

SITE SUSTAINABILITY PLAN FY 2015

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Sustainable NREL

SITE SUSTAINABILITY PLAN FY 2015

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Members of NREL's Energy Executives class learn about wind turbines as they tour the NWTC.

Cover photo: Members of NREL's Energy Executives class tour the High-Flux Solar Furnace at NREL's SRRL on the STM campus.





Nomenclature

AFV	Alternative Fuel Vehicles	FEMP	Federal Energy Management Program	MTCO₂e	Metric Ton Carbon Dioxide Equivalent
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers	FGC	Federal Green Challenge	MW	Megawatt
AWS	Alternative Work Schedules	FIMS	Facilities Information Management System	MWh	Megawatt-hour
BOA	Basic Ordering Agreement	ft²	Square Feet	NEPA	National Environmental Policy Act
Btu	British Thermal Unit	FTLB	Field Test Laboratory Building	NREL	National Renewable Energy Laboratory
CEDR	Consolidated Energy Data Report	FY	Fiscal Year	NWTC	National Wind Technology Center
cf	Cubic Feet	GFO	U.S. Department of Energy's Golden Field Office	OCIO	Office of the Chief Information Officer
CDOT	Colorado Department of Transportation	GHG	Greenhouse Gas	OSHA	Occupational Safety and Health Administration
CEQ	White House Council on Environmental Quality	GP	Guiding Principles for High Performance Sustainable Buildings	OTF	Outdoor Test Facility
CNG	Compressed National Gas	GPE	General Property Equipment	PPA	Power Purchase Agreement
CRADA	Cooperative Research and Development Agreement	GPMP	General Property Maintenance and Repair	PV	Photovoltaics
CRWG	Colorado Resiliency Working Group	GPP	General Plan Projects	PUE	Power Usage Effectiveness
Dashboard	U.S. Department of Energy's Sustainability Dashboard	GSA	General Services Administration	REC	Renewable Energy Certificate
DOE	U.S. Department of Energy	GSF	Gross Square Feet	RFHP	Renewable Fuel Heat Plant
DRCOG	Denver Regional Council of Governments	HEMSF	High-Energy Mission-Specific Facilities	RFID	Radio Frequency Identification
ECM	Energy Conservation Measure	HPC	High Performance Computing Data Center	RSF	Research Support Facility
EERE	Office of Energy Efficiency and Renewable Energy	HVAC	Heating, Ventilation, and Air-Conditioning Systems	RTD	Regional Transportation District
EFCOG	Energy Facility Contractors Group	IBRF	Integrated Biorefinery Research Facility	S&TF	Science and Technology Facility
EISA	Energy Independence and Security Act	ILA	Industrial, Landscaping, and Agricultural	SERF	Solar Energy Research Facility
EMS	Environmental Management System	ISMS	Integrated Safety Management System	SF₆	Sulfur Hexafluoride
EnMS	Energy Management System	ISO	International Organization for Standardization	SNREL	Sustainable NREL Team
EO	Executive Order from the President of the United States	kBtu	Thousand British Thermal Units	SPO	Sustainability Performance Office
EPEAT	Electronic Product Environmental Assessment Tool	kW	Kilowatt	SRRL	Solar Radiation Research Laboratory
EPP	Environmentally Preferable Products	kWh	Kilowatt-hour	SSEB	South Site Entrance Building
ESIF	Energy Systems Integration Facility	LCD	Liquid Crystal Display	SSPP	Strategic Sustainability Performance Plan
ESPC	Energy Savings Performance Contracts	LED	Light-Emitting Diode	STM	South Table Mountain Campus
FAA	Federal Aviation Administration	LEED	Leadership in Energy and Environmental Design	T&D	Transmission and Distribution
FAST	Federal Automotive Statistical Tool	MFD	Multifunctional Devices	TeAM	Technology Acceleration to Market
		MMBtu	Million British Thermal Units	TTF	Thermal Test Facility
				UESC	Utility Energy Service Contracts
				Western	Western Area Power Administration



NREL Director Dan Arvizu, meets with Colorado Governor John Hickenlooper at the Energy Systems Integration Facility (ESIF) at NREL.

Executive Summary

VISION STATEMENT

As the nation's only federal laboratory dedicated to the research, development, commercialization, and deployment of renewable energy and energy efficiency, the National Renewable Energy Laboratory (NREL) takes sustainability seriously. NREL fulfills the laboratory's mission to advance the science and technologies needed for energy security and economic prosperity in the nation, but also develops an approach to a climate of sustainability modeled on the laboratory campus.

NREL continues to excel in promoting sustainable laboratory operations and maintaining a dedicated team of professionals who manage energy and sustainability performance: Sustainable NREL (SNREL). With dedicated, stable funding, SNREL takes an integrated management approach, using engineering, administrative controls, and behavior change to facilitate sustainability across the laboratory as a whole.

SNREL is responsible for upholding all executive orders (EO), federal regulations, U.S. Department of Energy (DOE) orders, and goals related to sustainable and resilient facility operations. But under the leadership of Dan Arvizu NREL continues to expand sustainable practices above and beyond regulations and requirements of the laboratory—working to ensure that the laboratory can fulfill its mission into the future, with the smallest legacy footprint and to model sustainable operations and behaviors on national, regional, and local levels.

At a national level, NREL acts as one of DOE's environmental stewards in finding ways to meet sustainability goals through energy assessments, analysis, project guidance, and related activities by supporting these and other federal agencies:

- U.S. Department of Commerce
- U.S. Department of the Interior
- U.S. Department of Homeland Security
- General Services Administration
- U.S. Department of State
- National Science Foundation
- U.S. Department of Defense
- U.S. Department of the Treasury.

The Consolidated Utility Base Energy system in the Power Systems Integration Laboratory is an integrated power electronic platform for a 60 kilowatt (kW) PV-battery-diesel hybrid power system developed for the U.S. Army Mobile Electric Power to provide power to Forward Operating Bases. The onboard power electronics include PV maximum power point tracking converters, battery charge/discharge converters, and a three-phase inverter capable of smoothly transitioning between operation as a stand-alone voltage source and operation in parallel with the diesel generators or a utility grid connection.



On a regional level, NREL works with stakeholders—including the local transportation district, the county, and local organizations and businesses—to encourage them in their own sustainable planning practices and also to ensure that NREL has the resources it needs to fulfill its mission as climate changes occur. On a local level, NREL’s approach to sustainability is reflected in behavior changes adopted by employees, both at work and at home. Behavior changes such as recycling, waste reduction, and changes in commuting habits reflect DOE goals for sustainable behavior in employees and the wider community as outlined in DOE’s Strategic Sustainability Performance Plan.

Fostering changes on campus and beyond, NREL works to include sustainability and climate resilience as guiding principles in all of its work and decision making.

PLANNING SYNOPSIS

Since 2008, the baseline year used for the greenhouse gas (GHG) reduction goal, NREL has seen a substantial expansion in both population and square footage on its campus—a 95%

increase in population and a 147% increase in campus footprint. This growth has allowed NREL to move its mission forward; it has also required innovation and creative thinking to overcome the resulting challenges to meeting sustainability goals on campus.

Sustainability planning efforts in FY 2014 encompassed all sustainability goal areas, including:

- Continued execution of the Campus Master Plan, which includes established policies that promote sustainable design, operations, and maintenance practices
- Development of a *Scope 3 Greenhouse Gas Reduction Plan*, which will be finalized and implemented in FY 2015
- Continued work on a Strategic Energy Management Plan, to be finalized in FY 2015
- Stakeholder planning efforts with the Regional Transportation District (RTD), Jefferson County, and other regional partners to improve local land use decisions and transportation facilities that support sustainability

- Updates to the Fleet Management Plan
- Updates to a Water Management Plan, to be finalized in FY 2015
- Implementation of a Landscape Maintenance Plan, which was developed as part of the Sustainable SITES program
- Creation of an On-Site Renewables Master Plan
- Development of a Climate Resilience Plan, initiated in FY 2014, to be finalized in FY 2015.

These planning efforts continue to reveal the technologies, design ideas, behavior changes, and outreach goals that help NREL meet its sustainability goals—and that makes it a “living laboratory” for sustainable operations.

SUCCESSES AND CHALLENGES

In FY 2014, NREL’s sustainability success stories include the Renewable Fuel Heat Plant (RFHP), the Research Support Facility (RSF), and the Energy Systems Integration Facility (ESIF). High performance in all three of these showcase buildings supported a number of NREL’s sustainability goals.

- **RFHP:** The RFHP is a wood-fired combustion boiler that converts forest thinning and wood fuel to heat the laboratory's buildings. In FY 2014, the RFHP used reclaimed wood—including 1,700 tons of salvaged timber from a tragic forest fire nearby—to displace 45% of district heating on the South Table Mountain (STM) campus. The displaced natural gas reduced NREL's Scope 1 GHG emissions by 20%. The facility also won an award of recognition from the Biomass Thermal Energy Council.
- **RSF:** The U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) Platinum-rated RSF met its goals for operating one full year at net-zero energy from April 2013 through April 2014. Since then, overpopulation of the building has constrained operations. NREL is evaluating options to overcome this challenge and return to net-zero operations.
- **ESIF:** The LEED Platinum-rated ESIF—which houses research to improve the interconnection of distributed energy systems and clean energy technologies into the electricity grid—began operations in FY 2013. In its first year of operation as a new user facility, the ESIF executed third-party contracts with 46 non-NREL organizations (including 28 industry partners, 8 universities, 4 utilities, 4 laboratories, and 2 government agencies). These partnerships involved a variety of projects, including research on fuel cells, renewable energy, grid integration, hydrogen sensors, inverters, catalysts, electrodes, and other topics.

FY 2014 also saw a focus on climate resilience. NREL launched its climate resilience planning—financially supported by the DOE Sustainability Performance Office (SPO)—which will result in a

process that can be replicated and used at other DOE sites. Already, NREL has been providing technical assistance for projects reducing the impact of building resilience to climate change, such as those stemming from the Greensburg, Kansas, tornado; floods in Galena, Arkansas, and Colorado; and hurricanes in New Orleans, Louisiana, New York, and New Jersey. NREL's disaster recovery experts have been advisors for reducing GHG and improving resistance and resiliency. Post-disaster, NREL has worked with communities to identify disaster recovery and rebuilding opportunities.

On a regional level, NREL supports two climate resilience working groups. The Colorado pilot project, established by the White House's State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, is bringing together federal agencies and local communities to assess and plan for region-specific vulnerabilities and interdependencies associated with climate change. The Colorado Resilience Working Group, a group working to improve climate resilience throughout the state, was organized in response to recent flooding and catastrophic damage to many Colorado communities.

Looking into the future, NREL faces some challenges to meeting sustainability goals. In addition to the unpredictability of climate change, two challenges emerged in FY 2014:

- **Expected increases in energy use in NREL's new LEED Platinum-rated ESIF, which houses the High Performance Computing Data Center (HPC).** The ESIF currently uses 27% of total electricity at NREL, and energy use is projected to increase by nearly 500 kW per year until reaching maximum capacity for the facility's current infrastructure, at 10 MW.

- **Increasing building occupancy.** As population grows within the laboratory, crowded buildings tax the design performance goals of campus facilities. NREL's new high-performance facilities were not designed to meet sustainability goals with over-intended occupancy levels. NREL continues to explore options to improve the energy efficiency of its facilities and methods to reduce electricity consumption across the lab to continue to meet these goals despite population growth.

FUNDING

NREL implements sustainability in all aspects of laboratory operations and research activities. Lab-level policy and program decision making regarding sustainable operations is the responsibility of SNREL. The SNREL team consists of the Chief Sustainability Office, six staff, and two subcontractors. SNREL oversees all of NREL's energy-efficiency projects; fosters the use of renewable energy; and manages NREL's utility budget, sustainability performance tracking and compliance efforts, employee public transit, commuting, and alternative work options. The team also coordinates NREL's sustainable acquisition programs and waste streams management and reduction programs. To support the activities of SNREL, the team has a set annual budget that is direct funded.

NREL also leverages third-party funding mechanisms for sustainability projects. NREL pioneered the first power purchase agreement (PPA) in DOE for one of the laboratory's photovoltaic (PV) arrays; the laboratory currently has five PPAs for PV systems, with a total capacity of 2.35 MW. In addition, an energy savings performance contract (ESPC) was used to finance the wood-chip powered RFHP, which provides almost half of the district heat on the STM.

NREL is currently investigating another ESPC project and has received approval for conceptual design, level zero, to submit for third-party funding of a new Technology Education and Meeting Facility.

In addition, NREL leverages the sale of renewable energy credits from its PV arrays on the RSF—using the funding it receives to invest in new renewable energy and energy-efficiency projects. In FY 2014, NREL used that funding source to retrocommission NREL's Science and Technology Facility (S&TF), DOE's first LEED Platinum facility.

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/or systems to attain the goal.
- **Management risks:** Management systems and/or policies may require changes for which approval authority is outside the sustainability program or requires an internal DOE policy or procedural change.
- **Financial risks:** Funds are/are not identified in current or out-year target to achieve the goal.

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

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



Aerial view of NREL's SRRL and a 720 kW PV array on the mesa top on the STM.

SUMMARY TABLE OF GOALS AND TARGETS

SSPP Goal	DOE Goal	Performance Status through FY 2014 (Baseline, status, performance)	Planned Actions & Contribution (Main planned actions and projected contribution towards goals)	Risk of Nonattainment High (H) Medium (M) Low (L)
Goal 1: Greenhouse Gas Reduction				
1.1	28% Scope 1 and 2 GHG reduction by FY 2020 from a FY 2008 baseline (2014 target: 19% reduction)	Scope 1 and 2 emissions increased 17% from the 2008 baseline without RECs and decreased 84% including RECs.	Continue to optimize RFHP performance to reduce STM campus natural gas needs. Explore opportunities to more accurately report on refrigerants used and recycled at NREL. Continue to explore on-site renewable energy opportunities and as need be purchase RECs to offset emissions.	L – NREL will continue to meet or exceed this goal.
1.2	13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline (2014 target: 5% reduction)	Scope 3 emissions increased 8% from the 2008 baseline without RECs and decreased 14% including RECs.	Finalize <i>Scope 3 Greenhouse Gas Reduction Plan</i> to identify the best methods of Scope 3 emissions reduction. Continue to purchase RECs to offset T&D loss.	L – The absolute reduction from the 2008 baseline goal will be challenging due to population growth. However, with continued efforts to reduce commute and travel emissions NREL will likely meet this goal.
Goal 2: Sustainable Buildings				
2.1	30% energy intensity (Btu per gross square foot) reduction by FY 2015 from a FY 2003 baseline (2014 target: 27% reduction)	Energy intensity reduced 54% from the 2003 baseline.	Finalize the <i>Strategic Energy Management Plan</i>	L – NREL will continue to meet or exceed this goal.
2.2	EISA Section 432 energy and water evaluations	Conducted EISA evaluations for 2% of total site energy use in FY 2014 and audited nearly 92% of covered facilities to date.	Perform EISA audits for three additional facilities. Benchmark buildings in EPA's Portfolio Manager as required.	L – By 2015, NREL will have assessed more than 95% of the site energy use.
2.3	Individual buildings metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015) (2014 target: 90% and 75%, respectively) ¹	100% of NREL's buildings have energy meters (including electricity, natural gas, and renewables where appropriate). 100% of NREL's buildings have chilled water meters. 100% of NREL's buildings have hot water meters (NREL uses no steam).	Continue to pursue ISO 50001 certification. Continue initiative to create an energy information system.	L – In FY 2014 NREL is in full compliance.
2.4	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.	Cool roofs comprise 69% of NREL's roof areas.	Replace Shipping and Receiving and the IBRF roofs with new cool roofs (at least R-30 insulation).	L – NREL will continue to comply with this requirement.
2.5	15% of existing buildings greater than 5,000 gross square feet (GSF) are compliant with the Guiding Principles (GPs) of HPSB by FY 2015 (2014 target: 13% compliant)	Four buildings (18%) are 100% compliant with the GPs. Performed GP assessments on three additional buildings in FY 2014 and assessed 95% of buildings greater than 5,000 GSF to date.	Develop cost estimates for all assessed buildings to achieve GP compliance. Complete one additional GP assessment on the fully leased Washington, D.C. office building.	L – NREL will meet or exceed this requirement.

¹ Per NECPA (42 U.S.C Section 8253) the term "buildings" includes industrial, process, or laboratory facilities

SUMMARY TABLE OF GOALS AND TARGETS

SSPP Goal	DOE Goal	Performance Status through FY 2014 (Baseline, status, performance)	Planned Actions & Contribution (Main planned actions and projected contribution towards goals)	Risk of Nonattainment High (H) Medium (M) Low (L)
2.6	All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs. ²	All new construction at NREL is required to comply with GPs.	Develop CD-1 documents and investigate alternative financing for the Technology Acceleration to Market (TeAM) facility. Incorporate GP requirements into planning documents for new TeAM facility.	L – NREL will continue to meet this requirement.
2.7	Efforts to increase regional and local planning coordination and involvement	Coordinated with Denver Regional Council of Government's WayToGo program to promote commuter options. Participated in Colorado Recovery Office Statewide Resilience Working Group. Supported CEQ's Colorado Preparedness Pilot Project. Initiated the STM site-wide environmental assessment and finalized the National Wind Technology Center (NWTC) site-wide environmental assessment. Worked with Jefferson County Planning and Zoning to improve drainage swale on the STM campus.	Continue advocacy efforts and construction of bicycle and pedestrian supportive infrastructure. Continue advocacy efforts for enhanced transportation options with regional transportation providers. Continue participation in the Colorado Resilience Working Group and infrastructure subcommittee to develop a statewide resilience plan. Continue supporting the CEQ's Colorado Preparedness Pilot project. Continue to coordinate weed control efforts with adjacent land managers.	L – NREL will continue to meet this requirement.
GOAL 3: Fleet Management				
3.1	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline (2014 target: 136% cumulative increase since 2005)	Increased alternative fuel use 48% from the FY 2005 baseline.	Continue use and maintenance of the E-85 fueling station on the STM campus.	M – Management Risk: Decreased use of fleet vehicles continues to reduce overall E-85 fuel use.
3.2	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline (2014 target: 18% cumulative reduction since 2005)	Increased petroleum fuel use 63% from the FY 2005 baseline.	Investigate the feasibility of replacing shuttle vehicles (diesel mini-buses) with an alternative fuel vehicle (AFV).	M – Management Risk: Disposition of low-mileage AFVs to meet the secretary's vehicle reduction goal and increased use of the diesel buses have increased overall petroleum use.
3.3	100% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2015 and thereafter (75% FY 2000–2015)	No light duty vehicles were purchased in FY 2014.	Continue to acquire GSA-leased replacement vehicles with AFVs, if available and as required.	L – NREL will continue to work with GSA and DOE to purchase alternative fuel vehicles for the fleet whenever possible.

² DOE considers buildings meeting the following criteria as complying with GPs: Any building that achieves LEED-EB silver or higher or LEED-NC gold or higher; Any building that achieves a Green Globes-NC rating of four or a Green Globes CIEB rating of three; Any building that has been occupied for more than one year that achieves Living Status designation by the Living Building Challenge (although included as policy in the 2012 SSPP, these equivalencies are contingent upon OMB and CEQ approval).

