NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Sustainable NREL

BIENNIAL REPORT | FY 2010–2011

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

NREL reports on the laboratory's sustainability performance goals, objectives, and strategies. The Sustainable NREL Program has been rigorous in its pursuit to create the biennial report for FY 2010 and FY 2011 by expanding the reporting parameters to include the standardized sustainability framework of the Global Reporting Initiative (GRI). The GRI framework is considered the most credible in the world, and is the most used today by national and global corporations.

Many managers and staff members assisted with the production of the Sustainable NREL Biennial Report FY 2010–FY 2011—providing technical content and data collection and communication support. They include: the Sustainable NREL staff Michelle Slovensky (project lead and primary author); Jennifer Daw (contributing author); Commuications staff Grace Griego (editor) and Christina Chase (graphic designer); and the collaborating organizations of Environmental, Health, Safety, and Quality (EHS&Q), Site Operations, Human Resources, Finance, Public Affairs, General Counsel, and Internal Audit.

Special thanks go to Michelle Slovensky who led this project—correlating our sustainability reporting to the GRI framework in all areas significant to NREL's mission and operations and improving the standard for future reporting.

Adherence to standard disclosures such as materiality, stakeholder inclusiveness, and performance indicators raises this report and NREL to a heightened level of socially and environmentally responsible reporting.

—Frank Rukavina, Sustainability Director

Sustainable NREL

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"Our work is a crucial part of creating a sustainable energy future…for not only our nation but the world."

—Dan Arvizu, Director, NREL

Education events such as this Junior Solar Sprint/Hydrogen Fuel Cell Competition generate enthusiasm for a clean-energy future.

"Our leadership in sustainability strengthens our standing as the nation's preeminent institution for renewable energy."

—Dan E. Arvizu, Director, NREL

Message from the NREL Director

From its ultra energy-efficient buildings to its campus-wide infrastructure, NREL is building a state-of-the-art "laboratory of the future" to facilitate innovative research, development, and commercialization of renewable energy and energy efficiency technologies.

NREL's Sustainability Program underscores the lab's success in leading the nation toward a clean-energy future by engaging employees in a "living laboratory" that minimizes our use of resources, including energy, materials, and water while receiving the maximum value from resources used. Another important focus is the balancing of environmental, economic, and human impacts by:

- Providing a safe work environment
- Maximizing our use of on-site renewable energy and energy efficiency technologies to minimize the laboratory's environmental footprint
- Purchasing renewable energy certificates to offset the remainder of the laboratory's environmental footprint
- Meeting and exceeding the Department of Energy's Scope 1 and Scope 2 greenhouse gas emission goals
- Supporting the transformation of the nation's energy systems by the systematic, comprehensive, and aggressive deployment of technologies developed by NREL for marketplace commercialization
- Establishing green purchasing, recycling, and composting programs to support employees as agents of change
- Using alternative-fueled vehicles in our fleet
- Reaching out to educate the public.

We are very proud of our recent achievements at NREL. Bustling with construction activity, NREL's two new projects in FY 2010 and FY 2011 provide a global model for smart growth. The Research Support Facilities (RSF) and the Integrated Biorefinery Research Facility (IBRF) demonstrate:

- The integration of clean and sustainable energy technologies into the grid
- Building in accordance with the U.S. Green Buildings Council's standards to achieve LEED (Leadership in Energy and Environmental Design) Platinum and Gold certification.

NREL Mission and Foundational Values

The 218,000 ft² RSF uses 50% less energy than buildings that conform to current commercial codes. It is expected to achieve an aggressive energy efficiency goal of 32,000 Btu/ft² per year and has achieved LEED Platinum status. An expansion of this facility is on schedule to be complete in FY 2012.

The IBRF, which achieved LEED Gold Platinum status, is designed to support the nation's ambitious "20-in-10" energy initiative to: produce cost-competitive cellulosic ethanol; reduce U.S. gasoline use by 20% in 2017; and ramp up the production of biofuels to 60 billion gallons.

In FY 2010, design work was also underway for the 175,000 ft² Energy Systems Integration Facility (ESIF), which will include a state-of-the-art, high-performance computing and data center. The ESIF data center will be designed to be one of the most energy efficient in the world and is expected to achieve a LEED Gold designation. Construction is on schedule for completion in FY 2012.

The laboratory of the future is just one more asset in NREL's portfolio that will ensure NREL's leadership in addressing the nation's energy challenges. NREL's Sustainability Program will continue to uphold our smart-growth approach to a living laboratory—instilling a culture of guardianship over our resources and environment.

—Dan E. Arvizu, NREL Director

NREL MISSION

The National Renewable Energy Laboratory (NREL) is the only U.S. Department of Energy (DOE) national laboratory dedicated solely to advancing renewable energy and energy efficiency technologies from concept to commercial application. More than three decades of federal investment in NREL have enabled the laboratory to support DOE goals—spanning from science innovation through real-life applications—enabling a future where energy is clean, abundant, and affordable for our nation and the world. For NREL, this translates into growing demands for our technology innovations and integrated solutions, renewable energy analysis and data, and the need to get technologies into the marketplace more rapidly than ever. The laboratory's staff is our single greatest resource, and it is their contributions that will advance the next generation of renewable energy technologies and remove barriers to their use.

NREL FOUNDATIONAL VALUES

Safe and supportive work environment

- Respect the rights, differences, and dignity of others
- Protect the safety and health of our employees and the community
- Value individual initiative and foster professional growth
- Value teamwork and collaboration.

Leadership for societal impact

- Positively contribute to societies we serve nationwide and worldwide
- Demonstrate respect for our physical and social environment.

Integrity

- Maintain the highest standard of ethics, honesty and integrity in our work
- Demonstrate objectivity in analysis and policy recommendations
- Be accountable for commitments and results—to customers, stakeholders, partners, and employees.

Creativity

- Advance knowledge that will best serve the nation
- Take on big challenges and see them through
- Reward risk taking and tolerate mistakes.

Excellence

- Provide superior quality, value, and service to our customers
- Strive for excellence and continuous improvement in all aspects of the organization and its products and services
- Practice outstanding communications with all our stakeholders.

A global model for sustainability...

Sustainable NREL

Sustainable NREL is a long-standing program to foster social and environmental responsibility and implement initiatives that will exemplify the laboratory as a global model for sustainability. Sustainable NREL facilitates the adoption of campus-wide behaviors and procedures to support sustainability goals. These initiatives include:

- Alternative commuting
- Alternative work schedules and telecommuting
- Green fleet creation
- Greenhouse gas emissions reduction
- High performance sustainable campus and building design
- Educational outreach
- Electronic stewardship
- Energy efficiency
- Pollution prevention
- Regional and local planning coordination
- On-site renewable energy
- Water use efficiency and management
- Sustainable acquisitions
- Social responsibility
- Employee wellness and training.

Extraordinary Performance in 2011

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

DOE EStar Award – Highlighting environmental sustainability projects and programs that reduce environmental impacts, enhance site operations, reduce costs, and demonstrate excellence in pollution prevention and sustainable environmental stewardship:

- Living Lab: Building the Sustainable Campus of the Future
- Cradle to Cradle: Near-Zero Materials Waste and Beyond

GreenGov Presidential Award – Celebrating extraordinary achievement in the pursuit of President Obama's challenge to lead by example toward a clean-energy economy:

- Sustainable Information Technology Innovation at Work in NREL's RSF Green Data Center.

NREL's "Campus of the Future"

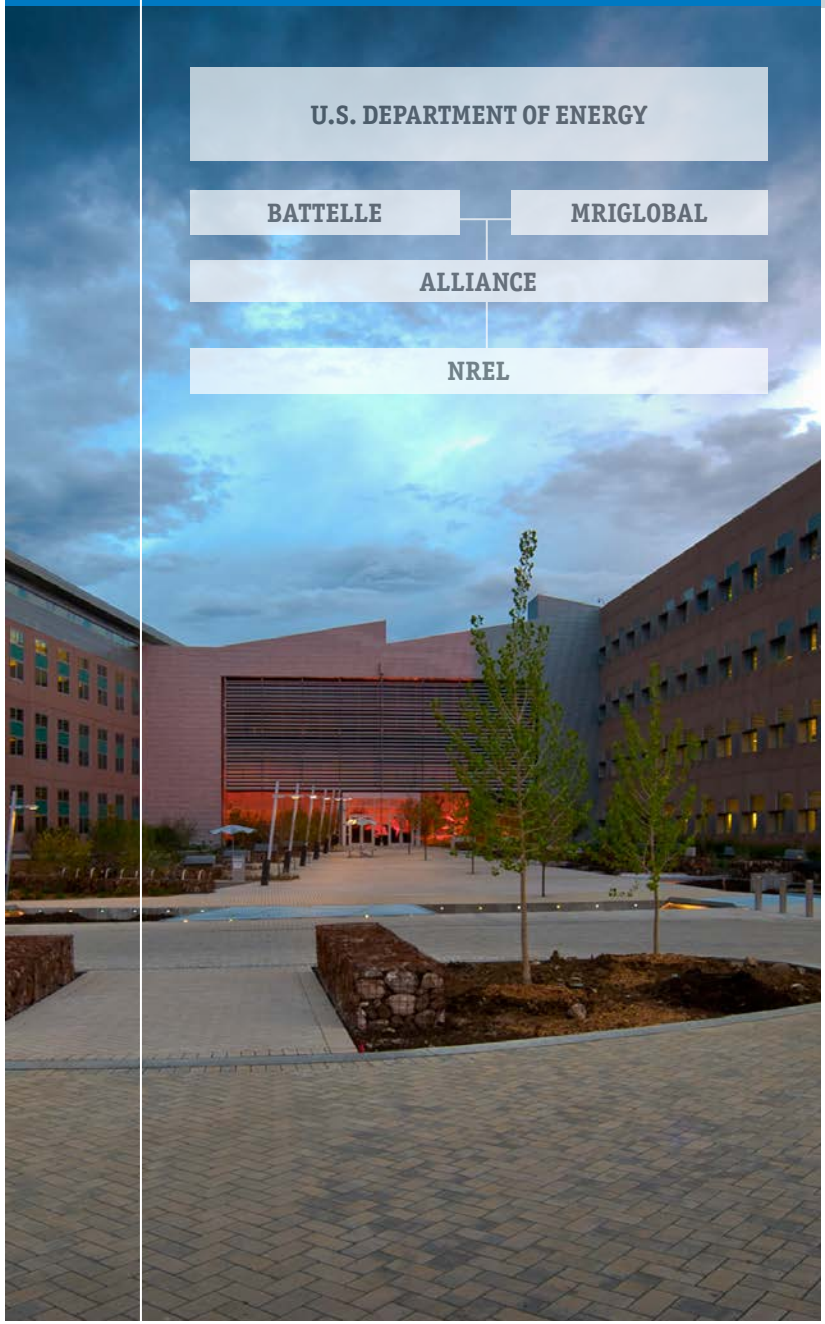
Sustainable NREL's leadership provides technical knowledge and recommendations; integrates energy, water, and material resource conservation and efficiency applications into NREL's daily research and operations; generates short-term and long-term planning measures for building our "Campus of the Future"; and oversees data collection and analysis of performance metrics for federal reporting.

Sustainable NREL has a support team that assists the laboratory in its integrated undertaking to be environmentally, socially, and economically sustainable. This Site Sustainability Transformation Team is comprised of experts and other representatives from many branches of science organizations within the laboratory.

An example of sustainable technology integration is the incorporation of NREL-invented technologies into the design and construction of our LEED-certified buildings.

NREL will continue to work closely with our research staff to ascertain ways in which we can mitigate our energy and water consumption and greenhouse gas (GHG) emissions.

As NREL identifies specific strategies to fulfill goal attainment, we will share this progress with other DOE Sustainability Transformation Teams.



Standard Disclosures

NREL ORGANIZATIONAL PROFILE

Battelle and MRIGlobal formed Alliance for Sustainable Energy, LLC (Alliance) solely to be NREL's management and operating (M&O) contractor. Alliance is a limited liability company that is equally owned and governed by Battelle and MRIGlobal. Alliance is fully accountable to DOE for NREL's performance over a five-year contract period that began in October 1, 2008 and may be extended for up to five additional years.

A prime goal of Alliance is to ensure that NREL becomes the catalyst for the creation of a renewable energy epicenter. Initially, it will be centered at the laboratory, but will eventually expand to help bring about global adoption of clean energy. Alliance wants to create an opportunity for NREL to become the focal point for renewable energy—a "Silicon Valley for renewables."

Alliance will accomplish this through:

- Strengthening NREL's scientific, technical, and analytical foundations by adding talent and connecting the laboratory to the nation's research engine at leading universities and laboratories
- Creating a Joint Institute for Strategic Energy Analysis in partnership with Massachusetts Institute of Technology (MIT), Stanford University, and the Colorado research universities—providing credible and objective technology and market and policy insights that will inform R&D, commercialization, policy, and market decisions to accelerate the impact of our portfolio on national energy goals
- Developing collaborative relationships among people, systems, and approaches for commercialization and deployment opportunities to move innovations rapidly from concept to customer
- Building a "Campus of the Future" that leverages our partnerships and showcases sustainable energy on and near the NREL site
- Creating a safe and supportive work environment for this vibrant, innovative, and entrepreneurial laboratory that attracts and will continue to attract and retain the best talent from around the world.

NREL directorates work to translate scientific discoveries into new knowledge and technical innovations that will help bring unprecedented change in the energy marketplace.

Dynamic Interaction among Directorates Enables NREL to Meet Challenges

Renewable energy and energy efficiency technologies are essential to resolving the top challenges facing our nation and the world: protecting the environment, achieving energy security, reducing petroleum dependence, creating new jobs, and generating the economic activity needed to help recover global economies.

NREL is helping to meet these challenges through the dynamic interaction and support of the lab's four directorates and associated offices and programs:

- Laboratory Operations
- Science & Technology
- Outreach, Planning & Analysis
- Commercialization & Deployment.

Together, NREL directorates work to translate scientific discoveries into new knowledge and technical innovations that will help bring unprecedented change in the energy marketplace and demonstrate the lab's leadership in sustainability.

Laboratory Operations

Creating a high-performance Laboratory of the Future—a model of sustainability—has involved all directorates in protecting the natural environment through sustainable development, integrating clean-energy technologies in new buildings, supporting workforce growth and development, and preserving our culture of safety, security and quality.

Efficient, effective, and responsive business management, and high performance and operational infrastructure are enabling the success of this model laboratory and are maximizing the R&D output per dollar invested.

Science & Technology

Research and development performed by scientists, engineers, and analysts across our facilities advance national energy goals and deliver relevant knowledge and sustainable energy technologies to the marketplace. Our leadership and innovation in solar, biofuels (including hydrogen and algae), biomass, and wind change the way we power our homes and businesses and fuel our vehicles. NREL's R&D competencies are:

- Renewable electricity conversion and delivery systems
- Renewable fuels formulation and delivery
- Efficient and integrated energy systems
- Strategic energy analysis.

Outreach, Planning & Analysis

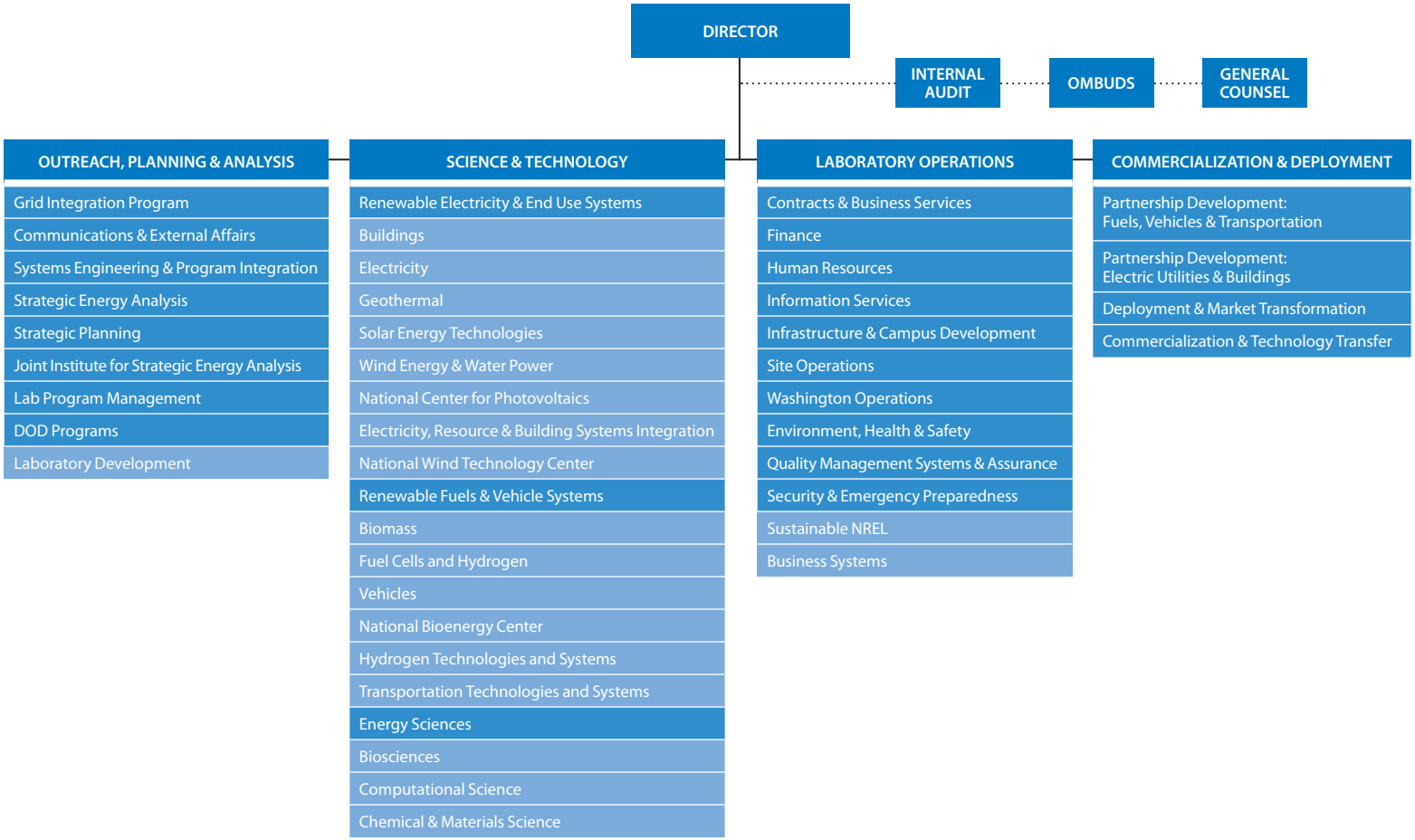
NREL's prominent position in the local community and our global reputation as the center for energy efficiency and renewable energy R&D drives this directorate to transfer knowledge to diverse audiences, including students, educators, consumers, and business and government organizations.

Outreach avenues include visits and tours, a community newsletter, websites, fact sheets, videos, reports, presentations, workshops, events, competitions, internships, and collaborative research.

Strategic planning efforts across the laboratory ensure that NREL is addressing critical goals and objectives for the nation and for our customers. NREL's long-term planning articulates the future vision of the laboratory, while near-term planning maps outline the specific steps we'll take to get there. This directorate facilitates capital planning, performance assessment, and investments in innovative research.

Credible and objective data and analysis are essential to the laboratory's competitive edge in science and applied research and ensure that our goals remain relevant to the changing external environment. Analysts examine NREL commitments, program principals and

FY 2011 NREL Organizational Profile



management, and best practices. They also look for opportunities to leverage knowledge and resources across program areas to provide opportunities for good stewardship of public resources. In addition, they integrate complex data sets across several technical areas including: interactions and roles of energy policies, markets, resources, technologies, environmental impacts (sustainability), and infrastructure. These analyses are used to inform decisions as energy-efficient and renewable energy technologies advance from concept to commercial application.

Commercialization and Deployment

NREL's commercialization and deployment activities focus on accelerating the commercialization of NREL-developed technologies, increasing the scale of deployment, and removing barriers to the market adoption of existing clean-energy solutions. The laboratory accomplishes this through: technology partnership agreements, innovation management, licensing, and the Innovation and Entrepreneurship Center.

Summary

The integrated strengths of NREL's four directorates are the foundation of NREL's success. By maintaining a sharp focus on the laboratory's key contributions—areas that leverage NREL's unique resources, expertise, and capability—we are maximizing our results and helping the nation to achieve its energy goals.

NREL's mission statement and values are the essential and enduring tenets of our organization and guide all our actions at the laboratory.

NREL's director, Dan Arvizu, left, and members of NREL's managerial staff, Bobi Garrett and Dr. Dana Christensen, lead a strategic business planning meeting.

GOVERNANCE

Structure

Alliance is a nonprofit organization serving the public purpose to manage NREL's research and development of renewable energy and energy-efficient technologies. NREL is governed by the Alliance Board of Directors consisting of 15 members. These 15 members represent five executives each from MRIGlobal and Battelle, and one each from the following five universities: the University of Colorado, Colorado State University, Colorado School of Mines, Massachusetts Institute of Technology, and Stanford.

The Board of Directors assesses the qualifications and expertise necessary to fulfill the highest governance body positions at NREL and determines the compensation associated with those positions. There is an incentive compensation program that is tied to performance.

Alliance's executive management team (EMT) is comprised of five members that oversee multiple directorate branches of the NREL organization. Dr. Dan Arvizu, president of the Alliance, serves as NREL's director. Mr. Bill Glover is NREL's Deputy Laboratory Director and Chief Operation Officer. Ms. Casey Porto is NREL's Senior Vice President for Commercialization and Deployment. Ms. Bobi Garrett is NREL's Senior Vice President for Integration, Planning, Analysis, and Assessment. Dr. Bob McGraph was NREL's Deputy Laboratory Director for Science & Technology in FY 2010. In FY 2011, Dr. Dana Christensen joined NREL as the Deputy Laboratory Director for Science & Technology.

NREL adopts and adheres to several processes set forth by DOE to ensure conflicts of interests are avoided. Alliance's prime contract clause I.10 52.203-13 outlines the accountability to the Contractor Code of Business Ethics and Conduct. The Board requires a conflicts disclosure statement. Additionally, each EMT member is required to sign a no-conflict-of-interest document and participate in an annual briefing.

Overseeing the Mission

The Performance Evaluation and Measurement Plan (PEMP) governs the annual assessment process of the Contractor (Alliance) in managing and operating NREL under DOE's contract. The PEMP assesses the Contractor's success in establishing NREL as a leader in a national energy technology, policy, and market arenas and its ability to create strategic value. It also assesses the Alliance's laboratory operation areas of environment, health, and safety (EHS), sustainability, business, infrastructure, and security. The PEMP defines the performance evaluation framework and process, the system for establishing expectations and performance measures, and the process for evaluating progress against performance objectives. It assigns weights to each performance goal and objective and defines how the award fee will be calculated once grades are determined. Additionally, it defines the grading system and weights that will be used for fee determination. The PEMP defines the general grading scale and provides performance targets tied to the NREL Annual Plan that calibrate performance to this scale. Goals for sustainable laboratory operations are included in the PEMP.

The NREL Five-Year Plan and the Ten-Year Site Plan (TYSP) describe the Contractor's vision for NREL and the major strategies and planned accomplishments that support the achievement of this vision, consistent with the performance goals contained in the contract's statement of work. The first section of the TYSP describes how "Sustainability underlies all strategic and supporting investments."

In the Five-Year Plan, the Contractor translates its vision and DOE direction into actions that will be accomplished during the fiscal year.

Building Staff Involvement

NREL values the individual staff member as its greatest asset and listens to the diversity of ideas and skills represented by our staff as a whole. We treat individuals with respect and promote healthy and amicable relationships with each other, DOE, and our other customers. The satisfaction of our professional lives comes from working as individuals and team members to achieve our goals. Our Staff Council, Employee Concerns Program, and Ombuds are the conduits in support of this positive work environment.

The NREL Employee Concerns Program is dedicated to developing and maintaining an environment that supports employees who raise concerns. The lab has zero tolerance for retribution and encourages and expects that issues will be communicated by staff. Personnel are encouraged to work within their line organizations toward resolving concerns, and NREL's Ombuds office also functions as an alternative means of resolution.

Staff Council helps NREL fulfill its mission by providing an effective channel of communication between staff and executive management. They serve as a conduit for staff suggestions, inquiries, and feedback for important lab-wide issues and changes, while also providing an avenue for management to respond. They promote better staff relations and aim to boost employee morale through laboratory-sponsored activities. NREL centers and offices have representatives on the Staff Council.

The Staff Council Bylaws provide details about the organization's purpose and methodology, districts, representatives, officers, and meetings. Staff Council meetings are held monthly.

An Executive Management Committee, made up of the elected Staff Council officers (President, Vice President, Executive Secretary, and Treasurer), meets with NREL Executive Management on a regular basis to discuss issues and topics raised by staff and the Council. These regular meetings provide an opportunity for upper management to use Staff Council as a resource to obtain staff input to selected management issues. The goal is to improve communications between management and staff, and inform executive management of issues that are high on staff radar.

NREL Commitment to Excellence

To underscore the manner in which we implement our mission, every employee's security badge is accompanied by NREL's core values. Environment, safety, and quality excellence are emphasized to heighten awareness for superior operational performance.

NREL's commitment to environment, safety, and quality excellence is also demonstrated by the lab's documented, replicable, streamlined processes to manage risk to an acceptable level. Certification to internationally recognized standards also verifies the lab's commitment to excellence. In 2011, NREL pursued certification through the International Organization for Standardization (ISO) and the Occupational Health and Safety Standards (OHSAS) in ISO 14001 (Environment), OHSAS 18001 (Safety), and ISO 9001(Quality).

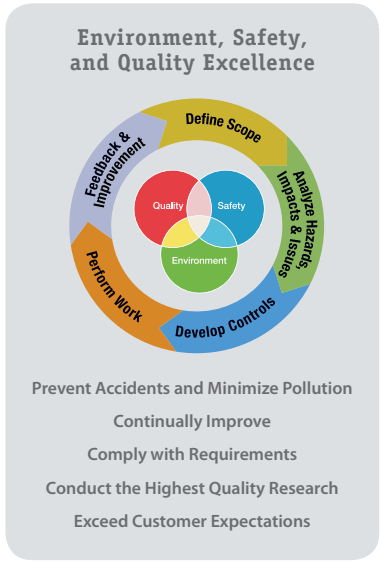
STRATEGY AND ANALYSIS

NREL's Key Impacts on Sustainability

As a DOE national laboratory, NREL meets environmental and energy-related requirements that foster the sustainability of NREL's campus.

These requirements and expectations are defined by the:

- Energy Policy Act (EPACT) of 2005
- Executive Order (EO) 13423 (Strengthening Federal Environmental, Energy, and Transportation Management)
- EO 13514 (Federal Leadership in Environmental, Energy, and Economic Performance)
- Energy Independence and Security Act (EISA) of 2007
- DOE 450.1A (Environmental Protection Program) replaced by DOE 436.1 in FY 2011
- DOE 430.1B (Real Property Asset Management)
- DOE 430.2.B (Departmental Energy, Renewable Energy and Transportation Management).



NREL's Core Values

These laws and regulations establish federal energy and environmental management requirements spanning energy efficiency, renewable energy, GHG, pollution prevention, water conservation, and alternative-fuel use.

In 2008, DOE issued Order 430.2B, emphasizing that all DOE operations are to maximize sustainable use of energy and natural resources; develop cost-effective energy efficiency and renewable energy projects; improve the performance of existing DOE building stock; use low-GHG-emitting energy sources to replace existing grid energy; prevent pollution; and eliminate waste. With the issuance of EO 13514, DOE developed its agency-level Strategic Sustainability Performance Plan (SSPP) to aggressively meet the federal management unifying priority with a deliberate planning process for managing GHGs. Relevant to this program, NREL is required annually to submit a Site Sustainability Plan (SSP) that documents the laboratory's progress and planned actions toward meeting—and exceeding—energy and environmental performance goals.

NREL's actions to meet these performance goals are aligned with the laboratory's mission, continuously integrated into daily operations and research activities, and used to inform long-term planning objectives that are represented in NREL's Ten-Year Site Plan (TYSP).

The Performance Snapshot, pages 17-19, shows both FY 2010 and FY 2011 reporting performance that meets or exceeds NREL's target objectives mandated by the SSP, with the exception of reducing GHG emissions for Scope 3. Between FY 2008 and FY 2020, NREL expects to experience significant growth. This growth is necessary to maintain NREL's position as the national leader for renewable energy and energy efficiency.

NREL's growth will pose new challenges in reducing emissions, particularly those in the Scope 3 category resulting from transmission and distribution (T&D) losses from purchased utility electricity, business travel, employee commuting, wastewater treatment, and contracted waste disposal. A larger workforce will result in greater commuting emissions, increased wastewater and municipal solid waste, and a rise in electricity requirements from the grid, leading to an increase in emissions associated with T&D losses. In the face of these challenges, NREL is proposing a variety of aggressive strategies for minimizing its Scope 3 emissions, which are identified in this report's GHG emissions section.

Impact of Sustainability Risks and Opportunities on Long-Term Prospects and Financial Performance

As a tool for long-term planning, scientific needs, and projection for future funding and investment needs, NREL creates a TYSP. The purpose of the TYSP is to provide DOE's Office of Energy Efficiency and Renewable Energy (EERE) a comprehensive assessment that identifies the current and proposed capabilities for NREL's real property assets. The report describes how these assets will be managed, maintained, and improved to support the DOE strategic plan. The TYSP also articulates NREL's commitment to achieve full compliance with, as well as leadership in, the implementation of EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance.

In short, the TYSP provides the sustainability link between NREL's mission, the capabilities required to perform that mission, and the physical assets that support these capabilities. As such, it is a key management tool for developing and communicating the integrated investment rationale—the business case for long-term planning for capital investments.

REPORT PARAMETERS

Determining Materiality

Throughout its history, NREL has progressively managed sustainability, and nearly a decade ago formalized the Sustainable NREL Program. Sustainable NREL has generated an annual sustainability report since 2002, and for the FY 2010/2011 report, is updating the format using the GRI Sustainability Reporting Guidelines to highlight activities and accomplishments achieved from October 2009 to September 2011.

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

- Implementation of DOE EERE directives
- Remaining 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.

Our chosen materiality assessment sections, per the GRI reporting format, represent key performance areas critical to achieving NREL's mission. A stakeholder process was used to determine these sections and included our DOE client and NREL staff members representing science and technology research, commercialization and deployment, and laboratory operations. Sustainable NREL presented to this group the unique aspects of the GRI reporting framework, which provides a platform to convey performance achievements in a rigorous manner while integrating environmental, social, and economic concerns. Our group prioritized and selected

NREL's South Table Mountain campus, comprised of laboratory and office buildings, features high-performance buildings, green building principles, and open space.

seven materiality assessment sections. Seven specialized sub groups were then formed to identify performance indicators and determine action steps to collect data unique to each section. Planning actions were also derived from these beneficial group discussions for future performance indicators that would require more intensive tracking and monitoring activities.

Report Scope and Boundaries

NREL's facilities are primarily located on two sites in Golden, Colorado: South Table Mountain (STM) and the National Wind Technology Center (NWTC). Facilities on these two sites are owned by DOE. NREL also leases office space in the Denver West Office Park and surrounding area, a Refuel Facility in Denver, as well as an office in Washington, D.C.

NREL's STM site consists of approximately 404,000 gross square feet (GSF) of existing facilities on 327 acres of land. Of these acres, DOE has granted a 175-acre conservation easement on its STM site to Jefferson County to provide hiking trails and permanent conservation status for the land. The remaining 152 acres are utilized for development of campus infrastructure and high performance building facilities for laboratories, offices and supporting mission functions. The facilities on the STM acreage include the following:

- Solar Radiation Research Laboratory (SRRL)
- Shipping and Receiving
- Alternative Fuel User Facility (AFUF)
- Integrated Biofuels Research Facility (IBRF)
- Research Support Facility (RSF)
- Thermal Test Facility (TTF)
- Outdoor Test Facility (OTF)
- Field Test Laboratory Building (FTLB)
- Waste Handling Building (WHB)
- Solar Energy Research Facility (SERF)
- Science and Technology Facility (S&TF)
- Vehicle Maintenance Shed (VMS)
- Visitor Center
- Two Site Entrance Buildings (SEB)
- Parking Garage (under construction)
- Energy Systems Integration Facility (ESIF) (under construction)
- Café (under construction)

During FY 2010, approximately 800 NREL staff moved from Denver West leased space to the new RSF B and C wings of the ultra-efficient 220,000 square-foot office building with a designed energy intensity of 32 kBtu/ft^2, including its data center, which serves the entire laboratory.

During FY 2011, 530 staff moved from Denver West leased space to the new RSF A wing, the second phase increasing the office buildings footprint by 159,000 ft^2.

The NWTC site is located approximately 20 miles north of Golden, Colorado, and has approximately 56,000 GSF of existing facilities on 280 acres of land. The facilities on the NWTC site include the following buildings:

- 251-Administration Building
- 252-Blade Testing Facility
- 253-Switchgear
- 254-Industrial User Facility (IUF)
- 255-Dynamometer Testing Facility
- 256-Modal Test Facility
- Hybrid Test Bed Facility.

As a DOE national laboratory, NREL works to meet environmental and energy-related regulatory requirements as defined by the EPACT of 2005;

NREL's National Wind Technology Center. The terrain and lack of obstructions make the site highly suitable for testing wind turbines.

EO 13423 and EO 13514; and the EISA of 2007. These laws and regulations establish federal energy and environmental management requirements spanning energy efficiency, renewable energy, water conservation, and alternative-fuel use.

