates of net global warming potential for these gases. Their direct warming effects (radiative forcing) are offset by indirect cooling effects (destruction of stratospheric ozone, another greenhouse gas). Direct, indirect, and unspecified emission reductions and sequestration have not been totaled to avoid double counting of reductions or sequestration that have been reported by more than one entity.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

Total direct emission reductions reported for 2003 increased by 1 percent over the reductions reported for 2002, to 268.3 million metric tons carbon dioxide equivalent (Table 5), and have quadrupled since the first year of the program (data year 1994). Reported direct reductions of carbon dioxide emission increased by 6.7 million metric tons, while direct reductions of methane emissions decreased by 3.1 million metric tons.

Indirect emission reductions reported for 2003, at 81 million metric tons carbon dioxide equivalent, were 1.0 million metric tons carbon dioxide equivalent (1.2 percent) higher than those reported for 2002. Largely responsible for the increase was a new reporter, Xenon Specialty Gas, which reported indirect reductions of SF_6 emissions equal to 2.2 million metric tons carbon dioxide equivalent.

Reported sequestration, after peaking at 12.5 million metric tons carbon dioxide equivalent for 1998, has fallen below 10 million metric tons carbon dioxide for the past 5 years. This decline was caused by the decline in, or nonrecurrence of, sequestration reported for several large forest preservation projects. Also, American Forests, which reported sequestration for 164 reforestation projects for 2000, has not reported for subsequent years. Unspecified reductions reported for 2003, which include reductions and sequestration reported on the short form, totaled 16.4 million metric tons carbon dioxide equivalent, a decrease of 5.2 percent from 2002.

Project-Level Reference Cases

Beginning with the 2000 annual report, EIA began dividing project-level data according to the reference case employed in calculating reported project-specific emission reductions. A "reference case" is an emissions or sequestration level against which actual emissions are compared to estimate emission reductions. In a "basic" reference case, actual historical emissions (or sequestration) in a specific year, or an average of a range of years, are used as the reference case. In a "modified" reference case, an estimate is made of what emissions or sequestration would have been in the absence of the project, and that estimate serves as the reference case.

Of the projects reported for 2003 on Form EIA-1605, 95 percent used modified reference cases (Table 6). A modified reference case is generally preferred for project-level analysis, because this approach attempts to isolate the effect of the action taken by the reporter from other factors that may have affected the reporter's emissions since the action was taken. The use of basic reference cases for 2003 was greatest for projects that reported reducing emissions of halogenated substances (42 percent of those projects), because the techniques for evaluating reductions for the projects are particularly suited to the use of a basic reference case. Emissions are determined using inventory management data, with emissions of a particular substance being equal to the amount purchased during the year to replace quantities emitted. Annual reductions can be calculated by subtracting the emissions in the years after emission abatement measures have been instituted from the emissions in the year before the measures were instituted.

In terms of emission reductions and sequestration reported for 2003, 261 million metric tons carbon dioxide equivalent in direct reductions (97 percent of total direct reductions), 74.8 million metric tons carbon dioxide equivalent in indirect reductions (92 percent of total indirect reductions), and 7.8 million metric tons carbon dioxide equivalent in sequestration (94 percent of total sequestration) were reported as having been estimated using modified reference cases (Table 7). The halogenated substance category was the only project category for which a significant proportion (92 percent or 5.6 million metric tons carbon dioxide equivalent) of the reported direct reductions was estimated using a basic reference case.

Entity Level

Most of the 126 reporters providing entity-level information included data on emissions as well as emission reductions or sequestration. In addition, 9 reporters provided entity-level data on emissions only, and 6 reporters provided entity-level data on emission reductions or sequestration only.

Total entity-level direct emissions reported for 2003 were 888.8 million metric tons, representing a 0.1-percent decrease from the direct emissions reported for 2002 (Table 8). Total entity-level indirect emissions reported for 2003 were 6 percent lower than those reported for 2002, at 104.7 million metric tons carbon dioxide equivalent. Total direct emission reductions reported at the entity level for 2003 (214.2 million metric tons carbon dioxide equivalent) were 8 percent lower than those reported for 2002 (231.6 million metric tons carbon dioxide equivalent). For 2003, 182.4 million metric tons carbon dioxide equivalent (85 percent) of the reported direct reductions were estimated using modified reference cases, and 31.8 million metric tons carbon dioxide equivalent (15 percent) were estimated with basic reference cases.

Reported entity-level indirect emission reductions for 2003 totaled 42.6 million metric tons carbon dioxide equivalent, 19 percent higher than the total reported for 2002. Reported indirect reductions of 45.6 million metric tons carbon dioxide equivalent calculated with modified reference cases were offset by -3.2 million metric tons carbon dioxide equivalent of indirect reductions (i.e., a net increase in emissions) calculated with basic reference cases. Entity-level sequestration reported for 2003

Table 5. Summary of Reported Project-Level Emission Reductions and Carbon Sequestration by Gas, Data Years 1994-2003

(Metric Tons Carbon Dioxide Equivalent)

Year	Carbon Dioxide	Methane	Nitrous Oxide	HFCs	PFCs	Sulfur Hexafluoride	Total
Direct							
1994	58,413,709	576,808	339,485	-29	3,199,649	83,579	**62,613,201**
1995	85,419,479	194,350	-438,673	-43	2,962,416	186,382	**88,323,910**
1996	77,601,577	9,411,042	-423,599	15,193	3,345,811	-69,985	**89,880,039**
1997	82,269,887	8,705,355	86,294	-42	3,318,600	516,732	**94,896,824**
1998	112,038,605	31,720,732	109,560	-1,738	3,504,380	624,786	**147,996,326**
1999	115,366,719	35,994,030	62,111	-1,738	3,425,480	595,379	**155,441,981**
2000	144,096,233	61,945,794	114,198	—	3,233,612	1,407,347	**210,797,186**
2001	159,129,312	81,569,042	711,633	—	3,606,813	2,475,144	**247,491,944**
2002(R)	178,393,155	80,073,702	-4,713	—	3,562,893	3,043,682	**265,068,719**
2003	185,139,849	76,992,749	8,879	—	3,550,504	2,611,910	**268,303,892**
Indirect							
1994	2,994,405	2,360,734	2,243	—	—	—	**5,357,381**
1995	27,063,660	24,777,246	630,358	—	—	7,653	**52,478,917**
1996	26,207,709	26,612,114	616,075	—	—	—	**53,435,898**
1997	25,848,951	11,630,239	102,639	—	3,631	81	**37,585,541**
1998	27,968,865	15,152,664	105,598	—	6,068	81	**43,233,274**
1999	37,233,635	19,027,769	270,531	—	5,856	81	**56,537,872**
2000	41,276,444	20,641,700	115,689	—	35,459	81	**62,069,372**
2001	48,255,932	23,216,197	154,566	—	34,319	81	**71,661,094**
2002(R)	55,347,688	24,555,786	164,214	47	36,705	81	**80,104,520**
2003	55,438,884	23,001,453	177,423	38,702	237,390	2,184,750	**81,078,602**
Sequestration							
1994	746,545	—	—	—	—	—	**746,545**
1995	1,190,754	—	—	—	—	—	**1,190,754**
1996	8,676,591	—	—	—	—	—	**8,676,591**
1997	9,849,807	—	—	—	—	—	**9,849,807**
1998	12,490,927	—	—	—	—	—	**12,490,927**
1999	9,623,599	—	—	—	—	—	**9,623,599**
2000	9,011,117	—	—	—	—	—	**9,011,117**
2001	7,956,823	—	—	—	—	—	**7,956,823**
2002(R)	7,296,516	—	—	—	—	—	**7,296,516**
2003	7,730,969	—	—	—	—	—	**7,730,969**
Unspecified[a]							
1994	3,721,047	564,022	—	—	—	—	**4,285,069**
1995	4,959,366	1,162,752	—	—	—	—	**6,112,117**
1996	4,436,523	1,232,174	—	—	—	—	**5,668,697**
1997	6,688,175	1,825,383	—	—	123,049	—	**8,636,607**
1998	16,499,427	2,918,818	—	—	—	—	**19,418,245**
1999	9,607,428	3,273,878	—	—	—	4,783	**12,886,089**
2000	9,125,506	3,127,762	—	—	—	20,744	**12,274,012**
2001	10,855,046	3,960,348	—	—	4,046	20,261	**14,839,701**
2002(R)	12,820,322	4,295,112	—	—	130,930	10,201	**17,256,565**
2003	12,494,809	3,835,371	—	—	1910	28,649	**16,360,738**

(R) = revised.

[a]Unspecified emission reductions represent quantities reported on the short form (Form EIA-1605EZ), which does not distinguish between direct and indirect emission reductions or sequestration.

Notes: Reductions of CFCs, HCFCs, and methyl chloroform are not included in the totals because of the uncertainty associated with estimates of their net global warming potential. Their direct warming effects (positive radiative forcing) are offset by indirect cooling effects (destruction of stratospheric ozone, another greenhouse gas). Totals may not equal sum of components due to independent rounding. Direct, indirect, and unspecified emission reductions and sequestration have not been totaled, in order to avoid double counting of reductions or sequestration that have may been reported by more than one entity. Negative reductions represent increases in emissions.

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

totaled 6.9 million metric tons carbon dioxide equivalent, 1 percent more than was reported for 2002.

Commitments

For 2003, formal commitments to reduce emissions, take specific action to reduce emissions, or provide financial support for activities related to greenhouse gas reductions were reported by 89 entities,[7] nearly one-third (30 percent) of which were electricity generators participating in DOE's Climate Challenge Program (Figure 3). Other voluntary programs represented among the commitments reported for 2003 included the EPA's Climate Wise, the EPA's Voluntary Aluminum Industrial Program, the U.S. Initiative on Joint Implementation, the EPA's Green Lights Program, the EPA's Landfill Methane Outreach Program, DOE's Motor Challenge, the EPA's Sulfur Hexafluoride Emissions Reduction Partnership for Electric Power Systems, DOE's Cool Communities Program, DOE/EPA ENERGY STAR Buildings, EPA's Natural Gas Star, and DOE's Renewable Energy Commercialization Program.[8]

There are three forms of future commitment in the Voluntary Reporting Program: entity commitments, financial commitments, and project commitments. Entity and project commitments roughly parallel the entity and project aspects of emissions reporting: an entity commitment is a commitment to reduce the emissions of an entire organization; a project commitment is a commitment to take a particular action that will have the effect of reducing the reporter's emissions through a specific project. A financial commitment is a pledge to spend a particular sum of money on activities related to emission reductions, without a specific promise as to the emissions consequences of the expenditure.

For 2003, 55 firms made 60 specific promises to reduce, avoid, or sequester future emissions at the entity level. Some of those entity-level commitments were to reduce emissions below a specific baseline, others to limit the growth of emissions per unit of output, and others to limit emissions by a specific amount relative to a baseline emissions growth trend. In their reports for 2003, companies reported commitments to reduce entity-level emissions by a total of 86 million metric tons carbon dioxide equivalent, including 14 commitments, representing 68 million metric tons carbon dioxide equivalent or 79 percent of the emission reductions promised, that

Table 6. Number of Projects Reported on Form EIA-1605 by Reduction Objective, Project Type, and Reference Case Employed, Data Year 2003
(Number of Projects)

Reduction Objective and Project Type	Type of Reference Case				Total Number of Projects
	Modified		Basic		
	Number of Projects	Percent	Number of Projects	Percent	
Reducing Carbon Dioxide Emissions	**867**	**94**	**56**	**6**	**923**
Electricity Generation, Transmission, and Distribution	458	99	4	1	462
Cogeneration and Waste Heat Recovery	19	90	2	10	21
Energy End Use	328	88	46	12	374
Transportation and Offroad Vehicles	62	94	4	6	66
Reducing Methane and Nitrous Oxide Emissions	**463**	**99**	**7**	**1**	**470**
Waste Treatment and Disposal (Methane)	421	99	4	1	425
Agriculture (Methane and Nitrous Oxide)	4	100	0	0	4
Oil and Natural Gas Systems and Coal Mining (Methane)	38	93	3	7	41
Carbon Sequestration	**429**	**96**	**17**	**4**	**446**
Halogenated Substances	**25**	**58**	**18**	**42**	**43**
Other Emission Reduction Projects	**74**	**88**	**10**	**12**	**84**
Total	**1,858**	**95**	**108**	**5**	**1,966**

Notes: Excludes projects reported on the short form (Form EIA-1605EZ), which does not collect information on the reference case employed. Excludes two projects reported on the long form (Form EIA-1605) for which no reference case was specified because reductions were not estimated. Table excludes projects submitted in confidential reports.
Source: Energy Information Administration, Forms EIA-1605.

[7]Formal commitments in one or more of the entity-level, project-level, or financial categories accommodated by Form EIA-1605 were reported by 81 companies. Descriptions of future activities were provided by 8 companies in the Additional Information section of Schedule IV.

[8]In 2001, the Climate Wise and Green Lights voluntary programs were incorporated into ENERGY STAR, a joint program of the U.S. Department of Energy and the U.S. Environmental Protection Agency.

were to be fulfilled by 2003 or earlier. The 12 other entity-level commitments, which promised reductions totaling 18 million metric tons carbon dioxide equivalent, were to be fulfilled by 2004 or later.

Commitments to undertake 116 individual emission reduction projects were reported by 22 companies. Some of the commitments were linked to results from projects already underway and forming part of the reporters' submissions. Others were for projects not yet begun. Reporters indicated that the projects were expected to reduce future emissions or increase carbon sequestration by 73 million metric tons carbon dioxide equivalent. In addition, 20 firms made 40 financial commitments. The total amount of funds promised was $50 million, of which $4 million was spent in 2003.

Table 7. Reported Emission Reductions and Sequestration for Projects Reported on Form EIA-1605 by Reduction Objective, Project Type, Source, and Reference Case Employed, Data Year 2003
(Million Metric Tons Carbon Dioxide Equivalent)

Reduction Objective and Project Type	Direct Reductions		Indirect Reductions		Sequestration	
	Modified	Basic	Modified	Basic	Modified	Basic
Reducing Carbon Dioxide Emissions	**184.4**	**1.3**	**27.8**	**0.1**	**NA**	**NA**
Electricity Generation, Transmission, and Distribution	157.2	0.6	14.7	*	NA	NA
Cogeneration and Waste Heat Recovery	0.1	*	3.1	*	NA	NA
Energy End Use	24.7	0.6	9.9	0.1	NA	NA
Transportation and Offroad Vehicles	2.5	*	0.1	*	NA	NA
Reducing Methane and Nitrous Oxide Emissions	**68.2**	**0.4**	**38.6**	**1.2**	**NA**	**NA**
Waste Treatment and Disposal (Methane)	47.6	0.4	38.6	1.2	NA	NA
Agriculture (Methane and Nitrous Oxide)	*	NA	*	NA	NA	NA
Oil and Natural Gas Systems and Coal Mining (Methane)	20.6	*	*	NA	NA	NA
Carbon Sequestration	**0.0**	**NA**	**NA**	**NA**	**7.3**	**0.5**
Halogenated Substances	**0.5**	**5.6**	**2.2**	**NA**	**NA**	**NA**
Other Emission Reduction Projects	**7.8**	**NA**	**6.1**	**5.0**	**NA**	**NA**
Total	**261.0**	**7.3**	**74.8**	**6.3**	**7.3**	**0.1**

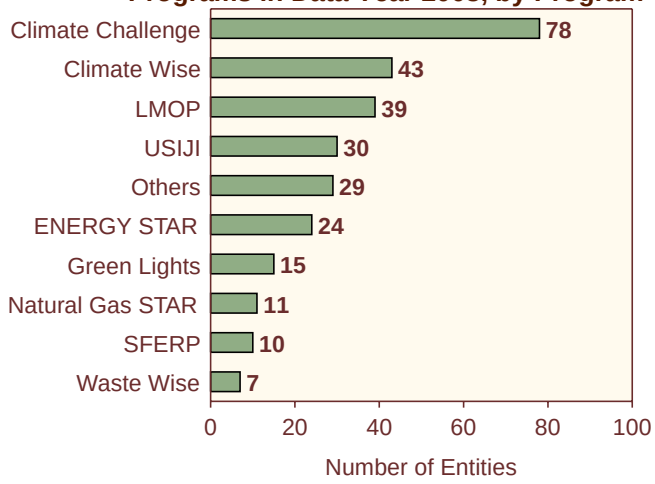
Note: Excludes reductions and sequestration for projects reported on the short form (Form EIA-1605EZ), which does not collect information on the reference case employed. Excludes projects submitted in confidential reports.
Source: Energy Information Administration, Form EIA-1605.

Table 8. Number of Entities Reporting at the Entity Level, Reported Emissions by Source, Emission Reductions by Source and Type of Reference Case Employed, and Sequestration, Data Years 1994-2003
(Million Metric Tons Carbon Dioxide Equivalent)

Year	Number of Entities Reporting	Emissions		Emission Reductions by Type of Reference Case						Sequestration
				Direct			Indirect			
		Direct	Indirect	Modified	Basic	Total	Modified	Basic	Total	
1994	39	752.7	494.9	38.2	22.6	60.8	1.6	1.2	2.8	0.5
1995	50	875.8	499.6	56.0	39.3	95.3	46.0	2.7	48.6	0.8
1996	55	1,183.1	461.5	65.4	44.6	110.0	42.9	5.7	48.6	7.9
1997	60	1,006.6	525.8	73.7	20.3	94.0	24.8	3.4	28.2	7.1
1998	76	1,110.7	473.5	105.8	22.6	128.4	28.3	13.2	41.6	11.2
1999	83	967.9	481.0	114.7	35.3	150.0	30.3	8.4	38.7	8.4
2000	109	1,068.2	111.7	123.6	83.0	206.7	34.8	-7.8	27.0	7.5
2001(R)	113	799.6	111.5	121.4	90.4	211.9	38.9	-6.7	32.2	7.5
2002(R)	119	889.3	111.2	148.4	83.3	231.6	44.2	-8.3	35.9	6.8
2003	126	888.8	104.7	182.4	31.8	214.2	45.6	-3.0	42.6	6.9

(R) = revised.
Notes: 2002 data year includes late reports that were not received in time to be included in last year's annual report and database. Negative reductions represent increases in emissions.
Source: Energy Information Administration, Form EIA-1605.

Figure 3. Number of Entities Reporting Commitments Associated with Voluntary Programs in Data Year 2003, by Program



Notes: LMOP = Landfill Methane Outreach Program, USIJI = United States Initiative on Joint Implementation, SFERP = Sulfur Hexafluoride Emissions Reduction Partnership. Others include Coalbed Methane Outreach Program, Cool Communities Program, Motor Challenge Program, and Voluntary Aluminum Industry Partnership. The sum of entities reporting commitments associated with each program exceeds the total number of entities reporting commitments because several entities reported commitments associated with more than one program.

Source: Energy Information Administration, Form EIA-1605.

Status of Policy Initiatives

In 2004, the Bush Administration continued to develop components of its Global Climate Change Initiative, which is expected to include enhancements to the Voluntary Reporting of Greenhouse Gases Program (see boxes on pages 14 and 15). In addition, some States and other organizations continued progress toward the development of greenhouse gas registry and trading programs; and the U.S. Congress considered, but did not pass, legislation relevant to greenhouse gas reporting. These developments, which occurred in 2003, would not have affected the reported emissions and emission reductions data for activities in 2003 discussed in this report, even if they had been formalized in laws or policies; however, they may affect the future of the Voluntary Reporting Program, future reporting of reductions or commitments, or both.

Enhanced 1605(b) Voluntary Emissions Reduction Registry

Pursuant to a key objective of the Global Climate Change Initiative, DOE is working to improve and expand the 1605(b) Voluntary Reporting of Greenhouse Gases Program. The primary goal of this effort is to create a credible and transparent program to report real reductions that support the national greenhouse gas intensity goal laid out in the Global Climate Change Initiative. In addition, a goal of the enhanced 1605(b) Program is to allow businesses and individuals to record their reductions and ensure that reporters are not penalized under a future climate policy. The objective of improving the registry is to help motivate firms to take cost-effective, voluntary actions to reduce greenhouse gas emissions, which would, in part, aid in the achievement of the Initiative's greenhouse gas intensity goal.

An interagency working group has undertaken several actions to improve the Voluntary Reporting Program, including outreach efforts, solicitation of public comments, and review of the existing program. On July 8, 2002, the Secretary of Energy, joined by the Secretary of Commerce, the Secretary of Agriculture, and the EPA Administrator, submitted recommendations to the White House to guide the process for improving and expanding the Voluntary Reporting Program.

In 2004, DOE continued to collaborate with the Department of Agriculture, the EPA, and other Federal agencies in developing revised Guidelines for the Voluntary Reporting of Greenhouse Gases Program. In November 2003, DOE released proposed revisions to the General Guidelines, which outline the principles that would govern the revised program, and also held a public workshop on the subject in Washington, DC, on January 12, 2004. The Technical Guidelines will specify the methods and factors to be used in measuring and estimating greenhouse gas emissions, emission reductions, and carbon sequestration under the revised Program.

Other U.S., State, and International Greenhouse Gas Initiatives and Registry Programs

In addition to activity on revisions to the Voluntary Reporting Program, a number of other efforts at the Federal, State, and international levels to reduce greenhouse gas emissions are being actively pursued. Some of those efforts are summarized below.

Climate VISION. Climate VISION—Voluntary Innovative Sector Initiatives: Opportunities Now—is a Presidential public-private partnership initiative launched by DOE on February 12, 2003, to contribute to the President's goal of reducing U.S. greenhouse gas emissions intensity—the ratio of emissions to economic output by American industry—by 18 percent over the next 10 years without sacrificing economic growth. Other agencies participating in Climate VISION include the EPA, Department of Transportation, Department of Agriculture, and Department of the Interior.

Business associations representing 12 industry sectors and the Business Roundtable have become program

partners with the Federal Government and have issued letters of intent to meet specific targets for reducing greenhouse gas emissions intensity. These Climate VISION partners, which include some of the largest companies in America, represent a broad range of industry sectors: oil and gas production, transportation, and refining; electricity generation; coal and mineral production and mining; manufacturing (automobiles, cement, iron and steel, magnesium, aluminum, chemicals, and semiconductors); railroads; and forest products. In December 2004, as part of its Climate VISION commitment, the electric power industry pledged to reduce collectively the power sector's greenhouse gas emissions intensity by the equivalent of 3 to 5 percent (measured as carbon emissions per unit of electricity produced) below 2000-2002 baseline levels, measured over the 2010-2012 period.

Climate Leaders. Climate Leaders is a voluntary industry-government partnership that encourages companies to establish and meet clear greenhouse gas emission reduction targets. EPA established Climate Leaders in February 2002 and has recruited 62 partners, 27 of which have established greenhouse gas reduction goals. By joining Climate Leaders, the partners commit themselves to documenting their emissions of the six major

The Global Climate Change Initiative

On February 14, 2002, President George W. Bush announced the Administration's Global Climate Change Initiative, which includes new emission intensity reduction goals, incentives for clean technology development, added support for scientific research, expanded collaboration with foreign governments on climate change, and the development of a framework for the enhancement of the Voluntary Reporting of Greenhouse Gases Program.

A primary goal of the Global Climate Change Initiative is to slow the growth rate of greenhouse gas emissions while sustaining economic growth, using market mechanisms and energy technology development. In the proposal, the President established a national goal of reducing the greenhouse gas intensity of the U.S. economy by 18 percent between 2002 and 2012. Emissions intensity is a measure of the ratio of greenhouse gas emissions to economic output (gross domestic product). To achieve the goal, the Initiative focuses on fossil fuel energy conservation, methane recovery, and carbon sequestration in the short term and development of advanced energy technologies in the longer term.

Key domestic and international elements of the Global Climate Change Initiative include:

- Domestic climate change initiatives:
  - Enhancement of the 1605(b) Voluntary Reporting of Greenhouse Gases Program
  - Significantly expanded funding for basic scientific research and advanced technology development
  - Tax incentives, such as credits for renewable energy, cogeneration, and new technology
  - Challenges for business to undertake voluntary initiatives and commit to greenhouse gas intensity goals, such as through recent agreements with the semiconductor and aluminum industries
  - Transportation programs, including technology research and development and fuel economy standards
  - Carbon sequestration programs, which include increased funding for U.S. Department of Agriculture conservation programs under the Farm Bill to enhance the natural storage of carbon, promote the development of targeted incentives for forestry and agriculture projects to increase carbon sequestration, and establish accounting rules and guidelines for crediting sequestration projects
- International climate change initiatives:
  - Investments in climate observation systems in developing countries
  - Funding for "debt-for-nature" forest conservation programs
  - Use of economic incentives to encourage developing countries to participate in climate change initiatives
  - Expanding technology transfer and capacity building in the developing world
  - Joint research with Japan, Italy, and Central America.

The Global Climate Change Initiative includes a future progress check: the U.S. Government, in 2012, will evaluate whether its greenhouse gas emissions reduction progress is sufficient and whether scientific understanding at that time will justify further action. If further action is deemed necessary, the Initiative proposes to accelerate technology development and deployment using additional market-based mechanisms, voluntary measures, and incentive programs.

greenhouse gases (carbon dioxide, methane, nitrous oxide, HFCs, PFCs, and SF_6) on a company-wide, facility-level basis (including, at a minimum, all their domestic facilities). Partners are required to develop an Inventory Management Plan (IMP) and report their annual corporate level emissions by emission source type to the EPA, using the EPA's Annual GHG Inventory Summary and Goal Tracking Form.[9]

In October 2004, the EPA issued updated guidance for corporate greenhouse gas inventories based on the existing protocol developed by the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD), described below. The EPA has finalized guidance covering design principles and cross-sector core guidance covering direct emissions from stationary combustion, indirect emissions from sales and purchases of electricity and steam, direct emissions from mobile sources, and direct emissions of HFCs and PFCs from refrigeration and air conditioning systems. The EPA has also completed draft sector-specific guidance for core emissions from the following industries: cement, manufacture of refrigeration and air conditioning equipment (HFC and PFC emissions), iron and steel, and municipal solid waste landfilling. The EPA is currently developing sector-specific guidance for aluminum production, pulp and paper production, semiconductor manufacturing, and SF_6 from electricity distribution.

California. The California Climate Action Registry (CCAR), established by the California Legislature in 2000, is a voluntary program for reporting and registering greenhouse gas emissions that occur inside or outside the State of California. CCAR issued reporting protocols and began enrolling members in October 2002 and, in December 2003, released an online reporting tool, the California Action Registry Reporting On-line Tool (CARROT), in order to simplify the inventorying and reporting of greenhouse gas emissions by program participants. CCAR requires third-party verification of reported emissions and has pledged to protect participants' reported reductions under possible future regulatory programs. As of November 2004, CCAR had enrolled 43 organizations and companies.[10] In October 2004, CCAR released a protocol for the accounting of carbon emissions and reductions associated with forest conservation, improved management practices, and reforestation and issued revised guidance for calculating greenhouse gas emissions from electric power generation.

Wisconsin. Wisconsin has developed a registry for recording reductions in emissions of greenhouse gases

Recommendations for Improving the Voluntary Reporting of Greenhouse Gases Program

The Secretaries of Energy, Commerce, and Agriculture and the EPA Administrator on July 8, 2002, submitted to the White House the following recommendations for improving and expanding the Voluntary Reporting of Greenhouse Gases Program:

- Develop fair, objective, and practical methods for reporting baselines, reporting boundaries, calculating real results, and awarding transferable credits for actions that lead to real reductions
- Standardize widely accepted, transparent accounting methods
- Support independent verification of registry reports
- Encourage reporters to report greenhouse gas intensity (emissions per unit of output) as well as emissions or emission reductions
- Encourage corporate or entity-wide reporting
- Provide credits for actions to remove carbon dioxide from the atmosphere (e.g., sequestration activities) as well as for actions to reduce emissions
- Develop a process for evaluating the extent to which past reductions may qualify for credits
- Ensure that the Voluntary Reporting Program will be an effective tool to assist in reaching the goal of an 18-percent reduction in greenhouse gas intensity
- Factor in international strategies as well as State-level efforts
- Minimize transactions costs for reporters and administrative costs for the Government, where possible, without compromising the recommendations above.

[9]U.S. Environmental Protection Agency, Climate Leaders Program, "Annual GHG Inventory Summary and Goal Tracking Form," web site www.epa.gov/climateleaders/summaryform.xls. For information on Climate Leaders Program reporting requirements, see web site www.epa.gov/climateleaders/reportreq.html.

[10]See web site www.climateregistry.org/members. Seven of the organizations have at one time or another submitted reports to the Voluntary Reporting Program, including the following reporters for 2003: BP America, Los Angeles Department of Water and Power, PG&E Corporation, Sacramento Municipal Utility District, and Southern California Edison.

and other pollutants. To date, 7 organizations have registered emission reductions, 3 of which include reductions of carbon dioxide totaling over 310,000 metric tons.

Northeastern States. The six New England States and the Eastern Canadian Provinces (New Brunswick, Newfoundland and Labrador, Nova Scotia, Prince Edward Island, and Quebec) are engaged in a joint effort to develop a regional greenhouse gas registry, as specified in the New England Governors and Eastern Canadian Premiers (NEG/ECP) Climate Change Action Plan, which was issued in 2001. In the United States, the Northeast States for Coordinated Air Use Management (NESCAUM), an interstate association of air quality control divisions from the New England States, New York, and New Jersey, has spearheaded this effort.[11]

In October 2003, as part of a New England States' NEG/ECP Climate Action Plan commitment, NESCAUM launched the Regional Greenhouse Gas Registry (RGGR), which has adopted the emissions accounting and reporting protocols developed by WRI/WBCSD and is collaborating with the California Climate Action Registry to ensure that the registries will be compatible.[12] In May 2004, the Connecticut legislature passed a bill that requires any entity that reports other air emissions to report direct greenhouse gas emissions to the RGGR beginning in July 2006. All entities whose direct and indirect emissions of greenhouse gases exceed 10,000 metric tons carbon dioxide equivalent will be required to report those emissions to the RGGR beginning in July 2008.[13] NESCAUM is also initiating Phase II of the Greenhouse Gas Emissions Trading Demonstration Project, which will include further examination of baseline scenarios and multi-pollutant caps and a comprehensive assessment of early actions to reduce greenhouse gas emissions reported to the Voluntary Reporting of Greenhouse Gases Program.[14]

West Coast States. In September 2003, the governors of Washington, Oregon, and California announced a joint initiative to address climate change by developing policy recommendations on a range of issues that require regional cooperation, including the development of protocols and standard accounting methods for greenhouse gas emissions reporting.[15] In November 2004, the governors approved a series of recommendations stemming from this initiative. The recommendations identified a market-based carbon allowance program as an area holding significant promise for achieving regional greenhouse gas reductions. The governors have directed their State agencies to continue the initiative in 2005.[16]

Georgia. In May 2004, the Georgia legislature enacted the Georgia Carbon Sequestration Registry Act, which establishes a voluntary registry for carbon sequestration projects that offset greenhouse gas emissions. The State Forestry Commission is responsible for developing the rules for the program, and the Georgia Superior Court Clerks' Cooperative Authority will administer the registry, which will include a State-wide uniform automated electronic information system.[17]

Other States. Other States, including Illinois, Iowa, Maine, and Texas, have taken initial steps toward the development of State-level registries of greenhouse gas emissions.

