National Renewable Energy Laboratory

Innovation for Our Energy Future

Sustainability Report

National Renewable Energy Laboratory (NREL) 2004–2005

INTRODUCTION

The National Renewable Energy Laboratory (NREL) is the U.S. Department of Energy's (DOE) preeminent laboratory for energy leadership. It is NREL's strategic intent to create clean technology options for securing our energy future.

By 2020, a significant part of the nation's new energy needs will be met by energy efficiency and renewable energy. A diverse, indigenous resource base—integrated with a new generation of more efficient energy systems—will support strong economic growth and a cleaner environment. Fifty areas of scientific investigation at NREL include photovoltaics, wind energy, biomass-derived fuels and chemicals, energy-efficient buildings, advanced vehicles, solar manufacturing, industrial processes, solar-thermal systems, hydrogen fuel cells, superconductivity, geothermal, distributed energy generation, and waste-to-energy technologies. *R&D*, *Discover*, and *Popular Science* magazines have ranked many of NREL's research achievements among the nation's most significant technical innovations.

NREL was established as the Solar Energy Research Institute (SERI) in 1974, and opened its doors in Golden, Colorado, in 1977. SERI became NREL in 1991 when President George H.W. Bush designated it a national laboratory.

Sustainability is an integral part of NREL's mission. The Laboratory believes in the balanced pursuit of economic viability, environmental stewardship, and public responsibility. We are pleased to present the second of our annual reports, the 2004-2005 Sustainability Report.

To serve as paradigm
Now of what a plausible Future might be
Is what we're here for. –W. H. Auden

Cover: NREL/PIX03370
Intro: NREL/PIX05325

Contents

Acknowledgments

The Sustainable NREL Master Plan implementation is managed by **Robert Westby**, Sustainable NREL lead; and **Susan Huffnagle**, Sustainable NREL coordinator.

The following staff members implement the master plan through collaborations of their individual work areas: **NREL Executive Management** (Lab economic viability); **Nancy Carlisle** (environmental stewardship activities—site planning and new buildings); **Chandra Shah** (water and green power purchasing); **Otto VanGeet** and **Anna Hoenmans** (electricity and natural gas use); **Dan Bilello** (GHG reductions); **Don Reed**, **Henri Hubenka**, and Computer Power Management Committee (computer power management); **Tim Peele** (transportation); **Karri Bottom** and the Recycling Advisory Committee (materials); **Maureen Jordan** (environmental management systems—including sustainability); **Michelle Kubik** (communications); **Laura Michael** (policies and procedures); **Lee Boughey** (public responsibility); and **Darren Legge** (Sustainable NREL intern).

Editorial and graphic support for this report were provided by Susan Huffnagle, Robert Westby, Michelle Kubik, and Jim Miller.

Message from the Director


NREL/PIX13724

Since becoming NREL's director in January 2005, I have been pleased with the Laboratory's response at instituting a more strategic management approach. This approach is synthesized in the NREL Strategic Roadmap, now under development. One of the roadmap priorities is that NREL have a "showcase campus." In support of this priority, I believe it's important that we incorporate sustainability into NREL's operations and practices.

Building on the successful launch of the Sustainable NREL Initiative, I am moving forward with an assessment of our sustainability efforts through the use of a Global Reporting Initiative Sustainability Reporting Guideline. This assessment will help us identify opportunities to improve our sustainability operations and practices. We will balance the decisions to implement identified opportunities with the considerations of good business practice and organizational efficiency.

This report provides a summary of the Sustainable NREL activities for 2004–2005. I am pleased to share that we have made considerable progress. Here are a few highlights:

- NREL was the first national laboratory to meet and exceed its 2005 EPA Climate Leaders Partnership GHG reduction goal of 10% over a 2000 baseline. With the inclusion of renewable energy certificates (RECs), NREL achieved a reduction of 63% from the 2000 baseline.
- The Laboratory energy consumption was 23% lower than our 1990 baseline and 61% lower when accounting for renewable energy credits. This reduction was achieved almost exclusively through investment in cost-effective energy retrofit measures. Although we have met and exceeded current federal energy use-reduction goals, NREL continues to support these expenditures.
- The Laboratory fleet petroleum use was reduced by 3% to 7,448 gallons as compared to FY 2004. Forty-three percent of the fleet was fueled by E85 (85% ethanol and 15% gasoline) and biodiesel, representing nearly 73% of the total fleet use.
- In FY 2005, we purchased renewable energy certificates equivalent to 100% of our annual electrical use in DOE-owned buildings.

I am convinced that our mission objectives are both enabled and enhanced by our leadership in sustainability. The employees of NREL and I are committed to incorporating sustainable principles in our efforts, and we encourage both engagement and participation by our stakeholder community. Through our actions, we can establish a new benchmark for what is possible. I look forward to continuing to position the Laboratory as a national leader in sustainability.

Dan Arvizu
Director, National Renewable Energy Laboratory
January 2006

About Sustainable NREL

NREL/PIX00241

Sustainable NREL is the internal program responsible for leading the planning, development, and implementation of the Laboratory's comprehensive suite of sustainability activities.

While the Management Framework remains consistent, the Sustainable NREL Master Plan is updated annually to reflect Lab-wide goals to be achieved that year.

For more information on Sustainable NREL or the Master Plan, visit our Web site: *http://www.nrel.gov/sustainable_nrel/*.

