Department of Energy Laboratory Plan
For the Office of Science's
Lawrence Berkeley National Laboratory

Mission and Overview

Founded in 1931, Lawrence Berkeley National Laboratory (LBNL) was a driving force behind the launch of serious investigations into particle physics and the nature of matter and energy in our universe. From those early days, as the birthplace of nuclear science and medicine LBNL has evolved into a multidisciplinary research facility that, under the Department of Energy's (DOE's) Office of Science, has a primary mission focus that includes; understanding the complexity of biological and earth systems for energy solutions, characterizing and fabricating nanostructured materials, advancing physics and cosmology, conducting computational science of scale, and developing new scientific approaches to the understanding and prevention of disease.

On a competitive basis, LBNL provides access to critical national research infrastructure for university, industry, and government researchers. Major facilities include: the Advanced Light Source, a world center for ultraviolet and soft x-ray synchrotron-based science; the Molecular Foundry, a nanoscale science user facility; the National Center for Electron Microscopy for materials science; the 88-Inch Cyclotron for nuclear science; the National Energy Research Scientific Computing Center (NERSC), a DOE-leading provider of high-performance computing capabilities for complex scientific applications; and the DOE Joint Genome Institute. With one-third of its scientific staff jointly affiliated with university campuses, LBNL delivers a highly capable science and engineering workforce for the nation's future. Founder Ernest Lawrence was the laboratory's first Nobel Laureate and following that tradition, overall, eleven Nobel Laureates are associated with the laboratory. In addition, 68 staff are members of the National Academies.

Laboratory Focus and Vision

Six core competencies underpin activities at Lawrence Berkeley National Laboratory:

1. Sustainable energy science and technology

Lab-at-a-Glance

Location: Berkeley, CA

Type: Multi-program lab

Contract Operator: University of California

Responsible Field Office: Berkeley Site Office

Website: http://www.lbl.gov/

Physical Assets:

- 200 acres (leased) and 107 Buildings
- 1.5M GSF in Active Operational Buildings
- 130K GSF in Non-Operational Buildings
- Replacement Plant Value: $819M
- Deferred Maintenance: $51.9M
- Asset Condition Index:
  - Mission Critical 0.93 (Adequate)
  - Mission Dependent 0.98 (Excellent)
- Asset Utilization Index: 0.97 (Good)

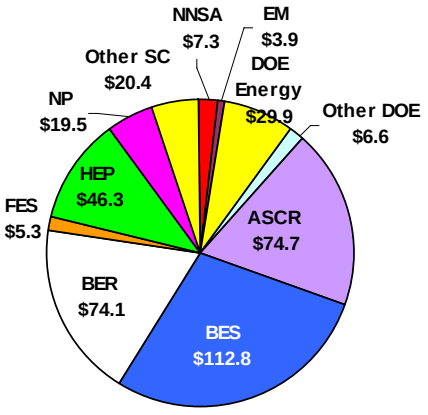
Human Capital:

- 2,862 full time employees;
- 1,712 students (undergraduate and graduate);
- 3,270 facility users and visiting scientists

FY 2006 Total DOE Funding: $400.8M

FY 2006 DOE Funding by Source

PALS data (BA in Millions):



FY 2006 Non-DOE Funding: $111M

FY 2006 Dept. Homeland Security: $6.4M

2. Nanoscience, materials synthesis, and characterization
3. Multidisciplinary biology and environmental science
4. Soft x-ray and ultrafast science, photon and particle beams including those for national user facilities
5. Computational science and engineering
6. Advanced detector systems for astrophysics, high energy physics, and nuclear science

The Office of Science believes that these six competencies will enable LBNL to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and to pursue its vision for scientific excellence and pre-eminence in the areas of:

- Energy science, including carbon-neutral fuels from solar to chemical energy conversion;
- Nanoscience, surface science, and condensed matter physics for energy and scientific applications;
- Genomics and bioscience for understanding the complexity of living systems for energy solutions, understanding health effects of energy, and the prevention of disease;
- Particle-, nuclear-, and astrophysics to understand matter and energy in the universe;
- Earth systems research for developing energy resources, global change modeling, improving the nuclear fuel cycle, and enhanced environmental restoration, and
- Mathematics, computer science, and large-scale computational science programs.

