3. Reducing Emissions from Energy End Use

Introduction

Greenhouse gas emissions from energy end use include emissions from the industrial, commercial, residential, and transportation sectors. In 2002, the transportation sector accounted for 1,850 million metric tons carbon dioxide, nearly all from mobile sources, and represented approximately 32 percent of U.S. carbon dioxide emissions. The industrial, commercial, and residential sectors combined generated the balance of U.S. carbon dioxide emissions, accounting for 3,880 million metric tons carbon dioxide, 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).

Reducing Emissions from Stationary Sources

Energy use at stationary sources in the industrial, commercial, and residential sectors accounted for emissions of 3,880 million metric tons carbon dioxide in 2002—two-thirds of total U.S. carbon dioxide emissions. Emissions from stationary sources included 2,246 million metric tons carbon dioxide from the generation of electricity that was ultimately consumed in these three sectors. Industry was responsible for the largest share of stationary-source emissions (43 percent), followed by the residential sector (31 percent) and the commercial sector (26 percent).

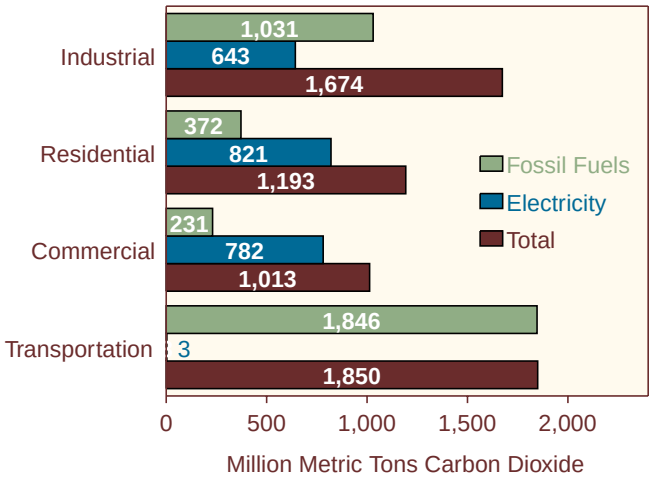
Between 1990 and 2002, carbon dioxide emissions associated with industrial, residential, and commercial energy use increased by 13.5 percent. The commercial sector is the fastest-growing emissions source, registering a 29.9-percent increase in emissions between 1990 and 2002. Emissions from the residential sector increased by 25.5 percent over the same period, while industrial sector emissions declined by 0.9 percent.[24]

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); and appliance replacement (e.g., retiring old appliances for Energy Star products). For 2002, 62 entities reported 315 energy end-use projects on Form EIA-1605 (Table 10). These 315 projects accounted for 18 percent of all the projects reported on the long form, ranking fourth behind sequestration (23 percent); electricity generation, transmission, and distribution (22 percent); and waste treatment and disposal (20 percent).

Among the 62 entities that reported energy end-use projects for 2002 on Form EIA-1605, 47 (76 percent) were electric utilities, of which 19 were publicly owned, 27 were privately owned, and 1 was an independent power producer. Manufacturers of automobiles and other transportation equipment were represented by 5 reporters (8 percent of end-use reporters). Three pharmaceutical and health care product companies reported energy end-use projects for 2002 (5 percent of end-use reporters). The remaining 11 percent of reporters was made up of 2 cement companies, 2 electronics companies, 1 food and kindred products company, 1 holding and other investment office, and 1 communications company.

Figure 8. Sources of U.S. Carbon Dioxide Emissions by Sector, 2002



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 2002*, DOE/EIA-0573(2002) (Washington, DC, October 2003).

[24]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2002*, DOE/EIA-0573(2002) (Washington, DC, October 2003), web site www.eia.doe.gov/oiaf/1605/1605a.html.

