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· Dallas Convention Center ·

Sustainability Criteria for Laboratories: LEED, ASHRAE 90.1, Labs21

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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 laboratories</u>.

Outline

- LEED-NC and Labs21 Environmental Performance Criteria
- ASHRAE 90.1 - Special Considerations for Laboratories
- 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 50 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 3.0 2009
- EPC is a Labs21 product
  - Current version EPC 2.2 (version 3.0 in Sep 2010)
  - No certification

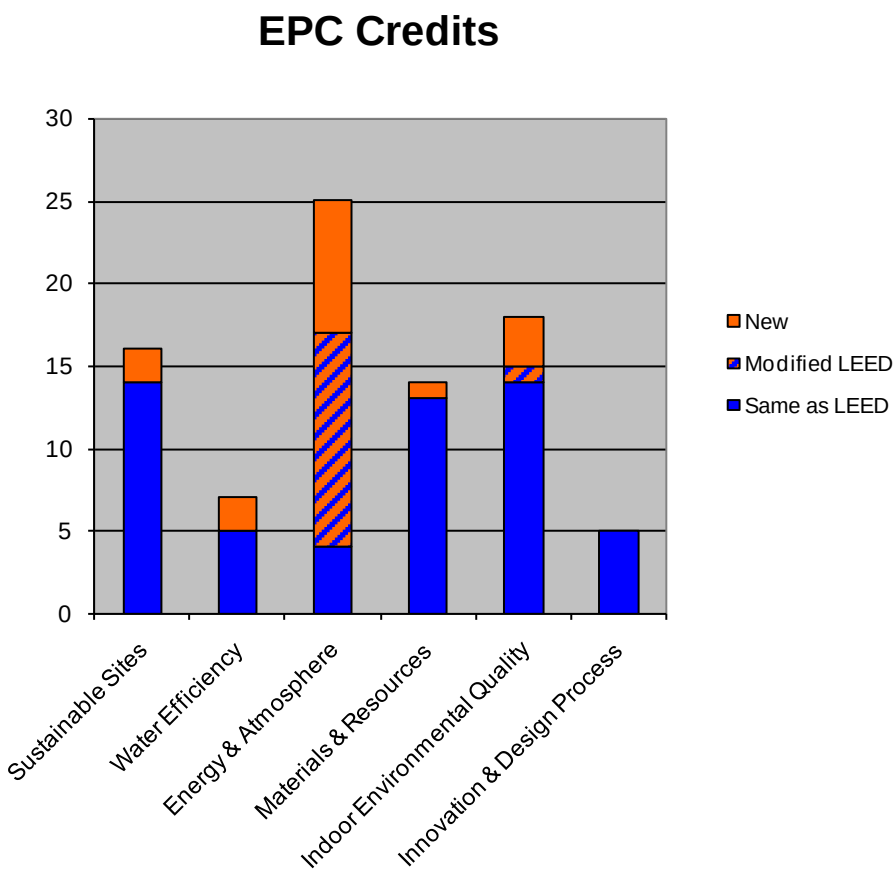
- USGBC “LEED for Labs” : uncertain

