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Charting a Course to Energy Independence

Providence, RI
August 9-12, 2009

Using LEED and ASHRAE 90.1 for Laboratories: Special Considerations

LABS FOR THE 21ST CENTURY

BERKELEY LAB

Paul Mathew, Ph.D
Staff Scientist
Lawrence Berkeley National Laboratory

GSA

Premise

- Various Federal mandates and guidelines require the use of LEED and ASHRAE 90.1

- LEED and ASHRAE 90.1 are <u>means, not ends</u>.
  - Need to apply these tools properly to ensure that you're evaluating <u>what matters in labs</u>.

Outline

- LEED-NC and Labs21 Environmental Performance Criteria
- ASHRAE 90.1 - Special Considerations for Labs
- LEED-EB and Labs21 Benchmarking

What is Labs21?

- A joint EPA/DOE program to improve the environmental performance of U.S. laboratories.
  - Technical assistance
  - Training
  - Tools

- Sponsors:
  - DOE Federal Energy Management Program
  - EPA Facilities Management and Services Division

Labs21 Environmental Performance Criteria (EPC)

- Rating system specifically for laboratories
- Leverages and builds on LEED
  - Modifications and additions to improve applicability to labs
- Developed with over 40 industry volunteers
- Used on many lab projects
  - Molecular Foundry at LBNL
  - Specified in UC Regents policy

LEED and EPC

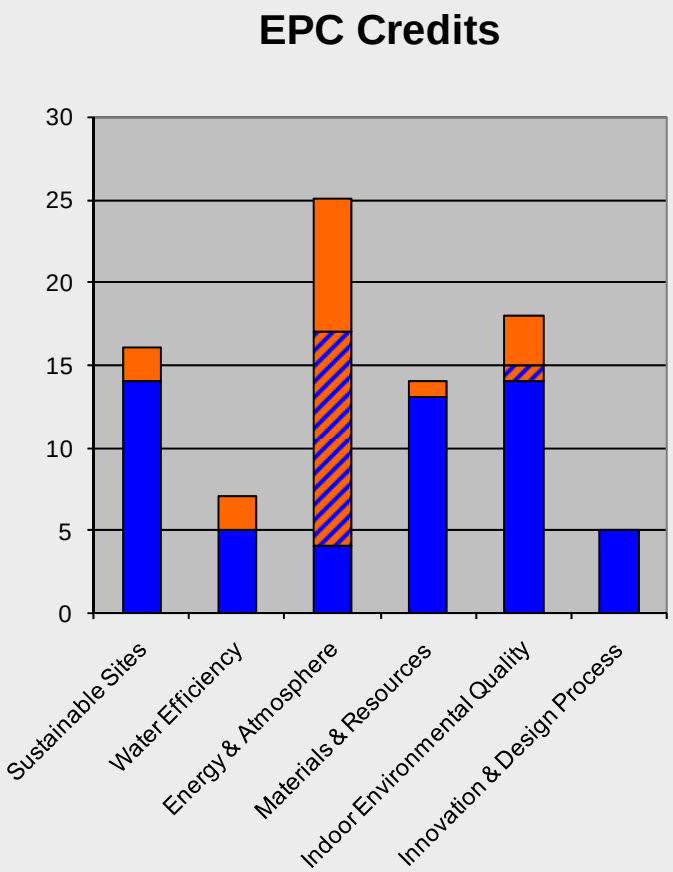
- LEED is a USGBC product
  - Current version LEED v3
- EPC is a Labs21 product
  - Current version EPC 2.2
  - No certification
- USGBC may add lab credits to LEED v3
  - Using EPC as starting point

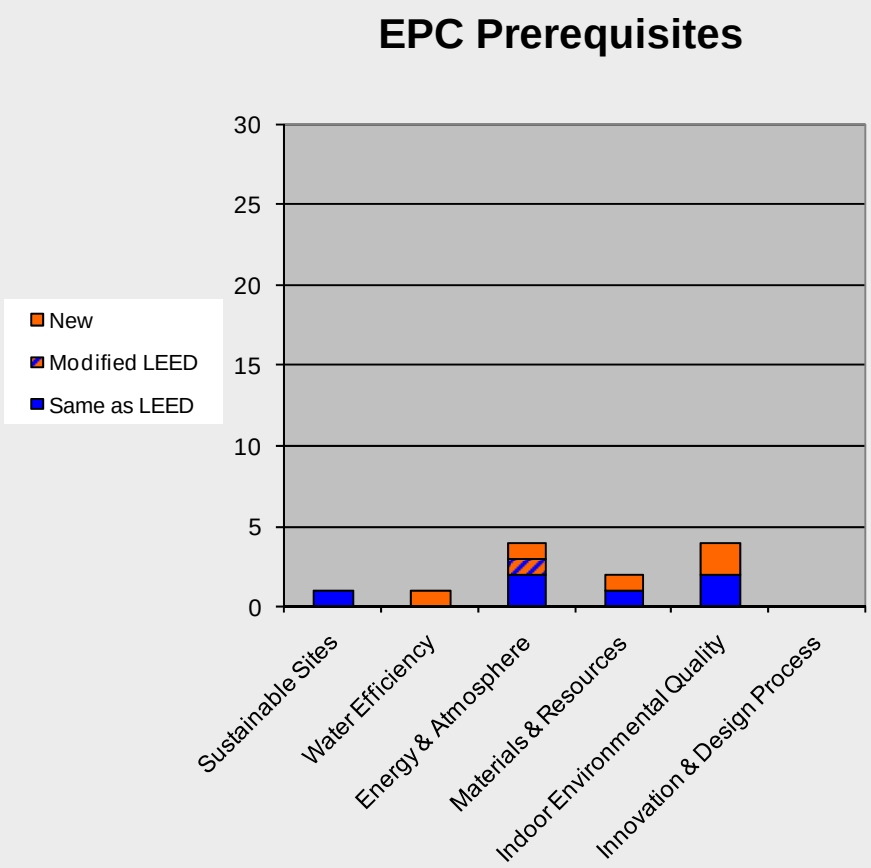
While Waiting for LEED-Labs….