Business Lines

The following capabilities, aligned by business lines, distinguish LBNL and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of LBNL and its role within the Office of Science laboratory complex. Items in italics within the column, Distinguishing Capabilities, identify research facilities that convey particular, strategic strengths and capabilities to the laboratory. Descriptions of these facilities can be found at the website noted in the Lab-at-a-Glance section of this Plan.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Science for a Secure and Globally Sustainable Energy Future	• Novel chemical synthesis processes; cell and molecular biology systems and pathways • Microbial organisms, genomics, and communities; • Earth systems modeling; biogeochemical changes and remediation • Efficient commercial building system designs; • Electricity reliability; • Carbon sequestration science and technologies;	National Academy of Sciences (NAS) report documents $23 Billion in energy savings from LBNL technologies; Most microbial genomes sequenced in the world; Two "Breakthroughs of the Year" for sequencing/analysis (*Science*); Lead Yucca Mountain vadose zone program; 30 NAS, 8 NAE, DOE recognition of Environmental Remediation leadership with award of "Distinguished Fellows".	Advance U.S. and global energy security and environment protection; Advance the core disciplines in basic energy sciences, including application of nanomaterials for reducing energy demands; Tap the power of biology for energy and environmental solutions, including carbon neutral sources of transportation fuels and carbon sequestration.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
	• *DOE Joint Genome Institute.*		
Leading Facilities in Vacuum-ultra-violet (VUV), Soft X-ray, and Ultrafast Science	• VUV, soft and intermediate x-ray probes for science and technology; • Chemical dynamics, photoionization, and other atomic, molecular, and optical phenomena; biological x-ray tomography, 8 crystallography beamlines • *Advanced Light Source.*	Recognized leaders in and ultrafast science experimentation and theory-1986 Nobel Prize in chemistry; Awarded design lead for next generation light source (selected to design of new Fermi light source at Trieste, Italy); Cover articles in *Science* and *Nature*; and ALS research cited for 2006 Nobel Prize in Chemistry. 15 NAS members, 7 NAE members, 3 institute of Medicine members.	Provide the resource foundations that enable great science; Advance basic sciences for energy independence.
Develop Novel Materials and Nanodevices	• Advanced catalytic, electronic, superconducting, structural, and optical materials; • Dynamic electron beam microcharacterization facilities; nanomedicine • *National Center for Electron Microscopy;* • *Molecular Foundry.*	Leader in nanoscience, biomimetic materials (Science Citation Index leader); 14 NAS members, 7 NAE members; LBNL leads national the Transmission Electron Aberration-corrected Microscope (TEAM) effort; Cover articles *Nature Materials, Physics World, Journal of Physical Chemistry, MRS Bulletin, Science, Journal of Physical Chemistry B.*	Lead the nanoscience revolution delivering controlled chemical processes, novel materials, and innovative energy technologies.
Understand, Detect, and Prevent Energy-Related and Environmental Causes of Disease	• Molecular, cellular, and tissue models of disease; • New probes and imaging systems for diagnosis; • Low-dose radiation effects and DNA damage response; • *Structural biology at the Advanced Light Source;* • *Center for Functional Imaging.*	3 Lawrence and 1 National Medal of Science Awards. 11 NAS members, 3 NAE members, 3 Institute of Medicine Recent cover articles include *Journal of Physical Chemistry B.*	Master the convergence of the physical and life sciences to deliver revolutionary technologies for health and medical applications
Matter and Energy in the Universe	• Astrophysics and neutrinos, nuclear structure; • Accelerator R&D (optical accelerators, superconducting magnets, ion sources); • RHIC and Large Hadron Collider (LHC) heavy-ion experiments; development of gamma ray detectors	Nobel Prize in Physics 2006; 8 Lawrence and 1 National Medal of Science Awards; 13 NAS members; Discovery of Dark Energy "Breakthrough of the Year" 1998 and 2004, also Shaw Prize in Astronomy 2006; Selected as science leader for national Deep Underground Science and Engineering Laboratory	Understand the cosmos and identify dark energy and dark matter; Explore nuclear matter from quarks to stars; Develop promising approaches to confining plasmas; Develop energy frontier accelerators using ultra-high