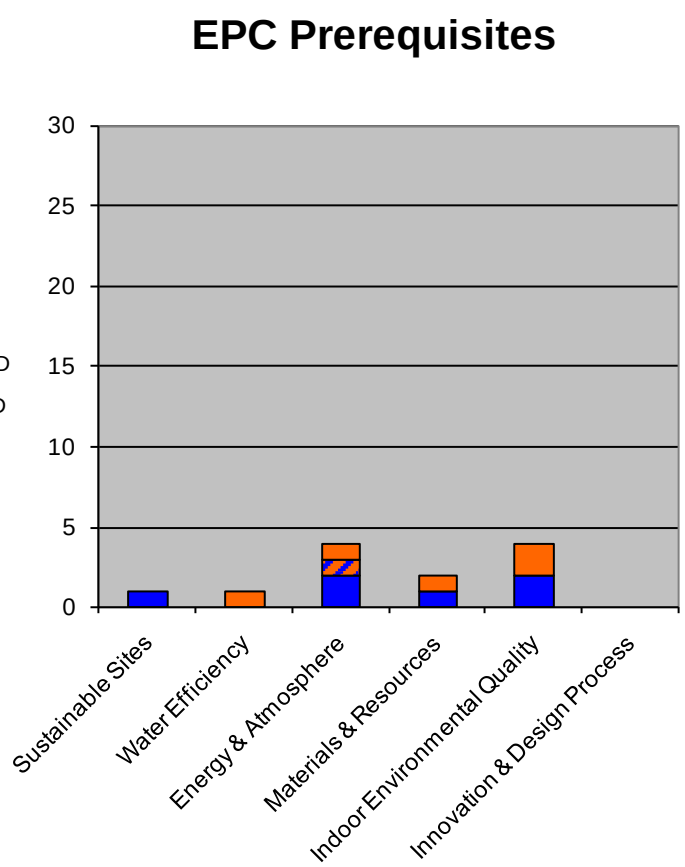
Using LEED and EPC

- Owners and designers can benefit from applying the EPC to 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

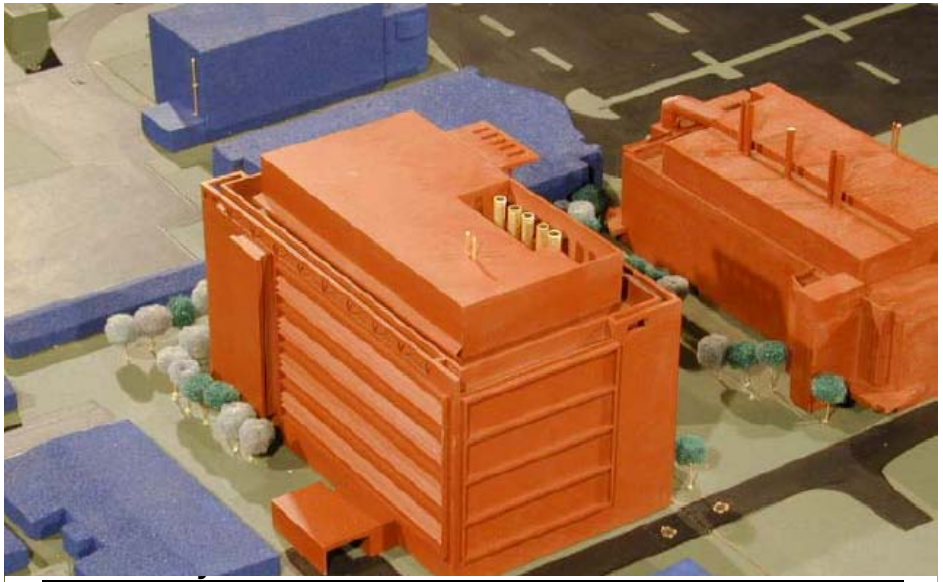

EPC Prerequisites
30
25
20
15
10
5
0
Sustainable Sites
Water Efficiency
Energy & Atmosphere
Materials & Resources
Indoor Environmental Quality
Innovation & Design Process

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

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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

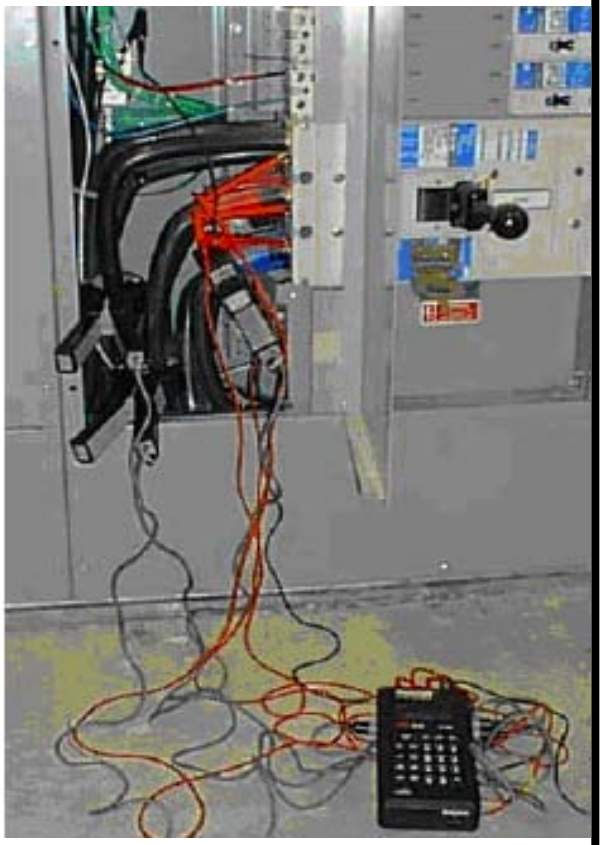
- Prerequisite 4: Min Ventilation Requirements
  - Assess with team-based process
  - Consider exhaust alternatives