WRI/WBCSD Greenhouse Gas Protocol Initiative. The WRI/WBCSD Greenhouse Gas Protocol initiative is an international program for developing accounting and reporting standards for greenhouse gas emissions and reductions that can be adopted by other reporting programs and registries. WRI/WBCSD has developed a corporate protocol for entity-level reporting, which was revised in 2004, and several calculation tools to support the preparation of corporate greenhouse gas inventories.[18] WRI/WBCSD continued to develop a project module in 2004.[19]

World Economic Forum Global Greenhouse Gas Register. In December 2003, the World Economic Forum

[11]Conference of New England Governors and Eastern Canadian Premiers, *Report to the New England Governors and Eastern Canadian Premiers on Climate Change Projects* (August 2003), web site www.cap-cpma.ca/images/pdf/eng/2003ReportClimate.pdf.

[12]Regional Greenhouse Gas Registry, "About the Project," web site www.rggr.us.

[13]State of Connecticut, "An Act Concerning Climate Change," Public Act No. 04-252, web site www.cga.ct.gov/2004/act/Pa/2004PA-00252-R00SB-00595-PA.htm.

[14]Northeast States for Coordinated Air Use Management, "Overview of the NESCAUM Greenhouse Gas Emissions Trading Demonstration Project: Phase II," web site www.nescaum.org/Greenhouse.

[15]"Statement of the Governors of California, Oregon and Washington on Regional Action tTo Address Global Warming" (September 22, 2003), web site www.climatesolutions.org/pubs/pdfs/Governors Statement.pdf.

[16]West Coast Governors' Climate Change Initiative, "West Coast States Strengthen Joint Climate Protection Strategy," Joint News Release (November 18, 2004), web site www.energy.ca.gov/global_climate_change/westcoastgov/releases/2004-11-18_JOINT_RELEASE.PDF.

[17]Georgia General Assembly, SB 356, "Georgia Carbon Sequestration Registry Act," web site www.legis.state.ga.us/legis/2003_04/versions/sb356_LC_25_3622S_hss_7.htm.

[18]World Business Council for Sustainable Development and World Resources Institute, *Greenhouse Gas Protocol Initiative Newsletter*, No. 11 (April 2004), web site www.ghgprotocol.org/docs/GHG_Protocol_Newsletter_No_11.pdf.

[19]World Business Council for Sustainable Development and World Resources Institute, *Greenhouse Gas Protocol Initiative Newsletter*, No. 13 (November 2004), web site www.ghgprotocol.org/docs/GHG_Protocol_Newsletter_No_13.pdf.

announced the creation of a Global Greenhouse Gas Register to provide a transparent, internationally consistent framework for companies to report emissions inventories and reduction targets. In 2004, 5 more companies (Alcan, Alcoa, Holcim, Santos, and Vitro) committed to participation in the registry,[20] joining the 8 founding members (Anglo American, Cemex, Hewlett-Packard, Lafarge, RAO Unified UESR, RWE, ScottishPower, and Vattenfall).[21] The Global Greenhouse Gas Register intended to begin accepting reports in January 2004, using reporting software based on CCAR's CARROT software.[22] As of November 2004, two participants (Cemex and Hewlett-Packard) had submitted annual emissions summary reports.[23]

Federal Legislation on Voluntary Greenhouse Gas Reporting

The second session of the 108th Congress, which convened in January 2004, produced little new action on legislation addressing the reporting of greenhouse gas emissions, emission reductions, and carbon sequestration by individual entities. The major exception was the introduction of the Climate Stewardship Act of 2004 (H.R. 4067) in the House of Representatives by Rep. Wayne Gilchrest (R-MD) and 19 cosponsors. The bill is a slightly revised version of the McCain-Lieberman Climate Stewardship Act of 2003 (S. 139), which was rejected by the Senate in a 45-53 floor vote in October 2003.[24]

H.R. 4067 would require covered entities (those with annual greenhouse gas emissions of more than 10,000 metric tons carbon dioxide equivalent) to submit an inventory of their emissions for the preceding year, beginning in 2008. The bill would limit greenhouse gas emissions by establishing a system of tradable emissions allowances, similar to the cap-and-trade system that has been used to limit sulfur dioxide emissions from electric power plants. Beginning in 2010, covered entities would be required to submit to the EPA allowances for emissions of greenhouse gases from stationary sources. Producers and importers of HFCs, PFCs, and SF_6 and producers and importers of fossil fuels used for transportation would also be required to submit to the EPA allowances for the products they sell that result in emissions of greenhouse gases. The objective of the legislation is to reduce emissions by the covered entities to 2000 levels by 2010. The bill also includes provisions for voluntary reporting of greenhouse gas emission reductions achieved between 1990 and 2010. Allowance allocation credits would be awarded to the reporters of emission reductions.

[20]World Economic Forum, "Greenhouse Gas Register," web site www.weforum.org/site/homepublic.nsf/Content/Global+Greenhouse+Gas+Register%5CParticipants+%26+Partners.

[21]World Economic Forum, "Global Greenhouse Gas Register Launched" (Press Release, January 12, 2004), web site www.weforum.org/site/homepublic.nsf/Content/Global+Greenhouse+Gas+Register+Launched.

[22]California Climate Action Registry, "CA Registry's Online Tool To Serve as Foundation for Global Greenhouse Gas Register" (Press Release, December 9, 2003), web site www.climateregistry.org/docs/PRESS/GHGRegister120903.pdf.

[23]World Economic Forum, "Public Annual Emission Summary Report," web site www.ghgr.org/public/PublicAnnualSummaryReport.aspx.

[24]"Senate Defeats Climate Bill, But Proponents See Silver Lining," *New York Times* (October 31, 2003).

2. Reducing Emissions from Electric Power

Electric Power Industry

The electric power industry emitted approximately 2,279.3 million metric tons of carbon dioxide in 2003, 38.8 percent of total U.S. carbon dioxide emissions.[25] Carbon dioxide emissions result from the combustion of fossil fuels—coal, oil, and natural gas—during electricity generation. For example, coal, which accounted for 83.5 percent of electric power industry carbon dioxide emissions in 2003, is the primary energy source for U.S. electricity generation (providing 51 percent of total generation in 2003) and has the highest rate of carbon dioxide emissions per unit of energy used among fossil fuels.[26]

Since 1990, carbon dioxide emissions from the electric power industry have increased by 491.4 million metric tons or 27.5 percent, a trend that reflects U.S. economic growth (gross domestic product grew by about 46 percent between 1990 and 2003) and corresponding increases in fossil energy consumption in the electric power sector. From 2002 to 2003, carbon dioxide emissions from the electric power industry increased by 1.0 percent. Contributing to the increase in emissions in 2003 were a 0.6-percent increase in total electricity generation and a 1.8-percent increase in emissions from coal-fired generation.

Projects Reported

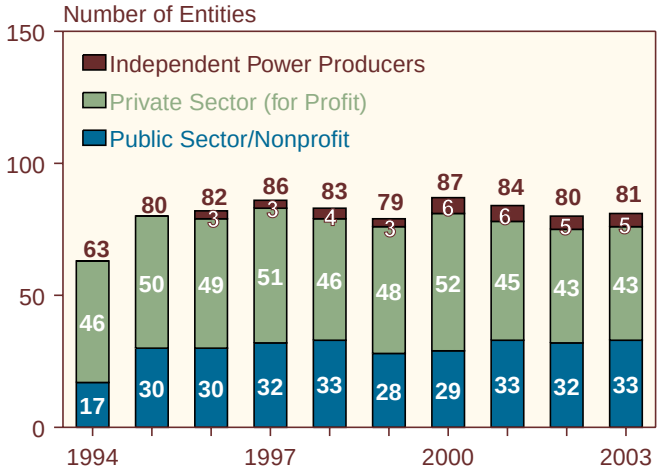
For the 2003 reporting year, 81 electric power providers reported to the Voluntary Reporting Program on Form EIA-1605 (Figure 4)—a decrease from the peak of 87 electric power providers reporting on the long form in 2000 but a 29-percent increase from the 63 reporters for the first reporting year, 1994. Since 1997, merger activity in the electric power industry has reduced the pool of electric utilities able to report to the Voluntary Reporting Program.[27]

Electric power providers made up 46 percent of the total 178 project-level reporters for data year 2003. Of the 81 electric power industry reporters, 48 were private-sector organizations, including 43 investor-owned utilities (IOUs) and 5 independent power producers (IPPs); and 33 were public-sector or nonprofit organizations, including electric cooperatives, municipal utilities, and other public-sector entities, such as the Tennessee Valley Authority (TVA).

The 485 electric power projects reported for 2003 (Figure 5) represent a 16-percent increase from the 2002 reporting year total of 417 and a 155-percent increase from the 190 projects reported for 1994. Electric power projects were the most numerous project type reported to the Voluntary Reporting Program, accounting for 25 percent of all projects reported on Form EIA-1605 for 2003.

Electric power projects are reported in two categories: (1) carbon content reduction; and (2) increasing energy efficiency in generation, transmission, and distribution. Carbon content reduction projects include availability improvements, fuel switching, and increases in lower emitting capacity. Increased efficiency through generation, transmission, and distribution projects includes

Figure 4. Number of Electric Power Providers Reporting on Form EIA-1605, by Entity Type, Data Years 1994-2003



Source: Energy Information Administration, Form EIA-1605.

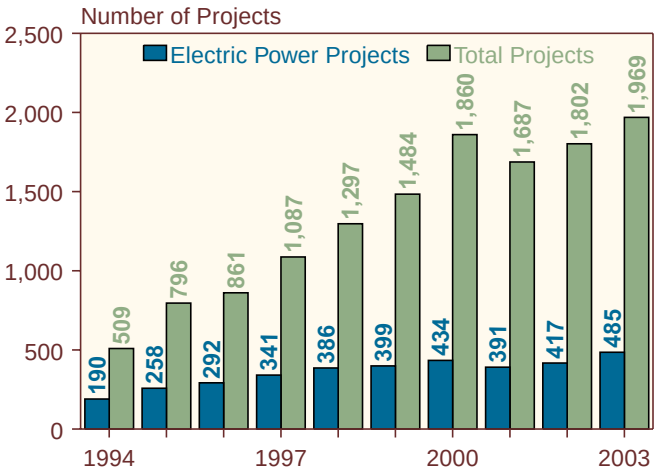
[25]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

[26]Energy Information Administration, *Voluntary Reporting of Greenhouse Gases, Instructions for Form EIA-1605*, DOE/EIA-1605(2004) (Washington, DC, April 2004), Appendix B, web site ftp://ftp.eia.doe.gov/pub/oiaf/1605/cdrom/pdf/FormEIA-1605_2003_Instructions.pdf.

[27]There were 141 operating electric utilities in the United States in 2000, compared with 172 in 1992. See Energy Information Administration, *The Changing Structure of the Electric Power Industry 2000: An Update*, DOE/EIA-0562(00) (Washington, DC, October 2000), web site www.eia.doe.gov/cneaf/electricity/chg_stru_update/update2000.html.

such activities as heat rate improvements, cogeneration and waste heat recovery, high-efficiency transformers, and reductions in line losses associated with electricity transmission and distribution. In 2003, 257 carbon content reduction projects were reported, and 255 projects for increased energy efficiency in generation, transmission, and distribution were reported.[28]

Figure 5. Electric Power Projects and Total Projects Reported on Form EIA-1605, Data Years 1994-2003



Source: Energy Information Administration, Form EIA-1605.

Reductions Reported

Total reported emission reductions from the 485 electric power projects reported for data year 2003 (Table 9) included 158.0 million metric tons carbon dioxide equivalent from direct sources and 17.8 million metric tons from indirect sources. The 257 projects in the category "reducing carbon content" reported emission reductions of 146.9 million metric tons carbon dioxide equivalent from direct sources and 13.5 million metric tons from indirect sources. The 255 projects included in the category "increasing energy efficiency in generation, transmission, and distribution" reported emission reductions of 15.5 million metric tons carbon dioxide equivalent from direct sources and 4.1 million metric tons from indirect sources.

Many of the largest projects reported to the Voluntary Reporting Program are electric power projects. In 2003, 27 electric power projects reported direct reductions of 1 million metric tons carbon dioxide equivalent or more, representing 55 percent of all the projects that reported direct emission reductions exceeding 1 million metric tons carbon dioxide equivalent. About three-fourths of those reported electric power projects were related to nuclear power.

Table 9. Number of Electric Power Projects and Emission Reductions Reported on Form EIA-1605 by Project Type and Reduction Type, Data Year 2003

Reduction Objective and Project Type	Number of Projects Reported	Emission Reductions Reported (Metric Tons Carbon Dioxide Equivalent)	
		Direct	Indirect
Reducing Carbon Content	**257**	**146,857,049**	**13,482,222**
Availability Improvements	44	70,235,626	7,407,809
Fuel Switching	47	17,655,099	14,605
Increases in Lower Emitting Capacity	115	62,051,111	6,756,833
Other Carbon Reductions	65	29,134,810	1,016,534
Increasing Energy Efficiency	**255**	**15,532,986**	**4,099,254**
Generation	*191*	*11,383,129*	*3,817,029*
Efficiency Improvements	170	11,219,307	657,944
Cogeneration and Waste Heat Recovery	21	163,821	3,159,085
Transmission and Distribution	*65*	*4,160,221*	*282,225*
High-Efficiency Transformers	31	1,811,477	247,990
Reconductoring	27	1,847,515	240,686
Distribution Voltage Upgrades	28	2,645,519	189,695
Other Transmission and Distribution	15	1,740,398	72,550
Total Electric Power Projects	**485**	**158,007,281**	**17,825,248**

Note: Project totals may not equal sum of components because some projects may be counted in more than one category.
Source: Energy Information Administration, Form EIA-1605.

[28]More than one project type may be assigned to a single project; therefore, the sums of projects and reductions by project type category may exceed the total numbers of projects and the total reductions reported.

Reducing the Carbon Content of Energy Sources

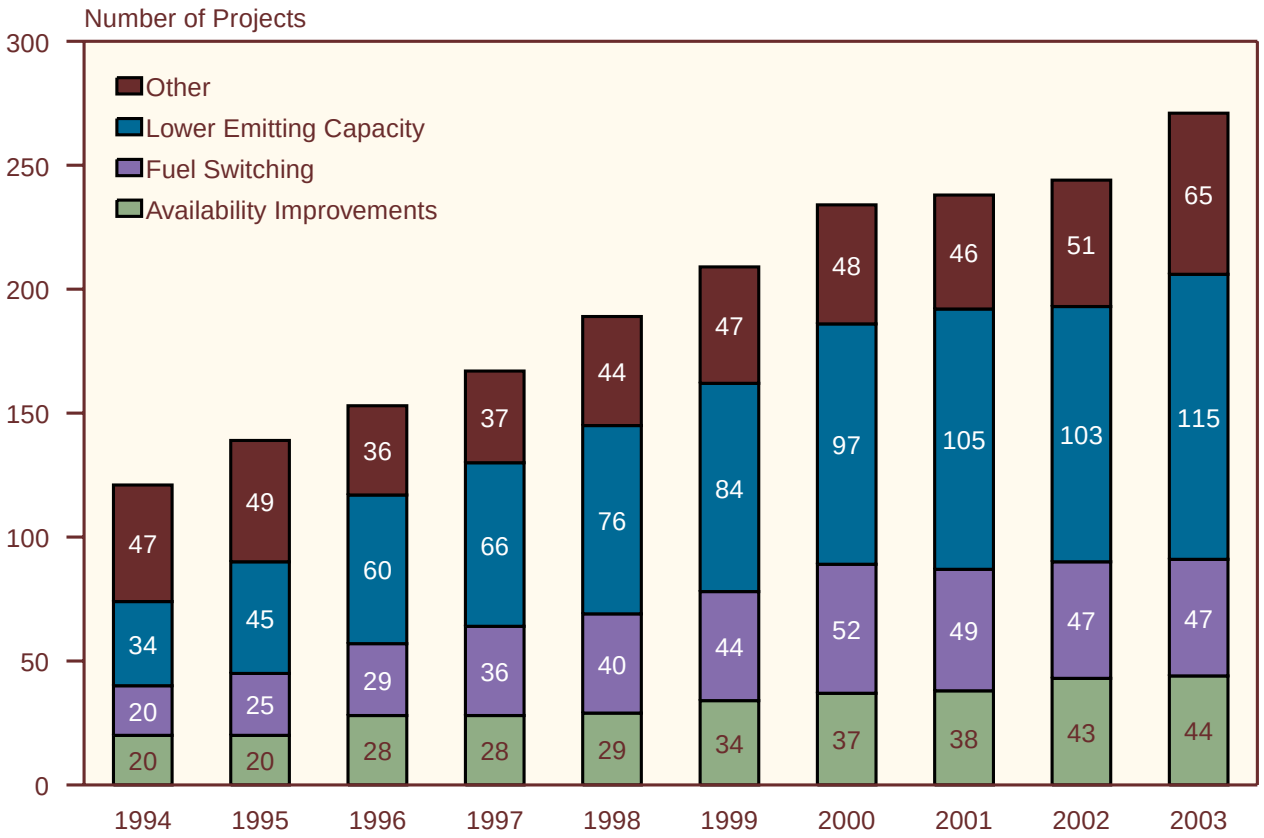
Projects involving fuel switching, power plant availability improvements for lower than average carbon-emitting plants, increases in low- or zero-emitting generation capacity, and other similar activities typically reduce the amount of carbon consumed to generate a unit of electricity. For 2003, 257 such projects were reported, including some of the largest projects reported to the Voluntary Reporting Program (Figure 6). The emission reductions reported for "carbon content reduction" electric power projects in 2003 totaled 146.9 million metric tons carbon dioxide equivalent from direct sources and 13.5 million metric tons from indirect sources. Some carbon content reduction projects are in fact "hybrids," combining efficiency improvements with measures such as availability improvements or increases in lower emitting capacity (see box on page 23).

Availability Improvements

There were 44 availability improvement projects reported for data year 2003—1 more than the 43 reported for 2002 and 24 more than the 20 reported for 1994. Availability improvement projects accounted for emission reductions of 70.2 million metric tons carbon dioxide equivalent from direct sources and 7.4 million metric tons from indirect sources in 2003. Of the 44 availability improvement projects reported, 33 involved nuclear power plants. As in previous reporting years, availability improvement projects, especially those undertaken at nuclear facilities, produced some of the largest reported reductions in carbon dioxide emissions. Mainly through significant advances in operating, maintenance, and refueling procedures, capacity factors at some nuclear plants have increased and, thus, have displaced some fossil-fuel-based power generation that would have been used in the absence of the availability improvements.

Because nuclear power plants are invariably large baseload facilities, even a fairly small improvement in plant availability can lead to a sizable reduction in carbon dioxide emissions through the displacement of fossil-fueled generation. For example, the Southern Company is committed to the continued enhancement of operational performance and efficiency improvements at Plant Vogtle. These improvements are targeted

Figure 6. Electric Power Projects Reported on Form EIA-1605 Reducing the Carbon Content of Energy Sources, by Project Type, Data Years 1994-2003



Note: The sum of projects in many project categories exceeds the total number of projects reported, because more than one project type may be assigned to a single project.

Source: Energy Information Administration, Form EIA-1605.

to safely reducing costs and increasing capacity factors by reducing outage lengths and forced outages. To achieve these improvements, a complex strategy consisting of many operational, maintenance, and outage-related activities continues to be implemented at the plants. Steam generator instrumentation upgrades at Southern Company's nuclear plants have minimized incidents in which a unit is automatically taken out of service. The results have been dramatic at the Vogtle plant, where megawatthours generated have increased and outage lengths have decreased since the 1990 baseline year of the project.

Several major performance records have been set in the nuclear industry in recent years, and major progress has been made in reducing the length of scheduled refueling outages. Factors that have contributed to the decrease in outage durations include: (1) online maintenance, with some activities that previously were performed during refueling outages now being performed while the unit is online, if it can be done safely; (2) optimum scheduling; and (3) use of robotic inspection equipment for steam generator and reactor inspection activities. Since 1991, total annual generation at the Vogtle plant has risen by approximately 20 percent. For 2003, Southern Company reported that 1,705,088 megawatthours of generation that would have come from fossil fuels was instead generated from nuclear power because of the project, reducing the company's emissions by 1,572,753 metric tons carbon dioxide equivalent. Southern Company has performed similar availability improvements at other nuclear power plants, with similar results.

Fuel Switching

A total of 47 fuel-switching projects were reported for 2003, the same number reported for 2002 and 27 more than the 20 reported for 1994. Switching from coal or oil to natural gas lowers carbon dioxide emissions because of the lower carbon content of natural gas relative to other fossil fuels. For example, switching from bituminous coal to natural gas can reduce carbon dioxide emissions per unit of energy consumed by approximately 43 percent. Although other reported actions, such as switching from oil to gas, may not lead to reductions of the same magnitude, they also reduce greenhouse gas emissions. The fuel-switching projects reported for 2003 accounted for emission reductions totaling 17.7 million metric tons carbon dioxide equivalent from direct sources and 0.01 million metric tons from indirect sources.

National Energy & Gas Transmission (NEGT), reported a fuel-switching program that added the ability to use natural gas as a boiler fuel for startup and co-firing to three coal-fired units at its Brayton Point Station in Somerset Massachusetts.[29] The plant's Unit No. 1 first used natural gas in June 1994, Unit No. 2 in November 1994, and Unit No. 3 in April 1995. Natural gas is used as a startup fuel (ignition and warmup) and is co-fired with coal to help control emissions of nitrogen oxides from the units. In 2003, the project decreased the plant's coal use by more than 150,000 million British thermal units (Btu) and residual fuel oil use by more than 53,000 million Btu. The fuel switching resulted in a reported reduction in emissions of 7,394 metric tons carbon dioxide equivalent in 2003.

Increases in Lower Carbon Emitting Capacity

Projects involving the construction of new, lower emitting power plants or increases in the capacity of existing lower emitting plants were among the most numerous electricity supply projects reported. For 2003, 115 such projects were reported, up from 103 reported for 2002. Most of the projects reported for 2003 involved increases in nuclear (23 projects), hydropower (18 projects), photovoltaic (21 projects), natural gas (13 projects), and wind capacity (36 projects). Emission reductions reported for increases in lower emitting capacity projects in 2003 totaled 62.1 million metric tons carbon dioxide equivalent from direct sources and 6.8 million metric tons from indirect sources.

For 2003, Exelon Corporation reported on a new project that entails an increase in lower emitting capacity. ComEd (a subsidiary of Exelon), the City of Chicago, the Illinois Department of Commerce and Economic Opportunity, the International Brotherhood of Electrical Workers, Chicago Public Schools, and Spire Solar Chicago have pooled funding and expertise to create the Chicago Solar Partnership to develop solar resources and to help increase the development of solar generation in Chicago. The increase in zero emitting generation will help to offset grid electricity generated from higher emitting sources. The project had 5 major photovoltaic installations in 2001, 8 in 2002, and 8 in 2003, for a total capacity around the city of 524 kilowatts, which translates to 386,849 kilowatthours of generation annually. In 2003, Exelon reported on 41 percent of this project, which equated to reported emission reductions of 287 metric tons carbon dioxide equivalent.

[29]This project was originally sponsored by New England Power Company and reported by its parent, New England Electric System (NEES) Company. In August 1998, USGen New England, Inc. (USGenNE) completed the acquisition of NEES Company's hydroelectric and fossil power generation business previously operated by New England Power. As part of the acquisition, the rights to the emission reductions and carbon sequestration achieved by this and other projects were transferred to USGenNE. For 2000 through 2002, the activities previously reported by USGenNE were incorporated into the report submitted by its parent, PG&E Corporation. For 2003, this project was included in a separate report submitted by NEGT, formerly known as PG&E National Energy Group, a subsidiary of PG&E Corporation.

Other Carbon Reduction Projects

Sixty-five "other carbon reduction" projects were reported for 2003, 14 more than reported for 2002 and 18 more than reported for 1994. The category of "other" projects includes projects that decrease higher emitting capacity, make dispatching changes only, or increase power purchases from lower or zero emitting capacity. In 2003, 34 projects used low or zero emitting power purchases to reduce emissions. This category was added to the Voluntary Reporting Program for the 1999 data year to classify electric power producer/supplier purchases of power from low or zero emitting generation sources for resale, replacing generation or purchases of power from more carbon-intensive generation sources. Another 4 projects reported for 2003 involved decreases in higher emitting capacity, and 2 involved changes in the dispatching of power plants. Changes in dispatch order can reduce carbon dioxide emissions if lower emitting plants are used more frequently. For 2003, reported emission reductions from "other carbon reduction" projects totaled 29.1 million metric tons carbon dioxide equivalent from direct sources. An emission reduction of 1.0 million metric tons carbon dioxide equivalent was reported from indirect sources.

Xcel Energy reported a new project in 2003 to reduce emissions in the Denver metropolitan area through a decrease in high emitting capacity. Units 1 and 2 of the Arapahoe plant were voluntarily retired at the end of December 2002. Their retirement was part of the Xcel Energy commitment to the Denver Metropolitan Emission Reduction Program (MERP), a program established through the Colorado Department of Public Health and Environment. Between 1999 and 2002, the average net generation of Units 1 and 2 was 365,272 megawatthours. Xcel reported a reduction of 607,814 metric tons carbon dioxide equivalent with the removal of these two high emitting generation units.

There were only two projects reported in 2003 that fell into the "dispatching changes only" category. One is the "Merger Dispatch Savings" project reported by Cinergy. The other is the "Renewable Energy Purchases – Small Hydro" project reported by Southern California Edison Company. Southern California Edison's project changed the dispatch order to increase the use of hydroelectric power over natural-gas-fired generation, leading to a reported direct reduction of 1,270 metric tons carbon dioxide equivalent in 2003.

Emission reductions were achieved from Cinergy's project through the economic dispatch of Cinergy's generating facilities. Before the merger of the Cincinnati Gas & Electric Company and PSI Energy, the same generating facilities were dispatched according to the demands of each operating company. After the merger, the units from both operating companies were operated and dispatched in coordination with each other. This method of operation and economic dispatch is estimated to provide a 1-percent efficiency gain in the operation of

Electricity Supply Carbon Reduction Projects: Definitions and Terminology

The combustion of fossil fuels to produce heat for electricity generation causes greenhouse gas emissions. In addition to substantial releases of carbon dioxide, fossil fuel combustion also emits other effluents, including small quantities of methane and nitrous oxide. Carbon content reduction projects typically reduce greenhouse gas emissions by replacing fuels with relatively high carbon dioxide emissions (such as coal) with fuels that have lower carbon dioxide emissions (such as natural gas) or no net carbon dioxide emissions (such as nuclear power or renewables).

Availability Improvements. By reducing the frequency and length of planned and unplanned power plant outages, availability improvement projects can result in increased use of a power plant. Emissions reductions occur when increasing generation from a lower carbon emitting plant displaces generation from a higher carbon emitting plant. Power plant utilization is measured by the plant's *capacity factor*, defined as the ratio of the average load on the plant over a given period to its total capacity. For example, if a 200-megawatt plant operates (on average) at 75 percent of its rated capacity (i.e., at a load of 150 megawatts) over a period of a year, the plant's capacity factor is 75 percent for that year. Hence, there is a reduction in carbon dioxide emissions when there is an improvement in the capacity factor of a lower than average carbon emitting plant that results in a reduction in generation of a higher than average carbon emitting plant.

Fuel Switching. The amount of carbon contained in fossil fuels and released in the form of carbon dioxide during combustion varies, depending on the type of fuel. Thus, switching from a higher carbon content fuel (such as coal) to a lower carbon content fuel (such as natural gas), results in reduced carbon dioxide emissions.

Increases in Generating Capacity With Low or No Net Carbon Dioxide Emissions. By increasing the capacity of an existing generating unit that produces relatively low emissions or no net emissions (e.g., a hydroelectric plant), or by constructing a new unit with low or no net carbon dioxide emissions (e.g., a wind turbine), a power supplier can reduce or avoid reliance on higher emitting plants, thus reducing the combined greenhouse gas emissions from all plants.

the system. The efficiency gain is realized because the more recently built generating units, which are the most efficient units, are the first dispatched to meet customer demands for electricity. Therefore, the most efficient generating units are operating more than the older, less efficient units. In 2003, Cinergy reported a decrease in consumption of 279,165 short tons of bituminous coal and direct emission reductions of 601,736 metric tons carbon dioxide equivalent.

Alliant Energy reported three new "low or zero emitting power purchase" projects in 2003. Although all three of these projects began in 1998, Alliant began reporting them for data year 2003. In two of the projects, Alliant purchased hydroelectric energy and transmitted it to Iowa and Wisconsin. Total hydroelectric power purchased for these two projects was 90,691 megawatthours. In the third project, Alliant purchased power produced from biomass by BFC Gas & Electric in Cedar Rapids, Iowa, which converts industrial, agricultural, and construction waste into renewable energy. The facility recycles the biomass materials into a low-Btu biogas through gasification. Some of the materials recycled include sawmill waste; light paper mill rejects; construction demolition wood; energy crops, such as switchgrass, sweet sorghum, and poplar trees; crop residues such as corn stalks, corncobs, and seed cord; and unrecyclable low-grade paper. Total electricity purchased from this biomass source in 2003 was 22,576 megawatthours, and total direct reductions for the three "low or zero emitting power purchase" projects were 88,702 metric tons carbon dioxide equivalent.