- Owners and designers can benefit from applying the EPC to guide and evaluate sustainable design for labs.
- When applying for LEED certification, EPC credits may be awarded as innovation points.

- Both tools are useful, but avoid “point-chasing”
  - Should not design by checklist

LEED and EPC


EPC Credits
30
25
20
15
10
5
0
Sustainable Sites
Water Efficiency
Energy & Atmosphere
Materials & Resources
Indoor Environmental Quality
Innovation & Design Process

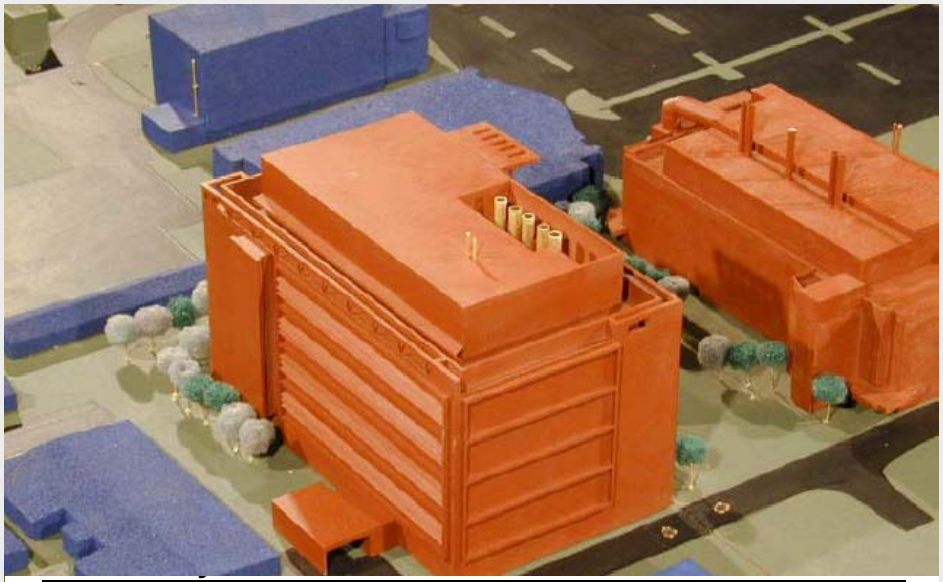

New
Modified LEED
Same as LEED
EPC Prerequisites
30
25
20
15
10
5
0
Sustainable Sites
Water Efficiency
Energy & Atmosphere
Materials & Resources
Indoor Environmental Quality
Innovation & Design Process

Labs21 EPC - Sustainable Sites

- Minimize impact of air effluents
  - Use mathematical modeling, physical modeling and/or post-construction testing and certification to prove compliance

Source: Cermak Peterka Petersen

Airflow Modeling – Federal Lab



Parameter	High Flow	Low Flow
Stack Height (ft)	21	21
Volume Flow (cfm)	60,000	30,000
Exit Velocity (fpm)	3,056	1,528
Fan Size (HP)	52	26
Annual Energy Cost	$20,340	$10,054
Design Criterion, HL/m	230	230
Max Measured C/m	81	162

Source: Cermak Peterka Petersen

Labs21 EPC - Water Efficiency

- Prerequisite: Avoid one-pass water for cooling
- Credits: Reduce process water and process wastewater
- Strategies:
  - Use closed loop cooling
  - Reduce, reuse, recycle.
  - Flow control – turn off when not in use
  - Reuse last rinse for first rinse of next cycle
  - Treat process wastewater for down-cycled use in cooling towers, etc.

Labs21 EPC - Energy & Atmosphere

- Prerequisite 4: Min Ventilation Requirements
  - Assess with team-based process
  - Consider exhaust alternatives

- Credit 1: Energy Efficiency
  - Use ASHRAE 90.1-2007 Appendix G with Labs21 modeling guidelines
    - 2007 version includes many improvements to address laboratory issues.

Labs21 EPC - Energy & Atmosphere

- Credit 8: Lab equipment efficiency
  - Equipment loads in labs are high and efficiency is often overlooked
  - Credit for selecting energy efficient lab equipment, where available
- Credit 9: Right-sizing HVAC equipment
  - HVAC often oversized due to overestimation of lab equipment loads
  - Credit for measuring equipment loads in a comparable lab space
  - Credit for metering provision

