

Lawrence Berkeley National Laboratory

7. INFRASTRUCTURE

Overview of Site Facilities and Infrastructure

LBNL's main site is located in the San Francisco Bay Area on 202 acres in hills above UC Berkeley (83 acres are leased to the DOE). The main site occupies 1.8 million gross square feet (gsf) in permanent facilities and temporary trailers. Seventy percent of that space was constructed prior to 1970 at a time when LBNL was mostly a High Energy Physics Lab. Over forty percent of the active space has been identified as seismically deficient given the probability of a major seismic event in the Bay Area. There are 3,068 employees and 6,935 facility users and guest scientists. The LBNL land use plan is found at <http://www.lbl.gov/Community/LRDP/index.html> .

The LBNL infrastructure strategy, articulated in the Science Laboratories Infrastructure (SLI) Modernization Initiative is to:

- Seismically upgrade or replace deficient LBNL buildings ensuring the safety of our staff
- Modernize our infrastructure to ensure that it is mission ready and meets climate control, cleanliness, and utilities standards

This strategy will be accomplished via a Mission Readiness based approach with funding from the SLI, Contractor Capital Contributions, and Lab allocations of IGPP, non-capital improvement and maintenance funds. The Mission Readiness approach will ensure that these expenditures are aligned with the priorities expressed in the science section of this plan.

LBNL also occupies 100,000 sf of space on the Berkeley campus and leases 395,000 sf in surrounding cities for administration and research. Relocating administrative services to the main site will allow termination of 46,300 sf of leases in FY 2009. In FY 2010, the 54,000 sf lease of West Berkeley Biocenter will be extended one year to accommodate Building 74 seismic rehabilitation. After NERSC moves to the main site in FY 2011, parts of the Oakland Scientific Facility lease may be extended for LBNL IT infrastructure and cluster support.

The Laboratory's utility infrastructure ranges between 5-50 years old. Although much of the infrastructure is in good to excellent condition, low conductivity water distribution piping connecting five buildings, storm water piping, a transformer bank in the Laboratory's electrical substation, and the network and telephone systems require immediate or near-term replacement. Other significant replacements anticipated within the term of this Plan include; site lighting, the site-wide energy management control system, the electrical transformers and service panels at a number of buildings, portions of the underground natural gas piping, portions of the sanitary sewer, and portions of the hydrauger de-watering system, as these systems are approaching the end of their expected useful lives.

The table below summarizes infrastructure status:

SC Infrastructure Data Summary (2008 except as noted)		
Replacement Plant Value (\$M)		964.3
Total Deferred Maintenance (\$M)		53.3
Asset Condition Index	Mission Critical	0.95
	Mission Dependent	0.98
	Not Mission Dependent	n/a
Asset Utilization Index	Laboratory	0.96
	Office	0.98
	All Other	0.89
FY 2007 Maintenance (\$M)		13.8

Facilities and Infrastructure to Support Laboratory Missions

Life safety is a primary focus of planned investments in DOE buildings at the Laboratory. Thirty four (34) of LBNL's ninety (90) occupied buildings have been rated as seismically deficient. The Laboratory proposes an investment program to fully address USGS forecasts of a 62% probability of a 6.7+ seismic event in the Bay Area by 2032. LBNL is also committed to achieving infrastructure mission readiness for the conduct of its Business Lines. Seventy percent of the Laboratory's facilities were constructed from the 1940's to the 1960's and much of this space is challenged or unable to meet the requirements of modern science missions effectively. In this Plan, LBNL proposes a series of integrated investments to ensure that the facilities and infrastructure are safe and meet the requirements of the Science Strategy described in Section 5 above. The table (Table 7.2.1) that follows identifies the facilities that conduct research for each Business Line, the condition of these facilities and the planned investment to achieve seismic safety and mission readiness. Most buildings and investments benefit multiple Business Lines; each investment is detailed once and then cross referenced in the following Business Line sections. Building numbers are identified on the FY09-FY18 Project Map at the end of the Table.

