NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Annual Sustainability Report FY 2014

INCORPORATES NREL SITE SUSTAINABILITY PLAN

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.

ACKNOWLEDGMENTS

Going beyond performance goals, objectives, and strategies, the *Sustainable NREL Annual Sustainability Report, Fiscal Year 2014* reflects the human side of sustainability. The National Renewable Energy Laboratory's (NREL's) "living laboratory" culture embodies the value of employee participation to create the most sustainable environment possible. NREL successfully integrates sustainability into every aspect of its mission to deliver clean energy solutions to the nation.

I'd like to acknowledge NREL staff for engaging in initiatives that minimize our carbon footprint and reduce waste and pollution. And I would especially like to acknowledge those who collaborated on producing this report to tell the Sustainable NREL story.

Thanks to the many managers and staff members who provided technical content, data collection, and communication support, including the Sustainable NREL (SNREL) staff; Communications & Public Affairs; Environment, Health & Safety; SITE Operations; Human Resources; Finance; General Counsel; and Internal Audit.

Special thanks to our annual report champion, Michelle Slovensky, who also served as the primary author and Suzy Belmont, who diligently kept the project and the team on track. Thanks also to additional authors: Nika Durham, Soudeh Motamedi, Gary Schmitz, and Ernie Tucker. Leigh Ramsey of Communications & Public Affairs provided project management support and production designer Stacy Buchanan created the report design.

Their efforts have heightened NREL's transparency and level of socially and environmentally responsible reporting.

Frank Rukavina, Sustainability Program Director,
Chief Sustainability Officer

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Sustainable NREL

ANNUAL REPORT FY 2014

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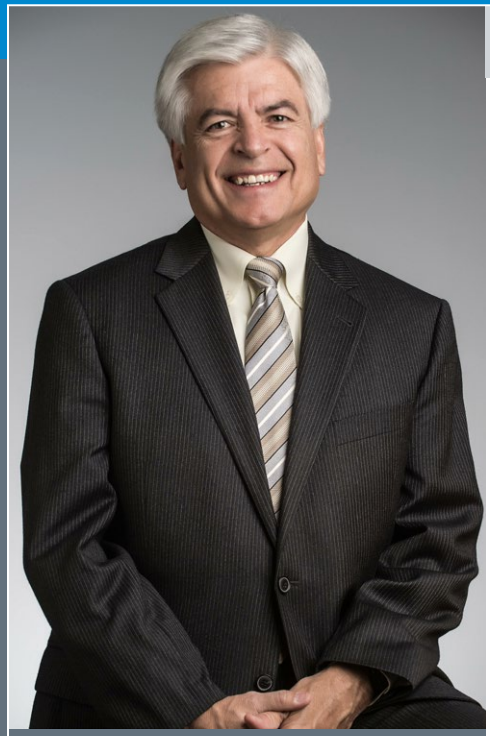
Members of the National Renewable Energy Laboratory's (NREL's) Energy Executives class learn about wind turbines as they tour the National Wind Technology Center (NWTC).

Cover photo: Members of NREL's Energy Executives class tour the High-Flux Solar Furnace at NREL's Solar Radiation Research Laboratory (SRRL) on the South Table Mountain (STM) campus.

NREL's vision is to develop a robust and sustainable integrated energy system across electricity, thermal, and fuel energy pathways.

NREL engineer Greg Martin (left) works with Solectria engineers Jonathon Smith and Jihua Ma to test Solectria's SmartGrid Inverter at the Power Systems Integration Lab at the Energy Systems Integration Facility (ESIF).



Message From the NREL Director

NREL's reputation for leadership in clean energy research is something we're all justly proud of. It is, after all, our central mission. But over the years we've also strived to carry out this important work in the most resource-efficient and responsible ways possible.

These efforts have provided a positive return on our investments. Today, more than ever, I'm seeing that our leadership in sustainability goes beyond demonstrating that we "walk the talk" when it comes to the environment. Our commitment to sustainable practices across the laboratory has also given us the opportunity to prove new technologies and concepts, and better understand how they can be effectively integrated into existing systems.

The laboratory's sustainability group plays an important role in that regard. It is a resource, advocate, and facilitator in meeting the lab's sustainability initiatives, oftentimes working with researchers to validate innovations here on our own campus before they're widely adopted in the marketplace.

Our "Campus of the Future" has become a living laboratory. Here we push the envelope of enlightened energy and resource use. We demonstrate that clean technology works in the real world by revealing how these advanced technologies help the environment, while simultaneously increasing efficiency and adding value to our business.

We are also exploring how our pioneering role in systems integration—a holistic approach to fusing diverse components of human and natural systems to achieve optimum performance—can be fully utilized on behalf of sustainability goals.

And we're gratified that corporations and other organizations in the United States and around the globe are embracing many of the sustainable principles that have guided our work here at the laboratory.

NREL's sustainability leadership is well recognized, as it should be, but we can't rest. Our laboratory is creating a roadmap—and test-driving it right here—to show companies, organizations, governments, and families how to find their own paths toward a sustainable energy future.

—Dan E. Arvizu, NREL Director

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Sustainability and the NREL Mission

The SNREL team has expertise in a variety of areas of sustainability and is committed to working with NREL staff to ensure sustainable laboratory operations. From left to right, Lissa Myers, Mike Sheppy, Soudeh Motamedi, Ellen Fortier, Frank Rukavina, Chris Gaul, Suzy Belmont, Michelle Slovensky, and Denise Zele.

As the nation's primary federal laboratory dedicated to the research and development (R&D), commercialization, and deployment of renewable energy and energy efficiency, NREL embeds sustainability in all core competencies. While NREL strives to fulfill the mission to advance the science and technologies needed for the nation's energy security and economic prosperity, the laboratory also cultivates a climate of sustainability that is modeled on NREL's campuses.

NREL successfully promotes sustainable laboratory operations by maintaining a collaborative team of professionals to manage energy and sustainability performance: SNREL uses dedicated funding to take an integrated management approach, using engineering, administrative controls, and behavioral changes to integrate sustainability across the laboratory.

SNREL is responsible for upholding all executive orders, federal regulations, U.S. Department of Energy (DOE) orders, and goals related to sustainable and resilient facility operations. But NREL continues to expand sustainable practices above and beyond the laboratory's regulations and requirements to ensure that the laboratory fulfills its mission into the future, leaves the smallest possible legacy footprint, and models sustainable operations and behaviors on national, regional, and local levels.

By approaching sustainability as a holistic and synergistic network, as opposed to multiple singular initiatives, linkages and associated benefits are synthesized to optimize outcomes. These collective sustainable strategies address consumption and adaptability within the energy-water nexus and improve NREL's resiliency.

Jennifer Daw, Sheila Hayter, and Rachel Romero of the Integrated Applications Center (IAC) discuss a current IAC project. SNREL works closely with a variety of partners across the laboratory, especially those on the deployment side, to incorporate new and evolving sustainability efforts into the living laboratory efforts at NREL.

Why does NREL integrate sustainability into its business operations?

Sustainability is essential to building a robust business culture of financial health, environmental accountability, and social wellness that enables an organization to thrive over the long term. Integrating sustainability into NREL's business operations addresses potential impacts, reduces risk, cultivates awareness, and delivers value.

NREL has attained multiple benefits from this approach:

- **Disclosure**—SNREL provides transparent, relevant, and verifiable data to reveal NREL's organizational performance and its role in developing leading solutions to the challenge of building a low-carbon and climate-resilient economy. Communicating these efforts and results elevates the awareness of NREL's internal and external stakeholders.
- **Successful Business Management**—SNREL creates a long-term strategic and short-term operational plan that integrates immediate tactics and milestones that are critical to achieving the overall sustainability mission of the laboratory.
- **Commitment to Sustainability**—Internally communicating the role of sustainability within the NREL culture allows staff to feel pride in their organization and understand the value of their participation in achieving sustainability goals. Through external communications with industry partners, NREL sets expectations of how the mission is executed. This heightens the laboratory's brand recognition, increases and sustains incoming revenue sources, and demonstrates leadership by influencing the broader community in its practices and choices as a consumer. By communicating to its federal partners NREL demonstrates the staff's shared commitment to their environment and to legislative and legal requirements.
- **Reinvestment in Facilities and Programs**—Sustainable actions have resulted in cost-savings that can be captured and reinvested to further improve the efficiency of facilities.
- **Drives Innovation**—Collaboration across NREL's organizational boundaries integrates operation and research staffs' capabilities to generate unique project strategies.

In the following chapters of this report, SNREL highlights FY 2014 performance achievements, shares NREL's challenges for meeting future targets, and presents conversations with valued NREL stakeholders who use integration as both a process and a tool for achieving sustainability.

The eastern edge of NREL's STM campus.

NREL Deputy Directors Kenneth Powers, Laboratory Operations; Bobi Garrett, Strategic Programs and Partnerships; and Dana Christensen, Science and Technology, are executive sustainability champions who foster staff participation to attain measurable gains in sustainable initiatives.

Standard Disclosures

NREL ORGANIZATIONAL PROFILE

The Alliance for Sustainable Energy, LLC (Alliance), equally owned by Battelle and MRIGlobal, is the management and operating contractor for NREL. The Alliance is fully accountable to DOE for NREL's performance over a 5-year contract period that began in October 1, 2008 and was extended through September 30, 2017.

The Alliance's roles are to build on the strong foundation that NREL has built over the last 38 years, ensure the success of the laboratory's strategy to advance innovation across the clean energy portfolio, and push the frontiers on related science. This is accomplished through:

- R&D initiatives that extend the impact of the laboratory beyond its baseline program roles for DOE's Office of Energy Efficiency and Renewable Energy (EERE)
- Foundational capabilities that underpin NREL's research, deployment, and analysis.

Research and Development Initiatives

The Alliance works with EERE to advance the office's strategic goals. While the roles of the laboratory vary across each program, all of NREL shares a commitment to bringing clean energy technologies to the commercial market and enabling them to scale within the nation's energy infrastructure.

Through this strategy for NREL, the Alliance aims to enable a transformation of energy systems that will support energy security and a vibrant economy and ensure stewardship of the environment.

The Alliance's efforts toward high mission impact require strategies that cut across individual programs and initiatives and bring a sharp focus to the primary mission of the laboratory. This is accomplished by:

- Creating an environment that stimulates creativity and that yields advances in foundational knowledge and market-relevant innovations that have potential for high impact
- Connecting the knowledge and know-how of the laboratory to the marketplace through partnerships that enable and amplify the impact of NREL's efforts.

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.

The Alliance also enables mission accomplishment through strategies to strengthen NREL's distinctive technical competencies and its operations, both of which provide a foundation for delivery. NREL's crosscutting strategies are applied to the laboratory's five major mission areas:

- **Energy Systems Integration**
- **Sustainable Transportation**
- **Renewable Generation**
- **Energy Productivity**
- **Strategic Analysis and Market Engagement.**

Foundational Capabilities

Underlying NREL's ability to produce mission outcomes are eight foundational capabilities that support the programs within the EERE portfolio:

- Materials Science and Engineering
- Chemical and Molecular Science
- Biological and Bioprocessing Science and Engineering
- Chemical Engineering
- Mechanical Design and Engineering
- Power Systems and Electrical Engineering
- Systems Engineering and Integration
- Decision Science and Analysis.

NREL's distinctive competencies combine foundational capabilities and scientific expertise; deep domain knowledge of the behavior of clean energy resources, technologies, and systems; and an understanding of energy markets and policies. This combination of these capabilities with the knowledge that has resulted from nearly four decades of experience sets the laboratory apart and makes it a valued partner for industry and government. These integrated competencies enable advancement of knowledge and delivery of information and innovations to meet market-relevant performance and cost targets.

Directorates Demonstrate NREL's Leadership in Sustainability

In FY 2014, NREL had three directorates: Strategic Programs and Partnerships, Science and Technology, and Laboratory Operations. Together with associated offices and programs, these directorates helped accelerate the advancement of renewable energy and energy efficiency technologies.

Strategic Programs and Partnerships

NREL's commercialization and deployment activities aim to accelerate new technology commercialization and remove barriers to market adoption of clean energy solutions. To this end, NREL has streamlined the way it does business and enhanced the entrepreneurial environment to provide greater access to capital and engage strategically with industry and stakeholders.

Partnerships are at the core of NREL's strategy. The laboratory collaborates with industry; academia; nonprofit organizations; federal agencies; state, local, and tribal governments; and international institutions to commercialize and deploy renewable energy and energy-efficient technologies. The laboratory engages with the private sector through a variety of research contracting mechanisms and licensing new technologies. Overall, federal investment in these partnerships has leveraged private funds by a factor of 8. NREL links entrepreneurs with investors, helps small businesses, and supports the emerging clean energy business sector through its enterprise development program and annual Industry Growth Forum.

NREL advances integrated, sustainable energy solutions to meet local and regional energy needs by looking at the entire renewable and energy efficiency portfolio to tailor cost-effective solutions that are based on locally available resources. NREL's deployment program supports DOE's strategy to accelerate the market adoption of alternative energy solutions. NREL's comprehensive approach helps transform the way local communities use energy by identifying opportunities, building partnerships, and creating a foundation for technology implementation. NREL offers technical assistance: staff members help communities assess renewable options and provide training to help build a skilled workforce.

Science and Technology

The laboratory's science and technology teams work in the full range of R&D, from basic science to applied research, engineering to testing, and scaleup to demonstration. NREL is developing nanoscale materials to convert the sun's energy into electricity, improve understanding of wind aerodynamics, and dive into the cellular structure of plants to make cost-competitive renewable biofuels. NREL also boasts strong R&D efforts in materials for sustainable buildings, transportation, electricity infrastructure systems, and hydrogen, ocean, and geothermal energy.

Laboratory Operations

Intrinsic to all levels of laboratory operations is a culture of safety, security, and quality. This translates to action by managing a sustainable environment, integrating clean-energy technologies in new buildings, and supporting workforce growth and development.

As a world-class research institution NREL commits to:

- Optimizing and managing natural resources to help sustain the environment
- Reducing its environmental footprint by constructing and monitoring the performance of its green buildings and providing alternative working and commuting programs for staff
- Supporting the community by stimulating the local economy, managing NREL's environmental impacts, and creating educational programs.

Summary

NREL focuses its integrated strengths on finding creative answers to today's energy challenges. From concept to the commercial marketplace, NREL's discoveries are transforming the way the world uses energy.

OPERATING BUDGET

Because NREL is a not-for-profit organization, the term *net revenue* does not apply. However, our total revenue, assets, and cost of operations and research follow:

- Revenue from the U.S. government and Work for Others Projects: $378.5 million
- Total Alliance capitalization as of September 30, 2014*:
  - Debt $0
  - Equity $1.9 million
- Total Alliance assets*: $74 million

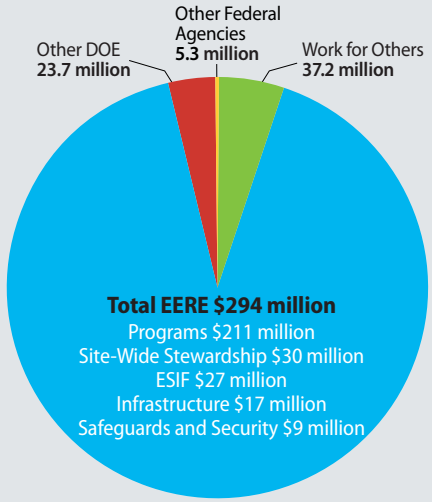


Figure 1. New Budget Authorization by Source

REPORT PARAMETERS

Determining Materiality

NREL's sustainability effort has evolved from basic paper recycling in the early 1980s to a comprehensive sustainability program that was formalized a decade ago.

The level of annual sustainability reporting has also progressed. From FY 2010 to FY 2014, NREL has used the Global Reporting Initiative (GRI) Sustainability Guidelines to highlight activities, progress, and accomplishments.

*These amounts do not include DOE assets or equity. The Alliance is the management and operating contractor of NREL.

STM is a pedestrian and bike friendly campus. The laboratory has committed to consistently improving pedestrian and bicycle safety throughout the campus. This also reduces Greenhouse Gas (GHG) emissions and improves employee health and wellness.

Critical to evaluating annual progress is the establishment and benchmarking of goals and objectives. NREL's mission remains the same as its internal activities respond to emerging circumstances:

- Implementing EERE directives
- Continuing as a leading innovator in the clean-energy research technology market while anticipating the dynamic changes occurring in the external geography of regional, national, and global politics, and environmental, social, and economic conditions.

The chosen materiality assessment sections, per the GRI reporting format, represent key performance areas that are critical to achieving NREL's mission. A continuous stakeholder process is conducted to examine and identify achievements, challenges, and methods to enhance data collection that are vital to these sections. Stakeholders include our DOE and various NREL staff members who represent science and technology research, commercialization and deployment, and laboratory operations.

NREL prioritized and selected six materiality assessment sections.

1. GHG emission reduction
2. Clean-energy technologies
3. Energy management
4. Water management
5. Environment and pollution prevention
6. Stakeholder initiatives.

Six specialized subgroups were formed to identify performance indicators and determine action steps to collect data that are unique to each section. Planning actions were also derived from these beneficial group discussions for future performance indicators that would require intensive tracking and monitoring activities. Additionally, several NREL communication specialists were asked to write feature articles to highlight significant achievements.

Report Scope and Boundaries

NREL's facilities are primarily located on two sites: STM in Golden, Colorado, and the NWTC in Louisville, Colorado. Facilities on these two sites are owned by DOE. NREL also leases office space in the Denver West Office Park, the Renewable Fuels and Lubricants Laboratory in Denver, and an office in Washington, D.C.

NREL's STM site consists of approximately 999,796 Gross Square Feet (GSF) of facilities on 327 acres. Of these, DOE has granted a 177-acre conservation easement to Jefferson County, which provides hiking trails and permanent conservation status for the land. The remaining 152 acres are used for campus infrastructure and high-performance building facilities for laboratories, offices, and supporting mission functions. The NWTC site is located approximately 20 miles north of the STM site and has approximately 81,335 GSF of facilities on 280 acres, and DOE has granted a 157-acre conservation easement.

Although some wind turbines at the NWTC help to offset electricity use at NREL through on-site generation, NREL also hosts turbines for research purposes including this 300 foot 3 MW Alstom wind turbine.

As a DOE national laboratory, NREL works to meet environmental and energy-related regulatory requirements as defined by the Energy Policy Act of 2005; Executive Order (EO) 13423 and EO 13514; and the Energy Independence and Security Act (EISA) of 2007. These laws and regulations establish federal requirements that span energy efficiency, GHGs, high-performance buildings, renewable energy, water conservation, pollution prevention, sustainable acquisition, electronic stewardship, and vehicle fleets.

Data Collection and Metrics

NREL's sustainability metrics are built upon a wealth of data that fully encompass its campus operations. A large component of NREL's reporting focuses on energy, specifically building-level energy consumption and on-site renewable energy production. NREL tracks energy information starting with building-level electricity and natural gas meters, which tie into the DOE Sustainability Dashboard (Dashboard), which allows access to up-to-date energy information.

On-site renewable energy production from the Renewable Fuel Heat Plant (RFHP), photovoltaic (PV) arrays, and wind turbines is also tracked in the Dashboard. Other on-site renewables are captured in tracking matrices that SNREL uses to manage capacity, production, Leadership in Energy & Environmental Design (LEED) allocation, and Renewable Energy Certificate (REC) retention. NREL regularly reports these energy data to DOE headquarters in federal reporting tools and benchmarks its energy performance monthly to look for improvement opportunities.

In addition to energy data and water use, SNREL tracks the performance of Scopes 1, 2, and 3 GHG emission sources. Scope 1 sources include NREL's: vehicle fleet, refrigerants, fugitive gases, process, and on-site combustion. NREL's Scope 2 sources are entirely composed of electricity purchases and on-site renewables. Information is tracked for Scope 3 emission sources, which include commuting, business ground and air travel, waste disposal, wastewater treatment, and transmission and distribution (T&D) losses. These data originate from a variety of sources, including utility meters, databases, travel, and expense reporting records. GHG data are compiled for each fiscal year and entered into the DOE Consolidated Energy Data Report to calculate emissions—allowing for annual tracking of progress toward NREL's reduction goals.