SUMMARY TABLE OF GOALS AND TARGETS

SSPP Goal	DOE Goal	Performance Status through FY 2014 (Baseline, status, performance)	Planned Actions & Contribution (Main planned actions and projected contribution towards goals)	Risk of Nonattainment High (H) Medium (M) Low (L)
GOAL 4: Water Use Efficiency and Management				
4.1	26% potable water intensity (Gal per gross square foot) reduction by FY 2020 from a FY 2007 baseline (2014 target: 14% reduction)	Reduced potable water intensity 43% from the 2007 baseline.	Correct piping issues limiting use of ESIF High Performance Computer waste heat. Finalize <i>Water Management Plan</i> document for both the STM and NWTC campuses. Use information on water fixtures to identify areas to reduce water consumption across the laboratory	L – NREL will need to monitor the water usage from ESIF HPC, but is on track to meet or exceed this goal.
4.2	20% water consumption (Gal) reduction of industrial, landscaping, and agricultural (ILA) water by FY 2020 from a FY 2010 baseline (2014 target: 8% reduction)	NREL does not use ILA water.	N/A	L – Unless reuse water becomes available, NREL will not consume ILA water.
GOAL 5: Pollution Prevention and Waste Reduction				
5.1	Divert at least 50% of nonhazardous solid waste, excluding construction and demolition debris, by FY 2015	Diverted 75% of campus waste from landfill in FY 2014.	Identify and implement projects to increase waste diversion. Conduct on-site waste audits to analyze the waste stream and identify opportunities for additional reductions. Work toward deployment of locked-printing campus-wide.	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 87% of construction waste from landfill in FY 2014.	Continue to track data and enforce subcontractor statement of work requirements for all construction projects.	L – NREL will continue to meet or exceed this requirement.
GOAL 6: Sustainable Acquisition				
6.1	Procurements meet requirements by including necessary provisions and clauses in 95% of applicable contracts	Met sustainable acquisitions requirements in 100% of construction contracts. Met sustainable acquisitions requirements in 100% of custodial contracts.	Continue to update business systems reporting to improve data accuracy around green purchases. Maintain training for PCard purchasers on definitions of environmentally preferable products (EPPs).	L – NREL will continue to meet or exceed this requirement.

SUMMARY TABLE OF GOALS AND TARGETS

SSPP Goal	DOE Goal	Performance Status through FY 2014 (Baseline, status, performance)	Planned Actions & Contribution (Main planned actions and projected contribution towards goals)	Risk of Nonattainment High (H) Medium (M) Low (L)
GOAL 7: Electronic Stewardship and Data Centers				
7.1	All core data centers are metered to measure a monthly Power Usage Effectiveness (PUE) of 100% by FY 2015 (2014 target: 90% metered)	The RSF core data center, as well as the ESIF non-core data center, are both fully metered to monitor monthly PUE.	Continue monthly monitoring.	L – NREL will continue to meet this requirement.
7.2	Core data centers maximum annual weighted average PUE of 1.4 by FY 2015 (2014 target: 1.5 PUE)	Averaged 1.18 PUE for the RSF core data center in FY 2014.	Continue to strive to meet or exceed world-class PUE (less than 1.2).	L – NREL will continue to meet or exceed this requirement.
7.3	Power management – 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012	Enabled power management on 100% of eligible devices. Some devices are exempt for research, security, or information technology purposes.	Continue study on power management practices throughout the laboratory.	L – NREL will continue to meet this requirement and continue to assess power management status after deployment of devices.
7.4	Electronic Stewardship – 95% of eligible electronics acquisitions meet electronic product environmental assessment tool (EPEAT) standards	Met EPEAT standards with 99% of eligible computers and monitors purchased. Met EPEAT standards in 97% of eligible electronics acquisitions.	Establish standards for televisions and revise those for imaging equipment to bring them into EPEAT compliance. Increase NREL's overall percentage of eligible, EPEAT-compliant purchases to above 97%.	L – NREL will continue to meet this requirement.
GOAL 8: Renewable Energy				
8.1	20% of annual electricity consumption from renewable sources by FY 2020 (2014 target: 7.5% consumption)	Generated 20% of total electricity on-site in FY 2014.	Exceed the 20% on-site electricity generation by 2020 goal. Explore options to increase renewable energy use specifically biomethane and off-site wind. Investigate installation and cost structure of a PPA with third party for multiple PV arrays and seek approval by Xcel.	L – NREL will continue to meet or exceed this requirement.
Goal 9: Climate Change Resilience				
9.1	Address DOE Climate Change Adaptation Plan goals	Initiated climate resiliency planning in the spring of FY 2014. Emphasis has been placed on identifying resiliency options that cut across NREL's operations and program areas, to create climate change resiliency strategies that reduce potential impacts, increase efficiency, and mitigate vulnerabilities. The project is intended to establish a framework to continually review and update the impacts and risk determinations as needed. The information collected will be used to enhance ongoing and existing planning and preparedness efforts at the laboratory.		
Goal 10: Energy Performance Contracts				
10.1	Utilization of Energy Performance Contracts	Pursued alternative financing mechanisms such as PPAs and ESPCs to the extent possible. To date, NREL has initiated one ESPC project for the campus RFHP and has installed 2.35 MW of PV using PPAs. In FY 2015 NREL will continue to investigate alternative financing to fund energy and water conservation projects.		

Greenhouse Gas Reduction

Goals:

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

- Scope 1 and 2 emissions increased 17% from the 2008 baseline without RECs and decreased 84% including RECs.

(1.2) 13% Scope 3 GHG reduction by FY 2020 from a FY 2008 baseline

- Scope 3 emissions increased 8% from the 2008 baseline without RECs and decreased 14% including RECs.

NREL's Scope 3 greenhouse gas reduction strategy involves a three tiered approach that enables and encourages NREL staff to avoid trips where possible, shift trips to cleaner modes where feasible, and improve remaining trips with lower emitting technologies.



Greenhouse Gas Reduction

STRATEGY AND PERFORMANCE SUMMARY

The National Renewable Energy Laboratory (NREL) has been tracking and reporting campus greenhouse gas (GHG) emissions for more than 10 years. The laboratory's goal is to demonstrate leadership in GHG management by maximizing the use of energy efficiency practices and on-site renewable power while minimizing impacts associated with all aspects of operations.

NREL continuously pursues new technologies and strategies to reduce GHGs associated with operations. For Scope 2 emissions that cannot be avoided and mitigated with on-site renewables, NREL is committed to purchasing renewable energy certificates (RECs) to offset the climate change impacts.

NREL's operational boundaries include all U.S. Department of Energy (DOE)-owned facilities, vehicle fleet, equipment, and non-highway vehicles on both the South Table Mountain campus (STM) and at the National Wind Technology Center (NWTC). NREL has partial lease agreements for office space in the Denver West office park, Joyce Street, and the Refuel Facility, which are not under NREL's operational control; however, some electricity and natural gas data for these properties are included in NREL's GHG emissions. Also included are Scope 3 emissions for sources outside NREL's organizational boundaries that are a result of its operations.

FY 2014 PERFORMANCE STATUS

Scope 1

In FY 2014, NREL's Scope 1 emission sources include:

- Stationary emissions: natural gas for heating facilities
- Mobile emissions: vehicle fleet, equipment, diesel generators, and non-highway vehicles
- Fugitive emissions: fluorinated gases for research, refrigerants for heating, ventilation, and air conditioning (HVAC) systems and on-site septic systems at the NWTC and NREL's Solar Radiation Research Laboratory (SRRL)
- Process emissions: dry ice for laboratory research.

Stationary Emissions

More than 63% of NREL's Scope 1 emissions are caused by stationary combustion. These emissions are primarily due to natural gas use for the generation of heat and hot water. Operation of NREL's on-site Renewable Fuel Heat Plant (RFHP) continued to improve, decreasing the need for natural gas in FY 2014. Stationary emissions decreased 34% from FY 2013 and are 28% below the FY 2008 baseline.

Mobile Emissions

NREL's mobile emissions represent nearly 7% of NREL's Scope 1 sources. In FY 2014, emissions from NREL's vehicle fleet decreased 14% from FY 2013 but increased 63% from the baseline.

In FY 2014, five security vehicles were designated as emergency response vehicles, and the Inspector General vehicle was designated as a law enforcement vehicle. Therefore, the fuel from these vehicles was deducted from the overall fuel totals for NREL. Non-fleet vehicles and equipment increased emissions by 1,556% from the FY 2008 baseline.

NREL experienced a large increase in diesel fuel use for emergency back-up generators this year due to several planned power shut downs from construction activities. Emergency generators were used to provide power while primary site power was down. NREL also added new motorized equipment on campus, further increasing non-fleet emissions. NREL is working to acquire more alternative fuel vehicles (AFVs) and to reduce overall mobile emissions (see the Fleet Management Section).

Fugitive Emissions

Fugitive emissions make up just over 29% of NREL Scope 1 source emissions and include fluorinated gases, refrigerants, and emissions associated with on-site septic systems at the NWTC and SRRL.

Refrigerant and fluorinated gas emissions are tracked through purchases and are monitored in a chemical inventory on a fiscal year basis. When feasible, NREL recycles refrigerants instead of disposing of them to avoid emitting the gases. Refrigerant gases are captured together in a recovery tank that is sent out for recycling.

once the tank has been filled. NREL monitors for refrigerant leaks on a regular basis. This recycling effort is not currently captured in the reporting of fugitive emissions; NREL will explore the option of improving reporting methodologies for refrigerants in FY 2015.

In FY 2014, fluorinated gas and refrigerant emissions decreased 32% from the FY 2008 baseline year. Sulfur hexafluoride (SF₆) purchases resulted in the largest source of fugitive emissions in FY 2014, totaling 253 cubic feet (cf). About 4 cf were used to test the energy efficiency of HVAC systems on campus. The remainder of the SF₆ purchased in FY 2014 was used as an insulator gas to prevent arcing in an electrostatic accelerator. The large quantity purchased was used for the initial load on this project, and a majority of the gas will be recaptured during annual maintenance on the device (with anticipated loss not to exceed one liter of gas).

On-site wastewater emissions increased 15% from the FY 2008 baseline year. This is mainly due to the change in the global warming factor for methane and partly due to a small increase in population being served by NREL's septic systems at the SRRL and the NWTTC.

Process Emissions

This fiscal year NREL reported a small increase in the quantity of dry ice used for research purposes to comply with recent safety and investment protection reporting guidance. These emissions represent less than 1% of Scope 1 emissions and have increased 6% from the FY 2008 baseline. In the past, due to lack of usage data, NREL did not have a baseline. This year NREL created a FY 2008 baseline by estimating dry ice usage for FY 2008 based on four years of data, from FY 2011 to FY 2014. Having a baseline allows progress on the executive goal to be more accurately measured.

Scope 1 Summary

FY 2014 Scope 1 emissions were 3,951 MTCO₂e, a 3% decrease from FY 2013 and a 25% decrease from the FY 2008 baseline.

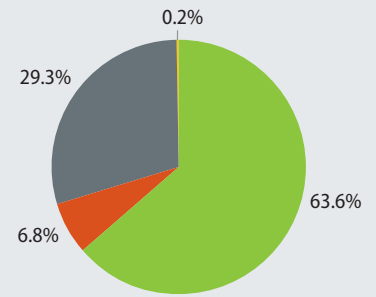
Scope 2

The majority of NREL's Scope 2 emissions are associated with purchased electricity. To mitigate the impact of emissions from purchased electricity, NREL maximizes campus energy efficiency and the amount of electricity generated on-site. The laboratory is committed to ensuring that the campus achieves Scope 2 carbon neutrality; as such, in FY 2014, NREL purchased Green-e certified RECs to offset all Scope 2 emissions that could not be avoided.

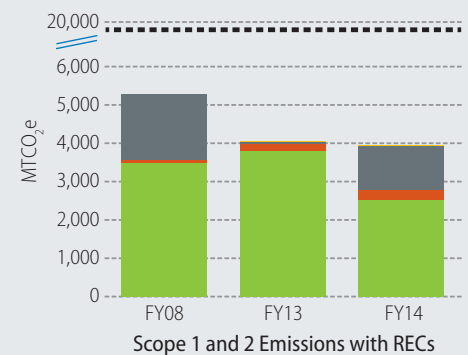
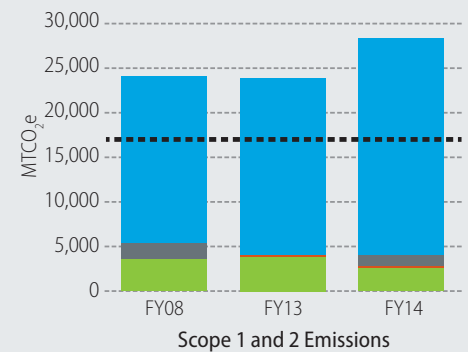
In FY 2014, electricity purchases generated 24,153 MTCO₂e. This represents a 29% increase from the FY 2008 baseline. NREL strives to construct and operate highly energy-efficient buildings on its campuses. Due to these efforts, NREL's electricity consumption has remained relatively constant even with an increase in campus footprint of more than 147% since FY 2008 and the relocation of the DOE's Golden Field Office (GFO) to NREL's Research Support Facility (RSF) C-Wing. In FY 2014, the large increase in electricity use is specifically attributed to the High Performance Computing Data Center (HPC) located in the Energy Systems Integration Facility (ESIF).

The addition of the GFO team also increased the electricity load at NREL. Before the move, NREL had only occupied 75% of the RSF C-Wing. When the GFO team moved into the C-wing, occupying 100% of the facility, electricity use increased, adding to the overall campus load. Although plug loads did decrease in the RSF C-Wing, lighting increased significantly from the previous use of the office space. NREL continues to explore

NREL Performance toward Meeting Scope 1 and 2 GHG Reduction Targets with and without RECs



Percentage Breakdown of FY 2014 Scope 1 Emissions



Stationary Mobile Fugitive Process
Purchased Electricity --- Reduction Goal Line

options to improve the energy efficiency of its facilities and methods to reduce electricity consumption across the laboratory.

Currently, NREL has three high-energy mission-specific facilities (HEMSFs)—which include ESIF, the Solar Energy Research Facility (SERF), and Field Test Laboratory Building (FTLB). These three facilities constitute 67% of NREL's total electricity consumption. The ESIF uses a large amount of electricity to run the HPC, despite special attention given to efficient design, equipment, and operation of the data center. The ESIF HPC currently uses 18% (about 550 kW) of total electricity usage at NREL. The SERF and FTLB are wet chemistry laboratories that require significant levels of ventilation and air exchange rates, requiring high levels of electricity use, to ensure the safety of the laboratories. In addition, the SERF houses larger chillers that serve multiple facilities on the STM campus.

Scope 1 and 2 Summary

The graphs on page 11 demonstrate NREL's overall performance toward meeting EO 13514's Scope 1 and 2 GHG reduction goals. Although NREL's Scope 1 and 2 GHG emissions have increased overall from the FY 2008 baseline, NREL purchases RECs to offset Scope 2 emissions as part of the laboratory's commitment to being a carbon neutral laboratory. In FY 2014, NREL decreased total Scope 1 and 2 emissions 84%, including REC purchases, from the 2008 baseline.

Scope 3

NREL's Scope 3 emissions are associated with transmission and distribution (T&D) losses from the power grid, business air and ground travel, commuting activities, contracted wastewater, and solid waste disposal for the campus.

Transmission and Distribution Losses

In FY 2014, NREL's T&D losses increased 29% from the FY 2008 baseline due to an increase in electricity usage for the STM campus. Increase in electricity use is mainly due to HEMSFs, specifically the HPC in ESIF, as well as an increase in population from the GFO move to campus facilities this year. NREL uses the standard T&D factor of 6.18% to estimate these system losses. These emissions represent more than 19% of NREL's Scope 3 sources in FY 2014. NREL's deployment of on-site renewable energy and highly energy-efficient buildings helps to mitigate emissions from this source. For emissions that cannot be mitigated NREL purchases RECs to offset emissions.

Business Air Travel

NREL's FY 2014 business air travel emissions decreased 1% from FY 2013; however, FY 2014 emissions are 34% higher than FY 2008 baseline levels. These trends are reflective of a 95% population growth since 2008 with an additional 1,294 NREL employees and contractors coming on site since FY 2008. Air travel is NREL's second largest Scope 3 source, representing more than 34% of this emissions category. NREL has extensive teleconferencing and video conferencing systems in place and continues to look for opportunities to address this emissions source. Note that air travel does not include GFO information because this is reported with DOE Headquarters.

Business Ground Travel

In FY 2014, business ground travel emissions were 69% lower than the FY 2008 baseline. The business ground travel 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 as well as use of public transit. NREL's rental car policy also allows the use of mid-size AFVs or hybrids when available. For FY 2014, 94% of the cars rented on business trips were in the compact category, less than 1% were economy, 1% were full size, 3% were midsize, and the remaining vehicles were minivans and sport utility vehicles. Note that business ground travel does not include GFO information because this is reported with DOE Headquarters.

Employee Commuting

Employee commuting represents just over 41% of NREL's Scope 3 emissions in FY 2014 and is NREL's largest Scope 3 emissions source. Overall, commuting emissions have decreased by 9% from the FY 2008 baseline. In FY 2014, NREL adjusted its baseline to include commuting information from the GFO in addition to including the GFO in FY 2014 reporting. FY 2014 showed an 11% decrease in one-way commuter miles for NREL and GFO staff, bringing the one-way average down to 16 miles from 18 miles in FY 2013.

NREL and GFO offers multiple commuting programs to its employees to reduce the laboratory's Scope 3 commuting emissions. These programs include:

- Free public transit (EcoPasses)
- 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).

This year NREL completed a laboratory-wide commuter survey. Distributed in April 2014, 31% of NREL and GFO employees completed the survey (See Appendix B for a copy of the survey). The survey focused in three major topic areas:

- Commuter behavior
- Public transit and on campus shuttles
- AWS and teleworking.

Survey results were used to establish more accurate commuting emissions for NREL employees and staff, as well as DOE employees, during FY 2014. Distributing a tri-annual commuter survey allows NREL the opportunity to monitor employee commuting needs and impacts more closely. The survey helps to identify areas to decrease Scope 3 emissions and to ensure that commuting options at NREL create an environment that facilitates employee flexibility and productivity. This year, NREL completed a zip code analysis with both survey and human resources information. This revealed that many employees live close to the NREL campuses but do not have access to adequate public transit services.

The FY 2014 commuter survey indicates a positive trend in commuting habits of NREL employees with a 16% decrease of commuters who drive to work alone and an increase in hybrid, electric, and AFVs. Both public transit use and telecommuting have increased by 8%.

Results of the commuter survey point to some remaining solutions for AWS and teleworking options at NREL. The *Scope 3 Greenhouse Gas*

Reduction Plan, developed in FY 2014, identifies ways in which the laboratory can move forward with Scope 3 emissions reductions. These options for reduction take into account employee needs as expressed in the commuter survey as well as the impacts that these measures could have on the reduction of Scope 3 emissions laboratory-wide.

Contracted Wastewater Treatment

NREL's emissions from contracted wastewater treatment increased 43% from the 2008 baseline. These emissions are calculated on a population basis; therefore, the substantial growth NREL has experienced since FY 2008 is reflected in this increase. The increase in wastewater emissions makes up less than 1% of NREL's Scope 3 emissions and does not significantly contribute to overall emissions for this scope. Increased teleworking and AWS at NREL are helping to manage emissions from this source on campus.

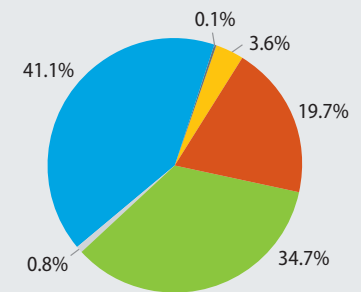
Contracted Waste Disposal

NREL's contracted waste disposal comprises nearly 4% of the FY 2014 Scope 3 emissions. In FY 2014, emissions from this source decreased 14% from the FY 2008 baseline. Given the population growth on campus since the baseline year, these substantial reductions demonstrate the effectiveness of NREL's campus-wide recycling and composting programs. This year's increase is attributed to the move of GFO staff on the STM campus as part of the relocation of DOE staff from leased to DOE-owned space.

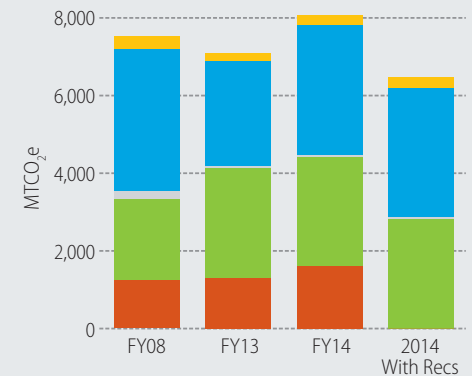
Scope 3 Summary

In FY 2014, NREL's Scope 3 emissions were 6,465 MTCO₂e with RECs, representing a 14% decrease from the FY 2008 baseline. However, without RECs, NREL's Scope 3 emissions increased by 8% relative to the baseline.