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

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

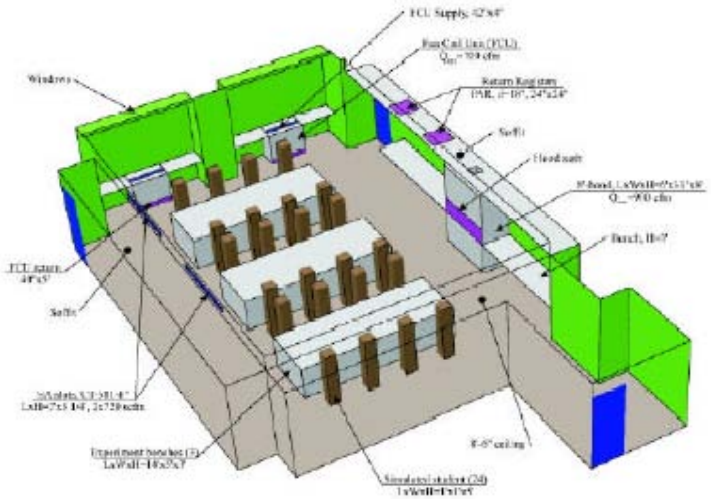
- $2.5 million first cost savings for right-sizing HVAC systems
  - Based on measured data from comparable labs

- 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.

- Ensure that <u>all addenda</u> are used
  - USGBC allows use of addenda for LEED

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 90.1-2007 Addendum 'p'

- 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. (2.15 in. w.c. for laboratory and vivarium systems)
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, biosafety cabinet	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.
Exhaust system serving fume hoods	0.35 in. w.c.
Laboratory and vivarium exhaust systems in high-rise buildings	0.25 in. w.c./100 ft of vertical duct exceeding 75 ft

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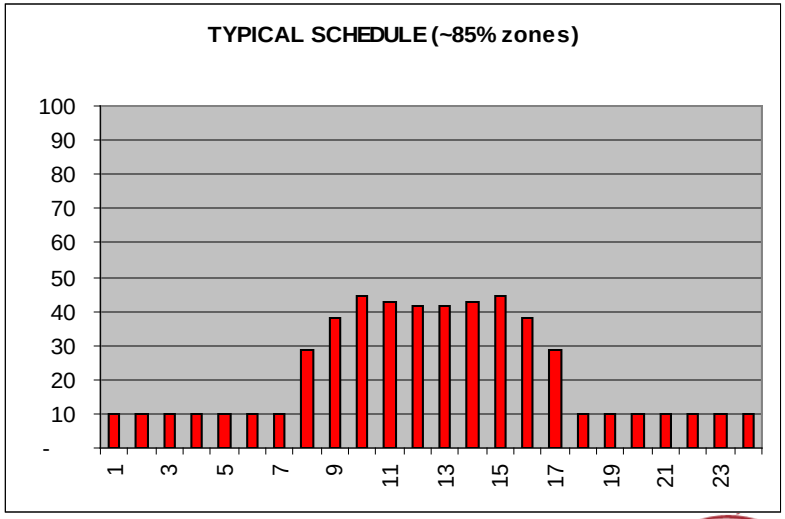
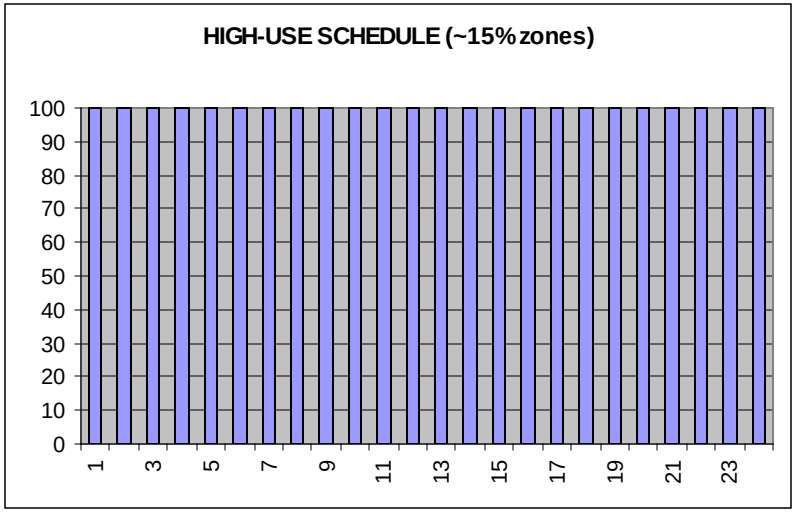
Labs21 Lab Modeling Guidelines

