HARVARD
Faculty of Arts and Sciences

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SHERMAN FAIRCHILD LABORATORY
7 Divinity Avenue, Cambridge, MA 02138
SUSTAINABLE BUILDING PROJECT PROFILE

LEED FOR COMMERCIAL INTERIORS v3
LEED PLATINUM
AUGUST 2011

Photo: copyright Payette, image by Rachellynn Schoen, 2011

In June 2009, Harvard University began the design of an ambitious two-year renovation of the existing Sherman Fairchild building at 7 Divinity Avenue in Cambridge to accommodate Stem Cell and Regenerative Biology (SCRB) research. The primary purpose of the project was to provide exemplary workplaces for both research and academic staff in a healthy and productive environment, while achieving robust sustainability goals at a competitive capital cost. This project reflects Harvard's commitment to sustainability and to building healthy and productive workplaces that support the University's academics and research mission while reducing the impact on the environment.

The project scope included the complete demolition of interior finishes and mechanical systems in this 107,000 square foot, four-story building, while the building structure and envelope remained largely unchanged. The program provides open lab bench space, tissue culture labs, microscopy rooms, zebra fish labs, interior lab support spaces, conference rooms, and offices. Revitalizing an existing building and increasing the number of occupants are two of the many sustainable aspects of the project. The new, high-density open lab layout encourages interaction and interdisciplinary research amongst the 340 SCRB staff, researchers and students, while affording the necessary flexibility for future development in working methods. These healthy, productive and creative workplaces maximize use of daylight and fresh air while optimizing an indoor environment that responds to a range of specific indoor demands.

The project team was committed to sustainability from the onset and throughout the duration of the project. The processes required under the Harvard Green Building Standards allowed the team to make more informed decisions by mandating thorough integrated design, energy modeling, and life cycle costing. By undertaking these methods, the project was able to include number of progressive design strategies to meet aggressive energy targets and reduce water use without significant additional cost. The project achieved LEED-CI v3 Platinum certification in March 2012, and is tied with a project in Hong Kong for the highest number of LEED-CI points achieved by any project in the world (and the highest for any LEED-CI lab).

LEED® Facts

Sherman Fairchild Laboratory
Harvard Faculty of Arts and Sciences

Location	Cambridge, MA
Rating System	LEED-CI v3
Certification Achieved	Platinum
Total Points Achieved	95/110
Sustainable Sites	20/21
Water Efficiency	11/11
Energy and Atmosphere	33/37
Materials and Resources	7/14
Indoor Environmental Quality	15/17
Innovation and Design	5/6
Regional Priority	4/4

PROJECT METRICS

42%	reduction in water use below code maximum
98%	of the eligible equipment and appliances by rated power are ENERGY STAR certified
15%	reduction in lighting power density (watts/square foot)
100%	of the project's perimeter daylit spaces include daylight sensors
97%	of seated spaces have views to the exterior
100%	of the project's adhesive, sealants, paints, and coatings are low-emitting
91%	of waste materials were diverted from landfill

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PROJECT HIGHLIGHTS

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The Sherman Fairchild renovation was the first project to be guided by Harvard's comprehensive Green Building Standards (adopted in 2009). The process included life cycle costing to select cost-effective systems that will reduce the building's environmental footprint and operational costs, and extensive engagement with future space users and building operations staff during the design period to ensure the finished space would best meet their needs.

The project dramatically reduces the amount of energy used per occupant by renovating to increase the number of occupants and researchers in the space without increasing the physical size of the facility.

The high-density workplaces maximize use of daylight and fresh air while optimizing an indoor environment that responds to a range of specific indoor demands.

Key sustainability features include:

- Energy efficiency measures include an internal heat shift chiller to capture heat from high load spaces to re-heat other areas of the building, an enthalpy wheel for sensible and latent heat recovery from exhaust air, occupancy sensors on fume hoods, heat recovery from zebra fish exhaust air, natural ventilation in non-lab spaces, and a 15% reduction in lighting power density.
- State-of-the-art energy reduction technology and design such as reduced overhead lighting and LED task lighting at benches, occupancy sensors to control air and lighting when spaces are not in use, extensive use of active chilled beams, and reduced air changes during unoccupied periods.
- Extensive water conservation measures, including the use of re-captured grey water (reverse osmosis reject water and air handling condensate) for toilet flushing and low-flow fixtures that are projected to reduce water use by 42% below code maximums.
- Sub-metering by floor and a comprehensive measurement and verification plan will allow FAS to continually evaluate energy use.

