

Site Sustainability Plan FY 2012

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Shown above, the entrance to NREL's Research Support Facility

NOMENCLATURE

AFV – Alternative Fuel Vehicles	kWh – Kilowatt-hour
ARRA – American Recovery and Reinvestment Act	LDRD – Laboratory Directed Research and Development Program
ASHRAE – American Society of Heating, Refrigerating, and Air-Conditioning Engineers	LEED – Leadership in Energy and Environmental Design
AWS – Alternative Work Schedules	LEED EB-O&M – LEED Existing Buildings: Operations and Maintenance
BTU – British Thermal Units	LEPC – Local Emergency Planning Committee
BBTU – Billion British Thermal Units	LID – Low Impact Development
CD – Construction Document	MFD – Multifunction Devices
CEDR – Consolidated Energy Data Report	MMBTU – Million British Thermal Units
CNG – Compressed Natural Gas	MTCO_{2e} – Metric Ton Carbon Dioxide Equivalent
CRADA – Cooperative Research and Development Agreement	MW – Megawatt
DC Pro – Data Center Energy Profiler Software Tool Suite	MWh – Megawatt-hour
DOC – Department of Commerce	NC – New Construction
DOD – Department of Defense	NEPA – National Environmental Policy Act
DOE – Department of Energy	NWTC – National Wind Technology Center
E85 – Ethanol 85	NREL – National Renewable Energy Laboratory
EA – Environmental Assessment	PCards – Purchase Cards
EERE – Office of Energy Efficiency and Renewable Energy	PDF – Portable Document Format
eGRID – Emissions and Generation Resource Integrated Database	PPA – Power Purchase Agreement
EHS – Environment, Health, and Safety	PPI – Pollution Prevention Initiative
EISA – Energy Independence and Security Act of 2007	PPTRS – Pollution Prevention Tracking and Reporting System
EO – Executive Order	PUE – Power Usage Effectiveness
EMS – Environmental Management System	PV – Photovoltaics
EPA – Environmental Protection Agency	R&D – Research and Development
EPACT – Energy Policy Act of 2005	RE – Renewable Energy
EPCRA – Emergency Planning and Community Right-to-know Act	REC – Renewable Energy Certificate
EPEAT – Electronic Product Environmental Assessment Tool	RFHP – Renewable Fuel Heat Plant
EPP – Environmentally Preferable Purchasing	RSF – Research Support Facility
ESCO – Energy Services Company	SEB – Site Entrance Building
ESIF – Energy Systems Integration Facility	SERF – Solar Energy Research Facility
ESPC – Energy Savings Performance Contract	SF₆ – Sulfur Hexafluoride
FAST – Federal Automotive Statistical Tool	SOW – Statement of Work
FEC – Federal Electronics Challenge	SSP – Site Sustainability Plan
FEMP – Federal Energy Management Program	SSPP – Strategic Sustainability Performance Plan
FIMS – Facilities Information Management System	SSRL – Solar Radiation Research Laboratory
FTLB – Field Test Laboratory Building	S&TF – Science and Technology Facility
FY – Fiscal Year	STM – South Table Mountain
ft² – Square Feet	Sustainable NREL – NREL's Sustainability Program
GHG – Greenhouse Gas	T&D – Transmission and Distribution
GGE – Gallons of Gas Equivalent	TEAM – Transformational Energy Action Management
GSA – General Services Administration	USGBC – United States Green Building Council
GSF – Gross Square Feet	USNORTHCOM – U.S. Northern Command
GP – Guiding Principles	VOC – Volatile Organic Compounds
HPSB – High Performance Sustainable Buildings	WAPA – Western Area Power Administration
HVAC – Heating, ventilation, and air conditioning	
IBRF – Integrated Biorefinery Research Facility	
ILA – Industrial, Landscaping, and Agricultural	
ISMS – Integrated Safety Management System	
IT – Information Technology	
ITIL – Information Technology Infrastructure Library	
kBTU – Thousand British Thermal Units	
kW – Kilowatt	

EXECUTIVE SUMMARY

Artist's rendition of completed STM campus looking east.

SITE MANAGEMENT VISION

The Department of Energy's (DOE) National Renewable Energy Laboratory's (NREL) goal is to expand our leadership as a state-of-the-art laboratory that supports innovative research, development, and commercialization of renewable energy and energy efficiency technologies that address the nation's energy and environmental needs. Fundamental to this goal is NREL's commitment to sustainability—operating in a manner that balances environmental, economic, and social values in the delivery of our mission. At NREL, sustainability is integral to both our research and operations. NREL is committed to demonstrating federal leadership in sustainability, working to continuously improve our performance and lead by example.

Sustainable NREL is a long standing laboratory program that fosters environmental and social responsibility, working to establish the lab as a global model for sustainability. Sustainable NREL is responsible for advocating for all executive orders, federal regulations, DOE orders, and goals related to sustainable facility operations. This program also executes NREL-specific goals to reduce our impacts on the community and environment and provides technical expertise to other organizations within the lab. Sustainable NREL provides leadership within the federal government and our community by actively mentoring and collaborating with other organizations to move sustainability into a new paradigm.

NREL's campus is a living laboratory that showcases new technologies, design practices, and operating behaviors. In all campus development, NREL looks for opportunities to integrate energy efficiency and renewable energy, high-performance buildings, and sustainable transportation options. On-site deployment of technologies developed by NREL researchers is also emphasized.

MAJOR PLANNING ASSUMPTIONS, ISSUES, AND FUNDING STRATEGIES

NREL is planning for significant future growth as represented in our long term campus plan—with a projected 83% increase in staff and 300% increase in campus footprint from FY 2008 to FY 2020. While currently experiencing growth, the current economic climate is uncertain. In this context, NREL is preparing to accommodate future growth through the construction of new high-performance buildings and renewable energy systems that take advantage of alternative financing mechanisms, including power purchase agreements (PPA), energy savings performance contracts (ESPC), partnerships with energy service companies (ESCO), and cooperative research and development agreements (CRADA). NREL also continues to review the use of overhead funds, cost savings reinvestment, and leveraging of alternative finance for retrofits or new projects.

SUCCESSSES AND CHALLENGES

As market demand for renewable energy and energy efficiency continues to expand, NREL responds. In FY 2011, our staff levels increased 20% from 2010, and NREL's campus square footage expanded 48%. This pace of campus construction will continue through FY 2012 with the addition of six new structures on campus. This growth poses challenges in NREL's pursuit of DOE's energy and sustainability goals. Even with all new construction meeting Leadership in Energy and Environmental Design (LEED®) Gold or Platinum certification standards, NREL's first net-zero energy building, and additional new on-site renewable systems, NREL's demand for energy and water will increase. Subsequently, greenhouse gas (GHG) emissions from purchased energy and travel will continue to grow even though impacts are being reduced on a per capita basis. Scope 3 GHG emissions will continue to be a high priority for NREL in our development of innovative solutions.

To reduce energy consumption with expected staff growth, NREL constructed two high-performance sustainable buildings and four on-site renewable energy installations in FY 2011. These buildings allow NREL to vacate leased space and move staff into a more efficient and sustainable work environment. In FY 2011 NREL:

- Achieved LEED Platinum certification from the U.S. Green Building Council for the new Research Support Facility (RSF I)
- Completed the Integrated Biorefinery Research Facility, which achieved LEED Gold status.

In FY 2011, NREL also deployed new on-site renewable-energy systems, including:

- Photovoltaics (PV) on the South Table Mountain (STM) campus—a 524 kilowatt (kW) array on the RSF visitor's parking lot and a 449 kW array on RSF I
- Two wind turbines at the National Wind Technology Center (NWTC)—one 3 megawatt (MW) and one 2 MW under cooperative research agreements.

FY 2011 also saw many innovative accomplishments for NREL, including:

- Rolling out a campus-wide no-idling policy and education program
- Establishing NREL's first green janitorial contract
- Enhancing NREL's office supply contract for sustainable acquisition
- Completing the first interagency Sustainability Challenge with DOE, the Environmental Protection Agency Region 8, General Services Administration, and City of Lakewood, Colorado
- Participating in the international Katerva Challenge
- Achieving net-zero energy performance for the RSF I
- Implementing a campus-wide composting program.

In FY 2011, NREL was also recognized for several prestigious awards that acknowledge our performance in sustainability:

- DOE EStar Awards, which highlight environmental sustainability projects and programs that reduce environmental impacts, enhance site operations, reduce costs, and demonstrate excellence in pollution prevention and sustainable environmental stewardship
 - Living Lab – Building the Sustainable Campus of the Future
 - Cradle to Cradle – Near-Zero Materials Waste and Beyond
- 2011 GreenGov Presidential Award, which celebrates extraordinary achievement in the pursuit of President Obama's challenge to lead by example toward a clean energy economy
 - Sustainable Information Technology Innovation at Work in NREL's RSF Green Data Center
- EPA's Federal Electronics Challenge (FEC) Platinum Level Award, which recognizes electronic stewardship that helps the federal government improve its sustainable practices when purchasing, managing, and disposing of their electronics assets.

As educators, NREL also hosted 233 tours of the net-zero energy RSF I to share pioneering energy efficiency technologies, and sustainable practices.

Staffing increases affect energy and resource consumption. To mitigate our impacts on the community and the environment while strongly promoting the laboratory's mission, NREL is educating staff on behavior changes necessary to uphold sustainability goals that meet reductions required by Executive Order (EO) 13514. Using a range of programs, procedures, and projects, Sustainable NREL supports the dynamic processes of creating a sustainable research campus.

Campus construction continues through FY 2012 with a new cafeteria, parking garage and associated roadway infrastructure, a new Site Entrance Building (SEB), RSF II, and Energy Systems Integration Facility (ESIF) on the STM campus, and a new 5 MW dynamometer at the NWTC.

SUMMARY

The following table summarizes each of DOE's Strategic Sustainability Performance Plan (SSPP) goals along with NREL's performance status, planned actions, and an assessment of the risk of non-attainment as noted below:

- *Technical risks.* Technology is available or not available in current facilities and systems to attain the goal.
- *Management risks.* Management systems and/or policies may require changes for which approval authority is outside the sustainability program.
- *Financial risks.* Funds are/are not identified in current or outyear targets to achieve the goal.

Each risk is assigned a rating of high (H), medium (M), low (L).

- *High (H).* Risk in at least one of the three categories is so significant that non-attainment of goal is likely or expected.
- *Medium (M).* Risk in at least one of the above categories is so significant that it is moderately likely that the goal that will not be attained.
- *Low (L).* Any risks associated with this goal are being satisfactorily mitigated such that attainment of the goal is likely.

SUMMARY TABLE OF GOALS AND TARGETS

SSPP Goal	DOE Goal	Performance Status in FY 2011	Planned Actions and Contribution in FY 2012	Risk of Nonattainment High (H), Medium (M), Low (L)
1.1	28% Scope 1 and 2 GHG reduction by FY 2020 from an FY 2008 baseline Purchase Renewable Energy Certificates (RECs) to offset all Scope 2 emissions	NREL reduced Scope 1 and 2 emissions 86% from the 2008 baseline (including RECs).	Work with NREL researchers to identify and institute Sulfur Hexafluoride (SF ₆) alternatives. Purchase RECs to offset all Scope 2 emissions.	L – NREL will meet this goal through our commitment to implement energy efficiency measures, generate on-site power, and purchase RECs to offset emissions.
1.2	30% energy intensity reduction by FY 2015 from an FY 2003 baseline	Energy intensity decreased 35% since 2003.	Perform Energy Independence and Security Act (EISA) audits of DOE-owned facilities. Populate the Portfolio Manager tool and pursue Energy Star certification for qualified buildings.	L – NREL will meet this goal provided the ESIF data center can be excluded from the energy intensity calculation.
1.3	Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015)	NREL connected electricity, hot and chilled water, and natural gas meters to the Energy Dashboard.	Connect remaining meters to the Energy Dashboard system such that 100% of NREL's electricity, hot and chilled water, and 95% of natural gas will be metered in 2012.	L – In FY 2012, NREL will be in full compliance.
1.4	Cool roofs, unless uneconomical, for roof replacements unless project already has CD-2 approval. New roofs must have thermal resistance of at least R-30	50% of NREL campus has cool roofs, a 27% increase from FY 2010.	NREL will continue to evaluate economic feasibility of existing roof replacement with cool roofs. All new LEED certified buildings will have cool roofs.	L – NREL will continue to comply with this requirement.
1.5	7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010–2012)	28% of NREL's total power comes from on-site sources.	NREL will continue to look for opportunities to generate or purchase renewable energy.	L – NREL will continue to meet or exceed this requirement.
1.6	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to an FY 2005 baseline	Alternative fuel use has grown 143% since 2005.	NREL's goal is to transform its fleet such that 100% of all non-exempt vehicles are Alternative Fuel Vehicles (AFVs). The laboratory will continue working with General Services Administration (GSA) and DOE to increase the number of AFVs in the fleet.	L – NREL will continue to meet or exceed this requirement.
1.7	2% annual reduction in fleet petroleum consumption by FY 2020 relative to an FY 2005 baseline	NREL established a campus-wide no-idling policy. Petroleum fuel usage has grown 92.6% since 2005.	Roll out an enhanced video-conferencing education program aimed at reducing ground travel. Provide training for all fleet shuttle drivers on no-idling policies and best practices.	M – Management Risk: Increased acquisition of petroleum hybrid vehicles and disposition of low-mileage AFVs to meet the Secretary's reduction goal are increasing petroleum use.
1.8	75% of light duty vehicle purchases must consist of AFVs by FY 2000 and thereafter	One Compressed Natural Gas (CNG) vehicle was added to the fleet in FY 2011.	NREL's goal is to transform its fleet such that 100% of all non-exempt vehicles are AFVs.	L – The laboratory will continue to work with GSA and DOE to increase the number of AFVs in the fleet.

SUMMARY TABLE OF GOALS AND TARGETS

SSPP Goal	DOE Goal	Performance Status in FY 2011	Planned Actions and Contribution in FY 2012	Risk of Nonattainment High (H), Medium (M), Low (L)
1.9	Reduce fleet inventory by 35% within the next 3 years relative to an FY 2005 baseline	NREL disposed of 7 vehicles, 15% of the fleet in FY 2011.	NREL will turn in 7 fleet vehicles, another 15% of NREL's vehicle fleet, as required by DOE in FY 2012.	L – NREL will meet this requirement.
2.1	13% Scope 3 GHG reduction by FY 2020 from an FY 2008 baseline	NREL Scope 3 emissions increased 10% from the 2008 baseline.	Analyze rental car data to identify opportunities for emissions reductions. Roll out green vehicle program campus-wide. Continue to incentivize and educate staff on employee commuting alternatives.	M – Management Risk: To support NREL's mission, some air travel is necessary. While on a per capita basis NREL will meet the reduction goal, the absolute reduction from the 2008 baseline will be challenging due to population growth.
3.1	15% of existing buildings greater than 5,000 gross square feet (GSF) are compliant with the Guiding Principles (GPs) of High Performance Sustainable Buildings (HPSB) by FY 2015	NREL currently has 3 buildings (13%) compliant with the GPs. NREL performed GP assessments on 3 additional buildings this year.	Conduct 3 additional GP building assessments. Develop cost estimates for all assessed buildings to achieve GP compliance. Conduct occupant comfort surveys for the IBRF and RSF II.	L – NREL will meet or exceed this requirement.
3.2	All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs and where the work exceeds \$5 million, each are LEED—NC Gold certification or equivalent	In FY 2011 NREL received LEED Platinum certification for RSF I and LEED Gold certification for IBRF.	RSF II is projected to receive LEED Platinum certification in FY 2012. Complete construction and receive LEED Platinum certification for RSF II and the SEB. Complete construction of the parking garage designed to LEED Platinum standards. Complete construction and receive LEED Gold certification for the cafeteria. Continue construction and pursuit of LEED Gold certification for ESIF.	L – NREL will continue to meet or exceed this requirement.
4.1	26% water intensity reduction by FY 2020 from an FY 2007 baseline	Reduced water intensity by 48% from FY 2007 baseline.	Perform EISA energy and water audits of DOE-owned facilities. Install new pervious paving mix prototype on campus as part of collaborative pervious paving research effort.	M – Technical Risk: To make ESIF the world's most energy efficient data center, a large amount of water will be needed for cooling, which offsets electricity use.
4.2	20% water consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from an FY 2010 baseline	NREL does not use ILA water.	NREL will continue to explore opportunities as they become available to utilize non-potable water sources for our campus.	L – Unless reuse water becomes available NREL will not consume ILA water.

SUMMARY TABLE OF GOALS AND TARGETS

SSPP Goal	DOE Goal	Performance Status in FY 2011	Planned Actions and Contribution in FY 2012	Risk of Nonattainment High (H), Medium (M), Low (L)
5.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY 2015	<p>Diverted 77% of campus waste from landfill.</p> <p>Rolled out Pollution Prevention Initiative (PPI) Pilot Program.</p> <p>Performed 3 pollution prevention assessments.</p>	<p>Task Near-Zero Waste Committee with identifying and implementing projects to reduce paper usage by 5% and increase waste diversion by 5% as part of participation in Environmental Protection Agency (EPA) programs.</p> <p>Perform on-site waste audits to analyze waste stream and identify opportunities for additional reduction.</p> <p>Participate in Sustainable SITES program.</p> <p>Perform 2 pollution prevention assessments.</p> <p>Provide updates to the Weed Management Program 6-2.12.</p>	L – NREL will continue to meet or exceed this requirement
5.2	Divert at least 50% of construction and demolition materials and debris by FY 2015	Diverted 88% of construction waste from landfill in FY 2011.	Sustainable NREL will continue to track data and enforce subcontractor Statement of Work (SOW) requirements for all construction projects in FY 2012.	L – NREL will continue to meet or exceed this requirement.
6.1	Procurements meet sustainability requirements and include sustainable acquisition clause (95% each year)	<p>Awarded first green janitorial contract.</p> <p>Enhanced office supply contract to include EO 13514 sustainable acquisition requirements.</p>	<p>Finalize and implement Policy 10-1 as well as (Purchase Cards (PCard), and purchase request procedures.</p> <p>Host a series of meetings to increase the visibility of green office-supply product selection with NREL staff and provide education on preferred purchasing procedures.</p> <p>Collaborate with CADD0 to host a green office supply fair featuring new product vendors and technologies for staff.</p> <p>Increase Environmentally Preferable Purchasing (EPP) by 5% in FY 2012 to support NREL's participation in the EPA Federal Green Challenge.</p> <p>Implement the green cleaning janitorial contract campus wide.</p>	L – NREL will continue to meet or exceed this requirement.
7.1	All data centers are metered to measure a monthly Power Utilization Effectiveness (PUE) (100% by FY 2015)	NREL's RSF data center measures monthly PUE.	NREL will continue to optimize data center operations and performance using measured monthly PUE.	L – NREL will continue to meet this requirement.
7.2	Maximum annual weighted average PUE of 1.4 by FY 2015	PUE for the RSF data center is 1.16.	NREL will meet or exceed a world-class PUE (less than 1.3).	L – NREL will continue to meet this requirement.
7.3	Electronic Stewardship— 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012	Power management is enabled on 100% of devices.	<p>Populate Data Center Energy Profiler Software Tool Suite (DC Pro) for energy assessment and energy profiling of RSF and legacy data centers.</p> <p>Roll out thin client systems to increase processing capacity.</p>	L – NREL will continue to meet this requirement.



ENERGY

A 3 MW Alstom turbine at NREL's NWTC. NREL's on-site renewable systems including PV and wind turbines generate 28% of NREL's power.

GOALS

(1.2) 30% energy intensity reduction by FY 2015 from an FY 2003 baseline

Energy intensity decreased 35% since 2003.

(1.3) Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015)

NREL connected electricity, hot and chilled water, and natural gas meters to the Energy Dashboard.

(1.4) Cool roofs, unless uneconomical, for roof replacements unless project already has construction document (CD-2) approval. New roofs must have thermal resistance of at least R-30

Cool roofs are on 50% of NREL campus, a 27% increase from FY 2010.

(1.5) 7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010–2012)

On-site renewable energy supplies make up 28% of NREL's total power.