Strategic Site Investments

LBNL's plan integrates investments by the Office of Science (SLI and Program Offices), the Office of Energy Efficiency and Renewable Energy, the Contractor (University of California), Internal GPP, and improvements and maintenance from Laboratory funds. These investments ensure mission readiness, support for the Business Lines and fully address safety commitments. Near term investments (next five years), are summarized below:

Office of Science Investments (SLI and Program Offices)

DOE has 1.65M gsf of research and support buildings at LBNL. Approximately 40% of this space has been determined to be seismically deficient. Further, 70% of LBNL buildings were built prior to 1970 largely for High Energy Physics research. The SLI Modernization program at LBNL, corrects seismic deficiencies and modernizes facilities for Mission Readiness. New buildings and major renovation projects meet LEED Gold and exceed energy efficiency requirements by 30%. SLI projects are outlined as follows:

- **SLI Seismic Phase 2 Project:** This investment is a priority for LBNL as it will remedy seismic life safety deficiencies in DOE buildings occupied by 250 staff and visitors. Project will modernize 45,000 gsf of lab space. A 43,000 gsf general purpose lab building will be constructed to replace 43,000 gsf of seismically unsafe and antiquated buildings. An ancient landslide under B85 will be corrected. PED will start FY09. Deferred maintenance is reduced by \$6.1M. Productivity improvement is equivalent to \$1.4M.
- **SLI Seismic Phase 3 Project:** This investment is a priority for LBNL as it will remedy seismic life safety deficiencies in DOE buildings occupied by 490 staff and visitors. Project replaces 74,000 gsf of seismically unsafe and antiquated buildings with 35,000 gsf of new modern general purpose labs and offices (the balance is replaced in the final project below). The project upgrades 56,600 gsf of existing general purpose labs, offices and shops. PED is planned to start FY10. Deferred maintenance is reduced by \$5.2M Productivity improvement is equivalent to \$2.7M.
- **SLI B70 Seismic Upgrade and Modernization:** This investment is a priority for LBNL as it will remedy seismic life safety deficiencies in DOE Building 70 occupied by 160 staff and visitors. Project will correct seismic deficiencies, modernize laboratory, mechanical, electrical and plumbing systems. PED is planned to start FY13. Deferred maintenance is reduced by \$2.6M. Productivity improvement is equivalent to \$0.9M

- **SLI Vintage Buildings Upgrades and Modernization:** This investment is a priority for LBNL as it will remedy seismic life safety deficiencies in DOE buildings occupied by 190 staff and visitors. Project upgrades and modernizes ~100,000 gsf of labs, shops and offices. A 43,000 gsf replacement wet laboratory is constructed as is a replacement 7,000 gsf fire house structure. 20,000 gsf of seismically deficient or antiquated structures are demolished. PED is planned to start FY15. Deferred maintenance is reduced by over \$3M. Productivity improvement is equivalent to \$0.9M. Scope to be finalized in next Annual Plan, after final seismic building evaluations are completed.

DOE Office of Science Programs provides essential support for mission-specific facilities and infrastructure. SC Program projects that are in progress or anticipated are outlined as follows:

- **BES Advanced Light Source User Support Building:** This investment is a priority for LBNL as it remedies seismic life safety deficiencies in DOE Building 10 and provides 30,000 gsf of modern user support space for the Advance Light Source. Construction begins FY08.
- **BES Seismic Safety of Building 6 (ALS):** This investment is a priority as it remedies seismic life safety deficiencies in Building 6, home of the Advanced Light Source. Second phase of construction begins FY08.
- **HEP BELLA:** This investment is a priority as it adapts portions of Building 71 to accommodate the BELLA experimental laser. Conceptual Design Report is underway.
- **BES Building 62 & 66 Redeployment:** This investment is a priority as it modernizes older research laboratories and offices to support research aligned with the Helios initiative. The Laboratory is concurrently modernizing the building infrastructure and general-purpose spaces.
- **BES NGLS:** This investment is a priority as it constructs the Next Generation Light Source including associated experimental and user facilities. Pre CD-0 assessments are in progress. .
- **EERE Electric Storage Research Center:** This investment is a priority as it constructs a 40,000 gsf laboratory and office building designed specifically to support achievement of major breakthroughs in energy storage research. CD-0 discussions are in progress.
- **EERE HiPerBRIC:** This investment is a priority as it constructs a laboratory and office facility designed specifically to support achievement of major breakthroughs in commercial building energy use research. A pre CD-0 proposal that addresses EERE participation is being developed.