Benefits of Right-sizing LBNL Molecular Foundry

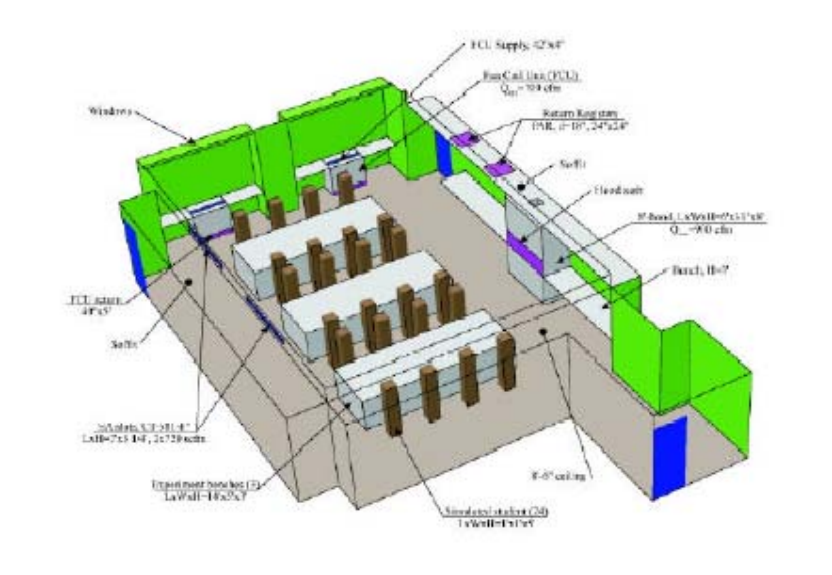
- $2.5 million first cost savings for right-sizing HVAC systems
  - Based on measured data from comparable labs

- LEED GOLD
  - Rightsizing savings allowed additional green features with 4% cost savings over baseline.

Labs21 EPC – Indoor Environmental Quality

- Prerequisite: Minimum requirements
  - Meet ANSI Z 9.5

- Credits for user health and safety
  1. Optimize indoor airflow based on CFD or physical modeling.
  2. Commission all fume hoods per ASHRAE 110, with performance rating of 4.0 AI 0.1
  3. Self-identifying and fail-safe alarm systems



Source: RWDI

ASHRAE 90.1

SPECIAL CONSIDERATIONS FOR LABS

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What Does “x% Better Than ASHRAE” Mean?

- Simply specifying “x% better than ASHRAE 90.1” is inadequate.
  - Multiple compliance paths
  - Multiple interpretations and assumptions

“I could scream I'm so sick of multiple, dueling, regressing, re-combining, amending & re-amending baselines (budgets, standards, references....) and the constant ‘wha, wha, wha, can't you show 15% savings instead of 5%’.....”

(Harassed) Energy Modeler

ASHRAE 90.1 Versions

- Current version is 2007
  - Incorporates several 2004 addenda that are relevant to labs.
- If using 2004, ensure that all addenda are used
  - USGBC allows use of addenda for LEED 2.2

Using ASHRAE 90.1 in Labs

- ASHRAE 90.1-2007 can be effectively used for laboratories...BUT need to pay special attention to some issues:
  - Baseline systems
  - Fan power limitations
  - Load diversity and reheat energy use

- Labs21 has developed additional guidance
  - Labs21 Modeling Guidelines

Baseline System for Labs

- Temperature controlled VAV capable of reducing flow to 50% during unoccupied periods.
- Baseline does NOT require energy recovery for systems serving lab spaces.

Fan Power Limitations

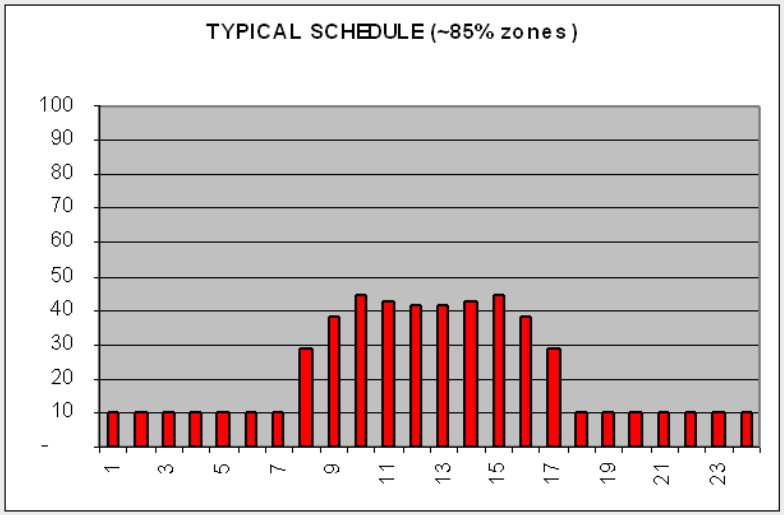
- Pressure drop adjustments increase fan power allowance for lab systems

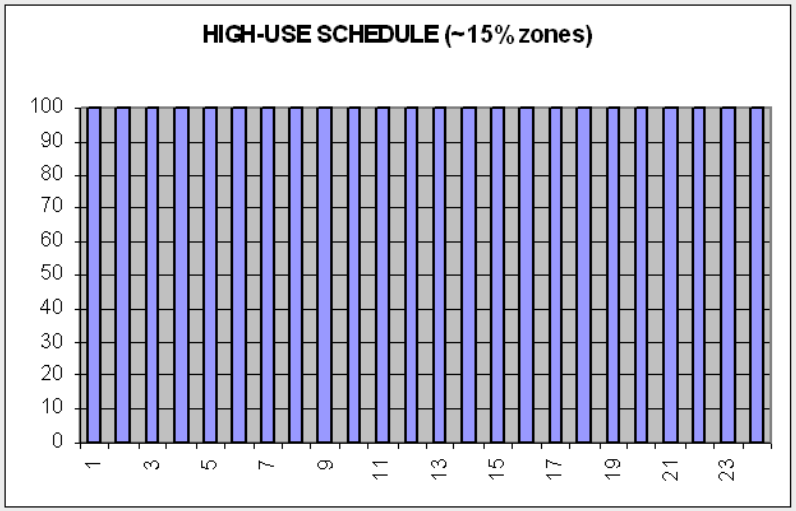
TABLE 6.5.3.1.1B Fan Power Limitation Pressure Drop Adjustment

