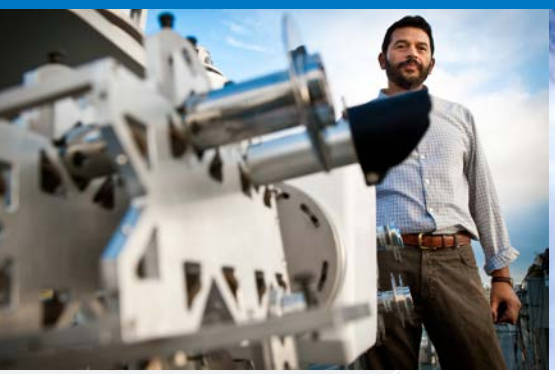
NREL
NATIONAL RENEWABLE ENERGY LABORATORY



Leading the Way to Energy Systems Research

Fast Facts

- NREL's main 327-acre campus is in Golden, Colorado.
- The laboratory operates the National Wind Technology Center on 305 acres 13 miles north of Golden.
- NREL's staff of nearly 1,500 full- and part-time employees and 800 visiting researchers, student interns, and contractors collectively hail from more than 40 countries.
- Total NREL payroll in FY 2014 was more than $158 million.
- The most recent study of NREL's economic impact was completed in 2013; NREL's economic impact totaled $814.8 million for FY 2012.

The National Renewable Energy Laboratory (NREL) is the U.S. Department of Energy's (DOE) primary national laboratory for renewable energy and energy efficiency research and development. From scientific discovery to accelerating market adoption, NREL deploys its deep technical expertise and unmatched breadth of capabilities to drive the transformation of our nation's energy systems. NREL's work focuses on advancing renewable energy and energy efficiency technologies from concept to the commercial marketplace through industry partnerships.

Alliance for Sustainable Energy, LLC, a partnership between Battelle and MRIGlobal, manages NREL for DOE's Office of Energy Efficiency and Renewable Energy.

History

NREL started as the Solar Energy Research Institute (SERI) in 1977, spurred by national concern during the 1973 oil embargo. President Jimmy Carter visited SERI in 1978, and in 1979 said, famously: "No one can ever embargo the sun or interrupt its delivery to us." Thirteen years later, President George H.W. Bush elevated SERI to a national laboratory and changed its name to the National Renewable Energy Laboratory.

Whereas SERI's roots were dedicated to harnessing power from the sun, NREL is dedicated to all forms of renewable energy and energy efficiency—and to working with industry to transfer innovative ideas into the marketplace.

Nearly 40 years of research on solar, wind, and biomass energy have yielded impressive results. The cost of solar energy has fallen 96%, and now stands at less than a dollar a watt for a solar module, pre-installation; globally, solar energy grew by more than 50% each of the past five years. The cost of wind energy has declined from 40 cents per kilowatt-hour when the lab was founded to 6 to 9 cents today. Wind energy has been the fastest-growing source of new electricity generation in the nation over the past five years; globally it has grown at an annual rate of greater than 25%. The cost of converting biomass into cellulosic ethanol has fallen by 67%, thanks in part to NREL's work on enzymes.

More recent innovations—enzymes that can digest methane, solar cells that can harvest two electrons from every photon, gearboxes that can double the lifespan of turbines, smart windows that can block stifling heat—will hasten the day when the world gets the most of its energy from renewable sources.

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.

Energy Integration

NREL's newest building, the Energy Systems Integration Facility (ESIF), is where utilities, industry partners, and government agencies are working toward an integrated energy future—a future in which solar, wind, and other renewables work together with traditional fuels to deliver clean, reliable energy to the nation.

The ESIF, a DOE User Facility, offers a set of unique resources under one roof to investigate how to get America's energy infrastructure ready for an infusion of renewable power, to upload and download energy for vehicles, to optimize storage devices, and to control strategies for power delivery. It's a place for public-private partnerships, where vendors and operators can try out new ideas, technologies, and architectures. Capabilities are at the megawatt scale, which allows researchers and manufacturers to conduct integration tests at full power and actual load levels in real-time simulations.

The ESIF has a petascale high-performance computer (HPC), which affords unprecedented modeling and simulation of materials, properties, processes, and fully integrated systems that would otherwise be too expensive or even impossible to study. The ESIF's unique and sophisticated data analysis and visualization system allows researchers and NREL partners to "see" complex systems and operations in a completely virtual environment. And in NREL's ongoing effort to "walk the talk," the HPC data center is one of the most energy efficient in the world.