Data Collection and Metrics

NREL's sustainability metrics are built upon a wealth of data that encompasses our campus operations. A large component of our reporting is focused on energy, including 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 a DOE energy dashboard system allowing access to up-to-date energy information. On-site renewable energy production from the Renewable Fuel Heating Plant, photovoltaic arrays, and wind turbines is also included in this dashboard system. Other on-site renewables are captured in tracking matrices that Sustainable NREL uses to manage capacity, production, LEED allocation, and Renewable Energy Certificate (REC) purchases. NREL regularly reports these energy data to DOE headquarters in federal reporting tools. NREL is working to refine our data tracking through the use of EPA's Portfolio Manager Tool, which allows building-level data to be analyzed for performance improvement and compared across the DOE portfolio.

In addition to energy data, Sustainable NREL tracks the performance of Scopes 1, 2, and 3 GHG emissions sources. Information is tracked for direct on-site energy usage, purchased electricity, and other indirect emissions from commuting, business travel, waste disposal, wastewater treatment, and transmission and distribution 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 FEMP Annual GHG and Sustainability Data Report to calculate emissions to allow for annual tracking of progress towards our reduction goals.

COMMITMENTS TO EXTERNAL INITIATIVES

NREL subscribes to and endorses various externally developed economic, environmental, and social charters, principles, and initiatives.

Rio Declaration Principle—Precautionary Approach to Risk Management

NREL takes the precautionary approach to risk management of its operations and the environment. This principal, as described in the Rio Declaration[1] indicates that:

- There is a social responsibility to protect the public and the environment from possible exposure to harm.
- The lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Operations/Enterprise Risk Management

NREL identifies enterprise risk in the context of strategic objectives associated with implementing lab strategy, delivering mission and operational excellence, and preserving the environment and community. The identification approach relies on both top-down and bottom-up processes that leverage input from a variety of sources throughout the laboratory. Risk management plans are developed to confirm that risks are managed within acceptable tolerances.

1 The Rio Declaration on Environment and Development, or Rio Declaration, was a product of the 1992 United Nations Conference on Environment and Development (Earth Summit). The Rio Declaration's 27 principles are intended to guide future sustainable development around the world.

Ongoing monitoring efforts ensure that appropriate risks are being addressed, that changes in the impact and probability of identified risks are assessed, and that the planned actions align with the desired outcomes and are validated.

Environmental Risk Management

NREL's multi-pronged approach assesses and mitigates potential environmental, health, and safety (EHS) risks:

- NREL's Hazard Identification and Control Program is a continuous process that incorporates integrated, systematic approaches that can be logically and consistently applied to NREL activities and facilities. Facilities and operations at NREL are systematically evaluated to identify EHS hazards. Necessary controls are implemented to maintain the risk from those hazards at an acceptable level.
- NREL's Environmental Management System (EMS) uses a comprehensive approach to assess potential environmental risks of NREL's activities, products, and services. NREL identifies and prioritizes activities, aspects, or areas that could impact the environment, and develops controls.
- The National Environmental Policy Act (NEPA) establishes a national policy to consider environmental values and factors in federal planning and decision-making. NREL's NEPA Program provides a mechanism to consider environmental factors in the decision-making process at NREL and to promote environmentally responsible decisions, including sustainability. NEPA review is required for research and operational activities conducted on both federally owned and leased NREL sites to evaluate the activity's potential impacts on the environment.

Each of these approaches adheres to the precautionary approach described in the Rio Declaration. At NREL, this approach was recently exercised when determining the risks of working with nano-materials for photovoltaic research. Because the potential risks of using and disposing of these materials are still not fully understood, NREL treats nano-materials as hazardous materials and manages these wastes as hazardous wastes in order to minimize the potential risk to workers, the public, and the environment.

Environmental Standard ISO Certification

Being certified to the only internationally recognized environmental standard ISO 14001:2004 means that an independent, external body has audited our organization's management system and verified that it conforms to the requirements specified in the standard. To meet these ISO requirements, NREL developed a management system that enables:

- The identification and control of environmental impacts from our activities
- Continual improvement of our environmental performance
- Implementation of a systematic approach to setting environmental objectives and targets
- Methods to demonstrate that the targets and objectives have been achieved.

Achieving ISO 14001:2004 certification (in FY 2011) has provided the following benefits:

- Predictability and consistency in managing environmental obligations
- More effective targeting of scarce environmental management resources
- Enhanced public posture with outside stakeholders.

Prior to the issuing of ISO 17025:1999—general requirements for the competence of testing and calibration in laboratories—there was no internationally accepted standard for laboratory-quality systems that could provide a globally accepted basis for accreditation. Accreditation was based on national standards. Organizations, such as NREL, certified to the current version of this standard (ISO 17025:2005), operate in accordance with the requirements of ISO 9001—Quality Management System Requirements—that are relevant to calibration and testing activities. Having achieved accreditation to this international standard, NREL has demonstrated that we are technically competent and able to produce precise and accurate test and/or calibration data.

Memberships in International, National, and Local Energy and Environment Organizations

As the nation's premier research institution for clean-energy technology, NREL and its scientists, engineers, and analysts provide science-based information on behalf of sustainable energy resources, sustainable energy generation, and sustainable energy use. NREL is operated by a nonprofit contracting organization for the U.S. Department of Energy, the lab does not lobby public officials, nor does it engage in direct advocacy for policy.

Through the involvement of NREL researchers who are frequently leaders in their respective fields, NREL plays a vital role in most of the nation's and the world's major non-governmental organizations dedicated to clean energy. These well-known organizations include:

- Alliance to Save Energy
- American Chemical Society

- American Council on Renewable Energy (ACORE)
- American Society for Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
- American International Standards InstituteAmerican Physical Society
- American Society of Mechanical Engineers (ASME)
- American Solar Energy Society (ASES)
- Association of Science & Technology Centers
- AVS: Science & Technology of Materials, Interfaces, Processing
- Electrochemical Society
- Hispanic Engineer National Achievement Awards Corporations (HENAAC)
- International Academy of Wood Science (IAWS)
- International Energy Foundation (IEF).
- New York Academy of Sciences
- Royal Society of ChemistrySociety of Automotive Engineers (SAE) International.

Membership in Economic and Social Organizations

In addition, NREL is actively involved in organizations that benefit Colorado communities, including:

- Asian Chamber of Commerce
- Boulder Chamber of Commerce
- Chamber of the Americas
- CO Labs
- Colorado Black Chamber of Commerce
- Colorado Renewable Energy Society (CRES)
- Colorado Women's Chamber
- Connected Organizations for a Responsible Environment (CORE)
- Denver Chamber of Commerce
- Denver Metro Visitor & Convention Bureau
- Denver Museum of Nature and Science
- Greater Golden Chamber of Commerce
- Hispanic Chamber of Commerce
- Jefferson Economic Council
- Lariat Loop Heritage Alliance
- Latina Chamber
- Metro Denver Economic Development Corporation
- Rocky Mountain Indian Chamber of Commerce
- West Chamber.

STAKEHOLDER ENGAGEMENT

NREL contributes directly to our nation's goal of finding clean ways to power our homes, businesses, and cars by bringing efficient and renewable energy technologies from the lab to the marketplace. Transforming energy systems to achieve the nation's energy and environmental goals requires a comprehensive approach—involving numerous stakeholders both internal and external to the lab. NREL's primary stakeholders include funding and management entities such as the DOE Office of Energy Efficiency and Renewable Energy (EERE), Office of Science, Office of Electricity Delivery and Energy Reliability, and numerous CRADA partners, as well as the Alliance for Sustainable Energy, LLC, which manages NREL for DOE.

Just as important are stakeholders that can affect or be affected by NREL's mission, including: NREL workers, public and private partners, educators, students, community members and organizations, visitors, and end users of renewable electricity and fuels.

Stakeholder engagement is essential to NREL's strategy to transfer knowledge and innovation. NREL stays engaged with stakeholders in several ways, including: partnerships, conferences and seminars, education programs, events and tours, and regular communications via websites, reports, periodicals, news releases, and surveys.

NREL Workers

Staff Members. NREL workers (employees and subcontractors) develop and support the research that produce clean-energy technologies, and it is their heightened commitment to sustainability that ensures the high performance of the buildings in which they work.

Recognizing workers as an important asset, NREL maintains an effective channel of communication with its long-standing Staff Council, whose members represent NREL centers and offices. The council serves as a conduit between staff and executive management to address staff suggestions, inquiries, and feedback for important lab-wide issues and changes at monthly meetings.

A few of Staff Council's successes include:

- The implementation of the Personal Time Off (PTO) bank for which Staff Council advocated
- The creation of an "Ask Staff Council" mailbox
- An increase of scholarships awarded from the Sunderman Continuing Education Fund for children and dependents of NREL staff members; six scholarships of $1,000 were awarded.

Other channels of communication with NREL workers include:

- Avenues to address work-related issues such as the Ombuds Office, a confidential, neutral, informal, and independent resource
- Surveys on diversity, newsletter readership, and other topics

Strategic stakeholder engagement at NREL's "living laboratory" is essential to the transfer of knowledge and innovation.

Conferences and seminars are two ways NREL engages stakeholders.

NREL Now, a weekly electronic newsletter, informs the staff on topics such as:

- NREL and DOE news
- Awards and recognition
- Benefits
- Opportunities
- Wellness, safety, and sports
- Sustainability
- Events and entertainment
- Training.

theSOURCE, an intranet website updated daily, presents:

- Announcements
- Events
- Employees Corner
- Sustainable NREL Web page
- Quick links to NREL departments and other popular topics
- Employee phonebook.

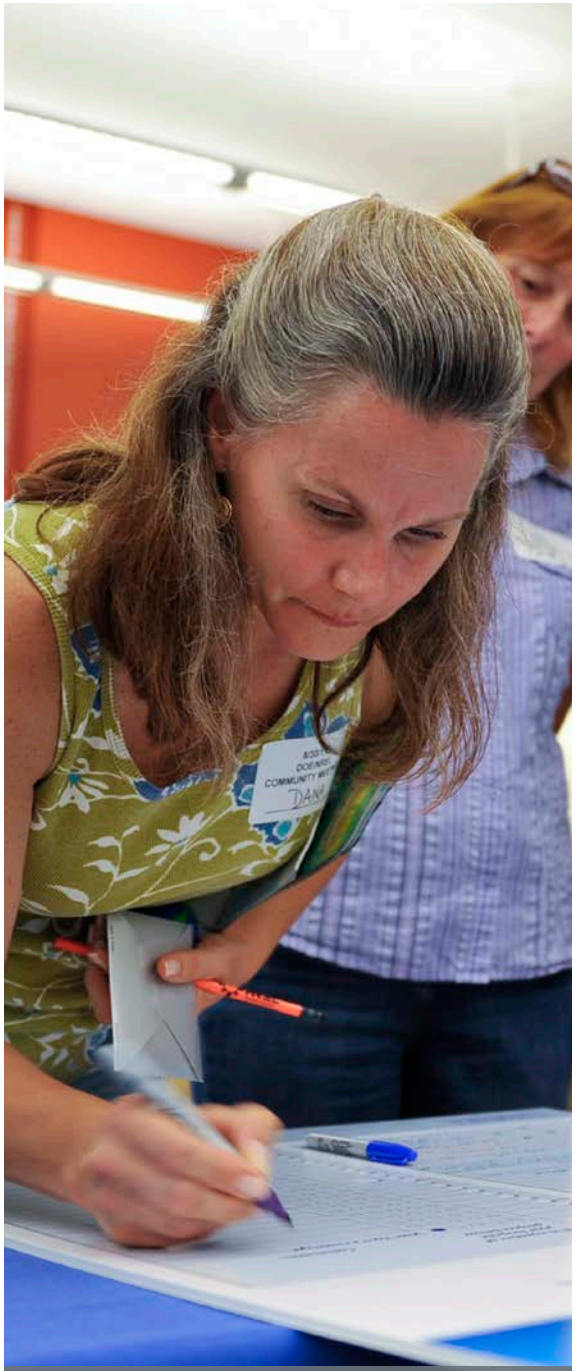
NREL Management. NREL directors communicate regularly through global emails, meetings, and events on: policies, procedures, trainings, security, services, sustainability, and internal programs, including an enhanced employee concerns program. In addition, an online Manager's Compass—available to managers as well as staff—provides information for NREL managers to discuss with their staff.

Public and Private Partners

NREL considers partnerships invaluable in helping to commercialize renewable energy technologies and to supply the lab with essential products and services. Partnership opportunities with NREL are available through:

- Cooperative Research and Development Agreements (CRADAs)
- Technologies Available for Licensing
- Technology Partnerships
- Work for Others
- Research Facilities.

NREL provides partners with technical support to help commercialize and deploy energy tech-nologies and products. In addition, NREL offers numerous business and research opportunities and has a strong history of working with industry, academia, government agencies, and a diversity of businesses outside the laboratory—including small businesses. NREL continually seeks to partner with small, small-disadvantaged, women-owned, HUBZone, veteran-owned, and disabled veteran-owned businesses.



NREL hosts events such as community tours—providing information about NREL's new facilities.

Educators, Students, Leaders

Education and information are part of the new-energy-future equation. To meet the challenges, we need to encourage new ways of thinking about energy. NREL reaches the following stakeholders through programs, events and tours, and leadership opportunities:

- K-12 science programs that engage young minds in renewable energy and also provide teacher support. Activities and support include:
  - Hands-on projects and curriculum for elementary school, middle-, and high-school students
  - Participation in DOE's National Science Bowl for middle- and high-school students—a fun, fast-paced academic competition that tests the brainpower of students on science and math topics
  - Participation in Junior Solar Sprint-Hydrogen Fuel Cell Competitions—a classroom-based, hands-on educational program for 6th, 7th, and 8th grade students. Student teams apply math, science, and creativity to construct model solar-powered and hydrogen-powered cars and race them in interscholastic competitions hosted within their schools or within their states or regions.
- College and post-graduate programs that help to develop a capable and diverse workforce for the future through mentored research internships and fellowships.
- Self-guided tours through the interactive exhibit hall at NREL's Visitors Center open weekdays from 9 a.m. to 5 p.m. The Visitors Center showcases sun, wind, and biomass technologies, as well as other sources of renewable energy that can save energy, improve the environment and lower the cost of energy bills. The Visitors Center routinely hosts speakers.
- NREL's Executive Energy Leadership Academy (Energy Execs) that provides opportunities for non-technical decision-makers throughout the country to learn about renewable energy and energy efficiency technologies, analytical tools, and financing. Energy Execs learning opportunities include the Leadership Program and the Leadership Institute. Both courses are designed to provide business, governmental, and community leaders with information and tools to guide their organizations and communities in energy-related decisions and planning.

Community and Local Neighbors

NREL holds community meetings routinely. The community and local neighbors are kept informed about facility construction at the STM site via the Design Advisory Board (DAB) that reviews new construction plans and meets with local agencies and neighbors to mitigate traffic and other concerns.

DAB advisor members include building and landscape architects, urban planners, and a community representative. DAB participants include individuals who represent the Alliance, DOE, and EERE, all of whom provide relevant information to the members.

Specifically, the DAB performs the following activities:

- Provides advice on both short- and long-range plans related to facilities and site development
- Reviews proposed facility designs for compatibility with current design standards, site development plans, and similar documents.

PERFORMANCE SNAPSHOT | Summary of Goals for Material Assessments

Key Performance Status: ✚ Exceeds Target ✱ On Target ▲ Behind Target

Investment	Objective and Target	Baseline	FY 2010	Status	FY 2011	Status
HIGH PERFORMANCE BUILDINGS	All new construction and major renovations greater than $5 million to be LEED Gold or Platinum certified. Meet high performance and sustainable building (HPSB) guiding principles if less than or equal to $5 million.	Policies in place since 2006 for both targets.	Construction completed for RSF I (pursuing LEED Platinum). Construction underway for IBRF and RSF II.	✚	RSF I (Platinum) and IBRF (Gold) received LEED Certification. Construction completed for RSF II (pursuing LEED Platinum). Construction underway for ESIF, Cafe, Garage and SEB.	✚
SCIENTIFIC AND TECHNICAL INNOVATION	Conduct outstanding basic and applied research and accelerate discoveries toward market-viable applications.		NREL invested approximately $8 million in more than 40 LDRD innovative research projects. The program covers a portfolio of projects focused on building capabilities and exploring new concepts aligned with our strategy for NREL including photovoltaics, wind, analysis, materials, energy storage, hydrogen, electricity systems and thermochemical, biochemical, and algal biofuels projects. NREL received two prestigious R&D 100 Awards for the "Black Silicon" Nanocatalytic Wet-Chemical Etch and the Amonix 7700 Solar Power Generator.	✱	NREL received three prestigious R&D 100 Awards for the Flash Quantum Efficiency System for Solar Cells, Optical Cavity Furnace, and Silicon Ink for High Efficiency Solar Cells. NREL's leadership in renewable grid integration and smart grid technology achieves growing recognition. Cutting-edge technology is developed in PbSe quantum dots, low-cost nano-pattering process, wind turbines, biofuels, and battery technologies.	✱
COMMERCIALIZATION AND DEPLOYMENT	Accelerate the commercialization of clean-energy technologies; remove barriers to enable their deployment at scale.		Expanded and piloted new partnership models; grew lab-wide strategic partnerships to support the expansion of renewable utility industry. Provided effective support to accelerate deployment of efficiency and renewable technologies at federal facilities.	✱	NREL provided assessment support for implementation of low-cost solar technology for several DOD installations. NREL partnerships via CREED produced 400+ jobs. NREL delivered an improved EERE Innovation Portal.	✱
SUPPORTIVE WORK ENVIRONMENT	Develop an innovative, entrepreneurial, highly connected, safe, and supportive work environment.		NREL began developing business-system enhancements to enable researchers to spend more time on research and less on process. NREL also began planning implementation for an integrated security and emergency response system.	✱	NREL received ISO 9001 certification for its quality management systems. Alliance invested to renovate and repurpose existing lab space to meet emerging program requirements.	✱
Community Relations	**Objective and Target**	**Baseline**	**FY 2010**	**Status**	**FY 2011**	**Status**
EDUCATION OUTREACH	Host and sponsor educational community outreach activities to share knowledge and promote the adoption of energy efficiency and renewable energy technologies.		NREL participated in the Interagency Sustainability Challenge that sponsored a series of federal interagency events to share knowledge on sustainability across organizations and within the local community. This interagency partnership allows NREL to educate others on the lab's research and technologies while helping to promote sustainability awareness and carbon-footprint reduction.	✱	NREL offered the fifth Executive Energy Leadership Program, which provides a means for the laboratory to transfer knowledge and help other organizations acheive their sustainability goals. NREL hosted 4,339 VIP and campus tours inside the laboratory for U.S. and international officials, business, finance, and thought leaders.	✚
CHARITABLE CONTRIBUTIONS	Support the community through financial and in-kind contributions at a level commensurate with staff growth.		NREL Charitable Giving Campaign donated $473,000 to community organizations through Partnership for Colorado and Mile High United Way. NREL employee participation doubled from the preceding year.	✚	NREL Charitable Giving Campaign donated $434,442 to community organizations through Partnership for Colorado and Mile High United Way.	✱

PERFORMANCE SNAPSHOT | Summary of Goals for Material Assessments

Key Performance Status: ✚ Exceeds Target ✱ On Target ▲ Behind Target

Agents of Change	Objective and Target	Baseline	FY 2010	Status	FY 2011	Status
SUSTAINABLE ACQUISITIONS	Ensure that 95% of new contract actions (including task and delivery orders under new contracts and existing contracts) require the supply or use of products and services that are energy efficient (ENERGY STAR® or FEMP-designated), water efficient, bio-based environmentally preferable [including Electronic Product Environmental Assessment Tool (EPEAT) registered products], non-ozone depleting, contain either recycled content or are a non-toxic or less toxic alternative.		NREL begins participation in the DOE Buy-Bio Program: – Purchases of recycled products from the office supply CADDO catalog grew over 450% in FY10 from FY09 – Green products acquired through Purchase Cards in FY10 increased 90% from FY09 – ENERGY STAR equipment was purchased for the RSF copy and kitchen areas – NREL purchased ENERGY STAR 4.0 and EPEAT for all computers, monitors, and associated hardware.	✱	NREL awarded its first janitorial contract with green requirements that are based on the LEED-EB O&M rating system of green cleaning credits. NREL implemented new policies and programs that increased the acquisition of sustainable products and contracts consistent with the EO 13514.	✚
BEHAVIOR CHANGE	Cultivate an employee culture focused on reduction of electricity use, process and fugitive emissions, waste, commuting, and business travel.		Sustainable NREL conducted orientations, websites, communication program trainings, and internal program initiatives to engage and educate all employees to improve sustainable operations.	✱	Sustainable NREL and the Buildings Technology Group conducted an interactive comfort survey with building occupants of RSF I to investigate and assess building environmental conditions and employee workstations.	✱
GHG Management	**Objective and Target**	**Baseline**	**FY 2010**	**Status**	**FY 2011**	**Status**
GHG EMISSIONS	Reduce GHG Scope 1 and Scope 2 emissions by 28% by FY20 from a FY08 baseline.	FY08: 26,201 MT CO_2e	25,149 MT CO_2e 4% reduction	✱	23,337 MT CO_2e 11% reduction	✱
	Reduce GHG Scope 3 emissions by 13% by FY20 from a FY08 baseline.	FY08: 6,375 MT CO_2e	8,813 MT CO_2e 38% increase	▲	7,117 MT CO_2e 12% increase	▲
Energy Management	**Objective and Target**	**Baseline**	**FY 2010**	**Status**	**FY 2011**	**Status**
ENERGY	Reduce energy intensity by 30% by FY15 from a FY03 baseline.	FY03: 257,552 Btu/GSF	Increased from 259,573 Btu/GSF in FY09 to 269,665 Btu/GSF at the end of FY10	✱	Energy intensity decreased 35% since 2003, 166,765 Btu/GSF.	✱
	Reduce campus annual electricity consumption by 7.5% by FY10 utilizing renewable sources .		19.4% of NREL's power came from on-site generation	✚	28% of NREL's power came from on-site generation.	✚
	NREL campus is to have at least one on-site renewable energy generating system by FY10.		Major installations included: – .7-MW STM Mesa Top PV system (2008) – .1-MW ST&F PV system (2009) – 1-MW NWTC PV system (2009) – 1.3-MW NWTC Research Wind Turbines – 1.5-MW NWTC GE Wind Turbine (2009) – 2.3-MW NWTC Siemens Wind Turbine (2009) – Renewable Fuel Heating Plant (RFHP) (2008)	✚	Major installations included: Two PV array systems at STM: –1,449 kW at RSF I –524 kW at the RSF visitor's parking lot Two wind turbines at NWTC: –Gamesa 2 MW –Alstom 3 MW	✚
	Install advanced metering for electricity (by October 2012), steam and natural gas (by October 2016), and standard meters for water.	FY09: 74 meters	Installed 24 meters in RSF I	✚	Connected remaining meters to Energy Dashboard systems—100% metering for electricity, hot and chilled water, 95% metering for natural gas	✚

WATER	Reduce water intensity by 16% by FY15 from a FY07 baseline; reduce by 26% by FY20.	FY07: 28.61 gallons per ft^2	32.90 gallons per ft^2 15% increase from a FY07 baseline	✱	14.25 gallons per ft^2 50% decrease from an FY07 baseline	✱
Waste Management	**Objective and Target**	**Baseline**	**FY 2010**	**Status**	**FY 2011**	**Status**
WASTE	Minimize the generation of waste and pollutants through source reduction.		NREL began a composting pilot in April 2010, which encompassed five buildings on the STM campus. NREL is working toward near-zero waste, taking the "4Rs" program (reduce, reuse, recycling, and re-buy) to a higher systemic level to eliminate the laboratory's waste stream.	✚	NREL transitioned its composting pilot to a campus-wide program, increasing compost 9% from 2010. NREL employees actively embrace the compost program, which will help bring NREL closer to achieving near-zero waste.	✚
RECYCLING	Divert at least 50% of non-hazardous solid waste from landfills, excluding construction and demolition debris, by the end of FY15.		Composted 68,468 lbs; disposed of 336,564 lbs of sanitary solid waste; diverted 54% from landfill.	✱	Composted 278,549 lbs; disposed 471,631 lbs of sanitary solid waste; diverted 77% from landfill.	✚
	Divert at least 50% of construction and demolition materials and debris from landfills by the end of FY15.	FY08: Recycled 299,090 lbs	Recycled 982,705 lbs 328% increase in recycling from a FY08 baseline	✱	Recycled 1,294,165 lbs 433% increase in recycling from a FY08 baseline	✚
Lab Operations	**Objective and Target**	**Baseline**	**FY 2010**	**Status**	**FY 2011**	**Status**
ENVIRONMENTS, SAFETY AND QUALITY	Demonstrate excellence in quality, environmental protection, and safety by attaining ISO 9001, ISO 14001, and OHSAS 18001 registration for the Integrated Management System (IMS).		Established an approach to certification: – Conducted gap assessments against all three standards – Implemented corrective actions for standard/system specific gaps – Conducted external audits.	✱	NREL EHS&Q Managment Systems attained ISO 9001 (Quality), ISO 14001 (Environment), and OHSAS 18001 (Safety) certification.	✱
POLLUTION PREVENTION	Implement a Pollution Prevention Initiative (PPI) Program to identify opportunities and provide resources and funding to achieve desired results.		Created a PPI board comprised of five employees from Sustainable NREL and the EHS Office. Secured $40,000 from EMT to fund pilot program proposals. Established proposal evaluation criteria.	✱	Three pollution prevention assessments were performed: – Printer reduction – SF_6 reduction – Aerosol can recycling. Three pollution prevention projects were funded: – NREL Library reduce and recycle – Idling reduction – Pump replacement.	✱

Investment

Multi-Year Goals:

- Conduct outstanding basic and applied research and accelerate discoveries toward market-viable applications.
- Accelerate the commercialization of clean-energy technologies—removing barriers to enable their deployment at scale.
- Develop a work environment that is innovative, entrepreneurial, highly connected, safe, and supportive.
- Design all new construction and major renovations greater than $5 million to at least Gold or greater under the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) program.

One-on-one networking sessions at an Industry Growth Forum help start-up companies identify resources that can help them grow.

Investment

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.

KEY CHALLENGES

The key challenges NREL faced in FY 2010 were associated with continued rapid growth, increased visibility, a slow economy, and increased competition. To meet the growing demand for energy innovations, accelerated commercial adoption, and analysis, NREL continues to:

- Expand its resident expertise and technical capabilities
- Support systems and infrastructure.

This rapid growth brings the need for increased space as well as a higher utilization of existing office and laboratory space.

Implications to Growth Expectations

Moving forward, NREL's greatest challenge will be balancing the significant growth of its campus and employee population with meeting its aggressive energy and sustainability goals. Between FY 2009 and FY 2010, NREL experienced unprecedented growth, including a 16% increase in its number of employees and a 48% increase in its combined South Table Mountain (STM) footprint. This continual growth is necessary to maintain NREL's position as the national leader for renewable energy and energy efficiency research. Further, it will enable NREL to continue to contribute to the international energy dialogue, influencing decisions that will catalyze a profound transformation in energy infrastructure. However, NREL's growth will also create new sustainability challenges:

- Energy consumption will increase dramatically, driving GHG emissions associated with purchased electricity and associated transmission and distribution losses higher.
- Additional staff will produce more commuting emissions and contribute to higher fuel consumption in NREL's fleet.
- Waste production and water consumption will correspond to the increase in staff levels. Some of the effects of growth are already reflected in NREL's energy, petroleum fuel, and water consumption, which grew in FY 2010 compared to the previous reporting year.

In the face of these challenges, NREL will continue to seek innovative ways to reduce its environmental footprint and disseminate lessons learned to the broader community. As NREL continues to build out its campus, the laboratory will use every opportunity to demonstrate and showcase how to plan for, and significantly reduce, conventional energy use by using demand- and supply-side reduction techniques. Employee engagement in sustainability practices is supplemental to these campus-wide physical and policy enhancements—creating a stronger, more sustainable NREL community. NREL's Ten-Year Site Plan (TYSP) draft provides DOE EERE a comprehensive document that identifies NREL's current and proposed capabilities for real property assets of NREL and describes how these assets will be managed, maintained, and improved to support DOE's strategic plan.

Through its campus sustainability strategy, NREL's buildings, on-site and grid power supply, transportation system, and campus operations will evolve to become one integrated system.

The table on page 23 summarizes the national value of creating a Laboratory of the Future in four broad categories: scientific capabilities, technology and innovation, market impact, and technology on campus.

A Vision for 2050: Sustainable Energy Systems

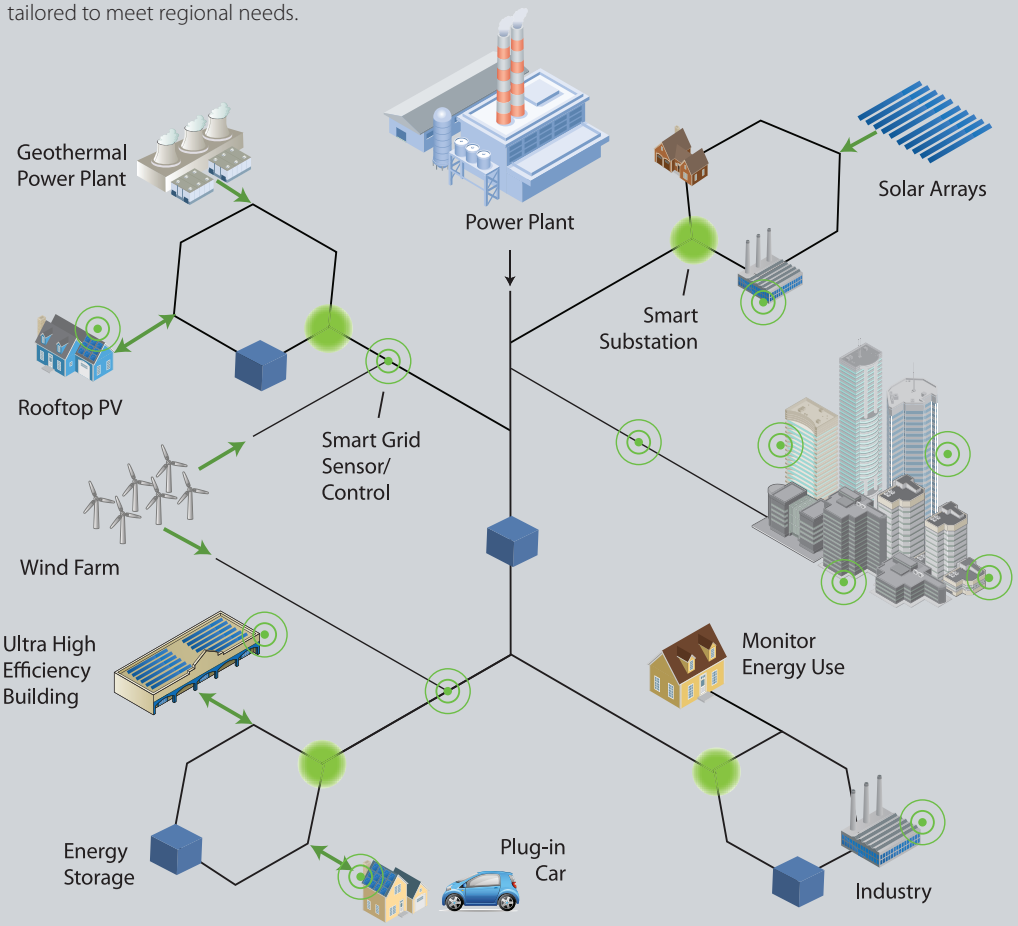
While NREL faces significant challenges, other opportunities are developing. NREL envisions a future sustainable energy system that is carbon neutral, highly efficient, affordable, and supportive of high-value domestic jobs. The 2050 energy system provides critical energy services through a "system of systems" working in concert, tailored to meet regional needs.

- Power is delivered to and from end-use systems through a highly reliable, modern grid.

THE 2050 ENERGY SYSTEM

"System of Systems"

The 2050 energy system provides critical energy services through a "system of systems" working in concert, tailored to meet regional needs.



- The built environment is highly efficient and uses combined heat and power systems or building integrated renewable systems to produce as much electricity as is consumed on an annual basis.
- Electricity systems incorporate high levels of baseload and variable renewable resources, operating effectively with other low-carbon generation sources to reduce carbon emissions.
- Mobility and access are provided by a highly efficient, fuel-flexible transportation system that uses fuels or electricity smartly matched to the transportation mode.
- Fuel production systems use a significant amount of renewable energy resources to end our dependence on a single source.

Working together, these systems enable communities and industries to develop and flourish locally and regionally—connected through sustainable energy systems that deliver high efficiency and greater use of renewable energy.

Domestic natural gas resource estimates and production have increased significantly during the past few years due to breakthroughs in the ability to economically recover unconventional gas, particularly shale gas. Advances in energy efficiency and renewable energy offer the opportunity to create a sustainable energy system that optimizes the combined use of renewable, fossil, and nuclear energy resources.

OPERATING BUDGET

In FY 2010, NREL received almost 89% of its funding from DOE EERE, the primary sponsor of the laboratory. Of the $536.6 million received in FY 2010, approximately $65.1 million was for infrastructure projects to support laboratory capabilities expansion.

NATIONAL VALUE OF NREL'S LABORATORY OF THE FUTURE	
SCIENTIFIC CAPABILITIES • Innovation through interdisciplinary research • Revolutionary and disruptive technologies • Computational science foundation • Promoting a balance between short- and long-term R&D	**TECHNOLOGY AND INNOVATION** • User-driven research as a bridge between basic science and technology R&D • Interfaces managed for accelerated impact • State-of-the-art information technologies enable two-way flow of data and information both within the site and with our partners and stakeholders • Technology validation: engineering and testing
MARKET IMPACTS • Integrated systems ready for competitive markets • Major impact on development of all energy systems: distributed electricity systems, buildings and vehicles technology, and entire communities • Expand space for industry collaboration • More public facilities for easier accessibility	**TECHNOLOGY SHOWCASE ON CAMPUS** • A campus showcase that exemplifies sustainable community design • High-performance buildings • Efficient transportation system • On-site power generation

In FY 2011, NREL received $388.6 million from DOE EERE, the primary sponsor of the laboratory. Approximately $51 million was for infrastructure projects to support laboratory capabilities expansion.