NREL Sustainability Management Framework

Economic Viability

Environmental Stewardship

- Campus
- Water
- Electricity/Natural Gas
- Transportation
- Reduce, Recycle, Reuse, Rebuy
- Environmental Management
- Education/Communications

Public Responsibility

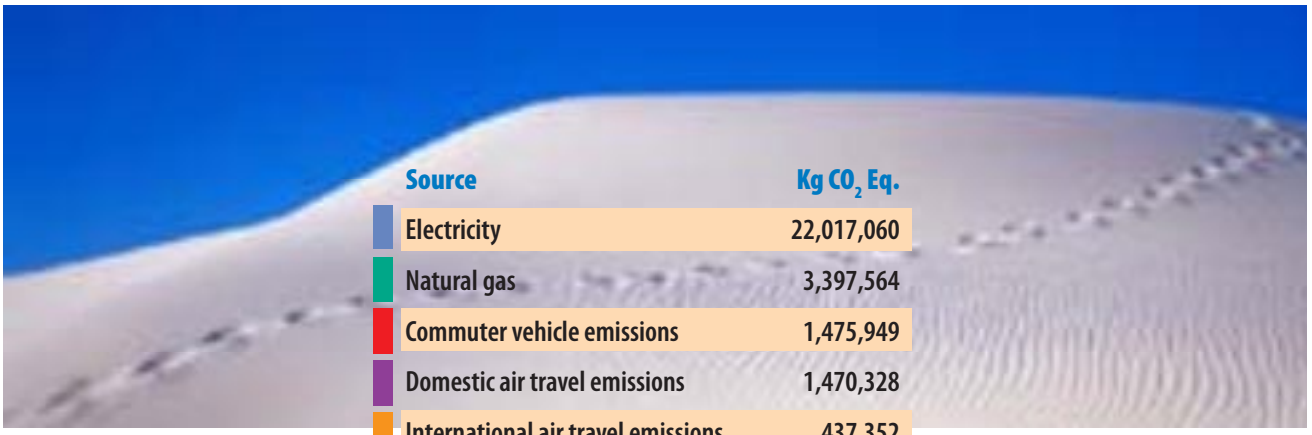
NREL Sustainability Vision

NREL will exemplify sustainability in an R&D organization by maximizing efficient use of all resources; minimizing waste and pollution; and serving as a positive force in economic, environmental, and community responsibility.

Environmental Footprint

NREL completed its first comprehensive life-cycle assessment-based "environmental" footprint in 2003. This CO_2 footprint is a representation of overall sustainability performance at the Laboratory.

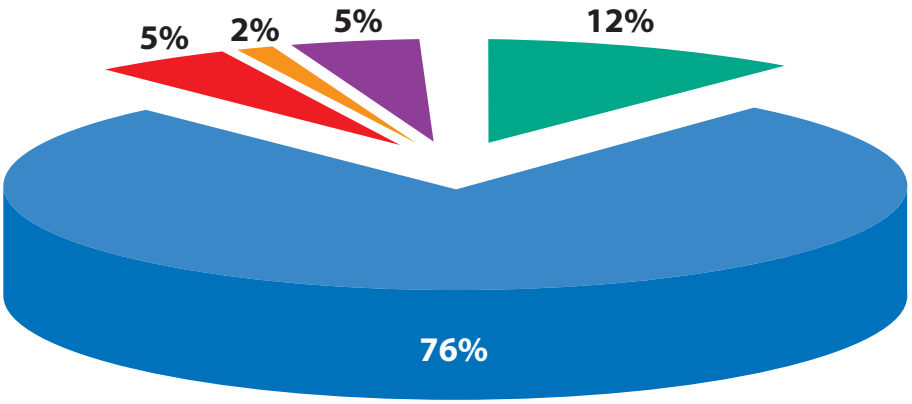
The use of the common CO_2 metric allows NREL to better understand the relative impacts of its decisions; measure progress; benchmark performance; and, in general, take responsibility for its actions.