Increasing Energy Efficiency in Electricity Production and Distribution

Projects involving improvements in the efficiency of electricity generation, transmission, and distribution reported for 2003 produced much smaller emission reductions on average than projects reducing carbon content. Efficiency improvement tends to be an ongoing effort by electricity suppliers, yielding a continuous stream of small, incremental improvements rather than one-time dramatic increases in efficiency. For example, heat rate improvement projects often are undertaken in response to normal plant deterioration. As power plants age, efficiency tends to erode gradually. Operators seek to maintain heat rates by replacing or refurbishing old, worn-out equipment. Similarly, new energy-efficient transformers are often installed gradually over a period of years, as old transformers fail.

For 2003, 255 "increasing energy efficiency" projects were reported, including some hybrid projects that combined efficiency improvements with measures such as availability improvements. The efficiency improvement projects fall into two main categories: (1) generation, involving efficiency improvements in the conversion of fossil fuels and other energy sources into electricity; and (2) transmission and distribution, involving reduced losses in the delivery of electricity from the power plant to the end user (see box on page 25).

Generation Projects

Efficiency Improvements. Improvements in generating efficiency were the most numerous type of efficiency project reported for 2003. There were 170 such projects undertaken in 2003. Heat rate improvements at coal-fired power plants are a commonly reported means of increasing efficiency and reducing carbon dioxide emissions. There are numerous opportunities for improving efficiency at existing power plants, but the efficiency gains, and hence reductions in fuel consumption and emissions, are limited by technology and tend to be marginal. Emission reductions reported for generation efficiency improvement projects in 2003 totaled 11.2 million metric tons carbon dioxide equivalent from direct sources and 0.7 million metric tons from indirect sources.

For 2003, Entergy Services Inc. reported 30 new efficiency improvement projects. The projects included equipment replacement or control system improvements on 14 different units at 7 different facilities. The equipment replacements included air preheater and bypass seal replacements, condenser vacuum pump replacements, neural net installations, cold-end preheater basket replacements, installation of newly designed condenser tube plugs, drip pump and bypass line replacements, and more. Control systems affected by the improvements included burner management systems, temperature control systems, boiler feedwater control systems, RheoVac air in-leakage monitoring systems, and condensate filtration systems. Each improvement was reported as a separate project, for a total of 30 efficiency improvements in all. The projects produced a combined total reduction of 427,695 metric tons carbon dioxide equivalent in 2003.

Cogeneration and Waste Heat Recovery. A total of 21 cogeneration and waste heat recovery projects were reported for 2003, 2 more than the 19 reported in 2002. Emission reductions reported for cogeneration and waste heat recovery projects in 2003 were, on average, larger than those reported for the other types of efficiency improvement projects but less than the average for carbon content reduction projects. Reported end uses of the thermal energy included electricity generation, process heat applications, space heating and cooling, humidification, and cooking. The emission reductions reported for cogeneration and waste heat recovery projects in 2003 totaled 163,821 metric tons carbon dioxide equivalent from direct sources and 3.2 million metric tons from indirect sources.

The direct reductions reported for cogeneration projects are low, because the City of Klamath Falls, Oregon, reported a negative direct reduction (or increase) in emissions of more than 2.3 million metric tons carbon dioxide equivalwent. The increase was attributed to carbon dioxide released during the combustion of natural

Efficiency Projects: Definitions and Terminology

Generation Projects

It is neither theoretically nor practically possible to convert all the thermal or other energy produced in, or consumed by, a power plant into electrical energy or useful heat. In fact, much of the energy is lost rather than converted. Typically, U.S. steam-electric generating plants operate at efficiencies of about 33 percent, meaning that two-thirds of the thermal energy produced is lost. Some more advanced power plants have higher efficiencies, but even new combined-cycle plants (in which the waste heat from a gas turbine is recovered to produce steam to drive a turbine) typically have efficiencies of only 50 to 60 percent. Generation projects seek to improve power plant efficiencies either by reducing the amount of energy lost during the conversion process or by recovering the lost energy for subsequent application.

Efficiency Improvements. By increasing the efficiency of the generation process, efficiency improvement projects at fossil-fuel-fired power plants reduce the plants' *heat rate*, defined as the amount of fossil energy (measured in Btu) needed to produce each kilowatthour of electricity. The result is a reduction in the amount of fuel that must be burned to meet generation requirements, and hence a reduction in carbon dioxide (and other greenhouse gas) emissions. Efficiency improvements at nonfossil (e.g., hydroelectric) power plants can also reduce greenhouse gas emissions. Emission reductions occur if the efficiency improvement leads to an increase in the amount of electricity generated by the affected plant, with a consequent reduction in the amount of electricity that must be generated by other (fossil fuel) plants to meet demand.

Cogeneration. Only a portion of the heat generated during the combustion of fossil fuels can be converted into electrical energy; the remainder is generally lost. Cogeneration involves the recovery of thermal energy for use in subsequent applications. Cogeneration facilities typically employ either topping or bottoming cycles. In a *topping cycle*, thermal energy is first used to produce electricity and then recovered for subsequent applications. Topping cycles are widely used in industry as well as at electric power plants that sell electricity and steam to customers. In a *bottoming cycle*, the thermal energy is first used to provide process heat, from which waste heat is subsequently recovered to generate electricity. Bottoming cycle applications are less common, usually associated with high-temperature industrial processes. Because cogeneration involves the recovery and use of thermal energy that would otherwise be wasted, it reduces the amount of fossil fuel that must be burned to meet electrical and thermal energy requirements, hence reducing greenhouse gas emissions.

Transmission and Distribution Projects

The purpose of the electricity transmission and distribution system is to deliver electrical energy from the power plant to the end user. Resistance to the flow of electrical current in cables, transformers, and other components of the transmission and distribution system causes a portion of the energy (typically about 7 percent) to be lost in the form of heat. Improving the efficiency of the various system components can decrease such line losses, reducing the amount of generation required to meet end-use demand and, thus, power plant fossil fuel consumption and greenhouse gas emissions.

High-Efficiency Transformers. Transformers, used to change the voltage between different segments of the transmission and distribution system, are a source of system losses. Transformer losses occur as a result of impedance to the flow of current in the transformer windings and because of hysteresis and eddy currents in the steel core of the transformer. When existing transformers are replaced with high-efficiency transformers (including improved silicon steel transformers and amorphous core transformers), losses are reduced.

Reconductoring. Like transformers, conductors (including feeders and transmission lines) are a source of transmission and distribution system losses. In general, the smaller the diameter of the conductor, the greater its resistance to the flow of electric current and the greater the consequent line losses due to heating. Reconductoring involves the replacement of existing conductors with larger diameter conductors or reduced resistance materials (i.e., superconductive materials), which not only reduces line losses but also allows for an increase in transmission capacity.

Distribution Voltage Upgrades. Line losses are dependent, in part, on the voltage at which the various segments of the transmission and distribution system operate. Upgrading the voltage of any segment can reduce line losses.

gas in the city's cogeneration plant. Emissions from higher carbon emitting generation sources usually offset these combustion-related emissions; however, according to the City of Klamath Falls, the electricity produced by the plant displaced other natural-gas-fired generation with an equivalent emissions rate. The project still resulted in a net reduction in emissions, because the cogeneration plant also produced steam that reduced indirect emissions by displacing fossil-fired steam production at the steam customer's facility. Without this project, direct reductions associated with the cogeneration projects reported for 2003 would be about 2.5 million metric tons carbon dioxide equivalent.

The Southern Company reported an example of a cogeneration project for a new cogeneration facility that its subsidiary, the Alabama Power Company, began operating in 2000 in Theodore, Alabama. The facility fires only natural gas to produce electricity, for INEOS Phenol, and process steam for Degussa, AG. The cogeneration facility consists of a 170-megawatt combustion turbine with a supplementally fired (duct burner) heat recovery steam generator, a 40-megawatt steam turbine, and two package boilers. The package boilers did not replace any existing boilers. Degussa produces its own steam and supplements it with steam from the Theodore cogeneration facility. The heat rate for the cogeneration facility improved from 7.083 million Btu per megawatthour in 2002 to 6.882 million Btu per megawatthour in 2003, leading to a total direct reduction of 669,857 metric tons carbon dioxide equivalent. In addition, a small indirect reduction probably was also achieved, because the steam supplied to Degussa was produced with newer and more efficient boilers than the older Degussa boiler; however, details about the Degussa boiler are not known.

Another example of a cogeneration project is a turbine-generator owned by Minnesota Power (MP) but located at the SAPPI Ltd paper mill in Cloquet, Minnesota. The MP unit, with 23 megawatts net capacity, was placed in a process steam line where steam previously had been throttled to lower pressure for process use. Consequently, electricity is produced with an overall process efficiency of 83 percent using steam produced from boilers fueled with 50 percent natural gas and 50 percent wood waste (biomass) from mill processes. MP estimates that the cogeneration application heat rate is 4,112 Btu per net kilowatthour of electricity generation. Through 2002, MP assumed that its generator displaced generation that would otherwise have been produced from conventional subbituminous coal. For 2003, MP assumed that the unit displaced generation that would have come from the Mid-Continent Area Power Pool (MAPP). Therefore, a MAPP number of 0.92 metric tons carbon dioxide per megawatthour was used to calculate carbon dioxide reductions. The 0.92 value was provided by the Minnesota Pollution Control Agency. This project was responsible for a direct emission reduction of 87,187 metric tons carbon dioxide equivalent.

Transmission and Distribution Projects

Transmission and distribution projects, although not as numerous as generation projects, were nonetheless reported in significant numbers. For 2003, 65 transmission and distribution projects were reported. Unlike generation projects, which typically have discrete start and completion dates, efforts such as upgrading conductors and replacing transformers are ongoing activities by electric power producers. Consequently, most of the transmission and distribution efficiency improvements reported for 2003 were reported as continuations of long-standing projects rather than as new projects.

The national average energy loss from transmission and distribution is about 7 percent of generation. In terms of average emission reductions, transmission and distribution projects typically are somewhat smaller than generation projects; however, reductions can still be significant. There are numerous opportunities for improving efficiencies in the delivery of electricity, but the efficiency gains generally are smaller than those from generation projects.

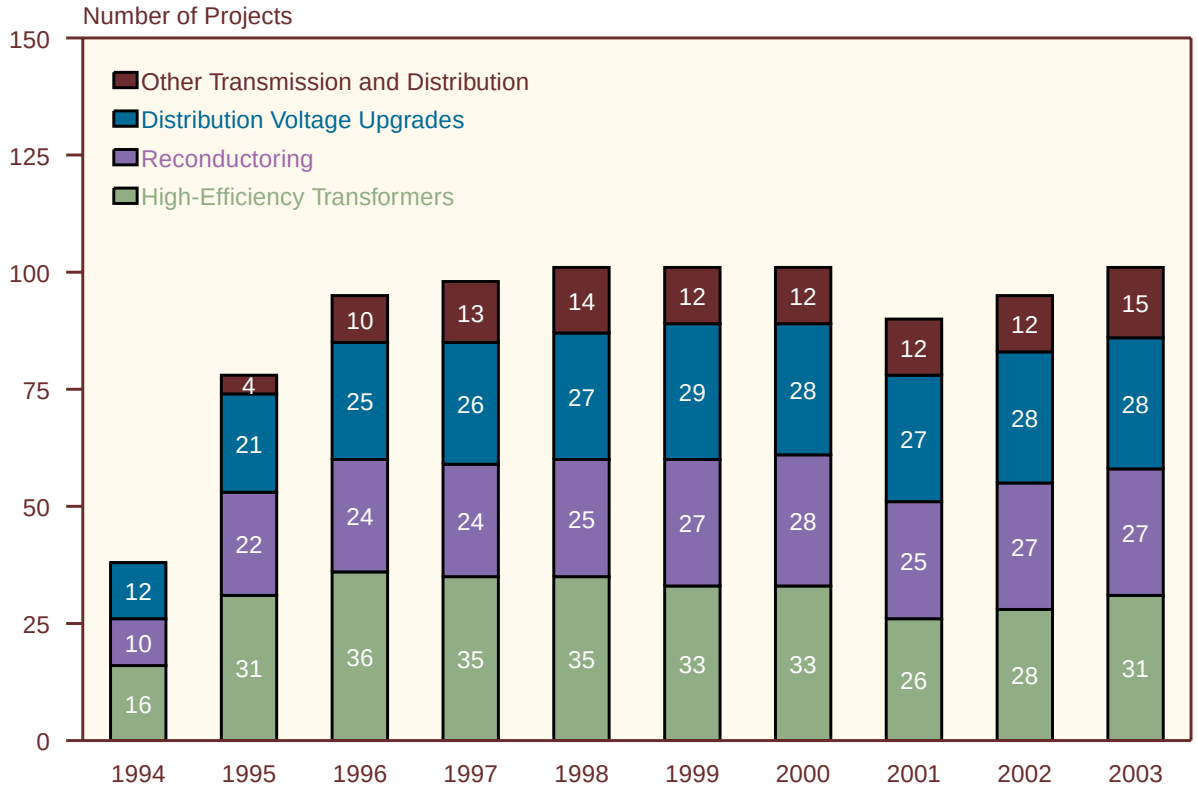
For 2003, the most frequently reported types of transmission and distribution projects (Figure 7) were high-efficiency transformers (including improved silicon steel and amorphous core transformers); reconductoring (replacing existing conductors with large-diameter conductors to reduce line losses); and distribution voltage upgrades (increasing the voltage at which the various segments of the system operate to reduce line losses). The other transmission and distribution project category includes projects that involve more than one type of activity, as well as such activities as transmission line improvements and capacitor installations. In 2003, 31 high-efficiency transformer projects were reported, 3 more than the 28 reported for 2002 and 15 more than the 16 reported for 1994. Many of the reported projects were "hybrids," combining high-efficiency transformer installation with one or more other transmission and distribution activities (e.g., reconductoring).

Another 27 projects involving reconductoring and 28 projects involving distribution voltage upgrades (again, often in combination with other activities) were reported for 2003—the same numbers that were reported in those categories for 2002. The reporters classified 15 projects as "general" or "other" transmission and distribution, 3 more than reported for 2002. Emission reductions reported for transmission and distribution projects in 2003 totaled 4.2 million metric tons carbon dioxide equivalent from direct sources and 0.3 million metric tons from indirect sources.

Xcel Energy reported a new high-efficiency transformer project in 2003. Effective November 1, 2003, Public Service Company of Colorado, a subsidiary of Xcel Energy, reduced transformer losses by 3.5 megawatts when a new transformer configuration was implemented at the Denver Zuni Terminal Substation. With the new configuration in full operation for 2 months of 2003, 5,124 megawatthours of energy was saved, leading to reductions in emissions of carbon dioxide, methane, and nitrous oxide that totaled 4,497 metric tons carbon dioxide equivalent.

American Electric Power, Inc. reported on a continuing project that fits into both the reconductoring and distribution voltage upgrade categories. Typical operation of the American Electric Power distribution system requires that improvements be made on a continuing basis for the purpose of rehabilitation and reinforcement to distribute power efficiently and reliably to customers. Improvements to the distribution system, which increase peak capacity and reduce line losses, include: voltage conversion of stations and circuits; circuit voltage conversions; primary line reconductoring; load transfers between phases to balance circuit loading; primary line additions and multiphasing; installation of more efficient distribution system devices; and installation of shunt capacitors on distribution circuits. For 2003, American Electric Power reported reduced electricity demand of 1,042,179 megawatthours and emission reductions of 835,020 metric tons carbon dioxide equivalent.

Figure 7. Reported Transmission and Distribution Projects Reported on Form EIA-1605 by Type, Data Years 1994-2003



Note: The sum of projects in a project category may exceed the total number of projects reported, because more than one project type may be assigned to a single project.

Source: Energy Information Administration, Form EIA-1605.

3. Reducing Emissions from Energy End Use

Introduction

Greenhouse gas emissions from energy end use include emissions from both stationary and mobile sources.[30] In 2003, the industrial, commercial, and residential sectors combined to emit 3,907 million metric tons carbon dioxide (68 percent of total U.S. carbon dioxide emissions)—nearly all from stationary sources (Figure 8). Emissions from stationary sources are produced both directly by the combustion of fossil fuels (e.g., natural gas consumption for home heating) and indirectly from the consumption of electricity (e.g., for commercial lighting). In 2003, the transportation sector accounted for 1,875 million metric tons carbon dioxide, nearly all from mobile sources, and represented approximately 32 percent of U.S. carbon dioxide emissions.

Reducing Emissions from Stationary Sources

Emissions from stationary sources in 2003 included 2,276 million metric tons carbon dioxide from the generation of electricity that was ultimately consumed in the industrial, commercial, and residential sectors. Industry was responsible for the largest share of total stationary-source emissions at 43 percent, followed by the residential sector at 31 percent and the commercial sector at 26 percent.

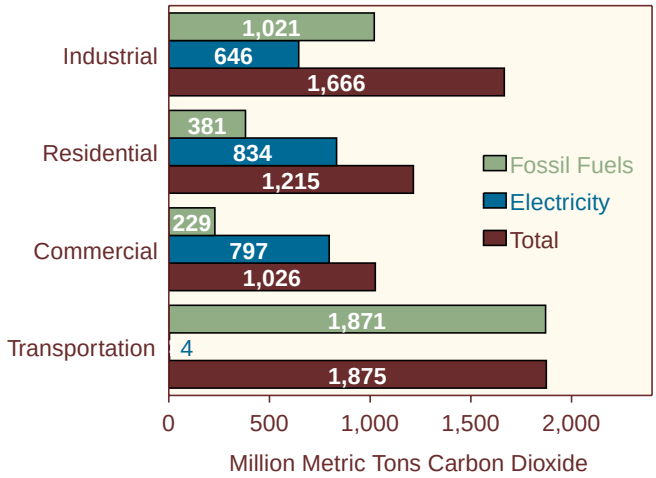
Between 1990 and 2003, carbon dioxide emissions associated with industrial, commercial, and residential energy use increased by 14.5 percent. Of the stationary sources, the commercial sector has the fastest-growing emissions, registering a 32.0-percent increase in emissions between 1990 and 2003. Emissions from the residential sector increased by 27.9 percent over the same period, and industrial sector emissions declined by 1.0 percent.[31]

Projects Reported

Reported emission reduction projects affecting stationary sources include fuel switching (e.g., from fuel oil to natural gas); light bulb replacement (e.g., substituting compact fluorescent bulbs for incandescents); heating, ventilation, and air conditioning (HVAC) system upgrades (e.g., maintenance or replacement with more efficient units); appliance replacement (e.g., retiring old appliances for ENERGY STAR[32] products); motor and motor drive upgrades; and industrial power system improvements. For 2003, 67 entities reported 374 energy end-use projects on Form EIA-1605 (Table 10). These 374 projects accounted for 19 percent of all the projects reported on the long form.

For the 2003 reporting year, the number of entities reporting energy end-use projects, the number of energy end-use projects reported, and the total reported direct and indirect emission reductions resulting from energy end-use projects all were higher than for the 2002 reporting year (Table 10). Energy end-use reporters increased from 65 in 2002 to 67 in 2003, the number of projects reported rose from 339 to 374, reported direct reductions increased from 24.7 million metric tons to 25.2 million

Figure 8. Sources of U.S. Carbon Dioxide Emissions by Sector, 2003



Note: The industrial sector includes agriculture; the residential and commercial sectors exclude transportation.

Source: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004).

[30]Stationary sources include emission sources at fixed locations, such as power plants, factories, refineries, mines, and heating plants or waste conversion facilities, among others. Mobile sources include transportation sector emissions from non-fixed locations, such as motor vehicles, aircraft, trains, and ships, among others.

[31]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

[32]ENERGY STAR is a joint program of the U.S. Department of Energy and the U.S. Environmental Protection Agency helping businesses and individuals protect the environment through increased energy efficiency. See web site www.energystar.gov.

metric tons carbon dioxide equivalent, and reported indirect reductions increased from 9.1 million metric tons to 10.0 million metric tons carbon dioxide equivalent.

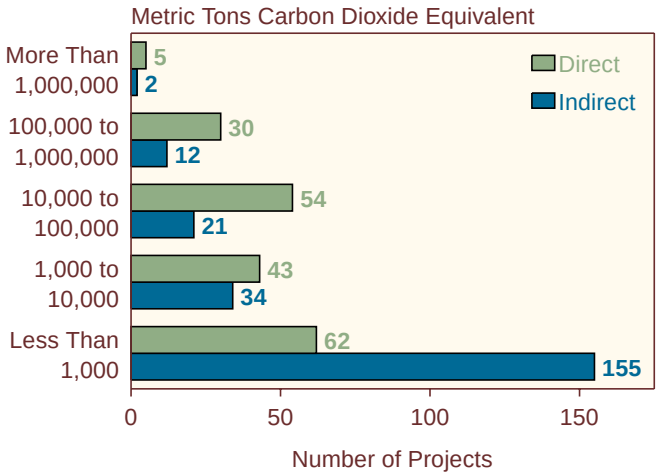
Among the 67 entities that reported energy end-use projects for 2003 on Form EIA-1605, 46 (69 percent) were electric utilities, of which 19 were publicly owned, 26 were privately owned, and 1 was an independent power producer. Companies in the industrial energy end-use sector, comprising 11 percent of all reporters for 2003, included 6 automobile and other transportation equipment manufacturers (9 percent), 5 cement companies (7 percent), 3 pharmaceutical and health care product companies, 2 electronic companies, 2 holding and other investment companies, 1 flood and kindred products company, 1 communications company and 1 oil company.

Emission reductions reported for individual energy end-use projects ranged from less than 1 metric ton to almost 4.2 million metric tons carbon dioxide equivalent, because some reporters included information on each individual end-use initiative separately, whereas others aggregated information on a range of activities into single projects. For example, an electric power distributor may report on a demand-side management (DSM) project that achieves direct emission reductions through multiple supplemental approaches, such as encouraging their residential, commercial, and industrial customers to change light bulbs, temporally shift electric loads, implement urban forestry projects, and upgrade appliances, building shells, and HVAC systems.

Among projects for which direct emission reductions were reported for 2003, 82 percent had reductions of less than 100,000 metric tons carbon dioxide equivalent (Figure 9). Similarly, among projects for which indirect emission reductions were reported, 94 percent had reductions of less than 100,000 metric tons carbon dioxide equivalent. Only seven energy end-use projects reported emission reductions greater than 1 million metric tons each for 2003, which was one less than for 2002.

In terms of emission reductions achieved in 2003, 5 of the 6 largest projects reported were aggregated electric company DSM programs. DSM projects may focus on one or

Figure 9. Energy End-Use Projects Reported on Form EIA-1605 by Size and Type of Emission Reduction, Data Year 2003



Source: Energy Information Administration, Form EIA-1605.

Table 10. Number of Energy End-Use Reporters, Projects, and Emission Reductions Reported on Form EIA-1605, Data Years 1994-2003

Data Year	Number of Reporters	Number of Projects Reported	Emission Reductions Reported (Metric Tons Carbon Dioxide Equivalent)	
			Direct	Indirect
1994	51	160	9,103,753	1,318,092
1995	63	221	12,450,879	1,591,590
1996	62	214	15,288,497	1,538,196
1997	67	249	16,685,010	3,798,030
1998	79	308	18,282,751	5,026,424
1999	80	330	16,047,912	6,786,832
2000	77	382	19,663,333	8,155,193
2001[R]	68	338	19,550,862	7,668,988
2002[R]	65	339	24,707,214	9,061,773
2003	67	374	25,232,544	9,955,603

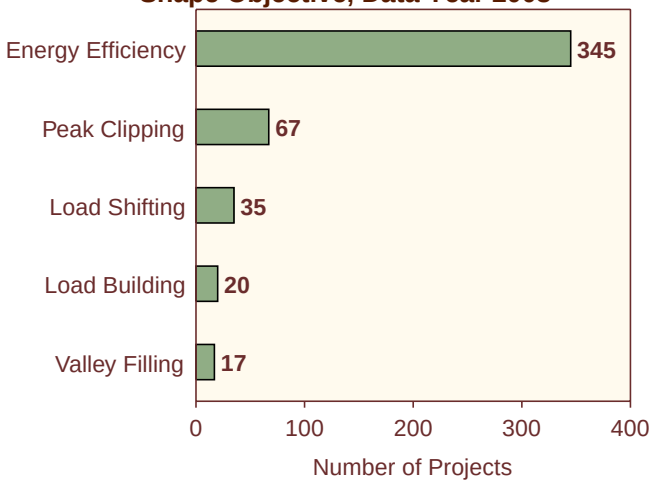
[R] Revised data.

Notes: More than one project type may be assigned to a single project; therefore, the sums of the projects and reductions in each project type category may exceed the total numbers of projects and reductions in the totals and subtotals. Table excludes data from confidential reports.

Source: Energy Information Administration, Form EIA-1605.

more load shape objectives (see box on page 32). Although the most common load shape objective of reported DSM projects for 2003 was increased energy efficiency (345 projects), electric utilities also attempted to balance their load profiles with various other load shape objectives, including peak clipping (67 projects), load shifting (35 projects), valley filling (17 projects), and load building (20 projects) (Figure 10).

Figure 10. Demand-Side Management Projects Reported on Form EIA-1605 by Load Shape Objective, Data Year 2003



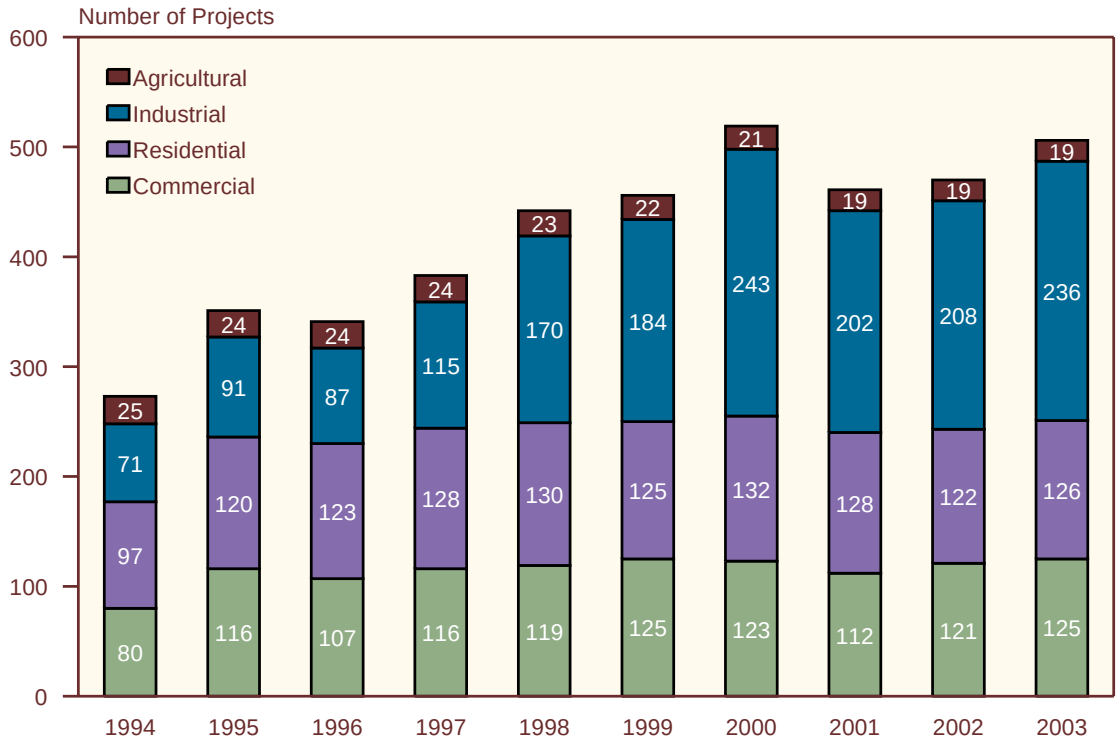
Notes: Some projects may be counted in more than one category. Figure excludes data from confidential reports.
Source: Energy Information Administration, Form EIA-1605.

Energy end-use projects can be carried out anywhere energy is consumed. Reporters indicate whether their energy end-use projects affect emissions in the industrial, commercial, residential, or agricultural sector. For 2003, 236 projects were reported to have reduced emissions in the industrial sector, 126 in the residential sector, 125 in the commercial sector, and 19 in the agricultural sector. More end-use projects were reported for each sector for 2003 than were reported for 2002, except for the agricultural sector. The total number of end-use projects reported was 10 percent above the total for 2002 (Figure 11). It should be noted that many projects—particularly electric company DSM programs—affect more than one end-use sector and are included in each applicable sector for the purposes of counting types of projects reported.

Project Types

None of the 16 new reporters to the 1605b program in 2003 reported energy end-use projects; however, many of the repeat reporters to the program did report new energy end-use projects along with their ongoing projects. Of the 374 energy end-use projects reported, 32 percent (120 projects) involved two or more project types. The most frequently reported type of energy

Figure 11. Energy End-Use Projects Reported on Form EIA-1605 by Sector, Data Years 1994-2003



Notes: Some projects target more than one sector and may be counted in multiple categories. Figure excludes data from confidential reports.
Source: Energy Information Administration, Form EIA-1605.

end-use project for 2003 was equipment and appliance replacement/improvements (157 projects), followed by lighting and lighting controls (153 projects) and HVAC (120 projects) (Table 11). Because of the varied levels of data aggregation in reports by different entities, it is not possible to calculate average emission reductions by project type or to draw conclusions about the most effective energy end-use project types in terms of total emission reductions achieved.

Equipment and Appliances

Replacements of equipment and appliances with more energy-efficient units (e.g., ENERGY STAR products) to reduce greenhouse gas emissions are frequently

Table 11. Number of Projects and Emission Reductions Reported on Form EIA-1605 for Energy End-Use Projects by Project Type, Data Year 2003

Project Type	Number of Projects Reported	Number of Projects Reporting Emission Reductions			Emission Reductions Reported (Million Metric Tons Carbon Dioxide Equivalent)	
		Direct	Indirect	Both Direct and Indirect	Direct	Indirect
Equipment/Appliances	157	85	94	22	16.9	8.1
Lighting/Lighting Controls	153	78	85	10	20.1	7.8
HVAC	120	69	62	12	19.7	6.1
Load Control	64	40	34	10	14.4	3.6
Building Shell	63	41	29	7	15.7	5.8
Motor/Motor Drive	58	36	31	9	14.4	4.7
Other[a]	31	20	17	6	2.0	0.5
Fuel Switching	26	17	13	4	6.7	1.6
Energy Effects of Urban Forestry	8	8	2	2	4.9	*
Industrial Power Systems	4	3	1	0	0.6	0.0
Total	**374**	**194**	**224**	**46**	**25.2**	**10.0**

[a]Includes all projects that cannot meaningfully be included in any of the specific project type categories.
*Less than 0.05 million metric tons.
Note: Project totals and emission reductions do not equal sum of components, because some projects are counted in more than one category.
Source: Energy Information Administration, Form EIA-1605.