PROJECT TEAM

Owner	FAS Office of Physical Resources and Planning
Occupant	Harvard Stem Cell and Regenerative Biology
Project Manager	Harvard FAS Capital Project Management
Owner's Rep.	Fluor/Left Field Management
Architect	Payette Associates
Contractor	Turner Construction
MEP Engineer	RG Vanderweil Engineers
Structural Engineer	Simpson Gumpertz and Herger
Commissioning Authority	Sebesta Bloomberg
Sustainability Consultant	Harvard Green Building Services

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MECHANICAL SYSTEMS

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The Sherman Fairchild project used both life cycle costing and energy modeling to evaluate and vet potential efficiency measures in an integrated and comprehensive design process. Life cycle costing was used to evaluate the feasibility of incorporating a combined heat and power plant, enthalpy wheels, an internal heat-shift chiller, AHU motor upgrades, and photovoltaic solar panels. Some of these systems were taken out of consideration based on poor life cycle cost performance and energy impact. The design includes:

WASTE HEAT RECOVERY is accomplished by capturing sensible and latent heat from laboratory general exhaust and transferring it to incoming supply air. An energy recovery system reduces the need to heat and cool the lab's 100% outside air supply, and results in the use of less campus chilled water and steam. Additionally, a refrigerant heat pipe recovers sensible heat from exhaust air of a zebra fish housing facility. Due to the odors generated in the zebra fish facility, a heat pipe in lieu of an enthalpy wheel is used to ensure no cross contamination occurs. The enthalphy wheels are anticipated to provide annual savings of 142 MTCDE and a discounted payback of less than 5 years.

N+1 DESIGN means that there are five 100% outside air handing units, manifolded together, but the design airflow can be handled by four if necessary. All five operate in unison, which allows the use of a redundant unit to reduce pressure drop and lower fan energy use.

A 50-TON INTERNAL HEAT SHIFT CHILLER is used to capture heat from high load spaces and to use it for reheat. The system uses internal heat produced by program equipment plus the heat of compression needed for cooling in lieu of fossil fuels or campus steam for reheat. This eliminates typical rejection of heat to the outdoors while producing heat for reheat in low load spaces needed due to minimum laboratory air change rates. Additionally, because heat is rejected within the building and not to the outdoors, the system does not require the installation of heat rejection device (i.e. cooling tower) or the associated water use. This system is expected to pay back within approximately five years.

ACTIVE CHILLED BEAMS AND SENSIBLE ONLY FAN COIL UNITS are installed in areas that have high internal heat gain (i.e. open bench areas) and areas that require supplemental cooling when space cooling requirements can't be met by the ventilation air. Fresh ventilation air supply is mixed with induced air to provide building occupants with conditioned air. Chilled beams are installed in open lab spaces and interior labs. Fan coil units are installed in the tissue culture labs. Active chilled beams require less energy than a conventional forced air system and allow the air handling system to provide ventilation air while the space cooling requirements are provided locally, resulting in supply and exhaust fan savings, ventilation conditioning savings, re-heat load reduction, and chilled/hot water pumping savings. Since water has the ability to hold more heat per unit volume than air, it is more efficient to pump chilled and hot water through pipes to active beams, rather than conveying conditioned air through ductwork using fans. Compared to an all-air system, the peak reduction is estimated to be 634,705 kWh annually and 7.5 MMBtu of steam annually, with a payback of 4.7 years.