Device	Adjustment
Credits	
Fully ducted return and/or exhaust air systems	0.5 in. w.c.
Return and/or exhaust airflow control devices	0.5 in. w.c.
Exhaust filters, scrubbers, or other exhaust treatment	The pressure drop of device calculated at fan system design condition
Particulate Filtration Credit: MERV 9 through 12	0.5 in. w.c.
Particulate Filtration Credit: MERV 13 through 15	0.9 in. w.c.
Particulate Filtration Credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2× clean filter pressure drop at fan system design condition
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition
Heat recovery device	Pressure drop of device at fan system design condition
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design condition
Sound Attenuation Section	0.15 in. w.c.
Deductions	
Fume Hood Exhaust Exception (required if 6.5.3.1.1 Exception [c] is taken)	–1.0 in. w.c.

Modeling Load Diversity

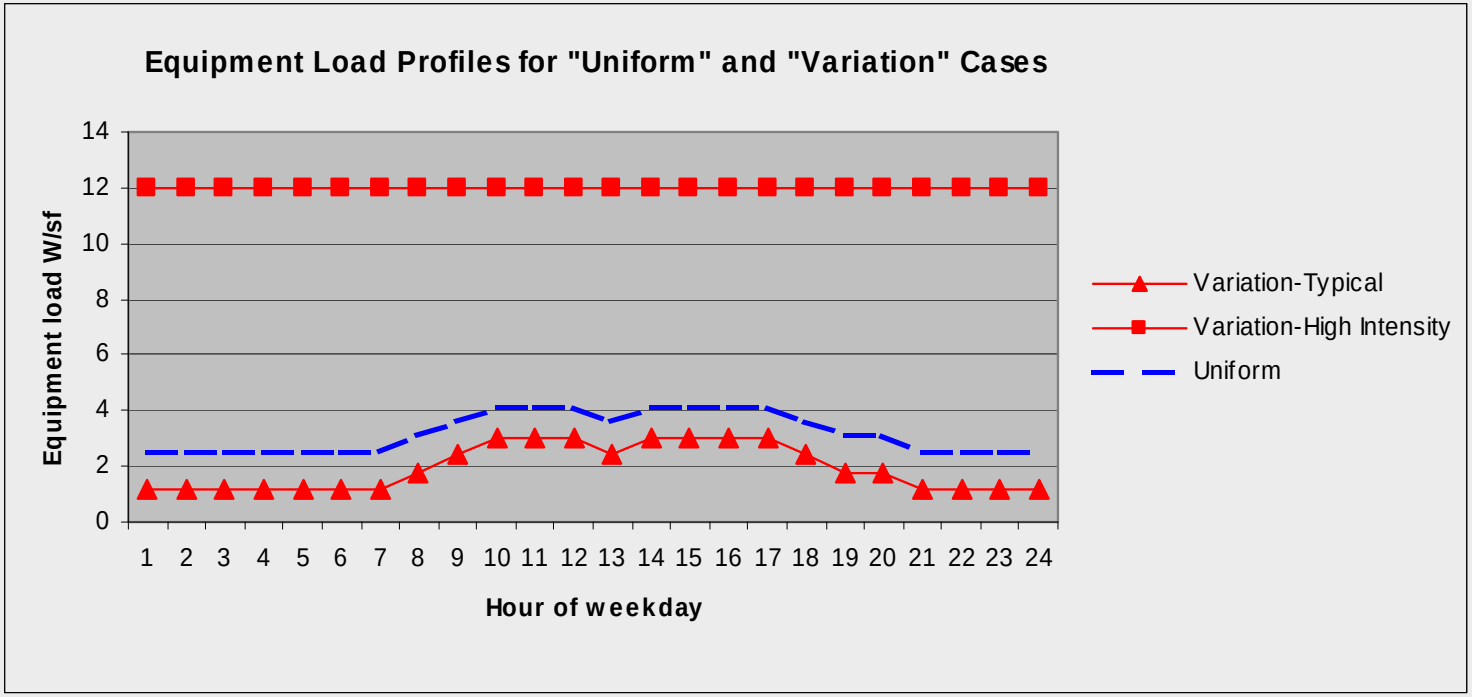
- Load diversity causes major reheat energy use
- Ensure that schedules reflect load diversity
  - ASHRAE 90.1 does not specify schedules
- Shows savings from chilled beams vs. VAV