Contractor Investments

The Laboratory has worked with the University of California (UC) to arrange over \$250M of funding for three significant facility investments aligned to the SC Business Lines.

- **Berkeley Lab Guest House:** This investment is a priority for LBNL's national user facilities and user community. The project was funded FY2008, with planned occupancy in 2009. The 57 room facility provides overnight accommodations for up to 70 guests.
- **Helios Energy Research Facility:** This investment is a priority for LBNL's growing sustainable energy research program. The project was funded beginning FY2007, with expected occupancy in 2011. Located on UC Regents land, LBNL will occupy a portion of the facility.
- **Computational Research & Theory Facility:** This investment is a priority for LBNL's high performance computing and computational research programs. The project was funded beginning FY2007, with scheduled occupancy early 2011. The project will consolidate NERSC and Computational Research Division at a single site.

Laboratory Investments

The Laboratory focuses its direct investments, including maintenance funding in excess of \$10M/year and IGPP funding in excess of \$4M/year beginning in FY09, to ensure that facilities are maintained effectively to serve the mission. Funding needs are identified annually in a Lab-wide UniCall process, and are reviewed by Laboratory leadership to ensure funds are allocated to the highest overall priority facility and infrastructure projects.

Additional Excess Facilities and Plans to Achieve ACI targets

Nearly eight percent of DOE building space (~126ksf) is non-operational, this area is within a single building which occupies a prime redevelopment site. All other buildings to be excessed and demolished during the Strategic Planning period are addressed in the projects above, with the exception of approximately four small trailers and sheds, which will be addressed in later years of this ten-year Plan period.

LBNL's plan conforms to DOE SC's expectation that the Asset Condition Index metric (ACI) for mission critical facilities at LBNL (approximately 90% of LBNL's capital assets) will be a minimum of 0.980 within the ten-year planning period. LBNL plans to reduce deferred maintenance and achieve this objective with a combination of DMR, IGPP, LIP, and ESCO project funding and to meet the 0.980 ACI target by 2016. The plan anticipates \$24M of funding from LBNL and that the SC SLI will eliminate an additional \$17M of deferred maintenance (of LBNL's funding, approximately \$8M is allocated in direct association with the SC Modernization Initiative).

Trends and Metrics

LBNL's annual infrastructure goals are defined in PEMP Section 7 - Sustain Excellence in Operating, Maintaining, and Renewing the Facility and Infrastructure Portfolio to Meet Laboratory Needs. These goals measure the overall effectiveness and performance of the University in planning for, delivering, and operating Laboratory facilities and equipment needed to ensure that required capabilities are present to meet today's and tomorrow's complex challenges.

For FY2007 the University scored 3.65 for Goal 7 which translates to a letter grade of A-. Noteworthy performance includes maintenance expenditures in excess of the Maintenance Investment Index (MII) goal, zero Facilities Information Management System (FIMS) deficiencies, completion of seismic surveys including corrective action plan, Molecular Foundry and User Support Building project management and SLI Modernization Initiative support. Of particular note, the Molecular Foundry won the 2007 Secretarial Excellence Award for project management. For FY2008 progress has been made on all tasks sufficient for a successful completion by the end of the fiscal year.