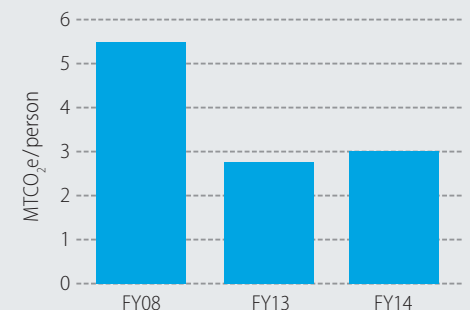
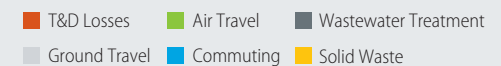
NREL's Performance Toward Meeting Scope 3 GHG Reduction Targets



2014 Scope 3 Emissions



Scope 3 Emissions with and without RECs



NREL's Scope 3 Per Capita Emissions



A flex fuel E-85 shuttle used on the STM campus at NREL is part of the sustainability strategy at NREL.

Success Story

ROADMAP TO REDUCE SCOPE 3 GHG EMISSIONS

Scope 3 emissions are a challenging GHG emissions source for NREL and have continued to increase each year since the baseline. From FY 2008 to FY 2014, NREL's campus has grown by 147% and population has increased by 95% (not including the GFO). This growth has been necessary to maintain NREL's position as the national leader for renewable energy and energy efficiency. Further, it enables NREL to contribute to the international energy dialogue and help make decisions that will catalyze a profound transformation in energy infrastructure. However, NREL's growth creates challenges in reducing GHG emissions, particularly those in the Scope 3 category, which are outside NREL's operational control.

Given that the Scope 3 GHG reduction goal is based on absolute emissions and not *per capita*, using a FY 2008 baseline poses unique difficulties for NREL. NREL will not meet the Scope 3 reduction goal without implementing further measures. Rather than reacting to Scope 3 emissions increases as NREL continues to grow, NREL has taken the initiative to develop measures that target the reduction of Scope 3 emissions. In FY 2014, NREL developed a *Scope 3 Greenhouse Gas Reduction Plan*. The plan proposes a range of strategies to help NREL reduce Scope 3 GHG emissions.

The plan provides an in-depth look at current programs and their estimated impact on Scope 3 GHG emissions. In addition, the plan recommends a variety of options for decreasing Scope 3 GHG emissions with the primary focus on commuting and air travel, because these areas constitute more than 75% of Scope 3 GHG emissions at NREL. The plan analyzes the feasibility of these options as well as the potential impact they could have on Scope 3 emissions. For example, NREL continues to investigate the expansion of teleworking for staff. Research suggests that the possible addition of a mandatory telework day once a week for eligible employees could help NREL reduce as much as 15% of Scope 3 commuting emissions.

This report has helped NREL to prioritize future strategies of GHG reduction to minimize the impact of commute and travel on Scope 3 emissions. The investigation of these measures provides a range of strategies to consider as NREL continues toward a decrease in Scope 3 GHG emissions.

Total GHG Emissions

Including REC purchases, NREL's overall emissions decreased to 67% below the FY 2008 baseline. In FY 2014, the majority of NREL's GHG emissions (67%) were Scope 2 emissions associated with the purchase of electricity. Scope 3 represents the next largest emissions source, comprising 22% of all NREL's emissions. Through campus policies and programs that address travel and commuting, NREL is attempting to mitigate the impact of these sources. The final category, Scope 1, represents 11% of NREL's overall GHG emissions. Through enhanced RFHP performance and the construction and operation of efficient buildings, NREL continues to decrease emissions from these sources despite an increase in campus population and square footage.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Scope 1

NREL will continue to optimize RFHP performance to reduce natural gas requirements for the campus. As mission appropriate, NREL will purchase additional AFVs to reduce emissions from the vehicle fleet and will evaluate fleet reduction opportunities annually in light of changing mission requirements. NREL will also investigate opportunities to promote the use of alternative fuel in the vehicle fleet as well as ways to improve fugitive and refrigerant gas data collection processes, procurement, and recycling practices to reduce fugitive emissions.

Scope 2

In FY 2014, growth continued at NREL with one full year of operation at the ESIF facility and the addition of the GFO to the NREL campus. Electricity use at the ESIF HPC is projected to increase by nearly 500 kW per year until reaching maximum capacity for the facility's current infrastructure at 10 MW. With each campus addition and increase in electricity usage, NREL will continue to uphold the highest standards for energy efficiency and deployment of on-site renewable energy.

Scope 1 and 2 Summary

NREL anticipates meeting the Scope 1 and 2 emissions reduction goal through efficiency measures, on-site renewables, and REC purchases to completely offset Scope 2 emissions.

Scope 3

Transmission and Distribution Losses

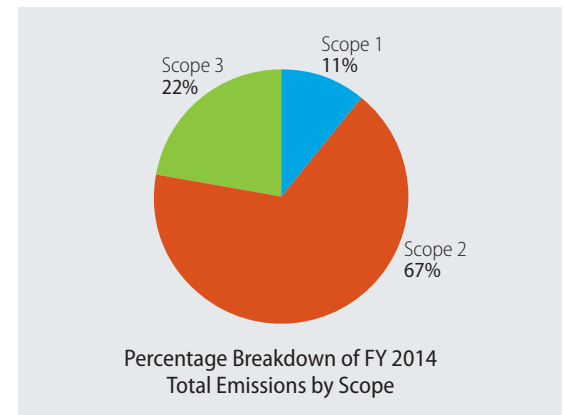
NREL will continue to identify methods to reduce campus electricity use through energy efficiency improvements, high-performance building technologies, and on-site renewables. These measures will help to reduce both Scope 2 emissions and Scope 3 T&D loss emissions. However, T&D loss emissions represent a challenge due to anticipated increased electricity demand. As need be, NREL will continue REC purchases to completely offset T&D loss emissions.

Business Air and Ground Travel

Air travel poses a challenge for NREL, because a certain degree of travel is necessary to support NREL's mission. NREL will continue to look for other opportunities to reduce air travel beyond what is required for mission-critical activities. NREL will also investigate opportunities for improved ground travel data collection methods that could potentially identify areas for further ground travel reductions.

Employee Commuting

NREL and GFO will continue to offer programs encouraging 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 to NREL employees. Investigation into further promotion of AWS and teleworking could help to reduce and manage emissions from this source. The positive trend of commuting reductions at NREL indicates that employees are taking advantage of opportunities to reduce their carbon footprint through commuting alternatives. NREL will continue to support these positive commuting trends.





NREL engineer Tony Markel plugs in a plug-in hybrid electric vehicle as he runs a test at the Medium Voltage Outdoor Test Area at the ESIF recording the net loads placed on a transformer from the single and aggregate charging of electric vehicles.

Contracted Wastewater Treatment and Waste Disposal

Although GHG emissions from wastewater are a function of population, NREL makes every effort to reduce the amount of sewage produced through the use of high-efficiency, low-flush or low-flow toilets, urinals, and fixtures. These products are part of NREL's design standards for all new construction and building remodels. NREL will continue efforts to reduce waste disposal on campus and increase recycling and composting measures. Additionally, NREL's support for telecommuting and AWS will decrease the load on the municipal wastewater conveyance system and waste generated on campus, as well as subsequent emissions from these sources.

Scope 3 Summary

NREL anticipates that it will meet Scope 3 emissions reduction goals through measures promoting campus efficiency of energy, waste, commuting, and travel—and that Scope 3 emissions will continue to increase as population and campus footprint grow. 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. The *Scope 3 Greenhouse Gas Reduction Plan* developed in FY 2014 will pave a path forward to reduce Scope 3 emissions without RECs and ensure that NREL is on track to meet the goal of a 13% reduction of Scope 3 emissions by FY 2020.

MEASURABLE GOALS

In FY 2015, NREL will:

- Use the *Scope 3 Greenhouse Gas Reduction Plan* to implement targeted reduction strategies
- Continue to promote teleworking and AWS practices
- Continue to optimize RFHP performance to reduce campus natural gas needs
- Explore opportunities to more accurately report on refrigerants purchased, used, and recycled at NREL
- Continue to offer alternative commuting programs
- Continue to purchase RECs to supplement current on-going strategies in offsetting emissions.

Energy Use and Reduction

Goals:

(2.1) 30% energy intensity reduction by FY 2015 from a FY 2003 baseline

- Energy intensity reduced 54% from the 2003 baseline.

(2.2) EISA Section 432 energy and water evaluations

- Conducted EISA evaluations for 2% of total site energy use and audited nearly 92% of covered facilities to date.

(2.3) 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)

- 100% of NREL's buildings have energy meters (including electricity, natural gas, and renewables where appropriate).
- 100% of NREL's buildings have chilled water meters.
- 100% of NREL's buildings have hot water meters (NREL uses no steam).

Aerial view of the award-winning LEED Platinum facility RSF, housing researchers developing clean energy technologies.



Energy Use and Reduction

STRATEGY AND PERFORMANCE SUMMARY

NREL's goal is to establish a "living laboratory" that showcases the most efficient use of energy and renewable sources. With this goal in mind, the laboratory 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 minimize energy footprint while accommodating campus growth.

FY 2014 PERFORMANCE STATUS

Energy Intensity

NREL's energy intensity is below DOE's target for FY 2014, with a value of 118 kBtu/ft²—a 54% decrease from NREL's FY 2003 baseline. FY 2014 energy intensity is down from 127 kBtu/ft² FY 2013. The year-over-year decrease is attributable to lower natural gas use. Natural gas use decreased from 72,372 MMBtu in FY 2013 to 47,540 MMBtu in FY 2014. This reduction is due to NREL's wood-chip fueled RFHP and milder winter temperatures.

The RFHP displaced 18,041 MMBtu of natural gas used to generate hot water. NREL has two natural gas-fired boiler plants, in the SERF and the FTLB, and a wood-fired hot water boiler in the RFHP, which all tie into the campus' district heating system.

Although natural gas usage decreased, electricity usage increased. STM campus electricity use increased 9% from FY 2013 to 25,619 MWh,

NREL'S ENERGY INTENSITY			
DOE FY15 Goal (Btu/GSF)	NREL FY03 Baseline (Btu/GSF)	FY14 (Btu/GSF)	Energy Change over Baseline (%)
180,521	257,552	118,424	-54.0%

coinciding with the first year the ESIF HPC was fully on-line. Highest peak demand increased 8% in FY 2014 from FY 2013 to 4,333 kW.

The overall reduction in energy intensity can be attributed to NREL's large fraction of energy-efficient office and laboratory space built since FY 2003. NREL's energy intensity calculation includes the STM and NWTC campuses as well as partially serviced leased facilities (Joyce Street Facility and the Refuel Facility). NREL excludes fully serviced leases (Denver West Buildings, and the Washington, D.C., offices) from its energy intensity calculation.

In new facility construction, NREL has complied with the Energy Independence and Security Act (EISA) 433 goal of fossil fuel reduction—increasing energy efficiency in building design and mechanical equipment and using on-site renewable energy sources as reduction measures. NREL's RSF and ESIF facilities integrate waste heat recovery systems from internal data centers to heat other building spaces such as office and laboratories. NREL's RSF, Parking Garage, and South Site Entrance Building (SSEB) are contributing to the pursuit of net-zero energy facilities by integrating energy-efficiency and

renewable-energy technologies (PV arrays and ground-source heat pump). NREL also continues to seek opportunities to use alternative financing to support campus energy efficiency and renewable energy measures through power purchase agreements (PPAs) and energy savings performance contracts (ESPC).

In FY 2014, NREL continued developing a *Strategic Energy Management Plan*. The purpose of this document is to delineate a campus energy management structure, vision, and strategies. The plan will be used to help prioritize energy improvement projects and identify funding opportunities to support their execution. As part of this plan, NREL intends to pursue International Organization for Standardization (ISO) 50001 certification for energy management systems (EnMS).

NREL has two certified and trained energy managers who analyze and report energy information for NREL.

EISA Audits

To date, NREL conducted EISA evaluations on nearly 92% of facilities covered by EISA Section 432.

NREL's Justin Peltz leads Metro Denver high school students on a tour of the data center in the RSF as part of IT Shadow Day at NREL. Educating future generations of energy engineers is a keystone value to deploying the purpose of NREL's mission while showcasing NREL's significant achievements in energy-efficient data technologies.



EISA Section 432-covered facilities represent the major energy-consuming facilities with opportunities for energy-efficiency improvements. In FY 2014, energy and water audits were performed on three of these buildings on campus: RSF I (A and B wings), East Site Entrance Building, and the Education Center (formerly the Visitor Center). These buildings, collectively, use less than 2% of total site energy. The value is very small—despite the fact that the RSF houses hundreds of employees—because it incorporates renewable systems to offset consumption. In-house experts performed the FY 2014 EISA audits, which evaluated mechanical, water, and plug-load systems.

In FY 2014, NREL continued using the U.S. Environmental Protection Agency's Portfolio Manager to benchmark metered building energy performance. NREL also implemented several energy conservation measures (ECMs) on campus, including designing an electric heater replacement, repairing insulation, repairing HVAC plenum for the RSF data center, rooftop AC,

adding light occupancy sensors, replacing hot water valves, and upgrading lighting controls.

This year, the NREL buildings operations team partnered with researchers to test a new building audit tool, Simuwatt, currently under development. Simuwatt was used to provide standardized data, processes, and analysis to develop an investment-grade energy audit of NREL's buildings and to identify potential energy and water conservation measures for implementation. Simuwatt was created using a local software developer, to develop a Building Component Library—an online repository of energy data on individual building components and ECMs that can be used to create building energy models using NREL's OpenStudio and EnergyPlus tools, with data broken down into separate components that represent parts of a building. The tablet-based Simuwatt application enables energy auditors to conduct audits that cost 75% less than traditional audits and helps to store data in a consistent and reusable format.

The FY 2014 audits identified a number of ECMs

that are currently under analysis for energy and cost savings. These ECMs are reported in DOE's Consolidated Energy Data Report (CEDR) and will also be included in annual EISA reporting. NREL will measure and verify the performance of implemented conservation measures to ensure performance.

Metering

NREL has exceeded performance goals for both energy and water metering.

Energy meters—100% of NREL's buildings have energy meters in use (including electricity, natural gas, and renewables where appropriate). Electrical metering at the laboratory includes more than 200 advanced electric meters 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 sub-meters that record HVAC, laboratory process, and lighting loads. All NREL facilities that use natural gas have building gas meters. The Energy Dashboard data system is



The Science and Technology facility (S&TF) on the NREL campus.

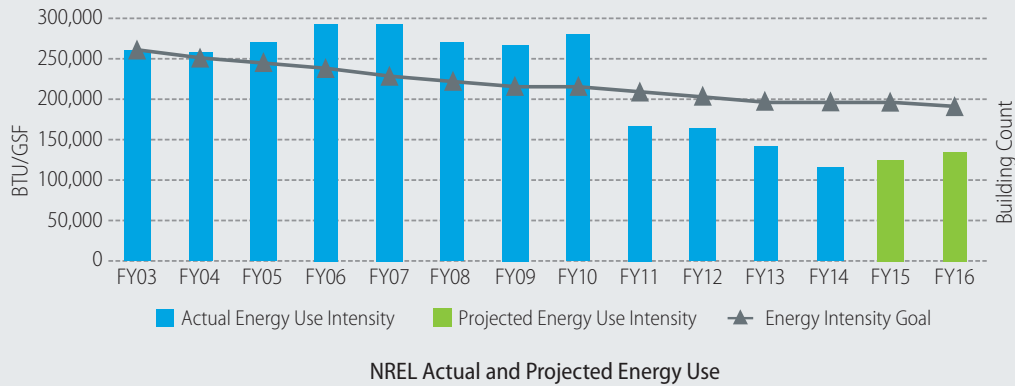
Success Story

SCIENCE AND TECHNOLOGY FACILITY RETRO-COMMISSIONING EFFORT NETS SAVINGS

NREL finished construction of the LEED Platinum S&TF in 2006. In FY 2014, NREL completed a retro-commissioning effort on the facility. Over the past few years, NREL has been investing in infrastructure to collect and analyze building performance data for the S&TF and other facilities on campus. In FY 2014, NREL took the opportunity to use this information as a tool for retro-commissioning the S&TF. The availability of this data enabled a more productive and cost-effective method of commissioning that NREL will continue to expound upon and develop in FY 2015.

The retro-commissioning process brought together a variety of expertise around the lab along with an outside contractor. Not only was NREL able to uncover energy and monetary savings in the facility, this collaborative approach brought about a multitude of other benefits. The process was a great learning experience for future retro- and continuous-commissioning ventures as well as an opportunity to develop relationships for cooperative research and development agreements (CRADAs) and contracts moving forward.

This retro-commissioning process was unique because NREL had the opportunity to draw upon two years of data for the entire S&TF facility. This allowed energy auditors to look at the building as a whole instead of only being able to focus on a few building systems. Having the data readily available also saved a considerable amount of time in the retro-commissioning process as it did not need to be collected manually. Through this process, the team was able to identify specific, underperforming building systems and provide recommendations for how these systems can be optimized to work synergistically with the entire building. At S&TF, the innovative retro-commissioning process was able to identify 11 inexpensive energy-efficiency measures with simple paybacks of less than 3.5 years. NREL plans to refine this process in FY 2015 to identify additional energy- and money-saving opportunities.



SCHEDULE FOR EISA AUDITS

Covered Facilities	Audit Year
SERF, S&TF, FTLB	2012
OTF, TTF, IBRF (East), Shipping and Receiving	2013
Site Entrance Building, Education Center, RSF I	2014
NREL NWTC Administration Building, Structural Testing Laboratory, Dynamometer Spin Test Facility	2015

an internal smart metering system that directly records 85% of natural gas use and 95% of the electricity used.

Water meters—all facilities that require water on the STM site have dedicated utility water meters. Chilled water meters and hot water meters (NREL uses no steam) are installed in 100% of NREL’s buildings. All new facilities at the STM site are required to have a main building utility water meter, which is supplied and installed by the water utility.

To support DOE’s metering requirements, NREL’s design standards for new and renovated spaces require water submeters at make-up water systems that support mechanical HVAC equipment and laboratory processes. Design standards also require installation of meters on chilled water and heated water systems for all new facilities that are tied into the main centralized heating and cooling plants. NREL submeters high-use water systems with new construction. An irrigation meter is also required for all newly constructed facilities that use water on a short-term basis to establish new plants. The submeters are maintained and data recorded weekly by NREL in-house maintenance staff.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Energy Intensity

NREL anticipates meeting and exceeding the energy intensity reduction goal by constructing new highly energy-efficient buildings, systematically implementing energy retrofits, and increasing on-site renewable energy generation. The laboratory will continue to optimize RFHP operations, including upgrades to the ash handling system in spring 2015 that will increase hot water output, and will seek opportunities to purchase biogas to further reduce natural gas consumption. Actual and projected energy intensity for NREL is presented below. NREL will also finalize the *Strategic Energy Management Plan* and pursue ISO 50001 certification in FY 2015.

EISA Audits

NREL has identified a path forward to uphold compliance with EISA by identifying covered facilities that will be audited over the next four-year cycle. NREL will conduct American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) level-3 audits on all buildings using the Simuwatt tool. As new LEED buildings are constructed, NREL will re-commission them,

bringing them into EISA compliance. Once the next four-year cycle of EISA audits are complete, NREL will have assessed more than 97% of the site energy use. The proposed schedule for these audits is also summarized above. NREL will continue to benchmark metered facilities in EPA’s Portfolio Manager.

The EISA audits conducted this year identified a number of ECMs. NREL is still finalizing analysis using the Simuwatt application; prioritization of these measures will be determined using criteria from NREL’s *Strategic Energy Management Plan*.