PERFORMANCE SNAPSHOT	Summary of Goals for Material Assessments	Key Performance Status: ✚ Exceeds Target ✱ On Target ▲ Behind Target			
GREENHOUSE GAS EMISSIONS REDUCTION MANAGEMENT	**Objective and Target**	**Baseline**	**Performance Status Through FY 2014**	**Planned Action and Contributions**	**Status**
GHG EMISSIONS	28% reduction in Scope 1 & 2 GHG emissions by FY 2020 from an FY 2008 baseline (2014 target: 19% reduction)	FY 2008: 23,964.65 $MTCO_2e$	• 28,104 $MTCO_2e$ of Scope 1 and 2 emissions, a 17% increase from the baseline without RECs • 3,950.82 $MTCO_2e$ of Scope 1 and 2 emissions, an 84% decrease from the baseline including RECs to offset all electricity use.	• 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 needed to purchase RECs to offset emissions.	✱
GHG EMISSIONS	13% reduction in Scope 3 GHG emissions by FY 2020 from an FY 2008 baseline (2014 target: 5% reduction)	FY 2008: 7,489.71 $MTCO_2e$	• 8,055.58 $MTCO_2e$ of Scope 3 emissions, an 8% increase from the baseline without RECs • 6,465 $MTCO_2e$ of Scope 3 emissions, a 14% decrease from the baseline including RECs to offset all T&D losses.	• Finalize *Scope 3 Greenhouse Gas Reduction Plan* to identify the best methods of Scope 3 emissions reduction. • Continue to purchase RECs to offset T&D losses.	✱
CLIMATE CHANGE RESILIENCY PLANNING	Address DOE Climate Change Adaptation Plan goals.	N/A	Initiated climate resiliency planning in spring FY 2014. Emphasized identifying resiliency options that cut across NREL's operations and program areas to create climate change adaptation 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 planning and preparedness efforts at the laboratory.		✱
ENERGY MANAGEMENT	**Objective and Target**	**Baseline**	**Performance Status Through FY 2014**	**Planned Action and Contributions**	**Status**
ENERGY	30% reduction in energy intensity (Btu/GSF) by FY 2015 from an FY 2003 baseline (2014 target: 27% reduction)	FY 2003: 257,552 Btu/GSF	Energy intensity reduced 54% from the baseline to 118 kBtu/GSF.	Finalize the *Strategic Energy Management Plan*.	✱
ENERGY	Complete EISA Section 432 energy and water evaluations.	N/A	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 in FY 2015. • Benchmark buildings in the U.S. Environmental Protection Agency's (EPA's) Portfolio Manager as required.	✱
ENERGY	Individual buildings metering for: • 90% of electricity (by October 1, 2012) • 90% of steam, natural gas, and chilled water (by October 1, 2015). (2014 target: 90% and 75%, respectively)[1]	FY 2009: 74 meters	100% of NREL's buildings have energy (including electricity, natural gas, and renewables where appropriate), chilled water, and hot water meters (NREL uses no steam). • 20 meters—Tier 1 (Critical - supporting DOE financial obligations such as power purchase agreements (PPAs) and net metering for wind and photovoltaic [PV]) • 52 meters—Tier 2 (High - supporting main building meters or high-priority meters) • 225 meters—Tier 3 (Low - supporting requirements not covered in Tier 1 or Tier 2 including submeters and low priority meters) Electricity metering alone includes more than 297 advanced electricity meters in all major facilities and on major process loads.	• Continue to pursue International Organization for Standardization (ISO) 50001 certification. • Continue initiative to create an energy information system.	✚

[1] Per National Energy Conservation Policy Act (42 U.S.C Section 8253) the term *buildings* includes industrial, process, or laboratory facilities.

ENERGY MANAGEMENT CONT.	Objective and Target	Baseline	Performance Status Through FY 2014	Planned Action and Contributions	Status
RENEWABLE ENERGY	20% of annual electricity consumption from renewable sources by FY 2020. (2014 target: 7.5% consumption)	N/A	Generated 20% of total electricity on-site in FY 2014.	• Exceed the 20% on-site electricity generation by FY 2020. • 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.	✱
ENERGY PERFORMANCE CONTRACTS	Utilization of Energy Performance Contracts.	N/A	Pursued alternative financing mechanisms such as PPAs and energy savings performance contracts (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.		✱
HIGH PERFORMANCE SUSTAINABLE BUILDINGS	Cool roofs implemented on campus, unless uneconomical, for roof replacements unless project already has CD (critical decision)-2 approval. New roofs must have thermal resistance of at least R-30.	N/A	Cool roofs make up 69% of NREL's roof areas.	Replace Shipping and Receiving and the Integrated Biorefinery Research Facility (IBRF) roofs with new cool roofs (at least R-30 insulation).	✱
HIGH PERFORMANCE SUSTAINABLE BUILDINGS	15% of existing buildings larger than 5,000 GSF are compliant with the Guiding Principles for High Performance Sustainable Buildings (GPs) by FY 2015. (2014 target: 13% compliant)	N/A	• Four buildings (18%) are 100% compliant with the GPs. • Performed GP assessments on three additional buildings in FY 2014 and assessed 95% of the 22 buildings larger 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.	✚
HIGH PERFORMANCE SUSTAINABLE BUILDINGS	All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with the GPs.[2]	N/A	All new construction at NREL is required to comply with GP.	• 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.	✱
DATA CENTERS	All core data centers are metered to measure a monthly power usage effectiveness (PUE) of 100% by FY 2015. (2014 target: 90% metered)	N/A	The Research Support Facility (RSF) core data center and the ESIF non core data center are fully metered to monitor monthly PUE.	Continue monthly monitoring.	✚
DATA CENTERS	Core data centers hold a maximum annual weighted average PUE of 1.4 by FY 2015. (2014 target: 1.5 PUE)	N/A	In FY 2014, the PUE for the RSF data center averaged 1.18.	Continue to strive to meet or exceed world-class PUE (less than 1.2).	✚

[2] DOE considers buildings meeting the following criteria as complying with GPs: Any building that achieves LEED-Existing Building Silver or higher or LEED-New Construction Gold or higher; Any building that achieves a Green Globes-New Construction rating of 4 or a Green Globes Continual Improvement of Existing Buildings rating of 3; Any building that has been occupied for more than 1 year that achieves Living Status designation by the Living Building Challenge (although included as policy in the 2012 Strategic Sustainability Performance Plan, these equivalencies are contingent upon Office of Management and Budget and White House Council on Environmental Quality [CEQ] approval).

ENERGY MANAGEMENT CONT.	Objective and Target	Baseline	Performance Status Through FY 2014	Planned Action and Contributions	Status
ELECTRONIC STEWARDSHIP	100% of eligible personal computers, laptops, and monitors have power management actively implemented and in use by FY 2012.	N/A	Power management is enabled on 100% of eligible devices. Some devices are exempt for research, security, or information technology (IT) purposes.	Continue study on power management practices throughout the laboratory.	✱
WATER MANAGEMENT	**Objective and Target**	**Baseline**	**Performance Status Through FY 2014**	**Planned Action and Contributions**	**Status**
WATER	26% reduction in potable water intensity (gal/GSF) by FY 2020 from an FY 2007 baseline (2014 target: 14% reduction)	FY 2007: 27.5 gal/GSF	Potable water intensity reduced 43% from the 2007 baseline to 15.7 gal/GSF.	• Correct piping issues limiting use of ESIF High Performance Computer (HPC) waste heat. • Finalize *Water Management Plan* for the STM and NWTC campuses. • Use information about water fixtures to identify areas to reduce water consumption across the laboratory.	✱
WATER	20% reduction in water consumption (gal) of industrial, landscaping, and agricultural (ILA) water by FY 2020 from an FY 2010 baseline	N/A	NREL does not use ILA water.	N/A	N/A
ENVIRONMENT AND POLLUTION PREVENTION	**Objective and Target**	**Baseline**	**Performance Status Through FY 2014**	**Planned Action and Contributions**	**Status**
POLLUTION PREVENTION	Divert at least 50% of nonhazardous solid waste, excluding construction and demolition debris, by FY 2015.	FY 2008: Diverted 58% of 925,435 lb of solid waste - Recycled 339,260 lb	Diverted 75% of the 2,684,736 lb of campus waste from landfill in FY 2014 • Recycled 1,169,970 lb • Composted 840,267 lb.	• 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 to deploy locked printing campus-wide.	✚
POLLUTION PREVENTION	Divert at least 50% of construction and demolition materials and debris by FY 2015.	FY 2008: Recycled 299,090 lb	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.	✚
SUSTAINABLE ACQUISITION	Procurements meet requirements by including necessary provisions and clauses in 95% of applicable contracts.	N/A	• 100% of construction contracts meet sustainable acquisitions requirements. • 100% of custodial contracts meet sustainable acquisitions requirements.	• Continue to update business systems reporting to improve data accuracy around green purchases. • Maintain training for purchase card (PCard) purchasers on definitions of environmentally preferable products (EPPs).	✚

ENVIRONMENT AND POLLUTION PREVENTION CONT.	Objective and Target	Baseline	Performance Status Through FY 2014	Planned Action and Contributions	Status
ELECTRONIC STEWARDSHIP	95% of eligible electronics acquisitions meet Electronic Product Environmental Assessment Tool (EPEAT) standards.	N/A	96% of eligible electronics acquisitions meet EPEAT standards.	• 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 at least 97%.	✱
FLEET	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to an FY 2005 baseline (2014 target: 136% cumulative increase since FY 2005)	FY 2005: 7,507 gasoline gallon equivalent (GGE) of alternative fuel	Alternative fuel use increased a cumulative 48% from the FY 2005 baseline to 11,090 GGE. This is a 16% decrease from FY 2013.	Continue use and maintenance of the high-level ethanol fuel (E-85) fueling station on the STM campus.	▲
FLEET	2% annual reduction in fleet petroleum consumption by FY 2020 relative to an FY 2005 baseline (2014 target: 18% cumulative reduction since FY 2005)	FY 2005: 7,722 GGE of petroleum fuel	Petroleum fuel use increased a cumulative 63% from the FY 2005 baseline to 12,572 GGE. This is a 10% decrease from FY 2013.	Investigate the feasibility of replacing shuttle vehicles (diesel mini buses) with an alternative fuel vehicle (AFV).	▲
FLEET	100% of light-duty vehicle purchases must consist of AFVs by FY 2015 and thereafter. (75% FY 2000–2015)	N/A	No light-duty vehicles were purchased in FY 2014.	Continue to acquire General Services Administration (GSA)-leased replacement vehicles with AFVs if available and as required.	✱
STAKEHOLDER INITIATIVES	**Objective and Target**	**Baseline**	**Performance Status Through FY 2014**	**Planned Action and Contributions**	**Status**
REGIONAL AND LOCAL PLANNING	Efforts to increase regional and local planning coordination and involvement	N/A	• Coordinated with Denver Regional Council of Governments 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 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 resiliency plan. • Continue to support the CEQ's Colorado Preparedness Pilot project. • Continue to coordinate weed control efforts with adjacent land managers.	✱

Greenhouse Gas Emissions Reduction

Goals:

28% Scope 1 and 2 GHG reduction by FY 2020 from an FY 2008 baseline

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

13% Scope 3 GHG reduction by FY 2020 from an FY 2008 baseline

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

Climate Change Resiliency

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

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

Greenhouse Gas Emissions Reduction

Strategic Intent

NREL is working to establish carbon-neutral campuses that efficiently use limited resources, reduce waste, and demonstrate fiscal responsibility. NREL's strategy for accomplishing carbon neutrality and reducing impacts on local and global environments includes establishing interim GHG goals based on a GHG baseline, DOE's sustainability commitments, and NREL's mission. Through the laboratory's GHG leadership, NREL hopes to catalyze the development of new technologies, maximize the use of renewable energy sources, and educate others on the feasibility of operating in a carbon-neutral paradigm.

STRATEGY AND PERFORMANCE SUMMARY

NREL has been tracking and reporting campus 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 and minimizing the 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 RECs to offset the climate change impacts.

NREL's operational boundaries include all DOE-owned facilities, vehicle fleet, equipment, and non highway vehicles on both the STM and at the NWTC campuses. NREL has partial lease agreements for office space storage, and laboratory space in the Denver West Office Park, the Joyce Street Facility, and the Renewable Fuels and Lubricants Laboratory, which are not under NREL's operational control; however, some electricity and natural gas data for these properties that are considered partially serviced leases 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, ventilating, and air-conditioning (HVAC) systems and on-site septic systems at the NWTC and the 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 used to generate heat and hot water. Operation of NREL's on-site 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 because of several planned power outages from construction activities. Emergency generators were used to provide power while primary site power was down. NREL also added new motorized equipment on campus, which further increased non fleet emissions. NREL is working to acquire more AFVs and to reduce overall mobile emissions (see the Fleet Management Section).

Fugitive Emissions

Fugitive emissions constitute slightly more than 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 each fiscal year. 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 regularly monitors for refrigerant leaks. 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 purchases resulted in the largest source of fugitive emissions in FY 2014, totaling 253 ft^3. About 4 ft^3 were used to test the energy efficiency of HVAC systems on campus. The remainder of the sulfur hexafluoride purchased in FY 2014 was used as an insulator gas to prevent arching in an electrostatic accelerator. The large quantity purchased was used for the initial load on this project, and most of the gas will be recaptured during annual maintenance on the device (with anticipated losses not to exceed 1 liter of gas).

On-site wastewater emissions increased 15% from the FY 2008 baseline year. This was 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 NWTC.

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, NREL had no baseline because use data were lacking. This year NREL created an FY 2008 baseline by estimating dry ice use for FY 2008 based on 4 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 $MTCO_2e$, a 3% decrease from FY 2013 and a 25% decrease from the FY 2008 baseline.

In FY 2015, NREL will continue to mitigate and search for methods to reduce these Scope 1 emissions. NREL plans to optimize RFHP performance to continue the reduction of 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 and ways to improve fugitive and refrigerant gas data collection processes, procurement, and recycling practices to reduce fugitive emissions.

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.

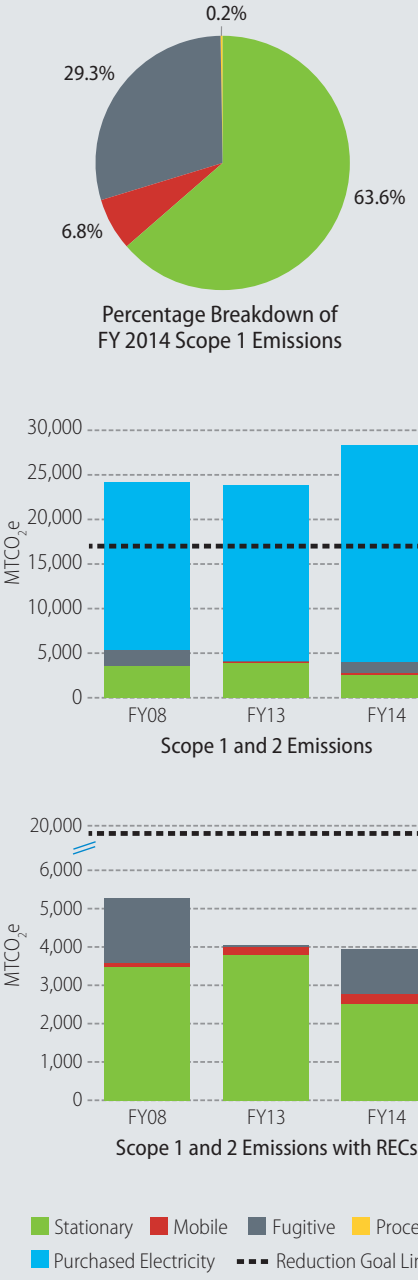


Figure 2. NREL Performance Toward Meeting Scope 1 and 2 GHG Reduction Targets With and Without RECs

In FY 2014, electricity purchases generated 24,153 $MTCO_2e$. This represents a 29% increase from the FY 2008 baseline. NREL strives to construct and operate highly energy-efficient buildings on its campuses. These efforts have enabled NREL's electricity consumption to remain relatively constant even with an increase in campus footprint of more than 135% since FY 2008 and the relocation of DOE Golden Field Office (GFO) to NREL's RSF C-Wing. In FY 2014, the large increase in electricity use is specifically attributed to the HPC in the ESIF. Electricity use at the ESIF HPC is projected to increase by nearly 500 kW per year until it reaches maximum capacity for the facility's current infrastructure at 10 MW. With each campus addition and increase in electricity use, NREL will continue to uphold the highest standards for energy efficiency and deployment of on-site renewable energy.

The addition of the GFO team also increased the electricity load at NREL. Before the move, NREL had occupied only 75% of the RSF C-Wing. When the GFO team moved into the C-wing, occupying 100% of the facility, electricity use increased and added to the overall campus load. Although plug loads decreased in the RSF C-Wing, lighting use increased significantly from the previous use of the office space. NREL continues to explore 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—which include ESIF, the Solar Energy Research Facility (SERF), and Field Test Laboratory Building. 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 use at NREL. The SERF and Field Test Laboratory Building 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

Figure 2 demonstrates 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 carbon neutral. 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 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 because electricity use for the STM campus increased. This increase was mainly due to high-emission mission-specific facilities, specifically the ESIF HPC, and an increase in population from the GFO move to the RSF. 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: an additional 1,294 NREL employees and contractors came 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 emission source. (Air travel does not include GFO information because this is reported with DOE Headquarters.) Air travel poses a challenge for NREL, because some 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.

Business Ground Travel

In FY 2014, business ground travel emissions were 69% lower than the FY 2008 baseline. This category represents less than 1% of NREL's Scope 3 emissions. To manage emissions from this source, NREL works to educate staff on available alternatives to ground travel, including teleconferencing, video conferencing, and 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, fewer than 1% were economy, 1% were full size, 3% were midsize, and the remaining

vehicles were minivans and sport utility vehicles. (Business ground travel does not include GFO information because this is reported with DOE Headquarters.) NREL will continue to investigate opportunities for improved ground travel data collection methods that could identify areas for further ground travel reductions.

Employee Commuting

Employee commuting represents slightly more than 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, reducing the one-way average to 16 miles from 18 miles in FY 2013.

NREL and GFO offer multiple commuting programs to their 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:
  - Teleworking
  - Compressed work weeks or alternative work schedules.

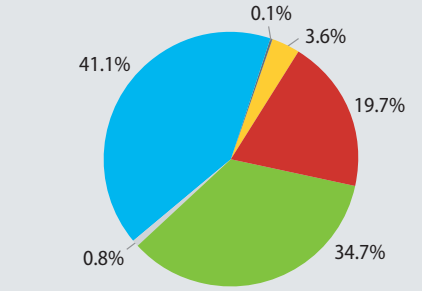
This year NREL completed a laboratory-wide commuter survey. Distributed in April 2014, 31% of NREL and GFO employees completed the survey. The survey focused on three major topic areas:

- Commuter behavior
- Public transit and on campus shuttles
- Alternative work schedules and teleworking.

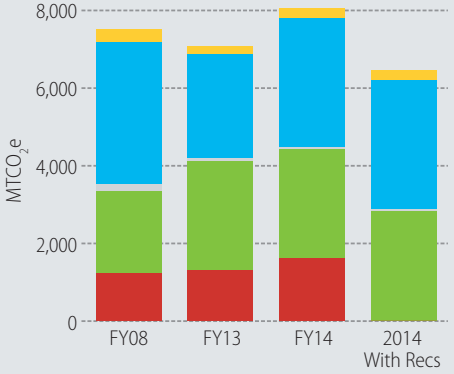
Survey results were used to establish more accurate commuting emissions for NREL employees and staff and DOE employees during FY 2014. Distributing a commuter survey once every 3 years enables NREL to monitor employee commuting needs and impacts more closely. The survey helps to identify areas to decrease 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 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 since 2007 and an increase in hybrid and electric vehicles and AFVs. Public transit use and teleworking increased by 8%.

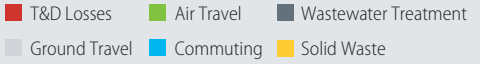
Results of the commuter survey point to some remaining solutions for alternative work schedules and teleworking options at NREL. The *Scope 3 Greenhouse Gas Reduction Plan*, developed in FY 2014, identifies ways in which the laboratory can move forward with Scope 3 emissions reductions. These options for reduction take into account employee needs as expressed in the commuter survey and the

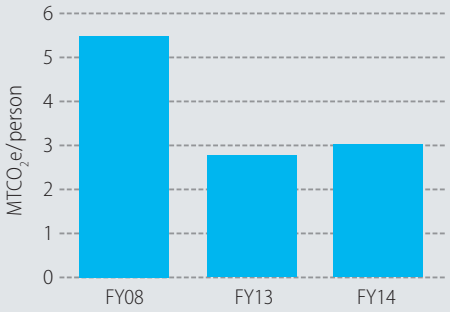


2014 Scope 3 Emissions



Scope 3 Emissions with and without RECs





NREL's Scope 3 Per Capita Emissions

Figure 3. NREL's Performance Toward Meeting Scope 3 GHG Reduction Targets

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

Success Story

ROADMAP TO REDUCE SCOPE 3 GREENHOUSE GAS EMISSIONS

Scope 3 GHG emissions are challenging for NREL and have continued to increase each year since the baseline. From FY 2008 to FY 2014, NREL's campus has grown by 135% and population has increased by 95% (not including 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 for 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 an 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. It also 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 and their potential impacts on Scope 3 emissions. For example, NREL continues to investigate the expansion of teleworking for staff. Research suggests that a possible mandatory telework day once a week for eligible employees could help NREL reduce Scope 3 commuting emissions by as much as 15%.

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 strives to decrease Scope 3 GHG emissions.

impacts that these measures could have on the laboratory-wide reduction of Scope 3 emissions.

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. NREL makes every effort to reduce the sewage produced with 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. Increased teleworking and alternative work schedules at NREL also help 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. NREL will continue efforts to reduce waste disposal on campus and increase recycling and composting measures.

Scope 3 Summary

In FY 2014, NREL's Scope 3 emissions were 6,465 $MTCO_2e$ 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 anticipates that it will meet Scope 3 emission reduction goals through measures that promote efficiency of energy, waste, commuting, and travel—and that Scope 3 emissions will continue to increase as the population and campus footprint grow. However, NREL will continue to work to decrease per-capita 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.

Total Greenhouse Gas Emissions

In FY 2014, most of NREL's GHG emissions (67%) were Scope 2 emissions associated with the purchase of electricity. Scope 3 represents the next-largest emission 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. Including REC purchases, NREL's overall emissions decreased to 67% below the FY 2008 baseline.

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 alternative work schedules.
- 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 on-going strategies to offset emissions.

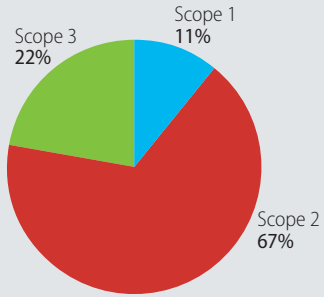


Figure 4. Percentage Breakdown of FY 2014 Total Emissions by Scope

Climate Change Resiliency

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 resiliency 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 emphasize 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 reviewed and updated annually with new impacts and risk determinations. As information is collected, it will enhance ongoing 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 by 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 that are critical to the key resources and researching the latest scientific knowledge about those variables
- Identifying, comparing, and analyzing climate risks with a risk management framework.