Sustainability

LBNL has been a leader in the development of new technologies and industry standards for energy/resource conservation and renewable energy sources since the 1970's. The Laboratory has managed its own facilities as a model of resource conservation and by 1996 had achieved a reduction in energy use of 43% (from a 1990 baseline) and a commensurate reduction in water consumption. LBNL has continued to meet or exceed DOE's goals for resource conservation and sustainable design - the LBNL Molecular Foundry was recently awarded the US Green Building Council's Gold Level for Leadership in Energy and Environmental Design (LEED).

Executive Order 13423 of January 24, 2007 and DOE Order 430.2B of February 27, 2008 established new long-term performance goals for energy and water efficiency, renewable energy generation, procurement, sustainable design, fleet operations, and related project financing. The FY2008 LBNL Comprehensive Energy Management Plan (CEMP) includes ten Objectives that will achieve significant progress towards meeting the goals defined in these Orders when completed. The Laboratory plans to complete five additional, non-mandatory measures in order to accelerate achievement of the

long-term goals. Executable Plans will be developed by the end of FY 2008 to form the FY 2009 Energy Management Plan (EMP). The Laboratory's financing plan to meet the new long-term goals and progress-to-date is contained in the table below.

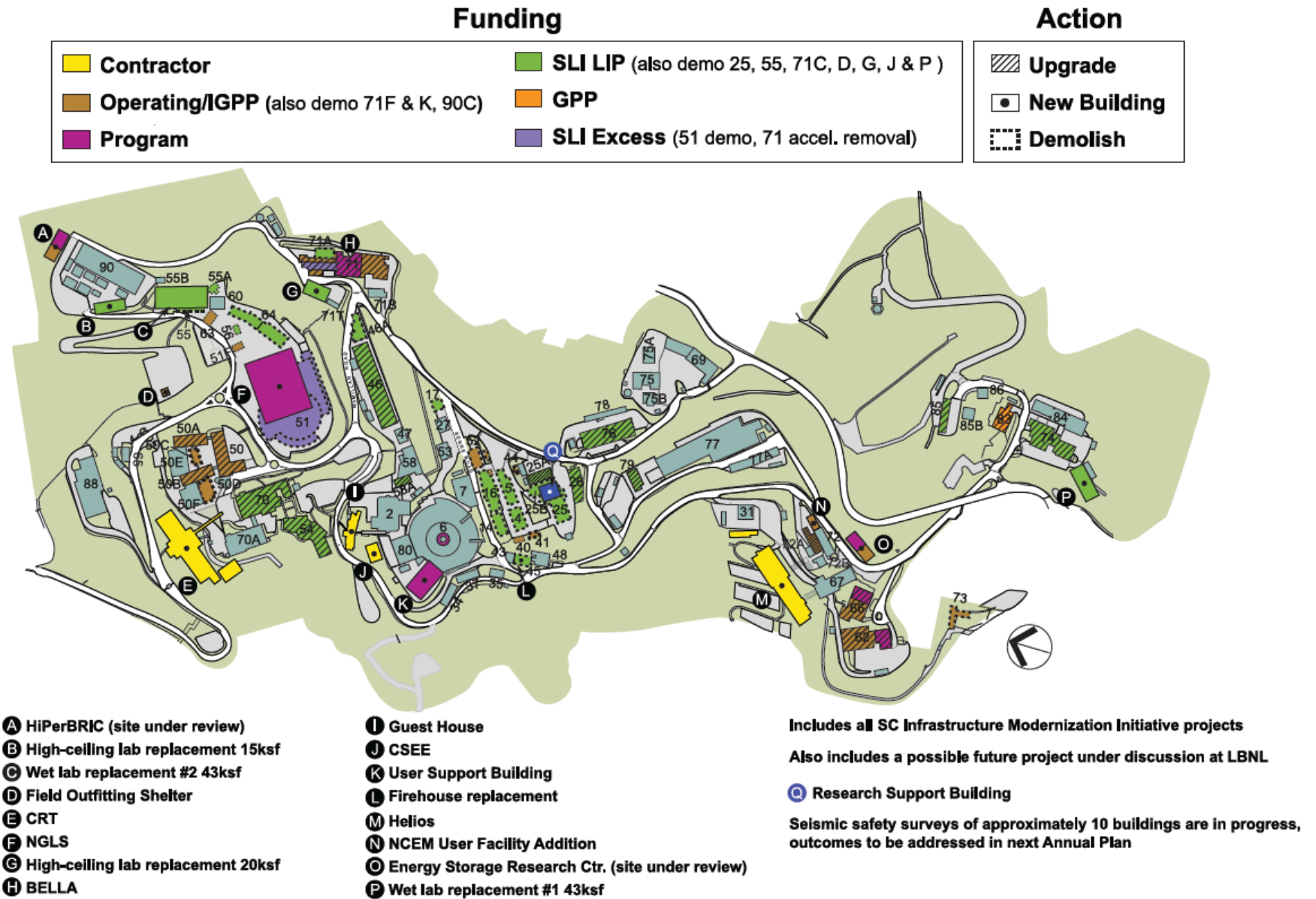
Table 7.2.1 Facilities and Infrastructure to Support Laboratory Business Lines