Other Funding Mechanisms

Power Purchase Agreements (PPAs) and Energy Savings Performance Contracts (ESPCs)

Due to the complexity of building on-site renewable energy projects, alternative project financing and maintaining operations can be challenging. NREL has pursued these types of projects through PPAs and ESPCs.

NREL utilized PPAs to install ground-mounted PV systems at the STM mesa top and NWTC, and rooftop systems on the S&TF and RSF. The benefit of using this agreement mechanism is that NREL can host an on-site generation system with no up-front cost, and agree to buy the power without owning the equipment. Under a PPA, a third party owns the renewable energy system and sells the power to the site host under a long-term contract (usually 10 to 20 years). NREL's third-party project developer, SunPower, collaborated in all aspects of the project development, including site assessment, system configuration, procurement, installation, and financing. Following installation, the project developer is also responsible for system operations and ongoing maintenance.

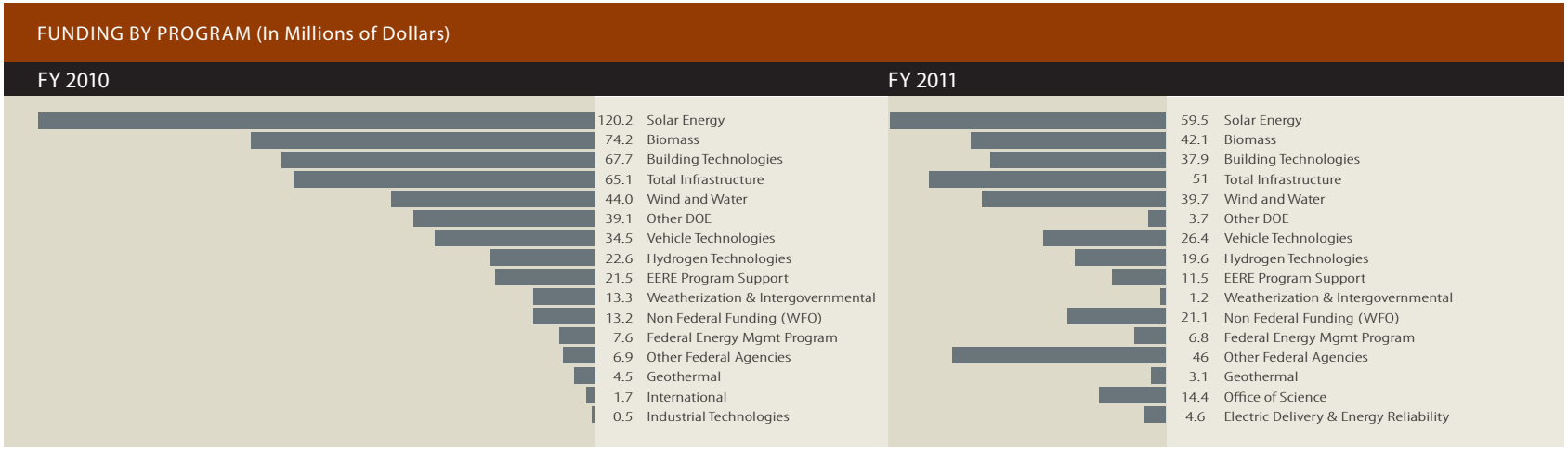
ESPCs allow federal agencies to conduct energy projects with no upfront capital costs, minimizing the need for congressional appropriations. NREL utilized an ESPC with the energy service company (ESCO) Ameresco to install the Renewable Fuel Heat Plant (RFHP). Ameresco financed the construction of the plant and buys the wood waste; the company will be repaid with the savings from NREL's natural gas utility cost.

American Recovery and Reinvestment Act (ARRA) or Stimulus Act

In February 2009, President Obama signed the ARRA or Stimulus Act into law. The ARRA of 2009 is the federal government's response to the country's recent economic crisis by putting capital to work in an effort to stimulate the American economy. Of the total $787 billion in funding provided by ARRA, $21.5 billion is earmarked for scientific endeavors. NREL received $86,764,000 for Renewable Energy and Site Supporting Infrastructure Portfolio (RESSI).

RESSI is an ARRA-funded portfolio of General Plant Projects (GPP) that support the ongoing NREL campus development and expansion program by providing additional funding for renewable energy and infrastructure development for:

- RSF II A wing
- Cafeteria
- Ingress/egress project that provides new campus access road, traffic circulation patterns, parking garage, and security entrance building
- ADA access improvements at STM and NWTC
- Extended sidewalk/lighting at FTLB to the S&TF
- West gate rebuild
- FTLB chiller boiler upgrade



- PV for RSF complex
- Security upgrades
- FTLB lobby
- Safety platforms at S&TF and FTLB.

Revenue

Because NREL is a not-for-profit organization, the term net revenue does not apply. However, our total revenue, assets, and costs for operations and research is as follows:

FY 2010

- Revenue from the U.S. government: $443.9 million
- Total capitalization as of September 30, 2010:
  - Debt: $0
  - Equity: $3.6 million
- Total assets: $110.2 million
- Total revenue: $437.5 million.

FY 2011

- Revenue from the U.S. government: $532.9 million
- Total capitalization as of September 30, 2011:
  - Debt: $0
  - Equity: $4.1 million
- Total assets: $125.8 million
- Total revenue: U.S. $532.9 million.

SCIENTIFIC AND TECHNICAL INNOVATION

Innovation is foundational to the development of high-performance, lower-cost renewable energy and energy efficiency technologies. Bridging the gap between basic and applied research to translate discoveries into innovations with potential to become market-viable solutions is imperative to addressing the looming issues of limited resources and climate change.

NREL's innovations spanned a wide variety of mission areas—from demonstration of a stable quantum dot solar cell, to construction of a recombinant organism that can sense hydrogen produced by green algae, to collaborative work in developing a catalyst for ethanol production and achieving a better understanding of bioreactor design and operating conditions. Notable advancements were also made in the field of nanoscience in FY 2010.

NREL's applied research and engineering portfolio also delivered important accomplishments toward national goals. The laboratory:

- Advanced technical development and large-scale deployment of wind power
- Advanced the development of methanol fuel cells
- Identified potential mechanisms for more efficient and lower-cost production of hydrogen from multiple processes including fermentation and algal mechanisms
- Improved performance of electrodes and battery anodes to help power hybrid electric vehicles
- Created an advanced tool to quantitatively model and predict conductivity in wide-gap transparent materials, offering a new option for transparent conductors in photovoltaic (PV) modules
- Advanced simulation and optimization routines for new buildings technologies with a strong focus on advanced heating, ventilation, and air conditioning (HVAC) and ground source heat pumps.

To meet program demands, NREL has strengthened the laboratory's workforce by recruiting outstanding individuals into key leadership positions and by hiring exceptional scientists and engineers at all levels necessary to support our mission.

Citations of NREL papers increased 8% over the previous year.

NREL researcher Hao-Chih Yuan demonstrates an innovative technique that produces a black silicon solar cell with a 16.8% efficiency.

In FY 2010, NREL continued to build on NREL's distinctive capabilities, including:

- *Photoconversion science and technology.* Renewable materials and chemistries will be enhanced to underpin solar research, including strengthening capabilities in optical materials to support the development of new reflector and absorber materials.
- *Bioconversion science and technology.* Process engineering capabilities will be extended to enable advanced biofuels research, and materials capabilities will be enhanced to address biomass destruction and component conversion to fuels.
- *Integrated renewable systems engineering.* Engineering capabilities will be improved to support research and innovation on interconnection and controls for renewable energy-grid and renewable energy-building interactions as well as to address fundamental storage and heat transfer fluids research.

External acknowledgement of NREL's science and technology accomplishments and extraordinary quality is a testament to the laboratory's strength. NREL received two R&D 100 awards for solar research for the:

- "Black silicon" nanocatalytic wet-chemical etch process
- Amonix 7700 solar power generator.

NREL published the largest U.S. wind integration studies ever undertaken in FY 2010—the Eastern Wind Integration and Transmission Study, and the Western Wind and Solar Integration Study.

NREL scientists also won several top national and international scientific honors in FY 2010. With more than 1,000 publications by NREL researchers in FY 2010 (a 15% increase over FY 2009), NREL furthered its presence in the scientific community. Citations on NREL papers increased 8% over the previous year, and papers authored by NREL researchers were listed among the IEEE Xplore Digital Library's top 25 cited and viewed publications on the topics of smart grid, PV, and renewable energy.

Among the key NREL scientific research outcomes or demonstration of improved performance or cost reduction in FY 2011 were:

- The first solar cell made from lead selenide (PbSe) quantum dots demonstrated a peak external photocurrent quantum efficiency exceeding 100% resulting from multiple exciton generation. This is a major step toward the promise of very high efficiency solar cells.
- Developed a new, low-cost nano-patterning process that makes millions of holes in a silver film was developed, boosting light-capturing qualities of solar cells
- An advanced control algorithm was developed and demonstrated that reduced wind turbine fatigue loads up to 40% compared to industry baseline standards

- The achievement of 2011 ethanol production cost targets was demonstrated for both the biochemical and thermochemical platforms through improvements in enzymes, fuel synthesis catalysts, and ethanol tolerance
- A breakthrough Internal Short-Circuit Testing Method was developed that has generated significant interest from partners in the Li-ion battery industry.

NREL received three R&D 100 awards in FY 2011 for solar research for the:

- "Flash" Quantum Efficiency System for Solar Cells
- Optical Cavity Furnace
- Silicon Ink for High Efficiency Solar Cells.

One way the laboratory advances its mission is through investments in cutting-edge research through the Laboratory Directed Research and Development (LDRD) Program. Through the LDRD Program, NREL will invest nearly $10 million in innovative research projects to explore new concepts and develop new capabilities. For FY 2011, the laboratory has identified strategic areas for investment that are aligned with NREL's strategy and will be the primary emphasis of the LDRD Program over the next three to five years:

- PV manufacturing research, including high-rate PV processing
- Advanced materials for energy technologies
- Energy systems and decision models
- Next generation building automation
- Advanced computing
- Advanced fuels/biofuels properties research.

There is a growing recognition of NREL's leadership in renewable grid integration and smart grid technology. For example, NREL provided thought leadership to support the White House in the development of the "Policy Framework for the 21st Century Grid." The Federal Energy Regulatory Commission (FERC) heavily cited NREL grid integration studies in its November 2010 Notice of Proposed Rule Making on Variable Generation Resource.

The research work of NREL scientists was acknowledged in 21,393 media stories. Documented research was published in a variety of forms: 1,252 publications; 345 journal articles; 374 conference papers; 198 technical and subcontract reports.

COMMERCIALIZATION AND DEPLOYMENT

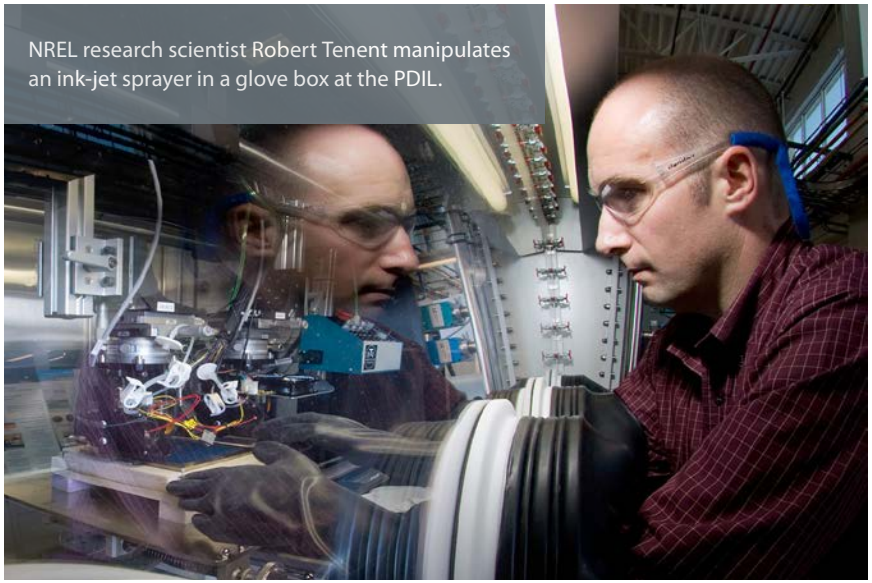
FY 2010

NREL surveys and implements best practices for disclosure, royalty distribution, technology maturation, and invention review with respect to commercialization processes and tools. In FY 2010, analysis was used to guide commercialization efforts by using insights from PV manufacturing cost analyses to inform the approach to an NREL invention disclosure and patent application. The successful licensing of NREL's award-winning black silicon technology directly resulted from this analysis. NREL also updated and improved the EERE Technology Commercialization Portal FY 2010, which became a best-in-class Web-based tool for marketing DOE laboratory technologies.

NREL's deployment work in FY 2010 continued to focus primarily on federal, state, and local government agencies. NREL conducted more than 75 webinars and workshops, responded to 125 Technical Assistance Program requests, and conducted more than 40 assessment projects for federal agencies to accelerate deployment of energy efficiency and renewable energy technologies. These high-priority projects were:

- Effective support to the ARRA Treasury-led Cash Grant in lieu of Tax Credit section 1603 program. NREL's support included managing the processing of approximately 1,000 applications, which led to more than $5.2 billion in cash payments, leveraging more than $17 billion in private-sector funding and impacting more than eight gigawatts (GW) of new RE projects.
- Execution of a portfolio valued at more than $6 million that included more than 40 ARRA projects for FEMP. NREL also made a major wcontribution to the Office of Weatherization and Intergovernmental Program's (OWIP) progress on weatherization workforce development by completing the National Guidelines for the Residential Retrofit Workforce for Vice President Biden's office.
- Establishment of new, replicable best practices, including a template for ultra-high energy-efficient military installations and new best-in-class training for Clean Cities coordinators.
- Launching a $21-million four-project portfolio with two agencies for the State of California and four industry partners that leveraged $5 million of EERE funding with $8 million of state funds and $8 million of industry investment to increase market penetration of efficient and clean natural gas vehicles.

NREL forged a strategic partnership with the Electric Power Research Institute (EPRI) to support the expansion of renewable energy in the utility industry. NREL also began implementing a standardized partnering facility model that was developed in FY 2009 to streamline practices and engage additional partners in the use of the Process Development and Integration Laboratory (PDIL), wind facilities, and the Integrated Biorefinery Research Facility (IBRF).



NREL research scientist Robert Tenent manipulates an ink-jet sprayer in a glove box at the PDIL.

CURRENT LAB SPACE

LEGACY
SINGLE-PURPOSE

ACTIONS

RENOVATE
REPURPOSE
REFURBISH

REVITALIZED LAB SPACE

MODERNIZED
MORE EFFICIENT
MULTI-PURPOSE
FLEXIBLE

PDIL brings together technical experts from NREL, the solar industry, and universities to accelerate the growth of PV knowledge.

NREL continues to develop and expand the use of the pre-competitive CRADA model beyond the initial effort with the biofuels industry. This partnership model leverages resources across multiple companies in areas that avoid proprietary issues by focusing on very preliminary stages of research.

FY 2011

NREL's strategy has yielded continued improvements in commercialization practices and a robust portfolio of CRADAs and license agreements. The delivery of an improved EERE Innovation Portal, which provides access to more than 15,000 DOE-funded patents and patent applications and more than 500 market summaries, is a tangible instantiation of NREL's leadership in commercialization across the laboratory system. NREL partnerships with the State of Colorado and other economic development entities via the Colorado Renewable Energy Economic Development (CREED) also continued to make an impact with more than 400 jobs created toward an NREL goal of 500. With more than $65 million in EERE investments resulting from Federal Energy Management Program (FEMP)-supported work at NREL, the laboratory's deployment efforts made a considerable impact on helping federal agencies meet the aggressive energy performance targets established by the president in Executive Order 13514. Some of these high-priority projects are as follows:

- With the publication of the Clean Cities 2010 metrics report, which demonstrated displacement of 606 million gallons of petroleum, NREL established the quantifiable impact of the program. This included the use of over 560,000 alternative-fueled vehicles. NREL released the Clean Cities 2011 Vehicle Buyer's Guide in October. It features the specifications and costs of model year 2011 alternative fuel and advanced light-duty vehicles, including all-electric, plug-in hybrid electric, and hybrid electric vehicles, as well as those that run on biodiesel, E85, natural gas, and propane. NREL also completed a fuel use analysis for the Department of Homeland Security (DHS) to identify vehicle concentrations that do not use alternative fuels, and have engaged the five Clean Cities Coalitions with the highest concentrations of DHS vehicles to help support the development for fuel infrastructure for DHS.
- NREL's work on non-hardware, balance-of-systems information included development of an approach to collect and efficiently analyze data (including costs) in the support of DOE's SunShot Initiative. SunShot is a collaborative national initiative to make solar energy cost competitive with other forms of energy by the end of the decade. Reducing the installed cost of solar energy systems by about 75% will drive widespread, large-scale adoption of this renewable energy technology and restore U.S leadership in the global clean-energy race.

- NREL FEMP provided assessment support for implementation of low-cost solar technology into several DOD installations including Marine Corps Base Kaneohe Bay, Marine Corps Air Station Miramar, and Naval Air Station Key West. NREL continues to work with these sites by assisting in the development of Energy Conservation Investment Program proposals. NREL is also working with GSA's Green Proving Ground program to perform field testing on an installed PVT (integrated PV and solar thermal) system, a promising way of reducing the life-cycle cost of solar.

CAMPUS OF THE FUTURE

At NREL, we put our mission into practice in facilities that showcase energy efficiency and renewable energy integration and in the support and development of a staff that conducts world-class work in every area—from research to engineering to operations. With its focus on energy, NREL leads by example—using the technology developed at the lab in its new and existing buildings.

Envisioned as a Laboratory of the Future, the campus showcases:

- High-performance energy-efficient building design
- On-site renewable energy generation
- Sustainable transportation
- Alternative-fuel vehicles
- Alternative commuting program that supports carpooling, vanpooling, public transit, bicycling, and walking.

NREL's campus is comprised of laboratory and office buildings. Typical laboratory buildings use four to six times more energy per unit of area than typical office buildings.[1] Because of this, the low-energy design strategies applied in offices are different from those applied in laboratory buildings. Office buildings focus primarily on reducing energy for lighting and cooling; laboratories focus on reducing the energy needed to meet ventilation requirements.

NREL's first energy strategy priority is investing in site design and building development that maximize energy efficiency. This is being achieved with appropriate building orientation and thermal mass that takes advantage of passive solar design for heating, cooling, and natural lighting in all new building construction.

Another priority is to maximize on-site power generation from renewable energy technologies. Renewable initiatives include the integration of roof or ground-mounted PV installations, the Renewable Fuel Heating Plant (RFHP), and a ground-source heat pump. Future campus facilities will incorporate PV installations to reduce the consumption of conventional energy and NREL's carbon footprint.

Before the EO 13514 goals were established, NREL developed aggressive design standards for all new construction and major renovations.

NREL's design standard includes energy conservation aimed to:

- Exceed the base case of ASHRAE 90.1-2004 by a minimum of 30% of energy cost
- Attain a minimum of LEED Gold certification
- Install ENERGY STAR equipment where applicable
- Provide a Substantiation Design Report, which includes a metering plan for energy inputs.

1 The Building Energy Data Book, Chapter 3, Commercial Sector (energy use), *buildingsdatabook.eren.doe.gov/ChapterIntro3.aspx.*

NREL completed the 71,000 ft^2 Science and Technology Facility (S&TF) in FY 2006. The S&TF became the first federal building to receive a certified Platinum rating under the USBC's LEED program. Only 28 other buildings in the world had achieved the LEED Platinum designation at that time, and only two of them were laboratories. NREL plans to build several hundred thousand square feet of new laboratory buildings in the next several years that will be based on the S&TF's building design technologies.

Phasing of campus development is dependent on federal funding from DOE EERE. NREL's Ten-Year Site Plan identifies the proposed construction of new facilities and their associated con-struction schedules. In 2009, an STM Campus Master Plan was created to give guidance for the planning and construction of site design, infrastructure, open space, pedestrian/vehicular/wildlife movements and connections, and green building principles.

Construction Completed in FY 2010

Research Support Facility I (RSF I)

In 2010, the $57.4 million RSF I was completed and received LEED Platinum certification. This ultra efficient net-zero energy building is a model for sustainable, high-performance design. The building is located on NREL's STM site and provides approximately 222,000 ft^2 of DOE-owned workspace for NREL administrative staff who previously occupied Denver West leased space. The design strategy of RSF was to create an affordable, lower life-cycle cost, highly energy-efficient space consistent with EERE's 2010 and 2025 Building Technologies Program goals.

In 2010, RSF I was completed and received LEED Platinum certification.

Low-emissivity windows maximize daylighting, thereby reducing RSF's electricity load.

The RSF minimizes its carbon footprint through substantial use of energy efficiency features such as daylighting and building orientation, super insulation, high mass structure, low-emissivity windows, and radiant heating and cooling. NREL set an aggressive LEED goal of Platinum for the RSF, which includes an energy design goal of 32 kBtu/ft^2/year (including the data center). The result is that RSF I is 50% more energy efficient than a conventional building designed to the ASHRAE 90.1 (2004) standard.

The building orientation of RSF I enables daylighting and natural ventilation for all building occupants, while balancing building heat requirements. Heating and cooling loads are offset with thermal massing, transpired solar collectors, and radiant piping that uses water to heat and cool the majority of workspaces. On-site electrical generation for the building will be accomplished with a 0.75-MW PV solar array. The RSF I also houses a highly efficient data center with a power usage effectiveness (PUE) of 1.14 that is half of its predecessor's. In addition, RSF I has strict energy efficiency requirements consistent with ENERGY STAR for the use of all refrigerators, coffee makers, computers, and monitors within the building. Building-level electricity meters have been installed to monitor building performance specific to lighting, HVAC, laboratory processes, and data center loads. Third-party building commissioning was conducted for all mechanical systems in RSF I.

Measurement and verification will follow in the next six to 18 months of initial occupancy, which will survey occupant and building system conditions.

During the construction of RSF I, roughly 75% of construction waste materials were diverted from landfills. The building also incorporates a wide range of recycled, rapidly renewable, and local products using:

- Wood from pine trees killed by an invasive beetle species in the lobby and as accent material throughout the building
- Recycled textile fibers and carpet tiles
- Recycled runway materials from Denver's decommissioned Stapleton Airport as aggregate in the building foundations and slabs
- Reclaimed steel gas piping as building structural columns.

Water efficiency was accomplished by installing water-conserving fixtures that reduce potable water consumption by 50%. The building landscaping consisting of native, xeric plants that only require irrigation during their establishment also reduces outdoor water consumption by 84%. Indoor environmental quality (IEQ) measures were addressed through the use of low volatile organic compounds (VOC) emitting materials, control of ozone-depleting compounds, and the execution of an IEQ construction management plan.

Employees inspect the biomass pretreatment reactor at the IBRF, which is capable of supporting a variety of advanced biofuels projects.

Construction Completed in FY 2011

Integrated Biofuels Research Facility (IBRF)

IBRF Stage Two was completed in FY 2011. This is an addition to the 27,000 ft^2 IBRF Stage One project, which was completed in FY 2010. Construction costs for IBRF Stage One were $20 million, and costs for IBRF Stage Two were $13,132,500. The IBRF conducts research for the commercial-scale production of cellulosic ethanol at a cost that is competitive with gasoline. This facility is a combination of offices and laboratories to support this scientific venture. The IBRF is planned to achieve LEED Gold certification by incorporating appropriate energy and resource efficiency measures. IBRF is also designed to achieve a minimum 30% energy savings as compared to ASHRAE 2004 Energy Performance Standards for Commercial Buildings.

Reinvestment

Maintenance, replacement, and refurbishment (collectively, "reinvestment") are necessary for the upkeep of NREL's buildings, roads, and utilities to respond to changing research needs and to meet safety and security requirements.

Reinvesting in Institutional Facilities and Infrastructure

As a relatively young institution in the DOE system with no environmental legacies, NREL's facilities are 32 years old and are in comparatively good condition with an overall facility condition index today of 0.83%, which is considered excellent.

Reinvesting in Institutional and Program Capital Equipment

In addition to its facilities and infrastructure, NREL has capital equipment. Annually this equipment gets assessed to identify items for replacement. Reinvestment funds consist of three categories:

1. Indoor environmental quality funds to replace the equipment beyond its expected service life
2. Funds to replace equipment when it reaches its expected service life
3. Funds for maintenance contracts that help extend the life of the asset to maintain optimal condition.

Buildings Currently Under Development

Research Support Facility II (RSF II)

The RSF II, a 159,000 ft^2 addition to the RSF I, will house Class A office space. Construction will be completed in 2012 and will cost $60,910,000. This building was modeled after the design of RSF I to create a highly energy-and-resource-efficient building. In pursuit of LEED Platinum certification, RSF II will incorporate features such as daylighting, in-ceiling radiant heating and cooling, transpired solar air heating collectors, and heat pump domestic hot water heaters with coincident air cooling. Like RSF I, the interior space will provide natural ventilation with operable windows and the rooftop of RSF II will be covered with PV panels. The adjacent parking lot to RSF I and RSF II will also have solar panels. The combined PV systems will accommodate all electrical needs for building occupants. Account-

ESIF is designed to achieve a minimum LEED Gold rating by demonstrating energy efficiency and low environmental impact.

Artist rendering of the ESIF, which began construction in 2011.

ing for these and other measures, the RSF II is anticipated to be 50% more energy efficient than the ASHRAE baseline building performance. After monitoring the performance of RSF I, opportunities were identified to increase its energy efficiency by an additional 17%. These planned improvements will include the installation of more efficient solar panels at a lower cost, better thermal breaks in the latest energy-efficient commercial window frames, larger transpired solar collector, displacement ventilation in conference rooms, daylighting controls in day-lit stairwells, and natural passive cooling in stairwells.

Energy Systems Integration Facility (ESIF)

The ESIF is currently under design and will cost $131,812,382 to construct. To be completed in FY 2012, the 183,000 ft^2 ESIF will accommodate the critical engineering, testing, optimization, and verification research needed for integrated engineering systems development for EERE programs. The facility will provide support space for approximately 225 researchers, effectively consolidating activities from several locations at NREL, some of which are in leased facilities. The facility is being designed to achieve a minimum LEED Gold rating in support of DOE EERE's goal to demonstrate energy-efficient buildings with a lower environmental impact. This structure requires very innovative strategies for energy efficiency because its program components are so varied. This facility will provide offices, laboratories, and a supercomputing data center. The challenge for the design is to simultaneously meet specific building system requirements for each program area while utilizing compatibilities to create synergies for energy efficiency, including:

- Utilizing the recovery water system's waste heat from the data center to be used for heating the offices and high bay laboratory
- Cooling towers for primary cooling for all facilities
- Compressor-free cooling and variable-speed primary pumping in the data rooms
- Active chilled beams for heating or cooling of the offices
- Dedicated outdoor air systems
- Daylighting
- Roof mounting systems for solar PV panels.

Outdoor pads will be available for testing larger equipment and systems up to the multi-megawatt scale. The ESIF will also contain advanced computational capability to support characterization of solar, wind, hydrogen, buildings systems, and integrated energy systems, including electricity storage. This information is required to effectively design, engineer, test, and verify technologies for commercial deployment.

Ingress and Egress

Plans are in place to facilitate additional STM campus ingress and egress. A new entrance on the south side of the NREL campus and a new road (from Moss Street) will give employees a third option for getting onto the campus and reduce

The new parking structure will offset electricity requirements with 5,038 SunPower 315-watt solar panels.

traffic congestion at the existing east and west gates. A new site entrance building will provide a security checkpoint for the new south entrance, and a new parking garage will eliminate the need for off-site parking and shuttling from those sites. These combined improvements will cost $42,050,000, and construction will begin in 2011.

Parking Structure

Preliminary design has been completed for this facility. This 578,320 ft^2 structure will provide employee parking for 1,800 vehicles, 20 motorcycles, and 30 bicycles, as well as a protected connection to the campus shuttle waiting area. Preferred parking spaces with charging stations for electric/hybrid vehicles will be available for 2% of the total parking capacity, and infrastructure will be in place for an additional 18% of the garage capacity in anticipation of future demand for charging stations. Preferred parking for Americans with Disabilities Act (ADA) accessible space, vanpools and carpools and fuel-efficient/low-emission vehicles will also be provided.

Daylighting plays a primary role in reducing the electrical lighting energy loads, so the garage can remain without artificial light for most of the work day, for most of the year. The rooftop and southern elevation façade will collectively support 5,038 SunPower 315-watt solar panels. The construction of this structure is to be completed in January 2012.

Southern Security Entrance Building (SEB)

This facility will be constructed at the end of the new access road located at the southern boundary of the STM campus. The key purpose of this structure is to provide a secure checkpoint for an expected 40% of the employees and visitors entering and exiting the NREL campus. The structure will achieve net-zero energy by incorporating numerous innovative energy efficient technologies such as: natural daylighting, solar PV panels, geothermal ground source heat pump, a radiant ceiling slab, under-floor air distribution, an entrance vestibule, heavily insulated triple pan glazing, thermal mass walls, and a low-energy mechanical recovery system, as well as a wind catch tower. The SEB is planned to achieve LEED Platinum certification. It is anticipated that construction for this structure will be completed in January 2012.

Cafeteria

The proposed NREL employee cafeteria will use highly efficient ENERGY STAR equipment, cutting-edge grease sensors for ducts, low-flow prerinse water valves, a variable volume exhaust system, daylighting, and LED lights with occupancy sensors. Operational programs will support composting and resource recovery. The project will be designed and constructed to meet LEED Gold certification. The construction cost is estimated at $6,750,000 and will be completed in May 2012.

CREATING A SUPPORTIVE WORK ENVIRONMENT

NREL is committed to maintaining an environmentally responsible, safe, and healthful workplace for its employees and visitors. NREL is constructing state-of-the art work environs,

acquiring research equipment, and enhancing business systems to enable and optimize staff's comfort and performance.

Security and Emergency Management

NREL managed a highly dynamic environment throughout the fiscal years that presented unique security challenges, with unprecedented levels of new employees and visitors, multiple subcontractors in construction zones, and the relocation of core information systems infrastructure to the data center housed in the RSF. NREL managed those challenges effectively and ended both FY 2010 and FY 2011 with sterling security records—zero incidents in either physical or cyber security. NREL moved forward in improving security and emergency response capability—implementing an integrated system for both. These improvements resulted from four self-assessments that included assessments on:

1. External vulnerability
2. Foreign national management processes
3. Internal emergency preparedness and response procedures
4. Internal issues related to the move to RSF.

Additionally, communications were deployed lab-wide to heighten awareness of cyber vulnerabilities through our weekly news on our intranet site and training classes. Recommendations for internal performance improvements were obtained through the collection and analysis of cyber security metrics. By ensuring a safe workplace, NREL provides staff with an environment that allows them to meet performance objectives and support innovation.

Business Operations

Effectiveness, accountability, and continuous improvement are key objectives of business systems. With the laboratory's aggressive growth in programs and personnel, the need arose to develop a more robust strategy for managing and developing integrated business systems. In FY 2010, three key processes were re-tooled to reduce their cycle time and improve their effectiveness: technology partnership, talent acquisition, and test equipment design process for the NWTC. The newly launched Project Delivery Lifecycle Program (PDLP) was formed to gather laboratory-wide requirements for a data warehouse, enterprise planning, and program/project management. This program is in addition to an Electronic Contents and Records Management System, the NREL Learning Management System, and the upgrade of the Space and Facilities Management system, positions NREL to better collect, manage, analyze, and use information to support decision-making.

In support of enabling NREL's mission, seven business systems projects were completed in FY 2011, including:

- Standard Labor Rates Planning and Costing
- Safe Operating Procedures Management
- Learning Management System
- Hyperion Analyst Planning Tool
- Subcontract Writing System
- Physical Records Management
- Interim Cost Reporting.

Campus Master Plan

In FY 2011, the Campus Master Plan was updated to include a more detailed analysis of the drainage basins and grading conditions, enhanced sustainability practices, on-campus PV installation and renewable initiatives, and future programmatic facilities to align with the intention of the TYSP.

NREL'S IMPACT ON COLORADO'S ECONOMY*

NREL provided significant economic benefits to Colorado and Jefferson County. The net economic benefit for Colorado totaled $588.3 million in FY 2009, growing to $742 million in FY 2010 and $831.3 million in FY 2011. The majority of economic benefits are derived from operations, including employment. The net economic benefit of NREL on Jefferson County totaled $227.9 million in FY 2009, growing to $275.2 million in FY 2010 and $304.9 million in FY 2011. The majority of economic benefits were derived from operations, including employment. Awarded research contracts, one-time expenditures on construction, and visitor impacts provided economic benefit to numerous industries in Jefferson County, including the ailing construction industry.

- *Employment*. Total full-time equivalent employment grew from 1,799 in FY 2009 to 2,027 in FY 2010, and to 2,131 in FY 2011. Salary and benefits averaged $87,586, $97,267, and $93,349 in fiscal years 2009, 2010, and 2011, respectively. Salaries are commensurate with educational level.
  - Educational level of NREL workers exceeds the national average—almost a third of NREL's employees have doctorates, and another third have master's degrees. Thirty-three percent have bachelor's degrees, and 4% have associate's degrees.

* The information in this section came from the National Renewable Energy Laboratory Economic and Fiscal Impacts of NREL on Colorado, FY 2009 – FY 2011. The Business Research Division (BRD) at the Leeds School of Business performed this study for the Alliance for Sustainable Energy, LLC (Alliance) to objectively measure the economic and fiscal impacts of NREL for fiscal years 2009, 2010, and 2011.