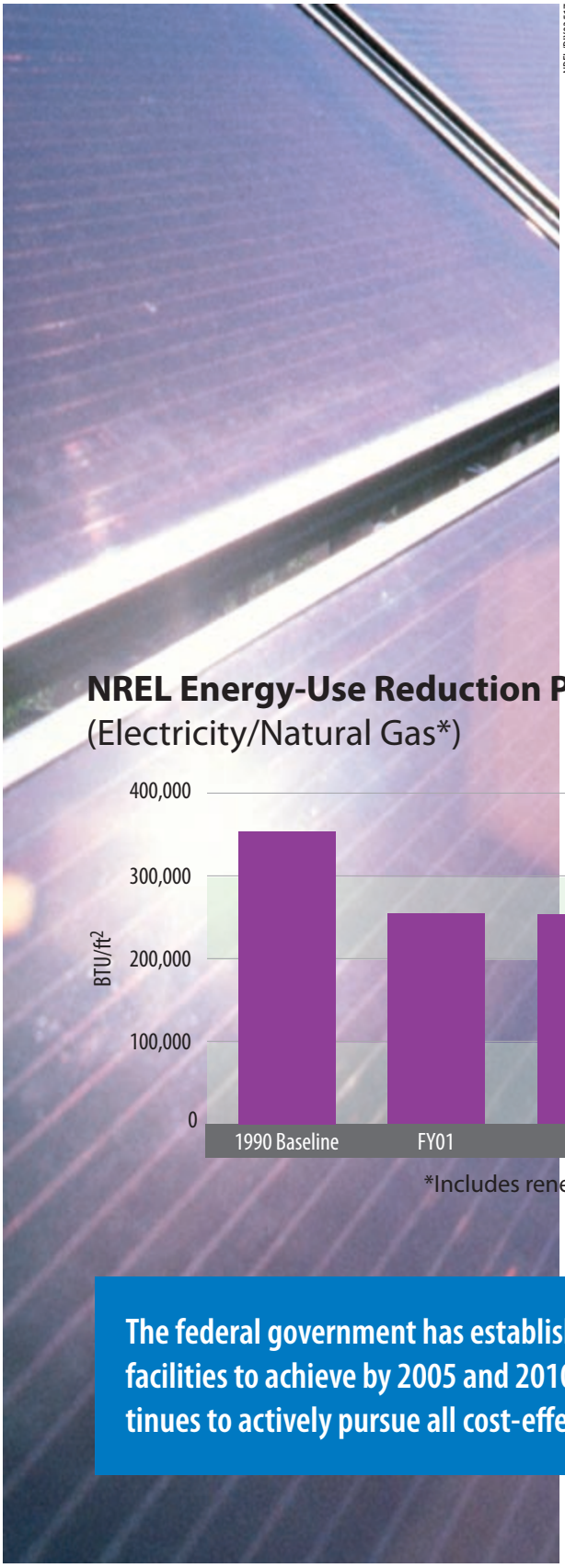
Source	Kg CO_2 Eq.
Electricity	22,017,060
Natural gas	3,397,564
Commuter vehicle emissions	1,475,949
Domestic air travel emissions	1,470,328
International air travel emissions	437,352
*Fleet vehicle emissions	99,073
*Solid waste disposal	51,000
*Water (electricity consumed)	10,185
*Water (natural gas consumed)	7,760
Totals	**28,966,271**

*Sources have negligible emissions

FY05 CO_2 Emission Breakdown

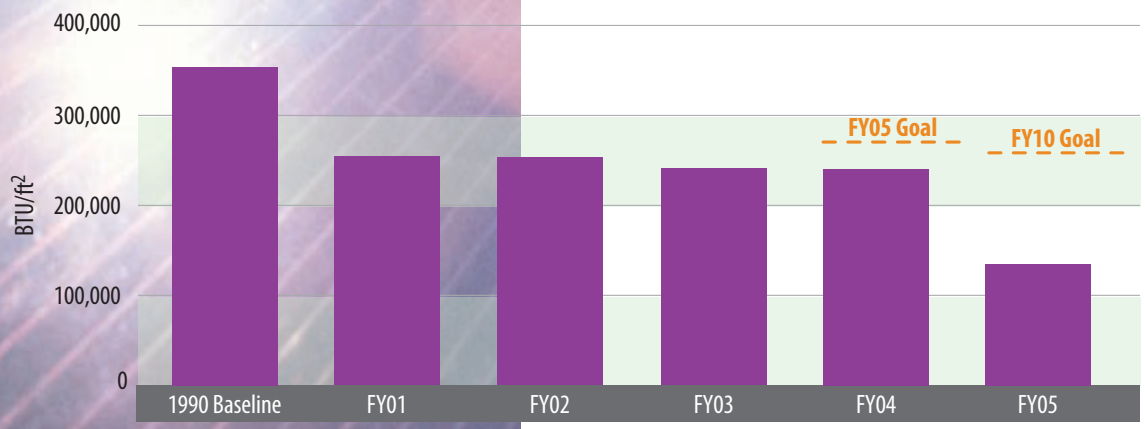


Energy Use


NREL/PIX03517

NREL manages its energy-use reduction activities through a comprehensive Energy Management Plan. The primary activities include energy efficiency retrofits; sustainable, energy-efficient, new-building construction; use of on-site renewable energy; extensive use of site-metering, energy-management control systems; peak demand management; and energy education.

NREL Energy-Use Reduction Progress
(Electricity/Natural Gas*)



*Includes renewable energy credits

The federal government has established energy-use reduction goals for federal facilities to achieve by 2005 and 2010. NREL has exceeded these goals and continues to actively pursue all cost-effective, energy-use reduction opportunities.

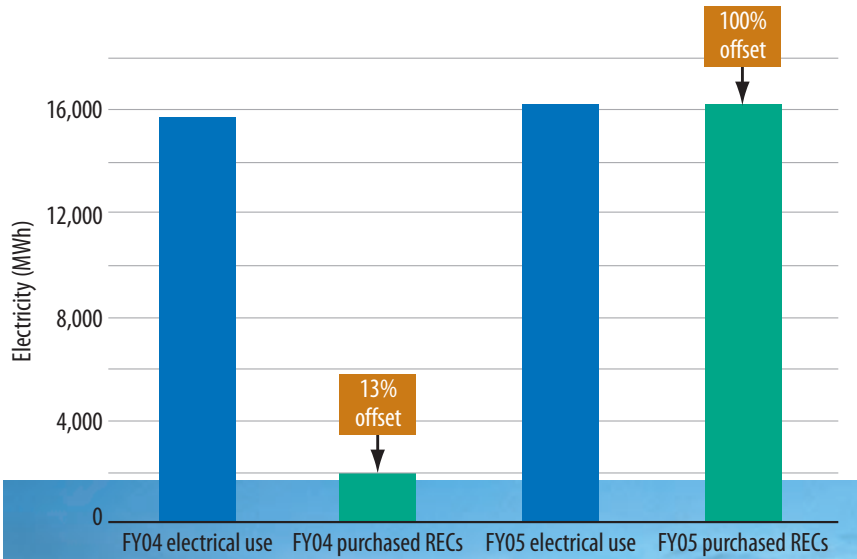
Renewable Energy Solutions

NREL makes extensive use of on-site renewable energy sources. On-site electricity generation sources include photovoltaics and wind. On-site renewable thermal energy sources include solar hot water systems, ventilation air preheat systems, and extensive use of passive solar heating and daylighting. At the National Wind Technology Center (NWTC), wind turbines used during research and development activities generate the electrical energy that simultaneously offsets on-site electrical load.