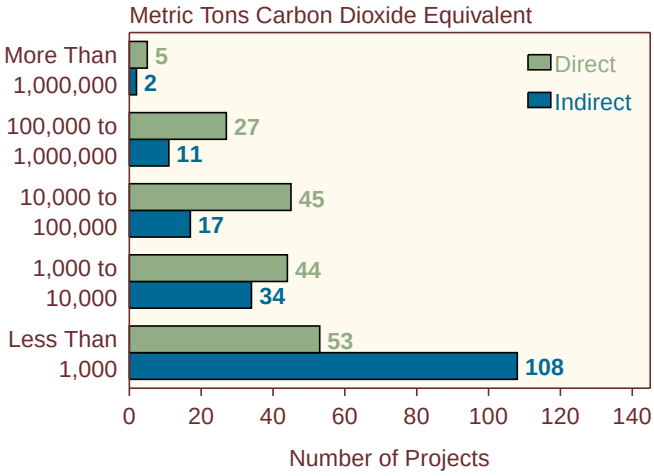
Although both the number of entities reporting and the number of energy end-use projects reported for 2002 were lower than those for 2001, the total reported direct and indirect emission reductions resulting from energy end-use projects increased in 2002 (Table 10). Changes in funding sources for efficiency programs and the transition toward competition in the electricity supply industry may have contributed to the decline in the numbers of entities and projects reported for 2002. For example, EIA reports that some States are now funding demand-side management (DSM) activities through State agencies, such as the California Board for Energy Efficiency, the New York Energy Research and Development Authority, and Efficiency Vermont.[25]

Emission reductions reported for individual energy end-use projects ranged from less than 1 metric ton carbon dioxide equivalent to almost 4.5 million metric tons, primarily because of the flexibility allowed in defining the scope of a project. Some reporters include information on each individual end-use initiative separately, whereas others aggregate information on a range of activities in a single project. For example, an electric utility may report on a 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 2002, 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, 92 percent had reductions of less than 100,000 metric tons carbon dioxide equivalent. Only eight energy end-use projects reported emission reductions greater than 1 million metric tons each for 2002 (two more than for 2001).

Nine of the 10 largest projects reported in terms of emission reductions achieved in 2002 were aggregated electric utility DSM programs. DSM projects may focus on one or more load shape objectives (see box on page 34). Although the most common load shape objective of reported DSM projects was increased energy efficiency

Figure 9. Energy End-Use Projects Reported on Form EIA-1605 by Size and Type of Emission Reduction, Data Year 2002



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 1994-2002

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]	66	329	19,550,862	7,668,988
2002	62	315	24,558,785	9,040,863

[R] Revised data.

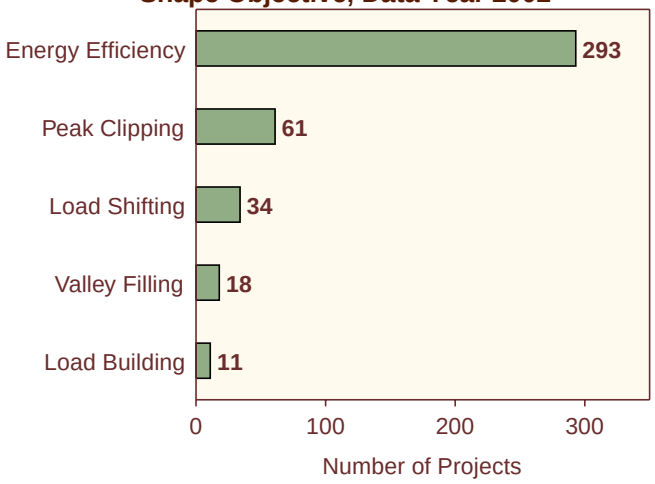
Notes: More than one project type may be assigned to a single project; therefore, the sums of the projects and reductions in each project type category may exceed the total numbers of projects and reductions in the totals and subtotals. Table excludes data from confidential reports.

Source: Energy Information Administration, Form EIA-1605.

[25]Energy Information Administration, "Electric Utility Demand-Side Management 2000" (January 2002), web site www.eia.doe.gov/cneaf/electricity/dsm00/dsm_sum.html.