NREL reuses the "waste" heat generated by the HPC system as the primary heat source in ESIF offices and lab space. Combining the efficiency of the data center with the energy efficiency features of the HPC system and reusing the system's heat to reduce overall energy use saves approximately $1 million in annual operating costs, compared to a traditional data center.

Science & Technology

NREL's research not only improves today's renewable energy and energy efficiency technologies, but it develops tomorrow's innovations to meet the nation's energy goals and change the way we power our homes, businesses, and transportation.

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

The work NREL researchers do in the lab with industrial partners and with governments around the world has led to:

- Enzymes that cost 10% of what they cost a decade ago, release sugar faster, and get America closer to the day when biofuels made from the non-food parts of plants are an economic, cleaner alternative to fossil fuels
- Advances in solar cells and modules, including pioneering work in multijunction cells, thin-film cells, and concentrated photovoltaics, that have launched several successful companies and made solar among the fastest-growing sectors in U.S. energy
- Reduction of the cost of plug-in electric vehicle (PEV) batteries by approximately 50% over the last four years; total U.S. 2014 PEV sales crossed the 100,000 milestone to 123,049 in sales
- An energy audit tool, simuwatt, that more accurately pinpoints potential energy savings while costing 35% to 75% less than traditional audits, an innovation that could save billions of dollars and keep billions of tons of greenhouse gases out of the atmosphere
- Landmark studies of the east and west sections of the U.S. power grid that show how to fully harvest the nation's bountiful wind and solar resources
- Pioneering work in wind energy at NREL's National Wind Technology Center, including: developing air foils and turbine blades that can catch the wind at maximum efficiency; improving the durability of turbine gearboxes; and testing the durability and lifespan of giant turbines under severe weather conditions with state-of-the-art dynamometers
- Partnerships in most U.S. states assessing renewable energy potential and creating blueprints for rebuilding "green" after tornadoes, hurricanes, and other disasters.

NREL's research facilities provide unique partnering capabilities. The Integrated Biorefinery Research Facility, Process Development and Integration Laboratory, and National Wind Technology Center allow R&D partners in biofuels, solar, and wind energy to collaborate, explore, and innovate using state-of-the-art facilities.

In 2014, NREL earned its 56th and 57th R&D 100 awards to add to scores of other honors from the science and technology community.

Energy Analysis

DOE turns to NREL for analysis of energy solutions and challenges, both present and future. Groundbreaking analyses have helped redefine what's possible for renewable energy. For example, with the Renewable Electricity Futures study, the Eastern Renewable Generation Integration Study, and several other foundational reports, NREL has incorporated detailed understanding of systems and technology performance and costs, markets, policies, and resources. Collectively, this body of analysis work illuminates what is feasible for renewable energy today, and where changes could lead to enhanced prospects for cleaner energy systems over time.

NREL's core energy analysis, technology development, and deployment teams are aligned so that insights gained at all scales inform the next set of research questions. Through disaster recovery assistance and numerous projects to support renewable technology deployment at scales from campus to community to continent, NREL collects operational insights on what is practical and what is possible. Lessons from market-driven projects define performance and cost goals for early-stage research and development. Together, NREL's energy analysis and decision support teams provide core lab capabilities that support and complement science and technology work. NREL's analysis efforts create a feedback loop between ideas and implementation and allow NREL to continually ask: What's next?

NREL analysis supports decision makers across the country and around the world in their efforts to transform their energy systems. Analysis tools, insights, and assistance help policymakers, investors, federal agencies, utilities, state and local government, technical institutions, and governments around the world make energy choices in the context of environmental, security, and economic priorities.

Technology Transfer

NREL research leads to industry partnerships that solve energy problems and improve lives. NREL has streamlined the way it does business and enhanced the entrepreneurial environment, providing greater access to capital and engaging strategically with industry and stakeholders.

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

NREL's deployment activities also aim to remove barriers to market adoption of existing clean energy solutions. NREL advances integrated, sustainable energy solutions to meet local and regional energy needs by looking at the entire renewable and energy efficiency portfolio, tailoring cost-effective solutions based on locally available resources. This comprehensive approach helps transform the way we use energy in local communities by identifying opportunities, building partnerships, and creating a foundation for technology implementation. We offer technical assistance, with NREL staff helping communities assess renewable energy options and providing training to help build a skilled workforce.