Load Shape Effects: Definitions and Terminology

Energy Efficiency. Projects that improve the energy efficiency of specific end-use devices and systems. Such projects usually reduce overall energy consumption, often without regard for the timing of project-induced savings. Generally, energy savings are achieved through the substitution of technically more efficient measures (i.e., equipment, systems, or operating procedures) to produce the same level of end-use service (e.g., lighting or warmth) with less energy use.

Load Building. Projects that increase energy consumption, generally without regard to the timing of the increase. Promotion of residential electric space heating systems and promotion of new industrial electrotechnologies are examples of electricity load-building projects.

Load Shifting. Projects that move energy consumption from one time to another (usually during a single day). For example, water-heater timers typically turn off the units during the daytime (when an electric company experiences peak demands) and allow the units to operate at night (during the company's off-peak period).

Peak Clipping. Projects that reduce energy demand at certain critical times, typically when the electric system experiences peaks. These projects generally have only small effects on overall energy use but focus sharply on reducing energy use at critical times. Load-shifting and peak-clipping differ because the former shifts much of the energy use from one time to another, whereas the latter eliminates a load without shifting it to another time period.

Valley Filling. Projects that increase off-peak energy consumption (without necessarily reducing on-peak demands). Replacement of an oil-fired furnace with an electric heat pump is an example of valley filling. Such projects can aim to fill daily or seasonal valleys.

reported energy end-use projects. For 2003, no new reporters to the Voluntary Reporting Program submitted reports on equipment and appliance projects; however, a number of repeat reporters submitted reports on new equipment and appliance projects. Exelon Corporation reported 2 new projects for 2003 that increased its efforts to reduce residential energy consumption. Exelon's Low Income Usage Reduction Program has provided $1.3 million to establish the installation of 150 solar water-heating systems for low-income residential customers with the potential for additional savings on their energy costs. The pilot was extended to allow for an additional 60 installations. The company also incorporated an education component to promote participation, as well as addressing any concern associated with the technology. This project, originally started in 1999, was reported for the first time in 2003. Annual savings for each household are projected to be 82.5 kilowatthours, for a total savings of 17.3 megawatthours of electricity consumption and total emission reductions of 4.4 metric tons carbon dioxide equivalent.

From April 15 through July 15, 2003, Exelon's Clothes Washer Rebate Program offered customer incentives, along with manufacturer's rebates, for a total of $100 off the purchase of an ENERGY STAR qualified clothes washer. The program, coordinated by the Midwest Energy Efficiency Alliance (MEEA), granted 1,100 rebates to ComEd customers at 110 participating retailers. A typical household does nearly 400 loads of laundry per year, using about 40 gallons of water per full load with a conventional washer. In contrast, a full-sized ENERGY STAR qualified clothes washer uses 18 to 25 gallons per load. ENERGY STAR clothes washers use up to 40 percent less energy and up to 50 percent less water than standard-efficiency washers. They are projected to save as much as 238 kilowatthours and 16 therms[33] of natural gas per year when used with an electric dryer and a gas water heater. Potential water savings are estimated at up to 7,000 gallons annually. The projected savings from these 1,100 energy- and water-efficient clothes washers over their expected 12-year lifespan are 371.9 megawatthours of electricity, 36,087 therms of natural gas, and 11.1 million gallons of water. Estimated emission reductions from this project in 2003 totaled 13 metric tons carbon dioxide equivalent.

Lighting and Lighting Controls

Lighting and lighting control projects, such as installing compact fluorescent bulbs and occupancy sensor lighting controls, have consistently been popular projects in the Voluntary Reporting Program. The U.S. Environmental Protection Agency (EPA) Green Lights Utility Ally Program promotes cooperation between utilities and the EPA in publicizing the environmental, economic, and quality benefits of energy-efficient lighting technologies. Allergan, Inc., has reported to the Voluntary Reporting of Greenhouse Gases Program on its participation in the Green Lights Utility Ally Program. In an ongoing project, existing fluorescent lighting has been upgraded at several Allergan facilities, including 40-watt tubes being replaced with energy-efficient 32-watt tubes, and conventional ballasts being replaced with energy-efficient and/or electronic ballasts. These upgrades are generally conducted in areas undergoing renovation or incorporated into new building designs. This project reportedly reduced the company's overall electricity consumption by 250 megawatthours in 2003, resulting in total emission reductions of 193 metric tons carbon dioxide equivalent.

For 2003, the Estee Lauder Company reported 4 new lighting projects and also, for the first time, reported 11 lighting and lighting control projects that commenced in 2002. Three of the four new projects reported for 2003 involved the installation of new Octron lighting fixtures, consisting of Octron fluorescent lamps, electronic ballasts, and specular reflectors, in place of T-12 fluorescent lamps. The final project was an upgrade from metal halide lights to pulse-start ion metal halide lights. The 4 new projects reportedly reduced the company's 2003 energy consumption by 1,654.9 megawatthours, leading to a reduction in indirect emissions from purchased power of 948 metric tons carbon dioxide equivalent.

Heating, Ventilation, and Air Conditioning (HVAC)

HVAC projects involve the reduced use or upgrade of HVAC systems in homes, businesses, offices, or industrial plants. Although there were no new reporters in the HVAC category, a number of new projects were reported for 2003. The majority of the new projects were not specifically HVAC projects but had HVAC components included in larger DSM efforts.

Both Allergan and the Estee Lauder Company reported new projects that were strictly HVAC. Allergan reported on 5 projects that included upgrades to HVAC system equipment, including a water pump, a cooling water pump, an air handler fan, hot water pumps, and a high-efficiency chiller. These improvements accounted for a total indirect emissions reduction of 667 metric tons carbon dioxide equivalent. The Estee Lauder Company reported on a project that incorporated solar panels into the HVAC system at its Aveda facility. A 1,270-square-foot solar wall system was installed on the high bay south wall, which extends above the lower roof of the office. Fresh air is drawn in through the cladding into a heat pump and distributed in the building though ducting. The preheated ventilation has lead to a better standard of indoor air quality and a reduction in energy

[33] A therm is equivalent to 100,000 British thermal units (Btu) of energy.

consumption. This project reportedly reduced natural gas consumption by 757.5 million Btu and electricity use by 14.1 megawatthours, leading to total indirect and direct emission reductions of 51 metric tons carbon dioxide equivalent.

Building Shell

Building shell projects improve the energy efficiency of buildings through upgrades to ceilings, walls, floors, windows, or doors (e.g., insulation, air sealing, or efficient materials). A large share of the projects reported in the building shell category for 2003 involved DSM programs by electric power providers. The Platte River Power Authority, a joint action public power utility owned by four Colorado cities (Estes Park, Fort Collins, Longmont, and Loveland) offered Fort Collins a design assistance program. Under this program, Platte River Power Authority paid for a portion of the additional design costs of a high-performance building, based on the recognition that constructing a highly energy-efficient building takes more up-front design time and cost. Daylighting and/or energy-efficiency consultants are often hired to assist in the design process. Customers receiving assistance are expected to achieve at least a 25-percent improvement in energy efficiency relative to a building that meets the current Fort Collins building code.

The methodology used to estimate energy and greenhouse gas savings from building shell projects uses computer models to compare different building designs. In the design phase, computer models are developed to establish a "base" building, which is compliant with the Fort Collins building code, and an "actual" building, which is representative of the high-performance building constructed. Model results were used to estimate the energy use and greenhouse gas emission savings of the new building design relative to the base building, based on actual electric company bills. In 2003, the program led to a reported reduction in electricity use of 508.6 megawatthours and a reduction in indirect emissions of 215 metric tons carbon dioxide equivalent.

Load Controls

Load controls are energy management techniques for minimizing—either overall or at specific times of the day—the load demands on electric power providers. Power companies themselves can use load management options and, through DSM programs, encourage their customers to apply load controls. Independently, power consumers can employ load controls to reduce their energy consumption, shift their demand to non-peak hours, reduce their consumption during peak hours, and reduce energy costs. Load control options include energy efficiency projects, load building, load shifting, peak clipping, and valley filling (see box on page 32).

For 2003, Cinergy Corporation reported a load control project, the Thermal Energy (Cool) Storage Project. Thermal Energy Storage (TES) is designed to reduce summer peak electric loads for space and process cooling applications by shifting those loads to off-peak periods, and to reduce energy use through off-peak system operations. Cooling energy is stored in cooled water, eutectic salts, or ice systems by the operation of electric chillers during off-peak periods and then used during on-peak periods, resulting in a reduction of on-peak electricity demand. Application of off-peak cooling systems can also reduce energy consumption by rejecting heat at lower ambient temperatures.

Cinergy's target market for its TES program includes schools, churches, and commercial or industrial office buildings, encompassing both new construction and retrofits of buildings that have relatively large cooling needs and operating hours that are conducive to ice-making during off-peak hours. Industrial process applications represent additional market potential for the TES system. The Cinergy program is designed to stimulate the market and help facility owners over the obstacles typically associated with new technologies: cost premiums over conventional HVAC systems; perception that the technology is new and/or complex; and reliability relative to existing systems. In 2003, this project reportedly reduced electricity consumption by 15.8 megawatthours, leading to a direct emissions reduction of 14,272 metric tons carbon dioxide equivalent.

Motor and Motor Drive

High- or ultra-high-efficiency motors and variable-speed or variable-frequency motor drives are more energy efficient than regular motors and motor drives. In addition, controls can be used to reduce electricity consumption by adjusting motor speeds or turning off motors when appropriate. Motor and motor drive projects are generally reported in the commercial and industrial categories, and often they are components of DSM programs, as is the case for all the new motor and motor drive projects reported for 2003.

Allegheny Energy, Inc., reported a motor and motor drive project in 2003 that has been an ongoing effort. Adjustable-speed drives (ASDs) on electric motors have the potential to save energy and demand where motor load is not constant. Allegheny, through its former operating company in Virginia, Potomac Edison, conducted a cooperative research project with an industrial customer and the Electric Power Research Institute (EPRI) to evaluate the use of ASDs on plastic injection molding machines. ASDs were installed on 18 motors for 7 different molding machines. Measured savings were 38 percent for total electrical motor load and 23 percent for total molding machine load. This project represents a good example of DSM activities aimed at industrial

customers. Electricity savings from the project were reported to be 689 megawatthours, resulting in a total emissions reduction of 705 metric tons carbon dioxide equivalent.

Fuel Switching

Switching from high-carbon to low-carbon fuels reduces carbon dioxide emissions generated during combustion. There were no new reporters in the fuel switching energy end-use category for 2003. Minnesota Power continued to report in 2003 on an ongoing project that expanded the use of renewable biomass as a fuel. Minnesota Power operates the M.L. Hibbard / Duluth Steam District No. 2 steam plant for the City of Duluth. The facility provides process steam to a paper mill and a recycled fiber plant. Acceptable fuels at the facility include coal, natural gas, and wood waste. The plant has sought to maximize use of renewable waste wood as a fuel since 1991 and will continue the effort to the extent that appropriate fuel is economically available. When natural gas is economically available, natural gas is also used to reduce consumption of subbituminous coal. Net carbon dioxide emissions from burning wood waste are significantly less than those from burning coal, because the wood waste would otherwise be placed in landfills or left to rot in the field. Hence, Minnesota Power assumes that net carbon dioxide emissions from burning waste wood in this application are zero. Indirect emissions are also significantly reduced, because waste wood can form methane gas under moist, anaerobic landfill conditions (however, avoided methane production from waste wood decay was not reported for 2003).

An additional benefit from the use of wood waste in the M.L. Hibbard / Duluth Steam District No. 2 boilers is that the ash formed during combustion of the wood waste is an agriculturally beneficial product. Potassium and alkalinity in the wood ash make it useful as a fertilizer on farmers' fields. In this manner, most of the Hibbard facility ash produced while burning wood waste is "disposed of" as a substitute for agricultural chemicals. (Again, avoided indirect emissions from this agricultural application of boiler ash were not reported for 2003.)

Minnesota Power also generates electricity at the M.L. Hibbard facility. The high proportion of wood waste burned at the facility results in lower carbon dioxide emissions from Hibbard generation compared to many coal-fired generation alternatives. Minnesota Power sells renewable biomass sourced electricity to Wisconsin Electric Power Company for use in its "Energy for Tomorrow" program. Wisconsin Electric is presuming a net zero carbon dioxide emissions base from its Hibbard renewable biomass energy purchases. In reporting its expanded use of renewable biomass, Minnesota Power increases the heat input from wood waste by the portion used to generate power for Wisconsin Electric. Minnesota Power , claims no benefit for this renewable generation, allowing Wisconsin Electric to claim the benefit based on avoided emissions from its other power supply resources. For 2003, this project was reported to have reduced coal usage by 812,072 million Btu and direct carbon dioxide emissions by 76,252 metric tons.

Energy Effects of Urban Forestry

Urban forestry is the planting and maintenance of individual trees within a city or community. Urban forestry projects can reduce both carbon dioxide emissions and energy expenditures for urban heating and cooling requirements. General examples of such projects include the planting of shade trees to reduce cooling requirements and windbreaks to reduce heating requirements. Urban forestry projects can also sequester carbon, as discussed in Chapter 4.

There were no new urban forestry projects reported in 2003, although all 8 of the urban forestry projects reported in 2002 continued to be reported, including Pacificorp's Salt Lake City Urban Forestry Project, which has been responsible for the planting of trees in residential areas that will provide shade to buildings and reduce energy use for cooling. Approximately 900 large trees and 400 small trees were planted throughout the project. At maturity, the trees will be between 45 and 75 feet tall. In total, 112 trees were planted around single-family homes with 2 trees per home, 962 trees were planted around single-family homes with 1 tree per home, and 170 trees were planted around multi-family dwellings and a school. The energy savings from this urban forestry program probably would not have occurred in the absence of the program. Although many homeowners plant trees on their own, it is unlikely that they would plant trees to optimize energy savings. For 2003, Pacificorp reported that the project produced direct emission reductions of 106 metric tons carbon dioxide equivalent.

Industrial Power Systems

Industrial power system projects are designed to reduce emissions from industrial power systems through efficiency improvements such as boiler system upgrades and replacements and turbine optimization. There were no new reporters or projects in the industrial power system category for 2003.

Other

There was one new project in the other project type category for the 2003 reporting year. The other project category captures the effects of energy end-use projects that cannot be meaningfully included in another category. Lehigh Cement Company (formerly Lehigh Portland Cement Company) reported a new project that involved the modernization and reconfiguration of its kilns. Two

long-dry kilns were converted to two one-stage preheater kilns, which produce more heat and are more energy efficient. This project was reported to have reduced coal use by 376,260 million Btu and direct emissions by 22,854 metric tons carbon dioxide equivalent.

Another project in the "other" category is an investment project reported by Ameren Corporation. The EnviroTech Investment Fund was created to support development and disbursement of energy-efficient technologies. Advent International Corporation manages EnviroTech in cooperation with the Edison Electric Institute. Advent International evaluates and underwrites the development of promising energy efficiency technologies. Union Electric (an Ameren Corporation company) has committed to invest up to $5 million in this program, which is currently 15.9 percent of the total investments in the EnviroTech Investment Fund. The remaining 84.1 percent of the Fund's capitalization comes from other participating investor-owned electric utilities. Ameren Corporation reports that it intends to make additional investments in the Fund over the next several years. Sufficient information is not available to describe each type of activity supported by EnviroTech that results in emission reductions.

Reducing Emissions from Transportation

The transportation sector is the largest contributing end-use sector to total U.S. energy-related carbon dioxide emissions, accounting for 32 percent of emissions in 2003. Direct use of petroleum fuels in mobile source applications accounts for 98 percent of transportation sector carbon dioxide emissions, and most of the remaining 2 percent results from the consumption of natural gas. Indirect emissions resulting from the use of purchased electricity account for about 0.2 percent of transportation sector emissions. Carbon dioxide emissions from the transportation sector increased by 19 percent between 1990 and 2003, from 1,570 million metric to 1,875 million metric tons carbon dioxide.[34] The increase was caused by increases in both the average number of miles driven per vehicle and the total number of vehicles on the road. The average number of miles driven by passenger cars increased by 13 percent between 1990 and 2001,[35] and the number of vehicles on the road increased by 22 percent between 1990 and 2001.[36] Emissions growth was moderated somewhat by an increase in average U.S. vehicle fleet fuel efficiency from 16.4 miles per gallon to 17.0 miles per gallon between 1990 and 2002.[37]

For 2003, 66 transportation projects were reported on Form EIA-1605 by 35 entities. All but 5 of the reporters were electric generation companies. One of the non-generators was CLE Resources, a subsidiary of an energy services company; the others were AT&T (telecommunications), The Burlington Northern and Santa Fe Railway Co. (transportation), Blue Source, LLC (emissions offset brokerage), and Arizona Portland Cement. Of the 66 transportation projects reported on Form EIA-1605 for 2003, 61 have been reported in previous years. Five new projects were reported for 2003:

- The Burlington Northern and Santa Fe Railway Co. reported on fuel efficiency improvements, including replacing old, inefficient locomotives, using newer roller bearing technology on rail cars, positioning trailers on intermodal trains to reduce drag, adjusting train speeds to optimize delivery schedules and fuel efficiency, and using friction reducers on the wheel-to-rail interface.
- Blue Source, LLC, an emissions offset broker, reported on the following three transportation actions for which it owns title to the associated greenhouse gas reductions:
  - An empty-mile reduction project conducted by J.B. Hunt Transport Services, Inc.[38]
  - An idling reduction program initiated by a major trucking company to reduce emissions from unnecessary fuel consumption.
  - An intermodal freight transport project that combines the most efficient aspects of truck and rail modes to carry cargo over long distances. The goal of the project is to expand the transportation of freight by trains, which are more than three times as efficient as trucks on a ton-mile basis.

[34]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003,* DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

[35]Energy Information Administration, *Annual Energy Review 2003*, DOE/EIA-0384(2002) (Washington, DC, September 2004), p. 57, web site www.eia.doe.gov/aer.

[36]U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2003* (Washington, DC, March 2004), Table 1-11, web site www.bts.gov/publications/national_transportation_statistics/2003/html/table_01_11.html.

[37]Energy Information Administration, *Annual Energy Review 2003,* DOE/EIA-0384(2003) (Washington, DC, September 2004), p. 57, web site www.eia.doe.gov/aer.

[38]Empty miles are the miles traveled by a vehicle without cargo between dropoff and pickup locations.

- Consolidated Edison reported on the use of B20, a mixture of 80 percent petroleum diesel fuel and 20 percent biodiesel,[39] by at least 122 fleet vehicles.

Of the 66 transportation projects reported for 2003, 35 (53 percent) were affiliated with the Department of Energy's Climate Challenge program.

Tables 12 and 13 show historical trends in the reporting of transportation projects to the Voluntary Reporting Program. The projects reported for 2003 fall into three broad categories:[40]

- Alternative fuel use, 31 projects (47 percent)
- Travel reduction, 26 projects (39 percent)
- Vehicle efficiency improvements, 9 projects (14 percent).

Table 12. Number of Projects and Emission Reductions Reported on Form EIA-1605 for Transportation Projects by Project and Reduction Type, Data Years 1994-2003

Year	Number of Projects				Emission Reductions (Metric Tons Carbon Dioxide Equivalent)	
	Vehicle Efficiency	Travel Reduction	Alternative Fuels	Total	Direct	Indirect
1994	3	6	18	**26**	4,203	6,346
1995	6	14	21	**40**	22,660	54,061
1996	7	15	26	**47**	28,813	54,043
1997	9	20	27	**55**	32,283	95,782
1998	9	23	28	**58**	25,085	89,174
1999	10	25	30	**62**	43,499	282,257
2000	9	25	32	**64**	22,611	134,519
2001	5	21	28	**53**	44,996	88,023
2002	5	26	30	**60**	41,966	161,156
2003	9	26	31	**66**	2,459,095	134,867

Notes: Project totals do not equal sum of components, because some projects are counted in more than one category. Table excludes data from confidential reports.
Source: Energy Information Administration, Form EIA-1605.

Table 13. Emission Reductions Reported on Form EIA-1605 for Transportation Projects by Project and Reduction Type, Data Years 1994-2003
(Metric Tons Carbon Dioxide Equivalent)

Year	Vehicle Efficiency		Travel Reduction		Alternative Fuels	
	Direct	Indirect	Direct	Indirect	Direct	Indirect
1994	1,244	5,651	1,170	—	1,956	695
1995	18,148	36,137	2,179	16,461	2,463	1,495
1996	18,647	38,602	5,427	13,903	4,847	1,546
1997	20,989	48,213	8,753	45,227	2,582	2,352
1998	18,436	70,527	3,110	15,923	3,632	2,746
1999	14,671	174,553	6,077	106,841	22,866	2,148
2000	53	66,324	8,549	67,404	14,021	2,306
2001	-1,109	51,905	13,059	34,050	33,053	2,068
2002	15	48,160	10,920	108,912	31,030	4,085
2003	2,387,335	49,543	38,951	83,156	32,810	2,168

Notes: Table excludes data from confidential reports.
Source: Energy Information Administration, Form EIA-1605.

[39]Biodiesel is any liquid biofuel suitable as a diesel fuel substitute or diesel fuel additive or extender. Biodiesel fuels are typically made from oils such as soybeans, rapeseed, or sunflowers, or from animal tallow. Biodiesel can also be made from hydrocarbons derived from agricultural products such as rice hulls.

[40]The sum of projects in each category exceeds the total number of projects, because some projects are counted in more than one category.

The primary effect of the transportation projects reported was to reduce emissions of carbon dioxide. Reductions in emissions of nitrous oxide or methane were also reported for 7 projects. For 18 of the 66 projects reported, either reductions did not occur in 2003 or they were not estimated.[41]

Direct reductions totaling 2.5 million metric tons carbon dioxide equivalent were reported for 30 transportation projects in 2003 (Table 12). This represents a significant increase from the 41,916 metric tons carbon dioxide equivalent in direct reductions reported for 2003. The Burlington Northern and Santa Fe Railway Co. (1.0 million metric tons carbon dioxide) and Blue Source, LLC (1.4 million metric tons carbon dioxide equivalent) reported four new projects that were responsible for the increase.

Indirect emission reductions in 2003 totaling 134,867 metric tons carbon dioxide equivalent were also reported for 24 transportation projects. The sources of the reduced emissions included "fuel cycle" emissions associated with production, refining, transportation, and distribution of fossil fuels; conventional vehicles displaced by customer-owned natural gas vehicles refueled by natural gas distribution companies; employee vehicles affected by reporter-sponsored travel reduction programs, such as carpooling; and railroad-owned locomotives hauling coal in lightweight aluminum rail cars owned by electric utilities. Indirect reductions for 2003 were 16 percent lower than those reported for 2002, due primarily to fewer reductions reported for three projects: an AT&T telecommunication project, a Public Service Enterprise Group employee trip reduction effort, and a TXU carpool program.

Using Alternative Fuels

Of the transportation projects reported for 2003, 47 percent involved alternative-fuel vehicles (AFVs). These projects, however, accounted for only 1 percent of the direct reductions and 2 percent of the indirect reductions reported for transportation projects. In general, the reported reductions for AFV projects were small, with reductions in excess of 1,000 metric tons carbon dioxide equivalent being reported for only one project.

AFV projects involved a variety of fuels, including natural gas, electricity, propane, B20, E85 (a blend of 85 percent ethanol and 15 percent gasoline), and M85 (a blend of 85 percent methanol and 15 percent gasoline). Electricity was the alternative fuel included in 11 project reports. Southern California Edison's electric vehicles reportedly logged 1.8 million miles in 2003, more than 10 times the 174,000 miles reported for 1996. The Los Angeles Department of Water and Power (LADWP) reported operating 258 electric vehicles in 2003, up from 204 in 2001 and 18 in 1996. Southern Company reported operating a fleet of 190 electric vehicles in 2003, including cars, trucks, neighborhood electric vehicles, and buses; however, the current size of Southern Company's electric fleet is less than one-half the 484 vehicles it operated in 2000. Operation of compressed natural gas (CNG) vehicles was reported for 15 projects, and 3 utilities reported operating fleets of more than 100 CNG or dual-fuel CNG/gasoline vehicles[42] in 2003: PG&E Corporation (6,010 vehicles), We Energies (654 vehicles), and NiSource (458 vehicles).

Eight AFV projects reported for 2003 involved fuels other than natural gas and electricity. Activity in 2003 was reported for four of those projects.[43] Exelon Corporation reported continued use of E85, propane, and B20. Cinergy reported continued use of E85 and B20 in 2003, but it has stopped using propane in company vehicles. Conectiv Delmarva Generation reported using a B20 fuel that included soy-based biodiesel in its fleet vehicles in 2003.

Reducing Vehicle Travel

Travel reduction, which includes such activities as carpooling and vanpooling, mass transit, telecommuting, and service efficiency improvements, was reported for 26 projects for 2003—accounting for 2 percent of the direct reductions and 62 percent of the indirect reductions reported for transportation projects in 2003. The 38,951 metric tons carbon dioxide equivalent of direct reductions reported for 2003 was more than 3 times the 10,920 metric tons reported for 2002. This increase in direct emission reductions was largely attributable to the new project reported by Blue Source, LLC, involving reduction in empty miles traveled by a trucking company. In contrast, indirect emission reductions reported for travel reduction projects for 2003 were 24 percent (25,756 metric tons) lower than those reported for 2002, primarily due to lower reductions being reported for AT&T's telecommuting program.

Of the 26 projects reported in the travel reduction category, 12 involved carpooling or vanpooling, 9 increased mass transit ridership, 5 reduced employee

[41] In some cases, reductions for the project may have been reported for years before 2003. In other cases, the reductions were not estimated due to the lack of data or other difficulties in quantifying the effects of the project. Entities may elect to report projects without reporting reductions to make a public record of the fact that they have conducted an activity in fulfillment of a commitment made under a voluntary program such as Climate Challenge.

[42] CNG dual-fuel vehicles are capable of operating on natural gas or gasoline.

[43] Two other reporters continued to submit information on projects that involved consumption of propane and M85 in previous years; however, the projects were inactive in 2003.

vehicle use through telecommuting, 4 increased service efficiency for freight or service vehicles, and 9 involved other actions, such as work week compression, videoconferencing, use of bicycles for electric or gas meter reading, promotion of employee commuting by bicycle or walking, and automation of electric or gas meter reading in areas of low population density.[44]

AT&T reported the largest travel reduction project, a telecommuting program that reportedly reduced indirect emissions by 48,988 metric tons carbon dioxide equivalent. Reductions of more than 5,000 metric tons carbon dioxide equivalent in 2003 were also reported for the following travel reduction projects:

- The Blue Source, LLC, empty miles reduction program reduced direct emissions by a reported 26, 649 metric tons carbon dioxide equivalent.
- LADWP reported on its employee carpooling and vanpooling program (8,167 metric tons carbon dioxide equivalent indirect emission reductions).
- Southern Company reported on its carpooling and mass transit programs (6,040 metric tons carbon dioxide equivalent indirect emission reductions).
- TXU reported efforts to reduce fleet and employee vehicle use (6,556 metric tons carbon dioxide equivalent direct emission reductions and 8,658 metric tons carbon dioxide equivalent indirect emission reductions).
- AT&T reported on its fleet cost reduction program (5,715 metric tons carbon dioxide equivalent direct emission reductions).
- CLE Resources reported its investment, through the Edison Electric Institute's EnviroTech investment fund, in McHugh Software, a company that developed software to improve routing for service vehicles (6,582 metric tons indirect carbon dioxide emission reductions from foreign and domestic sources).

Improving Vehicle Efficiency

Emission reductions were reported for 7 of the 9 vehicle efficiency projects reported for 2003. Indirect reductions were reported for 2 projects, both of which involved the use of light-weight aluminum railroad cars to transport coal. These projects, which were reported by electric utilities, resulted in indirect emission reductions because the locomotives using less fuel were owned by the railroads. Ameren Corporation reported reducing emissions by 21,576 metric tons carbon dioxide equivalent, and Kansas City Power & Light Company reported reducing emissions by 27,967 metric tons carbon dioxide equivalent.

CLE Resources, a subsidiary of Cleco Corporation, continued to report its investment (through the EnviroTech fund established by the Edison Electric Institute) in a company that developed and commercialized a device for monitoring and adjusting tire pressure on trucks to achieve optimal fuel efficiency. CLE Resources did not report emission reductions for this project, due to the unavailability of reliable data on the number of devices sold.

[44]The total number of travel reduction projects is less than the sum of the projects in each subcategory, because some projects include activities in more than one subcategory.

4. Carbon Sequestration

Background

Carbon sequestration plays an important role in the global carbon cycle. Green plants remove (sequester) carbon from the atmosphere through photosynthesis, extracting carbon dioxide from the air, separating the carbon atom from the oxygen atoms, returning oxygen to the atmosphere, and using the carbon to make biomass in the form of roots, stems, and foliage.

Globally, a very large amount of carbon dioxide—on the order of 120 billion metric tons of carbon—is sequestered in biomass.[45] At the same time, carbon is released to the atmosphere from vegetative respiration, combustion of wood as fuel, degradation of manufactured wood products, consumption of biomass for food by animals, and the natural decay of expired vegetation. The net numerical difference, or flux, between carbon sequestration and release can be viewed as a measure of the relative contribution of biomass to the carbon cycle. World flux associated with Earth's living matter is difficult to measure, but biomass is thought to provide a net "sink" equivalent to about 5.1 billion metric tons carbon dioxide per year.[46]

Forests can play an important role in offsetting human-produced carbon dioxide emissions. On average, trees are approximately 50 percent carbon by weight (oven-dry basis, excluding water).[47] The amount of carbon a plant can sequester depends on a number of variables, including species, health of vegetation, and age, but can be quite large. For example, one large sugar maple tree is capable of removing more than 450 pounds of carbon dioxide from the atmosphere in a year. At that rate, preserving approximately 31 trees per operating automobile in the United States would offset all U.S. automobile-related carbon dioxide emissions.[48]

Carbon sequestration on a national scale is substantial. The U.S. Environmental Protection Agency, relying heavily on the work of the U.S. Department of Agriculture's U.S. Forest Service, estimates annual U.S. carbon sequestration (generally defined according to the guidelines of the Intergovernmental Panel on Climate Change) at 691 million metric tons carbon equivalent,[49] which offsets approximately 10 percent of annual U.S. anthropogenic emissions of greenhouse gases.[50]

Projects Reported

For the 2003 reporting year, 51 entities reported projects on Form EIA-1605 that involved forestry or natural resources that sequestered carbon or reduced emissions (Table 14). The reporters included 48 electric companies, a private service organization providing reforestation services to corporate clients, a petroleum company, and a cement company. A total of 446 carbon sequestration projects were reported for 2003, an increase of 8 percent from 2002. Carbon sequestration projects were the third most numerous type reported on the long form, representing 23 percent of the projects reported for 2003. Methane reduction (470) and electricity generation (464) projects outnumbered carbon sequestration projects. The reported carbon sequestration projects were dispersed over a wide geographic area, including 33 States and 8 foreign countries. A total of 377 domestic and 69 international forestry projects were reported; 33 of the foreign projects represent individual equity shares in a single forest preservation project, the Rio Bravo Carbon Sequestration Pilot Project, in Belize.