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
	including Gammasphere and GRETINA[1] and next-generation instruments; • Heavy ion drivers for high energy density physics; • *88-Inch Cyclotron.*	(DUSEL); World's highest energy optical accelerator with low dispersion beams; highest field dipole magnet.	gradient technology Provide basic science for advancing nuclear energy.
Advanced Scientific Computing for DOE Research Programs	• Scientific computing capability and connectivity; • Mathematical tools and algorithms for science. • *National Energy Research Scientific Computing Center Energy Sciences Network(ESnet)*	National leader in mathematics and computational science—4 NAS members, 4 NAE members. 2 of the only 3 awarded SIAM/ACM[2] Prizes in Computational Science; S2 Sidney Fernbach and 2 Gordon Bell Prizes; Cover articles include *Science, Physics World, Nature*.	Provide discovery-class computational tools for the U.S. scientific community; Deliver network connectivity to the DOE science community through the ESnet.

Major Activities

Following is a set of major activities that LBNL is pursuing to support aspects of the DOE mission and build on core strengths and capabilities of the laboratory. These activities are either currently supported or appear in the FY 2008 budget submission to Congress.

The major new activities being pursued are:

1. Integrated Energy Research for a Sustainable Future: Helios
2. Joint Dark Energy Mission (JDEM) R&D
3. Optical Accelerators for the Energy Frontier
4. National Energy Research Scientific Computing Center (NERSC) Upgrade

1. Integrated Energy Research for a Sustainable Future: Helios

- **Summary:** The administration has announced the *Advanced Energy Initiative*. In support of that effort, LBNL has proposed a Helios research program comprised of integrated campaigns to develop a secure and sustainable world through: (1) creating new low-carbon energy sources, (2) advancing energy efficiency technology, and (3) improving the accuracy and use of climate change prediction. Helios will control climate forcing from greenhouse gases by expanding feedstock crops, replacing fossil fuels, and reducing fuel demand.
- **Expectations**: Providing carbon-neutral energy supplies will require extraordinary science to create new materials, chemical, and biological pathways for solar energy production. The conversion of electricity to fuels based on nanotechnology-enabled solar cells and direct photochemical or photo-electrochemical processes will be developed. Cellulosic biofuels will be expanded by feedstock engineering, deconstruction, and synthesis. Biofuels

[1] The GRETINA detector (a forerunner of the GRETA detector, the gamma ray energy tracking array, is under development at Lawrence Berkeley National Laboratory) and is used to detect gamma rays in nuclear physics experiments.
[2] Society for Industrial and Applied Mathematics (http://www.siam.org/) and the Association for Computing Machinery (http://www.acm.org/)

development also requires understanding hydrological, biological, and ecosystem processes which are affected by climate. Integrated climate modeling and field studies will enable accurate prediction of green house gas and aerosol climate forcing and ecological responses. Energy efficient technology strategies that mitigate climate change will also be addressed, emphasizing new building system technologies, batteries, fuels cells, and clean combustion.