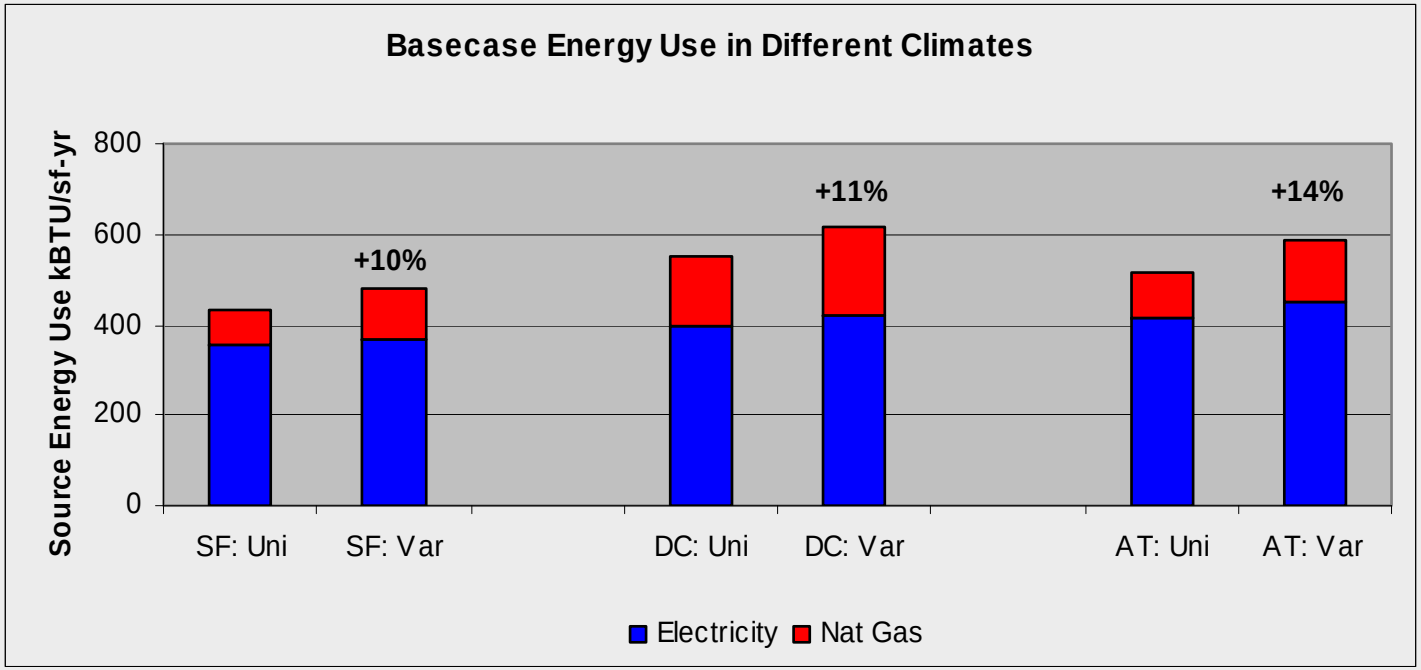
Impact of Load Diversity on Reheat Energy

- Simulation analysis of reheat energy use
  - Uniform vs. varied schedules



Impact of Load Diversity on Reheat Energy

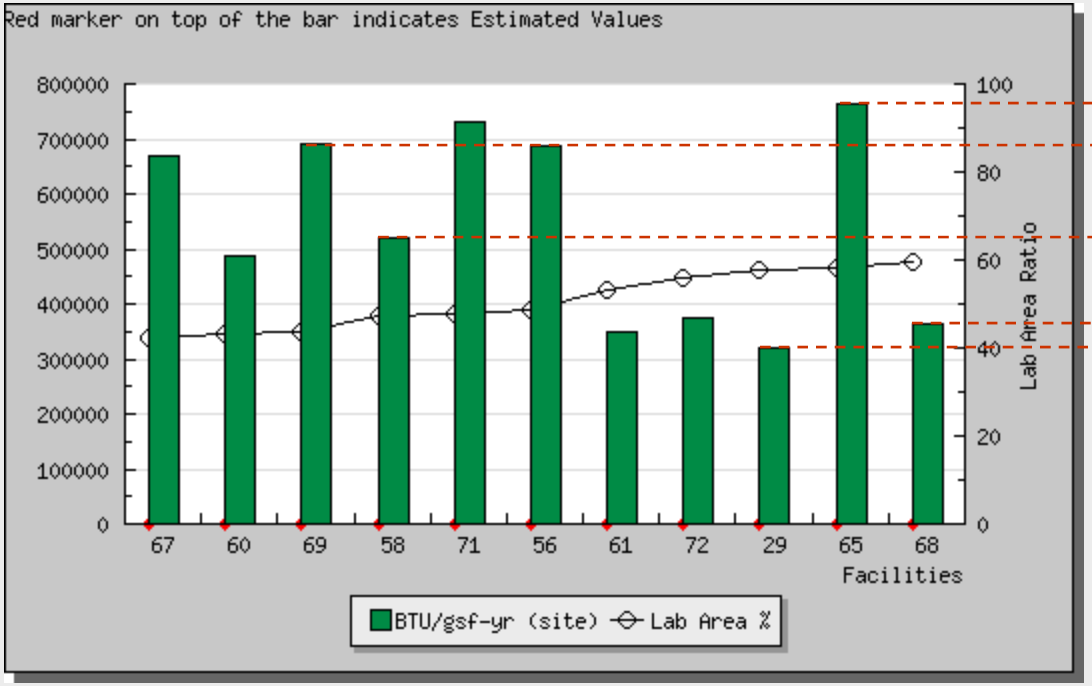
- Significant impact just from load diversity
  - Varies by location, ventilation rate



See Labs21 best practice guide on minimizing reheat
http://www.labs21century.gov/toolkit/ bp_guide.htm