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





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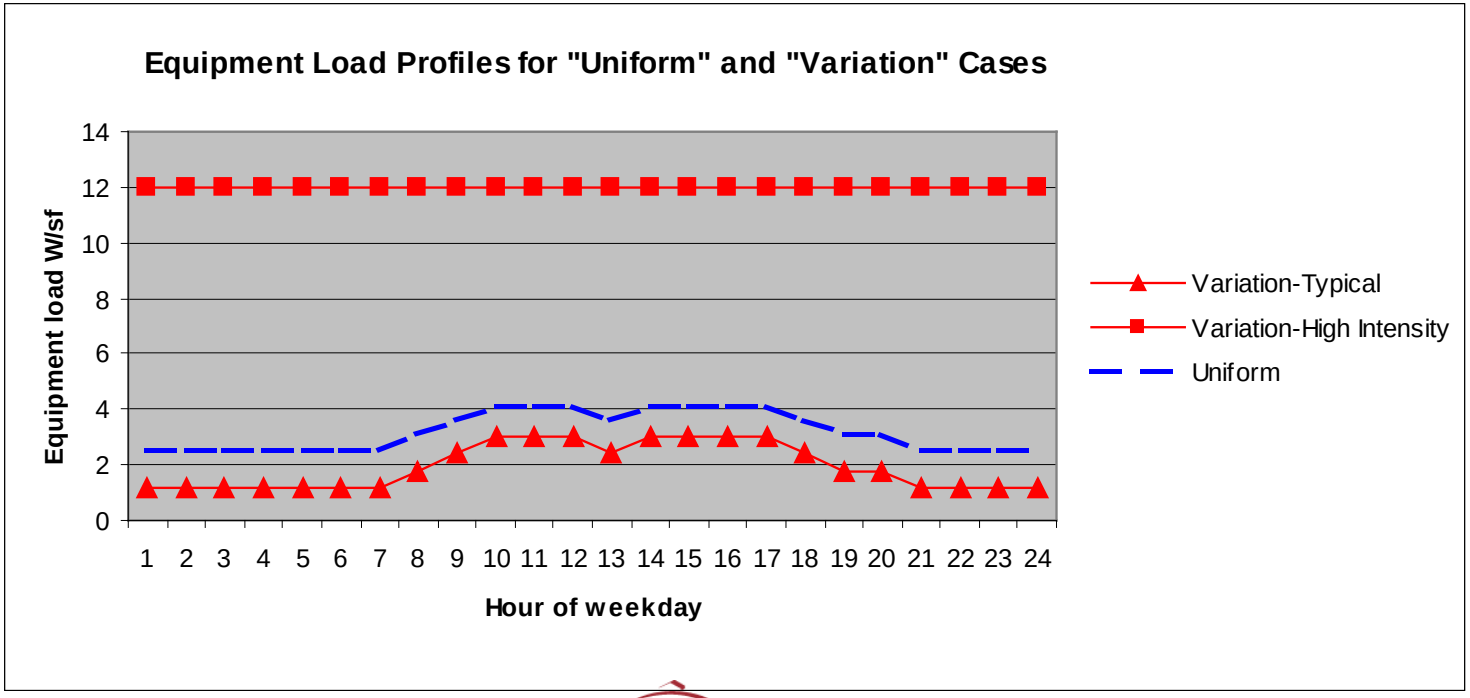
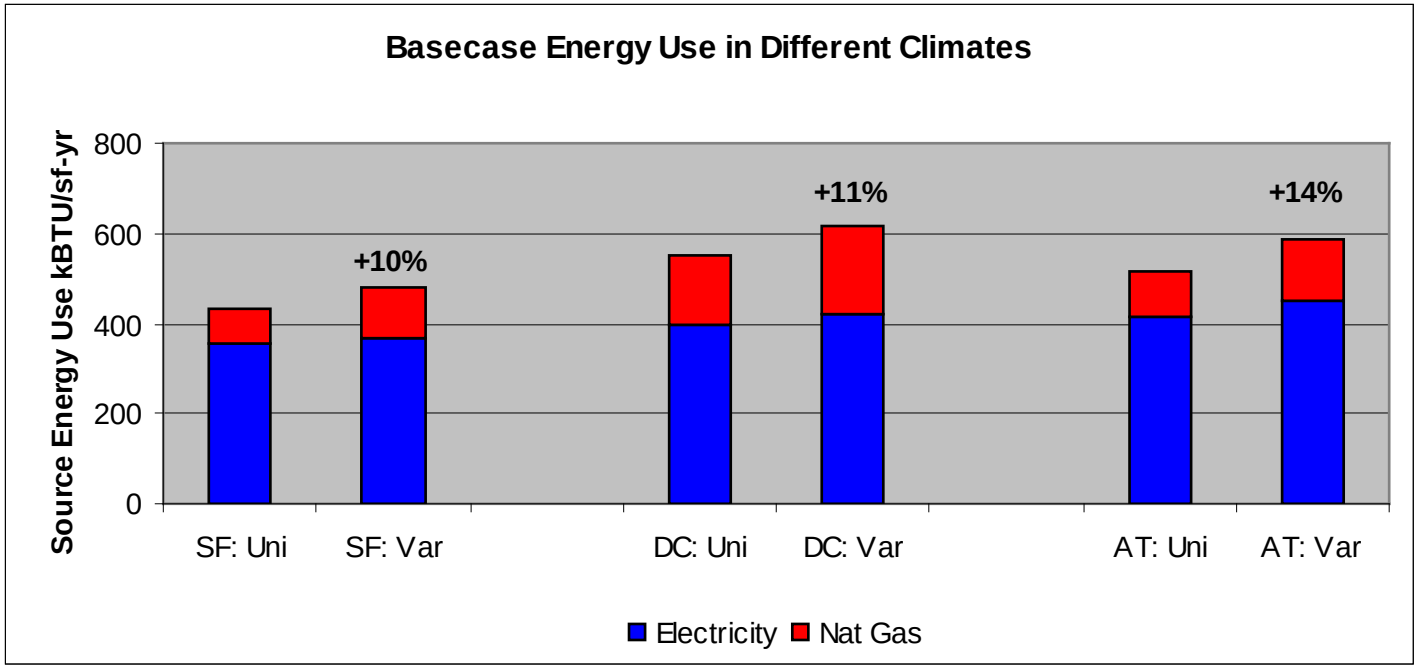
Impact of Load Diversity on Reheat Energy