Technology Partnerships (FY 2014)

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

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

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

Patents (FY 2014)

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



Laboratory of the Future

NREL has a state-of-the-art "Laboratory of the Future" with sustainable research buildings to foster innovation. NREL now boasts six facilities with Leadership in Energy and Environmental Design (LEED) Platinum designation from the U.S. Green Building Council.

NREL's Science and Technology Facility was the first federal facility in the nation to be certified LEED Platinum. In June 2011, the initial Research Support Facility (RSF) project was certified LEED Platinum, followed by a November 2012 LEED Platinum designation for the RSF expansion project. In July 2013, NREL's state-of-the-art energy-efficient cafeteria, south entrance building, and ESIF all received LEED Platinum ratings.

The 360,000-square-foot RSF is a model for sustainable, high-performance building design and is one of the largest commercial Class A office buildings in the world to generate as much energy as it uses over the course of the year, making it a "net-zero" building.

Expansion of the Integrated Biorefinery Research Facility (IBRF) was completed in 2011, and received a LEED Gold designation. The IBRF increases NREL's capabilities to develop new biofuels technologies beyond ethanol and allows the laboratory to work simultaneously on multiple research projects with multiple research partners.

A leader in federal greenhouse gas (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's Climate Leaders program and has played a critical support role in the development of federal guidelines for GHG accounting and reporting through DOE's Federal Energy Management Program. In 2014, NREL achieved "carbon neutrality" for Scope 2 GHG emissions for the fifth consecutive year.

The Laboratory of the Future is just one more asset in NREL's portfolio that will ensure the laboratory's leadership in addressing the nation's energy challenges.

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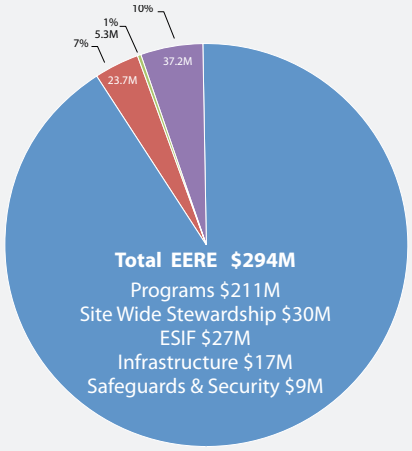
NREL Funding

More than 80% of NREL's funding is through DOE's Office of Energy Efficiency and Renewable Energy.

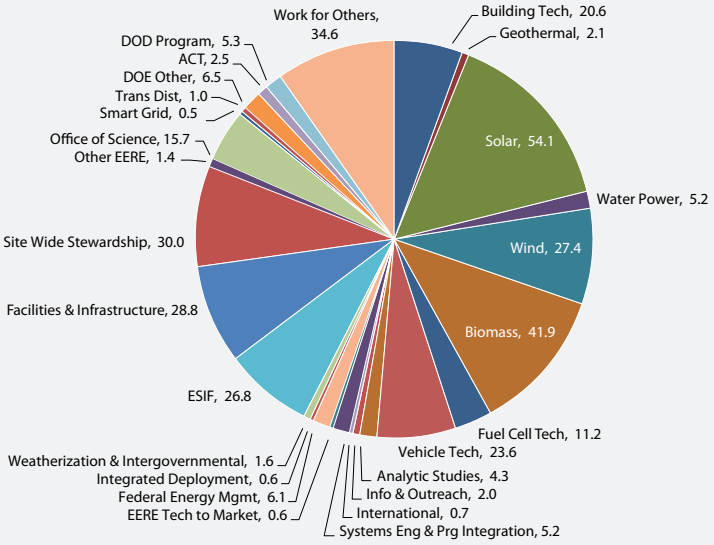
FY 2014 Forecasted Funds by Funding Source

	FY10	FY11	FY12	FY13	FY14
Operating	460.2	327.9	331.1	351.6	340.7
Capital Construction	76.3	60.7	20.9	20.0	19.6
Total	536.5	388.6	352.0	371.6	360.3

NREL FY 2014 Funds by Source $360M



FY 2014 Funds by NREL Program* $360M



*Note: Millions of dollars

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