ECONOMIC BENEFITS (Direct and Indirect in millions of dollars)						
	FY 2010			FY 2011		
Source	Direct	Indirect	Total	Direct	Indirect	Total
Construction	58.81	24.64	83.45	103.60	0.6	104.20
Subcontracts	75.30	33.70	109	93	27	120
Operations	268.27	64.90	333.17	189	118	307
Total Economic Benefits	**402.38**	**123.24**	**525.62**	**385.60**	**145**	**531.20**

EMPLOYMENT (Direct and Indirect in millions of dollars)						
	FY 2010			FY 2011		
Source	Direct	Indirect	Total	Direct	Indirect	Total
Construction	400	155	555	245	3	248
Subcontracts	280	211	491	300	175	475
Operations	1,631	543	2,174	1,726	576	2,302
Total Economic Benefits	**2,311**	**909**	**3,220**	**2,271**	**754**	**3,025**

  - Jefferson County, where NREL's main campus is located and where more than half of NREL's employees call home, enjoyed the greatest economic impact, with $305 million. NREL is one of Jefferson County's largest employers.
- *NREL Construction.* NREL's construction spending totaled $47.4 million in FY 2009, $97.4 million in FY 2010, and $105 million in FY 2011—translating to hundreds of new jobs for construction workers, who have been hit particularly hard by the national economic downturn.
- *Operation Expenses.* NREL's operating expenditures (supplies, materials, equipment, training, services, maintenance, printing, and shipping costs) totaled $35.2 million, $44.0 million, and $50.0 million in fiscal years 2009, 2010, and 2011, respectively. Approximately 90% of these expenditures remained within the state of Colorado, and 75% stayed in the Denver Metro region. Jefferson County captured 30% of expenditures.
- *Accommodations and food industry.* NREL's presence and the visitors and conferences it attracts are worth about $1 million a year. NREL had about 2,500 overnight visitors in FY 2011, and visitors averaged almost two nights stay each.
- *Contract/Agreements.* In August 2010, NREL had 329 contracts with Colorado companies totaling $414 million. NREL had cooperative research and development agreements (CRADAs) with 23 Colorado companies and technical service agreements with 24 Colorado firms in summer of 2010. In 2011, NREL had 364 contracts, 36 CRADAs, and 144 new technical service agreements.

NREL Programs Give Expertise, Money, Lab Time to Small Businesses

NREL's Photovoltaic Incubator Program helps solar companies get their technologies ready for full-scale production. NREL selects companies every 18 months and provides them with up to $18 million in total funding in each round. It also grants the selected companies access to NREL's facilities, testing sites, and other resources.

NREL sponsors the annual Industry Growth Forum (IGF) to connect clean-technology companies to investors. Companies headquartered in Colorado communities such as Golden, Thornton, Denver, Littleton, Fort Collins, and Boulder, among other cities, have presented at the IGF and have raised a total of $3.4 billion in funding.

NREL's Technology Commercialization and Development Fund allows companies to cost-share the development of technologies created at NREL. The dollar-for-dollar cost match has helped fuel the growth of Ampulse Corp. and SkyFuel Inc.—both Colorado companies.

NREL has helped wind and solar energy, biomass, and alternative fuels gain traction in the marketplace, helping to vault Colorado into sixth place nationally in the total value of clean-energy jobs. Between 1998 and 2007, clean-energy jobs in Colorado grew by 18.2%—that's more than double the 8.2% growth in all jobs in the state. As of the end of 2009, Colorado had 17,000 clean-energy jobs; and by the end of 2011, Colorado had19,000 clean-energy jobs.

According to the Solar Energy Industries Association, in 2011, over 54.6 MW of solar power were installed in Colorado, involving over 1,600 companies employing more than 19,000 workers.

Partnerships with NREL Prove Lucrative

FY 2010

Several Colorado companies that have entered into partnerships with NREL have become industry leaders. Abound Solar Manufacturing, LLC of Longmont, with the help of NREL, has developed a method to make cadmium telluride solar cell modules in less than two hours, the fastest in the industry. Abound was part of NREL's PV Technology Incubator, and its workforce has grown from 33 to 330 employees.

In late 2010, DOE announced a $400 million loan guarantee for Abound Solar to manufacture state-of-the-art thin-film solar panels. The project, which will use new manufacturing technology, will be capable of producing 840 MW of cadmium telluride solar panels each year. The company estimates it will create 1,000 manufacturing jobs in Tipton, Indiana, and 200 engineering and scientific jobs in Longmont, Colorado.

FY 2011

In April 2010, the 3-MW Alstom ECO wind turbine became operational at the NWTC. A joint team of NREL and Alstom engineers performed a series of analyses and tests to evaluate the wind turbines unique five drive-train configuration technology.

During the end of FY 2011 a second new venture was created at the NWTC. Gamesa Technology Corp., Inc. entered into a Work for Others (WFO) contract, a public-private partnership, to focus on innovations that will enhance the capabilities and performance of advanced wind systems in tapping the vast potential of this renewable energy resource and ultimately bring the nation closer to 20% wind energy by 2030. The installation of the Gamesa G9X-2.0 MW turbine will provide research in three key areas:

- Developing new wind turbine components and rotors for the U.S. market
- Researching and testing the performance of new control strategies
- Devising models that will help advance the development of offshore wind in U.S. coastal waters.

"Wind energy is going to continue to play a key role in creating a stronger and more sustainable American economy," said Dr. Miguel Angel Gonzalez-Posada, Vice President of Technology for Gamesa North America. "This partnership is an exciting venture that showcases Gamesa's commitment to enhanced clean-energy development, as well as our drive to deliver reliable, efficient, and cost-effective wind turbine technologies to the U.S. marketplace."

NREL'S PROCUREMENT ACTIVITIES 2010

Small Business Type	NREL Goal	NREL Actual
Small Business	55%	77.78%
Disadvantaged Business	5%	18.97%
Women Owned	5%	17.37%
HubZone	3%	4.34%
Veteran	3%	3.16%
Service Disabled Veteran	3%	1.38%

NREL'S PROCUREMENT ACTIVITIES 2011

Small Business Type	NREL Goal	NREL Actual
Small Business	55%	67.84%
Disadvantaged Business	5%	20.71%
Women Owned	5%	18.39%
HubZone	3%	2.94%
Veteran	3%	8.6%
Service Disabled Veteran	3%	4.68%

Procurement activities reflected a strong commitment to supporting small businesses, with an average of 73% of subcontract award dollars to small businesses, radically surpassing DOE's goal of 46%.

Small business support is another way by which NREL supports local economic growth and strives to utilize the most effective outside services, both technically and fiscally.

Community Relations

Multi-Year Goals:

- Host and sponsor educational community outreach activities to share knowledge and promote the adoption of energy efficiency and renewable energy technologies.
- Support the community through financial and in-kind contributions at a level commensurate with staff growth.

Fairview High School won the Colorado High School Science Bowl in FY 2010—one of several NREL-hosted educational events.

Community Relations

Strategic Intent

Our foundational values emphasize providing leadership for societal impact by demonstrating respect for our physical and social environment. NREL strives to positively contribute to the societies we serve within our local, national, and global community—working to build our reputation as a good corporate citizen. NREL focuses our efforts on educating and mentoring other organizations and finding ways to share our knowledge and resources to be an asset to our community. Employees are the foundation for community involvement, giving their time, money, and energy to help community organizations, support local economic development efforts, and educate teachers, students, and consumers about renewable energy and energy efficiency.

EDUCATIONAL MENTORSHIP

NREL's Executive Energy Leadership Program (Energy Execs) provides an opportunity for regional business and government leaders to expand their knowledge of renewable energy and energy efficient technologies. This six-month program offers in-depth, training sessions on renewable energy technologies, policies, and markets to help participants develop their own organizations' energy initiatives. FY 2011 was the fifth year NREL offered the program, which provides a means for the laboratory to transfer knowledge and help other organizations achieve their sustainability goals. Since its inception, the program has graduated more than 100 participants, who are now applying their training to their own organizations and communities and serving as effective ambassadors for NREL and clean energy.

The Wind Powering America, Wind for Schools Project is another avenue where NREL gives back to our communities by educating the next generation on renewable wind energy technologies. This program installs small wind turbines at rural elementary and secondary schools while developing Wind Application Centers at higher education institutions, reaching students from kindergarten to post-secondary education level. Teacher training and hands-on curricula are implemented at each host school to bring the wind turbine into the classroom through interactive and interschool wind-related research tasks. The students at the Wind Application Centers assist in the assessment, design, and installation of the small wind systems at the host schools, acting as wind energy consultants. They also participate in classwork and other engineering projects in the wind energy field.

NREL is a host site for the DOE Academies Creating Teacher Scientists (ACTS) program. During this three-year program, middle- and high-school teachers:

- Conduct state-of-the-art renewable energy research supervised by research staff
- Participate in professional development as summer research associates
- Continue their research experience the following summer in a four- to eight-week program at NREL or another participating national laboratory.

Resources and scientific consultation are provided to the teachers for at least three years. This program allows teachers to transfer their research experience back into the classroom.

COMMUNITY OUTREACH

NREL's Visitors Center showcases NREL's key research and development areas and technologies that can save energy, improve environmental quality, and lower energy bills. Visitors of all ages can tour the interactive exhibit hall and learn how we harness energy from the sun, wind, biomass, and other sources of renewable energy. The Visitors Center also offers free educational programs for adults and school groups that provide a fun and interactive way to explore renewable energy and energy efficiency topics.

In FY 2010, the Visitors Center served 18,000 visitors, hosted 382 community and school groups, and held 25 special programs informing visitors about clean-energy technologies. NREL campus tours were held for 3,500 representatives of local, state, national, and international business and government organizations—a record for NREL.

In FY 2011, the Visitors Center served 14,000 visitors, hosted 256 school groups, and held 25 special programs. NREL also hosted a record 4,339 VIP visitors and campus tours inside the laboratory. Visitors included U.S. and international officials, business and finance leaders, investors, thought leaders, and others who are engaged in clean energy. Among those who toured NREL in FY 2011 were Vice President Joe Biden and U.N. Secretary General Ban Ki-Moon.

NREL shares knowledge on sustainability across organizations and within the local community.

NREL hosts community tours, visits from community leaders, and workshops.

In August 2011, NREL invited the general public to see and tour the RSF—the world's largest net-zero energy commercial office building. The 351 metro Denver residents who registered for the event had an opportunity to engage with NREL and DOE officials at six "information stations" featuring the: NREL Campus; Construction and Roads; Security; Sustainable NREL; Environmental Stewardship; and NREL Information and Comments.

NREL also issued a newsletter to 7,000 neighboring households and regularly updated construction information on its website and telephone hotline.

In FY 2010, NREL kicked off the Interagency Sustainability Challenge—a partnership with the DOE Golden Field Office, the U.S. General Services Administration Region 8, the U.S. Environmental Protection Agency Region 8, and the City of Lakewood, Colorado. The purpose of this partnership was to reach out and increase awareness about environmental sustainability.

The Sustainability Challenge also provides a platform for staff to make a commitment to reduce GHG emissions over a six-month period.

The Sustainability Challenge sponsored a series of interagency events that included eight NREL-hosted public talks to share information across organizations and within the local community on clean energy, sustainability, and carbon footprint reduction.

EXPERT ADVISORS

NREL researchers share knowledge as expert advisors in local organizations. NREL staff hold advisory roles in the Metro Mayors Caucus and the Boulder Advisory Council on Climate Change. These advisors enhance NREL's credibility on energy efficiency and energy cost savings.

NREL has a lengthy relationship with the University of Colorado (CU), providing support on energy and environmental issues. NREL has advised CU on climate-neutral planning, campus energy, new-building energy efficiency, and energy infrastructure. NREL has provided similar support for many other universities including Northern Arizona University, University of North Carolina Ashville, Harvard, Emory, Stanford, Massachusetts Institute of Technology, State University of New York System, George Washington University, and University of Rochester. NREL also partners in research endeavors with universities and provides support to the Association for the Advancement of Sustainability in Higher Education (AASHE).

In 2010, NREL helped city officials develop the Energy Smart New Orleans Plan, which includes residential energy audits, incentives for energy efficiency, low-income weatherization, commercial and industrial programs, pilot programs for PV arrays, solar domestic hot water systems, and education outreach. In this effort, NREL worked with home builders to construct homes that would achieve ENERGY STAR ratings. NREL and others are working to ensure that all houses are at least 30% better than code. NREL also worked with design teams for the planned new Veteran's Administration hospital, Louisiana State University teaching hospital, and local

school district to design or renovate buildings to be 30% more energy efficient than code. NREL has also helped Solar America Cities to develop new rules and policies to simplify the path toward solar-powered homes.

Economic Development

Valuing Colorado's business and government economic development community, NREL participates with local economic development organizations such as the Metro Denver Economic Development Corporation, the Jefferson Economic Council, and a number of other economic development groups across the state. The laboratory provides technical counseling, conducts special workshops and forums, provides speakers, and hosts visits for these organizations. NREL also helps the Jefferson Economic Council with its initiative to attract new energy companies to the region. The Investment section describes how NREL has helped clean-energy technologies (wind, solar, biomass, and alternative fuels) gain traction in the marketplace.

Charitable Giving event resulted in $824,000 in staff donations for FY 2010 and FY 2011 combined.

CHARITABLE CONTRIBUTIONS

NREL has been the leading large business contributor for the past three years in charitable giving in Jefferson County. As staff levels have grown, so have their contributions—increasing from $328,000 in FY 2009 to a total of $824,000 in fiscal years 2010 and 2011 combined—benefiting the Partnership for Colorado and Mile High United Way. The Alliance has enhanced that contribution with donations of $43,000 in 2010 and $40,440 for administrative costs in 2011. NREL's Charitable Giving campaign has made it convenient for employees to contribute online and has expanded donation categories to increase participation.

Agents of Change

Multi-Year Goals:

- Cultivate an employee culture focused on reduction of electricity and natural gas use, process and fugitive emissions, waste, commuting, and business travel.
- Support sustainable acquisition. Ensure that 95% of new contract actions require the supply or use of energy-efficient and environmentally preferred products.

NREL's environment empowers employees to operate as agents of change. An annual Staff Awards Program recognizes employees—such as Communications' Gabe Boeckman—for their significant achievements.

Agents of Change

Strategic Intent

NREL goes beyond prescriptive management approaches and protocols to drive reductions in energy, water, waste, and GHG emissions 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. These agents are influential in balancing the growth of NREL's campus with meeting its aggressive energy and sustainability goals.

BEHAVIOR

Employee behavior is central to energy reduction, resource management, and overall sustainable laboratory operations.

Constructing new building environments, authorizing new policies to uphold federal mandates, and creating new methods to deploying energy efficient and renewable technologies requires the integration of a change management process. In FY 2011, two members of the Sustainable NREL team regarded this skill as an effective project tool and received change management certification from Prosci. The change management process offers a sequence of steps or activities that change management teams or project leaders. As Sustainable NREL addresses change and introduces new projects for sustainability efforts, we will be integrating these measures for increased project successes.

TRAINING

Since its inception, Sustainable NREL has worked to involve laboratory staff in the sustainability of our operations. By providing information, resources and training programs, NREL educates staff on waste reduction, recycling, composting, alternative work schedules, alternative commuting options, and GHG reduction. These educational efforts empower staff to effect change within their organizations by developing an understanding of how their day-to-day work influences NREL's sustainability goals.

BUILDING SYSTEMS

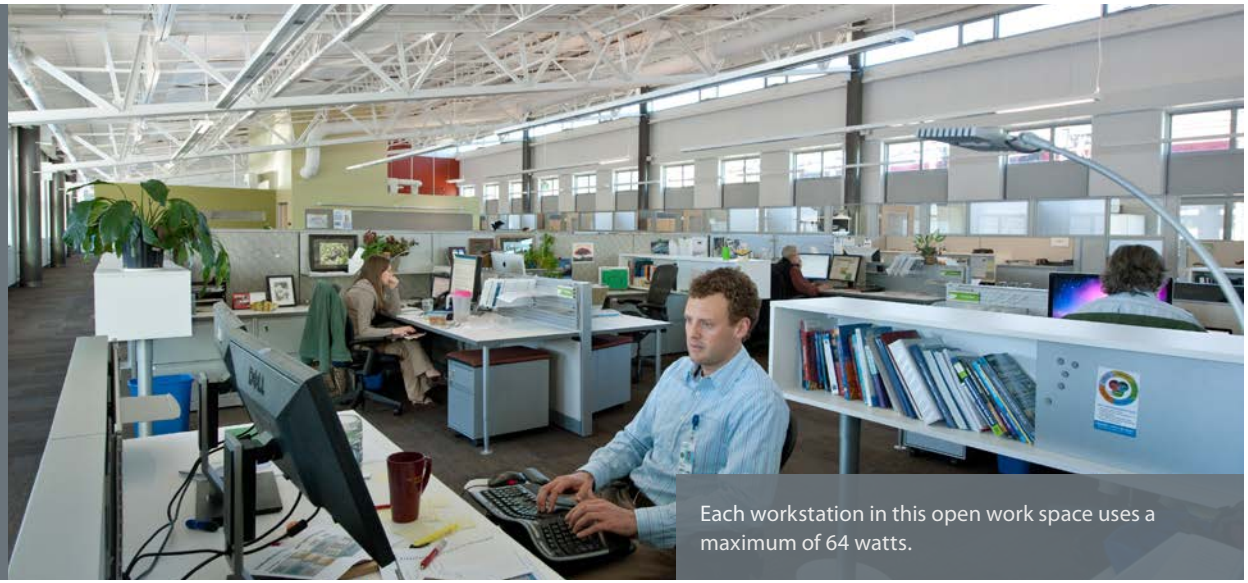
While the RSF's design incorporates numerous energy efficiency technologies, it is estimated that 28% of building energy efficiency is attributable to employee behavior. Therefore, prior to occupation in June 2010, NREL undertook an aggressive behavioral change program to educate employees on the new office environment that they would be encountering in the RSF. Employee education on energy efficiency is the primary focus for these changes. In advance of taking occupancy of the RSF, a number of NREL centers and offices piloted low-walled cubicles that would be used in the RSF for effective daylighting. Employees learned to use shared printing facilities, and a prohibition was placed on personal high-energy use devices such as space heaters.

Within a building's first year of operations, NREL tracks operating data to assess whether the building is performing to the modeled expectation. Through this effort, NREL establishes a "living laboratory" environment where efforts are also made to understand building occupants' comfort level with the deployed energy-efficient technologies and function of the building's environs. At the end of the first year, NREL conducts a survey to assess building occupants' comfort in two phases: a one-time, baseline survey (phase one) and phase two—ongoing monitoring to define occupant preferences by comparing their real-time comfort feedback to environmental conditions. As part of phase two, selected occupants will have small sensors placed on their workstations that will measure light, temperature, and humidity. The outcomes collected will help generate potential modifications to enhance occupants comfort conditions. In FY 2011, Sustainable NREL and the Commercial Buildings Group jointly developed the baseline survey. At the end of FY 2011, RSF I occupants participated in the phase one baseline survey. The Commercial Buildings Group formed a Laboratory Directed Research and Development (LDRD) project titled the Building Agent to develop phase two.

EMPLOYEE WORKSPACES

For the construction of each new NREL facility, whole system building design is mission critical to maximize energy and environmental performance. In 2010, the $57.4-million LEED Platinum

Building design is mission critical to maximize energy and environmental performance.



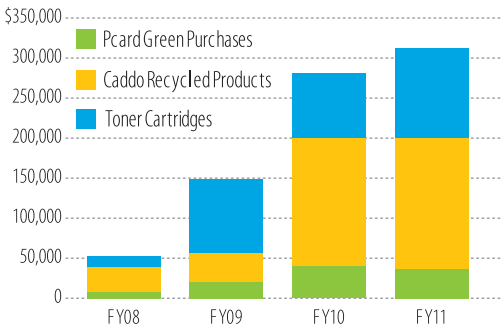
Each workstation in this open work space uses a maximum of 64 watts.

RSF I was completed and showcases innovative design concepts and advanced building technologies. A paradigm change for these occupants is a new type of office space—one that is open and encourages interaction and collaboration. Low-profile, modular work stations allow daylight and views for all 822 occupants. Workstations are located within 30 feet of the nearest window, and employees are able to open windows when climatic conditions permit, allowing for natural ventilation and improved indoor air quality. Highly efficient computer laptops, monitors, phone systems, and task lights contribute to lower energy use—a maximum of 64 watts per workstation. Being a "living laboratory," Sustainable NREL and the Buildings Technology Group will conduct an interactive comfort survey with building occupants to investigate and assess building environmental conditions and employee workstation experiences. Follow-up adjustment and monitoring will occur in workstations with a demonstrated need. For all future facilities, building occupants will utilize this Building Agent program for corrective actions.

PRODUCTS PURCHASED THROUGH SUSTAINABLE ACQUISITION

NREL's supports DOE's commitment to sustainable acquisition by ensuring that actions under new and existing contracts require the supply or use of products and services that are: energy- and water-efficient, bio-based, environmentally preferable, non-ozone-depleting, contain recycled content, are non-toxic, or contain less toxic alternatives.

Green purchasing practices govern how goods and services are acquired at NREL. All NREL employees are strongly encouraged to follow green purchasing guidelines when placing orders for products. The purchase of green office supplies is facilitated for staff through a web-based catalogue, which includes earth-friendly office supply products, which are manufactured from recycled content. NREL also follows EPA's Environmentally Preferable Purchasing (EPP) Program, which identifies federal requirements and information about green products and services, calculates the costs and benefits of purchasing choices, and manages the green purchasing process.



Sustainable Acquisitions FY 2004–2011

Wood from trees killed by bark beetles is used in the RSF.

NREL also participates in the DOE Buy-Bio Program, which advocates the purchase of commercial or industrial goods that are made of biological, renewable domestic agricultural, or forestry materials in lieu of petroleum. This program enhances the nation's energy security by substituting fossil-fuel-based products derived from imported oil and natural gas for domestically produced bio-based products.

In FY 2011, NREL implemented new policies and programs that increased the acquisition of sustainable products and contracts consistent with EO 13514. NREL's prime contract with DOE requires procurement actions to be conducted consistent with all federal green procurement preference programs, including:

- Electronics and computing equipment that are EPEAT registered, ENERGY STAR, or FEMP designated
- Products manufactured from recovered materials
- Environmentally preferable products
- ENERGY STAR energy-efficient products
- Bio-based products
- Non-ozone-depleting substances.

As a result of the enhanced policies and programs, purchases of green office supplies with recycled content continue to grow each year.

In FY 2011, NREL awarded its first janitorial contract with green requirements developed based on the LEED-EB O&M rating system green cleaning credits. NREL's Green Cleaning program reduces the exposure of building occupants and maintenance personnel to potentially hazardous chemical, biological, and particulate contaminants which adversely affect air quality, human health, building finishes, building systems, and the environment. All green cleaning products are Green Seal certified and cleaning equipment is certified by the Carpet and Rug Institute "Green Label" Testing Program.

NREL incorporates waste prevention and recycling into daily operations, with an emphasis on using products that can be recycled or composted at their end of life through our campus-wide recycling and composting programs. NREL also includes appropriate clauses in subcontracts to meet federal government sustainable acquisition goals.

In FY 2011, NREL incorporated new language in the SOW for existing building renovation projects, which requires all contractors to track waste diversion. NREL's SOW for construction was also updated to include new reporting requirements for recycled content quantities in construction materials for building remodels and additions.

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

GOAL: 32% of employees telecommuting or participating in AWS one day per week

Employee participation in NREL's Telecommuting Program helps reduce Scope 3 GHG emissions.

PROGRAM OUTREACH

Near-Zero Waste

NREL's Recycling Committee is comprised of staff volunteers who represent different centers on campus. This committee has evolved over the years to become the Near-Zero Waste Committee. The committee has:

- Developed an aggressive management-supported recycling program for employees
- Implemented a lab-wide composting program
- Earned the Federal Electronics Challenge Gold Level award two years running, and in FY 2011, earned a Platinum Level award—DOE's first certification of this level.

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

- Replacing 85 linear feet of print journals with electronic journals to reduce paper use and the footprint required for the new NREL library
- Creating new guidance and developing a site-wide education program for vehicle idling reduction
- Replacing an existing oil-based wet pump with an energy-efficient sealed pump in the S&TF, reducing oil waste and energy usage.

Commuting

NREL's Commuting Council was formed in March 2009 to assess the alternative work schedule (AWS) and telecommuting (working from home) options for NREL employees. This council acts as an advisory body that recommends and promotes the use of alternative commuting, AWS, and telecommuting to minimize NREL's employee commuting impact on NREL facilities, the local community, and the global environment. The Commuting Council developed and launched the teleworking program at NREL in FY 2009 and offered participation to 492 employees in twelve NREL offices and programs. The pilot program's success resulted in a laboratory-wide program launched in 2010.

In FY 2011, NREL conducted a commuter survey, which provided improved data on staff commuting modes as well as adoption of telecommuting and AWS. This information provided an updated perspective on staff commuting behaviors, of particular importance given that staff levels have grown 87% since 2008. The survey showed a shift away from single-occupant vehicle commuting. Survey responses also indicated single-occupant vehicle commute trips decreased to 75% of trips from 81% in 2008. The reduction in single-occupant vehicle trips was complemented by increases in alternative commuting methods such as bicycling, carpooling, and public transit. Additionally, 19% of the survey respondents reported telecommuting at least one day per week, with an additional 4% reporting telecommuting more than one day per week. Combined, this represents more than 5% of NREL's total commute trips. In FY 2011, 25% of NREL staff worked an AWS schedule.

Community Outreach

In FY 2011, GSA Region 8, DOE, NREL, the city of Lakewood, and the U.S. EPA Region 8 formed a partnership to increase conservation awareness, save natural resources, and reduce GHG emissions. The team created a Sustainability Challenge, which engaged several hundred employees from each agency, resulting in reductions of 1,079,000 pounds of carbon dioxide—the equivalent of taking 85 cars off the road or planting 12,519 trees. The team hosted more than 40 events with a broad range of sustainability topics to educate staff and local communities. The Sustainability Challenge concluded with an Earth Week celebration.

In FY 2011, NREL also participated in the Katerva Challenge, a UK-registered charity organization which serves to identify, award, and accelerate ingenious ideas toward impact at the global level. NREL provided scientific expertise in the review of three market-revolu-tionizing energy production, storage, and delivery innovations and made recommendations as to their market adoptability and readiness.

STAFF AWARDS

NREL's Staff Awards program began in 1980. Each year, exceptional NREL staff members are recognized for their outstanding performance, community and professional service, and significant achievements in scientific, technical, and administrative contributions towards NREL and its mission. Each year an all-staff banquet is held to award 19 dedicated, hard-working, individuals nominated by their peers.

CHANGE AGENTS IN INDUSTRY

NREL works to foster positive change within the lab as well as the clean-energy industry as a whole. Below are examples of how innovative scientific discovery, commercialization, and industry partnership led to increased market deployment of our technologies in FY 2010 and FY 2011.

Biorefining Processes

In FY 2010, NREL researchers made significant achievements in reassessing the entire integrated biorefining process and how one stage of the process can impact performance of the others. This work will help improve the cost effectiveness of cellulosic ethanol production processes and accelerate commercial-scale deployment.

In addition, the new IBRF is available to industry partners who wish to work with NREL through cooperative agreements. This will allow NREL to accommodate a greater number and variety of collaboration requests from industry partners who wish to test integrated pilot-scale biochemical conversion processes but who do not have the facilities or resources to do it on their own.

Thin-Film Manufacturing Process

As a result of NREL's pioneering research in thin-film PV technologies (which began in 1993), Abound Solar opened a large-scale PV production facility in Longmont, Colorado, in FY 2010.

Thin-film PV can generate lower-cost PV electricity (in dollars per watt) than many historical alternatives and is the fastest growing segment of the PV market. Providing innovations and a solid technical foundation for this rapidly expanding industry is at the heart of research activities within the NREL Polycrystalline Thin-Film Devices Group.

In addition, NREL's Process Development and Integration Laboratory (PDIL) brings together PV experts from NREL, the solar industry, and universities to access unique process development and integration capabilities.

Real-time QE Speeds Solar Cell Quality Tests

In 2011, NREL's Real-Time QE invention was licensed to Tau Science Corp. and embellished as FlashQE™. This invention, which won a 2011 R&D 100 Award, assesses the quality of solar cells at a speed that is orders of magnitude faster than had been done before. The instant feedback of quantum efficiency of solar cells allows manufacturers to get a whole new insight into each of their cells, and make adjustments on the line during the manufacturing process.

Tool Helps Utilities Assess Readiness for Electric Vehicle Charging

Is the grid ready to handle plug-in electric vehicles (PEVs)? A simulation tool developed by NREL in 2011 determined that in most scenarios, transformers have enough capacity to charge PEVs. This conclusion was drawn after analyzing the thermal loading characteristics of distribution transformers due to vehicle charging, and running millions of simulations replicating varying

Research technician Bill Bray assists with IBRF operation in support of R&D efforts focused on demonstrating that cellulosic ethanol can be cost competitive with corn-based ethanol.

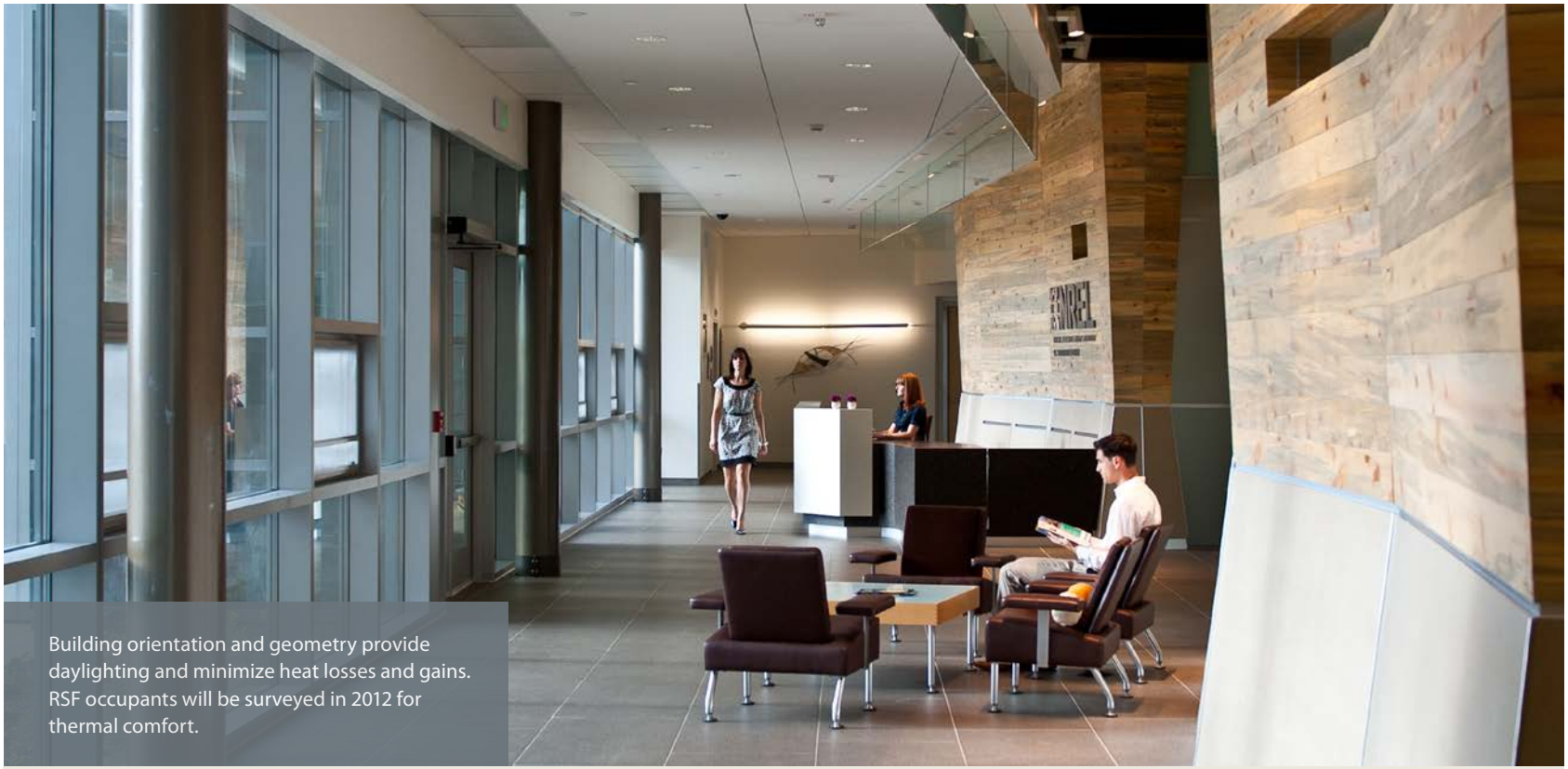
climates and conditions. These simulations provide actionable data on potential grid impacts, making important contributions in the effort to get more electric vehicles on the road, and ultimately, diminish polluting emissions and reliance on fossil fuels.

NREL Improves the Conversion of CZTSe Solar Cells

In 2011, NREL scientists continued to make progress on improving the conversion efficiency of in-house copper zinc tin selenide (CZTSe) solar cells, which are based on nontoxic Earth-abundant elements. Producing solar cells using commercially acceptable manufacturing techniques, scientists have advanced the efficiency from zero to 8.4% in just 11 months. The use of Earth-abundant materials provides environmental benefits, and the low cost of these materials benefits manufacturers.

Industry Growth Forum

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



Building orientation and geometry provide daylighting and minimize heat losses and gains. RSF occupants will be surveyed in 2012 for thermal comfort.

PLANNED ACTIONS

In FY 2012, the baseline survey of the Building Agent program will be conducted for occupants of RSF II and the IBRF to investigate occupant comfort and energy reduction behavior change. Building Agent phase two will be conducted for occupants in RSF I.