(293 projects), electric utilities also attempted to balance their load profiles with various other load shape objectives, including peak clipping (61 projects), load shifting (34 projects), valley filling (18 projects), and load building (11 projects) (Figure 10).

Figure 10. Demand-Side Management Projects Reported on Form EIA-1605 by Load Shape Objective, Data Year 2002



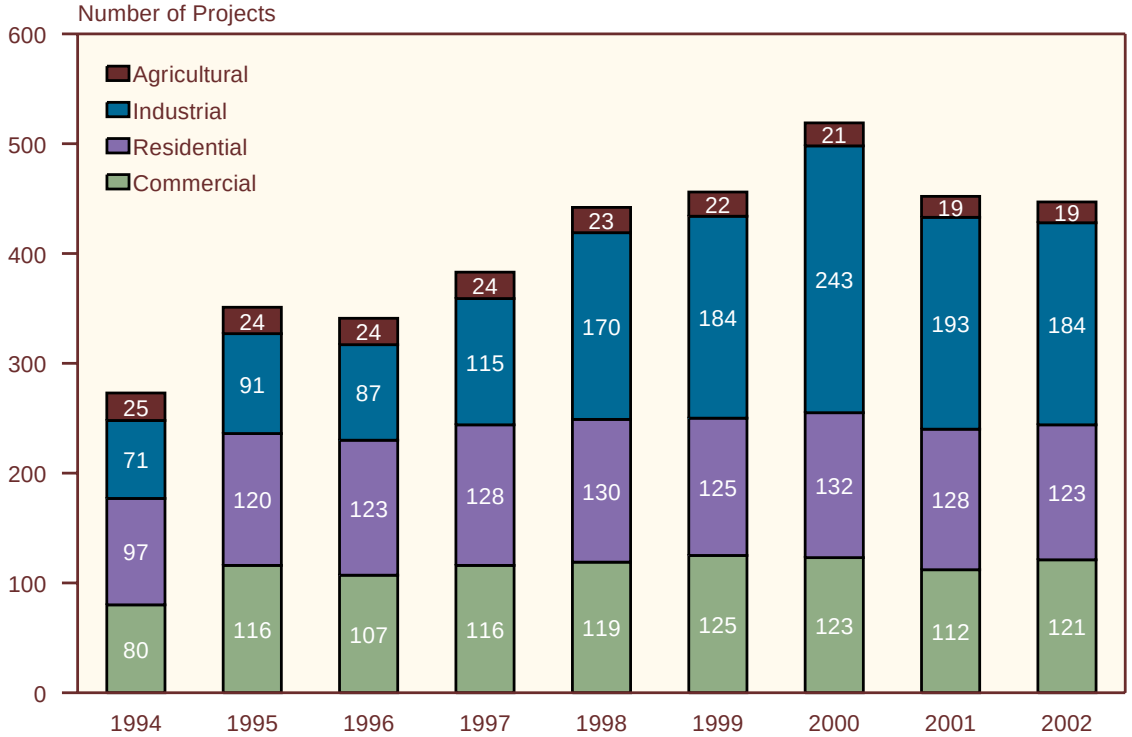
Notes: Some projects may be counted in more than one category. Figure excludes data from confidential reports.
Source: Energy Information Administration, Form EIA-1605.

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 2002, 184 projects were reported to have reduced emissions in the industrial sector, 122 in the residential sector, 121 in the commercial sector, and 19 in the agricultural sector. Fewer end-use projects were reported for each sector for 2002 than were reported for 2001, except for the commercial sector. The total number of end-use projects reported was 4 percent below the total for 2001 (Figure 11). It should be noted that many projects—particularly utility 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

Of the 315 energy end-use projects reported, 33 percent involved two or more project types. The most frequently reported type of energy end-use project for 2002 was lighting and lighting controls, with 141 projects, followed by equipment and appliances (128 projects) and HVAC (109 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

Figure 11. Energy End-Use Projects Reported on Form EIA-1605 by Sector, Data Years 1994-2002



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.

most effective energy end-use project types in terms of total emission reductions achieved.