Building Resiliency

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

NREL CLIMATE RESILIENCY PLANNING EFFORT: PROJECT TIMELINE FY 2014

	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)							

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, when feasible.

Project Timeline

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

Stakeholder Engagement

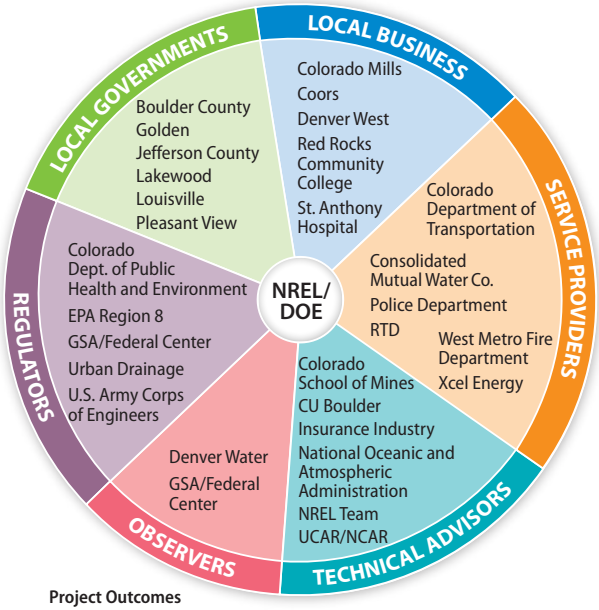
NREL is engaging internal and external stakeholders to gain information and build consensus on climate vulnerabilities, organizational risks, and resiliency options. Stakeholder representatives will be involved throughout the process to ensure that the final recommendations are inclusive, representative,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

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 affected by climate changes.



Project Outcomes

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

Figure 5. NREL's Climate Change Resiliency Planning Sphere of Influence

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

External Stakeholders

NREL recognizes that climate change impacts, and successful adaptation strategies that build resiliency, extend beyond the organizational control and geographic boundaries of NREL. Therefore, coordination with surrounding communities is critical. 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 plans to engage external stakeholders in a regional symposium when the vulnerability assessment and resiliency plan development conclude in FY 2015 (See Figure 5). 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.

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 resiliency plan, as a focus for additional adaptation planning efforts.

Stewardship in Climate Change Resiliency Planning

In addition to the efforts that focus 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 Louisiana, New York, and New Jersey. NREL's disaster recovery team has provided technical assistance for improving resistance and resiliency (e.g., through microgrids, building efficiency, islanding capabilities, vehicle fuel diversification, and 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 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 backup power); and design sustainable, resilient buildings or infrastructure projects.

A Holistic Approach to Resiliency: Is NREL Ready?

State of Colorado's Chief Resiliency and Recovery Officer, Molly Urbina, whose office along with Colorado Resiliency Working Group coordinated the development of the Colorado Resiliency Framework said "Through the Framework, the state seeks to not only support efforts to build back, but to support communities in their efforts to thrive in the face of threats from hazards and changing conditions."

Looking around NREL's STM campus in Golden, a story can be told about the laboratory's history, its visible growth, and characteristics of the landscape that indicate what the campus may experience down the road.

President Obama's Climate Action Plan enhanced the 2009 EO 13514 in an effort to reduce the amount of GHG emissions throughout the country. EO 13514 laid out a three-part framework requiring federal agencies to report GHG emissions and reduce those numbers to 2008 levels by 2015. While NREL began tracking and reporting GHG emissions more than a decade ago, the laboratory met FY 2014 targets and plans for a changing climate along the Front Range. In addition to GHG reduction, another part of the Climate Action Plan was to identify potential impacts of climate change and prepare for those risks through adaptive planning and resiliency.

When SNREL's Energy Program Manager Michelle Slovensky looks at the Golden campus, she sees two decades of evolving resilient building technologies. "The development and building systems record a timeline as you go across the site," she said. "If you really look at the evolution, at the growth of the population, and at the footprint that was reduced by energy conservation measures (ECMs), that's a success story."

One way SNREL responded to the 2009 GHG reduction order was by bringing on Sustainable Transportation Manager Lissa Myers. Myers tracks commuters' GHG emissions and encourages staff to consider lower emitting methods of travel. In addition to her work on transportation, Myers helped develop NREL's Climate Change Vulnerability Assessment, a required piece of this year's Sustainability Site Plan. With funding from DOE's Sustainability Performance Office, NREL was chosen to conduct a pilot vulnerability assessment for the site, which was followed by a resiliency plan.

"We're piloting a unique process, and we're in a unique geographic area," said Myers. "A lot of the communities and organizations that have already done climate resiliency planning are coastal areas, where they have already been impacted by sea level rise or major storms."

The study comprises a few parts: NREL's vulnerability assessment based on the expertise of climate scientists; the Climate Change Resiliency Action Plan to prepare for these vulnerabilities; and a methodology document for the Sustainability Performance Office that will inform a guidance document DOE is assembling for other agencies to conduct assessments and resiliency planning.

Myers pointed out that climate scientists helped develop a risk-based evaluation of the campus, considering the landscape and climate indicators such as aridity, elevation, and rising temperatures. These scientists, from Western Water Assessment, the University of Colorado, and the National Oceanic and Atmospheric Administration, provided SNREL with a current state of affairs on climate projections for the Front Range region. The scientists categorized climate projections by their level of certainty or uncertainty—and because Colorado is uniquely nestled between the northwestern and southwestern regions of the United States, this process wasn't easy.

"Precipitation models can show increases and decreases in total precipitation, because we're right on the cusp," Myers said. Climate scientists generally predict that the southwestern region of the United States will see much less precipitation and drought, whereas scientists predict more precipitation for the northwestern regions. It's hard to say exactly which trend Colorado will follow.

Yet there's a lot of certainty about rising temperatures. Scientists are more confident that Colorado will see increased fire danger, more precipitation in the form of rain than snow and more precipitation in shorter durations (which may lead to higher intensity storms and floods). One of the most impactful climate projections may be the increase in nighttime low temperatures. Because NREL buildings such as the RSF rely on natural cooling overnight, an increase in nighttime lows will leave less time for recovery.

The Resiliency Action Plan, to be developed in FY 2015, will demonstrate how the laboratory already takes climate change resiliency into account. For example, NREL now uses evaporative cooling towers to bring down temperature levels in the ESIF's data center. The cooling towers work by taking in heat and allowing some water in the towers to evaporate. To make this process even more efficient, SNREL is working on a chemical treatment strategy that will conserve cooling towers' water.

"The effort here is to come up with a chemical water treatment scheme that removes the water's ability to form scale and promote biological growth without having to run a fraction of it down the sewer," said Chris Gaul, senior energy engineer with SNREL. As water in the cooling towers evaporate over time, the level of mineral content builds up and can promote biological growth.

"In our present water treatment scheme, one-sixth of the water we use goes down the drain," said Gaul. "That's the one-sixth we want to tackle."

As Gaul explained, minerals are dissolved in water, so they can't just be removed with a filter. Employing a water treatment process that prevents high mineral content would reduce the need to just bleed the water off without using an energy-intensive method to keep the data center cool. If fans were used instead, for example, electricity from coal or natural gas, and the power plant's cooling towers (and therefore water), would all be required to cool the data center.

Further, in collaboration with the Strategic Energy Analysis Center, IAC, Energy Systems Integration, and Buildings Research, SNREL is developing an "intelligent energy informatics platform" for future design of the site with energy metrics taken into account. The cross-laboratory team is currently developing a model to island the Vehicle Testing and Integration Facility, so that the building may serve as a microgrid prototype for the rest of campus.

"A variety of tactical approaches must be used to bring this holistic solution," said Slovensky, adding that she and Energy Engineer Mike Sheppy recently asked themselves, *What does it take, if all power went down, to be resilient?* In the event of a utility outage that is caused by, say, a heat wave or ice storm, microgrid technologies would keep the most important systems at NREL running, which would save valuable data and millions of dollars.

"It's not just about a set of technologies," said Slovensky. "It's about being adaptive. It's about being resourceful. And I think that's what we're strengthening."

—Written by Nika Durham

Clean Energy Technologies

Multiyear Goals:

- Conduct outstanding basic and applied research and accelerate discoveries toward market-variable applications.
- Accelerate the commercialization of clean energy technologies; remove barriers to enable their deployment at scale.

NREL postdoctoral researcher Brenna Black, holds a vial of algae coproducts, mostly beta carotene, that were extracted from algae grown in tubular bag photobioreactors in the Algal Research laboratory.

Clean Energy Technologies

Global energy systems must transform to be secure, resilient, carbon-neutral, and supportive of growing economies. Energy efficiency and renewable energy will play an increasingly larger role in a future system, operating synergistically with other resources in a much more efficient, flexible, and intelligent system. Traditional energy production and delivery through a "hub-and-spoke" model will evolve into distributed energy systems-of-systems (electricity, fuels, thermal, water) that operate interdependently to deliver efficient energy services. A global transformation is already underway, but it comes with significant challenges that will need to be addressed to continue. Transformation requires advances in technologies and systems, in tools that support effective system design and operation, and in knowledge and understanding to inform the evolution of regulatory and policy frameworks that support market designs and enable the future energy system. As a vibrant national asset, NREL delivers the knowledge and innovations to significantly impact, enable, and accelerate the transition to future energy systems.

Strategic Intent

To align with national priorities and meet the global demand to produce clean energy alternatives, NREL must plan for program growth expectations and strategize an effective investment plan. Critical to advancing our role from scientific innovation to commercial implementation is our future investment in our scientific staff, research equipment, facility operations, and a work environment that supports NREL's significant mission.

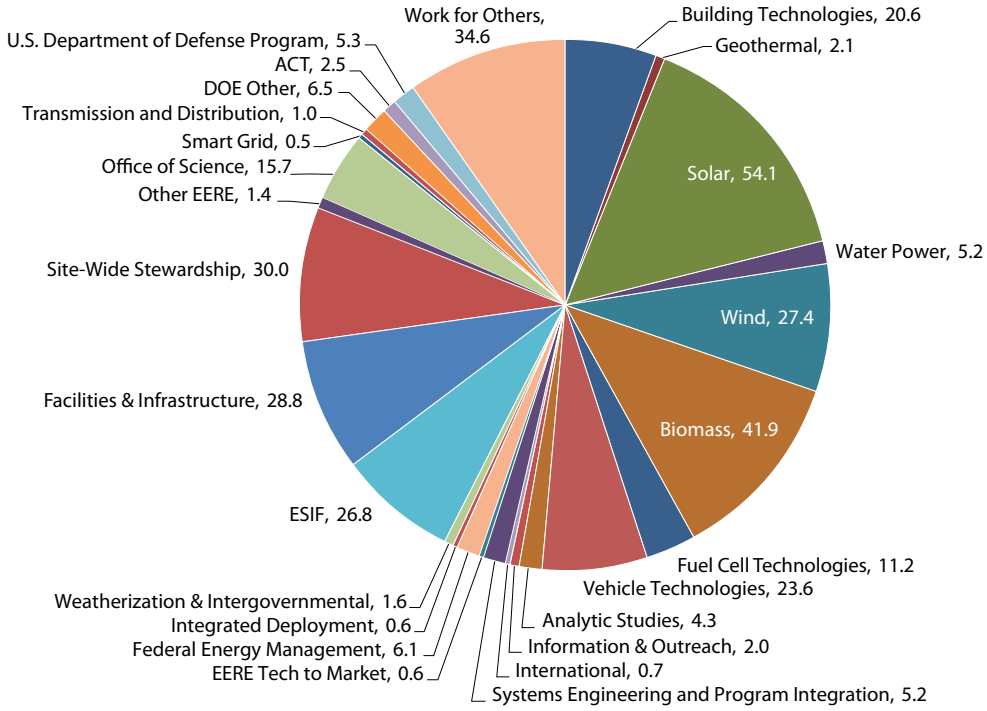


Figure 6. FY 2014 Funds by NREL Program*

*Note: Millions of dollars

TECHNOLOGY PARTNERSHIPS FY 2014

- 242 new partnership agreements
- $60 million in new partnership agreements value
- 657 active partnership agreements

Including 242 new agreements in FY 2014, NREL maintained 657 active partnerships with federal agencies, small and large businesses, foreign entities, educational institutes, and nonprofits.

- 30% federal government
- 27% large business
- 24% small business
- 8% educational institute
- 7% nonprofit
- 5% foreign

PATENTS FY 2014

- 208 issued U.S. patents
- 61 issued foreign patents
- 137 pending U.S. applications
- 135 pending foreign applications

Industrial partner Matt Brown and NREL researchers Lars Lisell and Andrew Parker review the latest version of the Simuwatt audit tool. Simuwatt 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 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 used to conduct the 2014 EISA audits for NREL facilities.

NREL Mission Priorities

- NREL will have an **agile, diverse,** and **innovative workforce** that is recognized for delivering market-relevant innovations that attract high-leverage partnerships through which market impact is realized.
- NREL **innovations** in renewable electricity, fuels production, energy efficiency, and systems integration have significantly reduced the cost of technology while ensuring reliable, secure, and resilient performance.
- NREL serves as a **convener** and **technical integrator** across the national laboratory system to leverage planning and implementation.
- NREL's **leadership** in energy systems integration is at the forefront of a strong systems science research community, anchored by the ESIF's capabilities.
- NREL is sought after as a **strategic advisor** and **partner** by DOE, other government agencies, and the private sector and is the hub of an integrated, vibrant analysis and decision science capability that crosses institutions.
- NREL's cost of operations is **best in class**, delivering **high value** for the public investment.
- NREL's campus operates as a **test bed** for energy systems integration and a leadership example for using real-time data to optimize energy operations.

NREL Mission Focus Capabilities

NREL is the home of recognized areas of technical expertise, grounded by deep domain knowledge and experience that is supported by flagship research facilities. These areas of expertise include:

- **Materials and chemistry science and engineering for energy conversion** that enables research across the renewable generation and transportation systems portfolios. These capabilities are enabled by the unique research assets in the SERF and the Science and Technology Facility (S&TF), the capabilities at the NWTC, and various laboratories that support energy conversion research such as the battery capabilities in the Thermal Test Facility.
- **Bioenergy science and engineering** that support research in the production of advance fuels and is conducted within the IBRF and the Pyrochemical and Thermochemical user facilities.
- **Energy analysis and decision science** that capitalize on NREL's deep knowledge of market drivers, policy implications, and technical knowledge around the energy system. This provides NREL the technical basis to deliver data, models, and insights that guide decisions on program direction, policy formulation, and investment.
- **Energy systems integration**, which is a rapidly growing competency that is enabled by the ESIF, but also capabilities at the NWTC and the highly instrumented building and energy systems on the STM campus.

Key Science and Technology Accomplishments

In FY 2014, NREL effectively managed the laboratory's R&D portfolio, which yielded innovations with significant potential, advanced technologies toward program technical targets,

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.

and delivered discoveries from science efforts that have the potential to impact the applied research portfolio.

- **Solar:** Developed and improved measurement techniques that revealed critical physics in deep regions of solar cells; four new world records in cell efficiency
- **Wind:** Completed a comprehensive study of how wind power can provide control of active power output into the grid therefore supporting power system reliability
- **Water:** Released beta versions of HARP_Opt and HydroFAST, which provide open-source simulation tools for modeling marine and hydrokinetic turbines
- **Geothermal:** Presented to House and Senate staffers in Washington, D.C., as part of the Geoscience Lecture Series; initiated Subsurface Research in Geothermal Energy in collaboration with Colorado School of Mines
- **Bioenergy:** Demonstrated a new mild-alkaline pretreatment, which shows lower cost and higher yield of hydrocarbon fuel products; won Bio-PAN award
- **Vehicles:** Developed new polymer coating for lithium ion (Li-ion) batteries, which improves Li-ion energy density; made progress toward achieving DOE's cost and energy storage goals
- **Fuel Cell and Hydrogen:** Demonstrated infrared/direct-current technique on ion power production fuel cell electrode coating web line
- **Buildings:** Enabled efficient data exchange for companies that focus on home energy performance; proved feasibility of polymeric film and solar water-heating prototype

Top Deployment Initiatives

NREL continues to be a leader among the national laboratories in attracting the partners and investments needed to move knowledge and clean energy technologies into commercial product lines and to remove barriers to the widespread adoption of technologies once they are in the marketplace. NREL's integrated technology deployment activities are making a significant impact on the global energy marketplace toward a clean energy future.

- U.S. Virgin Islands Cuts Diesel Use for Electricity and Water Production by 20%
- Disaster Recovery Support at FEMA Incorporates Sustainability in Rebuilding Efforts
- Portland, Oregon, Grassroots Solarize Campaign Drives Down Solar Prices 30%
- Combined Energy Savings of $200,000 Per Year Achieved in Greensburg, Kansas
- Remote Shading Tool Has Potential to Reduce Solar Soft Costs by 17 Cents/Watt
- DG Collaborative Brings Utilities and Energy Industry Professionals Together on Interconnection Issues
- Guidelines for Home Energy Professionals Improves Quality of Energy Efficiency Upgrades
- Fossil Fuel Dependency Falls from 100% to 56% on Alcatraz Island
- Renewable Energy Project Helps Tribe Reduce Carbon Footprint by 20,000 Tons
- Net-Zero and Energy Security Measures at Miramar Being Replicated Across the Military
- Hawaii's First Net-Zero Energy Affordable Housing Community

Energy Management

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

- Energy intensity decreased 54% from the 2003 baseline.

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.

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), chilled water meters, and hot water meters (NREL uses no steam).

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

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

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.

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.

Energy Management

Strategic Intent

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

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 lower than DOE's target for FY 2014, with a value of 118 kBtu/ft^2—a 54% decrease from NREL's FY 2003 baseline. FY 2014 energy intensity is down from 127 kBtu/ft^2 FY 2013. The year-over-year decrease is attributable to lower natural gas, which decreased from 72,372 MBtu in FY 2013 to 47,540 MBtu in FY 2014. Actual and projected energy intensities for NREL are presented in Figure 7. This reduction is attributable to NREL's wood-chip fueled RFHP and milder winter temperatures.

The RFHP generated 18,041 MBtu of hot water, displacing natural gas usage for district heating at the STM. NREL has two natural gas-fired boiler plants, (one in the SERF and one in the Field Test Laboratory Building), and a wood-fired water boiler in the RFHP, which all tie into the campus' district heating system. 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.

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

NREL'S ENERGY INTENSITY

DOE FY2015 Goal (Btu/GSF)	NREL FY2003 Baseline (Btu/GSF)	FY2014 (Btu/GSF)	Energy Change Over Baseline (%)
180,521	257,552	118,424	-54.0%

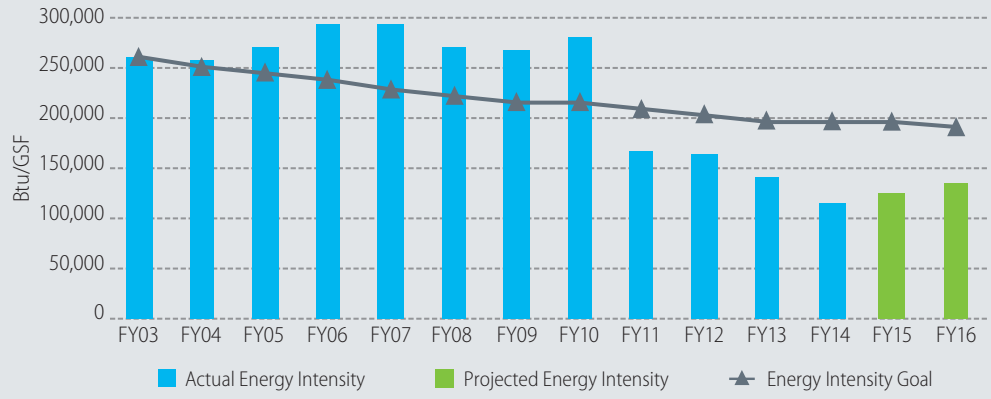


Figure 7. NREL Actual and Projected Energy Use

NREL's Justin Peltz (not pictured) 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.

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 the leased Joyce Street Facility. NREL excludes fully serviced leases (Denver West Office Park buildings, the Washington, D.C., offices, and the Renewable Fuels and Lubricants Laboratory) from its energy intensity calculation.

In new facility construction, NREL has complied with the 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 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 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 PPAs and ESPCs.

In FY 2014, NREL continued developing a *Strategic Energy Management Plan*. Its purpose 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 ISO 50001 certification for energy management systems.

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

Energy Independence and Security Act Audits

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

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 I houses hundreds of employees—because

SCHEDULE FOR EISA AUDITS

Covered Facilities	Audit Year
Outdoor Test Facility, Thermal Test Facility, 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
RSF II, Cafe, South Site Entrance Building, and IBRF	2016

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 EPA's Portfolio Manager to benchmark metered building energy performance. NREL also implemented several ECMs on campus, including designing an electric heater replacement, repairing insulation, repairing HVAC plenum for the RSF data center, installing rooftop air conditioning, 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, which is 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. A local software developer created Simuwatt 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 the DOE Consolidated Energy Data Report and will be included in annual EISA reporting. NREL will measure and verify the performance of implemented ECMs to ensure good performance.

Metering

NREL has exceeded performance goals for energy and water metering.

Energy meters—100% of NREL's buildings have energy meters in use (including electricity, natural gas, and renewables where appropriate). Electricity metering at the laboratory includes more than 200 advanced electricity 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 electricity meter and electricity submeters that record HVAC, laboratory process, and lighting loads. All NREL facilities that use natural gas have building gas meters. The Dashboard is an internal smart metering system that directly records 85% of natural gas use and 95% of the electricity use. In FY 2015 and beyond, NREL will work to enhance the Dashboard and other campus energy tools to provide additional analysis 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.