- **Benefit Perspective:** Potentially *transformational* benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* for R&D as biological systems may be difficult to fully characterize and many metabolic pathways are not known. Potential high risk for commercialization.
  - Market/Competition: *Moderate risk* as solar energy conversion, climate change and energy efficiency research is done by others, but LBNL work is complementary.
  - Management/Financial: *Moderate risk* for costs to engineer efficient conversion pathways and innovative technologies, possibly *high* commercialization risks

The integrated campaigns toward low carbon fuels, climate change modeling, and energy efficiency will support of the objectives of several DOE program offices. For the Office of Biological and Environmental Research (OBER), a Joint BioEnergy Institute (JBEI) will advance biofuels and an Integrated Earth System Model (IESM) will provide accurate predictions for climate change mitigation. IESM's next generation climate modeling capability would include biogeochemical cycles, atmospheric chemistry and aerosols, radiative forcing in cloud formation, high-resolution glacial processes, and ecosystem dynamics. For the Office of Basic Energy Sciences, LBNL will use both nanoscience and synthetic biology approaches for fuels synthesis. These include nano-photovoltaics that reach high efficiencies and can be integrated with catalytic molecules and bioengineered solar light driven proton pumps in synthetic organisms for biomass to fuel conversion. For the Office of Energy Efficiency and Renewable Energy research on energy efficient technology will place emphasis on the building sector, including new lighting systems, electrochromic windows, and integrated building control systems.

2. Joint Dark Energy Mission (JDEM) R&D

- **Summary:** Develop a competitive proposal for a space-based mission to study the dark energy and alternative explanations of the acceleration of the universe's expansion by performing systematic and highly controlled measurements.
- **Expectations:** Provide an understanding of the mechanism driving the acceleration of the universe by observing distant supernovae using a dedicated telescope in earth orbit. The satellite observatory will be capable of measuring over 2,000 distant supernovae during the three-year mission lifetime and survey over 1000 square degrees into the near-infrared.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* -- as the detector and associated electronics in development have good prospects for near term success, but meeting the space qualification requirements will be challenging.
  - Market/Competition: *Moderate risk* -- as delays in the program will put the laboratory's program at risk and limit their ability to compete in the JDEM down-selection process.
  - Management/Financial: *High risk* -- due to its early phase of forming mission partners and agreements.

Recent studies of Type Ia supernovae produced significant evidence that, over cosmological distances, the supernovae appear dimmer than would be expected if the universe's rate of expansion were constant or slowing down. This was the first direct experimental evidence for an accelerating universe potentially driven by an unknown dark energy. This space satellite mission would dramatically increase the discovery rate for such supernovae to eliminate possible alternative explanations, give experimental measurements of several other cosmological parameters, and put strong constraints on possible cosmological models.

As one of the possible JDEM designs, the SNAP project and collaboration is led by LBNL and includes scientists from DOE labs, National Aeronautics and Space Administration (NASA) centers, universities, and foreign institutions.

3. Optical Accelerators for the Energy Frontier

- **Summary:** Exploring centimeter-scale plasma structures that are able to accelerate high quality beams to GeV and multi-GeV energies.
- **Expectations:** Develop compact laser wakefield accelerators with multiple stages, which can produce focused, ultrafast, high-energy bunches of electrons to compete with state-of-the-art machines using conventional radiofrequency acceleration. High energy accelerators could be built on size scales that are three orders of magnitude smaller than those built today.
- **Benefit Perspective:** Potentially *transformational* benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* -- as the technology may not scale to TeV energies and high luminosity.
  - Market/Competition: *Moderate risk* -- as there is strong competition from groups in Europe, Japan, and China.
  - Management/Financial: *Moderate risk* -- as needed funding may not be available.

Laser wakefield technology offers the possibility of a compact, high-energy accelerator for probing the subatomic world, for studying new materials and new technologies, and for medical applications. Beams with 1 GeV energy have been demonstrated in three-centimeter long plasma channel structures using the L'OASIS laser system at 40 terawatt peak power. The next step would be to reach 10 GeV and beyond in one-half to one meter long accelerating structures built with plasma channels.

