



Sustainable Labs and LEED® - Strategies for Designing LEED Laboratories



John C. Mlade, LEED® AP
National Market Sector Research Manager,
Science & Technology Sustainability
e: john.mlade@perkinswill.com
www.perkinswill.com

Understanding Sustainable Building

What is sustainable building?

'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.'

(Our Common Future – The Brundtland Report - World Commission of Environment and Development – 1987)



Sustainability

"... the earth belongs to each generation during its course, fully and in its own right, no generation can contract debts greater than may be paid during the course of its own existence".

Thomas Jefferson, Sept. 6, 1789



3rd President of the United States

3

Understanding Sustainable Building



Integrated Design Process

Approach:

- Holistic / systems thinking
- Establish a vision and set goals
- Identify opportunities & challenges

Design Team:

- Multidisciplinary (green building expert)
- Include systems consultants from project outset

Collaboration & Tradeoffs:

- Identify synergies between systems, design strategies, & technologies

4

US LEED® Campuses

- Arizona State University, LEED Silver
- Brown University, LEED Silver
- Carnegie Mellon, LEED Silver
- Clemson University, LEED Silver
- Connecticut College, LEED Guide
- Dartmouth College, LEED Certified
- Emory University, LEED Certified
- Georgia Institute of Technology, LEED Certified
- Harvard University, LEED Guide
- Lewis and Clark College, LEED Silver
- Massachusetts Institute of Technology, LEED Silver
- Omaha Metropolitan Community College, LEED Certified
- Princeton University, LEED Guide
- Santa Clara University, LEED Certified
- State University of New York, LEED Guide
- University of California, LEED Certified
- University of Cincinnati, LEED Certified
- University of Florida, LEED Certified
- University of North Carolina- Chapel Hill, LEED Certified
- University of Oregon, LEED Certified



5

US Campuses with Other Sustainable Policies

- Connecticut College, Green Building Policy
- Harvard University, Statement of Sustainability Principles Implementation Framework
- Middlebury College, Green Building Principles
- Oregon State University, Sustainability in Campus Construction Policy
- Pomona College, Statement of Environmental Policy
- Princeton University, Design Standards
- Stanford University, Guidelines for Sustainable Buildings
- University at Buffalo (SUNY), UB High Performance Building Guidelines
- University of Connecticut, Campus Sustainable Design Guidelines
- University of Florida, Sustainability Program
- University of South Carolina, Sustainable Design Guidelines
- University of Toronto, Design Standards



6

Potential for Sustainable Laboratories

Labs consume approx. 3-8 times as much energy and water per square foot as the typical office building.

Large number of containment and exhaust devices like bio-safety cabinets and fume hoods.

Large number of heat-generating equipment and computers.

Critical experiments require fail-safe redundant backup systems and emergency power.



7

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LEED Platinum Labs

- Science & Technology Facility, National Renewable Energy Laboratory, LEED-NC v2 Platinum
- The Donald Bren School of Environmental Science and Management, LEED-NC v1 Platinum
- Biodesign Institute Building B, Arizona State University, LEED-NC v2.1



Nidus Center for Scientific Enterprise



The Donald Bren School



Biodesign Institute

8

Other Notable LEED Certified Labs

- CDC, Building 110, LEED-NC v2 Gold
- EPA Science and Technology Center, LEED-NC v2 Gold
- University of Pittsburgh, LEED-NC v2 Gold
- Vartan Group Inc, LEED-NC v2 Gold
- Whitehead Biomedical Research Building - Emory University, LEED-NC v2 Gold
- Applied Biosystems Campus, LEED-NC v2 Silver
- 9th & Stewart Life Sciences Building, LEED-CS v2.0 Silver
- SBI Project 2020E, Phase 2, LEED-CI v2.0 Silver