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 that meters be installed 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 short-term to establish new plants. The submeters are maintained and data recorded weekly by NREL in-house maintenance staff.

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 energy management system.

Conducting a retro-commissioning process not only delivered cost saving opportunities in one of NREL's High Performance Buildings but additionally aligned the proper coordination of controls where finding and fixing malfunctioning equipment can attain a superior level of energy performance.

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. These 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 laboratory 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 and 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 2 years of data for the entire S&TF. This allowed energy auditors to look at the building as a whole instead of focusing on a few building systems. Having the data readily available also saved considerable time in the retro-commissioning process because the data 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 ECMs with simple paybacks shorter than 3.5 years. NREL plans to refine this process in FY 2015 to identify additional energy- and money-saving opportunities.

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—continuing to use PPAs, ESPCs, RECs, and other financing mechanisms to make projects cost effective, which enables the continued 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, offsetting 20% of electricity consumption. NREL has 4.5 MW of on-site PV and 10.2 MW of on-site wind systems installed on both campuses. Some of these wind systems are hosted through CRADAs and do not count toward NREL's renewable energy production.

In FY 2014, NREL PV systems alone generated a total of 6,248 MWh of renewable energy. Three of the four wind turbines at the NWTC are operated by various manufacturers under CRADAs and are rated at 2.3 MW, 3 MW, and 2 MW. The fourth utility-scale wind turbine is a DOE-installed 1.5-MW General Electric turbine. NREL retains the RECs from small and midsize research turbines and the DOE turbine, and purchases replacement RECs from the 2-MW and 3-MW turbine 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.

While the current NWTC electricity generation capacity is 10.2 MW, turbine operations are curtailed to stay lower than the current 10-MW generation limit in accordance with an agreement with Xcel Energy, the local electricity and natural gas company. Thus, some turbines must be shut down when others are operating. The maximum combined rated electricity generation capacity for the NWTC site for the next five years is estimated to increase up to 30 MW. The NWTC plans to upgrade the electricity infrastructure on site and add an interconnection to the local utility, including a new higher voltage electricity service (transmission) to accommodate 50 MW of on-site electricity generation capacity. Plans in place to expand the electricity service infrastructure at NWTC could allow for greater production but will not be fully operational before 2018.

SunEdison Origination, LLC installed and currently owns and operates an eight-acre PV array on an easement provided by DOE on the western part of the NWTC site. The 1.08-MW array provides power to the on-site facilities side of the NWTC's electricity 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 was established on December 31, 2008. The Western Area Power Administration purchases power generated from the PV array and then sells it to GFO for use at the NWTC through a 30-year intra-agency agreement that was executed on December 29, 2008.

FY 2014 ON-SITE RENEWABLE ENERGY PRODUCTION

Source	Energy Produced (MWh)	Energy Produced (MBtu)	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

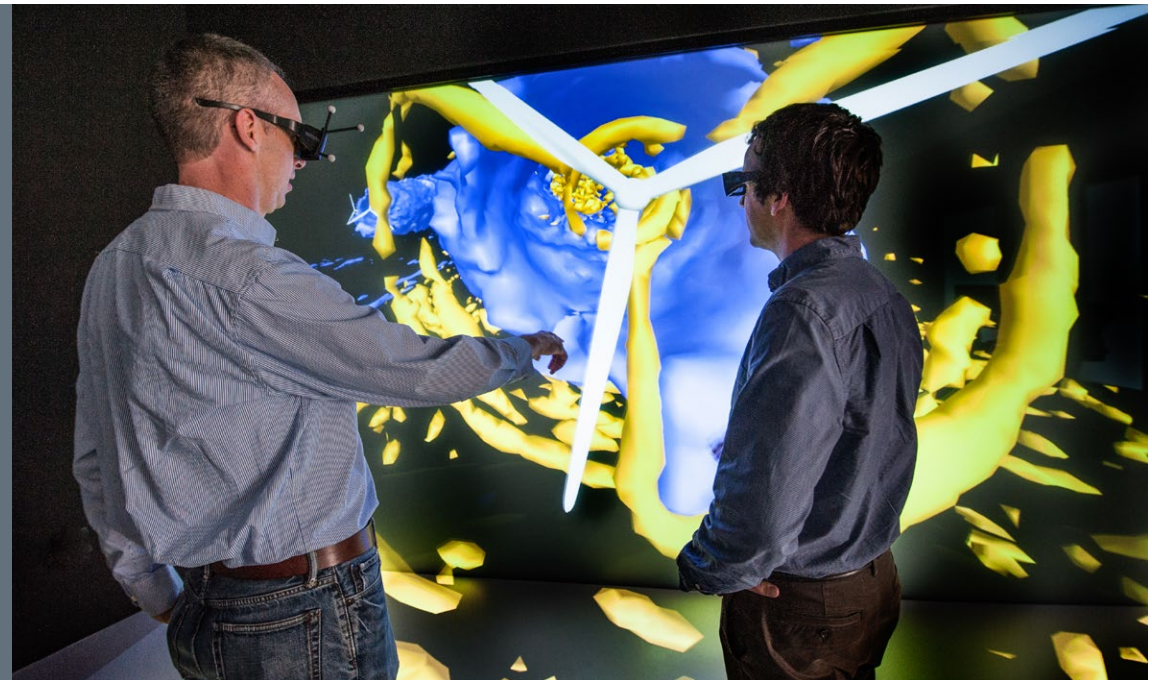
FROM ASHES TO FUEL

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. The use of fire salvage wood as fuel repurposes a material with no other use and supports fire mitigation efforts in the state.

In FY 2014, the RFHP displaced 22,551 MBtu of natural gas at the NREL campus. In FY 2015, NREL plans to use waste from sawmills to fuel the RFHP.

The photograph at the top of the page shows 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 the ESIF. The researchers have written open-source software that simulates wind farm conditions.

As part of the agreement NREL does not retain the RECs associated with this system. 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.

NREL's on-site thermal installation, the RFHP, produced 18,041 MBtu of thermal energy in FY 2014, offsetting 28% of campus natural gas demands and 37% 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 use for space heating on NREL's STM campus. NREL maintains a fixed cost supply contract for the RFHP. The laboratory is working with the energy services company Ameresco Federal Solutions to make combustor improvements that are projected to increase annual heat production in the RFHP by 50%.

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.

In FY 2014, NREL continued discussions with electricity 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.

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 current 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 southwestern side of the 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 electricity distribution system because of the system's limited capacity

Liz Doris (not in photo), technical manager of the Policy and Technical Assistance Program in the IAC, leads her group in a team-building exercise.

and because 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 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 systems: roof mounted, ground mounted, and canopy supported. Of the total potential for installation of 4.5 MW, 4 sizable projects equaling 2 MW emerged as short-term priorities within the next 5 years. NREL used Re-Opt software to conduct a financial assessment that illustrates the financial feasibility of the projects and explores potential funding mechanisms. If the PV arrays were sizable, a PPA could be attractive. NREL will enter into negotiations with Xcel to gain approval to proceed with PPA third-party supplier.

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.

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, and ESPCs to the extent possible. To date, NREL has initiated one ESPC project for the campus RFHP and has used PPAs to install 2.35 MW of PV.

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 be bundled into an ESPC. In the past year, NREL has been working with the Federal Energy Management Program 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 the Federal Energy Management Program to evaluate and determine the best approach for financing these projects.

In FY 2015, NREL will continue to investigate new financial mechanisms in addition to REC sales and utility rebates and look 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.

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* established policies that promote sustainable design, operations, and maintenance practices.

FY 2014 PERFORMANCE STATUS

Cool Roofs

In FY 2014, the cool roof area on the NREL campus remained the same at 69% of NREL's roof areas. FY 2013 increased the area of cool roofs by 43% with the replacement of the Thermal Test Facility roof and construction of the new LEED Platinum ESIF. Currently, 392,524 ft^2 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 and new high-performance building construction that included cool roof and PV specifications.

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 was not funded. NREL intends to pursue funding for the project in FY 2015. Additionally, NREL intends to complete a cool roof project at the IBRF. Once these projects are funded, the cool roof area is expected to increase to more than 427,000 ft^2 in FY 2015. Future roof replacement projects will be evaluated to determine the cost effectiveness of replacing with cool roofs or PV.

Guiding Principles

NREL uses EPA's Portfolio Manager to assess and manage GP compliance. All checklists, with supporting documentation, are maintained in this tool and are used to ensure that Facilities Information Management System 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: RSF I, RSF II, IBRF West, and the S&TF. With these four buildings, NREL is currently 18% compliant and exceeds the requirements of this goal.

NREL's plan for GP compliance is shown in Figure 8.

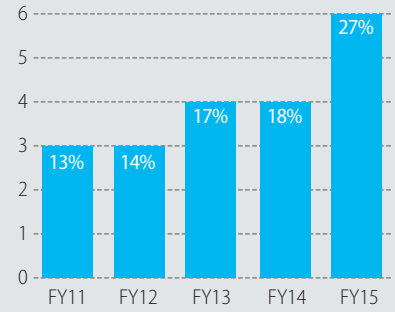
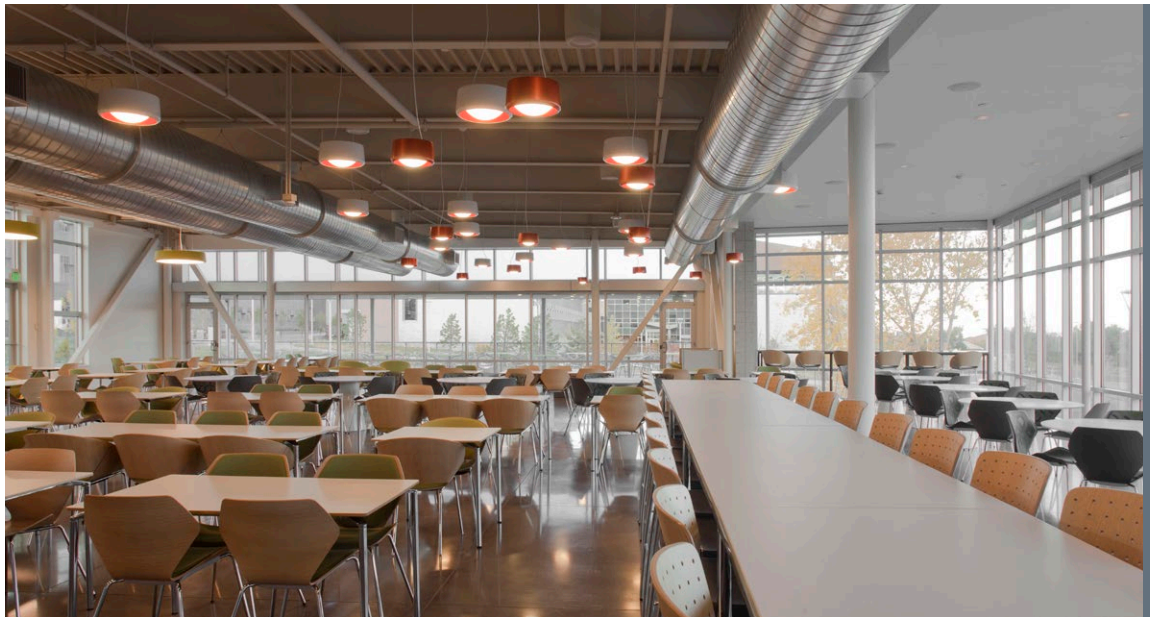


Figure 8. NREL's Plan for GP Compliance

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 Street 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. 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. All new construction at NREL will be fully GP compliant and achieve LEED Gold or higher certification.



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

Construction

LEED Certification

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.

New Facilities

During FY 2014, NREL's subcontracted design team completed 100% construction document submittals for the new two-story 16,000 ft^2 building addition to the Outdoor Test Facility. These construction drawings were publically bid for construction. Unfortunately, all bids received exceeded the approved project budget.

LEED CERTIFICATION STATUS

Building	LEED Certification Level
RSF I	LEED Platinum awarded FY 2011
IBRF	LEED Gold awarded FY 2011
RSF II	LEED Platinum awarded FY 2012
Parking Garage	Designed to LEED Platinum standards*
Café	LEED Platinum awarded FY 2013
ESIF	LEED Platinum awarded FY 2014
South Site Entrance Building	LEED Platinum awarded in FY 2014

* The 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.

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 general plan project list and funded a new clean room at the S&TF.

In FY 2014, NREL developed program requirements for a new TeAM facility that would support industrial engagement in the energy domain. The proposed 150,000-ft^2 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 Colorado Center for Renewable Energy Economic Development and NREL staff and an education center with a display area to welcome stakeholders to the STM campus. The

NREL and DOE employees learn about the new ESIF at an employee open house.

nature of this facility should attract considerable interest from noncongressional 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: 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.

MEASURABLE GOALS

In FY 2015 NREL will:

- Replace the Shipping and Receiving roof and the IBRF roof with new cool roofs 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.

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. This has included major shifts away from outdated systems that were significant energy consumers to a focus on efficient computing equipment and staff education on green information technology practices. FY 2014 proved to be a year of exceptional performance for NREL's core data center in the RSF—resulting in annual weighted average PUE that significantly exceeded DOE goals.

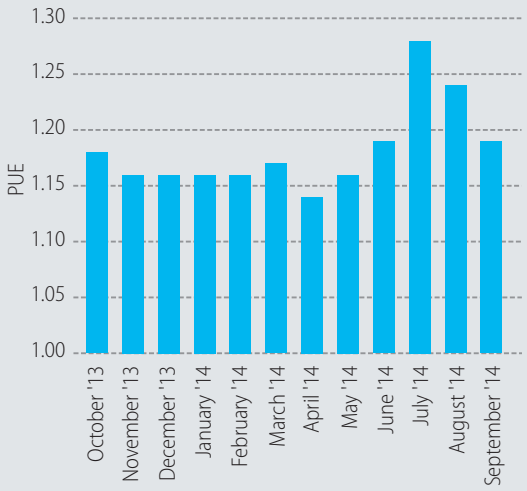


Figure 9. NREL's RSF Core Data Center Monthly Average PUE for FY 2014

FY 2014 PERFORMANCE STATUS

Data Center Operations

The primary core data center for NREL's campuses is located in the LEED Platinum RSF. 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 Consolidated Energy Data Report.

Average monthly PUE for the RSF data center was 1.18, which is an improvement over last year's performance of 1.20. Figure 9 shows the monthly average PUE in FY 2014 (see the DOE Consolidated Energy Data Report for additional performance details).

NREL's petaflop-scale ESIF HPC noncore 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 are 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.

During FY 2015, 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 that seek 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.

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 use 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 the 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 laboratory 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; as a result, preliminary policy recommendations were developed for NREL's campus that could save more than 11,000 kWh per year. NREL will continue to study current settings and finalize recommendations.

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

MEASURABLE 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 the Federal Green Challenge.
- Reduce nighttime plug loads in the office wing of the ESIF by using state-of-the-art power strips.
- Begin reporting data center information in DOE's Green IT program.
- Increase NREL's overall percentage of eligible EPEAT-compliant purchases.

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 dialog highlighted data center leadership in the Better Buildings Challenge. Hammond was asked to specifically discuss the initial barriers NREL was able to overcome with its own data center and plans for 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 center's electricity use.

Creating the Energy Intelligent Campus Platform

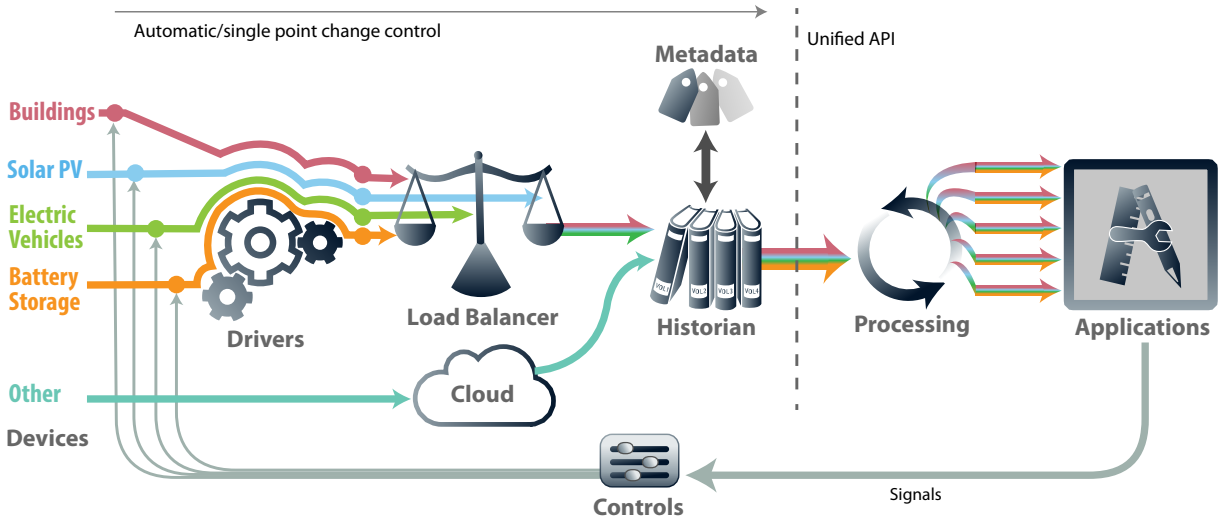


Figure 10. Instead of NREL researchers and engineers spending a multitude of hours on mere data collection the EIC will deliver significant value in providing a holistic modular system for project analytical decision making. This will result in a more cost effective use of program and energy infrastructure dollars.

NREL's sustainable campus and clean-energy research embodies the living laboratory concept as lessons learned are deployed to real-life applications. This is especially the case for moving the laboratory forward from its current state—which includes several LEED buildings, two of which are net-zero, to its ultimate goal—sustainable energy system integration.

As evidenced from tours, work for others, press coverage, and awards, the demonstration value and the cross-center expertise that has come from NREL's campus with 20% electricity generated on site and 28% thermal energy from renewable sources is one cornerstone of the overall strategy to position NREL as a world-class leader in energy systems integration. The Alliance's strategy for NREL is to continue to develop the campus infrastructure (buildings, on-site and grid power supply, and transportation system) into an integrated, and sustainable energy system that is also a tool for energy systems integration research. Realizing this vision in the next 5 years will be evident through laboratory-wide adoption of breakthrough technologies and observable interactions across programs.

To be successful more staff collaboration is required to achieve integration across EERE technologies and disciplines (building sciences, hardware and engineering, analysis, information technology, site operations). A technical cross-laboratory team from Buildings Research, SITE Operations, Strategic Energy Analysis Center, IAC, and Energy Systems Integration was established to discuss the creation of an intelligent energy informatics platform to improve innovative advanced analytic capabilities and actionable insights. Team members worked together on a series of Laboratory Directed Research and Development Strategic Initiatives that facilitated the development of campus-wide concepts related to data collection, systems for data control and demonstration, and campus applications of technologies. In March 2014, a charrette involving 60 staff members developed a collective and comprehensive understanding of campus energy data needs because many programs and projects at NREL require access to

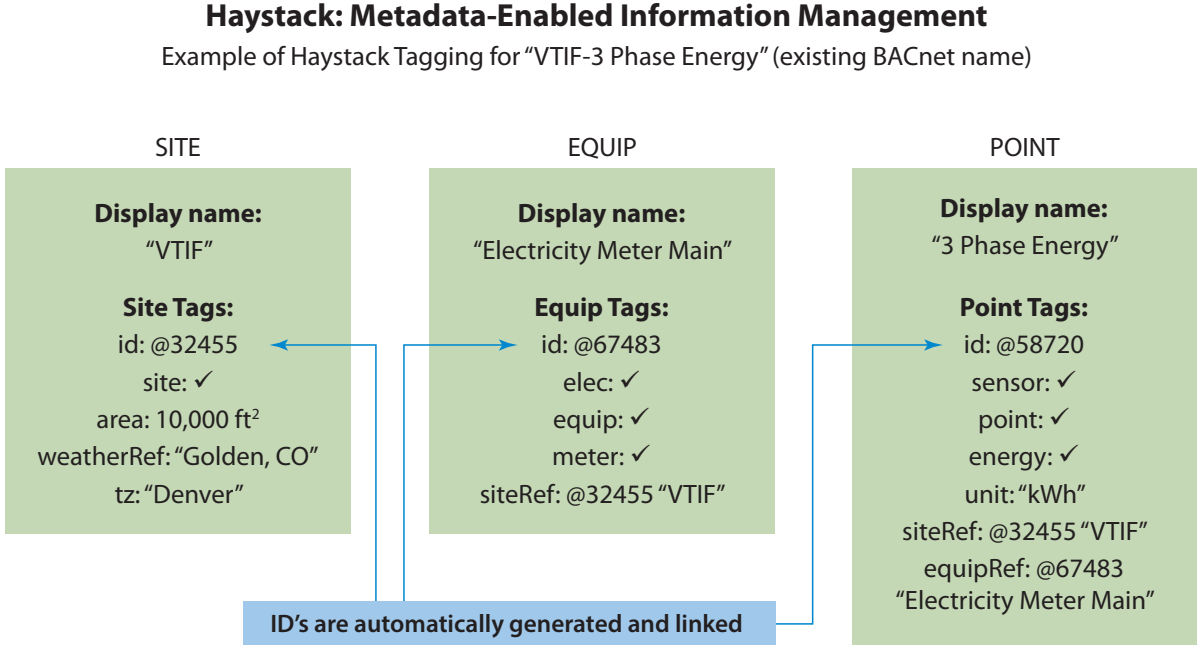


Figure 11. The EIC project will use the Haystack data schema to "tag" data and organize it into a Site-Equip-Point structure. Tags are added to data items as needed to group relevant pieces of information. For example, the temperature and humidity in a room can be associated with the air handler that serves it, thus creating a logical hierarchy of relationships. This is a significant improvement over conventional database schemas which use semantics (meaning and relationships) to organize data.

high-quality campus energy data. This successful charrette facilitated conversations to build bridges across disciplines and initiated the dialog to define shared needs for the underlying systems.