Business Line	Facilities and Infrastructure	Summary Condition Evaluation				Planned Investments		
		Seismically Deficient: Replace & Demolish	Seismic Deficiency: Upgrade/Modernize	Mission Deficient: Modernize	Mission Deficient: Capability	(note: Utility Investments are addressed in the Laboratory Operations Business Line)	FY Start	Funding (OH incl. IGPP)
Energy and Materials Through Electron Dynamics	<i>Research is primarily centered in Buildings: 2, 6, 7, 46, 62, 66, 67, 71, 71A, 72, & 80. Research and support also located within Buildings: 5, 16, 50, 52, 50, 58, 64, 70A, 74, 77, 77A, 83; Also requires LBNL IT, ESnet, & NERSC</i>	16, 25 & 71A				Replacement high-ceiling lab bldg. adjacent to 71 – 20KSF (“G” on map)	FY10	SLI
			6 ALS			Seismic upgrade	FY08	BES
			46			Seismic upgrade and Modernization	FY15	SLI
			50			Seismic upgrade	FY07	SLI
						Modernization	FY11	OH
			58A			Seismic upgrade and Modernization	FY15	SLI
			71			Seismic upgrade (removal of accelerator & shielding)	FY08	SLI Excess
						Modernization	FY08	OH
			72 NCEM			Seismic upgrade	FY09	OH
			74			Seismic upgrade and Modernization (two SLI projects)	FY07/09	SLI
					62	Infrastructure & Lab Modernization / Redeployment	FY09	OH, BES
					66	Infrastructure & Lab Modernization / Redeployment	FY08	OH, BES
						New ALS User Support Bldg. (“K” on map)	FY08	State/UC
						New Berkeley Lab Guest House (“T” on map)	FY08	State/UC
						Demolition of excess Bevatron facility	FY08	SLI Excess
				BELLA facility (“H” on map)	FY09	HEP		
				NCEM User Facility Addition (“N” on map)	FY09	OH		
				Next Generation Light Source facility (“F” on map)	Tbd	BES		
				Energy Storage Research Facility (“O” on map)	Tbd	EERE		
				Program investments requiring CD-0				
				Next Generation Light Source facility (BES)				
				Energy Storage Research Facility (EERE)				
Science and Technology for a Globally Sustainable Energy Future	<i>Research is primarily centered in Buildings: 25A, 46, 60, 70, 70A, 90, & JBEI; Research and support also located within Buildings 2, 6, 14, 50, 52, 58, 71, 62, 64, 66, 72, 77, 77A, ESnet, JGI & NERSC</i>	14, 46A, 50C, 50D, 52 & 64				Replacement high-ceiling lab bldg. adjacent to 90 – 15KSF (“B” on map)	FY10	SLI
			25A			Replacement wet lab bldg. @ 55-site – 43KSF (“C” on map)	FY15	SLI
			70			Seismic upgrade and Modernization	FY15	SLI
						Seismic upgrade and Modernization	FY13	SLI
						New Helios Energy Research facility	FY09	State/UC
						New HiPerBRIC facility (“A” on map)	Tbd	Multiple
						New Field Outfitting Shelter (“D” on map)	Tbd	OH
						<i>Other Planned Investments addressed in prior Business Line:</i>		
						<i>New ALS User Support Bldg.</i>		
						<i>New Berkeley Lab Guest House</i>		
				<i>Demolition of excess Bevatron facility</i>				
				<i>NCEM User Facility Addition</i>				
				<i>Next Generation Light Source facility</i>				
				<i>Energy Storage Research Facility</i>				
Multiscale Science and Engineering of Complex Biosystems	<i>Research centered in Buildings: 55, 56, 64, 73 74, 83, 84 JGI, & Berkeley West Biocenter Other locations: 2, 6, 46, 50, 62, 66, & 72</i>	55, 56 & 73		83		Replacement wet lab bldg. adjacent 74 – 43KSF (“P” on map)	FY09	SLI
						Modernization	FY08	GPP
						<i>Other Planned Investments addressed in prior Business Line:</i>		
						<i>New ALS User Support Bldg.</i>		
						<i>New Helios Energy Research facility</i>		
				<i>Demolition of excess Bevatron facility</i>				
				<i>NCEM User Facility Addition</i>				
				<i>Next Generation Light Source facility</i>				
				<i>Energy Storage Research Facility</i>				