CDC Building 110 - National Center for Environmental Health

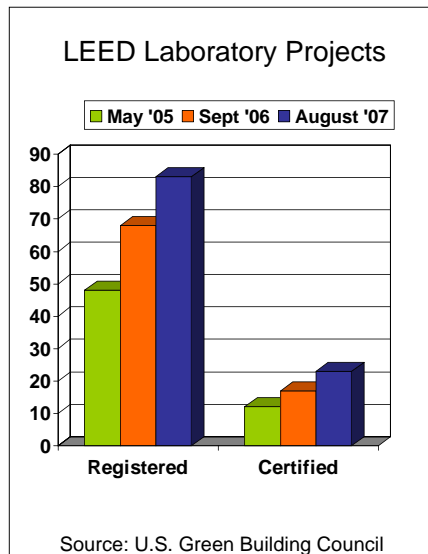


EPA Science & Technology Centre



Applied Biosystems Campus

Laboratory Growth in LEED



LEED® REGISTERED PROJECTS:

(March '07)
Laboratories: 76 (1.7%)
*83 as of 8/17/7
(Sep '06)
Laboratories: 68

LEED® CERTIFIED PROJECTS:

(March '07)
Laboratories: 19 (3.4%)
*23 as of 8/17/7
(Sep '06)
Laboratories: 17

The LEED Family of Rating Systems

LEED for New Construction

LEED for Commercial Interiors

LEED for Core and Shell

LEED for Existing Buildings

PERKINS + WILL

Future Programs

LEED for Homes

LEED for Neighborhood Developments

Market Sector Applications

LEED for:

- Schools
- Retail
- Healthcare
- Laboratories
- Multi-building Campuses (available)

Green Building Guidelines for Laboratories

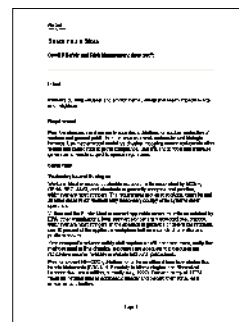
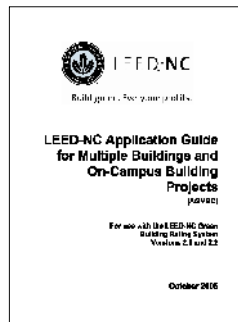
PERKINS + WILL

Labs21 Environmental Performance Criteria

LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects

LEED Application Guide for Laboratories (DRAFT)

Ideas + buildings that honor the broader goals of society



LEED Application Guide for Labs
 New Prerequisites: 2
 New Credits: 6
 Modified Prerequisites: 1
 Modified Prerequisites: 12

PERKINS + WILL

The LEED® NC 2.2 Rating System



Design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas:

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality

U.S. Green Building Council

The LEED® NC 2.2 Rating System

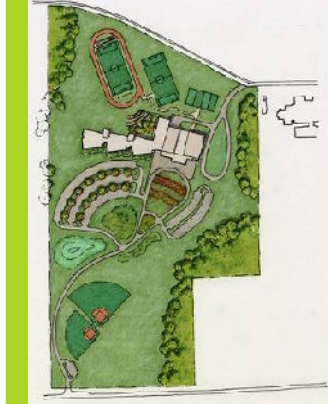
A screenshot of a document detailing the LEED NC 2.2 rating system. The document is divided into two columns. The left column contains text with a red circle around a heading and an arrow pointing to it labeled "Synergies". The right column contains a table with a red circle around a heading and an arrow pointing to it labeled "Summary Table".