STRATEGY AND PERFORMANCE SUMMARY

NREL's goal is to establish a campus of the future that showcases the possibilities that efficient use of energy and renewable sources can bring. To support this goal, NREL invests in site design and building development that maximizes energy efficiency and renewable energy opportunities. Where possible, NREL integrates renewable technologies on campus through a variety of financing mechanisms that help to minimize our energy footprint while accommodating campus growth.

FY 2011 PERFORMANCE STATUS

Energy Intensity

Electrical energy use in NREL's Department of Energy (DOE)-owned facilities increased slightly from FY 2010 (18,410 MWh) to FY 2011 (19,900 MWh). This increase can be attributed to the construction of RSF I and the Integrated Biorefinery Research Facility (IBRF) in FY 2011. Natural gas use in NREL's DOE-owned facilities decreased between FY 2010 (70 BBTU) and FY 2011 (63.5 BBTU), with an average of 51.6 MMBTU per capita despite increasing building square footage 48% and staff levels 20%. NREL's wood-chip fueled Renewable Fuel Heat Plant (RFHP) helped in this reduction by displacing 12 BBTU of natural gas in the reporting period, providing half the heat delivered to the campus' central heating system.

NREL has two natural gas fired boiler plants, in the Solar Energy Research Facility (SERF) and the Field Test Laboratory Building (FTLB), and a wood fired hot water boiler (RFHP) all tied into a the campus' central heating system. In FY 2011, inefficient boilers in the FTLB were replaced with high-efficiency condensing boilers. The SERF retained its average-efficiency fire tube boilers; however, a new operating scheme has been implemented to minimize the use of these boilers as much as possible. Building automation system programming was rewritten to run the condensing boilers first and to export hot water to the SERF when there is sufficient capacity. Valves were also added so that hot water from the RFHP flows to the SERF to maximize use of the new condensing boilers.

NREL's energy intensity is below DOE's goal for FY 2011, with a value of 167 kBtu/ft²—a 35% decrease from NREL's FY 2003 base-

line. This intensity reduction can be attributed to the completion of RSF I and its addition to the Facilities Information Management System (FIMS) database in FY 2011, increasing NREL's DOE-owned space by almost 50%. The photovoltaic (PV) arrays associated with the RSF I and II projects will ultimately provide enough on-site production to make these buildings net-zero energy. NREL's energy intensity data for FY 2011 was reported in the Consolidated Energy Data Report (CEDR) worksheet for submission to DOE. In addition to the buildings on the South Table Mountain (STM) and National Wind Technology Center (NWTC) campuses, NREL also leases several facilities, which are not included in NREL's energy intensity calculation.

NREL'S ENERGY INTENSITY			
DOE FY15 Goal (BTU/GSF)	NREL FY03 Baseline (BTU/GSF)	FY11 (BTU/GSF)	Energy Change over Baseline (%)
180,521	257,552	166,765	- 35%

In FY 2011, NREL began entering data into the Environmental Protection Agency's (EPA) Portfolio Manager Tool to benchmark our metered building energy performance. NREL also investigated the purchase of biogas from wastewater treatment facilities to further reduce campus natural gas consumption. An additional staff member also received Certified Energy Manager licensure to help enhance NREL's energy management capabilities.

Metering

NREL's electrical metering includes more than 20 advanced electric metering systems in all major facilities and on major process loads. To support DOE's metering requirements, NREL's design standard specifies that all new facilities include a main building electric meter and electrical submeters that identify heating, ventilation, and air conditioning (HVAC), laboratory process, and lighting loads. All NREL facilities that use natural gas have building gas meters. Efforts were made to connect both electric and gas meters to DOE's Energy Dashboard system in 2011.

NREL's design standards require installation of BTU meters on chilled water and heated water systems for all new facilities that are tied into the main centralized heating and cooling plants. In 2011, NREL also connected existing chilled and heated water meters to the DOE Energy Dashboard system.

NREL's new data center, located in the LEED Platinum RSF, is independently metered and connected to the DOE Energy Dashboard system. Additional data center functions, housed in Building 17, are sub-metered for computer operations and cooling.

All of the facilities that require water on the STM site have dedicated utility water meters. There are also submeters for all make-up water systems for cooling towers, boilers, deionized water, and evaporative cooling sections in all facilities where applicable. The submeters are maintained and data recorded weekly by NREL in-house maintenance staff.



Success Story | THE S&TF

NREL's Science and Technology Facility (S&TF), constructed in 2006, is the first federal building to earn a LEED Platinum rating. Design specifications for this PV cell research laboratory called for indoor relative humidity to be maintained between 30% to 50% based on general industry practice for PV wafer fabrication. When the building opened, humidity was set slightly lower than the specifications at 28% to save water and energy. The S&TF takes advantage of Colorado's dry climate by using evaporative coolers for summer temperature control, which reduces the need for refrigeration cooling. Evaporative coolers are also used in winter months to provide humidification. This, however, makes ventilation air too cold, requiring air to be reheated using natural gas fueled heaters. Discussions with researchers revealed that the absolute humidity number was not as important as maintaining stable humidity levels. It was determined that energy savings could be realized by lowering humidity levels in cold weather. Every gallon of water evaporated takes a calculated 10,000 BTU of natural gas fuel to counteract the cooling effect. After gaining researcher buy-in, the laboratory humidity setpoint was reduced from 28% to 20% at the beginning of FY 2011.

Energy savings were dramatic. The S&TF averaged 75,800 therms during its first four years of operation. After reducing humidity to 20%, gas consumption dropped to 51,800 therms, yielding a 32% gas savings worth \$14,500. Building water use also decreased 20%, with a savings of 160,000 gallons. This simple operational change shows how costly humidification can be in a dry climate. Design specifications are a starting point but humidity levels should be re-evaluated over time to optimize building performance research requirements.



More than 233,000 ft² of roof surfaces have at least R-30 insulation or are covered in PV or reflective surfaces. This PV array covers the roof of the RSF I.

All new facilities at the STM site will require a main building utility water meter, which will be supplied and installed by the water utility. NREL is moving towards submetering high-use water systems with new construction. As an NREL design standard for new and renovated spaces, water submeters are required at make-up water systems that support mechanical HVAC equipment and laboratory processes. An irrigation meter is also required for all newly constructed facilities, which use water on a short-term basis for plant establishment.

In 2011, NREL undertook an effort to survey and connect existing digital meters to the DOE sponsored enterprise-level Energy Dashboard system. Connections have been made to integrate data outputs from Building Automation Systems, hot and chilled water BTU meters, natural gas and electricity meters. The Energy Dashboard is web accessible and has data analysis tools that allow for continuous tracking of energy generation and consumption.

Cool Roofs

In FY 2011, the number of cool roofs at NREL increased 27% over the previous year through roof replacement and new construction. Currently more than 233,000 ft² of roof surfaces have at least R-30 insulation or are covered in PV or reflective surfaces. With the FY 2011 improvements, 50% of the NREL campus now has cool roofs. This improvement was the result of roof replacement projects on existing buildings as well as new high-performance building construction that included cool roof and PV specifications.

Renewable Energy

NREL's approach is to maximize on-site renewable energy generation on both the STM and NWTC sites. NREL went far beyond requirements for on-site electricity generation in FY 2011. NREL's on-site renewable systems, including PV arrays and wind turbines, generated a total of 7,892 MWh in 2011, or 28% of NREL's power.

FY 2011 ON-SITE RENEWABLE ENERGY (RE) PRODUCTION				
Source	FY11 Energy Produced (MWh)	FY11 Energy Produced (BBTU)	RE as a Percentage of Grid Electricity Use	RE as a Percentage of Thermal Energy Use
Electricity from solar	3,873	13.2	19.5%	N/A
Electricity from wind	4,607	15.7	23.2%	N/A
Renewable thermal energy	N/A	9.8	N/A	15.4%
On-site total	8,480	38.7	42.7%	15.4%
Purchased RECs from new renewable source	26,890	91.8	135%	N/A
Total	35,370	130.5	177.7%	15.4%



NREL's wood-chip fueled RFHP utilizes wood waste to displace natural gas usage for space heating. In FY 2011, the RFHP produced 9,826 MMBTU—providing 50% of the heat in the STM campus' central heating system.

In FY 2011, NREL installed:

- Two PV arrays at the STM site: RSF I, 449 kW and the 524 kW RSF visitor's parking lot
- Two wind turbines at the NWTC site: one 2 MW and one 3MW.

The NWTC has approximately 10.2 MW of installed wind turbine capacity. When the turbines are running, the electricity offsets simultaneous NWTC site electricity energy use. Four major turbines at NWTC include: a DOE-installed General Electric 1.5 MW; and turbines installed by their respective manufacturers under Cooperative Research and Development Agreements (CRADAs)—a Siemens 2.3 MW, a 3 MW Alstom, and 2 MW Gamesa. The turbines produced 4,607 MWh in FY 2011. In FY 2011, the NWTC wind turbines and PV array generated 6,591 MWh of electricity, over 475% of grid power usage for this site.

NREL's solar thermal installations produced an estimated 10.2 MMBTU of renewable thermal energy through solar hot water systems in FY 2011: ventilation air preheating systems and Trombe walls. NREL also installed a new ground-source heat pump in FY 2011 to provide heating and cooling to the Solar Radiation Research Laboratory (SRRL).

NREL has a wood-chip fueled RFHP that utilizes urban wood wastes and forest thinnings from Front Range Healthy Forest Initiative activities and other wood wastes to displace natural gas usage for space heating. In FY 2011, the RFHP produced 9,826 MMBTU. The RFHP is continuing to improve in performance and is providing 50% of the heat in the campus' central heating system.

To achieve Scope 2 carbon neutrality, NREL purchases RECs through the Western Area Power Administration (WAPA) Federal Agency Master Purchase Agreement. The RECs purchased under this agreement are from new renewable energy projects derived from wind resources installed after January 1, 1999. NREL's REC purchase is intended not only to offset electricity purchases from the grid, but also to provide replacement RECs for those RECs that the laboratory sells to fund its on-site renewable energy systems through power purchase agreements (PPAs) (see Greenhouse Gas Section).

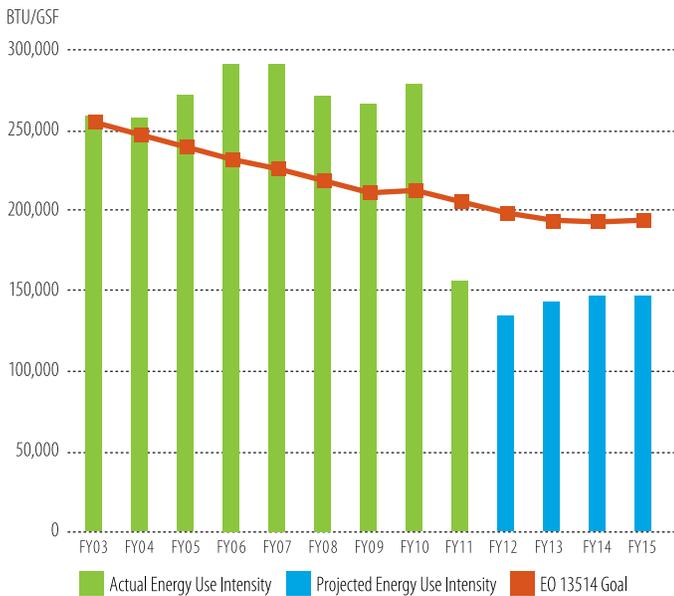
NREL's FY 2011 total on-site renewable energy production was in place after January 1, 1999 and is considered "new" renewable energy. With the inclusion of the interim REC purchases, NREL meets and far exceeds the goals set forth in DOE 430.2B, EO 13423, and Energy Policy Act (EPACT) 2005. The current and future projects will help NREL meet and far exceed the on-site goals set forth in EO 13514.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Energy Intensity

NREL will meet and exceed DOE's energy intensity reduction goal by constructing new highly energy efficient buildings, systematically implementing energy retrofits, and increasing on-site renewable energy generation. NREL will continue to optimize operations of the RFHP and will seek opportunities to purchase biogas to further reduce natural gas consumption. In addition, NREL has made commitments to purchase RECs to help reduce NREL's reportable energy intensity and subsequent greenhouse gas (GHG) emissions. As required under EPACT 2005 and EO 13423, RECs will only be counted toward the energy intensity reduction target until FY 2012; however, NREL will continue to purchase RECs to offset GHG emissions associated with campus electricity consumption.

In FY 2012, NREL will complete construction of the RSF II (151,500 ft²), planned for LEED Platinum certification. RSF I and II add 370,000 ft² and collectively double DOE-owned, NREL-occupied square footage on the main campus. The RSF complex has enough PV (including RSF I, II, data center, parking garage and visitor's parking lot) to offset all grid electricity and thermal-energy use and also achieve net-zero energy. In FY 2012, NREL will also complete construction of the anticipated LEED Gold cafeteria, anticipated LEED Platinum SEB, and parking garage designed to LEED Platinum standards. The addition of these high-performance buildings will enable NREL to reach its overall energy intensity goals by keeping energy demand low while increasing campus square footage (see High Performance Sustainable Buildings Section).



Actual and Projected Energy Use Intensity

The Energy Systems Integration Facility (ESIF), planned for LEED Gold certification, is under construction and will open in FY 2013. This energy intensive 130,000 ft² laboratory building will increase NREL’s electricity use by an estimated 45%, but has been designed to use energy as efficiently as possible: heat rejected from the 400 teraflop supercomputer will be used to heat the building in cool weather; in summer the supercomputer will rely on cooling towers, yielding a low PUE estimated to be 1.06 (see Water Section).

In addition to building loads, ESIF will have a high-performance data center projected to use at least a 1 MW constant load. Between these two loads ESIF has the potential to effectively double NREL’s electricity consumption. For reporting purposes, the data center is considered an exempted facility, which will not impact NREL’s energy intensity. According to the Uptime Institute, the typical data center has an average PUE of 2.5. This means that for every 2.5 watts in at the utility meter, only one watt is delivered out to the Information Technology load. Uptime estimates most facilities could achieve 1.6 PUE using the most efficient equipment and best practices. While the new supercomputer will perform more computations for the same energy used, it will perform so many more flops that energy efficiency gains are offset by increased computations, resulting in increased power consumption. The first generation supercomputer is planned to be 400 teraflop and draw 1 MW, with an ultimate build-out of 10 MW. With these high demands in mind, NREL is taking every action to ensure the data center operates as efficiently as possible. While a typical data center needs 100% to 200% of the electricity used in the supercomputer for external loads such as cooling and power conversion, ESIF will use less than 10% of computer energy for these purposes.

In FY 2012, the NWTC is adding a 5 MW dynamometer facility to test wind turbine drive trains. The dynamometer will run intermit-

tently over the course of the year, with an estimated 5,600 MWh and \$350,000 in annual electricity demand.

Energy Independence and Security Act of 2007 (EISA) audits will be kicked off for NREL’s DOE-owned buildings in 2012. NREL intends to perform all audits required to comply with the regulation by using in-house expertise to identify potential energy and water conservation measures. Prioritization of these measures will be determined based on a cost-benefit analysis. NREL will also continue to enter building data in the EPA Portfolio Manager tool. In FY 2012, NREL will also pursue Energy Star certification for our qualified buildings. Sustainable NREL will also look into the feasibility of making campus operational changes to promote energy conservation.

Metering

In FY 2012, NREL will have 100% of its electricity and 95% of its natural gas metered or submetered, and tied into the DOE Energy Dashboard data acquisition and analysis tool. NREL will also have 100% of heated and chilled water usage metered and recorded electronically by the DOE Energy Dashboard. In FY 2012, potable water data for the STM and NWTC will also be incorporated into the Energy Dashboard system.

In FY 2012 and beyond, NREL will work to enhance the Energy Dashboard system to provide additional analysis tools and reporting options. These enhanced capabilities will help to simplify direct monitoring of NREL’s energy consumption and reporting for development of our Site Sustainability Plan (SSP), Pollution Prevention Tracking and Reporting System (PPTRS), CEDR, GHG inventory, and other DOE data requests. Enhanced energy enterprise management capabilities will also support the analysis of GHG reduction and energy efficiency opportunities, calculation of REC purchase quantities and return on investment for energy improvements, and provide educational support and outreach to help NREL uphold DOE’s mission for energy efficiency and renewable energy. In addition, NREL is working to conserve and optimize our water efficiency for campus irrigation by using a WeatherTRAK® smart irrigation system to automatically adjust landscape watering based on plant needs and daily local weather conditions.

Cool Roofs

All roofs not meeting cool roof-criteria have been evaluated for replacement using a simple payback calculation. At this time, no other existing roofs are economically feasible to replace with a cool roof as none are approaching the end of their useful life. Thus, there are no roof replacements scheduled for FY 2012 on existing buildings. Progress will still be made to increase the square footage of cool roofs via new construction of the ESIF, cafeteria, and new SEB. Additionally, NREL will be moving out of three leased buildings that do not have cool roofs. These changes will increase the overall cool-roof area on NREL’s campus to 274,000 ft².

Renewable Energy

Planned renewable energy deployment and purchases that NREL is pursuing in FY 2012 are shown below. A 1.2 MW array on the roof of the new parking garage will be completed in FY 2012, along with

the addition of a 408 kW array on RSF II and a small array on the new net-zero SEB. Space for additional PV arrays will be allowed on future buildings, including the ESIF and cafeteria. These projects will exceed the Transformation Energy Action Management (TEAM) Initiative goal of acquiring at least 7.5% of each site's total annual electricity and thermal consumption from on-site renewable sources by FY 2010 and exceeds the EPACT 2005 goal of 7.5% for 2013 and beyond. In addition to these PV systems, the 2 MW Gamesa wind turbine at the NWTC will become fully operational in FY 2012.

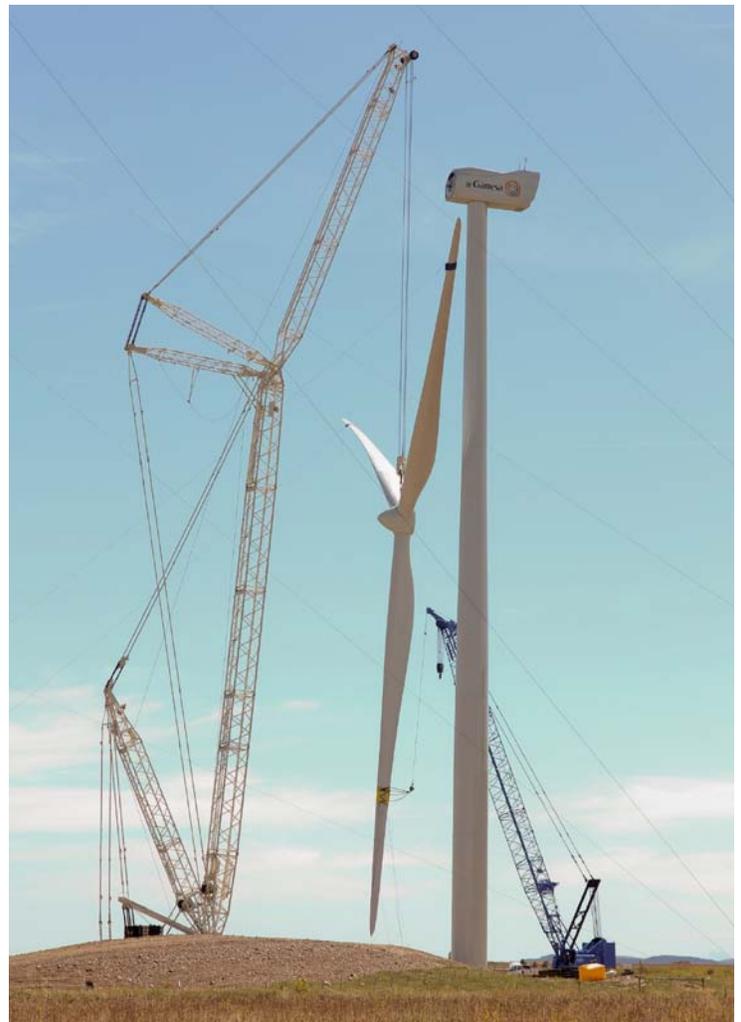
PLANNED RENEWABLE ENERGY DEPLOYMENT AND PURCHASES IN FY 2012		
Renewable Energy Projects	Estimated System Size (MW)	Generation Estimate (MWh)
STM PV	1.67	2,215
RECs to be Retained/ Purchased	—	33,000
Total	1.67	35,215

NREL retains the RECs from the small research turbines, Alstom, and DOE-owned wind turbines at the NWTC. NREL also has an existing WAPA contract to purchase RECs for campus electricity use and RSF LEED credit requirements. NREL is in the process of negotiating the purchase of RECs for the new Gamesa turbine. NREL is also collaborating with the GSA and WAPA to develop and procure energy from a new off-site wind farm project.