April 2008 Annual Lab Plan Section 7

Business Line	Facilities and Infrastructure	Summary Condition Evaluation				Planned Investments		
		Seismically Deficient: Replace & Demolish	Seismic Deficiency: Upgrade/Modernize	Mission Deficient: Modernize	Mission Deficient: Capability	(note: Utility Investments are addressed in the Laboratory Operations Business Line)	FY Start	Funding (OH incl. IGPP)
Enable Extreme Scale Computational Science	Research is primarily centered in Buildings: 50 and Oakland Scientific Facility (OSF)		See prior Business Line: 50		All	New Computational Research and Theory Facility ("E" on map)	FY09	State/UC
Nature of Matter and Energy in the Universe	Research is primarily centered in Building: 47, 50, 52, 58, 70, 70A & 88 Research and support also located within Buildings: 46, 71, 77, 77A, NERSC, ESnet	See Prior Business Line: 25 46A 50C 50D 52 71A	See prior Business Line: 46 50 58A 70 71	58 70A 88		Replacement high-ceiling lab bldg. adjacent to 71 – 20KSF ("G" on map) Replacement wet lab bldg. @ 55-site – 43KSF ("C" on map) Modernization Modernization Modernization Other Planned Investments addressed in prior Business Line: New Berkeley Lab Guest House BELLA facility New Computational Research and Theory Facility Demolition of excess Bevatron facility Next Generation Light Source facility Program investments requiring CD-0 Next Generation Light Source facility	FY10 FY15 FY15 Tbd Tbd	SLI SLI OH OH OH
Laboratory Operations	Site-wide utilities; Network and IT systems; Roads, Parking Lots and Walkways; Site Access & Environmental Monitoring facilities, and, Laboratory operation shops, offices, shared facilities and computer rooms /infrastructure	40, 44 & 45	26 (medical) 54 (cafeteria) 76 (facilities) 79 (support)	31 Lab-wide Site	Lab-wide	40 & 44 functions to be consolidated. GSF replaced, addressed in previous Business Line projects Replace 45 (fire house) at current site ("L" on map) Seismic upgrade and Modernization Seismic upgrade and Modernization Seismic upgrade and Modernization Seismic upgrade and Modernization Modernization Replace Grizzly Peak Sub-station Transformer Bank #2 Replace LCW line serving 80, 2, 58, 47 & 46 Replace Energy Mgmt. System Replace select storm water & sanitary sewer piping Replace select fire alarm & sprinkler elements Replace select bldg. electrical transformers and panels Replace select natural gas piping Replace select hydrauger piping Replace select network lines Upgrade select telephone lines New Science Education facility New Research Support Building OSF lease to be extended to support Operations IT clusters	FY15 FY09 FY09 FY09 FY15 FY12 FY09 FY08 Tbd Tbd Tbd Tbd Tbd Tbd Tbd Tbd Tbd Tbd Tbd Tbd Tbd Tbd Tbd FY10	SLI SLI SLI OH SLI OH OH OH OH OH OH OH OH OH OH OH OH OH OH OH OH OH OH OH OH OH