“Sanity Check” Simulated Results

- Compare simulation results to empirical data
  - e.g. Use Labs21 benchmarking tool



Highest Value
3rd Quartile
2nd Quartile
1st Quartile
Lowest Value

Labs21 dataset: Site BTU/sf-yr
Climate zone 3A (San Francisco)
Lab area ratio: 0.4-0.6

LEED-EB

LABS21 BENCHMARKING

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LEED-EB and Benchmarking

- LEED-EB requires energy benchmarking
  - EA prerequisite 2 and EA Credit 1
- Option A: Energy Star rating
  - Not available for labs
- Option B: Energy Star national average
  - Not specifically applicable for labs
  - Labs will need to use “other” category
- Option C: Alternative method

USGBC credit ruling for labs

- *"An alternative approach for your laboratory building would be to use the Energy Benchmarking Tool available through Laboratories for the 21st Century (Labs21), which is a resource co-sponsored by the EPA and DOE for the design, construction, and operation of laboratories. The Energy Benchmarking Tool can be found here: http://www.labs21century.gov/toolkit/ benchmarking.htm. Using the metrics provided by the tool, calculate your project's percent reduction in energy use compared to the benchmark. You can then calculate the corresponding number of LEED points."*

Labs21 Benchmarking Tool

- National database of lab energy use data
  - 170 buildings in core data set (as of 7/1/09)
  - Data sources: Labs21 partners, case studies, CBECS, other users
- Analysis and output
  - Building and system level metrics
  - Does not provide a rating or label
- Labs21 has developed guidance on how to use tool for LEED-EB

Benchmarking Labs for the 21st Century Web Toolkit - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address http://www.dc.lbl.gov/Labs21/StepThreeP3.php

LABS FOR THE 21ST CENTURY

benchmarking

step one of four - login

step two of four - enter facility name and year of data

step three of four - enter data for the facility

step four of four - review / edit entered data

*** Indicates Required Input**

Data / Facility Information

User	**LBNL**
Organization	**Lawrence Berkeley National Laboratory**
Facility chosen	**Bldg2-AdvancedMaterialLab**
Year chosen	**2001**

General Facility

Street Address*	One Cyclotron Road
Location*	Berkeley, CA
Zip Code (5 digit)*	94720
Lab Use*	Research/Development
Lab Type*	Combination/Others
Lab Category*	Combination/Others
Number of Building(s)	1
Gross Area (sq. ft.)*	85761

start Re: iLab age... Palm Desktop

Benchmarking Labs for the 21st Century Web Toolkit - Microsoft Internet Explorer

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Address http://www.dc.lbl.gov/Labs21/StepThreeP3.php

Energy Use

		Measured	Estimated
Annual Energy Utility Cost ($)*	231000	●	○
Annual Heating Energy (therms)*	124800	●	○
Does facility use CHP (Cogen) system?	No		
Annual Electric Use (kWh)			
Total*	2526000	●	○
Ventilation	1010000	○	●
Cooling Plant *(including campus chilled water, if any)*	298000	○	●
Lighting	460000	○	●
Process/plug	1150000	○	●
Peak Demand (kW)			
Total*	478	●	○
Ventilation	0	○	●
Cooling Plant *(including campus chilled water, if any)*	0	○	●
Lighting	0	○	●
Process/plug	0	○	●

System

		Measured	Estimated
Peak Cooling Load (Tons)	0	○	●
Average Cooling Load (Tons) *(Total annual cooling ton-hours divided by 8760)*	0	○	●
Cooling Plant Capacity (Tons)	500	●	○
Peak CFM *(Sum of exhaust, supply, and recirculating fans)*	0	○	●
Average CFM *(Sum of exhaust, supply, and recirculating fans)*	0	○	●

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Benchmarking Labs for the 21st Century Web Toolkit - Microsoft Internet Explorer

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Address http://www.dc.lbl.gov/Labs21/CompareData.php?UserID=2

LABS FOR THE 21ST CENTURY

benchmarking

Choose Metrics and Filtering Criteria

More Information

User LBNL

Organization Lawrence Berkeley National Laboratory

Please specify the metric criteria -

System: Total Building

Energy / Efficiency Metric: BTU/sf-yr (site)

Please specify the filtering criteria -

1. Lab Area / Gross Area ratio

is greater than or equal to 0.00 and is less than or equal to 0.99

2. Occupancy

- Standard (≤14 hours)
- High (>14 hours)
- Both (all data)

3. Climate [Climate Code, Climate Type, Representative City]

(To view the map of climatic distribution)

- ☑ 1A, **Very Hot - Humid** (Miami, FL)
- ☑ 2A, **Hot - Humid** (Houston, TX)
- ☑ 2B, **Hot - Dry** (Phoenix, AZ)
- ☑ 3A, **Warm - Humid** (Memphis, TN)
- ☑ 3B, **Warm - Dry** (El Paso, TX)
- ☑ 3C, **Warm - Marine** (San Francisco, CA)
- ☑ 4A, **Mixed - Humid** (Baltimore, MD)
- ☑ 4B, **Mixed - Dry** (Albuquerque, NM)
- ☑ 4C, **Mixed - Marine** (Salem, OR)
- ☑ 5A, **Cool - Humid** (Chicago, IL)
- ☑ 5B, **Cool - Dry** (Bosie, ID)
- ☑ 6A, **Cold - Humid** (Burlington, VT)
- ☑ 6B, **Cold - Dry** (Helena, MT)
- ☑ 7, **Very Cold** (Duluth, MN)
- ☑ 8, **Subarctic** (Fairbanks, AK)

Reset Values Continue...