Synergies

Summary Table

U.S. Green Building Council

The LEED® NC 2.2 Rating System



Sustainable Sites (14 Possible Points):

- Prerequisite 1: Construction Activity Pollution Prevention
- Prerequisite 2: Site Selection
- Credit 1: Development Density
- Credit 2: Brownfield Redevelopment
- Credit 3: Alternative Transportation (4 points)
- Credit 4: Site Development (2 points)
- Credit 5: Stormwater Design (2 points)
- Credit 6: Heat Island Effect (2 points)
- Credit 7: Light Pollution Reduction
- Credit 8: Safety and Risk Management

Sustainable Sites

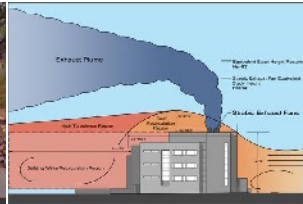
The LEED® NC 2.2 Rating System



Credit 5 (2 points):
Site Development:
Protect/Restore
Habitat; Maximize
Open Space



Credit 6 (2 points):
Stormwater
Design:
Quantity and
Quality



Credit 9 Safety and Risk Management:
LEED AGL 1 point
EPC 2 points

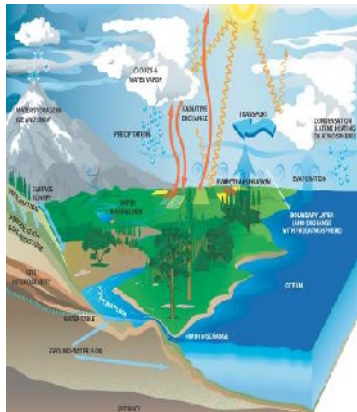
Sustainable Sites

The LEED® NC 2.2 Rating System



Klaus Advanced Computing Building
Georgia Institute of Technology, Atlanta, GA 17

The LEED® NC 2.2 Rating System



Water Efficiency (5 Possible Points)

Credit 1: Water-efficient Landscaping (2 points)

Credit 2: Innovative Wastewater Technologies

Credit 3: Water Use Reduction (2 points)

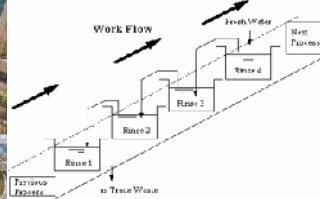
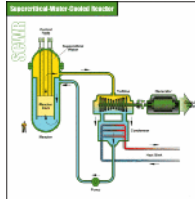
Prerequisite 1: Lab Equipment Water Use

Credit 4.1: Process Water Efficiency, 20%

Credit 4.2: Process Water Efficiency, 30%

Water Efficiency

The LEED® NC 2.2 Rating System



Prerequisite 1: Lab Equipment Water Use (AGL/EPC)

Credit 1 (2 Points): Water Efficient Landscaping

Credit 4: Process Water Efficiency
20% - 1 point
30% - 1 point (AGL/EPC)

Water Efficiency

The LEED® NC 2.2 Rating System



Energy and Atmosphere
(17 Possible Points)

Prerequisite 1: Fundamental Commissioning
Prerequisite 2: Minimum Energy Performance
Prerequisite 3: Fundamental Refrigerant Management
Credit 1: Optimize Energy Performance (10 points)
Credit 2: On-site Renewable Energy (3 points)
Credit 3: Enhanced Commissioning
Credit 4: Enhanced Refrigerant Management
Credit 5: Measurement & Verification
Credit 6: Green Power
Credit 7: Right-size Laboratory Equipment Load

Energy and Atmosphere

The LEED® NC 2.2 Rating System



System	Year	Energy	Cost	Points
ASHRAE 90.1-2004	2004	1000000	1000000	0
ASHRAE 90.1-2004	2004	950000	950000	1
ASHRAE 90.1-2004	2004	900000	900000	2
ASHRAE 90.1-2004	2004	850000	850000	3
ASHRAE 90.1-2004	2004	800000	800000	4
ASHRAE 90.1-2004	2004	750000	750000	5
ASHRAE 90.1-2004	2004	700000	700000	6
ASHRAE 90.1-2004	2004	650000	650000	7
ASHRAE 90.1-2004	2004	600000	600000	8
ASHRAE 90.1-2004	2004	550000	550000	9
ASHRAE 90.1-2004	2004	500000	500000	10



Money Isn't All You're Saving

Prerequisite 4: Assess Minimum Ventilation Requirements (EPC)