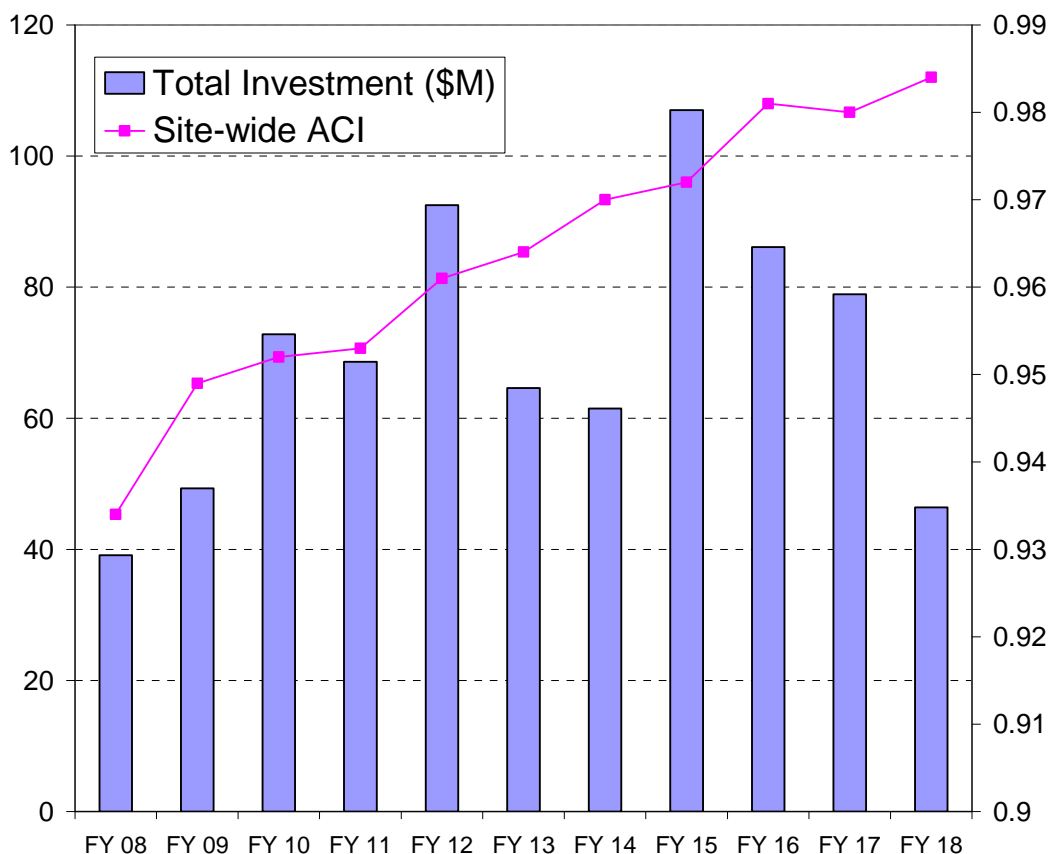
Project Map



Facilities and Infrastructure Investments (\$M) - Impact to Asset Condition Index