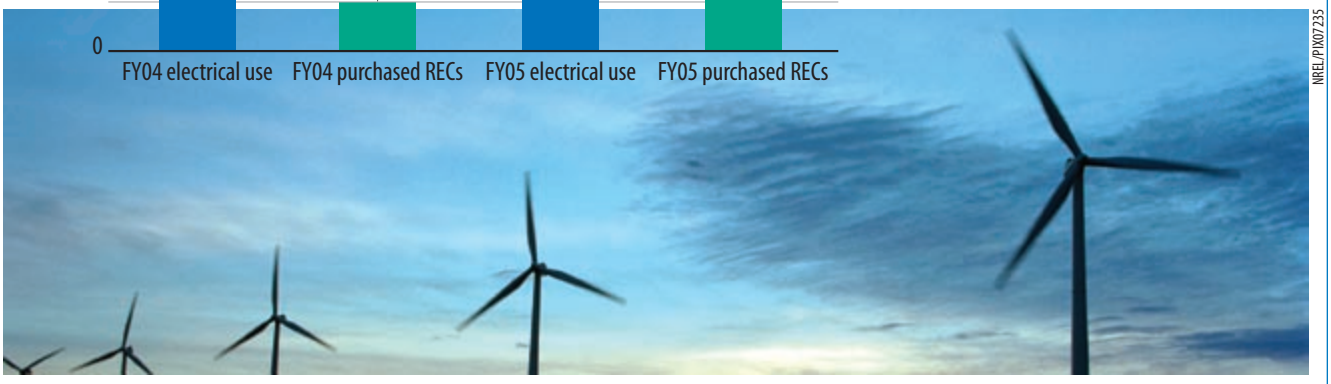
Photovoltaics also decrease the Laboratory electrical load. In FY05, approximately 52.2 MWh of electricity was generated by photovoltaics and 80 MWh from wind.

In FY04, NREL purchased 13% of its DOE-owned building annual electric load in renewable energy certificates (RECs). In FY05, NREL purchased 100% of its electric use in RECs. These purchases help support the DOE FY05 interim goal of 3% of electrical use from green power sources.

REC Purchase Offsets of Laboratory Electrical Use



A portion of NREL's on-site generated "green power" has been designated as the power source for the *nrel.gov* Web site.



NREL/PIX07235

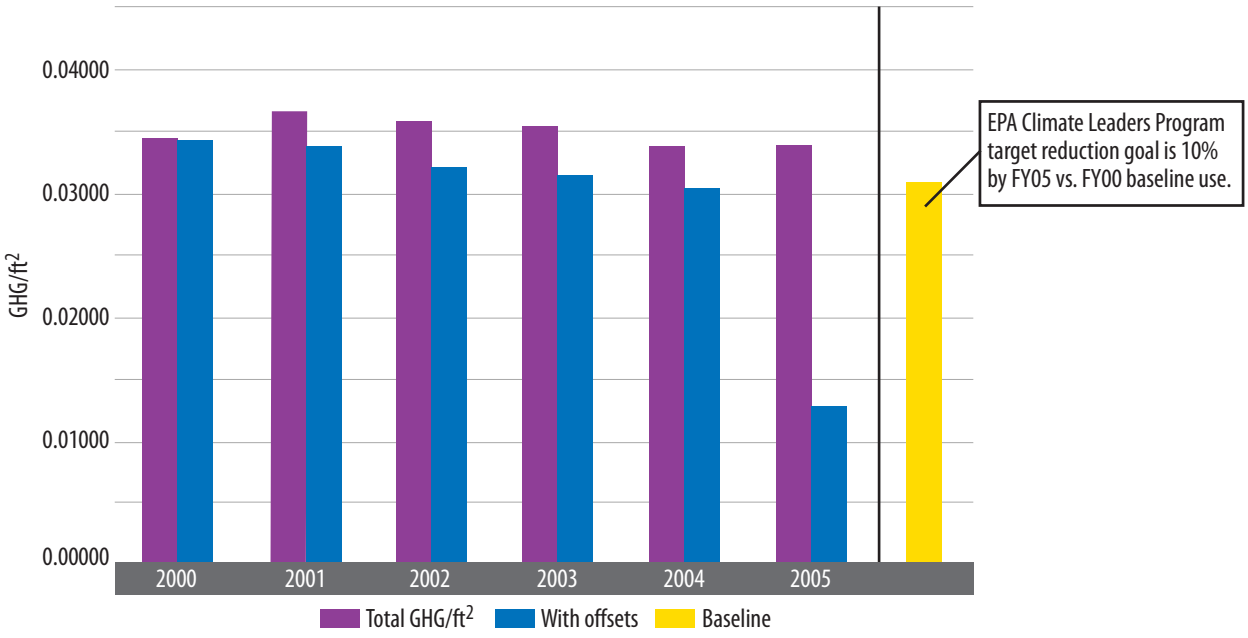
Greenhouse Gas Emissions

NREL/PIX02228

Greenhouse gas emission reductions are a focal point of NREL sustainability activities. Through the EPA Climate Leaders Partnership Program, NREL has made a voluntary commitment to reduce GHG emissions by 10% by 2005, compared to a year 2000 baseline. The Lab met and exceeded this goal in 2005.