Graphing - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Back Search Favorites Media

Address http://www.dc.lbl.gov/Labs21/Graphing.php Go

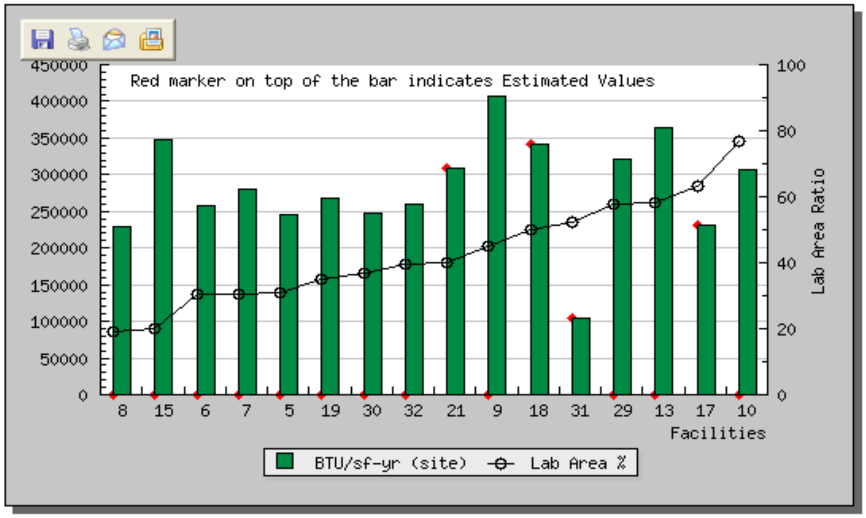
LABS FOR THE 21ST CENTURY

benchmarking

Graphing Data

User	LBNL
Organization	Lawrence Berkeley National Laboratory

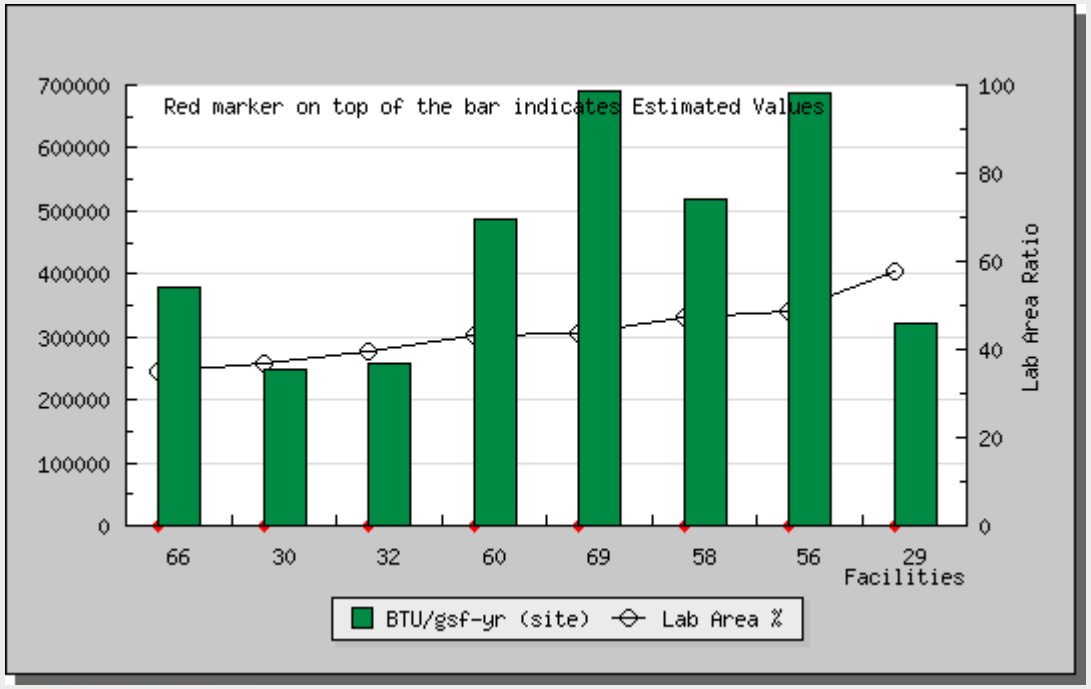
Total Building BTU/sf-yr (site)



Facility	Total Building Site Energy Use (BTU)	Gross Area (sq.ft.)	BTU/sf-yr (site)	Lab Area Ratio	Occupancy Hours	Climate
8	12613440000	54962	229493.83	0.19	12	3C
15	184866190404	532602	347100.07	0.2	11	4C
6	14396064000	55903	257518.63	0.3	12	3C
7	12350320000	44152	279722.78	0.31	12	3C
5	21098712000	85761	246017.56	0.31	12	3C
19	40723337460	151435	268916.28	0.35	12	4B
30	5198674400	21018	247343.91	0.37	24	3C

Labs21 Guidance…1

1. Retrieve Labs21 data for peer group
   - Peer group filters: climate zone, lab-type, lab area ratio, occupancy hours



Climate:
3C (San Francisco)

Lab type(s):
Chemical, Biological

Lab area ratio:
0.3-0.6

Labs21 Guidance…2

- Compare energy intensity (BTU/sf) to average intensity of peer group.
- Award points based on percentage below the average
  - Similar to option B in LEED-EB O&M