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MECHANICAL SYSTEMS

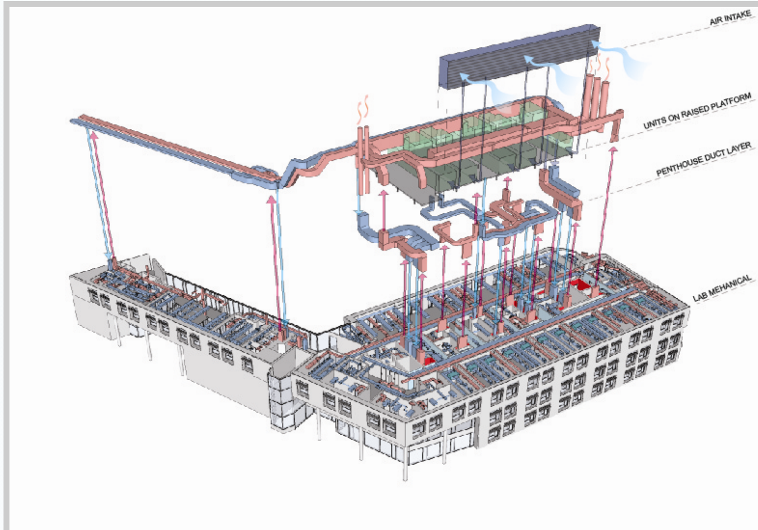

Image: copyright Payette, 2012

FUME HOODS include occupancy sensors to shut the sash when unoccupied. After a delay, these Mott Automatic Sash Operator systems automatically close when the operator leave the area. Fume hood layout has been selected to meet program requirements while density of layout is limited so that the fume hood exhaust does not exceed the minimum ventilation rate of 1 cfm/sf. RFV2 high performance fume hoods are installed.

LOWER LAB AIR CHANGE RATES DURING UNCCUPIED HOURS are set to reduce flow from the occupied rate of 5 to 6 air changes per hour. Spaces with VAV and two position boxes operate based on occupancy sensors to provide supply and exhaust fan savings, reduce ventilation conditioning loads and steam consumption. The reduction in consumption is estimated to be 472,236 kWh and 3,253 MMBtu annually (most savings are off-peak/unoccupied). Compared to a ASHRAE base case, this is estimated to consume 11% less electricity and 51% less steam annually. The payback period was calculated to be 7.3 years.

ZONING is configured such that each solar exposure in on a separate control zone, interior spaces are separately zoned, and thermostats are tied to occupancy sensors to set back temperature when unoccupied.

OPERABLE WINDOWS in non-lab areas provide natural ventilation and reduce HVAC demands.

SUBMETERING AND REAL-TIME UTIITY DISPLAYS Sub-metering by floor allows for accurate assessment of energy demand and consumption patterns. These touch-screen monitors/building dashboard displays located at the end of each of the floors in the building will provide building performance information to the occupants. The intent of these green screens is to help foster occupant awareness of energy consumption and sustainable building practices.

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ELECTRICAL SYSTEMS

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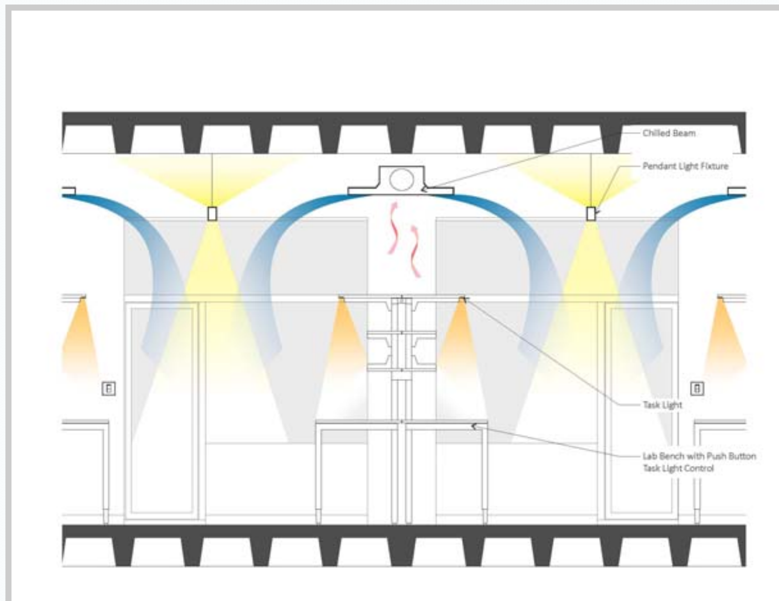
EFFICIENT LIGHT FIXTURES: Energy-efficient fluorescent lighting and LED options were carefully selected with the intent of providing optimal lighting in the research environments while reducing electricity demand of the lighting system. The lighting power density (watts per square foot) is reduced by 15% below the ASHRAE 90.1 baseline standard for the space type. The overall building lighting power density is 0.95 watts/sf. The fixtures are arranged such that a central linear fluorescent fixture provides ambient light to benches on either side. LED task lighting built into the lab benches provide additional light. Windows are located on the ends of each row to provide natural light. LED downlights and pendant parabolic T5 fixtures are used in corridors and lobbies and conference rooms.