NREL will work to increase employee focus and awareness of green products currently available from suppliers for essential items such as office supplies. This effort will include enhancing green product information provided to NREL Purchase Card holders. Guidance will also be developed to help staff make more sustainable product selections. These plans will give preference in procurement and acquisition programs to: recycled content products designated in the EPA Comprehensive Procurement Guidelines; EPA and DOE identified ENERGY STAR products; and bio-based products designated by the USDA BioPreferred program. NREL will also host a series of meetings to increase the visibility of green office-supply product selection with NREL staff and provide education on preferred purchasing procedures.

NREL will also develop a laboratory-wide procedure to facilitate the purchase of sustainable products for site operations and maintenance activities. This guidance will be based on the sustainable purchasing and green cleaning credit requirements in the LEED Reference Guide for Green Building Operations and Maintenance. As part of this effort, NREL will work to expand usage of the EPP program for products within building and site management's control to reduce the environmental impact of materials used for operation and maintenance activities. NREL will also implement the green cleaning janitorial contract campus-wide in FY 2012.

Greenhouse Gas Management

Multi-Year Goals:

NREL's long-term vision is to achieve carbon neutrality—i.e., balancing greenhouse gas (GHG) emissions with carbon reductions over the course of the year. Recognizing that carbon neutrality will require ongoing planning and implementation of reduction measures, our interim goal is to meet or exceed these DOE agency-wide GHG reduction targets:

- Reduce Scope 1 and 2 GHG emissions by 28% by FY 2020 from a FY 2008 baseline.
- Reduce Scope 3 GHG emissions by 13% by FY 2020 from a FY 2008 baseline.

Colorado School of Mines graduate student Lee Elliott collects water samples in his effort to isolate algal strains with high lipid productivity.

GHG Management

Strategic Intent

NREL is working to establish a carbon-neutral campus that makes efficient use of limited resources, reduces waste, and demonstrates fiscal responsibility. Our strategy for accomplishing carbon neutrality and reducing impacts on our local and global environment includes establishing interim GHG goals based on a GHG baseline, DOE's sustainability commitments, and NREL's mission. Through our 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.

REPORTING HISTORY

A leader in federal GHG management, NREL has conducted GHG inventories, developed reduction goals, and reported emissions since 2000. NREL was the first federal facility to become a partner in the Environmental Protection Agency (EPA) Climate Leaders program, and has played a critical support role through DOE's Federal Energy Management Program (FEMP) in the development of federal guidelines for GHG accounting and reporting.

NREL began tracking its Scope 1 and Scope 2 emissions through EPA's Climate Leaders Program in FY 2002 and completed two goals: decrease emissions by 10% per square foot between FY 2000 and FY 2005; reduce absolute emissions by 75% between FY 2005 and FY 2009.

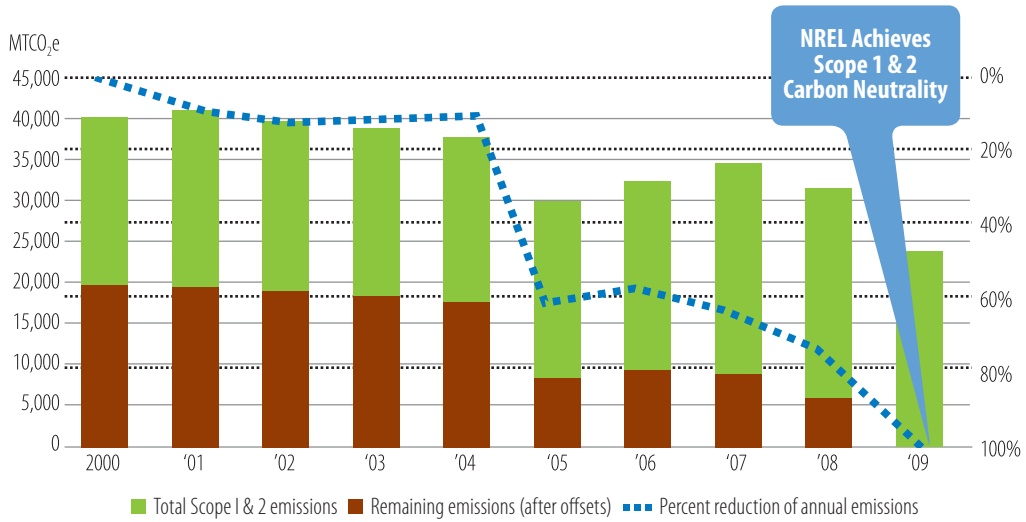
NREL surpassed both of its goals and reached Scope 1 and 2 carbon neutrality in FY 2009. NREL met this goal by:

- Reducing energy intensity in buildings
- Increasing use of renewable energy
- Reducing the use of petroleum fuels in fleet vehicles.

Additionally, NREL purchased RECs to offset Scope 2 emissions resulting from electricity purchases. Carbon offsets were also purchased in FY 2009 to achieve Scope 1 carbon neutrality.

Establishing a Baseline for Federal GHG Reporting

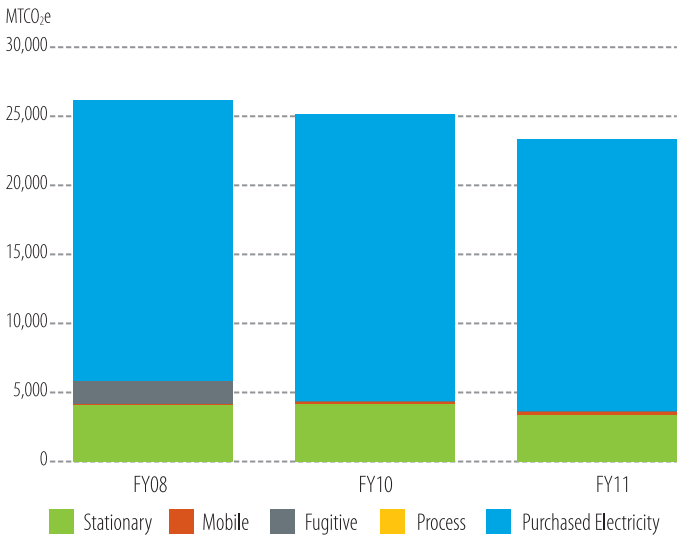
FY 2010 marked the first year of federal GHG reporting, using different GHG protocols for computing emissions than required by EPA Climate Leaders. To develop the new FY 2008 baseline and FY 2010 comprehensive GHG inventories, NREL used FEMP's Annual GHG and Sustainability Data Report, Version 1.6. In FY 2011, NREL's GHG inventory was reported using DOE's Consolidated Energy Data Report (CEDR) tool. NREL's FY 2008 baseline and Scope 1 and Scope 2 emissions, including REC purchases, are shown in the chart at left.



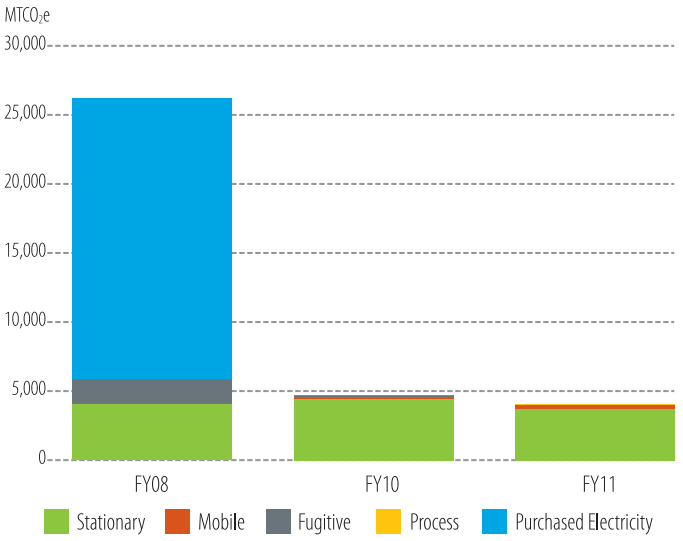
NREL GHG Reductions, FY00 – FY09

Reporting Scope 1 & 2 GHG Emissions

NREL's Scope 1 and 2 emissions represent approximately 80% of the laboratory's FY 2008 baseline emissions. The majority (61%) of these emissions result from the laboratory's purchase of electricity. In FY 2010, NREL decreased its Scope 1 and 2 emissions by 4% relative to the FY 2008 baseline. These reductions are



Scope 1 & 2 GHG Emissions



Scope 1 & 2 GHG Emissions after RECs

primarily due to decreased sulfur hexafluoride (SF_6) purchases, as well as an increase in on-site renewable energy and high-performance sustainable buildings. In FY 2011, NREL decreased total Scope 1 and 2 emissions 11% from the FY 2008 baseline and 7% from FY 2010. This was made possible through improved performance of NREL's on-site Renewable Fuels Heating Plant (RFHP), which decreased the need for natural gas purchases and emissions 19% from the previous year and FY 2008 baseline. Mobile emissions increased 119% in FY 2011 relative to the FY 2008 baseline due to campus growth.

NREL's REC purchases offset our Scope 2 emissions entirely, leading to a decrease in NREL's Scope 1 and Scope 2 emissions of 83% in FY 2010 relative to a FY 2008 baseline. In FY 2011, RECs were used to further reduce Scope 1 and 2 emissions—86% from the FY 2008 baseline and 16% from the previous year. Through these reductions, NREL is significantly exceeding DOE's 28% target for Scope 1 and 2 GHG emissions. Federal GHG accounting protocols do not allow the purchase of carbon offsets to reduce Scope 1 emissions. Thus NREL could only achieve Scope 2 carbon neutrality in FY 2010 and FY 2011. NREL will continue to explore options to achieve carbon neutrality for Scope 1 and 2 emissions sources in the context of the new federal reporting requirements.

Sulfur Hexafluoride Use

NREL researchers use small amounts of SF_6 in transmission electron microscopes for laboratory research and as a tracer gas for building and fume hood commissioning. NREL tracks its sulfur hexafluoride (SF_6) using a three-year rolling average. SF_6 purchases are monitored in NREL's Chemical Inventory, an electronic database maintained for all chemicals used on site. In FY 2010 and FY 2011, there were no purchases of SF_6, with a three-year rolling average of 4.3 lbs for each year. The FY 2008 baseline rolling average for SF_6 emissions was 153.3 pounds. Therefore, NREL's SF_6 emissions have decreased by approximately 97% from base year levels due to the lack of purchases.

In FY 2011, Sustainable NREL and Environment, Health, and Safety (EHS) kicked off an initiative to improve the understanding of SF_6 use on campus and identify opportunities for its reduction. Meetings with researchers helped to identify the primary uses of SF_6 on campus. Information on the impact of fugitive emissions was also included in annual mandatory chemical hazardous waste training for researchers. NREL is working to replace the use of SF_6 for fume hood testing with nitrous oxide and will also work with building energy efficiency researchers to find suitable alternatives to SF_6 for building commissioning tests.

NREL Vehicle Fleet

NREL makes every effort to right-size our vehicle fleet. In FY 2010 and FY 2011, NREL's fleet consisted of vehicles leased from the General Service Administration (GSA), shown in table at right.

In addition to these GSA-leased vehicles, NREL owns one dedicated compressed natural gas (CNG) vehicle and one diesel freightliner service truck. The lab also leased one commercial hydrogen bus, which was sold in FY 2011. NREL has on-site CNG fueling infrastructure and fuels our E85 vehicles through private sector alternative fuel distributors when fuel is available. There are currently no biodiesel retailers in NREL's vicinity.

Petroleum Reduction

Through FY 2008, NREL has met its FY 2015 target to reduce petroleum consumption 20% relative to an FY 2005 baseline. In FY 2008, NREL had reduced petroleum consumption by 21.8% relative to its FY 2005 baseline. To reduce our petroleum consumption, NREL has employed efficiency strategies such as purchasing small "Gators/Gem" vehicles to drive on site and using "re-refined oil" in the government vehicles when applicable.

Despite these efficiency measures, NREL's petroleum consumption increased significantly in the past two years, growing 92.8% higher in FY 2010 and 92.6% higher in FY 2011 than FY 2005 levels. This spike is attributable to a lack in alternative fuel availability, an increase in utilization, and substantial campus population growth. From FY 2010 to FY 2011 staff levels grew another 20% at NREL, further increasing fleet demands.

VEHICLES LEASED FROM GSA	
FY 2010	FY 2011
27 ethanol 85 (E85)	27 E85
4 compressed natural gas (CNG)	5 CNG
2 hybrid-electric	5 hybrid-electric
5 diesel	6 diesel
7 unleaded	7 unleaded

In this time of growth, NREL is working to the extent possible to mitigate impacts and reduce petroleum usage. In FY 2011, NREL established a campus-wide No-Idling policy as part of our Pollution Prevention Initiative, a program established to provide NREL staff with the opportunity to identify and implement new pollution prevention practices at the laboratory. The No-Idling program educates drivers of NREL and employee-owned vehicles about the health, environmental, and financial benefits of idling reduction and sets a policy that when parked for more than 30 seconds, engines should be turned off. This program will help to save fuel as well as reduce air emissions associated with idling, with an estimated savings of 1,700 gallons/yr and $6,400/yr in diesel fuel use for NREL shuttles.

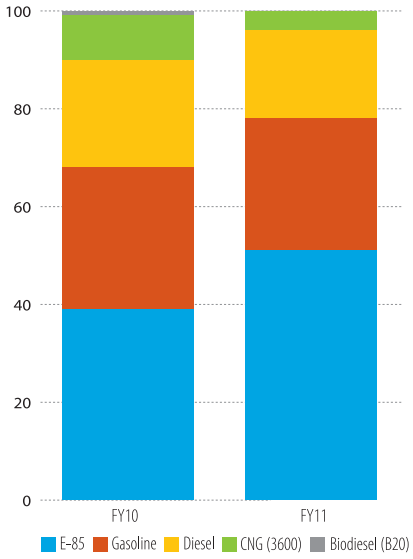
NREL is also committed to reducing vehicle miles through methods such as trip consolidation and video conferencing. In the past two years, NREL has increased the number of conference rooms with video conferencing capability to facilitate this alternative to off-site trips.

Planned Actions

Reduction of Scope 1 & 2 GHG Emissions

NREL is experiencing significant growth in staff levels and campus square footage, increasing campus energy requirements that are essential to meeting our mission. NREL anticipates surpassing our Scope 1 and Scope 2 GHG reduction target through fleet optimization, the RFHP, energy efficiency measures, high-performance buildings, deployment of on-site renewable energy, and the purchase of RECs. NREL has committed to purchase enough RECs each year between FY 2010 and FY 2013 to completely offset our Scope 2 emissions and has plans to continue these purchases beyond FY 2013. As a long-term goal, NREL will work to decrease REC purchases as additional on-site renewable energy installations are constructed on campus.

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



NREL's Fuel Consumption

Alternative Fuel Use

In FY 2010, NREL's alternative fuel consumption—CNG and E85—in our vehicle fleet increased 87.7% relative to the FY 2005 baseline, indicating that NREL has, on average, increased its annual fuel consumption more than 10% annually compared to the previous year. NREL's alternative fuel use is predominantly E85, which comprised 39.1% of NREL's fuel consumption in FY 2010.

In FY 2011, NREL exceeded federal requirements for alternative fuel consumption again, with a 30% increase from 2010. In FY 2011 NREL's alternative fuel use makes up 55% of NREL's fuel consumption. Since the baseline year of 2005, NREL's alternative fuel usage has grown 143%.

NREL's goal is to transform our fleet such that 100% of all non-exempt vehicles are alternative fuel vehicles (AFVs). The laboratory will continue working with GSA and DOE to increase the number of AFVs in the fleet. NREL also evaluates the size of our fleet to ensure that vehicle supply corresponds with demand.

Fleet Reduction

FY 2011 marks the first year for the fleet inventory reduction program as required by the Secretary of Energy's 35% fleet reduction requirement. NREL met this requirement for FY 2011 by disposing of seven vehicles, or 15% of NREL's fleet. At a time of campus growth, NREL is working to accommodate the reduction goal while looking for additional options to reduce our impacts through the use of AFVs as well as the establishment of new policies and programs.

Natural Gas and On-Site Generation

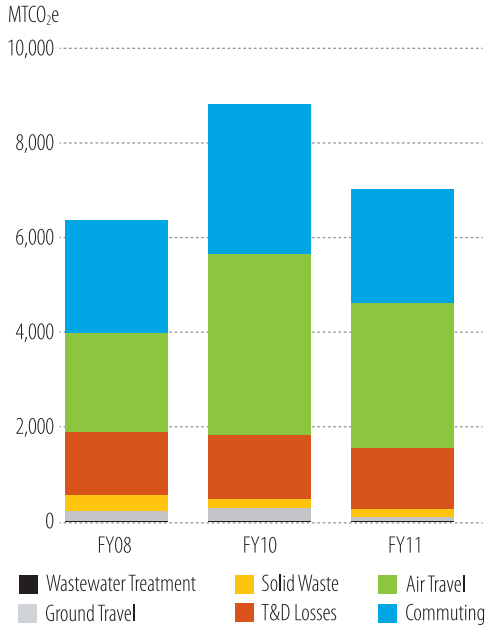
Natural gas use in NREL's owned facilities remained constant from FY 2008 to FY 2010 at approximately 66 BBtu, despite an increase in both building gross square footage and staff. The majority of natural gas consumption is for building heat. Natural gas use decreased between FY 2010 (66 BBtu) and FY 2011 (63.5 BBtu), with an average of 51.6 MMBtu per capita despite increasing building square footage 48% and staff levels 20%. NREL's RFHP, which provides on-site heat generation using wood waste materials, helped in this reduction by displacing 7.4 BBtu in FY 2010 and 12 BBtu in FY 2011 of natural gas. This represents half the heat delivered to the campus' central heating system in FY 2011. As designed, the RFHP could ultimately displace 2,200 metric tons of carbon dioxide (MT CO_2) per year. NREL will continue to optimize RFHP performance and investigate natural gas alternatives to help reduce GHG emissions

Electricity Use and On-Site Renewable Energy

Electricity purchases in NREL's owned facilities decreased slightly from FY 2008 (18,167 MWh) to FY 2010 (18,051 MWh). This decrease can be attributed to 4,348 MWh of on-site-PV and wind-generated electricity, as well as NREL's construction of energy-efficient facilities. In FY 2011, NREL used19,900 MWh of electricity. This increase is due to the construction of RSF I and the Integrated Biorefinery Research Facility (IBRF) in FY 2011. Electricity purchases represent more than 60% of NREL's GHG inventory in FY 2010 and 65% in FY 2011.

A total of 1,898 kW of PV panels were in place at the STM and NWTC sites in FY 2010. In FY 2011, NREL installed two additional PV arrays at the STM site: RSF I, 449 kilowatts (kW), and the 524-kW RSF visitor's parking lot. Because NREL sells the RECs from these systems to Xcel Energy for compliance with Colorado's Renewable Portfolio Standard, replacement RECs are purchased to help NREL achieve Scope 2 carbon neutrality.

In FY 2010 the NWTC had over 5 megawatts (MW) of installed wind turbine capacity. In FY 2011 two additional wind turbines were installed at the NWTC site: one 2 MW and one 3 MW. NREL retains or purchases the RECs from all turbines at the NWTC except for the 2.3-MW Siemens turbine.



NREL's GHG Scope 3 emissions

Newly Reporting Scope 3 GHG Emissions

FY 2010 marks NREL's first effort to rigorously inventory our Scope 3 emissions resulting from transmission and distribution (T&D) losses, employee business travel and commuting, wastewater treatment, and contracted waste disposal. Using FEMP's Annual GHG and Sustainability Data Report, Version 1.6 (which NREL played a key role in developing), NREL's Scope 3 GHG emissions for FY 2010 are 8,813 MT CO_2e. From FY 2008 to FY 2010, NREL's Scope 3 emissions increased by 38.5% due to staff growth. On a per capita basis, however, NREL's Scope 3 emissions decreased by 6% in FY 2010.

In FY 2011, NREL reported its GHG emissions using the CEDR tool. In FY 2011, NREL's Scope 3 emissions were 7,170 $MTCO_2e$—representing a 20% decrease from FY 2010. However, due to campus growth, a 10% increase in these emissions has occurred relative to the 2008 baseline. On a per capita basis, NREL's Scope 3 emissions continue to decrease—with a reduction of over 40% from 2008. NREL is implementing aggressive policies and initiatives to manage and minimize emissions from these sources.

Transmission and Distribution Losses

T&D losses account for the loss of power in an electric utility's transmission and distribution lines due to inefficiencies in the electrical grid. To reduce energy intensity and environmental footprint to the lowest levels possible, NREL uses passive energy, energy-efficient technologies and practices, and clean-energy sources in the planning, design, construction, and operation of its facilities. By maximizing on-site energy generation through wind and solar resources, NREL reduces the amoint of electricity purchased, and the subsequent T&D losses.

Wastewater Treatment—Contracted Off-Site

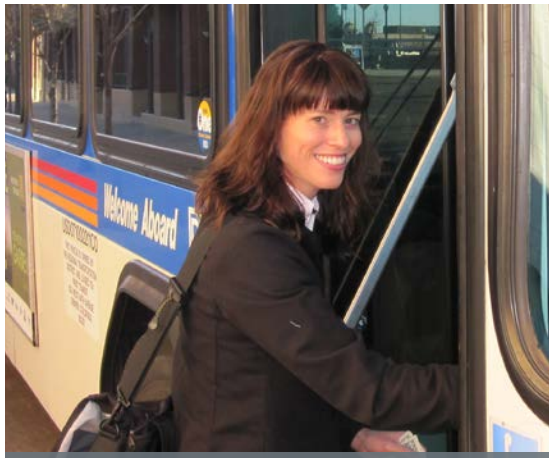
While NREL's policies promote efficient use of on-site water resources, wastewater generation is a function of the number of employees on site and the number of working days per year. GHGs are associated with treatment of this waste (sewage) by an off-site treatment facility. NREL's teleworking and alternative work schedule (AWS) options help to reduce the number of on-campus work days for staff, minimizing wastewater generation. The continued expansion of these programs will further support Scope 3 GHG reduction for this source.

Municipal Waste Disposal—Contracted Off-Site

NREL is striving to create a near-zero waste campus by emphasizing opportunities to reduce, reuse, recycle, and re-buy. NREL is working to systematically eliminate the laboratory's waste stream through the campus-wide recycling and composting programs. In FY 2010, NREL decreased its solid waste disposal by 15% compared to FY 2008 with a 76% rate of diversion from landfills. In FY 2011, NREL diverted 77% of campus waste from the local landfill. This was made possible by our robust recycling and composting programs. In FY 2011, NREL transitioned its composting pilot to a campus-wide program, increasing our compost 9% from the previous fiscal year in a time of campus growth.

Business Ground and Air Travel

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



NREL encourages the use of public transportation by providing a free Eco Pass to all regular employees.

NREL staff participates in Bike to Work Day. The lab won the Jeffco Business Class C award for the third year in a row.

NREL's new Vanpool Incentive Program provides monthly vouchers for up to $200 to pay the fare for employees who participate in official vanpools.

NREL also promotes the use of public transportation, shuttles, and alternative-fuel vehicles for ground business travel to the extent feasible for work assignments. In FY 2011, business ground travel decreased significantly—75% from FY 2010, and 68% from the FY 2008 baseline. This drastic reduction is due to improved data availability for cars rented on business travel. NREL's rental car policy requires that employees use compact regular-fuel cars and encourages the use of mid-size alternative-fuel or hybrid rental cars where available to reduce Scope 3 impacts.

Employee Commuting

Through the Sustainable NREL program, NREL has implemented the following measures to encourage alternative transportation and minimize commuter emissions:

Transit

NREL provides a free Eco Pass to each employee to use the Regional Transportation District (RTD) public transportation system.

Carpool/Vanpool

NREL provides rideshare support services that include an electronic bulletin board where employees can search for other employees who want to share a ride. NREL has also instituted preferential parking spaces to provide an incentive to carpool or vanpool. Additionally, in FY 2010, NREL began providing vouchers to pay up to $200 per month per employee for an organized vanpool.

Bicycles

NREL provides bicycle-friendly infrastructure on the STM campus including racks, lockers, and shower facilities. A bicycle repair station with tools and equipment for minor repairs and maintenance was installed on campus in FY 2010. The NREL shuttles also have bike racks to accommodate multi-modal (bike and shuttle) trips.

Shuttles

NREL provides alternatively fueled shuttle vehicles that transport people between nearby RTD park-n-Ride transfer centers and NREL facilities. The shuttles are fueled with biodiesel and E85.

Flexible Work Schedules

Conferencing by video, telephone, and the internet is encouraged at NREL to reduce unnecessary vehicle and air travel. NREL's AWS policy allows employees to work varying schedules, including compressed workweeks, which reduces miles driven by employees to and from the laboratory. AWS provides flexibility in how people work—saving time and energy, and reducing vehicle trips in the community. Roughly 14% of staff members took advantage of an AWS option in FY 2010. In FY 2011, 25% of staff report working an AWS schedule.

Telecommuting Program

NREL initiated a Telecommuting Pilot Program in FY 2009 and offered participation to 492 employees in 12 NREL offices and programs. The pilot program's success resulted in a laboratory-wide program launched in 2010. In FY 2010, 13% of NREL staff members participated in the telecommuting program. In FY 2011, 19%

On-site renewable energy helps displace conventional energy from the grid.

1 MW ground-mounted photovoltaic array is located at NREL's NWTC.

of survey respondents report telecommuting at least one day per week. Telecommuting is effective in decreasing GHG emissions and energy use while reducing parking requirements and traffic impacts on NREL's surrounding community.

Adding On-site Power Supply

NREL's plan for meeting our GHG emissions and energy reduction goals involves producing renewable electrical and thermal energy on site. By FY 2012, NREL plans to have more than 4 MW of PV and more than 4.5 MW of wind turbines installed at its STM and NWTC campuses. Additionally, NREL will work to increase the output capacity of its RFHP, which is rated at 29 BBtu.

NREL will continue to incorporate on-site renewable energy projects to support our GHG reduction and renewable energy goals. To optimize appropriated funds, NREL has directly purchased renewable energy systems and has used alternative financing opportunities to incorporate PV arrays in four new construction projects on site. NREL has also worked with the local power utility to assess the financial benefits of selling renewable power to the grid as compared to using the electricity on site.

Purchasing Off-site Dedicated Renewable/ Carbon-Free Electrical Energy

In FY 2015, NREL's vision is to supplement the thermal energy supplied by the RFHP with a proposed TriGEN Central Plant, which will be fueled with renewable methane gas produced off site and delivered via the grid. NREL is also working with EPA and GSA Region 8 to negotiate a federal interagency purchase of off-site wind electricity or RECs from tribal sources. This is an ongoing effort that could play a large role in NREL's long-term goal to be a net-zero energy laboratory.

Purchasing RECs

NREL plans to continue to purchase RECs to achieve Scope 2 carbon neutrality through FY 2020. NREL has also contracted to purchase enough RECs to offset electricity consumption at the RSF between FY 2010 and FY 2020. All NREL purchased RECs receive Green-e third-party certification.

Planned Actions

New On-site Renewables

NREL will install PV arrays on RSF II, the new Site Entrance Building, and the parking garage. Roof locations to support future PV arrays will be specified in the design of the ESIF facility. NREL will purchase RECs from the 3-MW Alstom and 2-MW Gamesa wind turbines at the NWTC and will continue working with Region 8 EPA and GSA to make an interagency purchase of off-site wind power, and will continue to investigate new opportunities for on-site production and RECs.

Planned Actions

Reduction of Scope 3 GHG Emissions

To support DOE in its agency-wide effort to reduce GHG emissions, NREL has developed its own Scope 3 emissions reduction target. Between FY 2008 and FY 2020, NREL expects to experience significant and unprecedented growth, including an 83% increase in number of employees and a 240% increase in its STM campus footprint. This growth is necessary to maintain NREL's renewable energy and energy efficiency leadership, while enabling NREL to continue to contribute to the international energy dialogue.

However, NREL's growth will pose new challenges in reducing emissions, particularly those in the Scope 3 category. A larger workforce will result in:

- Greater commuting emissions
- Increased wastewater and municipal solid waste
- A dramatic rise in the campus' overall electricity requirements from the grid (leading to an increase in emissions associated with T&D losses).

In the face of these challenges, NREL is proposing a variety of aggressive strategies for minimizing its Scope 3 emissions. These strategies will enable NREL to meet the following per capita (i.e., CO_2e per NREL employee) GHG reduction targets by FY 2020, relative to an FY 2008 baseline by investigating ways to:

- Reduce employee travel by 39%
- Reduce contracted waste disposal and treatment by 56%.

Per capita reductions in each of these categories will contribute to a per capita Scope 3 emissions reduction of 27%. However, because of the large increase in emissions associated with T&D losses and increased employee commuting, NREL is on course to increase its total Scope 3 emissions by 33% by FY 2020. NREL is continuing to seek innovative solutions to meet the DOE's Scope 3 reduction target.

Transmission and Distribution Losses

By FY 2020, NREL expects to add more than 5 million square feet of new facilities to its campus. The new energy-efficient buildings will house state-of-the-art laboratory and conferencing facilities, as well as a supercomputer required to meet the research needs of the campus. Due to the growing energy requirements of the STM campus, electricity consumption will outpace renewable energy production. By FY 2020, NREL will double its energy consumption at the STM, but on-site renewable energy will offset only 12% of its electricity purchases.

Because of the major increases in electricity consumption, and the fact that RECs cannot be used to offset Scope 3 emissions, NREL's GHG emissions resulting from electrical T&D losses are expected to increase by 126%. The increase in emissions associated with T&D losses will result in a per capita emissions increase of 23% between FY 2008 and FY 2020. NREL will investigate options to provide additional on-site energy generation to minimize T&D losses, including the use of fuel cells, PV, wind, and improvements to the electrical distribution system.

Business Air Travel

NREL will make efforts to reduce business air and ground travel even as staff levels grow through increased video conferencing capabilities and scrutiny of travel requests (consistent with mission considerations). Other modes of transportation are not viable options to replace air travel for the majority of business air travel destinations, due to the amount of time required to travel by train or bus. Thus, replacing flights with other forms of transportation is not considered to be a realistic option for reducing emissions from business air travel at this time. The overall per capita FY 2020 reduction target for GHG emissions associated with business air travel is 45%.

Business Ground Travel

Reducing air travel will have subsequent benefits including lowering emissions associated with rental cars and other modes of business ground travel. Additional reductions are expected to occur as taxi and rental fleets become more efficient due to fleet hybridization. The increased corporate average fuel economy (CAFE) standards required by 2016, will also yield emissions reductions for personal vehicles, taxis, rental cars, and vehicle fleets. NREL is also working to establish policies that require rental vehicles to meet an average fuel economy of 30 miles per gallon (mpg) for light-duty trucks and 39 mpg for passenger vehicles. The overall per capita FY 2020 reduction target for GHG emissions associated with business ground travel is 59% compared to baseline levels.

Wastewater Treatment Contracted Off Site

NREL is planning for an 83% growth in its staff by 2020, resulting in an equivalent increase in its emissions related to wastewater treatment. Increased telecommuting and AWS are anticipated to limit the projected emissions increase to 71%. The cumulative effects of telecommuting and AWS reduce the average number of workdays per year to 214 in FY 2010 and 211 in FY 2011, lowering the GHG emissions associated with contracted wastewater disposal. The wastewater district that serves NREL is also upgrading its facility to provide additional treatment in the future. This may further reduce Scope 3 GHG emissions.

Municipal Waste DisposalContracted Off Site

NREL has a strong commitment to solid waste reduction, with a waste diversion rate of more than twice the U.S. national average (2005, EPA). Through recycling additional waste streams and instituting a campus-wide composting program (piloted in 2010), NREL commits to reducing its FY 2008 GHG emissions from contracted solid waste disposal by 50% by FY 2020. NREL will also establish environmentally focused purchasing requirements and work to increase reusability/recyclability requirements in procurement practices.

Employee Commuting

To reduce emissions associated with employee commuting and incentivize commuting alternatives, NREL will continue to support transit subsidies for public transportation and vanpooling. NREL will also continue to promote AWS and telecommuting, with a goal of having 32% of staff not commute to work one day per week. Expansion of these programs is expected to contribute to substantial per capita emissions reductions. Reductions will also be realized through projected improvements to commuter vehicle fuel efficiency (resulting from the CAFE standards required by 2016). NREL will also investigate options to reduce commuting impacts such as providing electric charging stations for hybrid electric vehicles or instituting a system of parking preferences based on average person-mile carbon dioxide emissions of the vehicle. The FY 2020 per capita reduction potential for employee commuting is a 30% reduction from FY 2008 levels, based on technology and behavior changes.

NREL's wood-chip fueled Renewable Fuel Heat Plant (RFHP) helped reduce the need for natural gas. The RFHP helps offset Scope 1 GHG emissions.

Energy and Water Management

Multi-Year Goals:

- Reduce energy intensity by 30% by FY 2015 from a FY 2003 baseline.
- Reduce campus annual electricity consumption by 7.5% by FY 2010 utilizing renewable sources.
- Install at least one on-site renewable energy generating system by FY 2010.
- Install 100% advanced metering for electricity (by October 2012), 95% metering for steam and natural gas (by December 2012), and 100% metering for heated and chilled water (by December 2012).
- Reduce water intensity by 16% by FY 2015 from a FY 2007 baseline, 26% by FY 2020.

A 3-MW Alstom ECO 100 wind turbine was installed at NREL's NWTC.

Energy and Water Management

Strategic Intent

As a laboratory devoted to the research and development of renewable energy and energy efficiency technologies, clean energy is central to our mission. Beginning with the construction of our TTF in 1996, NREL has worked to integrate low-energy design in all new buildings. NREL demonstrates leadership in energy management by deploying renewable energy and energy efficiency technologies on campus and modeling their feasibility and cost effectiveness. Through high-performance buildings and clean-energy technologies, NREL is working toward a net-zero energy campus.