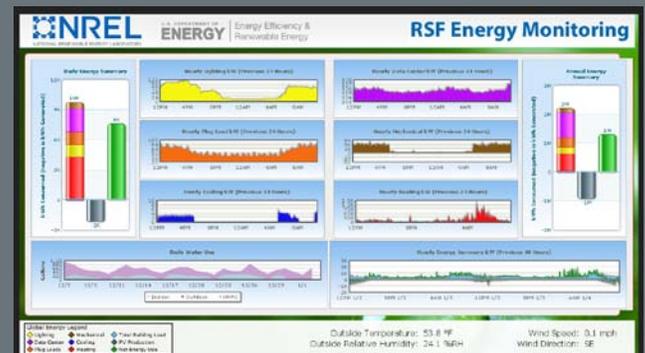
MEASURABLE GOALS

In FY 2012, NREL will:

- Perform EISA audits of DOE-owned facilities
- Populate the Portfolio Manager tool and pursue Energy Star-certification for qualified buildings
- Connect remaining electric, gas, hot and chilled water meters to the Energy Dashboard system such that 100% of NREL's electricity, hot and chilled water and 95% of natural gas will be metered in 2012.



In FY 2011 a new 2 MW wind turbine was erected at NREL's NWTC through a cooperative research agreement with Gamesa. With the addition of this turbine NREL's NWTC has 10.2 MW of wind generating capacity on site.



The RSF's energy dashboard provides real-time monitoring of energy consumption and renewable energy production from the roof-mounted PV array.



FLEET

Alternative fuel consumption at NREL includes compressed natural gas (CNG) and ethanol 85 (E85). NREL has five CNG vehicles and one on-site CNG fueling station.

GOALS

- (1.6) Increase annual fleet alternative fuel consumption by 10% by FY 2015, relative to an FY 2005 baseline**
 - Alternative fuel use has grown 143% since 2005.
- (1.7) 2% annual reduction in fleet petroleum consumption by FY 2020 relative to an FY 2005 baseline**
 - NREL established a campus-wide no-idling policy.
 - Petroleum fuel usage has grown 92.6% since 2005.
- (1.8) 75% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2015 and thereafter**
 - One CNG vehicle was added to the fleet in FY 2011.
- (1.9) Reduce fleet inventory by 35% within the next 3 years relative to an FY 2005 baseline**
 - NREL disposed of seven vehicles, 15% of the fleet in FY 2011.

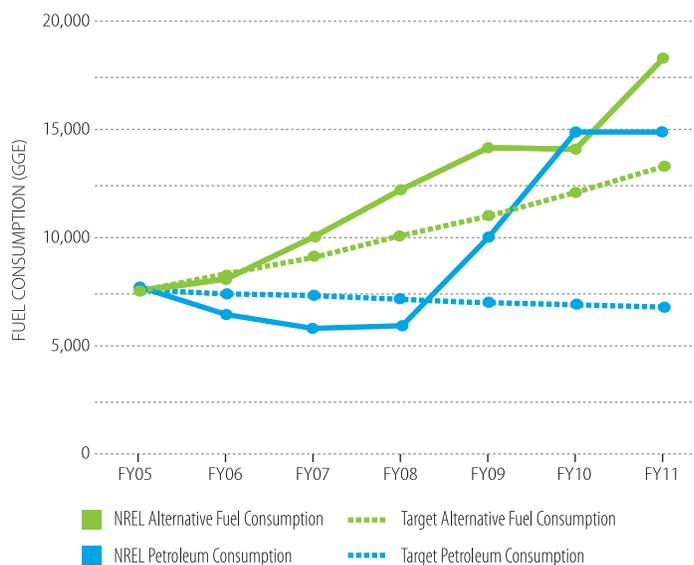
STRATEGY AND PERFORMANCE SUMMARY

FY 2011 marks the first year for the fleet inventory reduction program as required by the Secretary of Energy. At a time of campus growth, NREL is working to accommodate the reduction goal while looking for additional options to reduce our impacts through alternative fuel vehicles (AFVs) as well as establishment of new policies and programs.

FY 2011 PERFORMANCE STATUS

Alternative Fuel Consumption

All NREL fuel data is reported in the Federal Automotive Statistical Tool (FAST) for each fiscal year. In FY 2011, NREL is exceeding federal requirements for alternative fuel consumption, which includes compressed natural gas (CNG) and ethanol 85 (E85), with a 30% increase from last year. NREL's alternative fuel use makes up 55% of NREL's fuel consumption in FY 2011, the majority being E85. Since the baseline year of 2005, NREL's alternative fuel usage has grown 143%.



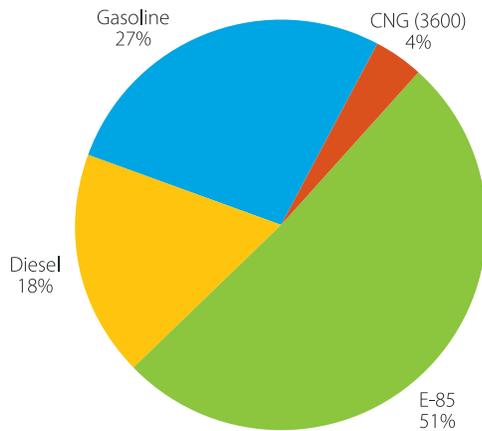
Alternative Fuel and Petroleum Consumption

NREL has one on-site CNG fueling station. All E85 vehicles are fueled through private sector alternative fuel distributors when fuel is available.

Petroleum Reduction

In FY 2011, NREL’s petroleum (gasoline and diesel) use made up 45% of fleet fuel consumption, decreasing slightly from last year, but growing 92.6% from the 2005 baseline. This spike is attributable to the increase in utilization standards at NREL. In FY 2011, NREL logged 383,891 fleet miles, a 21,556 mile increase in usage over the previous year.

This petroleum usage increase can also be attributed to our substantial campus growth in FY 2011. In addition, NREL received three new hybrid vehicles leased from GSA, which replaced two GSA-leased E85 vehicles and are solely fueled with unleaded petroleum. There continue to be challenges with obtaining E85 fuel near the NWTC and NREL’s CNG station has been periodically inoperable in FY 2011—forcing drivers to use unleaded petroleum fuel. Also, there are currently no biodiesel retailers in NREL’s vicinity.



FY11 Fuel Consumption

Alternative Fuel Vehicle Purchases

NREL makes every effort to right-size our vehicle fleet, which currently consists of 50 GSA-leased vehicles; 64% of the vehicle fleet is comprised of AFVs:

- 27 E85 vehicles
- 5 CNG vehicles
- 5 hybrid-electric vehicles
- 6 diesel vehicles
- 7 unleaded vehicles.

In addition to these GSA-leased vehicles, NREL owns one dedicated CNG vehicle and one diesel freightliner service truck. In FY 2011, NREL added one CNG, three hybrid-electric, and one diesel vehicle to the fleet.



Success Story | NO-IDLING POLICY



In this time of growth, NREL is working to the extent possible to mitigate impacts and reduce petroleum usage. In FY 2011, NREL established a campus-wide no-idling policy as part of our Pollution Prevention Initiative (PPI),

a program established to provide NREL staff with the opportunity to identify and implement new pollution prevention practices at the laboratory. The idling program educates drivers of NREL and employee-owned vehicles about the health, environmental, and financial benefits of idle reduction and sets a policy that when parked for more than 30 seconds, engines should be turned off. This program will help to save fuel as well as reduce air emissions associated with idling, with an estimated savings of 1,700 gallons/yr and \$6,400/yr in diesel fuel use for NREL shuttles.



Alternative fuel use makes up 55% of NREL's fuel consumption, the majority being E85. NREL has 27 E85 vehicles, which are fueled through private sector alternative fuel distributors.

Fleet Reduction

In FY 2011, NREL began the process to reduce the vehicle fleet in accordance with the Secretary of Energy's 35% fleet reduction requirement. NREL met this requirement for FY 2011 by disposing of seven vehicles, or 15% of NREL's fleet.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Alternative Fuel Consumption

NREL's efforts to establish the most fuel-efficient vehicle fleet relies on continuous monitoring and recording of vehicle miles and fuel consumption and assessing vehicle usage. NREL plans to increase overall fleet fuel economy by working with GSA to provide NREL with smaller sized, alternatively-fueled, or other advanced technology vehicles to improve the fleet efficiency.

NREL will continue to fuel with alternative fuel (E85) as available through private sector alternative fuel distributors, which are located approximately five miles from the STM site. NREL also continues to work with DOE's Federal Energy Management Program (FEMP) and the local Clean Cities coalition to improve the fleet's ability to access and use alternative fuels, such as biodiesel. There are no plans at this time to install additional on-site alternative fueling infrastructure.

Petroleum Reduction

NREL is committed to reducing vehicle miles and petroleum usage through methods such as right sizing of the fleet, using shuttles, and video conferencing to reduce ground travel. When vehicle leases expire, NREL will look to replace vehicles that use petroleum with AFVs.

Alternative Fuel Vehicle Purchases

NREL's goal is to transform its fleet such that 100% of all non-exempt vehicles are AFVs. The laboratory will continue working with GSA and DOE to increase the number of AFVs in the fleet.

Due to the fleet reduction requirements, NREL has no plans for new purchases or leases in FY 2012. As existing vehicles age and become less fuel efficient or leases expire, NREL will look for opportunities to replace these vehicles with AFVs.

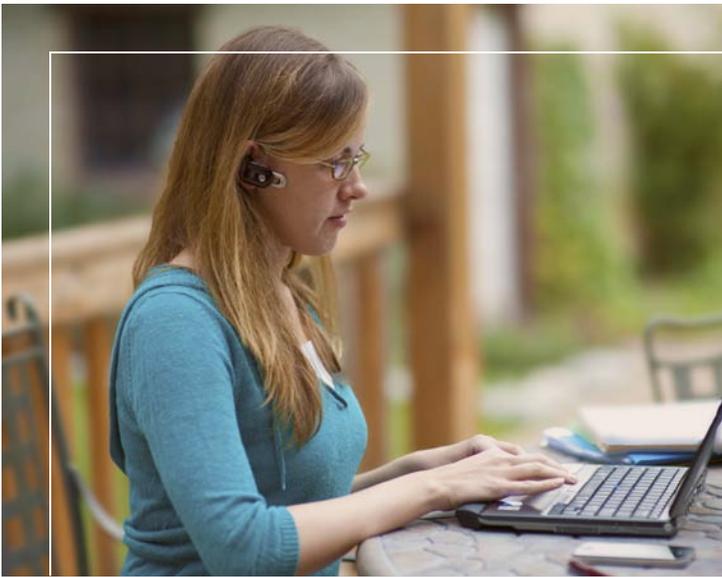
Fleet Reduction

NREL is in the process of reducing its vehicle fleet in order to meet the Secretary of Energy's 35% fleet reduction plan. NREL plans to turn in 17 vehicles prior to FY 2014; including seven vehicles in FY 2012 and three additional vehicles in FY 2013.

MEASURABLE GOALS

In FY 2012, NREL will:

- Roll out an enhanced video conferencing education program aimed at reducing ground travel
 - Turn in seven fleet vehicles, another 15% of NREL's vehicle fleet as required by DOE
 - Provide training for all fleet shuttle drivers on no-idling policies and best practices.
-



GREENHOUSE GAS

An employee participates in NREL's telecommuting program by working from home. To help reduce GHG emissions, NREL also encourages employees to participate in its alternative work schedule program to reduce the number of days employees drive to work.

GOALS

(1.1) 28% Scope 1 and 2 GHG reduction by FY 2020 from a FY 2008 baseline

NREL reduced Scope 1 and 2 emissions 86% from the 2008 baseline (including RECs).

(2.1) 13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline

NREL Scope 3 emissions increased 10% from the 2008 baseline.

STRATEGY AND PERFORMANCE SUMMARY

NREL has been tracking and reporting GHG emissions for more than 10 years. Our goal is to demonstrate leadership in GHG management by maximizing the use of energy efficiency practices and on-site renewable power, and minimizing impacts associated with all aspects of our operations. NREL continuously pursues new technologies and strategies to reduce GHGs associated with our operations. For Scope 2 emissions that NREL cannot avoid, NREL is committed to purchasing RECs to neutralize the climate change impacts.

All GHG emissions are reported in the CEDR to DOE. NREL's operational boundaries include all DOE-owned facilities, vehicle fleet, equipment, and non-highway vehicles at the STM and NWTC. NREL leases office space in the Denver West office park, Joyce Street, and the Refuel Facility, which are not under NREL's operational control; however, electricity and natural gas data for these properties are included in the CEDR. NREL also reports Scope 3 emissions for sources outside our organizational boundaries, which are a result of our operations. NREL revised the 2008 baseline in this year's CEDR report to be consistent with values reported in NREL's FY 2010 SSP.

FY 2011 PERFORMANCE STATUS

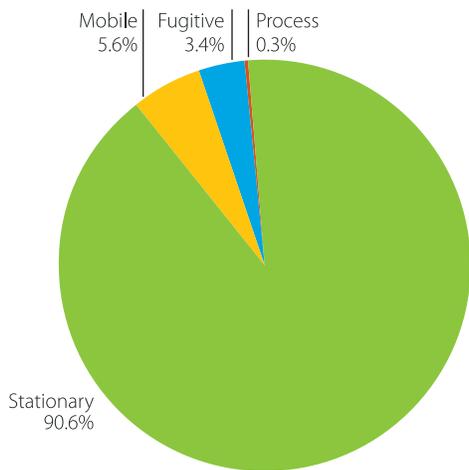
Scope 1

In FY 2011, NREL's Scope 1 emission sources include:

- Stationary emissions: natural gas for heating of DOE-owned and leased facilities
- Mobile emissions: vehicle fleet, equipment, and non-highway vehicles
- Fugitive emissions: fluorinated gases for research, refrigerants for DOE-owned HVAC systems, on-site septic systems at the NWTC and SRRL
- Process emissions: dry ice for laboratory research.

Stationary emissions

More than 90% of NREL's Scope 1 emissions are from stationary combustion. These emissions are primarily due to the use of natural gas for the generation of heat and hot water for our DOE-owned and leased buildings (for more information see the Energy Section).



FY11 Scope 1 GHG Emissions

NREL's on-site RFHP decreased the need for natural gas purchases this year, reducing emissions 19% from the previous year and 2008 baseline.

For consistency with the FIMS database, NREL is now reporting the Joyce Street property as being DOE-owned in NREL's GHG inventory. NREL does not have access to natural gas for the remaining leased spaces; therefore, this is not reported.

Mobile emissions

NREL's mobile emissions represent over 5% of NREL's Scope 1 sources. In FY 2011, emissions from our vehicle fleet remained constant with the previous year; however, mobile emissions have increased 119% relative to the 2008 baseline. While NREL is working to acquire more AFVs, the lab has increased the number of petroleum hybrid vehicles in the past year, increasing emissions from this source. Also, due to substantial campus growth, utilization of fleet vehicles by staff has grown. An increase in equipment and non-highway vehicle usage also took place in FY 2011 due to improved reporting procedures as well as greater demands for a growing campus (for more information see the Fleet Section).

Fugitive emissions

NREL's fugitive emissions make up over 3% of NREL's Scope 1 source and include fluorinated gases, refrigerants, and emissions associated with NREL's on-site septic systems at the NWTC and SRRL. In 2011, Sustainable NREL and the Environment, Health, and Safety (EHS) Office kicked off an initiative to improve the understanding of sulfur hexafluoride (SF₆) use on campus and identify opportunities for its reduction. Meetings with researchers helped to identify the primary uses of SF₆ on campus, including its application in transmission electronic microscopes, building commissioning, and for commissioning of laboratory fume hoods. Information on the impact of fugitive emissions was also included in annual mandatory chemical hazardous waste training for researchers.

NREL tracks its refrigerant and fluorinated gas emissions, the purchases of which are monitored in NREL's chemical inventory, using a three-year rolling average. In FY 2011, fluorinated gas and

refrigerant emissions decreased 93% from the baseline year. There were no purchases of SF₆ in FY 2011. On-site wastewater emissions decreased nearly 20% from 2010 and the baseline year due to a smaller population being served by NREL's septic systems.

Process emissions

In past years, NREL has not reported process emissions; however, new SSP reporting guidance encouraged the disclosure of dry ice usage for research experiments. A small quantity of dry ice was reported this fiscal year to comply with these requirements. These emissions represent less than 1% of NREL's Scope 1 emissions.

Scope 1 summary

The overall Scope 1 emissions from FY 2011 are 3,709 MTCO₂e, a 37% decrease from the 2008 baseline and a 16% decrease from FY 2010.

Scope 2

NREL's Scope 2 emissions are associated with purchased electricity for our DOE-owned and leased buildings (see Energy Section). While NREL maximizes the amount of electricity generated on-site, many of these systems were financed through PPAs that required the RECs to be sold. NREL purchases replacement RECs for these systems and has committed to purchase additional RECs to ensure the campus achieves Scope 2 carbon neutrality. When financially practical, NREL retains the RECs for on-site renewable systems.

In FY 2011, 19,628 MTCO₂e were generated from NREL's electricity purchases. This is a 5% decrease from last year, and a 3% decrease from the 2008 baseline. This trend is attributed to the revised Emissions and Generation Resource Integrated Database (eGRID) emissions factors used in the 2012 CEDR. It should be noted, however, that due to the construction and operation of high-efficiency buildings, NREL's electricity consumption has not grown in this timeframe, even though our campus footprint has increased over 70% since 2008. Additionally, NREL purchased Green-e certified RECs to offset all Scope 2 emissions, making NREL Scope 2 carbon neutral again in FY 2011.

Scope 1 and 2 Summary

The graphs on page 17 show NREL's overall performance toward meeting Scope 1 and 2 GHG reduction targets. In FY 2011, NREL decreased total Scope 1 and 2 emissions 11% from the 2008 baseline and 7% from FY 2010. NREL's purchase of RECs further reduced Scope 1 and 2 emissions, 86% from the 2008 baseline and 16% from the previous year. Through these reductions, NREL is significantly exceeding DOE's 28% target for Scope 1 and 2 GHG emissions.

Scope 3

Transmission and distribution losses

In FY 2011, NREL's transmission and distribution (T&D) losses decreased slightly—3% from the baseline and 5% from the previous year due to revised eGRID emissions factors. NREL uses the standard T&D factor of 6.18% to perform this calculation. These emissions represent over 18% of NREL's Scope 3 sources. NREL's

deployment of on-site renewable energy and highly energy-efficient buildings helps to mitigate emissions from this source.

Business air travel

NREL's FY 2011 business air travel emissions decreased 20% from FY 2010; however, FY 2011 business air travel emissions are 47% higher than 2008 baseline levels. These trends are reflective of travel restrictions in FY 2011, and an 87% population growth since 2008. Air travel is NREL's largest Scope 3 source, representing 44% of this category. NREL has extensive teleconferencing and video conferencing systems in place, and is installing video conferencing systems in new office buildings to continue to address this emissions source. NREL has also implemented travel restrictions to operate the lab as efficiently as possible in this economic time, which will also help to curb these emissions.

Business ground travel

In FY 2011, business ground travel decreased significantly—75% from the previous year, and 68% from the 2008 baseline. This drastic reduction is due to improved data availability for cars rented on business travel, allowing the use of an advanced GHG calculation methodology in lieu of the default methodology for this emissions source. This improved level of detail provides better accuracy for NREL's reporting on business ground travel emissions. This category represents less than 1% of NREL's Scope 3 emissions. To manage emissions from this source, NREL works to educate staff on available alternatives to ground travel including teleconferencing and video conferencing. NREL's rental car policy also allows the use of mid-size AFVs or hybrids when available.