4. National Energy Research Scientific Computing Center (NERSC) Upgrade

- **Summary:** Upgrade NERSC to accommodate a larger number (200-300) of user projects of medium to large scale and continue to provide high-performance computing and resources to support the requirements for scientific discovery.
- **Expectations:** NERSC continues to meet the Office of Science's high-performance production computing needs.
- **Benefit Perspective:** Potentially *substantial* benefits
- **Risk Perspectives:**
  - Technical: *Low risk* -- as the activity will use technology already existing to increase capacity.
  - Market/Competition: *Low risk* -- as user demand already has and will likely continue to exceed capacity.
  - Management/Financial: *Medium risk* -- due to increasing power and building lease costs.

NERSC is the flagship multi-purpose scientific computing facility for the Office of Science. It is one of the largest facilities in the world devoted to providing high-performance computational tools and expertise for unclassified basic scientific research and supports large, interdisciplinary teams of researchers to attack fundamental problems in science and engineering that require massive calculations. NERSC continues on a path to address the increased computational needs of the Office of Science to fulfill its user facility mission by doubling the computational capacity at NERSC within projected program funding levels. For NERSC to support a large number (200 – 300) of user projects of medium to large scale, this doubling of computational capacity is required. More than 2000 computational scientists use NERSC for basic scientific research on a wide range of disciplines including: climate modeling, research into new materials, simulations of the early universe, analysis of data from high energy physics experiments, investigations of protein structure, and a host of other scientific endeavors.

Financial Outlook

The financial outlook for the Lawrence Berkeley National Laboratory is subject to 1) competition and merit review, 2) the availability of appropriated funds and 3) programmatic decisions. The first two factors cannot be predicted or estimated in advance. The third, programmatic decisions are developed in accordance with the planning targets reflected in the Department of Energy programmatic plans, in complement to these laboratory business plans. In addition, because of the Office of Science commitment to competition and merit review, there is often a time lag between programmatic decisions and the determination of which research provider can best deliver the greatest value in conducting the research. Thus, it is not always apparent how programmatic decisions unfold for particular laboratories. Nevertheless, some decisions, such as the plans for large scientific user facilities, show clear paths to individual labs and therefore inform their business plans.

Support for non-DOE funded work is a vital role of our national laboratories, contributing to national security, energy security, environmental stewardship, scientific discovery, and more fundamentally, the competitiveness of the U.S. economy. This is no exception for Lawrence Berkeley National Laboratory where the Office of Science is supportive of this work.