REPORTING ENERGY INTENSITY

In FY 2010, NREL's energy intensity was 277 kBTU/ft^2, a 7.6% increase over NREL's FY 2003 baseline of 258 kBTU/ft^2. The increase is due to substantial growth at NREL—a 56% increase in staffing levels and campus footprint since 2008. In FY 2011, NREL's energy intensity is 167 kBTU/ft^2—a 35% decrease from NREL's FY 2003 baseline. This intensity reduction can be attributed to the completion of RSF I and its addition to the Facilities Information Management System (FIMS) database in FY 2011, increasing NREL's DOE-owned space by almost 50%.

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

FUTURE FACILITY

As a result of the increase in planned construction, heating and cooling loads are expected to grow significantly, driving the proposed construction of a TriGEN Central Plant to supplement our on-site generation. The TriGEN Plant is envisioned as the keystone of a plan to integrate advanced technology and renewable resources to make the STM campus more sustainable. The TriGEN Center could be fueled by renewable natural gas (RNG)—a methane gas indistinguishable from fossil natural gas—allowing standard natural gas equipment such as fuel cells, microturbines, internal combustion engines, and boilers to be used without alteration. RNG would be produced off site and delivered via the natural gas grid. The facility is projected to have a 75 million Btu/h heating capacity and 3,700 tons of cooling to handle loads in 2020. After the TriGen Plant is online, the SERF and FTLB thermal plants can be decommissioned.

ENERGY RETROFITS

In August of 2007, NREL participated in a Retro-Commissioning Study for the STM site financed through a cost-sharing effort between NREL and Xcel Energy, the local power utility. The scope of the study was to provide:

- An Action Plan Report for improving and optimizing NREL's building operation and maintenance (O&M)
- Recommendations for capital improvements
- Project cost estimates and estimated energy savings for each retro-commissioning measure (RCM).

The study produced five RCMs, which have a total estimated project cost of $100,000, total estimated electrical energy savings of 908.2 MWh, and 10,269 MMBTU of natural gas energy savings, which result in approximately 11% reduction of FY 2007 energy consumption.

Beginning in FY 2008, NREL participated in Phase 1 of the TEAM Initiative ESPC activity. The objective of the "S1 Initiative" was to help improve NREL's energy efficiency and energy costs and finance the project through an ESPC. A comprehensive report was developed to identify potential projects to replace inefficient equipment, upgrade or modernize building systems and infrastructure, and/or improve operations and control of existing equipment to reduce the overall energy and water costs and consumption. As a result, 15 ECMs were identified in the initial proposal to proceed to the Detailed Energy Study (DES). These Energy Conservation Measures (ECM) are detailed in the "Energy Retrofit Milestones" table on page 60. The list of viable ECMs from the initial proposal has been included as part of NREL's potential energy efficiency project list proposed for funding. The total energy reductions and project cost are estimated to be 2,840 MMBTU and $810,000, respectively. The total energy reduction is approximately 2% of the FY 2009 energy consumption. Implementation of these projects will be dependent on availability and priority of the funding source; funding is available for energy savings projects in FY 2011.

ENERGY RETROFIT MILESTONES					
Energy Conservation Measure	Energy Saved (MBtu/yr)	Project Cost	Projected Year of Implementation	Funding Source	Cost Savings ($/yr)
Install variable flow process chilled water	337	$45,900	2010	Overhead	5,200
Replace single-coil FCUs with new units	609	—	2012	General Plant Project (GPP)	11,300
Split process chilled water off of CHW system	337	$45,900	2012	Overhead	5,200
Replace T12 lighting with T8	291	—	2013	GPP	9,600
Install demand ventilation in office areas	146	$16,200	2014	Overhead	484
Install HVAC controls for auditoriums and conference spaces	58	$4,500	2015	Overhead	-12
Replace rooftop unit with direct-fired unit	-200	$33,700	2015	Overhead	943
Replace HID lighting with T5	49	$29,000	2015	Overhead	1,700
Install occupancy sensors	44	$23,800	2015	Overhead	1,400
Install daylighting units and controls for lighting	49	$16,200	2015	Overhead	820
Replace air compressor with appropriately sized unit	133	$82,200	2015	Overhead	2,800
RCM 1 – 3: Upgrade controls	10,750	$70,000	Complete 2009	GPP	111,200
RCM 5: Install filter in FTLB	866	$20,000	Complete 2009	Overhead	10,000
Install DDC controls	896	—	Complete 2010	GPP	25,926

Near-term planned actions include the implementation of the following ECMs: install a variable flow process chilled water system, replace single coil fan coil units (FCUs) with new units, and split process chilled water off of CHW system.

METERING

At NREL, 100% of utilities are metered. All necessary metering is in place to meet DOE requirements. NREL's design standard is to have all new facilities include a main building electric meter and electrical submeters that will identify heating, ventilating, and air conditioning (HVAC), laboratory process, and lighting loads. NREL's design standard includes installation of BTU meters on the chilled water and heating water systems for all new facilities that are tied into the main centralized heating and cooling plants.

Beginning in FY 2002, NREL installed 20 electric meters in all major facilities and on major process loads. In FY 2011, NREL undertook an effort to survey and connect existing digital meters to the DOE-sponsored enterprise-level Energy Dashboard system. Connections have been made to integrate data outputs from Building Automation Systems, hot and chilled water BTU meters, and natural gas and electricity meters. The Energy Dashboard is web accessible and has data analysis tools that allow for continuous tracking of energy generation and consumption. NREL's new data center, located in the LEED Platinum RSF, is independently metered and connected to the DOE Energy Dashboard system. Additional data center functions, housed in Building 17, are submetered for computer operations and cooling.

All of the facilities that require water on the STM site have dedicated utility water meters. There are also water submeters for all make-up water systems for cooling towers, boilers, deionized water, and evaporative cooling sections in all

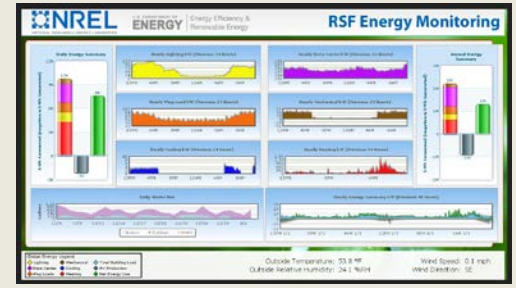
Planned Actions

Energy Intensity

NREL will exceed our energy intensity reduction goal by constructing highly energy efficient new buildings, systematically implementing energy retrofits, and increasing on-site renewable energy generation. In addition, NREL will purchase RECs to help reduce energy intensity and subsequent GHG emissions. As required under EPACT 2005 and EO 13423, RECs will no longer count toward the energy intensity reduction target in FY 2012; however, NREL will continue to purchase RECs to offset GHG emissions associated with electricity consumption.

Metering

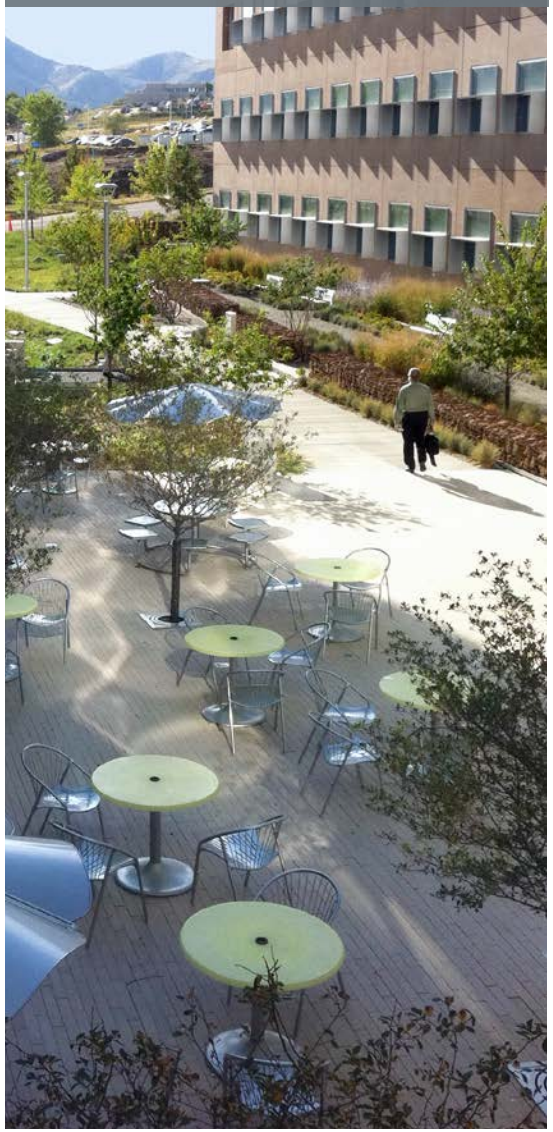
In FY 2012, NREL will have 100% of its electricity and 95% of its natural gas metered or submetered, and tied into the DOE Energy Dashboard data acquisition and analysis tool. NREL will also have 100% of heated and chilled water usage metered and recorded electronically by the DOE Energy Dashboard. In FY 2012, potable water data for the STM and NWTC will also be incorporated into the Energy Dashboard system. In FY 2012 and beyond, NREL will work to enhance the Energy Dashboard system to provide additional analysis tools and reporting options. These enhanced capabilities will help to simplify direct monitoring of NREL's energy consumption and reporting for development of our Site Sustainability Plan (SSP), Pollution Prevention Tracking and Reporting System (PPTRS), CEDR, GHG inventory, and other DOE data requests. Enhanced energy enterprise management capabilities will also support the analysis of GHG reduction and energy efficiency opportunities, calculation of REC purchase quantities and return on investment for energy improvements, and provide educational support and outreach to help NREL uphold DOE's mission for energy efficiency and renewable energy. In addition, NREL is working to conserve and optimize our water efficiency for campus irrigation by using a WeatherTRAK® smart irrigation system to automatically adjust landscape watering based on plant needs and daily local weather conditions.



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

An Exemplary Building researcher at the Thermal Test Facility at the STM campus checks the quantity of daylight and accuracy of the lighting sensors that are part of the TTF's high-efficiency lighting system.

Xeriscape, bioswales, and hardscape features improve water quality and promote water conservation at the RSF.



facilities where applicable. Water meters are unavailable at the NWTC; however, water usage is measured by the water level in the 15,000 gallon tank. NREL is moving towards submetering high-use water systems with new construction. As an NREL design standard for new and renovated spaces, water submeters are required at make-up water systems that support mechanical HVAC equipment and laboratory processes. An irrigation meter is also required for all newly constructed facilities, which use water on a short-term basis for plant establishment.

INCREASE RENEWABLE ENERGY CONSUMPTION

The table on page 63 summarizes NREL's renewable energy generation and purchases for FY 2010 and FY 2011. In FY 2010, NREL had 1,898 kW of direct current (DC) PV that generated 2,587 MWh of electricity offsetting loads at the STM and NWTC. These panels are located on the STM Mesa top, at the SERF, the STM Site Entrance Building, the OTF, the NWTC Site Entrance Building, the Distributed Energy Research Test Facility, as well as remote applications including walkway lights and parking lighting. In FY 2010, NREL added 1,000 kW of PV at the NWTC and 75 kW on the roof of S&TF.

NREL's on-site renewable systems, including PV arrays and wind turbines, generated a total of 7,892 MWh in 2011, or 28% of NREL's power. In FY 2011, NREL installed:

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

In FY 2010, the NWTC had approximately 1,600 kW of installed wind turbine capacity that is used for research purposes. When the turbines are running, the electric energy that they produce is used to offset simultaneous NWTC site electricity energy use. The turbines produced 1,761,084 kWh in FY 2010. The NWTC also has a DOE-owned General Electric 1,500 kW wind turbine that became operational in FY 2010.

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

NREL's solar thermal installations produce an estimated 10.2 MMBTU of renewable thermal energy through solar hot water systems in FY 2010 and 2011: ventilation air preheating systems and Trombe walls. NREL also installed a new ground-source heat pump in FY 2011 to provide heating and cooling to the Solar Radiation Research Laboratory (SRRL).

NREL has a wood-chip fueled RFHP that utilizes urban wood wastes and forest thinnings from Front Range Healthy Forest Initiative activities and other wood wastes to displace natural gas usage for space heating. In FY 2010, the RFHP produced 7,413 MMBTU, and in FY 2011, it produced 9,826 MMBTU. The RFHP is continuing to improve in performance and is now providing 50% of the heat in the campus' central heating system.

As part of PPA agreements, the environmental attributes associated with the on-site renewable systems are sold to Xcel Energy to meet their renewable portfolio standard requirements. NREL purchases replacement RECs to reduce our energy intensity and achieve Scope 2 carbon neutrality.

NREL ON-SITE GENERATED AND PURCHASED RENEWABLE ENERGY		
Source	FY10 Energy Produced (MWh)	FY11 Energy Produced (MWh)
Electricity from Solar	2,587	3,873
Electricity from Wind	1,761	4,607
Renewable Thermal Energy	7.4 (BBtu)	9.8 (BBtu)
On-Site Total	4,348	8,480
Purchased RECs from New Renewable Source	43,000	26,890
Total	**49,519**	**35,370**

WATER USE EFFICIENCY AND MANAGEMENT

NREL demonstrates federal leadership in managing water supplies through the use of water-efficient systems and storm water management practices.

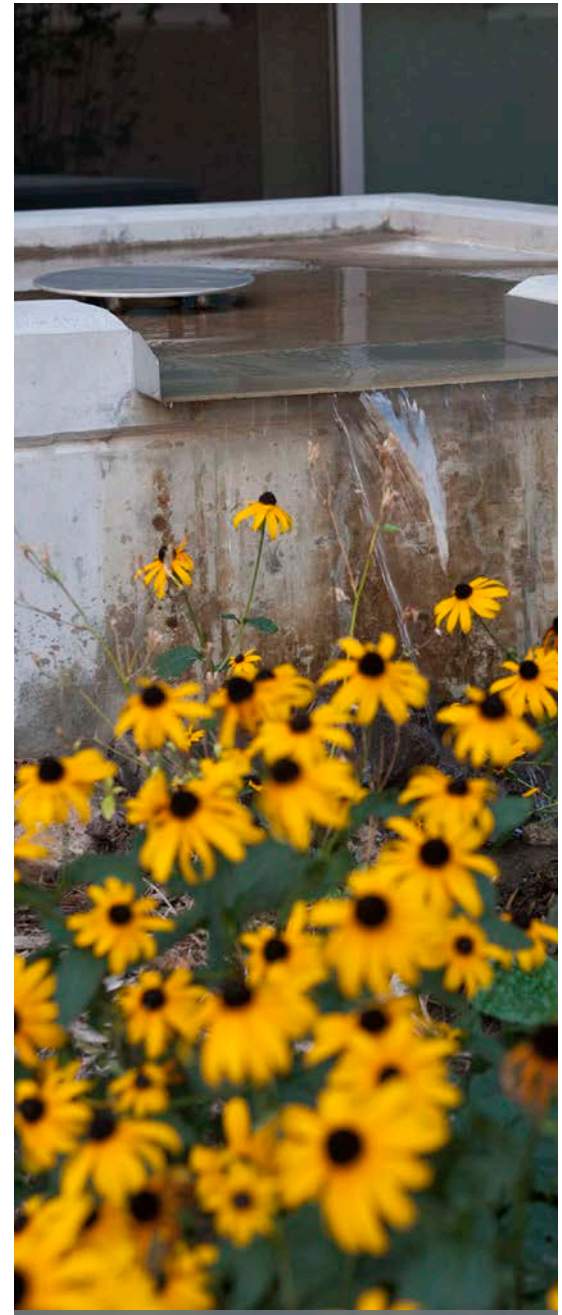
The total water consumption at NREL includes usage at both the STM and NWTC sites (see table on page 65 for a description of NREL's water meters). Total water consumption and water intensity for the FY 2007 baseline and FY 2010 are shown above.

WATER CONSERVATION

NREL does not have industrial, landscaping, and agricultural (ILA); NREL uses only tap water from municipal sources. NREL has very little irrigated landscaping (some sites use only stream or ditch water for irrigation), and the only permanent landscape irrigation system is located at the RSF, which is used to establish xeriscape plants.

Our new facility construction activities have created a lot of disturbance of our existing grassland communities. Habitat support systems cannot be replicated quickly following construction, so NREL is supporting landscape restoration with an irrigation system. The water-efficient irrigation system will help establish our native high plains desert landscape in the short term and after two or three years, the plants will be weaned off supplemental irrigation and returned to a nonirrigated state.

NREL's site uses only native plant species that are appropriate for the local environment.



One of the sustainable features of the RSF's exterior is the catch basins. Rain water from the RSF passes through landscaped areas before discharging into Lena Gulch.

FY 2010 NREL WATER CONSERVATION RETROFITS				
Water Conservation Measure	Estimated Water Saving (kgal/yr)	Year of Implementation	Implementation Cost	Cost Savings ($/yr)
Water softening of FTLB cooling tower makeup	230	Completed FY09	$4,000	230
Replace FTLB cooling tower make-up valve	62	Completed FY09	$1,200	220
Retrofit FTLB autoclaves	88	Completed FY09	$5,000	320
Eliminate FTLB single pass cooling	940	FY11	$10,000	3,400
Maintain SERF/FTLB cooling tower controller @ 3,000 uS/cm	300	Completed FY09	$4,500	1,100
Improve PM on evaporative coolers	120	Completed FY10	N/A	440
Fix leak on vacuum pump	35	Completed FY10	$100	100

Planned Actions

Energy Management

The table below summarizes planned renewable energy deployment and purchases that NREL will implement to meet and exceed DOE's goals.

Several future PV projects are planned for implementation in FY 2012 and beyond:

- A 408-kW RSF II roof mount PV array, 1.2-MW parking garage PV system, and a small PV array on the new Site Entrance Building are planned for FY 2012.
- Space for additional PV arrays will be allowed on future buildings, including the ESIF and the cafeteria. In addition to these PV systems, the 2-MW Gamesa wind turbine at the NWTC will become fully operational in FY 2012.

PLANNED RENEWABLE ENERGY DEPLOYMENT AND PURCHASES IN FY 2012		
Renewable Energy Projects	Estimated System Size (MW)	Generation Estimate (MWh)
STM PV	1.67	2,215
Gamesa Wind Turbine	2.00	1,500
RECs to be Retained/Purchased	—	31,200
Total	**1.67**	**35,215**

In FY 2010, NREL's site potable water intensity increased by 15% relative to a FY 2007 baseline. This increase was due primarily to heightened activity at NREL's STM campus. In FY 2010, NREL's headcount increased by approximately 80% compared to FY 2007 levels. In the context of this increase, it is noteworthy that NREL's water consumption increased by only 15%.

Water intensity is based on the gross square footage of NREL space reported to DOE in the facilities information management system (FIMS).

In FY 2010, the 220,000 ft^2 RSF I was not included in this database because phase two construction of the facility was not complete.

In FY 2011, water intensity was reduced by 48% from the 2007 baseline and 22% from the previous year. This was primarily accomplished by adding square footage with the new RSF I building. Through efficient fixtures and native xeric landscaping utilizing irrigation only for establishment, this building significantly increased NREL's floor space without a corresponding increase in water consumption. In FY 2007, a water audit was performed for NREL to provide a complete water balance for the STM site, and to evaluate and develop recommendations on capital improvements and O&M practices. Six of the seven recommended water conservation measures noted in the FY 2010 NREL Water Conservation Retrofits in the table above have been completed. The water conservation measures included in the survey have an estimated water savings of 1.8 million gallons, which is approximately a 14% reduction from the FY 2007 baseline.

Water Conservation

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

In FY 2013, ESIF will open. This 130,000 ft^2 building has cooling towers that will increase NREL water consumption by 30% or more. A more efficient technology, evaporative cooling, will be used in place of standard air conditioning for this building, eliminating electricity consumption at the expense of increased potable water use. NREL is implementing the most efficient cooling tower recirculation practices, with five cycles of optimal use before discharge. This is a best management practice for cooling tower operation. The resulting nonpotable water contains high-concentration mineral residuals that prevent its reuse on site for irrigation purposes.

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

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

NREL WATER CONSUMPTION

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

New Construction

To exceed our 26% potable water reduction goal, NREL will incorporate water saving measures in all new construction facilities. NREL has established best practices in our design standards and operating procedures to promote the efficient use of potable water on campus. NREL's design standard calls for high efficiency, low flow, or flow flush fixtures in all new and existing buildings. To conserve water, NREL also limits once-through cooling to devices that must operate at zero pressure and cannot be reconfigured to operate on building process cooling water. NREL's potable water usage on the STM campus is metered for each building. NREL has installed submeters on all high-intensity water devices including cooling towers, evaporative coolers, and autoclaves. NREL is also working to conserve and optimize our water efficiency for campus irrigation by using a WeatherTRAK®, smart irrigation system to automatically adjust landscape watering based on plant needs and daily local weather conditions.

New facilities are planned to achieve LEED Gold or higher certification and to incorporate water conservation measures to the extent possible. Upon completion of the RSF, NREL will achieve a 21% water reduction. It is assumed that future office-type buildings would have the same water intensity as RSF, while future lab-type buildings would have the same water intensity as the S&TF. The water intensity of the RSF is expected to be 3.58 gallons/ft^2, with a total annual consumption of 786,700 gallons of water. For FY 2008, S&TF had a water intensity of 12.03 gallons/ft^2.

The water intensities for both RSF and S&TF do not include any irrigation. NREL will continue to use xeriscape plants that require little to no irrigation. It has been NREL's practice since 2002 to only irrigate new landscaping and revert to natural rainfall once plantings are established.

Water Conservation Retrofits

NREL continues to seek water conservation opportunities by installing submeters on high-water-use machines and looking for alternative technologies.

Waste Management and Pollution Prevention

Multi-Year Goals:

- Minimize the generation of waste and pollutants through source reduction.
- Divert from landfills at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by the end of FY 2015.
- Divert from landfills at least 50% of construction and demolition materials and debris by the end of FY 2015.

NREL's recycling efforts divert waste from the landfill.

Waste Management and Pollution Prevention

Strategic Intent

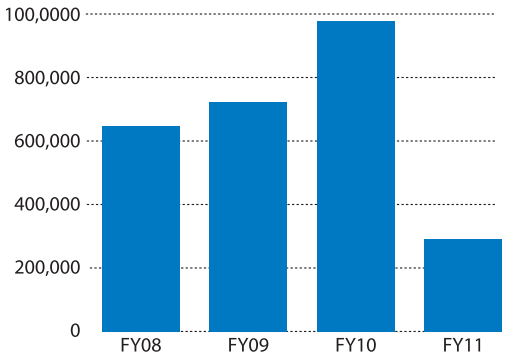
Since its inception, NREL has strived to be a good steward of the environment through our research and operations. As an early adopter of recycling, with a program established in 1980, NREL has a long history of creating a culture that supports waste reduction. NREL is working to further our efforts by establishing a near-zero waste campus that emphasizes source reduction and resource recovery, making efforts to minimize waste each step along the way.

HISTORIC PERFORMANCE

NREL's commitment to pollution prevention can be shown by our strong efforts to divert waste from the landfill. Since 2003, NREL has actively tracked waste diversion data (see chart below).

In FY 2010, NREL diverted 54% of our waste stream from landfills through our recycling and composting programs. In FY 2011, NREL saw an incremental improvement, with a 77% diversion rate for campus waste.

NREL began a composting pilot in April 2010, which encompassed five buildings on the STM campus. Compost is hauled offsite by A1 Organics. In a six-month period, NREL composted 68,468 pounds of material. In October 2010, the composting program was expanded to the entire laboratory. In FY 2011, NREL transitioned our composting pilot to a campus-wide program, increasing our compost 9% from FY 2010. NREL employees are actively embracing the compost program, which will help bring NREL closer to achieving near-zero waste.



Solid waste disposal and diversion, FY08–FY11

In FY 2011, NREL'S building square footage grew 48%. In spite of this growth, NREL was able to achieve an 88% diversion of construction waste. This, in part, was facilitated by new green specifications for existing building projects developed by Sustainable NREL in FY 2011, and new language added to statements of work (SOW), requiring all contractors to track the quantity of waste generated and recycled for campus projects.

THE 4RS PROGRAM

NREL is working toward near-zero waste by taking the "4Rs" program (reduce, reuse, recycle, and re-buy) to a higher level:

Reduce

Although NREL's population has grown, the use of paper has decreased primarily due to increased usage of paperless processes and the use of the all-in-one network printers. This has been accomplished by:

- Replacing paper drafts with electronic files
- Allowing for double-sided printing by using duplex modules on all network printers and setting duplex defaults on all computers.

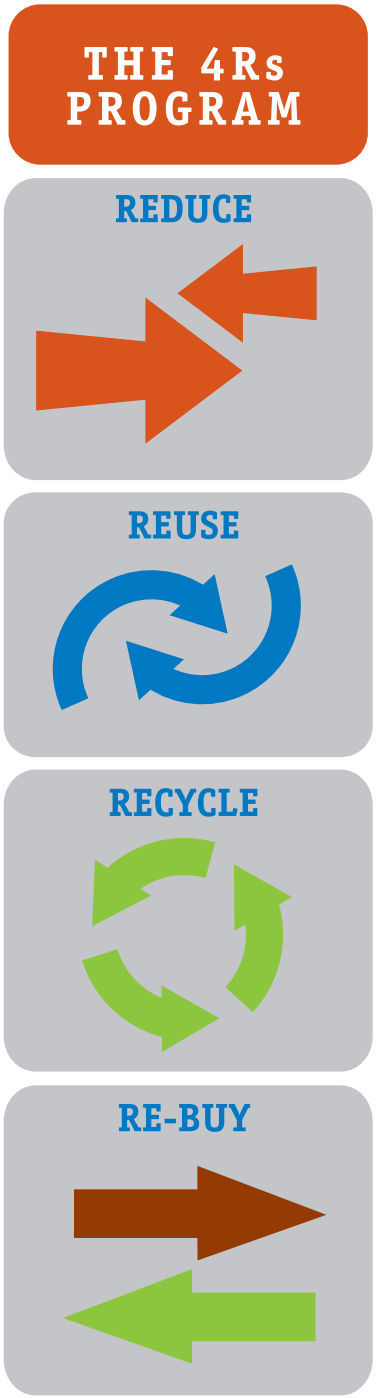
Reuse

- NREL's Reusable Office Supply Depot provides opportunities for centers and offices to save money and help the environment by repurposing office supplies that could end up in a landfill.
- Staff members are encouraged to take (and reuse) office supplies from the Depot or donate any new or good-as-new items for others to use.
- NREL reuses cardboard boxes, packing peanuts, plastic containers, and drums.

Recycle

NREL's long-established recycling effort includes recycling stations in each building. All recyclable materials are commingled in specified bins, including containers for large cardboard, batteries, and printer toner cartridges. Each employee workspace contains a recycling basket and a smaller waste container. Scrap metal, wooden pallets, computer monitors, and fluorescent light bulbs are also recycled.

Prior to FY 2009, all recycled materials were separated and weighed and a monthly report was provided to NREL. In FY 2009, the recycling vendor went to a single-stream, commingled pick-up. The vendor has a measurement system, which calculates the weight of recyclables from each pick-up to allow for annual reporting.



Re-Buy

NREL promotes green purchasing through an online catalog featuring environmentally preferable (recycled content) products. A range of office supply items are included. Since 1999, 100% of all carpet and office paper have contained at least 30% recycled content.

POLLUTION PREVENTION

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

1. *NREL Library Reduce and Recycle.* Replacing 85 linear feet of print journals with electronic journals to reduce paper use and the footprint required for the new NREL library, this project reduced collection shelving requirements by 30%, saving both material and energy costs.
2. *Idling Reduction.* Created new guidelines based on best practices and developed a site-wide education program for idling reduction. Estimated reductions include 1,700 gallons/yr and $6,400/yr in diesel fuel use for NREL shuttles.
3. *Pump Replacement.* Replacement of an existing oil-based wet pump with an energy-efficient sealed pump in the S&TF will reduce oil waste and energy usage associated with the pump.

In FY 2011, three pollution prevention assessments were also performed. The assessments included:

1. *Printer Reduction.* Estimated the environmental benefits and cost savings of removing desktop printers to encourage greater use of MFDs in the FTLB.
2. *SF_6 Reduction.* Determined the current uses of SF_6 at NREL, the feasibility to capture or reduce emissions for these uses, and estimated the potential environmental benefits of a capture or reduction program.
3. *Aerosol Can Recycling.* Evaluated the number of aerosol cans NREL annually sends to the landfill to understand the environmental impacts of this waste stream.

Findings from these assessments will be used to implement new procedures at NREL.

COMPOSTING PROGRAM

NREL's laboratory wide Composting Program makes it convenient for staff to divert organic material from the waste stream by providing composting bins in common areas. These materials are emptied on a daily basis and collected by a local vendor every week. Each spring this vendor brings processed compost back to NREL to utilize in landscape planting beds.

REDUCING CHEMICALS

NREL employs several means of reducing the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed of, including:

- *Chemical Management System.* Allows EHS staff to track chemical purchases and inventories through the use of a bar code system and database
- *Excess Chemical Inventory.* Provides a way to reduce chemical purchases and disposal by allowing researchers to share and redistribute chemicals
- *Annual training on chemical safety and hazardous waste management.* Required for all lab workers to encourage the use of less harmful chemicals whenever there is a viable alternative

- *Formal hazard identification and control process.* Minimizes the risks associated with any new or modified lab process by incorporating less toxic materials to reduce hazardous waste streams
- *Annual goals for pollution prevention established in NREL's EMS.*

NREL is also working to use alternative chemicals and processes by giving preference to environmentally preferable bio-based products, EPEAT electronics, and low or no VOC paints. In FY 2010, NREL's facilities group coordinated an effort to reduce paint purchases and waste by establishing a standard palette of low VOC paints.

MINIMIZING HERBICIDES

NREL's Weed Management Program seeks to minimize the impacts of herbicide applications, while at the same time control listed noxious weeds for which control is legally mandated. Beginning in FY 2011, NREL will participate in the Sustainable "SITES" Initiative Pilot Program and obtain Pilot Certification. 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 foster a transformation in land development and management practices. Similar to LEED, the program focuses on rigorous design, construction, operations, and maintenance criteria to supplement green buildings.

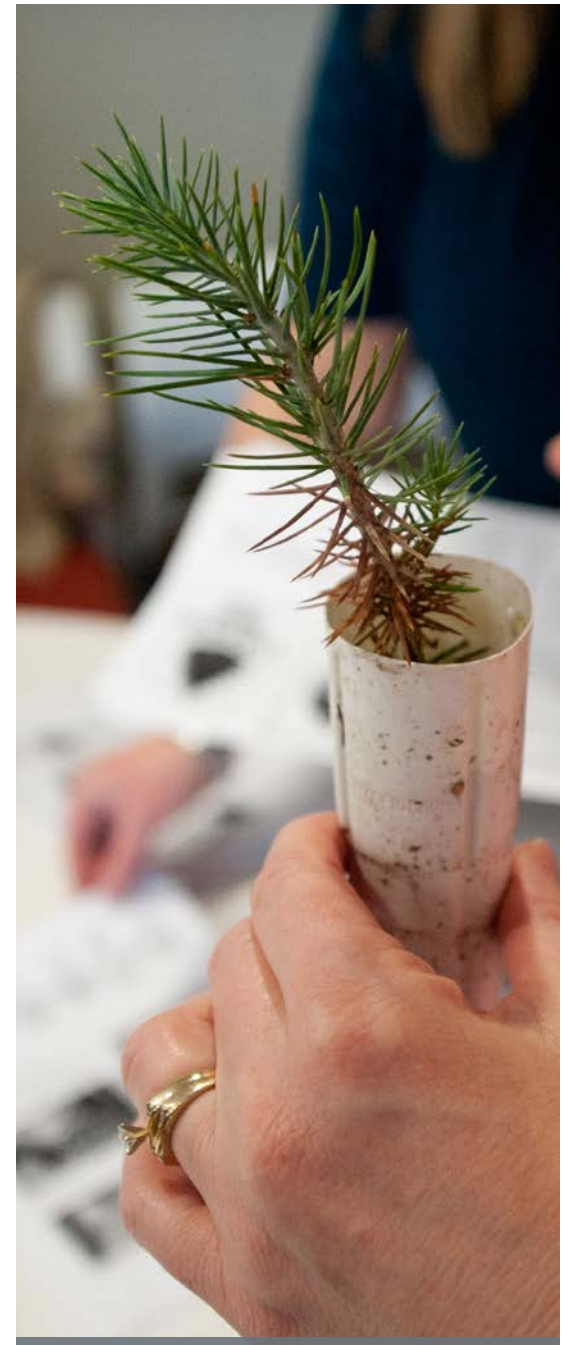
Planned Actions

Pollution Prevention

In FY 2012, NREL will solicit two pollution prevention assessments in topic areas that will help the lab uphold DOE's pollution prevention goals. The lab will also continue to research options for recycling items that are not easily recyclable and increase staff education on NREL's practices.

NREL will also continue to investigate the life-cycle impacts of products used on campus as well as the most environmentally sensitive disposal methods.

In FY 2012, NREL's Near Zero Waste committee will help NREL reach goals to reduce paper usage by 5% and increase waste diversion by 5% as part of NREL's participation in the EPA Federal Green Challenge and Waste Wise Programs. NREL will also begin performing on-site waste audits to help identify problem areas to continue to move closer to a near-zero waste campus.