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



Impact of Load Diversity on Reheat Energy

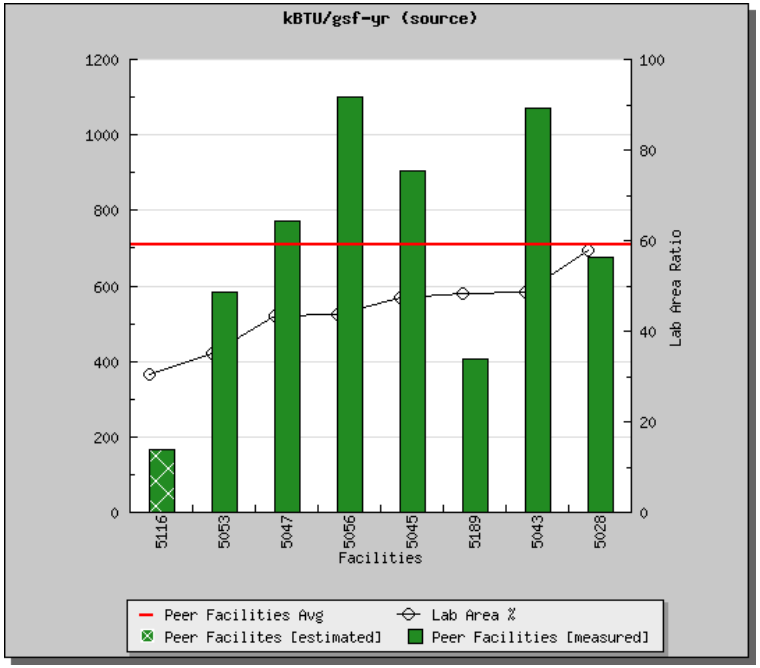
- Significant impact just from load diversity
  - Varies by location, ventilation rate



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



Labs21 dataset: Source BTU/sf-yr
Lab area ratio: 0.3-0.6
Lab Type: Chemical, Biological, Chem/Bio
Climate zone 3A (San Francisco)

LEED-EB

LABS21 BENCHMARKING

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LEED-EB and Benchmarking

- LEED-EB requires energy benchmarking
  - EA prerequisite 2 and EA Credit 1
  - Requires ENERGY STAR where available
- ENERGY STAR does not have rating for Labs
- LEED-EB Calculator will include option to use Labs21 benchmarking tool.

Labs21 Benchmarking Tool

- National database of lab energy use data
  - 200 buildings in core data set
  - Data sources: Labs21 partners, case studies, CBECS, …
- 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

Labs21 Benchmarking Tool

http://labs21benchmarking.lbl.gov/Step1

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**

General Facility Data

User	**Demo**
Organization	**Demo Organization**
Facility Name	**DemoFacility1**
Year (for which this data applies)	**2006**

Street Address*	300 Main Street
Location*	Anytown, VA
Zip Code (5 digit)*	22201
Organization Type *	Academic
Lab Use (most prevalent)*	Research/Development
Lab Type (most prevalent)*	Chemical/Biological
Number of Buildings*	3
Gross Area (sq. ft.)*	100000
Lab Area (sq. ft.)*	40000

Done

Labs21 Benchmarking Tool

http://labs21benchmarking.lbl.gov/Step1

		Measured	Estimated
Annual Electric Use (kWh)*	5300000	●	○
Peak Electric Demand (kW)	950	○	●
Annual Natural Gas Use (Million BTU)*	30002	●	○
Annual Fuel Oil Use (Million BTU)*	0	●	○
Annual Other Fuel Use* (Million BTU)	0	●	○
Annual District Chilled Water Use* (Million BTU)	0	●	○
Annual District Hot Water Use* (Million BTU)	0	●	○
Annual District Steam Use* (Million BTU)	0	●	○
Annual Energy Utility Cost ($)	500000	●	○

Ventilation System Energy Use Data

		Measured	Estimated
Annual Electric Use (kWh)	1000000	○	●
Peak Electrical Demand (kW)	100	○	●
Peak Airflow (cfm)	80000	●	○
Average Airflow (cfm)	60000	○	●
Peak Supply Airflow for Lab Area (cfm)	25000	●	○
Min Required Air Change Rate in Lab Area (air changes per hour)			
Fumehood operating sash height (inches)			
Fumehood operating face velocity (ft/min)			
System Type	Please choose one		