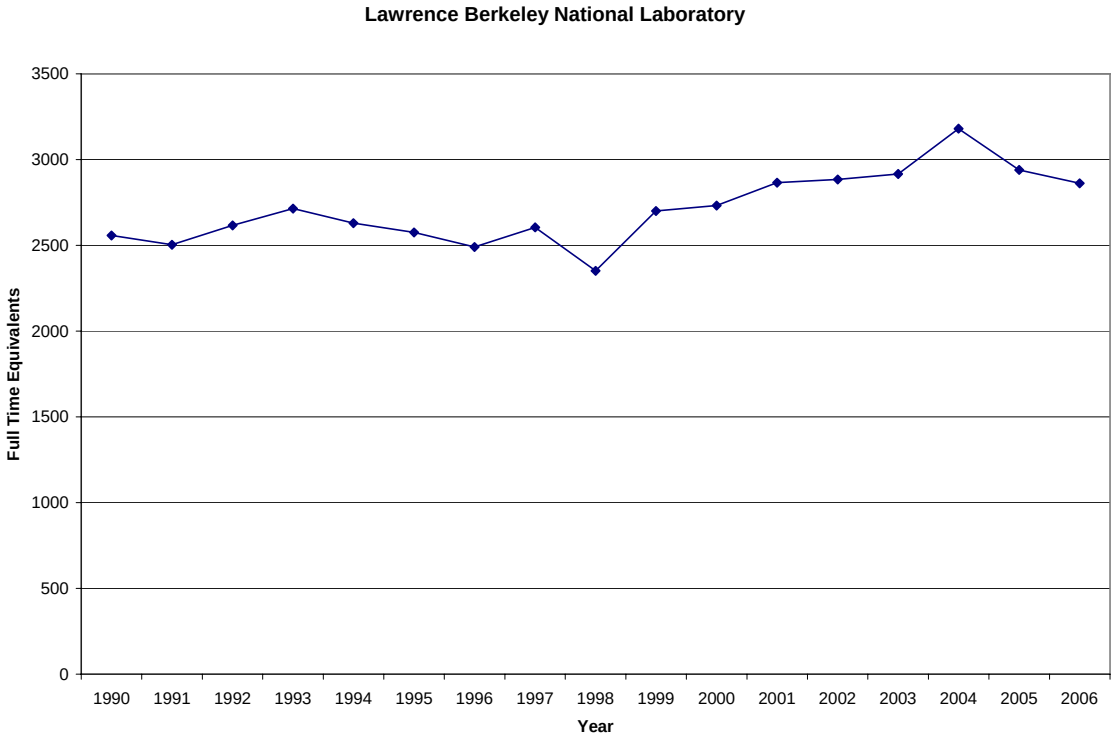
Current non-DOE federally funded activities at LBNL are primarily supported by the National Institutes of Health (NIH), the Department of Defense (DoD), the Department of Homeland Security (DHS), and NASA. NIH is the largest non-DOE funding organization and supports research in cancer biology, structural biology, DNA repair, and diagnostic imaging. DoD is expected to continue to sponsor breast cancer research, the use of particle beams to simulate space radiation, and detector development. It is anticipated that the DHS will sustain programs to develop neutron sources and detectors that scan for nuclear materials, indoor air quality monitoring, cyber-security systems, and other security instrumentation. NASA support for the Joint NASA/DOE Dark Energy Mission may grow. The laboratory is expected to continue to receive support for research from the California Energy Commission, the Environmental Protection Agency and other state agencies, universities, and the private sector. One example of special emphasis is in the area of carbon-neutral transportation fuels with industry and university sponsors. LBNL will also use funds received from authorized technology transfer activities (e.g., licensing of inventions and software) to support the research mission of the Laboratory. A portion of the net proceeds is allocated to the inventors, with the majority of the funds available for research, science education, or technology transfer.

Uncertainties and Risk Management

External Factors: Over the next five years, LBNL will face uncertainties and risks driven by external change. Primary among these is the Federal science budget outlook and unfunded mandates. LBNL will pay close attention to matching the level of science support services to the level of incoming financial resources. With the large user population at scientific facilities, increased security requirements may act as a barrier for qualified users to access scientific facilities. Mitigation strategies will need to be developed to handle each one of these risks, to sustain our vitality, core competencies, and mission accomplishments. LBNL has adopted an integrated approach to security management which combines oversight of site and cyber protection, balancing science and security based on cost and risk.

S&T Workforce: LBNL's workforce has the ability to develop new science innovations and to design, construct, and manage projects for complex, state-of-the-art scientific advances. These capabilities were built up in previous major DOE activities, and as a result, teams of highly skilled specialists were formed. With the potential for stable or declining funding, the workforce levels and expertise in areas such as advanced detectors, superconducting magnets, and precision optical instrumentation face the challenge of "use it or lose it." LBNL will work with the Office of Science to address this risk, including coordinating projects and engaging in underlying engineering and advanced instrumentation research.