Employee commuting

Employee commuting represents 34% of NREL's Scope 3 emissions. In FY 2011, commuting emissions decreased 24% from the previous year and have held steady with our 2008 baseline. These trends can be attributed to several alternative commuting options offered to staff, including:

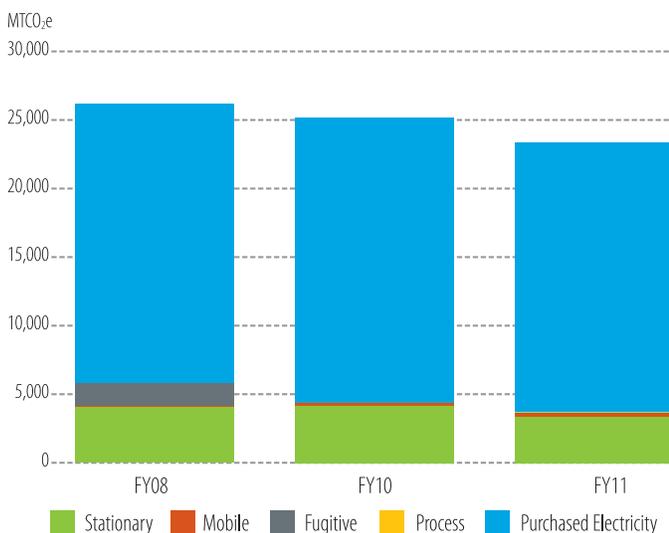
- Free public transit passes
- A rideshare website to find carpools and vanpools
- Vanpool vouchers
- Bicycle friendly infrastructure (bicycle parking, maintenance and repair stations, and showers)
- Free shuttles to move employees between NREL facilities and to connect to public transit routes
- Flexible work practices such as:
 - Telecommuting
 - Compressed work weeks or Alternative work schedules (AWS).

NREL also offers incentive parking to staff who participate in a carpool or vanpool or drive a low emitting vehicle.

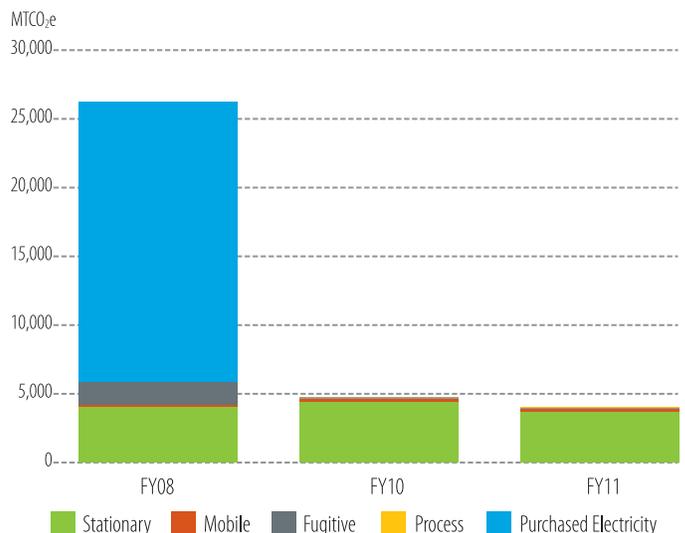
In FY 2011, NREL conducted a commuter survey, which provided improved data on staff commuting modes as well as adoption of telecommuting and AWS. This information provided an updated perspective on staff commuting behaviors, of particular importance since staff levels have grown 87% since 2008. The survey showed a shift away from single occupant vehicle commuting. Survey responses also indicated single occupant vehicle trips decreased to 75% of commute trips from 81% in 2008. The reduction in single occupant vehicle trips was complemented by increases in alternative commuting methods such as bicycling, carpooling, and public transit. Additionally, 19% of the survey respondents reported telecommuting at least one day per week with an additional 4% reporting telecommuting more than one day per week. Combined, this represents more than 5% of NREL's total commute trips. According to the survey, approximately 25% of NREL staff work an AWS schedule—4-10s or 9/80. (4-10s allow a four 10-hour day work week. 9/80 is a two-week schedule of eight 9-hour work days and an 8-hour day, allowing a day off every two weeks).

Contracted wastewater treatment

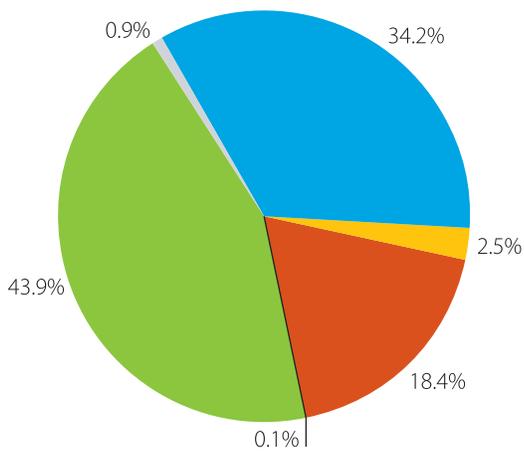
NREL's emissions from contracted wastewater treatment increased in FY 2011—83% from the baseline and 31% from FY 2010. These



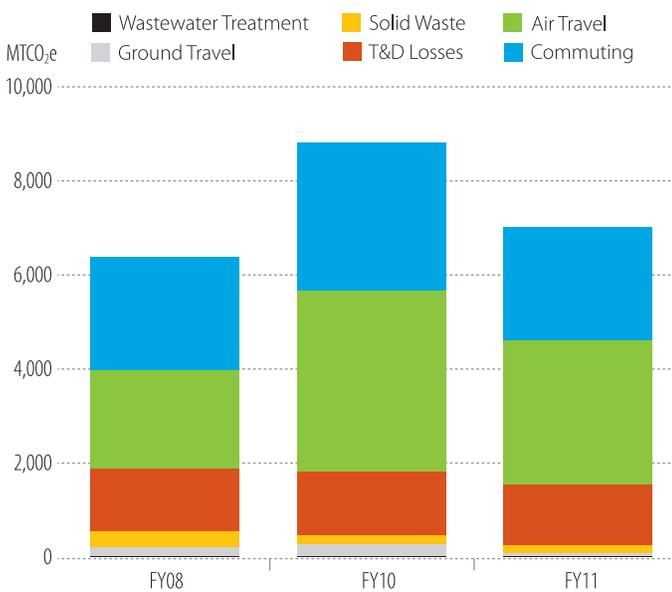
Scope 1 & 2 GHG Emissions



Scope 1 & 2 GHG Emissions after RECs



FY11 Scope 3 GHG Emissions



Scope 3 GHG Emissions FY08-FY11

emissions are calculated on a population basis, so the substantial growth NREL is experiencing is reflected in this increase. Wastewater emissions make up less than 1% of NREL's Scope 3 emissions, so the increase does not significantly contribute to overall emissions from this scope. Increased adoption of teleworking and AWS at NREL are helping to manage emissions from this source.

Contracted waste disposal

NREL's contracted waste disposal comprises 2.5% of the overall Scope 3 emissions. In FY 2011, emissions from this source decreased 12% from the previous year and 49% from the 2008 baseline. These reductions demonstrate the great strides NREL has made in establishing our campus-wide composting program in FY 2011 and improving education on our campus-wide recycling program. NREL supports these waste reductions through our Near-Zero Materials Waste program, which educates staff on appropriate disposal methods for all waste generated on campus (see Pollution Prevention Section).

Scope 3 Summary

In FY 2011, NREL's Scope 3 emissions were 7,015 MTCO₂e—representing a 20% decrease from FY 2010. However, due to campus growth, a 10% increase in these emissions has occurred relative to the 2008 baseline. On a per capita basis, NREL's Scope 3 emissions continue to decrease—with a reduction of over 40% from 2008.

Total GHG Emissions

NREL's overall emissions have decreased in FY 2011—11% from last year and 7% from 2008. In FY 2011, the majority of our emissions, 65%, came from the Scope 2 purchase of electricity. These emissions are offset in their entirety through the purchase of RECs. Scope 3 represents the next largest emissions source, comprising 23% of all NREL's emissions. Through campus policies and programs that address travel and commuting, NREL is working to mitigate this source. The final category, Scope 1, represents 12% of NREL's overall GHG emissions. Through enhanced performance of the RFHP and the construction and operation of efficient buildings, NREL continues to decrease emissions from these sources.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Scope 1

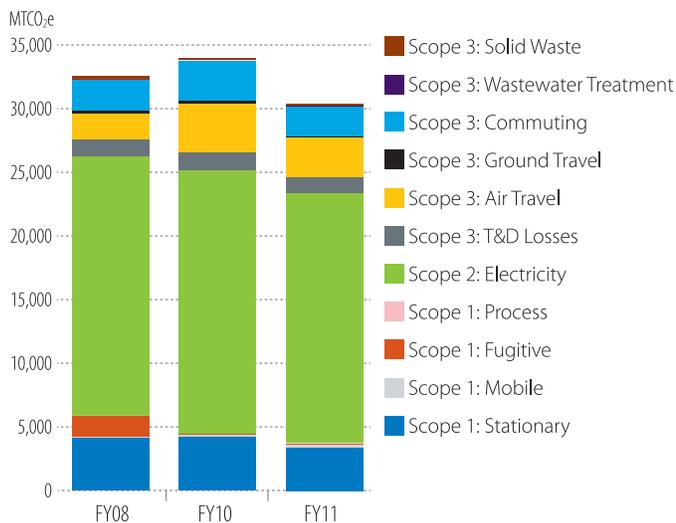
NREL will continue to optimize performance of the RFHP to reduce our natural gas requirements for the campus. NREL will also work to reduce emissions from our vehicle fleet through implementation of a no-idling policy, working to acquire more AFVs as mission appropriate, and meeting Secretary Chu's fleet reduction requirements (see Energy and Fleet Sections).

NREL has not purchased SF₆ since 2009 and uses only nominal quantities for research purposes (SF₆ use contributed to 1% of all Scope 1 emissions this year). Transmission electron microscopes off-gas SF₆ only when serviced. At that time, the contractor contains as much SF₆ as possible in the equipment, and the contractor retains the captured material. NREL is working to replace the use of SF₆ for fume hood testing with nitrous oxide, so a capture program will not be needed. NREL will also work with building energy efficiency researchers to find suitable alternatives to SF₆ for building commissioning tests.

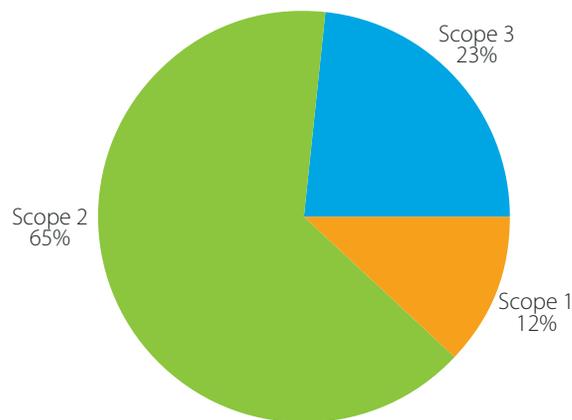
Scope 2

In FY 2012, growth will continue at NREL with the construction of RSF II, the cafeteria, parking garage, the SEB, and a 5 MW dynamometer facility. With each campus addition, NREL upholds the highest standards for energy efficiency and deployment of on-site renewable energy (see Energy and High Performance Sustainable Buildings Sections).

Due to the construction of these on-site facilities, NREL will vacate three leased spaces and move staff to DOE-owned facilities; however, this growth will increase campus electricity use. To combat this increase, NREL will look for opportunities to improve energy efficiency of existing buildings through EISA audits, deploy additional on-site renewable energy, and also purchase RECs to ensure all Scope 2 emissions are offset (see Energy Section).



Comprehensive GHG Inventory FY08-FY11



FY11 Total GHG Emissions

In FY 2012 NREL will finalize the contract and procure RECs from new Gamesa on-site wind system. As a long term goal NREL will work to decrease REC purchases as additional on-site renewable energy installations are constructed on campus.

Scope 1 and 2 Summary

NREL anticipates continuing to exceed DOE's reduction target for Scope 1 and 2 emissions through efficiency measures and the purchase of RECs to completely offset Scope 2 emissions.

Scope 3

Transmission and distribution losses

NREL will continue to identify methods to reduce campus electricity use through energy efficiency improvements, deployment of high-performance buildings, and on-site renewables. These measures will help to reduce both Scope 2 emissions and emissions from T&D losses. T&D losses, however, represent a challenging category for NREL. While RECs can be used to offset Scope 2 emissions, they cannot offset T&D losses. With the ESIF supercomputer coming online in FY 2013, NREL anticipates emissions from this source to increase.

Business air and ground travel

Air travel restrictions in FY 2011 have helped to mitigate emissions from this source; however, air travel poses a challenge for NREL given the dramatic population growth experienced since 2008. A certain degree of travel is necessary to support NREL's mission. To mitigate these impacts, NREL will enhance our campus-wide video-conferencing programs in FY 2012 to reduce travel by providing additional outreach and education to staff. NREL will also leverage the improved rental car data availability to identify opportunities to educate staff on lower emissions rental alternatives.

Employee commuting

NREL will continue to offer programs to encourage the use of alternative commuting modes including telecommuting, AWS, carpool

and vanpool, bicycling and public transit. NREL will also continue to provide free public transit passes, vanpool vouchers, and shuttles.

It should be noted, however, that with the completion of the new parking garage in FY 2012, NREL may experience an increase in commuting emissions as staff may elect to drive alone more frequently when it is more convenient to park on-site than it has been previously. To address this potential concern and continue efforts to decrease GHG impacts, in FY 2012, NREL will roll out a new "green vehicle" program that will incentivize carpool and vanpool participation as well as low-emitting vehicle use. The green vehicle program will provide preferred parking spaces in the new parking garage as well as at other buildings on campus. These spaces will be designated for use by staff members who drive to work in vehicles identified by the EPA's SmartWay certification program or participate in a carpool or vanpool.

Contracted wastewater treatment and waste disposal

While GHG emissions from wastewater are a function of population, NREL makes every effort to reduce the amount of sewage through the use of high efficiency, low flush or low flow toilets, urinals, and faucets. These products are in NREL's design standards for all new construction and remodeling of existing buildings. Additionally, NREL's support for telecommuting and AWS will decrease the load on the municipal wastewater system.

NREL's goal is to become a near zero waste campus. To support this goal, NREL will continue to provide staff training through the Near-Zero Materials Waste program and roll out sustainable purchasing practices. In FY 2012, NREL will also perform audits of campus waste to identify problem areas and target additional efforts (see Pollution Prevention Section).

Scope 3 Summary

In spite of NREL's measures to promote campus efficiency of energy, waste, commuting, and travel, NREL expects Scope 3 emissions to continue to increase. This increase is a result of the substantial



Success Story | COMMUTING PROGRAM

NREL's employee commuting program was initiated in 2008 to encourage the use of alternative modes of transportation and minimize emissions associated with employees' commute to work. NREL's comprehensive program provides a wide range of options for staff including transit passes, vanpool vouchers, rideshare support services, shuttles to major transit hubs, bicycle and pedestrian friendly infrastructure, and flexible work practices including compressed work weeks and telecommuting. Establishment of these commuting alternatives is critical to helping NREL achieve Scope 3 reduction goals and also provide a better quality of life, improved morale, and increased productivity of staff.

NREL has committed to measures that reduce commuting impacts with a goal of having 32% of staff not commute to work one day per week. To measure progress towards this goal NREL conducted commuter surveys in 2007 and 2011. The 2011 survey showed that approximately 19% of NREL staff reported telecommuting at least one day a week or more and an additional 24% of staff reported telecommuting less frequently than once a week but at least once per month. Telecommuting now represents about 4% of total commute trips up from just 1% in 2007. The 2011 survey also showed that NREL has experienced a 6% decrease in single occupant vehicle commute trips despite a 50% increase in population. NREL will continue to foster a culture that strongly supports its employee commuting program, helping NREL achieve goals while also being a good neighbor by reducing traffic and environmental impacts.

population and campus footprint growth since the baseline year of 2008. On a per capita basis, however, NREL will continue to work to decrease emissions from the Scope 3 category by implementing available measures to support DOE's reduction goal.

MEASURABLE GOALS

In FY 2012, NREL will:

- Work with NREL researchers to identify and institute SF₆ alternatives
 - Purchase RECs to offset all Scope 2 emissions
 - Analyze rental car data to identify opportunities for emissions reductions
 - Roll out green vehicle program campus-wide
 - Continue to incentivize and educate staff on employee commuting alternatives.
-



HIGH PERFORMANCE SUSTAINABLE BUILDINGS

The RSF courtyard shows high-efficiency windows, which are automatically and manually operable, promoting cross-ventilation and giving employees more control over thermal comfort.

GOALS

- (3.1) 15% of the number of existing buildings greater than 5,000 gross square feet (GSF) to be compliant with the five guiding principles of HPSB by FY 2015**
- NREL currently has three buildings (13%) that are GP compliant.
 - NREL performed GP assessments on three additional buildings this year.
- (3.2) All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs and where the work exceeds \$5 million, each are LEED-NC Gold certification or equivalent**
- In FY 2011, NREL received LEED Platinum certification for RSF I and LEED Gold certification for IBRF.
 - RSF II is projected to receive LEED Platinum certification.
 - Currently under construction is the SEB pursuing LEED Platinum certification, parking garage designed to LEED Platinum standards, and the ESIF and cafeteria pursuing LEED Gold certification.

STRATEGY AND PERFORMANCE SUMMARY

NREL capitalizes on every opportunity to integrate the principles of high-performance design into our new and existing buildings. In this effort NREL provides leadership by integrating energy efficient and renewable energy technologies into our new buildings, using our campus as a showcase for our research. NREL's Campus Master Plan and established policies promote sustainable design, operations, and maintenance practices. NREL has committed to DOE's goal of achieving LEED Gold or Platinum certification for all new construction and exceed American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1's requirements. NREL is also committed to upholding the new Better Buildings Initiative to make commercial and industrial buildings 20% more energy efficient by 2020 and accelerate private sector investment in energy efficiency.

FY 2011 PERFORMANCE STATUS

Guiding Principles

NREL uses the EPA Portfolio Manager tool for the assessment and management of Guiding Principles (GP) compliance. All checklists, with supporting documentation, are maintained in this tool. NREL currently has 23 owned and leased buildings over 5,000 ft² that make up the candidate pool for the GPs. In FY 2011, NREL had three buildings that met 100% of the GPs for high performance sustainable buildings (HPSB): Golden Hill, RSF, and S&TF. With these three buildings, NREL is currently 13% compliant towards this goal.

In FY 2011, NREL also continued efforts to perform GP assessments of our existing buildings. Three assessments were performed this year on the following facilities: Shipping and Receiving, SERF, and IBRF. As part of these assessments, NREL determined the percent compliance and necessary actions to achieve full compliance for these facilities. Based on this information, cost estimates will be developed to bring these facilities into full compliance. Currently, nearly 40% of NREL's buildings have been assessed or are in full GP compliance. All new construction at NREL will be fully GP compliant.

LEED BUILDING PROJECTS

Building	Status	LEED Certification
Research Support Facility I	Completed in FY 2011	LEED Platinum awarded
Integrated Biorefinery Research Facility	Completed in FY 2011	LEED Gold awarded
Research Support Facility II	Completed in FY 2012	LEED Platinum anticipated
Site Entrance Building	In progress, FY 2012 completion	LEED Platinum anticipated
Parking Garage	In progress, FY 2012 completion	Designed to LEED Platinum standards
Cafeteria	In progress, FY 2012 completion	LEED Gold anticipated
Energy Systems Integration Facility	In progress, FY 2013 completion	LEED Gold anticipated

LEED Certification

NREL is committed to meeting or exceeding DOE's goal to achieve LEED Gold certification on all major new construction. As part of NREL's commitment to building high performing and energy efficient buildings, two new buildings have received certification and five other high-performance buildings are under construction. The projects that have been completed or are in progress are indicated above.