NREL was the first federal pilot partner in the EPA Climate Leaders Partnership Program and was one of seven members to initially establish a target reduction of greenhouse gas emissions.

GHG Emissions Reductions



Transportation

Since 1997, the Laboratory has made a major commitment to the use of bio-based fuels in its fleet. Forty-three percent (or 20) of the 47 fleet vehicles are fueled by E85. The fleet used 10,384 gallons of E85 in FY05, almost 73% of the total fleet use—15,242 gallons of total gas and equivalent fuel.

Identifying and supporting employee alternative-transportation opportunities are key to achieving sustainability in transportation. NREL provides free bus passes to full-time employees, supplies shower facilities and bike lockers, and provides a free shuttle service using alternative-fueled vehicles (AFVs) for travel between buildings on campus. NREL also surveys its employees annually to collect metrics on alternative forms of employee commuting and guide the development of Laboratory transportation programs.

NREL also works with the Denver Regional Council of Governments (DRCOG) to improve commuting options for employees. For example, many NREL employees are part of DRCOG's carpooling programs. In addition, NREL hosts a booth at DRCOG's Annual Bike to Work Day Event—a statewide campaign promoting bike-riding as a viable commuting option.

Walk	4%
Carpool	10%
Bike	15%
Bus	17%

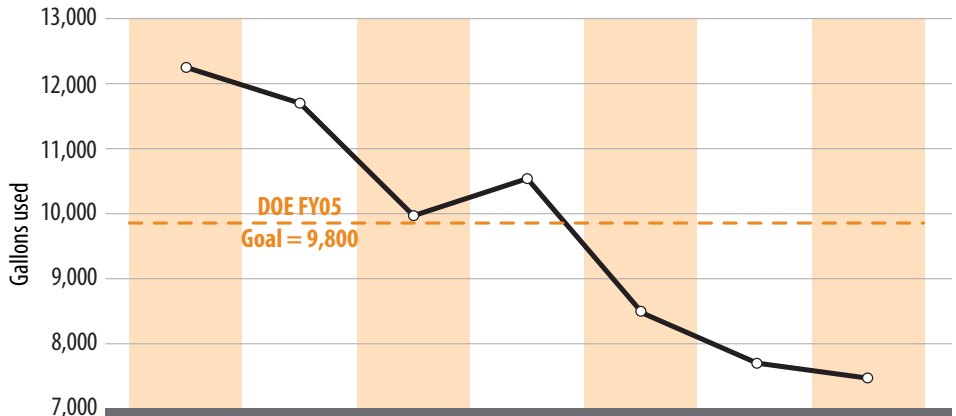
There were 384 employee respondents to NREL's Commuter Survey distributed in June 2005. The table above shows approximate percentages of employees who opt for alternative modes of transportation at least one time per week.

Mark Heitz-TRC/PIX06075

NREL FY04/FY05 Transportation Highlights

- NREL's vehicle fleet includes a variety of alternative-fuel vehicles (AFVs). Thirty-seven of the 47 fleet vehicles are AFVs.
- The Department of Energy establishes petroleum-use goals for all federal fleets. NREL's annual use goal is 9,800 gallons by FY05. The Laboratory met that goal in FY03 by using only 8,500 gallons of petroleum. In FY04, petroleum use decreased even further to 7,691 gallons. In FY05, NREL used only 7,448 gallons of petroleum.
- In FY05, NREL won a Department of Energy Pollution Prevention Star Award for "Green Fleet Team: Petroleum Reduction through Alternative Fuels," which recognized the Lab's reduced petroleum use in its fleet for FY04.

NREL Fleet Petroleum Use



	FY99	FY00	FY01	FY02	FY03	FY04	FY05
NREL gallons used	12,250	11,700	9,970	10,540	8,500	7,691	7,448

Water Use

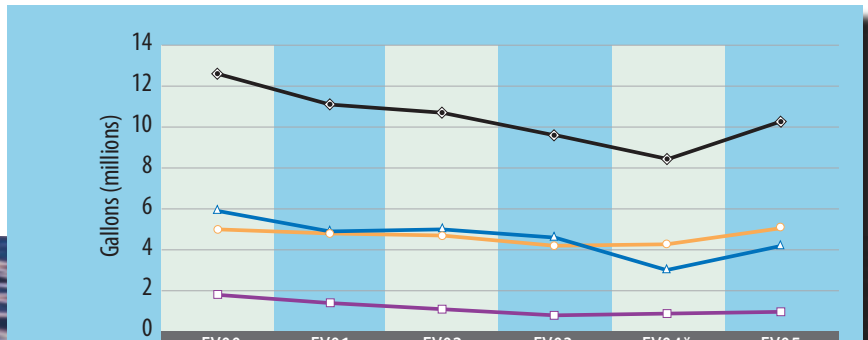
NREL has made significant progress in systematically implementing life-cycle, cost-effective, water-use reduction measures. Since 2003, six best management practices (BMPs) have been implemented. These BMPs include educating staff about water conservation, xeriscaping, low-flush toilets, waterless urinals, retrofitted faucets and showerheads, cooling-tower management and distribution audits, and leak detection and repairs.