Equipment and Appliances

Replacement of equipment and appliances with more energy-efficient units (e.g., Energy Star products) to reduce greenhouse gas emissions are frequently reported energy end-use projects. For 2002, no new reporters to the Voluntary Reporting Program submitted reports on equipment and equipment projects for the first time; however, a number of repeat reporters submitted reports on new equipment and appliance projects. National Grid USA reported a new project for 2002 that encompassed its efforts to reduce residential energy consumption. National Grid's Energy Efficiency and Conservation Program includes a broad range of interactions between the utility and its customers aimed at reducing the customers' use of electricity.

Table 11. Number of Projects and Emission Reductions Reported on Form EIA-1605 for Energy End-Use Projects by Project Type, Data Year 2002

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	141	90	85	34	21.2	7.4
Lighting/Lighting Controls	128	85	94	51	16.6	7.6
HVAC	109	77	82	50	20.8	6.3
Building Shell	62	49	32	19	17.0	5.4
Load Control	57	41	32	16	16.1	5.1
Motor/Motor Drive	56	44	35	23	15.4	3.3
Fuel Switching	27	21	15	9	1.5	0.3
Energy Effects of Urban Forestry	19	15	11	7	6.9	1.0
Industrial Power Systems	8	8	2	2	4.9	*
Other[a]	3	4	1	2	*	*
Total	**315**	**174**	**172**	**31**	**23.1**	**7.9**

[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 utility experiences peak demands) and allow the units to operate at night (during the utility's off-peak period).

Peak Clipping. Projects that reduce energy demand at certain critical times, typically when the utility experiences system 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.

The programs typically are aimed at improving the energy efficiency of appliances and equipment, improving the energy efficiency of new and existing construction, and managing energy demand during peak load periods. The programs began in 1991, but 2002 is the first year for which emission reductions associated with them have been reported. The project reduced electricity use by a reported 625,734 megawatthours in 2002, which led to indirect reductions totaling 269,066 metric tons carbon dioxide equivalent.

FirstEnergy Corporation reported a new project for 2002 that was designed to reduce internal energy consumption. The company's Acetone Catalytic Oxidizer Improvement Project upgraded its existing air control device for acetone tablet coating. The device was retrofitted and tuned up in October 2001, and the system's operating temperature was increased from 300ºC to 350ºC. This allowed the catalyst bed to reach a self-sustaining reaction for the majority (8 hours) of the 10-hour run time for each batch of tablets coated. As a result, the system requires power for only 2 hours to get the catalyst bed up to temperature, eliminating the need for another 8 hours of power consumption. The resulting reduction in electricity use was 66,693 kilowatthours in 2002, leading to a reduction in emissions of 51 metric tons carbon dioxide equivalent. The reduction associated with the project is small in comparison with those reported for other project types; however, it is significant considering that it was achieved by upgrading a single piece of equipment.

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. Allegheny Energy Inc. participated in the Green Lights Utility Ally Program in 1993 and 1994 and is still seeing reductions from that effort. The project, reported for the first time for 2002, covered only the emissions reductions attributable to energy-efficient lighting upgrades in facilities leased or owned by Allegheny. This project reportedly reduced the company's overall electricity consumption by 528 megawatthours, resulting in a direct reduction of 541 metric tons carbon dioxide equivalent.