Percentage better than national average (for buildings not eligible for an EPA rating)*	LEED for Existing Buildings: O&M points
15%	NA
17%	1
19%	2
21%	3
23%	4
25%	5
27%	6
29%	7
31%	8
33%	9
35%	10
37%	11
39%	12
41%	13
43%	14
45%	15

Outlook

- Collaboration with Energy Star to expand data set and develop rating
- Development of model-based benchmark
- Meanwhile…Use the tool today!
  - LEED-EB benchmarking
  - Identify and prioritize efficiency opportunities

Conclusion

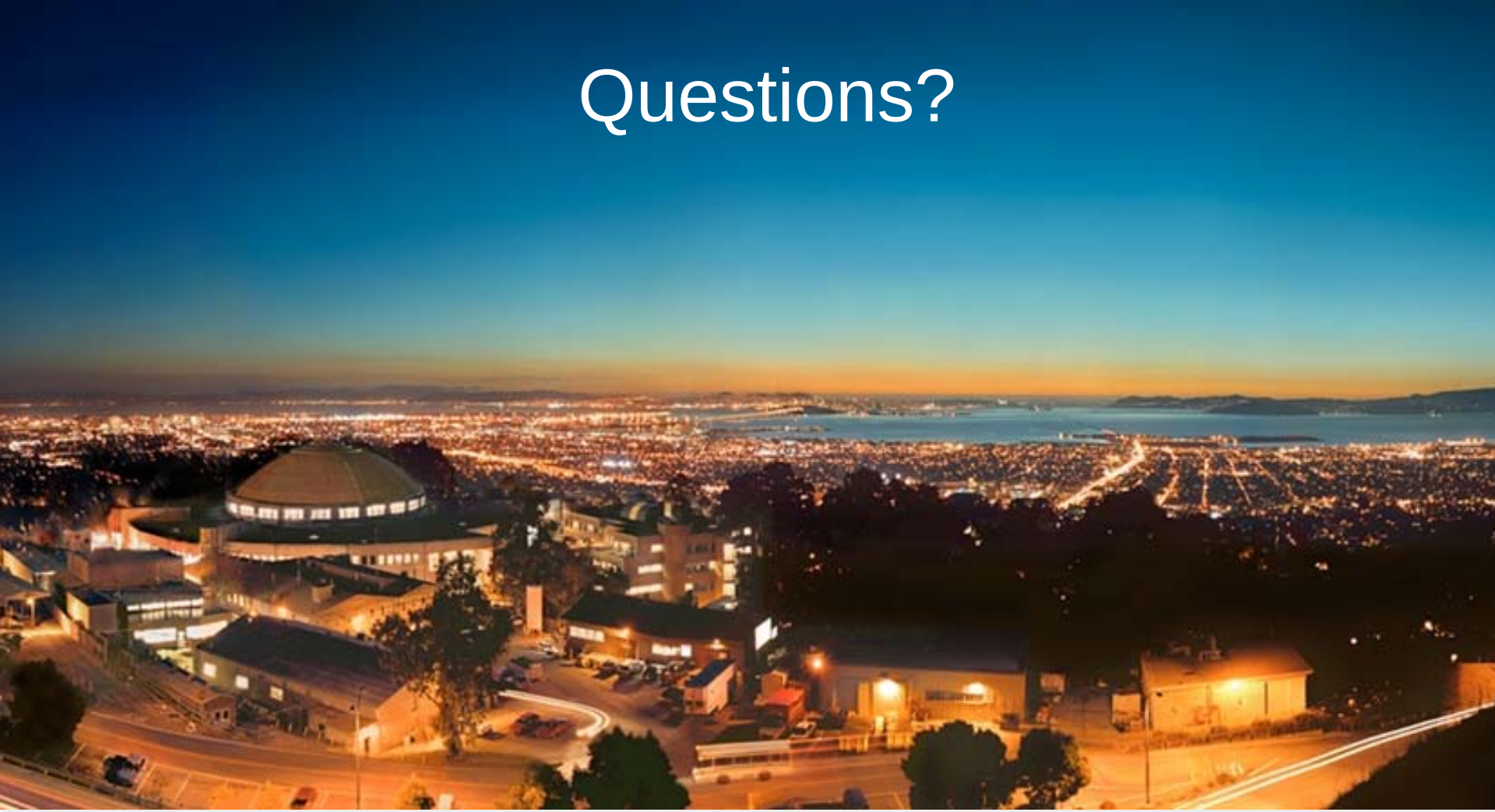
- When using LEED-NC for labs…..
  - Use the EPC to augment LEED assessment.
  - Apply EPC credits as innovation points.
- When applying ASHRAE 90.1 to labs….
  - Pay careful attention to baseline systems, fan power limits, and load diversity.
  - If using 2004, use all addenda.
- When using LEED-EB for labs…..
  - Use the Labs21 benchmarking tool and guidance for energy efficiency credit (EA c1).

Become a Labs21 Partner!

- Benefits
  - Technical support for project
    - Participation in charrettes, advice on technical issues
  - Networking and Recognition
    - Recognition via Labs21 events and publications
- Partner Requirements
  - Apply Labs21 principles on projects
  - Share best practices
  - No fee

http://www.labs21century.gov/partnership/

Questions?



Paul Mathew
Lawrence Berkeley National Laboratory

(510) 486-5116 pamathew@lbl.gov

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