Workforce Trends

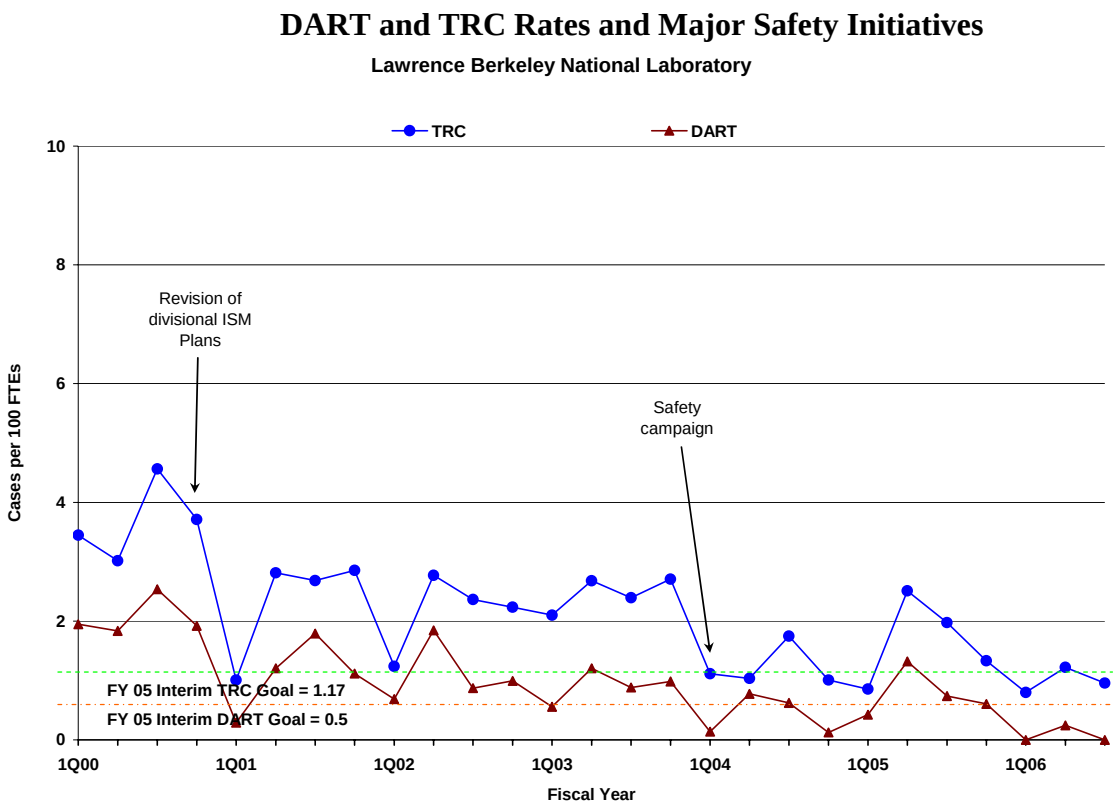


Employee Diversity: LBNL plans to strengthen the recruitment and retention of populations currently under-represented in the workforce, particularly African American and Hispanic scientific staff and women in the scientific workforce. This effort will focus on creating a diverse workforce through a comprehensive model that includes education and training, employee engagement, and

workforce recruitment. Our objective is to develop our internal capacity to tap all segments of the candidate pool easily and efficiently and to gain benefits of integrating talented professionals into our current workforce. LBNL has been developing and implementing new outreach, work environment surveys, and actions tailored to the workforce of every division that enhance the diversity of applicant pools and job hires. Lawrence Berkeley National Laboratory's enhanced diversity initiative takes into consideration the uniqueness of each of our research divisions with respect to diversity strategies to improve their activity. As a whole, the laboratory has developed a compendium of diversity best practices and strategies related to strategic recruitment, mentoring/scientific human capital pipeline and training/awareness. The compendium is intended to be a tool for divisions to enrich their diversity activities.

To address workforce goals, scientific divisions prepare Division Diversity Plans and Strategic Recruitment plans and engage in extensive outreach activities. Many approaches are applied, tailored to fields of science, and recruitment is statewide when it is necessary to broaden the applicant pool beyond the local area in order to get a diverse qualified pool. Recruitment is nationwide for job groups with high levels of responsibility and/or expertise and therefore a national search is necessary to yield the strongest candidate pool. LBNL is active at regional and national job fairs and in minority scientific societies such as the National Society of Black Physicists and the National Organization of Black Chemists and Chemical Engineers, and the Hispanic Engineers and Scientists. LBNL also provides mentored research experiences and educational outreach that help carry minority students into graduate school and tracks students to follow their developing scientific careers. HBCU faculty are specifically supported and encouraged to access programs of common interest and to contact their peers at LBNL. The laboratory implemented its first-ever comprehensive workplace climate survey in fiscal year 2006. The survey measures focused on several important retention issues, including job satisfaction, physical working conditions, peers, supervision/management, diversity, respect/civility and work/life balance.