In FY04, NREL achieved a minor reduction in total water use. This was due, in part, to the unplanned outages of two chillers. FY05 numbers represent a more accurate view of yearly water consumption at the Laboratory.

NREL/PIX07994

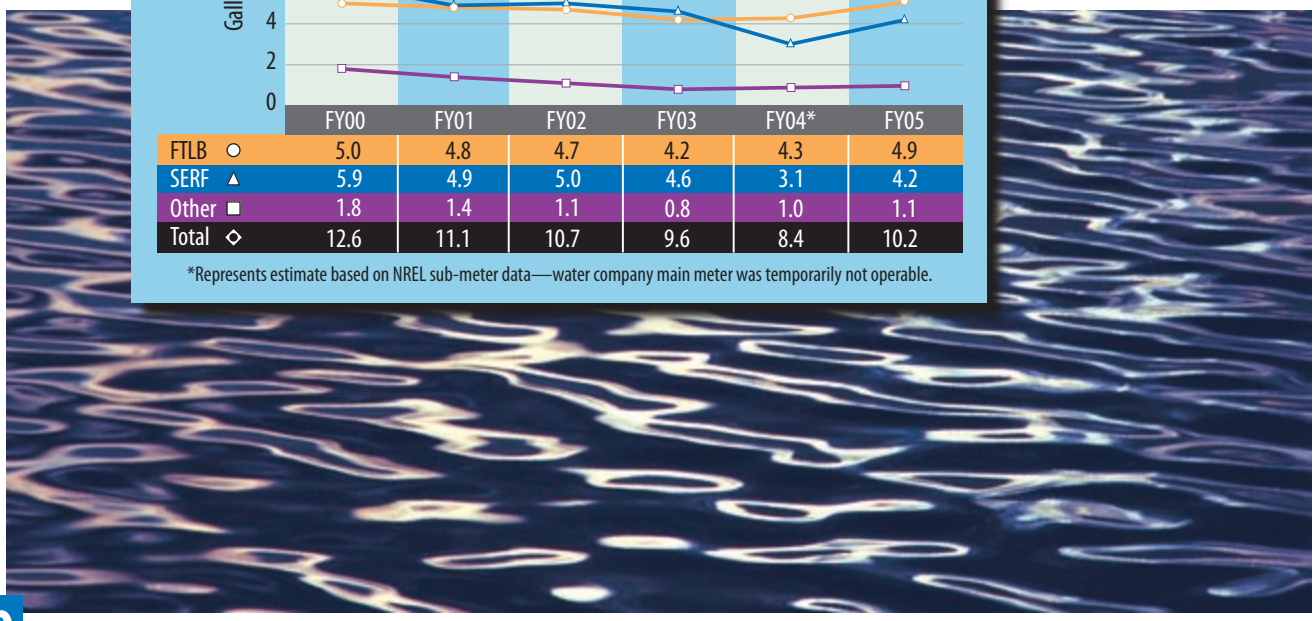
For more information regarding the FEMP best management practices, go to *http://www.eere.energy.gov/femp/technologies/water_ fedrequire.cfm*

NREL Water Use



	FY00	FY01	FY02	FY03	FY04*	FY05
FTLB ○	5.0	4.8	4.7	4.2	4.3	4.9
SERF △	5.9	4.9	5.0	4.6	3.1	4.2
Other □	1.8	1.4	1.1	0.8	1.0	1.1
Total ◇	12.6	11.1	10.7	9.6	8.4	10.2

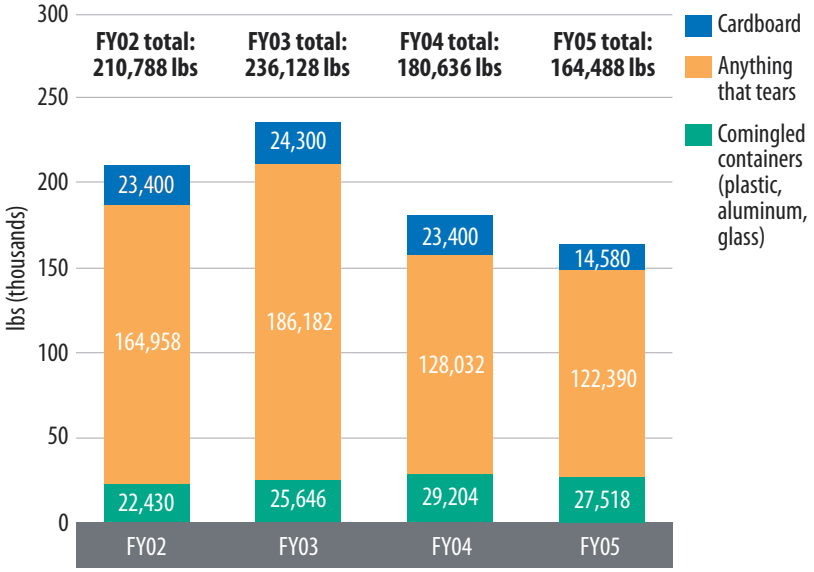
*Represents estimate based on NREL sub-meter data—water company main meter was temporarily not operable.