As opportunities arise to implement ECMs, deploy additional on-site renewables, and construct new high-performance buildings, NREL will use appropriate funding mechanisms including utility rebates. NREL will also coordinate with the Federal Energy Management Program (FEMP) to assess ESPC opportunities that could be used to finance ECM implementation in future years.

To reduce deferred maintenance, NREL site operations leverage several existing funding mechanisms for energy improvement projects, including general plan projects (GPP), general property equipment (GPE), general property

Industrial partner Matt Brown and NREL researchers Lars Lisell and Andrew Parker review the latest version of the Simuwatt audit tool. Simuwatt audit integrates a cloud-based library of energy conservation data, an established whole-building energy simulation engine, and advanced building geometry capture software into a single tablet-based software tool to help commercial and nonresidential building owners reduce the cost of walk-through audits and increase the accuracy of rapid energy modeling. This tool was utilized to conduct the 2014 EISA audits for NREL facilities.



maintenance and repair (GPMR), and minor construction. Although energy projects are eligible for funding under these programs, they are also in competition with other campus infrastructure improvement needs. NREL's *Strategic Energy Management Plan* will define a prioritization process to identify the most essential energy projects that should be recommended for improvement through these funding mechanisms.

Metering

In FY 2015 and beyond, NREL will work to enhance the Energy Dashboard system as well as other campus energy tools, 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 the Site Sustainability Plan, Dashboard, GHG inventory,

and other DOE data requests. Enhanced energy enterprise management capabilities will also support the analysis of GHG reduction and energy-efficiency opportunities, estimation of renewable energy needs, and return on investment for energy improvements. In addition, the system will provide educational support and outreach to help NREL uphold DOE's mission for energy efficiency and renewable energy.

MEASURABLE GOALS

In FY 2015, NREL will:

- Perform EISA audits on three additional covered facilities
- Benchmark building energy and water data in EPA's Portfolio Manager
- Pursue ISO 50001 certification for NREL's EnMS.

High Performance Sustainable Buildings

Goals:

(2.4) 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.

- Cool roofs comprise 69% of NREL's roof areas.

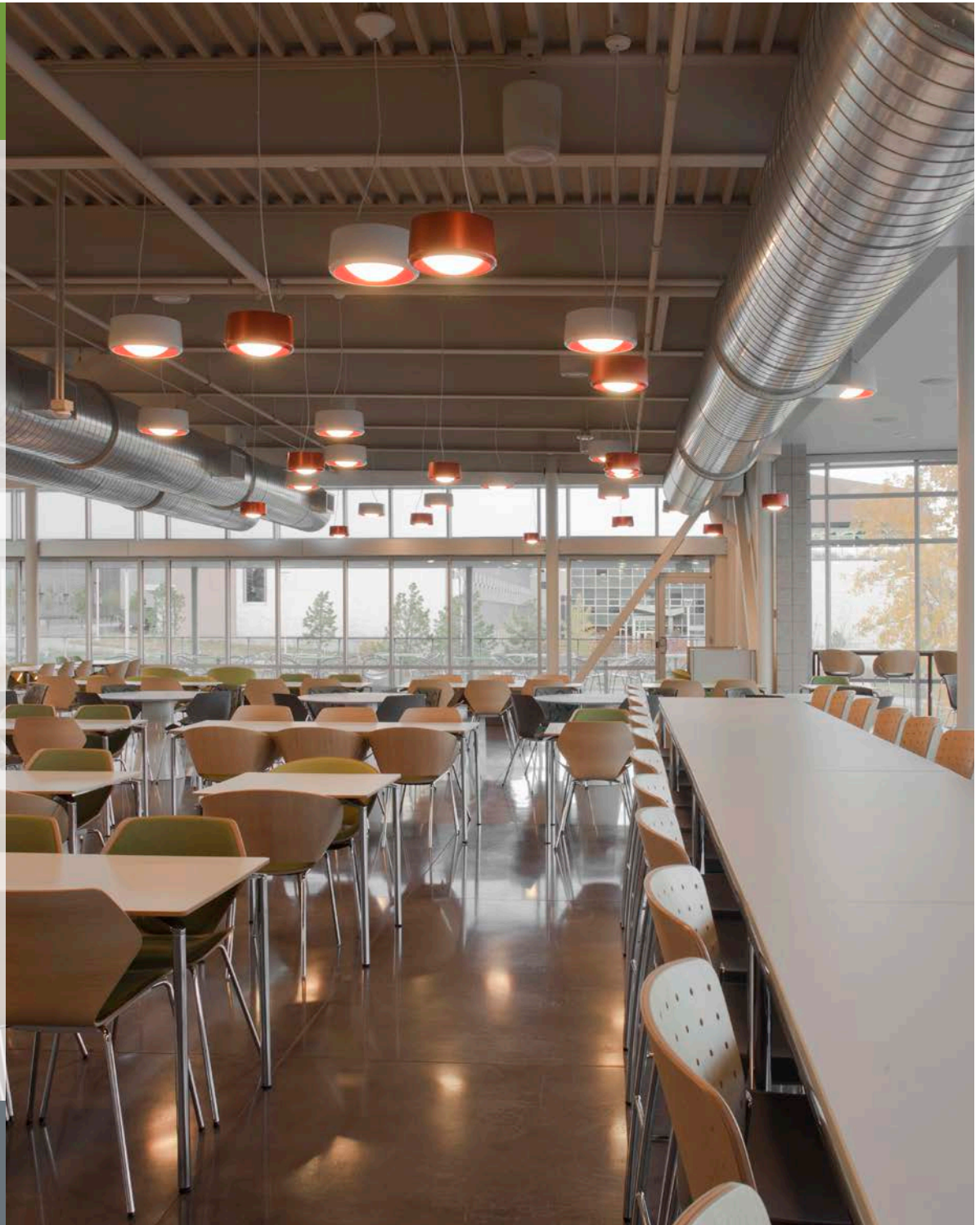
(2.5) 15% of the number of existing buildings greater than 5,000 gross square feet (GSF) to be compliant with the GPs of HPSB by FY 2015, with progress to 100% thereafter

- Four buildings (18%) are 100% compliant with the GPs.
- Performed GP assessments on three additional buildings in FY 2014 and assessed 95% of buildings greater than 5,000 GSF to date.

(2.6) All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs

- All new construction at NREL is required to comply with GPs.

NREL staff can enjoy natural light and beautiful views while eating lunch in the cafeteria.



High Performance Sustainable Buildings

STRATEGY AND PERFORMANCE SUMMARY

NREL capitalizes on every opportunity to integrate the principles of high-performance design into new and existing buildings. In this effort, the laboratory provides leadership by integrating energy-efficient and renewable energy technologies into new buildings, using the campus as a showcase for research. NREL's *Campus Master Plan* and established policies promote sustainable design, operations, and maintenance practices.

FY 2014 PERFORMANCE STATUS

Cool Roofs

In FY 2014, cool roof area on the NREL campus remained the same making up 69% of NREL's roof areas. FY 2013 increased the area of cool roofs by 43% with the replacement of the Thermal Test Facility (TTF) roof and construction of the new LEED Platinum ESIF facility. Currently, 392,524 ft² of roof surfaces have at least R-30 insulation and are covered in PV or reflective, cool roof surfaces. This is the result of roof replacement projects on existing buildings as well as new high-performance building construction that included cool roof and PV specifications. NREL is seeking out more projects for future funding to increase the area of cool roof surfaces.

Guiding Principles

NREL uses EPA's Portfolio Manager for the assessment and management of GP compliance. All checklists, with supporting documentation, are maintained in this tool and are used to ensure that Facilities Information Management System (FIMS) sustainability fields are accurate.

NREL currently has 22 owned and leased buildings larger than 5,000 GSF that make up the candidate pool for the GPs. As of FY 2014, four of these buildings meet 100% of the GPs for high-performance sustainable buildings: RSF I, RSF II, Integrated Biorefinery Research Facility (IBRF) West, and the S&TF. With these four buildings, NREL is currently 18% compliant and exceeding the requirements of this goal.

In FY 2014, NREL continued efforts to perform GP assessments of existing buildings. Three assessments were performed this year on the following facilities: Office Building 52/3, Office Building 16, and the Joyce St. storage facility. 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 understand what is required to bring these facilities into full compliance.

Currently, 95% of NREL's eligible buildings have been assessed or are in full compliance with the GPs. All new construction at NREL will be fully GP compliant, achieving LEED Gold or higher certification.

Construction

LEED Certification

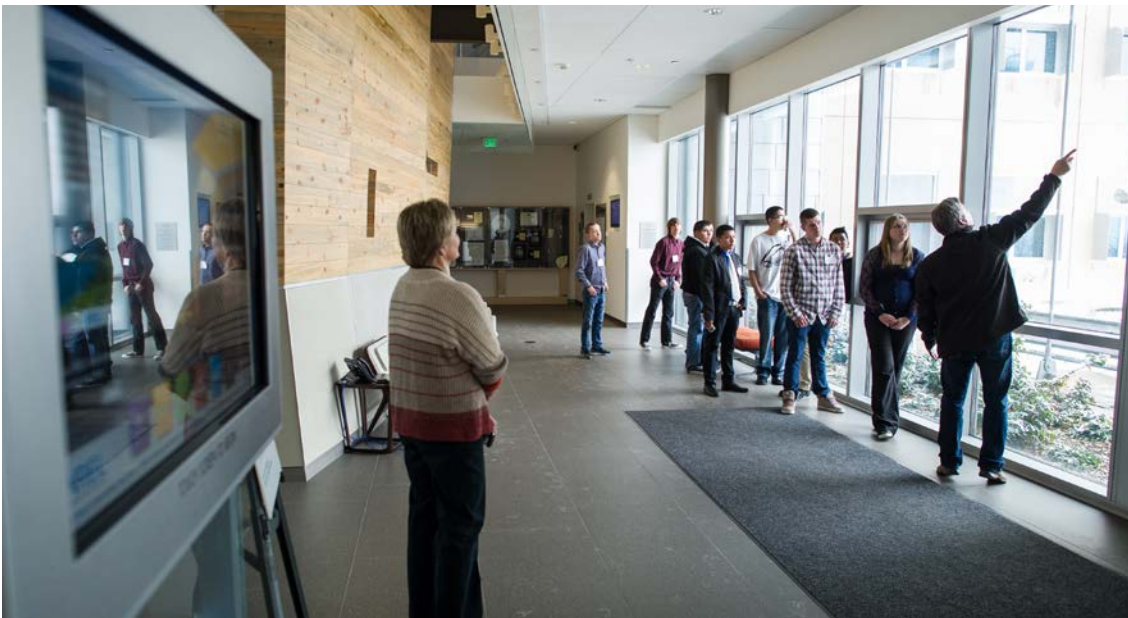
NREL's LEED-certified building projects are indicated below.

LEED CERTIFICATION STATUS	
Building	LEED Certification Level
Research Support Facility I (RSF I)	LEED Platinum awarded FY 2011
Integrated Biorefinery Research Facility (IBRF)	LEED Gold awarded FY 2011
Research Support Facility II (RSF II)	LEED Platinum awarded FY 2012
Parking Garage	Designed to LEED Platinum standards*
Café	LEED Platinum awarded FY 2013
Energy Systems Integration Facility (ESIF)	LEED Platinum awarded FY 2014
South Site Entrance Building (SSEB)	LEED Platinum awarded in FY 2014

*Parking garage was not intended to include occupied spaces. Therefore, it was not constructed with plumbing and ventilation systems and is not eligible for LEED certification.

New Facilities

During FY 2014, NREL's sub-contracted design team completed 100% construction document submittals for the new two-story 16,000-ft² building addition to the existing Outdoor Test Facility (OTF) building. These construction drawings were publically bid for construction.



NREL had 19,677 visitors to the lab in FY 2014. Tours of the high-performance buildings educate industry, government organizations, educators, and students about energy-efficient technologies.

Unfortunately, all bids received exceeded the approved project budget. Instead of reducing the required program to meet researchers' needs, NREL's executive management canceled the project to raise additional funds to establish a new construction budget. These existing minor construction project funds reverted back into the GPP project list and funded a new clean room at the S&TF.

In FY 2014, NREL developed program requirements for a new Technology Acceleration to Market (TeAM) facility that would support industrial engagement in the energy domain. The proposed 150,000ft² facility will house a 1,000-person conference center, multipurpose instrument laboratories, conference rooms, meeting spaces dedicated to secure industry collaboration, and 300 to 350 offices to support new industry partners. It will also house both Colorado Center for Renewable Energy Economic Development (CREED) and NREL staff as well as an education center with a display area to

welcome stakeholders to the STM campus. The nature of this facility should attract considerable interest from non-congressional line-item funding sources. During FY 2014, CD-0 documents were prepared and submitted to DOE's Office of Acquisition and Project Management. In the last quarter of the fiscal year, the proposed project received approval to proceed to the CD-1 stage.

User Facilities

In its first year of operation as a new user facility, the ESIF had third-party contracts with 46 non-NREL organizations (including 28 industry partners, 8 universities, 4 utilities, 4 laboratories, and 2 government agencies). These partnerships included a variety of projects including research on fuel cells, renewable energy, grid integration, hydrogen sensors, inverters, catalysts, electrodes, and a variety of other topics. The FY 2014 budget provided \$20 million to ESIF for program and building operations.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Cool Roofs

All roofs at NREL have been evaluated with respect to cool roof criteria, and remaining roofs are recommended for replacement at the end of their useful life. The Shipping and Receiving roof is at the end of its useful life, and was slated for replacement in FY 2014 with a cool roof, but the project did not receive funding. NREL intends to pursue funding for the project in FY 2015. Additionally, NREL intends to complete a cool roof project at the Integrated Bio-Refinery Research Facility (IBRF). Once these projects are funded, the cool roof area is expected to increase to more than 427,000 ft² in FY 2015. Future roof replacement projects will be evaluated to determine the cost effectiveness of replacing with cool roofs or PV.

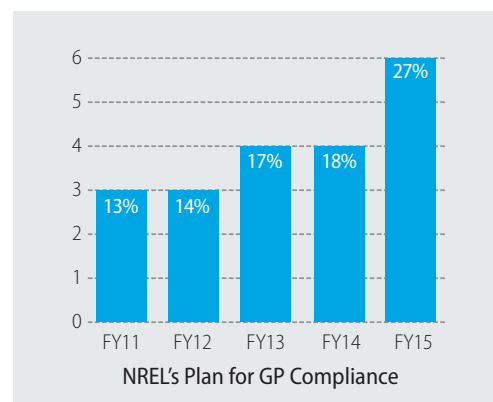
NREL and DOE employees learn about the new ESIF as they tour the facility at an employee open house.



Guiding Principles

In FY 2015, NREL will finish assessing 100% of the eligible GP buildings by performing an assessment on the Washington, D.C., office building. NREL will also develop cost estimates for all buildings assessed to prioritize GP improvements. NREL anticipates that two additional buildings, the Café and ESIF, will achieve 100% GP compliance in FY 2015 with the completion of the occupant comfort surveys. Contingent on funding availability, NREL will work to bring existing buildings into full GP compliance to help move the campus to 100% GP compliance. NREL will also work to include GP requirements in specifications for campus construction and remodeling.

NREL's plan for compliance is shown in the figure below.



Construction

NREL is committed to pursuing LEED Gold or higher certification to the extent possible for all new construction on campus. As part of this pursuit, NREL incorporates energy-efficient features in the building design resulting in

dramatic reductions from ASHRAE standards. NREL also incorporates on-site renewable generation capabilities to support the operation of net-zero energy buildings and is working toward the goal of a net-zero energy campus.

As part of NREL's commitment to high performing facilities, in FY 2015, NREL will develop CD-1 documents and investigate non-congressional line-item funding sources for the TeAM facility.

MEASURABLE GOALS

In FY 2015 NREL will:

- Replace the Shipping and Receiving roof and the IBRF with new cool roof and R-30 insulation if funding is approved
- Conduct one additional GP building assessment and develop cost estimates for all assessed buildings to achieve GP compliance
- Develop CD-1 documents and investigate alternative financing for the TeAM facility.

Regional and Local Planning

Goals:

(2.7) Efforts to increase regional and local planning coordination and involvement:

- Provided shuttles connecting staff to RTD public transit services.
- Coordinated with Denver Regional Council of Governments (DRCOG) WayToGo program to promote commuter options.
- Advocated for bicycle lanes on 20th Street with Jefferson County and City of Lakewood Climate and Disaster Preparedness Resilience Planning.
- Participated in Colorado Recovery Office Statewide Resilience Working Group
- Supported CEQ's Colorado Preparedness Pilot Project.
- Initiated the STM site-wide environmental assessment and finalized the NWTC site-wide environmental assessment.
- Worked with Jefferson County Planning and Zoning to improve drainage swale on the STM campus.
- Continue to monitor buildings for bird-window collisions and raise staff awareness of this issue.

Zebediah Raney, with PGI Wraps, applies a window pattern of dots, made for the prevention of bird collisions, to the exterior of windows at the ESIF.



Regional and Local Planning

STRATEGY AND PERFORMANCE SUMMARY

NREL coordinates with regional and local planning organizations and government agencies to improve land use, transportation, growth, and sustainability within the community.

Regional transportation and environmental management goals incorporate Executive Orders and expand sustainability initiatives. All campus projects work to integrate physical boundaries, connect to transportation and utility systems, and protect the ecosystem and open space. These initiatives nurture a sustainability culture and forge stronger community, neighbor, and user relationships.

FY 2014 PERFORMANCE STATUS

Regional Transportation Planning

All campus development is intended to create an environment that is pedestrian and bicycle friendly, as well as accessible to public transit—to reduce impacts of staff commuting. Moving laboratories and offices from leased space and consolidating them at newly constructed buildings on the STM campus is part of this objective.

NREL continues to work with regional partners to improve the local land-use decisions and transportation facilities that support alternative commuting options to NREL's STM campus such as bicycling, walking, and using public transportation.

NREL is actively involved with local governments and organizations to:

- Influence the enhancement and development of additional 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 on an informal, ongoing basis—and formally at public meetings—to engage with and influence transportation decision making in the west Denver metro area.

- **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 public 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 public transit routes that serve NREL. Close cooperation with RTD is essential to building ridership of NREL staff.

NREL's activities for FY 2014 include:

- Continuing construction of on-site bicycle and pedestrian-supportive infrastructure. This includes sidewalks, bike lanes, bike racks, bicycle maintenance stations, and storage lockers.

- Coordinating and hosting events for regional rideshare and public transit providers. These events enable interaction between providers and NREL staff on regional alternative commuting support services.
- Continuing to provide shuttle services that connect NREL staff with RTD public transit services enhancing mobility in the community by decreasing the peak-hour traffic congestion.
- Conducting a tri-annual commuter survey to identify commuting patterns and areas of concern that could be shared and discussed with regional transportation service providers. Information collected is used to guide development of transportation programs and infrastructure on NREL campuses and provide feedback within the surrounding communities, where appropriate.
- Providing a conduit for Boulder County and the Colorado Department of Transportation (CDOT) to communicate roadway construction activities on State Highways 128 and 93 to staff at NWTC campus, with emphasis on accommodations being made for bicyclists during construction and after the roadway is completed.

NREL's transportation program helps to manage traffic, reduce GHG emissions, and improve air quality by employing an "avoid, shift and improve" trip strategy. The program includes supporting alternative commuting options (ridesharing, bicycling, and public transit use), flexible work practices, telecommuting, and incentive parking for green vehicles, which are described fully in the Greenhouse Gas Reduction Section.



Visitors look into the Power Systems Integration Laboratory during a tour of the ESIF during a Community Open House at NREL.

NREL also collaborates 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.

Regional Climate Change and Disaster Preparedness Resiliency Planning **Colorado Resilience Working Group (CRWG)**

September 2013 brought record flooding and catastrophic damage to many Colorado communities. The State of Colorado organized around this disaster and created an opportunity to improve resilience throughout the state. At a summit in June 2014, involving state and federal partners, participants developed the group's mission, resilience principles and values, vision, and goals. Following the summit, those partners formed the CRWG to steer the development of a resilience framework and incorporate resilience strategies and activities into the flood recovery.