OCCUPANCY AND DAYLIGHT SENSORS are present to control both lighting and HVAC setbacks. This system of lighting control sensors helps to reduce the run time of light fixtures and to reduce the lighting intensity in areas where daylight is present. Both actions result in reduced electrical demand. Ceiling mounted dual technology occupancy sensors turn lights off by each row of benches when not in use. Photocells located in perimeter areas are combined with dimming fixtures to ensure that no unnecessary artificial lighting is provided when natural daylight is capable of providing the required levels of illumination.



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PLUMBING SYSTEMS

The Sherman Fairchild project has installed a greywater reuse system, which captures reverse osmosis reject water and condensate from air handling units located in the penthouse to flush toilets. The water is collected in a dedicated piping system and directed into two 750 gallon storage tanks in the basement. The stored water is continually circulated through UV lights to prevent bacterial growth and stagnation. The water is dyed blue to ensure it is not accidentally mistaken for potable water and delivered to flushing fixtures throughout the building. The system is backed up by potable water which will fill the storage tanks should there be a shortage of reclaim water.

The annual flushing fixture water consumption for 270 days of operation per year is estimated to be 352,080 gallons based on the EPAct 1992 baseline used by LEED, but the reclaim system will provide approximately 217,634 gallons of greywater per year. This is equivalent to a **62%** reduction in potable water used for toilets. Overall, with the greywater system and low-flow plumbing fixtures (showers, lavatory aerators, urinals, water closets), the project has estimated a 42% reduction in potable water consumption.

Photo: Harvard Green Building Services, 2011

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INDOOR ENVIRONMENTAL QUALITY

INDOOR AIR QUALITY DURING CONSTRUCTION: A comprehensive indoor air quality management plan was implemented during construction to maintain healthy indoor air quality for workers and future occupants. All ductwork and vents remained sealed and a HEPA Filtration unit maintained negative pressure to keep any construction debris from migrating into occupied spaces. Additionally, porous building materials were kept sealed and off the ground until installation.

Only materials with **LOW OR NO VOC CONTENT** were used in the Sherman Fairchild project. Volatile Organic Compounds (VOCs) are chemical compounds and known carcinogens found in many construction materials that are considered detrimental to indoor air quality. Reducing the use of VOCs whenever possible improves indoor air quality and consequently occupant health and productivity.

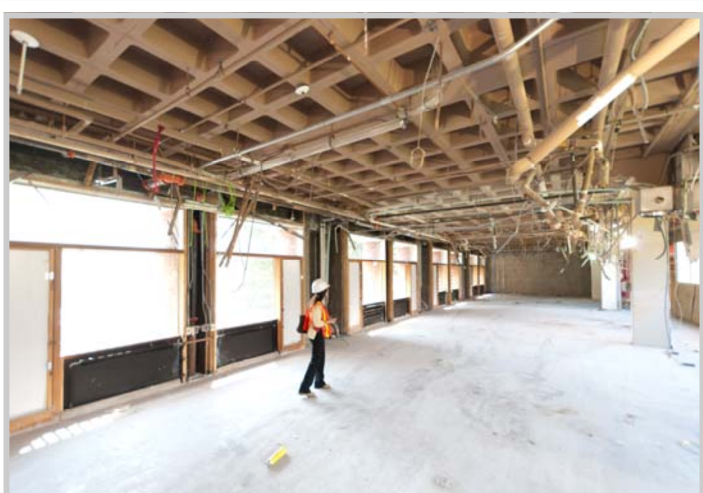
- **Composite Wood and Laminate Adhesives** used in the renovation do not have any added urea formaldehyde.
- **Adhesives and Sealants and Paints and Coatings** used in the renovation contain little to no VOCs.