Credit 1 (10 points): Optimize Energy Performance

Energy and Atmosphere

The LEED® NC 2.2 Rating System

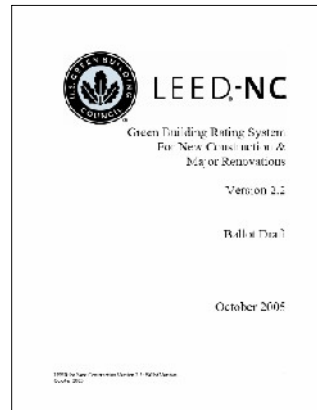
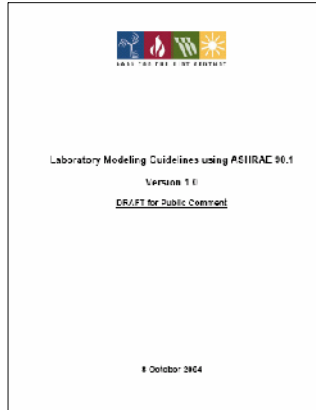
Credit 1: Optimize Energy Performance

Up to 10 Points available, based on increases energy performance.
Reduce energy cost compared to the energy cost budget required for ASHRAE / IESNA 90.1 2004
Measured in \$\$ (Annual energy cost)
Energy modeling used as a design tool
2 points minimum

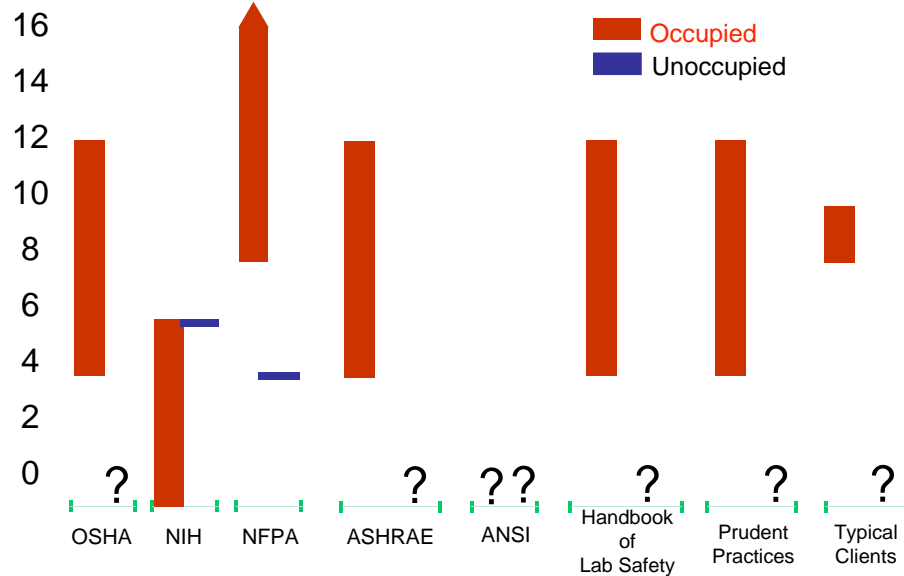


Energy and Atmosphere

Modified Modeling Guidelines



Guidelines for Minimum Air Changes/Hour in Biological Laboratories



LEED NC 2.2 Rating System

Strategies in laboratory design to achieve a reduction in energy consumption:

Orientation, Lab Zoning
Appropriate air change rates
Chilled Beams/Venturi Wedge result in reduction in the number of air handling units and exhaust
Efficient Lighting/Lighting Levels
Variable Frequency Drives
Humidification System
Accurate Equipment Loads/Right-sizing
Energy modeling

The study will analyze paybacks and inform design decisions



2 Credits – 14% reduction
3 Credits – 17.5% reduction
4 Credits – 21% reduction
5 Credits – 24.5% reduction
6 Credits – 28% reduction
7 Credits – 31.5% reduction
8 Credits – 35% reduction
9 Credits – 38.5% reduction
10 Credits – 42% reduction