The CRWG steers the efforts of the resilience framework's partners—who come from the whole community and participate in one or more resilience sector (water, infrastructure, economics, natural resources, etc.). A Leadership Committee sets the policy direction for the state's resiliency efforts and oversees the Working Group and sectors' activities. NREL staff attended the summit and have been participating in the CRWG since its creation, providing a key advisory role and supporting the state and all the regional partners in this effort.

Council on Environmental Quality (CEQ) **Colorado Preparedness Pilot Project**

In November 2013, the White House Administration established the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience that identified resiliency and climate adaptation as a priority. One specific outcome was a commitment to

“preparedness pilots,” to bring together federal agencies and local communities to assess and plan for region-specific vulnerabilities and interdependencies associated with climate change. The preparedness pilots are being held in Houston and in Colorado; the effort is intended to advance preparedness planning on the ground and to help create models for other communities and agencies to follow. CEQ coordinated with DOE's Deputy Under Secretary Knotek and Principal Deputy Assistant Secretary for Congressional and Intergovernmental Programs Alice Madden to have NREL coordinate and facilitate the Colorado pilot project.

The preparedness pilot projects directly support the recommendations (currently draft) of the State, Local and Tribal Leaders Task Force on Climate Preparedness and Resiliency by;

- Building resilient communities (providing a roadmap for communities on specific energy-related pathways)

Students compete in NREL's 24th Solar and Lithium Ion Car Races held at Dakota Ridge High School, in Littleton, Colorado. Nearly 300 students on 74 teams from 21 Colorado schools competed.



- Improving resiliency in the nation's infrastructure (identifying needs within critical infrastructure to build resilience during and after disasters)
- Building capacity for resiliency (focusing on building stronger public-private partnership opportunities and communication protocols for a streamlined response during emergencies).

The preparedness pilot project will directly assist with DOE's strategic approach to climate change resiliency and the proposed framework deliverable from the pilots could be tailored to DOE facilities. For more information on NREL's climate change activities see the Climate Change section.

Environmental Management and Planning

National Environmental Policy Act (NEPA) Guidance

GFO environmental assessments and supplements take into consideration routine on-site research and operational activities at the STM and NWTC campuses. Additional environmental reviews are not required for these ongoing activities, as long as project scopes are constrained within the boundary analyses discussed in the environmental assessment. A GFO NEPA review is required for projects requiring the expenditure of funds, such as subcontracts, cooperative research and development agreements, work for other agreements, and interagency agreements prior to contract award or initiation of activities. The subsequent GFO NEPA determination will identify if the activity fits within earlier

determinations in a site-wide environmental assessment or supplement, if any categorical exclusion applies, or if a more rigorous environmental analysis is required, such as an environmental assessment or supplement.

In FY 2014, NREL:

- Continued to include identification and analysis of impacts from energy usage and alternative energy sources in environmental assessments.
- Initiated the STM site-wide environmental assessment and finalized the NWTC site-wide environmental assessment. Both of these assessments include identification and impact analysis from energy use and alternative energy sources.
- Continued to incorporate new NEPA-implementing procedures in routine NEPA reviews.

NREL has a centralized site-planning process ensuring that program facilities, activities, and any future site reconfiguration are analyzed in conjunction with the laboratory's Environmental Management System (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 Executive Order 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, i.e., enhance biodiversity.

NREL uses native and adaptive plants during site development, avoiding invasive plants wherever possible, to promote regional identity and enhance wildlife habitat and biodiversity.

In 1999, NREL granted a 177-acre conservation easement on its STM site to Jefferson County to provide hiking trails and permanent conservation status for a portion of the STM site. According to NREL's *10-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."

NREL has established conservation management areas at the NWTC to protect the site's natural resources (including wetland drainages, a wooded ridge area, ancient soils, mesic grasslands, and ridge shrublands), and to prevent development within critical wind corridors. More than 60 acres are managed for this purpose. In addition to environmental commitments in the 2002 *Sitewide Environmental Assessment* to protect the site's unique natural resources, protocols are also included in NREL's Natural Resource Conservation Program 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. In addition, NREL is conscious of the impacts its site development could have on local watersheds and has developed a program addressing stormwater pollution prevention for construction activities, including construction specifications provided to construction contractors.

In FY 2014, NREL:

- Worked with Jefferson County Planning and Zoning on proposed improvements to a drainage swale used to divert stormwater from the eastern portion of the STM campus to a new stormwater detention basin. Construction of improvements was completed in 2014 and will reduce sedimentation to the new stormwater detention basin and improve the visual appearance of the swale to users of the adjacent Jefferson County Open Space trail.

- Coordinated with the contractor for NWTC on-site testing of a new turbine and meteorological tower lighting system for ultimate approval by the Federal Aviation Administration (FAA). The radar-activated lighting system, which is intended to decrease avian attraction and the potential for bird collisions with these structures, performed as was intended with tower lighting illuminating when a test aircraft was within three nautical miles of the NWTC, and it turned off once the aircraft was beyond that distance. The FAA will be documenting the work in an upcoming technical report.
- Continued to work with the Jefferson County Nature Association and Pleasant View Metropolitan District regarding noxious weed management at the STM and NWTC campuses.
- Completed annual monitoring of DOE's STM conservation easement with Jefferson County.
- Continued to monitor buildings for bird-window collisions and raise staff awareness of this issue. As a result of this monitoring, the ESIF building was identified as an area of high risk for bird-window collisions. A window retrofit project was undertaken applying a 3M window film over the exterior glass surface on over 6,600 square feet of windows. Preliminary post-project monitoring has revealed no strikes to retrofitted windows. Monitoring will continue in FY 2015.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Regional and Local Planning

In FY 2015, NREL will:

- Continue advocacy efforts and the construction of bicycle- and pedestrian-supportive infrastructure (sidewalks, crosswalks, bicycle lanes, bicycle racks) at NREL and throughout the community
- Continue to work with RTD to ensure that NREL is served by public transit 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 and sustainability planning processes as appropriate
- Continue working with local jurisdictions, RTD, and the Denver Regional Council of Government's WayToGo program to advocate for, and support, regional transportation demand management strategies.

Regional Climate Change and Disaster Preparedness Resiliency Planning

In FY 2015, NREL will:

- Continue ongoing participation in local and regional climate change and disaster preparedness resiliency planning.

Local Environmental Management and Planning

NEPA Guidance

In FY 2015, NREL will continue to include consideration of energy use and alternative energy sources, as applicable, in all future environmental impact statements and environmental assessments.

Ecosystem Coordination

In FY 2015, NREL will:

- Support researchers as needed in their collaboration with the FAA on future testing at the NWTC of a bird-friendly radar and lighting system for wind turbines and meteorological towers
- Continue to coordinate weed control efforts with adjacent land managers.

MEASUREABLE GOALS

In FY 2015, NREL will:

- Continue advocacy efforts and construction of bicycle and pedestrian-supportive infrastructure at NREL and throughout the community
- Continue advocacy efforts for enhanced transportation options with regional transportation providers and local governments such as DRCOG, WayToGo, RTD, CDOT, City of Lakewood, City of Golden, and Jefferson County
- Continue participation in the CRWG and infrastructure subcommittee to develop a statewide resilience plan
- Continue supporting the CEQ's Colorado Preparedness Pilot project
- Continue to coordinate weed control efforts with adjacent land managers.

Fleet Management

Goals:

(3.1) Increase annual fleet alternative fuel consumption by 10% by FY 2015, relative to a FY 2005 baseline

- Increased alternative fuel use
48% from the FY 2005 baseline.

(3.2) 2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline

- Increased petroleum fuel usage
by 63% from the FY 2005 baseline.

(3.3) 100% of light duty vehicle purchases must consist of alternative fuel vehicles (AFV) by FY 2015 and thereafter (75% FY 2000–2015)

- No light duty vehicles were purchased in FY 2014.



NREL E-85 tank on the STM, used to fill NREL service vehicles.

Fleet Management

STRATEGY AND PERFORMANCE SUMMARY

NREL is committed to a right-sized fleet, maximizing the use of AFVs and providing electric vehicle charging stations that serve employees, visitors, and research purposes. The laboratory continues to look for additional options to reduce GHG impacts, to promote alternative fuel use and vehicles, and to establish new policies and programs. The *NREL Fleet Management Plan* (see Appendix A) discusses fleet management operating practices in further detail.

FY 2014 PERFORMANCE STATUS

Alternative Fuel Consumption

In FY 2014, NREL increased its alternative fuel consumption by 48% since the baseline year of FY 2005. NREL's alternative fuel use comprised 47% of total fuel consumption in FY 2014, a decrease from FY 2013. All NREL fleet fuel data is reported each fiscal year in the Federal Automotive Statistical Tool (FAST).

To promote alternative fuel efforts, in FY 2014 NREL completed installation of an E-85 fueling tank on the STM campus. NREL policies require that all E-85 vehicles are to be fueled with E-85 unless directed by NREL's fleet manager.

NREL also has one on-site compressed natural gas (CNG) fueling station at the STM campus. No CNG fuel was used in FY 2014 because NREL does not have any CNG vehicles in the fleet at this time. CNG leased vehicles have not been available on the GSA lease list since FY 2009.

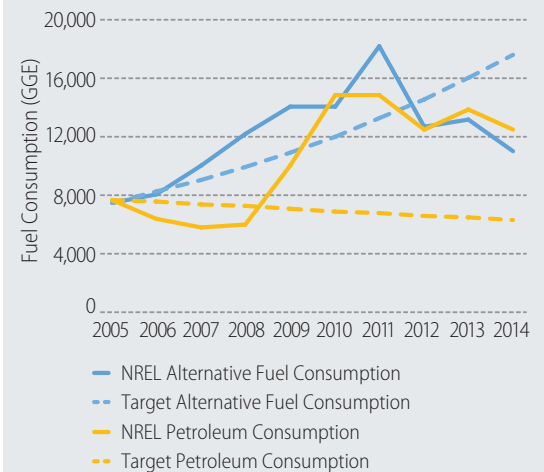
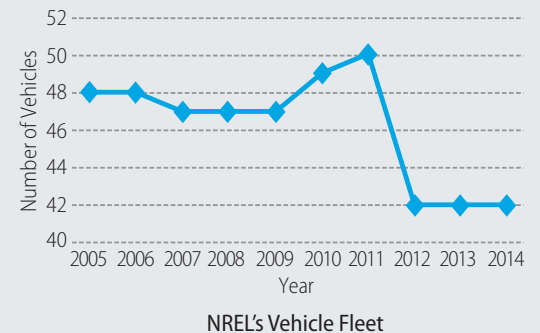
NREL has 36 electric vehicle charging stations on the STM campus that support research and fleet electric and plug-in hybrid electric vehicles. At present, NREL does not have any electric or plug-in hybrid electric vehicles in the fleet. The charging stations will support future fleet electric and plug-in hybrid electric vehicles. NREL staff and visitors are permitted to use the charging stations through a mission critical research project—*Expanding NREL's Energy Systems Integration Capabilities: Plug-in Electric Vehicle Load Control and Management*—being conducted on campus.

In FY 2014, the charging stations consumed 39,588 kilowatt-hours (kWh) of electricity. This is an increase of 57% from 25,200 kWh in FY 2013.

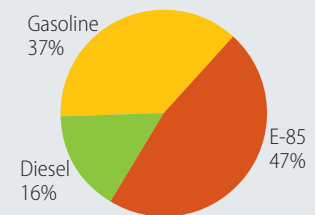
Petroleum Reduction

In FY 2014, NREL's petroleum use made up 53% of fleet fuel consumption. Overall, petroleum use is 70% higher than the FY 2005 baseline and 10% lower than FY 2013 use. The increase from the baseline year is due to the replacement of five CNG vehicles in FY 2012 and the increased use of the diesel buses since FY 2009. NREL is not yet meeting the petroleum reduction requirements—in part due to an almost-doubled laboratory population since the baseline year—but continues to work toward overcoming challenges to meeting this goal by FY 2020.

In FY 2014, NREL logged 301,454 fleet miles, a 4% decrease in usage compared to FY 2013. Per advice from DOE's Office of Management in FY 2014, NREL designated five security vehicles



NREL's Fuel Consumption by Type Relative to Targets



Fleet Fuel Consumption by Type for FY 2014



NREL's fleet of alternative fuel vehicles operate on 100% alternative fuel. This vehicle uses E-85.

for emergency response use and one IG vehicle for law enforcement use. Fuel use from these designated vehicles is now exempt, which reduced overall petroleum use at NREL in FY 2014.

In FY 2014, NREL investigated the feasibility of fueling its diesel vehicles with biodiesel to help meet the petroleum reduction goal. NREL contacted several retail fuel stations in proximity to NREL but none of them offer biodiesel. The closest biodiesel supplier is located in Boulder, more than 25 miles from the STM campus. Hill Petroleum, NREL's E-85 fuel supplier, does not have a biodiesel pump but could deliver biodiesel to the campuses. To do this, NREL would need to purchase or lease and install a storage tank and enter into a fueling subcontract. Hill Petroleum requires a minimum

300-gallon purchase per month as part of a contract. NREL regularly consumes slightly less than 300-gallons per month in diesel fuel. The analysis showed that fueling with biodiesel is not financially or logistically feasible at this time.

Alternative Fuel Vehicle Purchases

NREL makes every effort to right-size its vehicle fleet, which currently consists of 42 vehicles: 40 General Services Administration (GSA)-leased vehicles and two DOE-owned vehicles. In FY 2014, NREL exchanged one unleaded vehicle for an E-85 vehicle when the vehicles were up for replacement. The NREL fleet now includes 62% AFVs:

- 26 E-85 vehicles
- 5 hybrid-gas vehicles
- 4 unleaded gas vehicles
- 7 diesel vehicles.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Alternative Fuel Consumption

NREL's efforts to establish the most fuel-efficient fleet rely on continuous monitoring, recording, and use assessment. Through monthly monitoring and reporting, NREL's fleet manager reassigns vehicles to maximize use of alternative fuels. NREL works closely with GSA to procure vehicles that are smaller, consume alternative fuels, or that use advanced technologies to improve fleet efficiency. When a vehicle is scheduled for replacement, NREL's fleet manager reviews the need for the vehicle with the vehicle sponsor to determine if the same classification is required. The fleet manager then checks the GSA vehicle list to determine if a more fuel-efficient or low-emitting vehicle option is available. NREL's *Fleet Management Plan* documents this process in further detail.

Patrick Perry uses the E-85 tank on the STM campus to fill an NREL on-demand van.



In FY 2014, installation of the on-site E-85 fueling tank at the STM campus further increased the use of alternative fuels in NREL's fleet. NREL also continues to work with DOE's FEMP and the local Clean Cities coalition to improve the fleet's ability to access and use alternative fuels.

NREL's electric vehicle charging infrastructure is metered. If NREL acquires electric fleet vehicles, NREL has the systems in place to capture electricity use for reporting to DOE.

Petroleum Reduction

NREL is committed to reducing vehicle miles and petroleum use through methods such as right-sizing the fleet, using shuttles, and video conferencing to reduce ground travel. As vehicle leases expire, NREL seeks to replace vehicles that use petroleum with AFVs. Additionally, the E-85 fueling tank will help decrease vehicle miles traveled to obtain alternative fuel off site.

Alternative Fuel Vehicle Purchases

NREL's goal is to transform its fleet so 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.

NREL has no plans for new purchases or leases in FY 2015. As existing vehicles age and become less fuel efficient or leases expire, NREL will look for opportunities to replace these vehicles with AFVs.

MEASURABLE GOALS

In FY 2015, NREL will:

- Continue to acquire GSA-leased replacement vehicles that meet low emissions standards, if available and as required
- Continue to acquire GSA-leased replacement vehicles with AFVs, if available and as required
- Investigate the feasibility of replacing shuttle vehicles (diesel mini-buses) with an AFV.
- Investigate the feasibility of entering into a pilot project with GSA to acquire alternatively fueled vehicles such as electric or hydrogen fuel cell.

Water Use Efficiency Management

Goals:

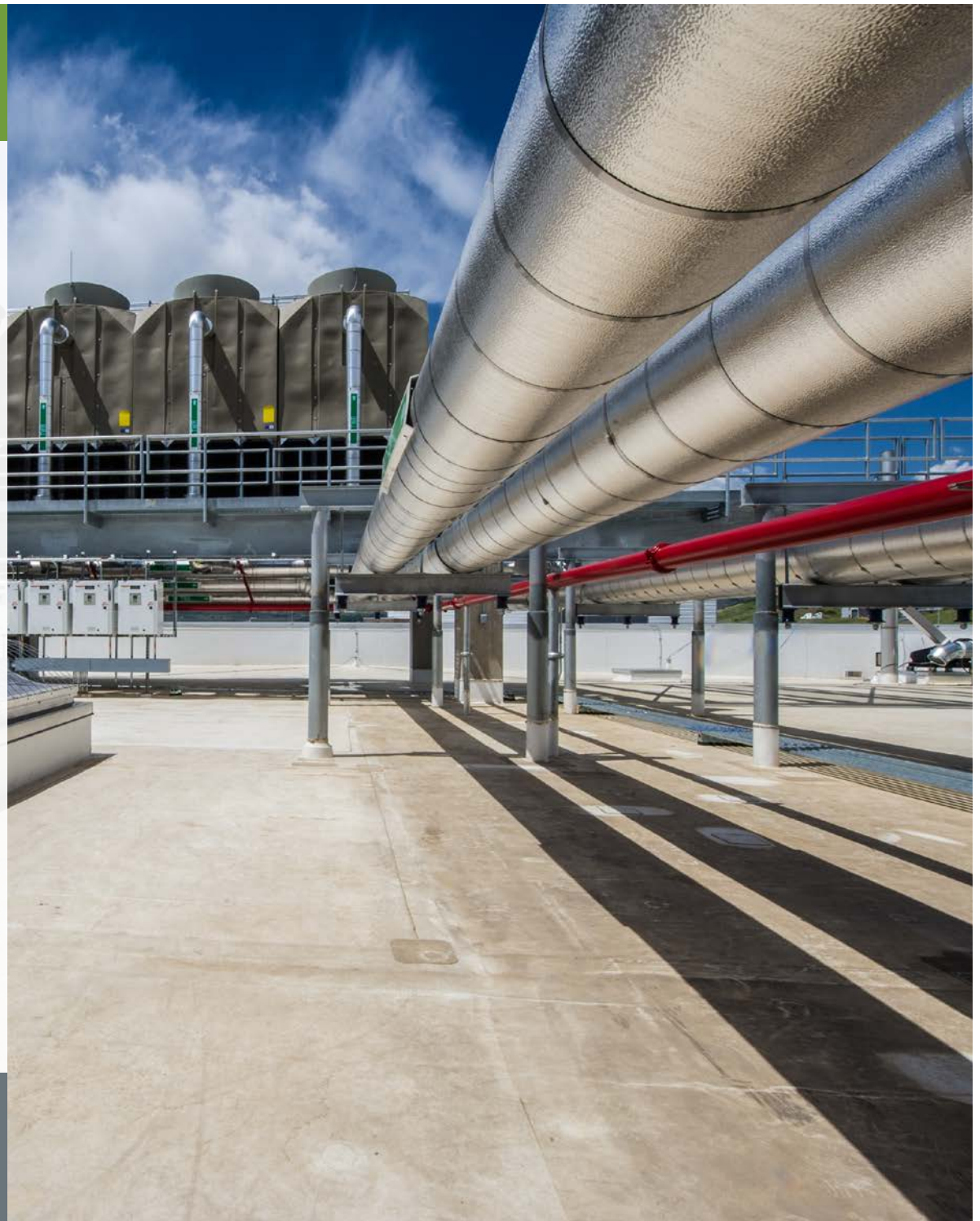
(4.1) 26% potable water intensity reduction by FY 2020 from a FY 2007 baseline

- Reduced potable water intensity 43% from the 2007 baseline.

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

- NREL does not use ILA water.

Seven rooftop cooling towers circulate and evaporate the 1.8 million gallons of water that are used to cool the high-performance computers in the ESIF.