Cooling System Energy Use Data Measured Estimated

Done

Labs21 Benchmarking Tool

http://labs21benchmarking.lbl.gov/Com

benchmarking

Choose Metrics and Filtering Criteria

More Information

User Demo

Organization Demo Organization

Select metric:

System: Total Building

Energy / Efficiency Metric: BTU/gsf-yr (source)

Specify data filtering criteria:

1. Lab Area / Gross Area ratio

   is greater than or equal to 0.3 and is less than or equal to 0.6

2. Occupancy hours per week

   - ○ Standard (≤80 hours)
   - ○ High (>80 hours)
   - ◉ Both (all data)

3. Lab Type

   - ☑ Chemical
   - ☑ Biological
   - ☑ Chemical/Biological
   - ☐ Physical
   - ☐ Combination/Others

4. **Lab Use**

   - ☑ Research/Development
   - ☑ Combination/Others
   - ☑ Manufacturing
   - ☑ Teaching

5. **Climate** [Climate Code, Climate Type, Representative City]

   (Click here to see map of climate zones)

   - ☐ 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)

Done

Labs21 Benchmarking Tool

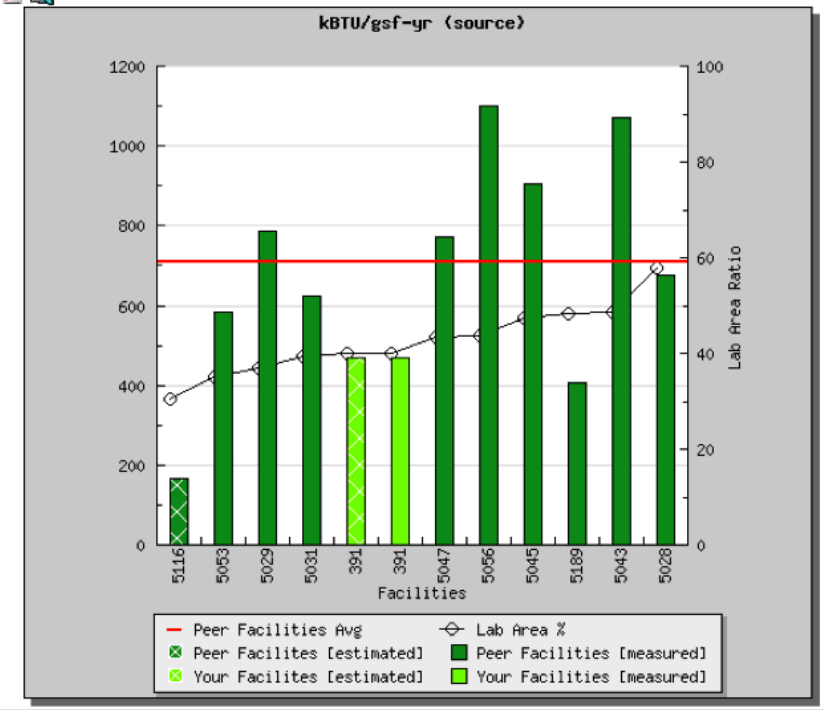
http://labs21benchmarking.lbl.gov/Grapl

Benchmarking Results

How to read these results

User	Demo
Organization	Demo Organization

Total Building kBTU/gsf-yr (source)



Lab area ratio: 0.3-0.6 | Occupancy hours: Both
Lab type: Chemical, Biological, ChemicalBiological
Lab uses: Research/Development, Manufacturing, Combination/Others, Teaching
Climate Zones: 3C
Measured data: Yes Estimated data: Yes

Benchmark Statistics for Peer Facilities

Metric	Min	Avg	Max	Count
Total Building kBTU/gsf-yr (source)	166.73	708.66	1099.76	10

Done

Outlook

- Collaboration with Energy Star to expand data set and develop rating

- Use the tool today!
  - LEED-EB benchmarking
  - Identify and prioritize efficiency opportunities