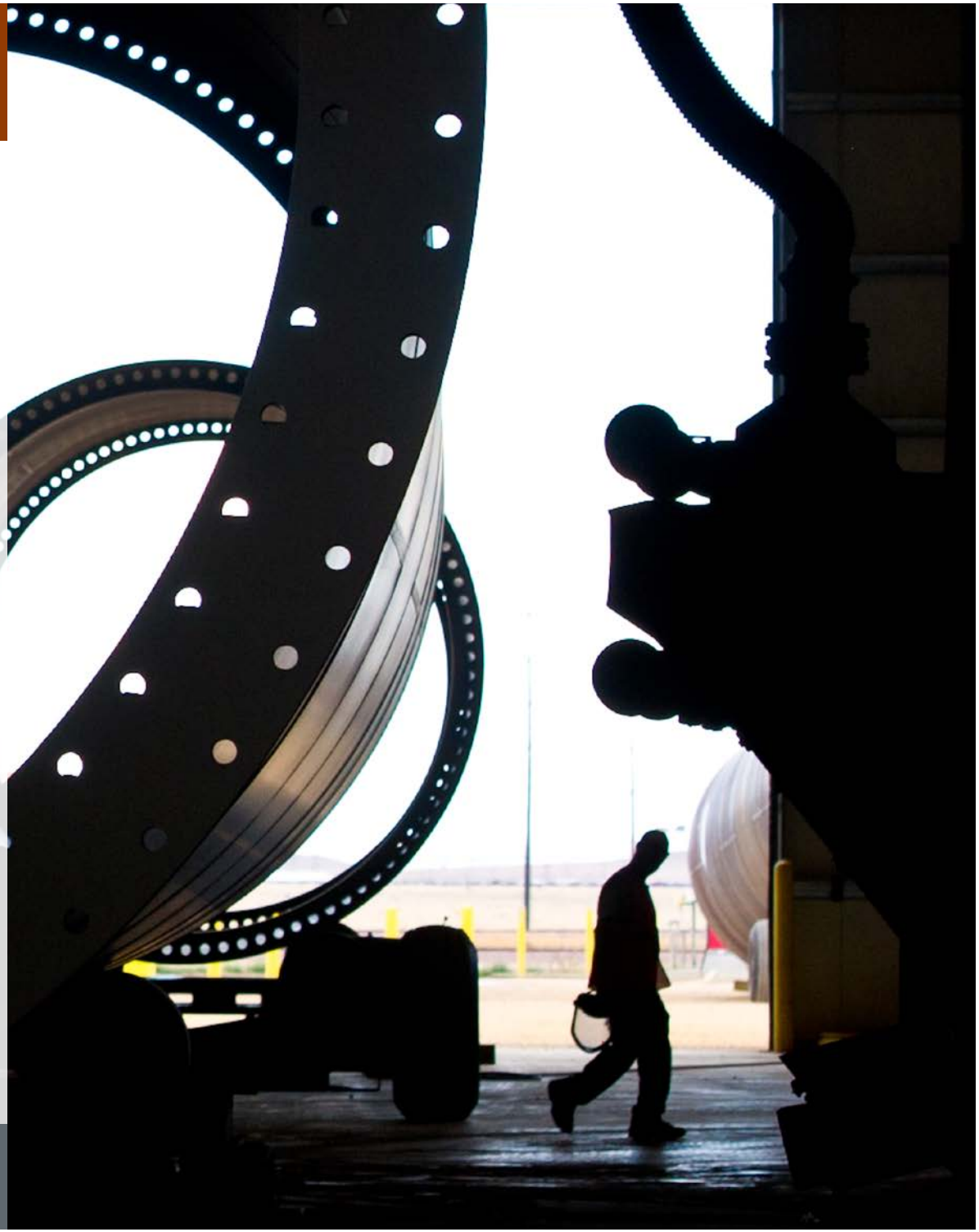


Ponderosa pine saplings given out at Earth Day events promote awareness of the environment among staff.

Laboratory Operations

Multi-Year Goals:

- Demonstrate excellence in quality, environmental protection, and safety, by attaining ISO 9001, ISO 14001, and OHSAS 18001 registration.
- Implement a Pollution Prevention Initiative Program to identify opportunities and provide resources and funding to achieve desired results.



Safety is a priority in all laboratory operations and facility maintenance.

Laboratory Operations

Strategic Intent

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 research done at NREL. A core value at NREL is to provide a safe and supportive work environment. This value is extended through our campus operations, by establishing a work environment focused on the safety and protection of staff, the public, and our environment. NREL is striving to uphold one of the best safety records among national laboratories by controlling on-site incidences and mitigating risks to the external community. In this endeavor, NREL's environmental performance is measured by accident and pollution prevention, regulatory compliance, and the pursuit of continuous improvement.

HISTORIC PERFORMANCE

Health and safety have been an integral value to NREL's operations since our inception. NREL's environmental, health and safety program has a long history of protecting our air, water, and land while working to reduce waste and impacts to the surrounding environment and cultural resources. NREL complies and works to exceed applicable state and federal environmental laws and regulations as well as Executive Orders and DOE requirements in our operational practices. In the context of growth, NREL is working to uphold high standards for health, safety, and quality in our laboratories, offices, and construction sites by aggressively educating new staff.

INTEGRATED MANAGEMENT SYSTEM

NREL's Integrated Management System (IMS) establishes the process to conduct our work in a manner that protects our staff, the public, the environment, and the laboratory's assets—all while contributing to the overall quality of our work. NREL's IMS approach merges the components of safety, quality, and environmental management into one coherent system so that the boundaries between processes are fully integrated. Our activities must be planned and managed in a manner to identify hazards and implement controls to reduce the level of risk associated with any activity to acceptable levels. The IMS establishes controls and provides a feedback mechanism to continually improve our performance. NREL's IMS is supported by our Quality Assurance, Environmental Protection, and Integrated Safety Management policies.

In FY 2010, NREL prepared for ISO 14001, ISO 9001, and OHSAS 18001 certifications for our environmental, quality, and health and safety management approaches. In FY 2011, NREL conducted a third-party audit of our IMS in pursuit of these three certifications and was awarded for all three in FY 2011.

QUALITY ASSURANCE

NREL delivers quality research, products, services, and work processes to meet or exceed DOE and NREL requirements, reflect applicable industry standards, and meet or exceed internal and external customer expectations. To these ends, NREL is committed to the following quality principles:

- Conducting the highest-quality research and technical work based on appropriate experimental design and scientific methodology
- Providing products and services consistent with the needs, expectations, and resources of customers and NREL
- Continuously improving business and technical internal work processes, systems, and capabilities to increase the value of the products and services NREL delivers
- Providing a safe, secure, and healthy work environment for NREL workers and protecting the general public and environment from unacceptable environmental, safety, and health risks
- Providing a work environment that facilitates fairness, diversity, honesty, integrity, and teamwork, and encourages workers to raise concerns without fear of retribution or retaliation
- Complying with laws, regulations, and contractual obligations.

Quality is achieved by:

- Integrating DOE-prescribed and management-driven quality requirements into NREL management systems and work processes
- Providing the quality infrastructure, procedures, processes, and training necessary to support a quality culture and promote laboratory-wide continuous improvement.

NREL conducts its mission-related activities to provide for conservation of natural resources to the maximum extent possible.

ISO 9001 certification supports our quality assurance program to ensure that all work delivered is consistent for a world-class research institution.

ENVIRONMENTAL MANAGEMENT

Laboratory operations are facilitated through the NREL EMS, which is used to provide effective environmental stewardship of our sites and minimize the environmental impacts of lab activities. The laboratory's EMS efforts protect and enhance the vegetation, wildlife, and natural resources of the lab sites; comply with environmental requirements; and encourage continuous improvement in environmental protection. The EMS supports Sustainable NREL's goals by focusing on protection of the natural and cultural resources on and around NREL sites by:

- Reviewing NREL's potential for environmental impacts through emissions, discharges, waste generation, purchases, and land use
- Conducting required permitting activities
- Managing site natural resources for protection and preservation of their natural character to the extent possible, while still fulfilling NREL's mission
- Managing site cultural resources to document resources of significance and minimizing disturbances whenever possible
- Recommending and coordinating measures to minimize any potential impacts NREL's activities have on the environment.

ISO 14001 certification for our EMS supports our mission and values for environmental stewardship, pollution prevention, compliance, and continual improvement in environmental and sustainability performance.

NATURAL RESOURCES MANAGEMENT

Lab-level policies for the management and conservation of natural resources include:

- *Policy 6-2.21. Natural Resources Conservation.* This program establishes a framework within which NREL conducts its mission-related activities to provide for conservation of natural resources, including wildlife, vegetation, and habitat, to the maximum extent possible.
  - *Avian Protection Plan.* Completed in 2011, this is incorporated into the Natural Resource Conservation Program.
- *Policy 6-2.21.* Provides guidance to reduce impacts to migratory birds by providing Best Management Practices (BMPs) for a variety of NREL activities.
- *Policy 6-2.2. National Environmental Policy Act Implementation.* Establishes a framework within which NREL conducts its mission-

related activities to provide for conservation of natural resources, including wildlife, vegetation, and habitat, to the maximum extent possible.

- *Policy 6-2.12 – Weed Management*. Updated in 2011, this policy provides the framework within which NREL conducts its activities to prevent the spread of noxious weed species and implements them to control these species.
- *Policy 6-2.19 – Sustainable Landscape Design, Management, and Maintenance*. Provides a framework for the sustainable management of government-owned land by balancing implementation of environmentally sound, cost-effective landscaping practices that reduce adverse impacts to the natural environment.
- *Policy 6-2.20 – Environmental Management System*. NREL's EMS conforms to the International Standards Organization (ISO) 14001 standard for environmental management systems, Department of Energy (DOE) requirements, and other laws and regulations that require federal facilities to implement an EMS. This policy provides the information describing conformance to these standards, DOE requirements, and other laws and regulations either directly or by reference.

The national regulations that are driving forces for these policies include:

- *10 CFR 1021 – DOE NEPA Implementing Regulations*
- *10 CFR Part 1022 – Department of Energy Floodplain and Wetland Regulations*
- *16 USC 661 et seq. – Fish and Wildlife Coordination Act*
- *16 USC 668 et seq. – Bald and Golden Eagle Protection Act*

INTERNATIONAL UNION FOR CONSERVATION OF NATURE (IUCN) RED LIST

2010	Total # Avian Species	Avian Species in Affected Habitats	FWS Conservation Listing	Total # Avian Species	Avian Species in Affected Habitats
Least Concern	51	15	Species of Concern	14	4
Vulnerable	0	0	Endangered	0	0
Near Threatened	0	0	Threatened	0	0
Endangered	0	0	Delisted	2	0
Critically Endangered	0	0	Candidate	1	1
2011	**Total # Avian Species**	**Avian Species in Affected Habitats**	**FWS Conservation Listing**	**Total # Avian Species**	**Avian Species in Affected Habitats**
Least Concern	98	33	Species of Concern	8	5
Vulnerable	0	0	Endangered	0	0
Near Threatened	0	0	Threatened	0	0
Endangered	0	0	Delisted	2	0

- *16 USC 703 et seq. – Migratory Bird Treaty Act*
- *16 USC 1531 et seq. – Endangered Species Act of 1973*
- *42 USC 432133 USC 403 – Rivers and Harbors Act*
- *42 USC 4321-4347 – The National Environmental Policy Act of 1969, as amended*
- *40 CFR Parts 1500-1508 – Council on the Environmental Quality Regulations for Implementing NEPA.*

Reporting the laboratory's strategy for achieving its policy biodiversity management

Biodiversity and natural resource management are achieved by following NREL's established policies and procedures, and by periodically performing updates to ensure compliance with current regulations. The flow down of institutional and

Environmental stewardship protects and enhances the wildlife, vegetation, and natural resources.

Conservation easement area atop STM mesa

regulatory requirements provides a framework for daily management of construction or operations-related natural resource issues through:

- *Integration of biodiversity considerations in analytical tools such as environmental site impact assessments*. NEPA reviews conducted for all on-site construction activities focused on avoiding, minimizing, and mitigating impacts to natural resources
- *Engagement with relevant stakeholders*. EHS information shared with federal (e.g., U.S. Fish and Wildlife Service), state (e.g., Colorado Division of Wildlife), and public agencies
- *Establishment of a methodology for establishing risk exposure to biodiversity*. Seasonal surveys conducted to identify the presence of, and evaluate any wetlands, endangered species, or nesting birds prior to on-site construction activities
- *Setting specific targets and objectives*. Tracking targets and objectives by Requirements Management and documentation on policies and procedures
- *Monitoring and evaluating processes from an internal quality assurance viewpoint as well as in NEPA reviews*.
- *Public reporting*. Reporting to appropriate agencies is conducted according to the NEPA process. Additionally, local newsletters and NREL Public Affairs distributions keep the community informed. News articles on NREL's website also provide valuable information on the relationship between NREL's mission and environmental sustainability. (Balancing Renewables and Natural Resources. Feb 12, 2010. *http://www.nrel.gov/features/20100212_nwtcsolar.html)*.

Protected Species

NREL performs regular assessments of our campuses to identify sensitive animal populations, working to ensure that these populations are protected in our development and daily operations of the sites. In FY 2010, wildlife and vegetation surveys of threatened or endangered species, or species of concern, were documented on NREL property. In FY 2009, a colony of black-tailed prairie dogs was moved to the northwest corner of the NWTC. An outbreak of sylvatic plague greatly reduced the colony's numbers, but the colony should recover.

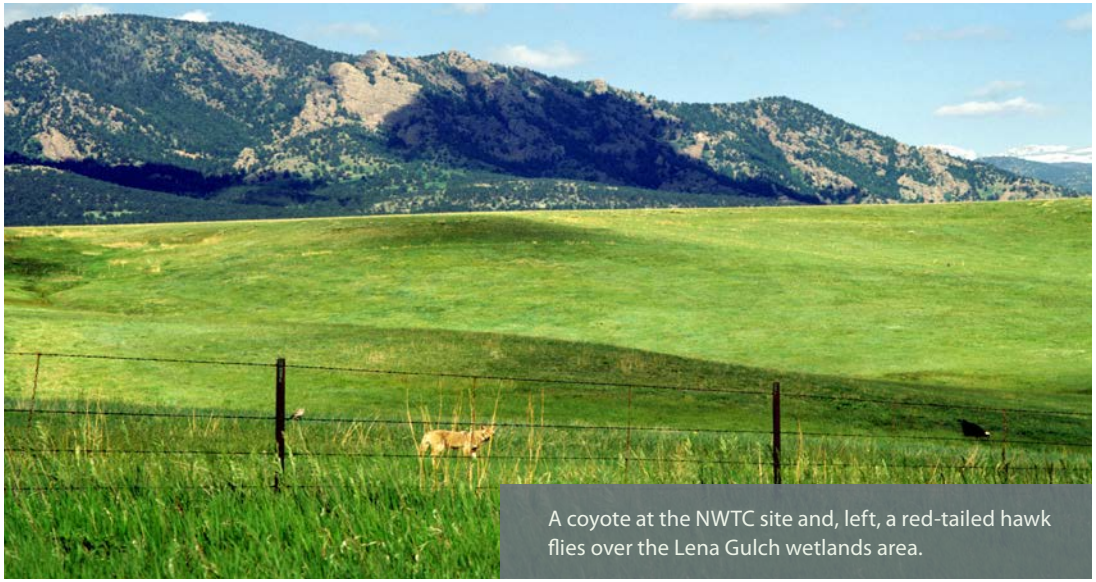
Habitat Protection

STM Conservation Easement

In FY 1999, 71.6 hectares of the STM mesa top and slopes were set aside in a formal conservation easement that prohibits development, thereby permanently protecting the site's natural resources. NREL manages this area to preserve and maintain the health/viability of the native ecosystem. NREL annually assesses and documents the environmental conditions of the conservation easement in relation to the baseline survey completed in FY 1999.

NWTC Conservation Management Areas

A total of approximately 63.4 hectares of land within site boundaries at the NWTC have been designated in four conservation management areas. The purpose of those areas is to protect the site's natural resources and in the western-



A coyote at the NWTC site and, left, a red-tailed hawk flies over the Lena Gulch wetlands area.

most area, also prevent development within critical wind corridors. NREL annually assesses and documents the environmental conditions of the conservation management areas. Additionally, 5.5 acres are being considered for inclusion as a fifth conservation management area that supports a unique soil type and robust native grassland community.

Restoration Efforts

Restoration measures primarily involve revegetation of areas following construction or other outdoor activities. Revegetation of areas to be left in their natural state following disturbance is conducted using a native seed mix of grasses and forbs. These mixes are site specific and are composed predominantly of native species that were originally present on the site before disturbance. The use of native species is required at both the STM and NWTC whenever possible. The success of revegetation efforts is not approved or validated by external professionals, but vegetation surveys are periodically conducted at NREL sites.

The most recent vegetation survey of the STM was conducted between June 2010 and May 2011. Five general habitats were described on the STM site, comprising seven plant communities.[1] No rare or imperiled plant species were found on the site. Areas of mixed foothills shrub lands were identified on top of the mesa within the conservation easement area. This natural community is listed as rare and imperiled by the Colorado Natural Heritage Program. No development will occur in the conservation easement area.

A vegetation survey of the NWTC site was also performed between July 2010 and May 2011. The survey defined five general habitats on the NWTC site, comprising 10 plant communities and 300+ vascular plant species.[1] No rare or imperiled plant species were found on the site. A number of changes in the vegetation patterns were noted since these areas were previously mapped.[2,3] Overall observed trends in vegetation patterns include a general increase in invasive and noxious weed species diversity and extent across the site and a broad shift in native species composition toward more upland species.[4]

Some possible factors that may be contributing to these apparent trends could include general drying of soils as well as changes in land use, including surface disturbing activities, since 2000.

In 2010 and 2011 wildlife and vegetation surveys, no threatened or endangered species were documented on NREL properties. Comprehensive surveys were performed in FY 2011.

1,4 Walsh, Environmental Scientists and Engineers. Vegetation and Wildlife Surveys at the NREL National Wind Technology Center. July 2011.

2 U.S. Department of Energy (DOE). Rocky Flats Environmental Technology Site. Vegetation Map. Rocky Mountain Remediation Services (RMRS). Map ID: 02-0208. Golden, Colorado. August 1998.

3 Plantae Consulting Services. Vegetation Report, National Renewable Energy Laboratory, National Wind Technology Center. September 30, 2000.

NREL's workplace training helps staff perform their work in a safe manner.

HEALTH AND SAFETY METRICS: TOTAL # OF INCIDENTS X 200,000 / TOTAL HOURS WORKED	
2010	2011
6 recordable injuries resulted in one day lost from work	6 recordable injuries resulted in two days lost from work
Injury rate (IR): 0.65	Injury rate (IR): 0.26
Occupational diseases rate (ODR): 0.0	Occupational diseases rate (ODR): 0.0
Lost day rate (LDR): 0.05	Lost day rate (LDR): 0.09
NREL fatalities: 0	NREL fatalities: 0

Biologists conducted surveys for three species most likely to occur at the NWTC and STM: the Ute ladies' tresses orchid; the Colorado butterfly plant; and the Preble's meadow jumping mouse. All surveys were negative.

Integrated Safety Management

NREL is committed to creating a safe work environment and protecting site resources to the extent possible in our daily operations. NREL's rigorous safety goals are to prevent accidents and continually improve and comply with relevant requirements. OHSAS 18001 certification upholds these goals.

NREL has established health and safety committees that help monitor occupational safety programs and provide advice. The committees include:

- Safety and Security Council
- Safety Panels: Chemical, Biosafety, Pressure, Hydrogen, Hazardous Production, Electrical, Laser, Radiation, Compressed Gas.

Out of 41 centers at NREL, more than 50% are represented in the above safety committees.

The safety committees and councils contain a total of 201 members, representing 8.1% of NREL's workforce.

In FY 2010, NREL's injuries, not including minor first-aid, meet the 29 CFR 1904 criteria as "OSHA Recordable." Metrics relevant to NREL's health and safety performance are presented in the calculations above.

Number 200,000 (from OSHA) is a normalizing factor to account for the effort of work provided by a full-time worker. The value is derived from 2,000 effort hours times 100.

Training

NREL offers a wide range of workplace training activities to educate and enhance our staff's ability to perform their work in a safe manner. In FY 2010, a total of 24,244 hours of staff training were provided. This does not include training sponsored within individual centers. With a total NREL staff of 2,298 in FY 2010, the average hour per employee is 10.5 hours. NREL also provides extensive training to orient all subcontractors to safe procedures for their work on site. In FY 2010, more than 2,000 hours of training were provided for NREL subcontractors. In FY 2011, a robust training was implemented but hours were not recorded. However, in FY 2012, NREL will be creating a database to comprehensively record these hours.

Integrated Safety Management committees monitor safety, quality, and environmental management.

Planned Actions

Laboratory Operations

Periodic assessment and management review of NREL's IMS and its components provide verification that the IMS continues to be an effective tool to achieve and maintain compliance with regulatory and legal requirements, meet the established goals of the laboratory, and maintain management support for NREL's goals. Assessments and management reviews also provide for continuous improvement of the EMS. NREL will continue to conduct annual internal assessments to monitor performance of the IMS.

NREL has received the Gold-level award for the past two years in Colorado's Environmental Leadership Program (CELP). The Colorado ELP is a voluntary partnership between the Colorado Department of Public Health and Environment (CDPHE) and participating private and public Colorado facilities, recognizing environmental leadership and performance.

ELP recognizes facilities that voluntarily:

- Exceed regulatory requirements
- Implement EMSs (which focus on incorporating environmental considerations into normal management processes and improving internal environmental management effectiveness)
- Work closely with their communities
- Set three-year goals focusing on measurable results.

Under this program, NREL sets voluntary three-year environmental performance goals in an effort to further enhance operations and performance at the laboratory. NREL's current commitments are to pursue development of sustainable buildings, GHG reduction, and electronics recycling.

GRI Key Performance Indicators

Auditor's Assessment

Internal Audit at the National Renewable Energy Laboratory (NREL) functions as an independent, objective assurance and consulting activity designed to add value and improve operations. It helps NREL accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control, and governance processes. The Internal Audit group performs financial, performance, compliance, and information technology audits plus various examinations and reviews as requested by management.

NREL Internal Audit has evaluated the *Sustainable NREL Biennial Report* for fiscal years 2010 and 2011 to determine whether the contents of the report are sufficient to receive an application level of B using the criteria set forth by the Global Reporting Initiative (GRI). Based on the results of our evaluation, the report appears to contain the required management disclosures, profile disclosures, and performance indicators set forth in the GRI G3.1 Guidelines and we support NREL's self-assessment that this report meets the GRI application level of B.

Senators Michael Bennet and Mark Udall engage in new energy economy dialogue at NREL's Research Support Facility.

GRI KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	2010	2011
ENVIRONMENTAL PERFORMANCE			
MATERIALS			
EN2	Percentage of materials used that are recycled input materials	39%	44%
ENERGY			
EN3	Direct energy consumption by primary energy source		
	Natural gas	67,481 MCF	61,618 MCF
	Propane	216 gallons	309 gallons
	Gasoline	8,704 gallons	9,683 gallons
	Diesel	6,405 gallons	9,388 gallons
	E85	11,318 gallons	16,911 gallons
EN4	Indirect energy consumption by primary source (MMBtu)	76,529 MMBtu	77,651 MMBtu
	Nonrenewable	0%	0%
	Renewable	100%	100%
EN5	Energy saved due to conservation and efficiency improvements	none	After reducing the humidity setpoint from 28% to 20%, the S&TF gas consumption dropped to 51,800 therms (yielding a 32% gas savings worth $14,500) and decreased water use by 160,000 gallons.
EN6	Initiatives to provide energy-efficient or renewable energy based products and services, and reductions in energy requirements as a result of these intiatives	36 electrical charging stations are planned for the parking garage. PPAs /ARRA funding have been acquired for RSF complex PV array systems (which will offset 359 MWh/yr of grid electricity and achieve a net-zero energy achievement annually). High-performance building technologies are being integrated into new construction.	36 electrical charging stations have been constructed in the parking garage. High-performance building technologies are being integrated into new construction. RSF 1 office equipment allocates 64 watts per workstation versus 300 watts in a typical office space. Purchase and construction of the PV array for South Security Entrance Building (SEB) will allow the building to operate as a net-zero facility.
EN7	Initiatives to reduce indirect energy consumption and reductions achieved	Utilized the sale of RECs for reinvestment in energy-efficient technologies, wind production exported to the grid is credited back to STM utility bill annually	
WATER			
EN8	Total water withdrawal by source	15.188 MG	15.492 MG
EN10	Percentage and total volume of water recycled and reused	Colorado rainwater harvest laws prohibit capturing stormwater for reuse.	
BIODIVERSITY			
EN11	Location and size of land owned, leased, managed in, or adjacent to protected areas and areas of biodiversity value outside protected areas	STM Conservation Easement: 0.716 km^2 NWTC conservation management areas: 0.634 km^2	
EN12	Description impacts of activities, products, and services on biodiversity in protected areas and areas of high biodiversity value outside protected areas	Restoration measures primarily involve revegetation of facility areas on both STM and NWTC campuses following construction or installation of research test equipment. In FY 2010 and FY 2011, wildlife and vegetation studies were conducted. Overall, observed trends in vegetation patterns include a general increase in invasive and noxious weed species and a broad shift in native species composition toward more upland and transitional prairie species. NREL internally manages the revegetation of these areas, which utilized native seed mix of grasses with forbs, and both native shrubs and trees.	

GRI KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	2010	2011
EN13	Habitats protected or restored	STM Conservation Easement: 0.716 km^2. This conservation easement is a joint agreement with Jefferson County Open Space. NREL manages this STM area to preserve and maintain the health/viability of the native ecosystem. Jefferson County maintains trails and strict access other than passive recreation and bicycle trail use. The NWTC conservation management area totals 0.634 Km^2. NREL is the only organization that manages this area.	
EN14	Strategies, current actions, and future plans for managing impacts on biodiversity	See chapter on Material Assessments: Laboratory Operations	
EN15	Number of IUCN Red List species with habitats in areas affected by operations, by level of extinction	20 IUCN Red List species – See table on page 73 of the Laboratory Operations section	38 IUCN Red List species – See table on page 73 of the Laboratory Operations section
EMISSIONS			
EN16	Total direct (Scope 1) and indirect (Scope 2) GHG emissions (metric tons of CO_2 equivalent)	25,149 $MTCO_2e$	23,337 $MTCO_2e$
EN17	Other relevant indirect (Scope 3) GHG emissions (metric tons of CO_2 equivalent)	8,813 $MTCO_2e$	7,117 $MTCO_2e$
EN18	Initiatives to reduce GHG and reductions achieved	As part of NREL's alternative commuting program: 13% participated in the telework program, 7% participated in the AWS 9/80, and 8% participated in the AWS 4/10. Additionally, 78% of campus waste was diverted from the landfill. Our Scope 3 GHG have grown due to increased staff population. These initiatives have helped manage increases, but individually they have not been specifically measured on a $MTCO_2e$ equivalent basis.	As part of NREL's alternative commuting program: 19% participated in the telework program, 15% participated in the AWS 9/80, and 10% participated in the AWS 4/10. The Renewable Fuel Heat Plant has reduced our GHG emissions by 18% since 2008 and 77% of campus waste was diverted from the landfill. Our Scope 3 GHG have grown due to increased staff population. These initiatives have helped manage increases, but individually they have not been specifically measured on a $MTCO_2e$ equivalent basis.
EN19	Emissions of ozone-depleting substance by weight	NREL utilizes these chemicals in facility operations and scientific research. The amounts consumed are extremely low. The recorded totals below represent the purchased ozone-depleting substances from a three-year rolling average: refrigerants 13.772 lbs, HFC 12.314 lbs, PFC 2.586 lbs, and SF_6 4.306 lbs.	NREL utilizes these chemicals in facility operations and scientific research. The amounts consumed are extremely low. The recorded totals below represent the purchased ozone-depleting substances from a three-year rolling average: refrigerants 36.328 lbs, HFC 13.314 lbs, PFC .031 lbs, and SF_6 4.306 lbs.
EN20	NO, SO, and other significant air emissions by type and weight	NREL generated in 2010 the following emissions in tons per year: CO, 5.90; NO_x, 8.35; VOC, 0.45; PM_{10}, 0.98, and SO_2, 0.20.	NREL generated in 2011 the following emissions in tons per year: CO, 5,82; NO_x, 8.03; OC, 0.44; PM_{10}, 0.97; and SO_2, 0.15.
WASTE			
EN22	Total weight of waste by type and disposal method (metric tons)		
	Recycled	290.3 MT	587.73 MT
	Reuse	NREL's Reusable Office Supply Depot provides opportunities for centers and offices to save money and help the environment by repurposing office supplies that could end up in a landfill. NREL promotes green purchasing through an online catalog featuring environmentally preferable (recycled content) products. Since 1999, 100% of all carpet and office paper have contained at least 30% recycled content.	
	Recovery (Demolition)	1292.57 MT	1306.59 MT
	Incineration	0	0

GRI KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	2010	2011
EN22	Total weight of waste by type and disposal method (metric tons)		
	Landfilled	152.7 MT	214.12 MT
	Composted	31.05 MT	126.46 MT
	On-site storage	0	0
	Deep well injection	0	0
	Regulated hazardous waste	0	0
EN23	Total number and volume of significant spills	0	0
EN24	Weight of transported, imported, exported, or treated waste deemed hazardous under the terms of the Basel Convention Annex I, II, III, VIII, and percentage of transported waste shipped internationally	0	0
EN25	Identity, size, protected status, and biodiversity value of water bodies and related habitats significantly affected by the reporting organization's discharges of water and runoff	On NREL's STM campus there are two dominant arroyos that were carved into the mesa's slopes by centuries of erosive runoff. These arroyos are ephemeral but do contain faculative grass species. The central arroyo, 2,300 lineal feet, traverses through the campus and discharges to Lena Gulch (Water of the U.S.). There are no delineated wetlands. These arroyos provide the most significant presence of large, native vegetation communities, including shrub understory and thriving cottonwood groves. They are critical in supporting ecological functions for stream health, wildlife habitat, migration corridor movements, and a visual amenity.	
PRODUCTS AND SERVICES			
EN26	Initiatives to mitgate environmental impacts of products and services, and extent of impact mitigation	NREL staff has a responsibility to incorporate the principles of environmental protection into their activities detailed in Policy 6.2, Environmental Management. The Hazard Identification and Control Program identifies and analyzes existing, planned, and unplanned hazards in NREL's facilities and operations. The risk associated with each hazard is then assessed so that logical, effective controls can be designed and implemented. NREL's chemical inventory contains thousands of chemicals, many exotic and highly toxic. It is imperative that their entire life cycle at NREL, from ordering through disposal, is properly documented via the Chemical Management System. The Chemical/Hazardous Materials Release Procedure details what to do in the event of a spill or release into the atmosphere of a chemical/hazardous material where the hazard severity is unknown or cannot be immediately controlled safely. NREL's chemical management function also consults workers on the safe use of chemicals and maintains the lab's chemical inventory. Additionally, NREL has addressed potential noise hazards. A restricted timetable is in place to manage noise from construction activities for new facilities to mitigate noise impact for adjacent neighborhoods. Internally to the Research Support Facility, a pink noise system was constructed so it would help dissipate conversations between collective workspaces.	
EN27	Percentage of products sold and their packaging materials that are reclaimed by category	NREL conducts scientific research to promote new energy-efficient and renewable energy technologies that can be deployed to the marketplace. We do not manufacture any products; therefore, there is no product responsibility waste stream.	
COMPLIANCE			
EN28	Monetary value of significant fines and total number of non-monetary sanctions for noncompliance with environmental laws and regulations	0	0
TRANSPORT			
EN29	Significant environmental impacts of transporting products and other goods and materials used for the organization's operations, and transporting members of the workforce	0	0

GRI KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	2010	2011
OVERALL			
EN30	Total environmental protection expeditures and investments by type	$1,350,614	$1,513,080
HUMAN RIGHTS			
INVESTMENT AND PROCUREMENT PRACTICES			
HR3	Total hours of employee training on policies and procedures concerning aspects of human rights that are relevant to operations, including the percentage of employees trained	NREL currently provides training for staff in the "human rights" categories of Diversity, Harassment, Drug/Alcohol Awareness, and Workplace Violence. These modules were offered in FY 2011: Diversity Awareness—this course is mandatory for all employees, and 310 people (14%) completed the course in FY 2010. Workplace Respect (Harassment)—this course is mandatory for all employees, and 294 people completed the course in FY 2010. Drug and Alcohol Awareness—this course is mandatory for all employees, and 292 people completed the course in FY 2010. Workplace Violence—this course is not mandatory for employees; 170 people completed the course in FY 2010.	NREL requires training for all new employees in the "human rights" categories of Diversity, Harassment (334), and Drug/Alcohol Awareness. Four employees attended the Violence/Bullying in the Workplace seminar (which is not a required seminar).
NON-DISCRIMINATION			
HR4	Total number of incidents of discrimination and actions taken	No incidents	No Incidents
SECURITY PRACTICES			
HR8	Percentage of security personnel trained in the organization's policies or procedures concerning aspects of human rights that are relevant to operations	100% of security staff is trained. NREL Security department does not hire any third-party subcontractors.	
LABOR PRACTICES AND DECENT WORK			
EMPLOYMENT			
LA1	Total workforce by employment type, employment contract, and region	STM: 1,668 employees NWTC: 63 employees Washington D.C.: 11 employees	STM: 1,668 employees, 844 contractors NWTC: 63 employees, 72 contractors Washington D.C.: 17 employees
LA2	Total number of new employee hires and employee turnover	393 new hires in FY 2010 Turnover rate in CY 2010 – 9.89%	334 new hires in FY 2011 Turnover rate in CY 2011 – 8.43%
LA3	Benefit provided to full-time employees that are not provided to temporary or part-time employees, by significant locations or operations	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 Loan Program.	
LA6	Percentage of employees represented in formal joint management-worker health and safety committees that help monitor and advise on occupational health and safety programs	Health & Safety: 14 NREL and 2 subcontract Environmental Protection: 7 NREL Occupational Medicine: 2 NREL and 1 subcontract	Health & Safety: 15 NREL and 3 subcontract Environmental Protection: 8 NREL Occupational Medicine: 2 NREL and 1 subcontract
LA7	Rates of injury, occupational diseases, lost days and absenteeism, and number of work related fatalities by region	6 injury incidents, 1 lost work day	6 injury incidents, 2 lost work days

GRI KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	2010	2011
OCCUPATIONAL HEALTH AND SAFETY			
LA8	Education, training, counseling, prevention, and disease-control programs in place to assist workforce members, their families, or community members regarding serious diseases	NREL is a smoke-free workplace. NREL strives to maintain an alcohol and substance abuse-free workplace as part of its commitment to provide a safe and healthful environment for its employees and other workers. All employees are required to take webinar training during employee orientation. NREL healthcare insurance providers regularly hold education, training, and counseling sessions for all NREL workforce for preventative care. NREL's occupational health activities (EH&S office) promote and maintain the physical, mental, and emotional well being of employees and prevent or reduce potential exposure to health hazards in the workplace.	
TRAINING AND EDUCATION			
LA10	Average hours of training per year per employee by employee category	In FY 2010, staff trained a total of 24,244 hours not including the training sponsored within the center. With a total NREL staff of 2,298 in FY 2010, the average hour per employee is 10.5 hours.	A robust training program was implemented in 2011, but hours were not recorded for the fiscal year.
LA11	Programs for skills management and lifelong learning that support the continued education 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 approved degree programs up to a fiscal year limit of $7,500 for undergraduate degrees ($10,000 for graduate degrees). NREL currently offers training opportunities to staff to advance employee skill sets and learning objectives. NREL course offerings include: Managing Conflict (primarily for managers), Exploring Inclusion, Leading Across Generations (primarily for managers), Communicating Across Cultures (primarily for managers), Executive Forum Leadership Series (for managers only), Proposing to Win, Interviewing Today's Workforce, Increasing Personal Effectiveness, Effective Writing and Presentations, Focus: Achieving your Highest Priorities – Outlook Edition, and 7 Habits of Highly Effective People. Individual NREL centers have overhead funding that can be used to pay for training to advance employee skill sets and learning objectives.	
LA12	Percentage of employees receiving regular performance and career development reviews	100%	100%
SOCIETY			
COMMUNITY			
SO1	Nature, scope, and effectiveness of any programs and practices that assess and manage the impacts of operations on communities, including entering, operating, and exiting	To implement Executive Orders and expand Sustainable NREL initiatives, campus projects integrate physical boundaries, connect to transportation and utility systems, and protect ecosystems and open space. All of these elements have linkages that forge stronger communuity, neighbor, and user relationships. NREL continues to coordinate with appropriate local and regional planning organizations and government agencies to improve land use, transportation, growth, and sustainability within the community. In FY 2010 and FY 2011, plannning and construction activities included: 1) a new South Entrance Road, which required a traffic mitigation report, 2) bicycle and pedestrian supportive infrastructure, 3) continuation of NREL's shuttle program to connect staff with regional public transit services, 4) a detention and water quality pond that would protect the watershed for the neighboring Lena Gulch, and 5) the installation of a wildlife-friendly boundary fence along the sourthern boundary of the STM campus, which will facilitate animal movement from the mesa Top through STM to Lena Gulch south of NREL.	
CORRUPTION			
SO2	Percentage and total number of business units analyzed for risks related to corruption	The risk of all forms of fraud, including corruption, is evaluated across the laboratory as follows: 1) The Enterprise Risk Management committee includes discussion of the potential for fraud, the probable impact if experienced, and the likelihood that it could occur several times each year. The Enterprise Risk Management program covers all operations. 2) The Alliance Finance and Audit Committee considers all forms of risk in meetings three times each year.	
SO3	Percentage of employees trained in organization's 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 assure timely completion.	