Product Category	Product & Manufacturer	VOC Content (g/l)	VOC Limit (g/l)	Standard
Paints & Coatings	Glidden Professional: Life Master Interior Primer 9116-1200	0	200	GS-11
	Glidden Professional Life Master Acrylic Flat 9100	0	50	GS-11
	Glidden Professional Life Master Interior Non-Flat Coating 9300	0	50	GS-11
Adhesives & Sealants	Dow Corning DOW 786	43	250	SCAQMD
	National Gypsum Company Joint Treatment	2	50	SCAQMD

Sealed Ductwork Openings

DAYLIGHT AND VIEWS: To provide a connection between indoor and outdoor environments, **90%** of the occupied spaces have access to daylight and views.

SMOKING POLICY: In addition to prohibiting smoking in all facilities, FAS does not allow smoking within 25 feet of buildings with LEED certified spaces.



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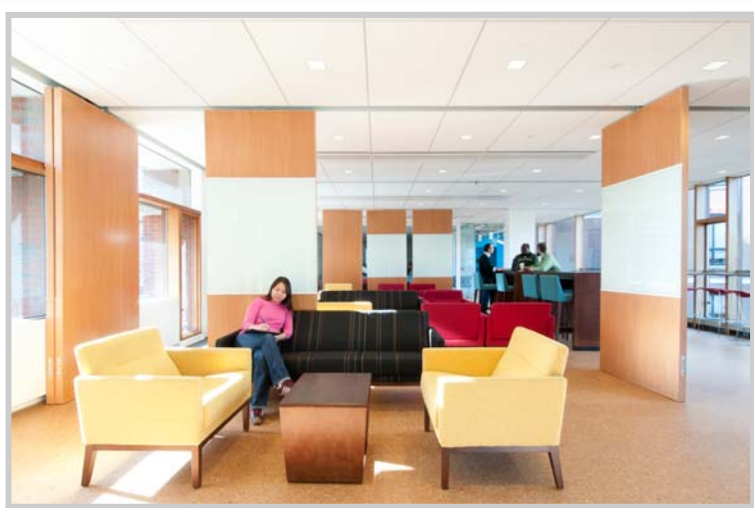

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MATERIALS & WASTE

20% of the materials (by cost) contain recycled content.

33% of the materials (by cost) were manufactured within 500 miles of the project site.

50% of the new wood (by cost) is Forest Stewardship Council certified.

91% of waste materials (by weight) were diverted from the landfill.

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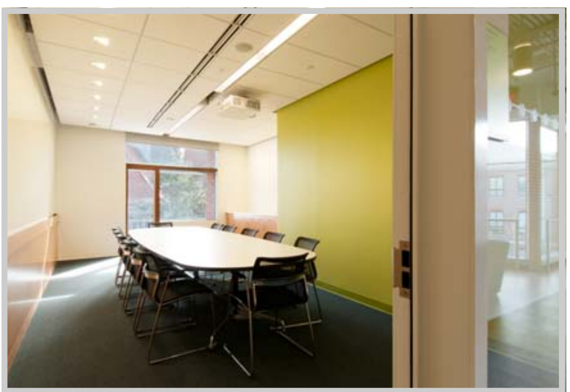
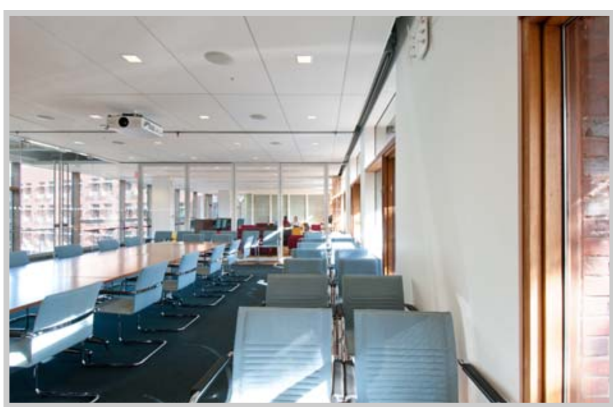
GREEN LABS PROGRAM: Because of the resource intensity of lab science and the unique conditions and requirements in each individual lab, lab sustainability approaches must be made from a building wide perspective. FAS Green Labs Program initiatives, with the support of paid lab sustainability representatives, help mitigate resource intensity, while respecting the resource demands of science.