[45]Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis* (Cambridge, UK: Cambridge University Press, 2001), p. 188.

[46]Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis* (Cambridge, UK: Cambridge University Press, 2001), p. 39.

[47]R.A. Birdsey, *Carbon Storage and Accumulation in United States Forest Ecosystems* (Washington, DC: USDA Forest Service, 1992), p. 12.

[48]Average mileage and fuel consumption for passenger cars from Energy Information Administration, *Annual Energy Review 2003*, DOE/EIA-0384(2003) (Washington, DC, September 2004), p. 57, web site www.eia.doe.gov/aer. Carbon dioxide emissions per mile driven and gallon of motor fuel from U.S. Department of Energy, *Sector-Specific Issues and Reporting Methodologies Supporting the General Guidelines for the Voluntary Reporting of Greenhouse Gases Under Section 1605(b) of the Energy Policy Act of 1992*, DOE/PO-0028 (Washington, DC, October 1994), Vol. 2, p. 4.19.

[49]U.S. Environmental Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2002*, EPA-430-R-04-003 (Washington, DC, April 2004), p. 206, web site http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsGHGEmissionsUSEmissionsInventory2004.html.

[50]U.S. anthropogenic greenhouse gases emissions were 6,936 million metric tons carbon dioxide equivalent in 2003. Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), p. ix, web site www.eia.doe.gov/oiaf/1605/ggrpt.

Carbon sequestration reported on Form EIA-1605 remained about the same in 2003 as it was in 2002, at 7.7 million metric tons carbon dioxide equivalent (Table 14). Of the 446 sequestration projects reported for 2003, most (354 or 79 percent) involved some kind of tree planting, which included afforestation, reforestation, urban forestry, and woody biomass production or agroforestry (Table 15).[51] These projects accounted for 15 percent of the sequestration (and related direct emission reductions) reported for 2003. Although only 39 forest preservation projects were reported, they accounted for 88 percent of the sequestration reported for 2003 (Table 16). Of the total sequestration for 2003, 89 percent was reported on behalf of foreign projects, including some very large forest preservation initiatives.

Urban forestry projects, involving the planting of trees in urban and suburban areas, accounted for 8 percent (34 projects) of the sequestration projects reported for 2003. Urban forestry projects are typically much smaller than forestry projects undertaken in rural or wilderness areas. The average carbon dioxide sequestration

Table 14. Number of Projects, Carbon Sequestered, and Net Reductions Reported on Form EIA-1605 for Sequestration Projects, Data Years 1994-2003

Data Year	Number of Reporters	Number of Projects	Sequestration (Metric Tons Carbon Dioxide Equivalent)	Net Emission Reductions (Metric Tons Carbon Dioxide Equivalent)	
				Direct	Indirect
1994	23	58	746,545	189	23,127
1995	44	175	1,190,754	378	48,730
1996	51	175	8,676,591	1,291	32,215
1997	56	279	9,849,807	6,160	—
1998	57	321	12,490,927	716	—
1999	53	401	9,623,599	3,406	—
2000	53	468	9,011,117	1,041	—
2001	51	369	7,956,823	1,114	—
2002 (R)	51	413	7,296,516	1,875	—
2003	51	446	7,730,969	1,860	—

(R) Revised data.
Source: Energy Information Administration, Form EIA-1605.

Table 15. Number of Sequestration Projects Reported on Form EIA-1605 by Project Type, Data Years 1994-2003

Data Year	1994	1995	1996	1997	1998	1999	2000	2001	2002(R)	2003
Tree Planting										
Afforestation and Reforestation	36	113	111	175	205	288	344	251	289	320
Urban Forestry	8	17	21	23	28	28	31	33	33	34
Woody Biomass Production and Other Agroforestry	8	14	2	3	3	3	3	3	3	2
Unspecified	—	2	1	—	1	—	—	—	—	—
Subtotal	44	131	133	199	235	318	376	285	323	354
Forest Preservation	2	22	29	38	43	38	42	37	38	39
Modified Forest Management	12	20	10	33	41	42	44	41	47	48
Conservation Tillage	1	1	1	2	2	2	2	2	1	1
Other Projects	3	4	5	10	4	5	5	5	5	5
Total	**58**	**175**	**175**	**279**	**321**	**401**	**468**	**369**	**413**	**446**

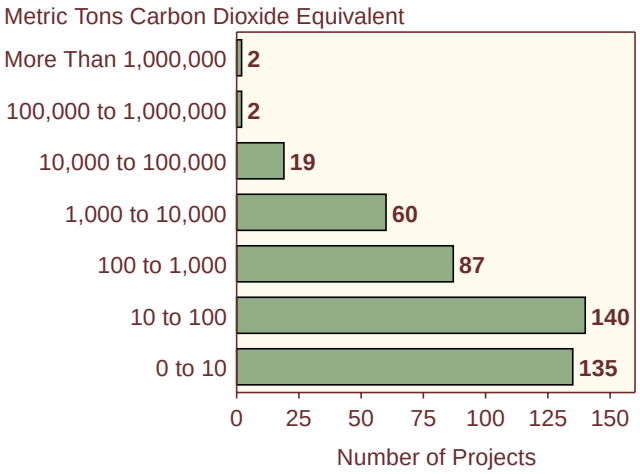
(R) Revised data.
Notes: Project totals do not equal sum of components, because some projects are counted in more than one category. In last year's report, "Unspecified" tree planting projects were included in the "Other Projects" category.
Source: Energy Information Administration, Form EIA-1605.

[51] Afforestation is the planting of new forests on lands that have not been recently forested. Reforestion is the replanting of forests on lands that have recently been harvested or otherwise cleared of trees. Urban forestry is the planting of trees individually or in small groups in urban or suburban settings. Agroforestry is the cultivation of trees in plantations for fuel or fiber.

reported per urban forestry project for 2003 was just 517 metric tons. In contrast, tree planting projects in rural or wilderness areas generally are much larger, accounting for 16 of the 19 projects that sequestered more than 10,000 metric tons carbon dioxide each in 2003 (Figure 12). For the 445 projects for which data were reported, average sequestration in 2003 was 16,456 metric tons carbon dioxide per project.

Almost all (414 or 93 percent) of the reported sequestration projects were undertaken in part to fulfill commitments made under the U.S. Department of Energy's Climate Challenge program.[52] Twenty-eight (28) of the investors in the UtiliTree Carbon Company[53] each submitted reports on the 10 projects that were operational in 2003. All the investors reporting were also participants in Climate Challenge. In addition, 36 sequestration projects reported on Form EIA-1605 for 2003 were undertaken as part of the U.S. Initiative on Joint Implementation (USIJI). Established under the Climate Change Action Plan (CCAP),[54] the USIJI is a pilot program that seeks to encourage foreign-based emission reduction and carbon sequestration projects conducted by U.S. and non-U.S. partners. The USIJI program has been inactive since 2000. The projects reported represent individual partner shares in two USIJI-approved forestry projects: the Rio Bravo Carbon Sequestration Pilot Project (Belize) and the Noel Kempff Mercado Climate Change Action Project (Bolivia).

Figure 12. Carbon Sequestration Projects Reported on Form EIA-1605 by Amount of Carbon Sequestered, Data Year 2003



Source: Energy Information Administration, Form EIA-1605.

Table 16. Carbon Sequestration Reported on Form EIA-1605 by Project Type, Data Years 1994-2003
(Thousand Metric Tons Carbon Dioxide Equivalent)

Data Year	1994	1995	1996	1997	1998	1999	2000	2001	2002(R)	2003
Tree Planting										
Afforestation and Reforestation	726.8	620.4	237.3	322.4	449.0	590.6	628.0	637.9	676.1	711.7
Urban Forestry	0.2	1.1	1.3	1.9	5.3	5.8	10.5	11.2	14.4	17.6
Woody Biomass Production and Other Agroforestry	356.6	213.9	1,964.6	1,962.3	1,962.3	503.2	392.5	425.7	428.0	425.4
Unspecified	—	7.0	*	—	0.1	—	—	—	—	—
Subtotal	727.0	627.7	2,188.1	2,263.6	2,393.6	1,077.3	1,006.4	1,056.4	1,097.6	1,135.7
Forest Preservation	73.0	615.8	6,546.5	7,545.5	10,073.4	8,523.4	7,879.6	6,804.3	6,055.9	6,469.6
Modified Forest Management	363.9	366.2	93.6	148.3	167.9	164.6	74.0	51.9	98.9	81.5
Conservation Tillage	4.3	4.3	3.3	8.5	8.5	8.5	11.9	4.4	4.4	4.4
Other Projects	2.8	3.1	4.1	44.9	58.9	59.1	59.1	59.8	59.7	59.8
Total	**746.5**	**1,190.8**	**8,676.6**	**9,849.8**	**12,490.9**	**9,623.6**	**9,011.1**	**7,956.8**	**7,296.5**	**7,730.9**

(R) Revised data.
*Less than 50 metric tons.
Notes: Project totals do not equal sum of components, because some projects are counted in more than one category. In last year's report, "Unspecified" tree planting projects were included in the "Other Projects" category.
Source: Energy Information Administration, Form EIA-1605.

[52]The Climate Challenge program, established in 1994, focused on commitments by electricity generators to reduce, avoid, or sequester greenhouse gases by the year 2000. Because its focus was on the year 2000, the Climate Challenge program is no longer active. It has been replaced by Power Partners[SM], which is the electric power industry's vehicle for participating in President Bush's Climate VISION initiative.

[53]The UtiliTree Carbon Company, a consortium of 41 North American electric utility companies investing in forestry projects that sequester carbon, was established under the Climate Challenge Program. It is administered by the Edison Electric Institute's (EEI's) Forest Carbon Management Program, which has identified and sponsored 10 ongoing domestic and international forestry projects. EEI has established a new program, PowerTree, to coordinate electric power industry sponsorship of forestry projects through Power Partners[SM] for Climate VISION.

[54]President William J. Clinton and Vice President Albert Gore, Jr., *The Climate Change Action Plan* (Washington, DC, October 1993), Appendix II, web site www.gcrio.org/USCCAP/toc.html.

Afforestation and Reforestation

Of the sequestration projects reported for 2003, 320 (72 percent) involved either afforestation or reforestation. The carbon sequestration and emission reductions reported for these projects totaled 0.7 million metric tons carbon dioxide, representing 10 percent of the total sequestration reported for 2003. All the afforestation and reforestation projects reported for 2003 were domestic.

American Electric Power, Inc. (AEP), a large investor-owned utility, accounted for the largest number of afforestation and reforestation projects, submitting 60 (19 percent) of the projects in this category for 2003. The AEP projects, all of which were afforestation projects, sequestered a reported 102,810 metric tons carbon dioxide in 2003. AEP reported 4 new domestic afforestation projects initiated in 2003, which sequestered a reported 2,121 metric tons carbon dioxide during the year.

Members of UtiliTree Carbon Company, a nonprofit consortium of 41 North American electric utilities, reported on 8 afforestation projects, including the Western Oregon Carbon Sequestration Project and 7 bottomland hardwood restoration initiatives in Louisiana, Arkansas, and Mississippi that are intended to convert marginal agricultural land to forest: the Mississippi River Valley Bottomland Hardwood Restoration, Upper Ouachita River Valley Bottomland Hardwood Restoration, Overflow Bottomland Hardwood Forest Restoration Project, St. Catherine-NFWF, Bayou Cocodrie Bottomland Hardwood Forest Restoration, St. Catherine-ESI, and St. Francis River Carbon Offset. The following afforestation and reforestation projects were reported for the first time for 2003.

The St. Francis River Carbon Offset Project, shares of which were reported by 28 UtiliTree Carbon Company partners, involves the restoration of 405 acres of bottomland hardwood forest using native tree species. The project site is on privately owned, marginal agricultural farmland in Lee County, Arkansas. Sequestration totaling 279 metric tons carbon dioxide equivalent was reported for 2003.

American Electric Power, Inc., reported on projects AEP-AGSPOIL-2003 and AEP-Private Lands-2003. AEP-AGSPOIL-2003 is an afforestation project on 1,089 acres of reclaimed mined grassland. AEP planted a total of 885,360 seedlings in 2003, including green ash; white ash; sycamore; pitlolly pine; loblolly pine; white oak; red oak; bur oak; sawtooth oak; black locust; and black alder. AEP-Private Lands-2003 involves financial assistance provided by AEP to private landowners who want to plant trees on their property in return for any associated greenhouse gas reduction benefits. These agreements are in 45- or 70-year durations, depending on the species planted and the nature of the site. The 2003 plantings involved afforestation of marginal agriculture cropland previously used for grain, hay, or cattle production. The species planted include white pine, white ash, green ash, sycamore, bur oak, white oak, and red oak. Together, these projects sequestered a reported 2,088 metric tons carbon dioxide equivalent in 2003.

ESI Florida Longleaf Pine Restoration, reported by Environmental Synergy, Inc., is located in the Withlacoochee State Forest managed by the Florida Division of Forestry. Native longleaf pine trees were planted in this 70-year project, which, beyond sequestering carbon, was designed to help create large forested blocks, rejoin fragmented forests, and create wildlife corridors for the benefit of neotropical migratory birds, waterfowl, and other animals such as deer and turkey. Carbon sequestration values were not estimated for this project.

DTE Energy/Detroit Edison reported on projects called "Six Lakes–2002" and "Miscellaneous Tree Plantings–2003." For Six Lakes–2002, DTE Energy/Detroit Edison planted trees on the site of the Six Lakes-Taggert Compressor Station, which is owned by Michigan Consolidated Gas Company (a subsidiary of DTE Energy). The planting in 2002 consisted of 80,000 red pine seedlings planted on 90 acres and 20,000 white spruce seedlings planted on 30 acres. These plantings reportedly sequestered 489 metric tons carbon dioxide equivalent in 2003.

Entergy Services, Inc., reported on projects called "Little Gypsy Plant Reforestation" and "Willow Glen Plant–Reforestation," which involved tree plantings at Entergy power plant sites. The former involved the planting of 20,000 nuttall oak, cypress, willow oak, green ash and pecan saplings and seedlings on 44 acres. The latter included the planting of 70,577 bottomland hardwoods on 234 acres, including the following species: water oak, nuttall oak, cottonwood, cherrybark oak, pecan, sweetgum, shumard oak, cow oak, sugarberry, green ash, and sycamore. These efforts sequestered a reported 462 metric tons carbon dioxide equivalent in 2003.

Urban Forestry

A total of 24 reporters, all of which were electric utilities, reported 34 urban forestry projects for 2003. For the 34 projects, total sequestration of 17,565 metric tons carbon dioxide was reported for 2003 (Table 16). Urban forestry projects are unique, in that under some circumstances they can reduce energy consumption as well as sequester carbon. Shade trees planted near buildings reduce summer air conditioning requirements; in addition, trees can act as windbreaks, reducing heating needs in the winter. Although the emission reductions associated with energy effects of urban forestry can be several times the sequestration benefits on a carbon dioxide equivalent basis, they are difficult to estimate. As a result, no energy-related emission reductions were submitted for 2003.

One new urban forestry project was reported for 2003. DTE Energy/Detroit Edison reported the planting of 3,082 trees, which were mostly white spruce, fir, pine, beech, oak, maple and birch. This project sequestered 5 metric tons carbon dioxide equivalent in 2003.

Forest Preservation

Forest preservation projects sequester carbon by avoiding the harvesting of timber or clearing of land and, thus, preventing the release of stored carbon. For 2003, 39 forest preservation projects were reported by 31 reporters; however, the vast majority (33) of these projects were reported separately by participating electricity generators as shares in the Rio Bravo Carbon Sequestration Pilot Project in Belize, held independently or through the UtiliTree Carbon Company. Also, 3 reporters provided information on their shares in the Noel Kempff Mercado Climate Action Project in Bolivia. No new forest preservation projects were reported for 2003.

The two largest forest preservation projects were reported by AES Hawaii and AES Shady Point, subsidiaries of the AES Corporation. AES Hawaii reported on the Mbaracayu Conservation project in Paraguay, and AES Shady Point reported on the OXFAM America Amazon project in Bolivia. Together, the two projects sequestered a reported 6.15 million metric tons carbon dioxide in 2003, representing 95 percent of the total sequestration reported for forest preservation projects (6.5 million metric tons carbon dioxide equivalent).

The Mbaracayu Conservation project is designed to offset carbon dioxide emissions from the AES Hawaii plant, a 180-megawatt circulating fluidized-bed coal-fired cogeneration plant on the island of Oahu. Sequestration of carbon is accomplished through the planting of fruit trees and cash-producing indigenous trees in the 143,000-acre Mbaracayu forest tract, which, according to AES, would have been sold to a timber company in the absence of the project.

AES Shady Point describes the OXFAM America Amazon Project as an innovative project to protect the tropical forest in the Amazon regions of Peru, Ecuador, and Bolivia. The project, which is being conducted in cooperation with national indigenous groups, OXFAM America, and the World Resources Institute (WRI), is intended to offset carbon dioxide emissions from the AES Shady Point plant in Oklahoma. The project will support efforts by indigenous groups to gain control over their lands and to develop sustainable resource extraction plans for the forest, thus avoiding tropical deforestation. WRI estimates that over 10 years the project would prevent the deforestation of 1.2 million hectares and avoid emissions of at least 233 million metric tons carbon dioxide equivalent.

American Electric Power, BP America, and PacifiCorp reported on the Noel Kempff Mercado Climate Action Project in Bolivia, which was accepted by the USIJI in November 1996. The project, which involves the preservation of 634,286 hectares of land on the southern and western boundary of the Noel Kempff Mercado National Park by incorporating it into the park, includes the following components: (1) carbon dioxide emission reductions through the cessation of logging activities and the protection of forest land from conversion to agricultural use; (2) protection, regeneration, and preservation; and (3) leakage prevention.[55] The sequestration reported for this project for 2003 totaled 243,660 metric tons carbon dioxide.

The Rio Bravo Carbon Sequestration Pilot Project, a forest preservation project in Belize, was reported by 28 utilities. Begun in 1995, the project is being undertaken through a partnership between Wisconsin Electric, Detroit Edison, Cinergy, PacifiCorp, and UtiliTree Carbon Company (which provided financial support), as well as The Nature Conservancy and a Belizean nongovernmental organization, Programme for Belize. A 14,400-acre parcel of forest threatened by agricultural conversion was secured, linking two forested Rio Bravo properties. The project implemented a sustainable forestry management program on the entire Rio Bravo Conservation and Management Area that aims to increase carbon sequestration through improved forest and timber management.

The entire Rio Bravo Carbon Sequestration Pilot Project sequestered an estimated 20,412 metric tons carbon dioxide in 2003, of which 19,890 metric tons (97 percent) was reported to the Voluntary Reporting Program.[56] The reported carbon sequestration for this project was estimated by defining a reference case that assumes a profile of carbon releases that would have occurred if the project had not been undertaken and the forest had been converted to agriculture over a 5-year period (1995-1999). The estimated carbon sequestration equals the projected avoided carbon releases. To date, it has been reported that the entire project has sequestered an estimated 4.4 million metric tons carbon dioxide. The UtiliTree Carbon Company estimates that most (91 percent) of that carbon dioxide was sequestered during the 5-year preservation phase of the project. The smaller annual sequestration totals reported for years after 2000 represent the accumulation of carbon in the forest that has occurred since the 1995 to 1999 preservation phase.

[55] "Leakage" refers to the migration of logging and land-clearing activities that would have occurred in the preserve to areas outside the preserve, which would offset the sequestration achievements of the project.

[56] Ten UtiliTree participants did not submit reports to the Voluntary Reporting Program for data year 2003, including one Canadian utility that is ineligible to report.

We Energies reported its independent sponsorship of an expansion to the Rio Bravo Conservation and Management Area, which added 20,630 acres to the preserve. We Energies reported that this preservation initiative sequestered an estimated 54,431 metric tons carbon dioxide equivalent in 2003.

Only one domestic forest preservation project was reported for 2003, by Alliant Energy, which reported sequestering 1,597 metric tons carbon dioxide by maintaining forested buffer lands around its power plants in the Wisconsin River Valley. This project involves the management of more than 10,000 acres along the Wisconsin River valley. Included in the land management plan are access restrictions for the preservation of osprey and eagle habitats in the forest.

Modified Forest Management

Modified forest management involves the modification of the management regimes of existing forests to increase their carbon capture rates. Of the 48 modified forest management projects reported for 2003, 29 were associated with two related reduced-impact logging initiatives in Malaysia. The first initiative was a pilot project reported by NEGT Corporation.[57] Started in 1992, this project implemented new logging techniques with the goal of reducing logging damage by 50 percent. The new techniques include pre-cutting of vines, directional felling, and planned extraction of timber on impact-reducing skid trails. On the second initiative, 28 utilities reported their shares of a full-scale project sponsored by the UtiliTree Carbon Company that introduced reduced-impact logging practices to 2,422 acres of forest beginning in 1997. The reported sequestration for the second initiative was 9,405 metric tons carbon dioxide equivalent in 2003.

American Electric Power reported the only new modified forest management project for 2003. This project was conducted in predominantly upland central hardwood stands ranging from 30 to 50 years in age. The stands were selectively harvested, removing overmature, mature, cull, and diseased trees, as well as other stems as necessary to improve growing relationships and maximize growth rates. The project is a continuation of annual forest management efforts reported separately since 1991. Including the 378 metric tons carbon dioxide equivalent for the 2003 project, these efforts together sequestered a reported 15,128 metric tons carbon dioxide equivalent in 2003.

Sequestration exceeding 10,000 metric tons carbon dioxide equivalent in 2003 was reported for the following three previously reported modified forest management projects:

- Southern California Edison Co. reported sequestration of 23,587 metric tons carbon dioxide equivalent by its Net Growth of Timber at Shaver Lake project.
- Alliant Energy's afforestation project also had a modified forest management component. The entire project sequestered a reported 19,958 metric tons carbon dioxide equivalent in 2003; however, Alliant Energy did not report the sequestration quantity attributable to modified forest management alone.
- American Electric Power's Guaraquecaba Climate Action Project, located in Brazil, sequestered a reported 11, 272 metric tons carbon dioxide equivalent in 2003.

On a smaller scale, DTE Energy/Detroit Edison conducted selective harvesting operations in previously unmanaged wood lots in southeastern Michigan and reported increasing sequestration by 1,398 metric tons carbon dioxide equivalent in 2003.

Forest Plantations

Forest plantations include woody biomass production and agroforestry. Woody biomass production is the cultivation of trees in intensively managed plantations to produce fuel or fiber. Agroforestry involves mixing trees with annual crops to provide wind shelter, stabilize soil, sequester carbon, and produce fuel wood and fruit crops.

One of the two woody biomass production projects reported for 2003 was Minnesota Power's Short Rotation Woody Crop Establishment project. Contracts to plant hybrid poplars were established with landowners enrolled in the Conservation Reserve Program. Following pre-planting site preparation, first commenced in 1994, the planting of 2,800 acres was phased in over 1995, 1996, and 1997. The project area was reduced to 2,550 acres in 2003 after consideration of adverse conditions such as seasonal flooding of low spots, insect damage, and poor growth rates. The project sequestered a reported total of 15,430 metric tons carbon dioxide equivalent in 2003.

The other plantation project reported was an AES Thames agroforestry project in Guatemala, which

[57] This project was originally sponsored by the New England Power Company and reported by its parent company, New England Electric System (NEES) Company. In August 1998, USGen New England, Inc. (USGenNE) completed the acquisition of New England Electric System (NEES) Company's hydroelectric and fossil power generation business previously operated by New England Power. As part of the acquisition, the rights to the emission reductions and carbon sequestration achieved by this and other projects were transferred to USGenNE. For 2000 through 2002, the activities previously reported by USGenNE were incorporated into the report submitted by its parent, PG&E Corporation. For 2003, this project was included in a separate report submitted by NEGT (National Energy and Gas Transmission), formerly known as PG&E National Energy Group, a subsidiary of PG&E Corporation.

involves establishing a plantation of fruit, pulp, and fuelwood trees. For 2003, AES Thames reported sequestering 410,000 metric tons carbon dioxide equivalent for this project.

Conservation Tillage and Other Sequestration Projects

Not all the carbon sequestration projects reported for 2003 involved conventional forestry. Other projects reported involved conservation tillage,[58] reuse of utility poles, and restoration of terrestrial, wetland, and marine habitats. Six such projects were reported for 2003.

Exelon (formerly Commonwealth Edison and PECO) reported on its Illinois Prairie Grass Plantings project, in which native prairie grasses are planted on various properties in the utility's State system. In contrast to conventional turf grass, the deep root systems of native Illinois prairie grasses afford environmental benefits that include reducing soil erosion and downstream flooding and eliminating the need for irrigation, fertilizers, pesticides, and herbicides. In addition, the deeper root systems sequester more carbon dioxide. For this project, Exelon claimed responsibility for the sequestration of 718 metric tons carbon dioxide in 2003. In another project, Exelon reused wood utility poles that are structurally sound in order to avoid the harvesting of trees to manufacture new utility poles. The utility pole reuse project was reported to have sequestered 649 metric tons carbon dioxide in 2003.

Alliant Energy reported on a conservation tillage project in south central Wisconsin that involved the conversion of 956 acres of former corn and soybean row cropland to a variety of other uses, including tall grass prairie, wetlands, conservation tillage, and oak savanna. This project reportedly sequestered 4,390 metric tons carbon dioxide in 2003. Alliant Energy also reported on a habitat restoration project in Wisconsin, which sequestered 3,493 metric tons carbon dioxide in 2003.

Other carbon sequestration projects include the reclamation of 5,500 acres of wetlands in Texas and Louisiana by Entergy Services, Inc., and the reclamation of 6 acres of wetlands by Conectiv Atlantic Generation. The two projects sequestered a reported 54,885 and 12 metric tons carbon dioxide in 2003, respectively.

[58]Conservation tillage includes practices (such as reduced till or no till) that, compared to conventional tillage methods, increase carbon storage on cropland.

5. Reducing Methane Emissions

Introduction

U.S. methane emissions totaled an estimated 26.2 million metric tons (601.9 million metric tons carbon dioxide equivalent) in 2003, representing 8.7 percent of total U.S. greenhouse gas emissions. Methane emissions in 2003 were approximately equal to 2002 levels and 4.6 million metric tons lower than 1990 levels.[59]

Methane emissions have been decreasing since 1990. Emissions from waste management and energy sources have been reduced, while emissions from the other primary methane source, agriculture, have remained nearly constant. In the waste management area, estimated emissions from landfills—the second largest source of methane after natural gas systems—have dropped from 10.5 million metric tons in 1990 to 6.3 million metric tons in 2003 as a result of a rapid increase in methane recovery at landfills. Overall, methane recovery at landfills, due to tax credits, regulation, and high natural gas prices have grown from about 1.3 million metric tons in 1990 to 6.3 million metric tons in 2003. Emissions from energy sources have also fallen, as a result of reductions in methane emissions from coal mining. Methane emissions from coal mines are estimated to have declined from 4.2 million metric tons in 1990 to 2.9 million metric tons in 2003. To some extent, the decline is attributable to an increase in methane recovery at coal mines, from 0.3 million metric tons in 1990 to about 0.8 million metric tons in 2003.[60]

The Voluntary Reporting Program has seen a rapid increase in reported methane emission reductions since 1994. The number of waste management projects reported (primarily landfill gas projects) has increased from 17 in 1994 to 425 in 2003. For the 2003 data year, reduction activities were reported on Form EIA-1605 for at least 341 separate landfills, up from 321 in 2002.[61] Projects reporting methane recovery from energy production (natural gas systems and coal mine methane recovery) have increased from 8 in 1994 to 41 in 2003. Agricultural projects remain a small category, fluctuating from 3 to 5 a year since 1994.

Overview of Projects Reported

For 2003, 71 organizations reported a total of 470 projects to reduce methane emissions, a 5.4-percent increase in projects from 2002 and nearly a 17-fold increase from the first (1994) reporting cycle (Table 17). Of the projects that were reported for 2003, 36 were reported for the first time, either because they began achieving reductions in 2003 or because they were reported by one of the 5 new reporters in the methane emission reduction categories. Some projects reported for previous years were not reported for 2003.

Direct reductions of methane emissions reported on Form EIA-1605 for all project types in 2003 totaled 3.3 million metric tons methane, down from 3.5 million metric tons reported for 2002 (Table 18). Waste treatment projects accounted for 72.8 percent of reported methane reductions. These reductions were derived from 425 waste treatment projects reported, averaging 5,736 metric tons of direct methane emission reductions per project (Figure 13). The 218 projects reported by Waste Management, Inc., resulted in a reported reduction of 1.4 million metric tons methane (33.0 million metric tons carbon dioxide equivalent), or 42.8 percent of total reported direct reductions of methane emissions.

Projects to reduce methane emissions from coal mines and natural gas systems generally yielded much larger direct reductions per project (Figure 13), averaging 22,964 metric tons methane. Total direct emission reductions of 0.4 million metric tons methane were reported for coal mining projects in 2003, accounting for 12.1 percent of the direct methane emission reductions reported for 2003. The 28 natural gas system projects reported for 2003 reduced direct methane emission by a total of 0.5 million metric tons methane, or about 15.9 percent of all reported direct methane emission reductions.