The Estee Lauder Company, which last reported for 1999, reported 11 new lighting and lighting control projects for 2002. All the new projects involved installation of either occupancy motion sensors or new Octron lighting fixtures consisting of Octron fluorescent lamps, solid state ballasts, and specular reflectors. The 11 projects reportedly reduced the company's energy consumption by 4,227 megawatthours, leading to a total reduction in indirect emissions from purchased power of 1,649 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, several new projects were reported for 2002. In March 2002, Platte River Power Authority introduced a "Cooling Rebate Program" as one of two new DSM programs directed at reducing the rate of growth in summer peak load on the electric system operated by Platte River and four owner cities. Through the program, Platte River provides rebates to residential and commercial customers for the installation of high-efficiency air conditioning equipment with less than 20.8 tons capacity. A $200 rebate is offered for units that meet or exceed a 12.0 seasonal energy efficiency ratio (SEER);[26] $250 per unit is offered for units with a 13.0 SEER or better. Staff from Platte River and supporting consultants work with local HVAC contractors and distributors to promote the program and to encourage proper sizing of units, efficient design of duct systems, sealing of ducts, and maintenance practices that promote safe, effective, and efficient system operation. This project reportedly reduced electricity consumption by 186 megawatthours, leading to an indirect emissions reduction of 177 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 involved DSM programs by electric power providers. Several new building shell projects were reported for 2002. For example, the Los Angeles Department of Water and Power (LADWP) reported on a new Cool Roofs Program that it started in July 2001. The program, administered by LADWP for customers within LADWP service territory on behalf of the California Energy Commission, is a State-funded incentive program to install Energy Star roofing

[26]The SEER is a measure of cooling performance, used for rating central air conditioners and central heat pumps. It is the ratio of cooling output divided by power consumption, calculated as British thermal units (Btu) of cooling output during normal annual usage divided by total electric energy input (in watthours) over the same period. In 1992, Federal appliance standards required a minimum SEER of 10 for split-system central air conditioners and central heat pumps. Heat pumps and central air conditioners sold in 1986 had an average SEER of about 9.

products on commercial or multi-family residential buildings. Cool roofs provide at least 65 percent solar reflectivity and 80 percent emissivity (ability to emit heat), and they stay 50 to 60ºF cooler during peak summer conditions. The goal of the LADWP program is to reduce peak electricity demand and energy usage. In 2002, the program led to a reported reduction in electricity use of 678 megawatthours and a reduction in indirect emissions of 530 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 also, 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 34).

For 2002, Rolls Royce Corporation reported a load control project using a peak clipping method, which involved the installation of new natural gas turbines to generate electricity during peak demand periods. FirstEnergy Corporation reported another load control project, the Thermal Energy Storage Project. FirstEnergy sought opportunities to reduce maximum weekday on-peak electrical loads.

Thermal energy storage is designed to reduce summer weekday 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 cold water, eutectic salts, or ice systems by the operation of electric chillers during off-peak periods and then retrieved 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. Methods employed by FirstEnergy included providing information on thermal energy storage design and application, providing funding to and participation in engineering studies, preparing or assisting in the preparation of proposals, and encouraging the use of off-peak thermal energy storage systems by new and existing customers. Efforts were focused on the application of space and process cooling storage systems with the potential to reduce customers' total operating costs, provide reasonable internal rates of return for users, and reduce on-peak electrical loads. FirstEnergy reported that its project resulted in direct emission reductions of 3,708 metric tons carbon dioxide equivalent in 2002.

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 electrical 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 a component of DSM programs.

Allergan reported two new motor and motor drive projects for 2002. In the first project, which began in November 2002, 10 5-kilowatt motors with efficiencies of 87 percent were replaced with new motors of the same size that had efficiencies of 91 percent. The project reportedly reduced electricity use by 615 kilowatthours and indirect emissions by a total of 0.5 metric tons carbon dioxide equivalent. A second project reported by Allergan uses energy-efficient motors to replace old motors when they wear out. Several motors, ranging in size from 1 to 150 horsepower, were replaced with higher efficiency models in 2002, resulting in electricity savings estimated at approximately 44,000 kilowatthours per year. A listing of all the motors in the facility at the time of the motor study was used as the basis for calculating the savings, which were pro-rated over the 8-month period of the project, beginning in May 2002. Electricity savings from the project were reported to be 29,369 kilowatthours, resulting in a total emission reduction of 19 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 2002, but one entity reported a new project. Green Mountain Energy Company reported a project that supported electricity generation from wind energy through the purchase of renewable energy credits. The renewable energy credits were used to support the development and utilization of wind energy in Texas equivalent to the amount of energy used in the company's corporate offices. The new renewable resources produce zero net emissions of carbon dioxide and offset non-zero-carbon generation that is typical of power purchasers in Green Mountain's geographic area. This project reportedly led to indirect emission reductions totaling 496 metric tons carbon dioxide equivalent.