Energy and Atmosphere

Credit 1 (10 Points): Optimize Energy Performance

25

2030 Challenge

New Buildings - 50%

2010 – 60%

2015 – 70%

2020 – 80%

2025 – 90%

2030 - Carbon Neutral
(no fossil fuel energy to operate)



The LEED® NC 2.2 Rating System



Credit 2 (3 Points):
On-site Renewable Energy



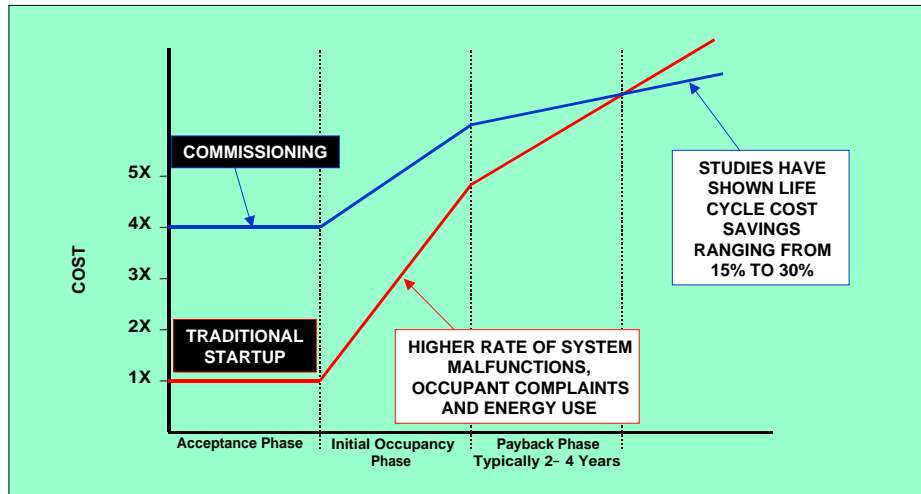
Credit 3:
Enhanced Commissioning



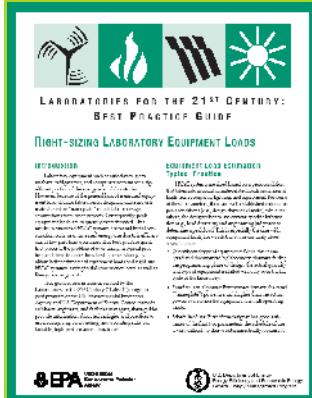
Credit 5:
Measurement and Verification

Energy and Atmosphere

Commissioning vs. Traditional Startup Fundamental and Additional Commissioning



The LEED® NC 2.2 Rating System



LEED AGL
Credit 7: Right-size Laboratory Equipment Load

EPC
Credit 7.1-5: Energy Supply Efficiency
Credit 8: Improve Laboratory Equipment Efficiency
Credit 9.1-2: Right-size Laboratory Equipment Load

Energy and Atmosphere

The LEED® NC 2.2 Rating System



Materials & Resources (13 Possible Points)

- Prerequisite 1: Collect Recyclables
- Credit 1: Building Reuse (3 Points)
- Credit 2: Construction Waste Management (2 Points)
- Credit 3: Materials Reuse (2 Points)
- Credit 4: Recycled Content (2 Points)
- Credit 5: Local / Regional Materials (2 Points)
- Credit 6: Rapidly Renewable Materials
- Credit 7: Certified Wood
- Credit 6: Environmentally Preferable Finishes, Fixed Furniture and Laboratory Furniture

Materials and Resources

The LEED® NC 2.2 Rating System



Prerequisite 2:
Hazardous Material
Handling (EPC)

Credit 6:
Rapidly-renewable Materials

Environmentally Preferable
Finishes, Fixed Furniture and
Laboratory Furniture (AGL)

Credit 8: Chemical
Resource Management
(EPC)

Materials and Resources

The LEED® NC 2.2 Rating System



Indoor Environmental Quality (15 Possible Points)