Since April 2014 the cross-laboratory team worked on developing requirements to build a platform prototype in the Vehicle Testing and Integration Facility. The prototype will be aligned with the current Laboratory Directed Research and Development to develop a microcontroller to island the Vehicle Testing and Integration Center. This pilot demonstration, the Energy Intelligent Campus project, will be deployed and monitored in FY 2015 to assess its capabilities for effective communication and data acquisition with a diverse set of protocols across devices, servers, and historians for applications at NREL. The new architecture will address ongoing concerns with network congestion that are caused by data acquisition. The Energy Intelligent Campus Project also unifies disparate systems into a single, well-defined architecture to improve data reliability, standardize access to energy data and metadata, reduce duplication of development efforts, and reduce the cost of maintaining NREL's energy informatics infrastructure. This platform is a conduit and instrument that allows campus energy objectives to align with the Energy Systems Integration research objectives, characterizes devices, studies electricity and thermal pathways and different types of controllers at various levels, and creates a test bed for power demand management and microgrid capabilities.

Constructing systems architecture with advanced methods to organize and use data aligns with the EERE Energy Systems Integration Strategic Agenda, creates a tool for federal facilities achievement of the High Performance Sustainable Buildings goal mandated by EO 13514 and can influence the development of open standard energy informatics products in the building sector.

—Written by Michelle Slovensky

Water Management

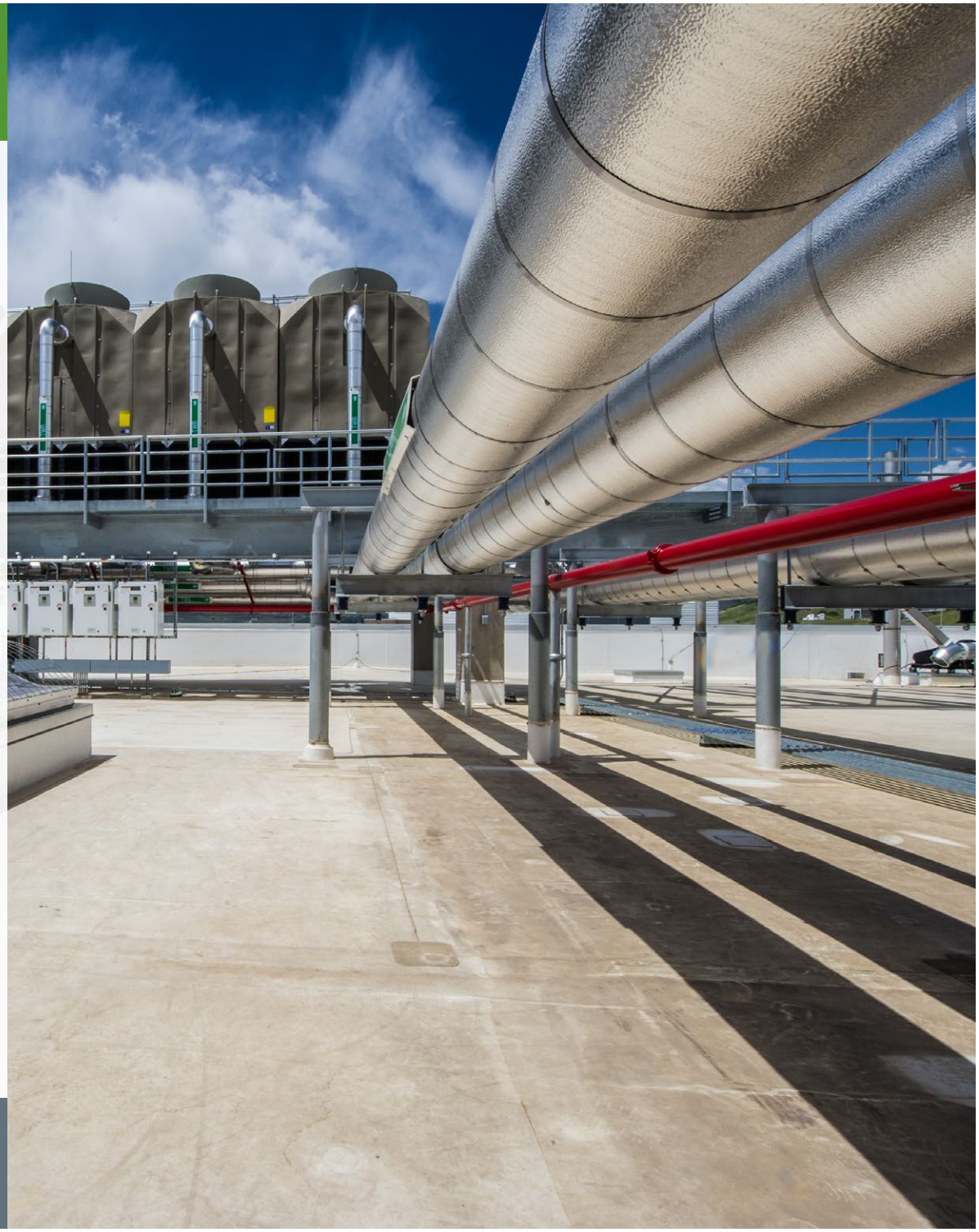
Goals:

26% potable water intensity reduction by FY 2020 from an FY 2007 baseline

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

20% water consumption reduction of ILA water by FY 2020 from an 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 ESIF HPC.

Water 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 its campuses and to implementing all available measures to reduce potable water consumption.

Though NREL will continue to explore nonpotable and water reuse 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 lower than the goal target. In FY 2014, NREL's water intensity was 15.7 gallons/ft^2, a decrease from the previous year and 23% lower than the reduction target (see Figure 12).

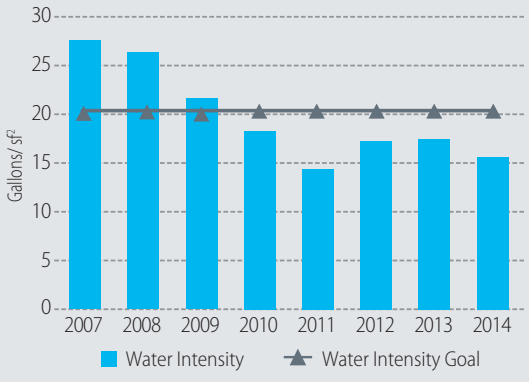


Figure 12. NREL's Potable Water Intensity for FY 2014

A variety of elements affected NREL's water 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 the increased consumption of potable water.

To reduce the impact on potable water use, cooling tower total dissolved solids were 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, also affected water intensity. Disturbed areas were vegetated with prairie grassland communities suited for Golden's semiarid climate. These areas all required irrigation to establish new vegetation. After three growing seasons, irrigation requirements diminish greatly and will be supplied in extended only during 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 during 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.

Strategic Intent

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

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 that target reducing campus potable water use.

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

Outdoor Potable Water

NREL has explored using nonpotable 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 run only 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 detention pond are irrigating to establish vegetation. The completion of the revegetation projects at the SERF and S&TF in FY 2015 will require irrigation for three successive growing seasons, which will temporarily increase potable water intensity.

Water conserving fixtures and appliances are used throughout the RSF. These fixtures can eliminate as much as 50% water use compared to a typical office building.

Success Story

WATER FIXTURE AUDIT COMPLETE FOR THE SOUTH TABLE MOUNTAIN CAMPUS

In FY 2014, NREL conducted an audit of the water fixtures on the STM campus. This included 12 owned buildings and 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, and 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 about their flow rates physically listed on the devices; 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 about the number of fixtures and flow rates will help determine the facilities and fixtures that need updating to more efficient systems and the possible impacts of these changes on NREL's water use reduction.

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

Water Management Plan

NREL's 2003 *Water Management Plan* was last updated in FY 2009. Since then, the STM campus has grown substantially with new high-performance buildings, extensive site and landscape restoration, new roadways, a new data center, and the 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. In FY 2015, NREL will finalize the *Water Management Plan*.

Stormwater

EISA Section 438 and its associated guidance (required by EO 13514 and developed by the EPA) define the performance objectives to be used for preserving or restoring the hydrology of federal property. EISA 438 requires that, for all federal facility construction projects exceeding larger than 5,000 ft^2, the hydrology of the site must be maintained or restored to predevelopment conditions to the maximum technically feasible extent.

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. NREL's project designers will continue to look for opportunities to incorporate low-impact design practices in all campus projects.

On most of the STM campus, stormwater runoff from impermeable surfaces is directed through surface drainage-ways to the Central Arroyo Detention Basin. Stormwater is detained and slowly released into Lena Gulch, the local natural watercourse, at predevelopment rates. The 4-acre detention pond, which can impound 15 acre-feet, maximizes stormwater runoff infiltration and evapotranspiration, and minimizes landscaping irrigation in ways that are consistent with EISA 438 and local, state, and federal water quality and water rights regulations. When additional DOE funding becomes available, the conceptual designs that were developed in the NWTC drainage study during FY 2011 will be finalized and constructed.

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 1 week. The detention basin captured 10.5 acre-feet and slowly discharged water for approximately 10 weeks.

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 that target reducing campus potable water use.

Environment and Pollution Prevention

Goals:

Divert at least 50% of nonhazardous solid waste and construction and demolition debris by FY 2015

- Diverted 75% of campus waste from landfill in FY 2014.
- Diverted 87% of construction waste from landfill in FY 2014.

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.

Increase annual fleet alternative fuel consumption by 10% by FY 2015, relative to an FY 2005 baseline

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

2% annual reduction in fleet petroleum consumption by FY 2020 relative to an FY 2005 baseline

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

Recycling paper and minimizing waste are important parts of the sustainability plan at NREL.

Environment and Pollution Prevention

Strategic Intent

Since its inception, NREL has strived to be a good steward of the environment through our research and operations. As a premier resource for renewable energy information, research, and technology, NREL has a unique role in supporting the nation's energy and environmental goals. NREL has a positive environmental presence, both in the operation of the laboratory facilities and in the major impacts to global conditions by laboratory research.

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. NREL makes the "4Rs philosophy" of reducing, reusing, recycling, and rebuying integral to operations to balance environmental, social, and financial considerations and make efficient use of all resources.

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.

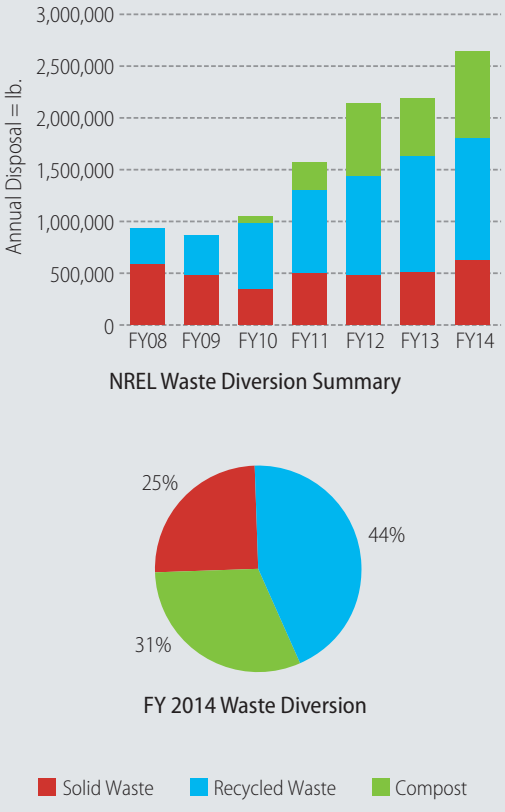


Figure 13. Summary of NREL's Waste Diversion Rates for FY 2014

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 caused by the 17% increase in full-time employees at the RSF C-Wing on the STM campus.

In the RSF C-Wing, 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, near-zero-waste, and composting educational materials. NREL will continue waste diversion efforts in FY 2015, and SNREL's Near-Zero Waste Committee will investigate additional measures.

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 1 day of trash collection in this area, and 1 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 compared to other similar facilities. In FY 2015, NREL will continue to conduct on-site waste audits to analyze NREL's waste stream and identify opportunities for additional reductions.

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 made efficient use of this resource for the production of biodiesel and saved packaging, reduced GHGs, and reduced the need for fertilizers and pesticides for 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. 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—effectively reducing the need for standalone imaging equipment. All new facilities are required to use multifunctional devices. All cartridges from the multifunctional devices are sent 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 and SNREL completed a project to audit printing throughout the laboratory in an effort to save paper and strengthen printing practices overall. The Office of the Chief Information Officer 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 multifunctional devices. The article also detailed the process for turning on the "locked print" option for PC and Macintosh systems. In FY 2014, NREL's paper use 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 these items 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 FY 2014, NREL had a three-sided equipment testing structure at the NWTC that was past its useful life. The structure was picked up by a company that repurposes local materials, allowing NREL to successfully divert 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 for reuse or recycling.

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. The laboratory also provides annual training about chemical safety and hazardous waste management for all laboratory workers and 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 environmental management system. NREL also works toward DOE's goal to use alternative chemicals and processes by giving preference to EPPs, including biobased products, EPEAT electronics, and low- or no-VOC paints.

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 Schlomberg, Ellen Fortier, Eric Schmidt and Eric Leimkuhler.

NREL conducted a wall-to-wall reinventory of chemicals and materials from January to June 2014. The level of accuracy in the chemical inventory system was measured at greater than 98%. Training programs continue to promote the use of materials with lower toxicity whenever possible and to emphasize the availability of the excess chemical inventory.

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 6 months to make sure that no dangerous levels of peroxides have accumulated. During the FY 2014 reinventory 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 2015, as the RFID chemical inventory pilot project expands, 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 use rates, make recommendations for removing aged materials, and investigate alternatives.

In FY 2014, the chemical inventory software was upgraded to accommodate storing the new Global Harmonization System hazard information. Occupational Safety and Health Administration 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 pest wildlife species need to be controlled, 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. Throughout

This vegetated bioswale extends from the RSF west courtyard conveying stormwater to NREL's central arroyo pond. This is an effective best management practice, as it reduces surface runoff and promotes infiltration. Additionally, this bioswale reduces sediment load and enhances water quality of the surrounding watershed by trapping pollutants so it does not reach Lena Gulch adjacent to the south site property STM boundary.

FY 2015, NREL will continue these weed management efforts and work to eliminate myrtle spurge from the STM campus.

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

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
- Snow and ice management.

Property Clearance and Release

Current NREL procedures call for mitigating any materials with radiological contamination before they are released. If any contaminated equipment is to be removed from the site, radiation levels must first be mitigated to background levels.

Construction Waste

In FY 2014, NREL was able to divert 87% of campus construction waste from small construction projects. SNREL will continue to track data and enforce subcontractor statement of work requirements for all construction projects in FY 2015.

MEASURABLE 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

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 EO 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 knowledgebase 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 via the Energy Facility Contractors Group 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 PCard and purchase request procedures to require the consideration of sustainable product alternatives before making a purchase. For employees with a PCard, a mandatory test was created that included the purchase of EPPs. NREL monitored

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

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% postconsumer 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.

the performance associated with these new policies and procedures through business systems, contractor tracking reports, and basic ordering agreements. 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, when green items represented less than 2%–15% of PCard purchases in those years. A significant part of this increase is attributable to better data accuracy about green items purchased. In FY 2015, NREL will continue its efforts to educate employees, and specifically administrators, about available green products. NREL plans to investigate options to enhance business systems to improve the accuracy of data reporting for green purchases in future years.

NREL uses locally sourced office supplies that are 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 backlit monitors with liquid crystal displays. In NREL's basic ordering agreement contracts for electronic purchases, NREL requires that vendors have the capacity to report on ENERGY STAR and 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.

MEASURABLE GOALS

In FY 2015, SNREL will:

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

Purchasing and Disposition Practices

NREL has long-established standards for computing equipment, which take into account sustainable acquisitions, operations best practices, and business needs. 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 review process, NREL is able to direct almost all 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% were bronze. Overall, 96% 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. NREL plans to establish standards for televisions and to revise the standards for imaging equipment in FY 2015 to bring this equipment in line with current 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.

In FY 2014, NREL received the gold level GreenBuy Award, achieving excellence in sustainable acquisitions for FY 2013 efforts.

Kevin Jackson, with Jackson Construction (left) speaks with Carol Johnston, NREL IT Support Services, at the Minority Supplier Developer Council workshop in Building 52 at Denver West. The meeting sponsored by the Minority Supplier Development Council, brings minority controlled businesses together with larger institutions to create new business opportunities and partnerships.

This is the third consecutive year that NREL has achieved the gold-level recognition. To achieve this award in FY 2013, NREL met the goals of 13 products in 6 categories. NREL continues to participate in the EPA Federal Green Challenge and WasteWise programs to support federal waste prevention and resource conservation.

Other projects in FY 2014 included using a database to track life cycle data for electronic equipment; ensuring the environmentally friendly disposal of electronics, and reviewing and revising policies to make NREL's IT 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 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 EO 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 Federal Green Challenge and will report on the laboratory's electronic stewardship initiatives through the Federal Green Challenge.

STRATEGY AND PERFORMANCE SUMMARY

NREL is committed to a right-sized fleet to maximize the use of AFVs and providing electric vehicle charging stations that serve employees and visitors and help fulfill research purposes. The laboratory continues to look for additional options to reduce GHG impacts, to promote alternative fuel use and AFVs, and to establish new policies and programs. The *NREL Fleet Management Plan* 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 are reported each fiscal year in the Federal Automotive Statistical Tool.

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 be fueled with E-85 unless directed by NREL's fleet manager. NREL also continues to work with the Federal Energy Management Program and the local Clean Cities coalition to improve the fleet's ability to access and use alternative fuels. 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 the use of alternative fuels.

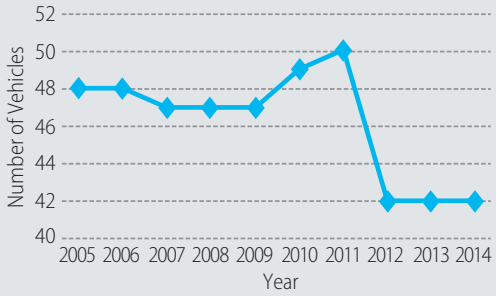
NREL also has one on-site compressed natural gas fueling station at the STM campus. No compressed natural gas was used in FY 2014 because NREL has no compressed natural gas vehicles in the fleet at this time. Compressed natural gas leased vehicles have not been available on the GSA lease list since FY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

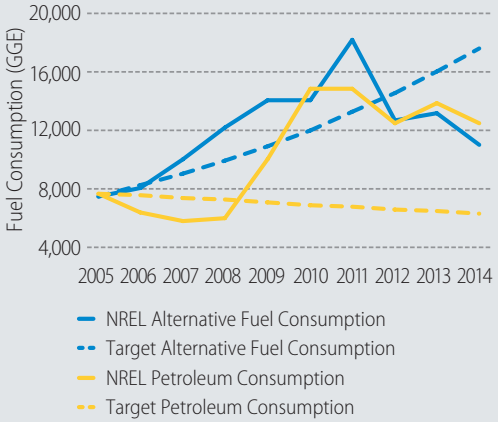
In FY 2014, the charging stations consumed 39,588 kWh of electricity. This is an increase of 57% from 25, 200 kWh in FY 2013. If NREL acquires electric vehicles, the systems are in place to capture electricity use data for reporting to DOE.

Petroleum Reduction

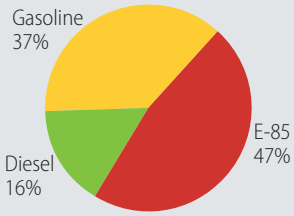
In FY 2014, NREL's petroleum use made up 53% of fleet fuel consumption. Overall, petroleum use is 63% higher than the FY 2005 baseline and 10% lower than FY 2013 use. The increase from the baseline year is due to the replacement of five compressed natural gas vehicles in FY 2012 and the increased use of the diesel buses since FY 2009. NREL is not yet meeting the petroleum reduction requirements—in part because of an



NREL's Vehicle Fleet



NREL's Fuel Consumption by Type Relative to Targets



Fleet Fuel Consumption by Type for FY 2014

Figure 14. Summary of NREL's Fleet and Fuel Consumption in FY 2014

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

almost-doubled laboratory population since the baseline year—but continues to work on overcoming the challenges to meeting this goal by FY 2020. 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.

In FY 2014, NREL logged 301,454 fleet miles, a 4% decrease compared to FY 2013. Per advice from DOE's Office of Management in FY 2014, NREL designated five security vehicles for emergency response use and one Inspector General 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 that are close to NREL but none offer biodiesel. The closest biodiesel supplier is 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 fleet, which currently consists of 42 vehicles: 40 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.

NREL works closely with GSA to procure vehicles that are smaller, consume alternative fuels, or that use advanced technologies to improve fleet efficiency. NREL's goal is to transform its fleet so that 100% of nonexempt vehicles are AFVs. 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. The *NREL Fleet Management Plan* documents this process in further detail.

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 AFVs, if available and as required.
- Investigate the feasibility of replacing shuttle vehicles (diesel minibuses) with an AFV.
- Investigate the feasibility of entering into a pilot project with GSA to acquire AFVs such as electric or hydrogen fuel cell vehicles.