Recycling is a priority at NREL. To facilitate recycling, NREL has set up 14 locations throughout the campus that include bins for cardboard, office paper, comingled containers, and miscellaneous recyclable materials. A Web site dedicated to recycling issues explains what materials are recyclable, where the recycling centers are located, and includes an FAQ section on recycling. It can be accessed at ***http://www.nrel.gov/sustainable_nrel/recycling.html***

An employee Recycling Advisory Committee guides the operation of NREL's recycling program. It also provides a way to communicate more effectively with the janitorial staff and building-area engineers to further improve NREL's recycling program. Laboratory-wide recycling metrics effectively illustrate how much and what materials NREL is recycling and also where the Laboratory can improve recycling efforts.

Recycling Data



Green Purchasing

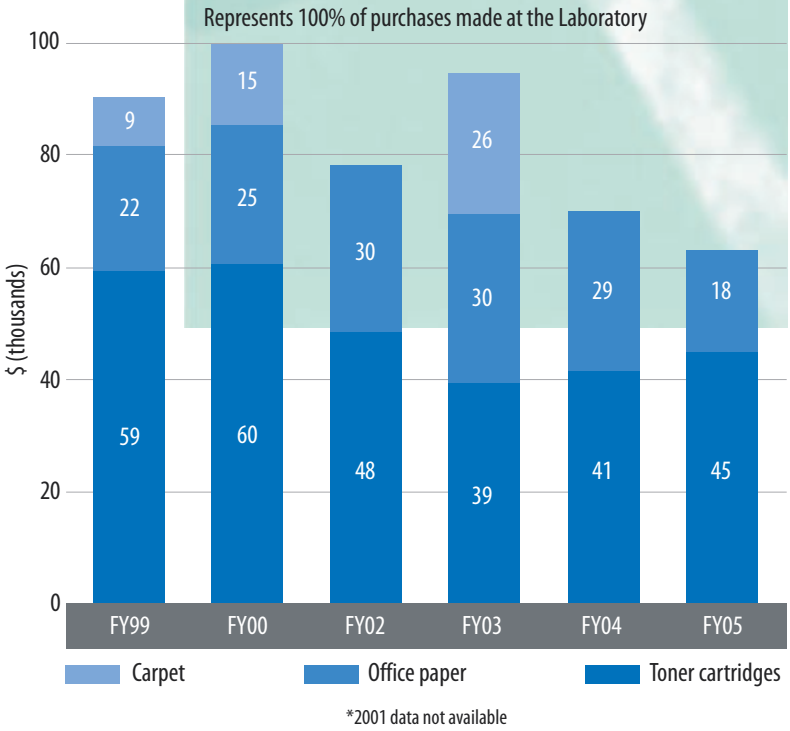
In 2004, The Department of Energy implemented the Buy Bio Pilot, a program that encourages government agencies to purchase bio-based products. NREL actively supports the Buy-Bio Program through its Bio-based Product Committee. The committee explores viable options for future bio-based product pilot programs for the Laboratory, in addition to sharing information regarding results of prior pilots.

Green purchasing was integral to the Laboratory's decision to create an electronic purchase card system implemented in FY05. This system tracks metrics on green purchases made at the Laboratory and encourages NREL employees to purchase green products whenever possible. To support this effort, NREL will offer a "recycled content only," on-line office supply catalog to employees to promote the use of recycled office products.

Another emerging environmentally preferable industry is "green" janitorial products. To support this industry, NREL will require its next janitorial vendor to use some type of bio-based cleaning products.

Since 1999, 100% percent of all carpet, toner cartridges, and office paper purchased at NREL have some amount of recycled content. NREL is testing office paper options, including Kenaf (a treeless paper) and 100% post-consumer waste office paper.

Laboratory Purchase of Recycled Products



*2001 data not available

Environmental Management

Innovative Design/PIX11334

Based on direction of "Executive Order 13148: Greening The Government Through Leadership In Environmental Management," federal agencies must establish a system that improves environmental performance by addressing environmental goals specific to each agency. NREL has had a formal Environmental Management System (EMS) in place since 2000. Through this program, the Laboratory practices the principles of pollution prevention and maintains open, responsive communication with the public and outside agencies.

The EMS system at NREL identifies the Laboratory's activities that impact the environment, audits and reports metrics on these impacts, and implements strategies to reduce them.

NREL prepares an annual environmental management report, summarizing NREL's environmental protection programs and activities. These reports include specific metrics and any permitting or notification efforts that occurred during the reporting period. Copies of these reports are available at ***http://www.nrel.gov/sustainable_nrel/environmental_manage.html***

National Environmental PerformanceTrack
U.S. Environmental Protection Agency

NREL has made a significant commitment to environmental management. The Laboratory was accepted into the Environmental Protection Agency's (EPA) National Environmental Performance Track (NEPT) in 2003. Each year, the Laboratory sets voluntary goals to enhance environmental management, establish stronger compliance, and develop more efficient operating processes.

Green Buildings

The design and construction of the Science & Technology Facility (S&TF) has provided NREL with a major opportunity in sustainability. At 71,000 square feet, the S&TF is the largest new laboratory/office building to be constructed on NREL's campus since the early 1990s. The S&TF is being constructed to qualify for a Leadership in Energy and Environmental Design (LEED) gold level rating, with a particular focus on energy efficiency. It also is being constructed in accordance with the principles of Laboratories for the Twenty First Century (LF21C) DOE/EPA program.