Conclusion

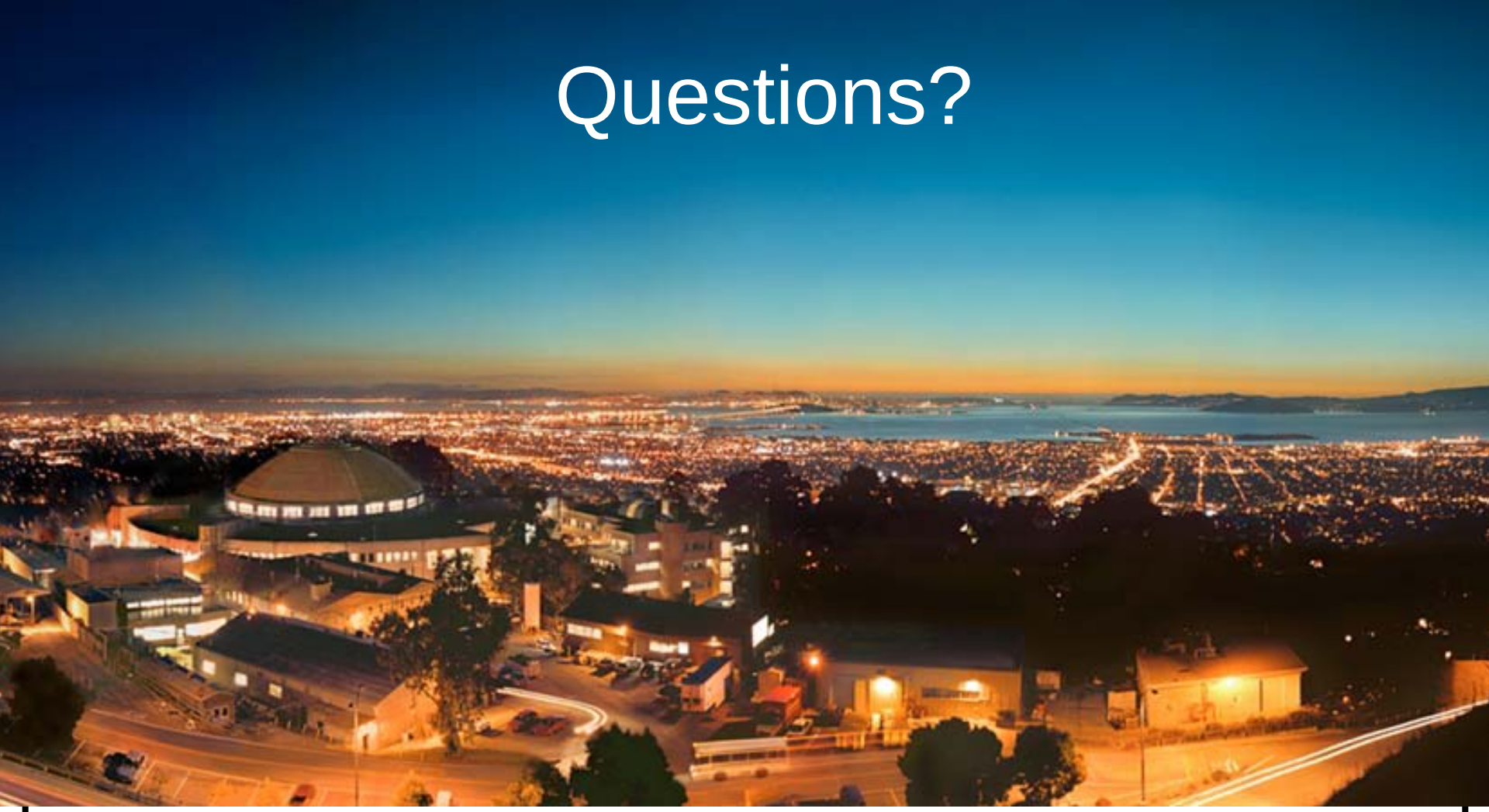
- When using LEED-NC for labs…..
  - Use the EPC to augment LEED assessment.
  - Apply EPC credits as innovation points.
- When applying ASHRAE 90.1 to labs….
  - Pay careful attention to baseline systems, fan power limits, and load diversity.
  - Use all addenda.
- When using LEED-EB for labs…..
  - 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?



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