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.

Eight urban forestry projects were reported for 2002. LADWP reported on its Cool Schools Urban Forestry - Energy Efficiency Effects project, which capitalizes on the energy effects of urban forestry. The project provides for the planting of trees at Los Angeles Unified School District campuses throughout the city. The participating schools teach the Cool Schools environmental curriculum, which exposes children to science and caring for the environment. Tree planting is coordinated with the installation of air conditioning and asphalt resurfacing at the campuses, leading to reduced expenditures for air conditioning , better air quality through the uptake of air pollutants, improved aesthetics, and reductions in carbon dioxide emissions. During 1998 and 1999, 3,278 trees were planted at schools participating in the program. Another 742 trees were planted in 2000, 591 in 2001, and 1,735 in 2002. The trees are approximately 2 years old, 15-gallon size, and 10 feet tall when planted. Survival is assumed to be 100 percent, because any tree that dies is replaced. The goal of the program is to plant 8,000 trees at more than 80 schools. It was scheduled to end in December 2002 but has been extended into 2003. For 2002, LADWP reported that the project produced direct emission reductions of 402 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 2002; however, an ongoing project reported by Xcel Energy provides energy saving opportunities for business, residential, and governmental applications. Xcel works with its clients to define direct-impact projects (those that produce measurable energy savings). Xcel's direct-impact projects fall into the end-use categories of chillers, industrial process efficiency, nonresidential equipment replacement, nonresidential new construction, residential natural gas dryers, industrial process efficiency audits, replacement of residential equipment, residential lighting, residential new construction, and bid projects typically involving commercial or industrial applications. Xcel reported that these DSM projects reduced emissions from its customers' electricity consumption by 30,736 metric tons carbon dioxide equivalent in 2002.

Other

There were five new projects in the other project type category for the 2002 reporting year, none of which was from a new reporter. This project category captures the effects of energy end-use projects that cannot be meaningfully included in another category. Reporters of new projects for 2002 include Allergan, Inc., Lehigh Cement, and Seattle City Light. Allergan reported an air compressor efficiency project in which two 150-horsepower air compressors that run continuously (24 hours a day, 365 days a year) at 125 pounds per square inch discharge pressure were reduced to 105 pounds per square inch. The maximum line pressure needed in Allergan's manufacturing process is 80 pounds per square inch. The reduction in pressure resulted in less energy consumption and reported emission reductions of 63 metric tons carbon dioxide equivalent. The other new projects include three reported by Lehigh Cement Company that used alternative fuels (such as waste tires, waste oil, and rice hulls) as energy sources and a project reported by Seattle City Light that is designed to provide process efficiency improvements in manufacturing, processing, and refining.

Reducing Emissions from Transportation

The transportation sector is the largest contributing sector to total U.S. emissions of carbon dioxide, accounting for 32 percent of emissions in 2002. These emissions result from the combustion of fossil fuels, and 98 percent result from the direct use of petroleum fuels. Emissions from the transportation sector increased by 18 percent between 1990 and 2002, from 1,570 million metric tons carbon dioxide equivalent to 1,850 million metric tons carbon dioxide.[27] 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 12 percent between 1990 and 2000,[28] and the number of vehicles on the road increased by 17 percent between 1990 and 2000.[29] Emissions growth was moderated somewhat by an increase in average U.S. vehicle fleet

[27]Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2002*, DOE/EIA-0573(2002) (Washington, DC, October 2003), web site www.eia.doe.gov/oiaf/1605/1605a.html.

[28]Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003), p. 61, web site www.eia.doe.gov/emeu/aer/.