Indirect methane emission reductions from all projects types totaled 1.0 million metric tons for 2003 (Table 18), down slightly from the 1.1 million metric tons reported for 2002. The vast majority (99 percent) of indirect

[59]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

[60]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

[61]The counts of landfills represent minimum levels, because not all reporters explicitly identified the landfills on which they were reporting. The counts exclude reports received after the close of the reporting cycles, in order to maintain comparability.

methane emission reductions were reported for waste treatment and disposal projects. The waste treatment and disposal category included two very large projects reported by DTE Energy and the Integrated Waste Services Association (IWSA). DTE Energy reported 0.2 million metric tons of indirect reductions from multiple landfill gas-to-energy systems reported as one large project, and IWSA reported indirect reductions of 0.4 million metric tons from the waste-to-energy facilities of its members.

Reducing Methane Emissions from Waste Treatment and Disposal

Reducing emissions from waste treatment and disposal sites was the most frequently reported method for lowering methane emissions in 2003. These projects made up 90 percent of all the methane emission reduction projects reported, with 21 more projects reported for 2003 than for 2002. The principal reported method for reducing methane emissions from waste treatment and disposal was landfill gas recovery (the capture of methane generated during the anaerobic decomposition of wastes in a landfill). The recovered methane may be flared, piped to an end-use customer to be used as a fuel, or used to generate electricity, which can reduce the need for generation from other, more carbon-intensive fuels. Other methods of lowering emissions from waste treatment and disposal include reducing the volume of waste reaching landfills through combustion or recycling, and capturing methane generated during anaerobic decomposition of organic material in wastewater.

The 425 waste treatment and disposal projects reported for 2003 accounted for 2.4 million metric tons of direct methane emission reductions and 1.0 million metric tons of indirect reductions (Table 19). Of the 425 projects reported, 412 achieved methane emission reductions at landfills by capturing methane from landfill gas generated at waste disposal sites, 5 lowered emissions through diversion of wastes that would have emitted methane during decomposition, and 8 captured methane from wastewater treatment facilities.

Recovery of Landfill Gas

As waste decomposes in a landfill, it produces a biogas that is approximately 50 percent carbon dioxide and 50 percent methane. As a result, landfill gas is a potentially

Table 17. Projects Reported on Form EIA-1605 with Methane Reductions as the Principal Outcome by Project Type, Data Years 1994-2003
(Number of Projects)

Project Type	1994	1995	1996	1997	1998	1999	2000	2001	2002(R)	2003
Waste Management and Disposal	**17**	**23**	**44**	**53**	**90**	**153**	**350**	**391**	**404**	**425**
Landfill Gas Recovery	14	19	40	48	80	139	337	381	391	412
Wastewater Treatment	2	2	2	3	5	6	8	4	7	8
Waste Combustion	1	2	2	2	5	8	5	6	6	5
Agriculture	**3**	**3**	**3**	**3**	**4**	**4**	**5**	**3**	**3**	**4**
Energy Production and Consumption	**8**	**11**	**13**	**15**	**28**	**28**	**28**	**35**	**39**	**41**
Coal Mining	2	3	4	5	17	15	14	16	18	13
Natural Gas Production, Transmission, and Distribution	6	8	9	10	11	13	14	19	21	28
Total	**28**	**37**	**60**	**71**	**122**	**185**	**383**	**429**	**446**	**470**

(R) = revised.
Note: Project totals do not equal sum of components, because some projects are counted in more than one category.
Source: Energy Information Administration, Form EIA-1605.

Table 18. Total Methane Emission Reductions Reported on Form EIA-1605, All Project Types, Data Years 1994-2003
(Metric Tons Methane)

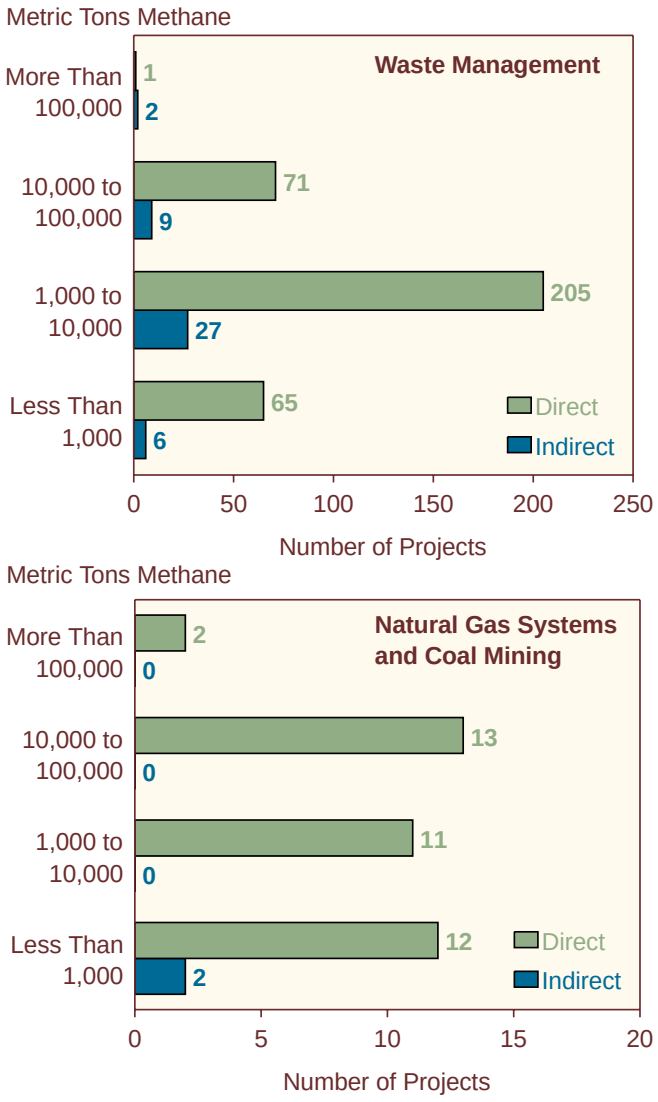
Type of Reduction	1994	1995	1996	1997	1998	1999	2000	2001	2002(R)	2003
Direct	25,079	8,450	409,176	378,494	1,379,162	1,564,958	2,693,295	3,546,480	3,481,465	3,347,511
Indirect	102,641	1,077,272	1,157,048	505,663	658,811	827,294	897,465	1,009,400	1,067,643	1,000,063

(R) = revised.
Source: Energy Information Administration, Form EIA-1605.

valuable source of energy, with a heat content of about 500 British thermal units (Btu) per cubic foot, or about half that of commercially marketed natural gas. Because of its relatively low Btu content and the presence of several impurities, the typical method for using landfill gas is to burn it for electricity generation rather than upgrading it for sale to a pipeline. The electricity generated is then used on site or sold to the grid. The process lowers methane emissions and reduces consumption of other fuels for electricity generation. When the electricity generated displaces oil- or coal-fired generation, carbon dioxide emissions are reduced. More recently, higher natural gas prices have resulted in an increasing number of projects that involve piping landfill gas for direct use in medium-Btu boilers, which also displaces fossil fuels.

For the 412 landfill gas recovery projects reported for 2003, reported direct methane emission reductions totaled 2.4 million metric tons and indirect reductions totaled 0.6 million metric tons. Of the projects reported, 170 recovered landfill methane for energy, 183 simply flared the gas, 49 included both recovery for energy and flaring, and 10 reported other activities.

Figure 13. Methane Emission Reduction Projects Reported on Form EIA-1605 by Type and Size of Reduction, Data Year 2003



Source: Energy Information Administration, Form EIA-1605.

Waste Combustion

When waste is diverted from a landfill through waste combustion, methane emissions that would have resulted when the waste decomposed at a landfill are avoided. Five waste combustion projects were reported for 2003. The preponderance of the methane emission reductions reported for waste combustion are indirect, because they typically occur at a landfill where diverted waste would have decomposed to produce methane, rather than at the site of the waste diversion activities. Total indirect reductions for the five projects were 0.4 million metric tons methane (Table 19). The majority of the reductions were reported by IWSA, which reported reductions associated with the combustion of waste at facilities owned by its members across the United States. IWSA's total reported reduction of methane emissions in 2003 was 0.4 million metric tons. Other methods of reducing methane emissions from waste include recycling and source reduction (see box on page 52).

Reducing Methane Emissions from Wastewater Treatment Plants

When wastewater is treated under anaerobic conditions, the decomposition of its organic portion yields methane. Like methane generated from waste at landfills, the methane generated from wastewater treatment may be captured and either flared or used as an energy resource. Because captured methane has value as an energy resource, operators may use an anaerobic digester to treat the wastewater and maximize methane generation. Eight projects to capture methane generated from wastewater treatment were reported for 2003, with total reported direct reductions of 60.1 thousand metric tons methane and indirect reductions of 10.7 thousand metric tons methane. Direct reductions of 43.2 thousand metric tons methane were reported for a Los Angeles County Sanitation District project, and Blue Source reported direct reductions of 16.9 thousand metric tons methane. Indirect reductions were reported for two projects sponsored by FirstEnergy.

Reducing Emissions from Energy Production and Consumption

Reducing Emissions from Coal Mines

As coal is formed from organic material by natural chemical and physical processes, methane is also created. The methane is stored in the pores (open spaces) of

Materials Management Projects

"Materials management" is a crosscutting category that can encompass a variety of greenhouse gas and emission sources, and may include any of the following activities:

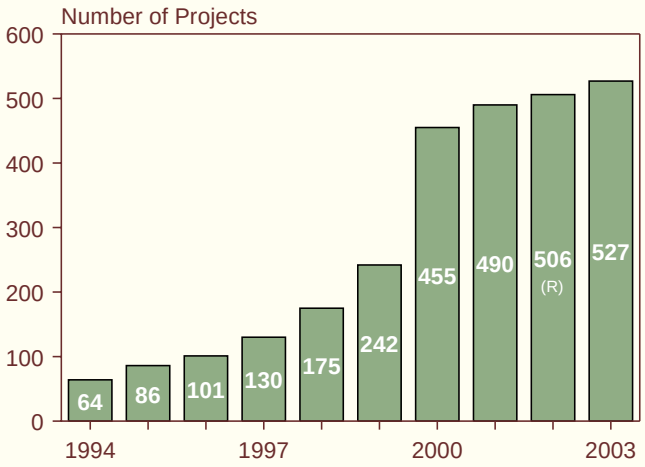
- Use of biomass fuels, such as wood waste, which reduces carbon dioxide emissions by displacing fossil fuels
- Avoidance of methane emissions from the decay of waste materials in landfills, wastewater treatment plants, and other waste management systems through activities such as recovery of methane from landfills or from anaerobic digesters treating municipal sewage, agricultural wastes, or animal manure, and diversion of municipal solid waste from landfills to waste-to-energy systems
- Recycling of halogenated substances, such as sulfur hexafluoride, hydrofluorocarbons, chlorofluorocarbons, and hydrochlorofluorocarbons
- Recycling and source reduction of solid waste, which reduce methane emissions from municipal landfills and reduce emissions of carbon dioxide and other gases associated with the production of virgin materials displaced by the materials recycled
- Reuse of coal ash as a substitute for Portland cement in concrete, which reduces carbon dioxide emissions from the manufacture of the cement.

Reporting of materials management activities on Form EIA-1605 increased more than eightfold from 1994 to 2003. A total of 526 projects were reported for 2003, 4 percent more than were reported for 2002 (see figure).

Landfill gas recovery accounted for most (78 percent) of the 526 materials management projects reported for 2003. In addition to 13 other methane emission avoidance projects reported, other materials management projects included coal ash reuse (33), recycling and source reduction of solid waste (34), recycling of halogenated substances (18), and biomass burning (16).

The emission reductions reported for materials management projects are shown in the table below. For 2003, reported net reductions in direct emissions were 50.4 million metric tons carbon dioxide equivalent, representing 19 percent of the total direct reductions reported. Reported indirect reductions were 52.0 million metric tons carbon dioxide equivalent, representing 64 percent of the total indirect reductions reported. Most of the reductions (99 percent of the direct and 89 percent of the indirect reductions) were associated with methane avoidance activities discussed in this chapter.

Materials Management Projects Reported on Form EIA-1605, Data Years 1994-2003



Source: Energy Information Administration, Form EIA-1605. (R) = revised.

Reported Emission Reductions from Materials Management Projects by Project Type and Type of Reduction, Data Year 2003

(Metric Tons Carbon Dioxide Equivalent)

Project Type	Number of Projects	Direct Reductions	Indirect Reductions
Biomass Burning	16	468,399	91,828
Methane Emission Avoidance			
Landfill Gas Recovery	412	54,659,548	14,923,688
Municipal Waste Combustion	1	-7,933,287	23,750,820
Wastewater Treatment	8	1,360,164	260,765
Agricultural Waste	4	1,616	2,204
Total	*425*	*48,088,042*	*38,937,478*
Halogenated Substances	18	1,633,398	2,224,018
Recycling and Source Reduction of Solid Waste	34	217,709	5,540,865
Coal Ash Reuse	33	0	5,233,686
Total	**526**	**50,407,548**	**52,027,875**

Source: Energy Information Administration, Form EIA-1605.

the coal itself and in cracks and fractures in the coalbed. As coal is mined, the pressure surrounding the stored methane decreases, allowing much of it to be released into the operating coal mine. Because methane in concentrations of 5 to 15 percent is explosive, mine operators use large fans to provide a steady airflow across the mine face and ventilate the mine shaft. Some very gassy mines must also employ degasification wells to remove methane before or after mining so that it does not enter the mine. Because methane is a valuable energy source, most of the mines with degasification systems now inject the methane into gas pipelines or use it to generate electricity or heat.

For 2003, 13 projects to reduce methane emissions from coal mines were reported, with total direct emission reductions of 0.4 million metric tons and indirect reductions of 96 metric tons methane (Table 20). Jim Walters Resources reported direct reductions of 0.2 million metric tons methane from three degasification projects, and CDX reported direct methane reductions of 0.1 million metric tons methane from its two projects.

Reducing Emissions from Natural Gas Production, Transmission, and Distribution

Methane is the principal constituent of natural gas (about 95 percent of the mixture). Methane emissions from natural gas production, processing, transmission, and distribution are generally process related, with normal operations, routine maintenance, and system upsets being the primary contributors. Emissions vary greatly from facility to facility and are largely a function of operation and maintenance procedures and equipment conditions. Thus, methane emissions can be reduced by replacing leaky system components, improving operations and maintenance, and limiting routine venting procedures. For 2003, 28 such projects were reported, with total direct emission reductions of 0.5 million metric tons methane. No indirect reductions were reported. NIPSCO reported 9 projects, associated with the Natural Gas STAR Program, that yielded 0.2 million metric tons of methane emission reductions. Other major reporters included NEGT, which reported one Natural Gas STAR

Table 19. Methane Emission Reductions from Waste Treatment and Disposal Projects Reported on Form EIA-1605, Data Years 1994-2003
(Thousand Metric Tons Methane)

Reduction and Project Type	1994	1995	1996	1997	1998	1999	2000	2001	2002(R)	2003
Direct Reductions	*	0.6	128.4	135.6	484.7	966.8	2,171.5	2,117.2	2,514.7	2,437.7
Landfill Gas Recovery	*	0.6	128.4	135.3	451.4	921.7	2,134.0	2,079.6	2,476.5	2,377.6
Wastewater Treatment	—	—	—	0.3	33.3	40.8	37.5	37.6	38.5	60.8
Waste Combustion	—	—	—	—	*	4.4	*	*	-0.8	-0.7
Indirect Reductions	99.4	1,061.7	1,142.9	449.6	644.7	815.3	884.5	1,003.3	1,003.3	988.4
Landfill Gas Recovery	99.4	111.3	250.5	298.3	470.9	575.5	612.9	701.9	623.8	569.1
Wastewater Treatment	—	*	*	—	4.7	19.6	12.7	13.1	13.1	10.7
Waste Combustion	*	950.4	892.4	151.3	169.1	220.2	259.0	288.3	366.5	408.6

*Less than 500 metric tons.
(R) = revised.
Source: Energy Information Administration, Form EIA-1605.

Table 20. Methane Emission Reductions from Natural Gas Systems and Coal Mining Reported on Form EIA-1605, Data Years 1994-2003
(Metric Tons Methane)

Reduction and Project Type	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Direct Reductions	19,687	7,714	279,766	242,040	893,927	595,311	518,590	657,894	797,154	941,512
Coal Mining	13,767	4,191	271,549	232,131	885,807	581,307	505,941	538,285	567,088	406,782
Natural Gas Systems	5,920	3,522	8,217	9,909	8,121	14,004	12,648	119,609	230,066	534,731
Indirect Reductions	—	3,543	4,039	5,439	7,603	6,565	6,785	96	96	96
Coal Mining	—	278	893	2,285	1,568	528	747	96	96	96
Natural Gas Systems	—	3,265	3,146	3,154	6,035	6,036	6,038	0	0	0

Source: Energy Information Administration, Forms EIA-1605 and EIA-1605EZ.

project with methane emission reductions of 0.2 million metric tons, and BP America, which reported 3 projects with aggregate reductions of 0.1 million metric tons methane.

Reducing Emissions from Agriculture

Four projects reported for 2003 focused on reducing emissions from agricultural activities, but only three of them reported methane emission reductions. FirstEnergy reported indirect methane emission reductions of 109 metric tons as the result of purchases of electricity generated from an anaerobic digester of animal waste at Mason Dixon Farms—an increase from the 73 metric tons reported for 2002. Alliant Energy reported two projects, at Deer Ridge Dairy and Double S Dairy, which reduced carbon dioxide emissions by 1,237 metric tons. The fourth agriculture project, reported by AES, was to improve feed supplements for cattle in India and reduce emissions from enteric fermentation. AES did not report an emission reduction quantity for 2003.

Federal Voluntary Programs To Reduce Methane Emissions

The U.S. Government sponsors a number of voluntary programs specifically targeted to reduce methane emissions. Most frequently cited by reporters to the Voluntary Reporting Program are the U.S. Environmental Protection Agency's Landfill Methane Outreach Program (LMOP), Coalbed Methane Outreach Program (CMOP), and Natural Gas STAR Program. In addition, reducing methane has been an effective method for meeting the reduction targets adopted by utilities under the U.S. Department of Energy's Climate Challenge voluntary program. The number of reported methane reduction projects associated with Federal voluntary programs has increased 14-fold since 1994, with a particularly large increase in the number of projects associated with the LMOP. Of the 425 waste treatment and disposal projects reported to the Voluntary Reporting Program for 2003, 365 (86 percent) were associated with the LMOP (Table 21).

Table 21. Number of Reported Methane Reduction Projects Associated with Other Federal Voluntary Programs, Data Years 1994-2003

Voluntary Program	1994	1995	1996	1997	1998	1999	2000	2001	2002(R)	2003
Climate Challenge	22	27	32	36	34	39	42	34	34	36
Landfill Methane Outreach Program	6	8	29	32	90	116	309	359	354	365
Coalbed Methane Outreach Program	1	1	2	2	10	11	6	9	9	6
Natural Gas STAR	7	9	11	6	5	7	7	14	17	23
Other	0	6	2	2	1	3	4	5	5	5
Total	**30**	**42**	**64**	**65**	**132**	**164**	**354**	**407**	**405**	**420**

(R) = revised.
Note: Totals may not equal sum of components, because some projects are associated with more than one voluntary program.
Source: Energy Information Administration, Form EIA-1605.

6. HFCs, PFCs, and Sulfur Hexafluoride

U.S. Emissions of HFCs, PFCs, and Sulfur Hexafluoride

In addition to the three principal greenhouse gases (carbon dioxide, methane, and nitrous oxide), three types of engineered gases—hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)—are also considered greenhouse gases under the United Nations Framework Convention on Climate Change (UNFCCC). HFCs are used as refrigerants, solvents, and propellants and in many other applications. PFCs are emitted as a byproduct of aluminum smelting and are used in semiconductor manufacture. The primary uses of SF_6 are in electrical transmission and distribution equipment and in magnesium production.

U.S. emissions of HFCs, PFCs, and SF_6 in 2003 were estimated to be 143.4 million metric tons carbon dioxide equivalent, down slightly from 143.7 million metric tons in 2002. Collectively, they accounted for 2.1 percent of total U.S. greenhouse gas emissions in 2003.[62] Annual emissions of these gases have increased by 62 percent since 1990, primarily due to increases in emissions of HFCs, which are used as replacements for chlorofluorocarbons (CFCs) in automobile air conditioners (Figure 14). CFCs are being phased out under the Montreal Protocol,[63] because they damage the Earth's stratospheric ozone layer, which absorbs harmful ultraviolet radiation from the sun. Emissions of both PFCs and SF_6 have fallen since 1990.

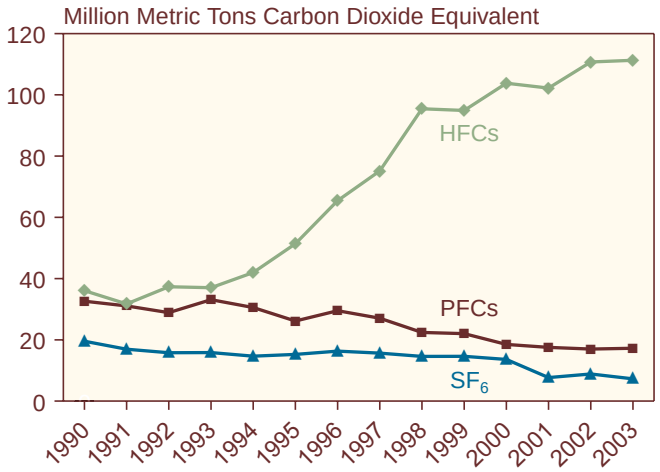
Projects Reported

For 2003, 38 entities reported on 66 projects that reduced emissions of HFCs, PFCs, and SF_6—1 more reporter and 2 more projects than were reported for 2002 (Table 22). Emissions avoidance and recycling of halogenated substances were two of the most frequently reported project types (24 and 18 projects reported, respectively), followed by substitution of other chemicals (7 projects reported) and the destruction of halogenated substances (1 project reported). Reductions in PFC emissions were also reported for 23 post-consumer waste-recycling projects in which aluminum was one of the materials collected and recycled.

The 38 entities reporting projects to reduce emissions of HFCs, PFCs, and SF_6 for 2003 included: 30 electric utilities; 2 aluminum smelters (Alcan Primary Products Corporation's Sebree Works and Noranda Aluminum, Inc.); a chemical company (Allergan); 1 transportation equipment company (General Motors); a company from the electronic equipment industry (Lucent Technologies, Inc.); a refrigerant reclamation company (Polar Refrigerant Technology); a holding and investment company (CLE Resources); an SF_6 recycling company (Xenon Specialty Gas); and a government organization (Burlington County Board of Chosen Freeholders).

Of the 38 entities that reported projects in this category, 16 were past participants in the U.S. Department of Energy's Climate Challenge Program and Rebuild America. Other voluntary programs with which the projects reported in this category were affiliated include the U.S. Environmental Protection Agency's (EPA's) Voluntary Aluminum Industrial Partnership, EPA's

Figure 14. Estimated U.S. Emissions of HFCs, PFCs, and Sulfur Hexafluoride, 1990-2003



Source: Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004).

[62]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

[63]The Montreal Protocol on Substances that Deplete the Ozone Layer is an international agreement, signed by most of the industrialized nations, to substantially reduce the use of CFCs. Signed in January 1989, the original document called for a 50-percent reduction in CFC use by 1992 relative to 1986 levels. The subsequent London Agreement called for a complete elimination of CFC use by 2000. The Copenhagen Agreement later accelerated that schedule, calling for a complete phaseout by January 1, 1996.

Waste Wise Program, and EPA's Sulfur Hexafluoride Emissions Reduction Partnership for Electric Power Systems.

Emission Reductions by Gas

Direct reductions of PFC and SF_6 emissions totaling 6.2 million metric tons carbon dioxide equivalent were reported by 21 entities for 24 projects carried out in 2003 (Table 23). The direct reductions included emissions of PFCs (3.6 million metric tons carbon dioxide equivalent) and SF_6 (2.6 million metric tons carbon dioxide equivalent). Indirect emission reductions totaled 2.5 million metric tons carbon dioxide equivalent, consisting primarily of SF_6 (2.2 million metric tons carbon dioxide equivalent) and smaller amounts of PFC and HFC emissions.

Hydrofluorocarbons

HFCs are used primarily as replacements for ozone-depleting substances such as CFCs and hydrochlorofluorocarbons (HCFCs). U.S. emissions of HFCs were estimated at 111 million metric tons carbon dioxide equivalent in 2003, a 209-percent increase over 1990 levels.[64] HFCs are used to replace CFCs as blowing agents, in automobile air conditioners and refrigerators, and in other manufacturing applications, where emissions result from system leaks. In the semiconductor industry, HFCs are also used in plasma etching and chemical vapor deposition processes. HFC-23 is a

Table 22. Number of Projects Reported on Form EIA-1605 for Hydrofluorocarbon, Perfluorocarbon, and Sulfur Hexafluoride Emissions, Data Years 1994-2003

Project Type	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
General	0	1	0	1	0	0	0	0	0	0
Reclamation: Recycling	7	10	10	14	15	15	18	16	18	18
Reclamation: Destruction	0	0	1	1	0	1	1	1	1	1
Substitution	1	5	7	7	8	9	9	6	6	7
Emissions Avoidance	3	6	8	13	17	16	23	23	24	24
Use of Improved Appliances	0	1	1	1	1	1	1	0	0	0
Other Projects/Activities	1	1	0	0	0	0	0	0	0	0
PFC Reductions from Materials Recycling	0	0	0	4	7	10	20	19	21	23
Total Number of Projects	**13**	**21**	**22**	**33**	**42**	**46**	**63**	**58**	**63**	**66**

Note: Project totals may not equal sum of components because some projects may be counted in more than one category.
Source: Energy Information Administration, Form EIA-1605.

Table 23. Reductions of Hydrofluorocarbon, Perfluorocarbon, and Sulfur Hexafluoride Emissions Reported on Form EIA-1605, Data Years 1994-2003
(Thousand Metric Tons Carbon Dioxide Equivalent)

Gas and Reduction Type	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
HFCs										
Direct	*	*	15.2	*	-1.7	-1.7	—	—	—	—
Indirect	—	—	—	—	—	—	—	—	**	38.7
PFCs										
Direct	3,199.6	2,962.4	3,345.8	3,318.6	3,504.4	3,425.5	3,233.6	3,606.8	3,562.9	3,550.5
Indirect	—	—	—	3.6	6.1	5.9	35.5	34.3	36.7	237.4
SF_6										
Direct	83.6	186.4	-70.0	516.7	624.8	595.4	1,407.3	2,475.1	3,043.7	2,611.9
Indirect	—	7.7	—	**	**	**	**	**	0.1	2,184.7
Total										
Direct	**3,283.2**	**3,148.8**	**3,291.0**	**3,835.3**	**4,127.4**	**4,019.1**	**4,641.0**	**6,082.0**	**6,606.6**	**6,162.4**
Indirect	**—**	**7.7**	**—**	**3.6**	**6.1**	**5.9**	**35.5**	**34.3**	**36.8**	**2,460.8**

*Less than 0 but greater than -50 metric tons.
**Greater than 0 but less than 50 metric tons.
(R) = revised. — = none reported.
Source: Energy Information Administration, Form EIA-1605.

[64]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

byproduct of HCFC-22 manufacturing. The Tennessee Valley Authority reported on a project that included direct reductions of HFC-134a, but for which no reduction data have been available since 1998.

Perfluorocarbons

U.S. emissions of PFCs in 2003 totaled 7.3 million metric tons carbon dioxide equivalent.[65] The principal source of PFC emissions is aluminum smelting. PFCs are produced during aluminum production when the alumina content of the electrolytic bath falls below critical levels required by the electrolytic effect. The resulting electrical upset in the reduction cell is manifested as a rapid voltage increase. The gases formed accumulate at the anode of the reduction cell (hence the name "anode effect"). PFCs are also used in some semiconductor manufacturing processes and, consequently, may be emitted from fabrication plants.

For 2003, five companies (Alcan Primary Products Corporation, Burlington County Board of Chosen Freeholders, City Public Service, Los Angeles Department of Water and Light, and Noranda Aluminum, Inc.) reported reductions in direct emissions of PFCs totaling 3.6 million metric tons carbon dioxide equivalent, which accounted for 58 percent of total reported project-level direct reductions in emissions of PFCs, HFCs, and SF_6 in 2003. Alcan and Noranda together accounted for 98 percent of total reported direct reductions of PFC emissions (3.5 million metric tons carbon dioxide equivalent) and 56 percent of total reported direct reductions of HFC, PFC, and SF_6 emissions.

During 2003, efforts by Noranda to reduce PFC emissions were focused on controlling the amount of alumina in solution to avoid anode effects and monitoring the process more closely to stop or correct them expeditiously. According to Noranda's report, perfluoromethane emissions were reduced by 2.6 million metric tons carbon dioxide equivalent and perfluoroethane emissions by 0.6 million metric tons carbon dioxide equivalent. Alcan reported direct reductions of perfluoromethane emissions totaling 0.3 million metric tons carbon dioxide equivalent. Additionally, City Public Service and Los Angeles Department of Water and Power reported materials recycling projects (see box in Chapter 5, page 52) that included direct reductions of PFC emissions totaling 22,516 and 1,630 metric tons carbon dioxide equivalent, respectively, during 2003.

The U.S. Environmental Protection Agency sponsors the Voluntary Aluminum Industrial Partnership, which seeks to reduce emissions of PFCs, carbon tetrachloride, and SF_6 during primary aluminum processing. For 2003, both Alcan and Noranda reported participation in the program.

Sulfur Hexafluoride

U.S. emissions of SF_6 in 2003 totaled 17.3 million metric tons carbon dioxide equivalent.[66] SF_6 is used as an insulator for circuit breakers, switch gear, and other electrical equipment and as a cover gas in magnesium smelting. It is also emitted during the aluminum smelting process. It has a very high GWP—22,200 times the warming effect of carbon dioxide per ton emitted.[67]

For 2003, 17 companies—including Allegheny Energy, Inc., American Electric Power, Inc., Cinergy Corp., City Public Service, City Utilities of Springfield, Consolidated Edison of New York, Inc., Constellation Energy Group, Inc., Duke Energy Corporation, Entergy Services, Inc., FirstEnergy Corporation, FPL Group, Minnesota Power, National Grid USA, NiSource/NIPSCO, Southern California Edison Co., Southern Company, Tucson Electric Power Company, and TXU—claimed direct reductions of SF_6 emissions that totaled 2.6 million metric tons carbon dioxide equivalent, accounting for 42 percent of the total reported project-level direct reductions in emissions of PFCs, HFCs, and SF_6 (Table 23).