Research Support Facility I

In operation since June 2010, the RSF I houses 800 staff and was constructed for \$57.4 million. In June 2011, this facility was awarded LEED Platinum certification. This 220,000 ft² office building is 50% more efficient than a conventional building designed to ASHRAE 90.1 (2004) standard. NREL's Commercial Buildings Group has collected metered data and monitored RSF's performance over the past year. The building energy use is 35.4 kBtu/ft²/year (50% less than a standard commercial building), which includes a high-performance data center. The reduction of electricity consumption was achieved through: aggressive plug load management, with a limit of approximately 64 W of power per occupant work station including laptop computer, LCD monitor, LED task lighting, and voice-over internet protocol units. Vital to achieving the largest reductions in energy intensity was the installation of a high-efficiency PV system for the RSF complex. To become a net-zero energy building, 2.65 MW of PV will be installed on the rooftops of RSF I, RSF II, a nearby parking garage, and the adjacent visitor's surface lot through PPAs. By April 2012, the RSF will be the first net-zero energy facility on the STM campus—achieving a critical DOE mission directive for the Net-Zero Energy Commercial Building Initiative prior to 2030.

Integrated Biorefinery Research Facility

This facility was completed in two phases. The high bay laboratory, Stage 1 comprised of 27,000 ft², was constructed in FY 2010. The office wing, Stage 2, comprised of 12,706 ft², was constructed in June 2011. This facility was recently awarded LEED Gold certification on December 19, 2011. This facility is significant to NREL's research to make commercial-scale production of cellulosic

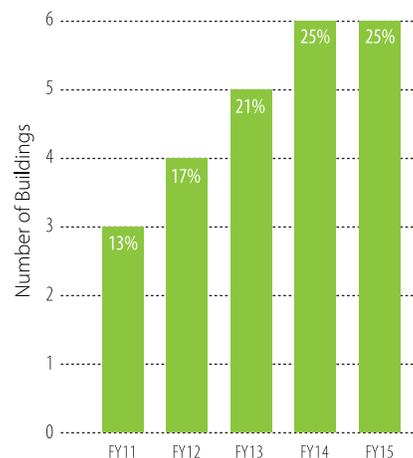
ethanol cost competitive with gasoline. Per our comprehensive energy management plan, metered data will be collected to track and monitor performance for this facility.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Guiding Principles

NREL is committed to performing annual assessments of existing buildings to identify gaps in achieving GP compliance. In FY 2012, NREL will perform three assessments on additional buildings and will develop cost estimates for all buildings assessed to prioritize GP improvements. Contingent on funding availability, NREL will work to bring existing buildings in full GP compliance.

Through the construction of new HPSBs on campus, NREL will continue to add new GP compliant buildings. Once the occupant comfort survey is complete for the IBRF and RSF II in FY 2012, these buildings will be in full GP compliance. (The survey is conducted one year after occupancy.) The new NREL cafeteria will achieve compliance in FY 2013, and the ESIF in FY 2014. NREL's plan for compliance is shown in the figure below, which accounts for NREL vacating three leased spaces in FY 2012. All GP compliance will be managed in the EPA Portfolio Manager tool.



Projected Guiding Principles Compliance Plan

LEED Certification

In FY 2012, NREL has several buildings under construction that are planned to receive LEED certification. These buildings are described in the following paragraphs.

Research Support Facility II

The RSF II, a 151,000 ft² addition to RSF I, will house Class A office space and 550 occupants. Construction was completed in November 2011 at a cost of \$60,910,000. This facility was modeled after the design of RSF I to create a highly energy and resource efficient building and is part of the net-zero energy RSF complex. In pursuit of LEED Platinum certification, RSF II incorporates features such as daylighting, in-floor radiant heating and cooling, transpired solar air heating collectors, and heat pump domestic hot water heaters with coincident air cooling. Like RSF I, the interior space provides natural ventilation with operable windows and the rooftop will be covered with PV panels. The combined PV systems will accommodate all electrical needs for building occupants. Accounting for these and other measures, the RSF II is anticipated to be 60% more energy efficient than the ASHRAE baseline building performance. After monitoring the performance of RSF I, opportunities were identified to increase its energy efficiency by an additional 17%. These improvements included the installation of more efficient solar panels at a lower cost, better thermal breaks in the latest energy efficient commercial window frames, larger transpired solar collectors, displacement ventilation in conference rooms, daylighting controls in day-lit stairwells, and natural passive cooling in stairwells.

Parking Garage

NREL's parking garage project is proving that large garages can be designed and built safely and sustainably—at no additional cost. This structure is designed to a LEED Platinum certification level. However, the USGBC does not award LEED certifications for parking structures because they do not contain occupiable spaces. While meeting staff needs with up to 1,800 parking spaces, the new structure (anticipated to open in FY 2012), will feature energy efficient technologies and blend with the landscape. One-hundred and eighty preferred parking spaces have been allocated for low-emitting vehicles, carpools, and vanpools. Additionally, thirty-six electric vehicle charging stations have been installed. The garage will use less than 160 kBtu per parking space per year and be more than 90% efficient than ASHRAE 90.1 standards. A 1.25MW PV array will be installed on the southern façade and the garage rooftop to offset electricity consumption. The cost per parking space is \$14,172 compared to typical garage parking spaces that range from \$15,500 to \$24,500.

Site Entrance Building

This 1,500 ft² structure is manned by two to three security staff and provides a secure control point for NREL staff and visitors to enter and exit. Adhering to the highest standards of LEED, the building maximizes points across every category of the rating system and is anticipated to be certified at the Platinum level. This structure will be a net-zero energy building with an extremely stringent energy



Success Story | NREL's "LIVING LAB"

NREL was honored to receive a 2010 EStar award for "Living Lab – Building the Sustainable Campus of the Future." This prestigious award highlights projects and programs that reduce environmental impacts, enhance site operations, reduce costs, and demonstrate excellence in pollution prevention and sustainable environmental stewardship. NREL's award submission highlighted NREL's long history as a laboratory that balances campus growth with sustainability.

In our development NREL emphasizes a transportation-friendly, pedestrian-oriented campus that features numerous on-site renewable energy and energy efficiency technologies (many developed by NREL) and high-performance LEED buildings. Sustainable NREL takes additional efforts to educate staff to foster the behavior change needed to operate the campus sustainably. In these efforts NREL works to uphold DOE's vision and sustainability goals, making them integral to the operation of our campus.



When complete NREL's ESIF building will be the nation's first facility that can conduct integrated megawatt-scale research and development working to rapidly move clean energy technologies into the marketplace.

consumption restriction. Given these parameters, numerous innovative energy efficient technologies will be utilized including; natural daylighting, solar PV panels, geothermal heat pump, radiant ceiling slab, underfloor air distribution, triple pane window glazing, thermal mass walls, a low energy mechanical recovery system, and a wind catch tower. This project will be complete in February 2012.

Cafeteria

This facility, comprised of 12,200 ft², will be a model for creating a high performing, low-energy consuming, and "state of the art" example of efficient food service, with a level of product quality and variety that will ensure the success of the venture. In addition to accommodating dining facilities, the interior space will provide spacial flexibility to accommodate large meetings or host events. This facility will house numerous Energy Star-rated kitchen appliances and other high-efficiency equipment. The building's location, adjacent to the central arroyo, allows diners on the patio to appreciate the area's natural beauty. This project will be complete in May 2012, with an anticipated LEED Gold certification level.

Energy Systems Integration Facility

The ESIF will soon be the nation's first facility that can conduct integrated megawatt-scale research and development of components and strategies in order to safely move clean energy technologies on the electrical grid "in-flight" at the speed and scale required to meet national goals. The \$135 million, 130,000 ft² laboratory and office building will house approximately 225 scientists and engineers and will be complete in FY 2013. The ESIF will include a high-performance computing data center for advanced computational capability to support characterization of solar, wind, hydrogen, buildings systems, and integrated energy systems including electricity storage. Like the RSF, the data center's waste heat will be recovered to heat all interior facility spaces. Outdoor pads will be available for testing larger equipment and systems up to the megawatt scale.

MEASURABLE GOALS

In FY 2012 NREL will:

- Conduct three additional GP building assessments
 - Develop cost estimates for all assessed buildings to achieve GP compliance
 - Conduct occupant comfort surveys for the IBRF and RSF II
 - Complete construction and receive LEED Platinum certification for RSF II and the SEB
 - Complete construction of the parking garage
 - Complete construction and receive LEED Gold certification for the cafeteria.
-

WATER

The RSF features a system where rainwater drains from the roof to recycled glass-filled drainage basins that filter the runoff before draining to a regional detention pond. By filtering runoff before discharging, NREL reduces its impact on local ecosystems.

GOALS

(4.1) 26% water intensity reduction by FY 2020 from an FY 2007 baseline

NREL reduced water intensity by 48% from FY 2007 baseline.

(4.2) 20% industrial, landscaping, and agricultural (ILA) water reduction by FY 2020 from 2010 baseline

NREL does not use ILA water.

STRATEGY AND PERFORMANCE SUMMARY

NREL is committed to using water as efficiently as possible on campus. Given our location in the arid west, water is treated as a particularly precious resource. NREL implements all available measures to reduce our potable water consumption. However, at this time state water law does not allow on-site collection and reuse of gray water sources and no municipal reuse water lines are in the vicinity of our campus. NREL will continue to explore opportunities as they become available to utilize non-potable water sources for our campus.

FY 2011 PERFORMANCE STATUS

Water Intensity

Potable water

In FY 2011, water intensity was reduced by 48% from the 2007 baseline and 22% from the previous year. This was primarily accomplished by adding square footage with the new RSF I building. Through efficient fixtures and native xeric landscaping utilizing irrigation only for establishment, this building significantly increased NREL's floor space without a corresponding increase in water consumption. NREL's water consumption is reported in the CEDR to DOE. Water intensity values in the CEDR are developed using square footage for DOE-owned and leased spaces; however, NREL does not collect or report water data for leased buildings. The numbers in the table below have been updated this fiscal year to be consistent with the CEDR.

NREL'S WATER CONSUMPTION

	FY07 Baseline	FY10	FY11	% Change (from baseline, FY10)
Million gallons	13.2	15.2	15.5	+17%, +2%
gallons/ ft ²	27.5	18.3	14.3	-48%, -22%



Success Story | PERVIOUS PAVEMENT

NREL has had great success with the application of on-site pervious pavement systems to reduce site runoff and maintain predevelopment hydrologic conditions. Over 59,000 ft² of pervious paving materials have been implemented on the STM campus in support of our living laboratory environment. These materials are being studied in partnership with Urban Watershed Research Institute, University of Colorado, Urban Drainage Flood Control District, and Colorado Rocky Mountain Concrete Association to understand their infiltration capacity, resulting water quality, means and methods for construction, material longevity, and maintenance requirements. As part of the first phase of the project, by the end of FY 2012, NREL will install a new pervious paving mix prototype on campus. NREL intends to share study results with other agencies through a white paper developed at study completion in FY 2017 to help improve understanding of low impact development practices and their application to DOE facilities.

NREL has established best practices in our design standards and operating procedures to promote the efficient use of potable water on campus. NREL's design standard calls for high efficiency, low flow or flow flush fixtures in all new and existing buildings. To conserve water, NREL also limits once through cooling to devices that must operate at zero pressure and cannot be reconfigured to operate on building process cooling water. NREL's potable water usage on the STM campus is metered for each building. The NWTC has potable water trucked in to the site as there are no wells or potable water supply available. NREL has installed submeters on all high-intensity water devices including cooling towers, evaporative coolers, and autoclaves.

NREL is also working to conserve and optimize our water efficiency for campus irrigation by using a WeatherTRAK® smart irrigation system to automatically adjust landscape watering based on plant needs and daily local weather conditions.

Stormwater

Section 438 of EISA and its associated guidance (required by EO 13514 and developed by the EPA) define the performance objectives to be used for preserving or restoring the hydrology of federal property. The following activities at the STM and NWTC campuses were conducted in FY 2011 to conform to EISA 438 requirements.

EISA 438 requires that for all federal facility construction projects that exceed 5,000 ft², the hydrology must be maintained or restored to predevelopment conditions, to the maximum extent technically feasible. The EPA guidance requires DOE facilities to determine the predevelopment hydrology of a site in one of two ways.

- *Method 1* assumes that the undeveloped site would generate runoff from storm events that exceed the 95th percentile 24-hour storm (i.e. the storm event for which the depth of precipitation over a 24-hour period is greater than or equal to 95% of all of the 24-hour storms over a certain period of record, in this case, 30 years).
- *Method 2* allows for calculation of the undeveloped site-specific hydrology through the use of several suggested hydrologic models, again using the 95th percentile 24-hour storm event as a basis for the predevelopment hydrology.

NREL examined all STM drainage basins for compliance with EISA 438. The middle drainage basin, which is tributary to Lena Gulch, was modeled using site specific data. Predevelopment conditions were defined as those that occurred prior to the occupation of the site by the U.S. Army (Camp George West) and the existing NREL facilities. Future conditions were assumed to be those identified in the 2009 STM Master Plan. The modeling effort resulted in the design of an extended dry detention basin (referred to as the central arroyo detention basin), which is intended to provide water quality and stormwater detention storage for the 100-year, 1-hour storm event within the middle drainage basin. The water quality volume will be slowly released over 72 hours through a slotted plate on the outlet structure. The flow will then be discharged

across the southern NREL boundary and reach Lena Gulch within approximately 400 feet via a grassy swale. In October 2011, an additional analysis was performed to ensure that the design for the detention basin was consistent with the volume, release rate and duration of flow identified in the EPA's technical guidance document. Once calculated and compared with the developed condition, EISA Section 438 requires that controls be established to retain all storms in excess of 100-year, 1-hour storm event depth. Because retention of stormwater violates provisions of Colorado water law, stormwater controls at NREL are designed to maintain the predevelopment hydrology through detention and subsequent release rates at predeveloped rates. Initial earthwork for the central arroyo detention basin began in August 2011. The planting installation will utilize native riparian and upland tree and shrub communities, pre-vegetated mats for enhanced water quality, and a perimeter walking trail for passive recreation. Project completion is anticipated in June 2012.

Within the west drainage basin at the STM campus, drainage improvements were completed that involved resloping a roadway that had been experiencing flooding following storm events; the road surface was re-graded to direct flow into an adjacent infiltration/detention basin. This improvement will not only prevent street flooding but also will provide additional filtering of stormwater runoff prior to its discharge to a storm drain that outfalls across NREL's southern boundary. Additional modeling was also conducted within the west drainage basin as part of the 2011 STM Master Plan update to evaluate future options for stormwater detention under buildout scenarios

Development within the east drainage basin in FY 2011 included completion of a 100-car parking lot to service the RSF building and the associated detention basin to manage runoff from the parking lot. In addition, construction began on the ESIF facility, whose stormwater runoff is being directed almost entirely to the central arroyo detention basin within the middle drainage basin for water quality and flood control purposes.

Low impact development (LID) practices have continued to be implemented in the following locations within all three drainage basins at the STM campus:

- *Porous pavements.* These materials are being installed in the courtyards of the new RSF north wing and are planned for the hardscape areas surrounding portions of the ESIF and the new 1,800-car parking garage, which are currently under construction.
- *Landscaping stabilization materials.* Prevegetated and slope stability mats are being installed in both the central arroyo detention basin and the smaller detention basin which serves the 100-car parking lot described above. These materials are designed to improve slope stability during the restoration phase and to speed vegetation establishment.
- *Native prairie grasses, shrubs and trees.* NREL is planting native vegetation to prevent wind erosion and erosion and sedimentation from storm water/snowmelt on steep slopes.

Development at the NWTC in FY 2011 was largely confined to indoor activities with the exception of the erection of the 2 MW wind turbine and associated meteorological tower. While construction activities disturbed just less than one acre of ground, the entire project area outside of the 300 ft² concrete turbine pad has been reseeded. A site-wide drainage study was also completed at the end of the fiscal year. The study mapped the NWTC drainage basins, computed predevelopment, existing and buildout stormwater runoff under three different methods (EISA 438, Jefferson County Colorado criteria, and LEED requirements) for a site certification, and generated conceptual drawings showing optimal locations for future detention basins to be constructed when funding becomes available.

Industrial, Landscaping, Agricultural Water

In the FY 2010 SSP, NREL reported the use of industrial, landscaping and agricultural (ILA) water. This information was reported incorrectly as NREL does not have any non-potable water usage on-site.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Water Intensity Reduction

Potable water

In 2012, several new high-performance buildings will come on-line at NREL. All buildings have been designed to conserve indoor and outdoor water use and should help support DOE's water intensity reduction goal.

In FY 2013, ESIF will open. This 130,000 ft² building has cooling towers that will increase NREL water consumption by 30% or more. A more efficient technology, evaporative cooling, will be used in place of standard air conditioning for this building, eliminating electricity consumption at the expense of increased potable water use. NREL is implementing the most efficient cooling tower recirculation practices, with five cycles of optimal use before discharge. This is a best management practice for cooling tower operation. The resulting non-potable water contains high concentration mineral residuals that prevent its reuse on-site for irrigation purposes.

NREL has other projects underway including replacement of a scrubber that uses 1.3 million gallons per year. This device was replaced with a unit that uses no water before the end of the 2011 calendar year. Further water reductions may be possible by retrofitting autoclave sterilizers to use house vacuum instead of water consuming eductors, which will be investigated in 2012.

In FY 2012, NREL will undertake an effort to perform EISA building audits on our campus. These audits will be used to identify energy and water savings opportunities within and around our buildings. Prioritization of improvements will be made using a cost-benefit analysis.

Stormwater

As buildings and other projects are identified at the STM site, LID practices will continue to be incorporated to manage stormwater runoff to maximize infiltration and evapotranspiration, and mini-



Water conserving fixtures and appliances are used throughout the RSF. These fixtures can eliminate as much as 50% water use as compared to a typical office building. Water fixtures include low-flow faucets and shower heads, no water urinals and water-saving toilets.

mize landscaping irrigation in ways consistent with EISA 438 and local, state, and federal water quality and water rights regulations.

Two construction projects that received funding at the NWTC during FY 2011 are scheduled to begin in the first quarter of FY 2012. These projects, the expansion of the Dynamometer facility and improvements to existing Building 251, will result in greater than 5,000 ft² of new or redeveloped site improvements. When additional DOE funding becomes available, the conceptual designs developed in the NWTC drainage study described above will be advanced and constructed. Project designers will continue to look for opportunities to incorporate LID practices in all NWTC projects.

Industrial, Landscaping, Agricultural Water

Unless ILA water becomes available in the campus vicinity, NREL has no plans to use ILA water.

MEASURABLE GOALS

In FY 2012, NREL will:

- Perform EISA energy and water audits of DOE-owned facilities
 - Install new pervious paving mix prototype on campus as part of collaborative pervious paving research effort.
-

POLLUTION PREVENTION

To foster a culture of waste reduction, NREL promotes its 4Rs program (reduce, recycle, reuse, re-buy) on-site and provides bi-annual paper shredding and electronics recycling day for its employees.

GOALS

(5.1) Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris by FY 2015

- Diverted 77% of campus waste from landfill
- Rolled-out Pollution Prevention Initiative Pilot Program
- Performed three pollution prevention assessments.

(5.2) Divert at least 50% of construction and demolition materials and debris by FY 2015

Diverted 88% of construction waste from landfill in FY 2011.

STRATEGY AND PERFORMANCE SUMMARY

NREL is building a laboratory of the future that is committed to sustainability through conscientious management of waste. Making the 4R's philosophy of reducing, reusing, recycling, and rebuying integral to our operations, NREL promotes balance among environmental, social, and financial considerations. By promoting sustainable decision making that considers product life from cradle to cradle, NREL is working to establish a campus with near-zero waste that supports vitality in the community and environment.

In FY 2011, NREL was honored to receive two prestigious awards for our performance in pollution prevention. NREL received DOE's 2010 EStar award in the "Cradle to Cradle" category for Near-Zero Materials Waste and Beyond and also was awarded another Federal Electronics Challenge (FEC) Award, receiving DOE's first Platinum level certification.