[29]U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 2002*, BTS02-08 (Washington, DC,December 2002), Table 1-11, web site www.bts.gov/publications/national_transportation_statistics/html/table_01_11.html.

fuel efficiency from 16.4 miles per gallon to 17.1 miles per gallon between 1990 and 2001.[30]

A total of 60 transportation projects were reported on Form EIA-1605 for 2002 by 33 entities, all but 2 of which were electric utilities. One of the nonutilities was CLE Resources, a subsidiary of an electric utility, and the other was the telecommunications firm AT&T. Fifty-three of the 60 transportation projects reported on Form EIA-1605 for 2002 have been reported in previous years. Seven new projects were reported for 2002:

- AT&T reported a fleet reduction program based on a strategy of reducing the number of and making upgrades to the vehicles in its fleet in order to reduce gasoline consumption.
- CLE Resources reported on the foreign component of its previously reported domestic McHugh Software project, which is an investment in a company providing warehouse and transportation management software that reduces fuel consumption through more efficient routing and avoidance of traffic problems.
- Connectiv Delmarva Generation provided information on emission reductions resulting from the subsidization of mass transit travel between Conectiv's headquarters in Delaware and the offices of its recent merger partner, Pepco, in Washington, DC.
- Conectiv Delmarva Generation also reported on the use of soy-based biodiesel fuel in its fleet vehicles.
- Consolidated Edison Company of New York, Inc., reported on its alternative-fuel vehicle program, which involves the operation of compressed natural gas (CNG) fleet vehicles and evaluation of other fuels, including biodiesel and E-85 (a blend of 85 percent ethanol and 15 percent gasoline).
- National Grid USA reported on its alternative-fuel vehicle program, which includes operation and testing of natural gas and electric vehicles.
- Portland General Electric Co. reported on the installation of power-line-based energy management systems in low population density areas to reduce vehicle travel for meter reading.

Thirty-five (58 percent) of the projects reported for 2002 were affiliated with the Department of Energy's Climate Challenge program, which was the only national voluntary program represented.

Tables 12 and 13 show transportation project trends in the first nine reporting cycles of the Voluntary Reporting Program. The projects reported for 2002 fall into three broad categories:[31]

- Alternative fuel use (30 projects or 50 percent)
- Travel reduction (26 projects or 43 percent)
- Vehicle efficiency improvements (5 projects or 8 percent).

The primary effect of the transportation projects reported was to reduce emissions of carbon dioxide, although reductions in emissions of nitrous oxide or methane were also reported for 5 projects. For 16 of the 60 projects reported, either reductions did not occur in 2002 or they were not estimated.[32]

Direct reductions totaling 41,966 metric tons carbon dioxide equivalent were reported for 27 projects in 2002 (Table 12). This represents a 7-percent decrease from the 44,996 metric tons carbon dioxide equivalent in direct reductions reported for 2001.

Indirect emission reductions in 2002 totaling 161,156 metric tons carbon dioxide equivalent were also reported for 24 projects. The sources of the reductions included "fuel cycle" emissions associated with production, refining, transportation, and distribution of fossil fuels; 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 from transportation projects reported for 2002 were 83 percent greater than those reported for 2001, due primarily to the addition of the AT&T telecommuting project, which accounted for 63,503 metric tons carbon dioxide equivalent in reductions that had not been reported since the 1999 data year.

Using Alternative Fuels

Fifty percent of the transportation projects reported for 2002 involved alternative-fuel vehicles (AFVs). These projects accounted for 30 percent of the direct reductions, but only 3 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 five projects.

[30]Energy Information Administration, *Annual Energy Review 2002*, DOE/EIA-0384(2002) (Washington, DC, October 2003), p. 61, web site www.eia.doe.gov/emeu/aer/.

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

[32]In some cases, reductions for the project may have been reported for years before 2002. 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.

AFV projects involved a variety of fuels, including natural gas, electricity, propane, biodiesel, E-85, and M-85 (a blend of 85 percent methanol and 15 percent gasoline). Electricity was included in 14 project reports. Southern California Edison's electric vehicles reportedly logged 1.9 million miles in 2002, more than 10 times the 174,000 miles reported in 1996. LADWP reported operating 258 electric vehicles in 2002, up from 204 in 2001 and 18 in 1996. Southern Company reported operating an electric vehicle fleet of 292 vehicles in 2002, including cars, trucks, neighborhood electric vehicles, and buses.