Sustainable Supply Chain Management

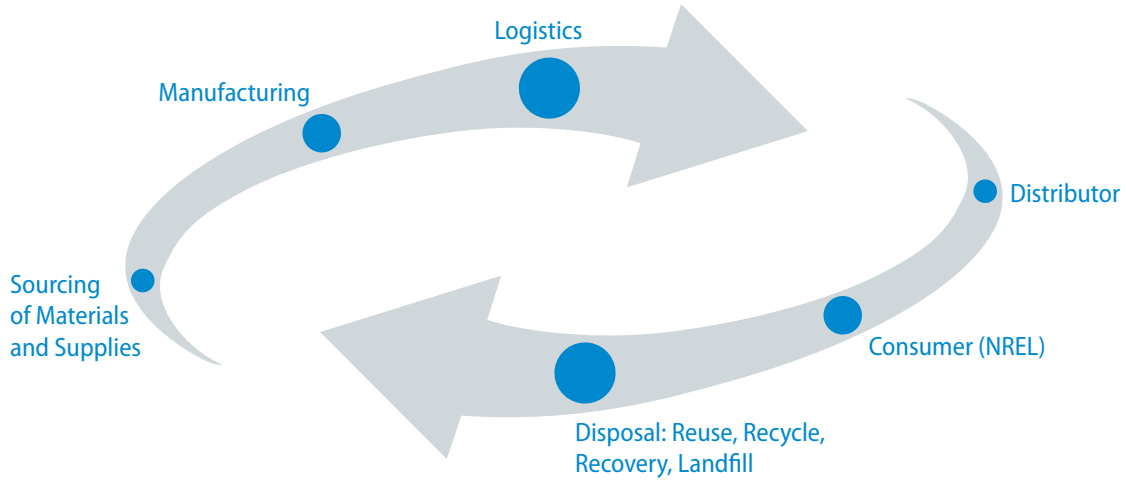


Figure 15. Sustainable supply chain management accounts for the life cycle of a product from inception to end of life.

Sustainable supply chain management (SSCM) coordinates efforts associated with identifying, acquiring, and accessing resources and related capabilities—including suppliers, logistics, providers, and customers—that an organization needs to attain its internal and external strategic objectives. Over the years, SSCM has evolved from a focus on continuing operations and maximizing profits to include social responsibility by taking into account environmental and societal impacts. SSCM balances the triple bottom line of financial, social, and environmental concerns.

NREL has some products in which SSCM practices are employed:

- NREL's Hazard Identification and Control Program accounts for the impact of potential chemicals and materials from the start of a project by assessing need, potential substitutions to reduce impact on the environment, and safe disposal.
- 100% of all electronic equipment at NREL is either reused, repurposed, or recycled. If the equipment can be reused, it is placed in a reutilization program and is either redeployed or donated/transferred to another organization. If the equipment is no longer useful, it is recycled through certified electronics recyclers.
- On average NREL diverts at least 75% of its municipal solid waste and construction waste from landfills through reuse, recycling, and composting.

NREL aims to achieve a more robust laboratory-wide SSCM strategy that exceeds federal requirements for waste management and procurement and focuses on a near -zero waste goal. NREL can achieve this goal by: 1) mapping the current supply chain for frequently purchased products; 2) ensuring contractors and vendors fully understand expectations around procurement, use, and end-of-life for all products; 3) developing a performance baseline, targets, and procedures; 4) developing specific training for NREL employees who are involved in procurement and project management with contractors and vendors; and 5) reassessing progress and auditing performance.

In FY 2015, NREL plans to initiate an investigation in its procurement practices to

In FY 2014, NREL continued an RFID chemical-inventory pilot project. The RFID device pictured streamlines data collection by remotely detecting inventory data without physically scanning each item and reduces inventory errors. This technology allows the chemical management system to more easily and efficiently track chemicals from the point of receipt through end-use and disposal improving research efficiency and minimizing hazardous waste generation.

identify areas for improvement and thereby reduce overall waste and pollution before the resources or materials arrive on site. The objective of this initial effort is to identify areas that NREL can improve upon to purchase more sustainably, lower costs by reducing resource use and needs, and move toward the attainment of a net-zero waste campus.

While NREL has procedures in place to promote the purchasing of EPPs, it is difficult to ensure every contractor follows through. In some cases EPPs may be lacking for research projects or these more sustainable choices may come at a significantly higher cost. NREL is committed to doing business through procurement with small, disadvantaged, women-owned, veteran-owned, service-disabled veteran-owned, and HUBZone small businesses. These smaller businesses cannot always secure lower prices for products relative to larger contractors. This illustrates one of the challenges of SSCM that NREL is investigating.

To achieve SSCM throughout the laboratory, NREL needs commitment and support from all employees, contractors, and vendors. Although NREL recognizes the importance of the environment and society, it takes commitment and practice to change the laboratory's daily operations. To address this challenge, measuring progress and incorporating this message into training are essential to progress and building capabilities. NREL already has many training opportunities but none that focus on procuring and managing sustainable projects and practices. As such, training and events that promote knowledge and enhance skills will need to be developed and updated based on performance progress.

NREL is committed to developing processes to demand greater transparency and responsibility from suppliers. A strong commitment to SSCM will ensure NREL becomes a leader in this field and demonstrates practices that benefit the environment and society.

—Written by Soudeh Motamedi

Stakeholder Initiatives

Goals:

Continuing efforts to increase regional and local planning coordination and involvement are to:

- Provide shuttles that connect staff to RTD public transit services.
- Coordinate with Denver Regional Council of Governments (DRCOG) WayToGo program to promote commuter options.
- Advocate for bicycle lanes on 20th Street with Jefferson County and City of Lakewood Climate and Disaster Preparedness Resiliency Planning.
- Participate in Colorado Recovery Office Statewide Resilience Working Group
- Support CEQ's Colorado Preparedness Pilot Project.
- Initiate the STM site-wide environmental assessment and finalize the NWTC site-wide environmental assessment.
- Work with Jefferson County Planning and Zoning to improve the drainage swale on the STM campus.
- Monitor buildings for bird-window collisions and raise staff awareness of this issue.

Zebediah Raney of PGI Wraps applies a window pattern of dots, made to prevent bird collisions, to ESIF's exterior windows.

Stakeholder Initiatives

STRATEGY AND PERFORMANCE SUMMARY

NREL coordinates with regional and local planning organizations and government agencies to improve land use, transportation, growth, and sustainability in 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 and that is 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 were 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 the efficient use of transportation, infrastructure, and services.

Through staff, NREL has direct contact with representatives from Jefferson County, the City of Lakewood, City of Golden, DRCOG WayToGo, and the RTD. NREL works with these entities frequently and informally—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 enhance adjacent roadways to improve conditions for public transit patrons and bicycle and pedestrian commuters.
- ***RTD Coordination***—NREL works frequently with RTD staff to encourage and support the 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 to enhance mobility in the community by decreasing the peak-hour traffic congestion.
- Conducting a commuter survey once every three years 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 the development of transportation programs and infrastructure on NREL campuses and provide feedback in the surrounding communities when appropriate.

Strategic Intent

NREL goes beyond prescriptive management approaches and protocols to drive reductions in energy, water, waste, and GHGs necessary to meet NREL's elevated performance standards. This leadership creates an environment that enables NREL employees to operate as agents of change to create a stronger, more sustainable community external and internal to NREL. NREL focuses our efforts on educating and finding ways to share our knowledge and resources to be an asset to our local, national and global communities.

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

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

- Providing a conduit for Boulder County and the Colorado Department of Transportation to communicate roadway construction activities on State Highways 128 and 93 to staff at NWTC campus, with emphasis on accommodations 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, teleworking, and incentive parking for green vehicles, which are described fully in the Greenhouse Gas Reduction Section.

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

Regional Climate Change and Disaster Preparedness Resiliency Planning

Colorado Resilience Working Group

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 resiliency statewide. At a summit in June 2014 that involved state and federal partners, participants developed the group's mission, resiliency principles and values, vision, and goals. Following the summit, those partners formed the Colorado Resiliency Working Group to steer the development of a resiliency framework and incorporate resiliency strategies and activities into the flood recovery.

The Colorado Resiliency Working Group steers the efforts of the resiliency framework's partners—who come from the whole community and participate in one or more resiliency 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 Lissa Myers and Michelle Slovensky attended the summit and have been participating in the Colorado Resiliency Working Group since its creation, providing a key advisory role and supporting the state and all the regional partners in this effort.

Council on Environmental Quality 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 Texas and 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)
- Improving resiliency in the nation's infrastructure (identifying needs within critical infrastructure to build resiliency 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 about NREL's climate change activities see the Climate Change section.

Environmental Management and Planning

National Environmental Policy Act 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 National Environmental Policy Act (NEPA) review is required for projects requiring the expenditure of funds, such as subcontracts, CRADAs, work for others agreements, and interagency agreements before contracts are awarded or activities initiated. The subsequent GFO NEPA determination will determine 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 such as an environmental assessment or supplement is required.

In FY 2014, NREL:

- Continued to include identification and analysis of impacts from energy use and alternative energy sources in environmental assessments.
- Initiated the STM site-wide environmental assessment and finalized the NWTC site-wide environmental assessment. Both 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 to ensure that program facilities, activities, and any future site reconfigurations are analyzed in conjunction with the laboratory's environmental management system, which is an integral part of the integrated safety management system, and with NEPA. These programs are incorporated into project planning and work authorization processes. NREL will continue to include consideration of energy use and alternative energy sources, as applicable, in all future environmental impact statements and environmental assessments. Such integration enables NREL to continuously improve environmental performance in accordance with the environmental sustainability goals of EO 13514.

Ecosystem Coordination

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

- Retain, preserve, and protect natural, scenic, ecological, and historic 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, and avoids 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 part of the STM site. According to NREL's *10-Year Site Plan*, "no development can occur on this land, with the

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.

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 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 consistently with NREL's Natural Resource Conservation Program. NREL is also conscious of the impacts its site development could have on local watersheds and has developed a program to address 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 part 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 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. The radar-activated lighting system, which is intended to decrease avian attraction and the potential for bird collisions with these structures, performed as 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 Federal Aviation Administration will document the work in an upcoming technical report.
- Continued to work with the Jefferson County Nature Association and Pleasant View Metropolitan District to manage noxious weed at the STM and NWTC campuses.
- Completed annual monitoring of DOE's STM conservation easement with Jefferson County.

Falconer Sam Dollar holds Houdini, a peregrine falcon, that has been fitted with GPS and a VHF tracker before a flight around wind turbines at NWTC. The falcon is part of research to test radar technology being developed by Laufer Wind and NREL. The GPS data from Houdini's flights provides a reference point for the researchers to compare their algorithms in the radar system. If these radar systems can better detect a bird, then they can track the bird's course more efficiently and use that information to decide whether or not to turn off a turbine.

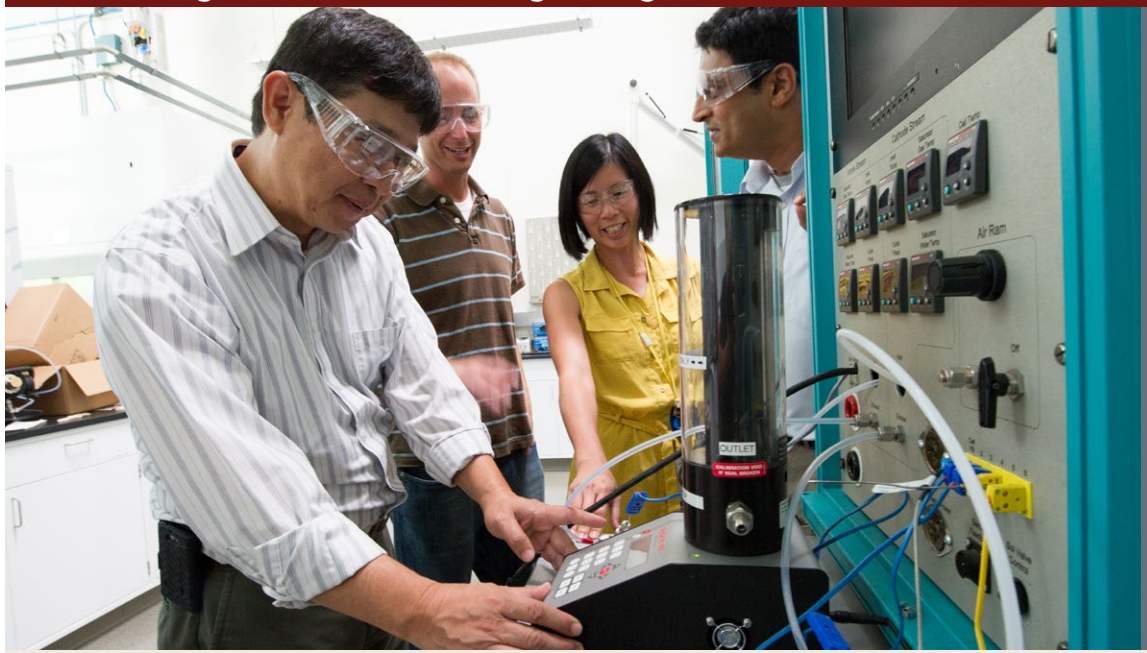
- Continued to monitor buildings for bird-window collisions and raise staff awareness of this issue. As a result of this monitoring, the ESIF was identified as an area of high risk for bird-window collisions. A window retrofit project was undertaken applying a 3M window film over the exterior glass surface on over 6,600 ft^2 of windows. Preliminary postproject monitoring has revealed no strikes to retrofitted windows. Monitoring will continue in FY 2015.

MEASURABLE 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, Colorado Department of Transportation, City of Lakewood, City of Golden, and Jefferson County.
- Continue to participate on the Colorado Resiliency Working Group and infrastructure subcommittee to develop a statewide resiliency plan.
- Continue to support the CEQ's Colorado Preparedness Pilot project.
- Continue to coordinate weed control efforts with adjacent land managers.

Sustaining NREL's Future Through Integration



NREL scientist Huyen Dinh (center) works with Paul Yu, Eric Bonn, and Balsu Lakshmanan, all from General Motors (GM), at the ESIF Fuel Cell Development and Test Laboratory. GM and NREL are working together in a CRADA project. Partnerships with commercial industry are an essential part of NREL's mission.

ONE VOICE, MANY SYSTEMS

Perhaps the biggest contributing factor to NREL's success in expanding the adoption of renewable energy technologies is integration. Without it, innovation that leads to impact at scale would remain static. Technology would be limited in scope, and individuals at laboratories such as NREL would still be highly skilled with many technologies, but separately. Without an awareness of the value behind fusing talents and assets, NREL would not be the sustainable institution that it is—internally, externally, fiscally, or environmentally.

As NREL Deputy Laboratory Director of Strategic Programs and Partnerships Bobi Garrett sees it, integration is well-represented by the tradeoffs in strategic decisions that shape long-lasting systems of clean energy produced at NREL and beyond.

Bobi Garrett
Deputy Laboratory Director of Strategic Programs and Partnerships

"At the end of the day," she said while wrapping up a 45-minute discussion about the role of integration at NREL, "the multiplicity of decisions at all levels—by individuals, by corporations, by governments—transforms."

Having worked at NREL for 16 years, Garrett has seen the ebb and flow of what drives individual passion for clean energy across the laboratory. Even when priorities change, she said, the "end game" is always consistent. For example, one driving factor that led to the laboratory's establishment as the Solar Energy Research Institute was the 1970s oil crisis. Energy security was a major concern during that time; oil was finally recognized to be a limited energy resource that has strong ties to the global economy and quality of life.

"I think to have a sustainable institution, we need to all be on one team, one voice, one vision, and we certainly have that vision," said Garrett, reflecting on feedback she received from the laboratory's recent "Listening Tours,"

sessions where staff could express concerns, as well as what they appreciate about working at NREL. What she found to be the most heartfelt takeaway of her experience was hearing staff answer the question: *Why do you come to work every day?*

"The single answer, with absolute fidelity that came out as number one in every listening tour group was, 'I come here to make a difference and have an impact on the world.' That's why everyone is here," said Garrett.

In addition to maintaining a sustainable institution through common vision, all the systems at NREL are impacted by future circumstances, from the perspective of climate change, the economy, and political influence to name just a few. Integrating these circumstances into the decisions that impact NREL's future is crucial for the laboratory's ongoing ability to extend renewable energy technologies to communities across the globe.

"One of the delightful things I did last year was work with our executive team to look a decade ahead at innovation," said Garrett, sharing how, instead of analyzing the future of engineering systems generation, transmission, and distribution, the Executive Management Team considered several "services" that might be impacted a decade from today. These included shelter, mobility, and access to information. With consideration for how these services might change within 10 years, the team explored what those changes might mean for the energy systems that support these services.

"We started with the output, or services, then backcast into what the systems need to look like," said Garrett.

Garrett views the world as connected, with small systems functioning in larger systems that range from acute and technical to broad, behavioral, and generational. According to Garrett, the "human system" is the most complex because it is the most difficult to model—not impossible, but complex.

Garrett added that NREL's Energy Intelligent Campus (see p. 46) offers a good example of how this is being done, as it involves bringing the human element into the loop of an engineered system. By drawing upon data that indicates peak energy use for the laboratory's operations, NREL can predict human behavior continuously and efficiently, and can therefore design the engineered campus in a way that integrates this data and plan at the outset.

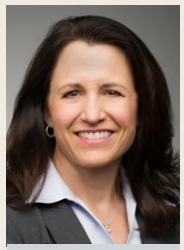
"I've had a passion about this my entire career," said Garrett. "I've been a system thinker forever. It's what motivates me. We're at the front end of a really significant transformation in how we think about our energy infrastructure—which is a wave of systems research and systems integration."

SEEING INTEGRATION AT THE CORE

As an institution and player in the global renewable energy arena, NREL's sustainable qualities must be present from the inside-out. Internally, when business needs of every office are identified, analyzed and addressed, the right amount of time and resources may become available to employees.

Within the institution of the entire laboratory, every office serves a function that contributes to the NREL mission. One of the most significant groups that manages and supports the laboratory's mission and mission support capabilities is the Office of the Chief Information Officer—NREL's center for IT expertise, including IT strategy, infrastructure, cyber security, applications, client services, and IT financial management.

For employees to be efficient, the IT systems in place must run as smoothly as possible. Kathleen Pinover, Manager of IT Strategic Planning and Operations with the Office of the Chief Information Officer, says that integration is "integral to mission and mission support systems. "These systems contribute directly to the R&D of clean energy and the systems operated by research support.



Kathleen Pinover
Manager of IT Strategic Planning and Operations

Pinover believes it's important to see NREL's internal processes from the perspective of a customer at the laboratory. The mission support systems, she said, are a big part of that discussion, considering the question: *Would our business systems serve the customer well?* When the internal data of NREL's day-to-day processes can be combined, repurposed, and efficiently used for the information they provide, all the data systems become more valuable.

Given this point of view, it's not surprising that Pinover played a significant role in developing the Phoenix Program, an initiative that seeks to simplify NREL's mission support systems through integration and efficiency. Though there had been a lot of conversation about this kind of change for years, the idea of the Phoenix Program truly caught fire around 2012. At this

time, Deputy Laboratory Director Ken Powers arrived at NREL, and he made it a priority to spend more time and energy investigating simpler processes for the mission support systems that keep the laboratory running.

The objectives included enhanced productivity; standard business practices that would produce higher quality and more reliable outcomes; a reduction in approval cycle time, by increasing trust; a reduction in the cost and time for employee benefits processes; and decreasing paper consumption.

According to Pinover, a primary goal of the Phoenix Program was to see NREL upgrade its business systems "in a way that adds significant value to the laboratory and refocuses our efforts on the work that our researchers are here to do." Systems that the Phoenix Program first sought to address included human capital management, travel, payroll, and timekeeping. Once the end business needs were identified, staff working with the Phoenix Program carried out market research and analysis of the tools that could satisfy these needs.

"A small group of vendors submitted proposals designed to fulfill the identified business requirements," Pinover said, adding that Source Evaluation Team representatives then reviewed the proposals and gathered input from a group of approximately 40 stakeholders from across the laboratory. Staff from all levels of NREL participated in demonstrations, on a variety of platforms to best evaluate the solutions against the staff's diverse needs.

Workday was selected as the solution to satisfy NREL's human capital management, payroll, and timekeeping requirements, while creating a fully integrated system in which all data would become more accessible. In addition to reducing the need for paper processes, Workday integrates a multitude of business processes.

"We've undertaken a large, very complex effort to take the data in Workday and send it out to other systems to enhance the value to those systems," Pinover said, referring to Oracle, which holds NREL's financial data. "We share data across NREL's financial and procurement systems, in addition to many of the other mission and mission support systems in use at the laboratory."

Currently 32 integrations facilitate the distribution of data between Workday and other mission support applications. In some cases, these tools collect data from dispersed systems and feed them to Workday to enhance employee information. In others, Workday sends new hire information to NREL's badging and learning management systems, or it's transferred back and forth between Workday and NREL's background check provider.

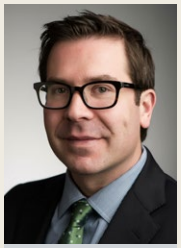
In addition to reducing paper and simplifying everyday processes, the efficiency of mission support systems at NREL is especially important, as Pinover stressed that core components of the 2008 recompete considered which business systems were in place, if they're were efficient, and whether they were highly integrated.

"Integration is a key underpinning component of competitive advantage," said Pinover. "It really is important to make sure that we're agile and effectively support the laboratory's evolving business model as we go forward."

SYSTEMS INTEGRATION: A KEYWORD AT NREL

Some centers on campus demonstrate a new wave of systems integration research just by what they are called, such as the IAC within Energy Analysis, The ESIF, and within ESIF, the Electricity Integration and Energy Systems Integration groups.