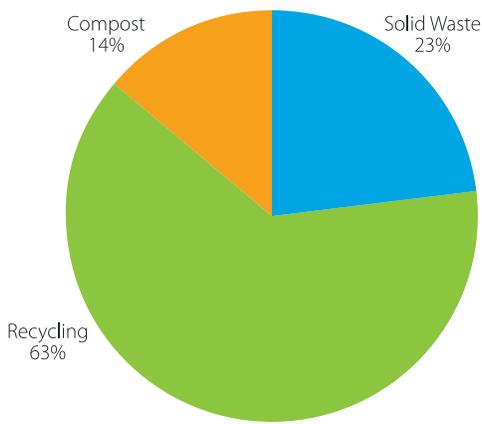
FY 2011 PERFORMANCE STATUS

Campus Waste

Waste diversion

NREL demonstrated substantial progress in FY 2011 by diverting 77% of campus waste from the local landfill. NREL's Near-Zero-Waste Initiative has helped to support these reductions by educating staff on workplace waste reduction through recycling and composting. Training on recycling and composting is now available for employees to learn about NREL's Near-Zero Materials Waste program. In FY 2011, NREL transitioned our composting pilot to a campus-wide program increasing our compost 9% from the previous fiscal year, showing progress in the establishment of this program. All solid waste, recycling, and compost data were sub-mitted for FY 2011 in the PPTRS.

NREL continues to demonstrate leadership in electronics recycling and has been awarded an FEC Platinum Level Award in FY 2011. The FEC is a partnership program that recognizes federal facilities and agencies that purchase green electronics, reduce impacts of electronics during use, and manage used electronics in an environmentally safe way.



FY11 Waste Diversion

NREL organizes regular electronics recycling events for staff, offering a convenient location for staff to dispose of hard-to-recycle personal items such as computers, printers, and monitors. In tandem with these events, NREL hosts document shredding and recycling events twice a year where staff can dispose of sensitive documents from home in a safe environmentally friendly way. For the first time this year, NREL also hosted a book drive, where staff donated books and journals to a local non-profit supporting children's education.

In FY 2011, efforts were made to replace computer printers, copiers, scanners and fax machines with Energy Star-certified multifunction devices (MFD) on campus, which reduce the need for standalone equipment. Defaults have been set on all computers and printers for double-sided printing. NREL also encourages the use of scanners, portable document format (PDF), and the print-to-PDF capabilities of most operating systems to avoid printing when possible. With these measures in place, the use of paper has decreased while NREL's population has grown—with 5.6 reams of paper used per person in FY 2010 to 4.9 reams per person in FY 2011—a 13% reduction. All paper used at NREL contains at least 30% post-consumer fiber. All cartridges from the MFDs are sent back to the manufacturer to be recycled or reused.

Pollution prevention

In FY 2011, Sustainable NREL and the EHS Office initiated the PPI Pilot Program, which provided NREL staff with the opportunity to identify and implement new pollution prevention practices at the laboratory. Project proposals were submitted by staff to help NREL promote reductions in waste, materials, water, air emissions, and energy use.

Projects

Three projects were funded in FY 2011, including:

1. *NREL Library Reduce and Recycle*. This project replaced 85 linear feet of print journals with electronic journals to reduce paper use and the footprint required for the new NREL library. This project reduced collection shelving requirements by 30%, saving both material and energy costs.

2. *Idling Reduction*. This project created new guidance based on best practices and developed a site-wide education program for idling reduction. Estimated reductions include 1,700 gallons/yr and \$6,400/yr in diesel fuel use for NREL shuttles.
3. *Pump Replacement*. This project replaced an existing oil-based wet pump with an energy-efficient sealed pump in the S&TF. This replacement will reduce oil waste and energy usage associated with the pump.

Assessments

In FY 2011, three pollution prevention assessments were also successfully completed:

1. *Printer Reduction*. This assessment estimated the environmental benefits and cost savings of removing desktop printers to encourage greater use of MFDs in the FTLB. The assessment verified existing printer inventories and the functionality of existing MFDs for color printing, copying, scanning, and faxing. The study determined that 50 to 60 devices could be removed with little or no impact to users. As a result, a printer consolidation project is currently under consideration for this building.
2. *SF₆ Reduction*. This assessment determined the current uses of SF₆ at NREL, the feasibility to capture or reduce emissions for these uses, and estimated the potential environmental benefits of a capture or reduction program. Meetings were held with SF₆ users to understand the quantities consumed and the possibility of using alternatives. Based on this assessment, SF₆ alternatives will be considered for future NREL fume hood commissioning. Additional efforts will be considered to help researchers transition their usage to lower global warming potential alternatives.
3. *Aerosol Can Recycling*. This assessment evaluated the number of aerosol cans NREL annually sends to the landfill to understand the environmental impacts of this waste stream. The study estimated that 400 empty aerosol cans per year are being sent to the landfill. Establishing a recycling program for aerosol cans is being considered based on this assessment.

Chemicals

NREL relies on several systems to reduce the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed of including a Chemical Management System and Excess Chemical Inventory. NREL conducts annual training on chemical safety and hazardous waste management for all lab workers and a formal hazard identification and control process is used to minimize the risks associated with any new or changed lab process. Annual goals for pollution prevention are set as part of NREL's Environmental Management System (EMS). NREL also works toward DOE's goal to use alternative chemicals and processes by giving preference to environmentally preferable products, including bio-based products, Electronic Product Environmental Assessment Tool (EPEAT) electronics, and low- or no-volatile organic compound (VOC) paints.

This year NREL's chemical inventory management system software was upgraded. The upgrade provided broader access to researchers and supports NREL's effort to expand the reuse of chemical stocks, which reduces the need for additional purchases of new chemicals.

Pest and landscape management

For pest control in and around buildings, poisons are used only as a last resort. Snap traps and live traps are the preferred methods of control at NREL.

NREL's Weed Management Program minimizes the impacts of herbicide applications, while at the same time controlling listed noxious weeds for which control is legally mandated. Appropriately timed annual mowing is used to reduce noxious weed seed production. Mowing also helps to improve the effectiveness of herbicide applications. NREL also uses a certified-weed free, native grass seed mix for reseeding of disturbed areas.

In FY 2011, NREL worked in cooperation with the Jefferson County Nature Society and surrounding landowners to improve the management of listed noxious weeds at its sites. NREL treated 3.3 acres of grasslands at its STM campus to control Canada thistle and 68 acres at its NWTC campus to control knapweed, both state-listed noxious weeds. Improved management will result in enhanced wildlife habitat and compliance capabilities.

In FY 2011, NREL began participating in the Sustainable "SITES" Initiative Pilot Program an interdisciplinary partnership, led by the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center, and the United States Botanic Garden, working to foster a transformation in land development and management practices and obtained Pilot Certification. Similar to LEED, the program focuses on rigorous design, construction, operations, and maintenance criteria as a complement to the construction of high-performance buildings.

Property clearance and release

Current procedures call for mitigation of any contaminated materials prior to release. NREL procedure 6-3.2, Laboratory and Equipment Decommissioning, was reviewed and reissued in 2009.

Right-to-Know Act

Quantities of extremely hazardous substances at NREL do not exceed threshold planning quantities and are not required to be reported under Emergency Planning and Community Right-to-know Act (EPCRA) requirements. EPCRA also requires the reporting of OSHA-hazardous chemicals in quantities above the threshold of 10,000 pounds. In FY 2011, NREL reported above-threshold quantities of diesel stored in above-ground storage tanks (primarily used in backup generators), petroleum oil, and sulfuric acid content present in lead-acid batteries. NREL actively participates in the Jefferson County Local Emergency Planning Committee (LEPC), which receives and manages the EPCRA reports for the planning area. The LEPC works with the state's emergency planning organizations to coordinate response activities.

THE 4Rs PROGRAM

REDUCE



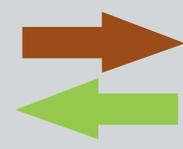
REUSE



RECYCLE



RE-BUY



Success Story | NEAR-ZERO WASTE

In FY 2011, NREL was honored to receive DOE's 2010 EStar award in the "Cradle to Cradle" category for Near-Zero Materials Waste and Beyond. EStar awards recognize DOE's "Best in Class" initiatives that support leadership in environmental sustainability. The award is based on NREL's efforts to establish a campus with near-zero waste by using the 4R's philosophy (reduce, reuse, recycle, and re-buy). This approach promotes balance between environmental, social, and financial considerations to foster sustainable decision making that considers product life from cradle to cradle. Through green purchasing, recycling, composting and reuse programs NREL has worked to systematically reduce campus waste.

Construction Waste

In FY 2011, NREL's building square footage grew 48%. In spite of this growth, NREL was able to achieve an 88% diversion of construction waste through comprehensive recycling programs. This, in part, was facilitated by new green specifications for existing buildings projects developed by Sustainable NREL in FY 2011, which are consistent with the LEED Existing Buildings: Operations and Maintenance (LEED EB-O&M) rating system and support aggressive waste diversion goals of at least 70% by volume. NREL also incorporated new language into Statements of Work (SOW) this year, which requires all contractors to track the quantity of waste generated and recycled for campus projects. Subcontractors performing on-site construction projects are also encouraged to participate in the campus composting program.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Campus Waste

Waste diversion

In FY 2011, NREL joined the EPA Federal Green Challenge and WasteWise Programs to participate in federal waste prevention and resource conservation. Under these programs, NREL established FY 2011 baselines with goals to reduce paper usage by 5% and increase waste diversion by 5% in FY 2012. These goals will be undertaken by Sustainable NREL's Near-Zero Waste Committee to determine the most appropriate means of achieving these reductions. NREL will also begin performing on-site waste audits to help identify problem areas to continue to reduce campus waste.

Pollution prevention

In FY 2012, NREL will also perform two pollution prevention assessments in topic areas that will help the lab uphold DOE's pollution prevention goals.

Chemicals

In FY 2012, several of NREL's laboratories are being remodeled. During this process, the EHS Office will encourage researchers to scrutinize chemical inventories for hazardous materials that are no longer needed and can be removed from use or surplus for use in other labs. NREL will continue to track refrigerants and fluorinated compounds purchased and maintain a chemical inventory using its Chemical Management System. NREL will also conduct regular reviews of Safe Operating Procedures and Readiness Verifications (for new activities or activities with changing scope of work) to include consideration of potential GHG impacts from chemical purchase, use, storage and disposal.

Pest and landscape management

In FY 2012, NREL will continue to participate in the Sustainable SITES Initiative Pilot Program and will update the campus Weed Management Program 6-2.12 to include new strategies and best practices.

Property clearance and release

NREL procedure 6-3.2, Laboratory and Equipment Decommissioning will be reviewed and revised as needed in FY 2014.

Right-to-Know Act

NREL will continue to perform annual reporting as required by EPCRA.

Construction Waste

Sustainable NREL will continue to track data and enforce subcontractor SOW requirements for all construction projects in FY 2012.

MEASURABLE GOALS

In FY 2012, NREL will:

- Task the Near-Zero Waste Committee with identifying and implementing projects to reduce paper usage by 5% and increase waste diversion by 5% as part of participation in EPA programs
 - Perform on-site waste audits to analyze waste stream and identify opportunities for additional reduction
 - Participate in Sustainable SITES program
 - Perform two pollution prevention assessments
 - Provide updates to the Weed Management Program 6-2.12.
-

SUSTAINABLE ACQUISITION

NREL aggressively promotes the acquisition of sustainable products. Shown here are office supplies made from recycled materials from NREL's sustainable office supplier.

GOALS

(6.1) Procurements meet sustainability requirements and include sustainable acquisition clauses (95% each year)

- Awarded first green janitorial contract
- Enhanced office supply contract to include EO 13514 sustainable acquisition requirements.

STRATEGY AND PERFORMANCE SUMMARY

This year, NREL has worked aggressively to implement new policies and programs that increase the acquisition of sustainable products and contracts consistent with EO 13514. NREL's prime contract with DOE requires procurement actions to be conducted consistent with all federal green procurement preference programs including:

- Electronics and computing equipment that are EPEAT registered, Energy Star, or FEMP-designated
- Products manufactured from recovered materials
- Environmentally preferable products (EPP)
- Energy Star energy-efficient products
- Biobased products
- Non-ozone depleting substances.

In FY 2011, NREL constructed several new LEED buildings, which catalyzed establishment of campus-wide green cleaning and sustainable acquisition policies and procedures. While it is critical to have policies and procedures in place, modifying staff and subcontractor behavior and providing incentives for participation is also key to transforming acquisition practices. To support this, NREL has focused efforts on providing education for staff and subcontractors about sustainable product alternatives.

FY 2011 PERFORMANCE STATUS

For existing building renovation projects, NREL incorporated new language in the SOW, which requires all contractors to track waste diversion. NREL's SOW for construction were also updated to include new reporting requirements for remodels and building additions for recycled content quantities in:

- Building insulation products
- Carpet, carpet cushion
- Cement and concrete (containing blast furnace slag, fly ash, latex paint)
- Low-VOC paints, adhesives, window caulking
- Floor tiles/or other types of floor products
- Wood

- Patio blocks
- Shower and restroom dividers/partitions
- Structural fiberboard
- Modular threshold ramps
- Non-pressure pipe
- Roofing materials
- Asphalt.

In FY 2011, Sustainable NREL developed green specifications for existing buildings projects, which are consistent with the LEED EB-O&M rating system and support the use of sustainable purchasing for electric equipment, furniture, lighting, construction materials, and cleaning supplies.

Sustainable acquisitions data were submitted for FY 2011 in the PPTRS. In 2011 86% of construction contracts included sustainable acquisition requirements.

In FY 2011, 30% of cleaning products used by janitorial staff were biobased and 100% of paper products used were made of recycled-content materials. This year, NREL also awarded its first green janitorial contract with green requirements developed based on the LEED-EB O&M rating system green cleaning credits.

In FY 2011 99% of NREL's desktop computing devices were compliant with EPEAT and Energy Star. Purchase of energy-efficient laptop computers grew 42% from 2009, decreasing the average watts per user for desktop equipment 47.5% per work station. NREL also made efforts to replaced existing printers, copiers, scanners and fax machines with multifunction systems that provide a more energy-efficient means of performing these functions.

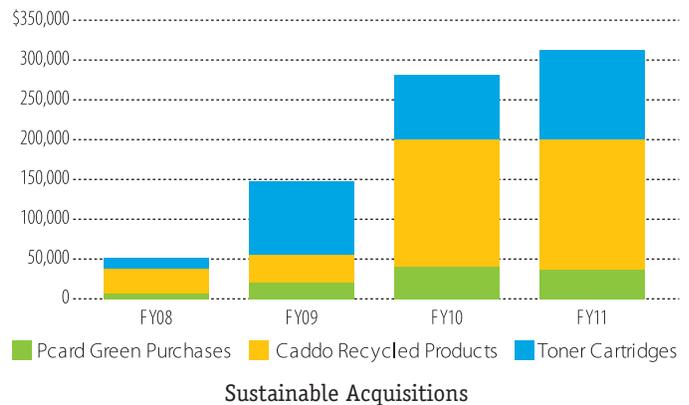
This year NREL purchased over \$300,000 in green office supplies, including toner cartridges and items from the CADDO office supply catalogue and purchase cards (PCards). The purchase of green office supplies is facilitated for staff through the CADDO catalogue, which includes earth-friendly office supply products, manufactured from recycled content. In 2011, purchases with recycled content from the CADDO catalogue increased 5% from 2010, with 44% of all office supply purchases having recycled content. Efforts have been made to also increase the use of recycled toner cartridges, with 92% of all toner cartridges used at NREL having recycled content.

To support these efforts, NREL updated existing policies to provide additional guidance to create sustainable acquisitions and green purchasing practices consistent with EO 13514, including the:

- General Procurement Policy 10-1
- Procedures for NREL PCard use and Purchase Requests
- Sustainable NREL Policy 2-7.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

In FY 2012, Policy 10-1 will be finalized to include a sustainable acquisition section. PCard and purchase request procedures will also be finalized and implemented in FY 2012. Performance associated with these new policies and procedures will be monitored



through NREL business systems, contractor tracking reports, and basic ordering agreements.

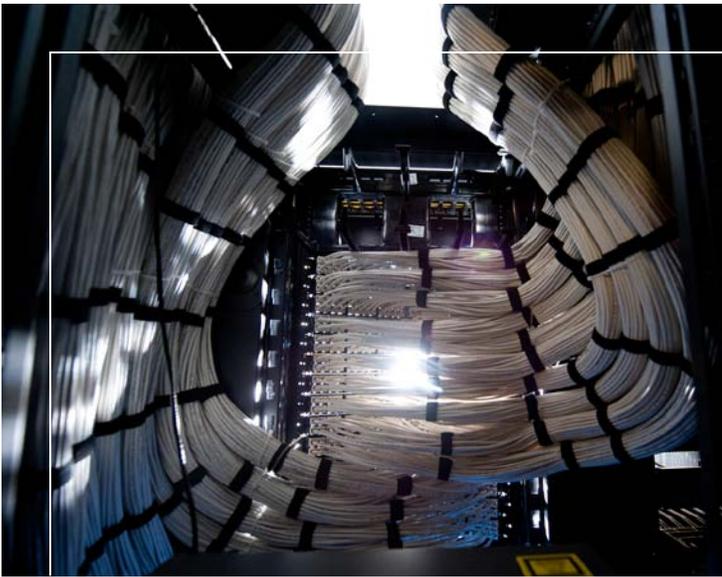
In the next year, NREL will continue to work to increase employee focus and awareness of the availability of green products for daily office functions. This effort will include enhancing green product information provided to administrative staff that performs the primary ordering of office supplies. An improved web-based CADDO office supply catalogue will also help direct staff toward greener product choices.

In FY 2012, NREL will also participate in the U.S. EPA's Federal Green Challenge, which is a national initiative for federal agencies to lead by example in reducing the federal government's environmental impact through sustainable materials management. As part of NREL's participation in this program, NREL has pledged to increase EPP for campus activities by 5% in this fiscal year.

MEASURABLE GOALS

In FY 2012, Sustainable NREL will:

- Finalize and implement Policy 10-1 as well as PCard, and purchase request procedures
- Host a series of meetings to increase the visibility of green office-supply product selection with NREL staff and provide education on preferred purchasing procedures
- Collaborate with CADDO to host a green office supply fair featuring new product vendors and technologies for staff
- Increase EPP by 5% in FY 2012 to support NREL's participation in the EPA Federal Green Challenge
- Implement the green cleaning janitorial contract campus wide.



DATA CENTERS AND ELECTRONIC STEWARDSHIP

NREL's world-class data center is located in the RSF. To be incorporated in this LEED Platinum and net-zero energy building, the energy center was designed to minimize its energy footprint without compromising needed service quality.

GOALS

(7.1) All data centers are metered to measure a monthly PUE (100% by FY2015)

NREL's RSF data center measures monthly PUE.

(7.2) Maximum annual weighted average Power Utilization Effectiveness (PUE) of 1.4 by FY 2015

PUE for the RSF data center is 1.16.

(7.3) Electronic Stewardship—100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012

Power management is enabled on 100% of devices.

STRATEGY AND PERFORMANCE SUMMARY

NREL is working to transform the delivery of its Information Technology (IT) products and services to demonstrate the leading edge of energy efficiency. By leveraging cloud computing, implementing the use of virtual desktops in the end-user computing environment, and monitoring performance, NREL strives for continuous improvement in our efforts to optimize IT service management.

NREL actively seeks opportunities to share information on our energy efficiency best practices through the development of case studies, participation in the FEC, mentoring activities, and industry presentations. NREL also performs staff outreach for electronic stewardship and full life-cycle management of equipment.

FY 2011 PERFORMANCE STATUS

Data Centers and Electronic Stewardship

Data center operations

NREL delivers its administrative IT products and services from its world-class energy-efficient data center located in the RSF, which has achieved a LEED Platinum rating and net-zero energy consumption (dependent on season) even with the inclusion of this energy-intensive function. To support the RSF's energy goals, NREL's data center was designed to minimize its energy footprint without compromising needed service quality.

Because the data center is located in the net-zero RSF, the facility capitalizes on the power generated by the RSF complex's roof-top solar PV panels. NREL also takes advantage of the climate for the use of "free cooling." Equipment racks are arranged in a hot aisle/cold aisle configuration with hot aisle containment. Air from the hot aisle is extracted from the data center and is reused to heat the RSF building during the colder months, or is vented to the outside when not needed. Evaporative cooling is required for a nominal number of days per year—this system cools the data center for all but the most hot and humid days of the year without air conditioning. In FY 2011, a chilled water meter was installed to track the energy associated with cooling of the data center.

Over the past two years, NREL has reduced per-user data center energy requirements by 81%, resulting in an annual cost savings of \$200,000 in utility bills (at \$0.06 per kilowatt hour), and an annual reduction in carbon dioxide emissions of nearly 5,000,000 pounds.