Safety: LBNL attention to safety performance and Integrated Safety Management (ISM) has led to a long term reduction in recordable illness and injuries. In FY 2006, LBNL reduced these rates to below contractual targets: Total Reportable Cases (TRC) 1.09 actual/1.17 target, Days Away, Restricted, or Transferred (DART) 0.24 actual/0.5 target (TRC = Total Recordable Cases per 100 Full Time Equivalents, DART = Days Away, Restricted, or Transferred per 100 Full Time Equivalents). This performance represents a reduction of the total number of recordable illnesses and injuries from 50 in FY 2005 to 36 in FY 2006. In striving to achieve the extremely aggressive contractual targets for FY 2007 (TRC = 0.65, DART = 0.25) and to continue progress in keeping employees from getting ill or injured, LBNL plans to focus on several areas: 1) Continue with an aggressive, multi-faceted strategy for reducing ergonomic injuries since this represents greater than 50% of the recordable injuries, 2) Advance laboratory leadership's commitment to safety as a collective responsibility, reinforced through communications, training, and skill building, 3) Continue to emphasize the importance of sharing and reporting errors or conditions that can lead to illness or injury through communications, training, and re-designing key management systems, 4) Consolidate and implement the recommendations from the ISM Peer Review (February, 2006) and the Evaluation of ISM at LBNL (November, 2006). With respect to environmental matters, LBNL plans to continue aggressively implementing our Environmental Management System through identification of environmental aspects that provide opportunities for pollution prevention and energy conservation.



Physical Infrastructure: Established as a Federal laboratory in the 1940s, LBNL has over 1.7M square feet (sf) of space in 107 buildings; 65% of the building space, as well as many of the utility systems and roads, are 40 years old or older. In order to meet programmatic needs, LBNL also leases over 287,000 sf off site and has contractual rights to an additional 72,000 sf of space on the UC Berkeley campus. LBNL's Asset Utilization Index (AUI) is 0.98 for offices and laboratories (excellent) and 1.0 for warehouses (excellent). The replacement plant value of LBNL's general purpose facilities is $819M in 2007.

Maintenance, recapitalization, and modernization are supported with overhead, operating, and GPP funds and with line item funding. LBNL attained a maintenance investment index of 2% of replacement plant value (excellent) in FY 2007. It is anticipated that this level will be continued in FY 2008 and the outyears.

LBNL's deferred maintenance (DM) backlog is $51.9M for 2007. The Asset Condition Index (ACI) is 0.93 for mission critical facilities (the DOE goal is 0.964) and 0.98 for mission dependent facilities (the DOE goal is 0.948 or above). ACI is computed as 1 minus the result of deferred maintenance divided by replacement plant value. To reduce the DM backlog, thereby improving the ACI, LBNL has a deferred maintenance reduction effort with a projected $6M of funding in FY 2008.

The Department has begun the clean up and removal of the de-activated Bevatron accelerator which will provide nearly 5 acres of land for re-development around FY 2011.

The FY 2008 GPP funding request is for $4.5 million. A new line item project was funded in FY 2007 – the Seismic and Structural Safety of Buildings, Phase I, TEC $17M. This project addresses the seismic vulnerability of DOE assets, in which high life-safety risks have been identified. LBNL's future recapitalization and modernization challenges include building replacements and renovations,

seismic upgrades, and utility renovations. The laboratory has reduced energy consumption by 6.3% compared to the 2003 baseline as defined by the Energy Policy Act of 2005, and is further working to reach the EPACT goals for energy reduction and renewable energy use.