For those companies reporting direct reductions of SF_6 emissions for 2003, Consolidated Edison of New York, Inc., reported the largest single reduction (1.5 million metric tons carbon dioxide equivalent), followed by the Southern Company (0.6 million metric tons), TXU (0.3 million metric tons), and Southern California Edison Company (0.1 million metric tons). These four project-level claims of emission reductions combined to account for 99 percent (2.6 million metric tons carbon dioxide equivalent) of total reported project-level direct reductions of SF_6 emissions for 2003 and 42 percent of total project-level direct emission reductions claimed for HFCs, PFCs, and SF_6 combined (Table 24).

[65]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

[66]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

[67]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

Table 24. Largest Project-Level Direct Reductions of Sulfur Hexafluoride Emissions Reported on Form EIA-1605 by Reporter, Data Year 2003

Reporter	Direct SF_6 Emission Reductions Reported		Percent of Total Reported Direct Reductions of HFC, PFC, and SF_6 Emissions[a]
	Metric Tons of Gas	Metric Tons Carbon Dioxide Equivalent	
Consolidated Edison Company of New York, Inc.	69.5	1,542,047	25.0
Southern Company	25.0	555,000	9.0
TXU	15.6	347,060	5.6
Southern California Edison Co.	6.1	134,363	2.2
National Grid USA	2.6	57,388	0.9
Cinergy Corp.	2.4	52,948	0.9
NiSource/NIPSCO	2.0	44,710	0.7
Duke Energy Corporation	1.9	42,180	0.7
Tucson Electric Power Company	1.6	35,561	0.6
National Grid USA	1.3	28,085	0.5
American Electric Power, Inc.	0.4	9,476	0.2
City Public Service	0.4	8,660	0.1
Entergy Services, Inc.	0.2	3,524	0.1
FPL Group	0.2	3,524	0.1
Reported Total	**129.0**	**2,864,526**	**46.5**

[a]Based on metric tons carbon dioxide equivalent.

Note: Totals may not equal sum of components due to independent rounding.

Sources: Energy Information Administration, Form EIA-1605. Global warming potentials from Intergovernmental Panel on Climate Change, *Climate Change 2001: The Scientific Basis* (Cambridge, UK: Cambridge University Press, 2001), Table 6.7, pp. 388-389.

7. Entity-Level Reporting and Future Commitments

Overview

The Voluntary Reporting of Greenhouse Gases Program permits three distinct types of emissions reporting:

- Entity-level emissions and emission reductions, defined as the emissions and reductions of an entire organization, usually defined as a corporation
- Project-level emissions and reductions, defined as the emission reductions consequences of a particular project or action
- Commitments to take action to reduce emissions in the future.

Chapters 2 through 6 of this report cover project-level emissions and reductions. This chapter covers entity-level emissions, emission reductions, and commitments to reduce emissions in the future.

Entity reporting and project reporting are not mutually exclusive. Most (177, or 76 percent) of the 233 non-confidential participants in the Program for 2003 reported project-level information on emissions and/or reductions, and 126 (54 percent) reported entity-level information. Of all the participants in the Program, 70 (30 percent) reported both entity-level information and project-level information. In addition, 89 entities (38 percent of all participants in the Program) reported formal commitments to reduce greenhouse gas emissions in the future or to provide financial support for activities related to greenhouse gas reductions.

Entity-Level Reporting

Who Reported

Electric power producers accounted for 45 of the 126 entity-level reporters. They included Allegheny Energy, Alliant Energy, Cinergy Corp., Constellation Energy, DTE Energy/Detroit Edison, Entergy Services, Inc., FirstEnergy Corporation, FPL Group, PG&E, PacifiCorp, Seattle City Light, the Southern Company, the Tennessee Valley Authority (TVA), and most of the largest electric power companies in the United States. In addition, 4 subsidiaries of the AES Corporation (an independent power producer) reported on domestic power plants with emissions offset by international forestry projects.

The remaining 81 entity-level reporters included an aluminum smelter (Alcan Primary Products Corporation, Sebree Works), 8 plants of CommScope (a designer and manufacturer of cables for telecommunications applications), a semiconductor manufacturer (Lucent Technologies, Inc.), and several large manufacturers (Daimler Chrysler, Toyota Motor North America, Inc., Ford, General Electric, General Motors, IBM, Johnson & Johnson, and Rolls-Royce Corporation). Also reporting at the entity level were the Lehigh Cement Company, 2 oil companies (Sunoco, Inc., and BP America), a chemical company (the Dow Chemical Company), an aircraft manufacturer (Sikorsky Aircraft Corporation), textile manufacturers (including 2 plants of Hanes Dye & Finishing, 4 plants of M.J. SOFFE Company, 6 plants of National Spinning, Inc., and the Valdese Manufacturing Company), a trade association (Integrated Waste Services Association), and the Miller Brewing Company.

Reported Emissions

Total 2003 entity-level direct emissions of greenhouse gases reported to the Voluntary Reporting Program were 889 million metric tons carbon dioxide equivalent, or 13 percent of total estimated U.S. emissions of greenhouse gases[68] (Table 25). Entity-level indirect emissions reported to the Program were 105 million metric tons carbon dioxide equivalent, or 2 percent of total U.S. greenhouse gas emissions. Carbon dioxide was the most widely reported greenhouse gas in terms of tonnage. Reported entity-level direct carbon dioxide emissions were 861 million metric tons, representing 97 percent of entity-level reported direct emissions (Table 25). Carbon dioxide also accounted for 95 percent (100 million metric tons) of all reported indirect emissions (Table 25), of which 99 million metric tons resulted from purchased power transactions (i.e., the indirect emissions associated with generation of the electricity purchased) (Table 26).

The single largest category of direct carbon dioxide emissions reported was the 836 million metric tons carbon dioxide emitted by stationary combustion sources (mostly electricity generators), which represented 97 percent of the total direct carbon dioxide emissions

[68]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, DC, December 2004), web site www.eia.doe.gov/oiaf/1605/ggrpt.

reported for 2003 (Table 26). The 5 largest reporters of direct carbon dioxide emissions were TVA (85 million metric tons), Cinergy Corporation (60 million metric tons), Duke Energy Corporation (56 million metric tons), FPL Group (55 million metric tons), and PacifiCorp (46 million metric tons) (Table 27). Companies reporting at least 20 million metric tons of direct carbon dioxide emissions included FirstEnergy Corporation, Allegheny Energy, Inc., DTE Energy/Detroit Edison, BP America, Entergy Services, Inc., The Dow Chemical Company, Florida Power Corporation, NEGT, Dynegy, Inc., and Constellation Energy.

Direct emissions of greenhouse gases other than carbon dioxide included methane (24 million metric tons carbon dioxide equivalent), hydrofluorocarbons (3 million metric tons carbon dioxide equivalent), sulfur hexafluoride (1 million metric tons carbon dioxide equivalent), and perfluorocarbons (less than 1 million metric tons carbon dioxide equivalent). Reported direct emissions of nitrous oxide were less than 0.1 million metric tons carbon dioxide equivalent (Table 25).

Entity-level direct emissions of methane were reported by 13 companies for 2003, including 4 companies that

Table 25. Total Reported Entity-Level Emissions of Greenhouse Gases Other Than Carbon Dioxide by Type of Emissions, Data Year 2003
(Million Metric Tons Carbon Dioxide Equivalent)

Gas and Type of Emissions	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Carbon Dioxide														
Direct	737.3	575.7	676.6	712.5	762.2	791.2	798.0	842.9	937.4	946.3	964.5	853.3	861.1	861.3
Indirect	434.4	420.9	423.0	429.7	432.5	432.4	438.9	457.8	428.5	428.3	98.1	91.7	107.7	99.9
Methane														
Direct	59.1	18.1	18.5	14.2	32.4	33.3	30.0	31.9	36.9	31.4	30.0	29.9	27.0	23.8
Indirect	2.1	2.1	2.1	2.1	2.0	1.9	1.9	1.8	1.7	1.6	0.4	0.4	0.3	0.3
Nitrous Oxide														
Direct	*	*	*	*	*	*	*	*	*	*	0.1	*	0.1	*
Indirect	17.3	18.1	19.0	19.8	20.5	20.4	19.9	19.3	18.6	17.9	*	*	*	*
Hydrofluorocarbons														
Direct	*	*	*	*	*	*	*	*	0.1	0.2	0.4	0.8	2.4	2.6
Indirect	*	*	0.1	2.2	4.9	5.4	5.0	5.2	5.2	5.2	5.2	3.9	5.6	4.5
Perfluorocarbons														
Direct	0.6	0.6	0.6	0.6	0.3	0.3	0.3	0.3	0.2	0.1	0.2	0.2	0.2	0.3
Sulfur Hexafluoride														
Direct	0.2	0.4	0.4	0.4	1.4	1.4	1.5	1.2	1.0	0.5	1.1	1.2	1.2	0.9
Total														
Direct	**797.2**	**594.8**	**696.1**	**727.7**	**796.4**	**826.2**	**829.8**	**876.4**	**975.5**	**978.5**	**996.3**	**885.4**	**892.0**	**888.8**
Indirect	**453.9**	**441.1**	**444.2**	**453.8**	**459.8**	**460.1**	**465.7**	**484.1**	**454.0**	**453.1**	**103.6**	**96.0**	**113.6**	**104.7**

*Less than 0.05 million metric tons.
Source: Energy Information Administration, Form EIA-1605.

Table 26. Total Reported Entity-Level Carbon Dioxide Emissions by Type and Source, Data Year 2003
(Million Metric Tons Carbon Dioxide)

Type of Emission Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Direct Emissions														
Stationary Combustion	731.8	570.6	667.8	703.2	752.1	770.5	777.1	822.3	915.3	924.1	942.7	830.9	838.1	835.8
Transportation	1.3	0.2	0.2	0.2	0.8	11.8	11.7	12.0	13.3	13.5	13.3	13.2	13.1	13.8
Other Direct Sources	4.2	4.9	8.6	9.0	9.3	8.9	9.2	8.6	8.4	8.6	8.4	9.2	9.9	11.7
Total Direct	**737.3**	**575.7**	**676.6**	**712.5**	**762.2**	**791.2**	**798.0**	**842.9**	**937.4**	**946.3**	**964.5**	**853.3**	**861.1**	**861.3**
Indirect Emissions														
Purchased Power	60.2	55.6	53.6	59.3	60.5	65.8	79.0	105.3	83.3	87.6	97.9	91.5	107.1	99.3
Other Indirect Sources	374.2	365.3	369.4	370.5	372.0	366.6	360.0	352.5	345.3	340.8	0.2	0.2	0.6	0.6
Total Indirect	**434.4**	**420.9**	**423.0**	**429.7**	**432.5**	**432.4**	**438.9**	**457.8**	**428.5**	**428.3**	**98.1**	**91.7**	**107.7**	**99.9**

Source: Energy Information Administration, Form EIA-1605.

reported direct methane emissions in excess of 1 million metric tons carbon dioxide equivalent: Consol Coal Group (11 million metric tons), Jim Walter Resources, Inc. (4 million tons), Peabody Holding Company, Inc. (4 million metric tons), and BP America (3 million metric tons) (Table 28). These 4 entities together accounted for 81 percent of all reported direct emissions of other greenhouse gases for 2003. Direct emissions of HFCs

Table 27. Largest Reported Entity-Level Direct Carbon Dioxide Emissions by Reporter and Source, Data Year 2003

Reporter	Emissions Source	Reported Direct Carbon Dioxide Emissions (Million Metric Tons)	Percentage of Total Reported Direct Emissions of All Greenhouse Gases
Tennessee Valley Authority	Stationary Combustion	85.4	9.6
Cinergy Corp.	Stationary Combustion	60.4	6.8
Duke Energy Corporation	Stationary Combustion	56.3	6.3
FPL Group	Stationary Combustion	55.1	6.2
PacifiCorp	Stationary Combustion	46.4	5.2
FirstEnergy Corporation	Stationary Combustion	42.3	4.8
Allegheny Energy, Inc.	Stationary Combustion	41.7	4.7
DTE Energy/Detroit Edison	Stationary Combustion	38.3	4.3
BP America	Stationary Combustion	33.7	3.8
Entergy Services, Inc.	Stationary Combustion	33.4	3.8
The Dow Chemical Company	Stationary Combustion	27.1	3.1
Florida Power Corporation	Stationary Combustion	22.5	2.5
NEGT	Stationary Combustion	21.3	2.4
Dynegy, Inc.	Stationary Combustion	20.4	2.3
Constellation Energy	Stationary Combustion	19.7	2.2
Total		**604.1**	**68.0**

Source: Energy Information Administration, Form EIA-1605.

Table 28. Largest Reported Entity-Level Direct Emissions of Greenhouse Gases Other Than Carbon Dioxide by Reporter and Emissions Source, Data Year 2003

Reporter	Gas	Emissions Source	Reported Direct Emissions (Thousand Metric Tons Carbon Dioxide Equivalent)	Percentage of Total Reported Direct Emissions of Other Greenhouse Gases
Consol Coal Group	Methane	Other Direct	11,129.8	40.4
Jim Walter Resources, Inc.	Methane	Other Direct	4,438.7	16.1
Peabody Energy	Methane	Other Direct	3,572.1	13.0
BP America	Methane	Other Direct	3,275.8	11.9
General Electric Company	HFC-134a	Other Direct	1,141.8	4.1
Dow Chemical Company	HFC-134a	Other Direct	1,128.5	4.1
Public Service Enterprise Group	Methane	Other Direct	723.1	2.6
Cinergy Corp.	Methane	Other Direct	459.7	1.7
Duke Energy Corporation	Sulfur Hexafluoride	Other Direct	297.5	1.1
Public Service Enterprise Group	Sulfur Hexafluoride	Other Direct	284.0	1.0
Alcan Primary Metals Group Sebree Works	Perfluoromethane	Other Direct	210.2	0.8
Mitsubishi Motors North America, Inc.	HFC-143a	Other Direct	137.6	0.5
Cinergy Corp.	Sulfur Hexafluoride	Other Direct	116.2	0.4
The Dow Chemical Company	Methane	Other Direct	115.8	0.4
Mitsubishi Motors North America, Inc.	HFC-125	Other Direct	108.8	0.4
Total			**27,139.6**	**98.5**

Source: Energy Information Administration, Form EIA-1605.

were reported by 6 companies, including 2 companies (General Electric and Dow Chemical) with emissions in excess of 1 million metric tons carbon dioxide equivalent. Direct emissions of sulfur hexafluoride were reported by 8 companies, including 2 companies (Duke Energy and Public Service Enterprise Group) with emissions in excess of 0.2 million metric tons carbon dioxide equivalent. Direct emissions of perfluorocarbons were reported by 3 companies, including Alcan Primary Metals Group–Sebree Works, which reported emissions of 0.2 million metric tons carbon dioxide equivalent.

Reported Reductions

Entity-level direct reductions of greenhouse gas emissions reported for 2003 totaled 214 million metric tons carbon dioxide equivalent, and reported indirect reductions totaled 43 million metric tons carbon dioxide equivalent. Carbon sequestration reductions reported at the entity level were 7 million metric tons carbon dioxide equivalent (Table 29).

Reported entity-level direct reductions of carbon dioxide emissions totaled 140 million metric tons (Table 30), of which 131 million metric tons was reported as reductions in emissions from stationary source combustion. Reported indirect reductions of carbon dioxide emissions totaled 31 million metric tons, including 30 million metric tons from sources other than stationary source combustion, such as load control improvements, building shell improvements, improvement or replacement of equipment and appliances, lighting and lighting control improvements, coal ash reuse, materials recycling and reuse, heating, ventilation, and air conditioning (HVAC), and improvements in motors and motor drives.

Reported direct reductions in emissions of greenhouse gases other than carbon dioxide for 2003 totaled 74 million metric tons carbon dioxide equivalent, and indirect reductions totaled 11 million metric tons (Table 29). Virtually all were reductions in emissions of methane.

The largest direct reductions for 2003 were reported by Waste Management, Inc. (33 million metric tons carbon dioxide equivalent of methane), TVA (25 million metric tons carbon dioxide), FPL Group (22 million metric tons carbon dioxide), Consol Coal Group (20 million metric tons carbon dioxide equivalent of methane), Southern Company (15 million metric tons carbon dioxide), and Duke Energy Corporation (11 million metric tons carbon dioxide). These 6 reported entity-level direct reductions

Table 29. Total Reported Entity-Level Reductions in Emissions of Greenhouse Gases by Gas and Source, Data Year 2003
(Million Metric Tons Carbon Dioxide Equivalent)

Gas and Type of Reduction	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Carbon Dioxide													
Direct	25.7	43.5	46.4	62.9	85.3	93.5	94.4	108.5	114.3	136.4	141.7	142.5	139.8
Indirect	12.7	10.9	9.1	5.4	10.1	13.4	13.4	17.3	18.8	19.4	20.9	26.1	31.1
Methane													
Direct	5.9	8.1	15.8	21.5	30.9	36.6	41.2	45.4	51.6	58.1	63.9	71.9	74.7
Indirect	1.7	2.7	3.2	3.6	4.0	4.6	5.6	6.2	6.8	8.0	9.0	10.7	11.3
Nitrous Oxide													
Direct	*	*	*	*	*	*	*	*	*	-0.1	*	*	*
Indirect	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Hydrofluorocarbons													
Direct	—	—	—	*	*	*	*	*	-0.2	-0.3	-0.7	-1.2	-1.1
Indirect	—	—	—	—	—	—	—	—	—	—	—	—	—
Perfluorocarbons													
Direct	*	*	*	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.4	0.5	0.4
Indirect	*	*	*	*	*	*	*	*	*	*	*	*	*
Sulfur Hexafluoride													
Direct	*	*	*	*	0.1	*	0.4	0.6	0.6	0.6	0.7	0.9	0.5
Indirect	—	—	—	—	—	—	*	*	*	*	*	*	*
Total													
Direct	**31.6**	**51.5**	**62.3**	**84.5**	**116.4**	**130.3**	**136.1**	**154.7**	**166.5**	**195.0**	**206.1**	**214.5**	**214.2**
Indirect	**14.5**	**13.7**	**12.3**	**9.1**	**14.2**	**18.2**	**19.1**	**23.6**	**25.7**	**27.5**	**29.9**	**36.9**	**42.6**

*Less than 0.05 million metric tons.
— = none reported.
Note: Negative numbers indicate increases in emissions.
Source: Energy Information Administration, Form EIA-1605.

accounted for 59 percent (125 million metric tons) of total reported entity-level direct reductions (Table 31).

The largest reporter of indirect emission reductions was the Integrated Waste Services Association (IWSA), which reported indirect emission reductions on behalf of its members. IWSA reported indirect emission reductions of 15 million metric tons of carbon dioxide and 9 million metric tons carbon dioxide equivalent of methane, resulting from the combustion of municipal solid waste. Southern Company and FPL Group reported indirect reductions of carbon dioxide emissions at 4 million and 3 million metric tons, respectively (Table 32). These 4 reductions together accounted for 30 million metric tons carbon dioxide equivalent or 62 percent of total reported positive indirect emission reductions.[69]

Most of the larger reported reductions (direct and indirect) were computed on the basis of "modified" reference cases—i.e., the reporter indicated that emissions were lower than they would have been without the actions taken (Tables 31 and 32). TVA, for example, used a generation planning model to calculate what its emissions from 1990 through 2003 would have been if it had used the set of generating units operational in 1990 at the 1990 capacity factors and heat rates. Since 1990, TVA has greatly expanded nuclear generation. Browns Ferry Unit 2 returned to service in 1991, Browns Ferry Unit 3 returned to service in 1995, and Watts Bar Unit 1 started commercial operation in 1996. TVA's reported carbon dioxide emissions from stationary combustion sources for 2003 were 11 million metric tons above 1990 levels but 25 million metric tons below what they would have been if the 1990 generation mix and heat rates had been used.

IWSA reported two sources of indirect reductions: (1) by burning municipal solid waste to generate electricity, its members made it possible for electric utilities to burn less coal; and (2) if the municipal solid waste had not been burned, it could reasonably have been expected to be landfilled, and some portion of the landfilled waste would have decomposed anaerobically, producing methane emissions. Thus, IWSA reported that burning the waste reduced both fossil fuel burning and methane emissions on the part of others.

A total of 31 companies reported emission reductions or sequestration at the entity level using a "basic" reference case. In a basic reference case, reductions are calculated as the difference between actual emissions in the reporting year and emissions in a baseline year. Of these 31 companies, 15 were electric power producers: AES Thames, LLC, Arizona Public Service Company, Consolidated Edison of New York, Inc., DTE Energy/Detroit Edison, Duke Energy Corporation, Florida Power Corporation, Hawaiian Electric Company, KeySpan Energy Corporation, Los Angeles Department of Water and Power, National Grid USA, PG&E Corporation, Sacramento Municipal Utility District, TVA, Tucson Electric Power Company, and Waverly Light & Power Company. The 16 other reporters using a "basic" reference case included BMW US Holding Corp., Consol Coal Group, The Dow Chemical Company, General Motors Corporation, International Truck and Engine Corporation, Lucent Technologies, Inc., Peabody Energy, Republic Metals Group, Rolls-Royce Corporation, Sunoco, Inc., and Toyota Motor North America, Inc.

Table 30. Total Reported Entity-Level Carbon Dioxide Emission Reductions by Type and Source, Data Year 2003
(Million Metric Tons Carbon Dioxide)

Type of Reduction Source	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Direct Reductions													
Stationary Combustion	25.5	44.6	47.7	64.1	86.1	94.1	94.0	107.7	112.9	128.3	133.0	134.4	130.9
Transportation	*	*	*	*	*	0.1	0.2	0.5	0.5	0.7	0.8	0.8	0.7
Other Direct Sources	0.2	-1.2	-1.3	-1.2	-0.9	-0.6	0.1	0.3	0.8	7.4	7.9	7.4	8.1
Total Direct	**25.7**	**43.5**	**46.4**	**62.9**	**85.3**	**93.5**	**94.4**	**108.5**	**114.3**	**136.4**	**141.7**	**142.5**	**139.8**
Indirect Reductions													
Purchased Power	*	-2.6	-4.1	-9.7	-8.4	-6.7	-6.8	-3.4	-5.1	-5.1	-4.4	-3.6	1.4
Other Indirect Sources	12.7	13.5	13.2	15.1	18.6	20.2	20.2	20.7	24.0	24.5	25.3	29.6	29.7
Total Indirect	**12.7**	**10.9**	**9.1**	**5.4**	**10.1**	**13.4**	**13.4**	**17.3**	**18.8**	**19.4**	**20.9**	**26.1**	**31.1**
Carbon Sequestered	**0.6**	**1.6**	**6.0**	**6.1**	**6.9**	**6.9**	**7.8**	**8.0**	**8.1**	**7.4**	**7.6**	**6.9**	**6.9**

*Less than 0.05 million metric tons.
Note: Negative numbers indicate increases in emissions.
Source: Energy Information Administration, Form EIA-1605.

[69]Negative indirect reductions in entity-level emissions (i.e., emission increases) were reported for 2003 by 25 participants in the Voluntary Reporting Program.

Future Commitments To Reduce Emissions

The Voluntary Reporting Program also permits entities to report commitments to reduce emissions or to take action to reduce emissions in the future. There are three types of future commitments in the Program: entity commitments, financial commitments, and project commitments. Entity and project commitments roughly parallel the entity and project aspects of emissions reporting: an entity commitment is a commitment to reduce the emissions of an entire organization; and a project commitment is a commitment to take a particular action that will have the effect of reducing the reporter's future emissions. A financial commitment has no emissions reporting counterpart: it is a commitment to spend a particular sum of money on emission reduction activities, without a specific promise on the emissions consequences of the expenditure.

Table 31. Largest Individual Reported Entity-Level Direct Emission Reductions by Gas, Source, and Type of Reference Case Employed, Data Year 2003

Reporter	Gas	Source	Reference Case	Reported Direct Emission Reduction (Million Metric Tons Carbon Dioxide Equivalent)	Percent of Total Reported Direct Reductions
Waste Management, Inc.	CH_4	Other Direct	Modified	32.9	15.4
Tennessee Valley Authority	CO_2	Stationary Combustion	Modified	25.2	11.8
FPL Group	CO_2	Stationary Combustion	Modified	21.6	10.1
Consol Coal Group	CH_4	Other Direct	Basic	20.2	9.4
Southern Company	CO_2	Stationary Combustion	Modified	14.5	6.7
Duke Energy Corporation	CO_2	Stationary Combustion	Modified	11.0	5.1
FirstEnergy Corporation	CO_2	Stationary Combustion	Modified	8.0	3.7
Blue Source, LLC	CO_2	Other Direct	Modified	6.8	3.2
Entergy Services, Inc.	CO_2	Stationary Combustion	Modified	6.7	3.1
Constellation Energy	CO_2	Stationary Combustion	Modified	6.2	2.9
Jim Walter Resources, Inc.	CH_4	Other Direct	Modified	5.1	2.4
NiSource/NIPSCO	CH_4	Other Direct	Modified	4.8	2.2
Florida Power Corporation	CO_2	Stationary Combustion	Modified	4.8	2.2
NEGT	CH_4	Other Direct	Modified	3.9	1.8
The Dow Chemical Company	CO_2	Stationary Combustion	Basic	3.8	1.8
PG&E Corporation	CO_2	Stationary Combustion	Modified	2.9	1.4
Municipal Electric Auth of Georgia (MEAG Power)	CO_2	Stationary Combustion	Modified	2.9	1.3
Palmer Capital Corporation	CH_4	Other Direct	Modified	2.8	1.3
Alliant Energy	CO_2	Stationary Combustion	Modified	2.6	1.2
KeySpan Energy Corporation	CO_2	Stationary Combustion	Basic	2.4	1.1
BP America	CO_2	Stationary Combustion	Modified	2.0	0.9
BP America	CH_4	Other Direct	Modified	2.0	0.9
DTE Energy/Detroit Edison	CO_2	Stationary Combustion	Basic	1.8	0.8
General Motors Corporation	CO_2	Stationary Combustion	Basic	1.7	0.8
Allegheny Energy, Inc.	CO_2	Stationary Combustion	Modified	1.5	0.7
Cinergy Corp.	CO_2	Stationary Combustion	Modified	1.5	0.7
Sunoco, Inc.	CO_2	Stationary Combustion	Basic	1.4	0.7
Hawaiian Electric Company, Inc.	CO_2	Stationary Combustion	Basic	1.3	0.6
PacifiCorp	CO_2	Stationary Combustion	Modified	1.2	0.6
Santee Cooper	CO_2	Stationary Combustion	Modified	1.2	0.6
NiSource/NIPSCO	CO_2	Stationary Combustion	Modified	1.1	0.5
The Burlington Northern and Santa Fe Railway Co.	CO_2	Transportation	Modified	1.0	0.5
Total				**207.0**	**96.6**

Note: For 2003, negative direct entity-level emission reductions were reported by 27 participants in the Voluntary Reporting of Greenhouse Gases Program.

Source: Energy Information Administration, Form EIA-1605.

Entity-Level Commitments

Entity-level commitments to reduce greenhouse gas emissions were reported by 56 participants in the Voluntary Reporting Program. These firms made promises to reduce, avoid, or sequester future emissions at the corporate level. As in the case of entity reporting, some commitments were to reduce emissions below a specific baseline, others to limit the growth of emissions per unit of output, and others to limit emissions by a specific amount in comparison with a baseline emissions growth trend. Participants reporting entity-level commitments to reduce greenhouse gas emissions in the future included Allegheny Energy, Inc., Alliant Energy, City of Klamath Falls, Entergy Services, Inc., FirstEnergy Corporation, FPL Group, Middlesex Generating Company, National Grid USA, Noranda Aluminum, Inc., and TVA.

The reporters of the largest individual entity-level commitments pledged to reduce emissions in the future by 84 million metric tons carbon dioxide (Table 33). TVA (23 million metric tons carbon dioxide), National Grid USA (15 million metric tons carbon dioxide), FPL Group (10 million metric tons carbon dioxide), City of Klamath Falls (6 million metric tons carbon dioxide), and Entergy Services and Middlesex Generating Company (5 million metric tons carbon dioxide, each) reported the 6 largest entity-level reduction commitments. These 6 commitments combined accounted for 74 percent (64 million metric tons carbon dioxide) of the total reported entity-level commitments to reduce greenhouse gases. National Grid USA, City of Klamath Falls, and Entergy Services, Inc., measured their reduction commitments using basic reference cases. The 3 other reporters used modified reference cases.

Project-Level Commitments

A total of 27 companies reported on commitments to undertake 191 individual emission reduction projects. Some of the commitments were linked to future results from projects already underway and forming part of the reporters' submissions. Others were for projects not yet begun. Data on the quantities of reductions expected were provided by 22 reporters for 116 projects.

Reporters indicated that projects were expected to reduce future emissions by 73 million metric tons carbon

Table 32. Largest Individual Reported Entity-Level Indirect Emission Reductions by Gas, Source, and Type of Reference Case Employed, Data Year 2003

Reporter	Gas	Source	Reference Case	Reported Indirect Emission Reduction (Million Metric Tons Carbon Dioxide Equivalent)	Percent of Total Reported Indirect Reductions
Integrated Waste Services Association	CO_2	Other Indirect	Modified	15.0	35.3
Integrated Waste Services Association	CH_4	Other Indirect	Modified	8.6	20.3
Southern Company	CO_2	Other Indirect	Modified	3.7	8.6
FPL Group	CO_2	Other Indirect	Modified	3.0	7.0
Sacramento Municipal Utility District	CO_2	Purchased Power	Basic	2.4	5.8
Mystic Development, LLC	CO_2	Other Indirect	Modified	2.0	4.6
Public Service Enterprise Group	CO_2	Other Indirect	Modified	1.6	3.8
Portland General Electric Co.	CO_2	Purchased Power	Modified	1.3	3.2
General Motors Corporation	CO_2	Purchased Power	Basic	0.9	2.1
PG&E Corporation	CO_2	Other Indirect	Modified	0.8	1.9
NEGT	CH_4	Other Indirect	Modified	0.8	1.9
Alliant Energy	CO_2	Other Indirect	Modified	0.8	1.9
FirstEnergy Corporation	CH_4	Other Indirect	Modified	0.7	1.7
Berkshire Power LLC	CO_2	Other Indirect	Modified	0.7	1.7
Waste Management, Inc.	CO_2	Purchased Power	Modified	0.6	1.4
Peabody Holding Company, Inc.	CO_2	Purchased Power	Modified	0.5	1.1
Total				**43.5**	**102.4**

Note: Twenty-eight participants in the Voluntary Reporting of Greenhouse Gases Program reported negative indirect entity-level emission reductions for 2002.