Water Use Efficiency Management

STRATEGY AND PERFORMANCE SUMMARY

In the arid west, water is a particularly precious resource. NREL is committed to using water as efficiently as possible on the campus and to implementing all available measures to reduce potable water consumption.

Though NREL will continue to explore non-potable and water re-use options, current state water law limits on-site collection and reuse of gray water sources—and no municipal reuse water lines are located in the vicinity of the campus.

FY 2014 PERFORMANCE STATUS

Since 2010, water intensity (water per square foot) on the NREL campus has stayed below the goal target. In FY 2014, NREL's water intensity was 15.7 gallons/ft², a decrease from the previous year and 23% below the reduction target.

A variety of elements affected NREL's energy intensity during FY 2014.

NREL had an anticipated increase in water demand with ESIF HPC operations, which uses a water-based cooling system at the computer hardware level. Although water-based cooling is a more energy-efficient alternative to air-conditioning, it relies on increased consumption of potable water.

To reduce the impact on potable water usage, cooling tower total dissolved solids was increased to six cycles of concentration. Additionally, NREL is cautiously researching new cooling tower water treatment systems that could further reduce water use.

Extensive construction on the NREL campus, which happened after the 2007 baseline was established, is another factor affecting water intensity. Disturbed areas were vegetated with prairie grassland communities suited for Denver's semi-arid climate. These areas all required irrigation to establish new vegetation. After a period of three growing seasons, irrigation requirements diminish greatly and only will be supplied in extended periods of drought. Irrigation systems have smart controllers to assess environmental and weather conditions and deliver water only when necessary.

FY 2014 was a wet year by Front Range standards, requiring less water than the FY 2013. This lower irrigation water use offset higher cooling tower consumption. When the baseline year was established in FY 2007, irrigation was not required on NREL's campus.

The potable water intensity square footage includes all DOE-owned and leased facilities (excluding fully leased facilities). However, NREL does not collect or report water data for partially leased buildings.

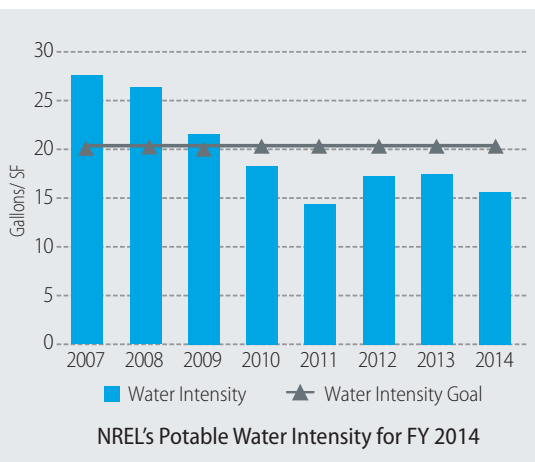
Indoor Potable Water

NREL's design standard and operating procedures call for high-efficiency, low-flow flush fixtures in all new and existing buildings. The standard also limits use of once-through cooling and sets other best practices. All facilities on the STM campus have water meters with submeters on high-intensity water devices including cooling towers, evaporative coolers, and autoclaves. At the NWTC, water must be trucked in: the site has no wells and no potable water supply available.

In FY 2014, NREL performed EISA audits on three buildings: the East Site Entrance Building, the Education Center, and RSF I. In-house staff performed the audits, evaluating mechanical, water, and plug load systems. Water audits considered the age and water efficiency of indoor fixtures such as faucets, toilets, urinals, showers, water heaters, and drinking fountains as well as outdoor water use for irrigation systems. Information from the water audits will inform recommendations for future funding needs and building retrofit projects targeted at reducing campus potable water use.

Outdoor Potable Water

NREL has explored using non-potable water for outdoor purposes, but a viable source has not been identified at this time. Colorado rainwater harvest laws currently prohibit capturing



stormwater for reuse. NREL continues to explore other opportunities to minimize outdoor potable water use.

NREL is working to conserve and optimize water efficiency for campus irrigation by using the WeatherTRAK® smart irrigation system to automatically adjust landscape watering based on plant needs and daily local weather conditions. Irrigation systems use moisture sensors and only run when necessary. After plant materials become established, irrigation systems are taken offline and the areas planted in native species adapt to local climate conditions. Currently the ESIF, Café, and the detention pond are irrigating to establish vegetation.

Water Management Plan

NREL's 2003 *Water Management Plan* was last updated in FY 2009. Since then, the campus has grown substantially with new high-performance buildings, extensive site and landscape restoration, new roadways, a new data center, and ESIF HPC. In FY 2014, NREL began updating its *Water Management Plan* to reflect recent facility additions. The plan outlines site objectives, documents historical water use patterns, describes water use by building, notes challenges, and identifies opportunities to address water use efficiency and management on NREL's campuses.

Stormwater

EISA Section 438 and its associated guidance (required by Executive Order 13514 and developed by the EPA) define the performance objectives to be used for preserving or restoring the hydrology of federal property. EISA 438 requires that, for all federal facility construction projects exceeding 5,000 ft², the hydrology of the site must be maintained or restored to predevelopment conditions to the maximum extent technically feasible.



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.

Success Story

WATER FIXTURE AUDIT COMPLETE FOR THE STM CAMPUS

In FY 2014, NREL conducted an audit of the water fixtures on the STM campus. This included 12 owned buildings as well as two leased facilities. The audit consisted of determining the number of fixtures in a building, the make and model of the fixtures, the year of their installation, as well as the flow rates for each individual fixture.

Faucets, toilets, urinals, drinking fountains, showers, dishwashers, and other fixtures were all taken into account. Not all fixtures had information on their flow rates physically listed on the device; some assumptions were made based on the age and model of the fixture.

This information will help to inform the *Water Management Plan* at NREL and support the goal of reducing water use at the laboratory. Having information on the number of fixtures and flow rates will help determine the facilities and fixtures that need updating to more efficient systems and what type of impact these changes can have on the reduction of water use at NREL.

Water is diverted from the NREL campus via an engineered arroyo as several inches of rain fall on the NREL campus within an hour.



NREL conducts all activities at both campuses consistent with the EISA 438 requirements. Per EISA Section 438, the laboratory incorporates low-impact development practices such as porous pavement, landscaping stabilization, and native planting.

On the majority of the STM campus, stormwater runoff from impermeable surfaces is directed through unlined waterways to the Central Arroyo Detention Basin. Stormwater is detained and slowly released into Lena Gulch, the local natural watercourse, at pre-development rates. The 4-acre detention pond, which can impound 15 acre-feet, maximizes stormwater runoff infiltration and evapotranspiration and minimizes landscaping irrigation in ways consistent with EISA 438 and local, state, and federal water quality and water rights regulations.

The Central Arroyo Detention Basin reached near maximum capacity during a major storm event in September 2013 when 6.5 inches of precipitation occurred during one week. The detention basin captured 10.5 acre-feet and slowly discharged water for approximately 10 weeks.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

NREL's work to meet projected performance goals and to implement strategies for greater water efficiency includes investigating water fixture efficiency, executing strategies identified in the water management plan, continuing to implement water quality, and reducing the effects of stormwater peak events to mitigate future climate change impacts.

Potable Water

In FY 2014, NREL conducted a survey of all water fixtures used on campus. Findings will be used to identify water fixtures needing replacement, reducing water consumption across the laboratory.

In FY 2015, NREL will install new piping for separation issues limiting use of ESIF HPC waste heat. This will reduce the ESIF cooling tower heat load and associated water consumption.

Outdoor Potable Water

The completion of the re-vegetation projects at the SERF and S&TF in FY 2015 will require irrigation for three successive growing seasons,

leading to a temporary increase in potable water intensity.

Water Management Plan

In FY 2015, NREL will finalize the *Water Management Plan*.

Stormwater

NREL's project designers will continue to look for opportunities to incorporate low-impact design practices in all campus projects. When additional DOE funding becomes available, the conceptual designs developed in the NWTC drainage study during FY 2011 will be finalized and constructed.

MEASURABLE GOALS

In FY 2015, NREL will:

- Perform EISA energy and water audits of three additional facilities
- Reduce ESIF cooling tower water consumption by increasing waste heat utilization
- Develop recommendations for future funding needs and building retrofit projects targeted at reducing campus potable water use.

Pollution Prevention and Waste Reduction

Goals:

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

- Diverted 75% of campus waste from landfill in FY 2014.

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

- Diverted 87% of construction waste from landfill in FY 2014.

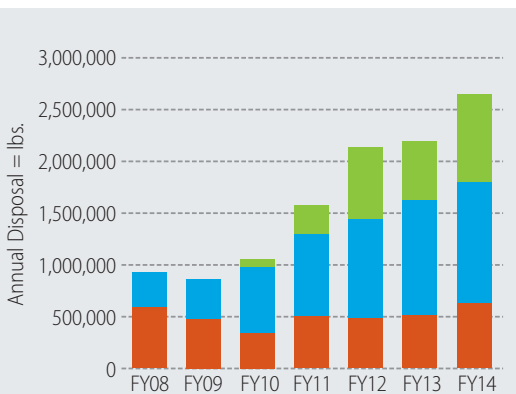
Recycling paper and minimizing waste is part of the sustainability plan at NREL.



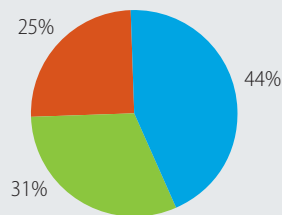
Pollution Prevention and Waste Reduction

STRATEGY AND PERFORMANCE SUMMARY

NREL continues to make progress toward establishing a near-zero-waste campus by using sustainable decision making that considers product life from cradle to cradle. Making the “4Rs philosophy” of reducing, reusing, recycling, and rebuying integral to operations, NREL balances environmental, social, and financial considerations and makes efficient use of all resources.



NREL Waste Diversion Summary



FY 2014 Waste Diversion

■ Solid Waste
 ■ Recycled Waste
 ■ Compost

NREL’s population and square footage have increased significantly since FY 2008. With this growth, total waste has had a corresponding increase. However, because NREL has diverted a large portion of this waste through recycling and composting, solid waste disposal numbers have remained generally stable.

FY 2014 PERFORMANCE STATUS

Campus Waste

Waste Diversion

In FY 2014, the laboratory exceeded DOE performance goals by diverting 75% of its campus waste from the local landfill. This was a 2% decrease in diversion from FY 2013—the slight decrease due to the 17% increase in full-time employees at the RSF C-Wing on the STM campus.

In the RSF C-Wing where new GFO employees took occupancy, NREL worked with GFO to provide training for GFO employees that is consistent with the trainings provided for the NREL staff. NREL’s achievement in waste reduction for FY 2014 can be attributed to education by the GFO Sustainable Team using NREL’s recycling, zero-waste, and composting educational materials.

Recycling, Compost, and Garbage Stream Analysis

In May 2014, NREL conducted a waste audit on the RSF A-Wing to better understand the facility’s compliance, to find out if further training for employees was needed, and to find waste streams that were not yet being recycled or composted. The waste audit looked at one day of

trash collection in this area, and a week’s worth of office and kitchen recycling and compost. The waste was physically separated using both volume and weight as the units of measurement.

Results of the audit showed that the RSF A-Wing had high diversion ratios as compared to other facilities similar to NREL.

Recycling Initiatives

In FY 2014, NREL continued its initiatives to recycle campus materials, focusing on plastic bags, used cooking oil from the Café, wood pallets and scrap metal, electronic devices, and office paper.

- **Plastic bag holders**—Based on the recommendations from the RSF A-Wing waste audit in May 2014, NREL installed plastic bag holders in the RSF A, B, and C wings. NREL employees were asked to deposit clean grocery bags, plastic bags, and baggies in these holders instead of discarding them in the trash. Employees can reuse bags as needed, and when the holders are full, volunteers take the bags to a local grocery store for recycling.
- **Expanded Recycling Efforts**—In July 2014, NREL installed a small recycling station at the Joyce Street Facility, which collects cardboard and comingled recycling.
- **Recycled Café Oil**—In the Café, NREL recycled 1,950 pounds of used cooking oil in FY 2014 from Café operations. The diversion of waste oil makes efficient use of this resource for the production of biodiesel, while saving packaging, greenhouse gases, and the need for fertilizers and pesticides in growing new alternative fuel sources.

- **Wood pallets and scrap metal**—At the STM and NWTC campuses, wood pallets and scrap metal are collected in specified single-stream, 30-yard bins. In total, NREL recycled 419,420 pounds of wood pallets and scrap metal in FY 2014.
- **Multifunction devices**—NREL continues to replace computer printers, copiers, scanners, and fax machines with Energy Star-certified multifunction devices (MFD)—effectively reducing the need for stand-alone imaging equipment. All new facilities are required to use MFDs. All cartridges from the MFDs are sent back to the manufacturer or a subcontractor for recycling.
- **Office paper**—All computers and printers at NREL have default settings installed for double-sided printing and employees are encouraged to use locked printing so as not to waste paper. NREL’s Office of the Chief Information Officer (OCIO) and SNREL completed a project to audit printing throughout the laboratory in an effort to save paper and strengthen printing practices overall. The OCIO also purchased and implemented a software tool to monitor and report on printing practices at the employee, group, and center/office level. The working group took an inventory of all desktop and small workgroup printers and wrote an article for NREL staff, highlighting the importance of using the “locked print” option and the use of MFDs. The article also detailed the process for turning on the “locked print” option for both PC and Macintosh systems. In FY 2014, NREL’s paper usage decreased 16% from FY 2013: the average NREL employee used 3.4 reams of paper for the year.

Repurposing of Materials

NREL makes every effort to reuse office furniture and equipment to divert it from the waste stream. The laboratory used Trendway office systems in the leased and older facilities and steel-case office systems in newer facilities. During modifications, or if NREL moves into a new facility, NREL regularly reuses these office systems.

In another FY 2014 successful diversion, NREL was able to “re-use” a three-sided structure at the NWTC campus that housed test equipment. The effort diverted 8,000 pounds of waste from the landfill.

Recycling Benefits to Staff

To encourage recycling both at NREL and at home, and to encourage a climate of sustainability, NREL organizes several campus events that allow staff members to recycle personal items:

- Electronics recycling to dispose of hard-to-recycle personal items such as computers, printers, monitors, and older televisions.
- Document shredding and recycling to dispose of sensitive personal documents in a safe and environmentally friendly manner.
- Used book, CD, and DVD recycling. Goodwill Industries of Denver comes to NREL and collects these items to reuse or recycle them.

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. In addition, the laboratory provides annual training on chemical

safety and hazardous waste management for all laboratory workers as well as a formal hazard identification and control process to minimize the risks associated with any new or changed laboratory process. Annual goals for pollution prevention are set as part of the EMS. NREL also works toward DOE’s goal to use alternative chemicals and processes by giving preference to environmentally preferable products (EPP), including bio-based products, Electronic Product Environmental Assessment Tool (EPEAT) electronics, and low- or no-volatile-organic-compound paints.

In FY 2014, NREL conducted a wall-to-wall re-inventory of chemicals and materials from January to June 2014. The level of accuracy in the chemical inventory system was measured at more than 98%. Training programs continued to promote the use of materials with lower toxicity wherever possible and to emphasize the availability of the excess chemical inventory.

The use of radio frequency identification (RFID) technology was initiated in FY 2013. In FY 2014, the pilot project was expanded to cover peroxide-forming chemicals. These materials must be tested every six months to make sure that no dangerous levels of peroxides have accumulated. During the FY 2014 re-inventory project, RFID labels were attached to peroxide formers as they were encountered. Occasionally, a container may be misplaced and a test cannot be conducted. RFID scanning can quickly locate an item if it is present.

In FY 2014, the chemical inventory software was upgraded to accommodate storing the new Global Harmonization System hazard information. Occupational Safety and Health Administration (OSHA) regulations promulgated

in 2012 require Global Harmonization System compliance by the end of 2015. The chemical inventory can track signal words, hazard statements, precautionary statements, and pictograms—the main elements of the new hazard communication standard.

Pest and Landscape Management

When control of pest wildlife species is necessary, NREL uses an integrated approach to humanely eradicate pests and minimize other potential impacts. In FY 2010, the laboratory's STM and NWTC sites had significant noxious weed infestations. In that year and the following year, NREL aggressively treated these infestations, primarily knapweed and Canada thistle. In FY 2014, having removed the worst infestations, noxious weed control has transitioned from the broadcast spraying of areas of high-density infestations to spot spraying in areas with low densities of weeds. Where high-density infestations arise, NREL still employs broadcast spraying, but these areas tend to be few and small. Remaining weeds are now better controlled, are not spreading aggressively, and require less intensive herbicide spraying, because mowing, hand-pulling, and reclamation techniques are controlling weeds. As a result, fewer herbicides are being applied, the cost of weed control activities is reduced, and the quality of wildlife habitat on site is being enhanced.

In FY 2014, NREL treated state-listed noxious weeds at its STM campus, including Canada thistle, Scotch thistle, myrtle spurge, and diffuse knapweed—as well as knapweed and Canada thistle at its NWTC campus. As a result of its weed management practices, the laboratory

maintained Jefferson County Nature Association Weed Management Program's highest rating for weed management at the NWTC.

In FY 2014, NREL continued to manage site landscape features in accordance with the Sustainable SITES Program requirements, and maintained certification to the program, which it received in 2013. Sustainable SITES is 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 create voluntary national guidelines and performance benchmarks for sustainable land design, construction, and maintenance practices.

The laboratory began implementation of a *Landscape Maintenance Plan*, which was developed as part of the Sustainable SITES program. The plan is intended to coordinate and plan landscape maintenance responsibilities and activities across multiple groups at the laboratory. The plan provides guidance on proper landscaping maintenance and materials use in support of:

- Plant stewardship
- Invasive species management
- Organic materials management
- Soil stewardship
- Irrigation and water use
- Stormwater management and best management practices
- Materials management
- Recyclable materials
- Landscape maintenance equipment, and
- Snow and ice management.

Property Clearance and Release

Current NREL procedures call for mitigation of any materials with radiological contamination prior to release. If any contaminated equipment is planned for removal from the site, radiation levels must be mitigated to background levels prior to removal.

Construction Waste

In FY 2014, NREL was able to divert 87% of campus construction waste from small construction projects.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Campus Waste Diversion

NREL will continue waste diversion efforts in FY 2015, and NREL's Sustainable NREL's Near-Zero Waste Committee will investigate additional measures. In FY 2015, NREL will continue to conduct on-site waste audits to analyze NREL's waste stream and identify opportunities for additional reductions. NREL will investigate options to reduce impacts associated with printer use and will work to deploy locked printing practices to decrease paper consumption campus-wide.

Chemicals

In FY 2015, as the RFID chemical inventory pilot project expands beyond the ESIF, specific chemical groups will be targeted to include time-sensitive chemicals and certain toxic materials. By tracking toxic materials closely, NREL can monitor locations and usage rates, make recommendations for the removal of aged materials, and investigate alternatives.

Pest and Landscape Management

In FY 2015, NREL will maintain NREL's Sustainable SITES certification, monitoring and documenting sustainable design practices, evaluating performance over time, and making modifications as needed.

At the NWTC campus, the laboratory will maintain the highest rating for weed management from Jefferson County Nature Association's Weed Management Program. At the STM site, NREL will work to eliminate myrtle spurge—a noxious weed identified by Colorado for eradication.

Construction Waste

Sustainable NREL will continue to track data and enforce subcontractor statement of work requirements for all construction projects in FY 2015.

MEASUREABLE GOALS

In FY 2015, NREL will:

- Task the Near-Zero Waste Committee with identifying and implementing projects to increase waste diversion as part of NREL's participation in EPA programs
- Perform on-site waste audits to analyze the waste stream and identify opportunities for additional reduction
- Work to eliminate myrtle spurge, a noxious weed identified by Colorado for eradication, from the STM site
- Continue working with staff to deploy locked printing campus-wide.

Sustainable Acquisition

Goals:

(6.1) Procurements meet requirements by including necessary provisions and clauses (Sustainable Procurements/ Biobased Procurements)

- Met sustainable acquisitions requirements in 100% of construction contracts.
- Met sustainable acquisitions requirements in 100% of custodial contracts requirements.