NREL/PIX01154

NREL/PIX13869

The Science and Technology Facility

U.S. Green Building Council Member

http://www.usgbc.org/

Partner LABS21 SM Partner

http://www.labs21century.gov/

Sustainability Features of the Science and Technology Facility

- Site was selected to keep the natural resources around the building intact.
- S&TF is located within one-half mile of a public transportation line.
- Roof is Energy Star compliant (high reflectivity, low emissivity).
- Rainwater will be captured for irrigation purposes.
- Building is designed to ***exceed*** ASHRAE 90.1-1999 requirements for energy efficiency.
- Effective use of daylighting.
- No CFC-based refrigerants will be used in the heating, refrigerating, and air-conditioning (HVAC&R) systems of the building.
- At least 50% (by weight) of the construction, demolition, and land-clearing waste will be recycled or salvaged.
- At least 25% of the total building materials will be composed of 20% PCW recycled content
- At least 20% of the total building materials will be manufactured regionally within a radius of 500 miles.
- CO_2 monitors will be installed to ensure that internal levels do not exceed outdoor levels by more than 530 ppm.

Public Responsibility/Community Outreach

Key Efforts

- NREL participates in numerous national and international energy conferences each year.
- The Annual Solar Decathlon gives children a way to learn about solar energy alternatives.
- Each year, the Laboratory hosts a booth at the National Western Stock Show that highlights the uses of renewable energy in rural applications.
- DOE Secretary Samuel Bodman visited the first "True Net Zero" Habitat for Humanity home in June 2005. The home was built with technical assistance from NREL and DOE's Building America Program, with financial assistance from the Laboratory's managing partners (Midwest Research Institute and Battelle).

Virginia Tech/PIX11532

NREL actively pursues education and community outreach. Two recent events that highlight this commitment included NREL presentations at the Catamount Institute's Sustainability Summit in Colorado Springs and the University of Colorado Sustainability Summit.

In addition to speaking engagements, NREL participates in many activities outside of the Laboratory, including hosting a booth for Denver's Bike to Work Day. NREL sponsors student tours of the Laboratory, and our "Renewable Energy Education on Wheels" van showcases NREL's latest technologies at various events.

NREL/PIX05457

NREL/PIX12838

Message from Sustainable NREL

We are pleased to be reporting for the second year on the state of sustainability activities at NREL. The first report, *Sustainability Report—National Renewable Energy Laboratory (NREL) 2003-2004*, discussed the program (implemented in 2002), which is based on the triple bottom-line foundation of sustainability with clearly defined outcomes and accountabilities.

In 2004-2005, the Laboratory was acknowledged with two awards for its sustainability activities. In the area of transportation, NREL received a DOE Energy Pollution Prevention Star Award for "Green Fleet: Petroleum Reduction through Alternative Fuels." For overall sustainability activities, NREL received a Federal Energy and Water Management Award for the Sustainable NREL program.

Because it has been four years since the inception of Sustainable NREL, in FY05 we have undertaken a review and evaluation of NREL's sustainability activities. To this end, we are in the process of preparing a Global Reporting Initiative (GRI) Report for the Laboratory. This report will use the *Global Reporting Initiative's 2002 Sustainability Reporting Guidelines and Public Institution Supplement*. Our objective is to enhance and fill gaps in our sustainability activities, particularly in the economic and social dimensions of our program.

We continue to have a mandate from our DOE sponsors and Laboratory management to proactively demonstrate leadership in sustainability. Part of this mandate is the public responsibility to make available and share our sustainability experiences. Please feel free to contact me, if we can be of assistance to you—and thank you for taking the time to read about NREL's sustainability program. At NREL, we feel that it is important to conduct Laboratory operations with sustainability as a priority.

Bob Westby
Director, Energy and Environmental Applications Office
and Sustainable NREL Lead
January 2006

Memberships and Awards

2005 Department of Energy Pollution Prevention Star award for "Green Fleet Team: Petroleum Reduction through Alternative Fuels."

Department of Energy (DOE) Federal Energy and Water Management Award

2004 U.S. Department of Energy Pollution Prevention Best-In-Class Awards: Office of Energy Efficiency and Renewable Energy (EERE)

- Sustainable NREL: New Building Program
- Sustainable NREL: Recycling Program
- Sustainable NREL: Education, Outreach, and Information sharing

EPA National Environmental Performance Track (NEPT)

Colorado Department of Health and Environment Environmental Leadership Program

2003 University of Colorado Wirth Chair Award in Environmental and Community Development Policy

Department of Energy Departmental Energy Management Achievement Award: Effective Program Implementation–Sustainable NREL

2002 EPA Climate Leaders Partnership: first federal laboratory member and one of seven members to establish a target GHG emissions reduction

Labs for the 21st Century: one of the first federal-sector labs that joined the program as a Pilot Partner in 2002

Federal Energy Management Program (FEMP) Energy Saver Showcase Award for the Thermal Test Facility (TTF)

2000 EPA Green Power Partnership : made commitment to purchase 10% of annual electric use in wind energy and first federal laboratory member

National Renewable Energy Laboratory
1617 Cole Boulevard, Golden, Colorado 80401-3393
303-275-3000 • www.nrel.gov

Operated for the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
by Midwest Research Institute • Battelle

NREL/MP-710-38487 • January 2006

Printed with a renewable-source ink on paper containing
100% postconsumer waste

NREL/PIX05296