Fifteen projects involved the operation of CNG or liquefied natural gas (LNG) vehicles. Three utilities reported operating fleets of CNG, LNG, or dual-fuel CNG/gasoline vehicles of more than 100 vehicles in 2002: PG&E Corporation (5,012 vehicles), We Energies (654 vehicles), and NiSource (522 vehicles).

Five AFV projects reported for 2002 involved fuels other than natural gas and electricity.[33] Activity in 2002 was reported for three of those projects. Exelon Corporation reported using E-85 in 247 vehicles, propane in another 85 vehicles, and biodiesel in 1,757 vehicles. Cinergy Corp. also reported the use of AFVs fueled by propane. Conectiv Delmarva Generation reported using a soy-based biodiesel fuel in its fleet vehicles in 2002.

Reducing Vehicle Travel

Travel reduction, which includes such activities as carpooling and vanpooling, mass transit, telecommuting, and service efficiency improvements, was reported

Table 12. Number of Projects and Emission Reductions Reported on Form EIA-1605 for Transportation Projects by Project and Reduction Type, Data Years 1994-2002

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

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 1994-2001
(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

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

[33]Two other reporters resubmitted information on projects that involved consumption of propane and M-85 in previous years; however, the projects were inactive in 2002.

for 26 projects for 2002—accounting for 26 percent of the direct reductions and 68 percent of the indirect reductions reported for transportation projects in 2002. Direct reductions reported for 2002 were 16 percent lower than the 13,059 metric tons carbon dioxide equivalent reported for 2001. In contrast, indirect emission reductions reported for travel reduction projects for 2002 were 220 percent (74,862 metric tons) higher than those reported for 2001, primarily due to the addition of AT&T's telecommuting (63,503 metric tons carbon dioxide equivalent) and fleet cost reduction (5,534 metric tons carbon dioxide equivalent) programs for 2002.

Of the 26 projects reported in the travel reduction category, 14 involved carpooling or vanpooling, 10 increased mass transit ridership, 5 reduced employee vehicle use through telecommuting, 3 increased service efficiency for freight or service vehicles, and 8 involved other actions, such as work week compression, videoconferencing, use of bicycles for utility meter reading, promotion of employee commuting by bicycle or walking, and automation of utility meter reading in areas of low population density.[34]

AT&T reported the largest travel reduction project, a telecommuting program that reportedly reduced indirect emissions by 63,503 metric tons carbon dioxide equivalent. Reductions of more than 5,000 metric tons carbon dioxide equivalent in 2002 were also reported for the following travel reduction projects:

- LADWP reported on its employee carpooling and vanpooling program (8,167 metric tons carbon dioxide equivalent indirect emission reductions).
- Public Service Enterprise Group reported on its employee carpooling, vanpooling, and mass transit programs (7,729 metric tons carbon dioxide equivalent indirect emission reductions).
- Southern Company reported on its carpooling and mass transit programs (6,220 metric tons carbon dioxide equivalent indirect emission reductions).
- TXU reported efforts to reduce fleet and employee vehicle use (5,830 metric tons carbon dioxide equivalent direct emission reductions and 1,466 metric tons carbon dioxide equivalent indirect emission reductions).
- AT&T reported on its fleet cost reduction program (5,534 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 (6,659 metric tons indirect carbon dioxide emission reductions from foreign and domestic sources).

Improving Vehicle Efficiency

Emission reductions were reported for only three of the five vehicle efficiency projects reported for 2002. Two projects, both of which involved the use of light-weight aluminum railroad cars to transport coal, were among the four largest reductions reported for transportation projects in 2002. Both projects resulted in indirect emission reductions, in that 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 22,275 metric tons carbon dioxide equivalent. Allegheny Energy, Inc., reported reducing direct emissions by 15 metric tons by using carry-all utility vehicles, which are similar to golf carts, to replace a fleet of pickup trucks and vans in performing various duties associated with the operation and maintenance of the Pleasants and Willow Island power stations in West Virginia.

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.

[34]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.