- Prerequisite 1: Minimum IAQ Performance
- Prerequisite 2: Tobacco Smoke Control
- Credit 1: Outdoor Air Delivery Monitoring
- Credit 2: Increase Ventilation
- Credit 3: Construction IAQ Plan (2 Points)
- Credit 4: Low-emitting Materials (4 Points)
- Credit 5: Indoor Chemical & Pollutant Control
- Credit 6: Controllability of Systems (2 Points)
- Credit 7: Thermal Comfort (2 Points)
- Credit 8: Daylight & Views (2 Points)
- Prerequisite 3: Laboratory Ventilation
- Credit 9.1: Containment Device Commissioning
- Credit 9.2: Protection and Notification System

Indoor Environmental Quality

The LEED® NC 2.2 Rating System



Prerequisite 3:
Laboratory Ventilation
(LEED AGL and EPC)

Prerequisite 4:
Exterior Door
Notification (EPC)

Credit 4 (4 points):
Low-emitting Materials

Indoor Environmental Quality

The LEED® NC 2.2 Rating System



Credit 8 (2 points):
Daylight and Views

LEED AGL

Credit 9.1: Containment Device
Commissioning

Credit 9.2: Protection and Notification
Systems

EPC

Credit 9.1: Airflow Modeling

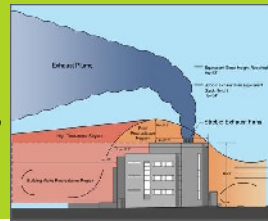
Credit 9.2: Fumehood Commissioning

Credit 9.3: Alarm Systems

Indoor Environmental Quality

Innovation & Design Process (5 Possible Points)

- **Green Education Program** GreenTouchscreen
Interactive kiosks placed throughout building for occupants to explore and learn about sustainability
- **Green Housekeeping Program**
Includes product research, reviewing and revising current cleaning practices, and full implementation of the program's objectives
- **Wind Tunnel Testing**
Performed on building model to optimize exhaust and intake locations
- **Laboratory Flexibility**
To design a flexible facility able to adapt to programmatic changes while minimizing associated construction waste, cost, and impact indoor air quality during construction.
- **Exemplary Performance:** 10% Reduction in non-regulated [process] water use (WE Credit 3)



LEED & Specifications

Division 1: General Requirement

- state environmental performance goals
- create LEED Requirements section
 - outline anticipated LEED credits
 - develop specification coordination checklist
 - identify contractor's responsibilities
 - submittal & documentation requirements
 - action plans
 - materials selection requirements

Points Achieved		Points Possible	Points From
Sustainable Sites		Collaborative Process	Green Building
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
11	11	11	11
12	12	12	12
13	13	13	13
14	14	14	14
15	15	15	15
16	16	16	16
17	17	17	17
18	18	18	18
19	19	19	19
20	20	20	20
21	21	21	21
22	22	22	22
23	23	23	23
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25	25	25	25
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29	29	29	29
30	30	30	30
31	31	31	31
32	32	32	32
33	33	33	33
34	34	34	34
35	35	35	35
36	36	36	36
37	37	37	37
38	38	38	38
39	39	39	39
40	40	40	40
41	41	41	41
42	42	42	42
43	43	43	43
44	44	44	44
45	45	45	45
46	46	46	46
47	47	47	47
48	48	48	48
49	49	49	49
50	50	50	50

LEED & Specifications

Divisions 2 - 10

- specify products & systems
- state specific LEED reference standards
- specify procedures (i.e., erosion & sedimentation control plans)
- included specific product attributes (i.e., Energy Star Roofs, FSC wood, Green Seal Paints)
- identify product performance criteria or characteristics (Low VOC content for paints, adhesives etc.)
- include submittal information in each relevant division.



37



John C. Mlade, LEED® AP
National Market Sector Research Manager,
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1382 Peachtree St. NE, Atlanta, GA 30309
t: 404.443.7540
john.mlade@perkinswill.com
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38