Members of the NREL Office of the CIO hold the Platinum Level Federal Electronics Challenge Award that they won. L-R- Jack Paterson, Mic Stremel, Bill Emerson, Peter Hathaway, John Williams, Kyle Mestas, Matt Goodnow, Kakie Atwell and Joe Beaty. Not in photo but part of the award is Greg Hoyer, Carolyn Dailey, Kurt Stromberg, Ellen Fortier, Eric Schmidt and Eric Leimkuhler.

Sustainable Acquisition

STRATEGY AND PERFORMANCE SUMMARY

NREL continues to work to implement new policies and programs that increase the acquisition of sustainable products and engage in contracts that support the objectives of Executive Order 13514. In acquiring goods and services in support of NREL and its mission, NREL is committed to environmentally preferable and sustainable purchasing that will promote the natural environment and protect the health and well-being of its employees, subcontractors, and visitors. NREL's prime contract with DOE requires that the laboratory's procurement practices be consistent with all federal green procurement preference programs.

NREL continuously seeks opportunities to share its expertise and expand the federal knowledge-base on sustainable purchasing practices. In FY 2014, NREL developed content for a webinar and summary document, which was conducted in September to the Sustainability Performance Office (SPO) via the Energy Facility Contractors Group (EFCOG) and will be posted and made available to other DOE sites.

FY 2014 PERFORMANCE STATUS

In FY 2014, NREL met sustainable acquisition requirements for this goal with 100% of construction contracts, including minor construction, congressional line item funding, and the janitorial contract.

In FY 2013, NREL implemented purchase card (PCard) and purchase request procedures to require the consideration of sustainable product alternatives before making a purchase. For those employees with a PCard, a mandatory test was created which included the purchase of EPPs. NREL monitored performance associated with these new policies and procedures through business systems, contractor tracking reports, and basic ordering agreements (BOA). NREL updated business systems to capture sustainable acquisitions information for PCard purchases. Green purchases have been defined for cardholders and include items that are EPPs:

- Products manufactured from recovered materials
- Energy-efficient products
- Biobased products
- Alternative fuels and fuel efficient vehicles
- Non-ozone depleting substances.

In FY 2014, green items represented more than 40% of overall PCard purchases. This demonstrates a substantial increase from previous fiscal years, where green items represented less than 2%—15% of PCard purchases in those years. A large portion of this increase is due to better data accuracy on green items purchased. In FY 2015, NREL will continue to explore further options to improve data accuracy for green purchases.

NREL uses locally sourced office supplies manufactured from recycled content, compostable, and biobased products. In FY 2014, NREL continued working with its suppliers to increase the availability of green office supplies as alternatives for staff, including:

- Ergonomic chairs made from recycled materials
- File folders
- Spiral notebooks
- Calendars
- Pens from recycled water bottles
- Pen refills (to reduce the amount of plastic sent to recycling).

Since 2010, NREL has been moving from the use of inefficient desktop computers toward highly efficient laptop computers. The laboratory primarily purchases light-emitting diode (LED)-backlit monitors with liquid crystal display (LCD). In NREL's BOA contracts for electronic purchases, NREL requires that vendors have the capacity to report on Energy Star and Electronic Product Evaluation Assessment Tool (EPEAT) purchases and that they report on EPEAT purchases monthly. During the contract evaluation process, NREL requires vendors to have knowledge, experience, and the ability to provide Energy Star and EPEAT products.



A recycled blue jeans product was purchased to insulate the photo studio on the STM campus as part of the sustainability plan at NREL.

Success Story

CEILING INSULATION UPGRADE USES RECYCLED DENIM

In FY 2014, NREL completed a project to upgrade the insulation in the photo studio and lobby area of the RSF A-Wing. The insulation used in the project is 90% post-consumer cotton material made from used jeans. Even with this large percentage of recycled material, the insulation still has excellent thermal insulation properties, acoustic insulation, and fire-resistant properties. The insulation was treated with an EPA-registered fungal inhibitor to protect from mold, mildew, fungus, and pests. Unlike other types of insulation, this recycled product was also safer to install and did not require the use of protective clothing or special respiratory equipment.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

In FY 2015, NREL will continue with efforts to educate employees about available green products and to encourage use of these products for daily office functions. This effort will include enhancing green product information provided to administrative staff that orders office supplies. NREL will also improve education around green purchasing for staff and investigate options to enhance business systems to improve the accuracy of data reporting in future years.

MEASURABLE GOALS

In FY 2015, Sustainable NREL will:

- Continue to update business systems reporting to improve data accuracy around green purchases
- Maintain training for PCard purchasers on definitions of EPPs.

Electronic Stewardship and Data Centers

Goals:

(7.1) All core data centers are metered to measure a monthly Power Usage Effectiveness (PUE) of 100% by FY 2015

- The RSF core data center, as well as the ESIF non-core data center, are both fully metered to monitor monthly PUE.

(7.2) Core data centers maximum annual weighted average PUE of 1.4 by FY 2015

- Averaged 1.18 PUE for the RSF core data center in FY 2014.

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

- Enabled power management on 100% of eligible devices. Some devices are exempted for research, security, or information technology purposes.

(7.4) Electronic Stewardship – 95% of eligible electronics acquisitions meet EPEAT standards

- Met EPEAT standards with 99% of eligible computers and monitors purchased.
- Met EPEAT standards with 97% of eligible electronics.

Energy Secretary Ernest Moniz (center) joins NREL Director Dan Arvizu, (right) and Steve Hammond (left) of the National Renewable Energy Laboratory in unveiling Peregrine—the newest Energy Department supercomputer capable of 1 million billion calculations per second.



Electronic Stewardship and Data Centers

STRATEGY AND PERFORMANCE SUMMARY

NREL continues to focus efforts on electronic stewardship. Using the most energy-efficient business solutions at the laboratory, including cloud computing, virtual desktops, and performance monitoring across campus, the laboratory has optimized information technology services and improved performance in this goal over the past several years. FY 2014 proved to be a year of exceptional performance for NREL's core data center in the RSF—resulting in annual weighted average power usage effectiveness (PUE) that significantly exceeded DOE goals.

FY 2014 PERFORMANCE STATUS

Data Center Operations

The primary core data center for NREL's campuses is located in the LEED Platinum-rated RSF building. The RSF data center's PUE is managed by monitoring and metering the following loads: lighting, uninterrupted power supply, power distribution units, air handling units, and chilled water. The data center's meters are connected to the RSF energy monitor for real-time visualization of data center performance. NREL reported FY 2014 energy assessment and energy profiling data for the RSF data center in the CEDR.

Average monthly PUE for the RSF data center was 1.18, which is an improvement over last year's performance of 1.20. A graph of the monthly average PUE in FY 2014 is presented below (see CEDR for additional performance details).

NREL's petaflop-scale ESIF HPC non-core data center had its first full year of operation in FY 2014. Though the ESIF HPC is not considered a core data center, it is designed to be a working model of energy efficiency—one of the most energy-efficient data centers in the world with a designed PUE goal of 1.06 or better. A full year of PUE data is not available for reporting yet, but initial data suggest that the ESIF HPC is on track to achieve its PUE goals. These data will be closely monitored in FY 2015.

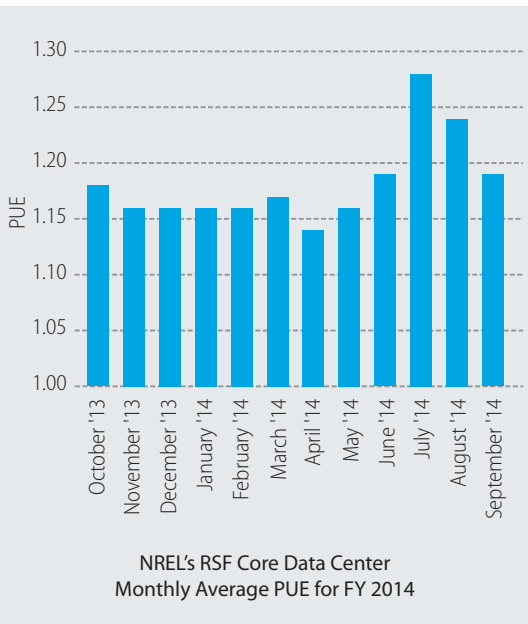
Power Management

NREL and GFO deploys power management settings on all eligible computing devices when they are issued to staff. NREL also continuously monitors the power usage of plug loads at the workstation level in its ESIF.

In FY 2014, NREL performed a study of power management settings on campus, particularly in areas with older computers. This study was piloted first in NREL's SERF through the use of state-of-the-art power strips that allow metering and control of plug loads at each desk. Data from the study of the entire lab highlighted the need for NREL to re-examine its computer power management settings on its campuses. More than 3,400 laptops and desktops were analyzed, and, as a result, preliminary policy recommendations were developed for NREL's campus that could potentially save more than 11,000 kWh per year. NREL will continue to study current settings and finalize recommendations.

Purchasing and Disposition Practices

NREL has long-established standards for computing equipment, which take into account sustainable acquisitions and operations best practices as well as business need. NREL also directs purchases for eligible equipment through vendors who have knowledge of EPEAT and can offer equipment that can meet and exceed EPEAT's stringent standards. Eligible requests for new equipment are vetted for adherence to these standards, and purchases are directed through small business vendors who meet these requirements. By establishing this standards and





Pumps provide cool water to the server racks in the ESIF HPC data center. Traditional direct expansion cooling is not used.

review process, NREL is able to direct the vast majority of its computing equipment purchasing toward EPEAT-compliant models and options. In FY 2014, 99% of eligible computers and monitors purchased were EPEAT compliant. Of those, 98% were certified gold, 2% were silver, and less than 1% was bronze. Overall, 97% of NREL's purchases of eligible, EPEAT-registered equipment categories—including computers, monitors, tablets, imaging equipment, and televisions—were compliant.

In reviewing purchasing data from FY 2014, NREL discovered that these policies do not fully address imaging equipment and televisions, which were incorporated into the EPEAT registry in FY 2013. Because the EPEAT standard for this equipment is relatively new, the compliant options considered acceptable do not meet EPEAT's standards. As a result, only 40% of televisions and 73% of imaging equipment purchased were EPEAT compliant.

In FY 2014, NREL received the gold level GreenBuy Award, achieving excellence in sustainable acquisitions for FY 2013 efforts. This is the third year in a row that NREL has achieved the gold-level recognition. To achieve this award in FY 2013, NREL met the goals of 13 products in 6 different categories. NREL continues to participate in the EPA Federal Green Challenge (FGC) and WasteWise programs to support federal waste prevention and resource conservation.

Other projects in FY 2014 included using a database to track lifecycle data for electronic equipment; ensuring the environmentally friendly disposal of electronics, and reviewing and revising policies to make NREL's information technology environment even more energy efficient. NREL is committed to using environmentally sensitive practices for the life cycle of electronic equipment. To fulfill this commitment NREL uses Metech, an environmentally sound electronics recycler, to dispose of all equipment that is not donated

Success Story

NREL JOINS THE BETTER BUILDINGS CHALLENGE ON DATA CENTERS

In FY 2014, NREL joined 18 other partners in the President's Better Buildings Challenge on data centers. As a partner, NREL has committed to reducing energy use in data centers by 20% and to improve efficiency and infrastructure across the laboratory. During the first year as a partner, NREL will share results, report on energy and cost savings, and develop an energy metering plan, a showcase project, and an implementation model.

Steve Hammond, NREL's director of the Computational Science Center, was asked to participate in a panel discussion entitled "Leader Strategies and Examples for Combating Data Center Energy Growth," at the GreenGov event September 30, 2014, hosted by the CEQ and the Office of Management and Budget.

This dialogue highlighted data center leadership in the Better Buildings Challenge. Hammond was asked to specifically discuss the initial barriers NREL was able to overcome with their own data center, as well as plans for future improvement. Hammond and his colleagues discussed how best to drive greater efficiency in federal data centers and pledged to apply energy efficiency and energy management strategies to reduce data centers electric use.

or resold at the end of its useful life. Each year, NREL participates in the Federal Electronic Challenge to ensure that the laboratory meets or exceeds the electronic equipment requirements of Executive Order 13514 for the full-cycle management of computers, laptops, monitors, printers, fax machines, and television set purchases. With the dissolution of the Federal Electronics Challenge in FY 2013, NREL will now focus its efforts as a member of the FGC and will report on the laboratory's electronic stewardship initiatives through the FGC.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

NREL continues to incorporate sustainability and leadership by example in the strategic plan, leveraging the use of cloud computing by identifying, evaluating, and implementing cloud-based solutions.

The past several years have included major shifts from outdated systems that were significant energy consumers to a focus on efficient computing equipment and staff education on green information technology practices. In FY 2015, NREL will continue to focus on maintaining sustainable practices and mentoring other organizations about green data centers and electronic stewardship.

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. NREL will also look for opportunities to share information and best practices associated with the new ESIF HPC.

Purchasing and Disposition Practices

During FY 2015, NREL plans to establish standards for televisions and to revise standards for imaging equipment to bring them in line with existing technologies—and to specifically reference EPEAT compliance. The laboratory will also continue to coordinate efforts between the IT and procurement department to ensure that all eligible purchases are reviewed against the laboratory's standards and that EPEAT-compliant equipment is purchased where available. These efforts are expected to increase the laboratory's overall percentage of eligible, EPEAT-compliant purchases.

Measureable Goals

In FY 2015, NREL will:

- Exceed the DOE goal of 1.40 PUE with an objective of obtaining a PUE of 1.20 or better for the RSF, core data center
- Report electronics purchasing data to FGC
- Reduce nighttime plug loads in the office wing of ESIF by using state-of-the-art power strips
- Begin reporting data center information in DOE's Green IT program (DOEGRIT)
- Increase NREL's overall percentage of eligible, EPEAT-compliant purchases.

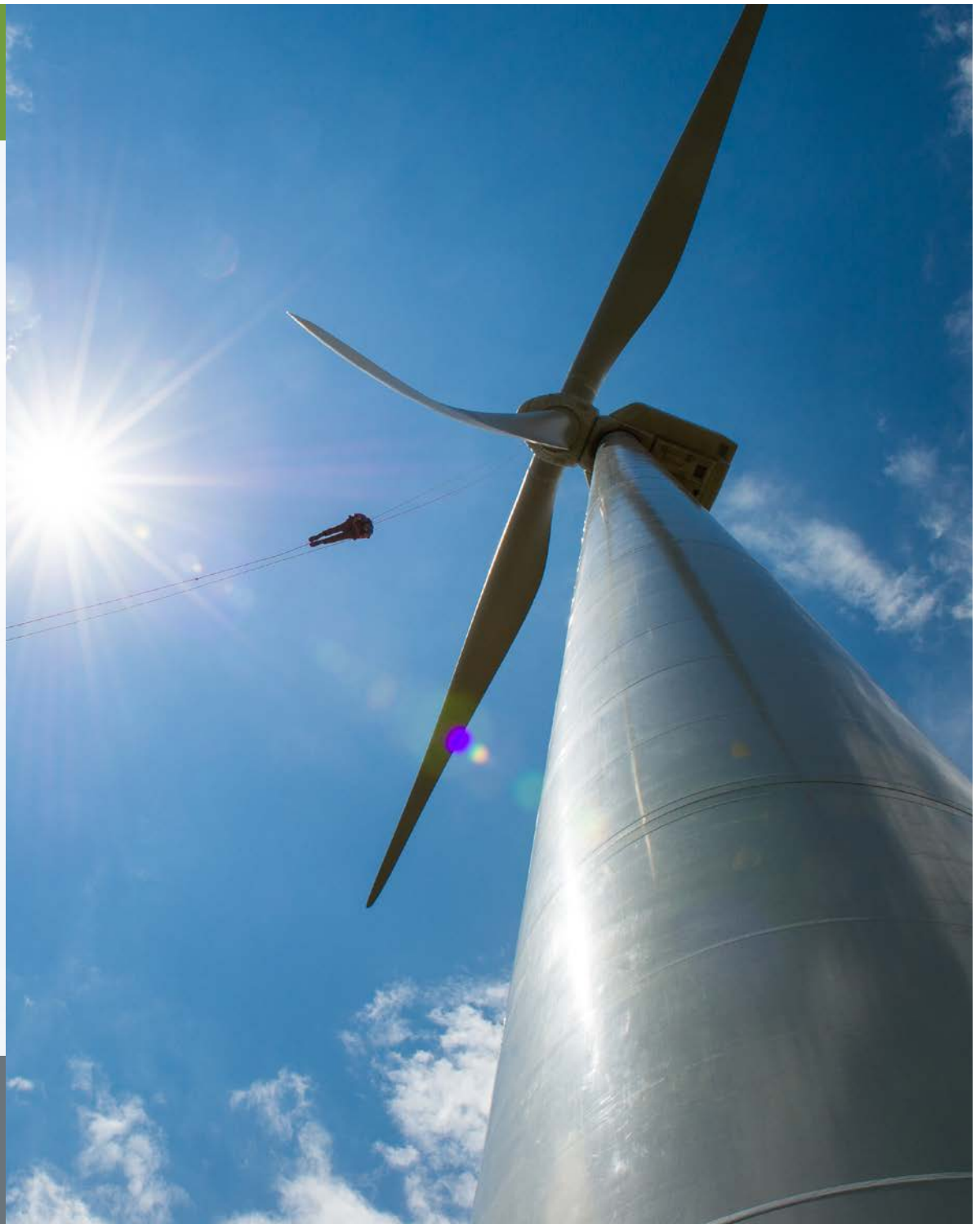
Renewable Energy

Goals:

(8.1) 20% of annual electricity consumption from renewable sources by FY 2020 and thereafter

- Generated 20% of total electricity on-site in FY 2014.

Pete Johnson of Gemini Rope Access Solutions inspects the blades of a 3 MW Alstom wind turbine by rappelling down the blades. The turbine is undergoing testing at the NWTC, in Boulder, Colorado.



Renewable Energy

STRATEGY AND PERFORMANCE SUMMARY

NREL strategically employs the use of energy-efficient technologies to the extent possible to reduce campus energy demands, leveraging on-site renewable energy systems to minimize the need for grid power. With a laboratory mission to advance energy efficiency and renewable energy, NREL strives to exceed on-site renewables requirements. The laboratory's goal is to lead by example in the use of renewables on campus—using PPAs, ESPCs, and RECs to make prudent use of taxpayer dollars.

FY 2014 PERFORMANCE STATUS

NREL's PV and wind system performance far exceeded federal requirements for on-site electricity generation in FY 2014 with 4.5 MW of on-site PV and 10.2 MW of on-site wind systems installed on campuses—providing 20% of the electricity needed for operations at the laboratory. In FY 2014, NREL PV systems alone generated a total of 6,248 MWh of renewable energy.

SunEdison Origination, LLC, (SunEdison) installed and currently owns and operates an 8-acre PV solar array on an easement provided by DOE on the western portion of the NWTC site. The 1.08 MW array provides power to the on-site facilities side of the NWTC's electrical system circuit. The PV array is metered and the power produced offsets a portion of NREL's energy consumption. A 20-year solar power and services agreement between SunEdison and DOE's Western Area Power Administration (Western) was established on December 31, 2008. Western purchases power

generated from the PV array, and then sells it to the GFO for use at the NWTC, through a 30-year intra-agency agreement that was executed on December 29, 2008. As part of the agreement NREL does not retain the RECs associated with this system.

In FY 2014, four utility-scale wind turbines were operating at the NWTC, including the DOE-installed 1.5 MW General Electric turbine. The other three turbines are operated by various manufacturers under CRADA and are rated at 2.3 MW, 3.0 MW, and 2.0 MW. NREL retains the RECs from small and mid-size research turbines as well as the DOE turbine, and purchases replacement RECs from the 2.0 MW and 3.0 MW manufacturers. The power generated from the turbines under CRADAs is generated on-site at NREL but transmitted directly to the grid. Therefore, the power from these turbines operated under CRADAs is not considered on-site generation. In FY 2014, on-site wind generation from the DOE and other research turbines yielded 645 MWh.