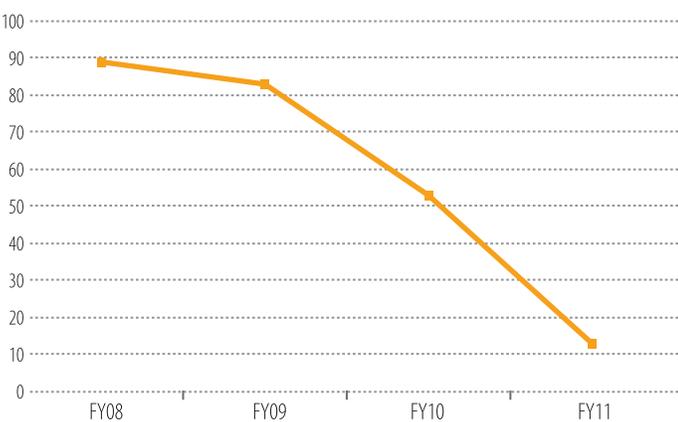
The RSF data center is independently metered and connected to the DOE Energy Dashboard system. Legacy data center functions, housed in Building 17, are submetered for computer operations and cooling. Once the new ESIF supercomputer comes on-line in 2013, the legacy data center will be removed. A metered data dashboard is also currently available for all staff to monitor and participate in achieving power effectiveness goals.

Purchasing and disposition practices

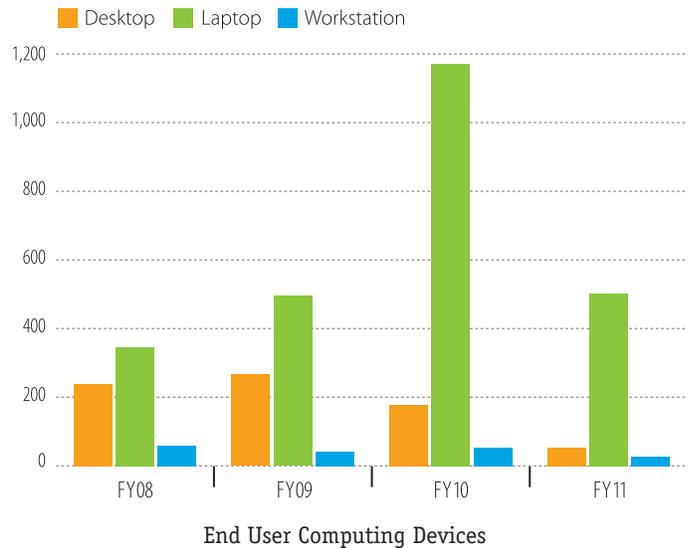
NREL provides purchasing guidelines and a recommended equipment list for all end-user computing equipment, printing devices, and network technology infrastructure to promote energy efficiency while maintaining operational quality. NREL employees are strongly encouraged to purchase electronics and computing equipment that are EPEAT-registered, Energy Star, or FEMP-designated as energy efficient. NREL's purchasing and ordering departments partner to monitor purchasing and track progress toward energy efficiency in electronics. Employees are offered a standardized equipment list and if they must purchase non-compliant equipment, they are required to submit a business case to justify the need.

NREL's hardware standards ensure that only the most highly-rated energy-efficient computers, monitors, and peripherals are purchased and used across the lab. This equipment meets Energy Star 4.0 and EPEAT standards. NREL purchases predominantly LED-backlit LCD monitors and has an ongoing project to replace all remaining fluorescent-backlit LCD monitors with more energy efficient alternatives. Exceptions are made on a case-by-case basis when approved through NREL's internal exception process.

NREL has moved from inefficient desktop computers toward highly-efficient laptop computers, and only purchases monitors with energy-saving features. Desktop printers and standalone fax machines are purchased only when needed, and are otherwise



Desktop Printers Purchased



End User Computing Devices

replaced by multifunction devices that copy, print, scan and fax. In FY 2011, NREL purchased 99% of its desktop computing devices as EPEAT- and Energy Star compliant. Because of NREL's purchasing policy and staff participation in adhering to recommended equipment when purchasing, 69.84% of the lab's computing equipment is EPEAT gold certified, 26.83% is silver certified, 0.08% is bronze certified, and only 3.25% does not align with FEC standards. NREL maintains a database of vendor sustainability practices to track vendors not governed by EPEAT standards. Only those vendors whose manufacturing, distribution, and operational practices meet or exceed EPEAT standards are selected for business with the lab.

NREL replaced the majority of the lab's standalone printers, copiers and fax machines with Energy Star-compliant multifunction devices. The lab saw an 85% reduction in desktop printers between 2008 and 2011.

To facilitate the lab's electronic stewardship practices, NREL participates in the FEC annually, to ensure that the lab exceeds the electronic equipment requirements of EO 13514 for the full life-cycle management of computers, laptops, monitors, printers, fax machines and television set purchases. NREL has participated since 2007 and is a Platinum-level partner (and the only DOE facility to achieve the newly-implemented Platinum level partnership). NREL's exemplary performance in the FEC helps ensure NREL's IT functions are performed in the most sustainable manner possible. NREL utilizes Metech, an environmentally-sound electronics recycler, to dispose of all equipment that is not donated or resold at the end of its useful life.

Power Utilization Effectiveness

NREL maintains a world class PUE in our RSF data center through continuous monitoring and adjustments based on metered data. Currently, 90% of NREL's server environment is virtualized. In some environments, NREL has experienced a 29:1 ratio for server virtualization. (Workload that used to run on 29 separate servers now runs on only one blade server). Blade servers, coupled with server

virtualization, have lessened energy consumption by approximately 90% to support the same workload of NREL's legacy data systems. Storage area networks are used to pool storage resources in an effort to reduce the amount of hardware that would typically be required for storage dedicated to server resources.

Power consumption for the RSF data center's cooling system, power systems, and equipment is completely metered. Currently, 97 kW of power is needed to support the data center's cooling, power systems and equipment needs. The equipment load is 80 kW with an average PUE of 1.16. NREL expects to reduce the PUE further by fine-tuning the sequencing for the cooling system and infrastructure operations.

Power Management

NREL enables Energy Star power management features on all eligible computing equipment (i.e., those without an exception due to laboratory use). All computers in the RSF have a script installed, which enforces even stricter power management settings. These practices are mandatory activities for participation in the FEC. NREL has also established default settings on all computers and printers for double-sided printing. NREL installed software and established a group policy that continually monitors and controls power management settings on all desktop computers across the lab and makes adjustments to policy.

NREL has implemented staff electronic sustainability education programs focused on staff responsibilities in meeting electronic stewardship goals. Education includes interaction with power management at the desktop, understanding purchasing and disposal policies, and how to practice electronic stewardship when working from home offices.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Data Centers and Electronic Stewardship

NREL's IT group has numerous projects underway to continue to enhance NREL's IT sustainability and leadership by example. NREL is currently creating a Data Center Energy Profiler Software Tool Suite (DC Pro) profile for the RSF and legacy data centers to help promote the use of the application for DOE's Office of the Chief Information Officer. NREL is also developing a sourcing strategy for the delivery of IT products and services, leveraging the use of virtualization and cloud computing to the extent possible.

NREL's IT group is working to implement tiered storage architecture to help reduce the energy footprint per terabyte. Efforts are being made to implement an Information Technology Infrastructure Library (ITIL) to increase IT service quality, reduce costs, and better manage IT resources for capacity management. In the next year, NREL will deploy a thin client technology pilot program for up to 25% of the installed base to increase processing capacity. The IT group will also continue to work closely with Sustainable NREL and building teams to identify education and interaction opportunities for staff and other agencies.

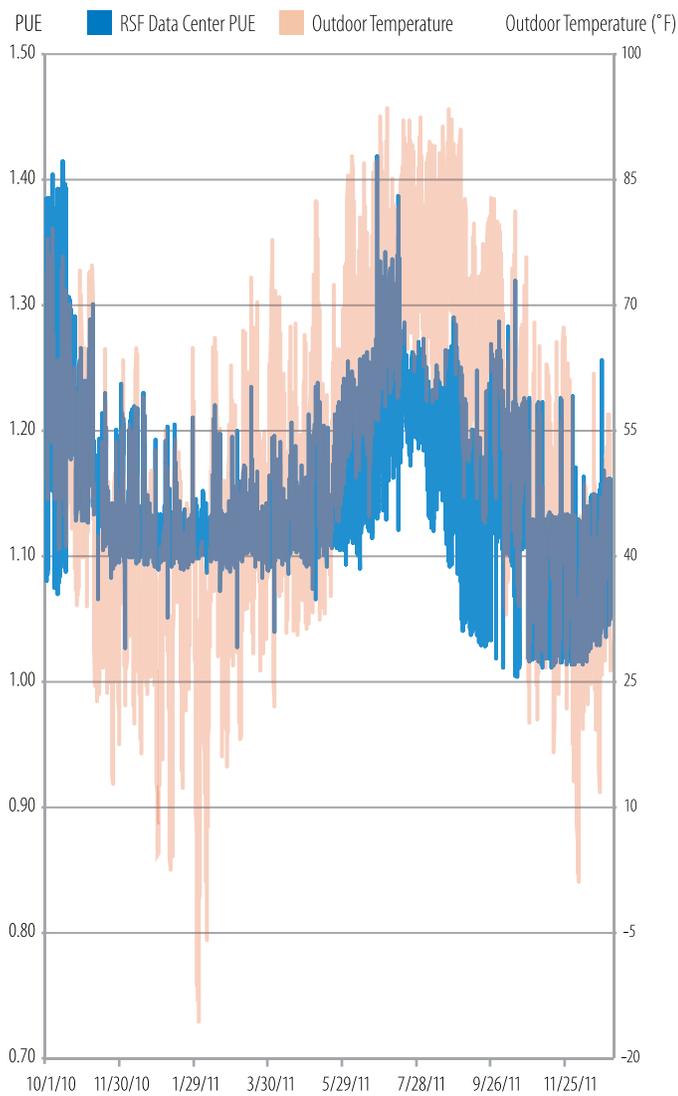


Success Story | GREEN DATA CENTER

NREL went to great lengths to ensure that the data center in the RSF enhanced the building's energy efficiency. In addition to drawing national attention for our innovative efforts, NREL received a 2011 GreenGov Presidential Award for our green data center. Recipients of the GreenGov Presidential Awards exemplify how the federal government is meeting the President's challenge for leadership in sustainability. NREL received the Green Innovation Award for our extraordinary efforts to promote sustainability in our operations.

The data center was selected as an award recipient for using the climate as a natural coolant, capturing waste heat to ventilate in the cooler months, and employing advanced equipment to minimize energy usage. NREL was also lauded for our efforts in employee education and the expectation that NREL's data center will save \$200,000 annually in electricity costs and reduce carbon emissions by nearly 5 million pounds per year.

Energy Secretary Chu "applaud(ed) the NREL team for leading by example on their commitment to innovation, which is helping to improve energy efficiency, reduce pollution, and save taxpayers money." NREL was one of eight winners, in six award categories, representing federal agency teams and employees from across the country. A panel of judges that included federal and local decision-makers reviewed nearly 250 nominations and recommended the award recipients to the President.



Data Center PUE

Data center operations

NREL will continue to optimize data center PUE operations and performance. The RSF data center success story will be used as a mentoring opportunity for other DOE agencies and organizations seeking to improve the sustainability of their operations.

Purchasing and disposition practices

NREL will continue its commitment to purchasing electronic equipment that is approved by the FEC and will continue to update its purchasing guidelines to reflect improvements in equipment energy efficiency. The lab plans to implement thin client systems where appropriate to further reduce equipment power consumption. NREL will also continue mentoring activities to assist other federal facilities with meeting the requirements of EO 13514 and to maintain FEC Platinum level partnership.

Power Utilization Effectiveness

The ESIF, planned for LEED Gold certification, is under construction and will open in FY 2013. This facility will have a data center that replaces the Building 17 legacy data center; therefore, it has been determined it is not cost effective to provide PUE monitoring for the legacy facility. The new ESIF data center will use at least 1 MW constant load, which at some point in the future may increase to 10 MW. ESIF has been designed to operate as energy efficiently as possible with a target PUE of 1.06.

Power Management

NREL is continuously monitoring power usage and plug loads at the desktop level. NREL will implement an application to monitor, audit, and report on desktop power management settings. The lab will also pilot thin client systems to reduce desktop and laptop use and enable power management on all administrative desktops.

MEASURABLE GOALS

In FY 2012, NREL will:

- Populate DC Pro for energy assessment and energy profiling of RSF and legacy data centers
 - Roll out thin client systems to increase processing capacity
 - Meet or exceed world class PUE (less than 1.3).
-



REGIONAL AND LOCAL PLANNING

NREL fosters a campus environment that encourages staff to use alternative modes of transportation to commute to work. In 2011 NREL won another Bike 2 Work Day business challenge award with 245 staff participants.

GOALS

Regional Transportation Planning

- Designed and began construction of a new site entrance and enhanced roadway system
- Participated in RTD and Jefferson County transit and bicycle/pedestrian planning efforts
- Provided shuttles connecting staff to RTD public transit services.

Environmental Management

- NREL's NEPA process considers energy usage and alternative energy sources.
- Continued to work with Jefferson County on the design of a large stormwater detention basin located on the STM campus
- Worked with the Jefferson County Nature Association and Jefferson County to manage noxious weeds
- Coordinated with the Fish and Wildlife Service and Boulder County Open Space on avian monitoring for NWTC campus.

STRATEGY AND PERFORMANCE SUMMARY

To implement Executive Orders and expand Sustainable NREL initiatives, campus projects integrate physical boundaries, connect to transportation and utility systems, and protect ecosystems and open space. Through all of these initiatives, Sustainable NREL is nurturing an internal sustainability culture. All of these elements have linkages that forge stronger community, neighbor, and user relationships. NREL continues to coordinate with appropriate local and regional planning organizations and government agencies to improve land use, transportation, growth, and sustainability within the community.

FY 2011 PERFORMANCE STATUS

Regional Transportation Planning

NREL is actively involved with local governments and organizations to:

- Influence the enhancement and development of regional transportation infrastructure and services
- Promote and encourage efficient use of transportation, infrastructure, and services.

Through staff, NREL has direct contact with representatives from Jefferson County, City of Lakewood, City of Golden, and the Regional Transportation District (RTD). NREL works with these entities both on an informal, ongoing basis and formally at public meetings to engage with and influence transportation decision-making.

- *Local Government Coordination.* NREL works with the City of Lakewood, City of Golden, and Jefferson County, Colorado to make enhancements to adjacent roadways to improve conditions for transit patrons, and bicycle and pedestrian commuters.
- *RTD Coordination.* NREL works with RTD staff on an on-going basis to encourage and support enhancement of transit routes that serve NREL. Close cooperation with RTD is essential to building ridership.

NREL's activities for FY 2011 included:

- Working with local jurisdictions to design and construct a new south entrance with roadway at Moss St. and South Golden Road, and an additional right turn lane on Denver West Parkway



Success Story | REVEGETATION

Installation of PV arrays typically requires vegetation to be removed and replaced with extensive gravel expanses, creating more heat underneath the array and removing all biological value for habitat. For the PV installation at the NWTC, NREL and SunEdison recognized this as an opportunity to evaluate revegetation approaches and develop best-management practices for re-establishing habitat, minimizing weed invasion, and preventing erosion, while also benefitting the PV company. A three-year test plot monitoring study was designed and implemented to determine whether successful revegetation could be accomplished in light of several challenges and site-specific criteria: no supplemental water, use of native or adapted species that could germinate and thrive in partial shade conditions, fast-spreading to outcompete weeds, and little residual biomass—so that any wildfires would move quickly through the area. After two years, results indicate that factors such as soil temperature, cultural treatment, and shading early in the day have a positive influence on germination and growth. In addition, warm season grasses showed greater success overall. The study design and approaches may be applicable to other DOE sites striving to re-establish habitat following installation of a PV array.

at Denver West Marriott Blvd. The new roadway will provide an alternative access route to the campus and the additional turn lane will provide additional traffic capacity at the main east entrance. These infrastructure improvements address potential traffic impacts to adjacent intersections within the community from the recent growth of the laboratory.

- Continuing construction of on-site bicycle and pedestrian supportive infrastructure (sidewalks, bike lanes, bike racks, etc.) and providing input to Jefferson County's regional bicycle and pedestrian master plan
- Working with the RTD by:
 - Attending planning sessions and coordinating with other local area businesses and local jurisdictions to provide feedback on a proposed bus and light rail service plan for the west metro area once RTD's West Corridor Light Rail line is open. This will help to ensure that NREL is connected to the extent feasible with the new light rail line when it opens in early 2013 and will support alternative commuting efforts by maintaining bus service
 - Coordinating information exchange meetings with NREL staff and RTD to alter an existing bus route to deviate from the established route to service NREL via the new south entrance roadway once constructed. This would enhance the public transit option for staff living in the Boulder area by decreasing the distance from the bus stop to NREL's STM campus
- Continuing to provide shuttle services that connect NREL staff with RTD public transit services enhancing mobility in the community by decreasing the amount of single occupant vehicle trips, especially during the peak commuter hours.

In addition, to help ease traffic concerns in the community as well as on-site, NREL addressed planned parking management, and decreased the reliance on single occupant vehicle trips and the related environmental impacts. NREL also continued its transportation program to help manage traffic, reduce GHG emissions and improve air quality. The program includes alternative commuting options, flexible work practices, and telecommuting, which are described fully in the Greenhouse Gas section.

NREL has also collaborated with and participates in DOE's Clean Cities Program. NREL provides technical and strategic support to the program, through publications, on-line tools and resources, and face-to-face meetings.

Environmental Management

Energy coordination

NREL contributes to state and regional energy goals through deployment of renewable energy systems under contracting mechanisms such as PPAs. The State of Colorado has a 30% renewable energy portfolio requirement by 2020 for investor-owned utilities. Under this requirement, Xcel Energy purchases the power and environmental attributes from several of the NWTC wind turbines

and NREL PV systems. The excess power produced from the NWTC also provides a credit to NREL's utility bill for the STM campus.

NREL is also working with the EPA and GSA Region 8 to negotiate the development of federal interagency off-site wind electricity from tribal sources. This is an ongoing effort that could play a large role in NREL's long-term goal to be a net-zero energy laboratory.

NEPA guidance

At NREL, on-site routine research and operational activities, including normal office work, have been addressed in the STM and NWTC site-wide Environmental Assessments (EA) and EA Supplements. As a result, additional environmental reviews are not required for these ongoing activities, as long as project scopes are constrained within the boundary analyses discussed in the EAs. Projects requiring the expenditure of funds, such as subcontracts, CRADAs, work for other agreements, and interagency agreements require an NREL National Environmental Policy Act (NEPA) review prior to contract award or initiation of activities. The subsequent NEPA determination will identify if the activity fits within earlier determinations in a site-wide EA or supplement, if any categorical exclusion applies, or if a more rigorous environmental analysis is required, such as an EA.

In FY 2011, NREL:

- Continued to include consideration of energy usage and alternative energy sources in NEPA reviews. A site-wide EA supplement for proposed facility expansion and infrastructure improvement was completed in November 2009 and generally addresses impacts from energy usage and alternative energy sources associated with this development
- Began an EA for proposed improvements to the RFHP. The proposed improvements include a silo for on-site storage of wood chip fuel to improve plant operational efficiency. This EA includes consideration of energy usage and alternative energy sources and will be completed in early FY 2012
- Initiated the subcontracting process for preparation of sitewide EAs for both the STM and NWTC. Both of these EAs will include consideration of energy usage and alternative energy sources. These EAs are planned to be completed in early FY 2013.

NREL has a centralized site-planning process that ensures program facilities, activities, and any future site reconfiguration are analyzed in conjunction with the laboratory's EMS, which is an integral part of the Integrated Safety Management System (ISMS), and with NEPA; these programs are incorporated into project planning and work authorization processes. Such integration affords NREL the opportunity to continually improve environmental performance in accordance with the environmental sustainability goals of EO 13514.