GRI KEY PERFORMANCE INDICATORS

GRI Indicator	Indicator Title	2010	2011
SO4	Actions taken in response to incidents of corruption	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 2010 and 2011, no reports of incidents of corruption were received, hence no action was necessary.	
PUBLIC POLICY			
SO5	Public policy positions and participation in public policy development and lobbying	As a U.S. national laboratory, operated by a nonprofit contracting organization for the federal Department of Energy, NREL does not lobby public officials nor engage in direct advocacy for policy. However, as the nation's premier research institution for clean-energy technology, NREL and its scientists, engineers, and analysts are actively engaged in providing science-based information on behalf of sustainable energy resources, sustainable energy generation, and sustainable energy use. Given that NREL researchers frequently are leaders in their respective fields, NREL plays a vital role in most of the nation's and world's major non-governmental organizations dedicated to clean energy.	
SO6	Total value of financial and in-kind contributions to political parties, politicians, and related institutions by country	0	0
ANTICOMPETITIVE BEHAVIOR			
SO7	Total number of legal actions for anticompetitive behavior, antitrust, and monopoly practices and their outcomes	NREL did not experience any legal actions for anticompetitve behavior, antitrust, or monopoly practices in either 2010 or 2011. Note: as a Federally Funded Research and Development Center (FFRDC), NREL has one primary business client, the U.S. Department of Energy (DOE). DOE provides comprehensive oversight of NREL operations. Both NREL and DOE policies maximize compliance with laws and regulations plus sound business practices.	
COMPLIANCE			
SO8	Monetary value of significant fines and total number of non-monetary sanctions for noncompliance with laws and regulations	NREL was not fined, nor did we experience any significant nonmonetary sanctions for noncompliance with laws and regulations in either 2010 or 2011. Note: as a FFRDC, NREL has one primary business client, the DOE. DOE provides comprehensive oversight of NREL operations. Both NREL and DOE policies maximize compliance with laws and regulations plus sound business practices.	
ECONOMIC			
EC1	Direct economic value generated and distributed, including: revenues, operating costs, employee compensation, donations and other community investments, retained earnings, and payments to capital providers and governments	Revenues of $443.9.9M Employee compensation of $135.1M Operating costs of $302.4M Donations of $30K Payment to capital providers and government: none	Revenues of $532.9M Employee compensation of $159.9M Operating costs of $366.4M Donations of $43K Payment to capital providers and government: none
EC2	Financial implications and other risks and opportunities for the organization's activities due to climate change	Our research is one fundamental step in NREL's work to mitigate climate change by advancing low-carbon energy alternatives. Esteemed NREL researchers also worked to spread the climate change message to local agencies and communities by delivering presentations with an aim of demystifying climate change. In FY 2011, NREL began participation in DOE's Climate Adaptation Planning Working Group. (NREL provided knowledge and input to the draft DOE Preliminary High Level Analysis of Vulnerability to Climate Change document to be completed in FY 2012.)	
EC3	Coverage of the organization's defined benefit plan obligations	NREL meets all required funding obligations. As we moved into PPA regulations, and higher funding targets, NREL chose to make higher than the minimum required contributions to spread out anticipated higher contributions. NREL funding for the retirement plan in FY 2010 was over $11M.	NREL meets all required funding obligations. As we moved into PPA regulations, and higher funding targets, NREL chose to make higher than the minimum required contributions to spread out anticipated higher contributions. NREL funding for the retirement plan in FY 2011 was over $18M.
EC4	Significant financial assistance received from government	NREL received no financial assistance from the government.	
EC8	Development and impact of infrastructure investments and services provided primarily for public benefit through commercial, in-kind, or pro bono engagement	NREL does not have investments or services primarily for public benefit.	

"Our leadership in sustainability strengthens our standing as the nation's preeminent institution for renewable energy."

—Frank Rukavina, Sustainability Director

Message from the Sustainable NREL Director

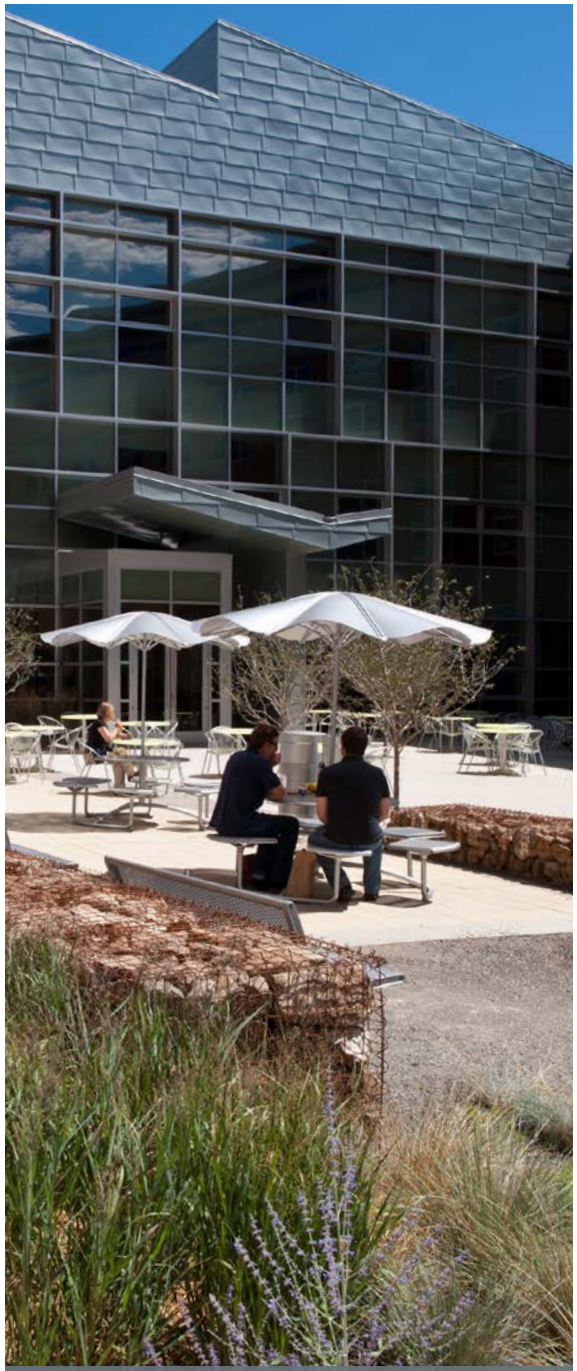
A Sustainable Response to the Nation's Need for Clean Energy

National and world events, including attention to climate change and the increased need for national energy independence have intensified our nation's and the world's urgency for cost-effective renewable energy, energy-efficient buildings, and alternatively fueled vehicles.

NREL is responding to these needs by accelerating our research and supporting the deployment of renewable energy and energy efficiency technologies, increasing our talent pool, and constructing new and nationally needed research infrastructure. The result is unprecedented growth at NREL. The employee population has more than doubled in the past four years, and research, office, and support facilities will increase to almost 1.1 million square feet by the end of current build-out on track to be completed in FY 2012.

We have undertaken this expansion utilizing the most sustainable and energy-efficient means possible following our commitment to sustainability, a key factor in NREL's mission and our values. NREL's Sustainability Program has been in place since FY 2000 and is recognized as a national leader due to its executive-level sustainable facility management. Through our corporate sustainable decision-making, we have:

- Maintained our internal goal that all capital construction at NREL will be LEED Gold- or Platinum-certified by the U.S. Green Building Council
- Added on-site renewable energy systems to both of our campuses by:
  - Purchasing photovoltaic (PV) arrays and entering into power purchase agreements for PV arrays that require no government capital funds
  - Operating a wood-burning Renewable Fuel Heating Plant. The capital costs are assumed by an Energy Services Company
  - Constructing new wind turbines at the National Wind Technology Center, through Cooperative Research and Development Agreement (CRADA) partnerships. (Excess power generated from NREL-owned turbines is credited to offset South Table Mountain campus electricity cost)
- Invested in advanced metering and developed enterprise-wide energy management systems to foster energy systems integration



Becoming a net-zero energy laboratory embodies NREL's sustainability goals.

- Utilized sustainably designed landscaping around the new Research Support Facility and associated Visitor Parking and 1,800-car sustainably designed parking garage, and pursued the SITES sustainable landscape certification.

With the dissemination of Executive Order 13514 Federal Leadership in Environmental, Energy and Economic Performance, the U.S. government is taking a leadership role to operate in a sustainable manner. NREL's goal is to lead this federal effort through innovative, sustainable life-cycle corporate decision-making and cutting-edge sustainable operations. The federal Energy Acts, Executive Orders, and DOE Orders provide the framework for goal setting. But NREL desires to exceed these goals and implement operational changes that will maximize the:

- Conservation of energy and resources
- Full use of renewable electric energy
- Lowering of GHG emissions and water and fuel use
- Management of waste streams to near zero.

NREL, having been on the cutting edge of implementing programs such as these for nearly a decade, has been successful in many areas and struggled in a few others. NREL has successfully lowered our energy and water use intensity per capita. However, we struggle in the areas where our increased population and growth in infrastructure make it difficult to attain *absolute* reduction goals as specified in federal guidance. We have been successful in all areas where reduction measures are adjusted for growth per capita or per square foot, but our goals have baseline years preceding our more than 100% growth in many areas, including population and building square footage.

As this report indicates, we are on track to meet all but two federal goals: fleet petroleum fuel and Scope 3 GHG. In addition, we are currently on track with our water intensity goal, but we are forecasting that water intensity will rise during FY 2013 due to plans to construct and cool a high-performance-computing (HPC) system as part of the future Energy Systems Integration Facility. We plan to replicate the success of our national award-winning Data Center at the Research Support Facility by utilizing our dry climate to air cool (via water) the HPC. The additional water usage will be somewhat offset by the large reduction in electricity use that is normally used for cooling HPCs.

NREL's sustainable operations leadership is helping meet federal Executive Orders, Guiding Principles, and Energy Act goals. Advancing the use of the Global Reporting Initiative (GRI) format of this report is just one example of elevating NREL's leadership to a higher level. Another is our aggressive goal of becoming a net-zero energy laboratory—a stretch measure to be sure—but one that embodies our quest to develop more cost-efficient renewable energy and does it in the most sustainable manner possible.

—Frank Rukavina, Sustainability Director

The award-winning Amonix 7700 is the first terrestrial photovoltaic system capable of converting one-fourth of the sun's energy into usable electricity.

NREL Awards and Honors FY 2010

R&D 100 AWARDS

"Black Silicon" Nanocatalytic Wet-Chemical Etch. NREL photovoltaic researchers demonstrated that "black silicon" solar cells, chemically etched to appear black, can better absorb the sun's energy—thereby reducing light reflection from silicon wafers to less than 2%.

Amonix 7700 Solar Power Generator. Developed in a partnership between NREL and Amonix, this highly concentrated, highly efficient bulk power generator produces 40% more energy than conventional fixed photovoltaic panels.

SCIENCE AWARDS AND HONORS

The Museum of Science and Industry honored Dr. Dan E. Arvizu, NREL Director, with its **National Hispanic Scientist of the Year Award** for his outstanding contributions.

The American Chemical Society (ACS) named Dr. Helena Chum, Research Fellow, a **2010 Fellow**.

HENAAC named Dr. Manuel Romero a **2010 HENAAC Luminary** for his research contributions to high-efficiency thin-film solar cells.

The University of Rome recognized Dr. Alex Zunger, Research Fellow, with two prestigious Italian scientific honors:

- **The Tomassoni Physics prize**
- **The Science Medal of Scola Physica Romana.**

The Institute of Electrical and Electronics Engineers, Inc. (IEEE) honored Mr. Dick DeBlasio, Program Manager for Electricity, with the **2010 IEEE Charles Proteus Steinmetz Award** for contributions to the standardization and global impact of distributed electric power supply system interconnection technology.

The French-American Chamber of Commerce honored Dr. Dan E. Arvizu, NREL Director, for **Outstanding Contributions to French-American Business and Research** and for his

contributions to research collaborations between NREL and the renewable energy laboratories in France.

The National Building Museum honored the U.S. Department of Energy Solar Decathlon with its 2010 Award for its Commitment to Educating the Next Generation of Engineers, Architects, and Builders through whole building design. NREL plays a major role in the coordination of this event.

Dr. Alex Zunger, Research Fellow, received the Gutenberg Lecture Award 2009 for the "Inverse Design: How to Predict Solids with Target Properties."

LEADERSHIP AWARDS

Rocky Mountain Minority Supplier Development Council honored NREL with its 2009 RMMSDC Growth through Partnership Corporation of the Year Award for the lab's outstanding work with minority business enterprise.

The Hispanic Contractors of Colorado honored Dr. Dan E. Arvizu, NREL Director, with its Public Achievement Award for his service to the state, country, and international community, particularly relating to renewable energy.

The National Energy Education Development (NEED) named NREL's Education Program the NEED State Program of the Year because of the diverse and dedicated partners providing energy education opportunities to students, teachers, and families in Colorado.

The Jefferson Economic Council presented NREL with its Industry Appreciations/Pioneer Awards for the lab's long-term commitment to the community and contributions to economic development with an emphasis on its 2009 growth.

Community Shares of Colorado honored NREL for its successful 2009/2010 corporate giving campaign. This was the third consecutive year that the lab received this award. Community Shares also honored Ms. Syl Morgan Smith with a Volunteer of the Year Award for her outstanding work leading the NREL charitable giving campaign.

DOE AWARDS

NREL received two awards from DOE for its long-term commitment to the National Science Bowl (NSB):

- NREL was honored for its coordination of the event
- Education staff member Ms. Linda Lung was honored for her dedication to, and organization of, the NSB program.

Mr. Michael Penev and Ms. Darlene Steward of NREL's Hydrogen Technologies and Systems Center received awards for their technical contributions to the systems analysis component of DOE's Fuel Cell Technologies Program. They developed the Fuel Cell Power Model, which is widely used by national laboratories and industry to assess the cost, energy savings, and benefits of fuel cells.

Dr. Lin Simpson of NREL's Chemical and Materials Science Center accepted a team award for the DOE Hydrogen Sorption Center of Excellence (HSCoE) for advancing the state of the art in hydrogen storage materials. Simpson is director of the HSCoE, which was among three centers of excellence recognized for significantly increasing the understanding and development of hydrogen storage materials over the past five years.

NREL consultant Mr. Douglas Wheeler received an award for his contributions to DOE's Fuel Cell Team. Wheeler served on an NREL-commissioned independent review panel that evaluated the 2008 Fuel Cell System Cost Estimate for Transportation.

Mr. John Christensen, also an NREL consultant, received an award for his contributions to the market transformation activity within the DOE Fuel Cell Technologies Program.

R&D 100 AWARDS

NREL Innovalight Silicon Ink for High-Efficiency Solar Cells. NREL/Innovalight partnership. Silicon Ink is a nanotechnology-based product that dramatically improves both the cost and conversion efficiency of silicon solar cells in the manufacturing environment. With the ink, one manufacturing step is added using a solar industry standard screen printer, which produces an immediate increase in solar cell efficiency.

"Flash" Quantum Efficiency System for Solar Cells. NREL/Tau Science partnership. Quantum efficiency (QE) measurements indicate how well a solar cell converts the various wavelengths of sunlight into electricity. The ability to measure QE provides a crucial diagnostic tool for solar cell performance.

Optical Cavity Furnace. NREL/AOS Solar, Inc. partnership. Conventional means of heating solar cells during the manufacturing process can waste a considerable amount of energy if it is not focused specifically on the cells, and uneven temperature can result in cells with subpar performance. The Optical Cavity Furnace delivers almost all the heat energy (1,200°C) to the cell. Using light as a heat source to illuminate a thin wafer of silicon, the furnace virtually eliminates energy loss.

SCIENCE AWARDS AND HONORS

Northeastern Section of the American Chemical Society honored Dr. Arthur Nozik, Senior Research Fellow, with the **2011 Gustavus John Esselen Award** for Chemistry in the Public Interest. Nozik received this award for breakthrough research on quantum dots that can tremendously increase the efficiency of PV cells for solar energy utilization.

Institute for Electrical and Electronics Engineers (IEEE) honored Research Engineer Richard DeBlasio with the **IEEE 2010 Charles Proteus Steinmetz Award** for his work in renewable electricity and end use systems.

American National Standards Institute (ANSI) recognized Research Engineer Richard DeBlasio with the **Finegan Standards Leadership Medal** for his research and development contributions to reducing technical barriers to the use of distributed generation technologies and grid integration by the national and international communities.

Institute of Electrical and Electronics Engineers (IEEE) honored Dr. Jerry Olson, Principal Scientist, with the **Cherry Award** at IEEE's annual Photovoltaic Specialists Conference in Seattle for his work in multi-junction solar cells for use in outer space and on Earth.

University of Maine, College of Engineering honored Lawrence Kazmerski, Executive Director of Science and Technology Partnerships, with the **Edward T. Bryand Award** for his outstanding contributions to the science and engineering of solar PV technology, including the first development of the copper-indium-diselenide thin-film solar cell at the University of Maine.

The American Council of Engineering Companies recognized the National Wind Technology Center (NWTC) Row 4 Turbine Infrastructure for improving wind turbine technology to meet soaring worldwide energy demands. This achievement also earned NREL the **McGraw Hill Golden Hard Hat Award.**

Oracle honored Sandia National Laboratory/NREL with its **2011 Eco-Enterprise Innovation Award** for taking an environmental lead and improving business efficiencies using green business practices.

World Renewable Energy Congress/Network (WREN) Pioneers recognized Senior Scientists Dr. Falah Hasoon, Dr. Chuck Kutscher, and Dr. David Renné for the impact their discoveries and innovations have made on the progress and acceptance of renewable energy technologies at WREN in Abu Dhabi.

NREL Awards and Honors FY 2011

Fellow American Association for the Advancement of Science (AAAS) named Stanley Bull, former Associate Director for Science and Technology, **Fellow of the AAAS.**

Federal Laboratory Consortium Technology Transfer Award for "Flexible Thin-Film Crystalline-Silicon Photovoltaics on RABiTS™" went to Ampulse in partnership with NREL/ORNL, for depositing crystalline silicon onto inexpensive substrate materials.

Federal Laboratory Consortium (FLC) Mid-Continent honored NREL with an **Award for Excellence in Technology Transfer.**

- The partnership between NREL and Innovalight tells a compelling story of how to shorten the timeline from development of a new product to commercialization. Silicon Ink is a nanotechnology-based product that dramatically improves both the cost and conversion efficiency of silicon solar cells in the manufacturing environment.
- NREL's work with The America's Next Top Energy Innovator program allowed NREL to give E-Chromic Accelerate a reduced price on an Option Agreement for electrochromic window technology. This technology has the potential to reduce the demand for cooling power during the day and can reduce cooling costs by 25%-30% for commercial buildings.

Federal Laboratory Consortium Mid-Continent Notable Technology Development recognition went to NREL's "black silicon" nanocatalytic wet-chemical etch. This is a one-step process for creating high-efficiency solar cells based on an innovative antireflection approach that promises to significantly reduce manufacturing costs, thereby helping propel PV toward cost competitiveness.

Federal Laboratory Consortium Mid Continent Outstanding Lab Representative recognition went to NREL's Carrieann McDonough, Commercialization and Technology Transfer Agreement's Specialist, who was recognized for her service as NREL's representative to the FLC Mid-Continent organization.

2010 Governor's Award for High-Impact Research Energy Efficiency went to Dr. Satyen Deb, Energy Sciences Center Director, who discovered that a small electrical charge can change the opacity of tungsten oxide from clear to tinted. Electrochromic windows allow natural light in while adding tint to reduce summer heat and glare; in the winter, the glass goes clear to allow sunlight through.

2010 Governor's Award for High-Impact Research, Energy Efficiency Finalist went to NREL's Vehicle Ancillary Loads Reduction team, which explored the question of how to reliably and repeatedly evaluate advanced heating and cooling systems in vehicles.

American Solar Energy Society honored Dr. Tom Stoffel, Principal Manager, Solar Resources and Forecasting Group, with the **2011 Charles Greely Abbott Award** for significant contributions to the measurement and understanding of the solar resource and for his leadership at NREL's Solar Radiation Research Laboratory.

The U.S. Environmental Protection Agency and Office of the Federal Environmental Executive honored NREL with the **Federal Electronic Challenge, Platinum Award** for leadership in the Federal Electronics Challenge during fiscal year 2010.

DOE Annual Merit Awards for Research, Development and Analysis of Fuel Cell and Hydrogen Technologies went to Marc Melaina, Infrastructure Analysis Team Leader, for outstanding achievement and significant contributions to the DOE Hydrogen Program.

American Society of Heating, Refrigerating and Air-Conditioning Engineers' (ASHRAE) honored Sheila Hayter, Senior Engineer, with the **Exceptional Service Award.**

Society of Automotive Engineers' recognized John Rugh, Senior Engineer, with its **2011 Lloyd L. Withrow Distinguished Speaker Award** for high-quality presentations during SAE technical sessions.

The U.S. Senate confirmed President Barack Obama's appointment of Dr. Dan Arvizu, NREL Director, to a seat on the National Science Board.

Dr. Dan Arvizu, NREL Director, was inducted into the National Academy of Administrators.

Doug Arent, Executive Director of the Joint Institute for Strategic Energy Analysis, was appointed to the National Research Council (NRC).

Oregon State University Engineering Hall of Fame. Dr. Bob Thresher, NREL Research Fellow, was selected for distinguished contributions to the engineering community and society at large.

Hispanic Engineering (HENAAC) recognized Manuel Romero, Senior Scientist, as a HENAAC Role Model of the Week for Hispanic engineers, scientists, and technology professionals.

Fuel Cell and Hydrogen Energy Association (FCHEA) invited Keith Wipke, Fuel Cell and Hydrogen Technologies Program Manager, to join its Board of Directors.

Biofuels Digest's "Top 100 People in Bioenergy" for 2010 selected scientists Tom Foust, Al Darzins, and Phil Pienkos as bioenergy leaders through a two-week Biofuels Digest reader poll that garnered more than 15,000 votes.

Association of Certified Fraud Examiners (ACFE), Board of Regents elected Johnnie Bejarano, Senior Financial Analyst, to serve on its board, the world's largest anti-fraud organization and premier provider of anti-fraud training and education.

SUSTAINABILITY AWARDS

GreenGov Presidential Award was received by the NREL Sustainability program for operating the living laboratory.

DOE E-STAR Award, Building the Sustainable Campus of the Future was received by Sustainable NREL.

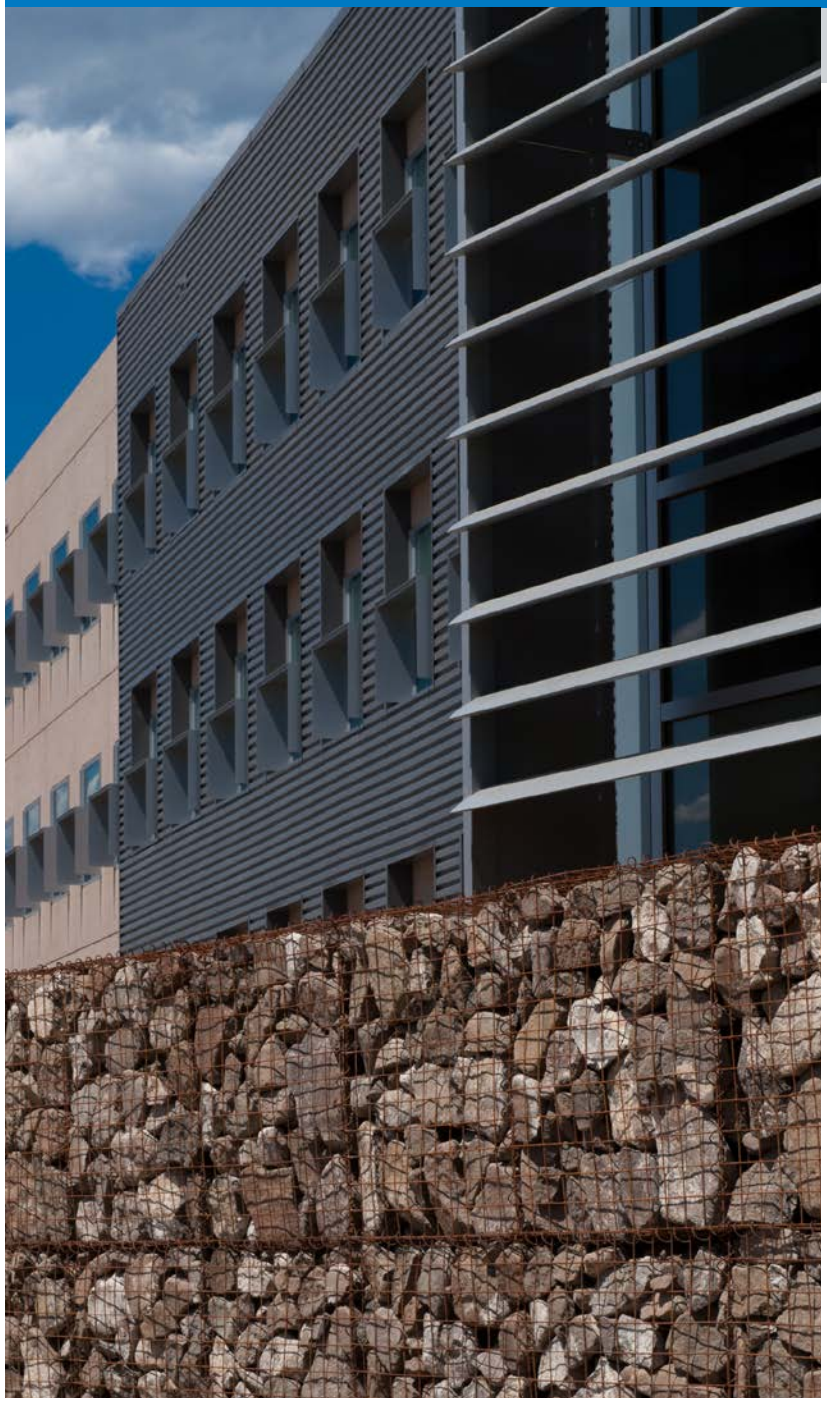
DOE E-STAR Award, Near-Zero Materials Waste and Beyond was received by Sustainable NREL.

Colorado Environmental Leadership Program (CELP) – 24K Gold Award – Silver Award for Sustainability video.

2011 American Institute of Architects COTE Top Ten Green Projects Award. With the help of technical Assistance provided by NREL's Lynn Billman, Senior Research Analyst/Supervisor, and Shanti Pless, Senior Research Engineer, among others, Greensburg has effectively deployed wind, solar, and geothermal technologies as well as numerous efficiency and sustainable measures.

2011 Siemens Sustainable Community Award for Small Community. A partnership between Siemens USA and the U.S. Chamber Business Civic Leadership Center, the Siemens Sustainable Community Awards recognize communities and coalitions that are developing solutions for green and economic sustainability.

2011 United Nations Global Green City Award. Greensburg received the "Global Green City" award from Assistant Secretary-General of the United Nations (UN), Dr. Awni Behnam, at the Sixth Global Forum on Human Settlements on April 8, 2011.



Research Support Facility Awards FY 2010 – FY 2011

The U.S. Department of Energy's Research Support Facility (RSF) at the National Renewable Energy Laboratory (NREL) has been honored with 29 awards for being a showcase for energy efficiency and renewable energy technologies; the most prominent include:

- The American Institute of Architects (AIA) 2010 Citation Award for Built for design excellence
- AIA Denver Design Award Citation Award for Built Architecture
- AIA Denver Design Award People's Choice Award
- 2011 AIA National/COTE Top Ten Green Project Award for excellence in sustainable design principles and reduced energy consumption
- Associated General Contractors (AGC) of America 2011 National AON Build America Merit Award for demonstrating one of the nation's most impressive construction projects
- Design-Build Institute of America (DBIA), Rocky Mountain Region, Best Project in the Public Sector
- DBIA 2011 Distinguished Leadership Award – Karen Leitner
- McGraw-Hill Construction Outstanding Green Building, 2010
- Mountain States Construction (MSC), Gold Hard Hat Award and Special Judges Award
- Engineering News Record (ENR), 2011 Award of Excellence and 2010 Newsmaker Award
- 2010 Colorado Sustainable Design Awards in the Civic category
- Colorado Department of Public Health, Achievement Award, Bronze
- Colorado Renewable Energy Society, Institutional Building Award.

NREL/MP-3000-54443 • September 2012

Graphics: Christina Chase, page 6, page 68. Illustrations: pages 4, 11, 32, RNL Design; page 22, Dean Armstrong; page 31, JEDunn. Photo by Christina Chase, page 74, NREL/PIX 22071. Photos by Dennis Schroeder: cover, NREL/PIX 18640; page i, NREL/PIX 18639; page ii NREL/PIX 19194; page 1, NREL/PIX 20120; page 5, NREL/PIX 17613; page 8, NREL/PIX 20381; page 12, NREL/PIX 19066; page 15, NREL/PIX 19914; page 16, NREL/PIX 22298; page 20, NREL/PIX 19789; page 25, NREL/PIX 17852; page 27, NREL/PIX 16937; page 29, NREL/PIX 19911; page 30, NREL/PIX 18535; page 36, NREL/PIX 18516; page 38, NREL/PIX 19785, NREL/PIX 19792; page 39, NREL/PIX 19793, NREL/PIX 18224; page 40, NREL/PIX 19799; page 42, NREL/PIX 19913; page 43, NREL/PIX 19797: page 44, NREL/PIX 19802; page 46, NREL/PIX 17937; page 47, NREL/PIX 17610; page 48, NREL/PIX 19788; page 54, NREL/PIX 19409, NREL/PIX 19262, NREL/PIX 19803; page 55, NREL/PIX 19794; page 57, NREL/PIX 20049; page 58, NREL/PIX 19070; page 61, NREL/PIX 05171; page 63, NREL/PIX 20954; page 66, NREL/PIX 18885; page 69, NREL/PIX 19800; page 70, NREL/PIX 19784; page 72, NREL/PIX 19912; page 75, NREL/PIX 20513, NREL/PIX 07768; page 76, NREL/PIX 22323; page 77, NREL/PIX 19787; page 78, NREL/PIX 19781, page 85, NREL/PIX 19895; page 86, NREL/PIX 17828; page 87, NREL/PIX 18524; page 92, NREL/PIX 22324. Photo by Michelle Slovensky, page 62, NREL/PIX 19782. Photo by Robb Williamson, page 3, NREL/PIX 20958

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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

NREL/MP-3000-54443 • September 2012

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