NREL's on-site thermal installation, the RFHP, produced 18,041 million Btu (MMBtu) of thermal energy in FY 2014, offsetting 28% of campus natural gas demands and 45% of NREL district heating demands. The RFHP typically uses forest thinnings from Front Range Healthy Forest Initiative activities and other wood wastes to displace natural gas usage for space heating on NREL's STM campus. NREL maintains a fixed cost supply contract for the RFHP.

To achieve Scope 2 carbon neutrality and meet LEED requirements, NREL purchases RECs through the Western Federal Agency Master Purchase Agreement each year. The RECs purchased under this agreement are from renewable energy projects installed after January 1, 1999. All REC request proposals give preference to tribal majority-owned business organizations that use a best-value approach to support DOE's preference for tribal renewable energy and efforts to promote tribal renewable energy development.

FY 2014 ON-SITE RENEWABLE ENERGY PRODUCTION

Source	Energy Produced (MWh)	Energy Produced (MMBtu)	Percentage of Total Electricity Use	Percentage of Thermal Energy Use (Natural Gas)
Electricity from solar	6,248	21,319	18%	N/A
Electricity from wind	645	2,201	2%	N/A
Renewable thermal energy	N/A	18,041	N/A	28%
On-site total	6,893	41,561	20%	28%

Success Story

FROM ASHES TO FUEL

This past year, NREL's RFHP repurposed 2,000 tons of fire salvage wood as fuel. In March 2012, the Lower North Fork fire burned for a week, resulting in the tragic deaths of 3 people, the destruction of 24 structures, and a burn area of 4,140 acres near Conifer, Colorado.

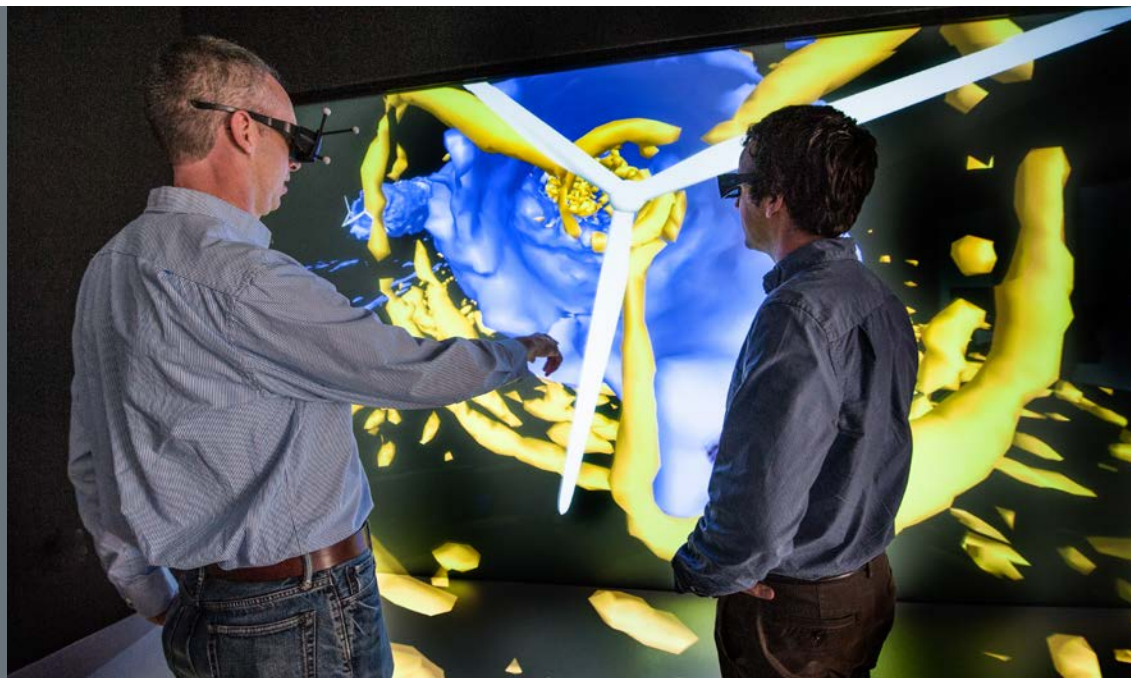
The trees harvested for use at NREL were not only fire salvage but beetle kill pine trees. To mitigate future fire risks in this area, these trees were harvested and put to good use at NREL's RFHP facility. The use of fire salvage wood as fuel repurposes a material with no other use while supporting fire mitigation efforts in the state.

In FY 2014, the RFHP displaced 18,041 MMBtu of natural gas at the NREL campus. In the upcoming FY 2015, NREL plans to use waste from sawmills to fuel the RFHP.

Below is a photograph of the wood salvaged from the Lower North Fork fire. The wood was processed into wood chips then used to fuel the RFHP. The photo to the right illustrates the initial loading of the wood chips entering the RFHP. These two photographs highlight NREL's dedication to maintaining a sustainable supply chain throughout the process of fueling the wood chip plant.



NREL senior engineering project manager Pat Moriarty (left) and NREL senior engineer Paul Fleming review velocity (blue) and turbulence (yellow) in a simulation of the Lillgrund Wind Farm in Denmark in the Visualization Laboratory in NREL's ESIF. The researchers have written open-source software that simulates wind farm conditions.



In FY 2014, NREL continued discussions with electric and gas utility provider Xcel Energy to expand its Wind Source program in efforts to provide a wind energy option to NREL and other federal agencies. Xcel Energy has expressed a desire to offer its customers an electricity product to meet their environmental goals; they are awaiting clarification from DOE as to whether RECs or some other green electricity product fulfills Executive Order 13514 requirements.

In addition, NREL is exploring options to purchase renewable natural gas from a biomethane plant operated by EDF Renewable Energy in Weld County, Colorado. This gas is pipeline quality, and transport would use existing gas infrastructure to transport the biomethane as well as the same business practices applied as when buying transport gas.

In another FY 2014 solar effort, NREL conducted a study to host a solar garden installation at the NWTC. NREL identified 10 acres of suitable land at the southwest side of NWTC bordering the Lafarge Company cement kiln plant. The solar garden developer investigated Xcel grid connection costs but decided the venture was not feasible. A solar garden cannot connect directly to the NWTC electrical distribution system due to the limited capacity of the system and the fact that it would exceed the allowable limits of the interconnection agreement with Xcel Energy.

NREL created an on-site renewables master plan as part of developing a tactical milestone plan to offset current and projected electricity campus consumption. This study investigated available land with appropriate attributes within the

STM campus boundary that would increase the installation of NREL's on-site renewable systems. The plan proposes three different systems; roof mounted, ground mounted, and canopy supported. Of the total potential for installation of 4.5 MW, 4 sizeable projects equaling 2 MW emerged as short-term priorities within the next 5 years. Using Re-Opt software, the laboratory conducted a financial assessment to illustrate how financially feasible the projects would be as well as to explore potential funding mechanisms. If the PV arrays were sizeable, a potential PPA agreement could be attractive. NREL will enter into negotiations with Xcel to gain approval to proceed with PPA third party supplier.



SULI intern Kathleen Gegner works with NREL electrical engineer Michael Kuss testing electric vehicle supply equipment at the Vehicle Testing Integration Facility at NREL.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

NREL will continue to build on-site renewable energy capacity, leveraging alternative financing mechanisms to make projects cost effective. With each new building addition, NREL designates space for on-site PV. For example, as funding becomes available, NREL plans to install another 270 kW of PV to complete the rooftop PV array for the parking garage.

Wind turbines and other energy-generating facilities at the NWTC will continue to contribute power to the local electrical distribution system as a natural byproduct of the research and testing activities on site. The current NWTC electrical generation capacity is 10.2 MW. However, turbine operations are curtailed to stay below an existing 10 MW generation limit in accordance with an agreement with Xcel Energy,

the local electric and natural gas company. As a result, some turbines must be shut down when others are operating. The maximum combined rated electrical generation capacity for the NWTC site for the next five years is estimated to increase up to 30 MW. The NWTC plans to upgrade existing electrical infrastructure on site and add an interconnection to the local utility, including a new higher voltage electrical service (transmission) to accommodate a total of 50 MW of on-site electrical generation capacity. Plans in place to expand the electrical service infrastructure at NWTC could allow for greater production but will not be fully operational before 2018.

FY 2014 was a high point for NREL's renewable energy as a percentage of total power use; as campus growth continues to increase energy demands on site, the installed renewables generation ratios will diminish.

NREL is committed to displacing natural gas used for building heat with the biomass fueled RFHP. The laboratory is working with the Energy Services Company Ameresco Federal Solutions on performing combustor improvements that are projected to increase annual heat production by 50%.

MEASURABLE GOALS

In FY 2015, NREL will:

- Explore options to increase renewable energy use, specifically biomethane and off-site wind
- Investigate the installation and cost structure of a PPA with a third party for multiple PV arrays—and seek approval from Xcel Energy
- Increase the annual heat production of the RFHP.

Climate Change Resilience

Goals:

(9.1) Climate Change Resilience

- Initiated climate resilience planning, including:
 - Determining key objectives
 - Engaging stakeholders
 - Developing a timeline



Energy efficient vehicles and their owners parked in front of NREL's Research Support Facility.

Climate Change Resilience

STRATEGY AND PERFORMANCE SUMMARY

With the potential for temperature increases, more frequent droughts, flash flooding, disease outbreaks, heat waves, floods, and winter storms, climate change has the potential to create additional challenges for NREL operations. Recognizing the increasing importance of current and future climate, NREL is proactively engaged in planning efforts to identify and manage site-specific climate risks, develop options for adapting to climate change, and improve NREL's resiliency in the face of climate change.

FY 2014 PERFORMANCE STATUS

NREL launched climate resilience planning efforts in FY 2014. Through the planning process, the laboratory will develop a general understanding of relevant climate science, translate that science into site-specific climate change vulnerabilities, evaluate the associated risks to NREL's operations and mission, and then develop strategies to address the risks.

Planning efforts place emphasis on identifying options for resiliency that cut across NREL's operations and program areas. This integrated approach will create strategies that reduce potential climate change impacts, increase efficiency, and minimize vulnerabilities throughout the laboratory.

Through the planning process, NREL intends to establish a framework that will be continually reviewed and updated with new impacts and risk determinations as needed. As information is collected, it will enhance ongoing and existing planning and preparedness efforts at the laboratory.

NREL envisions that this process could be replicated and used at other DOE sites. As part of the project, NREL is documenting the process using methods that could be tailored to meet the needs of individual sites as they undergo their own climate vulnerability assessments and planning efforts.

Key Project Objectives

- Identify the key climate-related risks to NREL's key resources.
- Identify and prioritize adaptation options that will minimize climate change impacts to NREL.
- Increase NREL's internal capacity to address climate change.

Process and Methodology

To achieve these objectives, NREL is working with a contractor to conduct the vulnerability analysis and create an adaptation and resiliency plan. The process and key elements of the methodology are outlined in this section; in practice many of the tasks are occurring in parallel.

Determining Risk

To perform the vulnerability analysis, a risk-based approach is being used to identify where NREL may be at risk from future changes in climate. This process includes:

- Identifying key NREL organizational objectives and resources that may be affected by climate change
- Identifying climate variables critical to the key resources and research the latest scientific knowledge about those variables
- Identifying, comparing, and analyzing climate risks using a risk management framework.

Building Resilience

After identifying NREL's key vulnerabilities, the project team will evaluate risks and identify and prioritize adaptation options that will build resiliency at the laboratory.

These options will involve managerial or infrastructure actions that can be taken now or in the future to reduce either the consequence or the likelihood of the risk, should climate impacts occur. The laboratory will prioritize options by such factors as cost, technical and political feasibility, and/or speed of implementation—resulting in a portfolio of actions for near-term and long-term implementation. Some action items may require participation or leadership from entities outside of NREL's control. In these cases, NREL will focus on engaging and encouraging those entities to consider climate change impacts in their own planning, where feasible.

NREL employees check out some electric and hybrid vehicles owned by fellow NREL employees as part of Earth Day events at NREL.



Stakeholder Engagement

NREL is engaging internal and external stakeholders to gain information and build consensus on climate vulnerabilities, organizational risks, and resiliency options. Stakeholder representatives will be involved throughout the process to ensure that the final recommendations are inclusive, representative, and achievable. Finding solutions that are acceptable and implementable by stakeholders is a priority. Identified stakeholder groups are described below.

Steering Committee

An internal Steering Committee has been assembled to provide overall project guidance, high-level information, and insight on potential climate stressors and impacts to NREL's operations and mission capabilities. The Steering Committee consists of key decision makers, senior managers, and directors from a representative cross-section of the laboratory.

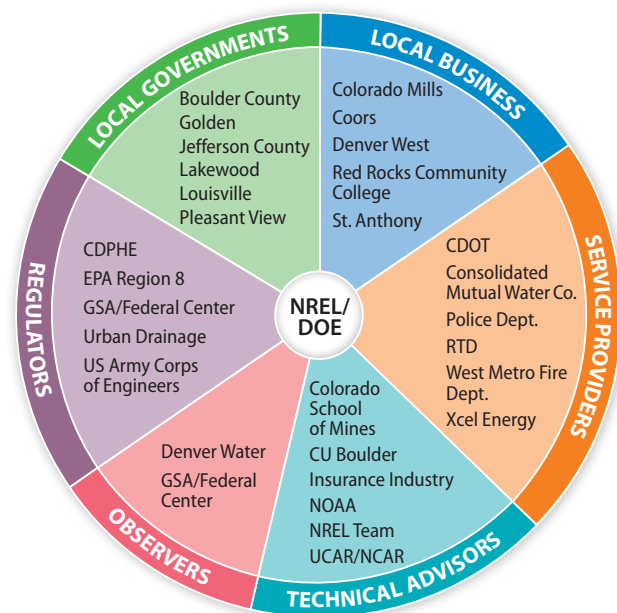
Internal Technical Work Groups

Key technical staff grouped according to their areas of expertise comprise internal technical work groups. NREL conducted interviews with these groups to obtain technical information on processes, operations, and facilities that are currently being impacted by climate or could be through climate changes.

External Stakeholders

Recognizing that some of NREL's greatest vulnerabilities stem from the actions of external stakeholders who control the supply of water, energy, and other fuels and materials, the project team is conducting a series of interviews with key external stakeholders. The interviews will be used to share information about the project, enquire about their climate preparedness efforts, and obtain their insights into NREL's resiliency options.

NREL's Climate Change Resiliency Planning Sphere of Influence



Project Outcomes

1. Climate Change vulnerability assessment: risk-based evaluation of impacts to services, infrastructure and operations
2. Climate Change Resiliency Action Plan

NREL CLIMATE RESILIENCY PLANNING EFFORT: PROJECT TIMELINE

	June	July	August	Sept	Oct	Nov	Dec
Communication and consultation	ONGOING						
Establish scientific basis for climate change	ONGOING						
Establish context for the vulnerability assessment		COMPLETE					
Identify risks				COMPLETE			
Compare risks					UNDERWAY		
Analyze risks					UNDERWAY		
Report findings and recommendations (vulnerability assessment)					UNDERWAY		
Evaluate risks					UNDERWAY		
Identify resiliency options							
Prioritize list of resiliency options							
Report findings and recommendations (adaptation strategies)							

DOE Climate Change Adaptation Screening Assessment

NREL has completed the DOE online screening assessment. The project team will use information obtained in the survey, in conjunction with the information obtained through the vulnerability assessment and resilience plan, as a focus for additional adaptation planning efforts.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

Project Timeline

A project timeline is provided below. NREL anticipates completing the vulnerability assessment and adaptation resiliency plan by the end of first quarter FY 2015.

Long-Term Regional and Local Coordination

NREL recognizes that climate change impacts, and successful adaptation strategies that build resilience, extend beyond the organizational control and geographic boundaries of NREL. Therefore, coordination with surrounding communities is critical. In addition to the outreach that is taking place as part of the vulnerability assessment described above, NREL plans to engage external stakeholders in a regional symposium when the vulnerability assessment and resilience plan development conclude (See Sphere of Influence graphic). The intent is to share what has been learned through the process, learn what community partners are doing to plan for climate change,

and identify opportunities for local partnerships and cooperation. The goal of the symposium is to initiate a long-term dialogue to improve the collective understanding of climate change science, share best practices and data, and establish regional coordination in adaptation planning and policy.

Stewardship in Climate Change Resilience Planning

In addition to the efforts focused on NREL campuses, NREL has provided renewable energy and energy efficiency technical assistance in response to several climate disaster events, including the Greensburg, Kansas, tornado; floods in Galena, Arkansas, and Colorado; and hurricanes in New Orleans, Louisiana, New York, and New Jersey. NREL's disaster recovery

NREL Director Dan Arvizu (left) shakes hands with Todd D. Stern, Special Envoy for Climate Change at the State Department, after a visit to NREL.



team has provided technical assistance for improving resistance and resiliency (e.g., through microgrids, building efficiency, islanding capabilities, vehicle fuel diversification, incorporating renewable energy); planning for secure, sustainable, and safe communities; and establishing policies and codes that support sustainability, security, and safety. Post disaster, NREL has worked with communities to identify disaster recovery and rebuilding opportunities to incorporate energy efficiency, water and fuel conservation, sustainability, and renewable energy measures; deploy on-site technology demonstrations (e.g., emergency back-up power); and design sustainable, resilient buildings or infrastructure projects.

Energy Performance Contracts

Goals:

(10.1) Utilization of Energy Performance Contracts

- To date, NREL has initiated one ESPC project for the RFHP and installed 2.35 MW of PV using PPAs.

Installing solar panel mounting clips to the standing seam roof of RSF-A wing avoids roof penetrations, mitigates water leakage, and saves both labor and material costs compared to typical unistrut and purlin framework.



Energy Performance Contracts

STRATEGY AND PERFORMANCE SUMMARY

To support campus energy efficiency and renewable energy projects and make prudent use of taxpayer dollars, NREL pursues alternative financing mechanisms such as PPAs, Utility Energy Service Contracts (UESC), and ESPCs to the extent possible. To date, NREL has initiated one ESPC project for the campus RFHP and has installed 2.35 MW of PV using PPA agreements.

FY 2014 PERFORMANCE STATUS

As opportunities arise to implement ECMs, deploy additional on-site renewables, and construct new high-performance buildings, NREL investigates appropriate mechanisms to finance these projects—including alternative finance. Currently, NREL has a substantial list of opportunities for energy reduction that could potentially be bundled into an ESPC. In the past year, NREL has been working with FEMP to evaluate using an ESPC to fund campus energy-efficiency improvements. So far these funding mechanisms have not led to an agreement. NREL will continue discussions with FEMP to evaluate and determine the best approach for financing these projects.

PROJECTED PERFORMANCE GOALS AND STRATEGIES

In FY 2015, NREL will continue to investigate new financial mechanisms in addition to REC sales and utility rebates, looking for new opportunities to fund energy and water conservation projects. NREL will also continue to explore the possibility of using an ESPC to fund campus energy efficiency improvements.

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Photos by Dennis Schroeder: cover, NREL 32282; page i, NREL 29194; page 1, NREL 28816; page 2, NREL 28840; page 4, NREL 30718; page 14, NREL 32220; page 16, NREL 28209; page 17, NREL 30739; page 19, NREL 29870; page 20, NREL 22299; page 22, NREL 27792; page 25, NREL 25396; page 26, NREL 26906; page 27, NREL 31164; page 29, NREL 31827; page 30, NREL 30200; page 33, NREL 32152; page 36, NREL 32160; page 37, NREL 26208; page 40, NREL 27612; page 41, NREL 32222; page 46, NREL 28803; page 48, NREL 32224; page 49, NREL 27496; page 51, NREL 31233; page 53, NREL 27198; page 56, NREL 31412; page 57, NREL 25037; page 58, NREL 32193; page 60, NREL 29890; page 62, NREL 23707; page 63, NREL 31139

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Office of Energy Efficiency and Renewable Energy
Operated by the Alliance for Sustainable Energy, LLC

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