Source: Energy Information Administration, Form EIA-1605.

dioxide equivalent. Of that amount, 61 million metric tons would be carbon dioxide, 7 million metric tons carbon dioxide equivalent would be methane, and 3 million metric tons carbon dioxide equivalent would be perfluorocarbons. Nitrous oxide and sulfur hexafluoride together would constitute about 1 million metric tons carbon dioxide equivalent.

The largest individual project-level commitment, made by TVA, was described as "an increase in low-emitting capacity" as a result of TVA's nuclear power program. It would reduce carbon dioxide emissions by 18 million metric tons. The second and third largest individual project-level commitments were made by Middlesex Generating Company, LLC (5 million metric tons carbon dioxide equivalent) and FirstEnergy Corporation (4 million metric tons carbon dioxide equivalent). These 3 project-level commitments accounted for 44 percent of total reported project-level commitments, or 27 million metric tons carbon dioxide equivalent (Table 34).

Financial Commitments

A total of 40 financial commitments to reduce greenhouse gas emissions in the future were made by 21 companies, 18 of which were electric utilities. The total amount of funds promised was $50.3 million. The single largest reported financial commitment to reduce greenhouse gas emissions was that of Entergy Services, Inc., which committed to spend $25.0 million on a "carbon burnout plant" to make fly ash suitable for sale to cement companies, followed by Noranda Aluminum, Inc. ($5.5 million) and Ameren Corporation ($5.0 million). Minnesota Power, FirstEnergy Corporation, CLE Resources, and Kansas City Power & Light Company each committed to spend $2.0 million, and the City of Klamath Falls reported two individual financial commitments that totaled $2.5 million. These 8 entities reported financial commitments that together accounted for 92 percent of the total financial commitments reported for 2003 (Table 35).

The largest expenditures reported for 2003 were by Entergy Services, Inc. ($2.0 million), Ameren Corporation and Noranda Aluminum, Inc. ($0.5 million each), Dynegy Midwest Generation, Inc. ($0.4 million), and Bountiful City Light & Power, PacifiCorp, and NiSource/NIPSCO ($0.2 million each). These 7 companies combined reported $4.0 million in expenditures to reduce greenhouse gas emissions in 2003, or 98 percent of total reported expenditures (Table 36).

Table 33. Largest Reported Individual Entity-Level Commitments To Reduce Greenhouse Gases by Gas and Type of Reference Case, Data Year 2003

Reporter	Gas	Reference Case	Reported Entity-Level Commitment (Million Metric Tons Carbon Dioxide Equivalent)	Percent of Total Reported Entity-Level Reduction Commitments
Tennessee Valley Authority	CO_2	Modified	22.6	26.3
National Grid USA	CO_2	Basic	15.1	17.6
FPL Group	CO_2	Modified	10.0	11.6
City of Klamath Falls	CO_2	Basic	6.3	7.3
Entergy Services, Inc.	CO_2	Basic	5.0	5.8
Middlesex Generating Company, LLC	CH_4	Modified	4.8	5.6
FirstEnergy Corporation	CO_2	Modified	2.9	3.3
Noranda Aluminum, Inc.	CF_4	Basic	2.8	3.2
Alliant Energy	CO_2	Modified	2.4	2.8
Greater New Bedford Regional Refuse Mgt District	CH_4	Modified	2.1	2.5
The Burlington Northern and Santa Fe Railway Co.	CO_2	Modified	2.1	2.4
Allegheny Energy, Inc.	CO_2	Basic	1.8	2.1
South Carolina Electric & Gas Company	CO_2	Basic	1.8	2.1
Alliant Energy	CO_2	Modified	1.8	2.0
Public Service Company of New Mexico	CO_2	Basic	1.5	1.7
Alliant Energy	CO_2	Modified	1.0	1.1
Total			**83.8**	**97.6**

CO_2 = carbon dioxide. CH_4 = methane. CF_4 = perfluoromethane.
Note: Reporters are not asked to indicate whether future reductions will be direct, indirect, or sequestration.
Source: Energy Information Administration, Form EIA-1605.

Table 34. Largest Reported Individual Project-Level Commitments To Reduce Greenhouse Gas Emissions, Data Year 2003

Reporter	Project Description	Reported Commitment (Million Metric Tons Carbon Dioxide Equivalent)	Percent of Total Reported Project-Level Commitments
Tennessee Valley Authority	Increase in low-emitting capacity	17.6	24.3
Middlesex Generating Company, LLC	Landfill gas control and energy recovery to produce electric power	4.8	6.6
FirstEnergy Corporation	Undertake supply side efficiency improvements	4.4	6.0
City of Klamath Falls-Cogen	As part of KCP's carbon offset proposal to EFSC, $1.5 million in funding was committed to the FRT program to support reforestation of underproducing lands in western Oregon	3.0	4.2
Noranda Aluminum, Inc.	Reduction of PFC emissions through anode effect reduction program in keeping with USEPA goal of 30-60%; 90% reduction in PFC emissions from Lines 1 & 2 and 69% reduction from Line 3; all reductions from 1990 baseline emissions	2.8	3.8
FirstEnergy Corporation	Nuclear generation operation improvement	2.5	3.5
City of Klamath Falls-Cogen	Under the Oregon State Energy Facility Siting Council Site Certificate, the Klamath Cogeneration Project committed to invest $1 million (in 1998 dollars) to extract useful energy (methane) for electricity production from two largely untapped sources	2.5	3.4
Municipal Electric Auth of Georgia (MEAG Power)	Increase nuclear unit availability	2.5	3.4
Alliant Energy	Modified forest management	2.4	3.3
New York Power Authority	NYPA customer energy services programs	2.3	3.1
Tennessee Valley Authority	Fuel switching	2.2	3.0
Greater New Bedford Regional Refuse Mgt District	Landfill gas control and future utilization	2.1	2.9
City of Klamath Falls-Cogen	Cogeneration of steam to displace fossil-fired boilers used at an off-site industrial facility	2.0	2.8
Alliant Energy	Other energy end-use projects/activities (electric)	1.7	2.3
PacifiCorp	Other energy end-use projects/activities	1.3	1.8
Santee Cooper	Cross Unit 2 retrofit	1.1	1.6
Municipal Electric Auth of Georgia (MEAG Power)	Increase nuclear unit capacity	1.0	1.3
Santee Cooper	Upgrade Summer Nuclear Station	0.9	1.3
Allegheny Energy, Inc.	Utilitree: Rio Bravo Carbon Sequestration Project, Belize: 134,400 acres	0.9	1.3
City of Klamath Falls-Cogen	Sales and installation of solar photovoltaic systems in off-grid rural households in India and Sri Lanka	0.8	1.2
Tennessee Valley Authority	Heat rate improvement	0.8	1.1
Tennessee Valley Authority	Other energy end-use projects/activities	0.8	1.1
Total		**60.4**	**83.3**

Source: Energy Information Administration, Form EIA-1605.

Table 35. Largest Reported Individual Entity-Level Financial Commitments To Reduce Greenhouse Gas Emissions, Data Year 2003

Reporter	Industry	Financial Commitment (Dollars)	Voluntary Program Affiliation	Percent of Total Reported Financial Commitments
Entergy Services, Inc.	Electric, Gas, and Sanitary Services	25,000,000	None	49.7
Noranda Aluminum, Inc.	Primary Metals Industries	5,500,000	Voluntary Aluminum Industrial Partnership	10.9
Ameren Corporation (formerly UE and CIPS)	Electric, Gas, and Sanitary Services	5,000,000	Climate Challenge	9.9
Minnesota Power	Electric, Gas, and Sanitary Services	2,000,000	Climate Challenge	4.0
FirstEnergy Corporation	Electric, Gas, and Sanitary Services	2,000,000	Climate Challenge	4.0
Kansas City Power & Light Company	Electric, Gas, and Sanitary Services	2,000,000	Climate Challenge	4.0
CLE Resources	Holding and Other Investment Offices	2,000,000	None	4.0
City of Klamath Falls-Cogen	Services, not elsewhere classified	1,500,000	None	3.0
City of Klamath Falls-Cogen	Services, not elsewhere classified	1,000,000	None	2.0
PacifiCorp	Electric, Gas, and Sanitary Services	610,000	Climate Challenge	1.2
City of Klamath Falls-Cogen	Services, not elsewhere classified	500,000	None	1.0
Dynegy, Inc.	Electric, Gas, and Sanitary Services	450,000	Climate Challenge	0.9
FirstEnergy Corporation	Electric, Gas, and Sanitary Services	400,000	Climate Challenge	0.8
Bountiful City Light & Power	Electric, Gas, and Sanitary Services	298,924	Climate Challenge	0.6
Kansas City Power & Light Company	Electric, Gas, and Sanitary Services	264,000	Climate Challenge	0.5
McMinnville Electric System	Electric, Gas, and Sanitary Services	249,600	Renewable Energy Commercialization	0.5
Conectiv Atlantic Generation (CAG)	Electric, Gas, and Sanitary Services	200,000	Climate Challenge	0.4
NiSource/NIPSCO	Electric, Gas, and Sanitary Services	200,000	Climate Challenge	0.4
FirstEnergy Corporation	Electric, Gas, and Sanitary Services	200,000	Climate Challenge	0.4
TXU	Electric, Gas, and Sanitary Services	105,000	Climate Challenge	0.2
Dynegy, Inc.	Electric, Gas, and Sanitary Services	105,000	Climate Challenge	0.2
TXU	Electric, Gas, and Sanitary Services	105,000	Climate Challenge	0.2
Constellation Energy	Electric, Gas, and Sanitary Services	100,000	Climate Challenge	0.2
City of Klamath Falls-Cogen	Services, not elsewhere classified	100,000	None	0.2
Total		**49,887,524**		**99.2**

Source: Energy Information Administration, Form EIA-1605.

Table 36. Reported Entity-Level Financial Expenditures To Reduce Greenhouse Gas Emissions, Data Year 2003

Reporter	Industry	2002 Financial Expenditure (Dollars)	Voluntary Program Affiliation	Percent of Total Reported Financial Expenditures
Entergy Services, Inc.	Electric, Gas, and Sanitary Services	2,000,000	None	49.1
Ameren Corporation (formerly UE and CIPS)	Electric, Gas, and Sanitary Services	500,000	Climate Change	12.3
Noranda Aluminum, Inc.	Primary Metals Industries	464,665	Voluntary Aluminum Industrial Partnership	11.4
Dynegy, Inc.	Electric, Gas, and Sanitary Services	400,000	Climate Change	9.8
Bountiful City Light & Power	Electric, Gas, and Sanitary Services	230,495	Climate Change	5.7
PacifiCorp	Electric, Gas, and Sanitary Services	218,067	Climate Change	5.4
NiSource/NIPSCO	Electric, Gas, and Sanitary Services	200,000	Climate Change	4.9
TXU	Electric, Gas, and Sanitary Services	20,000	Climate Change	0.5
TXU	Electric, Gas, and Sanitary Services	20,000	Climate Change	0.5
Kansas City Power & Light Company	Electric, Gas, and Sanitary Services	10,000	Climate Change	0.2
Xcel Energy	Electric, Gas, and Sanitary Services	5,000	Climate Change	0.1
NiSource/NIPSCO	Electric, Gas, and Sanitary Services	5,000	Climate Change	0.1
Cleco Corporation	Electric, Gas, and Sanitary Services	1,600	None	*
Total		**4,074,827**		**100.0**

*Less than 0.05 percent.
Source: Energy Information Administration, Form EIA-1605.

8. Project-Level Reporting on Form EIA-1605EZ

The Energy Information Administration (EIA) provides Form EIA-1605EZ to participants in the Voluntary Reporting of Greenhouse Gases Program as a less comprehensive and less detailed alternative to Form EIA-1605. Form EIA-1605EZ (the "short form") allows reporters to provide a brief summary of their emission reduction projects for a single year. The short form is used exclusively for reporting projects undertaken within the geographic boundaries of the United States, its territories and trusts. Because reports submitted on Form EIA-1605EZ do not make a distinction between owning or controlling an emissions source and simply initiating or participating in an emission reduction activity, there is no systematic way to distinguish between direct and indirect emissions reported on this form. Also, because the data reported in support of the emission reduction estimates are limited, it is difficult to perform anything but the most rudimentary arithmetic checks for accuracy.

Who Reported on Form EIA-1605EZ

A total of 34 entities submitted reports on Form EIA-1605EZ for 2003. Of those, 17 were electric power providers, typically, relatively small electric power cooperatives; 8 were alternative energy providers, including one coal mine methane developer, 2 landfill gas-to-energy developers, and 5 firms that combusted biomass to reduce greenhouse gas emissions; and 6 were manufacturing firms—one each from the textile, refining, fabricated metals, and microprocessor industries, and 2 from the chemical industry. One industry association, one individual household, and one forestry firm also filed Form EIA-1605EZ for 2003.

What Was Reported on Form EIA-1605EZ

A total of 219 projects were reported on Form EIA-1605EZ for 2003 (Table 37), down from 253 projects reported on the short form for 2002. The decrease was caused by the absence of reports for 2003 from 3 entities representing 14 projects that were reported for 2002, and by the reporting of fewer projects for 2003 than were reported for 2002 by 4 other entities. (For example, Wisconsin Public Power, Inc., reported 61 projects for 2002 but only 30 for 2003.) Another 10 entities reported more projects for 2003 than they reported in 2002. Of the 219 projects reported for 2003, 76 focused on improvements in energy efficiency, 50 emphasized reductions in emissions from electricity generation, transmission, and distribution, and another 44 involved the capture and combustion of methane. Although reporting on methane capture and combustion has grown steadily since 1994, 7 fewer such projects were reported for 2003 than were reported for 2002. For example, U.S. Energy Biogas Corp reported fewer methane capture and combustion projects for 2003 than it did for 2002.

Together, the 219 projects reported on the short form for 2003 reduced greenhouse gas emissions by 16.4 million metric tons carbon dioxide equivalent (Table 38). Of that total, 11.0 million metric tons resulted from efforts in the electricity generation, transmission, and distribution sector. Another 3.5 million metric tons was attributed to waste treatment and disposal, nearly all of which resulted from the capture and combustion of methane at municipal solid waste landfills (Table 39).

Federal voluntary programs played an important role in those projects reported on Form EIA-1605EZ. Of the projects reported, 120 (55 percent) were associated with some Federal voluntary initiative: 57 were associated with the U.S. Department of Energy's Climate Challenge program, and 41 of the 42 waste treatment and disposal projects reported referenced the U.S. Environmental Protection Agency's Landfill Methane Outreach Program (Table 40).

Table 37. Number of Projects Reported on Form EIA-1605EZ by Reduction Objective and Project Type, Data Years 1994-2003

Reduction Objective and Project Type	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Reducing Carbon Dioxide Emissions	**88**	**118**	**125**	**138**	**177**	**151**	**148**	**146**	**186**	**160**
Electricity Generation, Transmission, and Distribution	35	44	44	46	59	53	55	50	58	50
Cogeneration and Waste Heat Recovery	0	1	2	2	2	0	0	0	1	0
Energy End Use	44	50	53	60	66	56	61	64	97	76
Transportation and Offroad Vehicles	5	8	11	9	14	11	12	13	9	10
Other Projects	4	15	15	21	36	31	20	19	21	24
Reducing Methane and Nitrous Oxide Emissions	**15**	**21**	**30**	**32**	**41**	**45**	**44**	**47**	**51**	**44**
Waste Treatment and Disposal (Methane)	10	16	21	28	39	42	43	45	49	42
Agriculture (Methane and Nitrous Oxide)	0	0	0	0	0	0	0	0	0	0
Oil and Natural Gas Systems and Coal Mining (Methane)	5	5	9	4	2	3	1	2	2	2
Carbon Sequestration	**20**	**24**	**23**	**30**	**34**	**41**	**35**	**14**	**14**	**14**
Halogenated Substances	**2**	**1**	**1**	**1**	**0**	**0**	**2**	**3**	**2**	**1**
Total	**125**	**164**	**179**	**201**	**252**	**237**	**229**	**210**	**253**	**219**

Note: Table excludes projects submitted in confidential reports.
Source: Energy Information Administration, Form EIA-1605EZ.

Table 38. Emission Reductions Reported on Form EIA-1605EZ by Reduction Objective and Project Type, Data Years 1994-2003
(Million Metric Tons Carbon Dioxide Equivalent)

Reduction Objective and Project Type	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Reducing Carbon Dioxide Emissions	**3.7**	**5.0**	**4.4**	**6.7**	**16.4**	**9.6**	**9.2**	**10.9**	**12.8**	**12.5**
Electricity Generation, Transmission, and Distribution	2.3	2.9	2.1	3.8	13.0	8.1	7.8	9.7	11.6	11.0
Cogeneration and Waste Heat Recovery	—	*	*	*	*	—	—	—	*	—
Energy End Use	1.4	1.6	1.9	2.4	2.4	0.3	0.4	0.3	0.4	0.4
Transportation and Offroad Vehicles	*	*	*	*	*	*	*	*	*	*
Other Projects	0.1	0.5	0.4	0.5	0.8	1.1	1.0	0.9	0.9	1.0
Reducing Methane and Nitrous Oxide Emissions	**0.6**	**1.2**	**1.3**	**1.8**	**3.0**	**3.2**	**3.1**	**4.0**	**4.3**	**3.9**
Waste Treatment and Disposal (Methane)	0.6	1.1	1.2	1.8	3.0	3.2	3.1	3.8	4.0	3.5
Agriculture (Methane and Nitrous Oxide)	—	—	—	—	—	—	—	—	—	—
Oil and Natural Gas Systems and Coal Mining (Methane)	*	*	*	*	0.1	0.1	*	0.2	0.3	0.3
Carbon Sequestration	*****	*****	*****	*****	*****	**0.1**	*****	*****	*****	*****
Halogenated Substances	**—**	**—**	**—**	**0.1**	**—**	**—**	*****	*****	**0.1**	*****
Total	**4.3**	**6.1**	**5.7**	**8.6**	**19.4**	**12.9**	**12.3**	**14.8**	**17.3**	**16.4**

*Less than 0.05 million metric tons.
— = none reported.
Note: Table excludes data submitted in confidential reports.
Source: Energy Information Administration, Form EIA-1605EZ.

Table 39. Carbon Dioxide and Methane Emission Reductions Reported on Form EIA-1605EZ by Reduction Objective and Project Type, Data Year 2003
(Million Metric Tons Carbon Dioxide Equivalent)

Reduction Objective and Project Type	Carbon Dioxide	Methane
Reducing Carbon Dioxide Emissions	**12.4**	*****
Electricity Generation, Transmission, and Distribution	11.0	—
Cogeneration and Waste Heat Recovery	—	—
Energy End Use	0.4	—
Transportation and Offroad Vehicles	*	—
Other Projects	1.0	*
Reducing Methane and Nitrous Oxide Emissions	*****	**3.8**
Waste Treatment and Disposal (Methane)	*	3.5
Agriculture (Methane and Nitrous Oxide)	—	—
Oil and Natural Gas Systems and Coal Mining (Methane)	*	0.3
Carbon Sequestration	*****	**—**
Halogenated Substances	**—**	**—**
Total	**12.5**	**3.8**

*Less than 0.05 million metric tons.
— = none reported.
Notes: No reductions of nitrous oxide emissions were reported on Form EIA-1605EZ for 2003. Table excludes data submitted in confidential reports.
Source: Energy Information Administration, Form EIA-1605EZ.

Table 40. Number of Projects Reported on Form EIA-1605EZ Associated with Other Federal Voluntary Programs, Data Years 1994-2003

Voluntary Program	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Climate Challenge	106	127	117	124	129	114	111	97	75	57
Landfill Methane Outreach Program	—	—	2	2	34	40	42	44	48	41
Climate Wise Recognition Program	—	3	5	12	25	25	12	1	1	2
ENERGY STAR Programs	5	6	10	5	2	1	2	8	28	11
Energy Efficiency and Renewable Energy Information and Training Programs	—	—	—	—	—	—	—	—	27	—
Green Lights Program	1	3	6	4	6	2	1	1	1	—
Coalbed Methane Outreach Program	—	—	1	1	2	3	—	—	—	—
WasteWise Program	—	—	—	—	—	—	—	2	4	3
Other	4	11	3	9	7	1	3	11	7	6
Total	**116**	**150**	**144**	**157**	**205**	**186**	**171**	**164**	**191**	**120**

— = none reported.
Note: Table excludes data submitted in confidential reports.
Source: Energy Information Administration, Form EIA-1605EZ.

Glossary

Afforestation: Planting of new forests on lands that have not been recently forested.

Anaerobic lagoon: A liquid-based manure management system, characterized by waste residing in water to a depth of at least 6 feet for a period ranging between 30 and 200 days.

Associated natural gas: See associated-dissolved natural gas.

Associated-dissolved natural gas: Natural gas that occurs in crude oil reservoirs either as free gas (associated) or as gas in solution with crude oil (dissolved gas).

Baseline period: The years 1987 through 1990 for which entity-level emissions may be reported.

Biofuels: Liquid fuels and blending components produced from biomass (plant) feedstocks, used primarily for transportation.

Biogas: A mixture of carbon dioxide and methane produced through bacterial action.

Biomass: Organic nonfossil material of biological origin constituting a renewable energy source.

British thermal unit: The quantity of heat required to raise the temperature of 1 pound of liquid water by 1 degree Fahrenheit at the temperature at which water has its greatest density (approximately 39 degrees Fahrenheit).

Carbon sink: A reservoir that absorbs or takes up released carbon from another part of the carbon cycle. The four sinks, which are regions of the Earth within which carbon behaves in a systematic manner, are the atmosphere, terrestrial biosphere (usually including freshwater systems), oceans, and sediments (including fossil fuels).

Carbon sequestration: The fixation of atmospheric carbon dioxide in a carbon sink through biological or physical processes.

Chlorofluorocarbon (CFC): Any of various compounds consisting of carbon, hydrogen, chlorine, and flourine used as refrigerants. CFCs are now thought to be harmful to the earth's atmosphere.

Cogeneration: The production of electrical energy and another form of useful energy (such as heat or steam) through the sequential use of energy.

Commercial scale: Application of a demonstrated technology at a cost-effective scale.

Commitment: An expressed intention to undertake an action or actions that will reduce greenhouse gas emissions, increase carbon sequestration, or achieve a stated emissions goal.

Conversion factor: A number that translates units of one measurement system into corresponding values of another measurement system. *Note:* For specific conversion factors, see EIA data products.

Deforestation: The net removal of trees from forested land.

Emissions coefficient: A unique value for scaling emissions to activity data in terms of a standard rate of emissions per unit of activity (e.g., pounds of carbon dioxide emissions per unit of fossil fuel consumed).

Emissions: Anthropogenic releases of gases to the atmosphere. In the context of global climate change, they consist of radiatively important greenhouse gases (e.g., the release of carbon dioxide during fuel combustion).

Emissions, direct: Emissions from sources owned (wholly or in part) or leased by an entity.

Emissions, fugitive: Unintended leaks of gas from the processing, transmission, and/or transportation of fossil fuels.

Emissions, indirect: Emissions from sources not owned or leased by an entity that occur, wholly or in part, as a result of its activities.

Emission reduction: A decrease in annual greenhouse gas emissions.

Energy conservation: Activities that reduce end-use demand for energy by reducing the service demanded.

Entity: For the purposes of the Voluntary Reporting Program, an individual or organization that is a legal U.S. person (e.g., a U.S. citizen, resident alien, company, organization, or group incorporated under or recognized by U.S. law; or a Federal, State, or local government agency).

Entity boundary: Conceptually, a line drawn to encompass the emissions sources and sinks to be evaluated in an entity-level report. An entity boundary should

include all the emissions sources and sinks owned (wholly or in part) or leased by the entity and, to the extent possible, other emissions sources and sinks affected by the entity's activities.

Entity-level reporting: The reporting of greenhouse gas emissions, emission reductions, and carbon sequestration for an entire entity. See also Project-level reporting.

Estimation method: The techniques, including key assumptions and data sources, used by the reporter to derive the reported emissions, emission reductions, or sequestration.

Foreign activities: All actions outside the United States, its territories, and trusts.

Forest preservation: Protecting existing forests from harvest and, in some cases, conversion to another land use as a means of mitigating increases in atmospheric carbon.

Fossil fuel: An energy source formed in the Earth's crust from decayed organic material. The common fossil fuels are petroleum, coal, and natural gas.

Fuel cycle: The entire set of sequential processes or stages involved in the utilization of fuel, including extraction, transformation, transportation, and combustion. Emissions generally occur at each stage of the fuel cycle.

Fuel switching: The substitution of one type of fuel for another. The fuel substitution may be either temporary (as in the case of a power plant that temporarily switches from coal to natural gas) or permanent (as in the case of a fleet operator who replaces gasoline-powered automobiles with electric cars).

Fugitive emissions: See Emissions, fugitive.

Global warming potential (GWP): An index used to compare the relative radiative forcing of different gases without directly calculating changes in their atmospheric concentrations. GWPs are calculated as the ratio of the radiative forcing that would result from the emission of one kilogram of a greenhouse gas to that from the emission of one kilogram of carbon dioxide over a fixed period of time, such as 100 years.

Gob: A zone of rubble created when the roof of a coal mine collapses behind the mining operations.

Greenhouse effect: The result of water vapor, carbon dioxide, and other atmospheric gases trapping radiant (infrared) energy, thereby keeping the Earth's surface warmer than it would otherwise be. Greenhouse gases within the lower levels of the atmosphere trap infrared radiation that would otherwise escape into space, and subsequent re-radiation of some of the energy back to the Earth maintains higher surface temperatures than would occur if the gases were absent. See Greenhouse gases.

Greenhouse gases: Those gases, such as water vapor, carbon dioxide, nitrous oxide, methane, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride, that are transparent to solar (short-wave) radiation but opaque to long-wave (infrared) radiation, thus preventing long-wave radiant energy from leaving Earth's atmosphere. The net effect is a trapping of absorbed radiation and a tendency to warm the planet's surface.

Halogenated substance: A volatile compound containing halogens, such as chlorine, fluorine, or bromine.

Horizon year: The year in which a commitment to reduce greenhouse gas emissions or increase sequestration (reported on Schedule IV) is expected to be met.

Intergovernmental Panel on Climate Change (IPCC): A panel established jointly in 1988 by the World Meteorological Organization and the United Nations Environment Program to assess scientific information related to climate change and to formulate realistic response strategies.

Life cycle: The progression of a product through its service life. For most products, emissions and energy-consuming characteristics will be altered as they age.

Longwall mining: An automated form of underground coal mining characterized by high recovery and extraction rates, feasible only in relatively flat-lying, thick, and uniform coalbeds. A high-powered cutting machine is passed across the exposed face of coal, shearing away broken coal, which is continuously hauled away by a floor-level conveyor system. Longwall mining extracts all machine-minable coal between the floor and ceiling within a contiguous block of coal, known as a panel, leaving no support pillars within the panel area. Panel dimensions vary over time and with mining conditions but currently average about 900 feet wide (coal face width) and more than 8,000 feet long (the minable extent of the panel, measured in direction of mining). Longwall mining is done under movable roof supports that are advanced as the bed is cut. The roof in the mined-out area is allowed to fall as the mining advances.

Manure management: The method used to dispose of the solid waste produced by livestock and poultry.

Modified forest management: The modification of the management regimes of existing forests to increase their carbon capture rates.

Municipal solid waste: Residential solid waste and some nonhazardous commercial, institutional, and industrial wastes.

Ozone: A molecule made up of three atoms of oxygen. Occurs naturally in the stratosphere and provides a protective layer shielding the Earth from harmful ultraviolet radiation. In the troposphere, it is a chemical oxidant, a greenhouse gas, and major component of photochemical smog.

Photosynthesis: The manufacture of carbohydrates and oxygen from carbon dioxide and water in the presence of chlorophyll, with sunlight as the energy source. Carbon is sequestered and oxygen and water are released in the process.

Pilot project: A small-scale trial designed to test or demonstrate the efficiency or efficacy of a project.

Project: An action undertaken to reduce greenhouse gas emissions or sequester carbon.

Project boundary: Conceptually, a line drawn to encompass the emissions sources and sinks affected by a project. A project boundary should include all the significant and quantifiable effects of the project.

Project ID code: A unique code assigned by the Energy Information Administration to a reported project for tracking purposes.

Project-level reporting: Reporting on emission reductions or carbon sequestration achieved as a result of a specific action or group of actions.

Reconductoring: Replacement of existing conductors with large-diameter conductors to reduce line losses. Conductors (including feeders and transmission lines) are a major source of transmission and distribution system losses. In general, the smaller the diameter of the conductor, the greater its resistance to the flow of electric current, and the greater the consequent line losses.

Reference case: The emissions level to which current actual emissions levels are compared when emission reductions are calculated.

Reference case, basic: A reference case using actual historical emissions or sequestration values.

Reference case, modified: A reference case using projected emissions or sequestration values, representing the emissions level that would have occurred in the absence of reduction or sequestration efforts.

Reforestation: Replanting of forests on lands that have recently been harvested or otherwise cleared of trees.

Reporter: An entity (see definition above) completing either Form EIA-1605 or Form EIA-1605EZ and submitting it to the Energy Information Administration.

Room-and-pillar mining: The most common method of underground mining in which the mine roof is supported mainly by coal pillars left at regular intervals. Rooms are places where the coal is mined; pillars are areas of coal left between the rooms. Room-and-pillar mining is done either by conventional or continuous mining.

Sequestered carbon: Carbon that is removed from the atmosphere and retained in a carbon sink (such as a growing tree) or in soil.

Sequestration: See Carbon sequestration.

Sink: See Carbon sink.

Third-party reporter: An authorized party that submits a report on behalf of two or more entities that have engaged in emissions-reducing or sequestration-increasing activities. Possible third-party reporters include trade associations reporting on behalf of members that have undertaken reduction projects.

Urban forestry: The planting of trees individually or in small groups in urban or suburban settings.

Vhar metering: Phase shifters on watt-hour meters that measure reactive volt ampere hours or varhours.

Watt (W): The unit of electrical power equal to one ampere under a pressure of one volt. A watt is equal to 1/746 horsepower.