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Maintenance (\$M)	13.1	16.1	19.3	19.7	20.2	20.6	21.7	23.1	23.8	24.3	24.4
DMR* (\$M)	4.1	2.5	2.0	2.0	2.5	2.5	2.6	2.5	0.0	0.0	0.0
Excess Facility Disposition (\$M)	0.0	0.0	0.0	0.0	0.2	0.4	0.0	1.2	0.3	0.6	0.0
IGPP (\$M)	3.1	4.1	4.1	4.5	5.5	6.0	6.0	6.0	6.0	6.0	6.0
GPP (\$M)	4.6	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SLI Line Items (\$M)	14.2	26.6	45.5	42.4	64.1	35.1	31.2	74.2	56.0	48.0	16.0
Total Investment (\$M)	39.1	49.3	72.8	68.6	92.5	64.6	61.5	107.0	86.1	78.9	46.4
Estimated RPV (\$M)	964	986	1009	1032	1085	1156	1190	1218	1223	1251	1280
Estimated DM (\$M)	49.0	47	47	40	39	34	33	26	24	25	21
Site-wide ACI	0.934	0.949	0.952	0.953	0.961	0.964	0.970	0.972	0.981	0.980	0.984

* This line does not include DMR resulting from line items, GPP, IGPP, excess facility disposition or normal maintenance.



DOE Order 430.2B Goals

Requirement	Goal	Funding Source	Cost	Milestone	Progress to Date
Energy use intensity reduction based on	30%	ESPC*	\$11.3M	FY 2015	FY 2007: LBNL had reduced energy use intensity by 11.1% at year end.

April 2008 Annual Lab Plan Section 7

FY 2003					FY 2008 & beyond: Energy Savings Performance Contract under negotiation. Execution of the first Delivery Order planned for November 2008.
On-site renewable energy	7.5% where feasible & economic	ESPC*	TBD	FY 2010	TEAM ¹ On-Site Renewable Energy auditors visited on April-10 2008. Past analyses found renewable power generation not feasible.
Renewable energy	3.0% FY 07-09 5.0% FY 10-12 7.5% FY 13	Program & Overhead	\$1/MWH TBD TBD	FY 2007 FY 2010 FY 2013	Renewable Energy Credit (REC) purchased via WAPA for required percentage vs. total power use; FY 2007 = 43.1%.
Water reduction	16%	ESPC*	TBD	FY 2015	ESPC scope expanded to include water saving measures to achieve FY 2015 savings goal.
Electric metering	Advanced meters. for all buildings	Overhead & ESPC	TBD	FY 2012	Five (5) advanced meters planned in FY 2008 by overhead funds; additional via ESPC.
Sustainment	15% of space	TBD	TBD	FY 2015	Assessment tool development by LBNL now for DOE. Current percentage ~6%.
Fleet & alternative vehicle (AFV) fuels	Assure AFVs use alt. fuels	California Grant & Overhead	TBD	FY 2008	E-85 refueling card system allows only E-85 for AFVs. Plan to replace 3 diesel shuttles with Hybrid busses in a FY 2008-09 pilot project.
	Save 20% veh. petrol. fuel use	Overhead	\$0	FY 2015	End FY 2007 at 19% saved – current practice will result in meeting goal early.
	10% alt. fuel per yr to 100%	TBD	TBD	FY 2015	End FY 2007 at 43% total fuel use; ahead of 20% minimum FY 2007 goal.
	Acquire plug-in hybrid vehicles	Overhead	TBD	FY 2015	Will buy 4 electric vehicles during FY 08/09. GSA has no plug-in hybrid vehicles.

¹ TEAM = DOE Secretary's Transformational Energy Action Management

* The ESPC proposal for LBNL has not yet been received. A recommendation to proceed will be made if the project is found to be economically viable and in the best interest of the government and LBNL.