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ADDITIONAL RESOURCES

- **HARVARD UNIVERSITY DEPARTMENT OF STEM CELL AND REGENERATIVE BIOLOGY:** http://www.scrb.harvard.edu
- **FAS GREEN LABS PROGRAM:** http://green.harvard.edu/fas/labs
- **HARVARD GREEN BUILDING SERVICES:** http://green.harvard.edu/green-building-services | FACEBOOK | TWITTER
- **HARVARD GREEN BUILDING RESOURCE:** http://green.harvard.edu/theresource

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Sherman Fairchild - LEED-CI v3 Scorecard

LEED PLATINUM: MARCH 2012

21	**0**	**0**	**0**	**21 Points**		**SUSTAINABLE SITES**	
						Site Selection	
			x	5	SSc1	Select a LEED certified building	
				up to 5		**OR a Building with following characteristics:**	
1				1	Option 1A	**Brownfield Redevelopment**	
			x	1	Option 1B	Stormwater Design, Quantity Control	
			x	1	Option 1C	Stormwater Design, Quality Control	
			x	1	Option 1D	Heat Island Effect, Non-Roof	
1				1	Option 1E	**Heat Island Effect, Roof**	
			x	1	Option 1F	Light Pollution Reduction	
			x	2	Option 1G	Water Efficient Landscaping, Reduce by 50%	
			x	2	Option 1H	Water Efficient Landscaping, No Potable Use	
2				2	Option 1I	**Innovative Wastewater Technologies**	
			x	1	Option 1J	Water Use Reduction, 30% Reduction	
			x	2	Option 1K	On-Site Renewable Energy	
1				1	Option 1L	**Other Quantifiable Environmental Performance: Green Cleaning**	
6				6	SSc2	**Dev. Density & Community Connectivity**	
6				6	SSc3.1	**Alt. Transportation, Public Transportation**	
2				2	SSc3.2	**Alt. Transportation, Bicycles *(RP)***	
2				2	SSc3.3	**Alt. Transportation, Parking Availability**	
11	**0**	**0**	**0**	**11 Points**		**WATER EFFICIENCY**	
Y				**Required**	WEp1	**WE Prereq 1 Water Use Reduction,** 20% Reduction	
						WEc1 Water Use Reduction, 30%, 35%, 40%	
6				6 to 11	WEc1	30% Reduction	
2						35% Reduction	
3						40% Reduction ***(RP)***	
33	**0**	**0**	**4**	**37 Points**		**ENERGY & ATMOSPHERE**	
Y				**Required**	EA prereq 1	**Fundamental Commissioning**	
Y				**Required**	EA prereq 2	**Minimum Energy Performance** 10% Reduction in lighting power density from ASHRAE 90.1-2007 **AND**	
Y				**Required**	EA prereq 3	**Fundamental Refrigerant Management**	
						Optimize Energy Performance: Lighting Power	
1				1 to 5	EAc1.1	Reduce power density to 15% below Standard	
			1			Reduce power density to 20% below Standard	
			1			Reduce power density to 25% below Standard *(RP)*	
			1			Reduce power density to 30% below Standard	
			1			Reduce power density to 35% below Standard	
						Optimize Energy Performance: Light Controls	
1				1 to 3	EAc1.2	Option A - Daylight responsive controls within 15' of windows	
1						Option B - Daylight responsive controls for 50% of load	
1						Option C - Occupancy controls for 75% of load	
						Optimize Energy Performance: HVAC	
10				5 to 10	EAc1.3	Option A - Equipment Efficiency and Zoning & Controls ***(RP)***	
						Option B - Reduce Design Energy Cost ***(RP)***	
						Optimize Energy Performance: Equipment/Appliances	
1				1 to 4	EAc1.4	70% of eligible equipment is ENERGY STAR	
1						77% of eligible equipment is ENERGY STAR	
1						84% of eligible equipment is ENERGY STAR	
1						90% of eligible equipment is ENERGY STAR	
5				5	EAc2	**Enhanced Commissioning**	
						Measurement & Verification	
				2 to 5	EAc3	Case 1 - Install Sub-Metering Equipment (2 pts)	
						Case 1 - Tenant Pays for Energy (3 pts)	
5						Case 2 - Continuous Metering (5 pts.)	