Ecosystem coordination

NREL has worked with Jefferson County extensively to support regional planning and environmental management. In particular, NREL has established conservation management areas at both the STM and NWTC to:

- Retain, preserve, and protect natural, scenic, ecological, and historical aspects of the property
- Protect the habitat for diverse vegetation, birds, and animals.

In the development of its sites, NREL also uses native plants wherever possible to promote regional identity and enhance wildlife habitat and biodiversity.

In 1999, NREL granted a 175-acre conservation easement on its STM site to Jefferson County to provide hiking trails and permanent conservation status for the STM site. According to NREL's Ten Year Site Plan, "no development can occur on this land, with the exception of existing utility easements; and Jefferson County Open Space has responsibility to establish and maintain formal trails on the conservation easement property."

Similar conservation management areas have been established at the NWTC to protect the site's natural resources (including wetland drainages and wooded ridge areas and a remnant xeric tallgrass prairie area), and to prevent development within critical wind corridors. Approximately 60 acres have been set aside for this purpose. In addition to environmental commitments in the 2002 Sitewide EA to protect the site's unique natural resources, protocols are also included in NREL's Natural Resource Conservation Program (6-2.21) and in a Memorandum of Understanding between the Trustee Council for Natural Resources at Rocky Flats and DOE's office of Energy Efficiency and Renewable Energy (EERE). In this agreement, the Trustee Council and EERE agree to consult and work together to preserve natural resources at the NWTC, and that EERE will manage and operate the NWTC consistent with NREL's Natural Resource Conservation Program. NREL is conscious of the impacts its site developments may have on local watersheds.

In FY 2011, NREL:

- Continued to work with Jefferson County on the design of a large stormwater-detention basin located on the STM campus that is consistent with regional urban drainage master plans and will maintain wildlife movement across the STM campus
- Worked with the Jefferson County Nature Association and Jefferson County to manage noxious weeds at both the STM campus and the NWTC campus
- Coordinated with the Fish and Wildlife Service and Boulder County Open Space on avian monitoring for its NWTC campus
- Obtained permission from the U.S. Fish and Wildlife Service and City of Boulder to conduct avian surveys on their properties for comparison to avian monitoring results from its NWTC campus
- Worked internally within a multidisciplinary team to design bird-safe glass features that will be included in the new parking garage, the ESIF, and the new cafeteria
- As part of NREL's commitment to environmental stewardship, glass bus shelters were fitted with CollidEscape®, an exterior vinyl film designed to minimize bird collisions with glass. Similarly, etched or patterned glass has been installed on the stairwells of the newly constructed parking garage to minimize bird collisions.



NREL's shuttle system provides last mile connections between major regional transit stations and the NREL campus.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Regional Transportation Planning

In FY 2012, NREL will:

- Complete construction of new South Entrance Road and an additional turn lane on Denver West Parkway at Denver West Marriott Blvd.
- Continue construction of bicycle and pedestrian supportive infrastructure (sidewalks, bike racks, etc.)
- Continue working with RTD to alter a bus route to deviate from the established route to service NREL on the new South Entrance Road once constructed
- Continue to communicate with RTD as plans for the new West Corridor Light Rail Line come to fruition to ensure that NREL is best served by the new route to the extent possible
- Continue NREL's shuttle program to connect staff with regional public transit services
- Continue ongoing participation in local and regional transportation planning processes as appropriate.

Environmental Management

Energy coordination

NREL will continue to participate in discussions for a tribal wind purchase. NREL will also complete installation of the RSF complex PV systems for which RECs will be sold to Xcel Energy to meet their renewable portfolio standard. The sale of the RECs will be used for energy efficiency retrofit projects on NREL's campus.

NEPA guidance

In FY 2012, NREL will:

- Continue to include consideration of energy usage and alternative energy sources in all future environmental impact statements and environmental assessments
- Begin site-wide EAs covering all NREL facilities and operations planned over the short and long term
- Complete an EA for the RFHP silo construction.

Ecosystem coordination

In FY 2012, NREL will:

- Continue to work with Jefferson County to coordinate watershed planning for neighboring Lena Gulch, and maintain consistency with regional urban drainage guidelines for outflow from the NREL campus
- Continue to protect wildlife movement across the STM campus, while balancing the demands of an expanding campus infrastructure. In keeping with this commitment, NREL will install a wildlife-friendly boundary fence along the southern boundary of the STM campus which will facilitate animal movement from the Mesa Top through STM to Lena Gulch south of NREL
- Continue to work with interdisciplinary groups to incorporate bird-safe design features wherever practical.

MEASURABLE GOALS

In FY 2012, NREL will:

- Complete construction of campus ingress/egress project
 - Continue NREL's shuttle program to connect staff with regional public transit services
 - Complete an EA for the RFHP silo construction
 - Install a wildlife-friendly boundary fence along the southern boundary of the STM campus
 - Work with interdisciplinary groups to incorporate bird-safe design features wherever practical.
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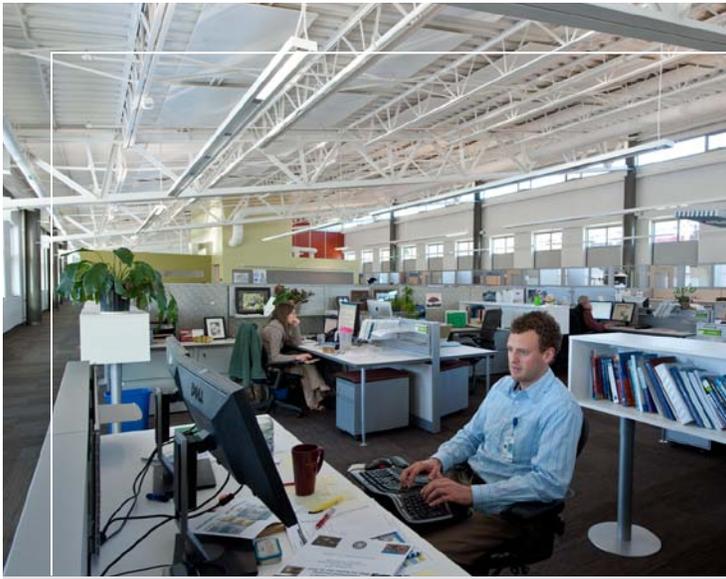
CLIMATE CHANGE

Climate change may pose a wide range of impacts including increased frequency and intensity of drought or storm events.

NREL's mission is to advance the research and deployment of renewable energy and energy efficiency technologies. Our research is one fundamental step in NREL's work to mitigate climate change by advancing low carbon energy alternatives. In FY 2011, esteemed NREL researchers also worked to spread the climate-change message to local agencies and communities by delivering talks with an aim of demystifying climate change.

NREL actively works to mitigate our climate change impacts by reducing our GHG emissions on campus through the installation of energy efficient measures and on-site renewable energy systems. NREL is now undertaking efforts to understand what adaptation strategies may be needed for our campus to operate in a changing climate. In FY 2011, NREL began participation in DOE's Climate Change Adaptation Planning Working Group. Through participation in this working group, NREL provided knowledge and input to the draft *DOE Preliminary High Level Analysis of Vulnerability to Climate Change* document to be completed in FY 2012.

Moving forward, NREL will take steps to initiate the climate change adaptation process. NREL will begin to evaluate the availability and accuracy of regional and local climate change models to develop an understanding of possible impacts to our campus associated with a changing climate. Given the uncertainties associated with climate change and the difficulty in downscaling climate change models, NREL will also begin work to craft plausible climate change scenarios, with an emphasis on identifying events which would pose challenges to daily operations and delivering our mission. Using this information, NREL intends to identify climate resiliency measures that can be incorporated into facility planning and development efforts, with an emphasis on identifying "low hanging fruit" that are good business decisions irrespective of climate change.



INNOVATION, GOVERNMENT SUPPORT, AND BEHAVIOR CHANGE

The RSF provides employees with a new type of office environment—one that is open and encourages interaction and collaboration. Surveys are being conducted to track occupants' comfort with building temperature, lighting, safety, ergonomic function, equipment performance, workstation areas, and proximity to support areas.

GOALS

Innovative ways in which research and development (R&D) technologies are being deployed at the site level to support sustainability goals

- Constructed the RSF, NREL's first net-zero energy building
- NREL Sustainability Transformation Team convened to address Scope 3 GHGs.
- NREL hosted the 24th Industry Growth Forum.
- Installed two wind turbines through CRADA partnerships
- Participated in the Katerva Challenge
- Developed the RSF Building Agent Survey
- Performed SF₆ outreach and education
- Obtained change management certification.

Government-wide support that has assisted other agencies in meeting or working towards their sustainability goals, including work for others

- Participated in the Interagency Sustainability Challenge
- Provided technical expertise to Fort Carson and DOC
- Evaluated a joint tribal wind purchase.

STRATEGY AND PERFORMANCE SUMMARY

NREL is both an epicenter for invention and innovation. As inventor, NREL is a global leader in advancing the science of renewable energy and energy-efficiency technologies. As innovator, NREL:

- Demonstrates exceptional capabilities to guide rapid deployment of these technologies for commercial marketplace applications
- Creates forums for external project opportunities
- Showcases how renewable energy and energy-efficiency technologies can perform and be utilized in the built environment by implementing them on NREL campus projects.

Through a diversity of methods, NREL continues to develop replicable processes to enrich knowledge sharing.

FY 2011 PERFORMANCE STATUS

Site Innovation

Sustainable campus projects

Campuses are complex systems, requiring vast amounts of resources, generating significant quantities of waste, managing building renovation, new building construction and a complex utility infrastructure bearing large financial risks and investments. Pushing a strategic energy agenda is a fundamental key to balancing the impact of NREL's energy usage with corresponding benefits to society as a whole. Over the past decade, NREL has reduced energy intensity in buildings, increased use of renewable energy, and increased the use of AFVs. While our past actions have produced reduction achievements, NREL recognizes a more aggressive plan is required to address our growth that will meet future federal mandate reduction goals. Thus, NREL is developing a rigorous comprehensive energy management plan to integrate supply, demand, operations, campus outreach, implementation, and financing opportunities to ensure campus energy use is as efficient as possible.

NREL is more than a decade ahead of the 2030 DOE mission directive in producing a net-zero energy building. By April 2012, the RSF will be the first net-zero energy building on our STM campus. Vital

to achieving large reductions in energy intensity was the installation of a high-efficiency PV system for the RSF complex. To become a net-zero energy building, 2.65 MW of PV is being installed on the rooftops of RSF I, RSF II, nearby employee parking garage, and the adjacent visitor's surface lot through PPA and American Recovery and Reinvestment Act (ARRA) funding mechanisms.

The construction of RSF I and II provide the opportunity to transfer NREL-developed energy efficient technologies from invention to installation. Two of these technologies include:

- Electrochromatic windows to reduce solar heat gain while providing daylighting and views to building occupants
- Transpired solar collectors for the passive heating system.

The RSF II, completed in November 2011, was modeled after the design of RSF I and is anticipated to be 60% more energy efficient than the ASHRAE baseline building performance. After modeling the performance of RSF I, opportunities were identified to increase its energy efficiency by an additional 17%. These improvements included the installation of more energy efficient commercial window frames, larger ratio surface areas receiving transpired solar collectors, displacement ventilation in conference rooms, daylighting controls in day-lit stairwells, and natural passive cooling in stairwells.

Addressing Scope 3 GHGs

In May 2011, NREL's Sustainability Transformation Team convened a meeting of in-house technical experts to focus on Scope 3 GHG transportation issues as this was identified as NREL's biggest challenge in FY 2010. Discussion of short-term and long-term strategies produced a multi-action plan. Efforts in the reduction of air travel and increase in telecommuting has achieved positive results for FY 2011. The team is currently exploring ideas for alternative modes of transportation vehicles on campus for employee and fleet commuting on-site to align with the development of our campus infrastructure plan.

Expanding clean energy

In FY 2011, NREL's efforts to expand clean energy grew:

- In November 2011, NREL hosted the 24th Industry Growth Forum which attracted more than 500 investors, entrepreneurs, scientists, and policymakers. The Industry Growth Forum is the premier event for clean-energy startups to maximize their exposure to receptive venture capital, corporate investors, and strategic partners. The Industry Growth Forum features presentations from 30 emerging clean energy companies; provocative panels led by thought leaders; one-on-one meetings; and organized networking opportunities. It is the perfect venue for growing companies to prepare, refine, and present their businesses to a wide range of investors. The best presenters were awarded cash prizes and commercialization services from NREL. Since 2003, the presenting prototype, precommercial, and expanding cleantech companies who have presented have collectively raised nearly \$4 billion in growth financing.



Success Story | EARTH WEEK

Earth Week was a great success at NREL, with 15 different events:

- More than 150 NREL and DOE employees attended the Earth Week kick-off event.
- The 30 yards of compost donated by A1 Organics for staff was gone in two days.
- Allegra coffee donated 600 burlap bags for the compost collection.
- 4,832 lbs of electronics were collected for recycling from NREL and DOE staff.
- 5,600 lbs of employee documents were shredded.
- 2,215 books and journals were collected for the Global Education Fund book drive, which will be used for programs in Guatemala, Kenya, and India.
- More than 170 people came to the Visitors Center Open House.

- In support of NREL's goal to maximize on-site renewable energy generation, two wind turbines were installed at the NWTC site: a 3 MW Alstom and a 2 MW Gamesa. Both turbines are research projects produced through CRADAs. When the turbines are running, the energy that they produce is used to offset simultaneous NWTC site electricity consumption.
- NREL participated as scientific experts to review three market-revolutionizing energy production, storage, and delivery innovations for the Katerva Challenge. Katerva is a UK-registered charity organization, which serves to identify, award, and accelerate ingenious ideas toward impact at a global level.

Behavior Change

In FY 2011, NREL initiated several behavior-change efforts to better understand building comfort, change management techniques, and discover SF₆ reduction opportunities:

- Within a building's first year of operations, NREL tracks operating data to assess whether the building is performing better than the modeled expectation. Through this effort, NREL establishes a "living laboratory" environment where efforts are also made to understand building occupants' comfort level with the deployed energy-efficiency technologies and function of the building's environs. Through NREL's investigation of the energy design of high-performance, innovative building features, NREL found that 30% of building performance is related to occupant behavior. In FY 2011, Sustainable NREL and the Commercial Buildings Group jointly developed a one-time baseline survey to assess the real-time comfort feedback and preferences of building occupants that will be deployed in FY 2012. The following phase is part of a Laboratory Directed Research and Development (LDRD) project titled the Building Agent, which aims to further engage occupants in building performance. Volunteers will be selected to place small sensors on their workstations that will measure light, temperature, and humidity.
- Constructing new building environments, authorizing new policies to uphold federal mandates, and creating new methods to deploy energy efficient and renewable technologies requires the integration of a change management process for project introduction and success. Two members of the Sustainable NREL team regarded this skill as an effective project tool and received change management certification from Prosci in FY 2011. This change management process offers a sequence of steps or activities that a change management team or project leader would follow to apply change management to a project or change. This process contains the following three phases:
 - *Phase 1* – Preparing for change (Preparation, assessment and strategy development)
 - *Phase 2* – Managing change (Detailed planning and change management implementation)
 - *Phase 3* – Reinforcing change (Data gathering, corrective action and recognition).

As Sustainable NREL addresses change and introduces new projects for sustainability efforts, we will be integrating these measures for project successes.

- NREL researchers use small amounts of SF₆ in transmission electron microscopes for laboratory research and as a tracer gas for building and fume hood commissioning. In FY 2011, Sustainable NREL and the EHS Office jointly conducted outreach and education to inform the lab's researchers that this chemical was a significant contributor to GHG emissions and warranted replacement. Investigation is being conducted to produce a suitable replacement.

Government-wide Support

NREL also provides support and expertise throughout the federal government to further adoption of energy efficiency, renewable energy and sustainability practices:

- Department of Defense's (DOD) U.S. Northern Command (USNORTHCOM) has partnered with the NREL to assess opportunities for increasing energy security through renewable energy and energy efficiency at Front Range installations. On the basis of the installation's strong history of energy advocacy and extensive track record of successful energy projects, USNORTHCOM selected Fort Carson to serve as the prototype installation for net-zero energy assessment and planning. NREL performed a comprehensive assessment to appraise the potential of Fort Carson to achieve net-zero energy status through energy efficiency, renewable energy, and electric vehicle integration.
- In FY 2011, NREL also aided the Department of Commerce (DOC) in developing a Strategic Sustainability Performance Plan (SSPP) guidance document in accordance with EO 13514. The SSPP guidance document is intended to help each bureau manage and track DOC's SSPP goals.
- In FY 2011, GSA Region 8, DOE, NREL, the city of Lakewood, and the U.S. EPA Region 8 formed a partnership to increase conservation awareness, save natural resources, and reduce GHG emissions. The team created a Sustainability Challenge, which engaged several hundred employees resulting in pledged reductions of 1,079,000 pounds of carbon dioxide—the equivalent of taking 85 cars off the road or planting 12,519 trees. The partnership hosted more than 40 events with a broad range of sustainability topics to educate staff and local communities. The Sustainability Challenge concluded with an Earth Week celebration.
- NREL is working with EPA and GSA Region 8 to negotiate a federal interagency of off-site wind electricity from tribal sources. This is an ongoing effort that could play a large role in NREL's long-term goal to be a net-zero energy laboratory.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Long-term Sustainability Goals

NREL is working to enhance our Energy Dashboard system to provide additional analysis tools and reporting options. These enhanced capabilities will help to simplify direct monitoring of NREL's energy consumption and reporting for development of our SSP, PPTRS, CEDR,

GHG inventory, and other DOE data requests. To help NREL uphold DOE's mission for energy efficiency and renewable energy, enhanced energy enterprise management capabilities will also:

- Demonstrate measured facility energy performance
- Support the analysis of GHG reduction and energy efficiency opportunities
- Calculate REC purchase quantities and return on investment for energy improvements
- Provide educational support and outreach.

These efforts will also identify effective prioritization of capital projects, dovetail with long-term sustainability goals, and provide a blueprint to forecast budget requirements.

Funding Strategies

NREL will continue to be resourceful for the planning and acquisition of funding for projects implementing the executive order, aligning with Sustainable NREL program initiatives and achieving NREL's mission. Mechanisms such as PPAs and Energy Services Companies (ESCOs) have been utilized on prior renewable energy projects and will be reviewed for future project opportunities. New CRADA partnerships will be pursued and could include the combination of appropriated funds with industry private funding. Sustainable NREL will also collaborate with the Commercial Buildings, Integrated Applications, and Site Operations Groups to strategize the use of overhead funds, cost savings reinvestment, and leverage alternative financing for future on-site renewable-energy installations and energy-efficiency improvements.

Behavior Change

A training manual was developed for RSF I building occupants to increase awareness and encourage behavior change for interacting with the various energy efficiency systems for the building and workstations. Occupation of the RSF II began in December 2011 and will be complete by the end of February 2012. New building occupants will also be provided with the same type of manual and webinar trainings for building features orientation.

MEASURABLE GOALS

In FY 2012, NREL will:

- Deploy the Building Agent comfort survey and install small sensors to measure light, temperature, and humidity on workstations of selected building occupant workstations
 - Conduct training for new RSF II building occupants for energy efficient technologies
 - Develop and enhance the NREL Energy Dashboard
 - Continue government-wide collaboration with other federal agencies for sustainability education and joint project opportunities.
-



Success Story | ENERGY EXECs PROGRAM

NREL works to promote positive change in the environment and community by leveraging our leading edge research and innovation. Transferring NREL's innovations to the market place, is integral to the lab's mission—addressing our nation's environmental and energy needs and improving the economy in the process.

In the photo above, Energy Execs—participants in NREL's Executive Energy Leadership Academy tour NREL facilities and learn about sustainable, clean-energy technologies and how they can guide their organizations in energy-related decisions and planning.

According to a soon-to-be released analysis by the University of Colorado, the presence of NREL in Colorado provides a \$714 million annual boost to the state's economy—more than three times what it was just three years ago. "NREL has had a positive, dynamic impact on Colorado's economy," said Dwayne Romero, Executive Director of the Colorado Office of Economic Development. "In addition to more than tripling the economic impact to the state in the last three years, NREL has created almost 1,400 new jobs in Colorado and helped people get back to work. Colorado's renewable energy industry is one of our key business sectors, and it is well-positioned for future growth because of the continuing success of NREL."



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