Also within ESIF, the Power Systems Engineering Center comprises the Transmission Grid Integration Group and Distributed Energy Systems Integration—two groups that are distinguished by scale and voltage.



Jim Cale
Group Manager of Distributed Energy Systems Integration

While the Transmission Grid Integration Group explores integration of renewable energy at the high-voltage bulk power system level, the Distributed Energy Systems Integration group research examines renewable energy integration at the lower voltage distribution level. According to Jim Cale, group manager of the Distributed Energy Systems Integration group, both groups "perform research that helps the commercial world absorb more renewable energy into their systems."

Cale joined Distributed Energy Systems Integration after working as a senior microgrid engineer for NREL's former Grid and Dispatchable Power group. With a comprehensive background in power electronics, electrical machines, and renewable energy before coming to NREL, he was unsurprisingly drawn to the microgrid research being done at NREL.

In his words, energy systems integration means "going beyond individual energy systems or device technologies to implement holistic solutions that optimize energy among diverse energy carriers." As an engineer, Cale's perspective is technical. He sees integration as optimized energy, generated from many sources—and this notion of integration allows a microgrid system to work.

"Microgrids do the same job of a traditional utility but on a small scale, typically for a piece of the electricity grid that's separate from the primary power system," explained Cale, adding that the purpose of the microgrid "is to maintain certain levels of power to critical electricity loads."

Microgrids offer enormous opportunity for companies, communities, and individuals to become more resilient and grid-independent in a changing climate. They can be a home, hospital, military base, data center, or a neighborhood to name a few. One of the greatest benefits of a microgrid is its ability to keep the power on if for some reason a utility outage occurred because of, say, a fault, heat wave, or hurricane. Yet controlling this system in a way that's stable and optimized, while incorporating large numbers of real-time data, isn't easy.

"One of the challenges is maintaining stability under a variety of potential load or resource changes that may be seen on a microgrid system," said Cale. He added that other microgrid challenges include optimization, coordinated control, and the charging and discharging of energy, based on resource availability. For example, the peaks in electricity use are typically in the morning when people get ready for work, then again around 6 p.m. "So a lot of excess PV in the middle of the day can be stored locally and used to offset demand in the afternoon," said Cale.

Yet solar resources are variable and cause loads to create stochastic systems for Cale's group to simulate and optimize the control technology. One strategy the group takes is predicting peak use hours and using distributed, stored energy during those times. They also do research on the impacts of high PV penetrations on the distribution system—a trend that is increasing every year.

Historically, electricity on the grid flowed in one direction, from large central generators to the customer on the distribution system. Now, Cale says the grid is changing, and "power is being generated at the 'grid edge,' from PV power on the distributed systems." This balance of integrating energy from many devices on the grid, while keeping voltage at a level that smaller power systems can withstand, is just one way of practicing the art of distributed energy.

"We are now helping utilities model and simulate their circuits," Cale said, "to predict where you might see problems, how you should deploy solar PV systems, where you should put them, and how you control them to mitigate the impacts of high PV penetration, such as voltage changes on the feeder."

To strengthen the efficiency of distributed systems going forward, generation, storage, and the optimized distribution of electricity loads must be controlled with intelligent forecasts. On a broader scale, this balance is possible by integrating human working groups, electricity systems, and forecasting—between NREL, utility companies, computer modeling, storage capacity, and the many types of circuits that produce electricity.

By optimizing distributed systems integration, renewable energy technologies may become more and more accessible, and ultimately reduce the need for energy produced by fossil fuels.

To reduce energy use, Cale considered how a common complaint that people have is *the government should not dictate the appropriate use of energy*. But there's a solution for that now, he said, without damaging the environment. "There's increasing energy efficiency and the use of more renewable energy through systems integration."

ENERGY SYSTEMS AT 360 DEGREES

The interplay between doing research for today and doing research for a clean energy future reveals yet another nuance of integration. At the IAC, Andy Walker is one individual who dedicates most of his time working with external clients, including federal and industry clients through external partnerships, as well as like-minded collaborators from the academic community.

Andy Walker
Principal Engineer of Integrated Applications Center

A principal engineer, Walker describes his work as "trying to survey the horizon and see what kinds of problems people are having." These people represent federal agencies and participating companies with NREL's work for others projects, now called Strategic Partnership Projects.

"We help them plan their approach to renewables and help them get through the process, all the way from identifying the most

cost-effective ways to meet their goals through contracting and acceptance of completed projects," said Walker.

This process—the REopt tool—determines the optimal combination of renewables that will help businesses or agencies meet their electricity, energy, or carbon-reduction goal. Walker stressed that in addition to the expertise that IAC provides in implementing renewable energy plans, securing long-term performance is also a big piece.

"The number of projects accumulating in the field out there is increasing," explained Walker. "So, whereas people before were focused on how to have renewables installed, now they focus on securing the long-term performance of assets that they've invested tens of millions of dollars in."

It's critical to look at the interdependent effects of the whole system to address this. In the early days, Walker said, feasibility studies addressed energy delivery (kilowatt hours) and energy cost savings. But what the IAC has come to understand more recently is that they must "look around 360 degrees and consider all the different ways that a project has to integrate with its surroundings."

For example, if a new project is located in a historic district, the team must involve the historic preservation community and considering technologies such as solar panels, making sure the features that make a building or district historically relevant are not compromised.

This "360-degree view" prevents Walker from doing his job in isolation. He takes frequent walks down to the ESIF, to investigate how new renewable energy projects are integrated with the electricity distribution system. When he needs more information about PV operations and maintenance, he talks to Sarah Kurtz about her work and PV reliability. For additional expertise on REopt planning, he visits Dan Getman and Donna Heimiller to discuss geospatial data and tools.

"It's safe to say that anything we offer to our external clients is based on this capability, this diverse internal capability—if it weren't for these people, I would not be able to offer what we offer," said Walker.

In addition to all the interactions Walker has with people throughout the laboratory, he's also well-connected to the academic community. An adjunct instructor with the Colorado School of Mines, University of Colorado in Boulder, and Metropolitan State University of Denver, Walker appreciates how teaching helps him stay well informed and conversant.

"When I was a student," he recalled, "a college professor told me that everyone should divide his or her time into three things: applying the skills you have to make a living; learning new things to add new skills; and then teaching other people the skills you've mastered." Teaching, Walker said, helps instill customer confidence in his expertise, because he continually does his own homework, keeping relevant equations fresh on his mind.

Further, these ties to academia allow Walker to stay informed about new renewable energy research ideas. He said there are two benefits to collaboration with the academic community—for the exposure to new ideas (many from the students), and because teaching is "a conduit for our own ideas to have impact through new course material delivered to students."

From Walker's perspective, the word *integration* means a few things. In the classroom, integration is what you'd find in a calculus textbook represented by an elongated "S," meaning "power integrated over time to calculate energy quantities, which is made challenging because power from multiple technologies varies with changing conditions." In the field, integration means "trying to anticipate and resolve any challenges with how renewable energy technologies integrate with the whole electricity system, with the rest of the site, and with the rest of the organization's mission."

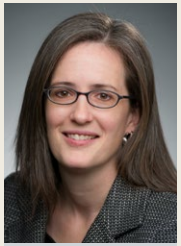
Put simply, he said, integration means "how things fit in."

ADVANCING THE MISSION

From the internal core of NREL's IT infrastructure, to the R&D of technologies that are integrated with transmission grids, many systems work alongside one another at NREL to achieve its mission—a big part of which is developing clean energy and energy-efficient technologies so that renewable energy can be deployed.

NREL's best-in-class systems, resources, and tools facilitate the transfer of technology from the laboratory to the marketplace. Kristin Gray, Director of NREL's Technology Transfer Office, said that she can effectively use the word *integration* to describe what her office aims to do, which is "to bring together research and researchers with industry and other federal agencies, to advance the clean technology mission."

For people such as Gray, the interaction between researchers and industry groups—and bridging that gap—comes with familiarity. NREL works with hundreds of partners in industry, government, academia, small business, international organizations, and nonprofits to catalyze the deployment of clean energy technologies. Bridging the gap is not simple; it requires networking, building trust, and having clearly defined partnering and licensing processes.



Kristin Gray
Director of NREL's Technology Transfer Office

"We do a combination of active and passive marketing," said Gray, adding that NREL's Technology Transfer Office is unique in that it offers a one-stop shop for both partnering and licensing activities. "We really look at the process from soup to nuts by engaging a partner early."

TTO strategically manages NREL's intellectual property portfolio. With partnering and licensing housed in one place, Gray said that a partner company can begin thinking about what intellectual property rights it might need early on to deploy a successful product, process, or service.

"Most often the principal investigators have really good ties to industry and generate interest to work with NREL," said Gray. She stressed that, through researcher and industry relationships, companies become more aware of the world-class facilities and research that NREL has to offer, which can help offset the risk associated with developing new, viable, clean energy technologies.

One way NREL fosters this kind of support is through its *Web portal* of DOE technologies that are available for license, so companies can easily search keywords for patents and locate a technology portfolio. Having this information readily available simplifies and expedites the process of placing a product built from research into the marketplace.

Gray said that another way TTO offers industry support is by "providing companies access to some of NREL's capabilities, facilities, and expertise." With access to world-class research facilities and laboratories, or equipment such as the ESIF's HPC, companies can come in and out of NREL's process in a way that helps their business progress without having to make extreme capital investments. NREL benefits by staying informed about the most current trends in the clean energy technology industry.

"We see ourselves as integrators in a way. The relationships we have encourage the deployment of our research and provide clean technology companies with the research support they need to be successful," said Gray. She added that the Technology Transfer Office focuses many efforts on its "convening power," helping clean technology companies network with one another, find commonalities, and find ways to do business with each other.

All the pieces that contribute to the transfer of NREL's technology—building relationships between NREL and industry, providing direct licensing opportunities to industry, bringing renewable energy companies together, and gaining the interest of clean technology investors—create the integrated system that pushes renewable energy technology to the market, which is, ultimately, the laboratory's main goal.

"If we are successful in our mission," Gray said, "we're really enabling widespread adoption and deployment of renewable energy and energy-efficient technologies."

—Written by Nika Durham

Global Reporting Initiative Key Performance Indicators

Energy-efficient vehicles and their owners in front of the RSF.

KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	Summary of Performance for FY 2014
CATEGORY: ECONOMIC		
ECONOMIC PERFORMANCE		
G4-EC1	Direct economic value generated and distributed	• Revenues: $378.5 million • Employee compensation: $157.9 million • Operating costs: $213.8 million • Payments to providers of capital/governments: $0 • Donations: $50,000
G4-EC2	Financial implications and other risks and opportunities for the organization's activities due to climate change	NREL continued work to conduct a climate change vulnerability assessment and develop a resiliency plan for its campuses. NREL has been working to understand current climate science projections for the region and is actively working to develop appropriate methodologies that allow for comparative climate change risk analysis and prioritizing of climate change resiliency actions for our campuses in support of EO 13653 released in November 2013. NREL has several projects at the international, federal, and organizational levels that deal with GHG emissions. Climate change and GHG activities continue to move to a broader, global focus with an emphasis on international accounting, private corporate responsibility, and the carbon reduction commitment. As such, discussions are being held to determine the best way provide technical support to other entities that build on NREL's experience and expertise in the area of GHGs.
G4-EC3	Coverage of the organization's defined benefit plan obligations	NREL meets all required funding obligations. NREL funding for the defined benefit retirement plan exceeded $16 million.
G4-EC4	Financial assistance received from government	NREL received no financial assistance from the government.
MARKET PRESENCE		
G4-EC5	Ratios of standard entry-level wage by gender compared to local minimum wage at significant locations of operation	NREL pays well above the federal and Colorado minimum wage requirements and pays competitive salaries for similar positions in the area. Men and women earn comparable wages throughout the laboratory in all positions.
G4-EC6	Proportion of senior management hired from the local community at significant locations of operation	NREL recruits on a national level and hires from the local community when possible for all senior management positions.
INDIRECT ECONOMIC IMPACTS		
G4-EC7	Development and impact of infrastructure and services supported	NREL does not have investments or services primarily for public benefit.
G4-EC8	Significant indirect economic impacts, including the extent of impacts	NREL continues to directly and indirectly encourage the renewable energy technology markets on a national and an international level. NREL had the following significant indirect economic impacts: • Assisted in designing a program to help entrepreneurs overcome technology and market gaps to bring new energy innovations from prototypes to full commercial production • Supported the convening of policy dialog events at global and regional workshops of international development assistance agencies to expand renewable energy technologies on a global scale • Developed software tools for a variety of renewable and sustainable energy purposes, which have been downloaded by a significant number of market participants • Convened an industry-based committee to revise and update the Standard Work Specifications for weatherization home energy professionals • Led a working group that has the potential to streamline and reduce costs for utility-scale PV systems
CATEGORY: ENVIRONMENTAL		
ENERGY		
G4-EN3	Energy consumption within the organization	
	Nonrenewable consumption	• Natural Gas—47,946 MBtu • Propane—527 gal • Gasoline —10,559 gal • Diesel—17,102 gal • E-85—15,449 gal
	Renewable consumption	• PV—6,248 MWh (21,319 MBtu) • Wind—645 MWh (2,201 MBtu) • RFHP—18,041 MBtu
	Electricity consumption	27,936.492 MWh
	Total energy consumption	190,400 MBtu

KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	Summary of Performance for FY 2014
ENERGY CONT.		
G4-EN4	Energy consumption outside the organization	
	Air Travel	• Long Haul (≥ 700 miles) – 13,561,103 Passenger miles • Medium Haul (300 mile ≤ × < 700 mile) – 915,132 Passenger miles • Short Haul (< 300 miles) – 110,554 Passenger miles
	Ground Travel	• Rental vehicles – 2,850 gal of gasoline • POV vehicles – 4,265 gal of gasoline • Cabs and Shuttles – 810 gal of gasoline • Mass Transit – 16,485 miles
	Commuting	• POV – 255,585 gal of gasoline and 13,727 gal of diesel • Carpool/Vanpool – 25,092 gal of gasoline • Mass Transit – 852,390 miles
G4-EN5	Energy intensity	118 kBtu/ft^2
G4-EN6	Reduction of energy consumption	Based on ECMs employed NREL saved: • 134 MWh of electricity • 1 M sf^3 of natural gas
WATER		
G4-EN8	Total water withdrawal by source	NREL uses municipal water supplies for all facilities at the STM and NWTC campuses. All municipal water in this area is drawn from surface water.
BIODIVERSITY		
G4-EN11	Operational sites owned, leased, managed in, or adjacent to, protected areas and areas of high biodiversity value outside protected areas	The Central Arroyo Detention Pond exhibits high biodiversity value, given its design and subsequent establishment of wildlife habitat. Because water availability has increased, the detention pond provides hydric and mesic habitat that is generally lacking across the STM campus. These hydric areas provide habitat for boreal chorus frogs, tiger salamanders, waterfowl, and shorebirds. Mesic areas provide habitat for songbirds and small mammals. NREL has also placed several nest boxes for bats and birds to further enrich the area that surrounds the detention pond.
G4-EN12	Description of significant impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas	None—although the STM campus has experienced rapid growth since 2009, the development of the site has not affected the biodiversity of habitats found in the conservation easement on top of STM.
G4-EN13	Habitats protected or restored	• STM conservation easement: 177 acres • NWTC conservation management areas: 157 acres A 5-acre parcel used for soil stockpiling was reclaimed, reseeded, and now contains vegetation cover of primarily native grasses and forbs. Given its early stages of restoration, most forbs are annual plants and some are nonnative invasive weeds. NREL will continue to manage this parcel to increase native grass and forb establishment.
G4-EN14	Total number of International Union of Conservation and Nature Red List species and national conservation list species with habitats in areas affected by operations, by level of extinction risk	• Wildlife surveys of the STM campus in 2010/2011 documented 102 species and included 86 bird species, 11 mammals, and 5 amphibians and reptiles. • Wildlife surveys of the NWTC campus in 2010/2011 documented 81 species and included 62 bird species, 16 mammals, and 3 amphibians and reptiles.

2014	Total # Avian Species	Avian Species In Affected Habitats	FWS Conservation Listing	Total # Avian Species	Avian Species In Affected Habitats
Least Concern	95	33	Species of Concern	15	4
Vulnerable	0	0	Endangered	0	0
Near Threatened	1	0	Threatened	0	0
Endangered	0	0	Delisted	2	0
Critically Endangered	0	0	Candidate	0	0

KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	Summary of Performance for FY 2014
EMISSIONS		
G4-EN15	Direct GHG emissions (Scope 1)	3,950.82 $MTCO_2e$
G4-EN16	Energy indirect GHG emissions (Scope 2)	24,152.54 $MTCO_2e$
G4-EN17	Other indirect GHG emissions (Scope 3)	8,055.58 $MTCO_2e$
G4-EN18	GHG emissions intensity	12.39 $MTCO_2e$/person (includes DOE and contractors)
G4-EN19	Reduction of GHG emissions	See the Material Assessment: GHG Emissions Reduction section for a detailed discussion about NREL's progress in reducing GHGs.
G4-EN20	Emissions of ozone-depleting substances	R-22 emissions – 0.00045 MT CFC-11 equivalent
G4-EN21	Nitrogen oxides, sulfur oxides, and other significant air emissions	• Nitrogen oxide emissions – 13.32 MT • Sulfur dioxide emissions – 0.41 MT • Carbon monoxide emissions – 5.67 MT • VOC emissions – 0.43 MT • Particulate matter (smaller than 10 microns) emissions – 3.53 MT
EFFLUENTS AND WASTE		
G4-EN23	Total weight of waste by type and disposal method	• Recycled waste (no construction and demolition) – 530.69 MT – Recycled oil – 0.88 MT – Recycled pallets and scrap metal – 191 MT • Recycled construction and demolition waste – 304 MT • Composted waste – 381.14 MT • Landfilled waste – 305.95 MT
G4-EN24	Total number and volume of significant spills	NREL had no significant spills.
G4-EN25	Weight of transported, imported, exported, or treated waste deemed hazardous under the terms of the Basel Convention Annex I, II, III, and VIII, and percentage of transported waste shipped internationally	NREL shipped 14,471 lb of hazardous waste, 0% was shipped internationally.
G4-EN26	Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the organization's discharges of water and runoff	None – the Central Arroyo Detention Pond is designed to handle runoff from the STM site. The pond functioned well during recent flood events (fall 2014) and is maintained to limit sediment accumulation.
COMPLIANCE		
G4-EN29	Monetary value of significant and total number of nonmonetary sanctions for noncompliance with environmental laws and regulations	NREL received no sanctions for noncompliance with environmental laws and regulations significant, nonmonetary, or otherwise.
TRANSPORT		
G4-EN30	Significant environmental impacts of transporting products and other goods and materials for the organization's operations, and transporting members of the workforce	NREL makes every effort to right-size its vehicle fleet, which currently consists of 42 vehicles: 40 GSA-leased vehicles, and two DOE-owned vehicles. The NREL fleet now includes 62% AFVs: • 26 E-85 vehicles • 5 hybrid-gas vehicles • 4 unleaded gas vehicles • 7 diesel vehicles. NREL's fleet consumed the following amount of fuel, emitting 123.12 $MTCO_2e$: • 11,090 GGE of E-85 • 3,831 GGE of diesel • 8,741 GGE of gasoline. NREL also used a variety of motor equipment for work across the laboratory. In total this equipment consumed the following amount of fuel, emitting 146.93 $MTCO_2e$: • 527 gal of liquefied petroleum gas • 13,762 gal of diesel • 333 gal of gasoline • 46 gal of E-85.

KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	Summary of Performance for FY 2014
OVERALL		
G4-EN31	Total environmental protection expenditures and investments by type	NREL is committed to environmental stewardship, pollution prevention, compliance with requirements, and continuous improvement in environmental protection and sustainability performance. A framework of policies, procedures, and programs that integrates environmental protection into daily work practices has been developed and implemented, and is registered to the ISO 14001:2004 standard. This includes processes to identify environmental needs, allocate funding and resources, and meet requirements.
ENVIRONMENTAL GRIEVANCE MECHANISMS		
G4-EN34	Number of grievances about environmental impacts filed, addressed, and resolved through formal grievance mechanisms	NREL did not file, address, or resolve any grievances about environmental impacts.
CATEGORY: SOCIAL - LABOR PRACTICES		
EMPLOYMENT		
G4-LA1	Total number and rates of new employee hires and employee turnover by age group, gender, and region	New hires: 338 employees and 7.19% turnover. NREL does not track this information by age group or gender.
G4-LA2	Benefits provided to full-time employees that are not provided to temporary or part-time employees, by significant locations of operation	Full-time and part-time employees are eligible for the following benefits that are not provided to temporary employees: long-Term disability, tuition reimbursement, and interest-free—payroll-deducted computer loans.
OCCUPATIONAL HEALTH AND SAFETY		
G4-LA5	Percentage of total workforce represented in formal join management-worker health and safety committees that help monitor and advise on occupational health and safety programs	Zero—NREL has instituted an alternative structure to address worker safety and health. 100% of the total workforce is represented, but not by a formal joint committee.
G4-LA6	Type of injury and rates of injury, occupational diseases, lost days, absenteeism, and total number of work-related fatalities, by region and by gender	This information encompasses all NREL sites. • Total reportable case rate: 0.58 cases per 100 employees • Days away, restricted, or transferred rate : 0.32 per 100 employees • Fatalities: Zero. NREL does not track this information by gender.
TRAINING AND EDUCATION		
G4-LA9	Average hours of training per year per employee by gender and by employee category	NREL has a robust training program but does not currently have the capacity to track training by gender, employee category, or total hours.
G4-LA10	Programs for skills management and lifelong learning that support the continued employability of employees and assist them in managing career endings	NREL has a tuition reimbursement program that allows qualified and approved employees to be reimbursed for up to 100% of their tuition costs in undergraduate and graduate degree programs. NREL currently offers training opportunities to staff to advance employee skill sets and learning objectives. NREL course offerings include: • Managing Conflict (primarily for managers) • Executive Forum Leadership Series (for managers only) • Technical Writing • 7 Habits for Managers • Crucial Conversations • Speed of Trust, Influence • Pillars of NREL Leadership • Interviewing Today's Workforce • 7 Habits of Highly Effective People®, and • BizLibrary – a collection of more than 5,000 online courses. Individual NREL centers have overhead funding that can be used to pay for training to advance employee skill sets and learning objectives.
G4-LA11	Percentage of employees receiving regular performance and career development reviews by gender and by employee category	100% of all NREL employees receive regular performance and career development reviews.

KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	Summary of Performance for FY 2014
CATEGORY: SOCIAL - HUMAN RIGHTS		
INVESTMENT		
G4-HR2	Total hours of employee training on human rights policies or procedures concerning aspects of human rights that are relevant to operations, including the percentage of employees trained	NREL requires training for all new employees in the human rights categories of diversity, harassment (334), and drug/alcohol awareness.
SECURITY PRACTICES		
G4-HR7	Percentage of security personnel trained in the organization's human rights policies or procedures that are relevant to operations	100% of security personnel are trained in NREL's human rights policies and procedures.
CATEGORY: SOCIAL - SOCIETY		
LOCAL COMMUNITIES		
G4-SO1	Percentage of operations with implemented local community engagement, impact assessments, and development programs	To implement executive orders and expand SNREL initiatives, campus projects integrate physical boundaries, connect to transportation and utility systems, and protect ecosystems and open space. All these elements have linkages that forge stronger community, neighborhood, and user relationships. NREL continues to coordinate with appropriate local and regional planning organizations and government agencies to improve land use, transportation, growth, and sustainability in the community. This past year NREL: • Provided shuttles that connected staff to RTD public transit services • Participated on the West Metro Sustainability Team (consisting of GFO, NREL, GSA, City of Lakewood, and Red Rocks Community College) • Supported the Sustainable Buildings Council of Colorado • Worked closely with the Battelle Sustainability Group • Partnered with the US Green Building Council • Worked closely with the Jefferson County Sustainability Board • Acted as a liaison to the Colorado Resiliency Working Group (stakeholders include the Federal Emergency Management Program and Colorado Recovery Office) • Held three Community Open House informational meetings discussing environmental and sustainability stewardship, and community opportunities • Expanded the NREL Community Portal to include local hiking and biking trails • Held regular student and adult programs through the Education Center including topics on clean energy innovation, sustainability, NREL's mission, and Sustainability Campus Tours (the Education Center is open weekdays to the community) • Public Affairs has a board representative on the Golden Chamber of Commerce and the Jefferson County Economic Development Corporation as well as participant engagement with the West Chamber of Commerce • Held multiple VIP Tours with numerous community representatives including Jefferson County administration and commissioners
G4-SO2	Operations with significant actual and potential negative impacts on local communities	NREL operations had no significant actual or potential negative impacts on local communities.
ANTI-CORRUPTION		
G4-SO3	Total number and percentage of operations assessed for risks related to corruption and the significant risks identified	The risk of all forms of fraud, including corruption is evaluated across the laboratory as follows: • The Enterprise Risk Management committee includes discussion of the potential for fraud, the probable impact if experienced, and the likelihood that it could occur, at least three times each year. The Enterprise Risk Management committee covers all NREL operations. • NREL's Deputy Laboratory Director/chief operating officer, Alliance Secretary/NREL General Counsel, and Alliance/NREL chief financial officer brief the Alliance Finance and Audit Committee on all forms of risk during each of the Alliance Finance and Audit Committee meetings, which occur three times each year. • The Finance and Audit Committee Chair, supported by the Alliance Secretary/NREL General Counsel and Alliance/NREL chief financial officer, brief the Alliance Board on all forms of risk during each of the three yearly Alliance Board meetings.
G4-SO4	Communication and training on anti-corruption policies and procedures	NREL requires that all employees complete ethics training. If an employee does not complete the training, an escalating follow-up notification procedure provides prompt notification to the employee's manager(s) to ensure timely completion.
G4-SO5	Confirmed incidents of corruption and actions taken	NREL maintains four anonymous reporting hotlines (three internal and one external) for employees and others to report good faith concerns and observations for potential investigation and resolution. During this fiscal year no reports of incidents of corruption were received, so no action was necessary.

KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	Summary of Performance for FY 2014
PUBLIC POLICY		
G4-SO6	Total value of political contributions by country and recipient/ beneficiary	NREL had $0 of political contributions.
ANTI-COMPETITIVE BEHAVIOR		
G4-SO7	Total number of legal actions for anti-competitive behavior, anti-trust, and monopoly practices and their outcomes	NREL did not experience any legal actions for anti-competitive behavior, anti-trust, or monopoly practices. Note: As a Federally Funded Research and Development Center, NREL has one primary business client, DOE. DOE provides comprehensive oversight of NREL operations. NREL and DOE policies maximize compliance with laws and regulations plus sound business practices.
COMPLIANCE		
G4-SO8	Monetary value of significant fines and total number of nonmonetary sanctions for noncompliance with laws and regulations	NREL was not fined, nor did NREL experience any significant nonmonetary sanctions for non-compliance with laws and regulations. Note: As a Federally Funded Research and Development Center, NREL has one primary business client, DOE. DOE provides comprehensive oversight of NREL operations. NREL and DOE policies maximize compliance with laws and regulations plus sound business practices.

NREL Team members (left to right), Kevin Regimbal, Steve Hammond, David Sickinger and Otto VanGeet of the 2014 DOE Sustainability Award for "Novel, Holistic Approach to Data Center Sustainability Yields Dramatic Energy Reductions."

Awards and Honors FY 2014

NREL garnered more than 30 honors and awards in FY 2014, including two R&D 100 Awards. The awards described here highlight a diverse group of achievements across the laboratory including researchers, staff, facilities, inventions, process improvements, mentorship, sustainable actions, and website development. NREL continues to search for meaningful ways to recognize the dedication of its employees. In FY 2014, NREL unveiled the Rising Star Awards which recognize employees with less than 6 years at NREL who have demonstrated increasing engagement with the commercialization and technology transfer process. The awards from FY 2014 illuminate a brief snapshot of the brilliant dedication and continual innovation across the NREL campuses throughout every year.

R&D 100 AWARDS

NREL won two R&D Awards—bringing the total to 57 awards since 1982.

Innovative Growth System Lowers Cost of Monocrystalline Silicon Wafers. NREL worked with the company Crystal Solar to demonstrate the viability of high-efficiency thin monocrystalline silicon solar cells and modules that are less than 80 microns thick and to show that they can be grown at lowcost through an epitaxial process. The Direct Monocrystalline Silicon Wafer Growth by High-Throughput Epitaxy Team demonstrated that this growth system produces cells at half the cost and 100 times the speed of conventional epitaxial reactors, opening the door to rapid commercialization. NREL performed characterization and reliability measurements on cells fabricated by Crystal Solar and collaborated with the company's technical team to develop and implement modifications to the measured cells, contributing to improved cell performance and reliability. Recognition to NREL's Harin Ullal, Bhushan Sopori, and Steve Johnston.

High Performance Supercomputing Platform Uses Warm Water to Prevent Heat Build-up. NREL collaborated with HP for the HP Apollo 8000 System. This innovative system uses component-level warm-water cooling to dissipate heat generated by the supercomputer, thus eliminating the need for expensive and inefficient chillers in the data center. This innovative design also allows waste heat from the computer to be captured and used to heat office and laboratory spaces, achieving even higher efficiency levels. HPCs provide the foundation for numerical modeling and simulations, which permit scientists to gain new insights and drive innovations in energy efficiency and renewable energy technologies. However, as HPC systems scale by orders of magnitude, energy use and cooling these systems become more challenging, begging a solution such as the one provided by HP and NREL. Recognition to NREL's Steve Hammond.

R&D Editor's Choice Award: ESIF and HP's HPC "Peregrine." Each year, the R&D 100 awards recognize the top 100 scientific and technological innovations as chosen by the judges. Only three of those 100 receive the additional honor of an Editors' Choice Award.

R&D 2014 LABORATORY OF THE YEAR

ESIF named R&D magazine's 2014 Laboratory of the Year. The LEED Platinum ESIF received this prestigious international award for being a first-of-its-kind research user facility that uniquely merges three very specialized components: an ultra-energy-efficient workplace that consumes 74% less energy than the national average for office buildings, one of the world's most energy-efficient high-performance computing data centers, and sophisticated high-bay laboratory spaces with outdoor test areas. This is the second laboratory of the year recognition for NREL. In 2008, NREL was recognized by *R&D Magazine* with a special award for the S&TF.

LEADERSHIP AWARDS AND HONORS

ESIF was honored as one of three international finalists for Project Management Institute's Project of the Year Award. This award recognizes projects from any industry in the public and private sectors that have demonstrated superior use of project management techniques. The innovative performance based design-build acquisition strategy employed by the project team, enabled the project to come in under budget and ahead of schedule.

NREL has been recommended for recertification to three significant international standards that demonstrate the laboratory's commitment to the environment, safety, and quality excellence. The management system certifications are ISO 14001:2004 (environment); Occupational Health and Safety Administration 18001:2007 (health and safety), and ISO 9001:2008 (quality, limited scope). Kurt Schlomberg, NREL's environmental management system coordinator, said, "These international certifications bolster NREL's position as a world-class research institution and enhance our competitiveness."

NREL created a new Innovation Impact site on the NREL.gov website. The site won an Outstanding Government Website award in the 2014 WebAwards competition sponsored by the Web Marketing Association.

NREL Senior Scientist Huyen Dinh was honored as an Outstanding Co-op Employer for 2013–14 from the University of South Carolina. Undergraduate Charlie Staub said Dinh deserves the honor "because of her dedication to improving my experience as a co-op student."

Mile High United Way honored NREL's most recent Charitable Giving Campaign with a 2014 Award Employee Engagement & Boots on the Ground award for exemplary employee engagement. Recognition to Owen Barwell, Kara Thate, Karen Kestrel, and Niall O'Connor.

SCIENCE AWARDS AND HONORS

Dan Arvizu, NREL's laboratory director, has been elected to membership in the National Academy of Engineering. This is one of the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to engineering research, practice, or education and who have made significant contributions to the pioneering of new and developing fields of technology, making major advancements in the traditional fields of engineering, or implementing innovative approaches to engineering education.

David Ginley, a Research Fellow and materials scientist at NREL, has been named an American Academy for the Advancement of Science Fellow. Ginley is recognized for his work on materials, PV, batteries, and education.

Dr. Ben Kroposki, director of Energy Systems Integration at NREL, has been named an Institute of Electrical and Electronics Engineers Fellow. Kroposki is recognized for his leadership in renewable and distributed energy systems integration in the electric power sector. Kroposki has led a number of efforts over the last 20 years that have contributed to the advancement of renewable and distributed energy systems.

Martha Symko-Davies was named one of the Top Women in Energy by the Denver Business Journal and Women in Energy. The award honors Denver's most influential and successful women working in the energy field. As NREL's director of Partnerships for Energy Systems Integration, Symko-Davies oversees the agreements that bring utilities and vendors to the ESIF where they can evaluate the impact of distributed energy resources such as solar technologies on the grid and find solutions to using the technologies safely, reliably, and cost-effectively at scale.

Gregg Beckham was honored with the American Institute for Chemical Engineers Computational Science and Engineering Forum Young Investigator Award and the American Chemical Society OpenEye Outstanding Junior Faculty Award. The awards recognize outstanding research in computational molecular science and engineering. As the winner for the American Institute for Chemical Engineers award, Beckham recently gave a lecture titled, "How the Walls Come Crumbling Down: Elucidating Mechanisms of Cellulose-Active Enzymes Using Molecular Simulation" at the American Institute for Chemical Engineers 2014 Annual Meeting.

Senior Research Fellow Emeritus Art Nozik and Principal Scientist Keith Emery have been included in Thomson Reuters' Highly Cited Research list for the thousands of citations of their work by fellow researchers over the past decade. Thomson Reuters also named the two scientists to the company's 2014 World's Most Influential Scientific Minds List.

Principal Engineer Bhushan Sopori, one of NREL's top inventors (measured by number of patents generated and licenses executed), was honored with the Distinguished Innovator of the Year Award. This award recognizes scientists who have shown leadership that has significantly impacted the commercialization of NREL technologies, demonstrated innovation productivity, and created impactful technologies.

This year marks the debut of the Rising Star awards. These awards recognize employees who have less than 6 years of service at NREL but who have demonstrated increasing engagement with the commercialization and technology transfer process. The three winners are Kirstin Alberi and Arrelaine Dameron of the Chemical and Materials Science Center and Gregg Beckham of the National Bioenergy Center.

NREL was the cowinner of HPCwire magazine's Editors' Choice – Top Supercomputing Achievement Award. The award honors NREL and the Texas Advanced Computing Center for the work their high-performance computers—Peregrine and TACC—did in support of the research on converting biomass to fuels. Recognition to NREL's Gregg Beckham. Beckham's team analyzed the most prevalent enzyme in cocktails used to break down biomass in the bioethanol facilities that are quickly coming online in the United States and Europe.

Awards and Honors FY 2014

NREL won three Federal Laboratory Consortium awards including: Representative of Year Award to NREL's Senior Licensing Executive Eric Payne for his work on intellectual property bundling to raise the marketability of intellectual property, Excellence in Technology Transfer to NREL scientist Dr. Chunmei Ban and Licensing Executive Ty Ferretti for their work in licensing innovative cathodes and anodes for rechargeable lithium-ion batteries that exhibit high sustainable energy density and superior power capability, and a Mentoring Award to NREL Education Program Manager Linda Lung for outstanding work in furthering science and technical education and making NREL a leader in workforce development.

DOE AWARDS AND HONORS

DOE recognized five members of NREL's Transportation and Hydrogen Systems Center team with awards at the 2014 Annual Merit Review and Peer Evaluation Meeting. Wendy Dafoe, for strong and long-lasting commitment to advancement of the Clean Cities mission, Gi-Heon Kim, for invaluable contributions to the Computer-Aided Engineering for Electric Drive Vehicle Batteries project, Jennifer Kurtz, for outstanding performance in technology validation, Todd Deutsch for outstanding dedication and collaboration in photoelectrochemical surface validation in hydrogen production, and Michael Penev, for strong analysis support of DOE's market transformation subprogram.

NREL also was recognized with two DOE Housing Innovation Awards in Advanced Technologies and Practices and its contributions to development of Home Performance eXtensible Markup Language.

SUSTAINABILITY AWARDS

NREL was honored with a Way to Go award by the DRCOG for excellence in alternative commuting options.

Lissa Myers was named a Way to Go Commuter Champion by DRCOG for passionately advocating for alternative transportation options and all associated benefits for NREL staff.

NREL was recognized as a Business Challenge Winner for 2014 Bike to Work Day for the 283 employees who participated in the 2014 Bike to Work Day.

NREL was also a designated Bicycle Friendly Business at the Bronze Level in 2014 by the League for American Bicyclists. NREL received this for promoting a healthy, happy, and green workplace and providing a roadmap to become even more bicycle-friendly in the years to come.

NREL received an Overall Achievement in the 2014 Federal Green Challenge awards for outstanding efforts in 2013 to advance sustainability efforts and for leadership in reducing the environmental footprint of federal government activities.

NREL continued its sustainable procurement program that earned the EPA Green Purchasing Partner and DOE Green Buy Program Gold Award for the fourth consecutive year by conducting new Pcard training including green product buyer instructions.

NREL won the DOE 2013 Sustainability Award (presented in FY 2014), Green IT Stewardship for exemplary performance implementing green, including power management, sustainable electronics acquisition, and datacenter sustainability. NREL has worked tirelessly to maintain this achievement through efficient purchasing, computer power management, and end-of-life management, including repurposing and recycling of equipment.

NREL also received the 2014 Department of Energy Sustainability Award for Novel, Holistic Approach to Data Center Sustainability yielding dramatic energy reductions.

"Throughout this on-going process of innovation, SNREL keeps pioneering new avenues by embracing more strategies in the near future to deepen our participation and broaden our leadership."

Message From the Sustainability Program Director

Just as everybody has a vision of what *quality* means, most people also have their own ideas about *sustainability*. That concept can differ for everybody—but what exactly does the term convey?

In 1987, the Brundtland Commission's report for the United Nations defined sustainable development as "development which meets the needs of current generations without compromising the ability of future generations to meet their own needs." These days, we hear about the idea frequently—a lot more so than in 2002, when we at NREL began doing its own *Sustainability Annual Report*.

The expanded worldwide debate about sustainability has led to the creation of GRI, a standardized system that reflects the wide range of variables that are recognized as part of sustainability—a universe that now ranges from environmental stewardship to workplace equality. GRI, a voluntary yardstick, is valuable because it can open our minds to the larger picture of sustainability. While the now-familiar basics are there—recycling, rideshares, or water conservation, for example—such standards are just the beginning of any discussion.

Here at NREL, we look beyond those foundational elements. Maybe that's because we know about energy, and our researchers are remaking the world into a more efficient place, more reliant on clean energy and integrated energy systems. In a manner of speaking, we are the place where the rubber meets the road as we drive to achieve sustainability and reduce our footprint. We are the model for the federal government—and beyond.

These are not just concepts to us. Look around the laboratory and you'll see:

- We're creating a macro-world on campus that will leverage our scientific community's insights and research into all areas of sustainability.
- We're embracing the global ideal of using less energy, as Dan Arvizu discussed.
- In so doing, we're finding ways to cut GHG emissions.
- And we're beginning to engage in conversations laboratory-wide about sustainability.

We are seeing ideas take hold. People are not only ridesharing, but making small choices such as spending their consumer dollars on companies that do embrace environmental stewardship.

And we're not stopping. Throughout this ongoing process of innovation, SNREL keeps pioneering new avenues by embracing more strategies in the near future to deepen our participation and broaden our leadership. We'll do this by:

- Continuing to add renewable energy technologies to the laboratory through innovative business and organizational partnerships
- Focusing on improving the energy efficiency of older NREL buildings through the implementation of the International Organization for Standardization ISO 50001, which provides a framework for implementing energy management systems
- Finding lower-energy solutions for high-performance computing.

As this happens, it will further expand our vision of sustainability.

At the same time, we help others realize that sustainability is attainable. We will continue to foster and mentor others to reach a greater acceptance of sustainability—both on campus and with stakeholders in the community, local municipalities, and across federal government agencies and national organizations.

We are helping with the adoption of practices that will move us as a laboratory into the future, redefining the word *sustainability*—and ensuring NREL's continued leadership. Because sustainability is the air we breathe, it is natural that we are the ones who can help give a whole new meaning to the term.

SNREL wants us to breathe deeply together—so generations to come can breathe freely.

– Frank Rukavina, Sustainability Program Director, Chief Sustainability Officer

Nomenclature

AFV	Alternative Fuel Vehicle
Alliance	Alliance for Sustainable Energy, LLC
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
Btu	British Thermal Unit
CEQ	White House Council on Environmental Quality
CRADA	Cooperative Research and Development Agreement
Dashboard	U.S. Department of Energy's Sustainability Dashboard
DOE	U.S. Department of Energy
DRCOG	Denver Regional Council of Governments
E-85	High-Level Ethanol Fuel
ECM	Energy Conservation Measure
EERE	Office of Energy Efficiency and Renewable Energy
EISA	Energy Independence and Security Act
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPEAT	Electronic Product Environmental Assessment Tool
EPP	Environmentally Preferable Product
ESIF	Energy Systems Integration Facility
ESPC	Energy Savings Performance Contract
ft²	Square Feet
ft³	Cubic Feet
FY	Fiscal Year
GFO	U.S. Department of Energy's Golden Field Office
GGE	gasoline gallon equivalent
GHG	Greenhouse Gas
GP	Guiding Principles for High Performance Sustainable Buildings
GRI	Global Reporting Initiative
GSA	General Services Administration
GSF	Gross Square Feet
HPC	High Performance computer
HVAC	Heating, Ventilating, and Air Conditioning
IAC	Integrated Applications Center
IBRF	Integrated Biorefinery Research Facility
ILA	Industrial, Landscaping, and Agricultural
ISO	International Organization for Standardization
IT	Information Technology
kBtu	Thousand British Thermal Units
kW	Kilowatt
kWh	Kilowatt-hour
LEED	Leadership in Energy & Environmental Design
MBtu	Million British Thermal Units
MTCO$_2$e	Metric Ton Carbon Dioxide Equivalent
MW	Megawatt
MWh	Megawatt-hour
NEPA	National Environmental Policy Act
NREL	National Renewable Energy Laboratory
NWTC	National Wind Technology Center
Pcard	Purchase Card
PPA	Power Purchase Agreement
PV	Photovoltaic
PUE	Power Usage Effectiveness
REC	Renewable Energy Certificate
RFHP	Renewable Fuel Heat Plant
RFID	Radio Frequency Identification
R&D	Research and Development
RSF	Research Support Facility
RTD	Regional Transportation District
S&TF	Science and Technology Facility
SERF	Solar Energy Research Facility
SITE	Sustainability, Infrastructure, Transformation, and Engineering
SNREL	Sustainable NREL
SRRL	Solar Radiation Research Laboratory
SSCM	Sustainable Supply Side Management
STM	South Table Mountain
T&D	Transmission and Distribution
TeAM	Technology Acceleration to Market

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