5				5	EAc4	**Green Power**	
6	**0**	**0**	**7**	**14 Points**		**MATERIALS & RESOURCES**	
Y				**Required**	MR prereq 1	**Storage & Collection of Recyclables**	
1				1	MRc1.1	**Tenant Space, Long Term Commitment**	
			1	1	MRc1.2	**Building Reuse, Maintain 40% Interior Non-Structural Components**	
			1	1	MRc1.3	**Building Reuse, Maintain 60% Interior Non-Structural Components**	
1				2	MRc2.1	**Construction Waste Management, Divert 50% from Landfill**	
1					MRc2.2	**Construction Waste Management, Divert 75% from Landfill**	
			1	2	MRc3.1 - 3.2	**Materials Reuse, (5%, 10% Materials) *(RP)***	
			1	1	MRc3.3	**Materials Reuse 30% Furniture and Furnishings**	
1				1	MRc4.1	**Recycled Content, 10% (post-consumer + 1/2 pre-consumer)**	
1				1	MRc4.2	**Recycled Content, 20% (post-consumer + 1/2 pre-consumer)**	
1				1	MRc5.1	**Regional Materials, 20% Manufactured Regionally *(RP)***	
			1	1	MRc5.2	**Regional Materials, 10% Extracted and Manufactured Regionally**	
			1	1	MRc6	**Rapidly Renewable Materials**	
			1	1	MRc7	**Certified Wood**	
15	**0**	**0**	**2**	**17 Points**		**INDOOR ENVIRONMENTAL QUALITY**	
Y				**Required**	EQ prereq 1	**Minimum IAQ Performance**	
Y				**Required**	EQ prereq 2	**Environmental Tobacco Smoke Control**	
1				1	EQc1	**Outside Air Delivery Monitoring**	
1				1	EQc2	**Increased Ventilation**	
1				1	EQc3.1	**Construction IAQ Management Plan, During Construction**	
1				1	EQc3.2	**Construction IAQ Management Plan, Before Occupancy**	
1				1	EQc4.1	**Low-Emitting Materials, Adhesives and Sealants**	
1				1	EQc4.2	**Low-Emitting Materials, Paints and Coatings**	
1				1	EQc4.3	**Low-Emitting Materials, Flooring Systems**	
1				1	EQc4.4	**Low-Emitting Materials, Composite Wood & Laminate Adhesives**	
1				1	EQc4.5	**Low-Emitting Materials, Systems Furniture and Seating**	
			1	1	EQc5	**Indoor Chemical and Pollutant Source Control**	
1				1	EQc6.1	**Controllability of Systems, Lighting**	
1				1	EQc6.2	**Controllability of Systems, Thermal Comfort**	
1				1	EQc7.1	**Thermal Comfort, Design**	
			1	1	EQc7.2	**Thermal Comfort, Verification**	
1				1	EQc8.1	**Daylight and Views, Daylight 75% of Spaces**	
1				1	EQc8.2	**Daylight and Views, Daylight 90% of Spaces**	
1				1	EQc8.3	**Daylight and Views, Views for 90% of Seated Spaces**	
5	**0**	**0**	**1**	**6 Points**		**INNOVATION AND DESIGN PROCESS (max 3 Exemplary Performance points)**	
1				1	IDc1.1	**IDc1.1: Low-Mercury Lighting**	
1				1	IDc1.2	**IDc1.2: Education**	
1				1	IDc1.3	**IDc1.3: Exemplary Performance, SSc3,1**	
1				1	IDc1.4	**IDc1.4: Exemplary Performance, EQc8.2**	
			1	1	IDc1.5	**IDc1.5: x**	
1				1	IDc2	**IDc2 LEED AP**	
4	**0**	**0**	**0**	**4 Points**		**REGIONAL PRIORITY CREDITS**	
1				1	RP	**Regional Priority Credit:** See ***(RP)*** above	Alt. Transportation, Bicycles
1				1	RP	**Regional Priority Credit:** See ***(RP)*** above	Water Use Reduction, 40%
1				1	RP	**Regional Priority Credit:** See ***(RP)*** above	EAc1.3
1				1	RP	**Regional Priority Credit:** See ***(RP)*** above	EAc1.1, 25% (or MRc5.1)
95	**0**	**0**	**14**	**109**		**TOTAL (pre-certification estimates)**	

Certified 40 to 49 points **Silver** 50 to 59 points **Gold** 60 to 79 points **Platinum** 80 to 110 points